Electromagnetic flowmeter in sandwich version

- Exceptional long-term stability and accuracy
- For highly aggressive and abrasive fluids
- Fully vacuum-resistant with high-tech ceramics liner

The documentation is only complete when used in combination with the relevant documentation for the signal converter.
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1.1 Solution with high-tech ceramics

The OPTIFLUX 5000 is one of the most accurate flowmeters available in the market today. This is the result of a special tube design with conical parts, optimizing the flow profile. Leading metrological institutes use the OPTIFLUX 5000 as their master meter in combination with the high-end signal converter IFC 300.
### Highlights
- Excellent long-term stability and accuracy
- Unique flow tube
- Fused in-place Cermet or platinum electrodes
- Transfer standard of international metrological authorities
- For most aggressive and abrasive fluids
- Fully vacuum-resistant
- High-tech ceramics liner
- Insensitive against temperature shocks

### Industries
- Chemical
- Paper & Pulp
- (Waste) water
- Minerals & Mining
- Food & beverage
- Machinery

### Applications
- Master transfer meter
- Precise volumetric dosing of additives
- Chemical injection
- For acids, alkaline, paste, slurries and many other aggressive media even with high solid contents
1.2 Options and variants

The OPTIFLUX 5000 is available in a diameter range of DN2.5 up to DN100 and is configurable with the IFC 100 and the IFC 300 signal converter. It is also optionally suitable in hazardous areas.

Grounding rings are available in high grade alloy’s. The installation of the OPTIFLUX 5000 SW can be further eased by choosing for the virtual reference. Grounding rings can then be omitted. This can only combined with the IFC 300 signal converter.
1.3 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage \( U \) is generated:

\[
U = v \cdot k \cdot B \cdot D
\]

in which:

- \( v \) = mean flow velocity
- \( k \) = factor correcting for geometry
- \( B \) = magnetic field strength
- \( D \) = inner diameter of flow meter

The signal voltage \( U \) is picked off by electrodes and is proportional to the mean flow velocity \( v \) and thus the flow rate \( q \). A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalising, recording and output processing.

![Diagram of field coils, electrodes, magnetic field, and induced voltage](image-url)
2.1 Technical data

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

### Measuring system

#### Measuring principle

- Faraday’s law

#### Application range

- Electrically conductive fluids

#### Measured value

<table>
<thead>
<tr>
<th>Primary measured value</th>
<th>Secondary measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow velocity</td>
<td>Volume flow, mass flow, electrical conductivity, coil temperature</td>
</tr>
</tbody>
</table>

### Design

#### Features

- Sandwich version with optimized flow tube

#### Modular construction

- The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. More information about the signal converter can be found in the documentation of the signal converter.

#### Compact version

- With IFC 100 converter: OPTIFLUX 5100 C
- With IFC 300 converter: OPTIFLUX 5300 C

#### Remote version

- In wall (W) mount version with IFC 100 converter: OPTIFLUX 5100 W
- In field (F), wall (W) or rack (R) mount version with IFC 300 converter: OPTIFLUX 5300 F, W or R

#### Nominal diameter

- DN2.5...100 / 1/10...4"

#### Measurement range

- -12...+12 m/s / -40...+40 ft/s

### Measuring accuracy

#### Reference conditions

- Medium: water
- Temperature: 20°C / 68°F
- Inlet section: 10 DN
- Outlet section: 5 DN
- Flow velocity: > 1 m/s / > 3 ft/s
- Operating pressure: 1 bar / 14.5 psig
- Valve closing time variation: < 1 ms
- Wet calibrated on EN 17025 accredited calibration rig by direct volume comparison.

#### Maximum measuring error

- Related to volume flow (MV = Measured Value).
- These values are related to the pulse / frequency output.
- The additional typical measuring deviation for the current output is ±10 μA.
- For detailed information refer to Measuring accuracy on page 12.

#### Repeatability

- ±0.1% of MV, minimum 1 mm/s

#### Long term stability

- ±0.1% of MV

#### Special calibration

- On request
**Operating conditions**

**Temperature**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Compact version: -40...+140°C / -40...+284°F</th>
<th>Remote version: -40...+180°C / -40...+356°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process temperature</td>
<td></td>
<td>For Ex versions different temperature ranges are applicable. Please see the relevant Ex documentation for details.</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-40...+65°C / -40...+149°F</td>
<td>For Ex versions different temperature ranges are applicable. Please see the relevant Ex documentation for details.</td>
</tr>
<tr>
<td>Maximum temperature change (shock)</td>
<td>120°C / 248°F</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-50...+70°C / -58...+158°F</td>
<td></td>
</tr>
</tbody>
</table>

**Pressure**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard: DN100: PN 16</th>
<th>Standard: DN2.5...80: PN 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient pressure</td>
<td>EN 1092-1</td>
<td>ASME B16.5</td>
</tr>
<tr>
<td>Vacuum load</td>
<td>0 mbar / 0 psi</td>
<td>1/10...4&quot;: 150 lb</td>
</tr>
<tr>
<td>Pressure ranges for secondary containment</td>
<td>Pressure resistant up to 40 bar / 580 psi</td>
<td>1/10...4&quot;: 300 lb</td>
</tr>
<tr>
<td></td>
<td>Burst pressure up to approx. 160 bar / 2320 psi</td>
<td></td>
</tr>
</tbody>
</table>

**Chemical properties**

<table>
<thead>
<tr>
<th>Physical condition</th>
<th>Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical conductivity</td>
<td>Non water: DN2.5...100: ≥ 1 μS/cm</td>
</tr>
<tr>
<td></td>
<td>DN4...15: ≥ 5 μS/cm</td>
</tr>
<tr>
<td></td>
<td>DN2.5: ≥ 10 μS/cm</td>
</tr>
<tr>
<td></td>
<td>Demineralised cold water: DN2.5...100: ≥ 20 μS/cm</td>
</tr>
<tr>
<td>Permissible gas content (volume)</td>
<td>≤ 5%</td>
</tr>
<tr>
<td>Permissible solid content (volume)</td>
<td>IFC 100: ≤ 10%</td>
</tr>
<tr>
<td>Recommended flow velocity</td>
<td>-12...+12 m/s / -40...+40 ft/s</td>
</tr>
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</table>
Installation conditions

<table>
<thead>
<tr>
<th>Installation</th>
<th>Take care that flow sensor always fully filled. For detailed information refer to Installation on page 16.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow direction</td>
<td>Forward and reverse. Arrow on flow sensor indicates positive flow direction.</td>
</tr>
<tr>
<td>Inlet run</td>
<td>≥ 5 DN (without disturbing flow, after a single 90° bend)  \n≥ 10 DN (after a double bend 2x 90°)  \n≥ 10 DN (behind a control valve)</td>
</tr>
<tr>
<td>Outlet run</td>
<td>≥ 2 DN</td>
</tr>
<tr>
<td>Dimensions and weights</td>
<td>For detailed information refer to Dimensions and weights on page 13.</td>
</tr>
</tbody>
</table>

Materials

| Sensor housing | DN2.5...15: stainless steel 1.4408  \nDN25...100: stainless steel 1.4306 |
| Measuring tube | Ceramic |
| Connection box (remote versions only) |  \n**Standard:** Polyurethane coated die-cast aluminium  \n**Option:** Stainless steel |
| Grounding rings |  \n**Standard:** Stainless steel  \n**Option:** Hastelloy®, titanium, tantalum  \nOther materials on request.  \nGrounding rings can be omitted with virtual reference option for the IFC 300 converter. |
| Stud bolts and nuts |  \n**Standard:** Steel  \n**Option:** Stainless steel, rubber centering sleeves |
| Gaskets | FPM / FKM, Gylon, EPDM, Kalrez, PTFE-PF 29, Chemtherm  \nOther materials on request. |
| Measuring electrodes | DN2.5...15: Cermet  \nDN25...100: Platinum |
### Process connections

<table>
<thead>
<tr>
<th>Standard:</th>
<th>Option:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 1092-1</td>
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<tr>
<td>DN100: PN 16</td>
<td>DN100: PN 25</td>
</tr>
<tr>
<td>DN2.5...80: PN 40</td>
<td></td>
</tr>
<tr>
<td>ASME</td>
<td></td>
</tr>
<tr>
<td>1/10...4&quot;: 150 lb</td>
<td>1/10...4&quot;: 300 lb</td>
</tr>
<tr>
<td>JIS</td>
<td></td>
</tr>
<tr>
<td>DN2.5...100: 10...20 K</td>
<td></td>
</tr>
</tbody>
</table>

### Electrical connections

<table>
<thead>
<tr>
<th>Signal cable</th>
<th>Only for remote systems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Standard cable, double shielded. Max. length: 600 m / 1950 ft (dep. on electrical conductivity and measuring sensor). See documentation of the converter for more information.</td>
</tr>
<tr>
<td>Type B</td>
<td>Optional cable, triple shielded. Max. length: 600 m / 1950 ft (dep. on electrical conductivity and measuring sensor). See documentation of the converter for more information.</td>
</tr>
</tbody>
</table>
## Approvals and certifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard/Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CE</strong></td>
<td>This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.</td>
</tr>
<tr>
<td></td>
<td>Harmonized standard: EN 61326-1: 2006</td>
</tr>
<tr>
<td></td>
<td>Harmonized standard: EN 61010: 2001</td>
</tr>
<tr>
<td></td>
<td>Category I, II or SEP</td>
</tr>
<tr>
<td></td>
<td>Fluid group 1</td>
</tr>
<tr>
<td></td>
<td>Production module H</td>
</tr>
<tr>
<td><strong>Other approvals and standards</strong></td>
<td></td>
</tr>
<tr>
<td>Non-ex</td>
<td>Standard</td>
</tr>
<tr>
<td>Hazardous areas</td>
<td></td>
</tr>
<tr>
<td>ATEX</td>
<td>KEMA 04 ATEX 2126 X</td>
</tr>
<tr>
<td></td>
<td>ATEX II 2 GD EEx me ia IIC</td>
</tr>
<tr>
<td></td>
<td>ATEX II 2 GD EEx de ia IIC</td>
</tr>
<tr>
<td></td>
<td>T6...T3</td>
</tr>
<tr>
<td></td>
<td>For more details, see Ex documentation of sensor and converter.</td>
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<tr>
<td>FM</td>
<td>Class I, Div 2, groups A, B, C and D</td>
</tr>
<tr>
<td></td>
<td>Class II, Div 2, groups F and G</td>
</tr>
<tr>
<td></td>
<td>Class III, Div 2, groups F and G</td>
</tr>
<tr>
<td>CSA</td>
<td>Class I, Div 2, groups A, B, C and D</td>
</tr>
<tr>
<td></td>
<td>Class II, Div 2, groups F and G</td>
</tr>
<tr>
<td>IEC-Ex</td>
<td>pending</td>
</tr>
<tr>
<td>NEPSI</td>
<td>GYJ85240</td>
</tr>
<tr>
<td></td>
<td>Ex ia IIC T6...T3</td>
</tr>
<tr>
<td></td>
<td>Ex de ia IIC T6...T3</td>
</tr>
<tr>
<td>Custody transfer</td>
<td>Standard: Without verification</td>
</tr>
<tr>
<td></td>
<td>Option: MI-001 type examination for DN25...100</td>
</tr>
<tr>
<td></td>
<td>Only in combination with IFC 300 converter.</td>
</tr>
<tr>
<td>Protection category acc. to IEC 529 / EN 60529</td>
<td>Standard: IP 66/67 (NEMA 4/4X/6)</td>
</tr>
<tr>
<td></td>
<td>Option: IP 68 (NEMA 6P)</td>
</tr>
<tr>
<td></td>
<td>IP 68 is only available for separate design and with a stainless steel connection box.</td>
</tr>
<tr>
<td>Hygiene</td>
<td>Ceramic measuring tube is FDA approved.</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>IEC 68-2-6</td>
</tr>
</tbody>
</table>

### Electromagnetic compatibility
- Harmonized standard: EN 61326-1: 2006

### Low Voltage Directive
- Directive: 2006/95/EC
- Harmonized standard: EN 61010: 2001

### Pressure Equipment Directive
- Directive: 97/23/EC
- Category I, II or SEP
- Fluid group 1
- Production module H

### Other approvals and standards
- Non-ex: Standard

### Hazardous areas
- ATEX: KEMA 04 ATEX 2126 X
- ATEX II 2 GD EEx me ia IIC
- ATEX II 2 GD EEx de ia IIC
- T6...T3
- For more details, see Ex documentation of sensor and converter.

### Custody transfer
- Standard: Without verification
- Option: MI-001 type examination for DN25...100
- Only in combination with IFC 300 converter.

### Protection category acc. to IEC 529 / EN 60529
- Standard: IP 66/67 (NEMA 4/4X/6)
- Option: IP 68 (NEMA 6P)
- IP 68 is only available for separate design and with a stainless steel connection box.

### Hygiene
- Ceramic measuring tube is FDA approved.

### Vibration resistance
- IEC 68-2-6
2 TECHNICAL DATA

2.2 Measuring accuracy

Each flowmeter is standard wet calibrated under reference conditions by direct volume comparison before leaving the factory.

Reference conditions

- Medium: water
- Temperature: 20°C / 68°F
- Pressure: 1 bar / 14.5 psi

![Graph]

Figure 2-1:

X (m/s): flow velocity
Y (%): deviation from the actual measured value (mv)

Accuracy

| DN2.5...6 / 1/10...1/4” | 0.3% of mv + 2 mm/s | Curve 3 |
| DN10...100 / 3/8...4” | 0.15% of mv + 1 mm/s | Curve 1 |

In combination with the IFC 300

In combination with the IFC 100

| DN2.5...6 / 1/10...1/4” | 0.4% of mv + 1 mm/s | As Curve 3 + 0.1% |
| DN10...100 / 3/8...4” | 0.3% of mv + 1 mm/s | Curve 2 |
2.3 Dimensions and weights

| Remote version | a = 77 mm / 3.1”  
b = 139 mm / 5.5”  
c = 106 mm / 4.2”  
Total height = H + a |
|----------------|--------------------------------------------------------------------------------|
| Compact version with IFC 300 | a = 155 mm / 6.1”  
b = 230 mm / 9.1”  
c = 260 mm / 10.2”  
Total height = H + a |
| Compact version with IFC 100 (0°) | a = 82 mm / 3.2”  
b = 161 mm / 6.3”  
c = 257 mm / 10.1”  
Total height = H + a |
| Compact version with IFC 100 (45°) | a = 186 mm / 7.3”  
b = 161 mm / 6.3”  
c = 184 mm / 2.7”  
Total height = H + a |

1. The value may vary depending on the used cable glands.
Figure 2-2: Construction details DN2.5...15

1. **O-ring**
2. **Grounding ring**

Figure 2-3: Construction details DN25...100

1. **Situation without grounding rings**
2. **Gasket**

- All data given in the following tables are based on standard versions of the sensor only.
- Especially for smaller nominal sizes of the sensor, the converter can be bigger than the sensor.
- Note that for other pressure ratings than mentioned, the dimensions may be different.
- For full information on converter dimensions see relevant documentation.
### TECHNICAL DATA

#### OPTIFLUX 5000

<table>
<thead>
<tr>
<th>Nominal size</th>
<th>Dimensions [mm]</th>
<th>Approx. weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>H: 123</td>
<td>W: 44</td>
</tr>
<tr>
<td>4</td>
<td>H: 123</td>
<td>W: 44</td>
</tr>
<tr>
<td>6</td>
<td>H: 123</td>
<td>W: 44</td>
</tr>
<tr>
<td>10</td>
<td>H: 123</td>
<td>W: 44</td>
</tr>
<tr>
<td>15</td>
<td>H: 123</td>
<td>W: 44</td>
</tr>
<tr>
<td>25</td>
<td>H: 116</td>
<td>W: 68</td>
</tr>
<tr>
<td>40</td>
<td>H: 131</td>
<td>W: 83</td>
</tr>
<tr>
<td>50</td>
<td>H: 149</td>
<td>W: 101</td>
</tr>
<tr>
<td>80</td>
<td>H: 181</td>
<td>W: 123</td>
</tr>
<tr>
<td>100</td>
<td>H: 206</td>
<td>W: 158</td>
</tr>
</tbody>
</table>

1. Total fitting length of flowmeter with integrated rings: dimension L + 2 x gasket thickness.
2. Total fitting length of flowmeter without rings: dimension L only.

#### Nominal size | Dimensions [inches] | Approx. weight [lb]
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1/10&quot;</td>
<td>H: 4.84</td>
<td>W: 1.73</td>
</tr>
<tr>
<td>1/8&quot;</td>
<td>H: 4.84</td>
<td>W: 1.73</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>H: 4.84</td>
<td>W: 1.73</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>H: 4.84</td>
<td>W: 1.73</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>H: 4.84</td>
<td>W: 1.73</td>
</tr>
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<td>1&quot;</td>
<td>H: 5.75</td>
<td>W: 2.68</td>
</tr>
<tr>
<td>1 1/4&quot;</td>
<td>H: 5.16</td>
<td>W: 3.27</td>
</tr>
<tr>
<td>2&quot;</td>
<td>H: 5.87</td>
<td>W: 3.98</td>
</tr>
<tr>
<td>3&quot;</td>
<td>H: 7.13</td>
<td>W: 5.24</td>
</tr>
<tr>
<td>4&quot;</td>
<td>H: 8.11</td>
<td>W: 6.22</td>
</tr>
</tbody>
</table>

1. Total fitting length of flowmeter with integrated rings: dimension L + 2 x gasket thickness.
2. Total fitting length of flowmeter without rings: dimension L only.

- Pressures at 20°C / 68°F.
- For higher temperatures, the pressure and temperature ratings are as per ASME B16.5.
### 3.1 Notes on installation

Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

Check the packing list to check if you received completely all that you ordered.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

### 3.2 Intended use

The OPTIFLUX 5000 SW flowmeter measures the volumetric flow rate of electrically conductive liquids, acids, alkaline solutions, pastes and slurries, also with very high solid contents.

### 3.3 Installation conditions

#### 3.3.1 Inlet and outlet

![Recommended inlet and outlet](image)

Figure 3-1: Recommended inlet and outlet

1. $\geq 5 \text{ DN}$
2. $\geq 2 \text{ DN}$

#### 3.3.2 Mounting position

![Mounting position](image)

Figure 3-2: Mounting position
3.3.3 Flange deviation

Max. permissible deviation of pipe flange faces:

$L_{\text{max}} - L_{\text{min}} \leq 0.5 \text{ mm} / 0.02^\circ$

![Figure 3-3: Flange deviation](image)

- $L_{\text{max}}$
- $L_{\text{min}}$

3.3.4 T-section

![Figure 3-4: Distance after T-sections](image)

- $\geq 10 \text{ DN}$

3.3.5 Vibration

![Figure 3-5: Avoid vibrations](image)
3 INSTALLATION

3.3.6 Magnetic field

![Avoid magnetic fields](image1)

3.3.7 Bends

![Installation in bending pipes](image2)

![Installation in bending pipes](image3)
3.3.8 Open discharge

![Diagram of open discharge]

Figure 3-9: Installation before an open discharge

3.3.9 Control valve

![Diagram of control valve]

Figure 3-10: Installation before control valve

3.3.10 Air venting

![Diagram of air venting]

Figure 3-11: Air venting

1. $\geq 5$ m
2. Air ventilation point
3 INSTALLATION

3.3.11 Pump

Figure 3-12: Installation after pump
4.1 Safety instructions

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

Observe the national regulations for electrical installations!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Grounding

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

Figure 4-1: Grounding

1. Metal pipelines, not internally coated. Grounding without grounding rings!
2. Metal pipelines with internal coating and non-conductive pipelines. Grounding with grounding rings!

Figure 4-2: Grounding ring number 1

Grounding ring number 1 (Optional for DN25...100):
- 3 mm / 0.1” thick (tantalum: 0.5 mm / 0.1”)

4.3 Virtual reference for IFC 300 (C, W and F version)

The virtual reference option on the IFC 300 flow converter provides complete isolation of the measurement circuit.
The benefits of virtual reference are that grounding rings or grounding electrodes can be omitted, safety increases by reducing the number of potential leakage points and the installation of the flowmeters is much easier.

Possible if:
- ≥ DN10
- Electrical conductivity ≥ 200 µS/cm
- Electrode cable max. 50 m / 164 ft, type D5
KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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Tel: +49 (0)203 301 0
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info@krohne.de

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