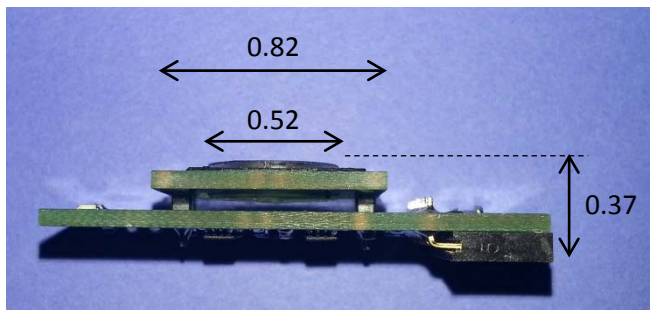
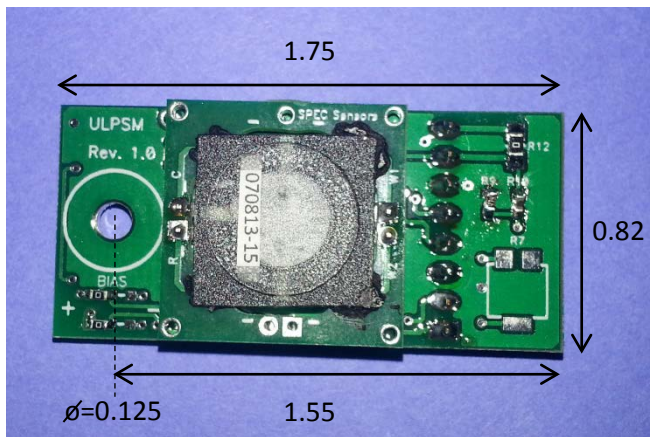


ULPSM-CO

Ultra-Low Power Sensor Module - Carbon Monoxide with Printed Sensor

The ULPSM-CO is a small form factor, ultra-low power CO sensor that produces a linear voltage output proportional to CO concentration from 0 to 500 ppm. This CO module combines the novel sub-millimeter thin electrochemical sensor technology from SPEC Sensors, Inc. with an ultra-low power analog front end.



*All dimensions in inches; shown with Option -T only

Device Connection:

Electrical connections to the ULPSM are made via a rectangular female socket connector (Sullins Connector Solutions P/N: PPPC041LGBN-RC; recommended mate for host board: P/N: PBC08SBAN). This connector also provides mechanical rigidity on one end of the board. A through-hole or threaded standoff (Option -C) is located on the opposite end of the board to provide additional mechanical connection.

Pin #	ULPSM Function
1	<i>Vgas</i>
2	<i>Vref</i>
3	<i>Vtemp</i>
4	(<i>SDA</i>)*
5	(<i>SCL</i>)*
6	<i>GND</i>
7	(<i>Vreg</i>)*
8	<i>V+</i>

*Optional

Vgas: The voltage signal output that is proportional to the target gas concentration throughout the specified range. See **Calculating Gas Concentration** for more details.

Vref: The voltage signal output that may be used as a measurement reference for *Vgas*. The difference, *Vgas* - *Vref*, is independent of the input voltage, *V+*. See **Calculating Gas Concentration** for more details.

Vtemp: The voltage signal output that is proportional to temperature. See **Calculating Temperature** for more details.

SDA: Optional EEPROM I2C data line.

SCL: Optional EEPROM I2C clock line.

GND: Universal ground for power and signal.

Vreg: Optional voltage regulator output voltage. When the option is not included, *Vreg* = *V+*.

V+: Input voltage.

Calculating Gas Concentration:

Sensors that pair with the ULPSM are calibrated at KWJ Engineering, Inc. The target gas concentration is calculated by the following method:

$$Cx = \frac{1}{M} \cdot (V_{gas} - V_{ref}),$$

where *Cx* is the gas concentration (ppm), *Vgas* is the voltage output gas signal (V), *Vref* is the voltage output reference signal (V), and *M* is the calibration factor (V/ppm) provided on the calibration certificate that is shipped with the module.

Measuring V_{ref} in-situ allows for variations in battery or supply voltage to be factored out of the calibration equation, minimizing these effects on C_x . In lieu of measuring V_{ref} directly, it may be measured initially with a voltmeter (following power-on warm-up, in clean air with 0 ppm of the target analyte) and included in the calculation. Alternatively, $V_{ref} \approx V_{+}/2$.

Calculating Temperature Compensated Gas Concentration:

A first-order temperature compensate gas concentration may be implemented using the following method:

$$C_{xc} = \frac{1}{M_c} \cdot (V_{gas} - V_{ref}),$$

where C_{xc} is the temperature compensated gas concentration (ppm) and M_c is the compensated calibration factor (V/ppm), which is defined as:

$$M_c = M \cdot (1.3 \cdot T + 74) \text{ for } T \leq 20 \text{ }^\circ\text{C}$$

$$M_c = M \cdot (0.4 \cdot T + 92) \text{ for } T \geq 20 \text{ }^\circ\text{C} ,$$

where T is the measured temperature ($^\circ\text{C}$). See **Calculating Temperature** for more details.

Calculating Temperature:

Temperature measurement via thermistor divider network is available on the ULPSM. Temperature ($^\circ\text{C}$) may be calculated to $\pm 3 \text{ }^\circ\text{C}$, within the range $-10 \text{ }^\circ\text{C}$ to $50 \text{ }^\circ\text{C}$, by using the theoretical relationship:

$$T = 29.0 \cdot V_{temp} - 18.0.$$

Electrical Specifications

Parameter			Value	
Supply voltage ($V+$ – GND)			2.7 to 3.3 V	
Supply current, I_s			TBD	
Power-on stabilization time			15 minutes	
Voltage signal output range (V_{gas} , V_{ref} , V_{temp})			0 to ($V+$ – 0.3 V)	
Voltage signal output*	ULPSM-CO	Vref	$V+/2 \pm 0.05$ V	
		Vgas	Zero	$V+/2 \pm 0.05$ V
			Span (M)	0.001 ± 0.0002 V/ppm nominal
	ULPSM-H ₂ S	Vref	TBD	
		Vgas	Zero	TBD
			Span (M)	TBD
	ULPSM-NO ₂	Vref	TBD	
		Vgas	Zero	TBD
			Span (M)	TBD
	ULPSM-O ₃	Vref	TBD	
		Vgas	Zero	TBD
			Span (M)	TBD

* Nominal values listed.

Sensor System Specifications

Parameter	Value*	
Measurement Range**	0-500 ppm	
Maximum Overload***	1000 ppm	
Lower Detection Limit	1 ppm	
Resolution	1 ppm	
Accuracy	± 2% of reading or 1 ppm, whichever is greater	
Response Time (t-90)	< 45 s	
Operating Temperature Range	Maximum	-20 to 50 °C
	Recommended	0 to 40 °C
Operating Humidity Range	Maximum	20 to 90% RH
	Recommended	35 to 65% RH
Temperature Coefficient of Span	-20 °C to 20 °C	1.3% / °C
	20 °C to 50 °C	0.4% / °C
Zero Drift (Over Temperature Range)	± 2 ppm	
Long term drift – zero	≤ ± 2 ppm / month	
Long term drift – span	≤ ± 2% of reading per month	
Maximum zero shift	< 8 ppm (-20 to 40 °C)	
Operating pressure range	± 0.2 atm	
Operating humidity range	20 to 90% RH	
Onboard filter	To remove SO _x , NO _x & H ₂ S	
Measurement principle	Electrochemical sensor	
Output linearity	Linear	
Dimensions	1.75 x 0.82 x 0.37 (inches)	
Estimated service life	> 5 years	
Storage temperature	5 to 20 °C	
Storage pressure	1 ± 0.2 atm	
Storage humidity range	50 to 65% RH	
Storage life	1 year in sealed package	
Warranty	1 year	

* Performance data indicated at standard conditions (25 °C, 50% RH) unless otherwise indicated.

** Recommended Operating Range, accuracy specs not implied above 500 ppm

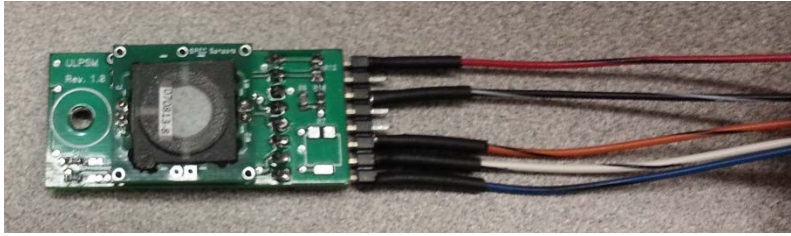
*** Sensor responds linearly in 500-1000 ppm range, but prolonged exposure will cause temporary zero shift.

Please contact KWJ Engineering, Inc. for applications information.

KWJ Engineering, Inc. reserves the right to alter the design features and specifications of this product without notice.

Additional Information

The ULPSM test connector has the following pin-out:



Pin #	ULPSM Function	Test Connector Wire Color
1	<i>Vgas</i>	Blue
2	<i>Vref</i>	White
3	<i>Vtemp</i>	Orange
4	(<i>SDA</i>)*	-
5	(<i>SCL</i>)*	-
6	<i>GND</i>	Black
7	(<i>Vreg</i>)*	-
8	<i>V+</i>	Red

* Options