

# COMBIMASS®

Thermal gas flow  
measurement system

For measuring  
and balancing of  
normal volumetric  
or gas mass flows





## COMBIMASS®

The **COMBIMASS®** series enables direct measurement of the normal volumetric flow or gas mass flow, unaffected by pressure and temperature fluctuations.

Various basic modules can be combined with different sensors in any manner. The modular concept is characterized by

- its advanced electronics
- multiple combinations as well as
- the expandability of the system.

**COMBIMASS®** sensors for thermal gas flow measurement

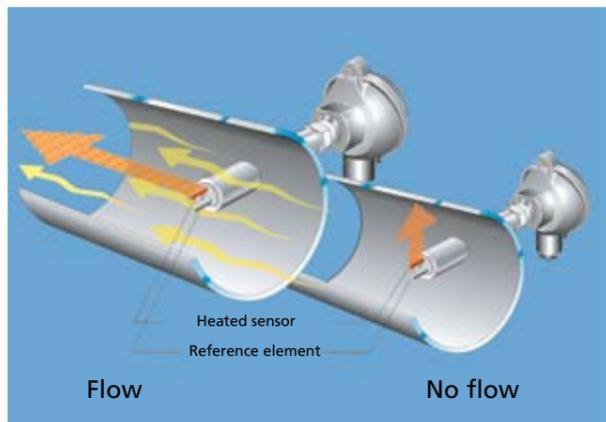
- are designed for minimal pressure loss
- are robust, corrosion-resistant and require minimal maintenance
- have no mechanical moving parts and
- are available in various models and probe geometries.

The use of state-of-the-art sensor technology ensures precise measuring results which are stable over time, even under extreme conditions and at high temperatures.

With **COMBIMASS®** you can assemble your gas flow meter individually according to your specific application.

# The principle of thermal measurement

Gas molecules flowing past a heated sensor element absorb heat energy causing it to cool down. This effect is used by **COMBIMASS®** for thermal flow measurement of gases. The degree of cooling depends directly on the number of gas molecules passing the sensor and therefore is a direct measurement of the gas mass. With other techniques of gas flow measurement the operating volumetric flow is usually measured instead of the mass flow. In such case the reading of the flow meter varies greatly according to pressure and temperature fluctuations.



**COMBIMASS®** measures in dry gases directly the standard volumetric flow or the mass flow of the gas respectively according to DIN 1343. This key value for the flow rate is independent of the operating state of the gas and may be compared directly. A heated sensor element and a reference element are used to determine the quantity of heat absorbed by the flowing gas. This value is directly proportional to the gas mass flow. Signal processing occurs either at constant heating power by evaluating the temperature differences between both sensor elements or at a constant temperature differential by readjusting and evaluating the required heating current.

Thus a basic distinction is made between the following two principles:

## The constant power principle

has proven to be ideal for process applications and is characterized by an extremely stable flow signal. This measuring mode is the best choice for monitoring of low flow rates, for measuring dirty and moist gases and for regulating tasks.

**The constant temperature principle** is mainly used for special measuring tasks. It is well known for its quick response characteristics. With clean gases the constant temperature principle is ideal for measuring high flow rates or monitoring dynamic processes.

**COMBIMASS®** uses both techniques and allows to select the measuring mode depending on the specific requirements of the application or measuring task.

## The **COMBIMASS®** sensors are unmatched in precision and stability

The choice of an appropriate sensor is crucial for precise gas flow measurement in various applications and process conditions. Therefore **COMBIMASS®** sensors differ in design and probe geometry.

### Various sensor models – Best choice for each application

Heavy-duty, fully welded sensors made of stainless steel or other special materials are available for a variety of applications. Depending on the nominal pipe size and the type of application, these probes are available in different diameters and lengths as well as with various process connections. All sensor heads are made from one-piece solid bar-stock construction.

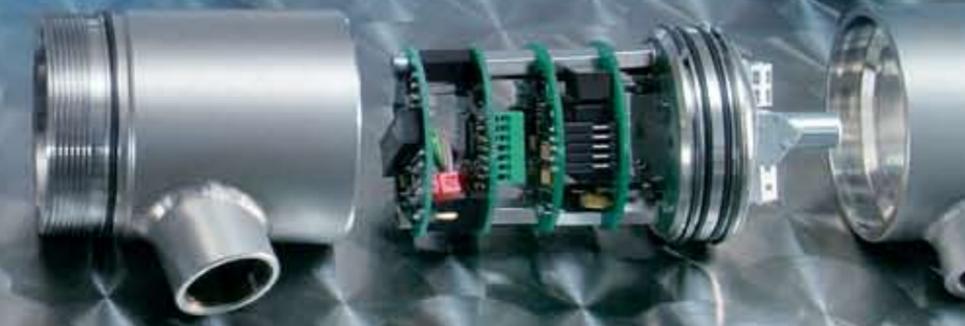
### The sensor elements – High-tech in detail

All probes of the **COMBIMASS®** series use technologically advanced sensor elements of the latest generation. The platinum thin-layer resistors are randomly distributed on a ceramic board. The structures of the sensor elements are created using modern manufacturing laser technology.

### **COMBIMASS®** sensors are characterized by

- high-precision resistors
- minimal drift of the raw signal
- excellent long-term stability

all this even under harsh operating conditions and at high temperatures.



# COMBIMASS®

## The modular concept

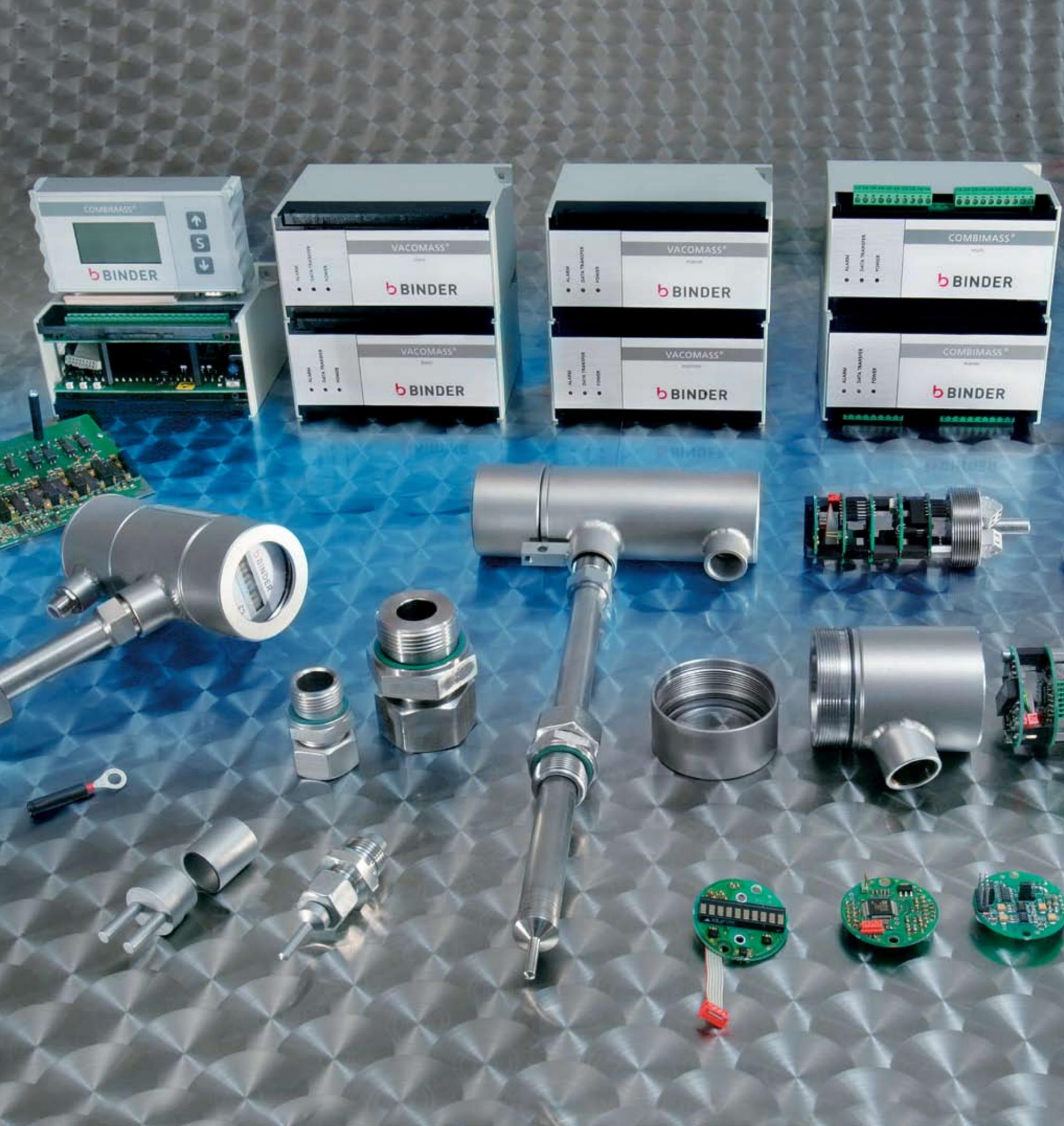
The **COMBIMASS®** series of gas flow meters is unique due to its advanced modular design. Various basic modules are available which may be combined as desired with different sensors. In this way the modular concept of the **COMBIMASS®** series enables ideal configuration for any possible measuring task.

Each flow meter can be customised to fit the application and your specific requirements. Once installed, a **COMBIMASS®** system can also be further expanded. Thus changes in requirements do not require expensive replacement by a new, higher performance device.

Besides various basic modules you have the choice between **COMBIMASS®** sensors available in different materials, dimensions and with various process connections. In addition these sensors are distinguished by their probe geometries.

During installation of the **2-pin sensor type**, the flow direction of the gas has always to be considered in order to guarantee precise flow rate measurement. This is balanced by some operational advantages in case of fast changing temperature of the medium to be measured. The 2-pin geometry also has proven to be reliable since many years.

The **1-pin sensor type** uses a unique sensor element developed especially for such probe geometries. The heated measuring resistor and the reference resistor are mounted on a single ceramic board. Due to the rotationally symmetrical design this thermal probe will always have identical flow to both thin layer resistors, thus avoiding erroneous measurements by turning the flow sensor during installation or maintenance work. This contributes to higher reliability in measuring gas flows.





## COMBIMASS® The basic modules

COMBIMASS® enables the combination with various basic modules and for this reason an ideal configuration for any possible measuring task. Each flow meter can be customised according to the application and the requirements.

### The basic modules

Field transmitter:

#### **COMBIMASS® basic**

Basic flow meter for flow rate measurement of compressed air and technical gases at process temperatures up to 130 °C

#### **COMBIMASS® eco**

Flow meter for various standard applications even in potentially explosive areas and at process temperatures up to 220 °C

#### **COMBIMASS® compact**

High performance flow meter for extreme applications even in hazardous areas and at process temperatures up to 580 °C

#### **COMBIMASS® eco-bio+ SS/AL respectively**

#### **COMBIMASS® oem-bio L**

Customised system for original equipment manufacturers such as manufacturers of biogas plants or gas compressors as well as operators

#### **COMBIMASS® monitor**

Flow switch for gases and liquids, a switch for level, foam and separation layer detection as well as for monitoring and run-dry protection of pumps.

DIN rail module:

#### **COMBIMASS® master**

Microprocessor based electronic module with additional signal inputs and outputs as well as extended monitoring, correction and evaluation capabilities for highly demanding application, also with data-logger

#### **COMBIMASS® multi**

Electronic module for multipoint measurement or redundant monitoring of gas flows with plausibility checking and various evaluation options (single point analysis, averaging, etc.)

#### **COMBIMASS® I.S. interface**

I/O module specially developed by BINDER for COMBIMASS® in EEx[ia] Zone 0-applications

#### **Customised COMBIMASS®**

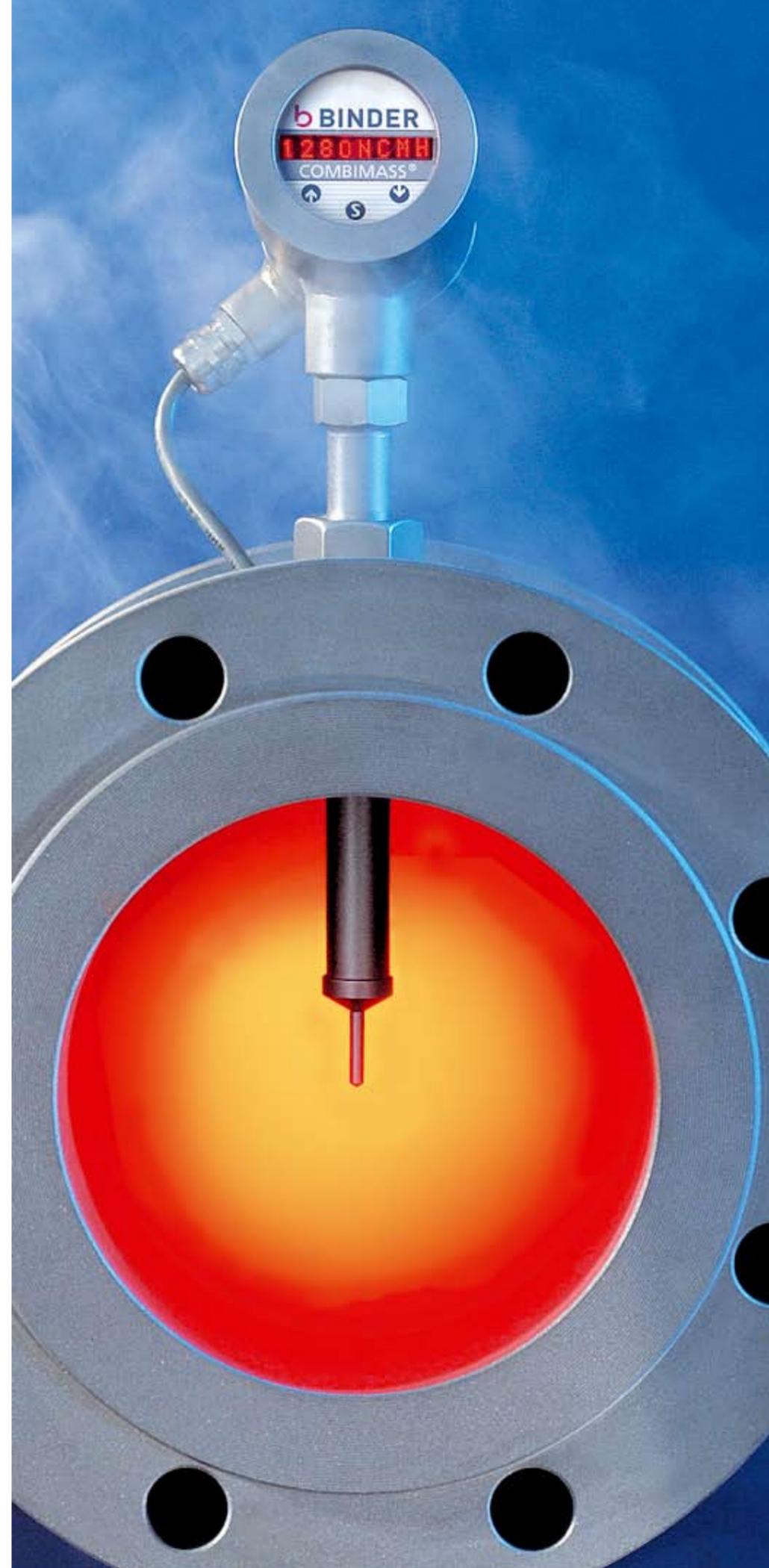
products built out of the modular components complete the program.

## The electronics

Due to the visionary sensor query and digital signal processing the **COMBIMASS®** electronics are distinguished by their superior stability and reliability.

The use of state-of-the-art components allows the electronics to be miniaturised in size, such that the data storage for calibration and sensor data as well as the entire signal analysis functionality can be incorporated into the sensor head. Thus it is possible to read out and check the sensor data. If the sensor is connected to the electronic interface the sensor electronics transfers the application data to the external module.

The **COMBIMASS®** electronics allows to select different measuring modes. Operation of the flow meters can be according to the constant power principle or the constant temperature principle, thus offering the greatest flexibility for every application and measuring task. The measuring mode will be selected before system calibration but can be changed at any time as needed.



## COMBIMASS® in action

Modern technology and the consideration of high safety standards allow these thermal gas flow meters to be deployed not only for simple applications but also in areas with explosion hazards, at high pressures and for process temperatures up to 580 °C. Manual or hydraulically operated hot tapping units for operating pressures up to 100 bar and process temperatures up to 450 °C are used to insert or retract the sensors during operation. This enables the sensors to be checked, cleaned and maintained at any time without difficulty.

## Explosion protection without compromises

**COMBIMASS®** flow meters are available in explosion proof version according to ATEX regulations. The instruments can be configured as intrinsically safe versions EEx [ia] or shipped with a pressure-proof dual compartment enclosure rated EEx [ed] for hazardous location use. The EEx [ia] configuration meets the requirements of category 1 as well as temperature class T4. **COMBIMASS®** flow meters therefore meet the highest safety standards and can also be used for applications in explosive areas classified up to zone 0. Versions for zone 1 and 2 are also available. Thus these devices cover a broad spectrum of process applications in the chemical and petrochemical industries up to biogas plants.

## COMBIMASS® handles the pressure

The solid machined sensor points of the **COMBIMASS®** series are welded to the sensor rod with a single weld only. This allows all sensors to be manufactured with tested welds.

**COMBIMASS®** flow meters therefore meet the requirements of the PED and the AD 2000 for pressurized components and can be used without observing any particular safety guidelines even at high operating pressures. Subsequent inspection of the plant after installation of the flow meter by a qualified technician is not necessary.

# COMBIMASS® flow meters are versatile and can be used anywhere

## The devices measure the flow rate

- of compressed air, supply and process gases
- of pure gases and gas mixtures
- of clean and sterile gases
- of dirty, moist or corrosive gases
- of flammable and toxic gases

in all kind of industries for the most diverse applications.

## The high-performance gas flow meters measure

- directly the normal volumetric or the gas mass flow in dry gases
  - unaffected by pressure and temperature fluctuations
  - with a turndown ratio up to 1000 : 1
  - an accuracy up to 1%
  - at process temperatures up to 580 °C
  - operating pressures over 100 bar
- and guarantee always precise and reliable results even for difficult measuring tasks.

## COMBIMASS® – always the best choice for your specific application

The COMBIMASS® series of flow meters was developed for a great variety of different applications in all kind of industries. For sterile applications, such as in pharmaceutical or food industry, COMBIMASS® sensors are available with highly-polished surface, approved materials and special process connections. Models made of Titanium, Tantalum, Inconel, Hastelloy, Ceramic or Carbide are used to measure corrosive, aggressive or abrasive gases or gas mixtures.

As you can see, COMBIMASS® covers a broad range of diverse applications and can be configured for any possible measuring task.



# COMBIMASS® flow conditioner

COMBIMASS® flow conditioners are used in the case of a complex pipe geometry with bends, reducers, fittings or pulsation of the gas flow. They balance out almost without any pressure loss the flow profile and ensure that there are reproducible conditions at the measuring point.

With COMBIMASS® flow conditioners the measuring section is only up to 3-7 fold of the pipe diameter. They are robust, insensitive to dirt and guarantee the highest measurement accuracy.

## The principle:

At the inlet, swirl-reducing guide plates cause counter-vortices which neutralize the swirl flow. Profile guide plates create cross flows, which are mixed with the fast and slow speed regions. Finally, a homogeneous outlet flow is generated.



# Applications

## biogas flowmeter and biogas analyser

Variable methane concentrations in wet and corrosive gases combined with dirty particles are a challenge for each gas mass flow measurement system. A gas mass flow meter with integrated humidity correction allows to measure the biogas flow at standard conditions according DIN 1343. Using a further combination with a gas analyser, the gas mass flow can be corrected by the measured methane concentration in the gas. The biogas analyser **COMBIMASS® GA-m** is a very compact and rigid hand held instrument which can also be used in a stationary version **COMBIMASS® GA-s**. The biogas analyser has an outstanding performance and is very flexible and easy to handle. The improvement of measurement accuracy and reliability causes a significant increase to the efficiency in the energy generation out of biomass.



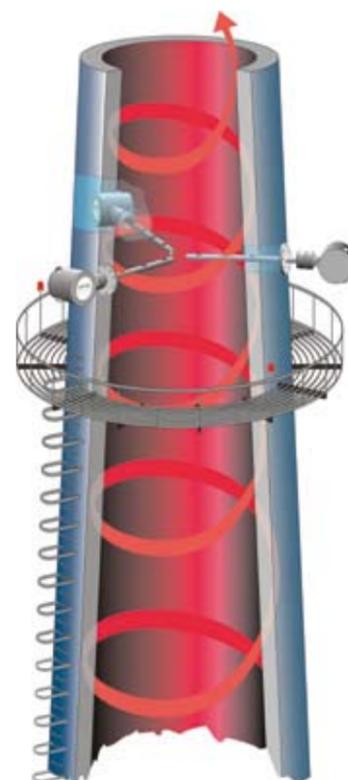
## Flaremass

Variable operating conditions and mixed gases are a challenge for the **COMBIMASS®** flare gas measurement system

- H<sub>2</sub>-inline-compensation, mixed gas lab calibration possible at **CAMASS®** Calibration Center and on site
- inline validation system, flow conditioning, multi-point measuring systems
- hot tapping unit, direct mass measurement, irrespective of pressure and temperature
- easy installation, measuring range 1000 : 1 at minimal pressure loss
- corrosion-resistant sensors, insensitive to dirt.

## Multipoint measurement

Flow profile distortions, such as those which occur with large nominal diameters, rectangular ducts and short inlet and outlet pipe sections, lead to errors in the flow rate measurement of gases. **COMBIMASS®** multipoint systems measure the flow velocity of gases at various points of the cross-section and averages the individual readings. Thus errors caused by flow profile distortions are suppressed and the measurement system provides correct values of the flow rate even at unfavourable installation position of the thermal flow sensors.



## Additional applications

**COMBIMASS®** measuring systems can also be used as monitor and flow switch for gases and liquids, as switch for level, foam and separation layer detection, for run-dry protection of pumps as well as for monitoring of lubricating circuit.



## CAMASS® calibration technology

With such high-precision measuring technology, correct calibration of the gas flow meters is the key to precise flow rate measurement.

In our **CAMASS®** Calibration Center, exactly the same process conditions that will be encountered later in your plant will be simulated for gas flow calibration. Each flow meter is calibrated individually in our flow stands.

The modern **CAMASS®** Calibration Center offers technology and service for gas flow applications even for corrosive and explosive gases and this with

- nominal diameters up to DN 500 as standard
- operating pressures from 0.1 to 100 bar (abs)
- operating temperatures up to 500 °C
- standard flow velocities from 0.01 to 600 m/sec
- volume flows up to 90 000 m<sup>3</sup>/h at standard conditions.

Besides various international standards for flow rate measurement, the laser doppler anemometry is used as a reference as well. This optical measuring technology requires no calibration and determines gas flow rates unaffected by pressure and temperature fluctuations with an overall accuracy of +/- 0.2%.

# COMBIMASS®

## Applications

### General industrial use:

Flow rate measurement, recording and balancing of compressed air, technical and combustion gases such as nitrogen, argon, oxygen, superheated steam or propane, butane, etc.

### Sewage treatment and environmental technology:

Measurement, balancing, control and distribution of aeration air, digester gas, landfill gas, biogas, natural gas, ozone and oxygen. Flow measurement and monitoring of exhaust air, waste gases, low temperature carbonization gas, flue gas, etc.

### Power plants, garbage incineration plants:

Flow rate measurement of combustion air, residual gases, flue gas and ammonia.

### Refining, petroleum processing:

Hydrocarbons, hydrogen sulphide, flare gases, hydrogen/hydrocarbon gas mixtures even with a high quantity of particles and variable composition.

### Pharmaceutical, biotech, food and beverage industries:

Nitrogen and supply gases, sterile gases, hot air for sterilization chambers, solvent vapors, waste gas and air exhaust.

### Chemical industry:

Monitoring and control of synthetic processes. Flow rate measurement and balancing of supply and process gases such as air, nitrogen, hydrogen, chlorine, ammonia, hydrogen sulphide, amines, phosgene, acetylene, hydrocarbons, gas mixtures, exhaust air and waste gases, combustion and flue gases.



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