

Vaisala CARBOCAP® Sensor for Measuring Carbon Dioxide



First launched in 1997, the Vaisala CARBOCAP® carbon dioxide (CO₂) sensor features a groundbreaking innovation – the micromachined, electrically tunable Fabry-Perot Interferometer (FPI) filter for built-in reference measurement. This reliable and stable sensor has been delivering accurate CO₂ measurements since the late 1990s across a wide range of industries and applications, from building automation and safety to life sciences and ecological research.

How It Works

Carbon dioxide has a characteristic absorbance band in the infrared (IR) region at a wavelength of 4.26 μm. This means that when IR radiation is passed through a gas containing CO₂, part of the radiation is absorbed. Therefore, the amount of radiation passing through the gas depends on the amount of CO₂ present, and this can be detected with an IR detector.

The Vaisala CARBOCAP® sensor features an electrically tunable FPI filter. In addition to measuring CO₂ absorption, the micromechanical FPI filter enables a reference measurement at a wavelength where no absorption occurs. When taking the reference measurement, the FPI filter is electrically adjusted to switch the bypass band from the absorption wavelength to a non-absorption wavelength. The reference

measurement compensates for any potential changes in the light source intensity, as well as for contamination and dirt accumulation in the optical path. This feature means that CARBOCAP® sensor operation is highly stable over time.

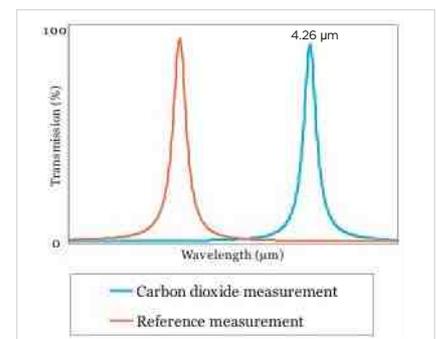
Instruments measuring at both the absorption and the reference wavelength with a single light source are known as single-beam dual-wavelength instruments. The technology is widely applied in costly analyzers. The unique feature of the CARBOCAP® sensor is its micromachined FPI filter, which performs a dual-wavelength measurement using a single detector. The compact size of the sensor means that this advanced technology can be incorporated into small probes, modules, and transmitters.

CARBOCAP® in Brief

- A silicon-based infrared (IR) absorption sensor
- Continuous internal reference measurement
- Both ppm and percentage-level CO₂ measurement
- Providing accurate measurements since the late 1990s

CARBOCAP's Unique Benefits

- Superior stability enabled by built-in reference measurement
- Minimal maintenance and calibration requirements
- Insensitive to dust, water vapor, and most chemicals
- Insensitive to changing air flow



Both absorption and reference are measured with the CARBOCAP® sensor.

Typical Applications for Carbon Dioxide Measurement

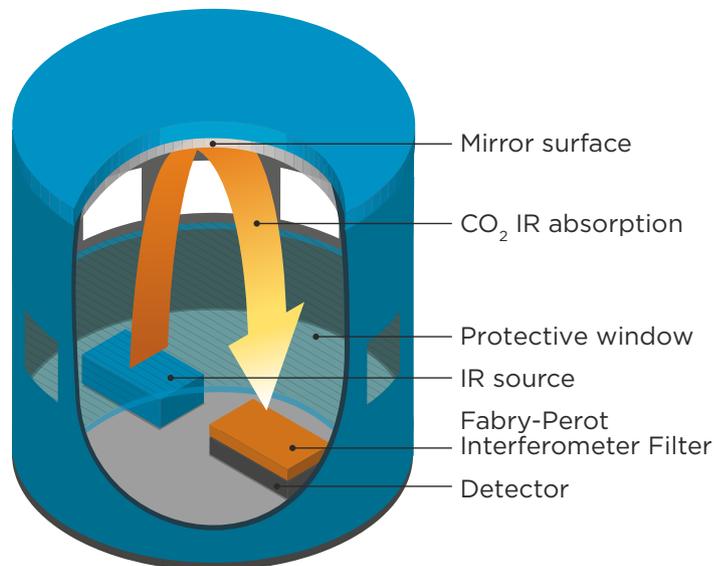
Vaisala CARBOCAP® instruments are well suited to a wide range of applications, from ppm (parts per million) to percentage-level CO₂ measurements. Since CO₂ replaces oxygen, it can be harmful to people in very high concentrations. CO₂ is present at percentage levels only within closed processes such as fermentation and controlled-atmosphere storage environments. Percentage-level measurements are also typical in life-science applications such as CO₂ incubation. Normal atmospheric air includes CO₂ at ppm levels. Typical CARBOCAP® applications include ventilation control in buildings occupied by people, animal shelters, and greenhouses. In areas where large volumes of CO₂ are handled, reliable CO₂ measurement with alarm control is an important safety precaution. The CARBOCAP® sensor is also a popular choice in ecological measurement applications, where

excellent long-term stability and tolerance to harsh conditions are important requirements.

CARBOCAP® CO₂ Products

Vaisala offers instruments for measuring CO₂ at ppm and percentage levels in both indoor and

outdoor environments. Vaisala's wide variety of CO₂ instruments ranges from hand-held meters, measurement modules, and industrial transmitters to high-volume, affordable transmitters for volume applications. View the complete range of CO₂ products at www.vaisala.com/carbondioxide.



Structure of the CARBOCAP® sensor.

The CARBOCAP® Story

The CARBOCAP® story began in 1992, when micromechanical sensors were being intensively researched at Vaisala. The groundbreaking idea of miniaturizing the Fabry-Perot Interferometer (FPI) was born, leading to collaborative development work with VTT Technical Research Center of Finland. Later, a patent application was submitted for a single-channel gas concentration measurement method using the FPI.

The driving force behind the innovation of the CARBOCAP® sensor was Vaisala's commitment to developing superior technologies for environmental measurements. And indeed, Vaisala's pioneering work in the field of silicon-based NDIR technology and electrically tunable filters resulted in the compact, simple and high-performance CARBOCAP® sensor. To this day, the long-term stability and reliability of the measurement provided by the FPI is unrivaled.

The first commercial CARBOCAP® products for measuring ppm-level CO₂ in ventilation applications were launched in 1997, with instruments for percentage-level CO₂ measurements following soon after. CARBOCAP® technology is proven in a wide range of applications, including ecological measurements, where it performs reliably in harsh environments such as soil and snow, satisfying the thirst for knowledge that scientists have for understanding nature's processes.

VAISALA

For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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