ABB MEASUREMENT & ANALYTICS | COMMISSIONING INSTRUCTION

SensyMaster FMT230, FMT250
Thermal mass flowmeter

Measurement made easy

Additional Information

Additional documentation on SensyMaster FMT230, FMT250 is available free of charge for downloading at www.abb.com/flow. Alternatively simply scan this code:
Short product description
Thermal mass flowmeter on the mass flow measurement of gases and gas mixtures in closed pipelines.

Device firmware version:
— 01.00.07 (Modbus)

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

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1 Safety

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

1.2 Warnings
The warnings in these instructions are structured as follows:

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

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

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

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

1.3 Intended use
This device can be used in the following applications:
— As a plug-in sensor flanged into the pipe component in pipelines with nominal diameters DN 25 ... DN 200 (1 ... 8 in.).
— Through a welding adapter directly in pipelines of nominal diameter DN 100 (4 in.) and above, as well as for non-circular cross-sections.

This device is intended for the following uses:
— for direct mass flow measurement of gases and gas mixtures in closed pipelines.
— for indirect measurement of standard volume flows (through standard density and mass current).
— For measuring the temperature of the measuring medium.

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

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

1.4 Improper use
The following are considered to be instances of improper use of the device:
— For operating as a flexible adapter in piping, e.g. for compensating pipe offsets, pipe vibrations, pipe expansions, etc.
— For use as a climbing aid, e.g. for mounting purposes
— For use as a support for external loads, e.g. as a support for piping, etc.
— Material application, e.g. by painting over the housing, name plate or welding/soldering on parts.
— Material removal, e.g. by spot drilling the housing.
1.5 Notes on data security
This product is designed to be connected to and to communicate information and data via a network interface. It is operator’s sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and / or theft of data or information.
ABB Automation Products GmbH and its affiliates are not liable for damages and / or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and / or theft of data or information.

2 Product identification

2.1 Name plate

![Name plate example](image-url)

Fig. 1: Name plate (example)

3 Transport and storage

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

3.2 Transport

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

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

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

Observe the following instructions:
— Do not expose the device to humidity during transport. Pack the device accordingly.
— Pack the device so that it is protected against vibrations during transport, e.g., by using air-cushioned packaging.

If the original packaging material is no longer available, wrap the device in bubble wrap or corrugated cardboard and place it in a box of sufficient size lined with a shock-absorbing material (e.g., foam rubber). The thickness of the padding should be appropriate for the device weight and type of shipment. The box must be labeled as "fragile".
For overseas shipment, always add a desiccant (e.g., silica gel) and hermetically seal the device plus desiccant in a layer of polythene that is 0.2 mm thick. Use an amount of desiccant that is appropriate for the packing volume and the expected transport time (at least for three months). You should also line the box with a layer of union paper.

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

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

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

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

⚠️ DANGER

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

⚠️ WARNING

Risk of injury due to process conditions.
The process conditions, e.g. high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.
— Before working on the device, ensure that the process conditions do not pose any safety risks.
— If necessary, wear suitable personal protective equipment when working on the device.
— Depressurize and empty the device / piping, allow to cool and purge if necessary.

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

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

![Inlet and outlet sections](image)

<table>
<thead>
<tr>
<th>Installation</th>
<th>Inlet section</th>
<th>Outlet section</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Pipe extension</td>
<td>≥15 x DN</td>
<td>≥5 x DN</td>
</tr>
<tr>
<td>B Pipe reduction</td>
<td>≥15 x DN</td>
<td>≥5 x DN</td>
</tr>
<tr>
<td>C 90° Pipe elbow</td>
<td>≥20 x DN</td>
<td>≥5 x DN</td>
</tr>
<tr>
<td>D 2 x 90° Pipe elbow</td>
<td>≥25 x DN</td>
<td>≥5 x DN</td>
</tr>
<tr>
<td>E 2 x 90° Pipe elbow</td>
<td>≥40 x DN</td>
<td>≥5 x DN</td>
</tr>
<tr>
<td>F Turn-off device</td>
<td>≥50 x DN</td>
<td>≥5 x DN</td>
</tr>
</tbody>
</table>

Fig. 2: Inlet and outlet sections

To achieve the specified measuring accuracy, the indicated inlet and outlet sections are required. In case of combinations of several inlet-side errors, e.g. valve and reduction, a longer inlet section must always be taken into account. In case of confined spaces at the installation place, the outlet section can be reduced to 3 x DN. However, reducing the specified inlet section will reduce the achievable level of accuracy. A high repeatability of the measured value is maintained. In case of insufficient inlet and outlet sections, a special calibration may be possible. To do this, a detailed alignment is necessary for individual cases. The specified inlet and outlet sections must be doubled for gases with a very low density (hydrogen, helium).

4.1.3 Installation at high ambient temperatures

![Mounting position at high ambient temperatures](image)

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.

4.1.4 Sensor insulation

![Insulation of the sensor](image)

The sensor may be insulated as shown in Fig. 4.
4.2 Environmental conditions
4.2.1 Ambient temperature
   — Standard: -20 ... 70 °C (-4 ... 158 °F)
   — Extended TA9: -40 ... 70 °C (-40 ... 158 °F)
   — Extended TA6: -50 ... 70 °C (-58 ... 158 °F)

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

IP rating
In accordance with EN 60529: IP 65 / IP 67

4.2.2 NEMA rating
NEMA 4X

4.3 Process conditions
4.3.1 Measuring medium temperature
Devices with ceramic element and flange connection
   — Standard: -25 ... 150 °C (-13 ... 302 °F)
   — Extended (optional, only FMTx50):
     -25 ... 300 °C (-13 ... 572 °F)

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

<table>
<thead>
<tr>
<th>Sensor connection</th>
<th>( T_{\text{medium}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded connection DIN 11851</td>
<td>-40 ... 140 °C (-40 ... 284 °F)</td>
</tr>
<tr>
<td>Clamp ring fitting</td>
<td>-25 ... 140 °C (-13 ... 284 °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 the chapter titled 'Integrated hot tap fitting' on page 10</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Sensor connection</th>
<th>( P_{\text{medium}} )</th>
</tr>
</thead>
<tbody>
<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 the chapter titled 'Integrated hot tap fitting' on page 10</td>
</tr>
</tbody>
</table>

Pressure drop

Fig. 5: Pressure loss in logarithmic representation
(A) Pressure loss (B) Mass flow
4.3.2 Material loads for process connections

DIN and ASME flanges

![Graph showing material loads for DIN and ASME flanges]

Fig. 6: DIN flange process connection

Fig. 7: ASME flange process connection

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

Integrated hot tap fitting

![Graph showing maximum pressure / temperature values for integrated hot tap fitting]

Fig. 8: Maximum pressure / temperature values for integrated hot tap fitting

4.4 Assembly of the pipe component

When installing the pipe components, observe the following points:

— During installation, it is important to ensure that the flow direction corresponds to the attached label.

— When welding the welding adapter, remember to observe the relevant welding instructions. The amount of heat introduced must be kept to an absolute minimum to prevent warping of the mounting flange’s sealing surface.

— In the case of flanged connections, flat gaskets must be installed, which should be in perfect condition and resistant to the measuring media.

— Before installing pipe components or sensors, check all components and gaskets for damage.

— Pipe components must not be installed under tension, otherwise the pipeline may exert impermissible forces on the device.

— When assembling the flanged connections, use screws that offer the required strength and dimensions.

— The screws must be tightened evenly and to the required torque.

— Once the pipe components have been installed, the insertion connection must be sealed by means of a blind flange plus gasket or by closing a shut-off device (if present).
4.4.1 Wafer type design (FMT091) and partial measuring section (FMT092)

Fig. 9: Installing a pipe component (example, wafer type design)
1 Flange screw 2 Washer 3 Flange 4 Flange gasket 5 Pipe component 6 Sensor connection flange 7 Centering pin, outflow side 8 Nut

Installation of the FMT091 pipe component (wafer type design) and FMT092 (partial measuring section).
1. Position the pipe component coplanar and centered between the piping. The flow direction must correspond to the arrow indicated on the pipe component. The centering pin on the pipe component must be located on the outflow side (behind the measuring point).
2. Install gaskets between the sealing surfaces.

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

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

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

Fig. 10: Tightening sequence for the flange screws
4.4.2 Weld-on adapter
Consider the following points when installing the welding dater in the piping:
— After welding, the welding adapter must have a length of L (see chapter ‘Mounting dimensions – welding adapter with flange and with and without ball valve’ on page 13 and ‘Assembly dimension - welding adapter with threaded connection in accordance with DIN 11851’ on page 14).

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

L  Length of the welding adapter
h  Installation length of the sensor
D  Outside diameter of the pipeline

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

Additional instructions for welding adapter with ball valve

**DANGER**

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

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

The design with ball valve is installed as described above, but the following indications must be observed in addition:
— To install the sensor, the ball valve must be opened completely. Then, the flowmeter sensor can be installed along with the appropriate gasket and screwed into place.
— Before disassembling the sensor, make sure that the pipeline has been depressurized. Then, you can release the screws on the flange, remove the flowmeter sensor and close the ball valve.

**NOTICE**

Damage to the sensor.
Closing the ball valve before you remove the sensor can seriously damage the protective cage or the sensor elements. Do not close the ball valve until the flowmeter sensor has been removed.
Mounting dimensions – welding adapter with flange and with and without ball valve

Without ball valve

With ball valve

Fig. 11: Welding adapter with flange - all dimensions given in mm (inch).

1 Centering pin 2 Nut for O-ring 3 connection flange DN 25 (1") 4 flow direction

<table>
<thead>
<tr>
<th>h – sensor length</th>
<th>( \varnothing \ D ) – outer pipe diameter (min. / max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without ball valve</td>
</tr>
<tr>
<td>263 (10.35)</td>
<td>100 ... 350 (3.94 ... 13.78)</td>
</tr>
<tr>
<td>425 (16.73)</td>
<td>&gt; 350 ... 700 (&gt; 13.78 ... 27.56)</td>
</tr>
<tr>
<td>775 (30.51)</td>
<td>&gt; 700 ... 1400 (&gt; 27.56 ... 55.12)(^1)</td>
</tr>
</tbody>
</table>

\(^1\) The limitation of the maximum pipe diameter only applies for installations with a measuring element in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the measuring element in the piping is considered in the calibration.
Assembly dimension - welding adapter with threaded connection in accordance with DIN 11851

Fig. 12: Dimensions in mm (inch)
1 Union nut 2 Flow direction 3 Centering pin
4.4.3 Integrated hot tap fitting

Wafer type design
Installation of the wafer type design is performed as explained in chapter ‘Assembly of the pipe component’ on page 10.

Welding design

⚠️ DANGER

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

The welding version of the integrated changing device is available in two installation lengths:
— for nominal diameters DN 100 ... DN 125 (4 ... 5") and
— for nominal diameters DN 150 ... DN 300 (6 ... 12")

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

Calculation of the outside 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 \( h = 425 \text{ mm (16.73 inch)} \)
— Pipe with external diameter of 210 mm (8.27 inch)
— The changing device 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).

⚠️ NOTICE

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

⚠️ NOTICE

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

---

Fig. 13: Integrated changing device in measurement position, dimensions in mm (inch)
1 Sensor 2 Centering pin 3 Flow direction
4.5 Installing the sensor
When installing the sensor, observe the following points:

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

4.5.1 Wafer type design and welding adapter

Fig. 14: Installing a sensor (example)


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

⚠ DANGER
Danger to life due to piping under pressure!
If the changing device is in the measurement position during disassembly of the sensor, this may pose a danger to life due to the possibility of the sensor being ejected.
Disassemble the sensor only if the changing device is in the disassemble position.

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

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

⚠ NOTICE
Damage to the changing device
Using tools or other devices to operate the lock nut can damage the hot tap fitting.
Only ever operate the lock nut manually.

---

**Fig. 15:** Sensor process connection
1 O-Ring 2 Connection flange 3 Centering pin 4 Screws to secure the guiding pipe 5 Union nut

**Fig. 16:** Sensor Installation / Disassembly
A Integrated changing device in disassemble position B Integrated changing device in measurement position
1 Sensor 2 Protection cap 3 Union nut in disassemble position 4 Union nut in measurement position 5 Special screws for protection cap
Installation of the sensor during operation

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The changing device must be in the disassemble position before disassembling the sensor, the sensor process connection is sealed.</td>
</tr>
</tbody>
</table>

Installing the sensor:
1. Place the supplied O-ring in the groove of the sensor connection flange.
2. Carefully slide the sensor into the changing device. Observe correct alignment to the centering pin in the process.
3. Fasten the sensor to the sensor connection flange using screws. Use the supplied M12 screws, as well as two extended special screws for this.
4. Place the protection caps onto the special screws and tighten using two nuts.
5. Twist the transmitter with the union nut into the measuring position. The lower edge of the union nut indicates the position of the sensor. Only when the measuring position is reached 50 - OPEN - MESSEN (the lower limit stop of the union nut) will the sensor be in the middle of the piping and precise values can be provided.
6. Carry out the electrical connection

Disassembly of the sensor during operation

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

4.6 Opening and closing the housing

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

Fig. 17: Cover safety device (example)

To open the housing, release the cover safety device by screwing in the Allen screw 1. After closing the housing, lock the housing cover by unscrewing the Allen screw 1.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential adverse effect on the IP rating</td>
</tr>
<tr>
<td>— Make sure that the cover of the power supply terminals is mounted correctly.</td>
</tr>
<tr>
<td>— Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.</td>
</tr>
<tr>
<td>— Check that the O-ring gasket is properly seated when closing the housing cover.</td>
</tr>
</tbody>
</table>
4.7 Electrical connections

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

The electrical connection may only be established by authorized specialist personnel and in accordance with the connection diagrams.
The electrical connection information in this manual must be observed; otherwise, the IP rating may be adversely affected.
Ground the measurement system according to requirements.

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

![Fig. 18: Laying of the connecting cable]

1 Drip loop

4.7.2 Electrical connection

![Fig. 19: Electrical connection]

PA = Functional ground (potential equalization)

**Connections for the power supply**

<table>
<thead>
<tr>
<th>DC voltage</th>
<th>Terminal</th>
<th>Function / comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>2-</td>
<td>-</td>
<td></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>
</tbody>
</table>
| 41 / 42  | Passive digital output DO1
The output can be configured as a pulse output, frequency output or switch output. |
| 51 / 52  | Passive digital output DO2
The output can be configured as a pulse output, frequency output or switch output. |

4.7.3 Electrical data for inputs and outputs

**Power supply**

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>24 V DC ± 20 % (ripple: ≤ 5 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>P ≤ 10 W</td>
</tr>
</tbody>
</table>
Digital output 41 / 42, 51 / 52
Can be configured via Modbus.

![Diagram](image)

**Fig. 20:** Passive digital outputs (I = internal, E = external)
- 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

**Pulse / frequency output (passive)**

<table>
<thead>
<tr>
<th>Terminals</th>
<th>41 / 42, 51 / 52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output &quot;closed (pulse)&quot;</td>
<td>0 V ≤ UCEL ≤ 3 V</td>
</tr>
<tr>
<td>For f &lt; 2.5 kHz: 2 mA &lt; ICEL &lt; 10 mA</td>
<td></td>
</tr>
<tr>
<td>For f &gt; 2.5 kHz: 10 mA &lt; ICEL &lt; 30 mA</td>
<td></td>
</tr>
<tr>
<td>Output &quot;open (pause)&quot;</td>
<td>16 V ≤ UCEH ≤ 30 V DC</td>
</tr>
<tr>
<td>0 mA ≤ ICEH ≤ 0.2 mA</td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;max&lt;/sub&gt;</td>
<td>10.5 kHz</td>
</tr>
<tr>
<td>Pulse width</td>
<td>0.05 … 2000 ms</td>
</tr>
</tbody>
</table>

**Binary output (switch output, passive)**

<table>
<thead>
<tr>
<th>Terminals</th>
<th>41 / 42, 51 / 52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output &quot;closed&quot;</td>
<td>0 V ≤ UCEL ≤ 3 V</td>
</tr>
<tr>
<td>2 mA ≤ ICEL ≤ 30 mA</td>
<td></td>
</tr>
<tr>
<td>Output &quot;open&quot;</td>
<td>16 V ≤ UCEH ≤ 30 V DC</td>
</tr>
<tr>
<td>0 mA ≤ ICEH ≤ 0.2 mA</td>
<td></td>
</tr>
<tr>
<td>Switching function</td>
<td>Can be configured via Modbus.</td>
</tr>
</tbody>
</table>

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

### 4.7.4 Modbus protocol

**NOTICE**
The Modbus protocol is not secure, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

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

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

**Fig. 21:** Communication via the Modbus protocol
- Modbus master
- Terminating resistor
- Modbus slave 1
- Modbus slave n … 32

**Modbus protocol**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Via the Modbus interface or via the local operating interface in connection with Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM)</th>
</tr>
</thead>
<tbody>
<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>Factory setting: 9600 baud</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td>None, even, odd</td>
</tr>
<tr>
<td>Stop bit</td>
<td>One, two</td>
</tr>
<tr>
<td>Factory setting: odd</td>
<td></td>
</tr>
<tr>
<td>IEEE format</td>
<td>Little endian, big endian</td>
</tr>
<tr>
<td>Factory setting: Little endian</td>
<td></td>
</tr>
<tr>
<td>Typical response time</td>
<td>&lt; 100 ms</td>
</tr>
<tr>
<td>Response delay</td>
<td>0 ... 200 milliseconds</td>
</tr>
<tr>
<td>(Response Delay Time)</td>
<td>Factory setting: 10 milliseconds</td>
</tr>
</tbody>
</table>
Modbus response time
The typical response time of the device is normally less than 100 ms (minimum response time). The response time is calculated from the end of the request telegram from the master to the beginning of the response telegram from the slave.
The response time can be increased via the parameter "modbusResponseDelayTime".
The length of the response telegram is dependent upon the number of bytes read and the baud rate configured.

Cable specification
The maximum permissible length is dependent on the baud rate, the cable (diameter, capacity and surge impedance), the number of loads in the device chain, and the network configuration (2-core or 4-core).
— At a baud rate of 9600 and with a conductor cross section of at least 0.14 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.
4.7.5 Connection on the device

Connect the compact design: Perform steps A … 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 diagram. Connect the cable shields to the designated grounding clamp in the terminal box.
— Connect the potential equalization (PE) on the ground terminal to the terminal box.
— Use wire end ferrules when connecting.

**NOTICE**

If the O-ring gasket is seated incorrectly or is damaged, this may have an adverse effect on the IP rating.

Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.

Check that the O-ring gasket is properly seated when closing the housing cover.

Observe the following points when connecting to the power supply:

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

![Connection diagram](image-url)
5 Commissioning and operation

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

![Diagram of write-protection switch, service LED, and local operating interface]

**Write protection switch**
The write protection switch is located in the sensor terminal box.

If write protection is active, the parameterization of the device cannot be changed via Modbus or the local operating interface. Turning the write protection switch clockwise deactivates the write protection function, while turning the switch counterclockwise activates it.

**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</td>
<td>Starting sequence, device not yet ready for operation</td>
</tr>
<tr>
<td>(100 ms)</td>
<td></td>
</tr>
<tr>
<td>Lit up continuously</td>
<td>Device operating, no critical error</td>
</tr>
<tr>
<td>Flashes slowly</td>
<td>A critical error has occurred, see chapter &quot;Diagnosis / error messages&quot; in the operating instruction</td>
</tr>
<tr>
<td>(1 second)</td>
<td></td>
</tr>
</tbody>
</table>

**Local operating interface**
The sensor can also be parameterized without a Modbus connection via the local operating interface, see chapter ‘Parameterization via the local operating interface’ on page 25.

5.2 Checks prior to commissioning
The following points must be checked before commissioning the device:

- The wiring must have been completed as described in the chapter 'Electrical connections' on page 19.
- The correct grounding of the sensor.
- The ambient conditions must meet the requirements set out in the technical data.
- The power supply must meet the requirements set out on the identification plate.

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

5.3 Switching on the power supply
1. Switch on the power supply.
2. Carry out parameterization of the flowmeter (see chapter 'Parameterization of the device' on page 24).
The flowmeter is now ready for operation.

5.3.1 Inspection after switching on the power supply
The following points must be checked after commissioning the device:

- The parameter configuration must correspond to the operating conditions.
5.4 Parameterization of the device

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

Usually at least the following parameters must be set during commissioning:
- The Modbus slave ID, baud rate, and parity,
- Units for mass flow, standard volume flow, standard density and temperature,
- The pulse width and the pulse factor for the pulse output,
- Low flow cut-off.

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

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

5.4.1 Parameterization via the Modbus interface

In case of parameterization via the Modbus interface, refer to the interface description in the device operating instructions (OI/FMT230/250).

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.

Changing an unknown Modbus slave ID

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

Upon delivery, the Modbus Slave ID corresponds to the last two digits of the serial number of the device (see chapter ‘Parameterization via the Modbus interface’ on page 24).

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”.

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

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.

![Modbus address on the name plate (example)](image)

![Write Multiple Registers (example)](image)
Parameterization via the local operating interface

**DANGER**

Risk of explosion during operation of the device with open terminal box!
Only perform parameterization of the device via the local operating interface outside the potentially explosive area!

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

In conjunction with the HART-DTM and the software "ABB AssetVision" available at www.abb.com/flow, all parameters can also be set without a Modbus connection.

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

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

When operating the device, please note the following:
- Aggressive or corrosive media may lead to the damage of wetted parts of the sensor. As a result, measuring medium under pressure can leak out.
- Measuring medium under pressure can leak out due to fatigue on the gasket of the sensor connection or the process connection (e.g. flange or pipe fitting).

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

6.1 Safety instructions

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

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

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

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

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

7 Specification

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

8 Additional documents

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

Trademarks

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9 Appendix

Statement on the contamination of devices and components

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

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

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

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

☐ Yes ☐ No

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

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

Which substances have come into contact with the device?

1. 
2. 
3. 

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

Town/city, date 
Signature and company stamp