Electromagnetic flow sensor for partially filled pipes

The documentation is only complete when used in combination with the relevant documentation for the converter.
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**DANGER!**
This information refers to the immediate danger when working with electricity.

**DANGER!**
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator’s plant.

**WARNING!**
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator’s plant.

**CAUTION!**
Disregarding these instructions can result in damage to the device or to parts of the operator’s plant.

**INFORMATION!**
These instructions contain important information for the handling of the device.

**HANDLING**
- This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.
- **RESULT**
  This symbol refers to all important consequences of the previous actions.

Safety instructions for the operator

**CAUTION!**
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

**LEGAL NOTICE!**
The responsibility as to the suitability and intended use of this device rests solely with the user. The supplier assumes no responsibility in the event of improper use by the customer. Improper installation and operation may lead to loss of warranty. In addition, the “Terms and Conditions of Sale” apply. They appear on the back of the invoice and form the basis of the purchase contract.

**INFORMATION!**
- Further information can be found on the supplied CD-ROM in the manual, on the data sheet, in special manuals, certificates and on the manufacturer’s website.
- If you need to return the device to the manufacturer or supplier, please fill out the form contained on the CD-ROM and send it with the device. Unfortunately, the manufacturer cannot repair or inspect the device without the completed form.
2.1 Scope of delivery

Figure 2-1: Scope of delivery

1. Ordered flowmeter
2. Product documentation
3. Factory calibration report
4. CD-ROM with product documentation
5. Grounding rings (optionally)
6. Cable

2.2 Transport

Figure 2-2: Transport
2.3 Installation conditions

2.3.1 Inlet and outlet

![Recommended inlet and outlet sections, top view](image1)

---

≥ 5 DN
≥ 3 DN

2.3.2 Mounting position

**CAUTION!**

*Only install the flow sensor in the shown position to keep the electrodes under water. Limit the rotation to ±2° to maintain the accuracy.*

![Mounting position](image2)
2.3.3 Flange deviation

**CAUTION!**
Max. permissible deviation of pipe flange faces:
\[ L_{\text{max}} - L_{\text{min}} \leq 0.5 \text{ mm} / 0.02" \]

![Figure 2-5: Flange deviation](image)

1. \( L_{\text{max}} \)
2. \( L_{\text{min}} \)

2.3.4 Vibration

![Figure 2-6: Avoid vibrations](image)

2.3.5 Magnetic field

![Figure 2-7: Avoid magnetic fields](image)
2.3.6 Control valve

![Diagram of installation before control valve](image)

Figure 2-8: Installation before control valve

2.3.7 Slope

**CAUTION!**

The accuracy is influenced by the slope. Stay within ±1% to get the most accurate measurements!

![Diagram of recommended slope](image)

Figure 2-9: Recommended slope

2.3.8 Mounting advice for difficult situations

If you cannot meet the installation conditions install the flowmeter between two containers. The inlet to the flowmeter must be higher than the outlet of the fluid. In this way you will have a calm flow into the flowmeter, resulting in a highly accurate measurement. The sizes of the containers must be proportional to the size of the flowmeter.

![Diagram of installing in difficult situations](image)

Figure 2-10: Installing in difficult situations

1. Use a container if the Inlet pipe has a slope > 1%. Make sure that the outlet level of this pipe is below the inlet to the flowmeter.
2. Inlet container
3. Inlet section of 10 DN
4. Outlet section of 5 DN
5. Outlet container advisable if outlet pipe has a slope > 1%.
2.3.9 Cleaning of flow sensor

The TIDALFLUX flow sensor is highly resistant against dirt and the measurement will rarely be influenced by anything. However, it is advisable to create a possibility for cleaning just before or after the sensor.

![Option for cleaning of flow sensor](image)

Figure 2-11: Option for cleaning of flow sensor

1 Opening for cleaning

2.3.10 Temperatures

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td>min.</td>
<td>max.</td>
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<tr>
<td>All versions</td>
<td>-5</td>
<td>60</td>
<td>-25</td>
<td>60</td>
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2.4 Mounting

2.4.1 Mounting grounding rings

CAUTION!

In order to get a reliable height measurement it is **absolutely necessary** that the inner side of the connecting pipeline is electrically conductive and connected to ground. If not, tailor-made grounding rings with a cylindrical part can be delivered. Please contact your local agency in case of doubt.

![Grounding with grounding rings](image)

**Figure 2-12: Grounding with grounding rings**

1. Existing pipeline
2. Grounding rings, custom made to inner diameter of pipeline
3. TIDALFLUX
4. Insert the cylindrical part of the grounding ring into the pipeline. Use an appropriate gasket between the grounding ring and the flange.

INFORMATION!

Sizes of the grounding rings are diameter dependent and available on request.

2.4.2 Torques and pressures

![Tightening of bolts](image)

**Figure 2-13: Tightening of bolts**

**Tightening of bolts**

1. Step 1: Apply approx. 50% of max. torque given in table.
2. Step 2: Apply approx. 80% of max. torque given in table.
3. Step 3: Apply 100% of max. torque given in table.
**INFORMATION!**
Tighten the bolts uniformly in diagonally opposite sequence.

<table>
<thead>
<tr>
<th>Nominal size DN [mm]</th>
<th>Pressure rating</th>
<th>Bolts</th>
<th>Max. torque [Nm]</th>
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<tbody>
<tr>
<td>200</td>
<td>PN 10</td>
<td>8 × M 20</td>
<td>68</td>
</tr>
<tr>
<td>250</td>
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<td>12 × M 20</td>
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<td>500</td>
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<td>20 × M 24</td>
<td>107</td>
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<td>20 × M 27</td>
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<td>20 × M 27</td>
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</tr>
<tr>
<td>1000</td>
<td>PN 10</td>
<td>28 × M 35</td>
<td>261</td>
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<table>
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<th>Flange class [lb]</th>
<th>Bolts</th>
<th>Max. torque [Nm]</th>
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<td>150</td>
<td>8 × 3/4&quot;</td>
<td>69</td>
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<tr>
<td>10</td>
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<td>12 × 7/8&quot;</td>
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<td>12 × 7/8&quot;</td>
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<td>150</td>
<td>12 × 1&quot;</td>
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<td>16 × 1&quot;</td>
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<td>32 × 1 1/2&quot;</td>
<td>269</td>
</tr>
<tr>
<td>40</td>
<td>150</td>
<td>36 × 1 1/2&quot;</td>
<td>269</td>
</tr>
</tbody>
</table>

**INFORMATION!**
Information for bigger sizes is available on request.
3.1 Safety instructions

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

**DANGER!**
Observe the national regulations for electrical installations!

**WARNING!**
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.

**INFORMATION!**
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 Important notes on electrical connection

**DANGER!**
Electrical connection is carried out in conformity with the VDE 0100 directive “Regulations for electrical power installations with line voltages up to 1000 V” or equivalent national regulations.

**CAUTION!**
- Use suitable cable entries for the various electrical cables.
- The sensor and converter are configured together in the factory. For this reason, please connect the devices in pairs. Ensure that the sensor constant GK [see type plates] are identically set.
3.3 Connection of cables

Figure 3-1: Electrical connection
1. Unscrew the cover to reach the connectors
2. Unscrew the cover to reach the connectors
3. Field current cable
4. Interface cable
5. Signal cable (DS or BTS)

Connection diagram

Figure 3-2: Connection diagram
1. Protective Earth connection (PE)
2. Mains power neutral (N)
3. Mains power live (L)
4. Field current cable
5. Interface cable
7. Connect housing to PE
Flow sensors with protection class IP 68 can not be opened anymore. The cables are factory connected and labeled as follows.

**Figure 3-3: Labeled cables for IP 68 versions**
- 1. Mains power (10 = blank, 11 = blue, 12 = black)
- 2. Field current (7 = white, 8 = green)
- 3. Data interface (black wires, C = marked “1”, D = marked “2”, E = marked “3”)
- 4. Electrodes (1 = blank, 2 = white, 3 = red)

### 3.4 Cable lengths

**CAUTION!**

The maximum allowed distance between the flow sensor and the converter is determined by the shortest cable length.

**Interface cable:** maximum length is 600 m / 1968 ft.

**Type B (BTS) signal cable:** maximum length is 600 m / 1968 ft.

**Type A (DS) signal cable:** maximum length depends on the conductivity of the fluid:

<table>
<thead>
<tr>
<th>Electrical conductivity [µS/cm]</th>
<th>Maximum length [m]</th>
<th>Maximum length [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>120</td>
<td>394</td>
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<tr>
<td>100</td>
<td>200</td>
<td>656</td>
</tr>
<tr>
<td>200</td>
<td>400</td>
<td>1312</td>
</tr>
<tr>
<td>≥400</td>
<td>600</td>
<td>1968</td>
</tr>
</tbody>
</table>

CAUTION! The maximum allowed distance between the flow sensor and the converter is determined by the shortest cable length.
**Field current cable**: The cross section of the cable determines the maximum length:

<table>
<thead>
<tr>
<th>Cross section</th>
<th>Maximum length</th>
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<tbody>
<tr>
<td>[mm²]</td>
<td>[AWG]</td>
</tr>
<tr>
<td>2 x 0.75</td>
<td>2 x 18</td>
</tr>
<tr>
<td>2 x 1.5</td>
<td>2 x 14</td>
</tr>
<tr>
<td>2 x 2.5</td>
<td>2 x 12</td>
</tr>
</tbody>
</table>
3.5 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: \( \geq 50 \text{ mm} / 2^\prime \)

**Figure 3-4: Construction of signal cable A**

1. Stranded drain wire (1) for the inner shield (10), 1.0 mm² Cu / AWG 17 (not insulated, bare)
2. Insulated wire (2), 0.5 mm² Cu / AWG 20
3. Insulated wire (3), 0.5 mm² Cu / AWG 20
4. Outer sheath
5. Insulation layers
6. Stranded drain wire (6) for the outer shield (60)
3.6 Preparing signal cable A, connection to measuring sensor

**INFORMATION!**
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The outer shield {60} is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: $\geq 50 \text{ mm} / 2''$

**Required materials**
- PVC insulating tube, $\varnothing 2.0...2.5 \text{ mm} / 0.08...0.1''$
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire {1}
- 2 wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors {2, 3}

1. Strip the conductor to dimension a.
2. Trim the outer shield {60} to dimension b and pull it over the outer sheath.
3. Remove the stranded drain wire {6} of the outer shield and the inner shield {10}. Make sure not to damage the stranded drain wire {1} of the inner shield.
4. Slide an insulating tube over the stranded drain wire {1}.
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire {1}.
6. Pull the heat-shrinkable tubing over the prepared signal cable.
3.7 Signal cable B (type BTS 300), construction

- Signal cable B is a triple-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: $\geq 50$ mm / 2”

![Figure 3-6: Construction of signal cable B](image)

1. Stranded drain wire for the inner shield (10), 1.0 mm² Cu / AWG 17 (not insulated, bare)
2. Insulated wire (2), 0.5 mm² Cu / AWG 20 with stranded drain wire (20) of shield
3. Insulated wire (3), 0.5 mm² Cu / AWG 20 with stranded drain wire (30) of shield
4. Outer sheath
5. Insulation layers
6. Stranded drain wire (6) for the outer shield (60), 0.5 mm² Cu / AWG 20 (not insulated, bare)

3.8 Preparing signal cable B, connection to measuring sensor

**INFORMATION!**

*Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.*

- The outer shield (60) is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: $\geq 50$ mm / 2”

**Required materials**

- PVC insulation tubing, $\varnothing 2.0...2.5$ mm / 0.08...0.1”
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)
1. Strip the conductor to dimension a.
2. Trim the outer shield (60) to dimension b and pull it over the outer sheath.
3. Remove the stranded drain wire (6) of the outer shield and the shields and stranded drain wires of the insulated conductors (2, 3). Remove the inner shield (10). Be sure not to damage the stranded drain wire (1).
4. Slide an insulating tube over the stranded drain wire (1).
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
6. Pull the heat-shrinkable tubing over the prepared signal cable.

Figure 3-7: Preparing signal cable B, connection to measuring sensor

a = 50 mm / 2”
b = 10 mm / 0.39”
3.9 Preparing field current cable C, connection to measuring sensor

INFORMATION!
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The field current cable is not part of the scope of delivery.
- The shield is connected in the terminal compartment of the converter directly via the shield and a clip.
- The shield is connected in the sensor via the special cable gland.
- Bending radius: ≥ 50 mm / 2"

Required materials
- Shielded 2-wire insulated copper cable
- Insulating tube, size according to the cable being used
- Heat-shrinkable tubing
- DIN 46 228 wire end ferrules: size according to the cable being used

![Diagram of cable preparation]

Figure 3-8: Preparation of field current cable C

a = 125 mm / 5"
b = 10 mm / 0.4"

- Strip the conductor to dimension a.
- Trim the outer shield to dimension b and pull it over the outer sheath.
- Crimp wire end ferrules onto both conductors.
At flow converter side:
Connecting shielding under clamp in connection box of converter

![Figure 3-9: Clamping of shields](image)

1. Field current cable
2. Signal cable

At flow sensor side:
Connecting shielding via special cable gland

![Figure 3-10: Connecting the shield within the cable gland](image)

1. Wires
2. Isolation
3. Shielding
4. Isolation
5. Feed cable through dome nut and clamping insert and fold shielding over clamping insert. Make sure that the braided shield overlaps the O-ring by 2 mm / 3/32”.
6. Push clamping insert into body.
7. Tighten the dome nut.
3.10 Interface cable

The data interface cable is a shielded, 3 x 1.5 mm² LIYCY cable. The standard length 10 m / 32.8 ft is included in the delivery.

Preparing the interface cable

Figure 3-11: Preparing the interface cable

1. Strip the conductor to dimension a.
2. Trim the outer shield to dimension b and pull it over the outer sheath.
3. Crimp the wire end ferrules onto the conductors 1, 2 and 3.

Connect the shielding at both sides of the cable via the special cable gland.

Connecting shielding via special cable gland

Figure 3-12: Connecting the shield within the cable gland

1. Wires
2. Isolation
3. Shielding
4. Isolation
5. Feed cable through dome nut and clamping insert and fold shielding over clamping insert. Make sure that the braided shield overlaps the O-ring by 2 mm / 3/32”.
6. Push clamping insert into body.
7. Tighten the dome nut.
3.11 Grounding

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

**CAUTION!**
In order to get a reliable height measurement it is absolutely necessary that the inner side of the connecting pipeline is electrically conductive and connected to ground. If not, tailor-made grounding rings with a cylindrical part can be delivered. Please contact your local agency in case of doubt.

Figure 3-13: Grounding ring number 3
4.1 Switching on the power

Before connecting to power, please check that the system has been correctly installed. This includes:

- The device must be mechanically mounted safely in compliance with the regulations.
- The power connections must be in compliance with the regulations.
- Make sure that all electrical connections are made and that the covers of the terminal compartments are closed.
- Check that the electrical operating data of the power supply are correct.

Switch on the power.

INFORMATION!
The sensor can not be programmed or changed in any way. All settable functions are included in the converter. Please see the relevant documentation of the converter for more information.
5.1 Dimensions and weights

The inner pipe diameter should match the inner diameter of the flowmeter. Since the inner diameter is not a standard DN size, choose the inner pipe diameter to be just a little bit bigger than the flow meter diameter. If a lot of sediment or fat is expected the optimal solution is to produce a diameter compensation ring on both sides to have smooth transits.

EN 1092-1

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<th>Nominal size</th>
<th>Dimensions [mm]</th>
<th>Approx. weight [kg]</th>
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<td>a</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>IP 67</td>
<td>IP 68</td>
</tr>
<tr>
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150 lb flanges

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<th>b</th>
<th>Øc</th>
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(1) Nominal size ≤ 24": ASME; > 24": AWWA

5.2 Vacuum load

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<th>Diameter [mm]</th>
<th>40°C</th>
<th>60°C</th>
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<table>
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<th>Diameter [inches]</th>
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<th>140°F</th>
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<td>7.3</td>
<td>8.7</td>
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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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info@krohne.de

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www.krohne.com