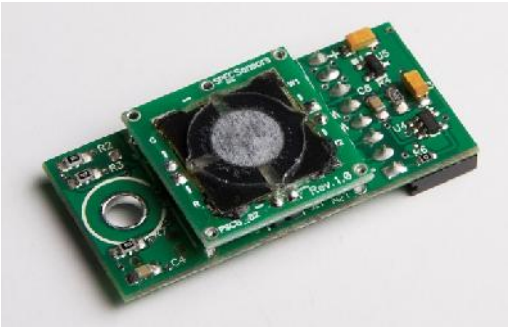
DGS-CO 968-034

January 2017

Digital Gas Sensor – Carbon Monoxide



CO MONITORING APPLICATIONS

- **Life Safety Levels**
- **Air Quality Levels**

BENEFITS

- **Low Power – 1 mW @ 1 minute sampling**
- **Fast Response – 15 seconds typical**
- **Calibrated & Temp. Compensated Output**
- **Simple Digital UART Interface**
- **Integrated T & RH Sensors**
- **Robust 10-year Estimated Lifetime**
- **ROHS Compliant**
- **Small form Factor**
- **UART to USB adapter provided**
- **Lightweight (< 2 oz.)**

DESCRIPTION

SPEC Sensors now offers an easy way to add gas sensing to the Internet of Things. Combining our Screen Printed ElectroChemical sensor technology (SPEC Sensor™) with state-of-the-art electronics and algorithms, enables easy integration of small, lightweight, high performance, ultra-low power consumption gas sensing into wireless, portable, and networked solutions.

MEASUREMENT PERFORMANCE CHARACTERISTICS

Based on Standard Conditions 25 °C, 50% RH and 1 atm	
Measurement Range	0 to 1000 ppm
Resolution	0.1 ppm (1)
Zero Accuracy	± 1 ppm (2)
Measurement Accuracy	15% of reading
Measurement Repeatability (2)	< ± 3% of reading or 2 ppm, whichever is greater
T90 Response Time (100 ppm step)	< 30 seconds (15 seconds typical)
Power Consumption	1 mW for 1 minute triggered samples 12 mW for continuous sampling 5, 10 30, 60 second intervals
Expected Operating Life	> 5 years (10 years @ 25± 10C; 60 ± 30% RH)
Operating Temperature Range	-20 to 40 °C (-30 to 55 °C intermittent)
Operating Humidity Range	15 to 95% (0 to 100% non-condensing intermittent)
Mechanical Dimensions	1.75 x 0.82 x 0.35 in. (44.5 x 20.8 x 8.9 mm)
Weight	< 2 Ounces

NOTES:

1) Based on Standard Deviation of noise at zero, 1 Hz measurement 60 second averaging.
2) When zeroed after 60 minutes of power-on stabilization
3) Based on consecutive measurements of 100 ppm
4) Contact factory for custom calibration for improved measurement performance

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ABSOLUTE MAXIMUM RATINGS

Parameter	Conditions	Min.	Rec.	Max.	Units
Maximum Concentration	Short term exposure	0	1000	5000	ppm
Supply Voltage	Regulated	2.6		3.6	V
Storage Temperature	Vapor sealed @ 50% RH	5	20	30	˚C
Storage Humidity	Non-condensing, vapor sealed	20	50	80	% RH
Storage Pressure	Vapor sealed	0.8	1	1.2	atm
Storage Time	Vapor sealed	-	12	-	Months
Operating Temperature	< 10 hours	-40	-	50	˚C
Operating Humidity	< 10 hours, Non-Condensing	0	-	100	% RH
Operating Pressure	Transient pulses	-.5	0	.5	atm
Operating Temperature	Continuous	-30	25	50	˚C
Operating Humidity	Continuous, Non-Condensing	10	50	95	% RH
Operating Pressure	Continuous	0.8	1	1.2	atm
ESD Rating	Human Body Model	2		8	kV

ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Supply Current	V+ = 3.0 V	0.05		4	mA
Power Consumption	V+ = 3.0 V	0.15		12	mW

CROSS SENSITIVITY

The following table lists the relative response of common potential interfering gases, and the concentration at which the data was gathered.

Gas/Vapor	Applied Concentration	Typical Response PPM CO
Carbon Monoxide	400 ppm	400
Hydrogen	100 ppm	17
Isopropyl Alcohol	200 ppm	1.3
Carbon Dioxide	5000 ppm	< 1
Methane	3000 ppm	< 1
Ammonia	100 ppm	< 1
Nitrogen Dioxide	10 ppm	< 1
Hydrogen Sulfide	25 ppm	< 1
Ozone	5 ppm	< 1
Sulfur Dioxide	20 ppm	< 1
Chlorine	10 ppm	< 1
n-Heptane	500 ppm	< 1
Toluene	200 ppm	< 1
Acetone	200 ppm	< 1

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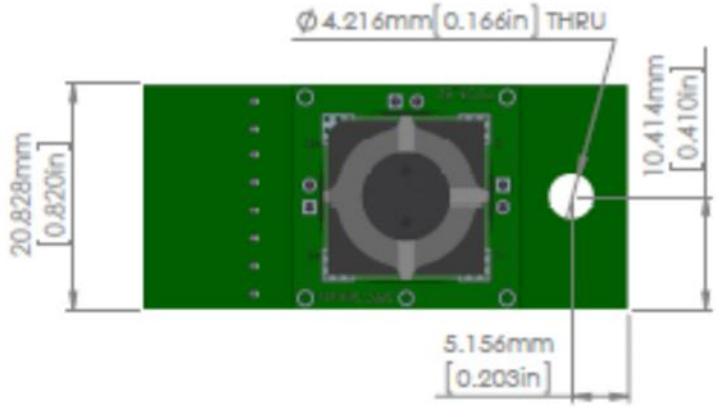
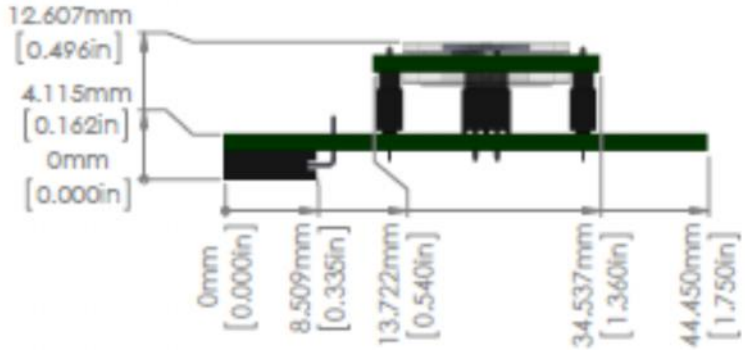
PACKAGE OUTLINE DRAWING & DIMENSIONS





PINOUT

Electrical connections to the DGS 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.

Pin#	Function	Notes
1	N/C	
2	RXD	
3	TXD	
4	N/C	
5	N/C	
6	GND	
7	N/C	
8	V+	Voltage Supply Input: 2.6 to 3.6 V

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USB to UART BRIDGE SETTINGS

- Voltage level: 3.3 V
- Baud: 9600
- Data bits: 8
- Stop bits: 1
- Parity: None
- Flow Control: None

QUICK START – TERMINAL PROGRAM OPERATION

1. Download and install a terminal program, such as Tera Term.

2. Connect the DGS to the USB to UART Bridge via the adapter board.

3. Connect the USB to your computer

a. If device drivers are not automatically downloaded and installed, you can find device drivers for your operating system by searching www.silabs.com for: “CP210x USB to UART Bridge VCP Drivers”.

4. Determine the COM port that is associated with the module

a. On Windows operating systems, locate and open the Device Manager.
b. The DGS device should be listed under the heading, “Ports (COM & LPT)”, as “Silicon Labs CP210x USB to UART Bridge (COMXX)”, where XX is the unique port number associated with the device.
c. Make a note of the unique port number.

5. Open Tera Term and establish a serial connection with the module

a. In the “New Connection” window, select the “Serial” radio button.
b. In the drop down list, select the appropriate COM port, identified above, then Select “OK”.
c. On the Menu bar, select “Setup”, then select “Serial port…”
d. Use serial parameters: 9600 baud, 8 data bits, 1 stop bit, no parity, no flow control, then Select “OK”

6. In the terminal window

a. Type any key to TRIGGER a measurement. The response time is about 3.5 seconds.
b. To start a continuous data output stream, type ‘cc’ (lower-case, without quotation marks).
c. The terminal prompts for an interval time. Type any of the 4 choices (5, 10, 30, or 60s) and then press “Enter” on your keyboard.
d. The format of the output is: [Serial Number, Gas Concentration (ppb), Temperature, Relative Humidity]
e. Type ‘r’ at any time to reset the module and stop the continuous data output stream.

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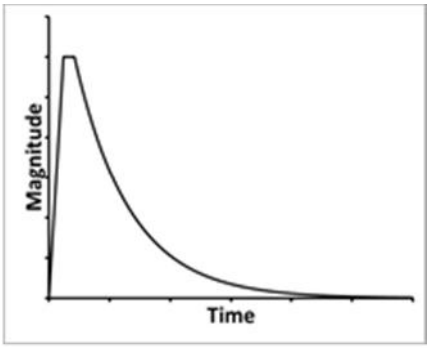
NORMAL SENSOR STARTUP FROM HAVING NO POWER APPLIED

The electrochemical sensor output has the normal startup profile pictured here. When powering the sensor, its output 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 and magnitude of this response may vary depending on the sensor type and the length of time the sensor has been unpowered.

For the best results, it is recommended that the module remains always on power. DGS module automatically enters a low-power state between TRIGGER measurements.



DGS OPERATION

When the DGS is connected to V+ and GND: The module's microprocessor will automatically configure the sensor and circuit for operation, output a measurement, delay for 1.5 seconds and then enter a low power stand-by mode. While in stand-by mode, critical sensor circuitry remains active to ensure the highest accuracy for future sensor measurements.

If the module is powered and in low-power stand-by mode: Any data received on the UART interface will TRIGGER a measurement that is transmitted via UART. Due to the high-accuracy ADC sampling method, there is a 3.5 second delay between when the module receives a command and when the module transmits a response. This is followed by a 1.5 second delay, after which the module will re-enter the low-power stand-by mode.

If the module receives a recognized command within 5-seconds of a TRIGGER: The command will be executed. Refer to the *Command Library* for more information on recognized commands.

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SIMPLE COMMAND LIBRARY

To execute one of the following commands, send the corresponding case-sensitive ASCII character via UART, within 5-seconds of a TRIGGER:

c CONTINUOUS data output

The user is prompted to enter a measurement period (5, 10, 30, or 60 seconds)

NOTE: In this mode, the module does not enter low power stand-by between measurements.

r RESET the module

This stops the continuous data output. After a 1.5 second delay, the module will enter the low power stand-by mode.

z ZERO user calibration

The sensor calibration is recalculated such that the module output is 0 ppm.

d DEFAULT factory calibration factors are restored.

v VERBOSE mode is toggled.

Disabled (default):

Output header: Serial Number, Gas Concentration (ppb), Temperature (°C), Relative Humidity (%)

Value Range: SN [XXXXXXXXXXXX], PPB [0 : 999999], TEMP [-99 : 99], RH [0 : 99]

Enabled:

Appends the time elapsed since the module was powered on (in days, hours, minutes, & seconds).

Output header: Serial Number, Gas Concentration (ppb), Temperature (°C), Relative Humidity (%), Days, Hours, Minutes, Seconds

Value Range: SN [XXXXXXXXXXXX], PPB [0 : 999999], TEMP [-99 : 99], RH [0 : 99], D [0 : 99], H [0 : 23], M [0 : 59], S [0 : 59]

e EEPROM

Stored module parameters are output for diagnostic purposes.

Example output:

```
**********************************EEPROM**********************************
                        User Values
User_ADC_Zero = 65535
User_T_Zero = 65535
User_RH_Zero = 65535
Operation_Mode = 1
```

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IMPORTANT PRECAUTIONS

All sensor designs are made for air monitoring @ 1 atm +/- 0.2 atm. Because applications of use and device implementation are outside our control, SPEC Sensors cannot guarantee performance in a given device or application, and disclaims any and all liability therefore. **Customers should test under their own conditions to ensure the sensors are suitable for their requirements.**

Contact the factory to discuss specific concerns that might damage the sensor performance or life.

- Condensation and Water (1)
- High Temperature Operation (> 40C) for more than 1 month
- Low Humidity Operation (< 15% RH) for more than 3 months
- Highly contaminated air over a prolonged period
- High levels of particles or soot (unless proper filtering is provided)[2]

(1) Use of porous PTFE membrane or filter cap may address this concern)
(2) Use of replaceable filter recommended where dust and particulate is expected.

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SENSOR STORAGE, HANDLING AND SOLDERING

This information embodies various general recommendations concerning the storage, handling, and manual soldering conditions for SPEC SENSORS CSPEC Modules. It is only applicable for modules guaranteed by SPEC SENSORS stated in SPEC SENSORS Sensor Specification Sheet. Moreover, SPEC SENSORS' modules are NOT warranted and should NOT be used in high temperature soldering (reflow) or pre-tinning baths.

Sensor & Module Handling
Handle sensors with care. Take precautions, including but not limited to the following:

A. DO NOT apply excessive pressure to the top or bottom of the sensor module.
B. Whenever possible, handle or make contact with the sensor module from the sides of the PCB or substrate.
C. Light vacuum pressure is possible during handling, DO NOT apply vacuum over gas sensor port.
D. If the sealed sensor package is opened, DO NOT re-seal using vacuum or nitrogen gas. DO NOT reseal with desiccant.
E. DO NOT obstruct the gas sensor port by making direct contact with any tape, apparatus, weights, etc.
F. DO NOT use silicone or other conformal coatings around the sensor or gas port-holes.
G. Operators are requested to wear powder free antistatic gloves.

Manufacturing Assembly Floor Environment
SPEC SENSORS recommends that the manufacturing assembly floor environment be maintained at controlled conditions:

A. Temperature: 18 - 26°C
B. Relative Humidity: 40 to 60%
C. Pressure: 1.0 ± 0.2 atm

Sensor & Module Storage Conditions
The shelf life for sealed, packaged components is 12 months from the pack seal date, when stored in the factory-sealed bag under the following conditions:

A. Temperature: 5 to 25 °C
B. Relative Humidity: 20 to 80%
C. Pressure: 1.0 ± 0.2 atm
D. Storage Time: 12 months

When moving from Storage Conditions to the Manufacturing Assembly Floor Environment, the sensors should be allowed to equilibrate at the new conditions for at least 24 hours prior to manufacturing.

Module Attach Soldering Process
Hand solder only. Keep the soldering iron or solder process tool away from the sensor. The sensor should not see pre-heat temperatures above 70 °C. There have been suggested cases where a heat sink cover over the sensor may be applicable to protect the sensor during processing. No Application notes to this approach available. Only to be used as reference only.

A. DO NOT heat sensor above 70 °C
B. Hand or peripheral process type approach
C. Use solder wire alloy with the lowest possible eutectic temperature
D. Use lowest possible soldering iron temperature
E. Contact the host board with the soldering iron at a 45° angle on the solder pad
F. Keep the soldering iron away from the top and bottom of the sensor module
G. DO NOT place in reflow, wave or IR reflow type processes
H. DO NOT place mounted board In a wash

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