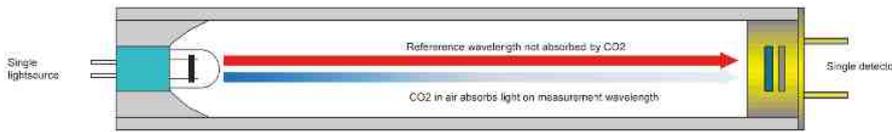


Challenges in HVAC CO₂ Measurements



CARBOCAP® Technology

Sensor stability, spaces occupied 24/7, transmitters' verification of operation, and temperature dependence pose the most common challenges in HVAC CO₂ transmitters. Due to the unique sensor technology, Vaisala has resolved these issues with its CARBOCAP® sensors.

Stability

Most HVAC instruments are rarely serviced or calibrated although they are still used for control purposes for many years. Automatic offset correction - if it works at all - only compensates for offset drift but not for sensitivity changes. Light sources, light paths, filters and detectors often have different aging properties.

The optimal way to eliminate most drift sources is using a single light source, single light path and single detector together with an adjustable filter, typical in Vaisala HVAC transmitters. By using these design solutions excellent long-term stability can be achieved: the specified stability for Vaisala's intelligent CO₂ module, GM10, is $\pm (15 \text{ ppm} + 2\% \text{ of reading})$ over 5 years.

Spaces Occupied 24/7

Many sensors depend on the CO₂ concentration dropping to 400 ppm at night to allow automatic offset correction in the transmitter. Without

this corrective measure stability of the measurement is poor. The challenge here is that many rooms are constantly occupied and do not reach the level of 400 ppm at any time of the night. Vaisala HVAC transmitters, however, have the unique CARBOCAP® sensors that use an internal reference measurement instead of the offset correction, see figure 1 above for an illustration. On every measurement cycle the light intensity at the detector is measured at two wavelengths:

1. A reference wavelength that is not absorbed by CO₂
2. A wavelength at which CO₂ light absorption is strong

These two wavelengths are filtered out of the same light beam using a tunable band pass filter. Both light intensities are measured using a single light detector, exactly identical light paths and the same light source. By calculating the ratio of these two light intensities most sources of instability can be eliminated.

Operation Verification

After sensors are installed, typically correct operation must be verified. It may take several weeks before the sensors with automatic offset correction show proper values. Due to the internal reference measurement, Vaisala CARBOCAP® sensors show correct values immediately when powered on; all Vaisala HVAC CO₂ devices have full, specified accuracy within 10 minutes after power-on.

Temperature Dependence

While the internal reference measurement of the CARBOCAP® sensors eliminate most of the sensors temperature dependence this is not enough to get correct ppm values. Measuring CO₂ absorbance is not enough – it is important to know the gas temperature, too. Without temperature compensation, you get a 0.3% of reading temperature dependence per °C. To overcome this challenge, temperature measurement for compensation of gas properties has been included in all Vaisala GMW80- and GMW90-series products for compensation purposes.

Conclusions

The unique Vaisala CARBOCAP® CO₂ sensors present an optimal and cost-efficient solution to the main challenges presented by HVAC measurements: reliability, long lifetime and ease of installation and operation. Learn more at www.vaisala.com/hvac

