Sensyflow FMT200-D
Thermal Mass Flowmeter

Direct mass and standard volume flow measurement of compressed air and biogas
— independent of operating pressure and temperature

Wide measuring range of 1:100
— Precise measurement even with light flows
— Measured value display starting at 0 Nm³/h

High measuring accuracy

Quick response time < 0.5 s

Negligible pressure loss

Defined, reproducible mounting position
— Easy installation via screwed or flanged pipe components
— Weld-on adapters for larger meter sizes

Compact unit with signal output on sensor head

Application areas
— Measurement of compressed air consumption
— Leakage detection
— Optimization of compressed air networks
— Measurement of the amount of biogas created
— Efficiency factor determination and balancing in biogas plants
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1 General information

1.1 Principle of operation and construction

Sensyflow FMT200-D is a compact, highly dynamic measuring system for mass flow or standard volume flow measurement specifically designed for biogas or compressed air.

The flowmeter sensor uses the hot film anemometer working principle. This method allows for direct measurement of the gas mass flow. As a result, the normally necessary pressure and temperature compensation and, thus, additional measuring points and the compensation computer can be omitted.

The Sensyflow FMT200-D plus the corresponding pipe components are installed in a defined way and locked in place as a component of the measuring pipe. Pipe components made of galvanized steel are available with external thread fittings in imperial sizes. Pipe components with flange connections as well as the weld-on adapter for meters sizes DN 100 ... DN 250 (4 ... 10") are manufactured from CrNi steel.

The flowmeter sensor includes the sensor unit and the evaluation electronics. Sensyflow FMT200-D directly provides a linearized output signal. The device is calibrated and ready for operation. An LCI adapter is used to parameterize the output signal.

A standard power supply unit can be used for powering the device.

Physics of measurement

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 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.

The gas stream flows past two temperature-sensitive resistors $R_H$ and $R_{MG}$ which are part of an electrical bridge circuit. Due to the chosen resistance ratio $R_H < R_{MG}$, $R_H$ is heated by the current $I_H$. $R_{MG}$ adopts the same temperature as the gas. The current $I_H$ is preset by the electronic control circuit to produce a constant temperature difference between the heated resistor $R_H$ and the temperature of the gas.

The electrical power generated with resistor $R_H$ exactly compensates its loss of heat to the gas flow. As this loss of heat is dependent on the number of particles which collide with the surface of resistor $R_H$, $I_H$ represents a measure of the mass flow rate.

Calibration for compressed air and biogas applications

The calibration of the devices is done on a highly precise flow test machine with air as calibration medium. For standard biogas applications, the calibration data are subsequently converted, whereby a medium gas composition is based on 53 Vol% methane, 45 Vol% carbon dioxide and 2 Vol% air.

For applications that clearly deviate from this gas composition devices must be ordered with a special calibration for biogas. In this case, the exact gas composition is to be specified with the order.
2 Specifications

### Measuring ranges

<table>
<thead>
<tr>
<th>Nominal diameter</th>
<th>Maximum measuring ranges for air/nitrogen</th>
<th>Maximum measuring ranges for standard biogas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg/h</td>
<td>Nm³/h</td>
</tr>
<tr>
<td>1&quot;</td>
<td>165</td>
<td>125</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>430</td>
<td>330</td>
</tr>
<tr>
<td>2&quot;</td>
<td>740</td>
<td>570</td>
</tr>
<tr>
<td>3&quot;</td>
<td>1775</td>
<td>1375</td>
</tr>
<tr>
<td>6&quot;</td>
<td>7500</td>
<td>5800</td>
</tr>
</tbody>
</table>

1) Notation also m³/h - qn
2) Notation also l/min - qn

All volume flow rate specifications are referenced to 0 °C / 1013.25 hPa (32 °F/14.696 psi).

### Output

**Analog output signal**

0/4 … 20 mA, switchable

**Load**

< 750 Ω, electrically isolated

### Characteristics

**Measurement deviation**

Air, nitrogen <1.5 % of rate plus ± 0.05 % of end value

Biogas <1.8 % of rate plus ± 0.1 % of end value

under calibration conditions in specified flow range

**Reproducibility**

< ± 0.25 % of rate, t<sub>meas</sub> = 10 s

**Response time**

T<sub>63</sub> = 500 ms

### Influences

**Temperature effect**

< 0.05 % / K of measured value

**Pressure effect**

± 0.2 % / 100 kPa (bar [14.5 psi]) of measured value

**Pressure drop**

< 1 kPa (10 mbar [0.145 psi]) at full scale

decreasing quadratically for smaller flow rates

### Ambient conditions

**Ambient temperature for flowmeter sensor**

-25 ... 70 °C (-13 ... 158 °F)

**Ingress protection**

IP 65, NEMA 4X

**Storage temperature**

-25 ... 85 °C (-13 ... 185 °F)

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**Measured medium conditions**

**Measured medium temperature, operating temperature**

-25 ... 150 °C (-13 ... 302 °F)

**Measured medium pressure, maximum**

Standard 1 MPa (10 bar [145 psi])

### Construction

**Weight in kg (lbs)**

<table>
<thead>
<tr>
<th>Threaded pipe component</th>
<th>Flange pipe component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal diameter</td>
<td>kg</td>
</tr>
<tr>
<td>1&quot;</td>
<td>1.5</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>3.0</td>
</tr>
<tr>
<td>2&quot;</td>
<td>5.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>9.5</td>
</tr>
<tr>
<td>Weld-on adapter incl. lock nut</td>
<td>kg</td>
</tr>
<tr>
<td>0.5</td>
<td>1.1</td>
</tr>
</tbody>
</table>

**Flowmeter sensor**

| kg | (lbs) |
| 1.8 | 4.0 |

**Materials, process connection**

Flowmeter sensor  CrNi steel, e.g. 1.4301

Pipe component with external threads

R 1" ... 3"  Galvanized steel

Pipe component with connection flanges

DN 25 ... DN 80  CrNi steel, e.g. 1.4301

Weld-on adapter  CrNi steel, e.g. 1.4301

Connection flanges to EN1092-1 Form B1, PN10

### Supply power

**Voltage**

24 V AC / DC ± 25 %

**Power consumption**

< 15 W

**Power consumption**

< 600 mA, recommended fuse of at least 2 A, slow-blow

Cable gland M20 x 1.5

### Communication interface

LCI adapter

### Accessories (optional)

– Power supply unit
– Display unit
– Integrator with indicator (current pulse transformer)

### Parameterize

The output signal of the Sensyflow FMT200-D flowmeter can be toggled between 0 … 20 mA and 4 … 20 mA. Additionally, a measuring range window can be expanded in such a way that a smaller span corresponds to a 20 mA current signal. A current < 3.5 mA or > 22 mA can be selected for the failure signal.

An LCI adapter is used to parameterize the device. It is possible to change the output signals or the settings of the measuring ranges and signals by using a standard PC or laptop.
3 Dimensions

3.1 Pipe component

![Dimensions Diagram]

**Fig. 2:** Dimensions in mm (inch)  
1 Middle of pipe component

<table>
<thead>
<tr>
<th>DN</th>
<th>A</th>
<th>L1</th>
<th>Ø D interior</th>
<th>External threads R</th>
<th>Flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 (1&quot;)</td>
<td>550 (21.65&quot;)</td>
<td>410 (16.14&quot;)</td>
<td>27.3 (1.07&quot;)</td>
<td>R1&quot;: 33.7 x 1.2</td>
<td>115 (4.53&quot;)</td>
</tr>
<tr>
<td>40 (1 1/2&quot;)</td>
<td>820 (32.28&quot;)</td>
<td>615 (24.21&quot;)</td>
<td>41.9 (1.65&quot;)</td>
<td>R1 1/2&quot;: 48.3 x 3.2</td>
<td>150 (5.91&quot;)</td>
</tr>
<tr>
<td>50 (2&quot;)</td>
<td>1080 (42.52&quot;)</td>
<td>810 (31.89&quot;)</td>
<td>53.9 (2.12&quot;)</td>
<td>R2&quot;: 60.3 x 3.2</td>
<td>165 (6.50&quot;)</td>
</tr>
<tr>
<td>80 (3&quot;)</td>
<td>1600 (62.99&quot;)</td>
<td>1200 (47.24&quot;)</td>
<td>79.9 (3.15&quot;)</td>
<td>R3&quot;: 88.9 x 4.5</td>
<td>200 (7.87&quot;)</td>
</tr>
</tbody>
</table>

Dimensions in mm (inch)
3.2 Weld-on adapter for Sensyflow FMT200-D

Length of weld-on adapter at delivery: \( L = 117 \text{ mm} \) (4.6").

For outer pipe diameter 100 ... 150 mm (4 ... 6"")
Prior to welding the weld-on adapter must be shortened to the appropriate length so that it has the length \( L \) after welding. This results in a measuring position in the middle of the pipeline.

\[
L = H_1 - \frac{1}{2} \times D_{\text{outer}} \quad \text{with} \quad H_1 = 120 \text{ mm} \ (4.72")
\]

For outer pipe diameter 150 ... 250 mm (6 ... 10"")
Shorten the weld-on adapter in such a way that the fixed length \( L = 45 \text{ mm} \) (1.77") is achieved after welding. As a result, the measuring position is not in the middle of the pipeline. For a correct calibration it is therefore mandatory to specify the exact inside diameter and wall thickness of the pipe in mm when ordering.

**IMPORTANT (NOTE)**
Always mount the weld-on adapter together with the lock nut to the pipeline. Mounting it at a later time is not possible.

Observe thickness of pipeline wall and degree of shrinkage when welding on.

It is essential to maintain a right angle to the pipe axis (max. tolerance: 2").

The adapter centering pin must be exactly 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 inches) free for the purpose of mounting the flowmeter sensor; drill to create if necessary.

For outer pipe diameter 100 ... 150 mm (4 ... 6") The distance \( H_1 \) from the upper edge of the adapter to the the pipe central axis must be within a tolerance of \( \pm 2 \text{ mm} \) (0.08").
4 Electrical connections

Fig. 4

1 Socket for LCI adapter
2 Analog output 0/4 ... 20 mA (electrically isolated)
3 Power supply 24 V AC/DC
4 Terminals
5 Ground
6 Cable entry
5 Recommended steadying lengths according to DIN EN ISO 5167-1

<table>
<thead>
<tr>
<th>Expansion</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>X = 0</td>
<td>X = 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>90° manifold</th>
<th>Two 90° manifolds at the same level</th>
<th>Two 90° manifolds at two levels</th>
<th>Valve / gate</th>
</tr>
</thead>
<tbody>
<tr>
<td>X = 5</td>
<td>X = 10</td>
<td>X = 25</td>
<td>X = 35</td>
</tr>
</tbody>
</table>

To achieve the stated measuring accuracy, the steadying lengths seen above must be provided. For combinations of inlet run disturbances, e.g. valve and reducer, you must always consider the longer inlet run length. In confined spaces at the mounting location the outlet run length can be shortened to 3 x D. The reduction of the minimum inlet run length, however, will impact on the achievable accuracy.

High repeatability of the measuring value is still provided. Under certain circumstances, special calibration can be performed for insufficient steadying lengths. For this purpose and in individual cases consulting is necessary.

For gases with extremely low density (hydrogen, helium) the steadying lengths must be doubled.
## 6 Ordering information

<table>
<thead>
<tr>
<th>Main order number</th>
<th>Add. order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensyflow FMT200-D thermal mass flowmeter for biogas and compressed air</td>
<td>V14223</td>
</tr>
</tbody>
</table>

### Type of calibration
- Standard calibration for air: 1)
- Special calibration for air: 2
- Standard calibration for biogas: 1)
- Special calibration for biogas: 3

### Analog output
- 4 ... 20 mA, failure message < 3.5 mA: 1
- 4 ... 20 mA, failure message > 22 mA: 2
- 0 ... 20 mA: 3

### Pipe component
- Without pipe component: 0
- 1 in. thread: 1
- 1-1/2 in. thread: 2
- 2 in. thread: 3
- 3 in. thread: 4
- DN 25 (1 in.) Flanges, DIN PN 10, nominal pressure 10 bar (1 MPa / 145 psi): A
- DN 40 (1-1/2 in.) Flanges, DIN PN 10, nominal pressure 10 bar (1 MPa / 145 psi): B
- DN 50 (2 in.) Flanges, DIN PN 10, nominal pressure 10 bar (1 MPa / 145 psi): C
- DN 80 (3 in.) Flanges, DIN PN 10, nominal pressure 10 bar (1 MPa / 145 psi): D
- Weld-on adapter, DIN 11851, with lock nut, for pipe diameter 100 ... 200 mm (4 ... 8 in.), stainless steel: N

### Certificates: Calibration
- Factory certificate: 0
- DAKkS certificate, calibration with air (not for process gas calibration): 2) 1

### Certificates and material traceability
- Material certificate 3.1 to EN 10204: CBB
- Test report 2.1 to EN 10204 for order conformity: CF3

### Certificates: GOST
- GOST Russia, metrological: CG1
- GOST Kazakhstan, metrological: CG2

### Adapter
- LCI adapter: GL

### Language of documentation
- German: M1
- English: M5

1) Operating pressure 1 ... 10 bar abs. (0.1 ... 1 MPa abs. / 14.5 ... 145 psi abs.), operating temperature 0 ... 60 °C (32 ... 140 °F)
2) DAKkS- / ILAC-accredited calibration equipment D-K-15081-01-00

### Accessories

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3KXS310130L1001</td>
<td>SMD130 DAKkS calibration for thermal mass flowmeter, certificate of calibration with air, DAKkS / ILAC - accredited calibration equipment D-K-15081-01-00</td>
</tr>
<tr>
<td>7962800</td>
<td>FMT power supply, housing for rail mounting 62.5 mm x 75 mm x 139 mm, input 230 V AC, output 24 V DC / 2.5 A</td>
</tr>
<tr>
<td>3KXF421005R4201</td>
<td>FMT200-D operating instruction, English</td>
</tr>
<tr>
<td>3KXF421005R4203</td>
<td>FMT200-D operating instruction, German</td>
</tr>
</tbody>
</table>
7 Questionnaire

Customer address: __________________________

Company: ________________________________

Zip code and location: ____________________________ Date: ______________________

Cust. no.: ____________________________ Telephone: ______________________

Contact person: ____________________________ E-mail: ______________________

Media data for gaseous, pure media:

<table>
<thead>
<tr>
<th>Description of media</th>
<th>Mixed gas, gas composition in vol.%</th>
<th>1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of gas (no mixtures):</td>
<td>Component 1/name/vol.%:</td>
<td></td>
</tr>
<tr>
<td>Operating pressure (bar abs.):</td>
<td>Component 2/name/vol.%:</td>
<td></td>
</tr>
<tr>
<td>Min./norm./max., approx.:</td>
<td>Component 3/name/vol.%:</td>
<td></td>
</tr>
<tr>
<td>Operating temperature (°C):</td>
<td>Component 4/name/vol.%:</td>
<td></td>
</tr>
<tr>
<td>Min./norm./max., approx.:</td>
<td>Component 5/name/vol.%:</td>
<td></td>
</tr>
</tbody>
</table>

Flowrate 2)

| Flow unit: | Min.: | Norm.: | Max.: | Pipeline/pipe component 3)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nm³/h</td>
<td>kg/h</td>
<td></td>
<td></td>
<td>DN/PN:</td>
</tr>
<tr>
<td>Nm³/min</td>
<td>kg/min</td>
<td></td>
<td></td>
<td>ANSI/lbs</td>
</tr>
<tr>
<td>Nl/min</td>
<td>g/min</td>
<td></td>
<td></td>
<td>Diameter [mm]</td>
</tr>
<tr>
<td>SCFM</td>
<td>t/h</td>
<td></td>
<td></td>
<td>Inside diameter specified in mm</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
<td></td>
<td></td>
<td>Wafer flange form 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Partial meas. section form 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Weld-on adapter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

*Standard condition, e.g., 0°C/1,013 mbar or

<table>
<thead>
<tr>
<th>Required device designs:</th>
<th>Design:</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMT500-IG</td>
<td>Integral mount design</td>
</tr>
<tr>
<td>FMT400-VTS</td>
<td>Remote design with</td>
</tr>
<tr>
<td>FMT400-VTCS</td>
<td>Cable length 5 m</td>
</tr>
<tr>
<td>FMT200-D</td>
<td>Cable length 15 m</td>
</tr>
<tr>
<td></td>
<td>Cable length 25 m</td>
</tr>
</tbody>
</table>

Output signal: 4)

<table>
<thead>
<tr>
<th>Ex protection class:</th>
<th>5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/4...20 mA</td>
<td>None</td>
</tr>
<tr>
<td>4...20 mA/HART</td>
<td>ATEX Zone 1/21</td>
</tr>
<tr>
<td>PROFIBUS DP-V1</td>
<td>ATEX Zone 0/21</td>
</tr>
</tbody>
</table>

Comments:

1) Please specify the composition of mixed gases (e.g., North Sea natural gas: 1) CH₄ 90%, 2) C₂H₆ 5%, 3) N₂ 3%, 4) C₃H₈ 1%, 5) CO₂ 1%).

2) Calibration is performed at the max. possible flow in the nominal size specified.

3) Please observe/determine the minimum inflow and outflow sections.

4) Output signal: 0...10 V as standard

Note: An order can only be confirmed and a delivery date specified once full technical clearance has been obtained.
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