

VOC Sensors

What are VOCs

VOC is an abbreviation for Volatile Organic Compounds and a collective term for gaseous carbonaceous substances. Depending on how high the concentration of these substances in the ambient air is, we can perceive them by smelling them with our nose. On average, a person inhales about 15 kg of air per day, 80% of it indoors. Outside air quality is routinely monitored by public agencies. Indoor air quality is the responsibility of the operators or occupants of the respective building.



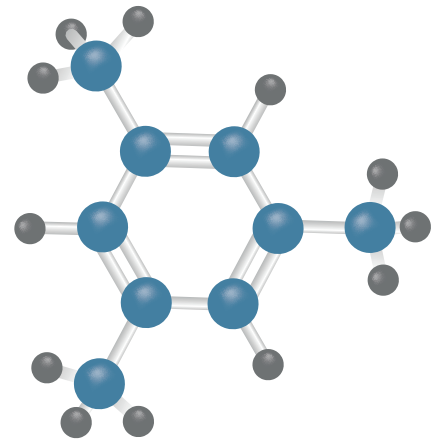
VOC Sources

In buildings there are numerous sources of VOC, for example:

- Human metabolism (methane)
- Perfume
- Hairspray
- Paint
- Floor coverings
- Adhesives
- Printers
- Furniture
- Tobacco
- Cleaning agents

Health implications

Volatile organic compounds have an impact above all on the well-being of humans. Even low concentrations can cause irritation to mucous membranes (eyes, nose and respiratory tract) as well as headaches, fatigue and nausea. At high concentrations and with certain compounds this may even be harmful to health. For most chemical compounds, local authorities have set maximum values for VOC concentrations in workplaces.



Xylene (chemical compound)

VOC Gases

The following gases can be detected with Belimo sensors:

Chemical compound	Formula	Chemical compound	Formula
Isobutane	C_4H_{10}	Acetone	C_3H_6O
Carbon monoxide	CO	Ethylene oxide	C_2H_4O
Carbon dioxide	CO_2	Formaldehyde	H_2CO
Methane	CH_4	Acetaldehyde / ethanal	C_2H_4O
Hydrogen	H_2	Glutaraldehyde	$C_5H_8O_2$
Ethanol	C_2H_6O	Acetic acid	$C_2H_4O_2$
Ethane	C_2H_6	Propanoic acid / Propionic acid	$C_3H_6O_2$
Propane	C_3H_8	Butanoic acid / Butyric acid	$C_4H_8O_2$
n-Hexane	C_6H_{14}	Pentanoic acid / Valeric acid	$C_5H_{10}O_2$
n-Heptane	C_7H_{16}	Ammonia	NH_3
n-Octane	C_8H_{18}	Hydrogen sulphide	H_2S
n-Decane	$C_{10}H_{22}$	Methanethiol	CH_4S
Undecane	$C_{11}H_{24}$	Dimethyl disulphide	$C_2H_6S_2$
Ethene	C_2H_4	Nitrogen monoxide	NO
Benzene	C_6H_6	Nitrogen dioxide	NO_2
Toluene	C_7H_8	Sulphur dioxide	SO_2
Xylene	C_8H_{10}	Triethylamine	$C_6H_{15}N$
Methanol	CH_4O	R-22	$CHClF_2$
Isopropyl alcohol	C_3H_8O	R-134a	$C_2H_6F_4$
1-Pentanol	$C_5H_{12}O$	R-12	CCl_2F_2

Measuring range

Today, metal oxide semiconductor sensors are almost exclusively used as VOC sensors in heating, ventilation and air-conditioning technology. This sensor element measures the conductivity of the nanocrystalline metal oxide that is applied to a substrate. These sensors only permit the measurement of a relative gas concentration. As a result, it is not possible to specify a measuring range or accuracy. This is due to the following reasons:

→ Gas-dependent sensitivity

Different gases can occur in one and the same room (e.g. from people, building materials or furniture), to which the sensor reacts with differing levels of sensitivity. In addition, the sensitivity for one gas can also be affected by the presence of another gas (cross-sensitivity). Therefore, a single gas cannot be clearly identified.

→ Stability

VOC sensors are not stable in the long term and drift after some time. Most VOC sensors compensate for this by evaluating the lowest measuring value over a period of time as "clean air" and then correcting the zero point if necessary (baseline correction).

→ Sample control

VOC sensors are not calibrated during manufacturing. As a result, even sensors of the same type may exhibit different behaviour.

MOX VOC sensors can be compared to the human nose, which also reacts with differing sensitivity to different gases, but very reliably detects rapid changes in gas concentration. But it quickly gets used to a smell. For example, the air quality in a meeting room after a long session is perceived quite differently by a newcomer than by those already present. Therefore, a **measuring range of 0...100% VOC** is specified.



Applications

VOC sensors are necessary wherever unpleasant odours may occur. The VOC sensor detects how much outdoor air must be supplied. The devices are not suitable for safety solutions, such as gas alarms, smoke alarms or activated carbon filter monitoring!

Since the sensors are not selective, they cannot distinguish between good and bad smells. As a result, they are not the right tool for saving energy in on-demand ventilation systems (e.g. in office spaces). However, they can be very effective in applications where expected odours are to be contained (e.g. smoker lounges, hookah bars, kitchens, toilets).



Commissioning

Commissioning VOC sensors involves a greater effort. Possible procedure:

1. Set the VOC setpoint to 50%
2. Assess the air quality and actual volumetric flow over several days
3. Optimise
 - a) Poor air quality and low fan speed
 - Decrease the VOC setpoint by 25% (50% to 37.5%)
 - More ventilation
 - b) Good air quality and high fan speed
 - Increase the VOC setpoint by 25% (50% to 62.5%)
 - Less ventilation
4. Return to step 2 and then adjust upward or downward. Track changes and results using a list to narrow down the optimal setpoint



VOC in combination with CO₂

Belimo only offers VOC sensors in combination with a CO₂ sensor element. This is because only the CO₂ sensor can reliably detect the occupancy of a room. In addition, the CO₂ sensor exhibits a more stable measurement behaviour and less drift. Supplementary to the CO₂ sensor, the VOC sensor detects unpleasant odours. As soon as the set limit values are exceeded, the sensors initiate the necessary air exchange, so that the pleasant feeling of fresh air is ensured. The mix signal, which is the output on some devices, calculates the measuring values from the VOC and CO₂ sensor elements for a combined air quality measurement result. This simplifies integration of the sensor into the management system. Compared to only a VOC sensor, combining the two measuring signals can save energy.



Overview of Belimo VOC sensors

Type	Measuring range VOC	Application	Output signals	Measured fluids
22DCV-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO ₂
22DCM-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO ₂ , temperature
22DCK-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO ₂ , temperature, mix CO ₂ + VOC

All inclusive.

As a global market leader, Belimo develops innovative solutions for the regulation and control of heating, ventilation and air-conditioning systems. In doing so, actuators, valves, and sensors make up the core business.

With a consistent focus on customer value, we deliver more than just products. We offer you the complete product range of actuator and sensor solutions for the regulation and control of HVAC systems from a single source. At the same time, we rely on tested Swiss quality with a 5-year guarantee. Our worldwide representatives in over 80 countries guarantee short delivery times and extensive support through the entire product life. Belimo does indeed include everything.

"Small" Belimo products have a major impact on comfort, energy efficiency, safety, installation, and maintenance. In short: small devices, big impact.



5-year guarantee



On site around the globe



Complete product range



Tested quality



Short delivery times



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BELIMO Automation AG

Brunnenbachstrasse 1, CH-8340 Hinwil, Switzerland
+41 43 843 61 11, info@belimo.ch, www.belimo.eu

