



**KROHNE**

► measure the facts

## Flow measurement

Product overview





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KROHNE trademarks:  
KROHNE  
CalSys  
CARGOMASTER  
EcoMATE  
EGM  
KROHNE Care  
OPTIBATCH  
OPTIBRIDGE  
OPTIFLEX  
OPTIFLUX  
OPTIMASS  
OPTIQUAD  
OPTISONIC  
OPTISOUND  
OPTISWIRL  
OPTISWITCH  
OPTISYS  
OPTIWAVE  
PipePatrol  
WATERFLUX  
SENSOFIT  
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SMARTMAC

Trademarks  
of other owners:  
Amphenol  
FDT Group  
FOUNDATION™ fieldbus  
HART  
HASTELLOY  
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PROFIBUS®  
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# measure the facts

technology driven by KROHNE

## Letter from the Corporate Management

Dear Customers,

Communication techniques are becoming ever more complex, from the field through to the control level. At the same time the demands for recording physical measured variables such as flow rates, fill levels, temperature, pressure and analysis parameters are constantly growing. The principal requirement in this respect is absolute reliability of the measured values. This means the measuring equipment, even when subjected to disruptive influences such as changing flow profiles or inclusion of gas bubbles, must always deliver reliable values, and above all must guarantee virtually 100 % security against failure.

**“Measure the facts”** means not only reliable measurement of standard process variables – even under the most difficult process conditions – but also clear and precise process diagnostics right through to the material composition of the medium. Both of these contribute to improved process control and allow remarkable increases in process efficiency and production.

In order to guarantee this for you, more than 400 engineers in the worldwide KROHNE Group are continuously engaged in research into promising technologies for the future, in pursuit of improved measurement and further developments. We are a family-owned enterprise and we take our responsibilities seriously. We have permanent representation in more than 130 countries and employ more than 3,500 people in order to bring you highly innovative products from a single source, and tailor-made technical solutions to your measurement requirements, now and in the future.



Michael Rademacher-Dubbick



Stephan Neuburger



## The solution for every application

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.

### Online configurator

For detailed device selection, take advantage of our online platform Configure It. It's quick and easy to find the right product variant for you, to check the availability of the selected product or to request a non-binding quote. For more information about Configure It go to [www.krohne-direct.com](http://www.krohne-direct.com)

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 NMiJ (Japan).

## Product selection list

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

	Electro-magnetic flowmeters	Variable area flowmeters	Ultrasonic flowmeters	Mass flowmeters	Vortex flowmeters	Differential pressure flow measurement	Flow controllers
	Page 8-17	Page 18-25	Page 26-33	Page 34-41	Page 42-47	Page 48-55	Page 56-61
Liquids							
Liquids (e.g. water)	x	x	x	x	x	x	x
Low flow rates (< 2 l/h)	x	x	-	x	-	o	-
High flow rates (> 100000 m³/h)	x	-	x	-	-	x	x
Non-conductive liquids	-	x	x	x	x	x	o
Viscous media	x	x	o	x	o	x	o
Gases							
Industrial gases	-	x	x	x	x	x	-
Low flow rates (< 20 l/min)	-	x	o	x	-	x	-
High flow rates	-	o	x	x	x	x	-
Steam	-	o	x	o	x	x	-
Special applications							
Slurry, media with solids	x	-	-	x	-	o	-
Emulsions (oil/water)	o	x	o	x	o	x	o
Corrosive liquids (acids, alkalis)	x	x	x	x	o	x	o
Corrosive gas flows	-	o	x	o	o	x	-
Bi-directional measurements	x	-	x	x	-	x	o
Version							
2-wire	x	x	-	-	x	x	x
4-wire	x	-	x	x	-	-	-

x = suitable, o = suitable under certain conditions, - = not suitable

## GDC concept: An electronics concept from which everybody benefits



MFC 400 for mass flowmeters  
UFC 400 for ultrasonic flowmeters



IFC 300 for electromagnetic flowmeters  
MFC 300 for mass flowmeters  
UFC 300 for ultrasonic flowmeters  
GFC 300 for ultrasonic gas flowmeters



VFC 200 for Vortex flowmeters



IFC 100 for electromagnetic flowmeters



IFC 050 for electromagnetic flowmeters

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® 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.

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 (SIL 2).

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



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.

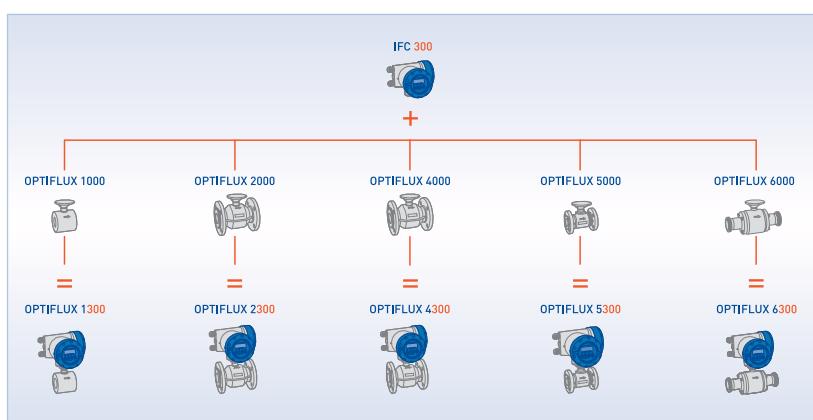
The converter can communicate with the user in many languages including German, English, French and Spanish.

## OPTICHECK: On-site verification tool for KROHNE flowmeters

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 050 C Display/Blind:  
Basic applications



IFC 100 W  
Wall-mounted



IFC 100 C  
Standard applications



IFC 300 R  
Rack-mounted



IFC 300 W  
Wall-mounted



IFC 300 F  
Field housing



IFC 300 C  
General purpose

## Flow sensors



OPTIFLUX 1000  
The sandwich (wafer)  
solution for compact  
installation



OPTIFLUX 2000  
The all-round solution for  
the water and wastewater  
industry



WATERFLUX 3000  
The solution for measuring  
small and large flows without  
requiring inlets or outlets



OPTIFLUX 4000  
The all-round solution for  
the process industry



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



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



OPTIFLUX 6000  
The hygenic solution for the  
food and pharmaceutical  
industry

## The specialists



OPTIFLUX 4040 C  
2-wire device



OPTIFLUX 7300 C sandwich  
With non wetted capacitive  
electrodes and ceramic liner



OPTIFLUX 7300 C flange  
With non wetted capacitive  
electrodes and ceramic liner



TIDALFLUX 2300 F  
For partially filled pipelines, Ex Zone 1



### Accessoires



OPTICHECK  
On-site verification tool for calibration  
verification and documentation

## Electromagnetic flowmeters

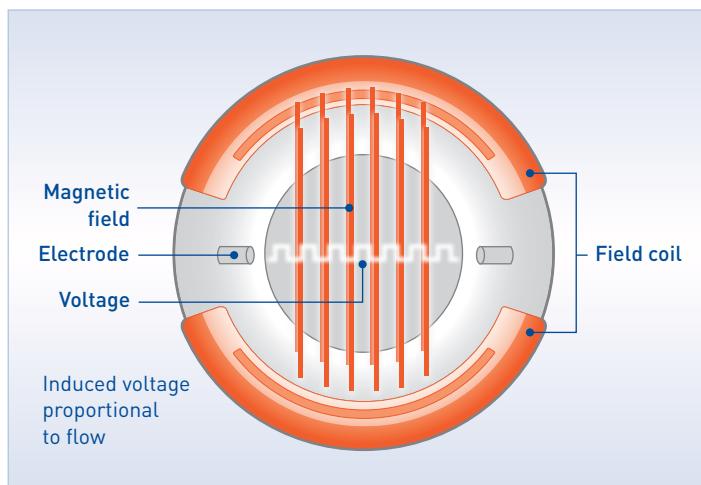
# Electromagnetic flowmeters

## Highlights:

- Minimal or no inlets/outlets
- All KROHNE electromagnetic flowmeters are wet-calibrated in a direct comparison of volumes
- Large choice of liner materials suitable for drinking water, wastewater, chemicals, SIP/CIP and solids
- Suitable for use in custody transfer applications
- Measurement is independent of the flow profile
- Abrasion and corrosion-resistant liners available
- Ceramic measuring tubes and liners available for flange and sandwich versions, also with non-wetted electrodes (capacitive flowmeter)
- Specific models for partially filled pipes
- Virtual reference option: grounding electrodes and grounding rings can be left out
- Electric conductivity of medium can be used for detection of product change
- For high bubble content, high solids content and pulsating flow
- Secure handling of rapid medium changes and pH jumps
- Zero-point stability regardless of changes in medium properties
- Nominal sizes DN 2.5 to 3,000
- 3x100%-diagnostics (application and device diagnostic, out-of-spec-test) exceeds NAMUR requirements

## 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).

## The standard for the competition: Electromagnetic flowmeters from KROHNE

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.

### Industries:

- Water and wastewater
- Chemical
- Food and beverage
- Pharmaceutical
- Power plants
- Pulp and paper
- Metal and mining

OPTIFLUX 4300 in the filtration system in the Haltern waterworks, Germany





Production process of high-performance ceramics

## Electromagnetic flow measurement: Increased safety through the use of high-performance ceramics in flange design

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.

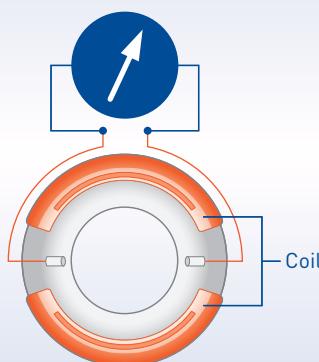
When it comes to measuring critical media such as those used in chlorine chemistry, it was also necessary to optimise the electrode construction. The result of these efforts? Using the so-called Cermet electrode has made it possible to develop a 100 % gap-free design. In doing so, the metal of the electrode 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.

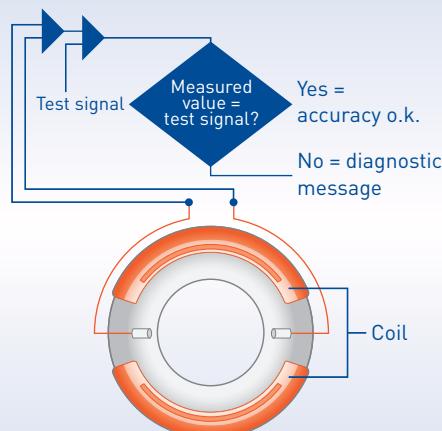
It is no wonder that the fields of application of the ceramic electromagnetic flowmeter are so numerous today. They range from measuring acids and alkalis in chemistry to usage in chlorine chemistry, to the volumetric filling of liquids in the beverage, pharmaceutical and cosmetics industries.

## Electromagnetic flowmeters: 3x100%-diagnostics for maximum certainty

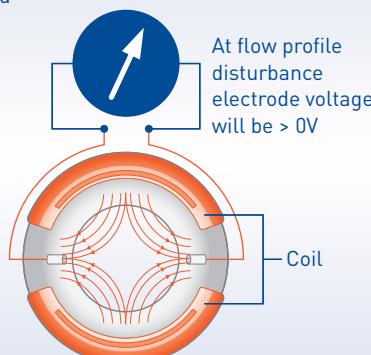
**Resistance measurement**  
for detecting electrode covering, electrode short-circuit, excessively low conductivity and for measuring the conductivity and the coil temperature (media temperature)



**Accuracy test**  
by means of a cyclically fed test signal



**Magnetic field polarity reversal**  
for checking the flow profile and  
for detecting a partially filled measuring tube



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

	The sandwich (wafer) solution for compact installation	The all-round solution for the water and wastewater industry	The solution for measuring small and large flows without requiring inlets or outlets
	OPTIFLUX 1050	OPTIFLUX 2050	WATERFLUX 3050
	OPTIFLUX 1000 + IFC 050 	OPTIFLUX 2000 + IFC 050 	WATERFLUX 3000 + IFC 050 
<b>Measuring accuracy</b>	±0.5% of measured value above 0.5 m/s; depending on measuring sensor ±2.5 mm/s below 0.5 m/s; independent of measuring sensor	±0.5% of measured value above 0.5 m/s; depending on measuring sensor ±2.5 mm/s below 0.5 m/s; independent of measuring sensor	±0.5% of measured value above 0.5 m/s; depending on measuring sensor ±2.5 mm/s below 0.5 m/s; independent of measuring sensor
<b>Electrical conductivity</b>	≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)
<b>Process conditions</b>	Solid content <10%	Solid content <10%	Solid content <10%
<b>Outputs</b>	Current, pulse, status	Current, pulse, status	Current, pulse, status
<b>Power supply</b>	100...230 VAC, 24 VDC	100...230 VAC, 24 VDC	100...230 VAC, 24 VDC
<b>Protection category: Compact (C) Wall (W)</b>	IP66/67; NEMA 4/4X	IP66/67; NEMA 4/4X	IP66/67; NEMA 4/4X
	OPTIFLUX 1100	OPTIFLUX 2100	WATERFLUX 3100
	OPTIFLUX 1000 + IFC 100 	OPTIFLUX 2000 + IFC 100 	WATERFLUX 3000 + IFC 100 
<b>Measuring accuracy</b>	±0.3% of measured value	±0.3% of measured value	±0.3% of measured value
<b>Electrical conductivity</b>	≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)	≥20 µS/cm
<b>Process conditions</b>	Solid content max. 10%	Solid content max. 10%	Clean drinking water
<b>Outputs</b>	Current, pulse, status	Current, pulse, status	Current, pulse, status
<b>Inputs</b>	Binary	Binary	Binary
<b>Communication</b>	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus
<b>Power supply</b>	100...230 VAC, 12...24 VDC, 24 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC
<b>Protection category: Compact (C) Field (F) Wall (W) 19" Rack (R)</b>	IP66, 67; NEMA4X, 6 - - -	IP66, 67; NEMA4X, 6 - - -	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 - -
	OPTIFLUX 1300	OPTIFLUX 2300	WATERFLUX 3300
	OPTIFLUX 1000 + IFC 300 	OPTIFLUX 2000 + IFC 300 	WATERFLUX 3000 + IFC 300 
<b>Measuring accuracy</b>	±0.3% of measured value	±0.2% of measured value	±0.2% of measured value
<b>Electrical conductivity</b>	≥1 µS/cm (water ≥20 µS/cm)	≥1 µS/cm (water ≥20 µS/cm)	≥20 µS/cm
<b>Process conditions</b>	Solid content max. 70%	Solid content max. 70%	Clean drinking water
<b>Outputs</b>	Current, pulse, status	Current, pulse, status	Current, pulse, status
<b>Inputs</b>	Binary	Binary	Binary
<b>Communication</b>	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus
<b>Power supply</b>	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC
<b>Protection category: Compact (C) Field (F) Wall (W) 19" Rack (R)</b>	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1
Measuring sensor	OPTIFLUX 1000	OPTIFLUX 2000	WATERFLUX 3000
	OPTIFLUX 1000 	OPTIFLUX 2000 	WATERFLUX 3000 
<b>Process connection EN 1092-1</b>	DN10...150; PN16, 40	DN25...3000; PN2.5...40	DN25...300; PN10, 16; DN350...600; PN10
<b>Process connection ASME B16.5</b>	3/8...6"; CL 150, 300	1...120"; CL 150, 300	1...12"; CL 150; 14"...24" CL 150 (10 bar/145 psi rated)
<b>Process temperature</b>	-25...+120°C; -13...+248°F	-5...+90°C; +23...+194°F	-5...+70°C; +23...+158°F
<b>Ambient temperature</b>	-25...+65°C; -13...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
<b>Materials liner</b>	PFA	Polypropylene, hard rubber, Polyolefin (PO)	DN25...600: Rilsan
<b>Materials electrodes</b>	Hastelloy®	Hastelloy®, titanium, stainless steel	Stainless steel 1.4301; AISI 304
<b>Sensor</b>	IP66, 67; NEMA4, 4X	IP66, 67, 68; NEMA4, 4X, 6, 6P	IP66, 67, 68; NEMA4, 4X, 6, 6P
<b>Ex-Approvals</b>	-	Ex, FM, CSA	-
<b>Other approvals</b>	FDA, MI-001, MI-005	KTW, WRAS, KIWA, ACS, OIML R49, MI-001, MI-005	ACS, DVGW, TZW/UBA, NSF, WRAS, MI-001

The all-round solution for the process industry	Ceramic measuring tube: maximum media and abrasion resistance and accuracy	Ceramic measuring tube: maximum media and abrasion resistance and accuracy	The hygenic solution for the food and pharmaceutical industry
			
-	-	-	±0.5% of measured value above 0.5 m/s; depending on measuring sensor ±2.5 mm/s below 0.5 m/s; independent of measuring sensor
-	-	-	≥5 µS/cm (water ≥20 µS/cm)
-	-	-	Solid content <10%
-	-	-	Current, pulse, status
-	-	-	100...230 VAC, 24 VDC
-	-	-	IP66/67; NEMA 4/4X
OPTIFLUX 4100	OPTIFLUX 5100 sandwich	OPTIFLUX 5100 flange	OPTIFLUX 6100
			
±0.3% of measured value	±0.3% of measured value	±0.3% of measured value	±0.3% of measured value
≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)
Solid content max. 10%	Solid content max. 10%	Solid content max. 10%	Solid content max. 10%
Current, pulse, status	Current, pulse, status	Current, pulse, status	Current, pulse, status
-	-	-	-
-	-	-	-
100...230 VAC, 12...24 VDC, 24 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC	100...230 VAC, 12...24 VDC, 24 VAC/DC
IP66, 67; NEMA4X, 6	IP66, 67; NEMA4X, 6	IP66, 67; NEMA4X, 6	IP66, 67; NEMA4X, 6
-	-	-	-
-	-	-	-
OPTIFLUX 4300	OPTIFLUX 5300 sandwich	OPTIFLUX 5300 flange	OPTIFLUX 6300
			
±0.2% of measured value	±0.15% of measured value	±0.15% of measured value	±0.2% of measured value
≥1 µS/cm (water ≥20 µS/cm)	≥1 µS/cm (water ≥20 µS/cm)	≥1 µS/cm (water ≥20 µS/cm)	≥1 µS/cm (water ≥20 µS/cm)
Solid content max. 70%	Solid content max. 70%	Solid content max. 70%	Solid content max. 70%
Current, pulse, status	Current, pulse, status	Current, pulse, status	Current, pulse, status
Binary	Binary	Binary	Binary
HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus
85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC
IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1
OPTIFLUX 4000	OPTIFLUX 5000 sandwich	OPTIFLUX 5000 flange	OPTIFLUX 6000
			
DN2.5...2,000; PN6...40	DN2.5...100; PN16, 40	DN15...300; PN10, 16, 40	DN2.5...150; hygienic connections
1/10...80"; CL 150, 300, 600, 900, 1500	1/10...4"; CL 150, 300	1/2...12"; CL 150, 300	1/10...6"; hygienic connections
-40...+180°C; -40...+356°F	-40...+180°C; -76...+356°F	-40...+180°C; -76...+356°F	-40...+180°C; -40...+356°F
-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
PFA, PTFE, ETFE and hard rubber, PU	Aluminium oxide, Zirconium oxide	Aluminium oxide, Zirconium oxide	PFA
Hastelloy®, titanium, tantalum, stainless steel, platinum, low noise	Cermet	Cermet <DN150/6", stainless steel, HC4, titanium, tantalum, platinum ≥DN150/6"	Hastelloy®, stainless steel, titanium, tantalum, platinum
IP66, 67, 68; NEMA4, 4X, 6, 6P	IP66, 67, 68; NEMA4, 4X, 6, 6P	IP66, 67, 68; NEMA4, 4X, 6, 6P	IP66, 67, 68; NEMA4, 4X, 6, 6P
Ex, FM, CSA	Ex, FM, CSA	Ex, FM, CSA	Ex, FM, CSA
FDA, OIML R49, R117, KIWA, MI-001, MI-005	FDA, MI-001, MI-005	FDA, MI-001, MI-005	FDA, 3A, EHEDG, MI-005

## The specialists

	For partially filled pipelines, Ex Zone 1	The battery operated solution for large turndown ratios and small spaces with no inlets or outlets
	TIDALFLUX 2300 F	WATERFLUX 3070
	 	
<b>Signal converter</b>	IFC 300 F	IFC 070
<b>Measuring accuracy</b>	±1% of full scale	±0.2% of measured value
<b>Electrical conductivity</b>	>50 µS/cm (water >50 µS/cm)	>20 µS/cm
<b>Process conditions</b>	Solid content max. 70%	Clean water
<b>Outputs</b>	Current, pulse, status	Pulse, status
<b>Inputs</b>	Binary	-
<b>Communication</b>	HART®, Modbus	Datalogger/GSM (option)
<b>Power supply</b>	24, 115/120, 230/240 VAC	1 or 2 internal battery, external battery, up to 15 years battery lifetime
<b>Protection category: Compact (C) Field (F)</b>	IP67; NEMA4, 4X -	IP67, 68; NEMA4x, 6, 6P IP66, 67; NEMA4x, 6
<b>Approvals</b>	Ex Zone 1	OIML R49, MI-001
<b>Measuring sensor</b>	TIDALFLUX 2000	WATERFLUX 3000
<b>Process connections</b>		
<b>EN 1092-1</b>	DN200...1800; PN6, 10	DN25...300; PN10, 16 DN350 ...600; PN10 14" ...24": CL 150 (10 bar/145 psi rated)
<b>ASME B16.5</b>	8...72"; CL 150, 300	1...12"; CL 150
<b>Temperature ranges</b>		
<b>Process</b>	-5...+60°C; +23...+140°F	-5...+70°C; +23...+158°F
<b>Ambient</b>	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
<b>Materials</b>		
<b>Liner</b>	Polyurethane	DN25...600: Rilsan
<b>Electrodes</b>	Hastelloy® C22, stainless steel	Stainless steel 1.4301; AISI 304
<b>Protection category</b>		
<b>Measuring sensor</b>	IP67, 68; NEMA4, 4X, 6, 6P	IP66, 67, 68; NEMA4, 4X, 6, 6P
<b>Approvals</b>		
<b>Ex (with signal converter)</b>	Ex Zone 1	-
<b>Other approvals</b>	-	ACS, DVGW, TZW/UBA, NSF, WRAS, OIML R49, MI-001

	2-wire device	With non wetted capacitive electrodes and ceramic liner	For volumetric filling systems in the beverage industry
	OPTIFLUX 4040 C	OPTIFLUX 7300 C sandwich, flange	BATCHFLUX 5500
			
<b>Signal converter</b>	IFC 040	IFC300 C/CAP	IFC 500
<b>Measuring accuracy</b>	±0.5% of measured value	± 0.5% of measured value ± 5 mm/s	±0.2% of measured value
<b>Electrical conductivity</b>	≥5 µS/cm (water ≥20 µS/cm)	0.05 µS/cm (demineralised cold water ≥1 µS/cm)	≥5 µS/cm (water ≥20 µS/cm)
<b>Process conditions</b>	Solid content max. 3%	Solid content max. 70%; gas content max. 5%	Water...milk
<b>Outputs</b>	Current	Current, pulse, status, frequency, limit switch	Frequency
<b>Inputs</b>	-	Control, current	-
<b>Communication</b>	HART®	HART®, FF, PA, DP, Modbus	-
<b>Power supply</b>	14...36 VDC	100...230 VAC, 24 VDC, 24 VAC/DC	24 VDC
<b>Protection category: Compact (C) Field (F) Wall (W)</b>	IP66, 67; NEMA4, 4X, 6 - -	IP66, 67; NEMA4, 4X, 6 - -	DN2.5, 4, 6, 25, 40: IP66, 67; NEMA4, 4X, 6; DN10, 15: IP69K; NEMA6P
	-	-	-
<b>Measuring sensor</b>	OPTIFLUX 4000	OPTIFLUX 7000	BATCHFLUX 5000
<b>Process connections</b>			
EN 1092-1	DN10...150; PN16, 25, 40	DN25...80, 100; PN16, 40	DN2.5...40
ASME B16.5	3/8...6"; CL 150, 300	1...4"; 150 lb	1/10...1 1/2"
<b>Temperature ranges</b>			
<b>Process</b>	-25...+140°C; -13...+284°F	-40...+100°C; -40...+212°F	-20...+140°C; -4...+284°F
<b>Ambient</b>	-25...+60°C; -13...+140°F	-40...+65°C; -40...+149°F	0...+60°C; +32...+140°F
<b>Materials</b>			
Liner	PTFE, PFA	Ceramic	Zirconium dioxide
Electrodes	Hastelloy®, platinum, stainless steel, tantalum, titanium	Non wetted, capacitive	Cermet
<b>Protection category</b>			
Sensor	IP66, 67; NEMA4, 4X, 6	IP66, 67; NEMA4, 4X, 6	DN2.5, 4, 6, 25, 40: IP66, 67; NEMA4, 4X, 6; DN10, 15: IP69K; NEMA6P
<b>Approvals</b>			
Ex (with converter)	Ex, FM	ATEX	-
Other approvals	FDA	Conform FDA regulations	3A, FDA

## Glass devices



DK46, 47, 48, 800  
Small and compact dosing  
meters with valve



VA40  
All-purpose flowmeter with  
various process connections



GA24  
For maximum safety  
requirements



DK700  
The cost-effective  
version for the  
analytical field



VA45  
For measuring gases with  
low operating pressures



K20  
The cost-effective  
plastic alternative

## Metal devices

H250 M40

The new  
standard device,  
explosion proof and  
intrinsically safe



H250 M9

The proven-in-use,  
intrinsically safe  
solution for the  
process industry



H250 M8M

With space-saving  
display



H250 M8E

With illuminated  
display and  
mA output



DK37 M8M

Dosing meter  
with large display



DK37 M8E

Dosing meter  
with electronic signal output

DK34

For vertical flows



DK32, 34

Dosing meter for high  
pressures and rough  
ambient conditions

## Variable area flowmeters

## Highlights:

- Local indication without the need for auxiliary power
- Use in hazardous areas
- Accurate measurement even at very low flow rates (<0.5 l/h)
- Extended turndown ratio up to 100:1
- Suitable for low operating pressures
- Can be used even with short or no straight inlets/outlets
- Modular display and measuring transducer concept: easy component replacement
- World's only all-metal variable area flowmeter with EHEDG certification
- Flowmeters for nuclear power plants meet requirements of KTA 1401, RCC-E, RCC-M and ASME Section III and we are authorized to manufacture products with ASME N stamp and NPT stamp
- SIL2 certified
- Any meter orientation possible: vertical, horizontal or in fall pipes
- Optional limit switches, current output, totalizer, communication interfaces

## 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.

Diagram of  
VA40

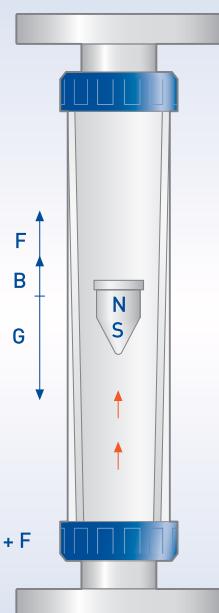
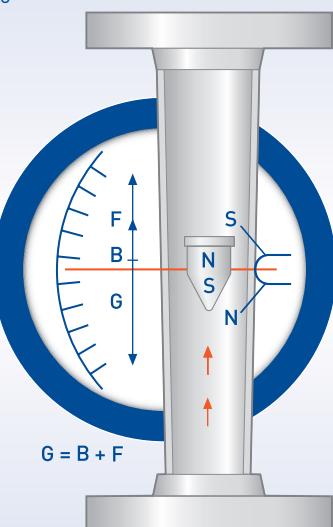


Diagram of  
H250 M40



## 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 and dosing 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
- Dosing and 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.

### Industries:

- Chemical
- Petrochemical
- Mechanical and plant engineering
- Offshore plants
- Pharmaceutical
- Food and beverage
- Water and wastewater
- Power plants

Measuring the flow of CO<sub>2</sub> in the inlet lines of the storage tanks in the beverage industry



## Metal devices

	With space-saving display	With illuminated display and mA output	The proven-in-use, intrinsically safe solution for the process industry	The new standard device, explosion proof and intrinsically safe
	H250 M8M	H250 M8E	H250 M9	H250 M40
				
<b>Measuring accuracy (VDI/VDE 3513-2)</b>	1.6%	1.6%	1.6%	1.6%
<b>Outputs</b>	-	4...20 mA	4...20 mA	4...20 mA
<b>Limit switches</b>	2	via HART®	2	2
<b>Totaliser</b>	-	via HART®	6 digit	8 digit, pulse output
<b>Communication</b>	-	HART®	HART®, PA	HART®, FF, PA
<b>Power supply</b>	-	14.8...30 VDC, (2-wire)	12...30 VDC, (2-wire)	14...30 VDC, (2-wire)
<b>Protection category</b>	IP65	IP65	IP65, 67; NEMA4, 4X, 6	IP66, 68; NEMA4, 4X, 6
<b>Process connections</b>				
EN 1092-1	DN15...25	DN15...25	DN15...150	DN15...150
ASME B16.5	1/2...1"	1/2...1"	1/2...6"	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	1/2...2" NPT, G1/2...G2
Special	Clamp, aseptic	Clamp, aseptic	Clamp, aseptic	Clamp, aseptic
<b>Pressure ratings</b>				
EN 1092-1	PN16, 40, 63, 100, 160, 250*	PN16, 40, 63, 100, 160, 250*	PN16, 40, 63, 100, 160, 250*	PN16, 40, 63, 100, 160, 250*
ASME B16.5	CL 150, 300, 600, 900, 1500*	CL 150, 300, 600, 900, 1500*	CL 150, 300, 600, 900, 1500*	CL 150, 300, 600, 900, 1500*
<b>Process pressure</b>	0...400 bar; 0...5802 psi, optional to 3000 bar; 43511 psi	0...400 bar; 0...5802 psi, optional to 3000 bar; 43511 psi	0...400 bar; 0...5802 psi, optional to 3000 bar; 43511 psi	0...400 bar; 0...5802 psi, optional to 3000 bar; 43511 psi
<b>Measuring ranges</b>				
Water	10...6300 l/h	10...6300 l/h	10...120000 l/h	10...120000 l/h
Air	0.7...220 m³/h	0.7...220 m³/h	0.7...2800 m³/h	0.7...2800 m³/h
<b>Temperature ranges</b>				
Process	-40...+200°C; -40...+362°F	-25...+200°C; -13...+362°F	-200...+300°C; -328...+572°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	-40...+120°C; -40...+248°F
Ambient Ex	-40...+60°C; -40...+140°F	-20...+60°C; -4...+140°F	-40...+60°C; -40...+140°F	-40...+65°C; -40...+149°F
<b>Materials</b>				
Wetted parts	Stainless steel, Hastelloy®, titanium, Monel®, ceramic, PTFE	Stainless steel, Hastelloy®, titanium, Monel®, ceramic, PTFE	Stainless steel, Hastelloy®, titanium, Monel®, ceramic, PTFE	Stainless steel, Hastelloy®, titanium, Monel®, ceramic, PTFE
Display	PPS or stainless steel	PPS or stainless steel	Die cast aluminium, polyurethane coating or stainless steel	Die cast aluminium, polyurethane coating or stainless steel
<b>Approvals</b>				
Ex	ATEX, NEPSI	ATEX, NEPSI	ATEX, NEPSI, FM	ATEX, IEC-EX, cFMus, NEPSI, CCOE/PESO, KGS, EAC/GOST, INMETRO
Hygiene	EHEDG	EHEDG	EHEDG	EHEDG

	Dosing meter for high pressures and rough ambient conditions	Dosing meter with large display	Dosing meter with electronic signal output
	DK32, 34	DK37 M8M	DK37 M8E
<b>Measuring accuracy (VDI/VDE 3513)</b>	4.0%	2.5%	2.5%
<b>Outputs</b>	-	-	4...20 mA
<b>Limit switches</b>	2	2	via HART®
<b>Totaliser</b>	-	-	via HART®
<b>Communication</b>	-	-	HART®
<b>Power supply</b>	-	-	14.8...30 VDC
<b>Protection category</b>	IP65	IP66	IP66
<b>Process connections</b>			
<b>Connections</b>	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*
<b>Flange adapter</b>	DN15, 25; 1/2, 1"	DN15, 25; 1/2, 1"	DN15, 25; 1/2, 1"
	-	-	-
	-	-	-
<b>Pressure ratings</b>			
<b>EN 1092-1</b>	PN40*	PN40*	PN40*
<b>ASME B16.5</b>	CL 150, 300*	CL 150, 300*	CL 150, 300*
<b>Process pressure</b>	130 bar; 1885 psi optional to 500 bar; 7251 psi	130 bar; 1885 psi optional to 500 bar; 7251 psi	130 bar; 1885 psi optional to 500 bar; 7251 psi
<b>Measuring ranges</b>			
<b>Water</b>	3...150 l/h	3...250 l/h	3...250 l/h
<b>Air</b>	16...4800 l/h	16...8000 l/h	16...8000 l/h
<b>Temperature ranges</b>			
<b>Process</b>	-80...+150°C; -112...+302°F	-40...+150°C; -40...+302°F	-25...+135°C; -13...+275°F
<b>Ambient non-Ex</b>	-20...+70°C; -4...+128°F	-40...+70°C; -40...+128°F	-20...+70°C; -4...+128°F
<b>Ambient Ex</b>	-20...+60°C; -4...+140°F	-40...+60°C; -40...+140°F	-20...+60°C; -4...+140°F
<b>Materials</b>			
<b>Wetted parts</b>	Stainless steel, titanium, Monel®, Hastelloy®	Stainless steel, titanium, Monel®, Hastelloy®	Stainless steel, titanium, Monel®, Hastelloy®
<b>Display</b>	Die cast aluminium, polyurethane coating	PPS or stainless steel	PPS or stainless steel
<b>Approvals</b>			
<b>Ex</b>	ATEX, NEPSI, FM, IEC-EX	ATEX, cFMus, NEPSI, IEC-EX	ATEX, cFMus, NEPSI, IEC-EX
<b>Hygiene</b>	-	-	-

\*others on request

## Glass devices

	Small and compact dosing meters with valve	The cost-effective version for the analytical field	All-purpose flowmeter with various process connections
	DK46, 47, 48, 800	DK700	VA40
			
Measuring accuracy (VDI/VDE 3513)	1.0%; 2.5%; 4.0%	4.0%; 6.0%	1.0%
Outputs	-	-	4...20 mA
Limit switches	2	-	2
Totaliser	-	-	-
Communication	-	-	-
Power supply	-	-	14...30 VDC (2-wire)
Protection category	IP65	-	IP67
Process connections			
Connections	1/4" NPT, G1/4, cutting clamp, clamping ring, hose connections*	G1/8, hose connections	Threaded, flange, hose connections, hygienic design
Pressure ratings			
EN 1092-1	-	-	PN40
ASME B16.5	-	-	CL 150
Process pressure	0...10 bar; 0...145 psi	0...4 bar; 0...58 psi	0...10 bar; 0...145 psi
Measuring ranges			
Water	0.4...160 l/h	0.25...40 l/h	0.4...10000 l/h
Air	0.5...5000 l/h	0.5...1000 l/h	0.007...310 m³/h
Temperature ranges			
Process	-5...+100°C; -23...+212°F	-5...+100°C; -23...+212°F	-20...+100°C; -4...+212°F
Ambient non-Ex	-20...+100°C; -4...+212°F	-20...+100°C; -4...+212°F	-20...+100°C; -4...+212°F
Ambient Ex	-20...+70°C; -4...+128°F		-20...+85°C; -4...+185°F
Materials			
Measuring cone	Borosilicate glass	Borosilicate glass	Borosilicate glass
Process connection	Stainless steel, brass, PVDF	PVDF	Stainless steel, PVDF
Approvals			
Ex	ATEX, NEPSI	-	ATEX
Hygiene	-	-	-

\*others on request

	For measuring gases with low operating pressures	For maximum safety requirements	The cost-effective plastic alternative
	VA45	GA24	K20
			
<b>Measuring accuracy (VDI/VDE 3513)</b>	2.5%	1.0%	±2.5% full scale
<b>Outputs</b>	-	-	-
<b>Limit switches</b>	-	2	-
<b>Totaliser</b>	-	-	-
<b>Communication</b>	-	-	-
<b>Power supply</b>	-	-	-
<b>Protection category</b>	-	-	-
<b>Process connections</b>			
<b>Connections</b>	Threaded, flange, hose connections	Flange DN15..50; ASME1/2...2"	Threaded G1/2...2"
<b>Pressure ratings</b>			
<b>EN 1092-1</b>	-	PN40	-
<b>ASME B16.5</b>	-	CL 150	-
<b>Process pressure</b>	1 bar; 14.5 psi	7...10 bar; 102...145 psi	0...6 bar; 0...72 psi
<b>Measuring ranges</b>			
<b>Water</b>	-	0.4...10000 l/h	0.65...25000 l/h
<b>Air</b>	150...60000 l/h	0.007...310 m³/h	-
<b>Temperature ranges</b>			
<b>Process</b>	-20...+100°C; -4...+212°F	-40...+120°C; -40...+248°F	-20...+100°C; -4...+212°F
<b>Ambient non-Ex</b>	-20...+100°C; -4...+212°F	-20...+100°C; -4...+212°F	-20...+100°C; -4...+212°F
<b>Ambient Ex</b>	-	-	-
<b>Materials</b>			
<b>Measuring cone</b>	Borosilicate glass	Borosilicate glass	Polysulphone
<b>Process connection</b>	Stainless steel	Steel plate galvanised and coated	Polysulphone
<b>Approvals</b>			
<b>Ex</b>	-	ATEX	-
<b>Hygiene</b>	-	-	-

## Process measuring technology



**OPTISONIC 3400**  
Universal 3-beam device for  
inline measurement of liquids



**OPTISONIC 7300**  
Universal 2-beam device for inline  
measurement of process gases



**UFM 3030**  
3-beam device for use in custody  
transfer heat measurement in  
district heating



**UFM 530 HT**  
Rugged 2-beam high-temperature  
device for extreme process conditions



**OPTISONIC 8300**  
2-beam ultrasonic flowmeter  
for superheated steam



**OPTISONIC 6300**  
Flexible clamp-on device  
with industrial clamp-on mechanism



**OPTISONIC 6300 P**  
Battery-powered portable clamp-on device

## Custody transfer



ALTOSONIC III

Cost-effective 3-beam device to measure light products for custody transfer



ALTOSONIC V12

12-beam device for measuring gas for custody transfer



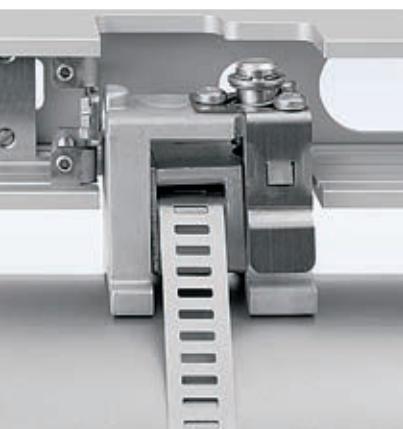
ALTOSONIC V

5-beam device for measuring crude oil and crude oil products for custody transfer

## Ultrasonic flowmeters



UFC 300 W



## 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.



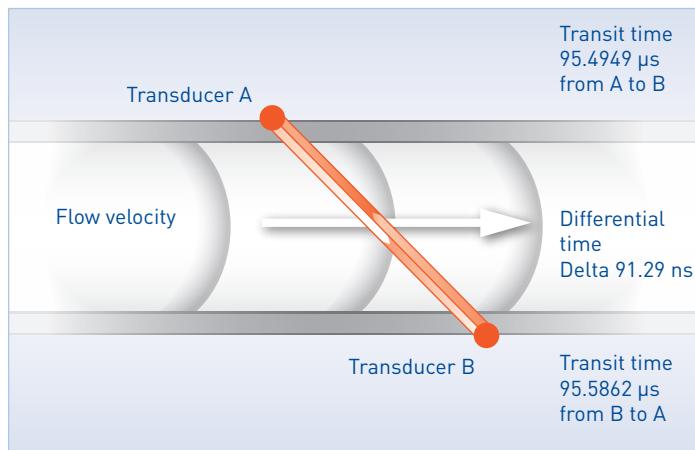
# Ultrasonic flowmeters

## Highlights:

- 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
- 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

## The measuring principle

KROHNE ultrasonic flowmeters are based on the time-of-flight method. This method consists of two diagonally opposed ultrasonic sensors which function alternately as transmitters and receivers. The sound signal alternately emitted from both is at once accelerated by the flow and slowed down against the flow. The difference in the time the signal requires to travel the measured sections is directly proportional to the mean flow rate from which the volumetric flow can then be calculated. Through the use of several ultrasonic paths, flow profile aberrations can be compensated.



## Standard in the process industry: Benchmark for custody transfer

Whether liquid or gaseous, aggressive or corrosive: KROHNE ultrasonic flowmeters measure a wide range of media.

In 1997, KROHNE introduced the ALTOSONIC V, the first high precision, calibratable ultrasonic flowmeter for the petroleum industry. The ALTOSONIC V's five measuring paths can perform extremely precise and reproducible measurements regardless of the viscosity of the medium – a real quantum leap.

As the world's leader in the field of ultrasonic inline flowmeters, our devices are at home in a wide range of 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.



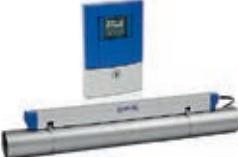
### Industries:

- Oil and gas
- Petrochemical
- Chemical
- Cold and hot water
- Heating, Ventilation and Air Conditioning (HVAC)
- Power plants
- Semi-conductors

## Process measurement

	Universal 3-beam device for inline measurement of liquids	Universal 2-beam device for inline measurement of process gases	2-beam ultrasonic flowmeter for superheated steam	3-beam device for use in custody transfer heat measurement in district heating	Rugged 2-beam high-temperature device for extreme process conditions
	OPTISONIC 3400	OPTISONIC 7300	OPTISONIC 8300	UFM 3030	UFM 530 HT
					
Signal converter	UFC 400	GFC 300	UFC 300	UFC 030	UFC 030
Measuring accuracy	Volume flow: DN100; 4": < ± 1.5% of measured value, DN150...600; 6...24": < ± 1% of measured value	Air calibration (atmospheric): 2...3": ± 1.5%; 4...24": ±1%	Super heated steams (>±15°C; +59°F superheat), high temperature gases	±0.5% of measured value	±1.0% of measured value
Process conditions	Liquids with max. 5% solid content and max. 2% gas content	Process gases	Super heated steams (>±15°C; +59°F superheat), high temperature gases	Liquids with max. 5% solid content and max. 2% gas content	Liquids with max. 5% solid content and max. 2% gas content
Outputs	Current, pulse, status	Current, pulse, status	Current, pulse, status	Current, pulse, status	Current, pulse, status
Inputs	Binary, mA (temp., pressure)	2 x 4...20 mA, active, binary	Binary, mA (temp., pressure)	Binary, mA (temp., pressure)	Binary, mA (temp., pressure)
Communication	HART®, PROFIBUS®, FF, Modbus	HART®, Modbus, FF	HART®, Modbus, FF	HART®	HART®
Power supply	100...240 VAC; 24 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	100...230 VAC; 24 VAC/DC	100...240 VAC; 24 VAC/DC	100...240 VAC; 24 VAC/DC
Protection category: Compact (C) Field (F) Wall (W)	IP67; NEMA6 IP65; NEMA4, 4X -	- IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X	- IP65; NEMA4X/6 -	IP67; NEMA6 IP65; NEMA4, 4X -	- IP65, NEMA4, 4X -
Measuring sensor	OPTISONIC 3000	OPTISONIC 7000	OPTISONIC 8000	UFS 3000	UFS 500 HT
Process connections					
EN 1092-1	DN25...3000; PN10...100	DN50...600; PN10, 16, 40	DN100...600; PN16...160 or flangeless	DN25...3000; PN10...100	DN25...80, 100...150, 200...300; PN10, 16, 40
ASME B16.5	1...120"; CL 150...1500	2...24"; CL 150...900	4...24"; CL 150...2500 or flangeless	1...120"; CL 150...1500	1...12"; CL 150
Temperature ranges					
Process	-200...+250°C; -328...+482°F	-40...+180°C; -40...+356°F	-25...+540°C; -13...+1004°F, higher on request	-25...+180°C; -13...+356°F	-25...+500°C; -13...+932°F
Ambient (incl. converter)	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
Materials					
Measuring tube, flange	Steel, stainless steel, Hastelloy® C4, duplex	Steel, stainless steel, Hastelloy® C, duplex	Carbon steel, high temperature steel on request	Steel, stainless steel	Stainless steel, steel, duplex, Inconel®
Protection category					
Measuring sensor	IP65, 67, 68; NEMA4, 4X, 6, 6P	IP67; NEMA6	IP67; NEMA6	IP65, 67, 68; NEMA4, 4X, 6, 6P	IP65; NEMA4, 4X
Approvals					
Ex	ATEX, IEC-EX, FM, CSA, NEPSI	ATEX, NEPSI, (FM, CSA pending)	ATEX, IEC, NEPSI	ATEX, FM, CSA, NEPSI	ATEX, FM, CSA
Custody transfer	-	-	-	MID MI-004	-

## Custody transfer

Flexible clamp-on device with industrial clamp-on mechanism	Battery-powered portable clamp-on device	Cost-effective 3-beam device to measure light products for custody transfer	12-beam device for measuring of gases for custody transfer	5-beam device for measuring crude oil and crude oil products for custody transfer
OPTISONIC 6300	OPTISONIC 6300 P	ALTOSONIC III	ALTOSONIC V12	ALTOSONIC V
				
UFC 300	UFC 300 P	UFC III	GFC V12	UFC-V / UFP-V
±1.0% of measured value	±1.0% of measured value	±0.2% of measured value for 20.000<RE<50.000; 0.15% of measured value for RE>50.000	±0.2% of measured value, ±0.1% after linearisation	±0.15% of measured value, turndown ratio 1:10; ±0.20% of measured value, turndown ratio 1:50
Liquids with max. 5% solid content and max. 2% gas content	Liquids with max. 5% solid content and max. 2% gas content	Single-hydrocarbons	Natural gas	Multi-hydrocarbons, viscosity 0.1...1500 cSt
Current, pulse, status	Current, pulse, status	Current, pulse, status	4 x digital	4 x digital, 1 x analogue
Binary	2 x 0(4)...20 mA	-	Binary	6 x digital, 16 x analogue
HART®	USB slave	-	Modbus 2 x RS485	Modbus RS422/485
85...250 VAC; 20.5...26 VAC/DC	Battery power	100...240 VAC; 24 VAC/DC	24 VDC	100...240 VAC; 24 VAC/DC
- IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X	- IP65, NEMA4 -	IP67; NEMA6 - -	IP66 - -	IP65, 67; NEMA4, 6 - -
OPTISONIC 6000	OPTISONIC 6000	ALTOSONIC III	ALTOSONIC V12	ALTOSONIC V
DN15...4000	DN15...4000	-	-	-
1/2...160"	1/2...160"	2...40"; CL 150...1500	4...64"; CL 150...2500	4...40"; CL 150...1500
-40...+200°C; -40...+392°F	-40...+200°C; -40...+392°F	-200...+250°C; -328...+428°F	-40...+100°C; -40...+212°F	-200...+250°C; -328...+428°F
-40...+60°C; -40...+140°F	-20...+55°C; -4...+131°F	-40...+70°C; -13...+149°F	-40...+65°C; -40...+149°F	-55...+60°C; -67...+140°F
Sensor in aluminium, stainless steel	Sensor in aluminum	Stainless steel	LT carbon steel, stainless steel and duplex optional	Steel, stainless steel, Hastelloy® C4, duplex
IP67; NEMA6	IP67; NEMA6	IP67; NEMA6	IP66	IP65, 67; NEMA4, 6
ATEX, FM, CSA, NEPSI	-	ATEX, FM, CSA, IECEEx	ATEX, FM, CSA, IECEEx	ATEX, FM, CSA,
-	-	MID MI-005, Gosstandard, OIML R-117-1 class 0.3, API	OIML R137 class 0.5, MID, AGA 9, ISO 17089	MID MI-005, Gosstandard, OIML R-117-1 class 0.3, API

# The modular product line

## Converters



MFC 300 R  
Rack-mounted



MFC 300 W  
Wall-mounted



MFC 300 F/MFC 400 F  
Field housing



MFC 300 C/MFC 400 C  
General purpose

## Flow sensors



OPTIMASS 1000  
The standard device with an  
excellent price-performance ratio



OPTIMASS 2000  
The first choice for bulk flows  
for custody transfer



OPTIMASS 3000  
Suitable for extremely  
low flow rates



OPTIMASS 7000  
High-end solution featuring a  
single straight measuring tube



OPTIMASS 6000

The standard high-performance meter with  
Entrained Gas Management™ for the process  
industry

## The specialists



OPTIGAS 4010

Specially designed for CNG  
in dispensing systems



OPTIBATCH 4011

Specially designed for linear  
and rotating filling machines

## Mass flowmeters

## Mass flowmeters: A solution for all process applications

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.



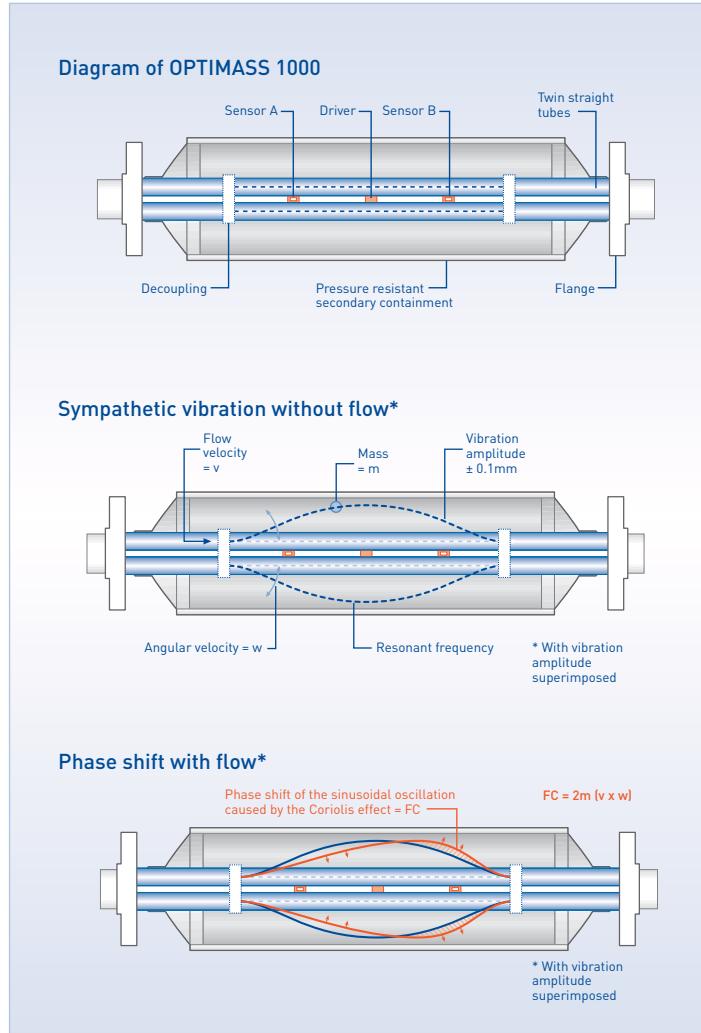
## Highlights:

- MFC 400 converter with Entrained Gas Management™
- Measurement of mass flow, density and temperature as well as calculation of volume flow and mass or volume concentration with a single device
- Complete line of measurement devices to cover every application
- Not susceptible to installation effects, can be installed regardless of type of installation and external influences such as tube vibrations
- Reliable measurement even for difficult applications such as highly viscous media, inhomogeneous mixtures, media with solid content or gas inclusions
- Rapid signal processing even with media and temperature changes and sudden changes in density
- Superior density accuracy, even during rapid changes in temperature; excellent zero-point stability
- From 0.0003 to 2300 t/h flow
- Wide temperature range from -200 °C; -328 °F to +400 °C; +752 °F
- Pressure range up to 350 bar; 5076 psi
- Pressure-resistant secondary containment up to 150 bar; 2175 psi
- Easily drained and easy to clean
- OPTIMASS 2400 with integrated pressure compensation for measuring bulk flow rates
- OPTIMASS 6400 is the standard high performance meter for the process industries
- OPTIMASS 7400 is the only straight tube measuring device for use when custody transfer is required in the highest OIML accuracy class of 0.3
- OPTIMASS 7400 for highly sensitive media as well as media with low flow velocity
- Minimal pressure loss with straight tube measuring devices = low power consumption
- OPTIBATCH – ideal for linear and rotating filling machines
- Wide range of tube materials

# Mass flowmeters

## The measuring principle

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.



**Industries:**

- Chemical
- Pharmaceutical
- Food and beverage
- Oil and gas
- Petrochemical
- Pulp and paper
- Mining and minerals
- Power plants
- Water and wastewater
- Marine

## 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.

OPTIMASS 2400 – Minimal installation footprint



## The modular product line

	The standard device with an excellent price-performance ratio	First choice for bulk flow and liquid custody transfer	Suitable for extremely low flow rates
	OPTIMASS 1010	OPTIMASS 2000	OPTIMASS 3010
<b>Measuring accuracy</b>	Liquid: $\pm 0.15\%$ gas: $0.35\%$ density: $\pm 2 \text{ kg/m}^3$	Liquid: $\pm 0.1\%$ gas: $0.35\%$ density: $\pm 2 \text{ kg/m}^3 (\pm 0.5 \text{ kg/m}^3)$	Liquid: $\pm 0.1\%$ gas: $\pm 0.5\%$ density: $\pm 2 \text{ kg/m}^3 (\pm 0.5 \text{ kg/m}^3)$
<b>Communication</b>	Modbus	Modbus	Modbus
<b>Power supply</b>	12 VDC	12 VDC	12 VDC
<b>Protection category</b>	IP67; NEMA4X	IP67; NEMA4X	IP67; NEMA4X
	OPTIMASS 1400	OPTIMASS 2400	OPTIMASS 3400
			
<b>Measuring accuracy</b>	Liquid: $\pm 0.15\%$ gas: $0.35\%$ density: $\pm 2 \text{ kg/m}^3$	Liquid: $<0.1\%$ (optional: $\pm 0.05\%$ ) gas: $<0.35\%$ density: $\pm 1 \text{ kg/m}^3 (\pm 0.2 \text{ kg/m}^3)$	Liquid: $\pm 0.1\%$ gas: $\pm 0.5\%$ density: $\pm 2 \text{ kg/m}^3 (\pm 0.5 \text{ kg/m}^3)$
<b>Outputs</b>	Current, pulse/frequency, status	Current, pulse/frequency, status	Current, pulse/frequency, status
<b>Inputs</b>	Binary	Binary	Binary
<b>Communication</b>	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus
<b>Power supply</b>	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC
<b>Protection category: Compact (C) Field (F) Wall (W) Rack (R)</b>	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1
	OPTIMASS 1000	OPTIMASS 2000	OPTIMASS 3000
			
<b>Nominal sizes</b>			
<b>Device, EN 1092-1</b>	DN15...50	DN100...250	DN1...4
<b>Connection EN 1092-1</b>	DN15...100	DN100...300	DN15
<b>Device, ASME B16.5</b>	1/2...2"	4...10"	1/25...4/25"
<b>Connection ASME B16.5</b>	1/2...4"	4...12"	1/2"
<b>Screw-on connector NPT</b>	-	-	1/4" (up to 300 bar; 4351 psi)
<b>Pressure rating EN 1092-1</b>	PN40, 63, 100	PN16, 40, 63, 100, 160	PN40, 63
<b>Pressure rating ASME B16.5</b>	CL 150, 300, 600	CL 150, 300, 600, 900, 1500	CL 150, 300, 600
<b>Secondary pressure containment</b>	100 bar; 1450 psi	40 bar; 580 psi (opt. 150 bar; 2175 psi)	30 bar; 435 psi
<b>Measuring ranges</b>	48...170000 kg/h	1560...2300000 kg/h	0.3...450 kg/h
<b>Process temperature</b>	-40...+130°C; -40...+266°F	-40...+130°C; -49...+266°F	-40...150°C; -40...+300°F
<b>Ambient temperature</b>	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...65°C; -40...+149°F
<b>Sensor materials</b>	Duplex stainless steel	Duplex steel, super duplex steel	Stainless steel, Hastelloy® C22
<b>Protection category sensor</b>	IP67; NEMA4X	IP67; NEMA4X	IP67; NEMA4X
<b>Ex-Approvals</b>	ATEX, FM, CSA, NEPSI, IECEx	ATEX, FM, CSA, NEPSI, IECEx	ATEX, FM, CSA, NEPSI
<b>Sanitary &amp; material approvals</b>	3A, EHEDG	NACE	NACE
<b>Custody transfer</b>	-	OIML R117-1, Inmetro, NTEP, MID 2004/22/EC	-
<b>Medium</b>			
<b>Water</b>	x	x	x
<b>Other liquids</b>	x	x	x
<b>Slurries</b>	x	x	-
<b>Gases</b>	x	x	x

## The specialists

The standard high-performance meter with Entrained Gas Management™ for the process industry	High-end solution featuring a straight single measuring tube	Specially designed for linear and rotating filling machines	Specially designed for CNG in dispensing systems
	<b>OPTIMASS 7010</b>	<b>OPTIBATCH 4011</b>	<b>OPTIGAS 4010</b>
-	Liquid: ±0.1% gas: 0.35% density: ±2 kg/m³ (±0.5 kg/m³)	Liquid: mass: ±0.15% volume: ±0.2%	Liquid: ±0.5% per batch gas: ±0.5% per batch
-	Modbus	Modbus (configuration)	Modbus
-	12 VDC	24 VDC	12 VDC
-	IP67; NEMA4X	IP67; NEMA6	IP67; NEMA4X
<b>OPTIMASS 6400</b>	<b>OPTIMASS 7400</b>	<b>OPTIBATCH 4011</b>	<b>OPTIGAS 4010</b>
			
<b>OPTIMASS 6000 + MFC 400</b>	<b>OPTIMASS 7000 + MFC 400</b>		
Liquid: ±0.1%, ±0.05% optional gas: 0.35% density: ±1 kg/m³ (±0.2 kg/m³)	Liquid: ±0.1% gas: 0.35% density: ±2 kg/m³ (±0.5 kg/m³)	Liquid: mass: ±0.15% volume: ±0.2%	Liquid: ±0.5% per batch gas: ±0.5% per batch
Current, pulse/frequency, status	Current, pulse/frequency, status	Pulse/frequency	-
Binary	Binary	-	-
HART®, FF, PA, DP, Modbus	HART®, FF, PA, DP, Modbus	Modbus (configuration)	Modbus
85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	85...250 VAC; 11...31 VDC; 20.5...26 VAC/DC	24 VDC	12 VDC
IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP66, 67; NEMA4, 4X, 6 IP66, 67; NEMA4, 4X, 6 IP65; NEMA4, 4X IP20; NEMA1	IP67; NEMA6 - - -	IP67; NEMA4X - - -
<b>OPTIMASS 6000</b>	<b>OPTIMASS 7000</b>	<b>OPTIBATCH 4000</b>	<b>OPTIGAS 4000</b>
			
<b>OPTIMASS 6000</b>	<b>OPTIMASS 7000</b>		
DN8...100 (150-250 pending)	DN6...80	DN8...15	DN15
DN10...100 (150-300 pending)	DN10...100	-	-
1/2...4" (6-10" pending)	1/4...3"	-	1/2"
1/2...4" (6-12" pending)	1/2...4"	-	-
-	-	-	3/4"
PN16, 40, 63, 100, 160	PN40, 63, 100	Process pressure: 10 bar; 145 psi	Process pressure: 350 bar; 5076 psi static, 300 bar; 4351 psi cyclical
CL 150, 300, 600, 900, 1500	CL 150, 300, 600	-	-
-	100 bar; 1450 psi	6...4320 kg/h	60...4200 kg/h
5...1500000 kg/h	9.5...560000 kg/h	0...+100°C; +32...+212°F	-40...+93°C; -40...+200°F
-200...+400°C; -328...-752°F	-40...+150°C; -40...+302°F	-40...+55°C; -40...+131°F	-40...+55°C; -40...+131°F
-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	Stainless steel	Stainless steel
Stainless steel , Hastelloy® C22, duplex steel	Stainless steel, Hastelloy® C22, titanium, tantalum	IP67; NEMA4X	IP67; NEMA4X
IP67; NEMA4X	IP67; NEMA4X	-	ATEX, NEPSI
ATEX, cFMus, IECEx, NEPSI	ATEX, FM, CSA, NEPSI, IECEx	3A, EHEDG, NACE	3A, ASME Bioprocessing, EHEDG
3A, EHEDG, NACE	EHEDG, 3A, ASME Bioprocessing	-	-
MID 2004/22/EC, OIML	Inmetro, NTEP, MID 2004/22/EC, OIML		PTB, OIML R139 (pending)
X	X	X	-
X	X	X	-
X	X	-	-
X	X		X



OPTISWIRL 4070 C flange  
OPTISWIRL 4070 C sandwich  
The universal device with standard integrated temperature compensation for saturated steam and optionally pressure compensation for superheated steam, gases, wet gases



OPTISWIRL 4070 F flange  
OPTISWIRL 4070 F sandwich  
Remote version with field housing converter with connecting cable up to 15 m / 49 ft



OPTISWIRL 4070 Dual version  
With two independent measuring sensors and two signal converters for multiproduct pipelines, redundant measurement and increased safety demands



Stainless steel centering rings for easy mounting



OPTISWIRL 4200 C flange  
Advanced signal filter technology  
AVFD complements the high accurate measurement with integrated density compensation



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



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  
Integrated reduction of nominal diameter for space-saving and economic installations and large measuring spans



All OPTISWIRL 4200 versions available for SIL 2 applications

## Vortex flowmeters

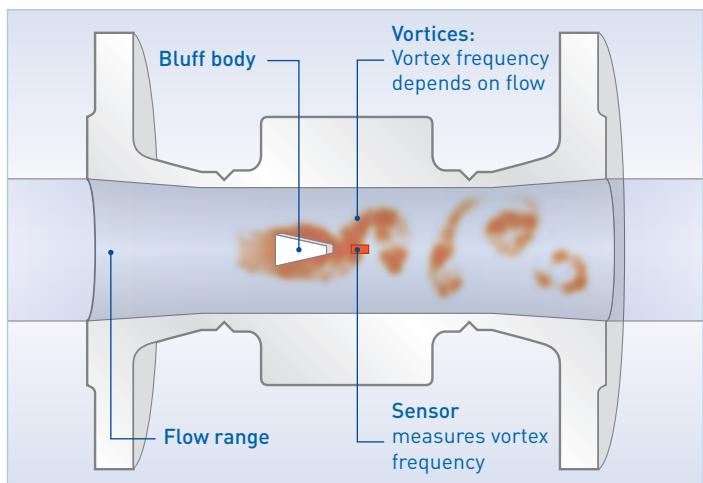
## Highlights:

- Integrated pressure and temperature compensation
- 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 4070: Intelligent Signal Processing (ISP) ensures maximum measurement reliability and stability
- OPTISWIRL 4200: Advanced Vortex Frequency Detection (AVFD) – state-of-the-art technology for digital signal filtering
- Instantly ready for operation (plug & play)
- SIL 2 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
- FAD (Free Air Delivery) functionality
- Gross and net heat calculation to support advanced energy management

## Vortex flowmeters

### 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.



## 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!

### Industries:

- Chemical
- Metal
- Power plants
- Oil and gas
- Petrochemical
- Pulp and paper
- Food and beverage
- Water and wastewater



	The universal device with standard integrated temperature compensation for saturated steam and optionally pressure compensation for superheated steam, gases, wet gases	Advanced signal filter technology AVFD complements the high accurate measurement with integrated density compensation	The first vortex flowmeter with integrated pressure and temperature compensation
	OPTISWIRL 4070 C/F flange	OPTISWIRL 4200 C/F flange	OPTISWIRL 4070 C/F sandwich
			
Signal converter	VFC 070 C/F	VFC 200 C/F	VFC 070 C/F
Measuring accuracy	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam
Repeatability	±0.1%	±0.1%	±0.1%
Product temperature	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F
Outputs	mA, pulse	mA, pulse/frequency/status/limit switch	mA, pulse
Input	-	mA	-
Communication	HART®	HART®, PA, FF	HART®
Power supply (Non Ex)	14...30 VDC	12...30 VDC	14...30 VDC
Power supply (Ex)	14...36 VDC	12...36 VDC	14...36 VDC
Protection category	IP66/67	IP66/67, optional IP66/68	IP66/67
Housing material	Aluminum	Aluminum, stainless steel	Aluminum
Functionality			
FAD	FAD	FAD	FAD
Gross and net heat calculation	Gross heat	Gross and net heat	Gross heat
Measuring sensor	VFM 4000 flange	VFM 4000 flange	VFM 4000 sandwich
Process connections			
EN 1092-1	DN15...300; PN16, 25, 40, 63, 100	DN15...300; PN16, 25, 40, 63, 100	DN15...100; PN16, 25, 40, 63, 100
ASME B16.5	1/2...12"; CL 150, 300, 600	1/2...12"; CL 150, 300, 600, 900, 1500	1/2...4"; CL 150, 300, 600
Temperature ranges			
Process	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F
Ambient (Non Ex)	-40...+85°C; -40...+185°F	-40...+85°C; -40...+185°F	-40...+85°C; -40...+185°F
Ambient (Ex)	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
Materials			
Measuring sensor	1.4404/316L, Hastelloy® C22	1.4404/316L, Hastelloy® C22	1.4404/316L, Hastelloy® C22
Sensor seal	1.4435/316L, Hastelloy® C276	1.4435/316L, Hastelloy® C276	1.4435/316L, Hastelloy® C276
Protection category			
Measuring sensor	IP66/67	IP66/67	IP66/67
Reduction of nominal diameter			
Measuring sensor	1 or 2 steps reduced bore meter	1 or 2 steps reduced bore meter	-
Approvals			
Ex	ATEX, FM (USA), IECEx, NEPSI	ATEX, FM (USA and Canada), IECEx	ATEX, FM (USA), IECEx, NEPSI
Functional Safety	-	SIL 2	-

	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 for multiproduct pipelines, redundant measurement and increased safety demands	With two independent measuring sensors and two signal converters for multiproduct pipelines, redundant measurement and increased safety demands
	OPTISWIRL 4200 C/F sandwich		OPTISWIRL 4200 Dual version
			
Signal converter	VFC 200 C/F	VFC 070	VFC 200
Measuring accuracy	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam	Re > 20000 ±0.75% for liquids Re > 20000 ±1% for gases and steam 10000 < Re < 20000 ±2% for liquids, gases and steam
Repeatability	±0.1%	±0.1%	±0.1%
Product temperature	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F
Outputs	mA, pulse/frequency/status/limit switch	mA, pulse	mA, pulse/frequency/status/limit switch
Input	mA	-	mA
Communication	HART®, PA, FF	HART®	HART®, PA, FF
Power supply (Non Ex)	12...30 VDC	14...30 VDC	12...30 VDC
Power supply (Ex)	12...36 VDC	14...36 VDC	12...36 VDC
Protection category	IP66/67, optional IP66/68	IP66/67	IP66/67, optional IP66/68
Housing material	Aluminum, stainless steel	Aluminum	Aluminum, stainless steel
Functionality			
FAD	FAD	FAD	FAD
Gross and net heat calculation	Gross and net heat	Gross heat	Gross and net heat
Measuring sensor	VFM 4000 sandwich		
Process connections			
EN 1092-1	DN15...100; PN16, 25, 40, 63, 100	DN25...100; PN16, 25, 40, 63, 100	DN25...100; PN16, 25, 40, 63, 100
ASME B16.5	1/2...4"; CL 150, 300, 600	1...4"; CL 150, 300, 600	1...4"; CL 150, 300, 600, 900, 1500
Temperature ranges			
Process	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F	-40...+240°C; -40...+464°F
Ambient (Non Ex)	-40...+85°C; -40...+185°F	-40...+85°C; -40...+185°F	-40...+85°C; -40...+185°F
Ambient (Ex)	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F	-40...+65°C; -40...+149°F
Materials			
Measuring sensor	1.4404/316L, Hastelloy® C22	1.4404/316L, Hastelloy® C22	1.4404/316L, Hastelloy® C22
Sensor seal	1.4435/316L, Hastelloy® C276	1.4435/316L, Hastelloy® C276	1.4435/316L, Hastelloy® C276
Protection category			
Measuring sensor	IP66/67	IP66/67	IP66/67
Reduction of nominal diameter			
Measuring sensor	-	1 or 2 steps reduces bore meter	1 or 2 steps reduced bore meter
Approvals			
Ex	ATEX, FM (USA and Canada), IECEx	ATEX, FM (USA), IECEx, NEPSI	ATEX, FM (USA and Canada), IECEx
Functional Safety	SIL 2	-	SIL 2

# The modular product line

## Pressure transmitters



OPTIBAR DP 7060  
Differential pressure transmitter  
for all flow applications, already  
with integrated absolute pressure  
measurement

## Primary elements



OPTIBAR OP 1000  
Standard orifice plates with single  
bore tapping for cost-effective flow  
measurement

OPTIBAR OP 1200  
Robust split ring orifice plates with  
interchangeable orifice plate

OPTIBAR PT 2000  
Averaging pitot tubes for  
energy-efficient flow measurement  
with lowest pressure loss

## Calibrated meter runs



OPTIBAR MR 1000

Calibrated meter run with orifice plate  
for nominal sizes DN 15...50 / 3/4...2"



OPTIBAR MR 2000

Calibrated meter run with averaging pitot  
tube for nominal sizes DN 15...50 / 3/4...2"

## Flow computers



OPTIBAR FC 1000

Flow computer for pressure and  
temperature compensated gas  
and steam measurement and  
gross/net energy calculation

## Accessories



Accessories 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

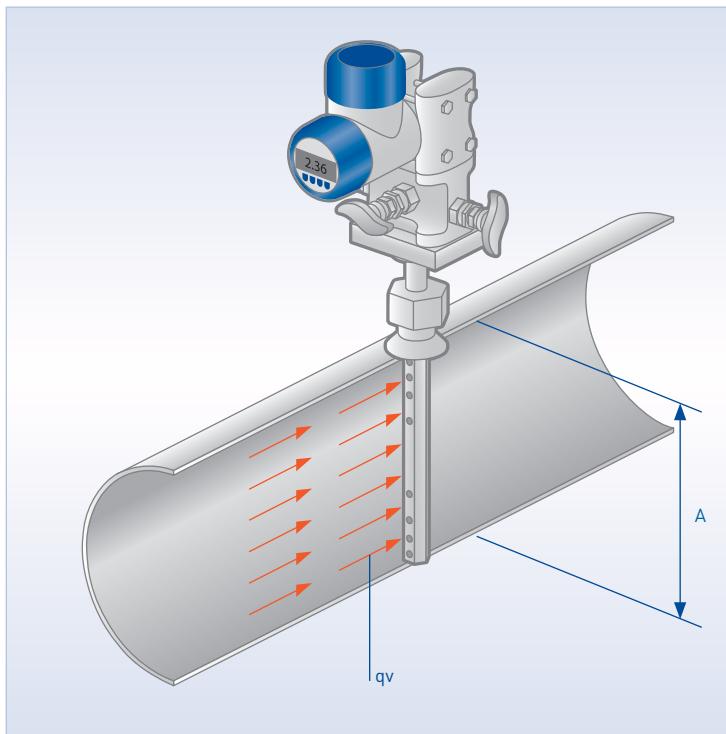
# Differential pressure flow measurement

## 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 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

The pitot tube offers you a simple, cost-efficient flow measurement solution which can be trusted to deliver accurate results over the long term. It is an excellent alternative to orifice plates 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  $qv = v \times A$ .

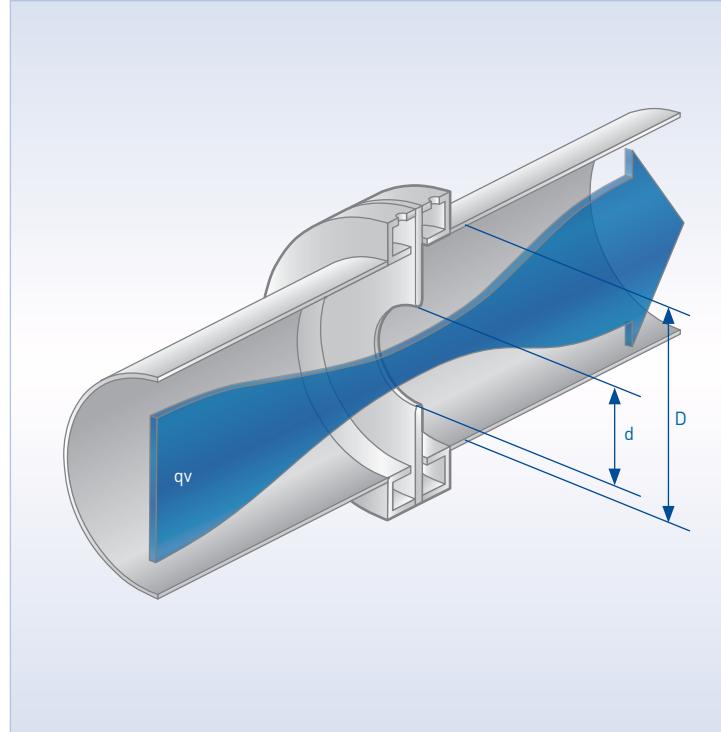
### Orifice plates

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  $\beta = d/D$  is determined for each measuring point, allowing each one to be optimised for specific requirements, including short inlet/outlet, low pressure loss and instances of small overall uncertainty.

Orifice plate primary elements are worldwide standardised according to ISO 5167.



## Highlights:

- Worldwide standardised flow measurement principle according to ISO 5167
- All measurement uncertainties under operational conditions are known and can be calculated
- Volume or mass flow measurement of liquids, gases or steam
- Medium temperatures -200...+1000°C / -328...1832°F
- Process pressure up to 420 bar / 6091 psi
- Line sizes from DN25...12000 / 1...470"
- One pressure transmitter for all flow applications, compact or remote version
- Integrated absolute pressure measurement
- Pressure and temperature compensation available as option
- Wet-calibrated meter runs for small line sizes and low measurement uncertainty
- Optimisation of measuring points according to a given specification, e.g. short inlet/outlet, low pressure loss, small overall uncertainty, etc.
- Change of pressure transmitter without process interruption
- No moving parts
- NACE compliant materials
- Compliant to PED 97/23/EC with CE marking
- Use in hazardous areas
- Large choice of materials for corrosive and non-corrosive media
- Wet calibration up to DN 3000 / 120" possible
- 4...20 mA HART® 7 / HART® SIL 2/3, FOUNDATION™ fieldbus, PROFIBUS® PA as communication options
- Smallest measuring span 10 mbar / 0.145 psi gauge

## 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

## Industries:

### 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.

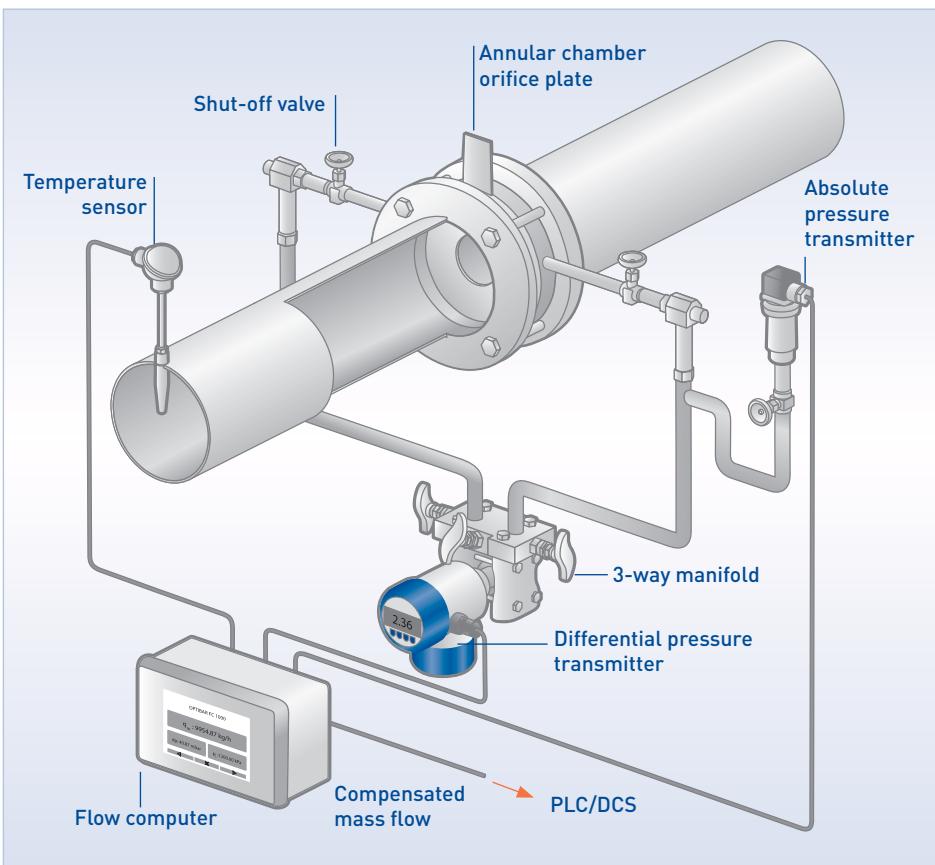
For measurement uncertainties due to changing process conditions, the flow computer holds appropriate algorithms for all primary elements. By adding temperature and pressure sensors, density compensation or gross and net energy calculations are also possible.

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.

- Oil and gas
- Chemical
- Petrochemical
- Heating, Ventilation and Air Conditioning (HVAC)
- Energy
- Metal and mining
- Food and beverages

Complete DP flow measuring point for compensated volume/mass flow



	Averaging pitot tubes for energy-efficient flow measurement with lowest pressure loss	Standard orifice plates with single bore tapping for cost-effective flow measurement	Robust split ring orifice plates with interchangeable orifice plate
	OPTIBAR PT 2000	OPTIBAR OP 1000	OPTIBAR OP 1200
			
Medium	Gas, liquid, steam	Gas, liquid, steam	Gas, liquid, steam
Type	Compact, remote	Compact, remote	Compact, remote
Sizing	KROHNE standard	ISO 5167:2003; ASME MFC-3M 2004; AGA 3; ASME PTC 19.5 2004	ISO 5167:2003; ASME MFC-3M 2004; AGA 3; ASME PTC 19.5 2004
Accuracy	< ±1% uncalibrated; < ±0.5% calibrated	< ±0.6...0.8%	< ±0.6...0.8%
Turn down ration (calibrated)	1:5 (1:7)	1:3 (1:6)	1:3 (1:6)
Pressure loss	5...12%	40...95%	40...95%
Max. pressure	PN40	PN40; PN63; PN100	PN40; PN63; PN100
Max. temperature	+450°C; +842°F	+450°C; +842°F	+450°C; +842°F
Line size	DN50...2000; 2...800"	DN50...2000; 2...800"	DN50...2000; 2...800"
Material primary element	316L	316L	316L
Material mounting parts	A105, 316L, 16Mo3	A105, 316L, 16Mo3	A105, 316L, 16Mo3
Optional temperature probe	Yes	No	No
	Differential pressure transmitter for flow applications, already with integrated absolute pressure measurement		
	<b>OPTIBAR DP 7060 C</b>		
			
Accuracy (of calibrated span)			
Reference accuracy DP	< ±0.065% up to TD 10:1		
Long-term stability	±0.1% within 5 years		
Total performance	< ±0.18%		
Max. turn down	100:1		
Reference accuracy pabs.	< ±0.1%		
Pressure range			
Sensor	Piezoresistive		
Measurement range	10, 30, 100, 500 mbar, 3, 16 bar; 0.15, 0.4, 1.4, 7.2, 43.5, 232 psi		
Line pressure	40, 160, 420 bar; 580.1, 2320.6, 6091.6 psi		
Temperature range			
Process	-40...+85°C; -40...+185°F		
Ambient	-40...+80°C; -40...+185°F		
Configuration			
PC Tool	Free DTM, also USB interface		
Software / HHT	Yes – generic and DD		
Local	With optional display and adjustment module		
Material			
Housing	DIN housing in 1- or 2-chamber configuration: 316L, aluminium, 316L [electro-polished], plastic (PBT)		
Diaphragm material	316L, Hastelloy C276, Monel 400, Tantal, Monel 400 with gold plating		
Communication			
Output	4...20 mA, HART® 7, PA, FF		
Approvals			
Ex	ATEX / IECEx Ex ia, Ex d, Ex d ia		

Calibrated meter run with orifice plate for nominal sizes DN 15...50 / 3/4...2"	Calibrated meter run with averaging pitot tube for nominal sizes DN 15...50 / 3/4...2"
<b>OPTIBAR MR 1000</b>	<b>OPTIBAR MR 2000</b>
	
Gas, liquid, steam	Gas, liquid, steam
Compact	Compact
ISO 5167:2003; ASME MFC-3M 2004; AGA 3; ASME PTC 19.5 2004	KROHNE standard
< ±0.5...1.5% calibrated	< ±0.5...1% calibrated
1:6	1:6
40...95%	5...12%
420 bar; 6091.6 psi	420 bar; 6091.6 psi
+450°C; +842°F	+450°C; +842°F
DN15...50; 3/4...2"	DN15...50; 3/4...2"
A105, 316L	A105, 316L
316L	316L
No	Yes
Differential pressure transmitter for flow applications, already with integrated absolute pressure measurement	
<b>OPTIBAR DP 7060</b>	
	
< ±0.065% up to TD 10:1	
< ±0.1% within 5 years	
< ±0.18%	
100:1	
< ±0.1%	
Piezoresistive	
10, 30, 100, 500 mbar, 3, 16 bar; 0.15, 0.4, 1.4, 7.2, 43.5, 232 psi	
40, 160, 420 bar; 580.1, 2320.6, 6091.6 psi	
-40...+85°C; -40...+185°F	
-40...+80°C; -40...+185°F	
Free DTM, also USB interface	
Yes - generic and DD	
With optional display and adjustment module	
DIN housing in 1- or 2-chamber configuration: 316L, aluminium, 316L (electro-polished), plastic (PBT)	
316L, Hastelloy C276, Monel 400, Tantal, Monel 400 with gold plating	
4...20 mA, HART® 7, PA, FF	
ATEX / IECEx Ex ia, Ex d, Ex d ia	

	Flow computer for pressure and temperature compensated gas and steam measurement and gross/net energy calculation
	<b>OPTIBAR FC 1000</b>
	
<b>Medium</b>	
Water, steam	IAPWS-97
Natural gas	AGA-8 G1/G2 (ISO20765-1) GERG-88 (ISO 12213-3) AGA-NX19
<b>Gases</b>	Ideal gas equation, optional acc. Redlich-Kwong, Redlich-Kwong-Soave, Peng-Robinson
<b>Thermal oil</b>	Therminol66, Shell Thermia B and various other oils by polynominal approximation
<b>Other mediums</b>	Assumption of constant physical properties
<b>Process inputs</b>	
<b>Primary elements</b>	ISO 5167, AGA-3
<b>Volume flow or velocity</b>	Mass flow calculation
<b>Temperature sensor</b>	2x Pt100
<b>Pipe</b>	
<b>Thermal expansion</b>	Acc. AGA-3, VDI-2040, ISO 5167
<b>Interfaces</b>	
<b>Modbus</b>	Modbus RTU and ASCII
<b>Ethernet</b>	Web server, software updates, backup/restore of parameters
<b>FSK modem</b>	Compatible to HART® field devices; digital transfer of measuring values and device parameters
<b>Analog signals</b>	1x Relay (6A; 230 VAC) 2x SPDT (50 mA; 60 VDC)
<b>Display adapter</b>	Link to a remote display module (optional)
<b>User interface</b>	
<b>Display</b>	4.3" TFT color display
<b>Controls</b>	Capacitive touchscreen
<b>Memory</b>	SD-card slot
<b>Inputs</b>	
<b>Flow</b>	0/4...20 mA active/passive, HART®, frequency or pulse inputs
<b>Pressure</b>	0/4...20 mA active/passive
<b>Temperature</b>	3- or 4-wire Pt100, max. length 250 m; 820.2 ft; all inputs are galvanically isolated
<b>Outputs</b>	
<b>Analog outputs</b>	2x 4...20 mA
<b>Switching outputs</b>	1x Relay (6A; 230 VAC) 2x SPDT (50mA; 60 VDC)
<b>Dimensions</b>	Panel housing 135x65x120 mm; 5.28x2.4x4.8 inch: IP20 External display 144x83x18 mm; 6x3.6x0.72 inch: IP65
<b>Power supply</b>	100...240 VAC or 18...36 VDC

## Measuring principle: Deflector plate



DW 181

Inline flow controller,  
process connection  
3/4...2" NPT, G3/4...2

DW 182

Inline flow controller,  
process connection  
DN15...65, 1/2...2 1/2" ASME

DW 183

Inline flow controller,  
process connection  
DN65...200, 3...8" ASME

DW 184

Insertion-type flow controller  
for pipe diameter ≥250 mm / 10",  
process connection DN150,  
6" ASME

Measuring principle: Electromagnetic



DWM 1000

Flow switch with adjustable set point

DWM 2000

Flowmeter with  
4...20 mA output

Flow controllers

## Highlights DWM 1000, 2000:

- Measurement and monitoring of electrically conductive liquids, pastes and suspensions
- Sturdy construction, no moving parts, maintenance-free
- Wetted parts made of stainless steel and ceramic
- Converter is rotatable and removable under process conditions
- FT Tuchenhagen® connection for hygienic applications
- Optional LCD indicator e.g. for on-site calibration
- IP68 stainless steel housing for immersed applications
- Long sensor for large pipes or open channels
- For pipelines >DN25; 1"

## 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 two measuring electrodes 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

### Industries:

- Water and wastewater
- Food and beverage
- Chemical
- Pharmaceutical
- Process industry
- Pulp and paper
- Mining and minerals
- Steel

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.

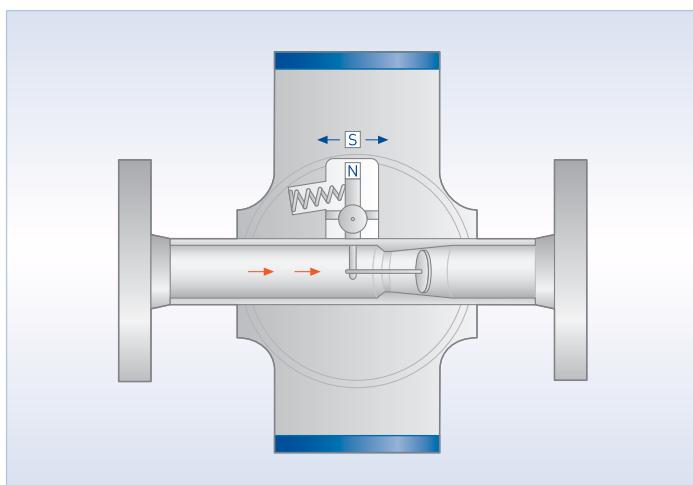
Depending on the design, the flow speed is monitored (DWM 1000) or measured and output via a 4...20 mA (DWM 2000).

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 springmounted 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 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 m<sup>3</sup>/h) via a scale. With this display, the switching points can be set even when there is no flow.

### Industries:

- Power plants
- Steel
- Mining
- Petrochemical
- Oil and gas
- Chemical
- Food and beverage
- Water and wastewater

### Highlights DW 181 to DW 184:

- One or two dry reed limit switches
- For horizontal or vertical pipes (DW 181 to 183)
- Insertion-type for horizontal pipes Ø >250 mm; 10" (DW 184)
- Available with threaded, flange or mounting flange connectors
- Two different flow displays (G and A) to choose from (DW 181 to 183)
- High-temperature design up to max. +300 °C; +572 °F
- Ex-versions (Ex d, Ex i)
- Tropical version with Amphenol® sockets and a double coating of epoxy on device
- Local indication without power supply, can be used as variable area flowmeter
- Additional amplifying relay for switching energies up to 1200 VA

## Flow controllers

	Flow controllers based on disc actuated measuring principle	Flow controller based on electromagnetic measuring principle
	DW 181 to 184	DWM 1000
		
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 (non-Ex and Ex d) HT version (alu terminal box): IP20, 66	Aluminium housing: IP65 Stainless steel housing: IP68
Nominal size		
Pipe diameter	>DN15; 1/2"	>DN25; 1"
Connection	3/4...2" NPT; G3/4...2" DN15...200; 1/2...8"	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 Tuchenhangen VARIVENT® connection for hygienic applications
Pressure ratings		
Max. operating pressure	100 barg; 1450.4 psig, higher on request	25 barg; 362.6 psig
Process conditions		
Medium	Homogeneous, clean liquids	Conductive liquids, pastes, slurries ≥20 mS/cm
Viscosity standard	≤30 mPas; 0.02 lb/fts	-
Viscosity special version	≤250 mPas; 0.16 lb/fts	-
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		
Process	-40...+150°C; -40...+302°F -25...+300°C; -13...+572°F (high temperature)	-25...+150°C; -13...+302°F -25...+60°C; -13...+140°F (IP68)
Ambient	-40...+80°C; -40...+176°F -25...+60°C; -13...+140°F (high temperature)	-25...+60°C; -13...+140°F
Materials		
Measuring tube	Bronze, stainless steel	Stainless steel, zirconium
Measuring system	Stainless steel	Electrode: platinum
Approvals		
Ex	ATEX	-
Miscellaneous	EAC	EAC

	<b>Flow controller based on electromagnetic measuring principle</b>
	<b>DWM 2000</b>
	
<b>Measuring accuracy</b>	When $v > 1 \text{ m/s}$ or $3.3 \text{ ft/s}$ : accuracy $\pm 5\%$ of measured value ( $\pm 2\%$ if calibrated onsite) when $v < 1 \text{ m/s}$ or $3.3 \text{ ft/s}$ : accuracy $\pm 2\%$ of measured value, $\pm 3 \text{ cm/s}$ ; $\pm 1.2 \text{ in/s}$
<b>Repeatability</b>	$\pm 1.5\%$ of measured value
<b>Limit switches</b>	-
<b>Output</b>	4...20 mA, 3-wire
<b>Communication</b>	RS232
<b>Power supply</b>	12, 24 VDC, 50 mA
<b>Protection category</b>	Aluminium housing: IP65 Stainless steel housing: IP68 Aluminium housing with display: IP55
<b>Nominal size</b>	
<b>Pipe diameter</b>	$\geq DN25$ ; 1"
<b>Connection</b>	Std fitting G1A, screw-on welding socket ( $\varnothing 39 \text{ mm}$ ; $\varnothing 1.25 \text{ in}$ ) Optional long sensor 1 1/2" NPT; G1 1/2, screw-on welding socket ( $\varnothing 60 \text{ mm}$ ; $\varnothing 2.4 \text{ in}$ ) spool piece (option) DN25...50; 1...2", DN32; 1 1/4" on request Optional FT Tuchenhagen VARIVENT® connection for hygienic applications
<b>Pressure ratings</b>	
<b>Max. operating pressure</b>	25 barg; 362.6 psig
<b>Process conditions</b>	
<b>Medium</b>	Conductive liquids, pastes, slurries $> 20 \text{ mS/cm}$
<b>Viscosity standard</b>	-
<b>Viscosity special version</b>	-
<b>Measuring range</b>	1...8 m/s; 3.3...26.3 ft/s
<b>Temperature ranges</b>	
<b>Process</b>	-25...+150°C; -13...+302°F -25...+60°C; -13...+140°F (IP68)
<b>Ambient</b>	-25...+60°C; -13...+140°F
<b>Materials</b>	
<b>Measuring tube</b>	Stainless steel, zirconium
<b>Measuring system</b>	Electrode: platinum
<b>Approvals</b>	
<b>Ex</b>	-
<b>Miscellaneous</b>	EAC

# Communication technology

Drivers · Protocols · Configuration · Diagnostics



## Open for the future

### PACTware™ and DTMs

PACTware™ is a manufacturer-independent tool based on FDT technology, providing device configuration and operation. It is free of charge.

DTMs are drivers for FDT-based systems. KROHNE DTM are also available free of charge, without licence and without any functional restrictions.

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. They meet 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 have made DTM available for our field devices with HART®, PROFIBUS® or FOUNDATION™ fieldbus interfaces.

For remote monitoring of applications such as water metering, KROHNE has developed a GSM-based solution for online data transmission and logging.

So you will always have the information you need conveniently close to hand.



## Clear and fast access to process and device data from any level

KROHNE DTMs are available for many field devices with HART®, FOUNDATION™ fieldbus or PROFIBUS® communication interfaces. They can be integrated into all FDT frame applications.

To assure conformity with the FDT standard, KROHNE DTMs are certified by the FDT Group after certification tests at the KROHNE FDT DTM Test Site, accredited in 2014. In addition, intensive interoperability tests with frames of major host system suppliers are performed.

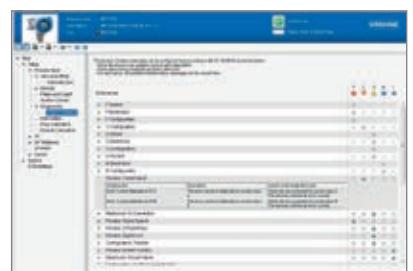
KROHNE DTMs do not require any licence, providing full functionality free of charge. Next to standard operating features, they provide additional information for commissioning and application engineers.

For example, the DTM for the MFC 400 mass flow converter features clear and configurable diagnostics according to NAMUR recommendations NE 107, and an intuitive layout for fast access to the most used functions. DTMs for level devices are enhanced by fully configurable parameterisation screens for easy commissioning.

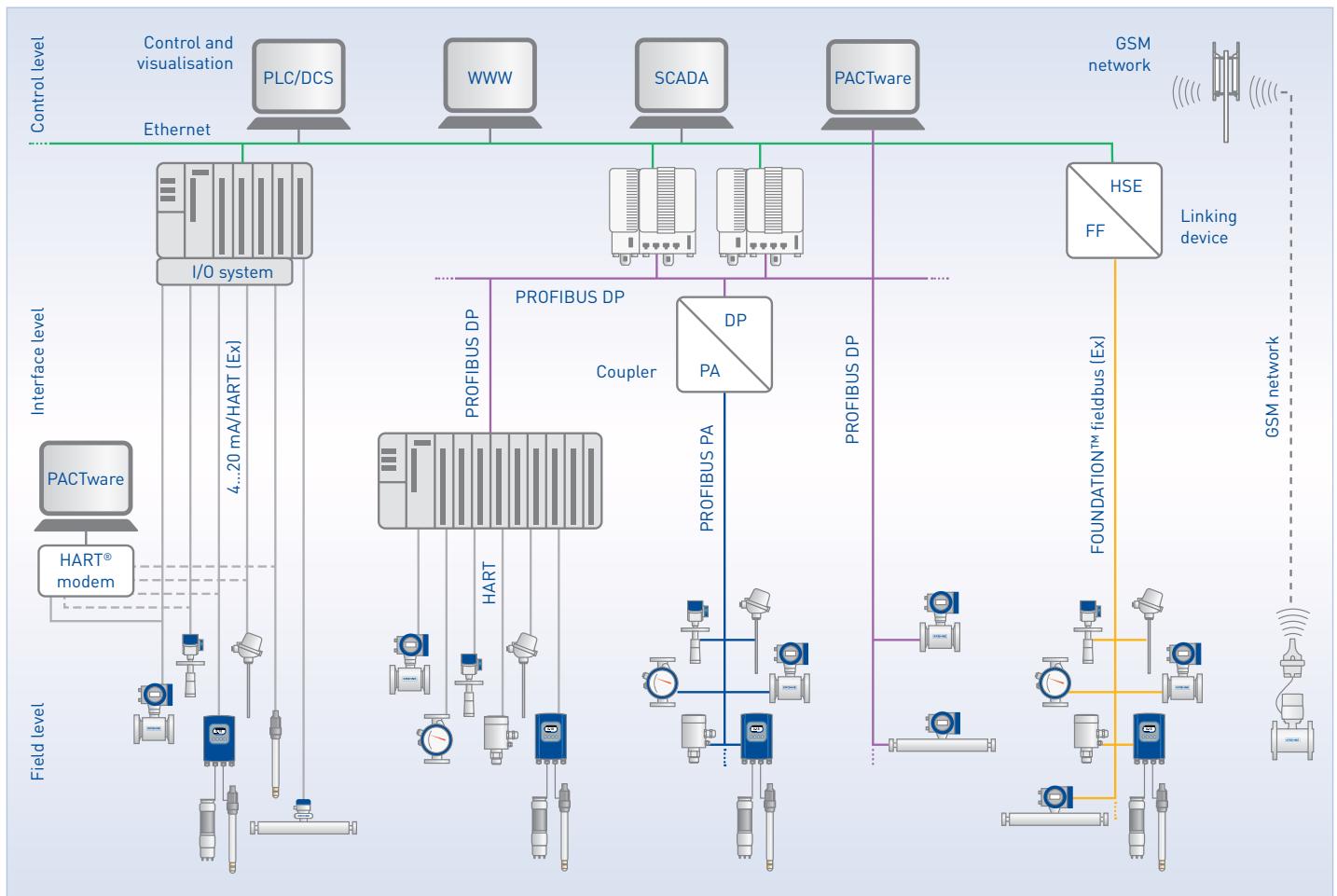
Together with PACTware™, KROHNE DTMs come alongside the device on a CD and can also be downloaded from KROHNE Download Centre at [www.krohne.com](http://www.krohne.com)



Configuration of OPTITEMP TT 51 temperature transmitter via PACTware™



Diagnostic data is categorized or can be user-mapped into five categories according to the severity and ease reactions by the operator. Detailed configuration enables predictive maintenance.



# KROHNE services

Engineering services · Online tools and services · Maintenance services ·  
Quality · Training and seminars · Calibration



## Beyond the highest requirements

For us, service starts at our first contact with you and lasts as long as the life of our systems installed at your plant.

Quality and reliability are key to maintaining the highest service standards. All KROHNE feeder factories are ISO 9001 certified. In fact, long before ISO 9000 existed, KROHNE was already manufacturing to the highest industrial standards. Now certification exists in every factory to demonstrate that we not only fulfil ISO requirements but have passed the ISO certification procedure every three years since the standard was introduced.

But it's not simply a one-way process. We actively encourage companies like yours to participate in our research and development activities. Many of our products that are today considered the pinnacle of excellence were developed in cooperation with our customers.

### Engineering services through all project stages

- Project management
- Control and asset management systems in project concept phase
- Basic engineering based on the specification required by the user
- Detail engineering phase
- Commissioning services
- On-site start-up and commissioning
- Product training (on-site)
- Calibration services

## Proven quality

Before shipping, every meter is thoroughly inspected. This rigorous programme of specific measurements, tests and factory inspections is called KROHNE proved.

So, if you install and operate any KROHNE product by following our operating instructions correctly, problems shouldn't occur. If they do, we will provide you with all the technical support and service you need.

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

## KROHNE Academy and KROHNE Academy online

The KROHNE Academy is a series of seminars organised in collaboration with leading automation companies aimed at plant engineers, operators and contractors across the process industries. It brings industry experts together to provide an insight into the various technologies, industrial standards and procedures that plant operators can find themselves faced with.

Taking place in various countries, KROHNE Academy seminars address key operating issues, from plant safety to ways of increasing plant efficiency and controlling costs, and show possible solutions. They also provide an ideal opportunity for you to speak to the experts and benefit from their vast application knowledge.

Learn more about KROHNE Academy at  
[www.krohne.com](http://www.krohne.com)

KROHNE Academy online is a free eLearning platform that contains audio-enhanced, interactive Web Based Trainings. As with its on-site seminars, the online KROHNE academy learning material is vendor-agnostic and not specific to individual products and/or industries. The main focus of each course is on a measurement technology such as Variable Area, Vortex, Ultrasonic or Mass flow or to a more general topic such as the basics of gas measurement or pipeline leak detection.

Register now for free and start your training at  
<http://academy-online.krohne.com>

Please check [www.krohne.com](http://www.krohne.com)  
for your local service contact.

## Additional online services:

(Find them at [www.krohne.com](http://www.krohne.com))

- **Configure It**  
Configure It is a highly advanced online configuration tool for standard devices offering free 2D/3D CAD data of KROHNE flow devices for planning engineers. It enables you to configure any KROHNE product to handle your application in a few simple steps.
- **KROVASY 4**  
Selection and calculation tool for variable area flowmeters.
- **Planning tool for water & wastewater industry**  
The planning tool for wastewater treatment plants as well as water and wastewater applications for generating tender documents covering flow, level, analysis, pressure and temperature.
- **PiCK**  
Get any information related to your KROHNE product from our dedicated online resource PiCK. Just enter your serial number, and key material like manuals, Quick Starts and calibration documents is at your fingertips.

## Calibration from KROHNE: Certainty you can count on

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.

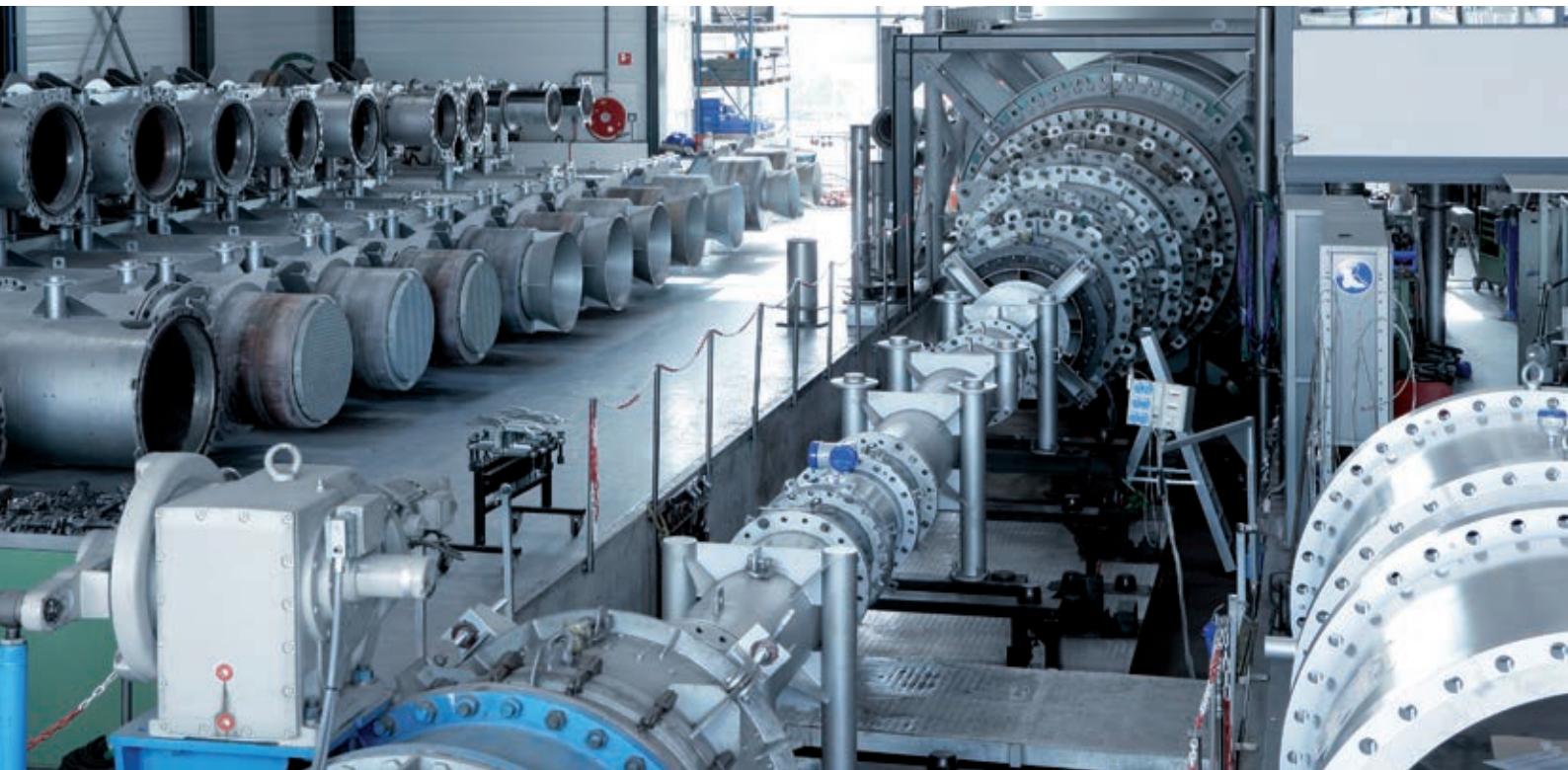
To achieve this, we operate more than 120 calibration facilities for volume flow, mass flow, level, temperature, density and pressure to (wet-)calibrate any device we manufacture. For example, every flowmeter is wet-calibrated using water or air as standard before leaving our facilities.

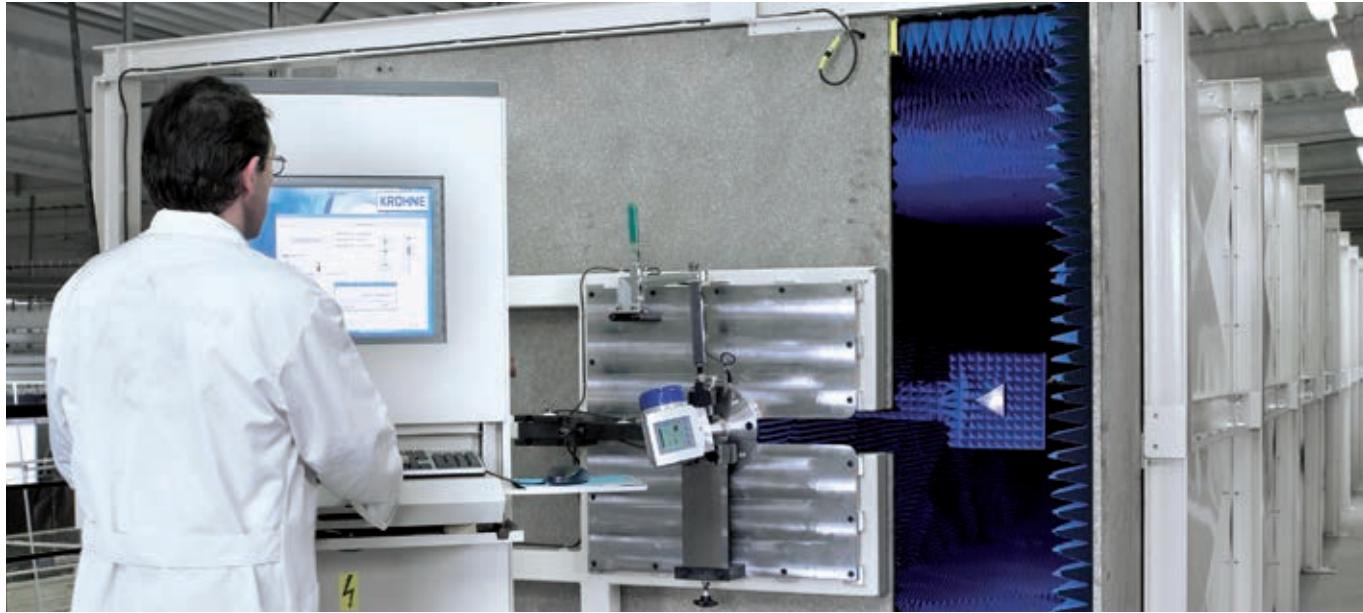
We can also provide customer specific calibration such as:

- 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.

The world's most precise volumetric calibration rig for flowmeters up to DN 3000/120"





Stretch for calibration of FMCW level transmitters

Volumetric piston prover

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 DN 3000/120" with a certified accuracy of 0.013 %. The reference vessel is a 44 m/144 ft high tank containing almost ½ million litres/132,000 gal (US) of water which allows for a maximum flow rate of 30,000 m<sup>3</sup>/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 – Process instrumentation and Measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process analysis
- Services

### Contact

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[www.krohne.com](http://www.krohne.com)

