ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

SensyMaster FMT230, FMT250

Thermal mass flowmeter

Measurement made easy

Further information

Additional documentation on SensyMaster FMT230, FMT250 is available for download free of charge at www.abb.com/flow.
Alternatively simply scan this code:

Short product description
Thermal Mass Flowmeter on the mass flow measurement of gases and gas mixtures in closed pipelines.

Device firmware version:
— 01.00.07 (Modbus)

Additional Information
Additional documentation on SensyMaster FMT230, FMT250 is available free of charge for downloading at www.abb.com/flow. Alternatively simply scan this code:

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Contents

1 Safety

1.1 General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.
The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.
Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed. These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

1.2 Warnings

The warnings in these instructions are structured as follows:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

i NOTICE

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

1.3 Intended use

This device can be used in the following applications:

— As a plug-in sensor flanged into the pipe component in pipelines with nominal diameters DN 25 ... DN 200 (1 ... 8 in.).
— Through a welding adapter directly in pipelines 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 standard volume flows (through standard density and mass current).
— 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 media for measurement the following points must be observed:

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

1.4 Improper use

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

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

1.5 Notes on data security

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

1.6 Warranty provisions

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

2 Function and system design

2.1 Overview

2.1.1 Sensor

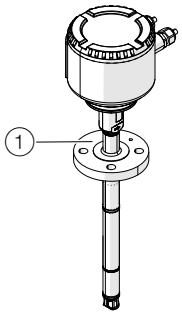

Fig. 1: sensor FMT230, FMT250 (example)
(1) Sensor connection

Model	FMT230	FMT250
Measuring media	Gases (Air, methane, nitrogen, hydrogen, carbon dioxide, oxygen, natural gas, ammonia, helium, argon, propane, ethane, butane, ethene, biogas) and gas mixes with known composition	
Measuring accuracy for gases[1)] Air, nitrogen	± 1.2 % of Q_m in range of 10 ... 100 % of the measuring range; ± 0.12 % of the Q_{max}DN possible at the nominal diameter in the range of 0 ... 10 % of the measuring range	± 0.6 % of the measured value, ± 0.05% of the Q_{max}DN possible in the nominal diameter
Other gases (optional process gas calibration)	–	± 1.6 % of the measured value, ± 0.1 % of the Q_{max}DN possible in the nominal diameter
Extended measuring range	No	Yes, optional
Measuring medium temperature T_{medium}	Standard: -25 ... 150 °C (-13 ... 302 °F)	Standard: -25 ... 150 °C (-13 ... 302 °F), optional: -25 ... 300 °C (-13 ... 572 °F)
Ambient temperature $T_{ambient}$	Standard: -20 ... 70 °C (-4 ... 158 °F), optional:-40 ... 70 °C (-40 ... 158 °F), -50 ... 70 °C (-58 ... 158 °F)	
Sensor connection	Flange DN 25 – PN 40, threaded connection DIN 11851, compression fitting	
Wetted materials	Stainless steel, ceramic measuring element (other materials on request)	
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		
— Explosion protection ATEX / IECEx	In preparation	
— Explosion protection cFMus	In preparation	
— Further approvals	Available on our website abb.com/flow or on request	

1) The stated measuring accuracy only applies under the reference conditions in the stated measuring range.

2.1.2 Process connections

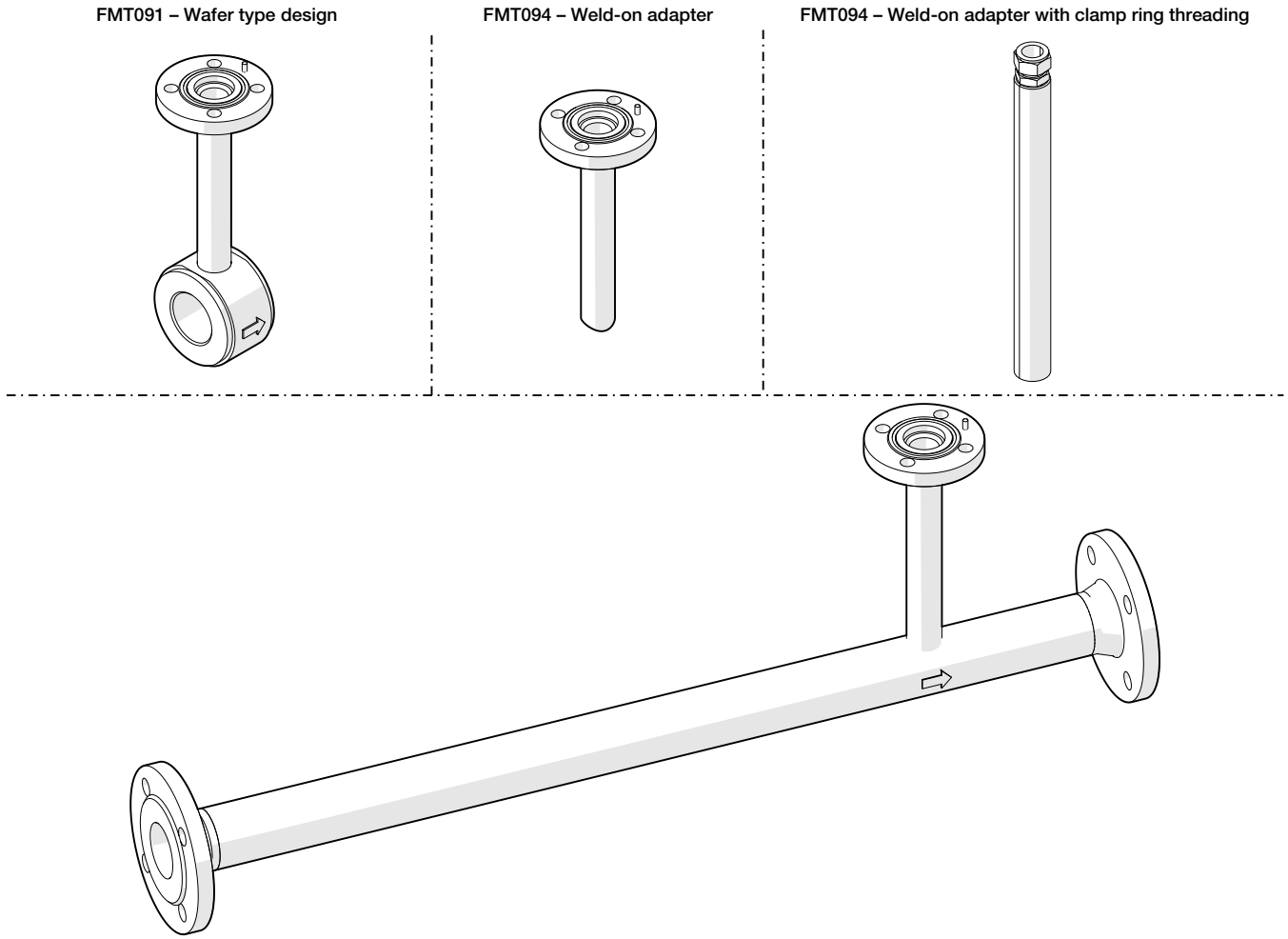

Fig. 2: Pipe components (examples)

Pipe components	
FMT091 – Wafer type design	In accordance with EN 092-1: DN 40 ... 200, PN 40 In accordance with ASME B16.5: 1 1/2 ... 8 in., CL 150 ... 300
FMT092 – Partial measuring section	Flange in accordance with EN 1092-1, DN 40 ... 100 (larger nominal diameters on request), PN 10 ... 40. Flange in accordance with ASME B16.5: 1 1/2 ... 8 in., CL 150 ... 300 Male thread DN 25 ... 80 R1 ... 3 in.
FMT094 – Weld-on adapter	For rectangular ducts or pipe diameters ≥ DN 100 (4 in.), PN 16 ... 40
Wetted materials	Stainless steel, galvanized steel (other materials on request)

2.2 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.

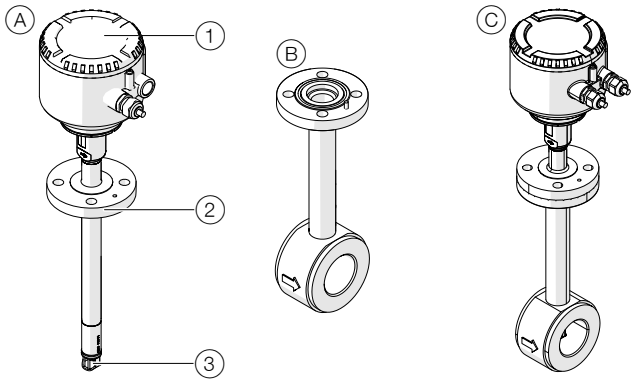

Fig. 3: Sensor (example, wafer type design)
(A) Sensor (B) Pipe component (C) Sensor with pipe component
(1) Transmitter (2) Sensor connection (3) Thermal measuring element

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 welding adapter makes it possible to install the sensor in rectangular ducts or pipelines with any diameter.

2.3 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.

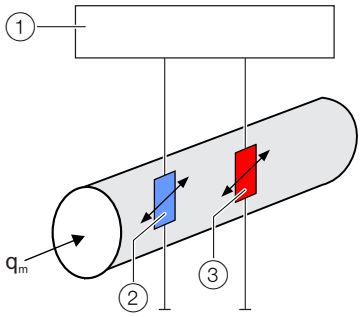

Fig. 4: Measuring principle (simplified)
(1) Transmitter (2) Measurement resistor gas temperature (3) Heat resistor

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.

3 Product identification

3.1 Name plate

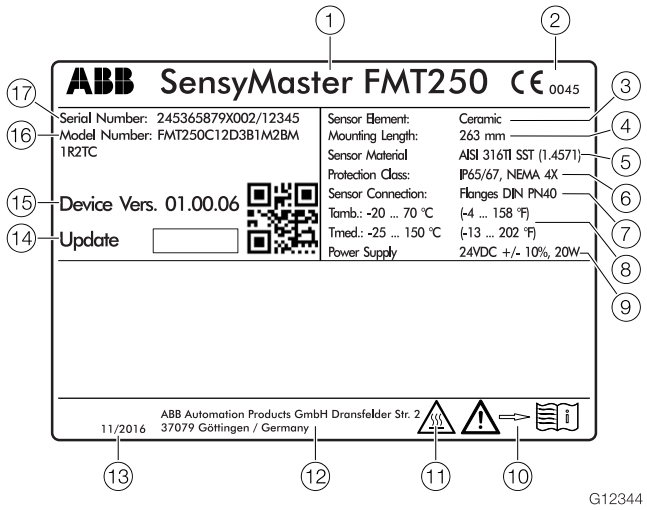

Fig. 5: Name plate (example)
(1) Type designation (2) CE mark (3) Measuring element design (4) Sensor installation length (5) Wetted material (6) IP / NEMA protection type (7) Sensor process connection (8) Ambient temperature / model number range ($T_{amb.}$ / $T_{med.}$) (9) Power supply (10) "Read operating instruction" symbol (11) "Hot surface" symbol (12) Manufacturer address (13) Manufacture date (month / year) (14) Update field device firmware (15) Device firmware revision (16) Order code (17) Serial number

4 Transport and storage

4.1 Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.
All claims for damages must be submitted to the shipper without delay and before installation.

4.2 Transport

⚠ DANGER

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

⚠ WARNING

Risk of injury due to device slipping.
The device's center of gravity may be higher than the harness suspension points.
- Make sure that the device does not slip or turn during transport.
- Support the device laterally during transport.

4.3 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, e.g., by using air-cushioned packaging.

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.

4.3.1 Ambient conditions

Storage temperature range
-25 ... 85 °C (-13 ... 185 °F)

Relative humidity
Maximum 85 % RH, annual average ≤ 65 % RH

4.4 Returning devices

For the return of devices, follow the instructions in the chapter ‘ Returning devices’ on page 79.

5 Installation

⚠ 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 replacement device.

⚠ WARNING

Risk of injury due to process conditions.

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

— Before working on the device, ensure that the process conditions do not pose any safety risks.

— If necessary, wear suitable personal protective equipment when working on the device.

— Depressurize and empty the device / piping, allow to cool and purge if necessary.

5.1 Installation conditions

5.1.1 Installation location and assembly

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

— The ambient conditions (IP rating, ambient temperature range T_{amb}) of the device must be adhered to at the installation location.

— Sensors and transmitters must not be exposed to direct sunlight.If necessary, provide a suitable means of sun protection on site. The limit values for the ambient temperature T_{amb} must be observed.

— On flange devices, ensure that the counterflanges of the piping are aligned plane parallel. Only install flange devices with suitable gaskets.

— Prevent the sensor from coming into contact with other objects.

— The device is designed for industrial applications.
No special EMC protective measures are required if the electromagnetic fields and interference at the installation location of the device comply with "Best Practice" guidelines (in accordance with the standards referred to in the declaration of conformity).
Maintain a suitable distance from electromagnetic fields and interference that extend beyond the usual dimensions.

Gaskets

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

Note the following points when selecting and mounting gaskets:

— Only gaskets made from a material that is compatible with the measuring medium and measuring medium temperature may be used

— Gaskets must not extend into the flow area, since possible turbulence may influence the accuracy of the device.

5.1.2 Inlet and outlet sections

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

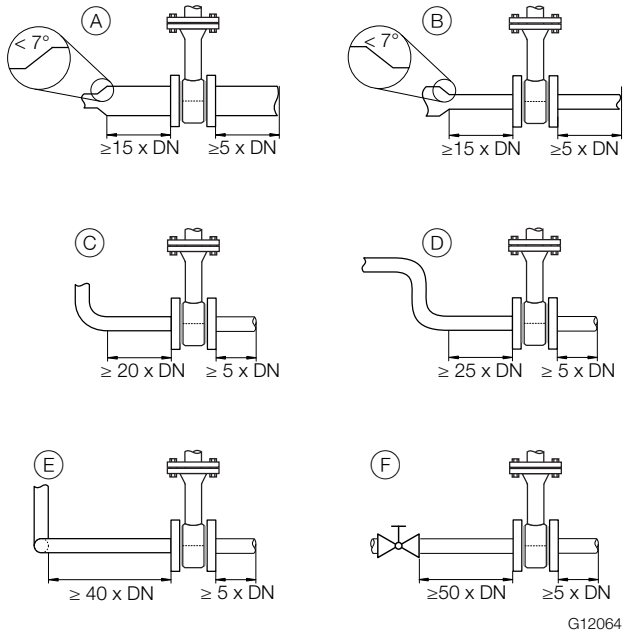

Fig. 6: Inlet and outlet sections

Installation	Inlet section	Outlet section
(A) Pipe extension	min. 15 x DN	min. 5 x DN
(B) Pipe reduction	min. 15 x DN	
(C) 90° Pipe elbow	min. 20 x DN	
(D) 2 x 90° Pipe elbow in one level	min. 25 x DN	
(E) 2 x 90° Pipe elbow in two levels	min. 40 x DN	
(F) Turn-off device	min. 50 x DN	

To achieve the specified measuring accuracy, the indicated inlet and outlet sections are required.
In case of combinations of several inlet-side errors, e.g. valve and reduction, a longer inlet section must always be taken into account.
In case of confined spaces at the installation place, the outlet section can be reduced to 3 x 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 alignment is necessary for individual cases.
The specified inlet and outlet sections must be doubled for gases with a very low density (hydrogen, helium).

5.1.3 Installation at high ambient temperatures

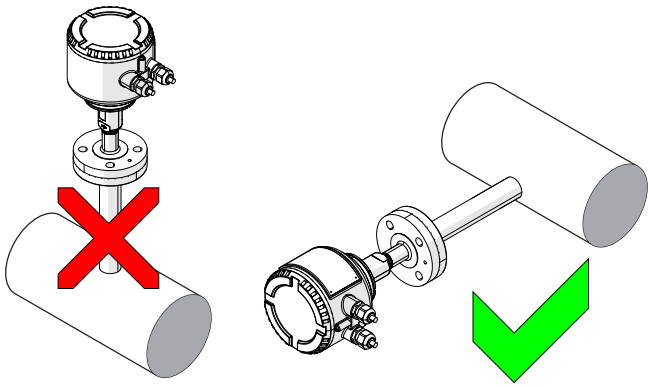

Fig. 7: Mounting position at high ambient temperatures

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.

5.1.4 Sensor insulation

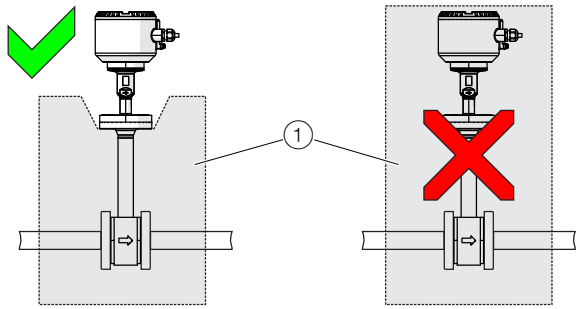

Fig. 8: Insulation of the sensor
(1) Insulation

The sensor may be insulated as shown in Fig. 8.

5.2 Environmental conditions

5.2.1 Ambient temperature

— Standard: -20 … 70 °C (-4 … 158 °F)
— Extended TA9: -40 ... 70 °C (-40 ... 158 °F)
— Extended TA6: -50 ... 70 °C (-58 ... 158 °F)

Relative humidity

Maximum 85 % RH, annual average ≤ 65 % RH

IP rating

In accordance with EN 60529: IP 65 / IP 67

5.2.2 NEMA rating

NEMA 4X

5.3 Process conditions

5.3.1 Measuring medium temperature

Devices with ceramic element and flange connection

— Standard: -25 … 150 °C (-13 … 302 °F)
— Extended (optional, only FMTx50):
-25 ... 300 °C (-13 ... 572 °F)

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

Sensor connection	T_{medium}
Threaded connection DIN 11851	-40 ... 140 °C (-40 ... 284 °F)
Clamp ring fitting	-25 ... 140 °C (-13 ... 284 °F)
Pipe components with ball valve	Maximum 150 °C (302 °F)
Integrated hot tap fitting	See the chapter titled 'Integrated hot tap fitting' on page 15

Maximum operating pressure

Standard for devices with flange connection, P_{medium}:
4 MPa, 40 bar (580 psi)

The approved operating pressure P_{medium} also depends on the selected sensor process connection and the design of the pipe components.
The following temperature specifications apply:

Sensor connection	P_{medium}
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 the chapter titled 'Integrated hot tap fitting' on page 15

Pressure drop

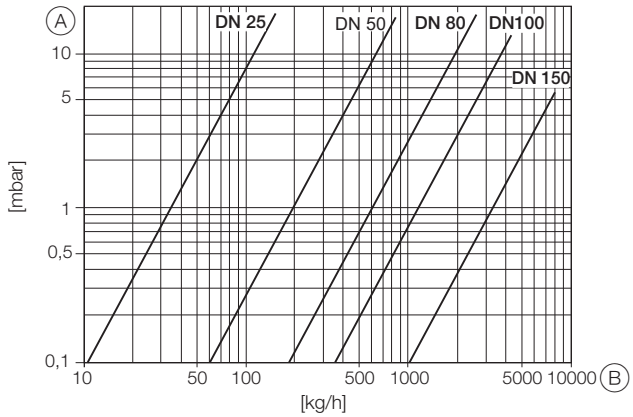

Fig. 9: Pressure loss in logarithmic representation
(A) Pressure loss (B) Mass flow

5.3.2 Material loads for process connections

DIN and ASME flanges

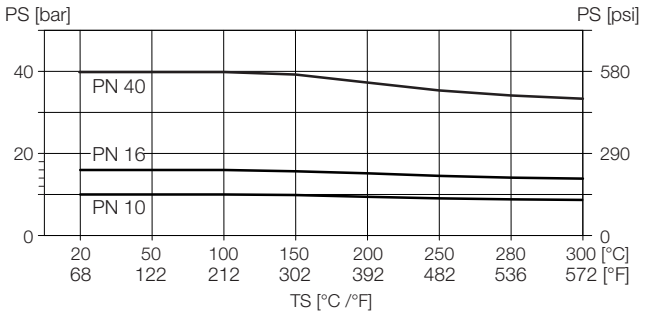

Fig. 10: DIN flange process connection

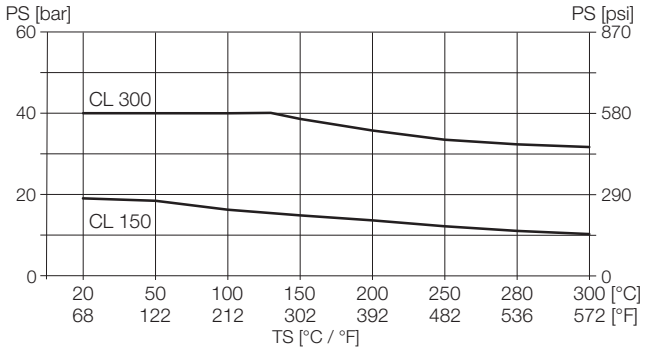

Fig. 11: ASME flange process connection

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

Integrated hot tap fitting

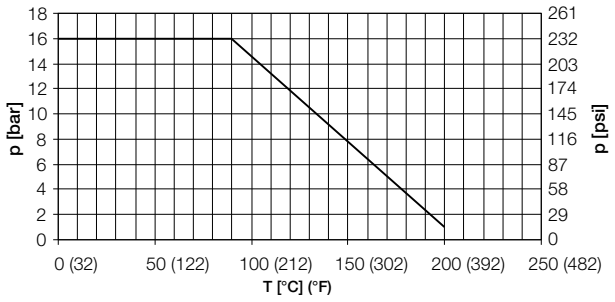

Fig. 12: Maximum pressure / temperature values for integrated hot tap fitting

5.4 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, flat gaskets must be installed, which should be in perfect condition and resistant to the measuring media.
- Before installing pipe components or sensors, check all components and gaskets for damage.
- Pipe components must not be installed under tension, otherwise the pipeline may exert impermissible forces on the device.
- When assembling the flanged connections, use screws that offer the required strength and dimensions.
- 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).

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

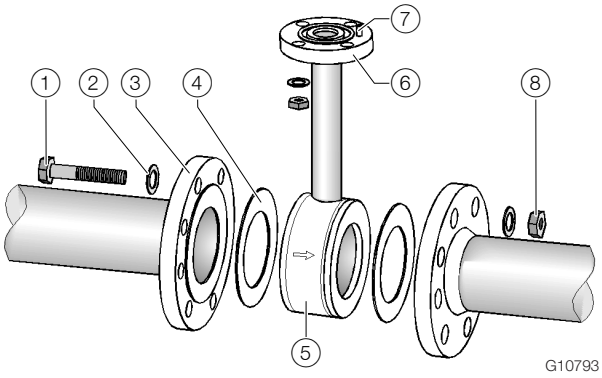

Fig. 13: Installing a pipe component (example, wafer type design) (1) Flange screw (2) Washer (3) Flange (4) Flange gasket (5) Pipe component (6) Sensor connection flange (7) Centering pin, outflow side (8) Nut

Installation of the FMT091 pipe component (wafer type design) and FMT092 (partial measuring section).

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.

NOTICE

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 as shown in 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.

NOTICE

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

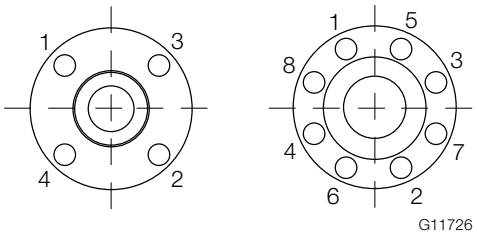

Fig. 14: Tightening sequence for the flange screws

5.4.2 Weld-on adapter

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

— After welding, the welding adapter must have a length of L (see chapter 'Mounting dimensions – welding adapter with flange and with and without ball valve' on page 18 and 'Assembly dimension - welding adapter with threaded connection in accordance with DIN 11851' on page 19).

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

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 inch).
— 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 inch).
— 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 inch) 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.

NOTICE

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 flowmeter sensor has been removed.

Mounting dimensions – welding adapter with flange and with and without ball valve

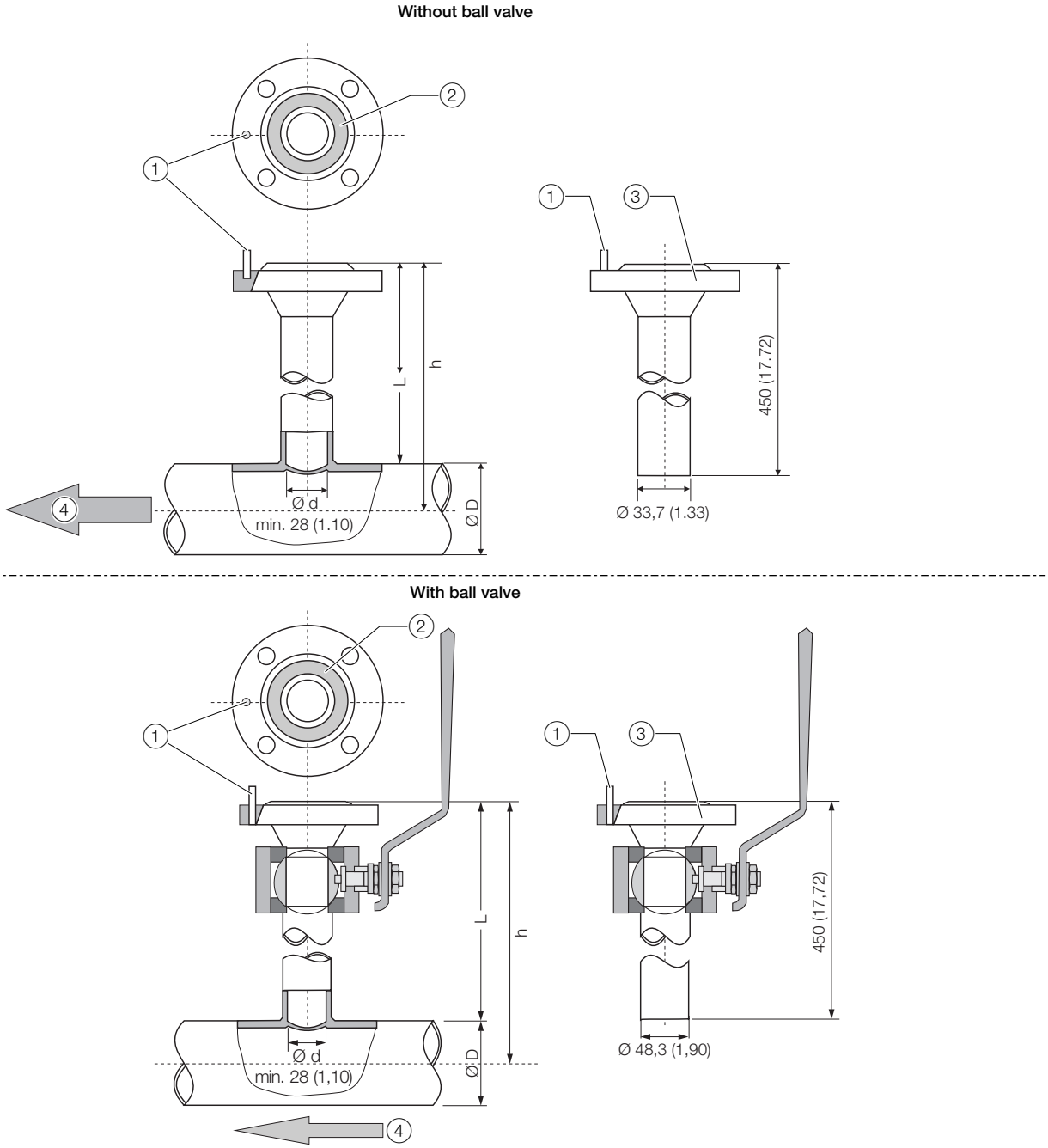

Fig. 15: Welding adapter with flange - all dimensions given in mm (inch).
(1) Centering pin (2) Nut for O-ring (3) connection flange DN 25 (1") (4) flow direction

h – sensor length	Ø D – outer pipe diameter (min. / max.)	
	Without ball valve	With ball valve
263 (10.35)	100 ... 350 (3.94 ... 13.78)	100 ... 150 (3.94 ... 5.91)
425 (16.73)	> 350 ... 700 (> 13.78 ... 27.56)	> 150 ... 500 (> 5.91 ... 19.69)
775 (30.51)	> 700 ... 1400 (> 27.56 ... 55.12)[1)]	> 500 ... 1150 (> 19.69 ... 45.28)[1)]

1) The limitation of the maximum pipe diameter only applies for installations with a measuring 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.

Assembly dimension - welding adapter with threaded connection in accordance with DIN 11851

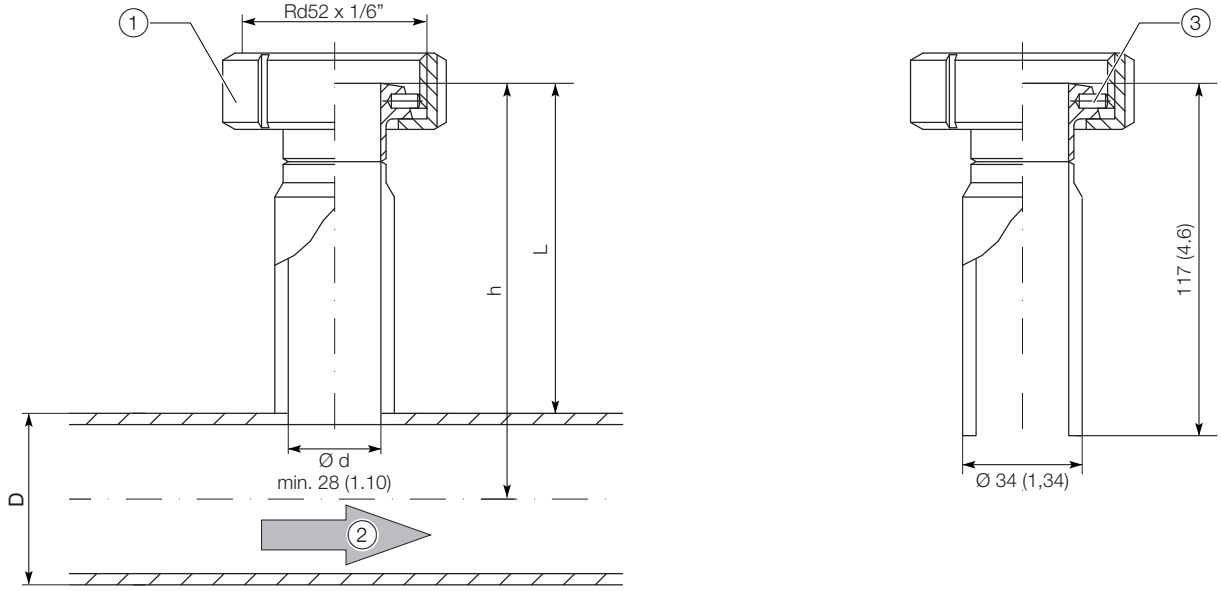

Fig. 16: Dimensions in mm (inch)
(1) Union nut (2) Flow direction (3) Centering pin

5.4.3 Integrated hot tap fitting

Wafer type design

Installation of the wafer type design is performed as explained in chapter ‘Assembly of the pipe component’ on page 15 .

Welding design

⚠ DANGER

Danger to life due to improper installation!

Do not shorten hot tap fitting components or interfere with the design. This can lead to the measuring medium escaping in an uncontrolled manner. This can result in severe injuries or death.

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

— for nominal diameters DN 100 ... DN 125 (4 ... 5") and
— for nominal diameters DN 150 ... DN 300 (6 ... 12")

i NOTICE

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

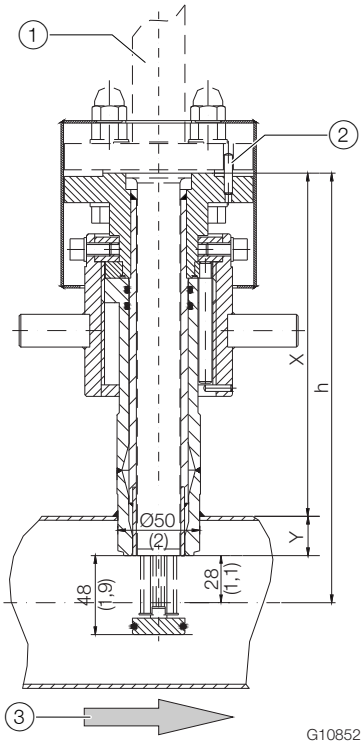

Fig. 17: Integrated changing device in measurement position, dimensions in mm (inch)

(1) Sensor (2) Centering pin (3) Flow direction

Calculation of the outside length X and installation depth Y

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

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

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 inch)
— Pipe with external diameter of 210 mm (8.27 inch)
— The changing device is in measurement position

X = 425 mm - (210 mm / 2) = 320 mm
Y = (210 mm / 2) - 28 mm = 77 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).

i NOTICE

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.

i NOTICE

Impact on measuring accuracy

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

5.5 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 flange.
— The measuring elements may not be damaged when inserting the sensor into the pipe component.
— If you are using an integrated changing device, you must check that the changing device is in the disassembly position before releasing the mounting screws.

5.5.1 Wafer type design and welding adapter

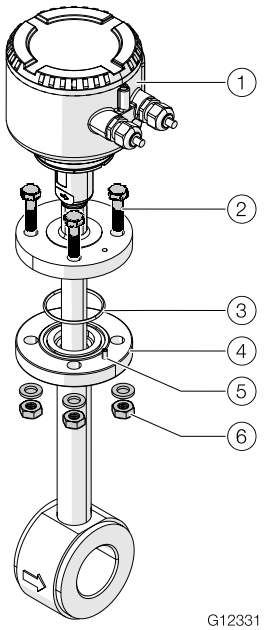

Fig. 18: Installing a sensor (example)
(1) Sensor (2) Flange screws (3) O-Ring (4) Sensor connection flange (5) Centering pin (6) Washers and nuts

Installing the sensor:

1. Place the supplied O-ring in the groove of the sensor connection flange.
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 flange 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).

5.5.2 Installation / Disassembly in connection with the changing device

⚠ DANGER

Danger to life due to piping under pressure!

If the changing device 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 changing device 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 changing device 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 fastening screws.
- Drain and rinse the piping before disassembling the sensor, check and repair the changing device.

⚠ CAUTION

Risk of injury due to leaking measuring medium!

When you disassemble the transmitter, small quantities of measuring medium may leak due to the nature of the design. Make sure that sufficient ventilation is ensured during disassembly of the sensor.

i NOTICE

Damage to the changing device

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

Only ever operate the lock nut manually.

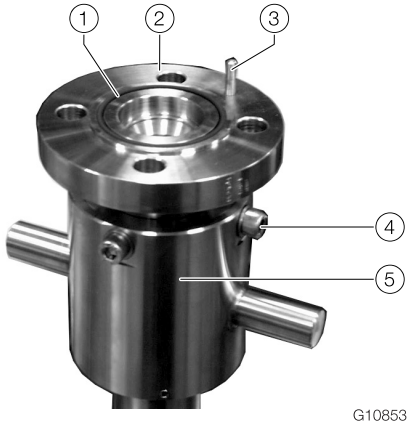

Fig. 19: Sensor process connection
(1) O-Ring (2) Connection flange (3) Centering pin (4) Screws to secure the guiding pipe (5) union nut

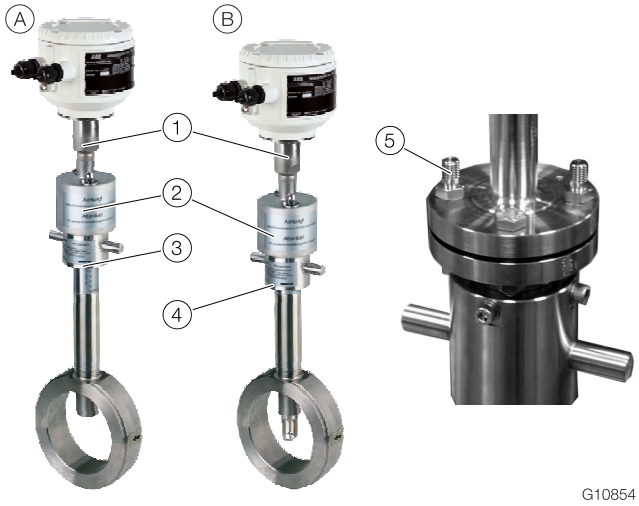

Fig. 20: Sensor Installation / Disassembly
(A) Integrated changing device in disassemble position (B) integrated changing device in measurement position
(1) Sensor (2) Protection cap (3) Union nut in disassemble position (4) Union nut in measurement position (5) Special screws for protection cap

Installation of the sensor during operation

NOTICE

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

Installing the sensor:

1. Place the supplied O-ring in the groove of the sensor connection flange.
2. Carefully slide the sensor into the changing device. Observe correct alignment to the centering pin in the process.
3. Fasten the sensor to the sensor connection flange using screws. Use the supplied M12 screws, as well as two extended special screws for this.
4. Place the protection caps onto the special screws and tighten using two nuts.
5. Twist the transmitter with the union nut into the measuring position. 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.
6. Carry out the electrical connection

Disassembly of the sensor during operation

Disassembly of the sensor:

1. Twist the transmitter with the union nut into the disassemble position. The lower edge of the union nut indicates the position of the sensor. Only when the disassemble position is reached 0 - CLOSE - ZU (the upper limit stop of the union nut) will the sensor be in the disassemble position and the changing device is sealed off from the process.
2. Disconnect electrical connections.
3. Remove protection caps.
4. Remove flange screws.
5. Carefully pull the sensor out of the changing device (do not tip to the side).

5.6 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.

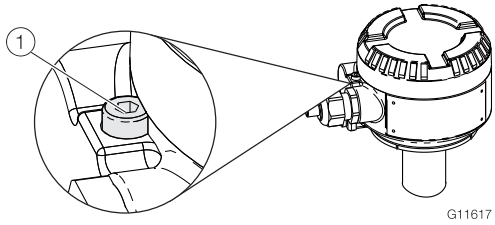

Fig. 21: Cover safety device (example)

To open the housing, release the cover safety device by screwing in the Allen screw (1).

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

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.

5.7 Electrical connections

⚠ WARNING

Risk of injury due to live parts.

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

— Connect the device only with the power supply switched off.

— Observe the applicable standards and regulations for the electrical connection.

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.

5.7.1 Installing the connecting cables

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

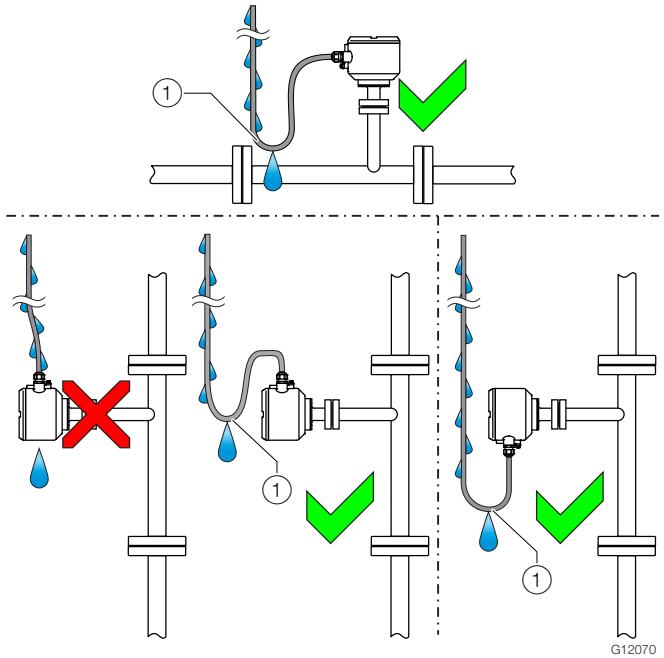

Fig. 22: Laying of the connecting cable
(1) Drip loop

5.7.2 Electrical connection

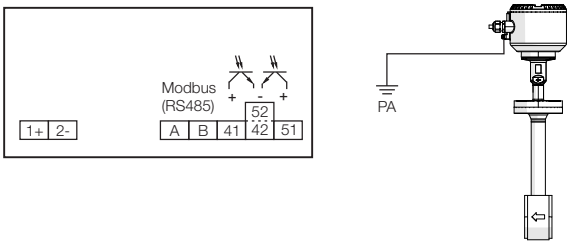

Fig. 23: Electrical connection
PA = Functional ground (potential equalization)

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, frequency output or switch output.

5.7.3 Electrical data for inputs and outputs

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.

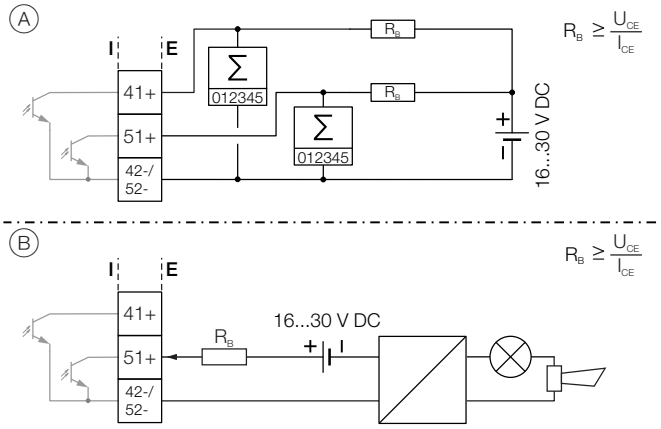

Fig. 24: Passive digital outputs (I = internal, E = external)
(A) Passive digital output 41 / 42 as pulse or frequency output, Passive digital output 51 / 52 as pulse output (B) Passive digital output 51 / 52 as binary output

Pulse / frequency output (passive)	
Terminals	41 / 42, 51 / 52
Output “closed (pulse)”	$0\ V \leq U_{CEL} \leq 3\ V$ For f < 2.5 kHz: $2\ mA < I_{CEL} < 10\ mA$ For f > 2.5 kHz: $10\ mA < I_{CEL} < 30\ mA$
Output “open (pause)”	$16\ V \leq U_{CEH} \leq 30\ V$ DC $0\ mA \leq I_{CEH} \leq 0.2\ mA$
f_{max}	10.5 kHz,
Pulse width	0.05 … 2000 ms

Binary output (switch output, passive)	
Terminals	41 / 42, 51 / 52
Output "closed"	$0\ V \leq U_{CEL} \leq 3\ V$ $2\ mA \leq I_{CEL} \leq 30\ mA$
Output "open"	$16\ V \leq U_{CEH} \leq 30\ V$ DC $0\ mA \leq I_{CEH} \leq 0.2\ mA$
Switching function	Can be configured via Modbus. See chapter ‘Parameter range - Output’ on page 57.

NOTICE

— Terminals 42 / 52 have the same potential. Digital outputs 41 / 42 and 51 / 52 are not electrically isolated from each other.

5.7.4 Modbus protocol

NOTICE

The Modbus protocol is not secure, 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.

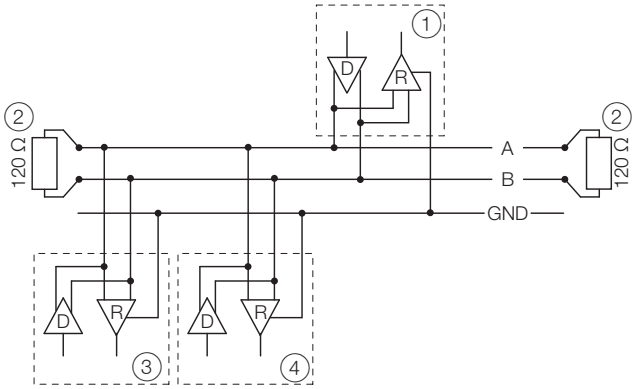

Fig. 25: Communication via the Modbus protocol
(1) Modbus master (2) Terminating resistor (3) Modbus slave 1
(4) Modbus slave n … 32

Modbus protocol	
Configuration	Via the Modbus interface or via the local operating interface in connection with Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM)
Transmission	Modbus RTU - RS485 serial connection
Baud rate	2400, 4800, 9600, 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 (Response Delay Time)	0 ... 200 milliseconds Factory setting: 10 milliseconds

Modbus response time

The typical response time of the device is normally less than 100 ms (minimum response time). The response time is calculated from the end of the request telegram from the master to the beginning of the response telegram from the slave.

The response time can be increased via the parameter "modbusResponseDelayTime".

See Chapter ‘Parameter range – Communication’ on page 62 .

The length of the response telegram is dependent upon the number of bytes read and the baud rate configured.

Cable specification

The maximum permissible length is dependent on the baud rate, the cable (diameter, capacity and surge impedance), the number of loads in the device chain, and the network configuration (2-core or 4-core).

— At a baud rate of 9600 and with a conductor cross section of at least 0.14 mm^2 (AWG 26), the maximum length is 1000 m (3280 ft).
— When using a 4-core cable as a 2-wire wiring system, the maximum length must be halved.
— The spur lines must be short, a maximum of 20 m (66 ft).
— When using a distributor with “n” connections, each branch must have a maximum length of 40 m (131 ft) divided by “n”.

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

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

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

5.7.5 Connection on the device

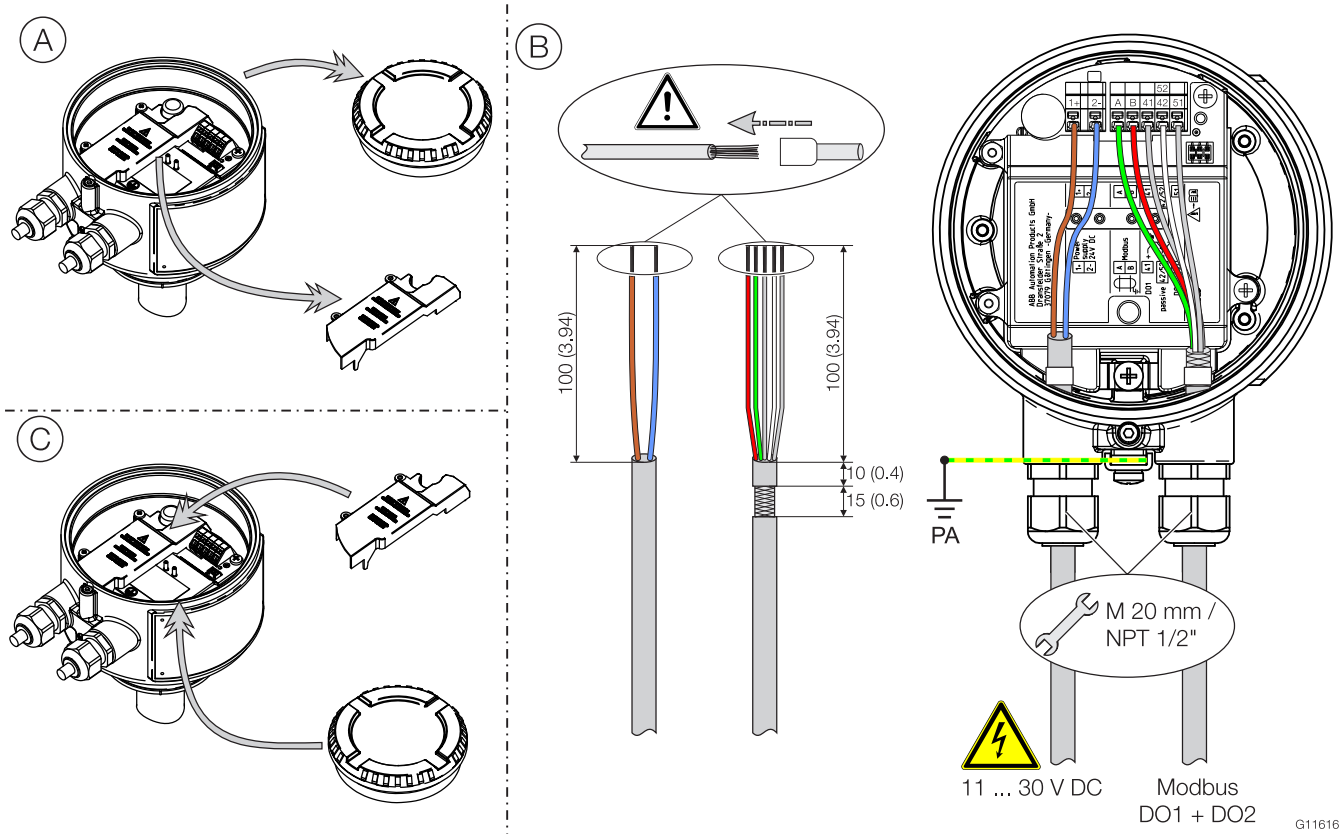

Fig. 26: Connection to the device (example), dimensions in mm (inch)
PA = potential equalization

Connect the compact design: Perform steps Ⓐ ... Ⓒ.
During the process, observe the following instructions:

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

NOTICE

If the O-ring gasket is seated incorrectly or is damaged, this may have an adverse effect on the IP rating.
Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.
Check that the O-ring gasket is properly seated when closing the housing cover.

Observe the following points when connecting to the power supply:

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

6 Commissioning and operation

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

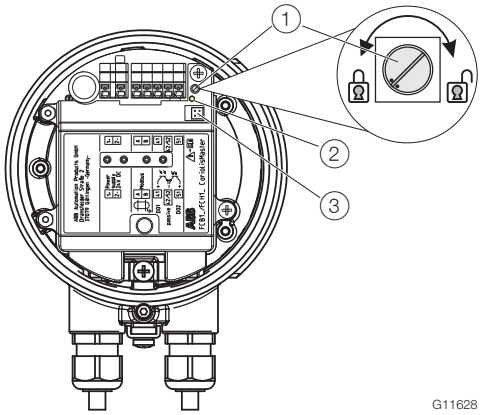

Fig. 27
(1) Write protection switch (2) Service LED (3) Local operating interface

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

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

Service LED	Description
Flashes rapidly (100 ms)	Starting sequence, device not yet ready for operation
Lit up continuously	Device operating, no critical error
Flashes slowly (1 second)	A critical error has occurred, see chapter ‘Parameter range – Diagnostics’ on page 63

Local operating interface
The sensor can also be parameterized without a Modbus connection via the local operating interface, see chapter ‘Parameterization via the local operating interface’ on page 30 .

6.2 Checks prior to commissioning

The following points must be checked before commissioning the device:
— The wiring must have been completed as described in the chapter ‘Electrical connections’ on page 24 .
— The correct grounding of the sensor.
— The ambient conditions must meet the requirements set out in the technical data.
— The power supply must meet the requirements set out on the identification plate.

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

6.3 Switching on the power supply

1. Switch on the power supply.
2. Carry out parameterization of the flowmeter (see chapter ‘Parameterization of the device’ on page 29).

The flowmeter is now ready for operation.

6.3.1 Inspection after switching on the power supply

The following points must be checked after commissioning the device:
— The parameter configuration must correspond to the operating conditions.

6.4 Parameterization of the device

NOTICE

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

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

- The Modbus slave ID, baud rate, and parity,
- Units for mass flow, standard volume flow, standard density and temperature.
- The pulse width and the pulse factor for the pulse output,
- Low flow cut-off.

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

6.4.1 Parameterization via the Modbus interface

Note chapter ‘Interface description’ on page 31 when parameterizing the Modbus interface.

Factory setting for the Modbus slave ID (address)

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

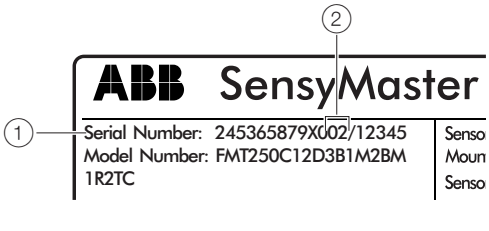

Fig. 28: Modbus address on the name plate (example)
(1) Serial number (2) Modbus Slave ID

Changing an unknown Modbus slave ID

The Modbus Slave ID (address) of the device must be known for Modbus communication.
Upon delivery, the Modbus Slave ID corresponds to the last two digits of the serial number of the device (see chapter ‘Parameterization via the Modbus interface’ on page 29).
If the Modbus address is not known, the Modbus Slave ID can be reset via a Modbus broadcast message. To do this, the following three Modbus registers must be sent to the bus together with the function code 16 (0x10) "Write Multiple Registers".

Address / data type [register length]	Description
65521 TUSIGN32 [2]	manufacturerDeviceID The manufacturer code (ABB = 0x1A) and the device code (FMT2xx = 0x27) must be written to the register 65522.
65523 TUSIGN32 [2]	sensorSerialID The Sensor ID of the device (on the calibration certificate). The information must first be written in the high-byte (65524) of the register.
65525 TUSIGN32 [2]	slaveID The new Modbus Slave ID must be written in the high byte (65526) of the register.

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

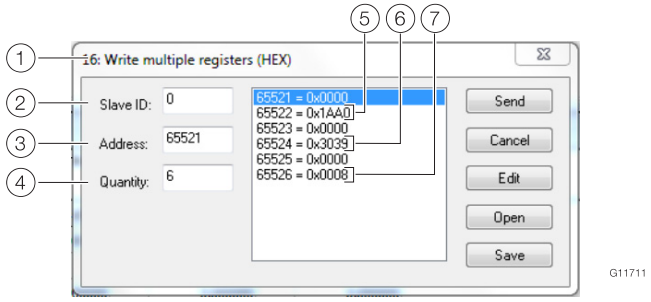

Fig. 29: Write Multiple Registers (example)
(1) Function code 16 (2) Broadcast Address "0"
(3) Register start address (4) Register number
(5) Manufacturer and device identification (6) Sensor ID
(7) New Modbus Slave ID

6.4.2 Parameterization via the local operating interface

⚠ DANGER

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

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

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

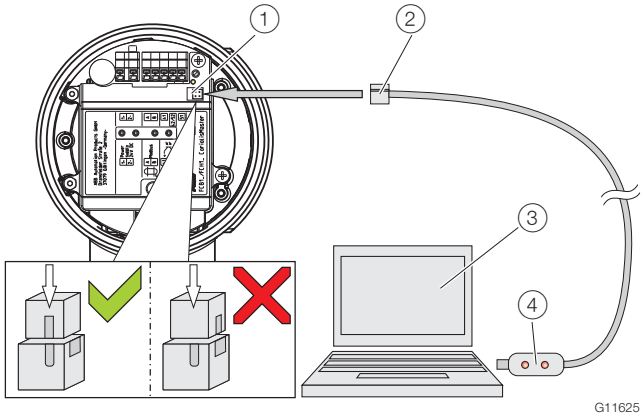

Fig. 30: Connection to the local operating interface
(1) Local operating interface (2) Programming plug
(3) PC / notebook (4) USB interface cable

1. Open device terminal box.
2. Connect programming plug to the local operating interface of the device.
3. Insert USB interface cable into a free USB female connector on the PC / notebook.
4. Switch on the device power supply.
5. Start ABB AssetVision and perform the parameterization of the equipment.

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

6.5 Operating instructions

When operating the device, please note the following:

— 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.
— Measuring medium under pressure can leak out due to fatigue on the gasket of the sensor connection or the process connection (e.g. flange or pipe fitting).

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

6.6 Interface description

NOTICE

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

6.6.1 Register tables (overview)

Description	Table type	Data type	Start index	End index
Input coils				
Diagnostic and error messages	Coil	TUSIGN8	1	1999
Register				
Dynamic 8-bit integer values	Single	TUSIGN8	1	125
Dynamic 32-bit float values, mainly process values	Single	TFLOAT	201	324
Dynamic 64-bit double values, mainly counter readings	Single	TDOUBLE	401	524
Read Scan Register 1	Single	TUSIGN16	1101	1200
Read Scan Register 2	Single	TUSIGN16	1201	1300
8-bit integer values (read only)	Single	TUSIGN8	2001	2099
16-bit integer values (read only)	Single	TUSIGN16	2101	2199
32-bit float values (read only)	Single	TFLOAT	2201	2499
Character strings (read only)	String	TCHAR	2501	2999
Configure Scan Register 1	Single	TUSIGN16	3101	3150
Configure Scan Register 2	Single	TUSIGN16	3201	3250
32-bit integer values, basis parameter	Single	TUSIGN32	3301	3399
Editable character strings	String	TCHAR	3401	4000
8-bit integer values, basis parameter	Single	TUSIGN8	4001	4999
32-bit float values, basis parameter	Single	TFLOAT	5001	5999
Application 1 to 8: byte parameter	Single	TUSIGN8	6001	6999
Application 1 to 8: floating point parameter	Single	TFLOAT	7001	8999
Action objects	Single	TUSIGN8	9001	9999
Set Modbus address (slave ID) with device code and sensor ID. See chapter ‘Changing an unknown Modbus slave ID’ on page 29 .	Single	TUSIGN32	65521	65526

The device error messages are transmitted via the Modbus interface by means of the "input coils."
See the chapter ‘Diagnosis / error messages’ on page 71 for detailed information.

6.6.2 Supported Modbus function codes

Summary

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

6.6.3 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 ... (4+n)-1	Discrete input data. Up to 2000 discrete inputs can be read in one request, if available.
(4+n), (4+n)+1	Check sum (CRC) of the Modbus telegram

0x03 Read Holding Registers

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

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

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

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

0x04 Read Input Registers

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

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

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

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

0x06 Write Single Register

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

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

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

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

0x08 Diagnostics

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

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

0x10 Write Multiple Registers

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

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

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

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

0x11 Report Slave ID

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

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

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

Byte	Description
1	Slave device code
2	Report Slave ID Function Code, 0x11
3	Number of data bytes
4	Manufacturer identification for ABB 0x1A
5	Device code for SensyMaster devices, 0x27
6	Software version, 0x30
7	Hardware version, 0x30
8	Not used, 0x30
9...11	Reserved for future use, 0x30,0x30,0x30
12...33	Device name (Hex) 41,42,42,20,46,4D,54,32,78,78,20,53,65,6E,73,79,4D,61,73,74,65,72 (ASCII) „ABB FMT2xx SensyMaster"
34...35	Check sum (CRC) of the Modbus telegram

6.6.4 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, e.g. 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

6.6.5 Modbus data types

ABB data type	Data type	Register count	Description
ACTION	unsigned char	One register	The data type "ACTION" is used to trigger device functions. Parameters with the data type "ACTION" have no internal memory requirements. Writing any value into the parameters triggers the corresponding device function.
TUSIGN8	unsigned char	One register	16-bit register, but only the first 8-bits are used - unsigned char.
TUSIGN16	unsigned short	One register	16-bit unsigned integer
TINT16	signed short	One register	16-bit signed integer
TUSIGN32	unsigned long	Two consecutive registers	32-bit unsigned integer
TINT32	signed long	Two consecutive registers	32-bit signed integer
TCHAR	unsigned char	One register. The total length of the register depends on the object length.	16-bit register, but only the first 8-bits are used - unsigned char. The register content is interpreted as an ASCII-value.
TFLOAT	float	Two consecutive registers	32-bit IEEE floating point. The device parameter "IEEEFormat" determines the order in which the data words of the data types "float" and "double" are interpreted. See also the chapter ‘Parameter range – Communication’ on page 62 .
TDOUBLE	double	Four consecutive registers	64-bit IEEE double-precision floating point. The device parameter "IEEEFormat" determines the order in which the data words of the data types "float" and "double" are interpreted. See also the chapter ‘Parameter range – Communication’ on page 62 . If the parameter is set to "1" (IEEE format deactivated), the data words of the data types "float" and "double" are sent in the standard Modbus format "big endian". Example: The value "5.525" is returned in hex as "40, 16, 19, 99, 99, 99, 99, 9A". If the parameter is set to "0" (IEEE format activated), the data words of the data types "float" and "double" are sent in the format "little endian" with the lowest value word first. Example: The value "5.525" is returned in hex as "99, 9A, 99 ,99, 19, 99, 40, 16".

6.6.6 Available units

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

NOTICE

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 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 (advp)
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
$inH^2O@4C$	51	Inches water column at 4 °C
$mmH^2O@4C$	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

6.6.7 Available gas types

The devices can be designed for the following gas types.

NOTICE

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

Table: Available gas types

Formula	Code	Description
–	0	No selection
–	1	Air[1] (only for gas type 1 of one application)
CH_4	144	Methane[1]
N_2	181	Nitrogen[1]
CO_2	72	Carbon dioxide[1]
O_2	187	Oxygen[1]
H_2	132	Hydrogen[2]
–	153	Natural gas[2]
NH_3	39	Ammonia[2]
He	120	Helium[2]
Ar	42	Argon[2]
C_3H_8	205	Propane[2]
C_2H_6	108	Ethane[2]
C_4H_{10}	69	Butane[2]
C_2H_4	114	Ethene[2]
–	48	Biogas[2]

1) Gas type available in ApplicationSelector (preconfigured applications) and for three configurable applications.
2) Gas type available only for preonfigured applications.

6.6.8 Available process variables

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

NOTICE

— Some of the process variables can be assigned to the digital outputs DO1 (terminals 41 / 42) and DO2 (terminals 51 / 52), configured as frequency [f] or pulse output [pulse].
(Code) indicates to which value the parameters "Output Value Freq." and "Output Value Pulse" must be set. See also chapter ‘Parameter range - Output’ on page 57 .

— The "Modbus address" column indicates the Modbus register address, data type and the register length for the corresponding process variable.

Process variable	Short form	Description	DO1 / 2 [f] (Code)	DO1 / 2 [pulse] (Code)	Modbus address	
					TFLOAT [2]	TDOUBLE [4]
Mass Flow [unit]	Qm	Mass flow in the selected mass flow unit	–	X (1)	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	∑m	Mass flow counter reading in the selected unit	–	–	215	409
Totalizer Qv @	∑v@	Standard volume flow counter reading in the selected unit	–	–	217	413
Current Batch Total[1)]	CBT	Current fill quantity	–	–	219	405
Current Batch Counts[1)]	CBC	Number of fill operations	–	–	3315 TUSIGN32 [2]	–

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

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

The SensyMaster FMT230, FMT250 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:

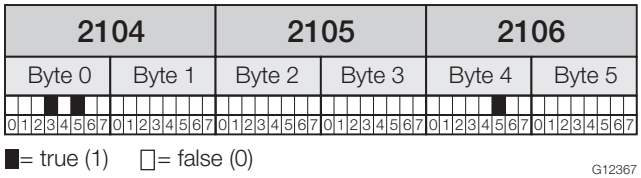

Fig. 31: Health indication register (Example)

The bit position is assigned to the errors in accordance with column “Byte / Bit pos.” of the table in chapter ‘Alarm status and alarm history status’ on page 73 .

The following assignment applies to the example in Fig. 31:

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.

6.6.10 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.

NOTICE

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

Restrictions

When using the Scan Registers, observe the following points:

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

Design of the scan register (example)

Content of the configuration register (Config scan register)

Config scan register 1, register range 3101 ... 3132		
Config scan register 2, register range 3201 ... 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	Standard 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	Standard 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 “0”.
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 1101 ... 1132	
Scan register 2, register range address 1201 ... 1232	
Read data register	**Register content**
1101 / 1201	Mass flow (data type float, register length 2)
1102 / 1202	
1103 / 1203	Standard volume flow (data type float, register length 2)
1104 / 1204	
1105 / 1205	Mass flow counter reading (data type float, register length 2)
1106 / 1206	
1107 / 1207	Standard volume flow counter reading (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	

6.6.11 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] 1: Standard ceramics 2: Ceramics high temperature design	Sensor element type
2233	Sensor Length	TFLOAT [2]	Installation length of the sensor
2012	Feature Series	TUSIGN8 [1] 50: FMT230 60: FMT250	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)

NOTICE

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

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] See chapter 'Available gas types' on page 39 .	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	TFLOAT[2] 10 … 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 … 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 … 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 … 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 … 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 ... 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 ... 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 ... 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 ... 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 ... 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 ... 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] 0.001 ... 1000	Correction factor for the flow measured value.

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 chapter 'Write protection switch' on page 28 . 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	Application	TUSIGN8 [1] 1: Application 1 … 8: Application 8	Select the application.

NOTICE

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

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]	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	TFLOAT[2]	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 39 .	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	TFLOAT[2] 10%...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]	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	TUSIGN8 [1]	
7005 (1), 7025 (2), 7045 (3), 7065 (4), 7085 (5), 7105 (6), 7125 (7), 7045 (8)	Concentr. Gas Type 3	TFLOAT[2]	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	TUSIGN8 [1]	
7007 (1), 7027 (2), 7047 (3), 7067 (4), 7087 (5), 7107 (6), 7127 (7), 7047 (8)	Concentr. Gas Type 4	TFLOAT[2]	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	TUSIGN8 [1]	
7009 (1), 7029 (2), 7049 (3), 7069 (4), 7089 (5), 7109 (6), 7129 (7), 7049 (8)	Concentr. Gas Type 5	TFLOAT[2]	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	TUSIGN8 [1]	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	TFLOAT[2]	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	TUSIGN8 [1]	
7013 (1), 7033 (2), 7053 (3), 7073 (4), 7093 (5), 7113 (6), 7133 (7), 7053 (8)	Concentr. Gas Type 7	TFLOAT[2]	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	TUSIGN8 [1]	
7015 (1), 7035 (2), 7055 (3), 7075 (4), 7095 (5), 7115 (6), 7135 (7), 7055 (8)	Concentr. Gas Type 8	TFLOAT[2]	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	TUSIGN8 [1]	
7017 (1), 7037 (2), 7057 (3), 7077 (4), 7097 (5), 7117 (6), 7137 (7), 7057 (8)	Concentr. Gas Type 9	TFLOAT[2]	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	TUSIGN8 [1]	
7019 (1), 7039 (2), 7059 (3), 7079 (4), 7099 (5), 7119 (6), 7139 (7), 7059 (8)	Concentr.Gas Type 10	TFLOAT[2]	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.

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 mass flow' on page 38 .	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 38 .	Selection of the unit for the mass counters and the pulse outputs.
4015	Unit Volumeflow Qv@	TUSIGN8 [1] Refer to 'Table 1: Units for the standard volume flow' on page 38 .	Selection of unit for standard volume flow (e.g. for the associated parameters and the corresponding process values).
4016	Einheit Norm-Volumenzähler	TUSIGN8 [1] Refer to 'Table 8: Units for the standard volume totalizer' on page 38 .	Selection of the unit for the standard volume totalizer and the pulse outputs.
4018	Std. Conditions Vol@	TUSIGN8 [1] Siehe 'Table 4: Standard conditions' on page 38 .	Set the standard state for calculation of the standard volume flow and standard volume counter.
3497	Volumeflow Qv@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Set the notation 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	Set the notation 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 38 .	Selection of the unit for the temperature (e.g. for the associated parameters and the corresponding process values).
4020	Pressure	TUSIGN8 [1] Refer to 'Table 9: Pressure units' on page 38 .	Selection of the unit for the pressure (e.g. for the associated parameters and the corresponding process values).
4019	Length	TUSIGN8 [1] Refer to 'Table 6: Length units' on page 38 .	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 38 .	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	Set the notation for standard density. If the first character is a space, the standard notation is used.

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	Set the notation for the user-defined unit Qm.
5071	Mass flow Qm Factor	TFLOAT [2] 0.0001 … 100000 kg/h	Set the factor in kg/h for the user-defined unit Qm.
3489	Mass Tot. Name	TCHAR [8] Alphanumeric, maximum 7 characters	Set the notation 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	Set the notation for the user-defined unit Qv@.
5073	Volumeflow Qv@ Fact.	TFLOAT [2] 0.0001 … 100000 m^3/h@	Set the factor in m^3/h for the user-defined unit Qv@.
3513	Density@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Set the notation for the user-defined standard density.
5067	Density@ Factor	TFLOAT [2] 0.0001 … 100000 kg/m^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. — 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 given as output (e.g. 1 pulse per kg). — Frequency: Digital output functions as frequency output (for process value see the parameter "Signal Source Freq.."). In frequency mode for example, 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: Standard volume flow rate	Selection of the process value issued via the pulse output.
5027	Quantity Pulses	TFLOAT [2] 1 … 1000000 pulses	Set the pulses per mass unit or volume unit (see table ‘Available units’ on page 38) for the pulse output. The pulse value is a result of the ratio of “Quantity Pulses” per “Quantity Mass” or “Quantity Pulses” per “Quantity Volume@”.
5031	Mass quantity or standard volumes	TFLOAT [2]	
5029	Pulse Width	TFLOAT [2] 0.05 ... 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. Setting range: 0.05 ... 2000 ms
… / ...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: Standard volume flow [%] 3: Temperature [%]	Selection of the process value issued via the frequency output.
5023	Upper Range Value	TFLOAT [2] 0 ... 10000 Hz	Sets the frequency for the upper range value. The entered value corresponds to 100 %.
5025	Lower Range Value	TFLOAT [2] 0 ... 10000 Hz	Set the frequency for the lower range value. The entered value corresponds to 0 %.

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. — 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] 0: Off 1: On	Selection of error messages signaled via the binary output 41 / 42. Only if the parameter "Signal Source Binary" has been set to 2 - Alarm signal.
4030	Qm Massflow Max		
4031	Qm Massflow Min		
4032	Qv@ Volumeflow Max		
4033	Qv@ Volumeflow Min		
4027	Tm Temperature Max		
4028	Tm Temperature Min		
4034	Sensor Soiling		

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …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 "90°" and "180°" are only available if digital output 41 / 42 has been configured as a pulse output. — Off: Digital output deactivated. — Binary: Digital output functions as binary output (for function, see the parameter "Signal Source Binary"). — Frequency: Digital output functions as frequency output (for process value see the parameter "Signal Source Freq.."). In frequency mode for example, 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.
… / …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: Standard volume flow 3: Temperature [%]	Selection of the process value issued via the frequency output.
5033	Upper Range Value	**TFLOAT** 0 … 10000 Hz	Sets the frequency for the upper range value. The entered value corresponds to 100 %.
5035	Lower Range Value	**TFLOAT** 0 … 10000 Hz	Set the frequency for the lower range value. The entered value corresponds to 0 %.

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / ...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. — 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] 0: Off 1: On	Selection of error messages signaled via the binary output 51 / 52. Only if the parameter "Signal Source Binary" has been set to 2 - Alarm signal.
4038	Qm Massflow Max		
4039	Qm Massflow Min		
4040	Qv@ Volumeflow Max		
4041	Qv@ Volumeflow Min		
4035	Tm Temperature Max		
4036	Tm Temperature Min		
4042	Sensor Soiling		

Parameter range – Process Alarm

Modbus register address	Parameter name	Data type [register length] / value range	Description
0 ... 95	Diagnosis register (discrete inputs, function code 0x02)	TUSIGN8 [1]	Display of alarm status and the alarm history. See also chapter 'Alarm status and alarm history status' on page 73 . 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] 0 - Masking deactivated 1 - Masking activated	Alarm messages are divided into groups. If masking is activated for a group (On), no alarm occurs. For more detailed information, see chapter 'Diagnosis / error messages' on page 71 .
4068	Function Check		
4070	Out Of Specification		
… / ...Alarm Limits / ...Application 1			
… / ...Alarm Limits / ...Application 8			
The numbers in brackets (1 ... 8) in the Modbus register addresses correspond to the associated application 1 ... 8.			
7187 (1), 7233 (2), 7279 (3), 7325 (4), 7371 (5), 7417 (6), 7463 (7), 7509 (8)	Qm Massflow Min	TFLOAT [2] 0 ... 110 % Factory setting: 0 %	Setting of the alarm limits for the mass flow. If the mass flow up-scales or down-scales the values set in the parameters "Qm Massflow Min" and "Qm Massflow Max," the "Mass flowrate exceeds limits. " error message is generated.
7185 (1), 7231 (2), 7277 (3), 7323 (4), 7369 (5), 7415 (6), 7461 (7), 7507 (8)	Qm Massflow Max	TFLOAT [2] 0 ... 130 % Factory setting: 110 %	
7195 (1), 7241 (2), 7287 (3), 7333 (4), 7379 (5), 7425 (6), 7471 (7), 7517 (8)	Qv@ Volumeflow Min	TFLOAT [2] 0 ... 110 % Factory setting: 0 %	Setting of the alarm limits for standard volume flow. If the standard volume flow up-scales or down-scales the values set in the parameters "Qv@ Volumeflow Min" and "Qv@ Volumeflow Max," the "Standard volume flow too high / low" error message is generated.
7193 (1), 7239 (2), 7285 (3), 7331 (4), 7377 (5), 7423 (6), 7469 (7), 7515 (8)	Qv@ Volumeflow Max	TFLOAT [2] 0 ... 130 % Factory setting: 110 %	
7205 (1), 7251 (2), 7297 (3), 7343 (4), 7389 (5), 7435 (6), 7481 (7), 7527 (8)	Tm Min	TFLOAT [2] -100 ... 250 °C Factory setting: −50 °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," the "Medium temperat exceeds limits. " error message is generated.
7203 (1), 7249 (2), 7295 (3), 7341 (4), 7387 (5), 7433 (6), 7479 (7), 7525 (8)	Tm Max	TFLOAT [2] -50 ... 300 °C Factory setting: 250 °C	

Parameter range – Communication

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Modbus			
4007	Device Address	TUSIGN8 [1] 1 … 247	Setting of the Modbus device address. For factory settings, see chapter 'Parameterization via the Modbus interface' on page 29 .
4012	IEEE Number Format	TUSIGN8 [1] 0 - IEEE format activated 1 - IEEE format deactivated	Selection of the byte order for the Modbus communication. — If the IEEE format is activated (1), the data words are sent in the "little-endian" format, with the lowest value word transmitted first. — If the IEEE format is deactivated (0), the data words are sent in the standard Modbus "big-endian" format. Factory setting: IEEE format activated.
4008	Baudrate	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 … 200 ms	Setting of the pause time in milliseconds after receiving a Modbus command. The device sends a response no earlier than expiration of the set pause time. Factory setting: 10 ms

Parameter range – Diagnostics

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / ...Diagnosis Control			
3313	Preset Maint. cycle	TUSIGN32 [2] 0 … 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	Measuring medium temperature	TFLOAT [2]	Output of current measuring medium temperature in °C. The parameter is read only.
223	Electronic unit temperature FE	TFLOAT [2]	Output the current temperature of the frontend board electronic unit in °C. The parameter is read only.
… / ...Simulation Mode			
4001	Process simulation	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 page ‘Setting of the simulated measured values.’ on page 64). 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 (binary / pulse / frequency) of the digital output 41 / 42.
5017	Freq.Out 41/42 Puls.Out 41/42	TFLOAT [2] 0 … 10,500 Hz 0 … 10,500 pulses	
4004	Dig.Out 51/52 State	TUSIGN8 [1] 0 - Off 1 - On	The respective simulated output value is dependent on the operating mode (binary / frequency) of the digital output 51 / 52.
5019	Freq.Out 51/52	TFLOAT [2] 0 … 10,500 Hz	
5003	Qm Massflow [unit]	TFLOAT [2] 0 ... 2 x QmMax DN	Setting of the simulated measured values. The simulated value is selected with the parameter "Simulation Switch".
5011	Qm Massflow [%]	TFLOAT [2] -200 ... 200 %	
5007	Qv@ Vol.flow [unit]	TFLOAT [2] 0 ... 2 x QvMax DN	
5015	Qv@ Vol.flow [%]	TFLOAT [2] -200 ... 200 %	
5001	Temperature [unit]	TFLOAT [2] -100 ... 250 °C	
5009	Temperature [%]	TFLOAT [2] -200 ... 200 %	
... / ...Output Readings			
239	Freq.Out 41/42	TFLOAT [2] 0 … 10,500 Hz	Output of the current output values. The available values are dependent on the configuration of the digital outputs. The parameters are read only.
18	Dig.Out 41/42 State	TUSIGN8 [1] 0 - Off 1 - On	
241	Freq.Out 51/52	TFLOAT [2] 0 … 10,500 Hz	
19	Dig.Out 51/52 State	TUSIGN8 [1] 0 - Off 1 - On	

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	Check	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	Results	TFLOAT [2] 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 2237 2239 2241	Value TDC1 Value TDC2 Value HDC1 Value HDC2	TFLOAT [2]	Read VeriMass parameters 2035: Temperature change TDC1 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: Off 1: Mass 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. 9: Device not calibrated. 10: Sensor memory defective. 11: NV data defect. Data storage irreparable. 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 73 .

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]	Sets the fill quantity using the selected unit. When the defined fill quantity is reached, the configured binary output is activated. NOTICE 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.
219 / 405	Current Batch Total	TFLOAT [2] / TDOUBLE [4]	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. — 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 ... 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 ... 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) — 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 ... 10 s Factory setting: 0.1 s	Sets the time for the overrun quantity correction after the fill valve is closed.

6.6.12 Software history

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

Device software package FMT2xx (Device Firmware Package)				
Version	**Issue date**	**Type of change**	**Description**	**Ordering number**
01.00.07	2017	New release	—	3KXF002045U0100

6.7 FillMass batch function

Only with FMT250

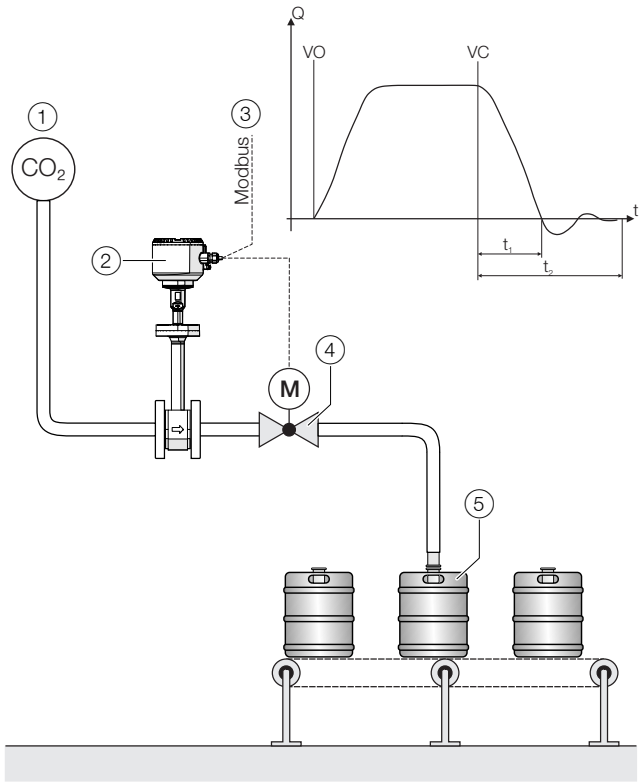

Fig. 32: Filling function FillMass (example CO_2filling)
(1) Gas line (CO_2) (2) Sensor (3) Fill start / stop (via Modbus) (4) Fill valve (5) Fill container

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 batch function allows filling processes to be recorded in > 3 seconds.
For this purpose, the filling quantity is given via an adjustable totalizer.
The Modbus interface is used to configure and control the fill function.
The valve is triggered via one of the digital outputs and closed again once the preset filling quantity is reached.
The transmitter measures the overrun quantity and calculates the overrun correction from this.
Additionally, the low flow cut-off can be activated if required.

6.7.1 Configuration

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 54 .
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 57 .
3. The parameters for the fill mass function must be configured. See also parameter range . ‘...FillMass’ on page 67 .

NOTICE

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 49 .

6.7.2 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:

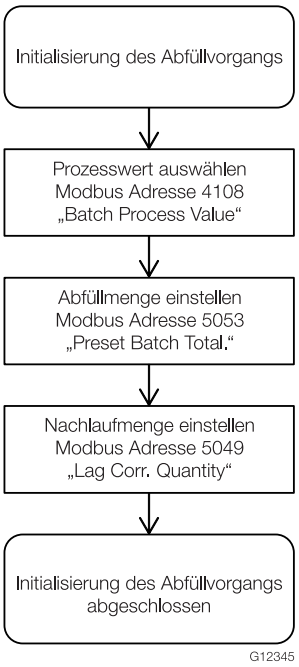

Fig. 33: Initialization

NOTICE

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:

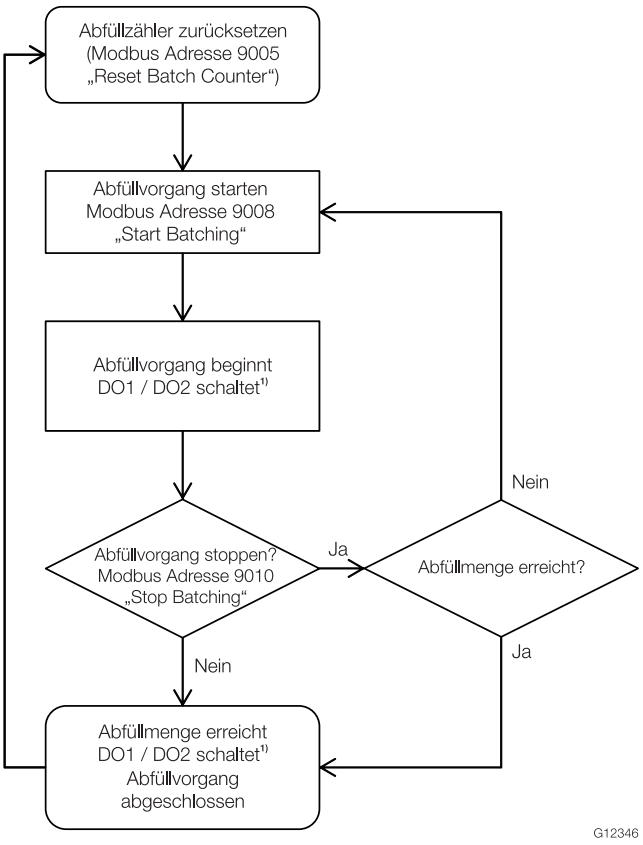

Fig. 34: Fill operation

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

The current fill quantity for the present fill operation can be read out via the Modbus address 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”.

7 Diagnosis / error messages

NOTICE

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

7.1 General remarks

Errors encountered are itemized in tabular form on the following pages. The response of the transmitter on error detection is described therein.
The table lists all possible errors together with a description of their impact on the value of measurement variables, the properties of current outputs and the alarm output.
If no entry is indicated in the table field, there is no effect on the measurement variable or no alarm signal for the particular output.
The sequence of the errors in the table corresponds to the error priorities.
The first entry has the highest priority and the last has the lowest.
If multiple errors are detected simultaneously, the error with the highest priority determines the alarm condition of the measurement variable and the current output. If an error with a higher priority does not affect the measurement variable or the output status, the error with the next highest priority determines the status of the measurement variable and the output.

The following critical errors are indicated by slow flashing (frequency: 1 second) of the service LED in the transmitter terminal box.
See also chapter ‘Service LED’ on page 28 .

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

7.2 Overview

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

Symbol	Description
STOP	Counter stop
–	No change, current value

Priority	Errors	Error text	Process variables				Counter
			Qm [%]	Qv@ [%]	Temperature [°C]	Standard density [kg/m³]@ 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.	–	–	–	–	STOP
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. Wrong config.	–	–	–	–	–
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.	–	–	–	–	–

7.3 Alarm status and alarm history status

Modbus address		Byte /	Error no.	Error text	Description	NAMUR
Active	History	bit pos.				classification
11	59	1 / 2	F084.010	NV data defect. Data storage irreparable.	SensorMemory defective — Contact ABB Service	Failure
30	78	3 / 5	F096.029	ADC Failure on Frontend Board.	Analog-digital converter in frontend board defective — Contact ABB Service	Failure
31	79	3 / 6	F092.030	Electronics failFrontend Board.	Electronic unit in frontend board defective — Contact ABB Service	Failure
34	82	4 / 1	F093.033	Sensor failure or disconnected.	Sensor electrical connection incorrect — 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 — Contact ABB Service	Failure
2	50	0 / 1	S044.000	Mass flowrate exceeds limits.	Mass flow outside of set alarm threshold — Check parameterization (see ‘Parameter range – Process Alarm’ on page 61)	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. — Check parameterization (see ‘Parameter range - Output’ on page 57)	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 — Check parameterization (see ‘Parameter range – Process Alarm’ on page 61) — Check measuring medium temperature (see chapter ‘Process conditions’ on page 14)	Out of specification
34	82	4 / 1	S055.032	Frontend temp. out of range.	Device temperature outside of permissible limit values — Check ambient temperature (see chapter ‘Environmental conditions’ on page 14)	Out of specification

Modbus address		Byte / bit pos.	Error no.	Error text	Description	NAMUR classification
Active	History					
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 — 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 — Check parameterization (see 'Parameter range – Process Alarm' on page 61) — Check measuring medium temperature (see chapter 'Process conditions' on page 14)	Out of specification
41	89	5 / 0	S041.039	Std.Volume flow exceeds limits.	Standard volume flow outside of set alarm threshold. — Check parameterization (see 'Parameter range – Process Alarm' on page 61)	Out of specification
44	92	5 / 3	S046.042	Dig.Out 51/52 is saturated. Wrong config.	Digital output 51 / 52 (pulse output) maximum pulse rate up-scaled. — Check parameterization (see 'Parameter range - Output' on page 57)	Out of specification
4	52	0 / 3	C072.002	Simulation is on! Simulating process/output value	Manual process control (simulation) active. — Deactivate simulation (see 'Parameter range – Diagnostics' on page 63)	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. — Deactivate simulation (see 'Parameter range – Diagnostics' on page 63)	Functional check

Modbus address		Byte / bit pos.	Error no.	Error text	Description	NAMUR classification
Active	History					
6	54	0 / 5	M026.004	Maintenance interval is reached	Maintenance interval reached — Conduct maintenance of the device — Maintenance interval start new cycle (see 'Parameter range – Diagnostics' on page 63)	Maintenance required
10	58	1 / 1	M024.008	Device not calibrated.	Device not calibrated — Contact ABB Service	Maintenance required
11	59	1 / 2	M038.009	Sensor memory defective.	SensorMemory faulty — Replace SensorMemory	Maintenance required
40	88	4 / 7	M059.038	Invalid Sensor configuration	Parameterization (configuration) of the device is incorrect. — Check parameterization (configuration) — Contact ABB Service	Maintenance required
42	90	5 / 1	M058.040	Sensor soiling detected.	Thermal measuring element contaminated. — Check thermal measuring element and clean as needed (see chapter 'Parameter range - Totalizer' on page 67	Maintenance required

8 Maintenance

8.1 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 replacement device.

⚠ 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 and any adjacent lines or containers.
— Check whether hazardous materials have been used as materials to be measured before opening the device. Residual amounts of hazardous material may still be present in the device and could escape when it is opened.

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

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

8.2 Flowmeter sensor

The flowmeter sensor is largely maintenance-free.
The following items should be checked annually:

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

8.3 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.

8.3.1 Clean measuring 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.

NOTICE

Damage to the sensor due to improper cleaning!

— Do not clean the measuring element with hard objects (screwdrivers, tweezers or wire brushes).
— Do not clean the measuring 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 changing device, as described in chapter ‘Installing the sensor’ on page 21 and ‘Disassembly of the sensor during operation’ on page 23 .
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 Ø 55 mm x 3 mm (2.16 x 0.12 inch)).
7. Install the sensor in the pipe component or changing device, as described in chapter ‘Installing the sensor’ on page 21 and ‘Installation of the sensor during operation’ on page 23 .
8. Perform electrical connection (see chapter ‘Electrical connections’ on page 24).
9. Perform commissioning (see chapter ‘Commissioning and operation’ on page 28).

8.4 Integrated hot tap fitting

Replace the O-ring gaskets

WARNING

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.

WARNING

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.

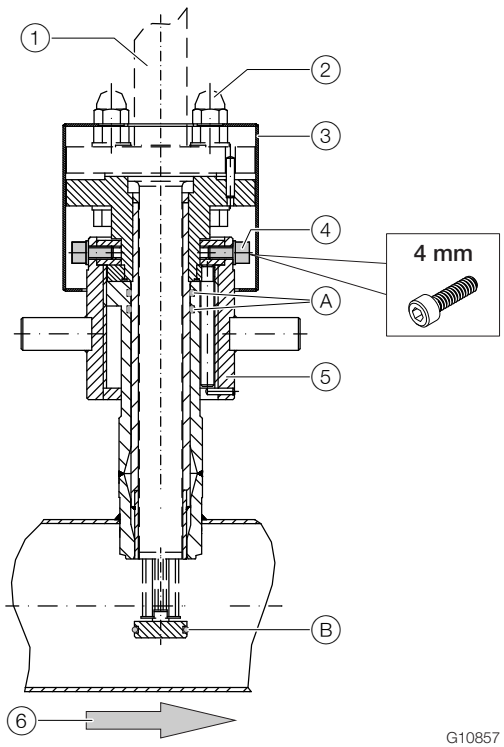

Fig. 35: Gaskets on the changing device
(1) Sensor (2) Special screws (3) Protection cap (4) Fixing screw for union nut (4x) (5) Union nut (6) Flow direction

O-ring seals		
Pos.	**Quantity**	**Design**
(A)	2	O-Ring Ø 36 x 3 mm (1,42 x 0,12 inch), Viton
(B)	1	O-Ring Ø 26 x 3 mm (1,02 x 0,12 inch), Viton

1. Disassemble the sensor (see chapter 'Disassembly of the sensor during operation' on page 23)
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 of the sensor during operation' on page 23)

9 Repair

9.1 Safety instructions

⚠ WARNING

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

⚠ CAUTION

Risk of burns due to hot measuring media.
The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!
Before starting work on the device, make sure that it has cooled sufficiently.

i 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.

9.2 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.

i NOTICE

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

9.3 Fuse replacement

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 chapter 'Opening and closing the housing' on page 23 to open and close the housing safely.

NOTICE

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

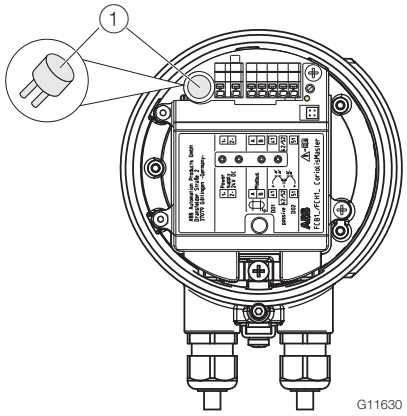

Fig. 36
(1) Fuse

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

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

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

9.4 Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes. Fill out the return form (see the Appendix) and include this with the device.
According to the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes: All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

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

10 Recycling and disposal

10.1 Dismounting

⚠ WARNING

Risk of injury due to process conditions.

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

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

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow the device / piping to cool and depressurize and empty. Collect any escaping medium and dispose of it in accordance with environmental guidelines.
- Use appropriate tools to dismantle the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- See the information in chapter ‘ Returning devices’ on page 79.

10.2 Disposal

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

Bear the following points in mind when disposing of them:

- This product is not subject to WEEE Directive 2012/19/EU or relevant national laws (e.g. ElektroG in Germany).
- The product must be surrendered to a specialist recycling company. Do not use municipal garbage collection points. Only privately used products may be disposed of in the municipal garbage according to the WEEE directive 2012/19/EU
- If it is not possible to dispose of old equipment properly, ABB Service can take receipt of and dispose of returns for a fee.

i NOTICE

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

11 Specification

i NOTICE

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

12 Additional documents

i NOTICE

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

13 Appendix

Statement on the contamination of devices and components

Repair and / or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.
Otherwise, the device / component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	E-Mail:

Device details:

Typ:	Serial no.:
Reason for the return/description of the defect:	

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

☐ Yes ☐ No

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

Biological	☐	Corrosive / irritating	☐	Combustible (highly / extremely combustible)	☐
Toxic	☐	Explosiv	☐	Other toxic substances	☐
Radioactive	☐				

Which substances have come into contact with the device?

1.
2.
3.

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

Town/city, date	Signature and company stamp

Notes

Notes

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