TEXAS INSTRUMENTS

Cal-B-Key Calibration Interface Keypad Set-up 4GS Carbon Dioxide Sensor Calibration Manual

Set-up and Calibration Operation Overview

When properly installed, the 4GS Series Carbon Dioxide Sensor is accurate to +/- 75 PPM (parts per million), and does not require any calibration upon installation. However, it is recommended that the sensor be fully field calibrated at least once every three years. The following guidelines will allow you to perform the standard calibration procedure on any 4GS Sensor. This procedure can be completed via the CAL-B-Key Calibration Interface Keypad. Note: The CAL-B-KEY calibration interface is not necessary when adjusting/calibrating the 4GS sensor with a LCD.

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

Calibration Procedure

This procedure will allow you to perform the field calibration for the 4GS gas sensor. This procedure is conducted as part of a scheduled maintenance program. It is not intended as a repair or rework procedure.

Words that are written in ***BOLD ITALICS*** denote actual keyswitches on the Interface Keypad. Words that are **CAPITALIZED BOLD FACE** are actual commands that will be displayed on the Interface Keypad LCD.

Equipment Requirements for Calibration:

- A copy of this manual
- Zero calibration gas
- Span calibration gas
- A gas regulator - To control the flow of calibration gas at .5 liters per minute. The regulator is used for both gas bottles.
- Tubing - to connect the regulator to the calibration inlet of the sensor
- The Interface Keypad - This tool is necessary if you do not have a display version of the 4GS
- A watch
- A paperclip

Warning: USE CAUTION WHEN WORKING WITH LIVE ELECTRICAL WIRING.

- Do not hang a calibration gas bottle from the sensor.
- Do not attempt to use any other keyswitch device to calibrate the sensor.

Violation of these warnings may void the unit's 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 will be required.

About the Equipment

In preparation for calibration, you must determine which model 4GS sensor is to be calibrated. There are two basic models - display models with a LCD display on the face of the sensor case and the non-display model with a blank or plain front cover.

Calibrating the 4GS or setting the user defined parameters requires inputs via two keyswitches or keys. On display models, these keys may be found on the back of the main board. Non-display models do not have keyswitches on the main board.

All 4GS models have a 16 pin connector on the left side of the unit, behind a small, user serviceable plastic panel. This connector allows connection of the Interface Keypad. This keypad contains both a LCD display and the two required keyswitches. All 4GS units can be serviced with the Interface Keypad. All non-display units require this accessory for calibration. A display-type unit may be calibrated with the Interface Keypad or with its on board keyswitches.

All adjustments on the 4GS are carried out via the use of two keyswitches clearly marked "***Enter***" and "***Select***". The keyswitches on the Interface Keypad and those on the main board of a display model are identical in function. Any instructions in this manual referring to a keyswitch can be performed on the Interface Keypad or the main board keyswitches.

Preparing for Calibration if you are using the TI Interface Keypad

The Interface Keypad is connected to the 4GS via a 16-pin header connector located on the left side of the sensor. This connector is located behind a protective 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 4GS. Here are the steps to follow:

Remove the protective cover by using a small screwdriver or equivalent tool to pry the cover out. Retain the cover for later re-installation.

Note the ridge on the side of the plug connector. This must be facing away from the circuit board during mating to ensure proper polarity. Plug in the connector. This step will automatically place the sensor into Menu Operation Mode.

When the user service operation is completed, be sure to re-install the protective cover.

Preparing for Calibration of a Display Model via use of the On Board Keyswitches

To access the on board keyswitches, you must remove the front case from the wall mounting plate. This will provide access to the rear of the main board where the on board keyswitches are located. Here are the steps to follow.

Remove the small, steel screw located in the bottom of the case front. Retain the screw for later re-installation.

The case front is held to the wall mounting plate by four snaps. The case should be gently pried off the back plate. This may be done with hand pressure or by gently prying with a small screwdriver or equivalent tool, taking care not to mar the case.

The sensor is wired to the system via a terminal strip. These connections must be maintained during user service. Warning: Use appropriate caution when handling these live circuits.

The sensor must be placed into Menu Operation Mode. This is done by moving a "jumper" which is found next to the top, right-side of the terminal strip.

When user servicing is complete, the jumper must be returned to its original position and the case re-installed.

User Servicing - The 4GS Menu System

The LCD (either on the 4GS or the 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.

The menu provides access to 4 Main Sections: Calibration, Select Full Span Maximum Voltage Value, Set Relay Close Value and Set Span Value. Each of these main sections has a series of menu choices. The basic structure of the menu system looks like this:

*The menu choice that appears in **BOLDFACE** below appears on the 4GS LCD. It is followed by an expanded description.*

Main Menu	Menu Level #1	Menu Level #2	Menu Level #2
CAL - Calibration	**ZERO** - Calibrate Zero Point	**SAVE** - Save new Zero value - or **EX** - Return to Main Menu	
	SPAN - Calibrate Span Point	**+/ -** Choose calibration gas concentration	**SAVE** - Save new Span value - or **EX** - Return to Main Menu
	EX – Return to Previous Menu		
VOLT - Select Full Scale Maximum Voltage Value	± - Select 5VDC or 10VDC output, and **SAVE** – save new setting		
RP - Set Relay Actuation point	± - Select relay closure value, and **SAVE** - Save new setting		
MX - Setting the CO2 Concentration where full output is delivered	± - Select maximum concentration value and **SAVE** - Save new setting		

User Servicing - The 4GS Menu System

Calibration: Calibrate Zero Point

Step 1. Prepare the zero gas bottle. This includes screwing the regulator onto the bottle and attaching the tubing to the hose barb on the end of the regulator.

Step 2. Locate the sensor to be calibrated. Locate the gas inlet in a small round hole in the bottom edge of the case front. Remove the protective cap from the gas inlet. Retain this cap for re-use. Connect the tubing from the zero gas bottle to the sensor gas inlet. Use of excessive force while attaching tubing will damage the sensor. Ensure the unit has been powered up a minimum of 90 seconds prior to Step 3. The sensor uses this time to stabilize its reading: premature action may result in an inaccurate calibration.

Step 3. The screen should display the main menu.

	M	X	>	C	A	L	
	R	P		V	O	L	T

Step 4. By pressing the ***Select*** keyswitch, move the cursor "**>**" (scroll) until it points to CAL and press Enter. Your display should look like this:

>	E	X		Z	E	R	O
	E	X		S	P	A	N

Scroll to **ZERO** and press ***Enter***. Display should read:

F	L	O	W		G	A	S
	E	X	>	S	A	V	E

Flow the zero gas for 5 minutes. Press ***Enter*** with the cursor pointing to **SAVE**. The display will briefly read complete, and then return to the main menu.

Step 5. Shut off the zero gas. Disconnect the gas tubing from the sensor. Re-install the protective cap on the gas inlet. Your zero calibration is finished.

Step 6. If this is the last procedure that you are performing, return the sensor to normal operation mode by repositioning the jumper or disconnecting the Interface Keypad. Return the case to its original condition with all covers in place.

Calibration: Non-Menu, Calibrate Zero Point

This alternate zero calibration procedure is a quick and easy procedure to re-zero the sensor. Any 4GS unit can be re-zeroed with this procedure.

Step 1. Power up the unit and wait 90 seconds. Locate the gas inlet in a small round hole in the bottom edge of the case front. Remove the protective cap from the gas inlet. Retain this cap for re-use. Attach the Zero gas tubing to the sensor gas inlet and flow gas for 5 minutes.

Step 2. Two access holes are located on the left side of the case. The bottom hole is the access hole for the Re-zero key. Straighten a paper clip and insert into the access hole and depress the keyswitch inside. The LED in the status hole above should begin to blink. Depress the keyswitch again and the LED should cease blinking. The second keyswitch actuation will complete the zero calibration. If the zero calibration keyswitch is not pressed within eleven blinks, the LED will stop blinking and the zero calibration will not be complete. This feature serves as a fail-safe. The prior values will not change.

Step 3. Turn off the zero gas and disconnect it from the CO2 sensor. Re-install the protective cap on the gas inlet. Your zero calibration is complete.

Calibration: Calibrate Span Point

Step 1. Power up the unit and wait 90 seconds. Locate the gas inlet in a small round hole in the bottom edge of the case front. Remove the protective cap from the gas inlet. Retain this cap for re-use. Attach the span gas tubing to the sensor gas inlet.

Step 2. The display should read:

	M	X	>	C	A	L	
	R	P		V	O	L	T

By pressing the ***Select*** keyswitch, move the cursor "**>**" (scroll) to point to **SPAN**. Press ***Enter***. The menu will look something like:

	+			0	8	0	0
	-		>	C	O	N	T

The number in the upper right is the CO2 concentration of the span gas. It is factory preset at 800 PPM. If the last user of the sensor used another value, this will be displayed.

Step 3. If you are using high accuracy calibration gas not purchased from TI, and need to adjust the span to a different value (concentration must be between 750 and 850 PPM), scroll to (**+**) or (**-**) by using the ***Select*** key, then, by repeatedly pressing the ***Enter*** key, adjust the LCD display value to match the span gas value. Then, scroll to **CONT**. Press ***Enter***. The screen should read:

F	L	O	W		G	A	S
	E	X	>	S	A	V	E

Flow the span gas for 5 minutes. Select **SAVE** and press the ***Enter*** key. The display will briefly display complete, and then return to the main menu.

Step 4. Shut off the span gas. Disconnect the gas tubing from the sensor. Re-install the protective cap on the gas inlet. Your span calibration is finished.

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

Setting the Relay Point - RP

The 4GS CO2 Sensor is designed to operate as a part of a control system. Some models contain a relay output. The CO2 PPM value at which the relay circuit closes is the Relay Set Point. This output is typically used to begin or end a function (i.e. actuate a ventilation damper).

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		V	O	L	T

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

Step 2. The menu will look something like:

	+			1	0	0	0
	-		>	S	A	V	E

The number in the upper right is the CO2 concentration at which the relay will close. It is factory preset at 1000 PPM. 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 100 PPM intervals each time you press the ***Enter*** key. You cannot choose a relay set point value above the saved **MX** value or below 300 PPM.

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 PPM Level - MX

The 4GS CO2 Sensor is designed to operate as a part of a control system. Every unit can be adjusted to provide its full electrical output at a CO2 value of your choice. This setting is typically adjusted to provide full actuation of a damper or other final control device at a CO2 concentration less than the sensor's full-scale capability.

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		V	O	L	T

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

Step 2. The menu should look something like:

	+			2	0	0	0
	-		>	S	A	V	E

The number in the upper right is the CO2 concentration at which the sensor delivers full output. It is factory preset at 2000 PPM. 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 100 PPM intervals each time you press the ***Enter*** key. You cannot choose a maximum output value above the 5000PPM or below 300 PPM.

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 repositioning the jumper or disconnecting the Interface Keypad. Return the case to its original condition with all covers in place.

Setting the Full Scale Maximum Voltage Value - VOLT

The 4GS CO2 Sensor is designed to operate as a part of a control system. Every unit can be adjusted to provide 2 different full-scale output voltages. The 4GS can be configured to provide 0-5VDC and 0-10VDC outputs.

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	>	V	O	L	T

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

Step 2. Your screen should look something like:

					1	0	V
	-		>	S	A	V	E

The number in the upper right is the DC voltage which the sensor delivers at full output. It is factory preset at 10VDC. 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 scroll to one of the two choices (5V or 10V) each time you press the ***Enter*** key. *NOTE: 10V must be selected when operating the 4GS in the 4-20mA output mode.*

Step 4. When the screen displays the correct value, scroll to **SAVE** and press ***Enter.***

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

Troubleshooting

Condition	Next Action	How To
Cannot calibrate the sensor.	Full cold restart.	Unplug sensor power connector. Leave unit unpowered for 1 full minute. Plug in sensor power connector and allow unit to warm-up for 5 full minutes before attempting calibration procedure.
Cannot locate all required calibration equipment.	Do not attempt to calibrate unit.	See table on last page for calibration parts list.
I have calibration gas available, but it is not gas purchased through TI.	TI calibration gases for these sensors are custom mixed to +/- 3% PPM. Use of gases other than TI gases need to be mixed to an equal precision or they will most likely cause the unit to operate unreliably.	See table on last page for calibration parts list.

Calibration component parts

Part Number	Description
CAL-A-0-5	Zero Gas Bottle, 100% Nitrogen, High Pressure, disposable 17 liter size. (Approx. 5 Calibration capacity). Requires Regulator.
CAL-A-800-5	Span Gas Bottle, 800 PPM CO2, High Pressure, disposable 17-liter size. (Approx. 5 Calibration capacity). Requires Regulator.
CAL-A-0-35	Zero Gas Bottle, 100% Nitrogen, High Pressure, disposable 105 liter size. (Approx. 35 Calibration capacity). Requires Regulator.
CAL-A-800-35	Span Gas Bottle, 800 PPM CO2, High Pressure, disposable 105-liter size. (Approx. 35 Calibration capacity). Requires Regulator.
CAL-A-Tube	.125" Thin wall tubing with adapter for CAL-A-REG-5 and CAL-A-REG-35. 6' length.
CAL-A-REG-5	Regulator for use with CAL-A-0-5 and CAL-A-800-5 gas bottles.
CAL-A-REG-35	Regulator for use with CAL-A-0-35 and CAL-A-800-35 gas bottles.
CAL-A-Case -5	Carrying case for 2 17 liter bottles, regulator, tubing and Interface Keypad (CAL-B-Key).
CAL-A-Case-35	Carrying case for 2 105 liter bottles, regulator, tubing and Interface Keypad (CAL-B-Key).
CAL-B-Key	Interface Keypad with hook-up cable.
CAL-B-Kit-5	Complete calibration kit with all necessary parts to calibrate approximately 5 sensors, includes carrying case.
CAL-B-Kit-35	Complete calibration kit with all necessary parts to calibrate approximately 35 sensors, includes carrying case.

To order calibration parts and supplies, please call TI 1-888-438-2214 or email tisensors@ti.com.

Application Note

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Questions regarding maintenance, care or replacement of parts for the TI 4GS CO2 sensor should be directed to 1-888-438-2214 or email tisensors@ti.com.

This instruction packet may also be found on our website.

Be sure to visit our website at:
www.ti.com/snc/products/sensors/gas.htm