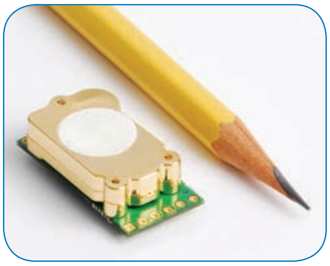
TELAIRE®

Guidelines for CO_2 Sensor Selection



Overview

With an increase regarding awareness in indoor air quality (IAQ), many manufactures of ventilation equipment, air purifiers, air quality monitors and thermostats are incorporating IAQ sensors into their products. This provides homeowners and building owners information about environmental parameters, such as temperature, relative humidity, carbon dioxide (CO_2), and total volatile organic compounds (TVOC’s) in the indoor environment. In this application note, we will focus on measuring the amount of CO_2 in the air.

In 1989, Telaire started a project to develop a low cost non-dispersive infrared (NDIR) sensor to measure CO_2 concentration in air. Telaire introduced the first maintenance free CO_2 sensor in 1992, and has since obtained over 35 patents centered around CO_2 sensing technologies. We are only manufacturer that offers single and dual wavelength sensors, which pertain to the method that sensor drift is controlled.

Single Wavelength NDIR

In its simplest configuration, a single wavelength sensor consists of an infrared light source, a chamber, a light filter, and an infrared detector. Virtually all gas sensors are subject to some drift over time. The degree of drift is partially dependent on the use of quality components and good design. Even with good components and excellent design, however, a small amount of drift can still occur over time which may ultimately result in the need for sensor replacement or recalibration.

Telaire’s single wavelength sensors feature the patented Automatic Background Calibration (ABC) Logic that continuously maintains calibration for the lifetime of the sensor (typically 15 years). ABC Logic continuously monitors the environment and logs the lowest concentrations of CO_2 in the air taking place over a 24 hour period. The sensor assumes this low point is the same as outside levels of CO_2. Outdoor levels of CO_2 are approximately 400 ppm worldwide. The sensor collects approximately 2 weeks of data and performs a statistical analysis to determine if there have been any slight changes in the sensor reading over background that can be attributed to sensor drift. If the analysis concludes there is sensor drift, a small correction factor is made to the sensor calibration to adjust for this change.

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Single Wavelength NDIR (cont.)

Since the single wavelength sensor uses outside air CO_2 levels as a reference point, these sensors should only be used in applications where a home or building will be unoccupied for periods of time, in order for indoor CO_2 levels to equalize with outdoor levels. This will occur in most home and commercial building applications where there is not 24-hour occupancy. Typical applications include commercial office buildings, movie theaters, restaurants, and residential residences.

Dual Wavelength NDIR

A dual wavelength sensor has a similar construction to a single wavelength sensor; however, it has an additional infrared detector that measures light intensity of a reference wavelength within the chamber. As stated above, virtually all gas sensors are subject to drift over time. In applications where outdoor air CO_2 levels cannot be used for reference, an alternate method is required to ensure calibration over time.

A second wavelength is used as a reference point for this sensor as it continuously measures slight changes associated with potential drift of electronic components over time. The sensor monitors these changes, analyzes the data and corrects the CO_2 output due to drift.

While not as accurate as the ABC Logic found in single wavelength sensor over time, the dual wavelength sensors is ideal for applications where the indoor environment will not be exposed to outside levels of CO_2 levels on a periodic basis. Typical applications include hospitals, food monitoring and storage, and agricultural applications.

Metal Oxide (Equivalent CO_2)

Metal oxide based sensors are a well-known method for VOC detection, typically consisting of a heater element on a Si-based MEMS structure and a metal oxide (MOx) chemiresistor. The signal conditioner controls the sensor temperature and measures the MOx conductivity, which is a function of the gas concentration.

Since there are thousands of volatile organic compounds, it is not possible to manufacture a cost-effective sensor to detect all possible VOC's in the indoor environment. Most sensor manufacturers focus on targeting certain VOC's, such as formaldehyde, toluene, xylenes, acetone and alcohols, just to name a few, and then use algorithms to provide an estimated total organic compound (TVOC) output in parts per billion (ppb). This type of sensor provides valuable information about the presence of contaminates in indoor air. However, it is typically used to provide trend data and are not recommended for exact measurements of VOC's.

In addition to TVOC output, some manufacturers have chosen to provide a CO_2 equivalent output in parts per million (ppm). While CO_2 is not a VOC and cannot be directly measured with a MOx type of sensor, humans are a source of VOC's through the process of breathing; therefore, algorithms are used to analyze the data to determine TVOC attributed to the presence of humans, and then estimates CO_2 in parts per million (ppm).

This type of sensor should be used in applications where there is a desire to monitor common indoor air quality contaminants, where one can take appropriate action to reduce the levels of TVOC via increased ventilation or removal of the VOC source. It should not be used in applications where the application specifically requires measurement of CO_2; an example of such is ASHRAE Standard 62.1.

If the requirement is to measure CO_2, one should choose a sensing technology that measures the concentration of CO_2 directly, instead of an inferred value; therefore, we would not recommend CO_2 equivalent for these type of applications.

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