Analog Gas Sensor Evaluation Kit – User Manual

The Analog Gas Sensor (AGS) Evaluation Kit is configured at the time of shipment for ONE target gas. The evaluation kit includes:

- One sensor element in a pinned-PCB package.
- One ultra-low power AGS module, configured to work with the included gas sensor.
- One AGS evaluation board

AGS MODULE

The AGS Module converts the sensor's linear current signal output to a linear voltage signal, while maintaining the sensor at its ideal biased operation settings. AGS Module is shown with sensor mounted.

- 0 to 3 V Analog Signal Output
- Low Power Consumption < 45 µW
- Fast Response
- On-board Temperature Sensor
- Easy Sensor Replacement
- Standard 8-pin connector

EVALUATION BOARD

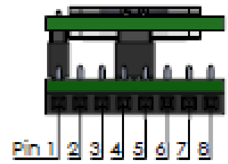
- Plug header that replicates the suggested layout for user-implemented solutions.
- Screw terminals for easy connection to external circuits and measurement equipment.
- Jumper-selectable power supply options
    - Position 1: BATTERY (default): CR2032 coin battery powered (included).
    - Position 2: 3V REG V+: External supply (V+) goes to 3.0V regulator in our circuit.

      V+ is un-fused – do not exceed 18 V input!
    - Position 3: V+: For connecting a 3V External Supply. This is unregulated and un-fused

      Do not exceed 3.3 V input!
- Unity gain buffers for *Vref* and *Vtemp* to allow connection to instrumentation
- Insulating rubber feet.

AGS MODULE PINOUT

Electrical connections to the AGS Module 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 is located on the opposite end of the board to provide additional mechanical connection.



The Evaluation board screw terminals have the same pinout

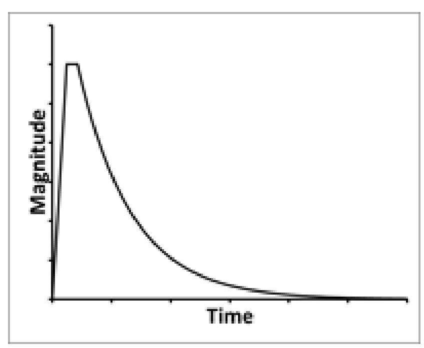
Pin #	AGS Module Function	Notes
1	Vgas[1]	Voltage Output. Vgas is proportional to the target gas concentration.
2	Vref[1,2]	Voltage Output. Vref is approximately half the supply voltage. Useful as a fixed reference; equivalent to zero for Vgas.
3	Vtemp[1,2]	Voltage Output. Vtemp is proportional to temperature.
4	N/C	
5	N/C	
6	GND	Universal ground for power and signal
7	V+	Voltage Supply Input: 2.7 to 3.3 V
8	V+	Voltage Supply Input: 2.7 to 3.3 V

[1] Connecting to measurement equipment can inject AC noise onto these DC signals. Be cautious to provide robust connections that are as short as possible.

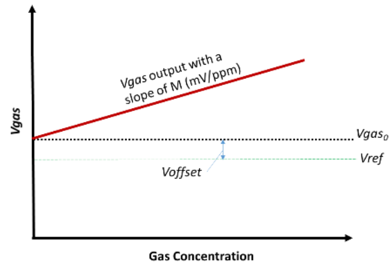
[2] This output is a low impedance output and requires a buffer to connect to any measurement device (as provided on the evaluation board).

NORMAL SENSOR STARTUP

The electrochemical sensor output has the normal power-on startup profile pictured here. When powering the sensor, its output magnitude will rapidly increase followed by a gradual decrease. Once this process is complete, the sensor output will be the most accurate and stable. The time, magnitude, and polarity of this response may vary depending on the sensor type and the length of time the sensor has been unpowered. After storage and/or shipping, the startup duration will be 1 - 24+ hours. For best performance: a 24+ hour startup duration is recommended. Following startup, the module should remain always on power.



CALCULATING GAS CONCENTRATION



The target gas concentration is calculated by the following method:

$$Cx = \frac{1}{M} \cdot (Vgas - Vgas_0),$$

where *Cx* is the gas concentration (ppm), *Vgas* is the voltage output gas signal (V), $Vgas_0$ is the voltage output gas signal in a clean-air environment (free of analyte gas) and *M* is the sensor calibration factor (V/ppm). The value, *M*, is calculated by the following method:

$$M\ (V/_{ppm}) = Sensitivity\ Code\ (^{nA}/_{ppm}) \times TIA\ Gain\ \left(^{kV}/_{A}\right) \times 10^{-9}\ (^{A}/_{nA}) \times 10^{3}\ \left(^{V}/_{kV}\right),$$

where the *Sensitivity Code* is provided on the sensor label and the *TIA Gain* is the gain of the trans-impedance amplifier (TIA) stage of the AGS circuit. Standard gain configurations are listed in the table below.

The value $Vgas_0$ can also be represented by:

$$Vgas_0 = Vref + Voffset,$$

where, *Vref* is the voltage output reference signal (V) and *Voffset* is a voltage offset factor. The *Vref* output acts as the reference voltage for zero concentration even as the battery voltage decreases. Measuring *Vref* in-situ compensates for variations in battery or supply voltage, minimizing these effects on *Cx*. A difference amplifier or instrumentation amplifier can be used to subtract *Vref* from *Vgas*. Alternatively, when measuring *Vref* directly, always use a unity gain buffer.

Voffset, accounts for a small voltage offset that is caused by a normal sensor background current and circuit background voltage. To start, *Voffset* = 0 is an adequate approximation. To achieve higher-precision measurements, *Voffset* must be quantified. Once the sensor has been powered-on and allowed to stabilize in a clean-air environment (free of the analyte gas) and is providing a stable output within your application's measurement goals, the value of *Vgas* may be stored as $Vgas_0$ and used in subsequent calculations of gas concentration, *Cx*.

Gas Type	Gas Sensor PN	AGS Sensor Bias (mV)	Nominal TIA Gain (kV/A)
CO	110-102	+3	100
CO	110-114	+3	100
EtOH	110-202	+100	249
H2S	110-303	+3	49.9
O3	110-406	-25	499
Cl2	110-450	-25	499
NO2	110-507	-25	499
SO2	110-610	+3	100
C2H4	110-650	+350	49.9
NO	110-701	+300	49.9
IAQ	110-801	+150	100
HCHO	110-850	+150	100
RESP	110-901	-200	499
H2	110-005	+3	100

TEMPERATURE COMPENSATION

Temperature fluctuations have a predictable, easily compensated effect on the sensor signal. This is a very uniform and repeatable effect, easily compensated for in hardware or software.

Please refer to the datasheet for the sensor of concern to determine the characteristics of the temperature effect on zero/baseline current and sensor sensitivity.

When implementing temperature compensation, first correct the temperature effect on the zero (offset) and then correct the temperature effect on the span (sensitivity) of the sensor.

These corrections can be done in software with:

- Curve fit
- Look up table
- A set of linear approximations

CALCULATING TEMPERATURE

Temperature (°C) may be calculated to ±3 °C, within the range -10 °C to 50 °C, by using the theoretical relationship:

$$T = \left({}^{87.0}/_{V+}\right) \cdot Vtemp - 18.0.$$