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

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

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

General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.

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

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed.
These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

Warnings

The warnings in these instructions are structured as follows:

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

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

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

NOTICE
The signal word ‘NOTICE’ indicates possible material damage.

Note

‘Note’ indicates useful or important information about the product.

Intended use

This device can be used in the following applications:

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

This device is intended for the following uses:

- for direct mass flow measurement of gases and gas mixtures in closed pipelines.
- for indirect measurement of volume flows (through standard density and mass 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 measuring media, the following points must be observed:

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

Imperfect use

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

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

Notes on data safety

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.

Warranty provisions

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

Manufacturer’s address

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

Service address

Customer service center
Tel: +49 180 5 222 580
Email: automation.service@de.abb.com
2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

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

Device overview

<table>
<thead>
<tr>
<th>Model number</th>
<th>Standard / No explosion protection</th>
<th>Zones 2, 22</th>
<th>Zone 1, 21 (Zone 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMT2xx Y0</td>
<td></td>
<td>FMT2xx A2</td>
<td>FMT2xx A1, A3</td>
</tr>
<tr>
<td>• Standard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Zone 2, 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Zone 1, 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Zone 0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ex marking

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

Temperature data

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

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

<table>
<thead>
<tr>
<th>$T_{\text{amb}}$</th>
<th>Temperature resistance for the connecting cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 50 ^\circ C$ (≤ $122 ^\circ F$)</td>
<td>$\geq 70 ^\circ C$ (≥ $158 ^\circ F$)</td>
</tr>
<tr>
<td>$\leq 60 ^\circ C$ (≤ $140 ^\circ F$)</td>
<td>$\geq 80 ^\circ C$ (≥ $176 ^\circ F$)</td>
</tr>
<tr>
<td>$\leq 70 ^\circ C$ (≤ $158 ^\circ F$)</td>
<td>$\geq 90 ^\circ C$ (≥ $194 ^\circ F$)</td>
</tr>
</tbody>
</table>

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

Note
The signal cable supplied by ABB can be used without restrictions up to an ambient temperature of $\leq 80 ^\circ C$ (≤ $176 ^\circ F$).
Environmental and process conditions for model FMT2xx...

<table>
<thead>
<tr>
<th>Ambient temperature $T_{\text{amb.}}$</th>
<th>$-20$ to $70 , ^\circ\text{C}$ ($-4$ to $158 , ^\circ\text{F}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring medium temperature $T_{\text{medium}}$</td>
<td>$-20$ to $150 , ^\circ\text{C}$ ($-4$ to $302 , ^\circ\text{F}$)</td>
</tr>
<tr>
<td>IP rating / NEMA rating</td>
<td>IP 65, IP 67 / NEMA 4X,Type 4X</td>
</tr>
</tbody>
</table>

Measuring medium temperature (Ex data) for model FMT2x0-A1... in Zone 1, Zone 21
The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... must not be up-scaled!

<table>
<thead>
<tr>
<th>Ambient temperature $T_{\text{amb.}}$</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-40 , ^\circ\text{C}$ to $40 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $104 , ^\circ\text{F}$)</td>
<td>280 °C (536 °F)</td>
<td>185 °C (365 °F)</td>
<td>90 °C (194 °F)</td>
<td>90 °C (194 °F)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $50 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $122 , ^\circ\text{F}$)</td>
<td>280 °C (536 °F)</td>
<td>185 °C (365 °F)</td>
<td>90 °C (194 °F)</td>
<td>90 °C (194 °F)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $60 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $140 , ^\circ\text{F}$)</td>
<td>280 °C (536 °F)</td>
<td>185 °C (365 °F)</td>
<td>90 °C (194 °F)</td>
<td>90 °C (194 °F)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $70 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $158 , ^\circ\text{F}$)</td>
<td>280 °C (536 °F)</td>
<td>185 °C (365 °F)</td>
<td>90 °C (194 °F)</td>
<td>90 °C (194 °F)</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Measuring medium temperature (Ex data) for model FMT2x0-A2... in Zone 2, Zone 22
The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... must not be up-scaled!

<table>
<thead>
<tr>
<th>Ambient temperature $T_{\text{amb.}}$</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-40 , ^\circ\text{C}$ to $40 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $104 , ^\circ\text{F}$)</td>
<td>300 °C (572 °F)</td>
<td>290 °C (554 °F)</td>
<td>195 °C (383 °F)</td>
<td>130 °C (266 °F)</td>
<td>95 °C (203 °F)</td>
<td>80 °C (176 °F)</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $50 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $122 , ^\circ\text{F}$)</td>
<td>300 °C (572 °F)</td>
<td>290 °C (554 °F)</td>
<td>195 °C (383 °F)</td>
<td>130 °C (266 °F)</td>
<td>95 °C (203 °F)</td>
<td>—</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $60 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $140 , ^\circ\text{F}$)</td>
<td>300 °C (572 °F)</td>
<td>290 °C (554 °F)</td>
<td>195 °C (383 °F)</td>
<td>130 °C (266 °F)</td>
<td>95 °C (203 °F)</td>
<td>—</td>
</tr>
<tr>
<td>$-40 , ^\circ\text{C}$ to $70 , ^\circ\text{C}$ ($-40 , ^\circ\text{F}$ to $158 , ^\circ\text{F}$)</td>
<td>300 °C (572 °F)</td>
<td>290 °C (554 °F)</td>
<td>195 °C (383 °F)</td>
<td>130 °C (266 °F)</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
... 2  Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Electrical data

Modbus outputs and digital outputs

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Operating values (general)</th>
<th>Type of protection</th>
<th>‘Ex ec’ (Zone 2, 22)</th>
<th>‘Ex e’ (Zone 1, 21)</th>
<th>‘Ex ia’ (Zone 1, 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modbus, active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals A / B</td>
<td>30 [V] 30 [mA]</td>
<td>U [V] I [mA] L [mW] C [nF] C [nF] L [µH]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital output DO1, passive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals 41 / 42</td>
<td>30 [V] 30 [mA]</td>
<td>30 [V] 30 [mA] 150 [mW] 13900 [nF] 20 [µH]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital output DO2, passive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals 51 / 52</td>
<td>30 [V] 30 [mA]</td>
<td>30 [V] 30 [mA] 150 [mW] 13900 [nF] 20 [µH]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Special connection conditions

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

The output circuits are designed so that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits.
- Combining intrinsically safe and non-intrinsically safe circuits is not permitted.
- On intrinsically safe circuits, potential equalization should be established along the entire length of the cable used for the signal outputs.
- The rated voltage of the non-intrinsically safe circuits is UM = 30 V.
- Intrinsic safety is preserved if the rated voltage UM = 30 V is not up-scaled when connections are established to non-intrinsically safe external circuits.
- The information in Changing the type of protection on page 11 must be observed when changing the type of protection.
Installation instructions

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

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

The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas). Comply with the applicable regulations for the protection of employees to ensure safe operation.

It is essential that the temperature classes as per the approvals in 'Temperature data on page 13' are observed.

The information in the installation diagram 3kxf000094G0009 on page 53 must be observed.

Use in areas exposed to combustible dust

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

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

Opening and closing the terminal box

⚠️ DANGER

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

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

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

⚠️ WARNING

Risk of injury due to live parts!

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

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

See also Opening and closing the housing on page 40.

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

Note

Spare parts can be ordered from ABB Service.

www.abb.com/contacts
... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Installation instructions

Cable entries
The cable glands supplied are ATEX-/IECEx-certified. The use of standard cable glands and seals is prohibited. The black plugs in the cable fittings are intended to provide protection during transport. Any unused cable entries must be sealed prior to commissioning, using the seals supplied. The outside diameter of the connection cable must measure between 6 mm (0.24 in) and 12 mm (0.47 in) to guarantee the requiredtightness.

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

Note
In order to provide the required temperature resistance, devices in the low-temperature design (optional – in preparation, ambient temperature up to −40 °C [40 °F]) are delivered with metal cable glands. These are then also to be used in intrinsically safe circuits.

Electrical connections

Grounding
The sensor must be grounded in accordance with the applicable international standards. Perform grounding of the device in accordance with Pin assignment on page 41.

Operating instructions

Protection against electrostatic discharges

DANGER

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

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

Instructions on cleaning

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

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

WARNING! - Do not open in a flammable or potentially explosive atmosphere.

Figure 1: Warning signs on the device

Repair

Contact ABB before commencing repair work.
Changing the type of protection

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

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

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

<table>
<thead>
<tr>
<th>Original installation</th>
<th>New installation</th>
<th>Necessary test steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1 / Div. 1: Modbus interface and digital outputs in non-intrinsically safe design</td>
<td>Zone 1 / Div. 1: Modbus interface and digital outputs in intrinsically safe ia / IS design</td>
<td>- $500 \times 1.414 = 710$ V DC/1min Test between terminals A / B, 41 / 42 as well as 51 / 52 and the terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. - Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.</td>
</tr>
<tr>
<td>Zone 1 / Div. 1: Modbus interface and digital outputs in intrinsically safe ia(ib) / IS design</td>
<td>Zone 1 / Div. 1: Modbus interface and digital outputs in non-intrinsically safe design</td>
<td>- Visual inspection, no damage visible on the threads (cover, ½ in NPT cable glands).</td>
</tr>
</tbody>
</table>

Note

For further details on explosion protection, types of protection and device models, refer to the installation diagram in the annex!
3 Use in potentially explosive atmospheres in accordance with FM and CSA

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

Device overview

<table>
<thead>
<tr>
<th>Model number</th>
<th>Standard / No explosion protection</th>
<th>Class I Div. 2 Zone 2, 22</th>
<th>Class I Div. 1 Zone 1, 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMT2xx Y0</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>FMT2xx F2</td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>FMT2xx F1</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Ex marking

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

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

**FM (marking for US)**

Certificate: FM19US0110X

NI: CL I, Div 2, GPS ABCD, T6...T2
NI: CL II,III Div 2, GPS EFG, T6...T3B
DIP: CL II, Div 1, GPS EFG, T6...T3B
DIP: CL III, Div 1,2, T6...T3B
CL I, ZN 2, AEx ec IIC T6...T2 Gc
ZN 21, AEx tb IIC T85°C...T165°C Db

See handbook for temperature class information

**FM (marking for Canada)**

Certificate: FM19CA0055X

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

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

**FM (marking for US)**

Certificate: FM19US0110X

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

**FM (marking for Canada)**

Certificate: FM19CA0055X

XP-IS: CL I, Div 1, GPS BCD,T6...T2
DIP: CL II,III, Div 1, GPS EFG,T6...T3B
CL I, ZN 1, AEx db IIB+H2 T6...T2 Ga/Gb
Ex la tb IIC T85°C...T165°C Db
IN-/OUTPUTS: Urated=30V
Ex la INTRINSICALLY SAFE
SECURITE INTRINSEQUE
Temperature data

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

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

<table>
<thead>
<tr>
<th>$T_{\text{amb}}$</th>
<th>Temperature resistance for the connecting cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 50 , ^\circ\text{C}$ (≤ $122 , ^\circ\text{F}$)</td>
<td>$\geq 70 , ^\circ\text{C}$ (≥ $158 , ^\circ\text{F}$)</td>
</tr>
<tr>
<td>$\leq 60 , ^\circ\text{C}$ (≤ $140 , ^\circ\text{F}$)</td>
<td>$\geq 80 , ^\circ\text{C}$ (≥ $176 , ^\circ\text{F}$)</td>
</tr>
<tr>
<td>$\leq 70 , ^\circ\text{C}$ (≤ $158 , ^\circ\text{F}$)</td>
<td>$\geq 90 , ^\circ\text{C}$ (≥ $194 , ^\circ\text{F}$)</td>
</tr>
</tbody>
</table>

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

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

Environmental and process conditions for model FMT2xx...

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature $T_{\text{amb}}$</td>
<td>$-20$ to $70 , ^\circ\text{C}$ ($-4$ to $158 , ^\circ\text{F}$)</td>
</tr>
<tr>
<td>Measuring medium temperature $T_{\text{medium}}$</td>
<td>$-20$ to $150 , ^\circ\text{C}$ ($-4$ to $302 , ^\circ\text{F}$)</td>
</tr>
<tr>
<td>IP rating / NEMA rating</td>
<td>IP 65, IP 67 / NEMA 4X, Type 4X</td>
</tr>
</tbody>
</table>
... 3 Use in potentially explosive atmospheres in accordance with FM and CSA

... Temperature data

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

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... on page 13 must not be up-scaled!

<table>
<thead>
<tr>
<th>Ambient temperature $T_{\text{amb}}$</th>
<th>Temperature class</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-40^\circ \text{C to } 40^\circ \text{C}$ ($-40^\circ \text{F to } 104^\circ \text{F}$)</td>
<td>T1</td>
</tr>
<tr>
<td>280 °C (536 °F)</td>
<td>185 °C (365 °F)</td>
</tr>
</tbody>
</table>

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

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... on page 13 must not be up-scaled!

<table>
<thead>
<tr>
<th>Ambient temperature $T_{\text{amb}}$</th>
<th>Temperature class</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-40^\circ \text{C to } 40^\circ \text{C}$ ($-40^\circ \text{F to } 104^\circ \text{F}$)</td>
<td>T1</td>
</tr>
<tr>
<td>300 °C (572 °F)</td>
<td>290 °C (554 °F)</td>
</tr>
</tbody>
</table>

Notice on dust-ignition protection for USA and Canada in accordance with NEC

The surface temperature of the device must not under any circumstances up-scale 85 °C (185 °F) if there is there carbonaceous dust or dust which can carbonate.

Attention, T-Class for Dust US and Canada information according NEC/CEC:

The maximum temperature cannot exceed 165 °C under any circumstances where a carbonaceous dust or dust likely to carbonize is present.

• For combustible dusts, less than the lower of either the layer or cloud ignition temperature of the specific combustible dust. For organic dusts that may dehydrate or carbonize, the temperature marking shall not exceed the lower of either the ignition temperature or 165 °C (329 °F).
• For ignitable fibers/flyings, less than 165 °C (329 °F) for equipment that is not subject to overloading, or 120°C (248°F) for equipment (such as motors or power transformers) that may be overloaded.
**Electrical data**

**Modbus outputs and digital outputs**

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Operating values (general)</th>
<th>NI (Div. 2, Zone 2)</th>
<th>XP (Div. 1, Zone 1)</th>
<th>IS (Div. 1, Zone 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modbus, active</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals A / B</td>
<td>U_n [V] I_n [mA]</td>
<td>U_N [V] I_N [mA]</td>
<td>U_M [V] I_M [mA]</td>
<td>U_O [V] I_O [mA]</td>
</tr>
<tr>
<td></td>
<td>30 30</td>
<td>30 30 30 100</td>
<td>4,2 150</td>
<td></td>
</tr>
<tr>
<td>Digital output DO1, passive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals 41 / 42</td>
<td>30 30</td>
<td>30 30 30 100</td>
<td>4,2 150</td>
<td></td>
</tr>
<tr>
<td>Digital output DO2, passive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminals 51 / 52</td>
<td>30 30</td>
<td>30 30 30 100</td>
<td>4,2 150</td>
<td></td>
</tr>
</tbody>
</table>

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

**Special connection conditions**

**Note**

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

![Image](https://via.placeholder.com/150)

The output circuits are designed so that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits.
- Combining intrinsically safe and non-intrinsically safe circuits is not permitted.
- On intrinsically safe circuits, potential equalization should be established along the entire length of the cable used for the signal outputs.
- The rated voltage of the non-intrinsically safe circuits is $U_M = 30 \text{ V}$.
- Intrinsic safety is preserved if the rated voltage $U_M = 30 \text{ V}$ is not up-scaled when connections are established to non-intrinsically safe external circuits.
- The information in **Changing the type of protection** on page 19 must be observed when changing the type of protection.
... 3 Use in potentially explosive atmospheres in accordance with FM and CSA

Installation instructions

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

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

It is essential that the temperature classes as per the approvals in 'Temperature data on page 13' are observed.

The information in the installation diagram 3kxf000094G0009 on page 53 must be observed.

Use in areas exposed to combustible dust

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

• The maximum surface temperature of the device may not up-scale 85 °C (185 °F).
• The process temperature of the connected line can up-scale 85 °C (185 °F).

Opening and closing the terminal box

DANGER

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

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

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

WARNING

Risk of injury due to live parts!

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

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

See also Opening and closing the housing on page 40.

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

Note

Spare parts can be ordered from ABB Service.

www.abb.com/contacts
Cable entries

The devices are delivered with ½ in NPT threads with transport protection plugs.

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

Note

Devices which are certified for use in North America are supplied with a ½ in. NPT thread only and without cable glands.

Electrical connections

Grounding

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

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

Perform grounding of the device in accordance with Pin assignment on page 41.

Process sealing

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

Note

The device is suitable for use in Canada.

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

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

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

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

SensyMaster flowmeters are designed as ‘Dual Seal Devices’.

In accordance with the requirements of standard ANSI / ISA 12.27.01, the existing operating limits of temperature, pressure and pressure bearing parts must be reduced to the following limit values:

<table>
<thead>
<tr>
<th>Limit values</th>
<th>Flange or pipe material</th>
<th>Nominal sizes</th>
<th>Operating temperature</th>
<th>Process pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>No limitations</td>
<td>DN 25 to DN 2000</td>
<td>(1 to 78 in)</td>
<td>~20 °C to 280 °C</td>
<td>PN 40 / Class 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(~4 °F to 536 °F)</td>
<td></td>
</tr>
</tbody>
</table>
3 Use in potentially explosive atmospheres in accordance with FM and CSA

Operating instructions

Protection against electrostatic discharges

⚠️ DANGER

Risk of explosion!
The painted surface of the device can store electrostatic charges.
As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:
- The device is operated in environments with a relative humidity of ≤ 30%.
- The painted surface of the device is thereby relatively free from impurities such as dirt, dust or oil.
- Instructions on avoiding ignition in potentially explosive environments due to electrostatic discharges in accordance with PD CLC/TR 60079-32-1 and IEC TS 60079-32-1 must be complied with!

Instructions on cleaning

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

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

⚠️ WARNING! – Danger due to electrostatic discharge.

Repair

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

Figure 3: Additional warning plate
Changing the type of protection

The Modbus interface and the digital outputs of the models FMT230/250 can be operated with different types of protection:

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

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

<table>
<thead>
<tr>
<th>Original installation</th>
<th>New installation</th>
<th>Necessary test steps</th>
</tr>
</thead>
</table>
| Housing: XP, \(U_{\text{max}} = 30\) V Outputs non IS | Housing: XP Outputs: IS | • 500 \(\times\) 1.414 = 710 V DC/1min
  Test between terminals A / B, 41 / 42 as well as 51 / 52 and the terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device.
  • Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion. |
| Housings: Div 2 Outputs: NI | • 500 \(\times\) 1.414 = 710 V DC/1min
  Test between terminals A / B, 41 / 42 as well as 51 / 52 and the terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device.
  • Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion. |
| Outputs: IS Housing: XP Outputs: non IS | • Visual inspection, no damage visible on the threads (cover, ½ in NPT cable glands). |
| Housing: XP Outputs: NI | • No special measures. |
| Housing: XP, \(U_{\text{max}} = 30\) V Outputs: NI | Housing: XP Outputs: IS | • 500 \(\times\) 1.414 = 710 V DC/1min
  Test between terminals A / B, 41 / 42 as well as 51 / 52 and the terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device.
  • Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion. |
| Housing: XP Outputs: non IS | • Visual inspection, no damage visible on the threads (cover, ½ in NPT cable glands). |

Note

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

Name plate

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

![Name plate example]

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

Figure 4: Name plate (example)

Note
Products that are marked with the adjacent symbol may not be disposed of as unsorted municipal waste (domestic waste).
They should be disposed of through separate collection of electric and electronic devices.

Plates and symbols

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

![Warning signs on the device]

WARNING! – Do not open in a flammable or potentially explosive atmosphere.

WARNING! Gefahr durch elektrostatische Entladung

WARNING! Danger by electrostatic unloading

AVERTISSEMENT! Risque de d'charge électrostatique

Figure 5: Warning signs on the device
5 Transport and storage

Inspection

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

Transport

⚠️ DANGER

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

⚠️ WARNING

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

Storing the device

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

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

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

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

Ambient conditions

Storage temperature range
−20 to 85 °C (−4 to 185 °F)

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

Returning devices

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

Fill out the return form (see Return form on page 52) and include this with the device.

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

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

Address for returns:
Please contact Customer Center Service according to page 5 for nearest service location.
6 Installation

Safety instructions

⚠️ DANGER

Danger to life due to piping under pressure!
Sensors which may eject during installation or removal in piping remaining under pressure may pose a danger to life.
• Install or remove a sensor only if the piping is depressurized.
• As an alternative, use a pipe component with an integrated hop tap fitting.

⚠️ WARNING

Risk of injury due to process conditions.
The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.
• Before working on the device, make sure that the process conditions do not pose any hazards.
• If necessary, wear suited personal protective equipment when working on the device.
• Depressurize and empty the device / piping, allow to cool and purge if necessary.

Installation conditions

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

Seals
Users are responsible for selecting and mounting suitable gaskets (material, shape).
Note the following points when selecting and mounting gaskets:
• Use gaskets made from a material that is compatible with the measuring medium and measuring medium temperature.
• Gaskets must not extend into the flow area, since possible turbulence may influence the accuracy of the device.
Inlet and outlet sections
The figures below show the recommended inlet and outlet sections for various installations.

Figure 6: Inlet and outlet sections

<table>
<thead>
<tr>
<th>Installation</th>
<th>Inlet section</th>
<th>Outlet section</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Pipe extension</td>
<td>min. 15 × DN</td>
<td>min. 5 x DN</td>
</tr>
<tr>
<td>B Pipe reduction</td>
<td>min. 15 × DN</td>
<td></td>
</tr>
<tr>
<td>C 90° Pipe elbow</td>
<td>min. 20 × DN</td>
<td></td>
</tr>
<tr>
<td>D 2 × 90° pipe elbow in one level</td>
<td>min. 25 × DN</td>
<td></td>
</tr>
<tr>
<td>E 2 × 90° pipe elbow in two levels</td>
<td>min. 40 × DN</td>
<td></td>
</tr>
<tr>
<td>F Turn-off device</td>
<td>min. 50 × DN</td>
<td></td>
</tr>
</tbody>
</table>

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 site, the outlet section can be shortened to 3 × DN. However, reducing the specified inlet section will reduce the achievable level of accuracy. A high repeatability of the measured value is maintained.

In case of insufficient inlet and outlet sections, a special calibration may be possible. To do this, a detailed alignment is necessary for individual cases. The specified inlet and outlet sections must be doubled for gases with a very low density (hydrogen, helium).

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

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

Sensor insulation
The sensor may be insulated as shown in Figure 8.
... 6 Installation

Ambient conditions

Ambient temperature

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

Relative humidity

Maximum 85 % RH, annual average ≤ 65 % RH

IP rating

In accordance with EN 60529: IP 65 / IP 67

NEMA IP rating

NEMA 4X

Process conditions

Note
When using the device in potentially explosive atmospheres, note the additional temperature data in Use in potentially explosive atmospheres in accordance with ATEX and IECEx on page 6 and Use in potentially explosive atmospheres in accordance with FM and CSA on page 12 beachten!

Measured medium temperature

Devices with ceramic element and flange connection

- Standard and explosion-proof design: −20 to 150 °C (−4 to 302 °F)
- High temperature design: −20 to 300 °C (−4 to 572 °F)
- DVGW design: 0 to 70°C (32 to 158 °F)

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

The following temperature specifications apply:

<table>
<thead>
<tr>
<th>Sensor connection</th>
<th>$T_{medium}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded connection DIN 11851</td>
<td>−20 to 150 °C (−4 to 302 °F)</td>
</tr>
<tr>
<td>Clamp ring fitting</td>
<td>−20 to 150 °C (−4 to 302 °F)</td>
</tr>
<tr>
<td>Pipe components with ball valve</td>
<td>Maximum 150 °C (302 °F)</td>
</tr>
<tr>
<td>Integrated hot tap fitting</td>
<td>See Integrated hot tap fitting on page 25</td>
</tr>
</tbody>
</table>

Maximum operating pressure

<table>
<thead>
<tr>
<th>Sensor connection</th>
<th>Maximum measuring medium pressure $P_{medium}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange in accordance with DIN EN 1092, PN 40</td>
<td>4 MPa, 40 bar (580 psi)</td>
</tr>
<tr>
<td>Threaded connection DIN 11851</td>
<td>1.6 MPa, 16 bar (232 psi)</td>
</tr>
<tr>
<td>Clamp ring fitting</td>
<td>2 MPa, 20 bar (290 psi)</td>
</tr>
<tr>
<td>Integrated hot tap fitting</td>
<td>See Integrated hot tap fitting on page 25</td>
</tr>
</tbody>
</table>

Pressure loss

Figure 9: Pressure loss in logarithmic representation

A Pressure loss  B Mass flow

$A$ Pressure loss  $B$ Mass flow

Figure 9: Pressure loss in logarithmic representation
Material loads for process connections
DIN and ASME flanges

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

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 piping 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).
6 Installation

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

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.

3. Use the appropriate screws for the holes.

4. Slightly grease the threaded nuts.

5. Tighten the nuts in a crosswise manner in accordance with the figure. First tighten the nuts to approx. 50 % of the maximum torque, then to 80 %, and finally a third time to the maximum torque.

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

Figure 13: Installing a pipe component (example, wafer type design)

1. Flange screw
2. Washer
3. Flange
4. Flange gasket
5. Pipe component
6. Sensor connection
7. Centering pin, outflow side
8. Nut

Figure 14: Tightening sequence for the flange screws

Note
For achieve the best measurement results, make sure the gaskets fit concentrically with the pipe component.
- The inside diameter of the pipe and flange must precisely match in the wafer type design. Any differences in levels or edges, or untidy weld seams, will reduce the measuring accuracy.
- To guarantee that the flow profile is not distorted, the gaskets must not protrude into the piping.
Assembly of the welding adapter with flange or threaded connector

Welding adapter with flange connector

Dimensions in mm (in)

Figure 15: Dimensions in mm (in)

<table>
<thead>
<tr>
<th>h – sensor length</th>
<th>Ø D – outer pipe diameter (min. / max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>263 (10.35)</td>
<td>100 to 350 (3.94 to 13.78)</td>
</tr>
<tr>
<td>425 (16.73)</td>
<td>&gt; 350 to 700 (&gt; 13.78 to 27.56)</td>
</tr>
<tr>
<td>775 (30.51)</td>
<td>&gt; 700 to 1400 (&gt; 27.56 to 55.12)*</td>
</tr>
</tbody>
</table>

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

Assembly of the welding adapter with flange or threaded connector

Dimensions in mm (in)

Figure 16: Dimensions in mm (in)

<table>
<thead>
<tr>
<th>h – sensor length</th>
<th>Ø D – outer pipe diameter (min. / max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>min. 28 (1.10)</td>
<td>Ø 263 (10.35) 100 to 150 (3.94 to 5.91)</td>
</tr>
<tr>
<td>263 (10.35)</td>
<td>Ø 425 (16.73) &gt; 150 to 500 (&gt; 5.91 to 19.69)</td>
</tr>
<tr>
<td>425 (16.73)</td>
<td>Ø 775 (30.51) &gt; 500 to 1150 (&gt; 19.69 to 45.28)</td>
</tr>
<tr>
<td>775 (30.51)</td>
<td></td>
</tr>
</tbody>
</table>

* The limitation of the maximum pipe diameter only applies for installations with a sensor element in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the measuring element in the piping is considered in the calibration.
Welding adapter with threaded connection in accordance with DIN 11851

Dimensions in mm (in)

1. Union nut
2. Flow direction
3. Centering pin

Figure 17: Dimensions in mm (in)
6 Installation

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

Mounting

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

- After welding, the welding adapter must have a length of \( \text{L} \) (see chapter Welding adapter with flange connector on page 27 and Welding adapter with threaded connection in accordance with DIN 11851 on page 29).

\[
L = h - \left( \frac{1}{2} \times D \right)
\]

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

Additional instructions for welding adapter with ball valve

DANGER

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

- Remove the ball valve before welding.

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

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

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

NOTE

Damage to the sensor.
Closing the ball valve before you remove the sensor can seriously damage the protective cage or the sensor elements.
- Do not close the ball valve until the sensor has been removed.
Assembly of the welding adapter with compression ring fitting

All dimensions in mm (in)

Figure 18: Welding adapter with compression fitting

Table 1: Dimensions of welding adapter with compression fitting

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

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

**Mounting**

Calculation of mounting dimensions

![Diagram showing mounting dimensions](image)

**Calculations (mm)**

\[
L = h_3 - \left(\frac{1}{2} \times \Omega D\right) \\
Z = (h_3 + 137 \text{ mm}) - \left(\frac{1}{2} \times \Omega D\right)
\]

**Calculations (in)**

\[
L = h_3 - \left(\frac{1}{2} \times \Omega D\right) \\
Z = (h_3 + 5.39 \text{ in}) - \left(\frac{1}{2} \times \Omega D\right)
\]

**Preparing the sensor**

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fire hazard in oxygen applications</strong></td>
</tr>
<tr>
<td>Fire hazard in oxygen applications due to the use of unapproved thread sealing compound.</td>
</tr>
<tr>
<td>• Use only approved thread sealing compound for oxygen applications!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk of injury</strong></td>
</tr>
<tr>
<td>Risk of injury due to the sensor ejecting because of a missing safety ring.</td>
</tr>
<tr>
<td>• Mount the sensor with compression fitting only with the safety ring in place.</td>
</tr>
</tbody>
</table>

![Diagram showing sensor components](image)

1. Slide the compression fitting onto the sensor and tighten by hand so that the compression fitting can still be moved.
2. Insert the safety snap ring using mounting pliers (see Figure 20, Pos. 2).

**Note**

For gas-tight sealing of the NPT thread of the compression fitting, you can for example use special thread sealing compounds by Swagelok such as SWAK™, Silver Goop™, PTFE-Free, etc., or PTFE thread sealing tape.
First installation of the sensor
When mounting the sensor, a distinction is made between first installation and reinstallation. We will address first installation below.


Required tools
- Open-end wrench, width across flats 35 mm (1⅜ in)
- Open-end wrench, width across flats 38 mm (1½ in)
- Caliper gage or comparable measurement tool
- Marker pen (permanent marker) for marking

Description of first installation
1. Carefully insert the prepared sensor into the welding adapter.

**NOTICE**
Mechanical damage to the sensor element can occur due to improper installation.
- When inserting into the welding adapter, the sensor protection frame must not hit the bottom of the piping.

2. Screw in the compression fitting (with thread sealing compound) into the welding adapter, first by hand and then tighten with 1.5 to 2.5 turns.
3. Move the sensor to the correct height for the calculated ‘Z’ dimension (see Figure 19) and secure the compression fitting against shifting by tightening the union nut by hand.
4. Align the sensor such that the lateral flow arrow on the upper sensor protection tube end points in the exact direction of the flow.
5. Using a suited marker pen, mark the orientation and height of the sensor on the sensor protection tube, compression fitting and the welding adapter (see Figure 20, pos. 3). The marking on the union nut is also used as a starting position (6 o’clock position, see Figure 21) for the tightening of the compression fitting.

6. Using an open-end wrench, hold the fitting body in position and with another open-end wrench, tighten the union nut by 1¼ turns clockwise to the 9 o’clock position. In the process, check the orientation of the sensor with the help of the markings and correct as needed. To achieve maximum measuring accuracy, the ‘Z’ dimension must be set with a tolerance of ±2 mm (±0.08 in) during installation of the sensor.

**Note**
Before commissioning, the tightness and compressive strength of the measuring point must be guaranteed!
- In addition, check the fittings using a suited leak detection spray.
... 6 Installation

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

Disassembly and reinstalltion of the sensor
When mounting the sensor, a distinction is made between first installation and reinstalltion. We will address reinstalltion below.


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

Disassembly of the sensor

⚠️ WARNING
Risk of injury due to process conditions
The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.
- Before working on the device, make sure that the process conditions do not pose any hazards.
- If necessary, wear suited personal protective equipment when working on the device.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

1. Depressurize and empty the device / piping, allow to cool and purge if necessary.
2. Switch off the power supply of the sensor and remove the connection cable.
3. Using a suited marker pen, mark the orientation and height of the sensor on the sensor protection tube, compression fitting and the welding adapter (see Figure 20, pos. 3).
4. Carefully loosen the union nut of the compression fitting and hold the sensor while doing so to prevent the sensor protection frame from hitting the bottom of the piping.

NOTE
Damage to the device
Mechanical damage to the sensor element can occur due to improper disassembly.
- The sensor protection frame must not hit the bottom of the piping.

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

Note
Very high clamping forces are exerted on the clamp ring when the compression fitting is tightened. As a result, the clamp ring is lightly pressed into the sensor protection tube. The compression fitting can no longer be shifted onto the sensor protection tube and the ‘Z’ dimension can be readjusted once again.

Reinstallation of the sensor

⚠️ WARNING
Risk of injury
Risk of injury due to the sensor ejecting because of a missing safety ring.
- Mount the sensor with compression fitting only with the safety ring in place.

1. Make sure that the safety snap ring is inserted in the provided snap ring groove (see Figure 20, pos. 2).
2. Apply sealing compound to the pipe thread of the fitting body.
3. Carefully insert the sensor into the welding adapter.

NOTE
Damage to the device
Mechanical damage to the sensor element can occur due to improper installation.
- When inserting into the welding adapter, sensor protection frame must not hit the bottom of the piping.

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

**DANGER**

**Explosion hazard**
Explosion hazard during installation or operation of the integrated hot tap fitting in potentially explosive atmospheres.
- The integrated hot tap fitting must not be installed or operated in potentially explosive atmospheres.

**Wafer type design**
Installation of the wafer type design is performed as explained in **Wafer type design (FMT091) and partial measuring section (FMT092)** on page 26.

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

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

![Figure 22: Integrated hot tap fitting in measurement position, dimensions in mm (in)](image)
... 6 Installation

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

Calculation of the installation length \( X \) and installation depth \( Y \)

\[
X = h - \left( \frac{D}{2} \right)
\]

\[
Y = \left( \frac{D}{2} \right) - 28 \text{ mm (1.1 inch)}
\]

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

Example

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

\[
X = 425 \text{ mm} - \left( \frac{210 \text{ mm}}{2} \right) = 320 \text{ mm}
\]

\[
Y = \left( \frac{210 \text{ mm}}{2} \right) - 28 \text{ mm} = 77 \text{ mm}
\]

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

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

**NOTE**

Damage to components

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

**NOTE**

Impact on measuring accuracy

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

When installing the sensor, observe the following points:

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

Installing the sensor:

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

Wafer type design and welding adapter

![Diagram of sensor installation](image)

Figure 23: Installing a sensor (example)
… 6 Installation

… Installing the sensor

Installation / Disassembly in connection with the hot tap fitting

⚠️ 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 hot tap fitting is in the disassemble position.

⚠️ DANGER

Danger to life due to leaking measuring medium!
If the changing device is in the measurement position during disassembly of the sensor or gaskets in the changing device are damaged, leaking measuring medium may pose a danger to life.
- Make sure that the hot tap fitting is in the disassemble position.
- If measuring medium should start to leak in spite of this, immediately stop disassembly of the sensor and tighten the fixing screws.
- Drain and rinse the piping before disassembling the sensor, check and repair the hot tap fitting.

⚠️ 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 guaranteed during disassembly of the sensor.

NOTE

Damage to the changing device
Using tools or other devices to operate the lock nut can damage the hot tap fitting.
- Operate the union nut by hand only.
Installation of the sensor during operation

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

Installing the sensor:
1. Place the supplied O-ring in the groove of the sensor connection.
2. Carefully slide the sensor into the changing device. Observe correct alignment to the centering pin in the process.
3. Fasten the sensor to the sensor connection 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 hot tap fitting 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).

7 Electrical connections

Safety instructions

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

⚠️ WARNING
Risk of injury due to live parts.
Improper work on the electrical connections can result in electric shock.
• Connect the device only with the power supply switched off.
• Observe the applicable standards and regulations for the electrical connection.

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

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

Installing the connection cables

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

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.

To open the housing, release the cover lock by screwing in the Allen screw \(^1\).

After closing the housing, lock the housing cover by unscrewing the Allen screw \(^1\).
Position of the terminals

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

Figure 28: Terminals on the device

Pin assignment

Figure 29: Electrical connection PA = functional ground (potential equalization)

Connections for the power supply

<table>
<thead>
<tr>
<th>DC voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal</td>
</tr>
<tr>
<td>1+</td>
</tr>
<tr>
<td>2−</td>
</tr>
</tbody>
</table>

Connections for the outputs

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

Electrical data for inputs and outputs

Note
When using the device in potentially explosive atmospheres, observe the additional connection data in page 6 and page 12!

Power supply

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>24 V DC ± 20 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ripple: ≤ 5 %)</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>P ≤ 10 W</td>
</tr>
</tbody>
</table>
... 7 Electrical connections

... Electrical data for inputs and outputs

Digital output 41 / 42, 51 / 52
Can be configured via Modbus.

![Diagram of digital output connections]

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

Passive digital output 51 / 52 as binary output

Figure 30: Passive digital outputs (I = internal, E = external)

### Pulse / frequency output (passive)

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Output 'closed'</th>
<th>Output 'open'</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 / 42 (pulse / frequency output)</td>
<td>0 V ≤ U_{CEL} ≤ 3 V</td>
<td>16 V ≤ U_{CEH} ≤ 30 V DC</td>
</tr>
<tr>
<td>51 / 52 (pulse output)</td>
<td>2 mA ≤ I_{CEL} ≤ 30 mA</td>
<td>0 mA ≤ I_{CEH} ≤ 0.2 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>f_{max}</th>
<th>10.5 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse width</td>
<td>0.1 to 2000 ms</td>
</tr>
</tbody>
</table>

### Binary output (passive)

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Output 'closed'</th>
<th>Output 'open'</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 / 42, 51 / 52</td>
<td>0 V ≤ U_{CEL} ≤ 3 V</td>
<td>16 V ≤ U_{CEH} ≤ 30 V DC</td>
</tr>
<tr>
<td></td>
<td>2 mA ≤ I_{CEL} ≤ 30 mA</td>
<td>0 mA ≤ I_{CEH} ≤ 0.2 mA</td>
</tr>
</tbody>
</table>

Switching function: Configurable

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

![Diagram of binary output connections]
Modbus® communication

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

Modbus is an open standard owned and administrated by an independent group of device manufacturers styled the Modbus Organization (www.modbus.org).
Using the Modbus protocol allows devices made by different manufacturers to exchange information via the same communication bus, without the need for any special interface devices to be used.

<table>
<thead>
<tr>
<th>Modbus protocol</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminals</td>
<td>V1 / V2</td>
</tr>
<tr>
<td>Configuration</td>
<td>Via the Modbus interface or via the local operating interface in connection with Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM)</td>
</tr>
<tr>
<td>Transmission</td>
<td>Modbus RTU - RS485 serial connection</td>
</tr>
<tr>
<td>Baud rate</td>
<td>2400, 4800, 9600, 19200, 38400, 56000, 57600, 115200 baud</td>
</tr>
<tr>
<td>Parity</td>
<td>None, even, odd</td>
</tr>
<tr>
<td>Stop bit</td>
<td>One, two</td>
</tr>
<tr>
<td>IEEE format</td>
<td>Little endian, big endian</td>
</tr>
<tr>
<td>Typical response time</td>
<td>&lt; 100 ms</td>
</tr>
<tr>
<td>Response delay time</td>
<td>0 to 200 milliseconds</td>
</tr>
</tbody>
</table>

Cable specification
The maximum permissible length is dependent on the baud rate, the cable (diameter, capacity and surge impedance), the number of loads in the device chain, and the network configuration (2-core or 4-core).
- At a baud rate of 9600 and with a conductor cross-section of at least 0.14 mm² (AWG 26), the maximum length is 1000 m (3280 ft).
- When using a 4-core cable as a 2-wire wiring system, the maximum length must be halved.
- The spur lines must be short, a maximum of 20 m (66 ft).
- When using a distributor with ‘n’ connections, each branch must have a maximum length of 40 m (131 ft) divided by ‘n.’

The maximum cable length depends on the type of cable used. The following standard values apply:
- Up to 6 m (20 ft): cable with standard shielding or twisted-pair cable.
- Up to 300 m (984 ft): double twisted-pair cable with overall foil shielding and integrated earth cable.
- Up to 1200 m (3937 ft): double twisted-pair cable with individual foil shielding and integrated earth cables. Example: Belden 9729 or equivalent cable.

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

**Connection on the device**

![Connection diagram](image)

**PA** Potential equalization

*Figure 32: Connection to device*

**Connecting integral mount design**

Perform steps (A) to (C).

During the process, observe the following instructions:

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

Observe the following points when connecting to the power supply:

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

Safety instructions

⚠️ DANGEROUS

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

⚠️ CAUTION

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

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

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

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

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

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

Write-protection switch, service LED and local operator interface

Figure 33: Operating elements in the terminal box

1 Write protection switch
2 Service LED
3 Local operating interface

Write-protect switch
The write protection switch is located in the sensor terminal box. If write protection is active, the parameterization of the device cannot be changed via Modbus or the local operating interface.

Turning the write protection switch clockwise deactivates the write protection function, while turning the switch counterclockwise activates it.

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

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

<table>
<thead>
<tr>
<th>Service LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashes rapidly (100 ms)</td>
<td>Starting sequence, device not yet ready for operation</td>
</tr>
<tr>
<td>Lit up continuously</td>
<td>Device operating, no critical error</td>
</tr>
<tr>
<td>Flashes slowly (1 second)</td>
<td>A critical error has occurred, see “Diagnosis / error messages” in the operating instruction</td>
</tr>
</tbody>
</table>

Local operating interface
The sensor can also be parameterized without a Modbus connection via the local operating interface, see

**Parameterization via the local operating interface** on page 48.
... 8 Commissioning and operation

Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with Electrical connections on page 39.
- Correct grounding of the device.
- The ambient conditions must meet the requirements set out in the specification.
- The power supply must meet the requirements set out on the name plate.

**NOTICE**

Damage to the device due to undervoltage.

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

The internal fuses can be damaged as a result.

- Make sure that the minimum operating voltage of the device is not down-scaled (see also Electrical data for inputs and outputs on page 41).

Switching on the power supply

1. Switch on the power supply.
2. Perform parameterization of the flowmeter (see Parameterization of the device on page 46).

The flowmeter is now ready for operation.

Inspection after power-up of the power supply

The following points must be checked after commissioning the device:

- Parameter configuration must correspond to the operating conditions.

Parameterization of the device

**Note**

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

**Note**

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

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

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

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

Parameterization via the Modbus interface

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

Factory setting for the Modbus slave ID (address)

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

![Modbus-address on the name plate (example)](image-url)
Changing an unknown Modbus slave ID

The Modbus Slave ID (address) of the device must be known for Modbus communication. Upon delivery, the Modbus Slave ID corresponds to the last two digits of the serial number of the device (see Figure 34, item 2).

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

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

### Table

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

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

![Write Multiple Registers (example)](image-url)
… 8 Commissioning and operation

… Parameterization of the device

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

![Diagram of connection to the local operating interface]

**Figure 37: Connection to the local operating interface**

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

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

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

Installation of the ABB Field Information Manager (FIM)
A software package is available for configuration:
- ABB Field Information Manager (FIM) combined with the ABB SensyMaster Field Device Information Package (FDI package).

![Link to download ABB Field Information Manager (FIM)]

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

![Link to download ABB FDI package](Image)

**Download the ABB FDI package using the adjacent download link.**

![Diagram of FIM with FDI package]

**Installation of the software and connection to the flowmeter:**
1. Install ABB Field Information Manager (FIM).
2. Unpack the ABB FDI package into the c:\temp folder.
3. Connect the flowmeter with the PC / laptop, see Connection on the device on page 48.
4. Power-up the power supply for the flowmeter and start the ABB Field Information Manager (FIM).
5. Drag and drop the ‘ABB.FMT2xx_FMT4xx.01.00.01.HART.fdix’ file (or newer version) to the ABB Field Information Manager (FIM). No special view is needed for this.
6. Right-click ![Diagram of FIM settings](Image) as shown in Figure 38.

![Diagram of FIM settings]

**Figure 38: Select FIM – ‘Device Settings’**

7. Select ‘DEVICE SETTINGS’ ![Diagram of FIM settings](Image) as shown in Figure 38.
9 Maintenance

Safety instructions

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

**DANGER**
Danger to life due to piping under pressure!
Sensors which may eject during installation or removal in piping remaining under pressure may pose a danger to life.
- Install or remove a sensor only if the piping is depressurized.
- As an alternative, use a pipe component with an integrated hop tap fitting.

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

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

**NOTICE**
Damage to components!
The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines).
- Make sure that the static electricity in your body is discharged before touching electronic components.

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

---

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

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

Dismounting

⚠️ WARNING

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

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

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow the device / piping to cool and depressurize and empty. Collect any escaping medium and dispose of it in accordance with environmental guidelines.
- Use suited tools to disassemble the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- Observe the notices in Returning devices on page 21.

Disposal

Note

Products that are marked with the adjacent symbol may not be disposed of as unsorted municipal waste (domestic waste).
They should be disposed of through separate collection of electric and electronic devices.

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

Bear the following points in mind when disposing of them:

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

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

12 Additional documents

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

Return form

Statement on the contamination of devices and components

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

Customer details:
Company:  
Address:  
Contact person:  Telephone:  
Fax:  Email:  

Device details:
Type:  Serial no.:  
Reason for the return/description of the defect:  

Was this device used in conjunction with substances which pose a threat or risk to health?  
☐ Yes  ☐ No

If yes, which type of contamination (please place an X next to the applicable items):
☐ biological  ☐ corrosive / irritating  ☐ combustible (highly / extremely combustible)
☐ toxic  ☐ explosive  ☐ other toxic substances  
☐ radioactive

Which substances have come into contact with the device?
1.  
2.  
3.  

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

Town/city, date  Signature and company stamp
FMT200 Installation diagram 3kxf000094G0009

Installation diagram FMT200

HAZARDOUS LOCATION

HAZARDOUS LOCATION

Zone 1/21
Zone 0 (inside pipe)
Division 1 & ZN 121

HAZARDOUS LOCATION

Zone 2/22
Division 2 & ZN 2/22

HAZARDOUS LOCATION

ORDINARY LOCATION

GENERAL PURPOSE

POWER SUPPLY
Non-IS
Terminals
max 30V DC

SIGNAL DATA INPUT/OUTPUT
Intrinsically safe ia
Connected to ATEX / IECEx or FM/CSA certified BARRIER

Alternative to
SIGNAL DATA INPUT/OUTPUT
Non Intrinsically Safe
max 30V

Version FMT200

Page 1 of 5
Notes: ATEX & IECEx application

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO ATEX/IECEx APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN: Uo OR VoC OR Vt < V MAX, Io OR IoC OR IiT < I MAX, Ca OR Co > Ci + Ccable, La OR Lo > Li + Lcable, Po < Pi.

2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN Zone 21/22 ENVIRONMENTS.

3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH.

4. INSTALLATION SHOULD BE IN ACCORDANCE WITH THE RELEVANT INTERNATIONAL OR NATIONAL REGULATIONS „INSTALLATION OF INTRINSICALLY SAFE FOR HAZARDOUS LOCATIONS” REGULATIONS.

5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE ATEX or IECEx APPROVED UNDER ENTITY CONCEPT.

6. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.

7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE'S INSTALLATION DIAGRAM.

8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM.

Notes: US and Canadian application

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO FM AND/OR CSA APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN: Uo OR VoC OR Vt < V MAX, Io OR IoC OR IiT < I MAX, Ca OR Co > Ci + Ccable, La OR Lo > Li + Lcable, Po < Pi.

2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND III ENVIRONMENTS.

3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH.


5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM AND/OR CSA APPROVED UNDER ENTITY CONCEPT.

6. ASSOCIATED APPARATUS MANUFACTURER’S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.

7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE’S INSTALLATION DIAGRAM.

8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM.
### Zone 2/21 & Division 2

<table>
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<th>Indication</th>
<th>Abbr.</th>
<th>Status</th>
<th>Option</th>
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<th>Operating Value</th>
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</thead>
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<td>If &quot;or&quot; occurs Terminal depends on MN</td>
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<td></td>
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<td>A / B</td>
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<td>30</td>
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<td>P</td>
<td>41/42</td>
<td></td>
<td>30</td>
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<tr>
<td>Digital Output 2</td>
<td>DO2</td>
<td>P</td>
<td>51/52</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>
### Zone 1/21 & Division 1

**Model code:** FMT2bcA1, FMT2bcA3, FMT2bcA5, FMT2bcB5  
FMT2bcF1

**HART Communication**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Abbr.</th>
<th>Status</th>
<th>Option</th>
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<th>Operating Value</th>
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<td>Ex ia / IS</td>
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**Installation diagram**  
3kxf00009G0009
Trademarks

Modbus is a registered trademark of Schneider Automation Inc.
Swagelok is a registered trademark of the Swagelok Company
Notes
ABB Measurement & Analytics

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

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

Introduction

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

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

Additional Information

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

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