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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1.1 Intended use

The TIDALFLUX 4300 F has been designed for measuring the flow of conductive fluids, even in partially filled pipes. It can be combined with the IFC 300 electromagnetic flow converter.

1.2 Safety instructions from the manufacturer

1.2.1 Copyright and data protection

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The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.
1.2.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.2.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.
1.2.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

**DANGER!**
This information refers to the immediate danger when working with electricity.

**DANGER!**
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

**DANGER!**
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

**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.

**LEGAL NOTICE!**
This note contains information on statutory directives and standards.

**• 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.

1.3 Safety instructions for the operator

**WARNING!**
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel. This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.
2.1 Scope of delivery

Figure 2-1: Scope of delivery

- Ordered flowmeter
- Product documentation
- Factory calibration report
- CD-ROM with product documentation
- Grounding rings (optionally)
- Cable

2.2 Device description

This flowmeter can measure the flow of conductive liquids, even in partially filled pipes. To be able to do this, a capacitive height measurement has been integrated into a normal electromagnetic flowmeter. If both the filled fraction and the velocity of the fluid are known, it is easy to calculate the amount of fluid running through the pipe.

2.3 Nameplates

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.

Figure 2-2: Example of nameplate

- Logo and address of manufacturer
- Type designation
- GK/GKL values [measuring sensor constants]; size [mm/inches]; field frequency
- Materials of wetted parts; protection category
3.1 Notes on installation

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

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

**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 Storage

- Store the device in a dry and dust-free location.
- Avoid lasting direct exposure to the sun.
- Store the device in its original packing.

3.3 Transport

Figure 3-1: Transport
3.4 Installation conditions

3.4.1 Inlet and outlet

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

\[\begin{align*}
\text{①} & \geq 5 \text{ DN} \\
\text{②} & \geq 3 \text{ DN}
\end{align*}\]

**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](image)

3.4.2 Mounting position
3.4.3 Flange deviation

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

![Figure 3-4: Flange deviation](image)

1. $L_{\text{max}}$
2. $L_{\text{min}}$

3.4.4 Vibration

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

3.4.5 Magnetic field

![Figure 3-6: Avoid magnetic fields](image)
3.4.6 Control valve

![Figure 3-7: Installation before control valve](image)

3.4.7 Slope

**CAUTION!**

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

![Figure 3-8: Recommended slope](image)

3.4.8 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.

![Figure 3-9: Installing in difficult situations](image)

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%.
3.4.9 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.

3.4.10 Temperatures

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

3.5.1 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.

![Diagram of grounding with grounding rings](image)

**Figure 3-11: 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.

3.5.2 Torques and pressures

![Diagram of tightening of bolts](image)

**Figure 3-12: 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>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>PN 10</td>
<td>8 × M 20</td>
<td>68</td>
</tr>
<tr>
<td>250</td>
<td>PN 10</td>
<td>12 × M 20</td>
<td>65</td>
</tr>
<tr>
<td>300</td>
<td>PN 10</td>
<td>12 × M 20</td>
<td>76</td>
</tr>
<tr>
<td>350</td>
<td>PN 10</td>
<td>16 × M 20</td>
<td>75</td>
</tr>
<tr>
<td>400</td>
<td>PN 10</td>
<td>16 × M 24</td>
<td>104</td>
</tr>
<tr>
<td>500</td>
<td>PN 10</td>
<td>20 × M 24</td>
<td>107</td>
</tr>
<tr>
<td>600</td>
<td>PN 10</td>
<td>20 × M 27</td>
<td>138</td>
</tr>
<tr>
<td>700</td>
<td>PN 10</td>
<td>20 × M 27</td>
<td>163</td>
</tr>
<tr>
<td>800</td>
<td>PN 10</td>
<td>24 × M 30</td>
<td>219</td>
</tr>
<tr>
<td>900</td>
<td>PN 10</td>
<td>28 × M 30</td>
<td>205</td>
</tr>
<tr>
<td>1000</td>
<td>PN 10</td>
<td>28 × M 35</td>
<td>261</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal size [inch]</th>
<th>Flange class [lb]</th>
<th>Bolts</th>
<th>Max. torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>150</td>
<td>8 × 3/4”</td>
<td>69</td>
</tr>
<tr>
<td>10</td>
<td>150</td>
<td>12 × 7/8”</td>
<td>79</td>
</tr>
<tr>
<td>12</td>
<td>150</td>
<td>12 × 7/8”</td>
<td>104</td>
</tr>
<tr>
<td>14</td>
<td>150</td>
<td>12 × 1”</td>
<td>93</td>
</tr>
<tr>
<td>16</td>
<td>150</td>
<td>16 × 1”</td>
<td>91</td>
</tr>
<tr>
<td>18</td>
<td>150</td>
<td>16 × 1 1/8”</td>
<td>143</td>
</tr>
<tr>
<td>20</td>
<td>150</td>
<td>20 × 1 1/8”</td>
<td>127</td>
</tr>
<tr>
<td>24</td>
<td>150</td>
<td>20 × 1 1/4”</td>
<td>180</td>
</tr>
<tr>
<td>28</td>
<td>150</td>
<td>28 × 1 1/4”</td>
<td>161</td>
</tr>
<tr>
<td>32</td>
<td>150</td>
<td>28 × 1 1/2”</td>
<td>259</td>
</tr>
<tr>
<td>36</td>
<td>150</td>
<td>32 × 1 1/2”</td>
<td>269</td>
</tr>
<tr>
<td>40</td>
<td>150</td>
<td>36 × 1 1/2”</td>
<td>269</td>
</tr>
</tbody>
</table>

**INFORMATION!**

Information for bigger sizes is available on request.
4.1 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.

4.2 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.
4.3 Connection of cables

Figure 4-1: 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 4-2: 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.

![Labeled cables for IP 68 versions](image)

4.4 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.
- **Type B (BTS) signal cable**: maximum length is 600 m.
- **Type A (DS) signal cable**: the maximum length depends on the conductivity of the fluid:

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

**Field current cable**: The cross section of the cable determines the maximum length:

<table>
<thead>
<tr>
<th>Cross section</th>
<th>Maximum length [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 0.75 mm²</td>
<td>150</td>
</tr>
<tr>
<td>2 x 1.5 mm²</td>
<td>300</td>
</tr>
<tr>
<td>2 x 2.5 mm²</td>
<td>600</td>
</tr>
</tbody>
</table>
4.5 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: $\geq 50$ mm / $2''$

![Figure 4-4: Construction of signal cable A](image)

1. Stranded drain wire (1) for the inner shield (10), 1.0 mm$^2$ Cu / AWG 17 [not insulated, bare]
2. Insulated wire (2), 0.5 mm$^2$ Cu / AWG 20
3. Insulated wire (3), 0.5 mm$^2$ Cu / AWG 20
4. Outer sheath
5. Insulation layers
6. Stranded drain wire (6) for the outer shield (60)
4.6 Prepare signal cable A, connect 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.

**Required materials**
- PVC insulation tubing, Ø2.0...2.5 mm / 0.08...0.1”
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the twisted stranded drain wires (1) and (6)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

**Figure 4-5: Prepare signal cable A, connect to measuring sensor**

a = 50 mm / 2”

1. Strip the conductor to dimension a.
2. Cut the outer shields (60) and (10). Make sure not to damage the stranded drain wires (1) and (6).
3. Twist the stranded drain wires (6) of the outer shield and the drain wire (1) of the inner shield (10).
4. Slide an insulating tube over the stranded drain wires (1) and (6).
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wires (1) and (6).
6. Pull the heat-shrinkable tubing over the prepared signal cable.
4.7 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: $\geq 50 \text{ mm} / 2''$

![Figure 4-6: Construction of signal cable B](image)

1. Stranded drain wire for the inner shield (10), 1.0 mm$^2$ Cu / AWG 17 (not insulated, bare)
2. Insulated wire (2), 0.5 mm$^2$ Cu / AWG 20 with stranded drain wire (20) of shield
3. Insulated wire (3), 0.5 mm$^2$ 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 mm$^2$ Cu / AWG 20 (not insulated, bare)

4.8 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.

**Required materials**
- PVC insulation tubing, Ø2.0...2.5 mm / 0.08...0.1”
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the twisted stranded drain wires (1) and (6)
- 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. Cut the outer shields (60), (10), the shields around the insulated conductors (2, 3) and the stranded drain wires (20, 30). Make sure not to damage the stranded drain wires (1) and (6).
3. Twist the stranded drain wires (6) of the outer shield and the drain wire (1) of the inner shield (10).
4. Slide an insulating tube over the stranded drain wires (1) and (6).
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wires (1) and (6).
6. Pull the heat-shrinkable tubing over the prepared signal cable.

Figure 4-7: Preparing signal cable B, connection to measuring sensor

a = 50 mm / 2”
### 4.9 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 supply.
- 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: $\geq 50 \text{ mm} / 2"$

**Required materials**

- Shielded 2-wire insulated copper cable
- Insulating tubing, 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](image.png)

**Figure 4-8: Preparation of field current cable C**

- a = 50 mm / 2"
- b = 10 mm / 0.4"

1. Strip the conductor to dimension a.
2. Trim the outer shield to dimension b and pull it over the outer sheath.
3. Crimp wire end ferrules onto both conductors.
4. Pull a shrinkable tube over the prepared cable.
At flow converter side:
Connecting shielding under clamp in connection box of converter

Figure 4-9: Clamping of shields
① Field current cable
② Signal cable

At flow sensor side:
Connecting shielding via special cable gland

Figure 4-10: 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.
4.10 Interface cable

The data interface cable is a shielded, 3 x 1.5 mm² Liycy cable. Standard is 10 m included in the delivery. Connect the shielding at both sides of the cable via the special cable gland.

Connecting shielding via special cable gland

Figure 4-11: 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.

4.11 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.
5.1 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.*
6.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are under normal operating conditions subjects to wear and tear.

6.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, technical support and training.

INFORMATION!
For more precise information, please contact your local representative.

6.3 Returning the device to the manufacturer

6.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.
- This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,
- to enclose a certificate with the device confirming that is safe to handle and stating the product used.
### 6.3.2 Form (for copying) to accompany a returned device

<table>
<thead>
<tr>
<th>Company:</th>
<th>Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department:</td>
<td>Name:</td>
</tr>
<tr>
<td>Tel. no.:</td>
<td>Fax no.:</td>
</tr>
<tr>
<td>Manufacturer’s order no. or serial no.:</td>
<td></td>
</tr>
</tbody>
</table>

The device has been operated with the following medium:

<table>
<thead>
<tr>
<th>This medium is:</th>
<th>water-hazardous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>toxic</td>
</tr>
<tr>
<td></td>
<td>caustic</td>
</tr>
<tr>
<td></td>
<td>flammable</td>
</tr>
</tbody>
</table>

We checked that all cavities in the device are free from such substances.

We have flushed out and neutralized all cavities in the device.

We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.

Date: Signature:  
Stamp:  

### 6.4 Disposal

**CAUTION!**

Disposal must be carried out in accordance with legislation applicable in your country.
7.1 Measuring principle

The TIDALFLUX 4000 is an electromagnetic flow sensor with an integrated capacitive level measurement system, designed for electrically conductive process liquids. The flow rate $Q(t)$ through the tube is:

$$Q(t) = v(t) \times A(t),$$

in which

$v(t)$ = Flow velocity of liquid product

$A(t)$ = Wetted area of tube section.

The flow velocity is determined on basis of the known electromagnetic measurement principle. The two measuring electrodes are located in the lower part of the measuring tube, on a level of approx. 10% of the inner diameter of the pipe in order to get a reliable measurement to a level of 10%.

An electrically conductive fluid flows inside an electrically insulating 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:

$$U = \nu \times k \times B \times D$$

in which:

$\nu$ = 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 $\nu$ and thus the flow rate $q$. The signal voltage is quite small (typically 1 mV at $\nu = 3 \text{ m/s} / 10 \text{ ft/s}$ and field coil power of 1 W). Finally, a signal converter is used to amplify the signal voltage, filter it (separate from noise) and convert it into signals for totalising, recording and output processing.

Figure 7-1: Measuring principle TIDALFLUX

1. Electrodes
2. Induced voltage (proportional to flow velocity)
3. Capacitive plates in liner for height measurement
4. Magnetic field
5. Field coils
The wetted area $A$ is computed from the known inside diameter of the pipe by the patented capacitive level measurement system that is built into the measuring tube liner. The required electronics unit is accommodated in a compact housing that is mounted on top of the measuring sensor. This electronics is connected to the remote IFC 300 F converter by means of a digital communication line.
### 7.2 Technical data

**INFORMATION!**

- 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

<table>
<thead>
<tr>
<th>Measuring principle</th>
<th>Faraday’s law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application range</td>
<td>Electrically conductive fluids</td>
</tr>
<tr>
<td><strong>Measured value</strong></td>
<td></td>
</tr>
<tr>
<td>Primary measured value</td>
<td>Flow velocity</td>
</tr>
<tr>
<td></td>
<td>Level</td>
</tr>
<tr>
<td>Secondary measured value</td>
<td>Volume flow</td>
</tr>
</tbody>
</table>

#### Design

<table>
<thead>
<tr>
<th>Features</th>
<th>Flange version with full bore flow tube</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard as well as higher pressure ratings</td>
</tr>
<tr>
<td></td>
<td>Broad range of nominal sizes</td>
</tr>
<tr>
<td>Modular construction</td>
<td>The measurement system consists of a flow sensor and a signal converter. It is available as remote version. More information about the signal converter can be found in the documentation of the signal converter.</td>
</tr>
<tr>
<td>Remote version</td>
<td>In field [F] version with IFC 300 converter: TIDALFLUX 4300 F.</td>
</tr>
<tr>
<td>Nominal diameter</td>
<td>DN200...1600 / 8...64”</td>
</tr>
<tr>
<td>Measurement range</td>
<td>-12...+12 m/s / -40...+40 ft/s</td>
</tr>
</tbody>
</table>
### Measuring accuracy

<table>
<thead>
<tr>
<th>Reference conditions</th>
<th>Slope: 0%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium: water</td>
</tr>
<tr>
<td></td>
<td>Electrical conductivity: 50...5000 μS/cm</td>
</tr>
<tr>
<td></td>
<td>Temperature: 10...30°C / 50...86°F</td>
</tr>
<tr>
<td></td>
<td>Inlet section: ≥ 10 DN</td>
</tr>
<tr>
<td></td>
<td>Outlet section: ≥ 5 DN</td>
</tr>
<tr>
<td></td>
<td>Flow velocity at full scale: &gt; 1 m/s / 3 ft/s</td>
</tr>
<tr>
<td></td>
<td>Operating pressure: 1 bar / 14.5 psig</td>
</tr>
<tr>
<td></td>
<td>Wet calibrated on EN 17025 accredited calibration rig by direct volume comparison</td>
</tr>
</tbody>
</table>

**Maximum measuring error**

For detailed information on the measuring accuracy, see chapter "Measuring accuracy".

Related to volume flow (MV = Measured Value, FS = Full Scale)

These values are related to the pulse / frequency output

The additional typical measuring deviation for the current output is ±10 μA

**Partly filled**: v ≥ 1 m/s / 3.3 ft/s @ Full Scale: ≤ 1% of FS

**Fully filled**: v ≥ 1 m/s / 3.3 ft/s: ≤ 1% of MV

v < 1 m/s / 3.3 ft/s: ≤ 0.5% of MV + 5 mm/s / 0.2 inch/s

Minimum level: 10% of inner diameter

### Operating conditions

<table>
<thead>
<tr>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process temperature</td>
</tr>
<tr>
<td>Ambient temperature</td>
</tr>
<tr>
<td>Storage temperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical condition</td>
</tr>
<tr>
<td>Electrical conductivity</td>
</tr>
<tr>
<td>Permissible gas content (volume)</td>
</tr>
<tr>
<td>Permissible solid content (volume)</td>
</tr>
</tbody>
</table>
**Installation conditions**

<table>
<thead>
<tr>
<th>Installation</th>
<th>For detailed information see chapter “Installation”</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)</td>
</tr>
<tr>
<td></td>
<td>≥ 10 DN (after a double bend 2x 90°)</td>
</tr>
<tr>
<td></td>
<td>≥ 10 DN (behind a control valve)</td>
</tr>
<tr>
<td>Outlet run</td>
<td>≥ 3 DN</td>
</tr>
<tr>
<td>Dimensions and weights</td>
<td>For detailed information see chapter “Dimensions and weights”.</td>
</tr>
</tbody>
</table>

**Materials**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor housing</td>
<td>Standard: sheet steel</td>
</tr>
<tr>
<td></td>
<td>Other materials on request</td>
</tr>
<tr>
<td>Measuring tube</td>
<td>Austenitic stainless steel</td>
</tr>
<tr>
<td>Measuring tube</td>
<td>Austenitic stainless steel</td>
</tr>
<tr>
<td>Flange</td>
<td>Standard: Carbon steel, polyurethane coated</td>
</tr>
<tr>
<td></td>
<td>Other materials on request</td>
</tr>
<tr>
<td>Liner</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Connection box</td>
<td>IP 67: polyurethane coated die-cast aluminium</td>
</tr>
<tr>
<td></td>
<td>IP 68: Stainless steel</td>
</tr>
<tr>
<td>Measuring electrodes</td>
<td>Hastelloy® C</td>
</tr>
<tr>
<td>Grounding rings</td>
<td>Stainless steel</td>
</tr>
<tr>
<td></td>
<td>Tailor made to innerdiameter of connecting pipeline.</td>
</tr>
<tr>
<td></td>
<td>Necessary if insides of connecting pipeline isn’t electrically conductive.</td>
</tr>
</tbody>
</table>

**Process connections**

<table>
<thead>
<tr>
<th>Flange</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EN 1092-1</strong></td>
<td>DN200...1600 in PN 6...40 (others on request)</td>
</tr>
<tr>
<td><strong>ASME</strong></td>
<td>8...64” in 150...300 lb RF (others on request)</td>
</tr>
<tr>
<td><strong>JIS</strong></td>
<td>DN200...1600 in JIS 10...20 K (others on request)</td>
</tr>
<tr>
<td><strong>Design of gasket surface</strong></td>
<td>RF (others on request)</td>
</tr>
</tbody>
</table>
## Electrical connections

<table>
<thead>
<tr>
<th><strong>General</strong></th>
<th>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 specifications.</th>
</tr>
</thead>
</table>
| **Power supply** | Standard: 110 / 220 VAC [-15% / +10%], 50/60 Hz settable by switch  
Option: 24 VAC, 50/60 Hz |
| **Power consumption** | 14 VA |
| **Field current cable** | Shielded cable must be used, no part of delivery. |
| **Signal cable** | DS 300 (type A)  
Max. length: 600 m / 1950 ft (dependent on electrical conductivity).  
BTS 300 (type B)  
Max. length: 600 m / 1950 ft |
| **Data interface cable** | For transmission of measured level to IFC 300 F.  
Shielded Liycy cable, 3 x 0.75 mm² |
| **Cable entries** | 2x M20 x 1.5  
1x M20 x 1.5 EMC type  
1x PG9 EMC type |

## Approvals and certificates

<table>
<thead>
<tr>
<th><strong>CE</strong></th>
<th>This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.</th>
</tr>
</thead>
</table>
| **Electromagnetic compatibility** | Directive: 2004/108/EC, NAMUR NE21/04  
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 |
| **Hazardous areas** | ATEX  
Option: Ex zone 2  
Ex zone 1 in preparation |
| **Other approvals and standards** | Protection category acc. to IEC 529 / EN 60529  
Standard: IP 66/67 (NEMA 4/4X/6)  
Option: IP 68 (NEMA 6P)  
Vibration resistance: IEC 68-2-6  
Random vibration test: IEC 68-2-34  
Shock test: IEC 68-2-27 |
### 7.3 Sizing

**INFORMATION!**

These tables state the flowrate in a partially filled pipe, dependant on slope, filling level, inner diameter and friction factors of the pipe. The values are calculated according the Manning-Strickler equation. The results do not consider: deposits, profile distortion, backwater, friction of air and the slightly smaller inner diameter of the TIDALFLUX.

#### Flow and velocity at 100% level, gravity fed, metric values

<table>
<thead>
<tr>
<th>DN Nominal size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel / PVC</td>
</tr>
<tr>
<td>v [m/s]</td>
</tr>
</tbody>
</table>

**slope 0.5%**

<table>
<thead>
<tr>
<th>DN</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>0.96</td>
<td>109</td>
<td>0.86</td>
<td>97</td>
<td>0.58</td>
<td>66</td>
</tr>
<tr>
<td>250</td>
<td>1.11</td>
<td>196</td>
<td>1.00</td>
<td>177</td>
<td>0.67</td>
<td>118</td>
</tr>
<tr>
<td>300</td>
<td>1.26</td>
<td>321</td>
<td>1.13</td>
<td>288</td>
<td>0.75</td>
<td>191</td>
</tr>
<tr>
<td>350</td>
<td>1.39</td>
<td>481</td>
<td>1.25</td>
<td>433</td>
<td>0.84</td>
<td>291</td>
</tr>
<tr>
<td>400</td>
<td>1.52</td>
<td>688</td>
<td>1.37</td>
<td>620</td>
<td>0.91</td>
<td>412</td>
</tr>
<tr>
<td>500</td>
<td>1.77</td>
<td>1251</td>
<td>1.59</td>
<td>1124</td>
<td>1.06</td>
<td>749</td>
</tr>
<tr>
<td>600</td>
<td>2.00</td>
<td>2036</td>
<td>1.8</td>
<td>1832</td>
<td>1.2</td>
<td>1221</td>
</tr>
<tr>
<td>700</td>
<td>2.21</td>
<td>3062</td>
<td>1.99</td>
<td>2757</td>
<td>1.33</td>
<td>1843</td>
</tr>
<tr>
<td>800</td>
<td>2.42</td>
<td>4379</td>
<td>2.18</td>
<td>3945</td>
<td>1.45</td>
<td>2624</td>
</tr>
<tr>
<td>900</td>
<td>2.62</td>
<td>6000</td>
<td>2.35</td>
<td>5382</td>
<td>1.57</td>
<td>3596</td>
</tr>
<tr>
<td>1000</td>
<td>2.81</td>
<td>7945</td>
<td>2.53</td>
<td>7153</td>
<td>1.68</td>
<td>4750</td>
</tr>
<tr>
<td>1200</td>
<td>3.17</td>
<td>12906</td>
<td>2.85</td>
<td>11603</td>
<td>1.9</td>
<td>7736</td>
</tr>
<tr>
<td>1400</td>
<td>3.51</td>
<td>19451</td>
<td>3.16</td>
<td>17511</td>
<td>2.11</td>
<td>11693</td>
</tr>
<tr>
<td>1600</td>
<td>3.84</td>
<td>27794</td>
<td>3.45</td>
<td>24971</td>
<td>2.3</td>
<td>16647</td>
</tr>
</tbody>
</table>

**slope 1.0%**

<table>
<thead>
<tr>
<th>DN</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
<th>v [m/s]</th>
<th>Q [m3/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>1.36</td>
<td>154</td>
<td>1.22</td>
<td>138</td>
<td>0.81</td>
<td>92</td>
</tr>
<tr>
<td>250</td>
<td>1.57</td>
<td>277</td>
<td>1.42</td>
<td>251</td>
<td>0.94</td>
<td>166</td>
</tr>
<tr>
<td>300</td>
<td>1.78</td>
<td>453</td>
<td>1.6</td>
<td>407</td>
<td>1.07</td>
<td>272</td>
</tr>
<tr>
<td>350</td>
<td>1.97</td>
<td>682</td>
<td>1.77</td>
<td>613</td>
<td>1.18</td>
<td>409</td>
</tr>
<tr>
<td>400</td>
<td>2.15</td>
<td>973</td>
<td>1.94</td>
<td>878</td>
<td>1.29</td>
<td>584</td>
</tr>
<tr>
<td>500</td>
<td>2.5</td>
<td>1767</td>
<td>2.25</td>
<td>1590</td>
<td>1.5</td>
<td>1060</td>
</tr>
<tr>
<td>600</td>
<td>2.82</td>
<td>2870</td>
<td>2.54</td>
<td>2585</td>
<td>1.69</td>
<td>1720</td>
</tr>
<tr>
<td>700</td>
<td>3.13</td>
<td>4336</td>
<td>2.82</td>
<td>3907</td>
<td>1.88</td>
<td>2605</td>
</tr>
<tr>
<td>800</td>
<td>3.42</td>
<td>6189</td>
<td>3.08</td>
<td>5573</td>
<td>2.05</td>
<td>3709</td>
</tr>
<tr>
<td>900</td>
<td>3.7</td>
<td>8474</td>
<td>3.33</td>
<td>7626</td>
<td>2.22</td>
<td>5084</td>
</tr>
<tr>
<td>1000</td>
<td>3.97</td>
<td>11225</td>
<td>3.57</td>
<td>10094</td>
<td>2.38</td>
<td>6729</td>
</tr>
<tr>
<td>1200</td>
<td>4.48</td>
<td>18240</td>
<td>4.03</td>
<td>16408</td>
<td>2.69</td>
<td>10952</td>
</tr>
<tr>
<td>1400</td>
<td>4.97</td>
<td>27542</td>
<td>4.47</td>
<td>24771</td>
<td>2.98</td>
<td>16514</td>
</tr>
<tr>
<td>1600</td>
<td>5.43</td>
<td>39302</td>
<td>4.89</td>
<td>35394</td>
<td>3.26</td>
<td>23596</td>
</tr>
</tbody>
</table>
EXAMPLE:

Consider a maximum flow to be measured of 1200 m³/h. The material of the pipeline is steel and the slope 1.0%.

From the table a maximum flow has to be selected that is bigger than the flow to be measured. Selection: DN500, \( Q_{\text{max}} = 1767 \text{ m}^3/\text{h} \) and \( v_{\text{max}} = 2.5 \text{ m/s} \).

To determine the level in the pipe at 1200 m³/h, calculated the ratio \( Q / Q_{\text{max}} = 1200 / 1767 = 0.68 \).

See above figure and read out the ratio's of \( \frac{H}{DN} \) and \( \frac{v}{v_{\text{max}}} \):

1. \( H/DN = 0.6 \) or \( 0.6 \times 500 \text{ mm} = 300 \text{ mm} \),
2. At \( H/DN = 0.6 \), find \( \frac{v}{v_{\text{max}}} = 1.05 \), so \( v = 1.05 \times 2.5 = 2.63 \text{ m/s} \).

INFORMATION!

\( v_{\text{max}} \) and \( Q_{\text{max}} \) are the values of \( v \) and \( Q \) if the pipe is completely filled.

A sizing tool for various slopes is available at the website of the manufacturer.
7.4 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 flowmeter 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

<table>
<thead>
<tr>
<th>Nominal size</th>
<th>Dimensions [mm]</th>
<th>Approx. Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN</td>
<td>PN</td>
<td>a</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
<td>350</td>
</tr>
<tr>
<td>250</td>
<td>10</td>
<td>400</td>
</tr>
<tr>
<td>300</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>350</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>400</td>
<td>10</td>
<td>600</td>
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<tr>
<td>500</td>
<td>10</td>
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<td>600</td>
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<td>1000</td>
<td>10</td>
<td>1000</td>
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<tr>
<td>1200</td>
<td>6</td>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
<td>6</td>
<td>1400</td>
</tr>
<tr>
<td>1600</td>
<td>6</td>
<td>1600</td>
</tr>
</tbody>
</table>
### 7.5 Vacuum load

**Diameter** | Vacuum load in mbar abs. at a process temperature of
<table>
<thead>
<tr>
<th>[mm]</th>
<th>40°C</th>
<th>60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN200...1600</td>
<td>500</td>
<td>600</td>
</tr>
</tbody>
</table>

**Diameter** | Vacuum load in psia at a process temperature of
<table>
<thead>
<tr>
<th>[inches]</th>
<th>104°F</th>
<th>140°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>8...64&quot;</td>
<td>7.3</td>
<td>8.7</td>
</tr>
</tbody>
</table>
7.6 Measuring accuracy

The measuring accuracy for partly filled pipes and completely filled pipes are different. In these graphs it is assumed that the velocity at full scale value is at least 1 m/s (is also the standard value for calibration, since it will result in the most accurate measurements).

**Fully filled pipes**

Figure 7-3: Maximum measuring error of measured value.

**Partly filled pipes**

Figure 7-4: Maximum measuring error of measured value.

1. Advised working area
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

Head Office KROHNE Messtechnik GmbH
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Tel.:+49 (0)203 301 0
Fax:+49 (0)203 301 10389
info@krohne.de

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www.krohne.com