Sensyflow FMT200-ECO2
Thermal Mass Flowmeter

Measurement made easy

Direct mass flow measurement of air
– No additional pressure and temperature compensation required
– Mass flow or standard volume flow measuring values

Wide measuring range of 1:100

High accuracy

Highly dynamic, response time ≤ 90 ms
– Optimized for advanced control systems

Compact design with low weight

No moving parts, no wear, maintenance-free

Arbitrary mounting orientation

Variable process connections
– Flanges, threads, tubes

Variety of output signals
– Current, voltage, frequency, pulse, alarm, parameter setting via RS 232 interface

Approvals for explosion protection (zone 2 and zone 22)
– Manufacturer’s declaration according to ATEX

Applications
– Paint robot control (Air dosing)
– Compressed air systems (Balancing, Leakage detection)
– Burner control
– Dosing technology
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1 General information

1.1 Principle of operation and construction

Sensyflow FMT200-ECO2 is a compact, highly dynamic measuring system for mass flow or standard volume flow measurement of air. The device consists of an easy to install pipe component which accommodates the sensor unit and the evaluation electronics. It directly provides a linearized output signal, and it is calibrated and immediately ready for use.

A standard RS 232 interface allows you to change over between the individual output signals (current, voltage, frequency, pulse and alarm) and to configure the device. Due to its flexible connection concept this measuring instrument can be installed in pipes or tubes of different types and sizes. Various process adapters are available for this purpose.

A standard power supply unit can be used for powering Sensyflow FMT200-ECO2.

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.

![Diagram](image)

Fig. 1: Analog measuring principle

- \( q_m \): Gas mass-flow
- \( R_{MG} \): Gas temperature measuring resistor
- \( R_H \): Heating resistor
- \( I_H \): Actual value of heater

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 \( I_H \) and \( R_{MG} \) 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.
2 Specifications

Measuring principle
Thermal: hot-film anemometer

Input
Measured medium
Air
Measuring ranges1)
0 (1) ... 100 kg / h or 0 (12) ... 1250NI / min2)

Output
Analog output signal
0 ... 5 V
0 ... 10 V
0 / 4 ... 20 mA
Load
< 500 Ω
Error indication
< 3.5 mA or > 22 mA

Digital output
24 V, 20 mA
Frequency output
variable 1 ... 2500 Hz
Counter pulse
Pulse evaluation and pulse duration configurable

Alarm values
Minimum and maximum, adjustable
Polarity adjustable

Characteristics
Measured error
< ± 3 % of measured value
Repeatability
< ± 0.5 % of measured value
Response time
T_{63} = 25 ms; T_{98} = 90 ms

Influences
Temperature effect
< 0.1 % / K of measured value
Pressure effect
< 0.2 % / 100 kPa (/bar) of measured value
Pressure drop
< 10 kPa (100 mbar) at full scale and using the small flange adapter DN 25; decreasing quadratically for smaller flow rates.

Environmental conditions
Ambient temperature for flowmeter sensor
-25 ... 50 °C (-13 ... 122 °F)
Degree of protection
IP 65
Storage temperature
-25 ... 85 °C (-13 ... 185 °F)

Measured medium conditions
Measured medium temperature
-25 ... 50 °C (-13 ... 122 °F)

Measured medium pressure
Standard: 10 x 10^2 kPa (10 bar abs.)
High pressure version: 16 x 10^2 kPa (16 bar abs.)

Construction
Weight
0.51 kg (accessories see ordering information)

Material
Flowmeter sensor: aluminium, Hostadur, tinned Cu, glass
Process connections: aluminium
Fittings: aluminium

Process connection
Small flange adapter ISO KF flange;
Threads G 3/8", G 3/4", G 1/2", G 1";
Legris tube adapter, Transair adapter

Electrical connection
Sub-D connector, serie 712, 8-pin, IP 65

Power supply3)
Voltage
24 V DC ± 10 %
Current consumption
< 15 W
Current consumption
Peak < 1 A; operation < 0.6 A
Slow-blow fuse of at least 2 A recommended

Communication interface
RS 232

Approvals for explosion protection (zone 2 and zone 22)
Gas: ATEX II 3 G Ex n A II T4 X
Dust: ATEX II 3 D T 135 °C IP 65 X

Accessories (optional)
- Inlet and outlet runs
- Pipe fittings
- Connection adapter
- Quick-clamping connectors
- Reducers
- Power supply unit
- Display unit
- Display and supply unit completely installed in an IP 65 housing

1) Approximate values are given for applications with air under atmospheric conditions. The values in brackets indicate the low limit of the measuring range for which the measured value accuracy indicated is specified.
2) It is possible to specify any unit which you can transform into a mass or standard volume flow. (Can also be written as: l / min-q_n).
3) Power supply with safe electrical separation in accordance with EN 61010 and IEC 950, with max. output power of 150 W.
3 Electrical connections

Please use the supplied cable for the electrical connection of the flowmeter sensor. On the measuring unit, a connector is used for the coupling.
Use a 24 V DC power supply with isolation according to EN 61010 and IEC 950 with a maximum output of < 150 W only.

3.1 Cable assignments

<table>
<thead>
<tr>
<th>Color of cores</th>
<th>Connector pin number</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>#1</td>
<td>Analog output +</td>
</tr>
<tr>
<td>Brown</td>
<td>#2</td>
<td>RS 232 / TxD</td>
</tr>
<tr>
<td>Green</td>
<td>#3</td>
<td>Pulse / frequency output</td>
</tr>
<tr>
<td>Yellow</td>
<td>#4</td>
<td>Power supply 24 V DC</td>
</tr>
<tr>
<td>Grey</td>
<td>#5</td>
<td>Power supply 0 V</td>
</tr>
<tr>
<td>Pink</td>
<td>#6</td>
<td>RS 232 / RxD</td>
</tr>
<tr>
<td>Blue</td>
<td>#7</td>
<td>GND / analog</td>
</tr>
<tr>
<td>Red</td>
<td>#8</td>
<td>GND / frequency + pulse + RS 232</td>
</tr>
<tr>
<td>Shielding</td>
<td>-</td>
<td>Functional earthing</td>
</tr>
</tbody>
</table>

3.2 Circueting the signal outputs

3.2.1 Analog output

Upon selection, the analog output of the current output supplies an active signal of 0 (4) ... 20 mA, i.e. the Sensyflow FMT200-ECO2 device supplies the current independently.

For this reason, do not use a 2-wire power supply unit or an active input of a PLC, but rather a passive signal receiver.

3.2.2 Digital output

![Fig. 2: Digital output](image)
The digital output offers a 24 V = HIGH signal or a 0 V = LOW Signal.
The digital output can be used as active or passive output.

Active digital output wiring

The output current in the HIGH-mode must be limited to 1 mA when the active digital output is used (passive signal receiver). This is to ensure an output voltage $U_a > 15$ V.

Passive digital output wiring

Using the passive output (active signal receiver), the output current in the LOW-mode must be limited to -20 mA. This is to ensure an output voltage $U_a < 2.5$ V.

3.2.3 Compatibility to Sensyflow eco1

Sensyflow eco1 und Sensyflow FMT200-ECO2 are compatible. Using the appropriate electrical adapter, FMT200-ECO2 can be connected to existing plants.

As "interface" and "digital output" functionality is not available with Sensyflow eco1, there is no wiring within the adapter for these functions.
4 Parameterization

The Sensyflow FMT200-ECO2 can simultaneously serve one analog output (current 0 / 4 ... 20 mA or voltage 0 ... 5 / 10 V), one digital output (frequency, pulse, alarm) and a serial RS 232 interface. Additionally, the measuring system can be configured via the serial interface. With this, it is possible to change the output signals or the settings of the measuring ranges and signals by using a standard PC or laptop.

4.1 Overview parameterization program Sensyflow FMT200-ECO2

The configuration program is included in the standard scope of delivery. A service and configuration box is available as an accessory part. It will help to connect the different signals of Sensyflow the FMT200-ECO2 quickly and easily.
4.2  Service and parameterization box

1  Power supply
2  Protection against polarity reversal
3  Analog output
4  Digital output (frequency / pulse)
5  Connector for Sensyflow FMT200-ECO2
6  Connector for PC, Laptop

Fig. 3

5  Dimensions
5.1  Flowmeter sensor FMT200-ECO2

Fig. 4: Flowmeter sensor FMT200-ECO2 with mounted small flange adapter
5.2 Accessories

Small flange connections
KF = ISO KF flange (ISO small flange)

G00952

Process adapter flange KF DN 25, inlet run and outlet run, 2 clamp rings and 2 sealing rings

Inlet run length 10 x D, both sides with KF-DN 25 connections

Outlet run length 5 x D, both sides with KF DN 25 connections

Hose adapter for KF DN 25, incl. 1 flange, 1 clamping ring and 1 sealing ring

Fig. 5: Dimensions in mm (inch)

Straight undisturbed pipes must be provided as steadying lengths. On the inlet side they should have a length of approx. 10 x D. When using the G 1/2" and G 3/8" adapters no additional steadying lengths are required, as flow-conditioning components are implemented in the adapters on the inlet side.

Note that flow conditioner causes a considerable pressure drop. Components affecting the flow like valves or shut-off devices should be installed on the outlet side, i.e. downstream of the measuring point.
Thermal Mass Flowmeter Sensyflow FMT200-ECO2
for air, compact design

Threads and adapter

Thread G 3/8", connection for Legris-tube adapters, pair) for inlet run and outlet run; inlet run adapter includes a high-tech flow conditioner

Legris-tube adapter (pair)

Thread G 3/4", also connection for Transair system 25 mm (pair)

Transair adapter 25 mm (pair)

Thread G 1/2" (pair) for inlet run and outlet run. Inlet run adapter includes a high-tech flow conditioner

Thread G 1"

Fig. 6: Dimensions in mm (inch)
6 Ordering information

<table>
<thead>
<tr>
<th>Variantenstelle</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensyflow FMT200-ECO2 Thermal Mass Flowmeter, for air, compact</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calibration Type / Operating Pressure**
- Standard calibration 0 ... 100 kg/h (0 ... 220 lbs/h) / Operating pressure 1 ... 10 bar abs. (0.1 ... 1 MPa abs. / 14.5 ... 145 psi abs.)
- Standard calibration 0 ... 100 kg/h (0 ... 220 lbs/h) / High pressure version, operating pressure 10 ... 16 bar abs. (1 ... 1.6 MPa abs. / 145 ... 232 psi abs.)
- Customer-specific calibration, operating pressure 1 ... 10 bar abs. (0.1 ... 1 MPa abs. / 14.5 ... 145 psi abs.)
- Customer-specific calibration, high pressure version, operating pressure 10 ... 16 bar abs. (1 ... 1.6 MPa abs. / 145 ... 232 psi abs.)

**Analog Output**
- 0 ... 5 V
- 0 ... 10 V
- 0 ... 20 mA, alarm > 22 mA
- 4 ... 20 mA, alarm < 3.5 mA
- 4 ... 20 mA, alarm > 22 mA

**Digital Output**
- Counter pulse output (high level)
- Counter pulse output (low level)
- Frequency output, adjustable up to 2500 Hz
- Alarm output (alarm = high)
- Alarm output (alarm = low)

**Process Connection**
- 1 pair of process adapters KF DN 25 (1 in.), incl. 2 clamping rings and 2 sealing rings
- 1 pair of threads G 3/8 in., also connection for Legris-section adapters, outlet run adapter includes a high-tech flow straightener
- 1 pair of threads G 1/2 in., outlet run adapter includes a high-tech flow straightener
- 1 pair of threads G 3/4 in., also connection for Transair system 25 mm
- 1 pair of threads G 1 in.
- Installed process adapter, KF DN25 (pair), incl. 2 clamping rings- and 2 sealing rings, hexagon socket head cap screw

**Version**
- Standard
- ATEX version for Zone 2 / 22

**Certificates: Calibration**
- Factory certificate
- DAkkS certificate of calibration with air (not for process gas calibration)

**Documentation Language**
- German
- Spanish
- French
- English

1) Customer specific configuration: measuring range, unit of measure, normalization conditions, upper measuring range value acc. code nos. 110 and 114
2) State pulse evaluation with code no. 310. The digital output can have states High = 24 V or Low = 0 V. Please specify the required polarity
3) Standard 10 ... 1000 Hz
4) State alarm values with code nos. 312 ... 313
5) DAkkS / ILAC - accredited calibration equipment D-K-15081-01-00
**Thermal Mass Flowmeter Sensyflow FMT200-ECO2**  
for air, compact design

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Order number</th>
</tr>
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<tbody>
<tr>
<td>SMD130 DAkkS calibration for thermal mass flowmeter, certificate of calibration with air, DAkkS / ILAC -</td>
<td>3KXS310130L1001 7962800</td>
</tr>
<tr>
<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>
<td></td>
</tr>
</tbody>
</table>

**FMT200-ECO2 small flange connections**
- FMT200-ECO2 process connections, ISO KF flange DN 25, for adapting inlet run and outlet run, incl. 2 clamp rings and 2 sealing rings  
  Order number: 7962850 7962801 7962802 7962809 7962803
- FMT200-ECO2 process connections, inlet run section 10 x D, both sides with ISO KF flange DN 25 connection  
- FMT200-ECO2 process connections, outlet run section 5 x D, both sides with ISO KF flange DN 25 connection  
- FMT200-ECO2 process connections, clamping ring and gasket for ISO KF flange DN 25 connection  
- FMT200-ECO2 process connections, tube adapter for KF DN 25, incl. small flange, 1 clamping ring and 1 sealing ring

**FMT200-ECO2 screwed connections and adapters**
- FMT200-ECO2 screwed connection G 3/8 in., pair for inlet run and outlet run, simultaneous connection for Legris tube adapter; inlet run adapter with high-tech flow straightener  
  Order number: 7962851 7962855 7962856 7962857 7962858 7962853 7962852 7962854
- FMT200-ECO2 Legris tube adapter, 10 mm, pair for inlet run and outlet run  
- FMT200-ECO2 Legris tube adapter, 12 mm, pair for inlet run and outlet run  
- FMT200-ECO2 Legris tube adapter, 14 mm, pair for inlet run and outlet run  
- FMT200-ECO2 screwed connection G 3/4 in., pair for inlet run and outlet run, simultaneous connection for Transair system 25 mm; inlet run adapter with high-tech flow straightener  
- FMT200-ECO2 Transair adapter, 25 mm, pair for inlet run and outlet run  
- FMT200-ECO2 screwed connection G 1/2 in., pair for inlet run and outlet run  
- FMT200-ECO2 screwed connection G 1 in., pair for inlet run and outlet run

**FMT200-ECO2 installation accessories**
- FMT200-ECO2 additional connection cable, 5 m with compact connector  
  Order number: 7962817 7962818 7962819 7962816
- FMT200-ECO2 service and configuration box  
- FMT200-ECO2 intermediate adapter, for connection cable eco 1 on FMT200-ECO2, length approx. 20 cm  
- FMT200-ECO2 mounting adapter for DIN top-hat rail

**FMT200-ECO2 full set**
- FMT200-ECO2 full set, measuring kit FMT200-ECO2 with standard parameterization  
  Order number: 7962814

**Instructions for use**
- FMT200-ECO2 operating instruction, English  
  Order number: 3KXF421004R4201
- FMT200-ECO2 operating instruction, German  
  Order number: 3KXF421004R4203
- FMT200-ECO2 operating instruction, French  
  Order number: 3KXF421004R4207
- FMT200-ECO2 operating instruction, Spanish  
  Order number: 3KXF421004R4206
## 7 Questionnaire

**Customer address:**

Company: ____________________________  Date: ____________________________

Zip code and location: ____________________________  Telephone: ____________________________

Cust. no.: ____________________________  E-mail: ____________________________

Contact person: ____________________________  ____________________________

### Media data for gaseous, pure media:

**Description of media**  Mixed gas, gas composition in vol.%

- **Type of gas (no mixtures):** ____________________________  Component 1/name/vol.%: ____________________________
- **Operating pressure (bar abs.):** ____________________________  Component 2/name/vol.%: ____________________________
- **Min./norm./max., approx.:** ____________________________  Component 3/name/vol.%: ____________________________
- **Operating temperature (°C):** ____________________________  Component 4/name/vol.%: ____________________________
- **Min./norm./max., approx.:** ____________________________  Component 5/name/vol.%: ____________________________

### Flowrate

<table>
<thead>
<tr>
<th>Flow unit</th>
<th>Min.:</th>
<th>Norm.:</th>
<th>Max.:</th>
<th>Pipeline/pipe component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nm³/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nm³/min</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Nl/min</td>
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<tr>
<td>SCFM</td>
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<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Flow rate:** Min.: _____  Norm.: _____  Max.: _____  Pipeline/pipe component:

**Flow unit:** Standard volume  Mass flow units

- **DN/PN:** ______
- **ANSI/lbs:** ______
- **Diameter [mm]:** ______
- **Inside diameter specified in mm:** ______
- **Weld flange form:** ______
- **Partial meas. section form:** ______
- **Other:** ______

### Required device designs:

<table>
<thead>
<tr>
<th>Device design</th>
<th>FMT500-IG</th>
<th>FMT400-IG</th>
<th>FMT400-VTS</th>
<th>FMT700-P</th>
<th>FMT200-D</th>
<th>FMT200-ECO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Integral mount design</td>
<td>Remote design with cable length 5 m</td>
<td>Cable length 15 m</td>
<td>Cable length 25 m</td>
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<td></td>
</tr>
</tbody>
</table>

### Output signal

<table>
<thead>
<tr>
<th>Signal</th>
<th>Ex protection class</th>
<th>Zone</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/4...20 mA</td>
<td>None</td>
<td>Zone 2/22</td>
<td>24 V</td>
</tr>
<tr>
<td>4...20 mA/HART</td>
<td>ATEX Zone 1/21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROFIBUS DP-V1</td>
<td>ATEX Zone 0/21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FM/CSA</td>
<td></td>
<td>230 V</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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