ABB MEASUREMENT & ANALYTICS | DATA SHEET

# SensyMaster FMT230, FMT250

## Thermal Mass Flowmeter

# Measurement made easy

## Precise and sensitive direct mass flow measurement of gases

**Efficient , high-grade thermal sensor elements**

- Single-chip design thermal sensors on ceramic support material for superior long term stability
- Effective sensor element protection frame with flow conditioning properties for best repeatability

**High performance ABB common platform based electronics**

- Fast Modbus communication vie RS485 interface
- “Plug-and-play” electronic exchange with SensorApplicationMemory
- Best accuracy with dynamic temperature compensation

**ApplicationSelector**

- Up to 8 configurable applications for maximum flexibility

**Integrated diagnostics and on-board verification**

- Lower costs with extended maintenance cycles
- Better plant availability with predictive maintenance
- Safe processes through sensor element verification

# Overview – models

## Flowmeter sensor

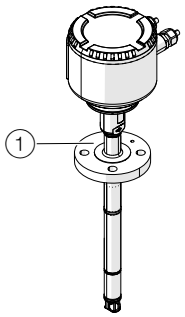



**Figure 1: Sensor FMT230, FMT250 (example)**

| Model | FMT230 | FMT250 |
|---|---|---|
| Measuring media | Gas (air ,methane, nitrogen, hydrogen, carbon dioxide, oxygen, natural gas, ammonia, helium, argon, propane, ethane, butane, ethene, biogas) and gas mixtures with known compositions | |
| Measuring accuracy for gases[1)]<br>Air, nitrogen | ± 1.2 % of Qm in the range of 10 ... 100% of the measuring range; ± 0.12 % of the $Q_{max}$DN possible in the nominal diameter in the range of 0 ... 10 % of the measuring range | ± 0.6 % of the measured value, ± 0.05% of the $Q_{max}$DN possible in the nominal diameter |
| Other gases (optional process gas calibration) | – | ± 1.6 % of the measured value, ± 0.1 % of the $Q_{max}$DN possible in the nominal diameter |
| Extended measuring range | No | Yes, optional |
| Measuring medium temperature $T_{medium}$ | Standard: -25 ... 150 °C (-13 ... 302 °F) | Standard: -25 ... 150 °C (-13 ... 302 °F),<br>optional: -25 ... 300 °C (-13 ... 572 °F) |
| Ambient temperature $T_{ambient}$ | Standard: -20 ... 70 °C (-4 ... 158 °F), optional:-40 ... 70 °C (-40 ... 158 °F), -50 ... 70 °C (-58 ... 158 °F) | |
| Sensor connection (1) | Flange DN 25 – PN 40, threaded connection DN 11851, compression fitting | |
| Wetted materials | Stainless steel, ceramic measuring element (other materials on request) | |
| Power supply | 24 V DC ± 20 % | |
| IP rating | In accordance with EN 60529: IP 65 / IP 67 | |
| NEMA rating | In accordance with NEMA 4X | |
| Communication | Modbus RTU, RS485 | |
| Outputs in serial production | Two passive digital outputs | |
| ApplicationSelector | Yes, up to 2 applications | Yes, up to 8 applications |
| Preconfigured applications | Yes, up to 2 applications | Yes, up to 4 applications |
| Free configurable applications | No | Yes, up to 4 applications |
| Selectable nominal diameters | Yes | Yes |
| Selectable gas type | No | Yes |
| Filling function | No | Yes, optional |
| "VeriMass" diagnosis function | Yes, optional | Yes, optional |
| **Approvals and certificates** | | |
| Explosion protection ATEX / IECEx | In preparation | |
| Explosion protection cFMus | In preparation | |
| Further approvals | Available on our website abb.com/flow or on request | |

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

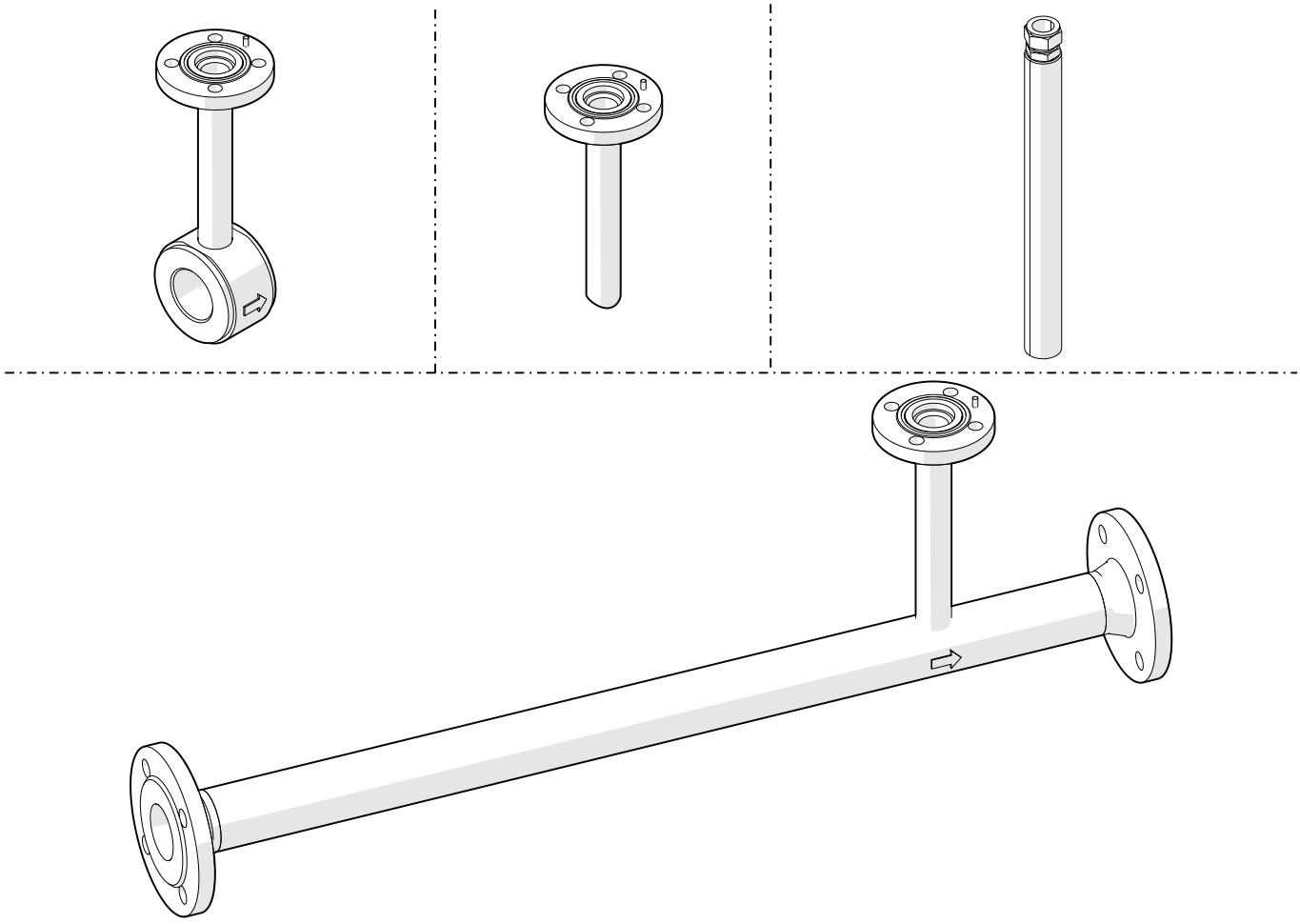
# ...Overview – models

## Pipe components (process connections)

**FMT091 – Wafer type design**

**FMT094 – Weld-on adapter**

**FMT094 – Weld-on adapter with clamp ring threading**



**FMT092 – Partial measuring section**

**Fig. 2: Pipe components (examples)**

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

## Device description

The SensyMaster FMT230, FMT250 works in accordance with the measuring principle of a hot-film anemometer. This measurement method allows for direct measurement of the gas mass flow.
Taking into account the standard density, the norm volume flow can be displayed without the need for additional pressure and temperature compensation.
The device is equipped with a Modbus interface and two fast digital outputs that can be configured as pulse, frequency or binary outputs.
The SensyMaster FMT230, FMT250 is used in the process industry for the flow measurement of gases and gas mixtures.

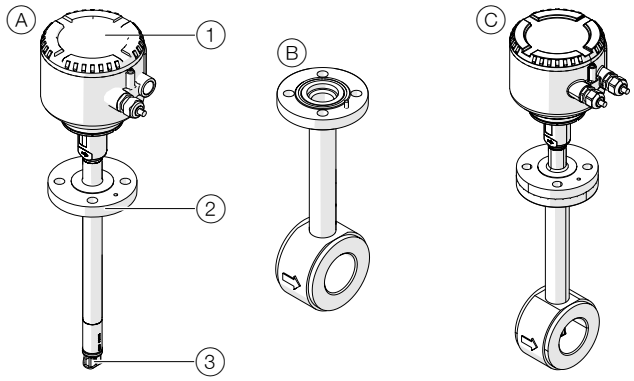



**Fig. 3:** **Sensor (example, wafer type design)**

| Pos. | Description |
|---|---|
| A | Sensor |
| B | Pipe component |
| C | Sensor with pipe component |
| 1 | Transmitter |
| 2 | Sensor connection |
| 3 | Thermal measuring element |

**Table 1** **Legend**

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

## Measuring principle

Thermal flow metering procedures use different ways to evaluate the flow dependent cooling of a heated resistor as measuring signal.
In a hotfilm anemometer with constant temperature difference control, the heated platinum resistor is maintained at a constant overtemperature in relation to an unheated platinum sensor inside the gas flow.
The heating power required for maintaining the overtemperature depends directly on the flow rate and the material properties of the gas. With a known (and constant) gas composition the mass-flow can be determined by electronically evaluating the heater current / mass-flow curve without additional pressure and temperature compensation. Together with the standard density of the gas this results directly in the standard volume flow.
Considering the high measuring range dynamics up to 1:100, an accuracy smaller than 1 % of the measuring value is achieved.

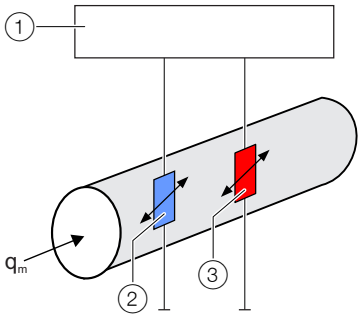



**Fig. 4:** **Measuring principle (simplified)**

| Pos. | Description |
|---|---|
| 1 | Transmitter |
| 2 | Measurement resistor gas temperature |
| 3 | Heat resistor |

**Table 2** **Legend**

The transmitter has three signals available. In addition to the heating power, the temperatures of the measuring medium and the heater resistance are included herein, which can be used to compensate the temperature dependency of gas parameters.
By storing the gas data in the transmitter the optimal tailoring can be calculated and performed at any operating point.

# ...Overview – models

**Advantages of the SensyMaster measuring principle**

- Through the provision of several primary and secondary signals, they can be displayed in parallel via the Modbus interface. This saves a gas temperature measurement.
- Regulating the measuring element and adjusting the signal processing becomes possible through the implementation of fully digital signal processing. Thus, an optimum measuring dynamic can always be achieved even under changing operating conditions.
- The SensyMaster measuring principle can offer an even larger measuring range.

**Typical applications**

- Gas volume measurement in chemical and process technology (air ,methane, nitrogen, hydrogen, carbon dioxide, oxygen, natural gas, ammonia, helium, argon, propane, ethane, butane, ethene, biogas)
- Pressurized air balancing
- Gas burner controls
- Digester gas and activation air measurements in sewage plants
- Gas measurement in air separators
- Hydrogen measurements in the process

## ApplicationSelector – Integrated data bank for gases

The thermal mass flowmeters SensyMaster FMT230, FMT250 have an integrated gas data base for air, methane, nitrogen, carbon dioxide, oxygen and other gases.
Two (FMTx30) or eight (FMTx50) different application can be defined in total. Two or four applications can also be preconfigured in the factory on request.
The operator can define their own applications (only with FMTx50)

- For each application the gas type can be chosen from a table, additionally gas mixtures of up to ten different gases can also be configured.
- For each application the pipeline diameter can be configured.
- For each application the parameters for the flow rate and temperature measurement can be configured.

## Diagnosis and self-monitoring

The thermal mass flowmeter SensyMaster FMT230, FMT250 also includes the internal monitoring of the transmitter and the sensor.
Amongst other things, the following functions and components are monitored:

- Monitoring of the power supply
- Limit value monitoring of the process values, temperature monitoring of the measuring medium
- Monitoring of the measuring element for line break and short-circuit
- Monitoring of the SensorMemory

## Sensor verification “VeriMass” (optional)

**SensorCheck**

VeriMass includes the SensorCheck, which verifies the integrity of the measuring elements and can notify of possible deposits on the measuring elements.
The SensorCheck relies on the comparison of fingerprints. The finger print includes values that are based on the temperature and heat conductivity of the measuring element. For instance, a fingerprint created during installation can be compared with a fingerprint created at a later point in time.

The sensor check must be started in the transmitter and always performed at zero flow under the same conditions. The comparison of values delivers information on possible damage or contamination of the measuring elements.

## FillMass batch function

**Only with FMT250**

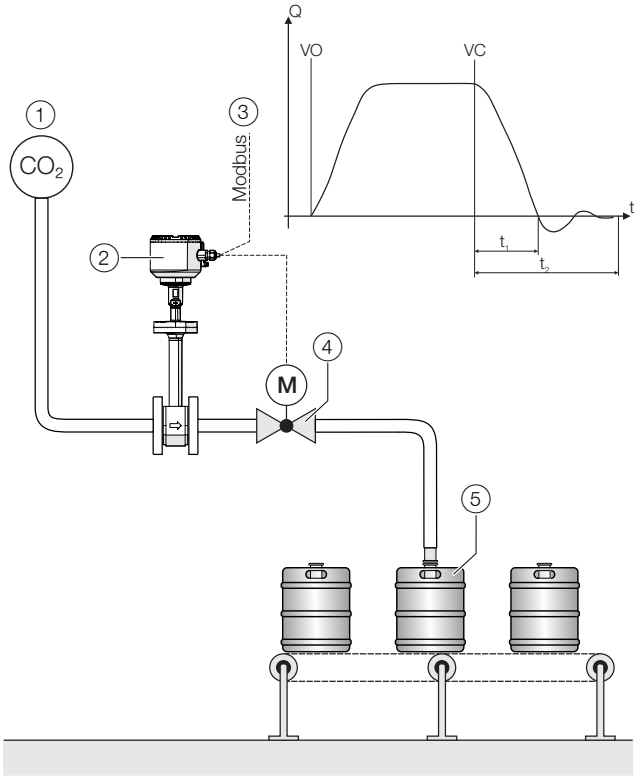



**Fig. 5: Filling function FillMass (example $CO_2$filling)**

| Pos. | Description |
|---|---|
| (1) | Gas line ($CO_2$) |
| (2) | Sensor |
| (3) | Fill start / stop (via Modbus) |
| (4) | Fill valve |
| (5) | Fill container |
| VO | Valve open (filling started) |
| VC | Valve closed (fill quantity reached) |
| $t_1$ | Valve closing time |
| $t_2$ | Overrun time |

**Table 3 Legend**

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

# Flowmeter sensor

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

### Gaskets

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

Note the following points when selecting and mounting gaskets:

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

### Inlet and outlet sections

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

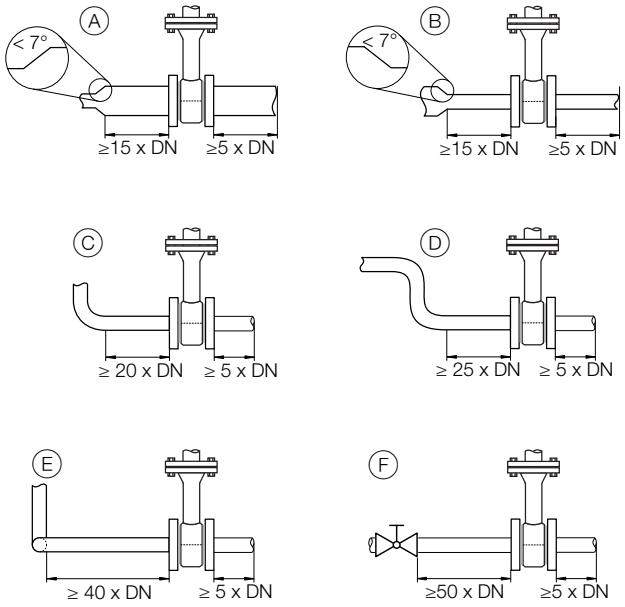



**Fig. 6: Inlet and outlet sections**

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

**Table 4 Legend**

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).

### Sensor insulation

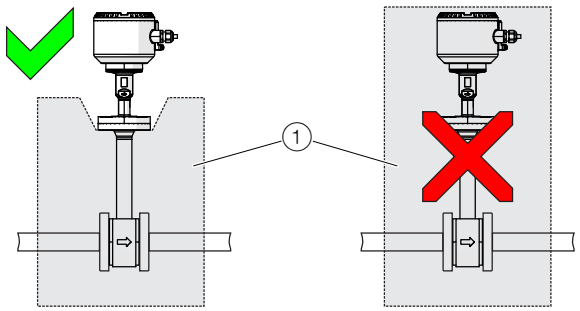



**Fig. 7: Insulation of the sensor**

The sensor may be insulated as shown in Fig. 7.

### Installation at high ambient temperatures

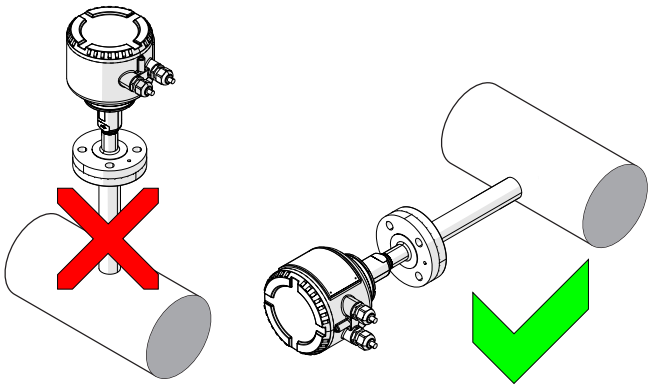


**Fig. 8: Mounting position at high ambient temperatures**

Under high but permissible ambient temperatures, avoid additional thermal stress from heat convection or radiation, since these sources of heat may exceed the permissible ambient temperature on the equipment surface.
If the device needs to be installed directly on a hot, horizontal piping, we recommend installing it on the side. In such cases, you should avoid installing it in the 12 o'clock position, otherwise the warm air that rises up will cause additional heating of the electronics.

**NOTICE – Damage of the device due to high ambient temperature!**
To prevent device damage through overheating of the electronics, pay attention to the following points:

- If it is being installed close to sources of heat, adequate shielding must be put in place.
- If it is being installed outdoors, sun protection must be provided.

# ...Flowmeter sensor

## Measuring accuracy

### Measured error

The stated measured error only applies under the reference conditions in the stated measuring range. Special calibration on request.

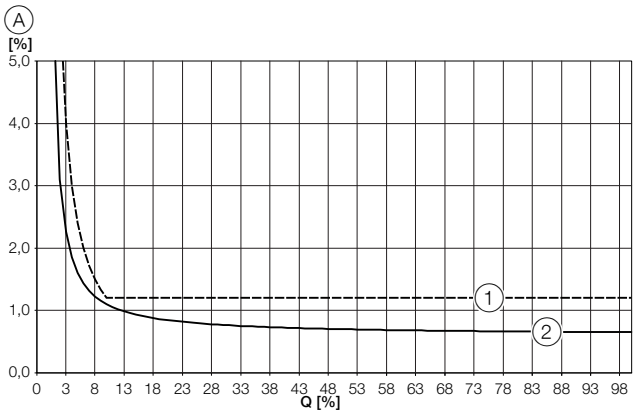



**Fig. 9: Measured error under reference conditions**

| Pos. | Description |
|---|---|
| A | Measured error in % |
| 1 | FMT230 |
| 2 | FMT250 |

**Table 5 Legend**

| Measuring medium | FMT230 | FMT250 |
|---|---|---|
| Air, nitrogen | ± 1.2 % of the measured value in the range of 10 ... 100 % of the measuring range | ± 0.6 % of the measured value |
| | ± 0.12 % of the measuring range's final value possible in the nominal diameter in the range of 0 ... 10 % of the measuring range | ± 0.05 % of the measuring range's final value possible in the nominal diameter |
| Other gases | – | Optional process gas calibration: ± 1.6 % of the measured value |
| | | ± 0.1 % of the measuring range's final value possible in the nominal diameter |

**Table 6 Measured error**

### Reference conditions

| Calibration with air | |
|---|---|
| Calibration gas | Air |
| Temperature | 21 °C, ± 2°C |
| Pressure | Atmospheric pressure |
| Relative humidity | 40 ... 60 % |
| Test laboratory | In accordance with ISO / IEC 17025 |

| Calibration with process gas | |
|---|---|
| Order code | RP, RM |

ABB offers the possibility of calibrating thermal mass flowmeters with non-corrosive and non-toxic gases and mixtures of such, subject to availability.

The availability of gases should be inquired prior to ordering with ABB.

The exact reference conditions are noted in the respective calibration certificate.

**Reproducibility**

< 0.2 % of the measured value, measuring time: 10 s

**Response time**

$T_{63}$ = 0.5 s

**Effect of the temperature of the medium being measured**

< 0.025 % of the measured value per Kelvin (depending on the gas type)

**Effect of the measuring medium pressure**

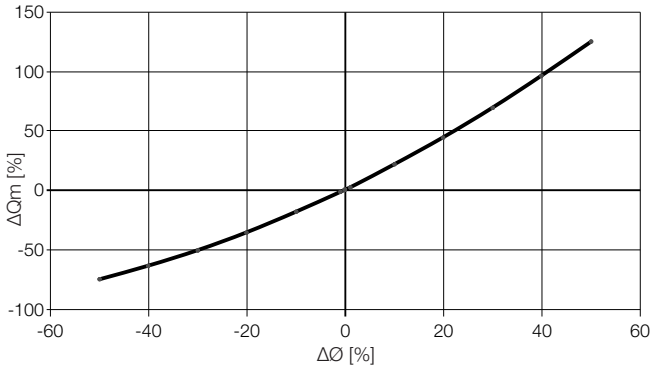
< 0.1 % of the measured value per 100 kPa (1 bar) (depending on the gas type)

**Influence of the relative humidity of the measuring medium**

0.2 % of the measured value per 10 % RH in the range of 15 ... 70 % RH

**Influence of the pipe cross-section**

If the inside diameter configured in the device does not correspond with the real diameter of the piping, measuring errors in the flow measurement occur.




**Δ Qm [%] = Measuring error mass flowmeter in %**

**Δ Ø [%] = Deviation piping inside diameter in %**

**Fig. 10: Influence of the pipe cross-section**

## Environmental conditions

**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)

**Storage temperature range**

-25 ... 85 °C (-13 ... 185 °F)

**Relative humidity**

Maximum 85 % RH, annual average ≤ 65 % RH

**IP rating**

In accordance with EN 60529: IP 65 / IP 67

**NEMA rating**

NEMA 4X

## Permitted pipe vibration

In accordance with IEC 60068-2-6
Maximum acceleration: 2 g in the frequency range of 10 ... 150 Hz

## Process conditions

**Measuring medium temperature**

**Devices with ceramic element and flange connection**

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

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

| Sensor connection | $T_{medium}$ |
|---|---|
| Threaded connection DIN 11851 | -40 ... 140 °C (-40 ... 284 °F) |
| Clamp ring fitting | -25 ... 140 °C (-13 ... 284 °F) |
| Pipe components with ball valve | Maximal 150 °C (302 °F) |
| Integrated hot tap fitting | See the chapter titled "Integrated hot tap fitting" on page 17 |

**Table 7 Approved measuring medium temperature $T_{medium}$ as a function of the sensor process connection**

# ...Flowmeter sensor

### Maximum operating pressure

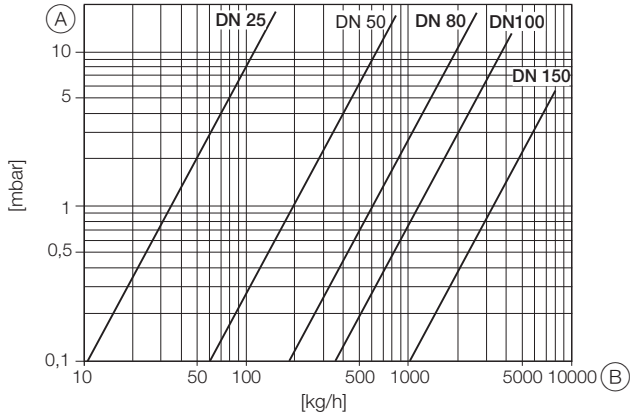
Standard for devices with flange connection, $P_{medium}$:
4 MPa; 40 bar (580 psi)

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

| Sensor connection | $P_{medium}$ |
|---|---|
| Threaded connection DIN 11851 | 1,6 MPa; 16 bar (232 psi) |
| Clamp ring fitting | 2 MPa; 20 bar (290 psi) |
| Integrated hot tap fitting | See the chapter titled "Integrated hot tap fitting" on page 17 |

**Table 8** **Approved operating pressure $P_{medium}$ as a function of sensor process connection**

### Pressure drop




Ⓐ Pressure loss
Ⓑ Mass flow

**Figure 11:** **Pressure loss in logarithmic representation**

## Sensor installation length

The sensor is available in different installation lengths. See chapter "Flowmeter sensor" on page 18 .

## Sensor connection

The following sensor connections are available for connecting the sensor to the pipe components or the process:

| Sensor connection |
|---|
| Flange in accordance with EN 1092-1 DN 25, PN 40 |
| Male thread in accordance with DIN 11851, PN 16 |
| Compression fitting NPT 1" Male thread, PN 20 |

## Materials

### Materials for the sensor

| Wetted components | Material |
|---|---|
| Sensor | Stainless steel 1.4571 (AISI 316 Ti) |
| Measuring element | Ceramic |
| Sensor connection gasket (O-ring) | • Viton (standard)<br>• Kalrez 4079 / Kalrez 1050 (for high temperature design)<br>• Kalrez 1050 (for oxygen)<br>• Kalrez Spectrum 6375 (for ammoniac)<br>• EPDM (DIN 11851) |

## Measuring range table

The recommended value for applications with air or nitrogen (other gases on request) under atmospheric conditions. For hydrogen and helium, the measuring range lower limit is typically approx. 10 % of the upper limit.

**Devices with process connections in accordance with EN 1029-1**

| | Standard measuring range | | Extended measuring range (only with FMTx50) | |
|---|---|---|---|---|
| **Nominal diameter** | **$Q_{max}$ [kg/h]** | **$Q_{max}$ [$Nm^3/h$][2)]** | **$Q_{max}$ [kg/h]** | **$Q_{max}$ [$Nm^3/h$][2)]** |
| DN 25 (1 in.) | 180 | 140 | 240 | 180 |
| DN 40 (1 1/2 in.) | 450 | 350 | 590 | 450 |
| DN 50 (2 in.) | 800 | 620 | 1050 | 820 |
| DN 65 (2 1/2 in.) | 1400 | 1100 | 1750 | 1400 |
| DN 80 (3 in.) | 1900 | 1500 | 2400 | 1900 |
| DN 100 (4 in.) | 3200 | 2500 | 4100 | 3200 |
| DN 125 (5 in.) | 4800 | 3800 | 6200 | 4800 |
| DN 150 (6 in.) | 7000 | 5500 | 9000 | 7000 |
| DN 200 (8 in.) | 12000 | 9300 | 15000 | 12000 |
| Ø up to 3000 mm (118 in.)[1)] | 2500000 | 2000000 | 3200000 | 2500000 |

**Device with process connections in accordance with ASME B16.5**

| | Standard measuring range | | Extended measuring range (only with FMTx50) | |
|---|---|---|---|---|
| **Nominal diameter** | **$Q_{max}$ [lbs/h]** | **$Q_{max}$ [scfm][3)]** | **$Q_{max}$ [lbs/h]** | **$Q_{max}$ [scfm][3)]** |
| 1 in. | 350 | 75 | 450 | 100 |
| 1 1/2 in. | 880 | 190 | 1100 | 250 |
| 2 in. | 1600 | 350 | 2000 | 450 |
| 3 in. | 3700 | 820 | 4900 | 1100 |
| 4 in. | 6400 | 1400 | 8400 | 1850 |
| 6 in. | 14500 | 3200 | 19000 | 4200 |
| 8 in. | 25500 | 5600 | 33100 | 7300 |
| Ø up to 3000 mm (118 in.)[1)] | 5500000 | 1200000 | 7100000 | 1600000 |

1) Rectangular ducts and larger diameters on request

2) Applies for oxygen or nitrogen at 0 °C (32 °F) / 1013.25 hPa (14.696 psia)

3) Applies for oxygen or nitrogen at 15 °C (59 °F) / 1013.25 hPa (14.696 psia)

**NOTE**

For further information regarding dependencies and restrictions and help regarding product selection please use the selection and design tool for flow rate (ABB Product Selection Assistant) on www.abb.com/flow.

# Transmitter

## Electrical connections

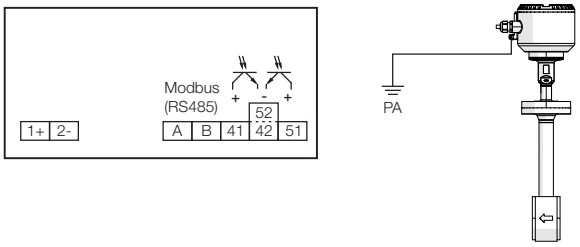



**Fig. 1: Electrical connection**

**PA = Functional ground (potential equalization)**

### Connections for the power supply

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

### Connections for the outputs

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

### Electrical data for inputs and outputs

### Power supply

| | |
|---|---|
| Supply voltage | 24 V DC ± 20 %<br>(ripple: ≤ 5 %) |
| Power consumption | P ≤ 10 W |

### Digital output 41 / 42, 51 / 52

Can be configured via Modbus.

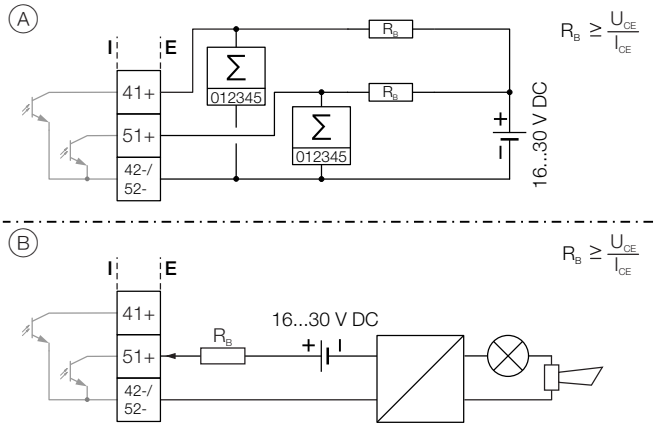



**Fig. 12: Passive digital outputs (I = internal, E = external)**

Ⓐ 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)** | |
|---|---|
| Terminals | 41 / 42 (pulse / frequency output) |
| | 51 / 52 (pulse output) |
| Output „closed“ | 0 V ≤ $U_{CEL}$ ≤ 3 V<br>For f < 2.5 kHz: 2 mA < $I_{CEL}$ < 10 mA<br>For f > 2.5 kHz 10 mA < $I_{CEL}$ < 30 mA |
| Output „open“ | 16 V ≤ $U_{CEH}$ ≤ 30 V DC<br>0 mA ≤ $I_{CEH}$ ≤ 0.2 mA |
| $f_{max}$ | 10.5 kHz |
| Pulse width | 0.1 … 2000 ms |
| **Binary output (passive)** | |
| Terminals | 41 / 42, 51 / 52 |
| Output „closed“ | 0 V ≤ $U_{CEL}$ ≤ 3 V<br>2 mA ≤ $I_{CEL}$ ≤ 30 mA |
| Output „open“ | 16 V ≤ $U_{CEH}$ ≤ 30 V DC<br>0 mA ≤ $I_{CEH}$ ≤ 0.2 mA |
| Switching function | Can be configured via Modbus. |

**Table 9 Electrical data Digital output 41 / 42, 51 / 52**

**NOTE**

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

### Modbus-Communication

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.

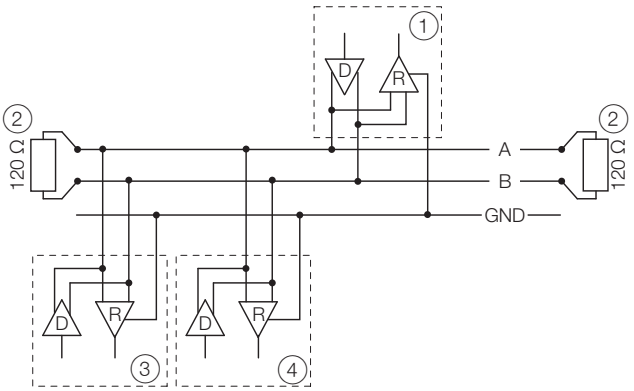



**Fig. 13: Communication via the Modbus protocol**

| Pos. | Description |
|---|---|
| 1 | Modbus-Master |
| 2 | Terminating resistor |
| 3 | Modbus slave 1 |
| 4 | Modbus slave n … 32 |

**Table 10 Legend**

| Modbus protocol | |
|---|---|
| Configuration | Via the Modbus interface or via the local operating interface in connection with Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM) |
| Transmission | Modbus RTU - RS485 serial connection |
| Baud rate | 2400, 4800, 9600, 19200, 38400, 56000, 57600, 115200 baud<br>Factory setting: 9600 baud |
| Parity | None, even, odd<br>Factory setting: odd |
| Stop bit | One, two<br>Factory setting: One |
| IEEE format | Little endian, big endian<br>Factory setting: Little endian |
| Typical response time | < 100 ms |
| Response delay time | 0 ... 200 milliseconds<br>Factory setting: 10 milliseconds |

**Table 11 Modbus-Parameter**

### Cable specification

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

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

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

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

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

## Materials

### Materials for the transmitter terminal box

| Housing |
|---|
| • Aluminum EN°AC-44200 (YL104) |
| or |
| • Stainless steel 1.4409 (AASTM CF3M) |
| Housing color (only for aluminum housing) |
| • RAL 9002 |
| Layer thickness of the paint: 80 ... 120 µm |

# Pipe components

## Process connections

The pipe components are available with the following process connections:

| Type | Process connection |
|---|---|
| FMT091 | Wafer type design<br>• DN 25 ... 200, PN 40 in accordance with EN 1092-1<br>• 1 ... 8 in., CL 150 / CL 300 in accordance with ASME B 16.5 |
| FMT092 | Partial measuring section<br>(optional with flow straightener)<br>• DN 25 ... 100, PN 40 flange in accordance with EN 1092-1<br>• 1 ... 8 in., CL 150 / CL 300 flange in accordance with ASME B 16.5<br>• DN 25 ... 80, PN 10 flange in accordance with EN 1092-1 B1<br>• DN 25 ... 80, PN 10, male thread R1 in. ... 3 in. |
| FMT094 | Weld-on adapter<br>With or without ball valve for rectangular channels or pipe diameter DN 100 ... 3000 |

The pipe components are available optionally with ball valve or integrated hot tap fitting.
The installation length of the sensor must be taken into account when selecting the pipe component!

## Materials

### Wetted materials for the pipe components

| Type | Material |
|---|---|
| **FMT091**<br>Wafer type design | Stainless steel 1.4571 (AISI 316 Ti) |
| **FMT092**<br>Partial measuring section | Stainless steel 1.4571 (AISI 316 Ti) or stainless steel 1.4301 (AISI 304) |
| Partial measuring section with male thread | Steel, galvanized |
| **FMT094**<br>Weld-on adapter | Stainless steel 1.4571 (AISI 316 Ti)<br>optional: carbon steel 1.0037 (S 235) |

### Material loads for process connections

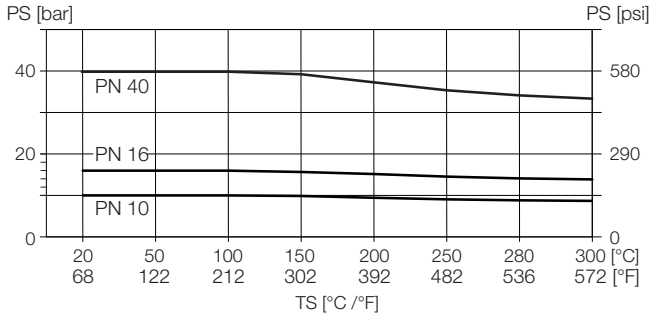



**Fig. 2:** **DIN flange process connection**

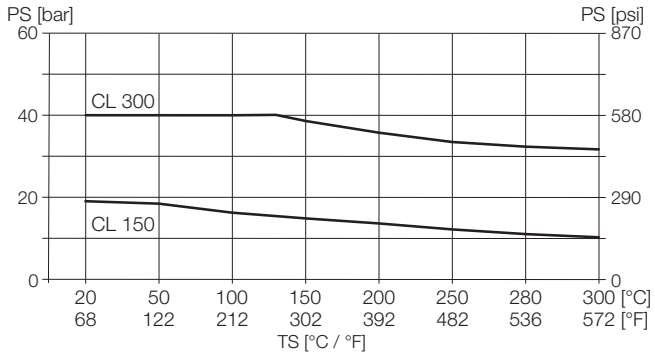



**Fig. 3:** **ASME flange process connection**

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

**Integrated hot tap fitting**

The integrated hot tap fitting is used instead of the previously described pipe components and weld-on adapters if taking out the sensor should be practically possible without gas escaping during running operation.

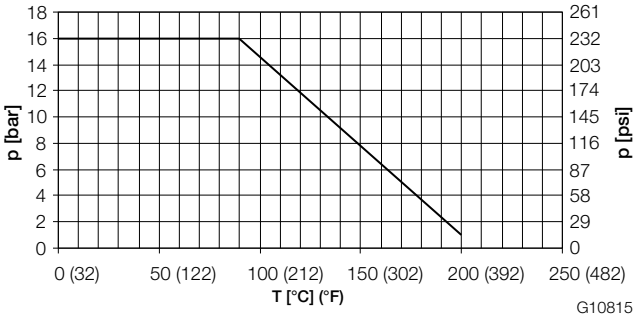



**Fig. 4: Maximum pressure / temperature values for integrated hot tap fitting**

The hot tap fitting is recommended in case of measurements in main lines (e. g. compressed air supply) or at measuring points that must be purged before removing the sensor.
In general, a hot tap fitting should be used in case of measurements that make shutting-off device parts necessary to remove the sensor.

**Handling**

The sensor is screwed onto the hot tap fitting via the DN 25 flange and the protective caps are mounted.
By rotating the union nut, the sensor is moved from the removable position to the measuring position. The lower edge of the union nut indicates the current position of the measuring element.
When you reach the measuring position 50 – OPEN – MESSEN (the lower limit stop of the union nut), the measuring element will be in the middle of the piping and measured values will be provided.

**NOTE**

Connection flanges PN 16 with four screw holes must be used in the integrated hot tap fitting in wafer type design DN 65.
Wafer type designs 2...8 in. only for connection flange ASME B16.5, Cl 150.

# Dimensions

## Flowmeter sensor

All specified dimensions and weights are in mm (in.) or kg (lb).

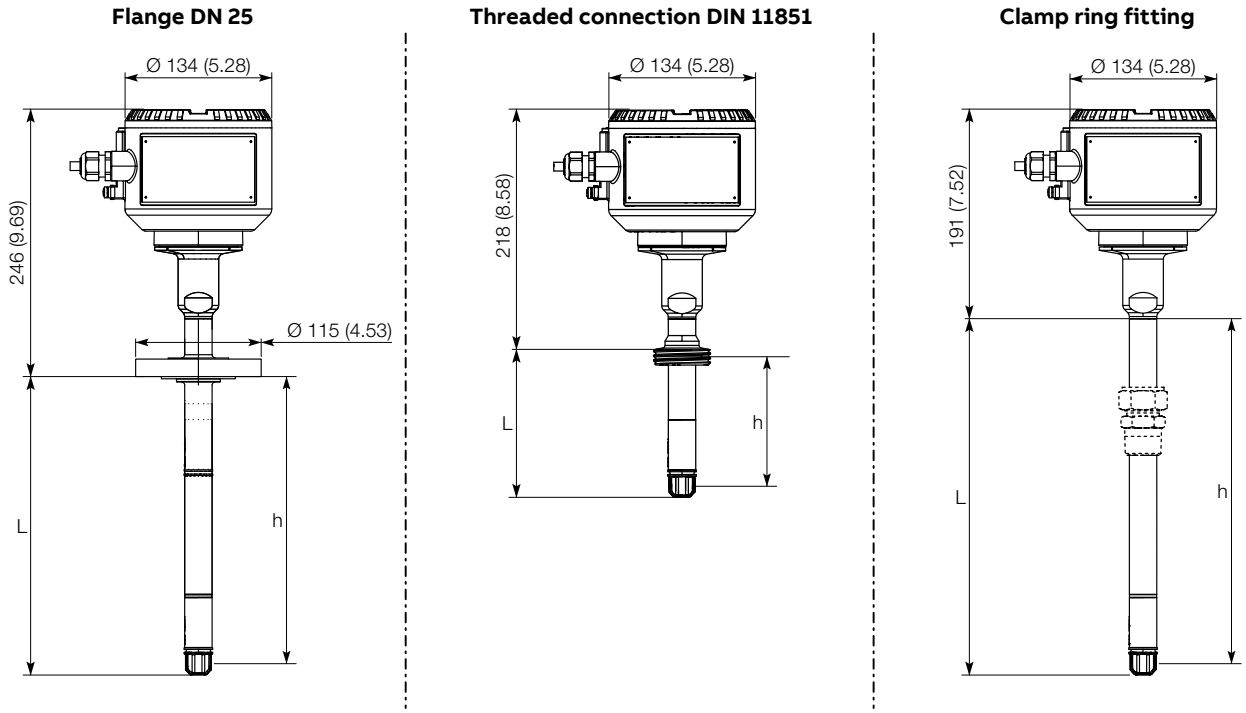



**Fig. 14: Sensor**

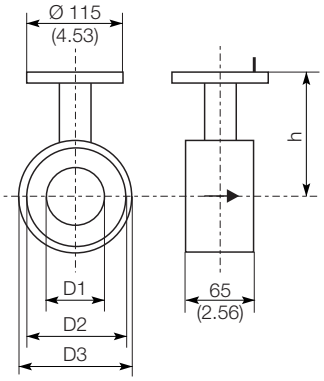
| Sensor connection | For nominal piping diameter | L<br>mm (in.) | h (installation length)<br>mm (in.) | Approx. weight<br>Kg (lb) |
|---|---|---|---|---|
| Flansch DN 25 | DN 25 ... 350 (1 ... 14 in.) | 271 (10.64) | 263 (10.35) | 5 (11) |
| | > DN 350 ... 700 (> 14 ... 28 in.) | 433 (17.05) | 425 (16.73) | 5,5 (12) |
| | > DN 700 (> 28 in.) | 783 (30.83) | 775 (30.51) | 6 (13) |
| Klemmringverschraubung | DN 100 ... 350 (4 ... 14 in.) | 326 (12.83) | 318 (12.52) | 4 (8,8) |
| | > DN 350 ... 700 (> 14 ... 28 in.) | 488 (19.21) | 480 (18.90) | 4,5 (9.9) |
| | > DN 700 (> 28 in.) | 838 (32.99) | 830 (32.68) | 5,5 (12) |
| Gewindeanschluss DIN 11851 | DN 25 ... 80 (1 ... 3 in.) | 136 (5.53) | 120 (4.72) | 3,2 (7) |

**NOTE**

The specified nominal piping diameters apply for the use of the sensor with pipe components without ball valves or hot tap fittings.

## Pipe components

All specified dimensions and weights are in mm (in.) bzw. kg (lb).




**FMT091 – Wafer type design**

**Fig. 15: Dimensions Wafer type design**

**FMT091 – Wafer type design in accordance with EN 1092-1, PN 40 – Sensor connection: flange DN 25**

| Nominal diameter | h | D1 | D2 | D3 | Weight |
|---|---|---|---|---|---|
| DN 40 | 263 (10.35) | 43.1 (1.70) | 88 (3.46) | 94 (3.70) | 4.5 (10) |
| DN 50 | | 54.5 (2.15) | 102 (4.02) | 109 (4.29) | 5.0 (11) |
| DN 65 | | 70.3 (2.77) | 122 (4.80) | 129 (5.08) | – |
| DN 80 | | 82.5 (3.25) | 138 (5.43) | 144 (5.67) | 7.0 (15.5) |
| DN 100 | | 107.1 (4.22) | 162 (6.38) | 170 (6.69) | 8.5 (18.7) |
| DN 125 | | 131.7 (5.19) | 188 (7.40) | 196 (7.72) | – |
| DN 150 | | 159.3 (6.27) | 218 (8.58) | 226 (8.90) | 11.5 (25.5) |
| DN 200 | | 206.5 (8.13) | 285 (11.22) | 293 (11.54) | – |

**FMT091 – Wafer type design in accordance with ASME B 16.5, CL 150 – Sensor connection: flange DN 25**

| Nominal diameter | h | D1 | D2 | D3 | Weight |
|---|---|---|---|---|---|
| 1 1/2“ | 263 (10.35) | 40.9 (1.61) | 73 (2.87) | 85 (3.35) | – |
| 2“ | | 52.6 (2.07) | 92 (3.62) | 103 (4.06) | – |
| 3“ | | 78.0 (3.07) | 127 (5.00) | 135 (5.31) | – |
| 4“ | | 102.4 (4.03) | 157 (6.18) | 173 (6.81) | – |
| 6“ | | 154.2 (6.07) | 216 (8.50) | 221 (8.70) | – |
| 8“ | | 202.7 (7.98) | 270 (10.63) | 278 (10.94) | – |

**FMT091 – Wafer type design in accordance with ASME B 16.5, CL 300 – Sensor connection: flange DN 25**

| Nominal diameter | h | D1 | D2 | D3 | Weight |
|---|---|---|---|---|---|
| 1 1/2“ | 263 (10.35) | 40.9 (1.61) | 73 (2.87) | 94 (3.70) | – |
| 2“ | | 52.6 (2.07) | 92 (3.62) | 110 (4.33) | – |
| 3“ | | 78.0 (3.07) | 127 (5.00) | 148 (5.83) | – |
| 4“ | | 102.4 (4.03) | 157 (6.18) | 180 (7.09) | – |
| 6“ | | 154.2 (6.07) | 216 (8.50) | 249 (9.80) | – |
| 8“ | | 202.7 (7.98) | 270 (10.63) | 307 (12.09) | – |

# ...Dimensions

All specified dimensions and weights are in mm (in.) bzw. kg (lb).

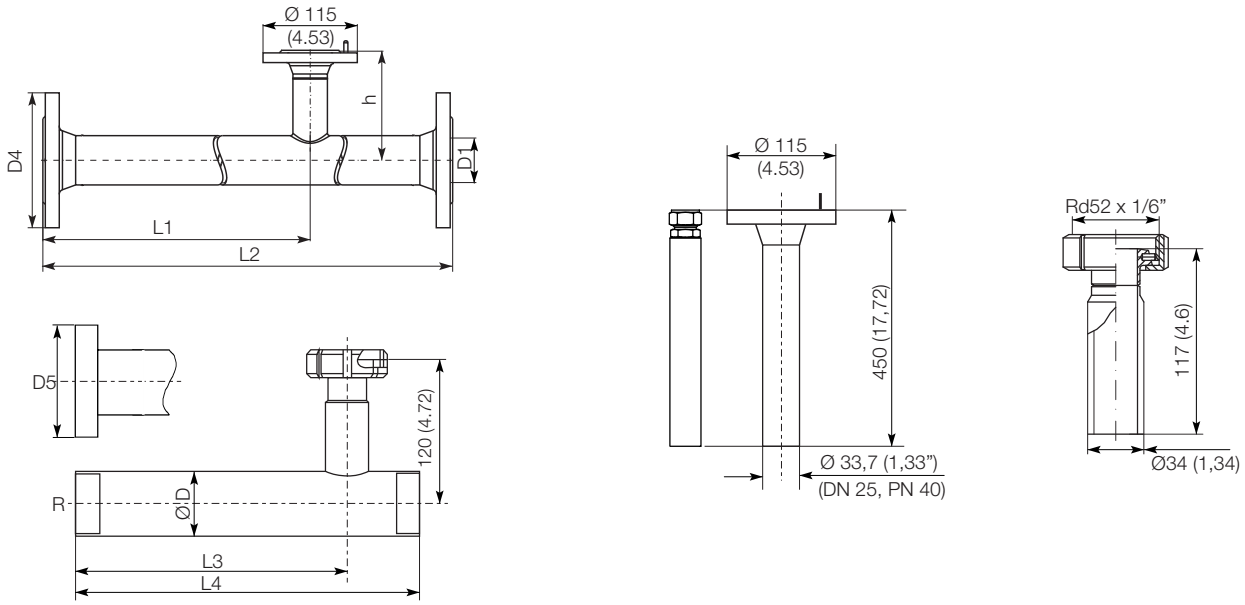



**Fig. 16: Dimensions pipe components and weld-on adapter**

**FMT092 – Partial measuring section with flange in accordance with EN 1092-1, Form B1, PN 40 – Sensor connection: flange DN 25**

| Nominal diameter | h | D1 | D4 | L1 | L2 | Weight |
|---|---|---|---|---|---|---|
| DN 25 | 263 (10.35) | 28,5 (1.12) | 115 (4.53) | 486 (19.13) | 600 (23.62) | 5.5 (12.0) |
| DN 40 | | 43.1 (1.70) | 150 (5.91) | 731 (28.78) | 860 (33.86) | 8.0 (17.5) |
| DN 50 | | 54.5 (2.15) | 165 (6.50) | 837 (32.95) | 1000 (39.37) | 11 (24.3) |
| DN 65 | | 70.3 (2.77) | 185 (7.28) | 1190 (46.85) | 1400 (55.12) | – |
| DN 80 | | 82.5 (3.25) | 200 (7.87) | 1450 (57.09) | 1700 (66.93) | – |
| DN 100 | | 107.1 (4.22) | 235 (9.25) | 1870 (73.62) | 2200 (86.61) | – |
| DN 125[1)] | | 131.7 (5.19) | 270 (10.63) | 2300 (90.55) | 2700 (106.3) | – |
| DN 150[1)] | | 159.3 (6.27) | 300 (11.81) | 2720 (107.09) | 3200 (125.98) | – |
| DN 200[1)] | | 206.5 (8.13) | 375 (14.76) | 3580 (140.94) | 4200 (165.35) | – |

1) On request

**FMT092 – Partial measuring section with flange in accordance with EN 1092-1, Form B1, PN 10 – Sensor connection: threaded connection DIN 11851**

| Nominal diameter | ØD inside | D5 | L3 | L4 | Weight |
|---|---|---|---|---|---|
| DN 25 | 27.3 (1.07) | 115 (4.53) | 410 (16.14) | 550 (21.65) | – |
| DN 40 | 41.9 (1.65) | 150 (5.91) | 615 (24.21) | 820 (32.28) | – |
| DN 50 | 53.9 (2.12) | 165 (6.50) | 810 (31.89) | 1080 (42.52) | – |
| DN 80 | 79.9 (3.15) | 200 (7.87) | 1200 (47.24) | 1600 (62.99) | – |

All specified dimensions and weights are in mm (in.) bzw. kg (lb).

**FMT092 – Partial measuring section with male thread, PN 10 – sensor connection: threaded connection DIN 11851**

| Nominal diameter | ØD inside | R male thread | L3 | L4 | Weight |
|---|---|---|---|---|---|
| DN 25 | 27.3 (1.07) | R1“ – 33.7 x 1.2 | 410 (16.14) | 550 (21.65) | – |
| DN 40 | 41.9 (1.65) | R1 1/2“ – 48.3 x 3.2 | 615 (24.21) | 820 (32.28) | – |
| DN 50 | 53.9 (2.12) | R2“ – 60.3 x 3.2 | 810 (31.89) | 1080 (42.52) | – |
| DN 80 | 79.9 (3.15) | R3“ – 88.9 x 4.5 | 1200 (47.24) | 1600 (62.99) | – |

**FMT092 – Partial measuring section with flange in accordance with ASME B 16.5, CL 150 – Sensor connection: flange DN 25**

| Nominal diameter | h | D1 | D4 | L1 | L2 | Weight |
|---|---|---|---|---|---|---|
| 1“ | 263 (10.35) | 26.6 (1.05) | 108 (4.25) | 454 (17.87) | 560 (22.05) | – |
| 1 1/2“ | | 40.9 (1.61) | 127 (5.00) | 741 (29.17) | 864 (34.02) | – |
| 2“ | | 52.6 (2.07) | 154 (6.06) | 846 (33.31) | 1003 (39.49) | – |
| 3“ | | 78.0 (3.07) | – | – | – | – |
| 4“ | | 102.4 (4.03) | – | – | – | – |
| 6“[1)] | | 154.2 (6.07) | – | – | – | – |
| 8“[1)] | | 202.7 (7.98) | – | – | – | – |

1) On request

**FMT092 – Partial measuring section with flange in accordance with ASME B 16.5, CL 300 – Sensor connection: flange DN 25**

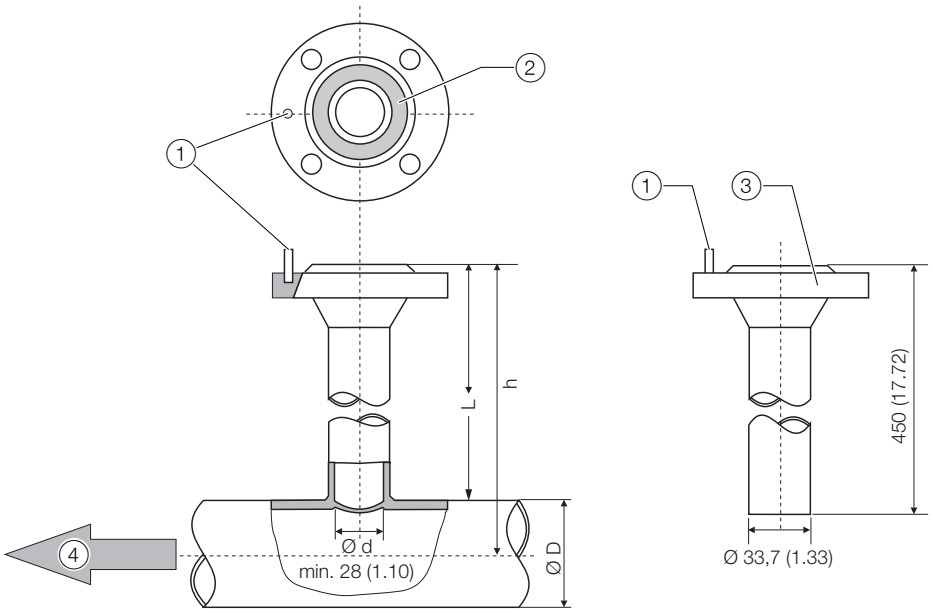
| Nominal diameter | h | d1 | D4 | L4 | L3 | Weight |
|---|---|---|---|---|---|---|
| 1“ | 263 (10.35) | 26.6 (1.05) | 123.9 (4.88) | 454 (17.87) | 560 (22.05) | – |
| 1 1/2“ | | 40.9 (1.61) | 155.4 (6.12) | 741 (29.17) | 864 (34.02) | – |
| 2“ | | 52.6 (2.07) | 165.1 (6.50) | 846 (33.31) | 1003 (39.49) | – |
| 3“ | | 78.0 (3.07) | – | – | – | – |
| 4“ | | 102.4 (4.03) | – | – | – | – |
| 6“[1)] | | 154.2 (6.07) | – | – | – | – |
| 8“[1)] | | 202.7 (7.98) | – | – | – | – |

1) On request

# ...Dimensions

**Weld-on adapter**

All dimensions specified in mm (in.).




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

**Fig. 17**

| h – sensor length | Ø D – outer pipe diameter (min. / max.) |
|---|---|
| 263 (10.35) | 100 ... 350 (3.94 ... 13.78) |
| 425 (16.73) | > 350 ... 700 (> 13.78 ... 27.56) |
| 775 (30.51) | > 700 ... 1400 (> 27.56 ... 55.12)[1)] |

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

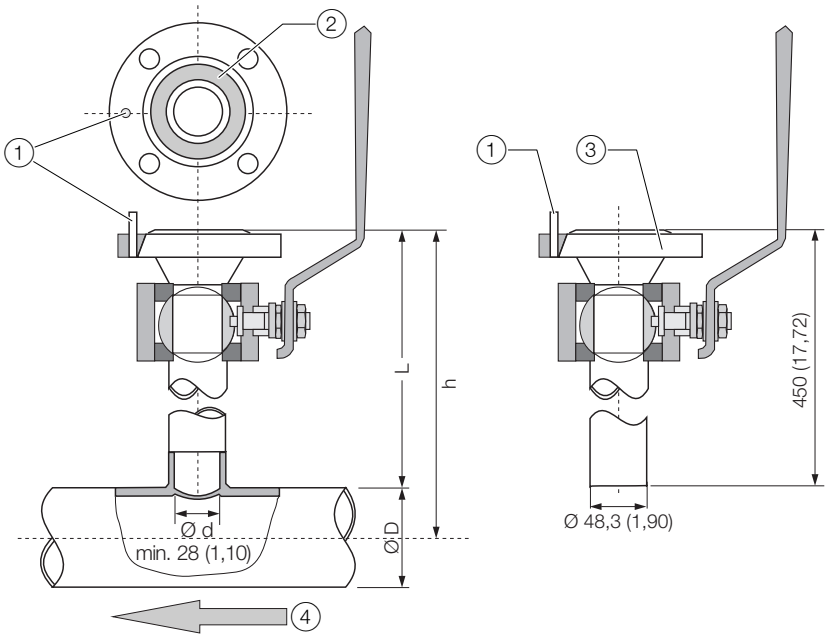
**NOTE**

When mounting the weld-on adapter, observe the following points:

- The weld-on adapters must be shortened to the dimension L before installation, in accordance with: L = h —(1/2 x Ø D).
- The distance h from the upper edge of the flange to the pipe central axis must be within a tolerance of ± 2 mm (± 0.08“).
- Maintain the 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).

**Weld-on adapter with ball valve**

All dimensions specified in mm (in.).




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

**Fig. 18**

| h – sensor length | Ø D – outer pipe diameter (min. / max.) |
|---|---|
| 263 (10.35) | 100 ... 150 (3.94 ... 5.91) |
| 425 (16.73) | > 150 ... 500 (> 5.91 ... 19.69) |
| 775 (30.51) | > 500 ... 1150 (> 19.69 ... 45.28)1) |

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

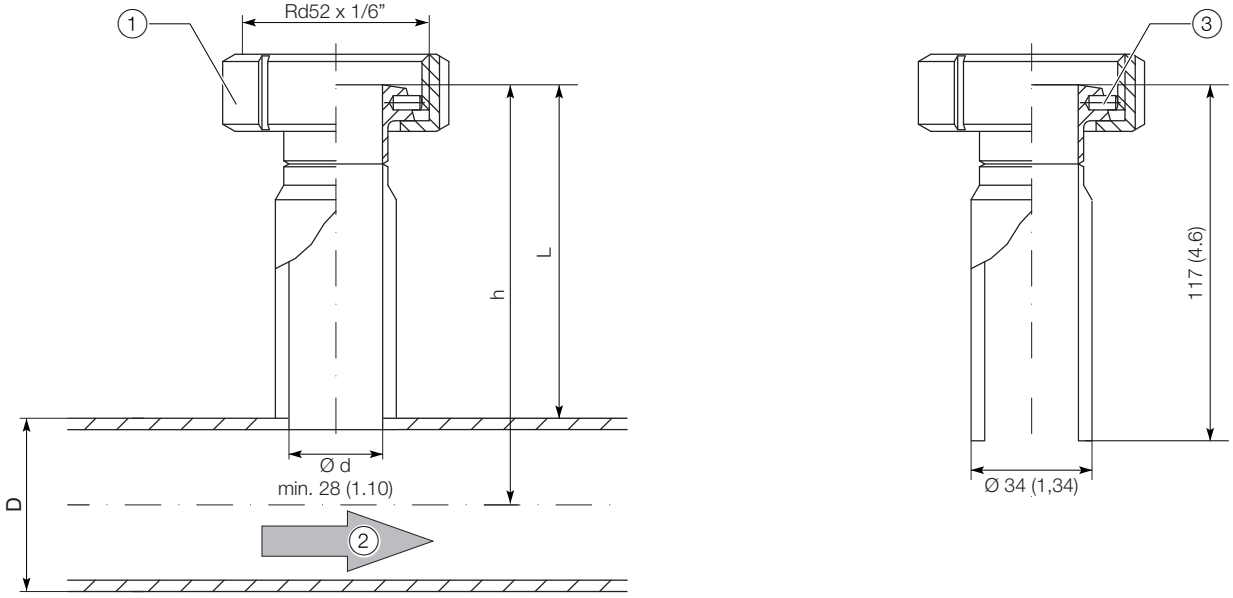
**NOTE**

When mounting the weld-on adapter, observe the following points:

- The weld-on adapters must be shortened to the dimension L before installation, in accordance with: L = h —(1/2 x Ø D).
- The distance h from the upper edge of the flange to the pipe central axis must be within a tolerance of ± 2 mm (± 0.08“).
- Maintain the 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).

# ...Dimensions

**Weld-on adapter with threaded connection in accordance with DIN 11851**
All dimensions specified in mm (in.).




① Union nut
② Flow direction
③ Centering pin

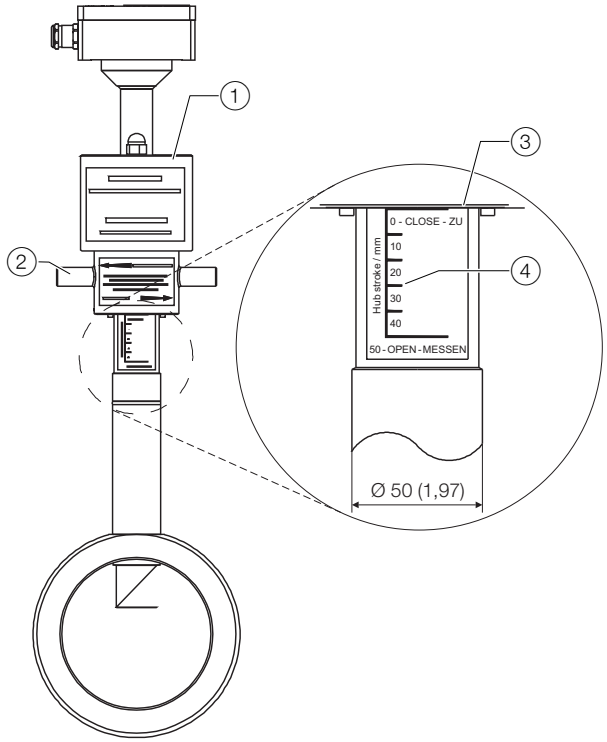
**Fig. 19**

**NOTE**
When mounting the weld-on adapter, observe the following points:

- Always mount the weld-on adapter together with the union nut on the piping. Mounting it at a later time is not possible.
- The weld-on adapters must be shortened to the dimension L before installation, in accordance with: L = h —(1/2 x Ø D).
- The distance h from the upper edge of the adapter to the pipe central axis must be within a tolerance of ± 2 mm (± 0.08 in.).
- Maintain the right angle to the pipe axis (max. tolerance ± 2°).
- Observe the thickness of pipeline wall and the degree of shrinkage when welding on.
- 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 a passage of at least 28 mm (1.10 in.) free for the purpose of mounting the sensor; drill to create if necessary.

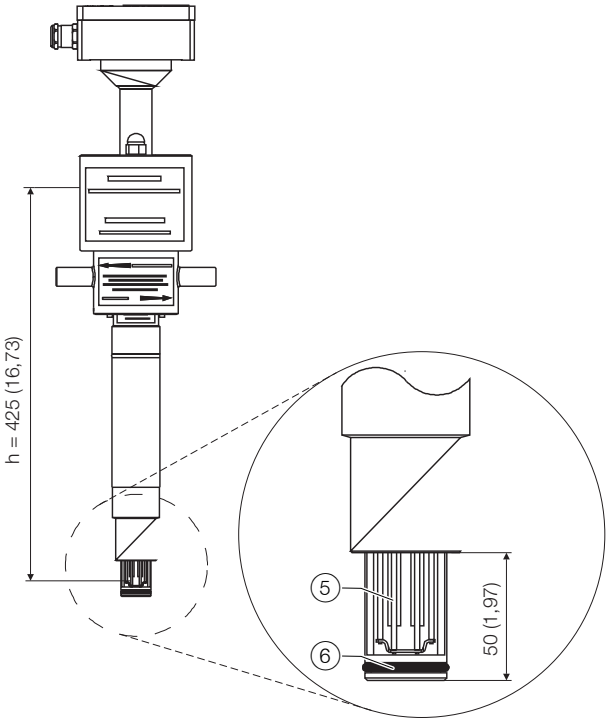
**Integrated hot tap fitting**

All dimensions specified in mm (in.).




**Wafer type design**

① Covering plates for flange DN 25 (1“)
② Union nut
③ Lower edge union nut




**Wafer type design**

④ Indicator position measuring element, hub 50 mm (1.97 in.)
⑤ Measuring element
⑥ O-ring

**Fig. 20**

| Nominal diameter | h - sensor length | |
|---|---|---|
| | **Wafer type design** | **Welding design** |
| DN 50, DN 65, DN 80 (2 in., 3 in.) | 263 mm (10.35 in.) | 425 mm (16.73 in.) |
| DN 100, DN 125, DN 150, DN 200 (4 in., 6 in., 8 in.) | 425 mm (16.73 in.) | |

# Ordering Information

**NOTE**

For further information regarding dependencies and restrictions and help regarding product selection please use the selection and design tool for flow rate (ABB Product Selection Assistant) on www.abb.com/flow.

## SensyMaster FMT230

Thermal Mass Flowmeter, for standard OEM applications

| **Base model** | **FMT230** | **XX** | **XX** | **X** | **X** | **XX** | **XX** | **XX** | **X** |
|---|---|---|---|---|---|---|---|---|---|
| SensyMaster FMT230 Thermal Mass Flowmeter | | | | | | | | | |
| **Explosion Protection Certification** | | | | | | | | | |
| Without | | Y0 | | | | | | | |
| **Measuring Medium** | | | | | | | | | |
| Air or other clean gas (One gas component only) | | | C1 | | | | | | |
| Gas mixtures with max. 23.5 Vol% O2 (eg. Natural gas or Biogas) | | | C2 | | | | | | |
| Oxygen / gas mixtures > 23.5 Vol% O2, oil and grease-free, with O2 certificate (max. 150 °C / 302 °F) | | | P1 | | | | | | |
| Ammonia | | | H3 | | | | | | |
| **Sensor Element Type / Temperature Range of Measuring Medium** | | | | | | | | | |
| Standard ceramic sensor / Standard range -25 ... 150 °C (-13 ... 302 °F) | | | | A | | | | | |
| **Mounting Length / Flowmeter Sensor Material** | | | | | | | | | |
| 120 mm (4.7 in.) / AISI 316Ti SST (1.4571) (DN 25 ... DN 125 [1 ... 5 in.]) | | | | 1) | 1 | | | | |
| 263 mm (10.4 in.) / AISI 316Ti SST (1.4571) (DN 25 ... DN 350 [1 ... 14 in.]) | | | | 1) | 2 | | | | |
| 425 mm (17 in.) / AISI 316Ti SST (1.4571) (> DN 350 ... DN 700 [> 14 ... 28 in.]) | | | | 1) | 3 | | | | |
| 775 mm (31 in.) / AISI 316Ti SST (1.4571) (> DN 700 [> 28in.]) | | | | 1) | 4 | | | | |
| **Sensor Connection** | | | | | | | | | |
| Flange DN 25, nominal pressure 4 MPa (40 bar, 580 psi) | | | | | | D3 | | | |
| Compression fitting, stainless steel, nominal pressure 2 MPa (20 bar, 290 psi) (-25 ... 140 °C (-13 ... 284 °F)) (> DN80) | | | | | | G2 | | | |
| Thread DIN 11851, nominal pressure 1.6 MPa (16 bar, 232 psi) (-40 ... 140 °C (-40 ... 284 °F)) | | | | | | F1 | | | |
| **Connection Design / Transmitter Housing Type / Transmitter Housing Material / Cable Glands** | | | | | | | | | |
| Integral / Single compartment / Aluminium / 2 x M20 x 1.5 | | | | | | B1 | | | |
| Integral / Single compartment / Aluminium / 2 x NPT 1/2 in. | | | | | | B2 | | | |
| Integral / Single compartment / Stainless Steel / 2 x M20 x 1.5 | | | | | | T1 | | | |
| Integral / Single compartment / Stainless Steel / 2 x NPT 1/2 in. | | | | | | T2 | | | |
| **Outputs** | | | | | | | | | |
| Digital output 1 (passive), MODBUS (No HART) | | | | | | | | M2 | |
| **Power Supply** | | | | | | | | | |
| 24 V DC, +/- 20 % | | | | | | | | | B |

Continued on next page...

## Additional ordering information SensyMaster FMT230

| SensyMaster FMT230 Thermal Mass Flowmeter | XX | XX | XX | XXX | XX | XX | XXX | XX |
|---|---|---|---|---|---|---|---|---|
| **Material Certificates** | | | | | | | | |
| Material monitoring with inspection certificate 3.1 acc. EN 10204 | C2 | | | | | | | |
| Declaration of compliance with the order 2.1 acc. EN 10204 | C4 | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for visual, dimensional and functional test | C6 | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI | CA | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI with material analysis | C5 | | | | | | | |
| **Calibration Certificates** | | | | | | | | |
| Certificate of DAkkS calibration, 7 points, traceable acc. ISO / IEC 17025 (Former DKD certificate, based on reference conditions with air) | | CH | | | | | | |
| Declaration of compliance for calibration 2.1 acc. EN 10204 | | CM | | | | | | |
| **Documentation Language** | | | | | | | | |
| German | | | M1 | | | | | |
| English | | | M5 | | | | | |
| **Configuration Type** | | | | | | | | |
| Parameters set to factory default | | | | NC1 | | | | |
| Parameters set customer specific | | | | NCC | | | | |
| **Calibration Type** | | | | | | | | |
| Accuracy grade B, incl. factory certificate | | | | | R3 | | | |
| **Device Identification Plate** | | | | | | | | |
| Stainless steel plate with TAG no. | | | | | | T1 | | |
| Stainless steel plate | | | | | | T5 | | |
| Adhesive label with TAG no. | | | | | | TC | | |
| Additional stainless steel plate | | | | | | TS | | |
| **Ambient Temperature Range** | | | | | | | | |
| Extended -40 ... 70 °C (-40 ... 158 °F) | | | | | | | TA9 | |
| Extended -50 ... 70 °C (-58 ... 158 °F) | | | | | | | TA6 | |
| **Extended Diagnostic Options** | | | | | | | | |
| VeriMass Verification Software | | | | | | | | V2 |

1) Nominal size ranges when using flanged pipe components or weld-on adapters without ball valve

# ...Ordering Information

## SensyMaster FMT250

Thermal Mass Flowmeter, for advanced OEM applications

| **Base model** | **FMT250** | **XX** | **XX** | **X** | **X** | **XX** | **XX** | **XX** | **X** |
|---|---|---|---|---|---|---|---|---|---|
| SensyMaster FMT250 Thermal Mass Flowmeter | | | | | | | | | |
| **Explosion Protection Certification** | | | | | | | | | |
| Without | | Y0 | | | | | | | |
| **Measuring Medium** | | | | | | | | | |
| Air or other clean gas (One gas component only) | | | C1 | | | | | | |
| Gas mixtures with max. 23.5 Vol% O2 (eg. Natural gas or Biogas) | | | C2 | | | | | | |
| Oxygen / gas mixtures > 23.5 Vol% O2, oil and grease-free, | | | | | | | | | |
| with O2 certificate (max. 150 °C / 302 °F) | | | P1 | | | | | | |
| Hydrogen (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | 1) | P2 | | | | | | |
| Helium (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | 1) | P3 | | | | | | |
| Ammonia | | | H3 | | | | | | |
| **Sensor Element Type / Temperature Range of Measuring Medium** | | | | | | | | | |
| Standard ceramic sensor / Standard range -25 ... 150 °C (-13 ... 302 °F) | | | | A | | | | | |
| Standard ceramic sensor / High temperature range -25 ... 300 °C (-13 ... 572 °F) | | | | B | | | | | |
| **Mounting Length / Flowmeter Sensor Material** | | | | | | | | | |
| 120 mm (4.7 in.) / AISI 316Ti SST (1.4571) (DN 25 ... DN 125 [1 ... 5 in.]) | | | | 2) | 1 | | | | |
| 263 mm (10.4 in.) / AISI 316Ti SST (1.4571) (DN 25 ... DN 350 [1 ... 14 in.]) | | | | 2) | 2 | | | | |
| 425 mm (17 in.) / AISI 316Ti SST (1.4571) (> DN 350 ... DN 700 [> 14 ... 28 in.]) | | | | 2) | 3 | | | | |
| 775 mm (31 in.) / AISI 316Ti SST (1.4571) (> DN 700 [> 28in.]) | | | | 2) | 4 | | | | |
| **Sensor Connection** | | | | | | | | | |
| Flange DN 25, nominal pressure 4 MPa (40 bar, 580 psi) | | | | | | D3 | | | |
| Compression fitting, stainless steel, | | | | | | | | | |
| nominal pressure 2 MPa (20 bar, 290 psi) (-25 ... 140 °C (-13 ... 284 °F)) (> DN80) | | | | | | G2 | | | |
| Thread DIN 11851, | | | | | | | | | |
| nominal pressure 1.6 MPa (16 bar, 232 psi) (-40 ... 140 °C (-40 ... 284 °F)) | | | | | | F1 | | | |
| **Connection Design / Transmitter Housing Type / Transmitter Housing Material / Cable Glands** | | | | | | | | | |
| Integral / Single compartment / Aluminium / 2 x M20 x 1.5 | | | | | | B1 | | | |
| Integral / Single compartment / Aluminium / 2 x NPT 1/2 in. | | | | | | B2 | | | |
| Integral / Single compartment / Stainless Steel / 2 x M20 x 1.5 | | | | | | T1 | | | |
| Integral / Single compartment / Stainless Steel / 2 x NPT 1/2 in. | | | | | | T2 | | | |
| **Outputs** | | | | | | | | | |
| Digital output 1 (passive), MODBUS (No HART) | | | | | | | | M2 | |
| **Power Supply** | | | | | | | | | |
| 24 V DC, +/- 20 % | | | | | | | | | B |

Continued on next page...

## Additional ordering information SensyMaster FMT250

| SensyMaster FMT250 Thermal Mass Flowmeter | XX | XX | XX | XXX | XX | XX | XX | XXX | XX |
|---|---|---|---|---|---|---|---|---|---|
| **Material Certificates** | | | | | | | | | |
| Material monitoring with inspection certificate 3.1 acc. EN 10204 | C2 | | | | | | | | |
| Declaration of compliance with the order 2.1 acc. EN 10204 | C4 | | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for visual, dimensional and functional test | C6 | | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI | CA | | | | | | | | |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI with material analysis | C5 | | | | | | | | |
| **Calibration Certificates** | | | | | | | | | |
| Certificate of DAkkS calibration, 7 points, traceable acc. ISO / IEC 17025 (Former DKD certificate, based on reference conditions with air) | | CH | | | | | | | |
| Declaration of compliance for calibration 2.1 acc. EN 10204 | | CM | | | | | | | |
| **Documentation Language** | | | | | | | | | |
| German | | | M1 | | | | | | |
| English | | | M5 | | | | | | |
| **Configuration Type** | | | | | | | | | |
| Parameters set to factory default | | | | NC1 | | | | | |
| Parameters set customer specific | | | | NCC | | | | | |
| **Special Applications** | | | | | | | | | |
| Filling application | | | | | PT | | | | |
| **Calibration Type** | | | | | | | | | |
| Accuracy grade A with standard measuring range, incl. factory certificate | | | | | | R2 | | | |
| Extended measuring range, non Ex version only, incl. factory certificate ( Only standard accuracy ) | | | | | | R4 | | | |
| Process gas calibration, up to two gas components, incl. factory certificate | | | | | | RP | | | |
| Process gas calibration, gas mixtures with more than two gas components, incl. factory certificate | | | | | | RM | | | |
| **Device Identification Plate** | | | | | | | | | |
| Stainless steel plate with TAG no. | | | | | | | T1 | | |
| Stainless steel plate | | | | | | | T5 | | |
| Adhesive label with TAG no. | | | | | | | TC | | |
| Additional stainless steel plate | | | | | | | TS | | |
| **Ambient Temperature Range** | | | | | | | | | |
| Extended -40 ... 70 °C (-40 ... 158 °F) | | | | | | | | TA9 | |
| Extended -50 ... 70 °C (-58 ... 158 °F) | | | | | | | | TA6 | |
| **Extended Diagnostic Options** | | | | | | | | | |
| VeriMass Verification Software | | | | | | | | | V2 |

1) With measured medium H2 or He in nominal size DN 25 ... DN 50 or 1 ... 2 in., please use pipe components FMT092 with flow straightener

2) Nominal size ranges when using flanged pipe components or weld-on adapters without ball valve

# ...Ordering Information

## SensyMaster FMT091 Pipe component / Wafer Design (Type 1)

| **Base model** | **FMT091** | **X** | **XXX** | **XX** | **XX** | **XX** | **XX** | **XX** |
|---|---|---|---|---|---|---|---|---|
| SensyMaster FMT091 Pipe component / Wafer Design (Type 1) | | | | | | | | |
| **Design** | | | | | | | | |
| Standard | | S | | | | | | |
| **Nominal Diameter** | | | | | | | | |
| DN 40 (1-1/2 in.) | | | 040 | | | | | |
| DN 50 (2 in.) | | | 050 | | | | | |
| DN 65 (2-1/2 in.) | | | 065 | | | | | |
| DN 80 (3 in.) | | | 080 | | | | | |
| DN 100 (4 in.) | | | 100 | | | | | |
| DN 125 (5 in.) | | | 125 | | | | | |
| DN 150 (6 in.) | | | 150 | | | | | |
| DN 200 (8 in.) | | | 200 | | | | | |
| **Process Connection** | | | | | | | | |
| Flanges DIN PN 40 | | | | D4 | | | | |
| Flanges ANSI / ASME B16.5 Class 150, Schedule 40 S | | | | A1 | | | | |
| Flanges ANSI / ASME B16.5 Class 300, Schedule 40 S | | | | A3 | | | | |
| **Sensor Connection** | | | | | | | | |
| Flange DN 25, nominal pressure 4 MPa (40 bar, 580 psi) | | | | | D3 | | | |
| **Measuring Medium** | | | | | | | | |
| Air or other clean gas | | | | | | C1 | | |
| Gas mixtures with max. 23.5 Vol% O2 | | | | | | C2 | | |
| Oxygen / gas mixtures > 23.5 Vol% O2, oil and grease-free, with O2 certificate (max. 150 °C / 302 °F) | | | | | | P1 | | |
| Hydrogen (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P2 | | |
| Helium (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P3 | | |
| Ammonia | | | | | | H3 | | |
| **Pipe Material** | | | | | | | | |
| Stainless steel AISI 316Ti (1.4571) | | | | | | | S2 | |
| **Mounting Length of the Sensor** | | | | | | | | |
| 263 mm (10.4 in.) | | | | | | | | L2 |
| 425 mm (17 in.) | | | | | | | | L3 |

Continued on next page...

## Additional ordering information SensyMaster FMT091

| SensyMaster FMT091 Pipe component / Wafer Design (Type 1) | | XXX | XXX | XX |
|---|---|---|---|---|
| **Sensor Connection Options** | | | | |
| With ball valve (max. 150 °C / 302 °F) | 2) | SCA | | |
| With integrated hot-tap fitting, for pipe component DN 50 ... DN 80 | | SCB | | |
| With integrated hot-tap fitting, for pipe component DN 100 ... DN 200 | | SCC | | |
| **Sensor Connection Accessories** | | | | |
| DN 25 blind flange to close flowmeter sensor connection, material stainless steel AISI 316Ti (1.4571) | | | SBA | |
| **Certificates** | | | | |
| Material monitoring with inspection certificate 3.1 acc. EN 10204 | | | | C2 |
| Declaration of compliance with the order 2.1 acc. EN 10204 | | | | C4 |
| Inspection certificate 3.1 acc. EN 10204 for visual, dimensional and functional test | | | | C6 |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI | | | | CA |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI with material analysis | | | | C5 |
| Pressure test acc. AD2000 | | | | CB |

1) Max. 0.8 MPa (8 bar, 116 psi). With DN 25 ... DN 50 (1 ... 2 in.): Please use pipe component FMT092 with flow straightener

2) Correct sensor length: For pipe component DN 50 ... DN 100: h = 263 mm, from DN 125: h = 425 mm.
For weld-on adapter up to 150 mm: h = 263 mm, up to 500 mm: h = 425 mm, > 500 mm: h = 775 mm

# ...Ordering Information

## SensyMaster FMT092 Pipe component, partial measuring section (type 2)

| **Base model** | **FMT092** | **X** | **XXX** | **XX** | **XX** | **XX** | **XX** | **XX** |
|---|---|---|---|---|---|---|---|---|
| SensyMaster FMT092 Pipe component, partial measuring section (type 2) | | | | | | | | |
| **Design** | | | | | | | | |
| Standard | | S | | | | | | |
| Integrated flow straighteners | | F | | | | | | |
| **Nominal Diameter** | | | | | | | | |
| DN 25 (1 in.) | | | 025 | | | | | |
| DN 40 (1-1/2 in.) | | | 040 | | | | | |
| DN 50 (2 in.) | | | 050 | | | | | |
| DN 65 (2-1/2 in.) | | | 065 | | | | | |
| DN 80 (3 in.) | | | 080 | | | | | |
| DN 100 (4 in.) | | | 100 | | | | | |
| DN 125 (5 in.) – on request | | | 125 | | | | | |
| DN 150 (6 in.) – on request | | | 150 | | | | | |
| DN 200 (8 in.) – on request | | | 200 | | | | | |
| **Process Connection** | | | | | | | | |
| Flanges DIN PN 40 | | | | D4 | | | | |
| Flanges ANSI / ASME B16.5 Class 150, Schedule 40 S | | | | A1 | | | | |
| Flanges ANSI / ASME B16.5 Class 300, Schedule 40 S | | | | A3 | | | | |
| Thread 1 ... 3 in. NPT-m, nominal pressure 1.6 MPa (16 bar, 232 psi) | | | | N6 | | | | |
| **Sensor Connection** | | | | | | | | |
| Flange DN 25, nominal pressure 4 MPa (40 bar, 580 psi) | | | | | D3 | | | |
| Thread DIN 11851, nominal pressure 1.6 MPa (16 bar, 232 psi) | | | | | F1 | | | |
| **Measuring Medium** | | | | | | | | |
| Air or other clean gas | | | | | | C1 | | |
| Gas mixtures with max. 23.5 Vol% O2 | | | | | | C2 | | |
| Oxygen / gas mixtures > 23.5 Vol% O2, oil and grease-free, with O2 certificate (max. 150 °C / 302 °F) | | | | | | P1 | | |
| Hydrogen (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P2 | | |
| Helium (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P3 | | |
| Ammonia | | | | | | H3 | | |
| **Pipe Material** | | | | | | | | |
| Stainless steel AISI 316Ti (1.4571) | | | | | | | S2 | |
| Stainless steel AISI 304 (1.4301) | | | | | | | S3 | |
| **Mounting Length of the Sensor** | | | | | | | | |
| 120 mm (4.7 in.) | | | | | | | | L1 |
| 263 mm (10.4 in.) | | | | | | | | L2 |
| 425 mm (17 in.) | | | | | | | | L3 |

Continued on next page...

## Additional ordering information SensyMaster FMT092

| SensyMaster FMT092 Pipe component, partial measuring section (type 2) | | XXX | XXX | XX |
|---|---|---|---|---|
| **Sensor Connection Options** | | | | |
| With ball valve (max. 150 °C / 302 °F) | 2) | SCA | | |
| With integrated hot-tap fitting, for pipe component DN 50 ... DN 80 | | SCB | | |
| With integrated hot-tap fitting, for pipe component DN 100 ... DN 200 | | SCC | | |
| **Sensor Connection Accessories** | | | | |
| DN 25 blind flange to close flowmeter sensor connection, material stainless steel AISI 316Ti (1.4571) | | | SBA | |
| Blind screw connection for Thread DIN 11851, to close flowmeter sensor connection, material stainless steel AISI 304 (1.4301) | | | SBB | |
| **Certificates** | | | | |
| Material monitoring with inspection certificate 3.1 acc. EN 10204 | | | | C2 |
| Declaration of compliance with the order 2.1 acc. EN 10204 | | | | C4 |
| Inspection certificate 3.1 acc. EN 10204 for visual, dimensional and functional test | | | | C6 |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI | | | | CA |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI with material analysis | | | | C5 |
| Pressure test acc. AD2000 | | | | CB |

1) Max. 0.8 MPa (8 bar, 116 psi). With DN 25 ... DN 50 (1 ... 2 in.): Please use pipe component FMT092 with flow straightener

2) Correct sensor length: For pipe component DN 50 ... DN 100: h = 263 mm, from DN 125: h = 425 mm.
For weld-on adapter up to 150 mm: h = 263 mm, up to 500 mm: h = 425 mm, > 500 mm: h = 775 mm

# ...Ordering Information

## SensyMaster FMT094 Pipe component, weld-on adapter

| **Base model** | **FMT094** | **X** | **XXX** | **XX** | **XX** | **XX** | **XX** | **XX** |
|---|---|---|---|---|---|---|---|---|
| SensyMaster FMT094 Pipe component, weld-on adapter | | | | | | | | |
| **Design** | | | | | | | | |
| Standard | | S | | | | | | |
| **Nominal Diameter** | | | | | | | | |
| Selection for weld-on adapter | | | 000 | | | | | |
| **Process Connection** | | | | | | | | |
| Selection for weld-on adapter | | | | W2 | | | | |
| **Sensor Connection** | | | | | | | | |
| Flange DN 25, nominal pressure 4 MPa (40 bar, 580 psi) | | | | | D3 | | | |
| Compression fitting, stainless steel, nominal pressure 2 MPa (20 bar, 290 psi) | | | | | G2 | | | |
| Thread DIN 11851, nominal pressure 1.6 MPa (16 bar, 232 psi) | | | | | F1 | | | |
| **Measuring Medium** | | | | | | | | |
| Air or other clean gas | | | | | | C1 | | |
| Gas mixtures with max. 23.5 Vol% O2 | | | | | | C2 | | |
| Oxygen / gas mixtures > 23.5 Vol% O2, oil and grease-free, with O2 certificate (max. 150 °C / 302 °F) | | | | | | P1 | | |
| Hydrogen (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P2 | | |
| Helium (max. 8 bar / 0.8 MPa / 116 psi, including process gas calibration) | | | | | 1) | P3 | | |
| Ammonia | | | | | | H3 | | |
| **Pipe Material** | | | | | | | | |
| Stainless steel AISI 316Ti (1.4571) | | | | | | | S2 | |
| Carbon steel S 235 (1.0037) | | | | | | | C1 | |
| **Mounting Length of the Sensor** | | | | | | | | |
| 120 mm (4.7 in.) | | | | | | | | L1 |
| 263 mm (10.4 in.) | | | | | | | | L2 |
| 425 mm (17 in.) | | | | | | | | L3 |
| 775 mm (31 in.) | | | | | | | | L4 |

Continued on next page...

### Additional ordering information SensyMaster FMT094

| SensyMaster FMT094 Pipe component, weld-on adapter | | XXX | XXX | XX |
|---|---|---|---|---|
| **Sensor Connection Options** | | | | |
| With ball valve (max. 150 °C / 302 °F) | 2) | SCA | | |
| With integrated hot-tap fitting, with weld on adapter for diameter DN 100 ... DN 300 (4 ... 12 in.) | | SCD | | |
| **Sensor Connection Accessories** | | | | |
| DN 25 blind flange to close flowmeter sensor connection, material stainless steel AISI 316Ti (1.4571) | | | SBA | |
| Blind screw connection for Thread DIN 11851, to close flowmeter sensor connection, material stainless steel AISI 304 (1.4301) | | | SBB | |
| **Certificates** | | | | |
| Material monitoring with inspection certificate 3.1 acc. EN 10204 | | | | C2 |
| Declaration of compliance with the order 2.1 acc. EN 10204 | | | | C4 |
| Inspection certificate 3.1 acc. EN 10204 for visual, dimensional and functional test | | | | C6 |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI | | | | CA |
| Inspection certificate 3.1 acc. EN 10204 for positive material identification PMI with material analysis | | | | C5 |

1) Max. 0.8 MPa (8 bar, 116 psi). With DN 25 ... DN 50 (1 ... 2 in.): Please use pipe component FMT092 with flow straightener

2) Correct sensor length: For pipe component DN 50 ... DN 100: h = 263 mm, from DN 125: h = 425 mm.
For weld-on adapter up to 150 mm: h = 263 mm, up to 500 mm: h = 425 mm, > 500 mm: h = 775 mm

**Sales** **Service**

## Trademarks

® Modbus is a registered trademark of the Modbus Organization

® Kalrez and Kalrez Spectrum™ are registered trademarks of DuPont Performance Elastomers.

# Questionnaire

| | |
|---|---|
| **Customer:** | **Date:** |
| **Ms. / Mr.:** | **Department:** |
| **Telephone:** | **Email:** |

**Modell:**

☐ FMT230 ☐ FMT430 ☐ Not determined

☐ FMT250 ☐ FMT450

**Application data:**

Operating pressure min. / norm. / max. [bar abs, psi, other]

_____

Temperature min. / norm. / max. [°C, °F]

_____

Flow rate min. / norm. / max. [kg/h, lbs/h, Nm3/h, other]

_____

Normal conditions (in volume flow)

☐ 0°C, 1013mbar ☐ other

☐ 20°C, 1013mbar _____

**Gas data:**

Gas type (pure gas):

_____

| Gas mixture (name, vol. %)1) | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|---|
| | _____ | _____ | _____ | _____ | _____ |

**Transmitter design:**

Design:

☐ Integral mount design ☐ Single-compartment housing

☐ Remote mount design ☐ Dual- compartment housing

Signal cable length (remote mount design)

☐ 5 m ☐ 25 m

☐ 15 m

Communication:

☐ current output / HART

☐ Modbus RTU

**Piping /pipe component**

Nominal diameter / pressure rating [DIN / ASME]

_____

Inside diameter [mm]

_____

Pipe component design

☐ Wafer type FMT091

☐ Partial measuring section FMT092

☐ Welding adapter FMT094

1) In case of mixed gases the composition must be specified by stating the components: $CH_4$ 90 %, $C_2H_6$ 5 %, $N_2$ 3 %, $C_3H_8$ 1 %, $Co_2$ 1 %

**NOTE**

The order can only be confirmed and a delivery date specified once full technical clearance has been obtained!

## Notes

# Notes

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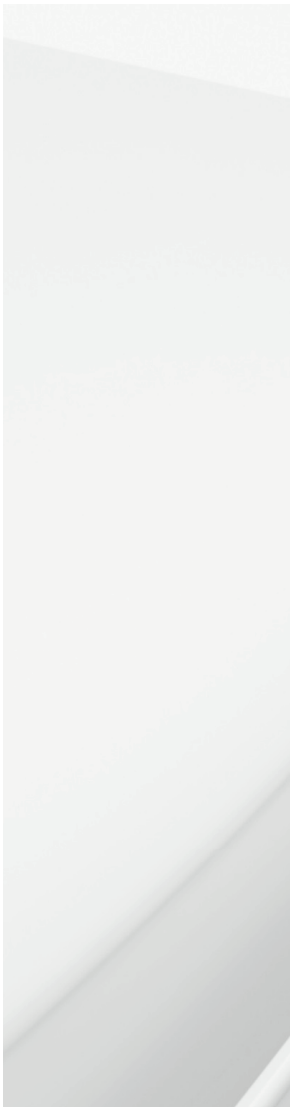
**abb.com/flow**





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