

ULTRA-LOW POWER GAS SENSORS



ENABLING A NEW GENERATION OF  
ENVIRONMENTAL SENSOR  
SOLUTIONS

## Technology Overview

Cambridge CMOS Sensors (CCS) MEMS Micro-hotplates provide the key technology platform for Metal Oxide (MOX) gas sensors by enabling sensor miniaturisation, significantly lower power consumption and ultra-fast response times for a wide range of applications.

CCS Micro-hotplates are suspended in a high reliability membrane and act as heater elements for a metal oxide-based sensing material. The Micro-hotplates contain electrodes that measure the resistance of the sensing material. The material resistance will change due to reactions to selected gases and concentrations at temperatures between 150°C to 450°C.

For reducing gases such as Carbon Monoxide (CO) a reaction takes place with the sensing material which decreases the resistance of the sensor. For oxidising gases such as Nitrogen Dioxide (NO<sub>2</sub>) the resistance increases. The magnitude of the resistive changes depends on the metal oxide composition/structure and the operating temperature of the sensor. Figure 1 illustrates the MOX gas sensor structure and how the resistance of the sensing material changes when gas molecules react on the surface.

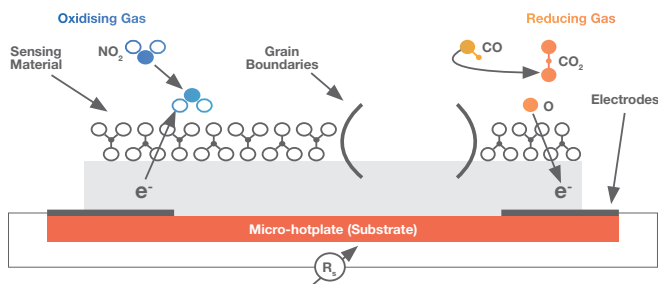


Figure 1 MOX sensor structure to illustrate gas detection principle

## Limitations of Traditional MOX Gas Sensors

Classic MOX gas sensors are large and expensive, have high power consumption, and suffer from the following limitations:

- **Cross Sensitivity** – Generally non-specific and react to a multitude of gases
- **Drift** – The baseline and sensitivity will vary from sensor to sensor, and over time
- **Stabilisation** – The stabilisation time is several hours to days before they reach a stable baseline

To counter these limitations, expensive and frequent calibration is needed. In addition, expensive filters are required to reduce cross sensitivity.

## Benefits of CCS800 Sensor Product Family

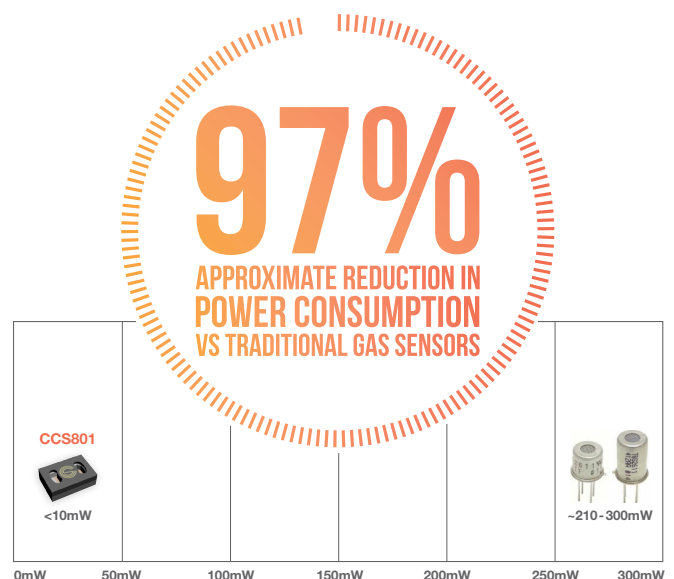
CCS miniature gas sensors use a unique silicon platform with advanced sensing materials, which :

- Reduces the baseline stabilisation time to a few seconds
- Greatly reduces cross-sensitivity, and enhances selectivity of gases
- Enables ultra-low power consumption for portable handheld devices

Advanced algorithms support the CCS8xx family of MOX gas sensors for maximum selectivity, drift compensation and for self-calibration, enabling easy and timely integration into a wide range of applications.

The inherent design of this family of MOX gas sensor enables ultra-low power consumption (<10mW) for gas sensing, with average power consumption in typical applications considerably less.

Traditional MOX gas sensors are high power consumption >200mW. Therefore, it is now practical for battery operated portable devices such as smartphones, tablets, wearables and IoT (Internet of Things) accessories to use CCS8xx product family for monitoring a wide range of gases.



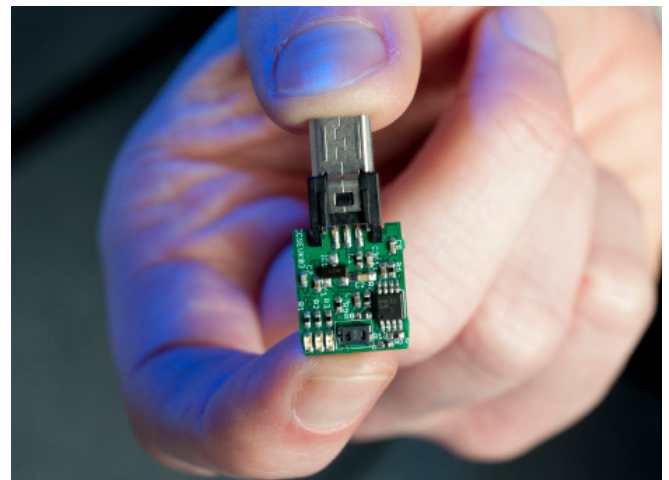
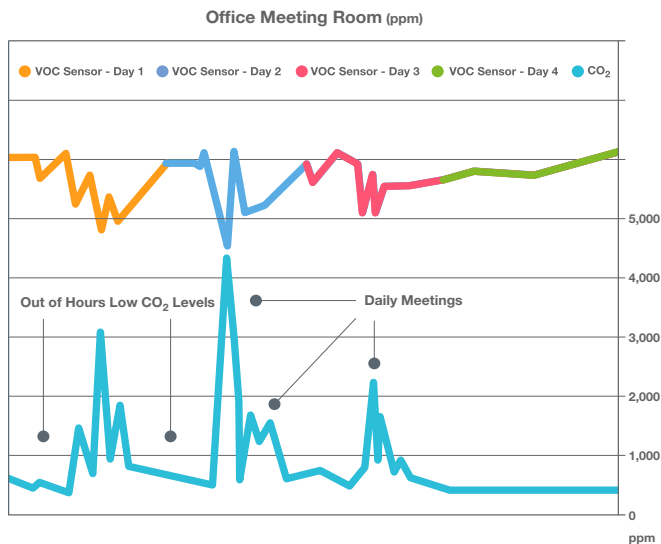
## Product Overview

The CCS8xx product family of ultra-low power MOX gas sensors can detect Carbon Monoxide (CO) and a wide range of Volatile Organic Compounds (VOCs). CCS801 and CCS811 can be used as a CO<sub>2</sub> equivalent sensor to represent CO<sub>2</sub> levels in real world environments, where the main cause of VOCs is from humans.

To support easy evaluation of the CCS8xx product family CCS offers the following evaluation kit and demonstrator boards.

Part Number	Description
CCS_EVK02	CCS80x evaluation kit (Main board) including windows based software GUI
CCS_EVK02_801SB	CCS801 sensor daughter board
CCS_EVK02_802SB	CCS802 sensor daughter board
CCS_EVK02_803SB	CCS803 sensor daughter board
CCS_EVK03_801	Micro-USB board for CCS801 including example Android App <sup>1</sup>
CCS_EVK03_803	Micro-USB board for CCS803 including example Android App <sup>1</sup>

<sup>1</sup> Requires USB host support on smartphone or tablet



The following table indicates the key product parameters for our CCS800 family of ultra-low power gas sensors.

Product	Description	Average Power Consumption <sup>1</sup>	Heater Resistance	Heater Voltage	Package
CCS801	Ultra-low power sensor for indoor air quality monitoring	~1.1 - 1.6mW <sup>2</sup>	45Ω ± 10%	1.1 - 1.4V <sup>2</sup>	2x3mm DFN
CCS802 <sup>3</sup>	Ultra-low power gas sensor for monitoring carbon monoxide	~1.2mW	42Ω ± 10%	1.1V ± 10%	2x3mm DFN
CCS803	Ultra-low power gas sensor for monitoring ethanol	~1.6mW	45Ω ± 10%	1.4V ± 10%	2x3mm DFN
CCS811	Ultra-low power digital gas sensor for air quality monitoring	~1.1 - 1.6mW <sup>2</sup>	45Ω ± 10%	1.1 - 1.4V <sup>2</sup>	2.7x4mm LGA

<sup>1</sup> Average power consumption when operated in pulse mode, assuming a 3 second heater ON period per minute. Timing will vary depending on application and use case requirements

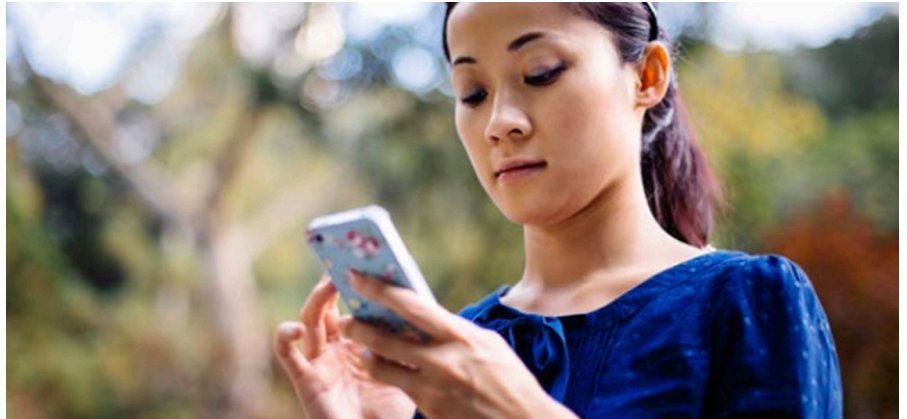
<sup>2</sup> Will vary depending on target gas being detected

<sup>3</sup> Carbon filter recommended

Founded in 2008, Cambridge CMOS Sensors (CCS) is the industry leader in advanced sensor solutions for monitoring indoor air quality (IAQ) including; VOCs and hazardous gases (such as CO), outdoor air pollution levels and breath analysis.

CCS is a fabless semiconductor company with an established high-volume supply chain that is qualified to ISO:9001, ISO:14001 as well as TS16949.

The technology developed by CCS offers a radical step change in performance when compared to the competition; this has opened up multiple markets which previously were unserviceable. Ultra-low power consumption, fast response time, embedded intelligence and ultra-small form factor has enabled the growth of new application areas for improved health and wellbeing such as; ambient air quality monitoring and breath analysis, in smartphones, tablets, wearables and Internet of Things (IoT) devices.



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