Flow measurement
Product overview
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KROHNE trademarks:
KROHNE
measure the facts
CalSys
CARGOMASTER
EcoMATE®
EGM
KROHNE Care
M-PHASE
OPTIBAR
OPTIBATCH
OPTIBRIDGE
OPTIFLEX
OPTIFLUX
OPTIMASS
OPTISENS
OPTISONIC
OPTISOUND
OPTISWIRL
OPTISWITCH
OPTISYS
OPTIWAVE
PipePatrol
WATERFLUX
SENSOFIT
SMARTMAC
SMARTPAT

Trademarks of other owners:
Amphenol
Bluetooth®
EtherNet/IP™
FDT Group
FOUNDATION™ fieldbus
HART®
HASTELLOY®
Metglas®
PACTware
PROFIBUS®
PROFINET®
VARIVENT®
KROHNE is your reliable partner for process instrumentation and automation. As our client, you benefit from our ability to solve your applications with matching measurement solutions; we offer a complete product portfolio, industry specific system solutions and complementary services for instrumentation projects of any size.

By having specialised in industrial process measurement since 1921, we have gained an enormous amount of application knowledge in various industries that is integrated into our products, solutions and services. We have truly mastered the physical principles our meters are based on: our ability to utilise physical effects and to find a matching measuring solution time after time are the reasons we are trusted by clients worldwide. The primary measured value is as accurate as possible to avoid consecutive faults that might affect your process control. It also enables our meters to measure reliably, even under changing or difficult process conditions. Both aspects are reflected by our claim “Measure the facts”.

The innovative technologies we employ for your benefit are based on our extensive R&D activities: 10% of the >3700 KROHNE employees work in research and development. Next to sensor physics, their focus is on device communication and enabling technologies for the Internet of Things (IoT) in process industry, e.g. ethernet communication to transmit process and device diagnostic data for evaluation and process optimisation.

Our “Technology Icons” perfectly sum up the above mentioned advantages for you. You will find them highlighted within our complete portfolio in this brochure. If you don’t find a matching solution for your measurement application, feel free to contact us, we look forward to solving it.
KROHNE has unique expertise when it comes to flow measurement. We hold over 1,000 patents relating to flow products and don’t just demonstrate our ability with standard applications but also with applications that are demanding, requiring custom solutions. For us, customer orientation starts as early as research and development. Many of our products which are considered today’s industrial standards, were developed in cooperation with our customers. Today, users around the world benefit from KROHNE innovation: Electromagnetic flowmeters with ceramic liners for highly corrosive media in chlorine chemistry. Mass flowmeters with just one straight tube – ideal for highly viscous media and low flow speeds. Ultrasonic flowmeters for custody transfer, working according to the time-of-flight method. Vortex measuring devices with integrated pressure and temperature compensation. And variable area flowmeters: they established KROHNE’s business in 1921, today we can’t imagine KROHNE without them, if a local display is to ensure the redundancy and the certainty of the system.

Due to their repeatability and accuracy, our flowmeters are installed as reference-meters on standard liquid flow calibration-rigs of national metrology institutes such as PTB (Germany), NMi/EuroLoop (the Netherlands) and NMJ (Japan).
## Product selection list

This table will help you in selecting the right measuring principle for your application.

<table>
<thead>
<tr>
<th></th>
<th>Electro-magnetic flowmeters</th>
<th>Variable area flowmeters</th>
<th>Ultrasonic flowmeters</th>
<th>Mass flowmeters</th>
<th>Vortex flowmeters</th>
<th>Differential pressure flow measurement</th>
<th>Flow controllers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquids (e.g. water)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Low flow rates</td>
<td>x</td>
<td>x</td>
<td>–</td>
<td>x</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>High flow rates</td>
<td>x</td>
<td>–</td>
<td>x</td>
<td>x</td>
<td>–</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Non-conductive liquids</td>
<td>–</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>o</td>
</tr>
<tr>
<td>Viscous media</td>
<td>x</td>
<td>x</td>
<td>o</td>
<td>x</td>
<td>0</td>
<td>x</td>
<td>0</td>
</tr>
<tr>
<td><strong>Gases</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Industrial gases</td>
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<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>Low flow rates</td>
<td>–</td>
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<td>o</td>
<td>x</td>
<td>–</td>
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<tr>
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<td>o</td>
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<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>Steam</td>
<td>–</td>
<td>o</td>
<td>x</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>–</td>
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<tr>
<td><strong>Special applications</strong></td>
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<td></td>
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</tr>
<tr>
<td>Slurry, media with solids</td>
<td>x</td>
<td>–</td>
<td>–</td>
<td>x</td>
<td>–</td>
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<tr>
<td>Emulsions (oil/water)</td>
<td>o</td>
<td>x</td>
<td>o</td>
<td>x</td>
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<td>x</td>
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<tr>
<td>Corrosive liquids (acids, alkalis)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>o</td>
<td>x</td>
<td>–</td>
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<tr>
<td>Corrosive gas flows</td>
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<td>0</td>
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<td>–</td>
</tr>
<tr>
<td>Bi-directional measurements</td>
<td>x</td>
<td>–</td>
<td>x</td>
<td>x</td>
<td>–</td>
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</tr>
<tr>
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<tr>
<td>2-wire</td>
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<td>–</td>
<td>x</td>
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<td>–</td>
<td>x</td>
<td>x</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

x = suitable, o = suitable under certain conditions, – = not suitable
Technology Icons

To deliver reliable values even under difficult conditions, KROHNE products and solutions use a number of high-end technologies.

These are highlighted by the technology icons, each representing a unique and characteristic feature that also generates additional benefit for users:

- **Ceramic durability**

  By implementing oxide ceramic sensors into OPTIFLUX and BATCHFLUX electromagnetic flowmeters as well as ceramic diaphragms into OPTIBAR pressure devices, KROHNE is using a superior material that is permanently resistant to corrosive and abrasive media and also immune to temperature shocks.

- **EGM™ Entrained Gas Management**

  EGM™ was developed for the OPTIMASS Coriolis mass flowmeters to overcome problems caused by air or gas entrainments in a liquid. Powerful control algorithms maintain measurement, even during a complete transition from a pure liquid phase to a gas phase and back. Mass flow and density measurements remain stable and continuous, which has been demonstrated in batch / loading / empty-full-empty applications.

- **Total 3D linearisation**

  For a robust and accurate differential pressure measurement, even under changing process conditions, each OPTIBAR DP 7060 differential pressure transmitter is linearised in 3 dimensions during calibration: differential pressure, ambient temperature and static pressure are taken into account in combination. Since the full specified operating range is covered, an utmost stable and accurate measurement under all process conditions is guaranteed.

- **SmartSense insulation monitoring**

  Temperature assemblies with Pt100 or thermocouple sensors can produce erroneous measurements due to humidity in the measuring insert, e.g. caused by wear, corrosion or cracks. OPTITEMP temperature transmitters with SmartSense monitor the temperature sensor and warn for isolation errors.
Transmitter built-in

The SMARTPAT series of analysis sensors significantly eases the handling of analytical sensors: formerly an external device, the transmitter has now been miniaturised and built into the sensor head, enabling direct 4...20 mA/HART® communication. This reduces the costs of ownership, eases installation and maintenance, and allows for usage in Ex applications (zone 0).

Flow computer built-in

Many KROHNE flowmeters have a built-in flow computer that compensates for the effects of pressure and temperature on the flow measurement or to convert to standard volume. The OPTISONIC 7300/8300 have analogue input for P & T sensors, the OPTISWIRL 4200 has both integrated. This saves both cost and installation efforts for an external flow computer.

80 GHz radar level measurement

The 80 GHz technology used in the OPTIWAVE series is the most recent and versatile radar technology for level measurement of liquids and solids. Over an identical distance, it presents a highly focused beam with a smaller diameter compared to lower frequency radars, ideal for dusty atmospheres or low reflective media. The small dead zone and narrow beam angle allow for use in both small and tall vessels.

Multiphase measurement

Multiphase measurement allows for the simultaneous measurement of flow rates of oil, water and gas in multiphase mixtures, without the need of separation. This saves time, costs, space and installation efforts compared to conventional test separators. Our magnetic resonance based multiphase flowmeter M-PHASE 5000 offers a full bore, non-radioactive solution for measuring multiphase flow.

E-RTTM pipeline leak detection

E-RTTM is a leading mathematical model for continuous internal monitoring of pipelines. Integrated in our PipePatrol system, it compares measurement data from the actual pipeline with those of a simulated “virtual pipeline” in real time. If the model detects a discrepancy, a leak signature analysis using leak pattern recognition determines whether it is a leak or safe, with outstanding accuracy.
User-friendliness is traditionally a top priority at KROHNE: whether during installation, commissioning, operation or communication – high-end technology only makes sense if it is simple and convenient for the customer to use.

That is why at KROHNE, user-friendliness begins with the electronics. Our development and application engineers have worked for years to develop a comprehensive design known as the General Device Concept – GDC for short.

What does it all mean? First of all, it features a uniform user interface to speed up the commissioning of the devices. Secondly, it boasts extensive device and process diagnostic functions, which can be exceeded by the Toolbox module. Thirdly, it’s easy to integrate fieldbus interfaces such as PROFIBUS®, PROFINET® and FOUNDATION™ fieldbus thanks to the high degree of modularity. And lastly, it’s an electronics package that can be used in various housing shapes.

The high-end position in terms of functionality and accuracy is occupied by the electromagnetic converter IFC 300. It offers full diagnostic capabilities and offers the maximum freedom in defining process parameters and settings for even the most complex measuring applications.

With IFC 100, its diagnostic capabilities and its hazardous area approvals we offer a sophisticated solution for general applications. Optionally it even provides communication protocols like PROFIBUS®, FOUNDATION™ fieldbus and Modbus.

The IFC 050 is the all-purpose device which boasts outstanding performance. Not only when it comes to measuring accuracy and diagnostics but also defines a new benchmark in terms of the price-performance ratio.

The converter MFC 400 is a further development of the GDC concept, providing new performance features such as Entrained Gas Management™ for mass flowmeters, and SIL2/3.

The most recent member of the GDC family is the VFC 200. The converter for Vortex flowmeters is the first 2-wire device in this group and – thanks to its development according to the latest edition of IEC 61508 – ideally suitable for safety-related applications (SIL2).
User-friendliness begins with selecting the right display and control elements.

All devices feature a large, high-contrast display which makes it possible to display plain text information as well as graphic information such as the trend development of the flow.

Operation is simple and convenient thanks to a user-friendly interface with four optical buttons. Not only does it look good – it’s also extremely practical.

For example, the glass cover which protects the display from dirt and dust does not have to be removed during parameterization or operation. Using the Quick Setup menu, the user can quickly adapt the OPTIFLUX to the application.

The converter can communicate with the user in many languages including German, English, French and Spanish.

Human Machine Interface (HMI):
Simply clever, simply well thought-out

OPTICHECK: Service tool for in-situ verification of KROHNE devices

The OPTICHECK is the essential tool for making sure that your installed flowmeters are performing to specification. When you connect the tool in-line on site, it gathers measuring data to ensure that the flowmeter is performing within 1% of the factory calibration. The baseline can be historic repair data from the factory or on-site test results after performing a full verification.

Modular product lines:
Many combinations for one customised solution

At KROHNE, we believe in the concept of modularity when it comes to offering our customers the measuring solution best suited to their process. Both our IFC and MFC converters can be freely combined with all devices in the OPTIFLUX and OPTIMASS lines. This modularity is also reflected in the names of the devices. For example, the OPTIFLUX 1300 is a combination of the OPTIFLUX 1000 sensor and the IFC 300 converter.
The modular product line

Converters

IFC 050 W Display/Blind: 
Wall-mounted

IFC 300 R 
Rack-mounted

IFC 300 W 
Wall-mounted

IFC 100 C 
Standard applications

IFC 100 W 
Wall-mounted

IFC 300 C 
Advanced applications

IFC 300 F 
Field housing

IFC 300 W 
Wall-mounted

IFC 300 R 
Rack-mounted

Flow sensors

OPTIFLUX 1000 
Sandwich (wafer) device for compact installation

OPTIFLUX 2000 
For water and wastewater applications

WATERFLUX 3000 
For small and large flows without requiring inlets or outlets

OPTIFLUX 4000 
For standard and advanced process and custody transfer applications

OPTIFLUX 5000 sandwich, flange 
Ceramic measuring tube: maximum media and abrasion resistance and accuracy

OPTIFLUX 6000 
For hygienic food and pharmaceutical applications

OPTIFLUX 5000 sandwich, flange 
Ceramic measuring tube: maximum media and abrasion resistance and accuracy

OPTIFLUX 6000 
For hygienic food and pharmaceutical applications
The specialists

- **OPTIFLUX 7300 C sandwich, flange**
  - With non wetted capacitive electrodes and ceramic liner

- **BATCHFLUX 5500**
  - For volumetric filling systems in the beverage industry

- **POWERFLUX 4000**
  - For nuclear applications

- **POWERFLUX 5000**
  - For nuclear applications, with ceramic measuring tube

- **TIDALFLUX 2300 F**
  - For partially filled pipelines, Ex Zone 1

- **WATERFLUX 3070**
  - Battery-powered water meter for district metering and custody transfer

Accessories

- **OPTICHECK**
  - Service tool for in-situ verification of field devices

Electromagnetic flowmeters
Electromagnetic flowmeters

The measuring principle

As early as 1832, Michael Faraday tried to determine the speed of the current in the Thames by measuring the voltage induced in flowing water by the earth’s magnetic field. Electromagnetic flow measurement is based on Faraday's law of induction. According to this law, a voltage is induced when an electric conductive fluid flows through the magnetic field of an electromagnetic flowmeter. This voltage is proportional to the flow velocity of the medium.

The induced voltage is picked up either by two electrodes in contact with the medium or by capacitive electrodes with no contact to medium and supplied to a signal converter.

A signal converter amplifies the signal and converts it into a standard signal (4…20 mA) as well as to a frequency/pulse signal (e.g. one pulse for every cubic meter of measured medium that flows through the measuring tube).

Highlights:

- Minimal or no inlets/outlets
- All KROHNE EMF are wet-calibrated in a direct comparison of volumes
- Large choice of liner materials suitable for potable water, wastewater, chemicals, SIP/CIP
- Measurement independent of flow profile
- Custody transfer approvals
- Abrasion and corrosion resistant liners
- Ceramic measuring tubes and liners for flange and sandwich versions, also with non-wetted electrodes (capacitive flowmeter)
- Standard device for partially filled pipes
- 4-wire, 3 x 4…20 mA, HART®, Modbus, FF, PROFINET®-PA/DP, PROFINET® etc.
- Virtual reference option: grounding electrodes and grounding rings can be left out
- Electrical conductivity of media can be used for detection of product change
- For high bubble content, high solids content and pulsating flow
- Secure handling of rapid media changes and pH jumps
- Zero-point stability regardless of changes in media properties
- Nominal sizes DN2.5…3000/1/10…120”
- 3x100% diagnostics (application and device diagnostic, out-of-spec test) exceeds NAMUR requirements
As founder and world market leader in electromagnetic flowmeter technology, we have been impressing our customers with innovation for more than 60 years, innovations that continue to set the standard for the competition. Our OPTIFLUX product line is an excellent example of this: a converter for all applications. A one-of-a-kind diagnostics package that can even look into the process. An intuitive operating concept featuring a quick start function for simple start-up.

Thanks to this unique combination of high-end technology and maximum user-friendliness, you will benefit in a wide range of industries: in the food and beverage industry, where fruit juices, milk and liquid hops must be mixed, dosed and filled under hygienic conditions. In the chemicals industry and in the pulp and paper industry, where our devices deal with acids, alkalis, pastes, sludges and other caustic media, or in the metal and mining industry where media with a high solid content are encountered on a daily basis.

We produce electromagnetic flowmeters in our plants in the Netherlands, Brazil, India and China. It is no wonder that the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany, relies on electromagnetic flowmeters from KROHNE in their calibration systems.
The converter is not the only critical factor in the reproducibility of the measured value during electromagnetic flow measurement. The form stability of the measuring tube under temperature and pressure stresses also plays an important role. To obtain a reliable measurement even with critical media, the measuring tube material, the electrode construction and the process connection must all be taken into account.

The challenge: The new measuring tube material should be highly resistant to caustic, corrosive and abrasive media and show off its superiority to conventional liners made of plastic such as PFA.

KROHNE accepted this challenge and, in close cooperation with FRIATEC AG from Mannheim, Germany, developed a high-performance ceramics for industrial use which can even withstand rapid temperature changes and high mechanical stresses.

When it comes to measuring critical media such as those used in chlorine chemistry, it was also necessary to optimise the electrode construction. The result of these efforts? Using the so-called Cermet electrode has made it possible to develop a 100% gap-free design. In doing so, the metal of the electrode combines with the material of the ceramic to form an insoluble compound when exposed to high temperatures.

In addition to the sandwiched version, our engineers also developed a flanged version. This version not only guarantees easy installation but also minimises the risk of leakage in case of a fire.

It is no wonder that the fields of application of the ceramic electromagnetic flowmeter are so numerous today. They range from measuring acids and alkalis in chemistry to usage in chloride chemistry, to the volumetric filling of liquids in the beverage, pharmaceutical and cosmetics industries.

Electromagnetic flow measurement: Increased safety through the use of high-performance ceramics in flange design
KROHNE offers its customers complete application and process diagnostics as well as an accuracy and linearity test (out-of-spec diagnostics) in addition to the usual device diagnostics for the OPTIFLUX line.

With the indicators supplied by OPTIFLUX and knowledge of the process, the user can detect the following application problems with a high degree of certainty:

- Gas bubbles
- Electrode corrosion, deposits on electrodes
- Short-circuit
- Low conductivity of measured medium
- Partial filling of measuring tube
- Liner damage
- External disrupting magnetic fields
- Disrupted flow profile

During the out-of-spec test, a determination is made, both online and cyclically, as to whether the device is still within its specifications. In particular, the accuracy is tested by feeding a test signal. The linearity of the device and the accuracy of the field current with which the magnetic field is generated are also checked.

Thanks to the 3x100% diagnostics, the OPTIFLUX is much more than a simple flowmeter: it examines the process and provides the user with valuable information. In this respect, the OPTIFLUX even exceeds the requirements of VDI/VDE/NAMUR 2650.
## The modular product line

<table>
<thead>
<tr>
<th>OPTIFLUX 1050</th>
<th>OPTIFLUX 2050</th>
<th>WATERFLUX 3500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sandwich (water) device for compact installation</strong></td>
<td><strong>For water and wastewater applications</strong></td>
<td><strong>For small and large flows without requiring inlets or outlets</strong></td>
</tr>
<tr>
<td>OPTIFLUX 5000 + IF 2050</td>
<td>OPTIFLUX 5000 + IF 2050</td>
<td>WATERFLUX 3500 + IF 2050</td>
</tr>
<tr>
<td><strong>Measuring accuracy</strong></td>
<td>±0.5% of measured value ±0.2% of measured value</td>
<td>±0.5% of measured value ±0.2% of measured value</td>
</tr>
<tr>
<td><strong>Electrical conductivity</strong></td>
<td>≥5 µS/cm (water ≥20 µS/cm)</td>
<td>≥5 µS/cm (water ≥20 µS/cm)</td>
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<tr>
<td><strong>Precession conditions</strong></td>
<td>Solid content max. 10%</td>
<td>Solid content max. 10%</td>
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<tr>
<td><strong>Outputs</strong></td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>HART®, FF, PA, DP, Modbus</td>
<td>HART®, FF, PA, DP, Modbus</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
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<tr>
<td><strong>Protection category</strong>: Compact (C) Wall (W)</td>
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<td>IP66, 67; NEMA 4, 4X</td>
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<td><strong>OPTIFLUX 1100</strong></td>
<td><strong>OPTIFLUX 2100</strong></td>
<td><strong>WATERFLUX 3100</strong></td>
</tr>
<tr>
<td><strong>Measuring accuracy</strong></td>
<td>±0.3% of measured value</td>
<td>±0.3% of measured value</td>
</tr>
<tr>
<td><strong>Electrical conductivity</strong></td>
<td>≥5 µS/cm (water ≥20 µS/cm)</td>
<td>≥5 µS/cm (water ≥20 µS/cm)</td>
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<td><strong>Precession conditions</strong></td>
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<td>Solid content max. 70%</td>
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<td><strong>Outputs</strong></td>
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<td>Current, pulse, status</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>HART®, FF, PA, DP, Modbus</td>
<td>HART®, FF, PA, DP, Modbus</td>
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<tr>
<td><strong>Power supply</strong></td>
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<td>100...230 VAC, 12...24 VDC, 24 VAC/DC</td>
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<td><strong>Protection category</strong>: Compact (C) Wall (W)</td>
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<td>IP66, 67; NEMA 4X, 6</td>
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<td><strong>OPTIFLUX 1300</strong></td>
<td><strong>OPTIFLUX 2300</strong></td>
<td><strong>WATERFLUX 3300</strong></td>
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<tr>
<td><strong>Measuring accuracy</strong></td>
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<td>±0.2% of measured value</td>
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<td><strong>Electrical conductivity</strong></td>
<td>≥1 µS/cm (water ≥20 µS/cm)</td>
<td>≥20 µS/cm</td>
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<td><strong>Precession conditions</strong></td>
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<td>Clean drinking water</td>
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<td><strong>Outputs</strong></td>
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<td>Current, pulse, status</td>
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<tr>
<td><strong>Communication</strong></td>
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<td>HART®, FF, PA, DP, Modbus, PROFINET®</td>
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<td><strong>Power supply</strong></td>
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<td>85...250 VAC, 11...31 VDC, 20.5...26 VAC/DC</td>
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<tr>
<td><strong>Protection category</strong>: Compact (C) Field (F) Wall (W) 19” Rack (R)</td>
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<td>IP66, 67; NEMA 4X, 4X, 6</td>
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</table>

## Specifications
- **Process connection**: ASME B16.5
- **Material electrodes**: Hastelloy®
<table>
<thead>
<tr>
<th>For standard and advanced process and custody transfer applications</th>
<th>Ceramic measuring tube: maximum media and abrasion resistance and accuracy</th>
<th>Ceramic measuring tube: maximum media and abrasion resistance and accuracy</th>
<th>For hygienic food and pharmaceutical applications</th>
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<tr>
<td>OPTIFLUX 4000</td>
<td>OPTIFLUX 5000</td>
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<td>OPTIFLUX 6000 + IFC 100</td>
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<td>+ IFC 100</td>
<td>+ IFC 100</td>
<td>+ IFC 100</td>
<td>+ IFC 100</td>
</tr>
<tr>
<td>±0.3% of measured value</td>
<td>±0.3% of measured value</td>
<td>±0.3% of measured value</td>
<td>±0.3% of measured value</td>
</tr>
<tr>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
</tr>
<tr>
<td>Solid content max. 10%</td>
<td>Solid content max. 10%</td>
<td>Solid content max. 10%</td>
<td>Solid content max. 10%</td>
</tr>
<tr>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
</tr>
<tr>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
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<tr>
<td>IP66, 67; NEMA 4X, 6</td>
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<tr>
<td>IP66, 67; NEMA 4X, 6</td>
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<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPTIFLUX 4300</td>
<td>OPTIFLUX 5300</td>
<td>OPTIFLUX 5300</td>
<td>OPTIFLUX 6300</td>
</tr>
<tr>
<td>+ IFC 300</td>
<td>+ IFC 300</td>
<td>+ IFC 300</td>
<td>+ IFC 300</td>
</tr>
<tr>
<td>±0.2% of measured value</td>
<td>±0.15% of measured value</td>
<td>±0.15% of measured value</td>
<td>±0.2% of measured value</td>
</tr>
<tr>
<td>±1 µS/cm (water ±20 µS/cm)</td>
<td>±1 µS/cm (water ±20 µS/cm)</td>
<td>±1 µS/cm (water ±20 µS/cm)</td>
<td>±1 µS/cm (water ±20 µS/cm)</td>
</tr>
<tr>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
</tr>
<tr>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
</tr>
<tr>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
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<tr>
<td>IP66, 67; NEMA 4X, 6</td>
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<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPTIFLUX 4000</td>
<td>OPTIFLUX 5000</td>
<td>OPTIFLUX 5000</td>
<td>OPTIFLUX 6000</td>
</tr>
<tr>
<td>+ IFC 100</td>
<td>+ IFC 100</td>
<td>+ IFC 100</td>
<td>+ IFC 100</td>
</tr>
<tr>
<td>±0.5% of measured value above</td>
<td>±0.5% of measured value above</td>
<td>±0.5% of measured value above</td>
<td>±0.5% of measured value above</td>
</tr>
<tr>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
<td>±5 µS/cm (water ±20 µS/cm)</td>
</tr>
<tr>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
<td>Solid content max. 70%</td>
</tr>
<tr>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
<td>Current, pulse, status</td>
</tr>
<tr>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
<td>100...230 VAC, 24 VDC</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP66, 67; NEMA 4X, 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Electromagnetic flowmeters

<table>
<thead>
<tr>
<th>Signal converter</th>
<th>IFC 300 F</th>
<th>IFC 070</th>
<th>IFC300 C/CAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring accuracy</td>
<td>±1% of full scale</td>
<td>±0.2% of measured value</td>
<td>± 0.5% of measured value ± 5 mm/s</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>&gt;50 μS/cm (water ≥50 μS/cm)</td>
<td>&gt;20 μS/cm</td>
<td>0.05 μS/cm (demineralized cold water ≥1 μS/cm)</td>
</tr>
</tbody>
</table>

**Process conditions**

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Current, pulse, status</th>
<th>Pulse, status</th>
<th>Current, pulse, status, frequency, limit switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>-</td>
<td>Binary</td>
<td>Control, current</td>
</tr>
<tr>
<td>Communication</td>
<td>HART®, Modbus, PROFINET®</td>
<td>Datalogger/GSM option</td>
<td>HART®, FF, PA, DP, Modbus, PROFINET®</td>
</tr>
</tbody>
</table>

**Power supply**

| Power supply | 24, 115/120, 230/240 VAC | 1 or 2 internal battery, external battery, 100…230 VAC, 24 VDC, 24 VAC/DC |

**Protection category**

<table>
<thead>
<tr>
<th>Protection category: Compact (C)</th>
<th>Wall (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field (F)</td>
<td>IP67; NEMA 4, 4X</td>
</tr>
<tr>
<td>IP67, 68; NEMA 4X, 6, 6P</td>
<td></td>
</tr>
<tr>
<td>IP66, 67; NEMA 4, 4X, 6</td>
<td></td>
</tr>
</tbody>
</table>

**Approvals**

<table>
<thead>
<tr>
<th>Ex Zone 1</th>
<th>DIML R49, MI-001</th>
</tr>
</thead>
</table>

**Measuring sensor**

<table>
<thead>
<tr>
<th>Measuring sensor</th>
<th>TIDALFLUX 2300 F</th>
<th>WATERFLUX 3070</th>
<th>OPTIFLUX 7300 C sandwich, flange</th>
</tr>
</thead>
</table>

**Process connections**

| EN 1092-1 | DN200...1800; PN6, 10 | DN25...300; PN10, 16; DN350...600; PN10 | DN25...85; 100; PN16, 40 |
| ASME B16.5 | 8...72”; 150, 300 lb | 1...12”; 150 lb | 1...4”; 150 lb |

**Temperature ranges**

| Process | -5...+60°C/+23...+140°F | -5...+70°C/+23...+158°F | -40...+100°C/-40...+212°F |
| Ambient | -40...+65°C/-40...+149°F | -40...+65°C/-40...+149°F | -40...+65°C/-40...+149°F |

**Materials**

| Liner | Polyurethane | DN25...600: Rilsan |
| Electrodes | Hastelloy® C22, stainless steel | Stainless steel 1.4301; AISI 304 |
| Sensor housing | Non wetted, capacitive |

**Protection category**

<table>
<thead>
<tr>
<th>Measuring sensor</th>
<th>IP67, 68; NEMA 4, 4X, 6, 6P</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP66, 67; NEMA 4, 4X, 6</td>
<td></td>
</tr>
</tbody>
</table>

**Approvals**

| Ex Zone 1 | - | ATEX |
| Other approvals | - | ACS, DV6W, TZW/UBA, NSF, WRAS, OIML R49, MI-001 | Conform FDA regulations |
### Electromagnetic flowmeters

<table>
<thead>
<tr>
<th>For volumetric fitting systems in the beverage industry</th>
<th>For nuclear applications</th>
<th>For nuclear applications, with ceramic measuring tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATCHFLUX 5500</td>
<td>POWERFLUX 4030/4300 F</td>
<td>POWERFLUX 5000</td>
</tr>
</tbody>
</table>

#### Signal converter
- **IFC 500**
- **AFC 030**

#### Measuring accuracy
- ±0.2% of measured value
- ±1% of measured value
- ±1% of measured value

#### Electrical conductivity
- >5 µS/cm (water >20 µS/cm)
- Water: > 20 µS/cm
- Non water: > 1 µS/cm
- Water: DN2.5...100: > 20 µS/cm
- Non water: DN2.5...100: > 1 µS/cm
- DN4...15: > 5 µS/cm, DN2.5: > 10 µS/cm

#### Process conditions
- Solid content ≤ 10%, gas content ≤ 3%

#### Outputs
- Frequency
- Current

#### Inputs
- -

#### Communication
- -

#### Power supply
- 24 VDC
- 85...250 VAC, 50/60 Hz

#### Protection category: Compact (C)
- Wall (W)
- Field (F)

#### Approvals
- -

#### Measuring sensor
- **POWERFLUX 4030**
- **POWERFLUX 4000**
- **POWERFLUX 5000**

#### Process connections
- **EN 1092-1**
- **ASME B16.5**
- **Temperature ranges**
- **Process**
- **Ambient**

#### Materials
- **Liner**
- Zirconium dioxide
- ETFE, DN25...1000; PFA, DN25...15
- Ceramic

#### Electrodes
- Cermet
- Hastelloy®C, Platinum, stainless steel, titanium, tantalum, low noise
- DN2.5...25: Cermet, DIN40...100: Platinum

#### Sensor housing
- Stainless steel, other materials on request
- DN2.5...15: stainless steel 1.4408, DN25...100: stainless steel 1.4301

#### Protection category
- Measuring sensor
- DN2.5, 4, 6, 25, 40: IP66, 67; NEMA 4, 4X; DN10, 15: IP69K; NEMA 6P
- IP66, 67; NEMA 4, 4X
- IP65, 66; NEMA 4, 4X
- IP45, 66; NEMA 4, 4X

#### Approvals
- Ex [with signal converter]
- -
- Other approvals
- 3A, FDA

#### Other approvals
- TID 5E+06 Rad [ETFE], TID 1E+06 Rad [PFA], IEC 61000-4-4, EN60068-2-6, IEC 60980 - 1989 [300 m/s²], IEC 68-2-24, IEC 68-2-27
- TID 1E+08 Rad, IEC 61000-4, EN 60068-2-6, IEC 60980 - 1989 [300 m/s²], IEC 68-2-24, IEC 68-2-27
Glass devices

DK46, 47, 48, 800
For low flow gas or liquid applications and sample flow monitoring

VA40
For basic applications

VA45
For low pressure gas applications

K20
Plastic tube, for basic water applications
Metal devices

H250 M40
For liquids and gases, modular design from mechanical to fieldbus

H250 M8
For liquids and gases, mechanical or with electronic bargraph indicator

DK32/34
For low liquid and gas flows, compact mechanical indicator, optional MIN/MAX switches and needle valve

DK37 M8
For advanced low liquid and gas flows, mechanical or with electronic indicator

Variable area flowmeters
Variable area flowmeters

The measuring principle

Variable area flowmeters are suitable for the measuring of clean liquids and gases. They consist of upright conical tube made of metal, glass or plastic, in which a sophisticated float moves freely up and down. The flow goes through the tube, which is applied from the bottom to top, causes the float to rise until the forces are in equilibrium.

Three forces are acting on the float:
- The buoyancy force $B$, which depends on the density of the medium and the volume of the float.
- The gravity force $G$, which depends on the mass of the float.
- The flow force $F$ which depends on the float shape and the flow velocity through the variable area between float and tube.

Every flow rate corresponds to a defined variable area resulting from the conical shape of the measuring tube and the specific position of the float. With glass cones, the flow value can be read directly from a scale at the level of the float. With metal cones, the float position is transmitted to an indicator by magnetic means. There is no need for auxiliary power. Different measuring ranges are realised through variations in cone sizes and shapes and in selecting different float shapes and materials.
Maximum reliability when measuring liquids and gases – Since 1921

Since 1921, the name KROHNE has not only stood for innovative and reliable process measuring technology solutions, but also for exact, reliable and long-lasting variable area measuring technology.

Today, as the world’s market leader, we cover a variety of applications with our comprehensive product portfolio of metal, glass and plastic cones.

Typical applications include:

- Measurement of additives such as catalysts, surfactants, foam and corrosion inhibitors, caustic soda, chlorine or sulphur substances, etc.
- Inerting of tanks or containers
- Measurement and dispensing of rinsing mediums (purge meters)
- Sample feed measurement for analyser systems
- Monitoring of lubricants and coolants for bearings and seals for process pumps and rotating machinery
- Hygienic applications in the food and pharmaceutical industries
- Measurement of gases and chemicals in laboratories and test facilities
- Gas/oil burner consumption measurement

For over 30 years, KROHNE has been a reliable partner for nuclear power plant operators and system builders. In this field, KROHNE meets the requirements of KTA 1401, RCC-E, RCC-M and ASME Section III. This authorizes us to mark products with the N stamp and NPT stamp.

Measuring the flow of CO₂ in the inlet lines of the storage tanks in the beverage industry
## Metal devices

<table>
<thead>
<tr>
<th></th>
<th>For liquids and gases, mechanical</th>
<th>For liquids and gases, with electronic bargraph indicator</th>
<th>For liquids and gases, modular design from mechanical to fieldbus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H250 M8 M</td>
<td>H250 M8E</td>
<td>H250 M40</td>
</tr>
</tbody>
</table>

### Measuring accuracy (VDI/VDE 3513-2)
- 1.6%
- 1.6%
- 1.6%

### Outputs
- 4...20 mA
- 4...20 mA
- 11 digit, pulse output

### Limit switches
- 2
- via HART®
- 2

### Totaliser
- via HART®
- HART®, FF, PA
- 11 digit, pulse output

### Communication
- HART®, FF, PA
- HART®, FF, PA
- HART®, FF, PA

### Power supply
- 14.8...30 VDC, (2-wire)
- 12...30 VDC, (2-wire)
- 12...30 VDC, (2-wire)

### Protection category
- IP65
- IP65
- IP66, 68; NEMA 4, 4X, 6

### Process connections
- EN 1092-1
  - DN15...25
  - DN15...25
  - DN15...150
- ASME B16.5
  - 1/2...1”
  - 1/2...1”
  - 1/2...6”
- Threaded
  - 1/2...1” NPT, G1/2...G1
  - 1/2...1” NPT, G1/2...G1
  - 1/2...2” NPT, G1/2...G2
- Special
  - Clamp, aseptic
  - Clamp, aseptic
  - Clamp, aseptic

### Pressure ratings
- EN 1092-1
  - PN16, 40, 63, 100
  - PN16, 40, 63, 100
  - PN16, 40, 63, 100, 160, 250*
- ASME B16.5
  - 150, 300, 600 lb
  - 150, 300, 600 lb
  - 150, 300, 600, 900, 1500, 2500* lb

### Process pressure
- 0...145 bar/0...2102 psi
- 0...145 bar/0...2102 psi
- 0...400 bar/0...5802 psi, optional to 1000 bar/14500 psi

### Measuring ranges
- Liquids
  - 10...6300 l/h
  - 10...6300 l/h
  - 10...120000 l/h
- Gases
  - 0.7...220 m³/h
  - 0.7...220 m³/h
  - 0.7...2800 m³/h

### Temperature ranges
- Process
  - -40...+200°C/-40...+362°F
  - -25...+200°C/-13...+362°F
  - -200...+300°C/-328...+572°F
- Ambient non-Ex
  - -40...+70°C/-40...+128°F
  - -20...+70°C/-4...+128°F
  - -40...+120°C/-40...+248°F
- Ambient Ex
  - -40...+60°C/-40...+140°F
  - -20...+60°C/-4...+140°F
  - -40...+65°C/-40...+149°F

### Materials
- Wetted parts
  - Stainless steel
  - Stainless steel
  - Stainless steel, Hastelloy®, titanium, Monel®, ceramic, PTFE, Inconel®
- Display
  - PPS or stainless steel
  - PPS or stainless steel
  - ATEX, IECEx, FM, NEPSI, CCOE/PESO, KGS, EAC, Inmetro

### Approvals
- Ex
  - ATEX, IECEx, QPS, NEPSI
  - ATEX, IECEx, QPS, NEPSI
  - ATEX, IECEx, FM, NEPSI, CCOE/PESO, KGS, EAC, INMETRO
- Sanitary and material approvals
  - NACE MR 0103/0175
  - NACE MR 0103/0175
  - FDA, EC 1935/2023, NACE MR 0103/0175
<table>
<thead>
<tr>
<th></th>
<th>For liquids and gases in hygienic processes</th>
<th>For acid and corrosive liquids and gases</th>
<th>For horizontal or upside down installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H250 F M40</td>
<td>H250 PTFE</td>
<td>H250 H</td>
<td></td>
</tr>
</tbody>
</table>

**Measuring accuracy** (VDI/VDE 3513)
- 1.6% 1.6% 1.6%

**Outputs**
- 4...20 mA 4...20 mA 4...20 mA

**Limit switches**
- 2 2 2

**Totaliser**
- 2 via HART® 2 2 2

**Communication**
- - HART®, FF, PA HART®, FF, PA HART®, FF, PA

**Power supply**
- - 12...30 VDC, (2-wire) 12...30 VDC, (2-wire) 12...30 VDC, (2-wire)

**Protection category**
- IP66, 68, 69K; NEMA 4, 4X, 6 IP66, 68; NEMA 4, 4X, 6 IP66, 68; NEMA 4, 4X, 6

**Process connections**
- EN 1092-1 DIN 11851, DIN 11864-1, SMS EN 1092-1
- ASME B16.5 1/2…1" 1/2…1" 1/2…6"
- Threaded 1/2…100 DN15…150 1/2…4” NPT, G1/2…G1
- Special Clamp, aseptic Clamp, aseptic Clamp, aseptic

**Pressure ratings**
- EN 1092-1 PN16, 40, 60, 100, 160, 250* PN16, 40, 63, 100, 160, 250*
- ASME B16.5 150, 300, 600, 900 lb 150, 300 lb 1500, 2500*
- Process pressure 0...40 bar/0...580 psi 0...40 bar/0...580 psi 1500, 2500*

**Measuring ranges**
- Liquids 10...64000 l/h 25...60000 l/h 10...120000 l/h
- Gases 0.7...1800 m³/h 1.8...350 m³/h 0.7...2800 m³/h

**Temperature ranges**
- Process -200...+300°C/-328...+572°F -80...+250°C/-112°F...+482°F -200...+200°C/-328...+392°F
- Ambient non-Ex -40...+120°C/-40...+248°F -40...+120°C/-40...+248°F -40...+120°C/-40...+248°F
- Ambient Ex -40...+65°C/-40...+149°F -40...+65°C/-40...+149°F -40...+65°C/-40...+149°F

**Materials**
- Wetted parts Stainless steel PTFE, ceramics Stainless steel, Hastelloy*
- Display Die cast aluminum, polyurethane coating or stainless steel Die cast aluminum, polyurethane coating or stainless steel Die cast aluminum, polyurethane coating or stainless steel

**Approvals**
- Ex On request ATEX, IECEX, FM, NEPSI, CCOE/ PESO, KCS, EAC, INMETRO ATEX, IECEX, FM, NEPSI, CCOE/ PESO, KCS, EAC, INMETRO
- Sanitary and material approvals FDA, EC 1935/2023 FDA NACE MR 0103/0175

*others on request
## Metal devices

<table>
<thead>
<tr>
<th>For low liquid and gas flows, compact mechanical indicator, optional MIN/MAX switches and needle valve</th>
<th>For advanced low liquid and gas flows, mechanical</th>
<th>For advanced low liquid and gas flows, with electronic indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK32, 34</td>
<td>DK37 M8M</td>
<td>DK37 M8E</td>
</tr>
</tbody>
</table>

### Measuring accuracy (VDI/VDE 3513)
- 4.0%  
- 2.5%
- 2.5%

### Outputs
- -  
- 4...20 mA

### Limit switches
- 2  
- via HART®

### Totaliser
- -  
- via HART®

### Communication
- -  
- HART®

### Power supply
- -  
- 14.8...30 VDC

### Protection category
- IP65  
- IP66  
- IP66

### Process connections

#### Connections
- 1/4" NPT, 1/2" NPT, G1/4, cutting clamp, clamping ring, hose connections*  
- 1/4" NPT, 1/2" NPT, G1/4, cutting clamp, clamping ring, hose connections*  
- 1/4" NPT, 1/2" NPT, G1/4, cutting clamp, clamping ring, hose connections*

#### Flange adapter
- DN15, 25/1/2", 1"  
- DN15, 25/1/2", 1"  
- DN15, 25/1/2", 1"

### Pressure ratings

#### EN 1092-1
- PN40, PN100*  
- PN40, PN100*  
- PN40, PN100*

#### ASME B16.5
- 150, 300, 600, 1500, 2500 lb  
- 150, 300, 600, 1500, 2500 lb  
- 150, 300, 600, 1500, 2500 lb

#### Process pressure
- 130 bar/1885 psi, optional to 400 bar/5800 psi  
- 130 bar/1885 psi, optional to 400 bar/5800 psi  
- 130 bar/1885 psi, optional to 400 bar/5800 psi

### Measuring ranges

#### Liquids
- 3...150 l/h  
- 3...250 l/h  
- 3...250 l/h

#### Gases
- 16...4800 l/h  
- 16...8000 l/h  
- 16...8000 l/h

### Temperature ranges

#### Process
- -80...+150°C/-112...+302°F  
- -40...+150°C/-40...+302°F  
- -40...+150°C/-40...+302°F

#### Ambient non-Ex
- -20...+70°C/-4...+128°F  
- -40...+70°C/-40...+128°F  
- -40...+70°C/-40...+128°F

#### Ambient Ex
- -20...+60°C/-4...+140°F  
- -40...+60°C/-40...+140°F  
- -40...+60°C/-40...+140°F

### Materials

#### Wetted parts
- Stainless steel, titanium, Monel®, Hastelloy®, Inconel®  
- Stainless steel, titanium, Monel®, Hastelloy®, Inconel®  
- Stainless steel, titanium, Monel®, Hastelloy®, Inconel®

#### Display
- Die cast aluminum, polyurethane coating  
- PPS or stainless steel  
- PPS or stainless steel

### Approvals

#### Ex
- ATEX, IECEX, FM, NEPSI, Inmetro  
- ATEX, IECEX, QPS, NEPSI, CCPE/PESO, EAC  
- ATEX, IECEX, QPS, NEPSI, CCPE/PESO, EAC

#### Sanitary and material approvals
- NACE MR 0103/0175  
- NACE MR 0103/0175  
- NACE MR 0103/0175
## Glass devices

<table>
<thead>
<tr>
<th>For low flow gas or liquid applications and sample flow monitoring</th>
<th>For basic applications</th>
<th>For low pressure gas applications</th>
<th>Plastic tube, for basic water applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK46, 47, 48, 800</td>
<td>VA40</td>
<td>VA45</td>
<td>K20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measuring accuracy (VDI/VDE 3513)</th>
<th>1.0%, 2.5%, 4.0%</th>
<th>1.0%</th>
<th>2.5%</th>
<th>±2.5% full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outputs</td>
<td>-</td>
<td>4...20 mA</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Limit switches</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Totaliser</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Communication</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power supply</td>
<td>-</td>
<td>14…30 VDC (2-wire)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP65</td>
<td>IP67</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Process connections

<table>
<thead>
<tr>
<th>Connections</th>
<th>1/4” NPT, G1/4, cutting clamp, clamping ring, hose connections*</th>
<th>Threaded, flange, hose connections, hygienic design</th>
<th>Threaded, flange, hose connections</th>
<th>Threaded G1/2…2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange adapter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Pressure ratings

<table>
<thead>
<tr>
<th>EN 1092-1</th>
<th>-</th>
<th>PN40</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.5</td>
<td>-</td>
<td>150 lb</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Process pressure</td>
<td>0...10 bar/0...145 psi</td>
<td>0...10 bar/0...145 psi</td>
<td>1 bar/14.5 psi</td>
<td>0...6 bar/0...72 psi</td>
</tr>
</tbody>
</table>

### Measuring ranges

<table>
<thead>
<tr>
<th>Liquids</th>
<th>0.4…160 l/h</th>
<th>0.4…10000 l/h</th>
<th>-</th>
<th>0.65…25000 l/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gases</td>
<td>0.5…5000 l/h</td>
<td>0.007…310 m³/h</td>
<td>150…60000 l/h</td>
<td>-</td>
</tr>
</tbody>
</table>

### Temperature ranges

<table>
<thead>
<tr>
<th>Process</th>
<th>-5...+100°C/-23...+212°F</th>
<th>-20...+100°C/-4...+212°F</th>
<th>-20...+100°C/-4...+212°F</th>
<th>-20...+100°C/-4...+212°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient non-Ex</td>
<td>-20...+100°C/-4...+212°F</td>
<td>-20...+100°C/-4...+212°F</td>
<td>-20...+100°C/-4...+212°F</td>
<td>-20...+100°C/-4...+212°F</td>
</tr>
<tr>
<td>Ambient Ex</td>
<td>-20...+70°C/-4...+128°F</td>
<td>-20...+85°C/-4...+185°F</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Materials

<table>
<thead>
<tr>
<th>Measuring cone</th>
<th>Borosilicate glass</th>
<th>Borosilicate glass</th>
<th>Borosilicate glass</th>
<th>Polysulphone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process connection</td>
<td>Stainless steel, brass, PVDF</td>
<td>Stainless steel, PVDF</td>
<td>Stainless steel</td>
<td>Polysulphone</td>
</tr>
</tbody>
</table>

### Approvals

<table>
<thead>
<tr>
<th>Ex</th>
<th>ATEX, NEPSI, CCOE/PESO</th>
<th>ATEX</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary and material approvals</td>
<td>FDA</td>
<td>FDA</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*others on request
For liquids

OPTISONIC 3400
For process applications

OPTISONIC 3400 District Heating
For district heating applications

OPTISONIC 4400 HP
For high pressure liquids

OPTISONIC 4400 HT
For high temperature liquids

OPTISONIC 6300
Clamp-on flowmeter

OPTISONIC 6300 P
Portable clamp-on flowmeter

For gas and steam

OPTISONIC 7300
For natural gas, process gas and utility gas applications

OPTISONIC 7300 Biogas
For biogas, landfill and sewage gas applications

OPTISONIC 8300
For superheated steam and high temperature gases
Ultrasonic flowmeters

For custody transfer

- **ALTOSONIC III**
  - For light liquid hydrocarbons

- **ALTOSONIC V LNG**
  - For liquid hydrocarbons, including Liquefied Natural Gas (LNG)

- **ALTOSONIC V12**
  - For custody transfer measurement of natural gas

- **ALTOSONIC 5**
  - For crudes, refined products, cryogenic media and chemicals

- **OPTISONIC 6300 P**
  - Portable clamp-on flowmeter
User-friendliness redefined

Ultrasonic clamp-on flowmeters: no training, no special tools, no open issues

Whether it’s installation, commissioning, calibration or maintenance, KROHNE is the first manufacturer of ultrasonic clamp-on flowmeters to comprehensively deal with and redefine the topic of user-friendliness.

For the OPTISONIC 6300 ultrasonic flowmeter, for example, it takes just 15 minutes from installation to complete commissioning of the device.

This is due not only to the simple installation using patented clamping devices requiring no special tools but also to the signal measuring transducers pre-installed on the rail at the factory.

And commissioning the OPTISONIC 6300 is as simple as it is safe. After being switched on for the first time, the electronic unit carries out an automatic self test. The preset parameters cover 90% of all applications.

An intelligent installation assistant now guides the user step by step through the program – and simultaneously provides support during optimisation of the flow measurement.
Ultrasonic flowmeters

The measuring principle

All KROHNE ultrasonic flowmeters are based on the transit time measurement principle. With this method, acoustic signals are transmitted and received along a diagonal measuring path. A sound wave going downstream with the flow travels faster than a sound wave going upstream against the flow. The difference in transit time is directly proportional to the mean flow velocity of the medium. Multiplied by the inner diameter of the pipe, the volumetric flow can be calculated. Through the use of multiple ultrasonic paths, flow profile disturbances are compensated for.

- Complete portfolio for liquid, gas and steam applications
- Accuracy and reproducibility regardless of medium properties such as viscosity, temperature, density and electrical conductivity
- Diagnostic and compensation functions for disturbed flow profiles and deposits; NAMUR NE107 diagnostics
- No moving parts or components that protrude into the measuring tube
- Low operating and maintenance costs due to non-wearing parts
- Excellent long-term stability, no recalibration required
- High degree of reliability thanks to redundant measuring paths
- High-temperature versions available
- Large dynamic range
- Bi-directional flow measurement
In the early 1980’s KROHNE started with the development of ultrasonic flowmeters which was the start of a continuous stream of innovative products.

In 1996, KROHNE introduced the ALTOSONIC V, the first high precision ultrasonic flowmeter for custody transfer measurement in the petroleum industry.

In 2003 the 3 path UFM 3030 was released, the first all-digital ultrasonic flowmeter. In 2008, KROHNE launched the ALTOSONIC V12, the first custody transfer flowmeter for natural gas certified to OIML R137 class 0.5.

Today KROHNE has a complete portfolio of ultrasonic flowmeters providing unparalleled performance and accuracy for a wide variety of applications in many different industries. Whether it’s measuring cooling water and demineralized water in power plants, controlling dosing and mixing processes in the chemical industry or measuring liquid hydrocarbons in the oil and gas industry, you can put your absolute trust in KROHNE ultrasonic flowmeters in any situation.

Standard in the process industry: Benchmark for custody transfer

Industries:
- Chemical
- Oil & Gas
- Petrochemical/Refineries
- Power Generation
- Water & Wastewater
# Ultrasonic flowmeters

## For liquids

**For process applications**

<table>
<thead>
<tr>
<th>Signal converter</th>
<th>Measuring accuracy</th>
<th>Process conditions</th>
<th>Power supply</th>
<th>Inputs/Outputs</th>
<th>Communication</th>
<th>Protection category</th>
<th>Measuring sensor</th>
<th>Sensor types</th>
<th>Diameter range</th>
<th>Pressure range</th>
<th>Process temperature</th>
<th>Materials measuring sensor (wetted)</th>
<th>Protection category</th>
<th>Hazardous area approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>UFC 400</td>
<td>0.3% ± 2 mm/s of m.v.</td>
<td>Liquids with max. 5% solid content and max. 2% gas content</td>
<td>100...240 VAC, 24 VAC/DC, 24 VDC</td>
<td>Current-, pulse-, status output and control input</td>
<td>HART®, PROFIBUS® PA/DP, FF, Modbus RS485</td>
<td>IP66, 67; NEMA 4X, 6</td>
<td>OPTISONIC 3000</td>
<td>Standard, extended temperature, cryogenic, high viscosity</td>
<td>DN25...3000/1...120”</td>
<td>EN1092-1: PN6...40 ASME B16.5: 150...900 lb</td>
<td>Stainless steel 1.4404 (AISI 316(L)), carbon steel</td>
<td>ATEX, IECEx, cQPSus, NEPSI, DNV, TIIS, PESO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UFC 400</td>
<td>Class 1, 2 or 3</td>
<td>Liquids with max. 5% solid content and max. 2% gas content</td>
<td>100...240 VAC</td>
<td>Current-, pulse-, status output and control input</td>
<td>HART®</td>
<td>IP66, 67; NEMA 4X, 6</td>
<td>OPTISONIC 3000</td>
<td>Standard</td>
<td>DN25...2000 / 1...80”</td>
<td>EN1092-1: PN6...40 ASME B16.5: 150...900 lb</td>
<td>0...180°C/32...356°F</td>
<td>Stainless steel 1.4404 (AISI 316(L)), carbon steel</td>
<td>ATEX, IECEx, cQPSus, NEPSI, DNV, TIIS, PESO</td>
<td></td>
</tr>
<tr>
<td>UFC 400</td>
<td>± 0.5% ± 5 mm/s of m.v.</td>
<td>Liquids with max. 5% solid content and max. 2% gas content</td>
<td>0...240 VAC</td>
<td>Current-, pulse-, status output and control input</td>
<td>HART®</td>
<td>IP66, 67; NEMA 4X, 6</td>
<td>OPTISONIC 4000 HT</td>
<td>-</td>
<td>DN25...1000 / 1...40”</td>
<td>ASME B16.5: 150...900 lb</td>
<td>-45...+600°C/-49...+1112°F</td>
<td>Carbon steel ASTM A106 gr B/A105N</td>
<td>ATEX, IECEx, cQPSus, NEPSI, PESO</td>
<td></td>
</tr>
<tr>
<td>UFC 400</td>
<td>± 1% ± 10 mm/s of m.v.</td>
<td>Liquids with max. 5% solid content and max. 2% gas content</td>
<td>100...240 VAC</td>
<td>Current-, pulse-, status output and control input</td>
<td>HART®, Profibus® PA/DP, FF, Modbus RS485</td>
<td>IP66, 67, NEMA 4X, 6</td>
<td>OPTISONIC 4000 HP</td>
<td>-</td>
<td>DN25...600 / ½...24”</td>
<td>ASME B16.5: 150...2500 lb</td>
<td>-45...+180°C/-40...+356°F</td>
<td>Stainless steel 1.4404 (AISI 316(L))</td>
<td>ATEX, IECEx, cQPSus, NEPSI, PESO</td>
<td></td>
</tr>
</tbody>
</table>

**For district heating applications**

- OPTISONIC 3400
- OPTISONIC 3400 District Heating

**For high temperature liquids**

- OPTISONIC 4400 HT
- OPTISONIC 4400 HP

**For high pressure liquids**

- OPTISONIC 6300
- OPTISONIC 6300 P
- OPTISONIC 7300
- OPTISONIC 7300 Biogas
- OPTISONIC 8300

**Signal converter**

- UFC 400

**Measuring accuracy**

- 0.3% ± 2 mm/s of m.v.
- ± 0.5% ± 5 mm/s of m.v.
- ± 1% ± 10 mm/s of m.v.

**Process conditions**

- Liquids with max. 5% solid content and max. 2% gas content
- Liquids with max. 5% solid content and max. 2% gas content
- Liquids with max. 5% solid content and max. 2% gas content
- Liquids with max. 5% solid content and max. 2% gas content
- Liquids with max. 5% solid content and max. 2% gas content

**Power supply**

- 100...240 VAC, 24 VAC/DC, 24 VDC
- 100...240 VAC
- 100...240 VAC, 24 VAC/DC, 24 VDC
- 100...240 VAC, 24 VAC/DC, 24 VDC
- 100...240 VAC, 24 VAC/DC, 24 VDC

**Inputs/Outputs**

- Current-, pulse-, status output and control input
- Current-, pulse-, status output and control input
- Current-, pulse-, status output and control input
- Current-, pulse-, status output and control input
- Current-, pulse-, status output and control input

**Communication**

- HART®, PROFIBUS® PA/DP, FF, Modbus RS485
- HART®, Profibus® PA/DP, FF, Modbus RS485
- HART®, Profibus® PA/DP, FF, Modbus RS485
- HART®, Profibus® PA/DP, FF, Modbus RS485
- HART®, Profibus® PA/DP, FF, Modbus RS485

**Protection category**

- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6

**Measuring sensor**

- OPTISONIC 3000
- OPTISONIC 3000
- OPTISONIC 4000 HT
- OPTISONIC 4000 HP

**Sensor types**

- Standard, extended temperature, cryogenic, high viscosity
- Standard
- -
- -

**Diameter range**

- DN25...3000/1...120”
- DN25...2000 / 1...80”
- DN25...1000 / 1...40”
- DN25...600 / 1...24”
- DN25...600 / ½...24”

**Pressure range**

- EN1092-1: PN6...40 ASME B16.5: 150...900 lb
- EN1092-1: PN6...40 ASME B16.5: 150...900 lb
- ASME B16.5: 150...900 lb
- ASME B16.5: 1500...2500 lb
- -

**Process temperature**

- -200...+250°C/-328...482°F
- 0...180°C/32...356°F
- -45...+600°C/-49...+1112°F
- -45...+180°C/-40...+356°F
- -25...620°C/-13...+1148°F

**Materials measuring sensor (wetted)**

- Stainless steel 1.4404 (AISI 316(L)), carbon steel
- Stainless steel 1.4404 (AISI 316(L)), carbon steel
- Carbon steel ASTM A106 gr B/A105N
- Stainless steel 1.4404 (AISI 316(L))
- Carbon steel

**Protection category**

- IP67; NEMA 6
- IP67; NEMA 6
- IP67; NEMA 6
- IP67; NEMA 6
- IP67; NEMA 6

**Hazardous area approval**

- ATEX, IECEx, cQPSus, NEPSI, DNV, TIIS, PESO
- ATEX
- ATEX, IECEx, cQPSus, NEPSI, PESO
- ATEX, IECEx, cQPSus, NEPSI, PESO
- ATEX, IECEx, cQPSus, NEPSI, PESO
### Ultrasonic Flowmeters

**Ultrasonic flowmeters**

- For process applications
- For district heating applications
- For high temperature liquids
- For high pressure liquids

**Clamp-on flowmeter**

<table>
<thead>
<tr>
<th>Clamp-on flowmeter</th>
<th>Portable clamp-on flowmeter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPTISONIC 6300</strong></td>
<td><strong>OPTISONIC 6300 P</strong></td>
</tr>
</tbody>
</table>

**UFC 300**

- **UFC 300**
- **UFC 300 P**

<table>
<thead>
<tr>
<th>UFC 300</th>
<th>UFC 300 P</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 1%</td>
<td>± 1%</td>
</tr>
</tbody>
</table>

- Liquids with max. 5% solid content and max. 2% gas content
- 100...240 VAC, 24 VAC/DC, 24 VDC
- Current-, pulse-, status output and control input, 2x Current input
- **HART®**
- USB Slave
- IP66, 67; NEMA 4X, 6

**OPTISONIC 6000**

<table>
<thead>
<tr>
<th>OPTISONIC 6000</th>
<th>OPTISONIC 6000 P</th>
</tr>
</thead>
</table>

- Small, medium, large, stainless steel, extended temperature
- DN15...4000 / ½...160”
- -
- -40...+200°C/-40...+392°F
- Aluminum, stainless steel
- IP67, 68; NEMA 6, 6P
- ATEX, IECEX, cQPSus

For gas and steam

- **GFC 300**
- **GFC 300 P**

<table>
<thead>
<tr>
<th>GFC 300</th>
<th>GFC 300 P</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 1%</td>
<td>± 1%</td>
</tr>
</tbody>
</table>

- Process gases with variable composition
- 100...240 VAC, 24 VAC/DC, 24 VDC
- Current-, pulse-, status output and control input, 2x Current input
- **HART®**, FF, Modbus RS485
- IP66, 67; NEMA 4X, 6

### For natural gas, process gas and utility gas applications

- **OPTISONIC 7300**
- **OPTISONIC 7300 Biogas**
- **OPTISONIC 8300**

### For biogas, landfill and sewage gas applications

- **OPTISONIC 6300**
- **OPTISONIC 6300 P**

### For superheated steam and high temperature gases

- **OPTISONIC 6000**
- **OPTISONIC 6000 P**

<table>
<thead>
<tr>
<th>OPTISONIC 7000</th>
<th>OPTISONIC 7000 Biogas</th>
<th>OPTISONIC 8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- Process conditions
- Liquids with max. 5% solid content and max. 2% gas content
- Process gases with variable composition
- Superheated steam

- **Hazardous area approval**
- ATEX, IECEx, cQPSus, NEPSI, DNV, TIIS, PESO

- **Materials measuring sensor (wetted)**
- Stainless steel 1.4404 (AISI 316(L)), carbon steel
- Aluminum, stainless steel
- ATEX, IECEX, cQPSus

### Power supply

- 100...240 VAC, 24 VAC/DC, 24 VDC
- Battery powered

### Inputs/Outputs

- Current-, pulse-, status output and control input
- 2x Current input

### Communication

- HART®, PROFIBUS® PA/DP, FF, Modbus RS485
- HART®, USB Slave

### Measuring accuracy

- 0.3% ± 2 mm/s of m.v.
- ± 0.5% ± 5 mm/s of m.v.
- ± 1% ± 10 mm/s of m.v.

### Process conditions

- Liquids with max. 5% solid content and max. 2% gas content
- Process gases with variable composition

### Pressure range

- EN1092-1: PN6…40
- ASME B16.5: 150…900 lb

### Diameter range

- DN25…3000/1…120”
- DN25…2000 / 1…80”
- DN25…1000 / 1…40”
- DN25…600 / 1…24”
- DN15…4000 / ½…160”
- DN15…1500 / ½…60”
- DN50…600/2…24”
- -

### Process temperature

- -200…+250°C/-328…482°F
- 0…180°C/32…356°F
- -45…+600°C/-49…+1112°F
- -40…+200°C/-40…+392°F
- -40…+180°C/-40…+356°F
- -25…620°C/-13…+1148°F

### Materials measuring sensor (wetted)

- Stainless steel 1.4404 (AISI 316(L)), carbon steel
- Aluminum, stainless steel
- Stainless steel 1.4404 (AISI 316(L)), carbon steel
- Carbon steel ASTM A106 gr B/A105N

### Protection category

- IP67, 68; NEMA 6, 6P
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 4X, 6
- IP66, 67; NEMA 6
- IP66, 67; NEMA 6
- IP66, 67; NEMA 6
For custody transfer

<table>
<thead>
<tr>
<th></th>
<th>For light liquid hydrocarbons</th>
<th>For crudes, refined products, cryogenic media and chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTOSONIC III</td>
<td>ALTOSONIC 5</td>
<td></td>
</tr>
<tr>
<td><strong>Signal converter</strong></td>
<td>UFC III</td>
<td>UFC 5</td>
</tr>
<tr>
<td><strong>Measuring accuracy</strong></td>
<td>± 0.20% for Reynolds range &gt; 10.000</td>
<td>± 0.15%, No Reynolds limitation ± 0.10%, for Reynolds range &gt; 10.000</td>
</tr>
<tr>
<td><strong>Process conditions</strong></td>
<td>Single products / light hydrocarbons, water content &lt; 10 %, Solids content &lt; 5% (volume), air/gas content &lt; 1% (volume)</td>
<td>Single- and multi products / light...heavy, crudes water content &lt; 10 %, Solids content &lt; 5% (volume), air/gas content &lt; 2% (volume)</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td>Current, pulse, status</td>
<td>Dual pulse, free configurable digital/analogue output</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>Analogue 4…20 mA</td>
<td>Free configurable digital/analogue inputs</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>None</td>
<td>MODBUS, TCP/IP, USB</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>24 V AC/DC (10 VA/10 W)</td>
<td>24 VDC (28 W)</td>
</tr>
<tr>
<td></td>
<td>100…240 VAC (11 W)</td>
<td>100 ... 240 VAC (35 W)</td>
</tr>
<tr>
<td><strong>Protection category:</strong></td>
<td>IP66, IP67</td>
<td>IP66</td>
</tr>
<tr>
<td></td>
<td>Compact (C) Field (F) Wall (W)</td>
<td></td>
</tr>
<tr>
<td><strong>Measuring sensor</strong></td>
<td>UFS III</td>
<td>UFS 5</td>
</tr>
<tr>
<td><strong>Process connections</strong></td>
<td>DN50…1000/PN10…PN40</td>
<td>DN100…1200/PN10…40</td>
</tr>
<tr>
<td></td>
<td>2…40”; 150…900 lb</td>
<td>4…48”; 150…900 lb</td>
</tr>
<tr>
<td><strong>Temperature ranges</strong></td>
<td>-200°C…+250°C/-328°F…+482°F</td>
<td>-200°C…+250°C/-328°F…+482°F</td>
</tr>
<tr>
<td><strong>Ambient (incl. converter)</strong></td>
<td>-40°C…+70°C/-40°F…+158°F</td>
<td>-55°C…+55°C/-67°F…+131°F</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>Stainless steel</td>
<td>Stainless steel</td>
</tr>
<tr>
<td><strong>Protection category</strong></td>
<td>IP66/67; NEMA 4X</td>
<td>IP66; NEMA 4X</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>ATEX, IECEx, DIV1</td>
<td>ATEX, IECEx, DIV1, EAC, NEPSI, INMETRO, CCoE</td>
</tr>
<tr>
<td><strong>Custody transfer</strong></td>
<td>OIML R117 class 0.3, MID MI-005, API, SIRIM</td>
<td>OIML R117 class 0.3, MID MI-005, API, INMETRO, SIRIM</td>
</tr>
</tbody>
</table>
### Ultrasonic Flowmeters

<table>
<thead>
<tr>
<th>ALTOSONIC V12</th>
<th>ALTOSONIC V</th>
</tr>
</thead>
<tbody>
<tr>
<td>For custody transfer measurement of natural gas</td>
<td>For liquid hydrocarbons, including Liquefied Natural Gas (LNG)</td>
</tr>
</tbody>
</table>

#### Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>ALTOSONIC V12</th>
<th>ALTOSONIC V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal converter</td>
<td>GFC V12</td>
<td>UFC-V / UFP-V</td>
</tr>
<tr>
<td>Measuring accuracy</td>
<td>±0.2% of measured value, ±0.1% after linearisation</td>
<td>±0.15% of measured value, turndown ratio 1:10; ±0.20% of measured value, turndown ratio 1:50</td>
</tr>
<tr>
<td>Process conditions</td>
<td>Natural gas</td>
<td>Multi-hydrocarbons, viscosity 0.1...1500 cSt</td>
</tr>
<tr>
<td>Outputs</td>
<td>4 x digital</td>
<td>4 x digital, 1 x analogue</td>
</tr>
<tr>
<td>Inputs</td>
<td>Binary</td>
<td>6 x digital, 16 x analogue</td>
</tr>
<tr>
<td>Communication</td>
<td>Modbus 2 x RS485</td>
<td>Modbus RS422/485</td>
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<tr>
<td>Power supply</td>
<td>24 VDC</td>
<td>100...240 VAC; 24 VAC/DC</td>
</tr>
<tr>
<td>Protection category:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compact (C)</td>
<td>IP66; NEMA X4</td>
<td>IP65, 67; NEMA 4, 6</td>
</tr>
<tr>
<td>Field (F)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wall (W)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Measuring sensor</td>
<td>ALTOSONIC V12</td>
<td>ALTOSONIC V</td>
</tr>
<tr>
<td>Process connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 1092-1</td>
<td>DN100...600</td>
<td>DN100...600</td>
</tr>
<tr>
<td>ASME B16.5</td>
<td>4...64&quot;; 150...2500 lb</td>
<td>4...40&quot;; 150...1500 lb</td>
</tr>
<tr>
<td>Temperature ranges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>-40...+100°C/-40...+212°F</td>
<td>-200...+250°C/-328...+428°F</td>
</tr>
<tr>
<td>Ambient (incl. converter)</td>
<td>-40...+65°C/-40...+149°F</td>
<td>-55...+60°C/-67...+140°F</td>
</tr>
<tr>
<td>Materials</td>
<td>LT carbon steel, stainless steel and duplex optional</td>
<td>Steel, stainless steel, Hastelloy® C4, duplex</td>
</tr>
<tr>
<td>Protection category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring sensor</td>
<td>IP66; NEMA 4X</td>
<td>IP65, 67; NEMA 4, 6</td>
</tr>
<tr>
<td>Approvals</td>
<td>ATEX, FM, CSA, IECEx, EAC RU</td>
<td>ATEX, FM, CSA,</td>
</tr>
<tr>
<td>Custody transfer</td>
<td>OIML R137 class 0.5, MID, AGA 9, ISO 17089</td>
<td>MID Mi-005, Gosstandard, OIML R-117-1 class 0.3, API</td>
</tr>
</tbody>
</table>
The modular product line

**Converters**

- **MFC 400 C**
  General purpose

- **MFC 400 F**
  Field housing

- **MFC 010**
  Modbus converter for economical OEM system integration

**Flow sensors**

- **OPTIMASS 1000**
  For universal applications and process control

- **OPTIMASS 2000**
  Dual or four straight tube design for bulk flows for custody transfer up to DN400/16”

- **OPTIMASS 3000**
  For low flow and dosing applications

- **OPTIMASS 7000**
  For advanced applications, with single straight measuring tube
Mass flowmeters

The specialists

OPTIGAS 4010
Specially designed for CNG and LPG in dispensing systems

OPTIBATCH 4011
Specially designed for linear and rotating filling machines

OPTICHECK
Service tool for in-situ verification of field devices

Accessories

OPTIMASS 6000
The standard high-performance meter for the process industry, up to DN300/12"

Mass flowmeters
When it comes to selecting a flowmeter for your application, the OPTIMASS range covers all bases. Our engineers have developed a family of meters from small to large, for high pressure, cryogenic temperatures and high temperatures.

All meters have been designed to reduce constraints on the user with regards to installation – simply follow good engineering practice to obtain the desired results. Another highlight is the diagnostics platform, which is unique in this class of device. It not only monitors the device itself but also the process environment.

Within the system, the diagnostics software monitors the process temperature and a series of auxiliary values such as the driver energy, in order to ultimately confirm the condition of the process medium. OPTIMASS can even generate intelligent warning messages when a certain proportion of gas bubbles or solids is exceeded, providing valuable information about the process itself.
Mass flowmeters work on the Coriolis principle. The mass flow rate of liquids and gases can be calculated from the deformation of the measuring tube caused by the flow. The media density can also be derived from the resonance frequency of the oscillating tube. Two sensor coils are used to calculate the Coriolis effect. If there is no flow, both sensors record the same sinusoidal signal. Once the flow begins, the Coriolis force acts on the flowing mass particles of the medium and causes the measuring tube to deform, resulting in a phase shift between the sensor signals. The sensors measure the phase shift of the sinusoidal vibrations. This phase shift is directly proportional to the mass flow rate.

### Highlights:

- **Entrained Gas Management EGM™:** no loss of measurement with gas entrainments up to 100%
- **Indication or configurable alarm to improve processes by identifying transient gas entrainments**
- **Not susceptible to installation effects:** can be installed regardless of type of installation (no straight inlets/outlets) and external influences such as tube vibrations
- **Only straight tube measuring devices for custody transfer applications in the highest OIML accuracy class of 0.3, approved to OIML R117/MID**
- **Flow rates from 0.0003 to 4,600 t/h**
- **4-wire, 3 x 4...20 mA, HART®, Modbus, FF, PROFIBUS®-PA/DP, PROFINET etc.**
- **Minimal pressure loss with straight tube measuring devices: reduced power consumption of pumps**
- **High density accuracy, not affected by medium and temperature changes**
- **Suitable for highly viscous media, inhomogeneous mixtures, media with solid content or gas inclusions**
- **Modular design for quick and easy replacement of electronics and/or flow sensors**
- **Self-draining and easy to clean**
- **OPTIMASS 7000 suitable for highly sensitive media as well as media requiring low flow velocity**
- **Variety of wetted materials [e.g. for corrosive media]: titanium, stainless steel, HASTELLOY®, tantalum, duplex and superduplex**
- **Options for secondary containment up to 100 bar/1450 psi (OPTIMASS 2000 up to 150 bar/2176 psi)**
- **Turnkey solutions for the operation of batch plants**
Superior performance – Even with quick temperature and media changes

Just how accurate and reliable a mass flowmeter actually is becomes obvious when constant parameters such as medium, temperature or pressure undergo sudden changes. The OPTIMASS series from KROHNE sets the standard. With high performance straight and bent tube designs.

KROHNE offers superior straight and bent tube design mass flowmeters, so the customer now can choose the best meter for their application. We offer a unique straight tube design for minimal pressure drop, highly viscous and slurry applications. The superior bent tube design is suitable for cryogenic, high temperature applications and extremely high pressures.

The MFC 400 converter offers excellent zero stability, advanced density and concentration measurement and a high performance with air entrainment. With new Entrained Gas Management™ the meter is now able to measure from 0 % to 100 % gas entrainment.

Industries:
- Chemical
- Pharmaceutical
- Food & Beverage
- Oil & Gas
- Petrochemical
- Pulp & Paper
- Metal & Mining
- Power Generation
- Water & Wastewater
- Marine
### The modular product line

<table>
<thead>
<tr>
<th>Device, EN 1092-1</th>
<th>OPTIMASS 1000</th>
<th>OPTIMASS 2000</th>
<th>OPTIMASS 3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN15…50</td>
<td>DN100…400</td>
<td>DN1…4</td>
<td></td>
</tr>
<tr>
<td>Connection EN 1092-1</td>
<td>DN15…100</td>
<td>DN100…400</td>
<td>DN15</td>
</tr>
<tr>
<td>Device, ASME B16.5</td>
<td>1/2…2”</td>
<td>4…16”</td>
<td>1/25…4/25”</td>
</tr>
<tr>
<td>Connection ASME B16.5</td>
<td>1/2…4”</td>
<td>4…16”</td>
<td>1/2”</td>
</tr>
<tr>
<td>Screw-on connector NPT</td>
<td>-</td>
<td>-</td>
<td>1/4” (up to 300 bar; 4351 psi)</td>
</tr>
<tr>
<td>Pressure rating EN 1092-1</td>
<td>PN40, 63, 100</td>
<td>PN16, 40, 63, 100, 160</td>
<td>PN40, 63</td>
</tr>
<tr>
<td>Pressure rating ASME B16.5</td>
<td>150, 300, 600 lb</td>
<td>150, 300, 600, 900, 1500 lb</td>
<td>150, 300, 600 lb</td>
</tr>
<tr>
<td>Secondary pressure containment</td>
<td>100 bar/1450 psi</td>
<td>40 bar/580 psi (opt. 150 bar/2175 psi)</td>
<td>30 bar/435 psi</td>
</tr>
<tr>
<td>Measuring ranges</td>
<td>48…1700000 psi</td>
<td>1560…4600000 psi/kg</td>
<td>30 bar/435 psi</td>
</tr>
<tr>
<td>Process temperature</td>
<td>-40…+130°C/-40…+266°F</td>
<td>-40…+130°C/-49…+266°F</td>
<td>-40…+150°C/-40…+300°F</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-40…+65°C/-40…+149°F</td>
<td>-40…+65°C/-40…+149°F</td>
<td>-40…+65°C/-40…+149°F</td>
</tr>
<tr>
<td>Sensor materials</td>
<td>Stainless steel</td>
<td>Stainless steel, duplex, super duplex</td>
<td>Stainless steel, Hastelloy® C22</td>
</tr>
<tr>
<td>Protection category sensor</td>
<td>IP67; NEMA 4X</td>
<td>IP67; NEMA 4X</td>
<td>IP67; NEMA 4X</td>
</tr>
<tr>
<td>Ex-Approvals</td>
<td>ATEX, FM, CSA, NEPSI, IECEx</td>
<td>ATEX, FM, CSA, NEPSI, IECEx</td>
<td>ATEX, FM, CSA, NEPSI, NEPSI</td>
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<tr>
<td>Sanitary &amp; material approvals</td>
<td>3A, EHEDG</td>
<td>NACE</td>
<td>NACE</td>
</tr>
<tr>
<td>Custody transfer</td>
<td>-</td>
<td>OIML R117, Inmetro, NTEP, MI 005, MI 002</td>
<td>-</td>
</tr>
<tr>
<td>Functional Safety</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The specialists

<table>
<thead>
<tr>
<th>Product</th>
<th>OPTIMASS 7010</th>
<th>OPTIBATCH 4011</th>
<th>OPTIMASS 7000</th>
<th>OPTIGAS 4010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>Liquid: ±0.1%</td>
<td>Liquid: ±0.15%</td>
<td>Gas: ±0.35%</td>
<td>Liquid: ±0.5% per batch</td>
</tr>
<tr>
<td>Features</td>
<td>Density: ±2 kg/m³ (±0.5 kg/m³)</td>
<td>Mass: ±0.15%</td>
<td>Volume: ±0.2%</td>
<td>Gas: ±0.5% per batch</td>
</tr>
<tr>
<td>Current, pulse/frequency, status</td>
<td>Current, pulse/frequency, status</td>
<td>Current, pulse/frequency, status</td>
<td>Pulse/frequency</td>
<td>-</td>
</tr>
<tr>
<td>Binary</td>
<td>Binary</td>
<td>Binary</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power supply</td>
<td>85…250 VAC; 11…31 VDC;</td>
<td>Modbus (configuration)</td>
<td>-</td>
<td>Modbus</td>
</tr>
<tr>
<td>Communication</td>
<td>HART®, FF, PA, DP, Modbus, PROFINET®</td>
<td>Modbus</td>
<td>-</td>
<td>Modbus</td>
</tr>
<tr>
<td>Process pressure</td>
<td>Process pressure: 10 bar/145 psi</td>
<td>-</td>
<td>Process pressure: 350 bar/5076 psi static; 300 bar/4351 psi cyclical</td>
<td>-</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-</td>
<td>0…+93°C/-40…+200°F</td>
<td>-</td>
<td>6…+4200 kg/h</td>
</tr>
<tr>
<td>stainless steel, Hastelloy® C22, duplex steel</td>
<td>Stainless steel, Hastelloy® C22, titanium, tantalum</td>
<td>Stainless steel</td>
<td>Stainless steel</td>
<td>-</td>
</tr>
<tr>
<td>IP67; NEMA 4X</td>
<td>IP67; NEMA 4X</td>
<td>-</td>
<td>IP67; NEMA 4X</td>
<td>-</td>
</tr>
<tr>
<td>ATEX, cFMus, IECEx, NEPSI</td>
<td>ATEX, FM, CSA, NEPSI, IECEx</td>
<td>-</td>
<td>ATEX, NEPSI</td>
<td>-</td>
</tr>
<tr>
<td>3A, EHEDG, NACE</td>
<td>EHEDG, 3A, ASME Bioprocessing</td>
<td>-</td>
<td>3A, ASME Bioprocessing, EHEDG</td>
<td>-</td>
</tr>
<tr>
<td>OIML R117, OIML R137, Inmetro, NTEP, MI 005, MI 002</td>
<td>OIML R117, Inmetro, NTEP, MI 005</td>
<td>-</td>
<td>PTB, OIML R139 (pending)</td>
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</tr>
<tr>
<td>SIL2/3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</table>
OPTISWIRL 4200 C flange
For utility applications and energy management systems

OPTISWIRL 4200 C sandwich
All advantages of the OPTISWIRL 4200 in a space-saving sandwich design; centering rings guarantee an easy installation without any offset

OPTISWIRL 4200 F flange

OPTISWIRL 4200 F sandwich
Remote version with field housing converter with connection cable up to 50 m/164 ft
**Vortex flowmeters**

**OPTISWIRL 4200 Dual version**
With two independent measuring sensors and two signal converters for multiproduct pipelines, redundant measurement and increased safety demands

**OPTISWIRL 4200 C 1R / 2R**
With integrated nominal diameter reduction for space-saving and cost-saving installations

**Accessories**

**OPTICHECK**
Service tool for in-situ verification of field devices

**Stainless steel centering rings for easy mounting**
The measuring principle

The function of vortex flowmeters is based on the principle of the Karman vortex street: Opposing vortices form behind an object in a stream. The measuring tube contains a bluff body, behind which vortex shedding occurs. The frequency of the vortex shedding is proportional to the flow rate. The shedded vortices are picked up and counted as pressure surges by a piezo crystal in the sensor.

Vortex flowmeters

Highlights:

- Integrated pressure and temperature compensation for fluctuating pressures and temperatures
- Temperature compensation for saturated steam is a standard feature
- All devices feature 2-wire technology
- Excellent long-term stability thanks to sturdy construction
- High measuring accuracy
- Maintenance-free sensor
- Non-wearing, fully-welded stainless steel construction with high resistance to corrosion, pressure and temperature
- OPTISWIRL 4200: Advanced Vortex Frequency Detection (AVFD) – state-of-the-art technology for digital signal filtering
- Instantly ready for operation (plug & play)
- SIL2 certified
- Use in hazardous areas
- Dual version for redundant measurement and multiproduct pipelines
- Integrated reduction of nominal diameter for space-saving installation and large measuring spans
- Redundant Data Management: Easy exchange of electronics without loss of calibration and parametrisation data
- FAD (Free Air Delivery) functionality
- Gross and net heat calculation to support advanced energy management
Allrounder with integrated pressure and temperature compensation

Vortex flowmeters are suitable for a wide range of media. This is particularly true of the KROHNE OPTISWIRL: It measures both conducting and non-conducting liquids as well as all industrial gases. It also measures saturated steam and superheated steam, compressed air and nitrogen, liquefied gas and flue gas, demineralized water and boiler feed water, solvents and heat transfer oil.

The KROHNE OPTISWIRL even masters fluctuating pressures and temperatures thanks to integrated pressure and temperature compensation.

The collection of the volume flow and the process data at only one point ensures accurate density compensation and combines high system accuracy with low investment costs. Internal gross and net heat calculation complete the device to be a reliable partner for advanced energy management.

Highest reliability and lowest probability of failure: The new OPTISWIRL 4200 was designed for safety related applications right from the start. Both its hardware and its software are developed to meet the strict requirements of SIL 2 safety functions. On demand as well as continuously!
## Vortex flowmeters

<table>
<thead>
<tr>
<th>For utility applications and energy management systems</th>
<th>All advantages of the OPTISWIRL 4200 in a space-saving sandwich design; centering rings guarantee an easy installation without any offset</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPTISWIRL 4200 C/F flange</strong></td>
<td><strong>OPTISWIRL 4200 C/F sandwich</strong></td>
</tr>
</tbody>
</table>

### Signal converter

<table>
<thead>
<tr>
<th>VFC 200 C/F</th>
<th>VFC 200 C/F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measuring accuracy</strong></td>
<td><strong>Measuring accuracy</strong></td>
</tr>
<tr>
<td>$Re &gt; 20000\pm0.75%$ for liquids</td>
<td>$Re &gt; 20000\pm0.75%$ for liquids</td>
</tr>
<tr>
<td>$Re &gt; 20000\pm1%$ for gases and steam</td>
<td>$Re &gt; 20000\pm1%$ for gases and steam</td>
</tr>
<tr>
<td>$10000 &lt; Re &lt; 20000\pm2%$ for liquids, gases and steam</td>
<td>$10000 &lt; Re &lt; 20000\pm2%$ for liquids, gases and steam</td>
</tr>
<tr>
<td><strong>Repeatability</strong></td>
<td><strong>Repeatability</strong></td>
</tr>
<tr>
<td>$\pm0.1%$</td>
<td>$\pm0.1%$</td>
</tr>
<tr>
<td><strong>Product temperature</strong></td>
<td><strong>Product temperature</strong></td>
</tr>
<tr>
<td>$-40...+240^\circ\text{C}/-40...+464^\circ\text{F}$</td>
<td>$-40...+240^\circ\text{C}/-40...+464^\circ\text{F}$</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td><strong>Outputs</strong></td>
</tr>
<tr>
<td>mA, pulse/frequency/status/limit switch</td>
<td>mA, pulse/frequency/status/limit switch</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td><strong>Input</strong></td>
</tr>
<tr>
<td>mA</td>
<td>mA</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td><strong>Communication</strong></td>
</tr>
<tr>
<td>HART®, PA, FF</td>
<td>HART®, PA, FF</td>
</tr>
<tr>
<td><strong>Power supply (Non Ex)</strong></td>
<td><strong>Power supply (Non Ex)</strong></td>
</tr>
<tr>
<td>12...30 VDC</td>
<td>12...30 VDC</td>
</tr>
<tr>
<td><strong>Power supply (Ex)</strong></td>
<td><strong>Power supply (Ex)</strong></td>
</tr>
<tr>
<td>12...36 VDC</td>
<td>12...36 VDC</td>
</tr>
<tr>
<td><strong>Protection category</strong></td>
<td><strong>Protection category</strong></td>
</tr>
<tr>
<td><strong>Housing material</strong></td>
<td><strong>Housing material</strong></td>
</tr>
<tr>
<td>Aluminum, stainless steel</td>
<td>Aluminum, stainless steel</td>
</tr>
</tbody>
</table>

### Measuring sensor

<table>
<thead>
<tr>
<th>VFM 4000 flange</th>
<th>VFM 4000 sandwich</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functionality</strong></td>
<td><strong>Functionality</strong></td>
</tr>
<tr>
<td>FAD</td>
<td>FAD</td>
</tr>
<tr>
<td>Gross and net heat calculation</td>
<td>Gross and net heat calculation</td>
</tr>
<tr>
<td><strong>Measuring sensor</strong></td>
<td><strong>Measuring sensor</strong></td>
</tr>
<tr>
<td>1.4404/316L, Hastelloy® C22</td>
<td>1.4404/316L, Hastelloy® C22</td>
</tr>
<tr>
<td>1.4435/316L, Hastelloy® C276</td>
<td>1.4435/316L, Hastelloy® C276</td>
</tr>
<tr>
<td><strong>Protection category</strong></td>
<td><strong>Protection category</strong></td>
</tr>
<tr>
<td>IP66, 67</td>
<td>IP66, 67</td>
</tr>
<tr>
<td>1 or 2 steps reduced bore meter</td>
<td>-</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td><strong>Approvals</strong></td>
</tr>
<tr>
<td>ATEX, FM (USA and Canada), IECEx</td>
<td>ATEX, FM (USA and Canada), IECEx</td>
</tr>
<tr>
<td><strong>Functional Safety</strong></td>
<td><strong>Functional Safety</strong></td>
</tr>
<tr>
<td>SIL2</td>
<td>SIL2</td>
</tr>
</tbody>
</table>
Vortex flowmeters

For utility applications and energy management systems
All advantages of the OPTISWIRL 4200 in a space-saving sandwich design; centering rings guarantee an easy installation without any offset.

With two independent measuring sensors and two signal converters multiproduct pipelines, redundant measurement and increased safety demands.

<table>
<thead>
<tr>
<th>Signal converter</th>
<th>VFC 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring accuracy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Re &gt; 20000 ±0.75% for liquids</td>
</tr>
<tr>
<td></td>
<td>Re &gt; 20000 ±1% for gases and steam</td>
</tr>
<tr>
<td></td>
<td>10000 &lt; Re &lt; 20000 ±2% for liquids, gases and steam</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.1%</td>
</tr>
<tr>
<td>Product temperature</td>
<td>-40...+240°C/-40...+464°F</td>
</tr>
<tr>
<td>Outputs</td>
<td>mA, pulse/frequency/status/limit switch</td>
</tr>
<tr>
<td>Input</td>
<td>mA</td>
</tr>
<tr>
<td>Communication</td>
<td>HART®, PA, FF</td>
</tr>
<tr>
<td>Power supply (Non Ex)</td>
<td>12...30 VDC</td>
</tr>
<tr>
<td>Power supply (Ex)</td>
<td>12...36 VDC</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP66, 67, optional IP66, 68</td>
</tr>
<tr>
<td>Housing material</td>
<td>Aluminum, stainless steel</td>
</tr>
<tr>
<td>Functionality</td>
<td>FAD</td>
</tr>
<tr>
<td>Gross and net heat calculation</td>
<td>Gross and net heat</td>
</tr>
<tr>
<td>Measuring sensor</td>
<td>FAD</td>
</tr>
<tr>
<td>Process connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 1092-1</td>
</tr>
<tr>
<td></td>
<td>DN25...100; PN16, 25, 40, 63, 100</td>
</tr>
<tr>
<td></td>
<td>ASME B16.5</td>
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<tr>
<td></td>
<td>1...4&quot;; 150, 300, 600, 900, 1500 lb</td>
</tr>
<tr>
<td>Temperature ranges</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>-40...+240°C/-40...+464°F</td>
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<tr>
<td>Ambient (Non Ex)</td>
<td>-40...+85°C/-40...+185°F</td>
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<tr>
<td>Ambient (Ex)</td>
<td>-40...+65°C/-40...+149°F</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
</tr>
<tr>
<td>Measuring sensor</td>
<td>1.4404/316L, Hastelloy® C22</td>
</tr>
<tr>
<td>Sensor seal</td>
<td>1.4435/316L, Hastelloy® C276</td>
</tr>
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<td>Protection category</td>
<td></td>
</tr>
<tr>
<td>Measuring sensor</td>
<td>IP66, 67</td>
</tr>
<tr>
<td>Reduction of nominal diameter</td>
<td>1 or 2 steps reduced bore meter</td>
</tr>
<tr>
<td>Approvals</td>
<td></td>
</tr>
<tr>
<td>Ex</td>
<td>ATEX, FM (USA and Canada), IECEx</td>
</tr>
<tr>
<td>Functional Safety</td>
<td>SIL2</td>
</tr>
</tbody>
</table>
Differential pressure transmitters

Compact

OPTIBAR DP 3050
World’s most compact differential pressure transmitter for pressure, level and flow applications

Process

OPTIBAR DP 7060
Advanced differential pressure transmitter for pressure, level, flow, interface and density applications

Primary flow elements

Orifice plates

OPTIBAR OP 1100/1110
Raised face (RF) or ring type joined (RTJ) designs

OPTIBAR OP 3100/3200
With flat sealing face and corner taps

OPTIBAR OP 4100
With annular chamber and corner taps

OPTIBAR OP 5100/5110
Assembly with measuring flanges (ASME 16.36)

Averaging pitot tubes

OPTIBAR PT 2000
With multiple impact-sensing ports

Other flow elements such as venturis, nozzles, cone and wedge meters facc. to ISO or ASME standards available on request.

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Averaging pitot tubes

OPTIBAR PT 2000
With multiple impact-sensing ports

Other flow elements such as venturis, nozzles, cone and wedge meters facc. to ISO or ASME standards available on request.
Accessories

OPTIBAR MR 4300
Orifice meter run assembly with corner taps and annular chambers

OPTIBAR MR 6300
Cone meter run with single taps

For safe and easy installation of pressure transmitters in the process:
- Manometer and barstock valves, 3-/5-way valve manifolds, also for steam and high temperature applications
- Condensate pots for steam applications
- Fittings, seals, blind-plugs, oval flange adapter and gauge snubber

Differential pressure flow measurement
Differential pressure flow measurement

The measuring principle

For over 100 years, the process industry has used the Differential Pressure (DP) flow measurement method to determine the volume or mass flow of liquids, gases and steam in commercial use.

With DP, pressure is measured at two points across a restriction in the line – for example, a primary element. Using the Bernoulli equation, the difference in pressure between these two points indicates flow velocity and, because the pipe size is known, a volume flow rate can be calculated.

Today, DP is being constantly improved and adapted to meet the requirements of modern processes, and KROHNE is helping to lead the way.

Pitot tube

As an alternative to orifice plates, the pitot tube provides a simple, cost-efficient and long-term stable flow measurement solution for:

- Applications that require a low pressure loss
- Retrofitting of existing pipelines with flow measurement
- Line sizes >DN 300/12" 
- Low pressure gases

A pitot tube consisting of two chambers is placed in the pipe transversely to the direction of the flow. An upstream chamber faces the flow and a downstream chamber is placed at the back of the probe.

The impact of the medium against the upstream chamber causes an overpressure that adds to the static pressure in the pipe. Depending on its shape, a negative pressure builds up in the downstream chamber. Both pressures are transmitted to a differential pressure transmitter that converts the difference between the two chambers into an output signal.

Flow velocity is calculated using the differential pressure and medium density $v = k \times \sqrt{2 \times \Delta p / \rho}$. Volume flow is calculated from the flow velocity and the crosssection area $qv = v \times A$. 
Orifice plates

Orifice plates work by restricting the flow of the liquid, gas or steam being monitored. According to the Bernoulli equation, the flow velocity increases at the restriction, and the static pressure drops. The difference in pressure at the measuring point is a measure for the flow velocity of the medium.

Volume flow is calculated from the flow velocity and the cross-section area: \( qv = v \times A \)

The diameter ratio \( \beta = \frac{d}{D} \) is determined for each measuring point, allowing each one to be optimised for specific requirements, including shorter inlet/outlet runs, lower pressure losses and in some instances smaller overall uncertainty.

Orifice plate primary elements are worldwide standardised according to ISO 5167.
Introducing OPTIBAR differential pressure flow measurement products

Today, in over 40% of all flow applications, differential pressure meters are still the first choice. With the release of the OPTIBAR series, KROHNE is extending its process instrumentation portfolio to meet this demand.

The range includes a variety of modular transmitters, application specific diaphragm seals, primary elements, accessories, valves and manifolds. This offers you the option to buy, from one source, single DP pressure transmitters as well as complete DP flow measuring points, with matched, preconfigured components, (wet) calibrated and ready to install.

Modular design concept
Complete measuring points

KROHNE will provide you with all necessary instruments for your flow measurement point: from primary elements, up to a flow computer for gas, liquid and steam calculations.

For measurement uncertainties due to changing process conditions, the flow computer holds appropriate algorithms for all primary elements. By adding temperature and pressure sensors, density compensation or gross and net energy calculations are also possible.

When commissioning a complete measuring point from us, investment costs like primary element design, component assembly up to pre-parametrisation of the differential pressure transmitter and flow computer are all less. And there are no additional costs for piping, installation and testing at the measuring point.

KROHNE’s approach to design also guarantees that up to 70 % of potential leakage points will be eliminated, cutting service and maintenance costs.

Industries:
- Oil & Gas
- Chemical
- Petrochemical
- Heating, Ventilation and Air Conditioning (HVAC)
- Power Generation
- Metal & Mining
- Food & Beverage
## Orifice plates

<table>
<thead>
<tr>
<th>Raised face (RF) or ring type joined (RTJ) designs</th>
<th>With flat sealing face and corner taps</th>
<th>With annular chamber and corner taps</th>
<th>Assembly with measuring flanges acc. ASME 16.36</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTIBAR OP 1100/1110</td>
<td>OPTIBAR OP 3100/3200</td>
<td>OPTIBAR 4100</td>
<td>OPTIBAR OP 5100/5110</td>
</tr>
</tbody>
</table>

### Medium
- Gas, liquid and steam
- Gas, liquid and steam
- Gas, liquid and steam
- Gas, liquid and steam

### Type
- Separate
- Compact, separate
- Separate
- Separate

### Sizing
- ASME PTC 19.5 2004; GOST 8.586; RD 50-411-83
- ASME PTC 19.5 2004; GOST 8.586; RD 50-411-83

### Uncertainty / Accuracy
- Uncertainty of C: ±0.5...0.8%
- Uncertainty of C: ±0.5...0.8%
- Uncertainty of C: ±0.5...0.8%
- Uncertainty of C: ±0.5...0.8%

### Turn down ratio
- 6:1
- 6:1
- 6:1
- 6:1

### Pressure loss
- 40...95%
- 40...95%
- 40...95%
- 40...95%

### Max. pressure
- 300...2500 lb
- PN10...100
- PN10...100
- 300...2500 lb

### Max. temperature
- +400°C/+752°F
- +400°C/+752°F
- +400°C/+752°F
- +400°C/+752°F

### Line size
- 1…24”
- DN50…600
- DN50…600
- 1…24”

### Material primary element
- 316L
- 316L
- 316L
- 316L

### Material mounting parts
- n.e / Soft Steel, 316L
- 316L
- 316L
- SA105, 316L

### Optional temperature probe
- no
- no
- no
- no

### Differential pressure transmitters for flow applications, already with integrated absolute pressure measurement for combination with all orifice plates, averaging pitot tubes and meter runs.

<table>
<thead>
<tr>
<th>OPTIBAR OP 3050</th>
<th>OPTIBAR OP 7060</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy (of calibrated span)</strong></td>
<td><strong>Accuracy (of calibrated span)</strong></td>
</tr>
<tr>
<td>Reference accuracy DP</td>
<td>&lt;±0.1 up to TD 10:01</td>
</tr>
<tr>
<td>Long-term stability</td>
<td>&lt;±0.1% within 5 years</td>
</tr>
<tr>
<td>Total performance</td>
<td>&lt;±0.3%</td>
</tr>
<tr>
<td>Max. turn down</td>
<td>10:1</td>
</tr>
<tr>
<td>Reference accuracy pabs.</td>
<td>&lt;±0.1%</td>
</tr>
<tr>
<td>Pressure range</td>
<td></td>
</tr>
<tr>
<td>Sensor</td>
<td>Piezoresistive</td>
</tr>
<tr>
<td>Piezoresistive</td>
<td></td>
</tr>
<tr>
<td>Measurement range</td>
<td>100, 500 mbar; 3, 16 bar/1.4, 7.2, 44, 232 psi</td>
</tr>
<tr>
<td>10, 30, 100, 500 mbar; 3, 16 bar/1.4, 7.2, 43.5, 232 psi</td>
<td></td>
</tr>
<tr>
<td>Line pressure</td>
<td>160 bar/2320 psi</td>
</tr>
<tr>
<td>40, 160, 400 bar/580, 2320, 5800 psi</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>40...+85°C/-40...+185 °F</td>
</tr>
<tr>
<td>Ambient</td>
<td>40...+80°C/-40...+176 °F</td>
</tr>
<tr>
<td>Configuration</td>
<td></td>
</tr>
<tr>
<td>PC Tool</td>
<td>n/a</td>
</tr>
<tr>
<td>Free DTM, also USB interface</td>
<td></td>
</tr>
<tr>
<td>Software / HHT</td>
<td>Yes – generic HART®</td>
</tr>
<tr>
<td>Yes – generic and DD</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>with optional display and adjustment module</td>
</tr>
<tr>
<td>with optional display and adjustment module</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>316L</td>
</tr>
<tr>
<td>DIN housing in 1- or 2-chamber configuration; 316L, aluminum, 316L (electro-polished), plastic (PBT)</td>
<td></td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>316L</td>
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<tr>
<td>316L, Hastelloy C-276</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>4...20 mA HART® 7</td>
</tr>
<tr>
<td>4...20 mA, HART® 7, PA, FF</td>
<td></td>
</tr>
<tr>
<td>Approvals</td>
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<tr>
<td>Ex</td>
<td>ATEX / IECEx Ex ia</td>
</tr>
<tr>
<td>ATEX / IECEx Ex ia, Ex d</td>
<td></td>
</tr>
<tr>
<td>Functional Safety</td>
<td>n/a</td>
</tr>
<tr>
<td>SIL 2/3</td>
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</tbody>
</table>
# Differential pressure flow measurement

## Averaging pitot tubes / Meter runs

<table>
<thead>
<tr>
<th>Description</th>
<th>OPTIBAR PT 2000</th>
<th>OPTIBAR MR 4300</th>
<th>OPTIBAR 4300</th>
</tr>
</thead>
<tbody>
<tr>
<td>With multiple impact-sensing ports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orifice meter run assembly with corner taps and annular chambers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cone meter run with single taps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium</th>
<th>Gas, liquid and steam</th>
<th>Gas, liquid and steam</th>
<th>Gas, liquid and steam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Compact, separate</td>
<td>Compact, separate</td>
<td>Compact, separate</td>
</tr>
<tr>
<td>Sizing</td>
<td>KROHNE standard</td>
<td>EN ISO 5167</td>
<td>EN ISO 5167</td>
</tr>
<tr>
<td>Uncertainty / Accuracy</td>
<td>&lt;±1% uncalibrated; &lt;±0.5% calibrated</td>
<td>Uncertainty of C: ±0.5...0.8%</td>
<td>Uncertainty of C: ±5% calibrated: ±0.25...0.35%</td>
</tr>
<tr>
<td>Turn down ration (calibrated)</td>
<td>5:1</td>
<td>6:1</td>
<td>6:1</td>
</tr>
<tr>
<td>Pressure loss</td>
<td>5...12%</td>
<td>40...95%</td>
<td>40...95%</td>
</tr>
<tr>
<td>Max. pressure</td>
<td>PN40</td>
<td>150...600 lb/ PN10...100</td>
<td>300...600 lb</td>
</tr>
<tr>
<td>Max. temperature</td>
<td>+400°C/+752°F</td>
<td>+400°C/+752°F</td>
<td>+400°C/+752°F</td>
</tr>
<tr>
<td>Line size</td>
<td>2...800”/DN50...2000</td>
<td>1/2”...4”/DN15...10</td>
<td>4...24”</td>
</tr>
<tr>
<td>Material primary element</td>
<td>316L</td>
<td>316L/1.4404</td>
<td>316L</td>
</tr>
<tr>
<td>Material mounting parts</td>
<td>A105, 316L, 16Mo3</td>
<td>316L/1.4404</td>
<td>SA105</td>
</tr>
<tr>
<td>Optional temperature probe</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>
Measuring principle: Deflector plate

DW 181
For clean liquids,
G3/4...2, 3/4...2 NPT

DW 182
For clean liquids,
DN15...65, 1/2...2 1/2”
ASME

DW 183
For clean liquids,
DN65...200, 3...8” ASME

DW 184
Insertion-type flow controller
for pipe diameter ≥250 mm / 10”,
process connection DN150,
6” ASME
Flow controllers

Measuring principle: Electromagnetic

DWM 1000
With binary output

DWM 2000
With 4...20 mA output
Electromagnetic flow controllers

The measuring principle

As early as 1832, Faraday tried to determine the speed of the current in the Thames by measuring the voltage induced in flowing water by the earth’s magnetic field. Electromagnetic flow measurement is based on Faraday’s Law of induction. According to this law, a specific voltage is induced in a conductor or conductive medium that moves through a magnetic field. This voltage is proportional to the speed of movement of the medium.

On electromagnetic flow controllers, the induced voltage is tapped via one reference electrode and one measuring electrode in conducting contact with the medium.

An electronic converts the signal into a proportional output signal.

Sturdy and maintenance-free:
Flow switch DWM 1000 and flowmeter DWM 2000

KROHNE invented and founded the industrially used electromagnetic flow measuring technology more than 45 years ago. Today, we continue to impress customers with our innovations in this field.

With the DWM 1000 and DWM 2000 flow controllers, we offer two sturdy units.

Depending on the design, the flow speed is monitored (DWM 1000) or measured and output via a 4...20 mA (DWM 2000).

The only prerequisite is that the electrical conductivity of the medium be at least 20 µS/cm. DWM 1000 and DWM 2000 flow controllers are ideal for use with largely homogenous liquids, pastes and sludges – even with solid content.
Mechanical flow controllers

The measuring principle

With the flow controllers DW 181 to 184, the liquid flows against a spring-mounted disc. The position of the disc changes with increasing flow. A built-in magnet transmits the position to the display and also activates the limit switch.

Always the right choice:
Flow controllers
DW 181, 182, 183, and 184

With the flow controllers DW 181, 182, 183 and 184, KROHNE offers the ideal flow control solution for virtually any process connection.

Each device is equipped with a limit switch (dry reed contact) and it is possible to install another switch at any time. For greater switching energies of up to 1200 VA, an additional amplifying relay can be installed.

Choose the display which is most adapted to your needs: DW 181, 182, 183, 184 can be ordered with two display types, G and A.

The G display enables visual monitoring of the flow via a linear 10-point scale. The switching point can be changed at any point along the way. The A display allows a more accurate reading of the flow value (e.g. in l/h or in m³/h) via a scale. With this display, the switching points can be set even when there is no flow.

Industries:
- Power Generation
- Steel
- Metal & Mining
- Petrochemical
- Oil & Gas
- Chemical
- Food & Beverage
- Water & Wastewater
# Flow controllers

<table>
<thead>
<tr>
<th>Mechanical flow controllers</th>
<th>Electromagnetic flow controllers</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW 181 to 184</td>
<td>DWM 1000</td>
</tr>
</tbody>
</table>

- **Measuring accuracy**: ±15% of switching point
  - When $v > 1$ m/s or 3.3 ft/s: accuracy ±5% of switching point
  - When $v < 1$ m/s or 3.3 ft/s: accuracy ±2% of switching point, ±3 cm/s/±1.2 in/s

- **Repeatability**: ±3% of switching point
  - ±1% of switching point

- **Limit switches**: 1 or 2 binary outputs; 1 or 2 relay outputs
  - 1 binary output

- **Output**: -
  - -

- **Communication**: -
  - -

- **Power supply**: Switching voltage AC: 24, 48, 110, 240 VAC; switching voltage DC: 24, 48, 110 VDC
  - 48...240 VAC; 48 VDC; relay voltage: 48, 110, 240 VAC; 48 VDC

- **Protection category**: Polycarbonate housing: IP65 (non-Ex and Ex i), aluminum housing: IP65, stainless steel housing: IP68
  - Aluminum housing: IP65, stainless steel housing: IP68

- **Nominal size**: >DN15/1/2"
  - >DN25/1"

- **Pipe diameter**: 3/4...2" NPT; G3/4...2
  - Std fitting G1A; screw-on welding socket (Ø39 mm/Ø1.25"
  - long sensor [option] 1 1/2" NPT; G1 1/2 screw-on welding socket (Ø60 mm; Ø2.4"
  - spool piece [option] DN25...50/1...2", DN32/1 1/4" on request;
  - Optional FT Tuchenhagen VARIVENT® connection for hygienic applications

- **Pressure ratings**: 100 barg/1450.4 psig, higher on request
  - 25 barg/362.6 psig

- **Process conditions**: Homogeneous, clean liquids
  - Conductive liquids, pastes, slurries ≥20 µS/cm

- **Viscosity standard**: ≤30 mPas; 0.02 lb/ft/s
  - -

- **Viscosity special version**: ≤250 mPas; 0.16 lb/ft/s
  - -

- **Measuring range**: 0.2...4 m/s/0.66...13.1 ft/s
  - 0.1...9.9 m/s/0.3...32.5 ft/s

- **Temperature ranges**: -40...+150°C/-40...+302°F
  - -25...+150°C/-13...+302°F
  - -25...+60°C/-13...+140°F [IP68]

- **Materials**: Bronze, stainless steel
  - Stainless steel, zirconium

- **Approvals**: Ex ATEX
  - -

- **Miscellaneous**: EAC
  - EAC
## Electromagnetic flow controllers

**DWM 2000**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring accuracy</td>
<td>When v &gt;1 m/s or 3.3 ft/s: accuracy ±5% of measured value ±2% if calibrated onsite. When v &lt;1 m/s or 3.3 ft/s: accuracy ±2% of measured value, ±3 cm/s/±1.2 in/s.</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±1.5% of measured value</td>
</tr>
<tr>
<td>Limit switches</td>
<td>-</td>
</tr>
<tr>
<td>Output</td>
<td>4...20 mA, 3-wire</td>
</tr>
<tr>
<td>Communication</td>
<td>RS232</td>
</tr>
<tr>
<td>Power supply</td>
<td>12, 24 VDC, 50 mA</td>
</tr>
<tr>
<td>Protection category</td>
<td>Aluminum housing: IP65, stainless steel housing: IP68, aluminum housing with display: IP55</td>
</tr>
<tr>
<td>Nominal size</td>
<td></td>
</tr>
<tr>
<td>Pipe diameter</td>
<td>&gt;DN25; 1”</td>
</tr>
<tr>
<td>Connection</td>
<td>Std fitting G1A, screw-on welding socket (Ø39 mm/Ø1.25”)</td>
</tr>
<tr>
<td></td>
<td>Optional long sensor 1 1/2” NPT; G1 1/2, screw-on welding socket (Ø60 mm/Ø2.4”) spool piece option DN25...50/1...2”, DN32/1 1/4” on request Optional FT Tuchenhagen VARIVENT® connection for hygienic applications</td>
</tr>
<tr>
<td>Pressure ratings</td>
<td>Max. operating pressure 25 barg/362.6 psig</td>
</tr>
<tr>
<td>Process conditions</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Conductive liquids, pastes, slurries ≥20 µS/cm</td>
</tr>
<tr>
<td>Viscosity standard</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity special version</td>
<td>-</td>
</tr>
<tr>
<td>Measuring range</td>
<td>1...8 m/s/3.3...26.3 ft/s</td>
</tr>
<tr>
<td>Temperature ranges</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>-25...+150°C/-13...+302°F</td>
</tr>
<tr>
<td>Ambient</td>
<td>-25...+60°C/-13...+140°F (IP68)</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
</tr>
<tr>
<td>Measuring tube</td>
<td>Stainless steel, zirconium</td>
</tr>
<tr>
<td>Measuring system</td>
<td>Electrode: platinum</td>
</tr>
<tr>
<td>Approvals</td>
<td>-</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>EAC</td>
</tr>
</tbody>
</table>
KROHNE is committed to making communication convenient. Which is why our field devices communicate reliably with controllers, control systems and PCs, and can also be used for a variety of control and regulating tasks.

**Protocols and interfaces**

We support proven and established protocols as well as new ones for certain industries, e.g. EtherNet/IP™ for the food and beverage industries, or PROFINET® for the water and wastewater sector.

**Device integration**

KROHNE meets all of the prerequisites for integration into modern plant asset management systems, based on integration technologies such as DD/EDD and FDT/DTM.

We are a longstanding member of PACTware™ and the FDT Group®. Since 2003, we provide DTM and EDDs for our field devices with HART®, PROFIBUS® or FOUNDATION™ fieldbus interfaces.
Configuration and diagnostics via DTM's

Easy navigation, device status available anytime
Simple parameterisation supported by graphic elements

Detailed diagnostics overview with recommendations to resolve actual events
Advanced monitoring functions with optional recording of events

Fast and convenient access to process and device data from any level
From engineering and planning to commissioning, training and documentation: our services cover all project stages, and can be offered for all enterprise sizes:

- Complete project management for instrumentation projects
- Engineering
- Commissioning
- On-site start-up
- Product training (on-site)
- Calibration, (in-situ) verification and documentation
- Maintenance services
- Seminars and trainings on various topics

Please see right page for more details on selected services.

Beyond the highest requirements

Online tools:

**PICK**
Enter the serial number and get device specific documents, e.g. manuals, handbooks, calibration certificates, etc.: pick.krohnegroup.com

**Configure It**
Configure flow and level devices and get free 2D/3D CAD data: www.krohne-direct.com
Maintenance services

Choose from maintenance and service contracts tailored to suit all business sizes and needs:

- Spare parts and consumables
- Field service and on-site repair
- Returns
- Workshop repair
- Helpdesk

Metrological accreditation of custody transfer applications

We offer special services for metrological accreditation of measuring and loading systems for liquids and gases, according to local fiscal regulations:

- Project management from planning to commissioning, training and documentation
- For mobile and stationary measuring systems

Seminars: KROHNE Academy & KROHNE Academy online

KROHNE Academy is a series of seminars in collaboration with leading automation companies. Taking place in various countries, it addresses key operating issues, from plant safety to ways of increasing efficiency and controlling costs, and shows possible solutions. Should your interest be more towards working “hands-on” with our devices, then our service academy is what you are looking for. Learn more about KROHNE Academy at www.krohne.com

KROHNE Academy online is an online eLearning platform, focusing on industrial process instrumentation. It comprises electronic learning content with full audio, explaining measuring technology without relation to specific manufacturers. Register now for free and start your training at academy-online.krohne.com

In-situ verification

OPTICHECK is the essential tool to assure that your process measuring devices are performing according to specification. When connected to an installed meter (in-situ), it gathers data to ensure that the meter is performing within 1% of the factory calibration.

- Printed individual verification certificate
- Preventive maintenance and service features
- Storage of verification data
- Download factory calibration settings from KROHNE manufacturing database
Calibration is one of KROHNE’s core areas of expertise. If you buy a KROHNE product, you will get a measuring device that performs most accurate with low uncertainty under real process conditions.

To achieve this, we operate more than 140 calibration facilities for volume flow, mass flow, level, temperature, density and pressure to (wet-)calibrate any device we manufacture. For example, every flowmeter is wet-calibrated using water or air as standard before leaving our facilities.

We can also provide customer specific calibration such as:

- Carry out multipoint calibrations
- Vary different parameters such as temperatures, viscosities, pressures etc.
- Use the actual medium or similar
- Build or emulate customer-specific flow geometries
- Use piping provided by the customer

For calibration we only use direct comparison of measurands (e.g. we calibrate our Coriolis mass flowmeters with a gravimetric weighing system). Our calibration rigs are the most accurate used in measuring device production worldwide: the accuracy of the reference is usually 5 to 10 times better than that of the meter under test.
This goes for small as well as for very large sizes: KROHNE operates the world’s most precise volumetric calibration rig for flowmeters up to DN3000/120” with a certified accuracy of 0.013 %. The reference vessel is a 44 m/144 ft high tank containing almost 0.5 million litres/132,000 gal (US) of water which allows for a maximum flow rate of 30,000 m³/h/7,925,000 gal (US)/h.

Certified technology for fiscal & custody transfer applications

Our meters can be calibrated and certified according to various standards such as OIML, API, Measuring Instruments Directive (MI-001, 002, 004, 005), GOST, etc. The standards we use for calibration are ISO/IEC 17025 accredited and traceable to international or national standards. Regular inspections by national metrology institutes, round robin tests and alignments with national and international metrological standards according to ISO 9000 and EN 45000 guarantee the quality and comparability of our calibration rigs. Staff performing the calibrations are trained and given regular re-trainings to ensure quality and continuity.
KROHNE – Products, Solutions and Services

- Complete product portfolio: flow, level, temperature, pressure, process analytics
- Application-specific system solutions for various industries
- Services for instrumentation projects

Contact

Head office:
KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg
Germany
Tel.: +49 203 301 0
Fax: +49 203 301 103 89
info@krohne.com

Global companies and representatives
The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com