



**KROHNE**

▶ measure the facts

# Process instrumentation and Measurement solutions

Overview



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## KROHNE trademarks:

KROHNE  
measure the facts  
CalSys  
CARGOMASTER  
EcoMATE  
EGM  
KROHNE Care  
M-PHASE  
OPTIBATCH  
OPTIBRIDGE  
OPTIFLEX  
OPTIFLUX  
OPTIMASS  
OPTISENS  
OPTISONIC  
OPTISOUND  
OPTISWIRL  
OPTISWITCH  
OPTISYS  
OPTIWAVE  
PipePatrol  
WATERFLUX  
SENSOFIT  
SMARTBASE  
SMARTMAC  
SMARTPAT

## Trademarks

of other owners:  
Amphenol  
EtherNet/IP™  
FDT Group  
FOUNDATION™ fieldbus  
HART®  
HASTELLOY®  
Metaglas®  
PACTware  
PROFIBUS®  
PROFINET®  
VARIVENT®



# 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 3,700 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

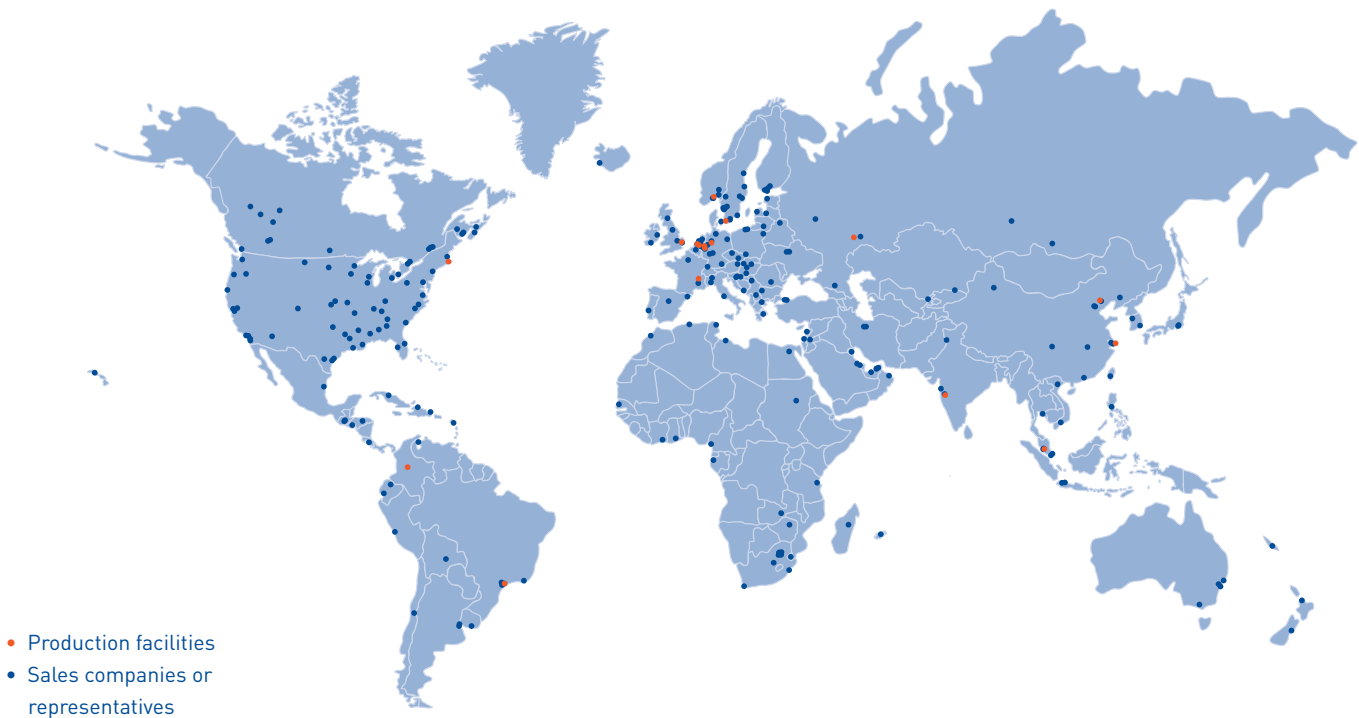


Stephan Neuburger

## Global presence

When you are a global enterprise, you want the people you are dealing with to have the same kind of reach. KROHNE has 17 production facilities, owns 44 companies and joint ventures and works with 55 exclusive representatives worldwide. This means you can deal with a contact or a local office wherever you are.

Find your local contact at [www.krohne.com](http://www.krohne.com)



Working with people like you gives us a wealth of experience or, as we call it, application knowledge.

This means we have a good idea where to look if you have a measuring task that can't be met by an existing product. We will analyse the problem and come up with a way forward. Our ability to do this time after time is one of the very good reasons we are trusted by customers worldwide.

The industries we serve include:

- Chemical & petrochemical
- Food & beverage
- Heating, ventilation & air conditioning (HVAC)
- Iron, steel & metal
- Marine
- Minerals & mining
- Oil & gas
- Pharmaceutical
- Power generation
- Pulp & paper
- Water & wastewater



Manufacturing of converters in Duisburg, Germany

## Development and production sites

Headquartered in Duisburg, Germany, KROHNE has a large network of development and production sites who specialise in manufacturing different parts of our product range:

- Beverly, MA, USA (completion mid of 2018): electromagnetic, variable area and mass flowmeters, radar and guided radar level transmitters
- Breda, the Netherlands: oil & gas metering and proving systems, custody transfer products, leakage detection and localisation systems, flow computers, asset management systems
- Brevik, Norway: tank monitoring and alarm systems, fuel consumption and bunkering monitoring systems
- Bogota, Colombia (joint venture): metering systems
- Chengde, China (joint venture): variable area, vortex, DP, turbine flowmeters, flow controllers, level transmitters, temperature instruments
- Dordrecht, the Netherlands: electromagnetic, ultrasonic and multiphase flowmeters, oil & gas metering and proving systems
- Duisburg, Germany: variable area and vortex flowmeters, analysis sensors and systems
- Kuala Lumpur, Malaysia: oil & gas metering skids
- Malmö, Sweden: temperature assemblies, sensors and transmitters
- Minden, Germany: pressure and differential pressure devices
- Pune, India (joint venture): vortex, variable area and electromagnetic flowmeters, flow controllers and switches, mechanical level transmitters
- Romans-sur-Isère, France: radar and guided radar level transmitters, mechanical level transmitters, level switches, flow controllers and switches
- Samara, Russia: ultrasonic, vortex and electromagnetic flowmeters; radar, guided radar and mechanical level transmitters
- São Paulo, Brazil (joint venture): electromagnetic flowmeters
- Shanghai, China (joint venture): electromagnetic flowmeters
- Shanghai, China: electromagnetic and mass flowmeters, radar and guided radar level transmitters
- Wellingborough, United Kingdom: mass flowmeters



Production of ultrasonic flowmeters in Dordrecht, the Netherlands

At KROHNE, we have a thorough quality and sustainable development policy applied and integrated into all levels of organisation. Available certifications and declarations include:

- Quality management: all KROHNE feeder factories are ISO 9001 certified
- Certified calibration standards (see chapter "Calibration")
- Welding certifications (ISO 3834)
- Certified environmental management system (ISO 14001)
- Industry-related certifications: ATEX, IECEx, FM, NEPSI, EHEDG, HART®, FOUNDATION™ fieldbus, ITK, GOST, EAC, SIL, Achilles JQS, NSF, OHSAS etc.

For more information about quality management and certifications, please visit [www.krohne.com](http://www.krohne.com)

## Flowmeters and flow controllers

Electromagnetic flowmeters · Mass flowmeters · Ultrasonic flowmeters ·  
Variable area flowmeters · Differential pressure · Vortex flowmeters · Flow controllers

A close-up photograph of a grey metal panel, likely part of a flowmeter or flow controller. The panel is secured with several screws. In the lower right corner, the word "KROHNE" is printed in a bold, blue, sans-serif font, enclosed within a blue rectangular border. The background shows the curved, metallic surface of the device.

**KROHNE**

## Move into the lead: Flowmeters and flow controllers

KROHNE offers a comprehensive range of world-class flowmeters:

- Every flowmeter is wet-calibrated
- We hold over 1,000 patents relating to flow products
- All flowmeters come with the relevant approvals

Our flowmeters are used in just about every type of plant and processes around the world. The expertise we have gained, spanning installation effects, different media and meter performance under real process conditions, adds value to every KROHNE meter you purchase.

We are more than capable of handling standard applications, as well as overcoming particularly tough challenges in enterprising ways.

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), EuroLoop (the Netherlands) and NMIJ (Japan).

### Over 95 years' experience:

#### 1921

Ludwig KROHNE starts manufacturing variable area flowmeters in Duisburg, Germany, to measure the flow of air, gases and liquids.

#### 1952

The first electromagnetic flowmeter (EMF) for industrial measurement is launched.

#### 1981

First EMF with measuring tube made of oxide ceramics and sintered platinum electrodes.

#### 1994

First straight tube Coriolis meter.

#### 1996

First ultrasonic meter for custody transfer of liquids in the world.

#### 2006

First vortex flowmeter with integrated pressure and temperature compensation.

#### 2008

ALTOSONIC V12, the first 12-chord ultrasonic gas flowmeter with compensating and diagnostic functions.

#### 2010

WATERFLUX EMF with rectangular cross-section allows installation without straight inlets and outlets.

#### 2014

First ultrasonic flowmeter for biogas applications with direct measurement of methane content.

#### 2014

First Vortex flowmeter with integrated gross and net heat measurement for hot water (condensate) and steam.

#### 2015

First multiphase flowmeter based on magnetic resonance technology

## The modular product line

### Converters



IFC 050  
Basic applications  
(Display/Blind)



IFC 100  
Standard applications



IFC 300 C  
General purpose



IFC 300 F  
Field housing



IFC 300 R  
Rack-mounted



IFC 300 W  
Wall-mounted

### 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 standard  
solution for the  
process industry



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



OPTIFLUX 6000  
The solution for the  
food and pharma-  
ceutical industry

## The specialists



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



TIDALFLUX 2300 F  
For partially filled pipes,  
Ex Zone 1



BATCHFLUX 5500  
For volumetric filling systems  
in the beverage industry



## Battery-powered water meters



WATERFLUX 3070 C  
Battery powered water meter  
with optional pressure and  
temperature sensors



WATERFLUX 3070 F  
Subsoil installation sensor  
with remote converter

## Accessories



OPTICHECK  
On-site verification tool for calibration  
verification and documentation



## Electromagnetic flowmeters

The measurement principle of electromagnetic flowmeters (EMF) is based on Faraday's law of induction. EMF can measure the volume flow of any electrically conductive liquid medium, even those with low conductivities.

### Typical applications include:

- Water industry: revenue metering, district metering, water abstraction, leakage detection
- Wastewater industry: transport networks, sewage treatment plants, sludges
- Food & beverage industry: mixing, dosing and filling of drinks under hygienic conditions, filling systems applications
- Chemical industry: acids, alkalis, dosing applications, abrasive or corrosive media
- Pulp & paper industry: pulp, pastes, sludges and other caustic media, liquor, additives, bleaches, colourants
- Metal & mining industry: media with a high solid content, like ore or excavator mud

OPTIFLUX 4300 in the filtration system in city waterworks



### Highlights:

- Minimal or no inlets/outlets
- All KROHNE EMF are wet-calibrated in a direct comparison of volumes
- Large choice of liner materials suitable for potable water, wastewater, chemicals, SIP/CIP
- Measurement independent of flow profile
- Custody transfer approvals
- Abrasion and corrosion resistant liners
- Ceramic measuring tubes and liners for flange and sandwich versions, also with non-wetted electrodes (capacitive flowmeter)
- Standard device for partially filled pipes
- PROFINET I/O interface
- Virtual reference option: grounding electrodes and grounding rings can be left out
- Electrical conductivity of media can be used for detection of product change
- For high bubble content, high solids content and pulsating flow
- Secure handling of rapid media changes and pH jumps
- Zero-point stability regardless of changes in media properties
- Nominal sizes DN2.5...3000
- 3x100% diagnostics (application and device diagnostic, out-of-spec test) exceeds NAMUR requirements

### Highlights:

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

## Mass flowmeters

The function of mass flowmeters is based on the Coriolis principle. They allow for a direct measurement of mass flow, density and temperature of liquids and gases as well as calculation of volume flow and mass or volume concentration with a single device.

### Typical applications include:

- Chemical: measurement of concentration or density, bulk loading, batching to reactors, hydrocarbon cracking, aggressive, abrasive or viscous media or media of unknown composition
- Food & beverage: filling machine applications, measurement of degrees Brix, flow, density, specific gravity, additive components dosing
- Pharmaceutical: batching, dosing and filling, solvent extraction ultra-pure water measurement
- Water & wastewater: flocculent dosing, sludge flow and density measurement
- Pulp & paper: paper stock, pulp, additives, bleaches, colourants
- Oil & gas: metering skids, bypass density measurement, CNG/LPG dispensers, leak detection, custody transfer applications such as tanker loading, bunkering and pipeline transfer

OPTIMASS 2000 – Minimal installation footprint



## The modular product line

### Converters



MFC 400 C  
General purpose



MFC 400 F  
Field housing



MFC 010  
Modbus converter  
for economical OEM  
system integration

### Flow sensors



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



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



OPTIMASS 3000  
Suitable for extremely  
low flow rates



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



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



### The specialists



OPTIGAS 4010  
Specially designed for CNG and  
LPG in dispensing systems



OPTIBATCH 4011  
Specially designed for linear  
and rotating filling machines

### Accessories



OPTICHECK  
On-site verification tool for calibration  
verification and documentation

## Ultrasonic flowmeters for liquids



**OPTISONIC 3400**  
3-path device for liquids, with MI-004 approval for district heating applications



**OPTISONIC 4400 HT/HP**  
2-path for high temperature / high pressure liquids



**OPTISONIC 6300 W/P**  
Clamp-on flowmeter for liquids, stationary or battery-powered portable versions

## Ultrasonic flowmeters for gas and steam



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



**OPTISONIC 7300 Biogas**  
For biogas applications with direct measurement of methane content



**OPTISONIC 8300**  
2-path device for superheated steam

## Custody transfer



**ALTOSONIC III**  
3-path device for light liquid hydrocarbons



**ALTOSONIC 5**  
8-path device for crudes, refined products and other liquid hydrocarbons, with gas detection



**ALTOSONIC V LNG**  
5-path device for Liquefied Natural Gas (LNG)



**ALTOSONIC V12**  
12-chord device for natural gas and hydrogen with compensating and diagnostic functions



Process gas measurement  
with OPTISONIC 7300

## Ultrasonic flowmeters

Using the transit time method, ultrasonic flowmeters measure liquid and gaseous media.

### Typical applications include:

- Power plants: cooling water and demineralised water, steam, thermal oil (HTF), molten salt
- Chemical industry: metering of liquid hydrocarbons and low-conductivity liquids, including feedstock, solvents, chemical addition in reactor control metering, demineralised water
- Petrochemical refineries: feedstock, cooker feed flow, cracking, desulphurisation, residues, blending of crude oil and refined product
- Petrochemical plants: feedstocks (e.g. naphtha and natural gas), (intermediate) products such as ethylene, propylene, solvents
- Oil & gas industry: measurement of crude oil and refined product, natural gas, liquefied natural gas (LNG) and biogas; standard and custody transfer applications in production, pipeline transfer and leak detection, loading and off-loading, storage and distribution
- Water/utilities: demineralised water, water purification, effluent, compressed air
- HVAC: metering of chilled water and hot water for (custody transfer) energy measurement

### 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, detection of gas entrainments in liquids, etc.
- 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

**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

Variable area flowmeters are suitable for measuring pure liquids and gases. They have an upright conical tube made of metal, glass or plastic, in which a float moves freely up and down. The flow through the tube causes the float to rise until the forces are in equilibrium.

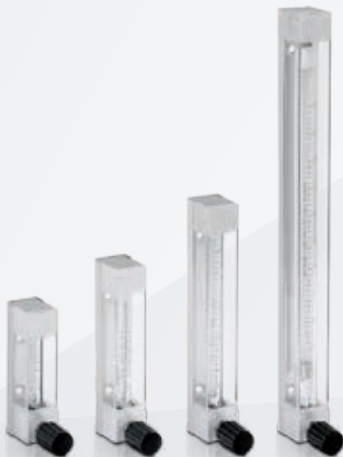
### Typical applications include:

- 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 media (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

Measuring the flow of CO<sub>2</sub> in the inlet lines of storage tanks at Eckes-Granini, Germany



Glass devices



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



VA40  
All-purpose flowmeter with various process connections

Metal devices

DK32, 34, 37  
With mechanical or electronic indicator and metering valve to set flow value accurately



H250 M40  
The new standard device, explosion-proof and intrinsically safe



# The modular product line

## Pressure transmitters



OPTIBAR DP 7060

Differential pressure transmitter for flow applications, already with integrated absolute pressure measurement



## Primary elements

### Orifice plates



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



OPTIBAR OP 3100/3200  
Integral design, single-bore tapping



OPTIBAR OP 4100  
With annular chamber and split ring



OPTIBAR OP 5100/5110  
With weld neck flanges

### Averaging pitot tubes



OPTIBAR PT 2000  
Low pressure loss, cost efficient  
performance

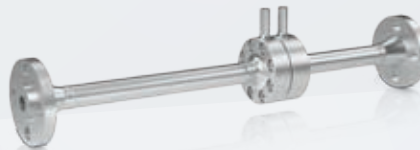


Other flow elements such as  
Venturis, nozzels, cone and wedge  
meters from SEIKO acc. to ISO  
or ASME standards available on  
request.

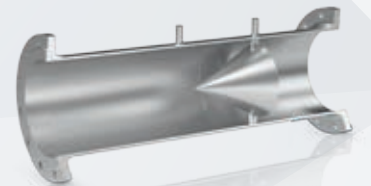
### Meter runs



OPTIBAR MR 2000  
Calibrated, with averaging pitot tube for  
nominal sizes DN 15...50 / 3/4...2"



OPTIBAR MR 4300  
With orifice plate, for nominal line sizes  
DN 15...50 / 3/4...2"



OPTIBAR MR 6300  
With cone, for nominal sizes 4...24"

### 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

### Flow computers



OPTIBAR FC 1000  
Flow computer for pressure and  
temperature compensated gas and  
steam measurement and gross/net  
energy calculation



## Differential pressure flow measurement

The principle of differential pressure (DP) is used to measure volume or mass flow of liquids, gases or steam.

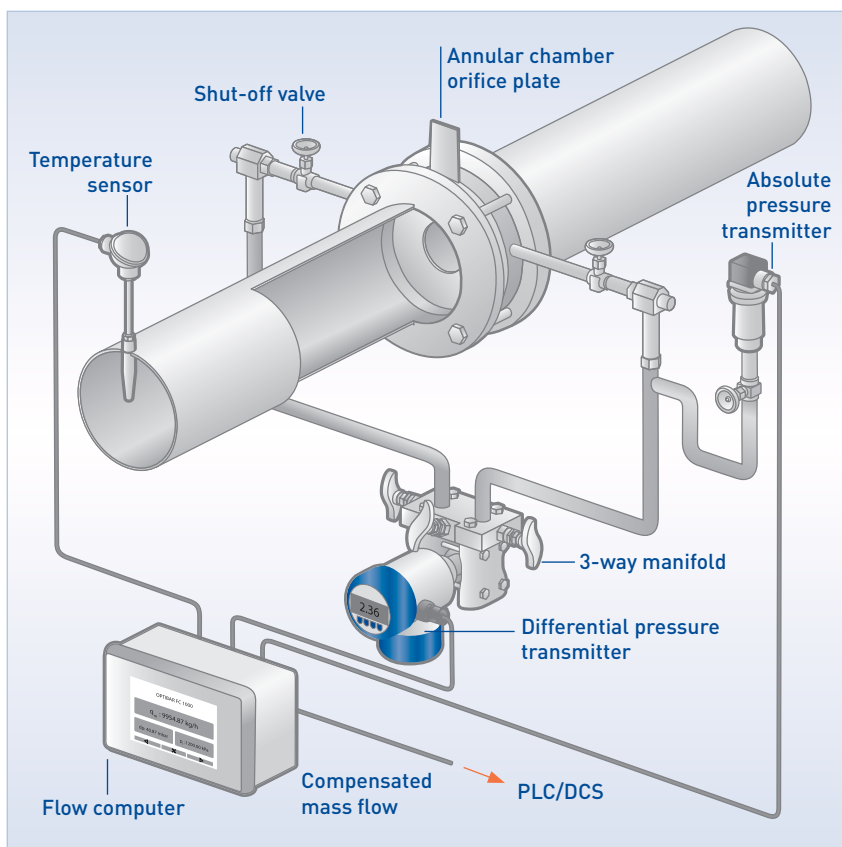
The pressure is measured at two points across a restriction in the line (e.g. a primary element). By using the Bernoulli equation, the difference in pressure between the two points is an indication for flow velocity and, as the pipe size is known, calculated to a volume flow rate.

The OPTIBAR modular product line ranges from DP pressure transmitters to complete DP flow measuring points from one source with matched, pre-configured components, (wet) calibrated and ready to install.

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

- Applications that require a low pressure loss
- Retrofit of existing pipes with a flow measurement
- Line sizes > DN300 / 12"
- Low pressure gases

Complete DP flow measuring point for compensated volume/mass flow



### Highlights of DP flow measurement:

- Worldwide standardised flow measurement principle according to ISO 5167
- All measurement uncertainties underoperational conditions are known and can be calculated
- Volume or mass flow measurement of liquids, gases or steam
- Primary elements manufactured by SEIKO Flowcontrol
- Medium temperatures -200...+1000°C / -328...1832°F
- Process pressure up to 420 bar / 6091 psi
- Line sizes from DN15...12000 / 1/2...470"
- Pressure and temperature compensation available as option
- Wet calibration up to DN 3000 / 120", larger sizes on request
- Optimisation according to a given specification, e.g. short inlet/outlet, low pressure loss, small overall uncertainty, etc.
- Large choice of materials for corrosive and non-corrosive mediums

## Vortex flowmeters



**OPTISWIRL 4200**  
Vortex flowmeter with Advanced Vortex Frequency Detection for stable measurement under different process conditions



**OPTISWIRL 4200 C 1R / 2R**  
Integrated reduction of nominal diameter for space-saving and economic installations and large measuring spans



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

## Accessories



**OPTICHECK**  
On-site verification tool for calibration verification and documentation

## Mechanical flow controllers



**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  $\geq 250$  mm / 10",  
process connection  
DN150, 6" ASME

## Electromagnetic flow controllers



**DWM 1000**  
Monitoring unit with  
binary output

**DWM 2000**  
Flowmeter with  
4...20 mA output

## Vortex flowmeters

Vortex flowmeters are based on the principle of the Kármán vortex street and are used in main as well as auxiliary and supply processes.

Capable of compensating for different temperature and pressure conditions, they measure the volume flow of both conducting and non-conducting liquids, industrial gases and steam.

**Applications include measurement of:**

- Saturated steam and superheated steam
- Gross and net heat for energy management systems
- Hot steam, also for CIP and SIP processes
- Liquefied gas, wet gas and flue gas
- Demineralised water and boiler feed water
- Solvents and heat transfer oil
- Steam boiler monitoring
- Compressor output
- Consumption in compressed air systems
- Free air delivery (FAD)
- Burner consumption

## Mechanical flow controllers

Mechanical flow controllers work via a spring-mounted baffle that changes its position as flow increases. Adjustable switches generate alarms once switching points are reached.

**Typical applications include:**

- Local indication of flow without power supply – cooling systems, pump protection, lubrication control or cavitation alarm, for instance

## Electromagnetic flow controllers

Based on Faraday's law of induction, electromagnetic flow controllers monitor or measure the flow speed of electrically conductive liquids.

**Typical applications include:**

- Largely homogenous liquids, pastes, suspensions and sludges, even with solid content

### Highlights of vortex flowmeters:


- Integrated pressure and temperature compensation for fluctuating pressures and temperatures
- Temperature compensation for saturated steam included as standard
- Gross and net heat calculation to support advanced energy management
- Non-wearing, fully-welded stainless steel construction with high resistance to corrosion, pressure and temperature
- SIL2 certified
- Redundant Data Management: Easy exchange of electronics without loss of calibration and parametrisation data
- Use in hazardous areas

### Highlights of mechanical flow controllers:

- One limit switch (dry reed contact) as standard, second switch can be added
- For horizontal or vertical pipelines
- Available with screw-type, flange or mounting flange connectors
- Tropical version with Amphenol® sockets and a double coating of epoxy on device
- Additional amplifying relay for switching energies of up to 1200 VA

### Highlights of electromagn. flow controllers:

- Minimum conductivity 20  $\mu\text{S}/\text{cm}$
- Sturdy construction, no moving parts
- Parts in contact with medium made of stainless steel and ceramic
- Electronic unit can be replaced under operating conditions
- For pipelines  $\geq \text{DN}25/1''$



## Level measurement

Transmitters: FMCW radar · TDR guided radar · Ultrasonic ·  
Magnetic Bypass · Displacer · Potentiometric · Hydrostatic pressure  
Switches: Vibration · Microwave  
Accessories: Surge protectors · Signal conditioners

## For the highest level of quality: Level transmitters, switches, indicators and accessories

KROHNE offers a comprehensive range of level technologies for the accurate and reliable measurement, detection or indication of liquids and solids in any industry.

Our factory calibrated and field-proven level instruments ensure optimized performance and safety even in the most challenging applications like high temperature, high pressure, dusty atmosphere, liquid-liquid interface, agitated or corrosive liquids. The instruments are easy to use and comply with a broad spectrum of industry standards and approvals.

With over 60 years of experience in level measurement, KROHNE is also your partner for individually tailored solutions in terms of special materials or installations.

### Over 60 years' experience:

#### 1955

Production of mechanical level transmitters for measuring liquids in tanks and containers begins.

#### 1989

KROHNE introduces the first FMCW radar transmitter for process tanks, pioneering the use of radar level measurement technology in process applications.

#### 1995

KROHNE launches the first TDR guided radar transmitter.

#### 2000

KROHNE develops the first 2-wire FMCW radar device.

#### 2004

The next quantum leap in level measurement comes with the OPTIWAVE and OPTIFLEX series, a new generation of non-contact and guided radar devices with a unique wizard-driven operating concept.

#### 2009

Introduction of the innovative Drop antenna for OPTIWAVE. Its ellipsoidal shape prevents product deposits in dusty or humid atmospheres.

#### 2012

Modular housing concept with bayonet locking system for OPTIFLEX.

#### 2013

Unique PP/PTFE Wave Horn antennas for OPTIWAVE in corrosive environments.

#### 2017

New 24 and 80 GHz radars added to OPTIWAVE series, each designed for specific industry needs.

## Frequency Modulated Continuous Wave (FMCW) radar



FMCW radar continuously emits a linear, frequency-modulated microwave signal with a constant amplitude which is reflected from the product surface and received back. These transmitters allow for the continuous, contactless level measurement of liquids, pastes, granulates, powders and other solids in a wide variety of industries:

- Chemical & petrochemical: solvents, alcohols, chlorine, resins, fertilizers (urea), liquefied gas, hydrocarbons, plastics, asphalt (bitumen), acids, bases, butadiene, propylene, soap powder, molten sulphur, additives, foaming agent
- Energy: hydrocarbons, animal flour, dried sludge, coal, fly ash, biogas, cooling water, molten salt, lime milk, acids
- Agriculture, food & beverage: syrup, animal feed, juice, spirits, salt, sugar, sodium carbonate, flour, cereals, coffee, chocolate, milk powder, yeast, vegetable oil, molasses, starch
- Iron, steel & metal: molten steel, iron-disulphide, ore, coke
- Marine: cargo, ballasts
- Metals: molten steel, additives
- Minerals & mining : stone, gravel, sand, lime, cement, concrete, gypsum, calcium carbonate, clinker, coal, sludge, silica
- Oil & gas: hydrocarbons, condensates, liquefied gases
- Pharmaceutical: alcohol, high purity water, solvents, various raw materials
- Pulp & paper: binding agents, wood chips, saw dust, pulp moulding, titanium oxide
- Water & wastewater: potable, sea and river water, sewage, biological waste, dried sludge, flocculants, ferric chloride, lime, chlorine

### Typical applications include:

- Reaction vessels
- Silos, bunkers and stockpiles for solids
- Stock monitoring for inventory
- Storage and production of toxic or corrosive liquids
- Storage of liquefied gases in high pressure/low temperature spheres
- Hygienic process applications
- Flow measurement in open channels with pre-shaped flumes and weirs
- Tank farms

### Highlights:

- Distance, level, volume and mass measurement
- Not affected by fixed or moving inserts/agitators
- Lens, Drop and Horn antennas to suit all process and installation conditions
- Drop antenna made of plain PP, PEEK or PTFE: its ellipsoidal shape and non-adhesive surface prevents product deposits in dusty or humid atmospheres
- Suitable for high and low process pressure/temperature applications
- Modular design from mechanics to converter
- Metaglas® dual process sealing system for dangerous products

For liquids



OPTIWAVE 1010 C  
6 GHz FMCW radar for liquids  
in bypass chambers



OPTIWAVE 3500 C  
80 GHz FMCW radar for liquids  
with hygienic requirements



OPTIWAVE 5200 C/F  
10 GHz FMCW radar for liquids in  
storage and process applications



OPTIWAVE 5400 C  
24 GHz FMCW radar for liquids in  
basic process applications



OPTIWAVE 7400 C  
24 GHz FMCW radar for agitated  
and corrosive liquids



OPTIWAVE 7500 C  
80 GHz FMCW radar for liquids in narrow  
tanks with internal obstructions

For solids



OPTIWAVE 6400 C  
24 GHz FMCW radar for solids from granulates to rocks



OPTIWAVE 6500 C  
80 GHz FMCW radar for powders and  
dusty atmospheres



OPTIFLEX 1100 C  
2-wire TDR guided radar  
for storage or standard  
process applications



OPTIFLEX 2200 C  
2-wire TDR guided radar for  
solid and liquid applications



OPTIFLEX 2200 F remote version  
2-wire TDR guided radar for  
solid and liquid applications



OPTIFLEX 1300 C  
2-wire TDR guided  
radar for solid, liquid and  
interface applications



OPTIFLEX 4300 C Marine\*  
2-wire TDR guided  
radar for marine and  
offshore applications

\*marketed through KROHNE Marine sales offices (see page 64)



## TDR guided radar

TDR radar (Time Domain Reflectometry) emits electromagnetic pulses which are transmitted along a rigid or flexible conductor before being reflected from the product surface and received. It allows for continuous level measurement of liquids, pastes, granulates, powders and liquid interface in industries which include:

- Chemical & petrochemical: fertilizers (ammonia), solvents, carbon dioxide, hydrocarbons, liquefied gases, plastics, bitumen emulsion
- Energy: hydrocarbons, coal powder, fly ash
- Food & beverage: animal feed, recycled cooking oil, coffee peel
- Iron, steel & metal: ore, cooling water, hydraulic oil
- Marine: cargo, ballasts
- Minerals & mining: mineral powders (cement, coal, alumina, talc, salt), sand, perlite
- Oil & gas: water/hydrocarbon interface, liquefied gases
- Pharmaceutical: solvents, alcohol and intermediate products
- Pulp & paper: binding agents, wood chips, saw dust
- Water & wastewater: potable, sea and river water

### Typical applications include:

- Crude oil distillation in extraction vessels
- Storage of liquefied gases in high pressure/low temperature spheres
- Storage of raw materials and intermediates in bulk solid containers
- Separation of liquids
- Rag layer detection in impounding basins
- Condensation vessels for liquids and gases
- Storage of raw and finished products in tank farms of refineries
- Rock crushers, hoppers
- Water towers, basins and reservoirs
- Tide level, flood warning

### Highlights:

- Distance, level, volume, mass and/or interface measurement
- Not affected by process conditions: dust, foam, vapour, agitated or boiling surfaces, changes in pressure, temperature and density
- Suitable for high and low process temperature/pressure applications
- Converter can be rotated and removed under process conditions
- Metaglas® dual process sealing system for dangerous products
- Modular design from mechanics to converter





## Ultrasonic

This particular transmitter type emits ultrasonic pulses which are reflected from the product surface and received. It is suitable for continuous, non-contact level measurement of liquids and solids in the following industries:

- Chemical: acids, bases, plastics
- Water & wastewater: potable, sea and river water, sewage

**Typical applications include:**

- Non-contact flow measurement in open channels
- Level of solids in silos and storage tanks
- Slightly corrosive acids and lies
- Hazardous areas
- Sumps, water and wastewater basins

### Highlights:

- Integrated temperature sensor for velocity compensation
- Unaffected by product properties
- Set-up without medium
- Gas and dust approvals for hazardous areas
- Highly resistant materials for acoustic signal transducers and process connections
- SIL2, FOUNDATION™ fieldbus, PROFIBUS® PA as options



OPTISOUND 3010 C  
2-/4-wire ultrasonic  
level transmitter for  
small tanks



OPTISOUND 3020 C  
2-/4-wire ultrasonic  
level transmitter  
for small and  
medium-sized tanks



OPTISOUND 3030 C  
2-/4-wire ultrasonic  
level transmitter for  
medium-sized tanks

## Magnetic bypass



BM 26 BASIC/  
ADVANCED  
Magnetic bypass level  
indicator (MLI) for  
liquid applications  
(tube inner diameter  
38.4 mm / 1 1/2")



BM 26 A  
Magnetic bypass level  
indicator (MLI) for  
liquid and interface  
applications (tube  
inner diameter  
67.4 mm / 2.65")



BM 26 W1010  
BM 26 ADVANCED  
with welded  
OPTIWAVE 1010  
for liquid  
applications



BM 26 W7300  
BM 26 A with  
OPTIWAVE 7300  
for liquid  
applications



BM 26 F2200  
BM 26 A with  
OPTIFLEX 2200  
for liquid level  
and/or interface  
applications



RC F1300  
Reference chamber  
with OPTIFLEX 1300  
for liquid level and/or  
interface applications

## Displacer



BW 25  
Broadband displacer  
level transmitter for  
high pressures and  
temperatures

## Potentiometric



BM 500  
4-wire potentiometric  
level transmitter for  
hygienic applications

## Magnetic bypass

Magnetic bypass float level transmitters are based on the principle of communicating vessels and allow for a continuous level or interface measurement of liquids.

### Typical applications include:

- Chemical industry: suitable for safety-related applications – flammable, toxic and corrosive media, liquids in low pressure storage and process tanks
- Oil & gas, petrochemical industries: measuring the level of hydrocarbons in refining applications

### Highlights of magnetic bypass transmitters:

- Robust stainless steel design also for use in extreme process conditions
- Hermetically sealed (IP68), easy to read local indication
- Variety of process connections, special materials, valves, insulation
- Analogue transmitters (FF/PA/HART®) with optional display
- Adjustable, clamp-on limit switches
- Local float failure indication
- Ex and PED-compliant

## Displacer

Based on the Archimedes or displacer principle, these transmitters measure level and separating layers of liquids.

### Typical applications include:

- Chemical & petrochemical industries: hydrocarbons, solvents, bases
- Energy, power generation: steam generator, water

### Highlights of displacer transmitters:

- Suitable for use in extreme process conditions, e.g. high pressure/temperature liquids
- Reference vessel available for bypass installation
- Modular design, retrofitting under process conditions is possible
- Converter/indicator scale are mechanically sealed from the process

## Potentiometric

Potentiometric transmitters measure the potential difference in voltage between a working and a reference electrode and enable level measurement independent of medium properties.

### Applications in the food & beverage, pharmaceutical industries:

- Small tanks and hygienic applications
- Tough, pasty or strongly adhesive media

### Highlights of potentiometric transmitters:

- Not sensitive to adhesives and foam
- Defined empty reporting function
- Quick response time
- Automatic position detection
- Resistant to high temperatures (CIP/SIP)
- Compact or remote version

## Pressure transmitters



**OPTIBAR P 2010**  
Ultra-compact pressure transmitter with flush metallic diaphragm also for hygienic applications



**OPTIBAR PC 5060**  
Process pressure transmitter with ceramic diaphragm for pressure and level measurement



**OPTIBAR PM 5060**  
Process pressure transmitter with metallic diaphragm also for high pressure ranges and hygienic applications



**OPTIBAR DP 7060**  
Differential pressure transmitter for hydrostatic level measurement with integrated absolute pressure measurement

## Diaphragm seals



**OPTIBAR DS series**  
Diaphragm seals for temperatures up to +450 °C / +842 °F or corrosive media



**OPTIBAR DS direct**  
Differential pressure transmitter with direct mounted single-sided OPTIBAR DS diaphragm seal



**OPTIBAR DS capillary**  
Differential pressure transmitter with capillary mounted two-sided OPTIBAR DS diaphragm seal



**OPTIBAR DS direct/capillary**  
Differential pressure transmitter with combined direct/capillary mounted two-sided OPTIBAR DS diaphragm seal

## Submersible probes



**OPTIBAR LC 1010**  
Submersible level probe with ceramic diaphragm 22 mm / 1" diameter

## 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
- Flange adapter according to DIN EN and ASME
- Condensate pots for steam applications
- Straight and curved connecting pipes, syphons in U- and circular shapes
- Fittings, seals, blind-plugs, oval flange adapter and gauge snubber

## Hydrostatic pressure

Hydrostatic pressure is used to measure level or density of a liquid in a vessel. The OPTIBAR modular product line offers a complete portfolio for hydrostatic level measurement of corrosive and non-corrosive liquids and slurries.

For open vessels under atmospheric conditions, process pressure transmitters are used:

- OPTIBAR PM 5060 and OPTIBAR P 2010 with fully welded metallic diaphragm for aseptic / hygienic applications
- OPTIBAR PC 5060 with ceramic measuring cell also for abrasive or corrosive liquids, and small measuring ranges (H<sub>2</sub>O: 0,25 m / 10")

For closed/pressurised vessels, differential pressure (DP) transmitters are used:

- OPTIBAR DP 7060 for precise level measurement for pressurised containers up to 420 bar / 6091 psi, with integrated head pressure measurement

If the level of a liquid is known, the DP transmitter can also be used to measure the density of the liquid, or the position of interface between two liquids of different density.

The pressure transmitters can be combined with diaphragm seals for high process temperatures up to +450°C / +842°F, corrosive media, and can also be equipped with different hygienic and pharmaceutical process connections.

To be used as a simple level measurement solution for wells or tanks, submersible probes are available, perfectly suited for water and wastewater applications.

### Typical applications include:

- Level measurement of liquids in open and pressurised vessels
- Level measurement in vessels with agitators
- Hygienic level measurement applications
- Steam boiler monitoring
- Level or interface measurement in distillation columns
- Level measurement in water wells, rainwater retaining / overflow basins

### Highlights of hydrostatic pressure products:

- Level, density or interface measurement of liquids in vessels
- Medium temperatures up to +450°C / +842°F
- Process pressure up to 420 bar / 6091 psi
- Not affected by fixed or moving inserts/ agitators
- Not affected by process conditions: dust, foam, vapour, agitated or boiling surfaces, or pressure changes
- Large portfolio of process connections suitable for any industry application
- Different hygienic process connections for a hygienic, dead zone-free installation
- Differential pressure transmitter with integrated absolute pressure measurement to measure head pressure
- Measuring range starting at 10 mbar / 0.14 psi
- Interface measurement, also with emulsion layers
- Multiple functions for vessel linearisation integrated in converter
- NACE compliant materials
- Use in hazardous areas
- Smallest measuring span 10 mbar / 0.145 psi gauge
- 4...20 mA HART® 7 / HART® SIL2/3, FOUNDATION™ fieldbus, PROFIBUS® PA as communication options

**Highlights of vibration switches:**

- Unaffected by process conditions
- Rugged oscillating fork, high abrasion resistance
- Reproducible switching point without adjustment
- Continuous self-monitoring of correct oscillating frequency, corrosion and cable breakage to the piezo drive
- Hygienic design with polished surface
- Recurring test acc. to WHG via test button (with SU 501)
- Functional safety: up to SIL2 in a single channel architecture and up to SIL3 in a multiple channel, redundant architecture

**Highlights of microwave switches:**

- Measurement independent of media properties
- Not sensitive to adhesives and foam, condensate or build-up of deposits
- Hygienic installation by means of a hygienic process weld sleeve, nearly flush with the front
- Dry-run protection beyond a nominal width of DN15
- Not affected by vibration

**Highlights of surge protectors:**

- Direct screw connection
- Ingress protection IP67
- Zinc or stainless steel housing

**Highlights of signal conditioners:**

- Signal conditioning and power supply for connection with 4...20 mA devices
- Additional features, e.g. integrated relays for control of actuators
- Carrier rail, panel and surface mounting

## Vibration

Vibration switches indicate the presence of liquid or solids when the medium comes in contact with their vibrating forks and dampens their oscillation.

**Typical applications include:**

- Applications with heavy dust build-up and mechanical stresses
- Light bulk goods
- Pump dry-run protection
- Limit and overflow detection
- Liquid detection in pipes
- Detecting solids in water

## Microwave

A microwave switch uses the phase shift that electromagnetic waves experience when emitted to a medium. It is suitable for level detection for liquids and pastes or as a dry-run protection. It can also detect liquid/liquid interfaces or identify the presence of a specific medium.

**Applications in the food & beverage, pharmaceutical industries:**

- Small tanks and hygienic applications
- Tough, pasty or strongly adhesive media

## Accessories

**Surge protectors**

Surge protective devices for standard communication signals are directly attached to any measuring device via their connecting threads, eliminating the need for an additional connection box. They are also suited for rough industrial environments and hazardous areas.

**Signal conditioners**

Signal conditioners can power connected sensors and process their measurement signals. The measured variable is shown on the display and also outputted to the integrated current output for further processing. The measurement signal can thus be transferred to a remote indicator or a control system. They are also suited for rough industrial environments and hazardous areas..



## Vibration



OPTISWITCH 3X00 C  
Vibration level  
switches for solids



OPTISWITCH 4000 C  
Vibration level switch  
for liquids for simple  
applications



OPTISWITCH 5X00 C  
Vibration level switches  
for liquids for process and  
high temperature / high  
pressure applications

## Microwave



OPTISWITCH 6500 C  
Microwave level switch for  
advanced hygienic  
applications



OPTISWITCH 6600 C  
Microwave level switch  
for standard hygienic  
applications

## Surge protectors



SURGEPROTECT SP-F / EX(I)-24DC  
Surge protection for measurement  
and control technology in intrinsi-  
cally safe power circuits



SURGEPROTECT SP-F / 1X2-24DC  
Surge protection for measurement  
and control technology in current  
loops and non-hazardous areas



SURGEPROTECT SP-F / EX-24DC  
Surge protection for measurement  
and control technology in acc. with  
protection types Ex d, Ex tD, Ex ia IIC

## Signal conditioners

SU 501  
For vibration level  
switches, also in  
hazardous areas and  
safety-related systems



SU 600  
For 4...20 mA level  
transmitters, with  
integrated relays for  
control of pumps or  
other actuators



## Pressure measurement

Process pressure · Differential pressure · Hydrostatic pressure



## Always the right pressure. Anytime. Any Process.

Pressure is one of the most commonly measured parameters in the process industry. Today, in over 40 % of all flow applications, differential pressure is still the first choice for metering liquids, gas or steam.

Almost 25 % of all liquid level measurement applications are hydrostatic pressure measurements – in case of pressurised vessels almost exclusively differential pressure level measurements.

With the release of the OPTIBAR series, KROHNE is extending its range of process instrumentation to include pressure measurement.

The OPTIBAR series includes a variety of pressure transmitters with ceramic or metal measuring cells, application specific diaphragm seals, primary elements and accessories to match a wide range of industrial process applications.

### Milestones

#### 2012

Introduction of OPTIBAR P 3050 C compact pressure transmitter

#### 2014

Release of OPTIBAR DP 7060 differential pressure transmitter

#### 2015

Complete OPTIBAR series of pressure transmitters, diaphragm seals, primary elements and accessories is released

#### 2016

Multi-dimensional 3D linearisation for every OPTIBAR DP transmitter established as standard

## The modular product line

### Pressure transmitters



**OPTIBAR P 1010**  
Ultra-compact pressure transmitter with recessed metallic diaphragm up to 600 bar / 8700 psi



**OPTIBAR P 2010**  
Ultra-compact pressure transmitter with flush metallic diaphragm also for hygienic applications



**OPTIBAR P 3050**  
Compact pressure transmitter with recessed metallic diaphragm, optional display and adjustment module



**OPTIBAR PC 5060**  
Process pressure transmitter with ceramic diaphragm for pressure and level measurement



**OPTIBAR PM 5060**  
Process pressure transmitter with metallic diaphragm also for high pressure ranges and hygienic applications



**OPTIBAR DP 7060**  
Differential pressure transmitter for precise relative gauge pressure measurement with high overload resistance

### Diaphragm seals



**OPTIBAR DS series**  
Diaphragm seals for temperatures up to +450 °C / +842 °F or corrosive media



**OPTIBAR DS direct**  
Differential pressure transmitter with direct mounted single-sided OPTIBAR DS diaphragm seal

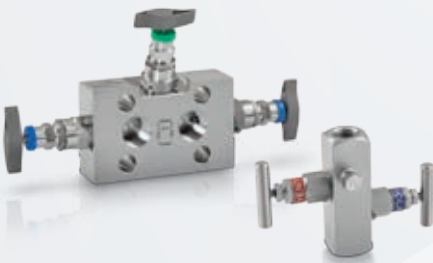


**OPTIBAR DS capillary**  
Differential pressure transmitter with capillary mounted two-sided OPTIBAR DS diaphragm seal



**OPTIBAR DS direct/capillary**  
Differential pressure transmitter with combined direct/capillary mounted two-sided OPTIBAR DS diaphragm seal

### 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
- Flange adapter according to DIN EN and ASME
- Condensate pots for steam applications
- Straight and curved connecting pipes, syphons in U- and circular shapes

## Process pressure

Process pressure transmitters are used to measure pressure in pipes or vessels.

OPTIBAR PC, PM and DP transmitters feature a modular concept that meets various requirements of modern process applications:

- Intrinsically safe and explosion proof
- Optional display and adjustment module
- 4...20 mA HART® 7 / HART® SIL 2/3, FOUNDATION™ fieldbus, PROFIBUS® PA
- Plastic, 316L, 316L hygienic, Aluminum

### Measuring cells:

- Ceramic (OPTIBAR PC 5060)
- Metallic (OPTIBAR PM 5060)
- DP (OPTIBAR DP 7060)

Capacitive ceramic measuring cells (99.9% Al<sub>2</sub>O<sub>3</sub>) with high long-term stability, vacuum and overload resistance are used for all common process applications. The robust ceramic diaphragm with integrated diaphragm breakage detection, covers about 80 % of all pressure applications up to +100 bar / +1450 psi gauge.

Metallic measuring cells (strain gauge or piezoresistive) with fully welded process connection are used for high pressures up to +1000 bar / +14504 psi gauge, aseptic processes, and in combination with OPTIBAR DS diaphragm seals for high temperature or corrosive applications.

### Typical applications include:

- Pump dry-run protection and compressor monitoring
- Flue gas ventilation control
- Monitoring processes from low pressure to absolute vacuum
- Overload resistant level and overpressure measurement in batch tanks
- Monitoring of supply pressure in pipelines

## Differential pressure

For differential pressure (DP) flow measurement please refer to chapter "Flowmeters and flow controllers", page 16.

## Hydrostatic pressure

For level, density and interface measurement with hydrostatic pressure, please refer to chapter "Level transmitters and level switches", page 30.

### Highlights of process pressure products:

- Process pressures -1...+1000 bar / -14...+14504 psi gauge and 0...+600 bar / 0...+8702 psi gauge absolute
- Process temperatures up to +150°C / +302°F without diaphragm seal
- Ceramic or metallic measuring cells
- Quick step response times even with small measuring ranges
- Over 250 thread, flange and aseptic process connections available
- Duplex, HASTELLOY® C-276, PVDF as well as NACE compliant materials
- Use in hazardous areas

# Temperature measurement

Temperature assemblies · Transmitters



## A new degree of contact: Temperature measurement

KROHNE temperature assemblies and transmitters are as versatile as your requirements and specific applications need them to be.

Our OPTITEMP line covers a wide range of electrical temperature instruments for industrial temperature measurement. Alongside standard applications, they are also ideal for high temperatures, extreme pressures or high flow velocities.

KROHNE INOR, a fully-owned subsidiary of KROHNE, has been designing and producing temperature measurement equipment for over 75 years. Located in Malmö, Sweden, KROHNE INOR is today one of the world's leading manufacturers of temperature signal transmitters, specialised in industrial temperature measurement.

Building on this specialist knowledge and experience, KROHNE INOR is successfully expanding global production.

### Over 75 years' experience:

#### 1939

INOR is started as a family-owned company working with process instrumentation.

#### 1965

Development of the first temperature transmitter.

#### 1974

INOR presents world's first head-mounted transmitter.

#### 2006

KROHNE acquires INOR.

#### 2010

First temperature transmitter with dual sensor input in 4-wire connection.

#### 2011

Temperature transmitter with SmartSense insulation resistance monitoring to detect cracks in the thermowell is developed.

## Temperature assemblies

KROHNE has a wide portfolio of standard pre-fitted temperature assemblies for solid, liquid, gaseous and steaming media. We can also provide you with systems that are custom-made for your specific requirements.

### Typical applications include:

- Chemical industry: measurement of liquids, gases and solids, acids and alkalis, abrasive or corrosive media in pipes, vessels and reactors
- Iron & steel industry: measurement in production and during the thermal treatment of steels, gas and ovens, as well as cooling media temperatures
- Power generation: steam and flue gas, as well as measurements of cooling media and bearing temperatures
- Hygienic applications: production and cleaning processes according to the stringent requirements of GMP, FDA, EHEDG and others

Depending on process conditions – temperature, pressure, flow velocity and media properties – we will recommend an appropriate temperature assembly and materials to be used. We will then support you when it comes to choosing the right combination of thermowell and sensors/measuring inserts for your application – resistance (RTD) or thermocouple (TC).

Used in combination with the correct insert, head and neck pipe, our range of thermowells will ensure maximum process certainty.

### Highlights of temperature assemblies:

- Various process connections: insert, screw-in/threaded, flanged, weld-in, compression fittings, coatings and covers, gas-tight threaded sleeves, sliding flange
- Standardised and customer-specific temperature assemblies
- Replaceable spring-loaded measuring inserts made from mineral isolated cable, durable, with low drift and high resistivity against any mechanical load
- Connection heads for a wide variety of requirements
- Extensive range of accessories

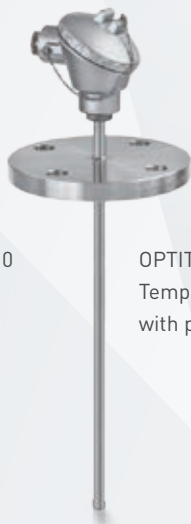
### Highlights of thermowells:

- Reduced and tapered tips for faster response
- Wide range of materials
- Additional PTFE or tantalum coating for use in conditions like exposure to a high level of chemicals
- Corrosion and abrasion-resistant versions
- Individual stress calculations
- Various test and examination certificates available, including pressure test, PMI test, X-ray test, ultrasonic test, dye penetration test





OPTITEMP TRA/TCA-P10  
Temperature assembly  
for compression fitting



OPTITEMP TRA/TCA-F13  
Temperature assembly  
with process flange



OPTITEMP TRA/TCA-S22  
Temperature assembly  
for screw-in



OPTITEMP TRA/TCA-F42  
Temperature assembly  
with process flange



OPTITEMP TRA/TCA-T30  
Temperature assembly  
for weld-in



OPTITEMP TRA/TCA-TS35  
Temperature assembly  
for screw-in



OPTITEMP TCA-P62  
High temperature  
assembly for plug-in



OPTITEMP TCA-P64  
High temperature  
assembly for plug-in



OPTITEMP TRA/TCA-S50  
Temperature assembly  
without thermowell



OPTITEMP TRA/TCA-TF56  
Temperature assembly  
with process flange



OPTITEMP TRA/TCA-TS53  
Temperature assembly  
for screw-in



OPTITEMP TRA-V20  
HVAC temperature  
sensor for outdoor  
applications



OPTITEMP TRA-W40  
Cable sensor for screw-on



OPTITEMP TCA-M50  
Mineral insulated thermocouple  
with mini thermo plug



OPTITEMP TRA/TCA-W70  
Cable sensor with  
bayonet fitting

## Compact sensors



OPTITEMP TRA-C10  
Hygienic compact  
sensor with flange



OPTITEMP TRA-C20  
Compact sensor  
for screw-in



OPTITEMP TRA-C30  
Compact sensor  
for screw-in

**Highlights:**

- Analogue temperature transmitters for basic applications
- Digital, universally programmable state-of-the-art transmitters for demanding applications
- Fits any B-connection head and on DIN rail
- Excellent measurement accuracy with high precision, long-term stability and low temperature drift
- HART® 6 compatible transmitters
- PROFIBUS® interface available
- Diagnostic functions for high process safety: monitoring of isolation resistance (SmartSense), sensor drift, sensor breakage and short circuit
- Dual sensor input TC and RTD, 2-, 3- and 4-wire (4-wire on OPTITEMP TT 51 R only) with automatic back-up in case of sensor failure (redundancy)
- High galvanic isolation
- NAMUR compliance: NE 21/NE 43/NE 53/NE 89/NE 107
- 10-g vibration resistance
- 50-point individual sensor linearisation
- Communication options: PC, FC375/475, AMS, PDM, EDD, DTM
- Ex-approval acc. to ATEX Ex i and Ex n (non-incendive) approvals
- SIL2 (acc. to IEC 61508)
- Configuration via PC without external power supply

## Temperature transmitters

In 1974, INOR launched the world's first temperature transmitter which could be built into the connection head of a temperature assembly to convert the sensitive thermometer signal into a stable, noise-immune signal directly at the measuring point.

KROHNE INOR has an extensive programme, based on years of experience developing transmitters, covering low to high-performance accuracy, fail-safe measuring that fits into all kinds of applications in the process industries.

### Typical industries include:

- Machine-building industry
- HVAC applications
- Energy & power generation
- Petrochemical
- Oil & gas





OPTITEMP TT 10 C, TT 10 C Ex    OPTITEMP TT 10 R  
Analogue, adjustable, 2-wire transmitters for Pt100  
or thermocouple with current output



OPTITEMP TT 11 C    OPTITEMP TT 11 R  
Analogue, adjustable 3-wire transmitters  
for Pt100 or Pt1000 with voltage output



OPTITEMP TT 22 C, TT 22 C Ex    OPTITEMP TT 22 R  
Head-mounted temperature transmitter with RTD input



OPTITEMP TT 31 R, TT 31 R Ex  
1 or 2-channel universal, programmable 2-wire transmitters for  
thermocouples and resistance  
thermometers with current output



OPTITEMP TT 32 R  
Universal, programmable 4-wire  
transmitter for thermocouples  
and resistance sensors with  
current and voltage output



OPTITEMP TT 33 C, TT 33 C Ex    OPTITEMP TT 33 R, TT 33 R Ex  
Head-mounted temperature transmitter with universal inputs  
and galvanic isolation



OPTITEMP TT 40 C    OPTITEMP TT 40 R  
Highly precise, universal, programmable  
2-wire transmitters for thermocouples  
and resistance sensors with current  
output



OPTITEMP TT 50 C    OPTITEMP TT 50 R  
Temperature transmitter with universal  
inputs, galvanic isolation and HART®



OPTITEMP TT 51 C, TT 51 C Ex    OPTITEMP TT 51 R, TT 51 R Ex  
Highly precise, universal, programmable 2-wire HART® transmitters  
for thermocouples and resistance sensors with current output, full  
assessment on SIL2 according to IEC 61508:2010



OPTITEMP TT 60 C, TT 60 C Ex    OPTITEMP TT 60 R  
Highly precise, universal, programmable PROFIBUS®  
transmitters for thermocouples and resistance sensors

# Process analytics

Sensors · Systems · Assemblies · Transmitters and operating units · Accessories



## From analysis to the solution: Process analytics

KROHNE is your partner for all aspects of analytical instrumentation, from pH measurement in hazardous areas to sludge level and sedimentation measurement on wastewater treatment plants.

We offer a comprehensive portfolio of liquid analytical sensors with and without integrated transmitter, complete measuring systems as well as installation equipment, transmitters and accessories to match the requirements of various industries.

Our main goals are attaining sturdiness, reliability and quality in the various application areas. We will gladly assist you in the search for the optimum solution to your measurement task. Should it be necessary to specifically design a measuring system according to your requirements, we are able to modify our systems in line with your needs and include additional components.

### **Milestones:**

#### **2005**

First presentation of analysis instruments for the water industry.

#### **2008**

Launch of complete portfolio with digital analysis sensors for wastewater treatment plants featuring integrated sensor spray cleaning with air or water.

#### **2008**

Launch of turbidity measuring system with unique cuvette calibration and ultrasonic cleaning for easy calibration and low maintenance costs.

#### **2010**

KROHNE is the first manufacturer to offer a standardised operating and service concept for both flow-meters and analysis instruments.

#### **2012**

OPTISENS range of sensors is expanded with sensors specially suited for food & beverage processes.

#### **2013**

KROHNE introduces SMARTPAT: the first digital sensor portfolio with integrated transmitter technology and direct connection to control system via 4...20 mA/HART®.



pH measurement in a dairy  
with insertion assembly

## Sensors

Based on different physical, electrochemical and optical effects, liquid analysis sensors measure values such as pH, ORP, conductivity, TSS, turbidity, oxygen, and various others.

KROHNE offers an extensive portfolio of analytic sensors: each sensor is specifically designed for its area of application; the respective approvals, certificates and process connections range from hazardous (zone 0) to hygienic areas.

### Potentiometric pH sensors



SMARTPAT PH 8320\*  
For water and wastewater applications



SMARTPAT PH 8530  
For pure water and low conductivity media (>2  $\mu\text{S}/\text{cm}$ )



SMARTPAT PH 8570\*  
For food, beverage and pharmaceutical applications



SMARTPAT PH 8150\*  
For chemicals and industrial wastewater applications



SMARTPAT PH 1590  
For potable, process or treated water applications



SMARTPAT PH 2390  
For municipal and industrial wastewater applications



\*also available with Ex approval



OPTISENS PH 8300  
For wastewater, surface and process water applications



OPTISENS PH 8500  
For potable water applications



OPTISENS PH 9100  
For lower conductivity water applications (>20  $\mu\text{S}/\text{cm}$ )



OPTISENS PH 8100  
For pure water and low conductivity media (>2  $\mu\text{S}/\text{cm}$ )



OPTISENS PH 8390  
For wastewater applications



OPTISENS PH 8590  
For municipal and industrial wastewater applications



OPTISENS PH 9500  
For lower conductivity water applications (>20  $\mu\text{S}/\text{cm}$ )

### Inductive conductivity sensors



OPTISENS IND 7000  
For food and beverage applications



OPTISENS IND 1000  
For water, wastewater and chemical applications

### Total suspended solids (TSS) sensors



OPTISENS TSS 3000  
For wastewater applications



OPTISENS TSS 7000  
For food & beverage applications

## Highlights analytical sensors:

- With or without integrated transmitter technology
- Wide range of sensor designs, materials, diaphragms and standard process connections
- For any industrial requirements – from hygienic to Ex applications
- Configuration and offline sensor calibration via PACTware™ with dedicated DTM

Next to the OPTISENS series for “traditional” use with an external transmitter, KROHNE offers the SMARTPAT series with integrated transmitter. Introduced in 2013, SMARTPAT is the first sensor series with built-in fieldbus communication and current output: any SMARTPAT sensor can be connected directly to the process control system via 4...20 mA/HART® 7. For offline calibration, the sensor can be connected to a PC running PACTware™ (FDT/DTM).

## Potentiometric ORP sensors



SMARTPAT ORP 8150\*  
For chemicals and industrial wastewater applications



SMARTPAT ORP 8510  
For water and wastewater applications, process connection PG 13.5



SMARTPAT ORP 1590  
For water and wastewater applications, process connection 3/4 NPT (male)



OPTISENS ORP 8590  
For water and wastewater applications, process connection 3/4 NPT (male)



OPTISENS ORP 8500  
For water and wastewater applications, process connection PG 13.5

## Conductive conductivity sensors



SMARTPAT COND 1200  
For water and wastewater applications



SMARTPAT COND 3200  
For condensate, process, boiler feed or (ultra)pure water



SMARTPAT COND 5200\*  
For chemicals and industrial wastewater applications



SMARTPAT COND 7200  
For food, beverage and pharmaceutical applications



OPTISENS COND 7200  
For water, wastewater, process water or pure water



OPTISENS COND 7200  
For food, beverage and pharmaceutical applications

## Oxygen sensors



OPTISENS ADO 2000  
Amperometric sensor for water and wastewater applications



OPTISENS ODO 2000  
Optical sensor for water and wastewater applications

## Disinfectant sensors



OPTISENS CL 1100  
Potentiostatic amperometric sensor for water and wastewater

## Turbidity sensors



OPTISENS TUR 2000  
Optical sensor for water and wastewater applications

### Highlights of analytical measuring systems:

- Completely mounted sets with configured outputs
- Pre-installed and tested
- Bypass or inline installation
- Ready to use set-up with valves, holders or assemblies
- Additional sensors as option, e.g. pH sensor for chlorine measuring system

## Systems

Liquid analytical measuring systems are preconfigured combinations of sensor(s), transmitter, mounting assembly or process connections, specially designed for a certain area of application.

From potable water disinfection, sludge monitoring in wastewater treatment, to quality control in dairies, breweries or beverage production – KROHNE offers a wide range of analytical measuring systems for:

- Chlorine and turbidity analysis
- Hygienic conductivity and total suspended solids measurements
- Monitoring of sludge blanket level and sedimentation

Sludge blanket measurement in secondary clarifier of wastewater treatment plant, Krefeld, Germany





## Inductive conductivity systems



OPTISYS IND 7100  
For food and beverage applications, process connection conical nozzle (DIN 11851) DN50



OPTISYS IND 8100  
For food and beverage applications, process connection G1 (hygienic, male) with hygienic adapters

## Disinfectant measuring systems



OPTISYS CL 1100  
Potentiostatic amperometric measuring system for water and wastewater

## Turbidity measuring systems



OPTISYS TUR 1050  
Optical measuring system for potable water applications

## Sludge level measuring systems



OPTISYS SLM 2100  
Optical measuring system for sedimentation profile measurement and continuous tracking of sludge blanket

## Total suspended solids (TSS) measuring systems



OPTISYS TSS 1050/3050  
For hygienic applications, process connection G1/2



OPTISYS TSS 2050/4050  
For hygienic applications, process connection PG 13.5 for use in retractable assemblies



Manual retractable assembly for a pH sensor in a chemical plant

#### Highlights of assemblies:

- Retractable, immersion or insertion housings
- Flow-through process adaptations and weld-in sockets

#### Highlights of transmitters and operating units:

- Display of readings and alarms
- Loop-powered equipment
- Operating units for on-site calibration and configuration of SMARTPAT sensors
- Transmitters for on-site calibration and configuration of OPTISENS sensors

#### Highlights of accessories:

- Loop powered indicators
- Convenient offline calibration
- PC-based evaluation of calibration data

## Assemblies

KROHNE offers a large variety of installation equipment for analytical sensors for use in harsh environments, hazardous areas, hygienic or other applications.

## Transmitters and operating units

Transmitters and operating units for liquid analytical sensors provide a convenient on-site access to sensor readings and parameterisation.

## Accessories

A large range of accessories allows for convenient use and handling of liquid analytical sensors in the plant.

## Manual retractable assemblies



**SENSOFIT RET 5000**  
For harsh chemical and water treatment applications, length up to 700 mm / 11.81"



**SENSOFIT RET 5810**  
For harsh chemical and water treatment applications, length 107 mm / 4.21"



**SENSOFIT RET 5830**  
For hygienic applications in the food, beverage and pharmaceutical industry

## Automatic retractable assemblies



**SENSOFIT RAM 5810**  
For harsh chemical and water treatment applications



**SENSOFIT RAM 5830**  
For hygienic applications in the food, beverage and pharmaceutical industry

## Flow-through assemblies



**SENSOFIT FLOW 1000 Y/T**  
For chemical and water treatment applications, G1 (female) or socket weld



**SENSOFIT FLOW 2000 Y/T**  
For water and wastewater applications, for OPTISENS ADO or ODO sensors

## Insertion assemblies



**SENSOFIT INS 1310**  
For all-purpose applications in various industries



**SENSOFIT INS 7311**  
For hygienic applications, process connection Tri-Clamp



**SENSOFIT INS 7312**  
For hygienic applications, process connection VARIVENT® N

## Mounting assemblies



**SENSOFIT MOUNT 1000**  
For applications in various industries

## Immersion assemblies



**SENSOFIT IMM 2920**  
For chemical and wastewater treatment applications



**SENSOFIT IMM 1000**  
For general water and wastewater treatment applications



**SENSOFIT IMM 2000**  
For general water and wastewater treatment applications, telescopic rod holder mounted to handrail

## Transmitters



**MAC 100**  
Analytical transmitter for OPTISENS sensors



**MAC 300**  
Analytical transmitter for OPTISENS TSS, pH/ORP and COND sensors



**SMARTMAC 200\***  
Operating unit for on-site calibration and configuration of SMARTPAT sensors

## Indicators



**SD 200\***  
Multiparameter indicator for analytical and other parameters

## Interface cables



**OPTIBRIDGE\***  
USB interface cable for offline calibration and configuration of SMARTPAT sensors

## Databases

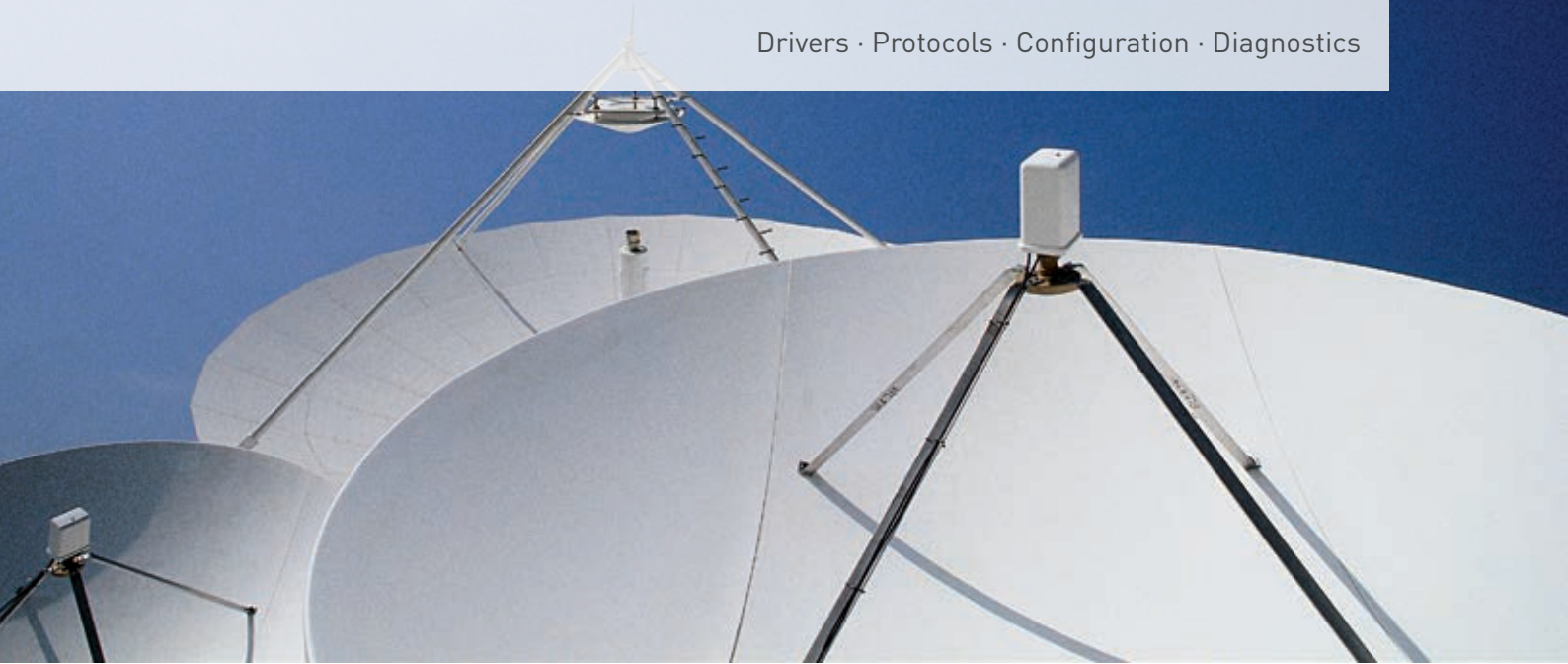


**SMARTBASE**  
Database for all SMARTPAT PH sensors

\*also available with Ex approval

# Communication technology

Drivers · Protocols · Configuration · Diagnostics



## Open for the future

KROHNE is committed to making communication convenient. Which is why our field devices communicate reliably with controllers, control systems and PCs, and can also be used for a variety of control and regulating tasks.

### Protocols and interfaces

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

### Device integration

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

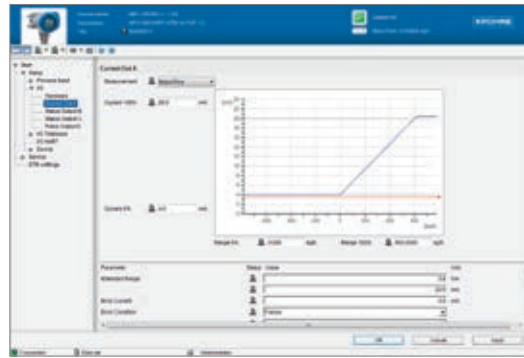
We are a longstanding member of PACTware™ and the FDT Group®. Since 2003, we provide DTMs and EDDs for our field devices with HART®, PROFIBUS® or FOUNDATION™ fieldbus interfaces.



Configuration and diagnostics via DTMs



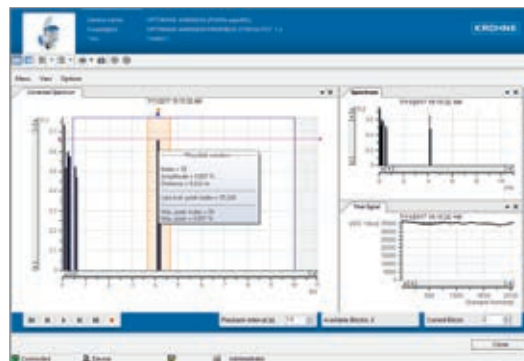
Easy navigation, device status available anytime



Simple parameterisation supported by graphic elements

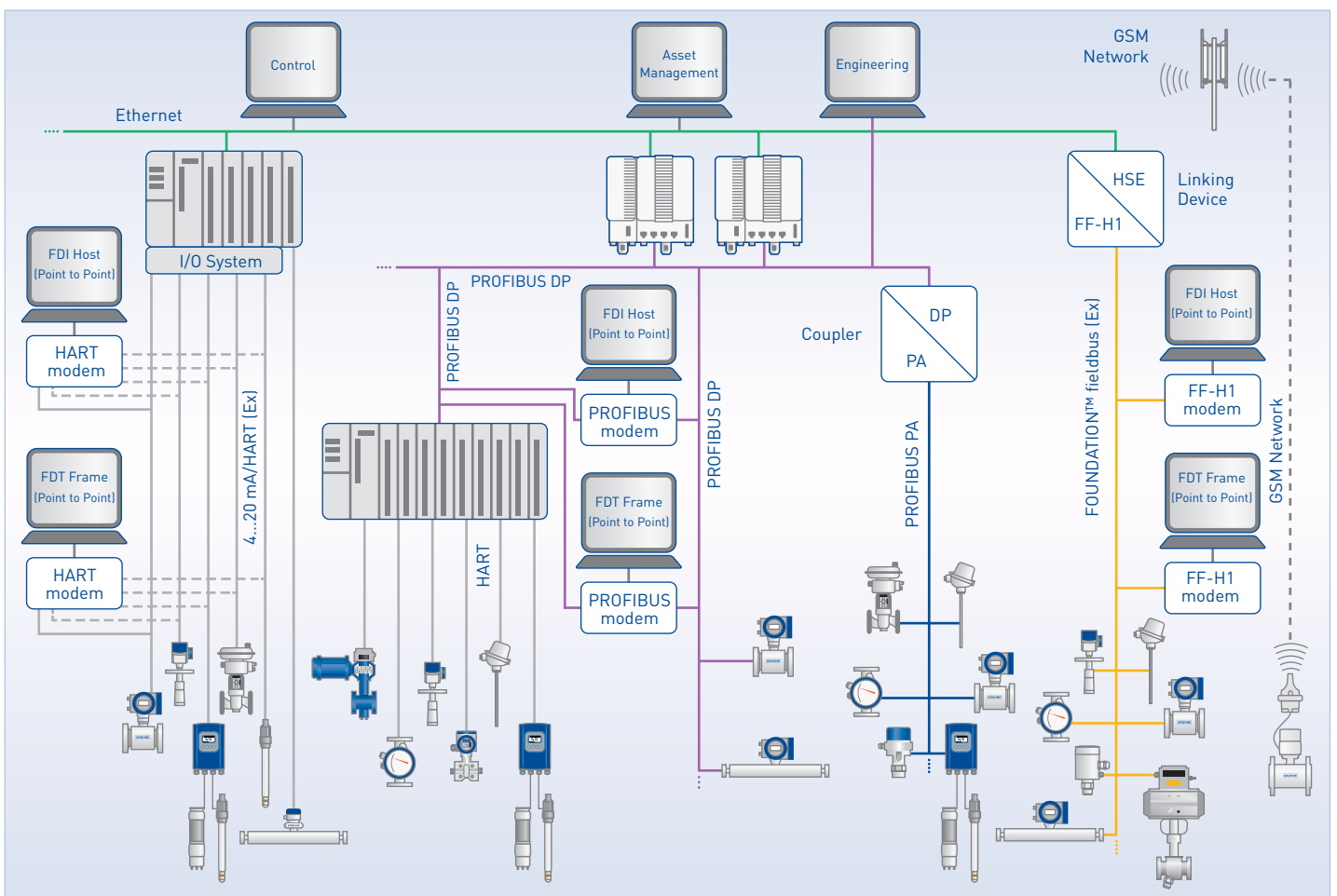


Detailed diagnostics overview with recommendations to resolve actual events



Advanced monitoring functions with optional recording of events

Fast and convenient access to process and device data from any level



## Technology Icons

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

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



### Ceramic durability

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



### EGM™ Entrained Gas Management

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



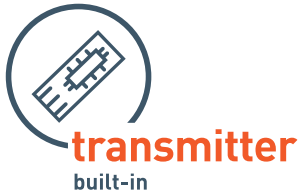
### Total 3D linearisation

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



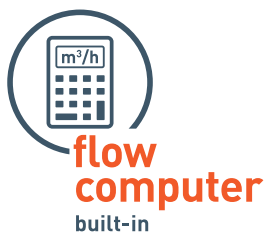
### SmartSense insulation monitoring

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



#### Transmitter built-in

The SMARTPAT series of analysis sensors significantly eases the handling of analytical sensors: formerly an external device, the transmitter has now been miniaturised and built into the sensor head, enabling direct 4...20 mA/HART® 7 communication. This reduces the costs of ownership, eases installation and maintenance, and allows for usage in Ex applications (zone 0).



#### Flow computer built-in

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



#### 80 GHz radar level measurement

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



#### Multiphase measurement

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



#### E-RTTM pipeline leak detection

E-RTTM is a leading mathematical model for continuous internal monitoring of pipelines. Integrated in our PipePatrol system, it compares measurement data from the actual pipeline with those of a simulated "virtual pipeline" in real time. If the model detects a discrepancy, a leak signature analysis using leak pattern recognition determines whether it is a leak or safe, with outstanding accuracy.



## Water & Wastewater

Products · Solutions · Services

**KROHNE**

**Water & Wastewater**

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Water & Wastewater  
Tel. +49 203 301 4213  
m.rumpff@krohne.com

## From generation of tender documents to remote monitoring of measurement points

The provision of reliable water supply and sustainable wastewater treatment are essential for the development of entire regions. At the same time, operators focus on efficiency while not neglecting process safety and availability.

Here, our dedicated industry division contributes the essence of over 50 years of experience and application know-how we have gained in the water and wastewater industry. We provide highly sophisticated, market oriented and competitively priced measuring devices, matched and fully equipped solutions up to integration into the control system, complemented by extended services and support.

Our team comprises consultant engineers and specialists who assist you from early planning stages to commissioning. Together with automation partners PhoenixContact, Danfoss Drives, hawle, wilo, VAG, mall umweltsysteme, WAVIN or VIDEDEC we offer trainings and (in-house) seminars.



Level measurement  
in waterworks



## Products

In 1961, KROHNE introduced the worlds first electromagnetic flowmeter (EMF) for water, wastewater, additives and sludge. Since then, we have developed a large and dedicated portfolio with approvals from potable water to Ex:

- (Battery powered) electromagnetic water meters up to DN3000/120", with extended functionality e.g. to gain additional parameters or for use in leakage detection
- Dedicated flowmeters for partially filled pipes, biogas, etc.
- Level transmitters for open or closed vessels of any size
- Analytical sensors and systems for process monitoring and quality control

## Solutions

We have developed numerous system solutions for typical applications that have their very own requirements, e.g.:

- Bulk water metering with remote data communication
- Sludge level measurement on scraper bridges with remote data communication
- Level measurement on tanks with remote data communication
- Chlorine/disinfectant measurement in outlets of waterworks with remote data communication

## Services

We offer a variety of services to assist you in all stages of your water or wastewater project:

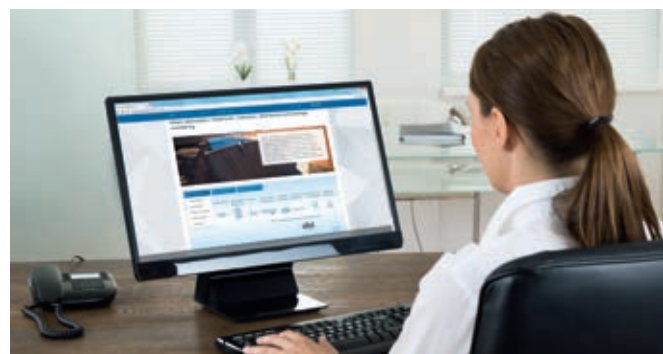
- Internet-based Planningtool: easy creation of precise tender documents (Word, Excel or GAEB) for flow, level, analysis, pressure and temperature instrumentation, combined with comfortable configuration of the devices. Find the free tool at <http://planningtool.krohne.com/>
- Periodic re-calibration of water meters and metrological services
- In-house trainings or free KROHNE Academy seminars on automation topics such as energy efficiency in water&wastewater plants, metrological requirements, dimensioning of devices, and many more. Send us your request: [seminare.wasser@krohne.com](mailto:seminare.wasser@krohne.com)




Flow measurement of wastewater in partially filled pipes



Battery-powered IP68 metering point with GSM/GPRS communication



Planningtool for generation of tender documents

A photograph of laboratory glassware containing various colored powders. In the foreground, there are three distinct piles of powder: a bright orange one on the left, a yellow one in the center, and a large blue one on the right. In the background, a glass beaker with the number '150' is visible, containing a clear liquid. The overall scene is brightly lit, typical of a laboratory setting.

## Chemical & Petrochemical

Products · Solutions · Services

**KROHNE**

**Chemical & Petrochemical**

For all inquiries,  
please contact:

Industry Management Chemical  
Tel. +49 203 301 4242  
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## Highly concentrated know-how for your process

The chemical and petrochemical industries form the foundation of the manufacturing industry. KROHNE has actively supported these industries for almost a century: we have implemented industry-specific standards and requirements regarding Ex proof, resistance against chemical attack, corrosion and abrasion resistance, or plant safety.

Our specialised team brings their experience and extensive knowledge to the table: we have continuously contributed ingenious and reliable measuring technology, making processes more efficient, more reliable and more economical.

We provide an extensive range of products and solutions, complemented by consultancy offerings and other services for your process.



Inertisation with purge meters

## Products

As a main instrumentation vendor and preferred supplier for many international chemical and petrochemical producers, we have developed a large product portfolio:

- Broad application range, e.g. cryogenic & high temperature applications -200...+400 °C /-328...+752 °F with a standard device
- EMF with oxide ceramics measuring tube for aggressive and abrasive products, capacitive pickup option
- Coriolis meters with straight and bent tube designs, secondary containment, tantalum option
- Wide range of devices for safety-related applications: FM, CSA, ATEX, IECEx, NEPSI, cFMus, NAMUR compliant, SIL2/3, etc.

## Solutions

Based on application know-how gained over decades, we offer a number of measuring solutions for challenges in process automation, for example:

- Entrained Gas Management EGM™ for Coriolis meters: considerable improvements with plant start-up and shut-down, full-empty-full applications, reliable indication of gas entrainments, uninterrupted output signal, etc.
- Pipeline leak detection and localisation system for liquid and gas pipelines, continuous and robust monitoring during all operating conditions, new or retrofit, multiproduct
- Metering systems for liquids and gases, mobile or stationary, e.g. tanker loading, custody transfer, batching/blending

## Services

Chemical and petrochemical facilities and processes are becoming increasingly complex and extensive: this is why our service does not start at the time of the first maintenance or repair call, but right from the initial contact, through the entire life cycle of the plant:

- Project management, commissioning, training and documentation
- Metrological accreditation of custody transfer applications according to Measurement Instruments Directive, OIML
- Customer inspections (FAT, SAT, TPI), pre-manufacturing (PMM) and pre-inspection meetings (PIM), quality audit support
- On-site calibration verification and documentation, calibration of devices, temporary measurements
- Seminars, trainings and workshops on relevant topics: Functional Safety, virtual grounding, diagnostics, etc.



Gas measurement in a plastics plant



Butanol level measurement on bypass chamber



Virtual reference for EMFs: grounding rings made redundant



Straight tube coriolis meters in a safety application



## Food & Beverage

Products · Solutions · Services



For all inquiries,  
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[r.kromhout@krohne.com](mailto:r.kromhout@krohne.com)

## Optimisation in hygienic processes through key technologies

The food and beverage industry is a key industry for KROHNE: our dedicated division comprises a global team of industry specialists and account managers to take care of your needs. Being an instrumentation supplier for the food and beverage industry for over 20 years, we have gained industry- and application-specific know-how that we implemented into our devices and measuring solutions.



Temporary flow measurement with  
clamp-on flowmeter in a dairy



Level measurement on a milk tank

## Products

We offer a complete portfolio for flow, level, pressure and temperature measurement as well as inline analysis for hygienic and auxiliary applications. The hygienic instruments feature conformity to EC 1935/2004 and FDA and are EHEDG and 3A approved.

- Flowmeters for low conductive liquids and liquids with gas entrainments
- Mass or volume flowmeters for filling machines
- Non-contact level measurement of liquids and solids, also in dusty atmospheres without air purge
- DN2.5...150/0.1...6", wide range of hygienic connections
- Best-in-class inline density measurement: 0.2 g/cm<sup>3</sup>
- Wide flow ranges: smaller meter size possible where competition can only offer larger and more expensive sizes

## Solutions

Contact us to learn more about the optimisation potentials we offer. Here are some impulses:

### For process applications:

- Entrained Gas Management EGM™ for our OPTIMASS series: immune to gas entrainments/two phase flows, it allows for
  - Converting applications from batch to inline/continuous, e.g. by replacing loading cells with mass flowmeters, even with aerated products
  - reliable measurement of mass, density, and concentration of air-containing products without process interruption, e.g. with raw milk, ice cream, dough, syrup, tomato concentrate, spinach, meat, margarine, mayonnaise
- In-line analysis of compositions, e.g. fat content in milk
- Avoid overdosing of cryogenic cooling, e.g. on meat, through dosing based on continuous temperature measurement

### Examples auxiliary applications:

- Monitoring of CIP/SIP plants
- Measurement of steam, hot water, compressed air, natural gas, (thermal) oil or cooling fluids
- Gross and net heat measurement for hot water and steam with direct energy output
- Monitoring air compressor efficiency (FAD) or gas burner consumption
- MID MI-004 heat metering, supporting ISO 50001 energy management systems

## Services

Our industry division team provides technical consulting, maintenance and service concepts for any plant size. We can also support you with:

- On-site verification (calibration verification and documentation),
- Calibration and metrological services
- Useful online configuration tools (see chapter "Services")

### Case study:

### Ice-cream production with Entrained Gas Management EGM™



### Consistent product quality and overrun measurement:

- Immunity to entrained air allows in-line density measurement after the freezer
- Maximize ice cream output based on continuous mass flow measurement and simultaneous control of air addition
- Increase product quality, eliminate sample taking, reduce freezer start-up time



OPTIMASS straight tube mass flowmeter for shear sensitive products

# Oil & Gas

Products · Solutions · Services



**KROHNE**  
Oil & Gas

## From well-head to refinery

For all inquiries,  
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oilandgas@krohne.com  
www.krohne.com/oilandgas

Headquartered in Breda, the Netherlands, our Global Industry Division Oil & Gas is dedicated to servicing customers in the Oil & Gas industry.

Our offering extends from elementary process instrumentation up to fully engineered custody transfer metering systems, and from engineering consultancy during design phase up to on-site commissioning and training.

With local presence in around 100 countries, local support is usually available from just around the corner. Please contact us to learn more about our capabilities and the experience we can offer to tackle your metering challenges.



M-PHASE 5000 magnetic resonance  
multiphase flowmeter



SUMMIT 8800 flow computer

## Products

We offer a large instrumentation portfolio, including:

- Process instrumentation for the entire oil & gas value chain, including flow, level, pressure and temperature measurement
- Custody transfer ultrasonic and coriolis flowmeters for crude oil, refined products, natural gas and LNG
- Multiphase and wet gas flowmeters for reservoir measurement and well testing
- Flow computers with full custody transfer approvals

## Solutions

In house consultancy, design and manufacturing of measurement solutions:

- Custody transfer metering systems
- Mobile master meters, ball provers and calibration systems
- Analyser houses and shelters
- Metering control systems including flow computer cabinets
- SCADA/HMI software and AMADAS analyser management
- Pipeline management and leak detection systems

## Services

Our service offering covers all aspects of measurement and includes :

- Expert consultation during design phase
- On site commissioning and training
- Service level agreements
- Periodical inspection and validation
- Metrological accreditation according to local legal requirements
- In-house seminars and workshops on a wide range of topics



Mobile master metering system



Skid mounted metering system with integrated ball prover



Analyser house for liquid metering system

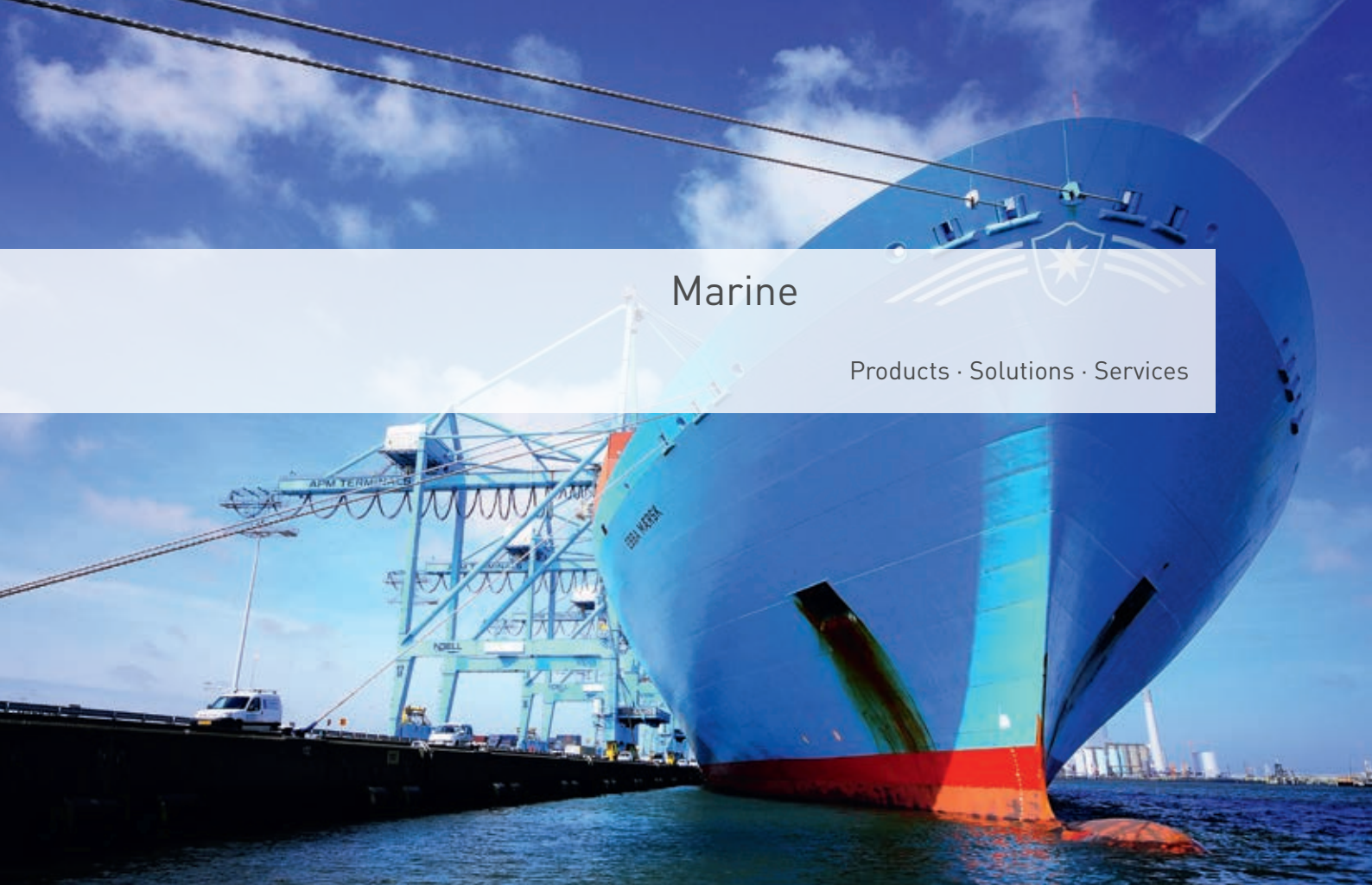
## Case study: Natural gas and LNG metering systems

- For a large LNG liquefaction plant in Australia, KROHNE supplied over 20 custody transfer metering systems for natural gas and cryogenic LNG.
- With system integration and instrumentation from one company, KROHNE provided a cost effective, impeccable project execution, well within customers planning.



# Marine

Products · Solutions · Services



**KROHNE**  
Marine

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NO-3950 Brevik  
Norway  
Tel.: +47 35 561 220  
marine@krohne.com  
www.krohne-marine.com

## Safe monitoring of liquids onboard all kinds of ships

Based in Norway, the Marine team holds over 60 years of experience in equipping seagoing vessels, from small product tankers to complex chemical tankers and large VLCCs. KROHNE Marine has its own network of sales representatives and service agents and is present in all the main global shipping hubs and shipbuilding countries. Contact us for all marine specific applications!



### Case study: Fuel balance calculation for Maersk Line

- Task: transfers between onboard tanks, consumption of main engine, auxiliary engines and burners/water boilers for a vessel fuel balance calculation (marine diesel oil, heavy fuel oil and mixtures of both)
- For a proof of concept (POC) testing, KROHNE Marine delivered a complete measuring and monitoring solution, including system engineering, piping, mechanical and electrical installation
- Key points were overall accuracy achieved, response time during pilot stage, fulfilment of timelines and availability to clients inquiries
- After successful POC phase, Maersk Line decided to equip 84 vessels (provisionally) of different sizes with the KROHNE Marine solution



## Products

We offer a large range of flow, level, temperature and pressure instruments specially designed for onboard use, e.g. with heavy-duty stainless steel housing:

- Bunkering flowmeters
- Ballast water flowmeters
- FMCW radar level transmitters

## Solutions

- EcoMATE software for monitoring and reporting of fuel consumption for ship owners and operators:
  - Onboard monitoring and reporting of fuel consumption and key emission data
  - MRV ready: compliant and verified according to EU regulation 2015/757
  - Automatic calculation reporting of emission (e.g. CO<sub>2</sub>) and efficiency data
  - Optimized for use with OPTIMASS mass flowmeters
- CARGOMASTER system for onboard tank monitoring and alarming:
  - Readings from all tanks and lines onboard available via application-specific software on standard marine computers, optional integration into other systems
  - All vessel sizes
  - Instrumentation and software, full scope of supply: engineering, drawings, documentation and commissioning
- Onboard valve & pump management and control system:
  - Can be combined with CARGOMASTER for an integrated solution for liquid cargo control of tankers
  - Remote control and service tanks gauging system for all kinds of merchant ships

## Services

We are glad to assist you with our offering including dedicated research and development, engineering and system design, project management, commissioning and service.



OPTIWAVE 8300 C  
26 GHz FMCW radar for marine applications



EcoMATE for monitoring and reporting of fuel consumption



CARGOMASTER tank monitoring and alarming system



Suction flow monitoring on dredgers

# Power generation

Products · Solutions · Services



**KROHNE**

**Power**

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please contact:

Tel. +31 612 962 193  
s.kranz@krohne.com

**KROHNE**

**Nuclear**

For all inquiries,  
please contact:

Tel. +33 617 683 109  
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## For a safe and efficient operation

In power plants, process instrumentation has a very important role: the functional safety and accuracy of the measurements is essential for plant availability and safe and efficient operation.

With over 40 years of experience in the field of instrumentation for the power generation sector, our team can cope with the increasing requirements of today's highly efficient and flexible plants. Please contact us to learn how you can benefit from our knowledge!



Ultrasonic flow measurement of superheated steam

**Products**

For liquid and gaseous media:

- Large range of flow, level, temperature, pressure instrumentation and process analytic
- Flow measurement with temperatures up to +600°C/ 1112°F, pressures up to 490 bar/ 7107 psi, higher on request
- Custody transfer flowmeters
- High accuracy flow meters for feed water applications
- Dedicated products for resistance to radiation and/or seismic

**Solutions**

Our scope includes design and manufacturing of measuring solutions for:

- Nuclear: nuclear island systems, steam/water cycle systems, cooling systems, emergency power generation systems, auxiliary systems
- Hard coal/ lignite: storage/preparation, steam/water cycle, condensate-system, external cooling, flue gas cleaning, ash handling
- Gas/ oil: gas turbine, HRSG HP/IP/LP steam system, condensate & cooling water system, flue gas treatment
- District heating: heating network, large users
- Industrial power generation
- Waste incineration: fuel preparation, steam/water cycle, external cooling, flue gas cleaning
- Biogas: methane content, power & heat production/ efficiency monitoring, biomethane injection
- Biomass: steam, power & heat production, biomass storage, flue gas cleaning
- Solar thermal: HTF circuit, liquid salt, water/ steam circuit
- Power-2-gas: electrolysis, methanation, injection

**Services**

Our services offerings include:

- Project management
- Design and calculations
- Qualification and tests
- Documentation

**Nuclear projects**

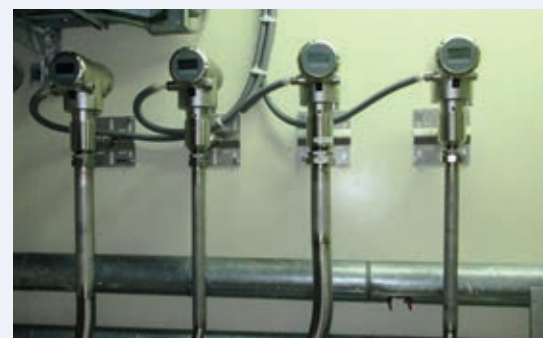
- Dedicated team of engineers and technicians for nuclear projects
- Flow, level, temperature and pressure range for safety-related and non-safety-related applications
- New designs or re-engineered solutions on request
- All relevant approvals and certifications for design, manufacturing and testing of instrumentation for nuclear power plants (e.g. ASME Section III, RCC-M)
- Qualifications and test reports according to IEEE 323, IEEE 344, and RCC-E for safety-related applications
- High level of safety consideration in all project procedures




Mass flow measurement of heavy fuel oil



TDR level transmitter as overfill protection in water pit



TDR level measurement of condensates in irradiating environment



## Services

Project services · Online tools · Maintenance services · Metrological services · Seminars · In-situ verification · Calibration

## Beyond the highest requirements

From engineering and planning to commissioning, training and documentation: our services cover all project stages, and can be offered for all enterprise sizes:

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

Please see right page for more details on selected services.



Commissioning of flowmeters

### Online tools:



#### PiCK

Enter the serial number and get device specific documents, e.g. manuals, handbooks, calibration certificates, etc.:  
[pick.krohnegroup.com](http://pick.krohnegroup.com)

#### Configure It

#### Configure It

Configure flow and level devices and get free 2D/3D CAD data:  
[www.krohne-direct.com](http://www.krohne-direct.com)

### Maintenance services

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

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

### Metrological accreditation of custody transfer applications

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

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

### Seminars: KROHNE Academy & KROHNE Academy online

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

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



Large team of field service engineers and technicians



MID MI-005 tanker filling system for liquefied gas



Functional safety seminar at KROHNE headquarters, Duisburg, Germany

### In-situ verification

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

- Printed individual verification certificate
- Preventive maintenance and service features
- Storage of verification data
- Download factory calibration settings from KROHNE manufacturing database



## Calibration 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.

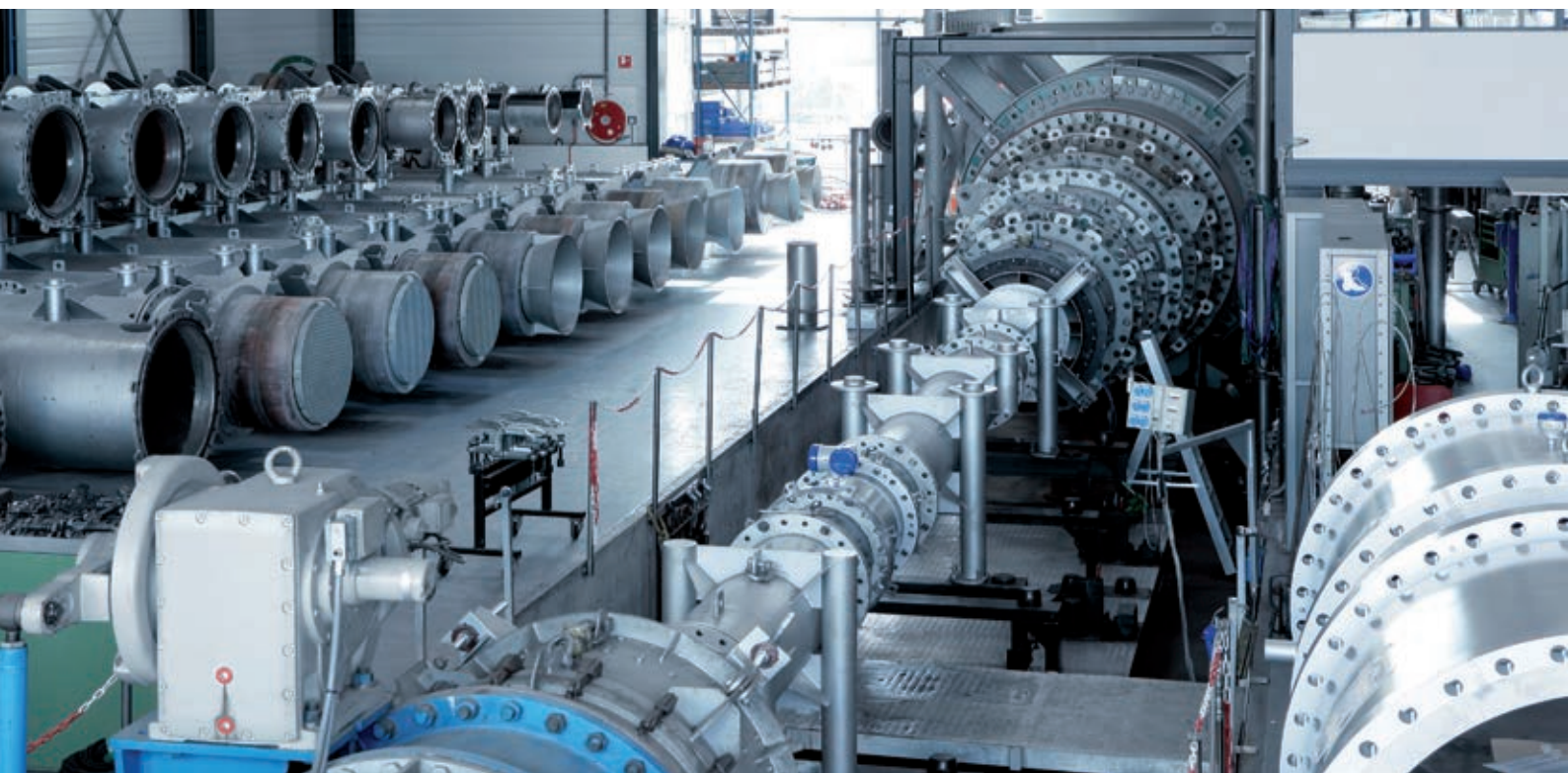
To achieve this, we operate more than 140 calibration facilities for volume flow, mass flow, level, temperature, density and pressure to (wet-)calibrate any device we manufacture. For example, every flowmeter is wet-calibrated using water or air as standard before leaving our facilities.

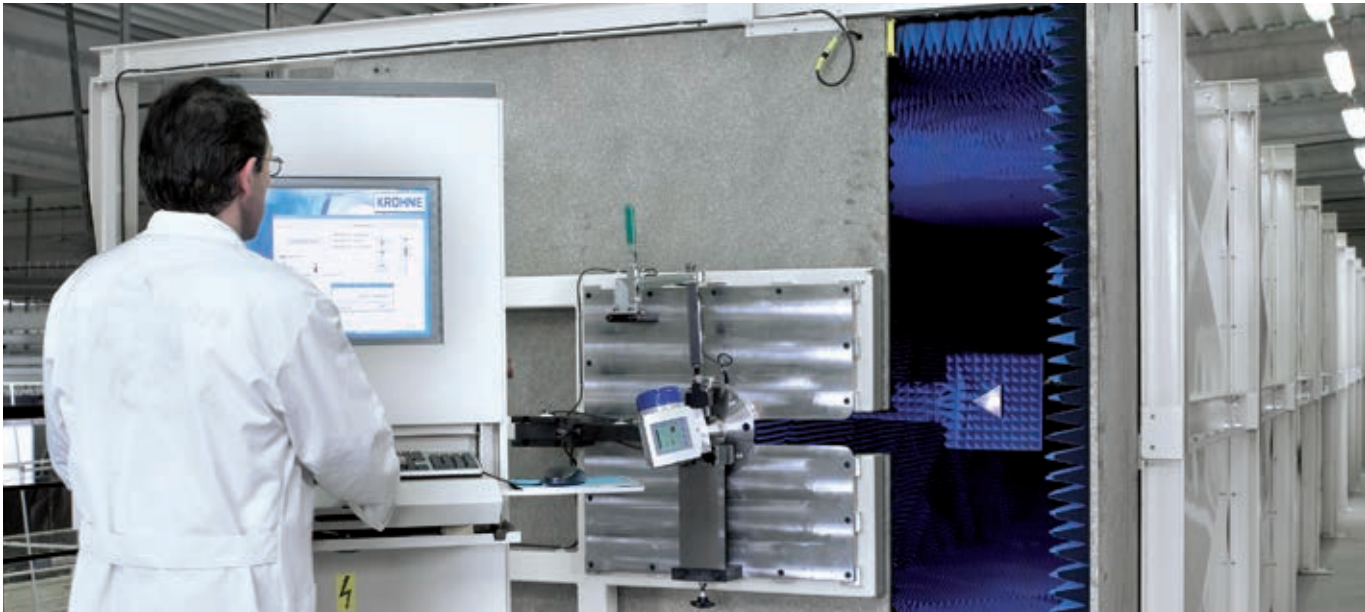
We can also provide customer specific calibration such as:

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

For calibration we only use direct comparison of measurands (e.g. we calibrate our Coriolis mass flowmeters with a gravimetric weighing system). Our calibration rigs are the most accurate used in measuring device production worldwide: the accuracy of the reference is usually 5 to 10 times better than that of the meter under test.

The world's most precise volumetric calibration rig for flowmeters up to DN3000/120"





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 DN3000/120" 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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