

# Absolute electronic insulating gas density measurement based on the oscillating quartz principle

Starting in the mid-90s, Trafag introduced gas density sensors. They are the first choice when continuous and long-term, drift-free insulating gas density measurement and data acquisition are required. Exposure of an oscillating quartz to gases of different densities causes a shift and damping of the resonant frequency. The insulating gas densities of  $\text{SF}_6$  as well as those of alternative insulating gases can thus be measured directly and electronically.



With the kind support of Swiss Grid

Gas-insulated switchgear: Gas density sensors can be used either directly or combined with gas density monitors, the so-called hybrid gas density monitors.

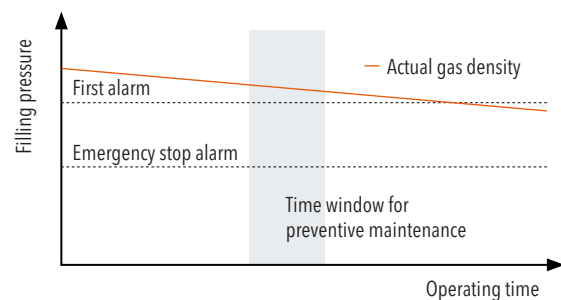
The operational reliability and operational safety of gas-insulated high-voltage switchgear can only be guaranteed if the required gas density in the pressure compartments is maintained. Leakage would endanger the safety of the switchgear and at the same time violate environmental regulations.  $\text{SF}_6$  in particular is a potent greenhouse gas and must therefore not be released into the environment. Strict regulations regarding  $\text{SF}_6$  emissions (e.g. F-Gas Regulation 517/2014) must be observed and require permanent monitoring of the pressure compartments.

Gas density sensors determine the current status and transmit the measured values to a control system. This real-time data enables analysis of the operational availability of the plant and provides characteristic values for predictive maintenance. Continuous density measurement thus supplements the pure monitoring of the safety switching points.

In addition to measuring  $\text{SF}_6$  gas density, the densities of commercial alternative insulating gases such as Greentric, EconiQ, Clean Air,  $\text{g}^3$  as well as  $\text{CF}_4$ ,  $\text{N}_2$  and  $\text{CO}_2$  can also be monitored.

## Gas density measurement provides information for preventive maintenance of gas-insulated switchgear

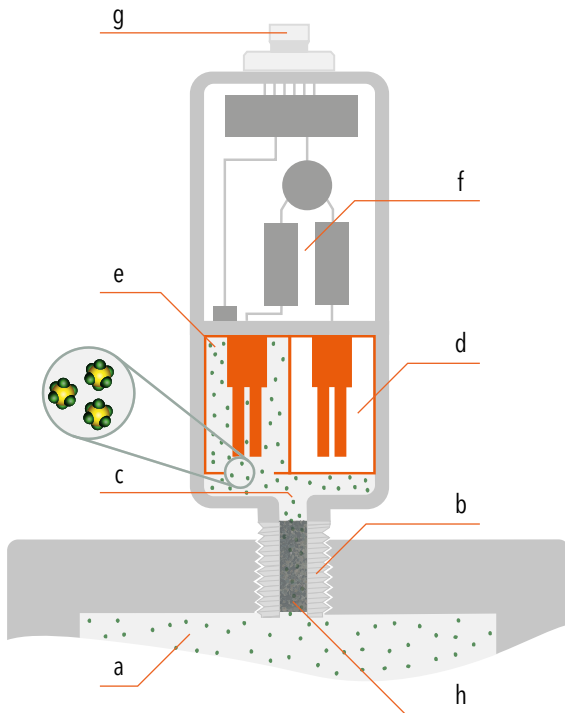
Continuous gas density measurement provides important trend information about possible insulating gas losses or undesirable operating conditions, allowing preventive maintenance measures to be determined.



Continuous measurement of the insulating gas density provides valuable additional information for determining the condition of the switchgear. Switching contacts, on the other hand, protect when defined alarm values are reached and are thus safety-relevant components.

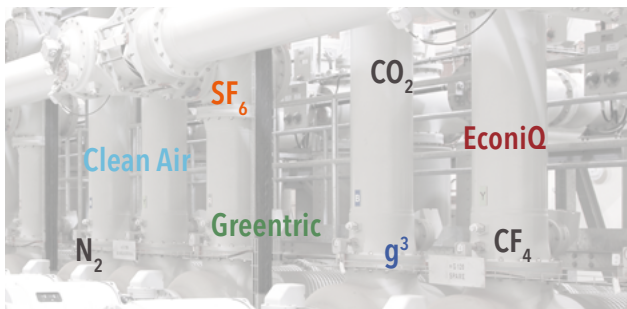
## Continuous measurement of the insulating gas density according to the oscillating quartz principle

The density sensor is mounted to the pressure compartment (a) filled with insulating gas via an optionally selectable process connection (b). Thus, the density in the pressure compartment and in the sensor measuring chamber (c) is in equilibrium.



Functional principle Trafag gas density sensor

Trafag's gas density sensors are based on the comparison of the constant resonance frequency of an oscillating quartz in the vacuum (d) with the resonant frequency of an identical quartz surrounded by insulating gas (e). Gases of different density influence the preset resonance frequency of the oscillating quartz surrounded by the insulating gas.

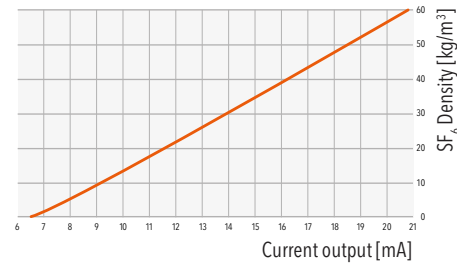


The measurement signal is proportional to the density. This makes the measuring principle ideal for measuring  $\text{SF}_6$ , mixed gases and all alternative gases as well as dry compressed air.

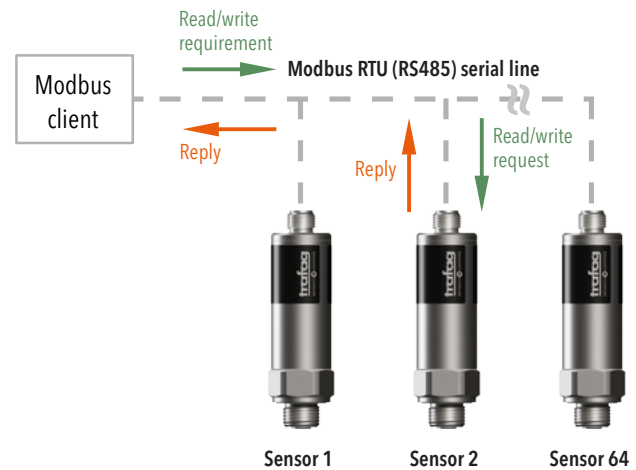
The response time for the detection of density changes is less than 10ms. The shift of the resonance frequency is proportional to the density of the insulating gas to be measured and is evaluated by the electronics (f).

The measurement signal is provided via selectable electrical output terminals (g). An analog current output signal is offered as an option.

### Example: Current output signal at $\text{SF}_6$ gas density



The current output signal has a resolution of 6.5 ... 20mA. Trafag provides conversion formulas for gas density and standardized gas pressure at 20 °C for  $\text{SF}_6$  and alternative insulating gases.



The open available Modbus protocol is used for the digital data transmission between electronic devices via RS485 lines. It is a client-server protocol. In a standard Modbus network there is one client and up to 64 servers (sensors), each with a unique server address.

On the other hand, the signal can be transmitted via a Modbus/RS485 digital output. The evaluation electronics is additionally equipped with a temperature sensor. The temperature can be read out via the Modbus output.

## Legend operating principle

- a Pressure compartment to be measured (e.g. filled with insulating gas  $\text{SF}_6$ )
- b Process gas connection (type)
- c Measuring chamber in direct balance with the insulating gas pressure compartment

- d Oscillating quartz under vacuum
- e Oscillating quartz surrounded with insulating gas
- f Signal processing unit with integrated digital temperature sensor
- g Signal output connector (variant)
- h Integrated process gas filter

## Absolute electronic insulating gas density measurement based on the oscillating quartz principle

### Gas density sensors

**Electronic absolute measurement of gas density of SF<sub>6</sub> or alternative insulating gases with patented oscillating quartz principle**

The gas density sensor is based on an oscillating quartz pairing to directly measure gas density electronically - a unique technology patented by Trafag. By providing continuous output signals (analog or digital), Trafag opens up new paths for the power distribution industry. Comprehensive density trend analyses of pressure compartments are thus easy to implement. State-of-the-art production facilities under clean room conditions and strictly monitored production processes ensure that Trafag products meet the highest quality standards.

- Type 8774 with current interfaces or pulse width modulation output
- Type 8775 with digital RS485/Modbus output



### Hybrid gas density monitors

**Combined, mechanical monitoring and electronic measurement of the density of SF<sub>6</sub> and alternative insulating gases**

The hybrid gas density monitor combines the advantages of the mechanical monitor and the electronic gas density sensor in one compact multi-function device. With its continuous measurement output, it is ideal for use in gas management and trending systems, but also features a local display and robust switchpoint alarm contacts.

- Type 878x with current output
- Type 879x with digital RS485/Modbus output



### Trafag - the hightech sensor company

Trafag, headquartered in Switzerland, was founded in 1942 and has a broad sales and service network in over 40 countries worldwide. Trafag develops, manufactures and distributes precise, robust and maintenance-free measuring instruments for monitoring SF<sub>6</sub> and alternative insulating gases in high and medium voltage switchgear. Trafag guarantees extremely accurate, highly shock resistant instruments, with the widest temperature range available on the market. In addition, Trafag has a wide product portfolio in pressure and temperature monitoring. With the ability to develop and manufacture all major components in-house, Trafag is able to mass produce as well as short run small series. Strict quality management according to ISO 9001, state-of-the-art production facilities under clean room conditions and strictly monitored production processes ensure that Trafag products meet the highest quality standards.

### The right instruments for your needs

The gas density monitors and sensors of Trafag AG stand for durability and reliability according to Swiss quality standards, and also for innovations oriented to the current needs of plant operators. Accordingly, we provide you with consulting and engineering services and support you in selecting the instruments best suited to your needs.

Contact us directly for a consultation.

Trafag AG  
Industriestrasse 11, 8608 Bubikon (Switzerland)  
Phone +41 44 922 32 32  
trafag@trafag.com | www.trafag.com