Application Note

Broadcom Spectrometers and Pyroelectric Detectors

Continuous Emission Monitoring with Broadcom Optical Sensors

Introduction

Continuous emission monitoring systems (CEMS) are critical for environmental protection and play a crucial role in human life and public health. These systems are used to reach compliance and ensure safety by monitoring pollution and controlling and reporting emissions in industrial sites.

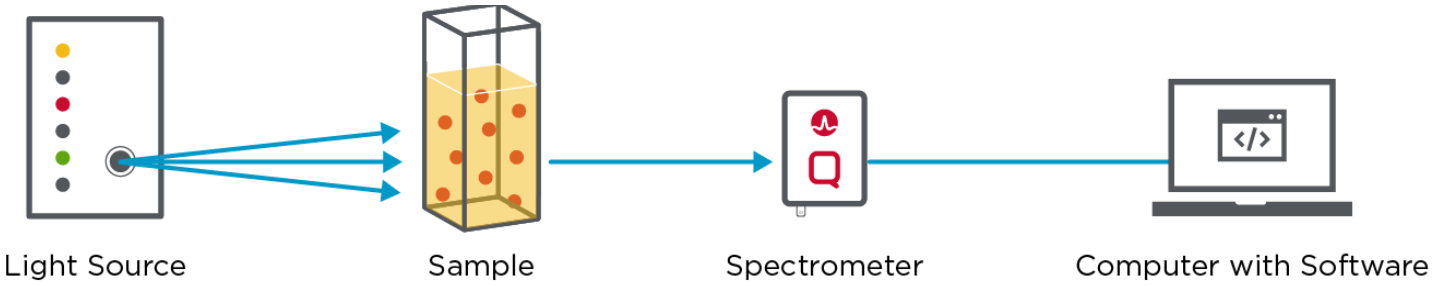
Optical sensors, such as spectrometers and pyroelectric detectors that target individual gases, play an important role in emission measurement.

Typical CEMS Use Cases

Gas Analytics: Sensors can identify and measure specific pollutants and their concentrations. With many wavelength configurations, Broadcom spectrometers are available for deep UV measurements starting at 185 nm up to short-wave NIR at 1700 nm. For mid-infrared (MIR) and far-infrared (FIR) sensing, Broadcom offers a wide range of pyroelectric detectors.

Pollution	Wavelengths	Product	Part Number
Sulfur Dioxide (SO_2)	200 nm – 350 nm	Qmini deepUV: 185 nm – 375 nm, res. 0.5 nm	AFBR-S20M2DUV
		Qmini UV: 220 nm – 400 nm, res. 0.5 nm	AFBR-S20M2UV
		Qmini WIDE UV: 220 nm – 1000 nm, res. 1.5 nm	AFBR-S20M2WU
		Qwave UV: 220 nm – 390 nm, res. 0.3 nm	AFBR-S20W2UV
	7.3 µm	Pyroelectric single-channel sensor with a 5-µm longpass filter and system application filter	AFBR-S6PY2214
Nitrogen Oxides (NO_x)	NO: 200 nm – 300 nm	Qmini deepUV: 185 nm – 375 nm, res. 0.5 nm	AFBR-S20M2DUV
		Qmini UV: 220 nm – 400 nm, res. 0.5 nm	AFBR-S20M2UV
		Qmini WIDE UV: 220 nm – 1000 nm, res. 1.5 nm	AFBR-S20M2WU
		Qwave UV: 220 nm – 390 nm, res. 0.3 nm	AFBR-S20W2UV
	5.3 µm	Pyroelectric single-channel sensor with a 5-µm longpass filter and system application filter	AFBR-S6PY2214
	NO_2: 400 nm – 600 nm	Qmini VIS: 370 nm – 750 nm, res. 0.8 nm	AFBR-S20M2VI
		Qmini WIDE UV: 220 nm – 1000 nm, res. 1.5 nm	AFBR-S20M2WV
		Qmini WIDE VIS: 220 nm – 1000 nm, res. 1.5 nm	AFBR-S20M2WU
		Qwave VIS: 350 nm – 880 nm, res. 0.6 nm	AFBR-S20W2VI
	6.2 µm	Pyroelectric single-channel sensor with a 5-µm longpass filter and system application filter	AFBR-S6PY2214
Carbon Monoxide (CO)	4.6 µm	Analog pyroelectric single-channel sensor: 4.64 µm/180 nm	AFBR-S6PY0211
Carbon Dioxide (CO_2)	2.0, 4.3, and 15 µm	Analog pyroelectric dual-channel sensor: 3.91 µm/90 nm and 4.24 µm/180 nm	AFBR-S6PY0234
		Digital ezPyro® SMD pyroelectric sensor: 4.26 µm/180 nm	AFBR-S6EPY12231R
Methane (CH_4)	3.3 µm and 7.7 µm	Analog pyroelectric dual-channel sensor: 3.91 µm/90 nm and 3.30 µm/160 nm	AFBR-S6PY2626
Volatile Organic Compounds (VOCs)	These pollutants can vary widely based on their specific compounds; therefore UV, VIS, and infrared spectrometers are used to detect the VOCs of interest.	Qmini platform: Seven configurations from: 185 nm – 1100 nm	AFBR-S20M2xx
		Qwave platform: Three configurations from: 220 nm – 1030 nm	AFBR-S20W2xx
		QtubeSpectrometer: 190 nm – 1000 nm	AFBR-S20T1WU
		Qneo: 950 nm – 1700 nm	AFBR-S20N1N256
Particulate Matter (PM)	Particulate matter is often measured using light-scattering techniques. In some special cases, laser-light scattering at 450 nm – 650 nm is employed for real-time monitoring.	Qmini VIS: 370 nm – 750 nm, res. 0.8 nm	AFBR-S20M2VI
		Qmini VIS/NIR: 480 nm – 1100 nm, res. 1.5 nm	AFBR-S20M2VN
		Qmini WIDE: 220 nm – 1000 nm, res. 1.5 nm	AFBR-S20M2WU
		Qwave VIS: 350 nm – 880 nm, res. 0.6 nm	AFBR-S20W2VI

Why Spectroscopy?



The following features use Broadcom spectrometers in CEMS:

- **Real-time Monitoring**: Broadcom spectrometers offer online analytics with very fast readout times to ensure real-time monitoring.
- **Reliable Monitoring**: Broadcom spectrometers are highly sensitive instruments that are capable of detecting the smallest amounts of pollution in emissions with high resolution, starting with 0.3 nm (FWHM). This sensitivity is important to ensure compliance and meet environmental regulations.
- **Multicomponent Analytics**: A spectrometer can simultaneously analyze multiple components in gas mixtures within one fast measurement.
- **Fast Communication with Remote Access to Data**: The various digital interfaces (USB, SPI, UART) help to ensure fast and easy communication between the spectrometer and the control system. In addition, the small dimensions of the Qseries make it possible to place the spectrometers inside of process probes in harsh industrial surroundings, enabling remote and live monitoring of processes.

Why Pyroelectric Sensors?

Broadcom pyroelectric sensors offer the following benefits:

- **Fast Response**: Broadcom pyroelectric detectors have fast-responding thin-film sensing elements that enable NDIR system power consumption reduction and increase time resolution.
- **High Sensitivity**: Broadcom pyroelectric detectors have built-in amplification, reducing the readout system complexity and protecting the sensitive parts of the circuit from EMI.
- **Digital Interface**: Broadcom ezPyro SMD digital pyroelectric sensors further increase the signal readout integration, offering I^2C communication to the system microcontroller.

Why Is CEMS So Important?

Continuous emission monitoring systems ensure that industrial companies meet national and international emission standards and guidelines. Broadcom sensor solutions can easily integrate in CEMS, enhancing these systems in terms of reliable, reproducible, real-time, and especially accurate monitoring.