CCS803 Ultra-low power gas sensor for Ethanol detection

Technology Advantage

Cambridge CMOS Sensors (CCS) micro-hotplate technology provides a unique silicon platform for the CCS80x range of Metal Oxide (MOX) gas sensors. These devices enable sensor miniaturisation, have ultra-low power consumption and provide fast response times due to the ability to heat the micro-hotplate very quickly.

The Micro-hotplates are fabricated using a robust silicon dioxide membrane and include an embedded tungsten heater acting as a heating element for the MOX based sensing material. The micro-hotplate can be used to heat the MOX sensing material up to 500°C and the electrical resistance of the MOX sensor can be monitored to detect the target gas. Through enabling fast heater cycling times, temperature modulation techniques can be used to reduce the device power consumption and implement advanced gas sensing methods.

Software including algorithms, single-point calibration and an example Android app are available for Alcohol breath analysis applications. Refer to application note CC-000614-AN for more details.

Product Overview

The CCS803 is an ultra-low power MOX gas sensor for monitoring Ethanol.

The sensitivity of CCS803 to Ethanol is optimised by adapting the heater voltage (V_H) of the integrated micro-heater, and the gas concentration can be correlated to the change in resistance of the MOX sensing layer (R_S).

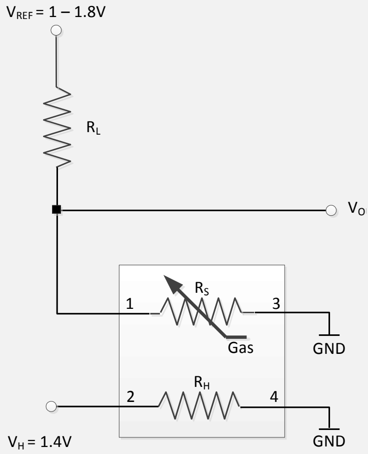
V_H can be set using a low-dropout (LDO) regulator or operated in pulsed PWM mode to reduce power consumption. The sensor resistance (R_S) is typically determined using a series load resistor (R_L), a reference voltage (V_{REF}), and an output voltage (V_{OUT}) read by an Analogue-to-Digital Converter (ADC).

Miniaturisation

The CCS803 is supported in a compact 2 mm x 3 mm DFN (Dual Flat No lead) package as standard. Other package options may be available on request. The inherent design of this sensor enables ultra-low power consumption for battery operated portable handheld devices.

Key Benefits

- Ultra-low power consumption - ideal for battery operated devices
- High sensitivity to Ethanol
- Fast heating time <25ms for quick response
- Compact 2mm x 3mm DFN package for small form factor designs



Recommended Sensor Configuration

Applications

- Detection of Ethanol
- Alcohol breathalyser in consumer devices

Electrical characteristics

Parameters	Comments / Conditions	Min	Typical	Max	Units
Absolute maximum Heater voltage (V_H)	50% Relative humidity and 25°C ambient temperature			1.8	V
Recommended operating temperature		-5		+50	ºC
Heater voltage (V_H) to set operating temperature		1.4	1.6		V
Average power consumption (P_{AV}) [1]	See note below		10.2		mW
Peak power consumption (P_{DC})	V_H= 1.6V (DC powered)		41		mW
Heater resistance (R_H)	V_H = 1.6V	50	58	66	Ω
Reference voltage (V_{REF})[2]		1.0	1.8		V
Load resistance (R_L)			1		kΩ
Typical sensor resistance in air R0	V_H = 1.6V	0.1	1.0	10	kΩ

Note:

1. Based on 30s heater on time which includes a 20s warm-up period and a 10s measurement window performed once in a 2min period for Alcohol breath analysis. Refer to application note CC-000614-AN for more details.

2. The reference voltage (V_{REF}) needs to cover the input range of the ADC.

Sensor performance

Gas type	Test condition	Typical Sensitivity Range [1,2]
Ethanol (C_2H_5OH)	R0 / R_{100ppm}	5 – 10

Note:

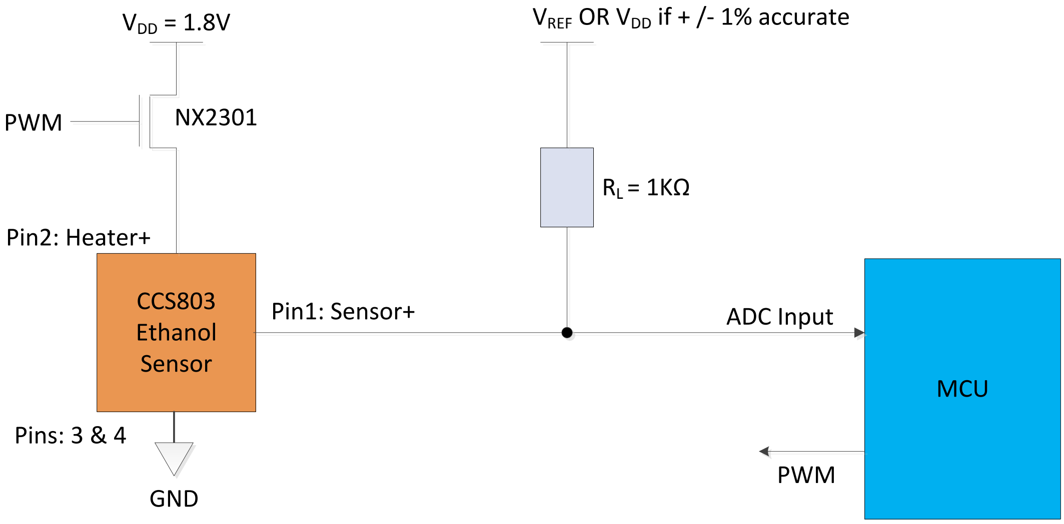
1. Defined as the sensor's resistance in air (R0) divided by the sensor's resistance at a specific gas concentration level at 50% relative humidity and 25°C ambient temperature.

2. A minimum burn-in time of 24hrs is recommended to ensure sensor performance is consistent over longer period of time.

Recommended basic application circuit

For more information refer to application note CC-000018-AN on CCS80x hardware design guidelines.

The recommended basic application circuit for CCS803 sensor is shown below.



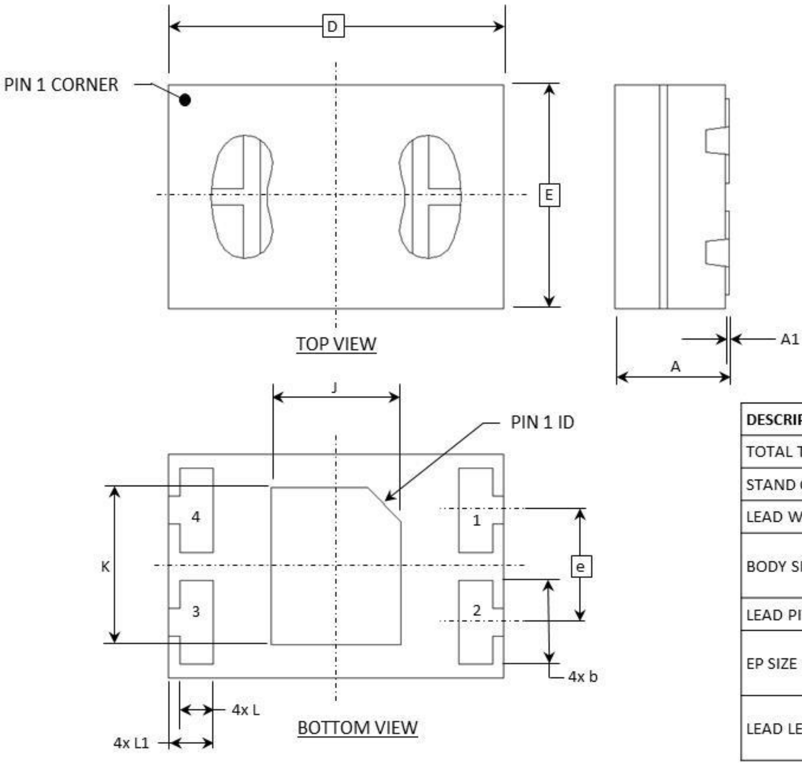
Notes:

1. The sensor can be operated in pulsed mode to reduce overall power consumption. This assumes a PWM output from the MCU is available to drive an external MOSFET switch (p-channel). The PWM must operate with a minimum frequency of 10 kHz. The following table illustrates PWM duty cycle requirements to enable V_H in the range 1.4 – 1.6V for CCS803:

Target Heater Voltage (V_H)	Supply Voltage (V)				
	1.5V	1.8V	2.5V	3V	3.3V
1.40	87%	60%	31%	22%	18%
1.50	100%	69%	36%	25%	21%
1.60	-	79%	50%	28%	24%

2. An ADC input is required on the MCU to measure the sensors resistance.

DFN package outline and pin assignment



Pin	Function
1	Sensor+, V_{OUT}
2	Heater+, V_H
3	Sensor, 0V
4	Heater, 0V

ALL DIMENSIONS ARE IN MM

DESCRIPTION	SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS	A	0.95	1.0	1.05
STAND OFF	A1	0	0.035	0.05
LEAD WIDTH	b	0.7	0.75	0.8
BODY SIZE	D		3 BSC	
	E		2 BSC	
LEAD PITCH	e		1.0 BSC	
EP SIZE	J	1.06	1.16	1.26
	K	1.3	1.4	1.5
LEAD LENGTH	L	0.25	0.3	0.35
	L1	0.35	0.4	0.45

Ordering Information

Part Number	Description	Package	MOQ
CCS803A-COPR	Volume production of CCS803 Ultra-low power gas sensor for ethanol detection	2x3mm DFN	5000
CCS803A-COPS	Sample of CCS803 Ultra-low power gas sensor for ethanol detection	2x3mm DFN	100

Note:

1. Refer to JEDEC J-STD020 lead-free standard for maximum soldering profile
2. Refer to application note CC-000090-AN on device assembly guidelines
3. A reliability report (CC-000430-RP) for CCS803A-COPR is available on request