Introduction
The CO2 transmitter uses Infrared Technology to monitor CO2 levels within a range of 0 – 2000 ppm and outputs a linear 4-20 mA or 0-5 Vdc signal. Options include an LCD, a control relay, 0-10 Vdc output and RS-485 network communications. Operating parameters are programmed using a keypad for specific applications. The output scale can be programmed using the Out_Lo and Out_High variables to obtain a 4-20 mA signal to represent (for example) 800 – 1000 ppm if desired.

Mounting
The room type sensor installs directly on a standard electrical box and should be mounted five feet from the floor of the area to be controlled. Do not mount the sensor near doors, opening windows, supply air diffusers or other known air disturbances.

The duct type sensor installs on the outside of a return air duct with the air sampling tube inserted into the duct. Use the included foam plug to prevent air from entering the enclosure through the conduit and causing an incorrect reading. Mount the sensor in an easily accessible location in a straight section of duct at least five feet from corners and other items that may cause disturbances in the air flow. Avoid areas where the transmitter is exposed to vibrations or rapid temperature changes.

Wiring
Use 22 AWG shielded wiring for all connections and do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Disconnect the power supply before making any connections to prevent electrical shock or equipment damage. Make all connections in accordance with national and local codes.

This is a 3-wire sourcing device. Connect the plus dc or the ac voltage hot side to the **POWER** terminal. The supply common is connected to the **COM** terminal. The device is reverse voltage protected and will not operate if connected backwards. It has a half-wave power supply so the supply common is the same as the signal common. Several devices may be connected to one power supply and the output signals all share the same common. Use caution when grounding the secondary of a transformer or when wiring multiple devices to ensure the ground point is the same on all devices and the controller.

The analog output is available on the **SIGNAL OUTPUT** terminal. This signal is jumper selectable for either voltage or 4-20 mA active output. In voltage mode the output is 0-5 or 0-10 Vdc. These options are indicated on the circuit board. The current output operates in the Active mode and does not require a loop power supply. This means **the signal current is generated by the transmitter and must not be connected to a powered input or device damage will result.** Check the controller Analog Input to determine the proper connection before applying power. Both current and voltage signals are referenced to the **COMMON** terminal. The analog output signal is typically connected directly to the Building Automation System (B.A.S.) and used as a control parameter or for logging purposes.

An optional signal is the relay output available on the **NO, R.COM** and **NC** terminals. The Relay COM terminal is NOT connected to the signal or power supply COMMON terminal. The relay output is completely isolated and has both Normally Open (NO) and Normally Closed (NC) signals. This signal can be used to directly control an alarm or ventilation fan.

Start-up
Verify the transmitter is properly wired and connections are tight. Apply power and note that the CO2 sensor chamber light flashes on and off. If an LCD is installed it will indicate the software version number and then begin a two minute warm-up where the output is fixed at 4 mA or 0 Vdc. After the warm-up period the sensor will begin reading the CO2 level, output the correct analog signal and display the value on the LCD. The sensor operates on a 5 second interval and will update the output and display every 5 seconds. If installed, the Modbus option will also be functional at the end of the warm-up period.

Menu Configuration
The menu may be used any time after the warm-up period. The menu is controlled by the four buttons on the circuit board labeled MENU, SAVE, UP and DOWN. If a jumper is present on pins 1 and 2 of J6 it must be removed to access the menu.

The standard menu has 13 items as shown below. Pressing the <MENU> key while in normal operation will set the mode to step 1, pressing the <MENU> switch a second time advances to step 2. Each press of the <MENU> switch advances the menu item. No values are saved or changed by using the <MENU> key.

The <SAVE> key saves the current setting to memory, exits the configuration menu and returns to normal operation. The <UP> and <DOWN> keys are used to make changes to program variables. Menu operation is explained below.

<MENU> Press and release key to enter the configuration menu

1. Restore Defaults Press the <SAVE> key to restore all factory defaults to their original factory settings.

<MENU>

2. Out_Low 0 PPM The default CO2 range is 0-2000 ppm. Use the <UP> or <DOWN> keys to change the zero point from 0 to 950 ppm in increments of 50 ppm. Press the <SAVE> key to save the change.

<MENU>

3. Out_High 2000 PPM The span point can be changed from 1000 to 10,000 ppm in increments of 50 below 1500 ppm or increments of 500 above 1500 ppm. Press the <SAVE> key to save the change to memory.

<MENU>

4. Altitude 0ft The default is 0 feet. Change by using the <UP> or <DOWN> keys from 0 to 5000 feet in 500 ft increments. Change this for local altitude correction and save by pressing the <SAVE> key.

<MENU>

5. Auto_cal ON Automatic Cal Mode defaults to ON. This corrects sensor drift to better than ± 10 ppm per year. Change with the <UP> and <DOWN> keys and save using <SAVE>. ON is recommended for applications where the CO2 level will be close to normal (350 ppm) at least once per day. If a building is occupied 24 hours and the CO2 level is fairly constant then this should be set to OFF.

<MENU>

6. Trip SET 1000 PPM Relay trip point default is 1000 ppm. It can be changed from 500 to 1500 in 50 ppm increments and from 1500 to 10,000 in 250 ppm increments. Save changes by using the <SAVE> key.

<MENU>

7. Hyst SET 50 PPM The relay hysteresis default is 50 ppm. This can be changed from 25 to 200 in 25 ppm increments.

<MENU>

8. Calibrat 0PPM This item is used for zero gas calibration and is explained later.

<MENU>

9. Calibrat 2000PPM This item is used for span gas calibration and is explained later.

<MENU>

Item 10 is only available if the voltage jumper is installed, otherwise the program skips directly to step 11.

10. Calibrat 5V x This item allows calibration of the 5 Vdc output signal. Use the <UP> or <DOWN> keys to set the output to exactly 5.0 Vdc. Use the <SAVE> key to save any change.

<MENU>

Items 11 and 12 are only available if the current jumper is installed, otherwise the program skips directly to step 13.

11. Calibrat 4mA x This item allows calibration of the 4 mA output signal. Use the <UP> or <DOWN> keys to set the output to exactly 4.0 mA. Use the <SAVE> key to save any change.

<MENU>

12. Calibrat 20mA x This item allows calibration of the 20 mA output signal. Use the <UP> or <DOWN> keys to set the output to exactly 20.0 mA. Use the <SAVE> key to save any change.

<MENU>

13. Menu Quit Press the <SAVE> key to exit the menu and return to normal operation.

Modbus Introduction (Modbus communication is optional and the correct device must be ordered to have this capability) Modbus is a network protocol in industrial manufacturing environments. The CO2 detector communicates on a standard Modbus network using either of two transmission modes: RTU (Remote Terminal Unit) or ASCII (American Standard Code for Information Interchange). The hardware interface is RS-485. Select the desired mode along with the other parameters using the test menu. For complete details, see the document titled *CO2 Detector - Modbus Implementation Specification*.

Modbus Wiring Instructions
Connect the network twisted shielded pair to the terminals marked A(-), B(+) and SHIELD. The positive wire connects to B(+) and the negative wire connects to A(-). The total network length should be less than 4000 feet (1220 meters).

Install a 121 ohm resistor in parallel to the A(-) and B(+) terminals if the device is at the end of the network. The ground wire of the shielded pair should be connected to earth ground at the end of the network and the master is not grounded. A jumper must be installed on pins 2 and 3 of J6 for Modbus to function. If the Modbus option is not installed there will be no jumper.

Test Menu
A test menu is available by first removing the jumper on J6 pins 2-3 and then briefly shorting J6 pins 1-2 (leave the jumper uninstalled while using the menu). This menu is used for communication setup. If the device has Modbus option installed, the jumper must be re-installed on J6 pins 2-3 after the menu is exited. The test menu is explained below.

Short pins 1-2 on J6	Enters test menu
1. TEST Relay ON	The <UP> and <DOWN> keys will set the relay ON or OFF. Press the <SAVE> key to exit.
<MENU>	
2. TEST 4mA or 0V	This item will test the analog output, either current or voltage. Use the <UP> or <DOWN> keys to select 4, 8, 12, 16 or 20 mA or 0, 1, 2, 3, 4 or 5 Vdc. Press the <SAVE> key to exit the menu.
<MENU>	
3. MODBUS ADDRE 01	The factory default slave address is 01. Use the <UP> or <DOWN> keys to change the value from 01 to 32. Press the <SAVE> key to save and exit the menu.
<MENU>	
4. MODBUS BR 9600	The factory default baud rate is 9600. Use the <UP> or <DOWN> keys to change the value from 300 to 19200. Press the <SAVE> key to save and exit the menu.
<MENU>	
5. MODBUS MODE	The factory default transmission mode is RTU. Use the <UP> or <DOWN> keys to change the mode from RTU to ASCII. Press the <SAVE> key to save and exit the menu.
<MENU>	
6. MODBUS PARITY N	The factory default parity bit is N (none). Use the <UP> or <DOWN> keys to change the bit to N (none), O (odd) or E(even). Press the <SAVE> key to save and exit the menu.
<MENU>	
7. MODBUS STOP 1	The default stop bit is 1. Use the <UP> or <DOWN> keys to change the bit from 1 to 2 *(for some configurations the value is fixed)*. Press the <SAVE> key to save and exit the menu.
<MENU>	
8. MODBUS CRC A001	The default RTU mode CRC polynomial is 0XA001. Use the keys to change the value to A001 (CRC-16 reverse), 1021(CITT), 8005(CRC-16) or 8408(CITT reverse). Save and exit the menu.
<MENU>	
9. MODBUS DELAY MI	The factory default slave response delay is MI (minimum) *(minimum delay means just more than 3.5 character time delays, 4ms for 9600 baud rate, for example).* Use the <UP> or <DOWN> keys to change the value from MI to 350ms. Press the <SAVE> key to save and exit the menu.

<MENU>

10. Test Quit Use the <SAVE> key to quit the test menu and return to normal operation.

Remember to reinstall the jumper on J6 pins 2-3 for normal operation.

Modbus Trouble-shooting

The pcb will have a connector at the A(-), B(+) and Shield positions if the Modbus option is installed.

The CO2 device operates as a slave. It will not communicate unless a master is connected to the network and sends a request for information, then the slave will answer. If the device does not communicate properly, first check that the jumper is installed on J6 pins 2-3 and that the communication wires are not reversed. Then check the communication parameters in the menu in the following sequence: Slave address, baud rate, transmission mode, parity bit, stop bit, RTU mode CRC polynomial and slave response delay.

The factory default Modbus address is 01 and each device must have its unique address to communicate properly on the bus. Use the menu as described above to change the Slave address to a unique number for each unit.

The default Modbus baud rate is 9600. Use the menu as described above to change the baud rate to the correct setting.

The default transmission mode is RTU. If this is incorrect, use the menu to change the transmission mode to ASCII.

The default Modbus parity is N for None. If this is not correct, use the menu to change the parity from None to Odd or Even.

The default stop bits is 1. Use the menu to change the stop bit setting to 2. For some configurations the value is fixed.

The default Modbus CRC value is A001. The menu can be used to change this setting. This only applies to RTU mode and has no effect in ASCII mode. It is the CRC polynomial setting and can be changed between A001, 1021, 8005 or 8408.

The default Modbus delay is minimum (MI). This can be changed as described above. It is the slave response delay and can be set from minimum to 350ms. For example, the minimum delay means 3.5 character time delays or 4ms for 9600 baud rate.

Calibration

If necessary, the 4 mA, 20 mA and 5 Vdc outputs can be calibrated as described previously in the Menu Configuration section by using the keypad and a meter connected to the output.

Calibration with gas requires a field calibration kit consisting of an LCD, a bottle of zero gas (nitrogen), a bottle of span gas (2000 ppm CO2 in nitrogen), a tank pressure regulator with flow restrictor and the necessary tubing to connect to the device. Note that because of the Automatic Calibration Mode and other technology incorporated into the CDD series, only a single point 0 ppm calibration is required to meet specified accuracy. The span gas calibration can also be done if required.

Disconnect the power to the device and install the LCD by plugging it into the on-board connector. **Ensure that the pins of the connector are properly aligned and that the tabs on the LCD are pointing downward** and then restore the power. Verify that the device and LCD are operating correctly.

Turn the regulator on/off knob fully off and attach it to the 0 ppm nitrogen gas bottle and firmly tighten it by hand. Remove the cover of the unit to be calibrated to expose the gas sensor chamber. The tubing from the gas bottle can be connected to either port on the chamber after the cap is removed. Gently remove one cap and connect the tubing, note that strong shock or vibration can affect calibration.

Ensure the device has been operating normally for at least five minutes and use the menu as described previously to verify that the elevation is correctly set. Then use the menu to access the item labeled **Calibrat 0PPM**. Press the <SAVE> key and the display will change to **Set 0 Test xxx**. This means that 0 ppm is the desired setting and the current CO2 reading is xxx.

Slowly turn the valve knob on the regulator to let the gas begin flowing. The regulator will restrict the flow rate to the specified 100 ml/min. After a brief period the gas will flow into the chamber and the xxx reading will begin to fall towards 0.

Wait 1 to 2 minutes until the xxx reading stabilizes and then press the <SAVE> key. The display will change to **Waiting 5 minute** to indicate that the process of reprogramming the internal zero setting is taking place. This zero calibration process takes about 5 minutes. Do not disturb the unit or the gas flow during this period. When calibration is complete the unit will revert to normal operation and then the gas can be shut off. To abort the calibration for any reason while the display is Waiting 5 minute, simply remove power to the device and the calibration will remain unchanged.

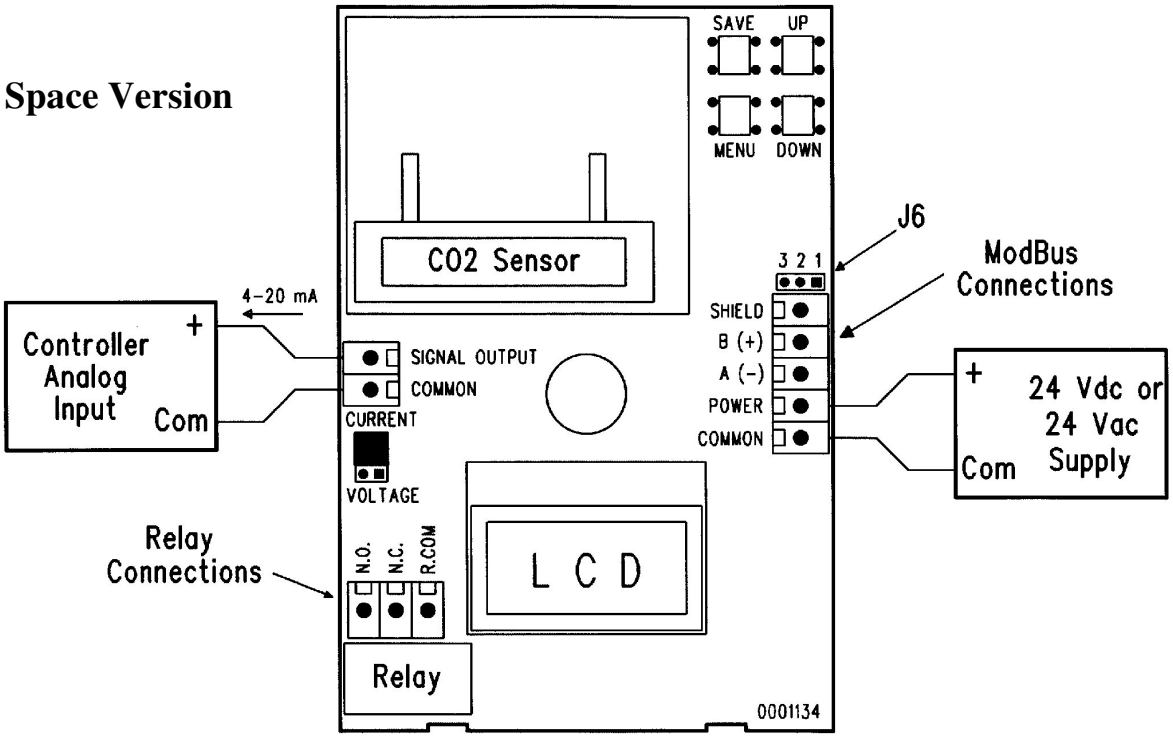
Disconnect the tubing and replace the cap on the sensor chamber if calibration is complete or repeat the above process for the span 2000 ppm gas if required. For span calibration, access the menu item labeled **Calibrat 2000PPM**. Note that the <UP> and <DOWN> keys can be used to set the actual span gas value from 100-5000 ppm as required.

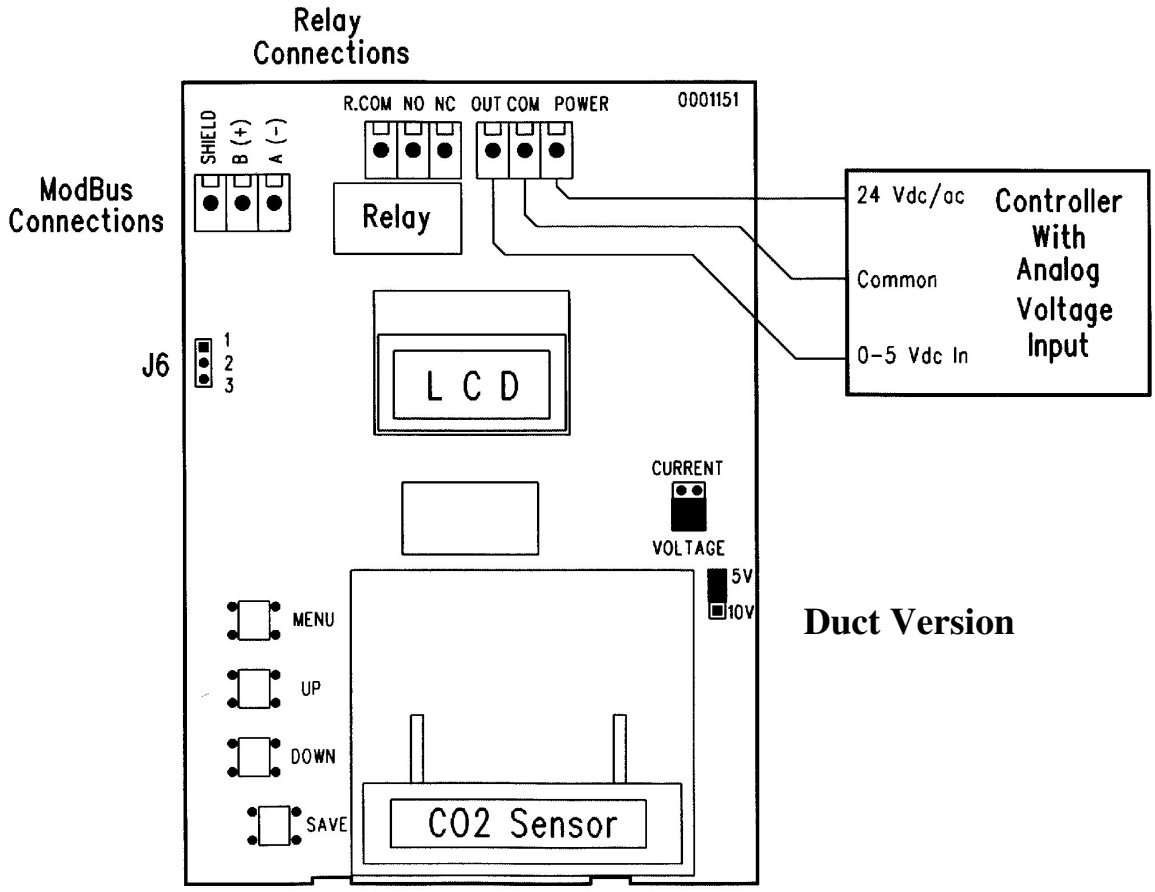
When the correct span calibration value is shown, press the <SAVE> key to display **Span2000 Test xxxx**. Start the 2000 ppm gas flow and wait for the xxxx reading to stabilize. Then press the <SAVE> key to display **Waiting 5 minute** while the unit recalibrates the internal span values. When finished, disconnect the gas and carefully reinstall the sensor cap. Calibration is complete.

Specifications

Measurement	Non-Dispersive Infrared (NDIR)
Sample Method	Diffusion or flow through, sample tube for duct
Measurement Range	Programmable from 0-1500 up to 0-10,000 ppm in 500 ppm increments, 0-2000 ppm standard
Standard Accuracy	± 50 ppm + 3% of reading @ 22 °C (72 °F) compared to certified calibration gas
Temperature Dependence	0.2 %FS per °C
Stability	< 2 %FS over life of sensor (15 year typical)
Pressure Dependence	0.13 % of reading per mm Hg
Altitude Correction	Programmable from 0-5000 ft in 500 ft increments
Response Time	< 2 minutes for 90 % step change typical
Warm-up Time	< 2 minutes
Operating Conditions	0-50 °C (32-122 °F), 0-95 %RH non-condensing
Power Supply	20 – 30 Vac/dc (non-isolated half-wave rectified)
Consumption	140 mA max (40 mA typical) @ 24 Vac/dc
Input Voltage Effect	Negligible over specified operating range
Protection Circuitry	Reverse voltage protected and output limited
Output Signal	4-20 mA active (sourcing), 0-5 or 0-10 Vdc, jumper selectable
Output Drive Capability	550 ohm max for current output, 10 Kohm min for voltage output
Output Resolution	10 bit PWM
Optional Relay Output	Form C contact (N.O. and N.C.), status LED, 5 Amps @ 250 Vac, 5 Amps @ 30 Vdc, pf = 1
Relay Trip Point	Programmable 500-1500 ppm in 50 ppm increments
Relay Hysteresis	Programmable 25-200 ppm in 25 ppm increments
Optional LCD Display	1 ppm resolution, 1.1” w x 0.5” h (28 x 13 mm) alpha-numeric 2 line x 8 characters
Programming and Selection	Via internal push-buttons and jumpers
Wiring Connections	Screw terminal block (14 to 22 AWG)
Enclosures	Decorative wall mount enclosure, 3.6”w x 5”h x 1.7”d (91 x 127 x 43 mm) Duct mount enclosure with sampling tube, 4.9”w x 7.2”h x 2.2”d (124 x 183 x 56 mm)

Space Version





Duct Version