Texas Instruments 9GS-1 High Concentration (0-25% Volume) Carbon Dioxide Sensor

Installation, Set-up and Calibration Manual

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This manual specifically applies to the TI-9GS-1 series sensor only.

9GS-1 High Concentration Carbon Dioxide Gas Sensor Installation and Operation Overview

The 9GS-sensor product line was specifically designed to meet several specialized OEM needs. Because of this, there are also several ways in which the 9GS sensor can actually be applied and installed. As such, the following procedures will allow you to perform only a general field installation of the 9GS-1 Sensor. For more specific installation or application information, please consult the factory or your authorized servicing distributor.

READ THIS ENTIRE MANUAL BEFORE PROCEEDING. Failure to follow this procedure may cause unreliable sensor operation or may cause permanent damage to the unit.

Part Numbering System

Your 9GS-1 Gas Sensor is available in a variety of configurations, each with any of several optional features. Each configuration and option set is described within **Tables 1 & 2.** To identify the version you have, refer to the model number on the back of the sensor.

Table 1 9GS-1 Standard Configurations

Part Number	*Description*
9GS-1	**Standard High-Concentration configuration with PC board mounted sensing element, 0-25% volume range, voltage output and 'Quick-Zero' function.**

Table 2: 9GS general part-numbering scheme.

9GS-1-5 Z C R

Product	Version	Output	Zeroing Mode	Packaging	Relay option
9GS	**1** – 25% Max	**5**- 0-5V (standard)	**Z**- Zeroing button (recommended)	**C**- Case Please Consult the Factory	**R**- Relay
		1- 0-1V	**Blank**- No Zero Button	**Blank**- No case	**Blank**- No relay
		A- 4-20mA			

Table 3 Specifications

ITEM	*CHARACTERISTICS*
Sensing Method	NDIR - Non-Dispersive Infrared.
Sampling mode	Diffusion and/or pump capability
Range	0-25% Volume CO_2. (Lower ranges available)
Accuracy	± 0.5% Volume CO_2 or 5% of reading, whichever is greater.
Warm-up	< 90 seconds.
Response time	< 35 seconds to 63% of step change @ 500 ml/min flow rate.
Zero Calibration	Push-button calibrates sensor.
Drift	.17% Vol. CO_2/month
Output voltage	Linearized 0-5V standard.
Available Outputs	• 0-5V (linear). • 0-1V (linear). • 4-20mA Current loop. • User definable upper Volume setting. • Relay output: user adjustable.
Input power	12 VDC ±5%.
Temperature range	• 0°C to +50°C (Operating). • -40°C to +70°C (Storage).
Humidity range	5-95%, non-condensing (operating).
Dimensions	3.5" x 3.5" x 1.36"
Patents	Patents pending

Sensor Installation

Step 1: Choosing a location

Your Texas Instruments 9GS CO_2 gas sensor has the capability to be mounted in a variety of ways depending on the application. Some important points to remember:

- If the application uses natural diffusion for sensing the target gas, select a mounting location with good air circulation that represents concentrations of the targeted carbon dioxide levels.

Your sensor has been designed for long life within a variety of environments. Extreme conditions could cause the performance to deteriorate.

Avoid locations subject to the following conditions:

- Moisture condensing
- Liquid splashing or soaking
- Strong fumes from cleaning solutions or other chemicals
- High or low temperature extremes

Step 2: System Chassis or Wall Mounting Preparation

NOTE: Due to the exposed components on the 9GS-1 PCB, handling and ESD care should be exercised at all times.
When directly mounted to a system wall or chassis, the 9GS-1 should be mounted via the four corner-holes on the sensor PCB. It is recommended that four #4-40 X ¼ screws and four ½" metal or nylon standoffs be used for this type of installation (Not Included).

For most direct chassis or wall mount applications:

- Ensure that four screw holes are provided to match up with the holes on the corners of the PCB.
- Do not actually mount the PCB until noted within Step 4.

Step 3: Electrical Installation

IMPORTANT: Read these wiring instructions carefully. Make all electrical connections as illustrated. Wiring errors may cause permanent damage to your CO_2 Sensor.

- Electrical connection of your 9GS-1 sensor requires size 18-22 AWG wires. A minimum of four wires are required, two for power and two to carry the signal from the sensor.
- Disconnect wiring electrical power. Trim all wires so 6" to 8" extends from the chassis or wall opening. Strip insulation from all wires so 1/4" of conductor is exposed. Label each wire for reference later.

CAUTION: Be sure all electricity is disconnected before attaching the wires to the sensor. Terminate the leads/ wires for input power and sensor outputs to the terminal strip on the sensor according to the chart below. **Note: Correct polarity must be maintained for the 12VDC input, reversed polarity will destroy the sensor.**

- Securely connect all wires according to **Table 4 and Figure 1**.

Table 4: Connector Block Wiring

Position	Wire	Comments
1	12VDC In	Polarity sensitive.
2	12VDC Common	Polarity sensitive.
3	Relay	Optional.
4	Relay	Optional.
5	CO_2 Signal Output	Linearized voltage output, or 4-20mA current output (Opt).
6	CO_2 Signal Common	CO_2 Common, or optional 4-20 mA current loop return.

- Carefully screw the 9GS PCB to the standoffs at its mounting location. **CAUTION**: Mounting screws should be snug but not over-tightened. Over-tight screws can damage the PCB.

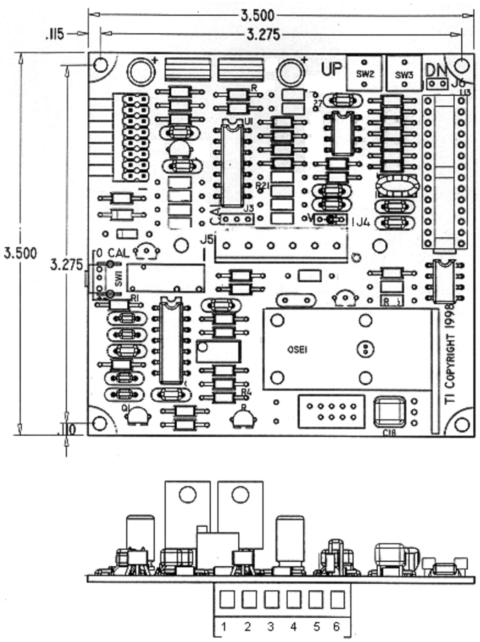

Figure 1: 9GS-1 PCB and Connector

Mounting the 9GS with wall-mount case (Optional)

Your Texas Instruments 9GS-1 CO_2 gas sensor can also be configured with a case that allows for wall mounting. This procedure assumes that the sensor will be attached to a junction box, or by other adequate attachments to steel, plastic, drywall, plaster or wood construction using appropriate mounting hardware.

Step 1: Wall Mounting Back Plate Installation

When directly wall mounted, **the 9GS requires a 2" diameter access hole** in the wall to which it is mounted. Alternatively, if the sensor is mounted to a standard junction box, the necessary clearance is provided by the junction box.

When appropriately configured, the 9GS sensor is shipped from the factory with the case front and back plate mated. They snap together. Unsnap the case parts by gently prying apart.

For direct wall mount applications,

- Ensure that a 2" diameter hole is provided
- Note the molded in arrows in the back plate. Ensure that either one is pointing up.
- Using the backplate as a template, mark and drill the required screw holes to attach the sensor back plate.
- Securely screw the back-plate in place.

For junction box mounting applications

- Choose the proper wall mounting back-plate for your application. Sizes to fit both European and US junction boxes are available.
- Align the screw holes to the junction box while ensuring that one molded in arrow is pointing up.
- Securely screw the back plate to the junction box. **CAUTION**: Mounting screws should be snug. If backplate is bent by over-tight screws, front cover may not latch!

Step 2: Electrical Installation

Refer to Step 3 on page 2.

Step 3: Installing the Sensor Front Case

- Re-attach the 9GS front case to the base plate and re-install the security screw.

CALIBRATION/RE-ZEROING PROCEDURE

Overview

Developed for a variety of OEM applications, the 9GS-1 Carbon Dioxide gas sensor is designed to require minimal maintenance. While calibrating/Re-Zeroing the 9GS is a simple process, its specific procedure is highly dependent on the actual 9GS rating being used and the particular application. Please consult the factory or your authorized distributor for related details.

GENERAL CALIBRATION PROCEDURE

Overview

This procedure will allow you to field calibrate the 9GS gas sensor, and should be conducted as part of a scheduled maintenance program. This is not intended as a repair or rework procedure.

- Warning: USE CAUTION WHEN WORKING WITH LIVE ELECTRICAL WIRING. Violation of any warning may void the warranty.

Getting Started

READ THIS ENTIRE MANUAL BEFORE BEGINNING THE CALIBRATION PROCEDURE. Incorrect calibration will cause unreliable sensor operation and may cause permanent damage to the unit. If the sensor is not operating correctly after completing this procedure, repairs at an authorized repair location may be required.

ABOUT THE EQUIPMENT

In preparation for calibration, you must determine which model 9GS sensor is to be calibrated. There are two basic models – Those with a zero calibration (0 CAL) button, and those without the zero calibration button. **NOTE: All 9GS units without the zero calibration button are designed for specific OEM applications and the following procedures do not apply**.

Calibration: "Quick-Zero" Zero Point Calibration

The 9GS zero calibration procedure is a quick and easy procedure to re-calibrate the sensor. No other calibration procedure is necessary. Any 9GS unit can be re-zeroed with this procedure, and all that is required is room air at normal indoor air gas concentrations of 350 – 800 PPM (parts per million) of CO_2.

NOTE: For non-diffusion models of the 9GS the air sample must be pumped through the sensor (nitrogen can also be used for this procedure). For diffusion models, pumping the air/gas sample through the sensor is an optional procedure.

Step 1. Power up the unit and wait 90 seconds. If you are pumping the air sample through the sensor, locate the lower gas inlet nozzle protruding from the Optical Sensing Element and attach your air hose there. Allow the air or gas to flow through the sensor for at least one minute.

Step 2. Depress the 0 CAL button and hold it for at least 4 seconds. For wall-mount case models, locate the lower access hole on the left side of the case. Straighten a paper clip and insert into the access hole and depress the keyswitch inside and hold for at least 4 seconds.

Step 3. If necessary, turn off the air or gas and disconnect it from the CO_2 sensor. Your calibration procedure is now complete.

OEM Servicing Procedures

Servicing the 9GS using the TI-4GS CAL-B-Key (Optional)

NOTE: These procedures are only available for authorized users. Unauthorized use can damage the sensor and will void the warranty. Also, while the CAL-B-Key was initially designed for the TI-4GS sensor line, it works just as well on the TI-9GS series sensor.

Setting the user defined parameters (Authorized users only) requires inputs via the two keyswitches or keys on the CAL-B-Key.

All 9GS models have a 16-pin connector on the left side of the unit. This connector allows for connection of the Interface Keypad. This keypad contains both an LCD display and the two required keyswitches. All 9GS units can be serviced with the Interface Keypad.

All adjustments on the 9GS are carried out via the use of two keyswitches clearly marked "***Enter***" and "***Select".***

Preparing to use the TI Interface Keypad

The Interface Keypad is connected to the 9GS via a 16-pin header connector located on the left side of the sensor. For wall-mount case models this connector is located behind the plastic cover. The cover must be removed to gain access to the connector. Then the ribbon cable from the Interface Keypad must be connected to the 9GS. Here are the steps to follow:

Note the ridge on the side of the plug connector. When holding the 9GS so that the connector is at the upper left-hand side of the PCB, the ridge of the plug connector must be facing right during mating to ensure proper polarity. Plug in the connector. This step will automatically place the sensor into Menu Operation Mode. If no display is evident, quickly un-plug and then re-plug the connector until the menu options are displayed.

Servicing - The 9GS Menu System

The LCD on the CAL-B-Key interface keypad provides a menu-type system to guide the user through any required user servicing. The SELECT keyswitch is used to move the cursor. The cursor looks like this: >. Each time the SELECT key is pressed, the cursor moves to the next menu option. The ***Enter*** key allows the user to confirm a menu choice. When the ***Enter*** key is pressed, the choice is saved and a new value is now operational.

While the menu indicates 3 Main Sections: Cal, Set Relay Close Value and Set Maximum Range Value, only the Set Relay and Set Maximum Range Value are available.

NOTE: The CAL function can only be utilized by the factory. Any attempt to use the CAL function by any OEM, distributor or end user will damage the sensor and will void any warranty.

Each of these main sections has a series of menu choices. The basic structure of the menu system looks like the following:

The menu choice that appears in **BOLDFACE** appears on the 9GS LCD. It is followed by an expanded description.	
Main Menu	Menu Level #1
CAL- SEE NOTE!	**FACTORY USE ONLY**
RP - Set Relay Actuation point	**±** - Select relay closure value, and **SAVE** - Save new setting
MX - Setting the CO_2 Concentration where full output is delivered	**±** - Select maximum concentration value and **SAVE** - Save new setting

Setting the Relay Point - **RP**

Some 9GS models contain a relay output. The CO_2 % volume value at which the relay circuit closes is the Relay Set Point.

Step 1. Enter the Menu Operation Mode. (See the Preparing for Calibration section above). From the main menu screen

	M	X		C	A	L	
>	R	P		E	X	I	T

Scroll to **RP** and press the ***Enter*** key.

Step 2. The menu will look something like this, with 1000 = 10% volume:

	+			1	0	0	0
	-		>	S	A	V	E

The number in the upper right is the CO_2 concentration at which the relay will close. It is factory preset at 10% volume. If the last user of the sensor used another value, this will be displayed.

Step 3. If the relay set point value is acceptable, skip to step 4. If you wish to change the relay set point value, ***Select*** (**+**) or (**-**) and press ***Enter*** to alter the value. The relay set point value will change in 1% intervals each time you press the ***Enter*** key. You cannot choose a relay set point value above the saved **MX** value or below 3% volume.

Step 4. When you have set the relay point that is correct for your application, scroll to SAVE and press ***Enter***. You have now completed this procedure.

Setting the Maximum Output % Volume Level - **MX**

Every 9GS unit can be adjusted to provide its full electrical output at a CO_2 value of your choice.

Step 1. Enter the Menu Operation Mode. (See the Preparing for Calibration section above). From the main menu,

>	M	X		C	A	L	
	R	P		E	X	I	T

scroll to MX and press the ***Enter*** key.

Step 2. The menu should look something like this, where 2500 would equal 25% volume:

				2	5	0	0
	-		>	S	A	V	E

The number in the upper right is the CO_2 concentration at which the sensor delivers full output. It is factory preset at 25% volume. If the last user of the sensor used another value, this will be displayed.

Step 3. If the maximum output value is acceptable, skip to step 4. If you wish to change the maximum output value, ***Select*** (**+**) or (**-**) and press ***Enter*** to alter the value. The maximum output value will change in 1% intervals each time you press the ***Enter*** key. You cannot choose a maximum output value above 25% or below 3%. For maximum ranges at or below 5% the 9GS-4 (0-5% Vol.) sensor should be used.

Step 4. When the screen displays the correct value, scroll to **SAVE** and press ***Enter.*** Note: If you save a maximum output value that is less than the current relay point, the relay point will automatically be changed to the maximum output value.

Step 5. If this is the last procedure that you are performing, return the sensor to normal operation mode by disconnecting the Interface Keypad. Return the case to its original condition with all covers in place.

NOTE: For specific application assistance, technical information or to order Calibration Parts and Supplies, please call TI at (508) 236-3681, fax: TI at (508) 236-2349 or e-mail: tisensors@ti.com

Application Note

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Questions regarding maintenance, care or replacement of parts for the TI 9GS-1 CO_2 sensor should be directed to (508) 236-3681, fax: (508) 236-2349 or e-mail: tisensors@ti.com. Be sure to visit our Web Site at: http://www.ti.com/snc/products/sensors/gas.htm.