

**Introduction**

The Carbon Monoxide Transmitter uses an electrochemical sensor to monitor the CO level and outputs a 4-20 mA or voltage signal. Options include an LCD to display the CO ppm level, control relays, an audible alarm, test switch and RS485 network communications. Operating parameters are easily programmed via the keypad to configure the transmitter to a specific application. The transmitter also features a pre-calibrated replaceable sensor module for convenient maintenance.

**Mounting**

The ABS enclosure installs on a standard electrical box and should be mounted three to 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 sampling duct sensor is mounted 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 with vibrations or rapid temperature changes.

Remove the cover from the unit and use the existing holes to mount the device to an electrical box or directly to the wall or duct. The correct knockout should be removed first. Use care not to damage the circuit board, components or the sensor. Reinstall the cover after wiring and mounting.

**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 positive dc voltage or the hot side of the ac voltage to the terminal marked **PWR**. The power supply common is connected to the terminal marked **COM**. The device is reverse voltage protected and will not operate if connected backwards. This device has a half-wave type power supply so the power supply common is the same as the output signal common. Therefore, several devices may be connected to one power supply and the output signals all share the same signal common. Use caution when grounding the secondary of an ac transformer or when wiring multiple devices to ensure that the circuit ground point is the same on all devices and the controller.

The analog output signal is available on the **OUT** terminal. This signal is jumper selectable for either voltage or 4-20 mA active output. The voltage output can be set by a second jumper for either 0-5 or 0-10 Vdc. These options are clearly 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**. This is the typical operating mode of a "three-wire device". Check the controller Analog Input to determine the proper connection before applying power. Both current and voltage signals are referenced to the **COM** 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. Study the wiring diagrams to ensure all connections are correct.

Two optional signals are relay outputs available on the **NO1**, **COM1** and **NC1** terminals and the **NO2**, **COM2** and **NC2** terminals. The relay COM terminals are NOT connected to the signal or power supply COM terminal or to each other. The relay outputs are completely isolated and have both Normally Open (NO) and Normally Closed (NC) signals. These signals can be used to directly control alarms, ventilation fans or may be connected to digital inputs of the B.A.S. for status monitoring.

If the device is equipped with the optional TEST switch, it will also have a Test connector. This allows operation of the TEST function using a dry contact digital output from the panel. This is an active low input so the TEST + is shorted to COM to activate the TEST function. The TEST - is connected to the COM terminal. If desired, only one wire need be connected to TEST + connection and use the power supply COM as the signal return.

**Start-up**

Verify that the Carbon Monoxide Transmitter is properly wired according to the wiring diagrams and all connections are tight. Apply power to the device. If an LCD is installed it will indicate the software version number and then begin a warm-up period. During this period the output is fixed at 4 mA or 0 Vdc and the relays are off. After the warm-up period the sensor will begin reading the CO level, output the analog signal and display the value on the LCD.

**Operation**

In normal operation the sensor will measure the CO level in the surrounding air and display this value on the LCD (if present). The standard measurement range is 0 to 300 ppm for the electrochemical economy sensor and 0 to 500 ppm for the electrochemical sensor. Custom ranges are available for both sensors. The analog output is proportional to the measured concentration of CO. The signal type must be selected during installation via the jumpers on the PCB. One jumper selects either 4-20 mA or voltage output and if voltage is selected than the other jumper sets the full scale as either 5 or 10 Vdc.

Two optional relays are used to indicate alarm conditions. The trip point, hysteresis and delay time of each relay can be programmed. For example, the first relay defaults to 50 ppm trip point, 10 ppm hysteresis and 2 minute delay time. All of these values can be changed via the menu. In this example, a timer is started when the CO level exceeds 50 ppm (the trip level). If the level drops below 50 ppm before 2 minutes (the delay time) has expired then the relay is not activated. If the CO level exceeds 50 ppm for 2 minutes then the relay is activated. The relay will remain activated until the CO level drops below 40 ppm (trip level – hysteresis). This relay can be used to signal a “low alarm”. The second relay operates in the same manner and has independently programmable trip point, hysteresis and delay time. This relay can be used to signal a “high alarm”.

The optional buzzer trip point and delay time can be programmed similarly to the relays to indicate an alarm condition. When the trip point is exceeded for a time longer than the delay time, then the buzzer will sound until the CO level falls below the trip point. The buzzer can be disabled in the Normal Menu.

To initiate the TEST function, either press and hold the TEST switch for 1 second or activate it remotely by shorting the TEST + to TEST – (COM). This will cause the TEST LED to blink, the outputs to go to 100% and both relays to activate. The TEST function will continue for 5 minutes and then the device will reset to normal operation.

**Menu Configuration**

The menus may be accessed any time after the initial warm-up period. The menus are used for setup, testing and calibration and are controlled by using the three buttons on the circuit board labeled MENU, ROLL and SAVE. There are four sub-menus available from the Main Menu as shown below.

- <MENU>                      Press and release the key to enter the Main Menu.
- 1. NORMAL MENU**        Press the <SAVE> key here to enter the Normal Menu.
- <MENU>
- 2. MODBUS MENU**        Press the <SAVE> key here to enter the ModBus Menu.
- <MENU>
- 3. TEST MENU**            Press the <SAVE> key here to enter the Test Menu.
- <MENU>
- 4. CALIBRAT MENU**      Press the <SAVE> key here to enter the Calibration Menu.
- <MENU>                      Returns to normal operation.

If the <SAVE> key is pressed and any sub-menu selected then the first item of that menu will be displayed. Each press of the <MENU> key 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 menu system and returns the CO transmitter to normal operation. The <ROLL> key is used to make changes to program variables. Each menu item is explained below.

**Normal Menu**

- 1. BUZZER TRIP=150**    The factory default for the buzzer trip level is 150 ppm. This can be changed by using the <ROLL> key from 50 to 400 ppm in increments of 10 ppm. Use the <SAVE> key to save any change to memory.
- <MENU>

2. BUZZER DEL=5MIN The factory default is 5 minutes and this can be changed with the <ROLL> key to 0, 1, 2, 3, 4 or 5 minutes. Use the <SAVE> key to save any changes to memory.  
<MENU>
3. BUZZER ENABLE The factory default is ENABLE. It can be changed to DISABLE with the <ROLL> key. Use <SAVE> to save any changes to memory. If this is set to DISABLE the buzzer will never sound.  
<MENU>
4. RELAY1 TRIP=50 The factory default relay1 trip level is 50 ppm. Use the <ROLL> key to change it to 25 or 40 to 350 ppm in increments of 10 ppm. The <SAVE> key saves any changes.  
<MENU>
5. RELAY1 HYST=10 The factory default for relay1 hysteresis is 10 ppm. Change using the <ROLL> key to 10, 15, 25, 50 or 75 ppm. Save using the <SAVE> key. (RELAY1 HYST is always less than RELAY1 TRIP)  
<MENU>
6. RELAY1 DEL=2MIN The factory default is 2 minutes and this can be changed with the <ROLL> key to 0, 1, 2, 3, 4 or 5 minutes. Save using the <SAVE> key.
7. RELAY2 TRIP=150 The factory default relay2 trip level is 150 ppm. Use the <ROLL> key to change it from 100 to 400 ppm in increments of 10 ppm. The <SAVE> key saves any changes.  
<MENU>
8. RELAY2 HYST=25 The factory default for relay2 hysteresis is 25 ppm. Change using the <ROLL> key to 10, 15, 25, 50 or 75 ppm. Save using the <SAVE> key.  
<MENU>
9. RELAY2 DEL=2MIN The factory default is 2 minutes and this can be changed with the <ROLL> key to 0, 1, 2, 3, 4 or 5 minutes. Save using the <SAVE> key.  
<MENU> Returns to normal operation.

**ModBus Menu**

1. MODBUS ADDRE 01 The <ROLL> key will change the device modbus address from 01 to 32. Use the <SAVE> key to save and exit the menu.  
<MENU>
2. MODBUS BR 9600 The <ROLL> key will change the transmission baud rate to either 300, 600, 1200, 2400, 4800, 9600 or 19200. Use the <SAVE> key to save and exit the menu.  
<MENU>
3. MODBUS MODE RTU The <ROLL> key will change the transmission mode to RTU or ASCII. Use the <SAVE> key to save and exit the menu.  
<MENU>
4. MODBUS PARITY N The <ROLL> key will change the parity bit to N (none), O (odd) or E (even). Use the <SAVE> key to save and exit the menu.  
<MENU>
5. MODBUS STOP 1 The <ROLL> key will change the stop bit to 1 or 2 ( *for some configurations, the value is fixed*). Use the <SAVE> key to save and exit the menu.  
<MENU>
6. MODBUS CRC A001 This is only available when the transmission mode is RTU. The <ROLL> key will change the value to A001 (CRC-16 reverse), 1021(CITT), 8005 (CRC-16) or 8408 (CITT reverse). Use the <SAVE> key to save and exit the menu  
<MENU>
-

7. MODBUS DELAY MI The <ROLL> key will change the value from MI TO 350ms (*Here, minimum delay means just more than 3.5 character time delays, 4ms for 9600 baud rate, for example*). Use the <SAVE> key to save and exit the menu.

<MENU> Returns to normal operation.

**Test Menu**

1. OUTPUT TEST 4mA This item will test the analog output, either current or voltage depending on the jumper position. Use the <ROLL> key to change the output signal to 4, 8, 12, 16 or 20 mA or 0, 1, 2, 3, 4 or 5 Vdc or OUTPUT TEST 0V as applicable. Use the <SAVE> key to exit the menu.

<MENU>

2. BUZZER TEST OFF If installed, use the <ROLL> key to turn the buzzer ON or OFF. Use <SAVE> to exit the menu.

<MENU>

3. RELAY1 TEST OFF If installed, use the <ROLL> key to turn the relay ON or OFF. Use <SAVE> to exit the menu.

<MENU>

4. RELAY2 TEST OFF If installed, use the <ROLL> key to turn the relay ON or OFF. Use <SAVE> to exit the menu.

<MENU> Returns to normal operation.

**Calibration Menu**

1. SENSOR (ECON100) The sensor type and range are indicated on the LCD. The Economy EC has ranges of 100 ppm, (ECON150) 150 ppm, 300 ppm or 400 ppm and the electrochemical has ranges of 250ppm or 500 ppm. (ECON300) **This item is factory set to the correct sensor type and should never be changed unless the** (ECON400) **sensor type is replaced.** The <ROLL> key will change the sensor type. Use the <SAVE> key (EC-250) to save and exit the menu. (EC-500)

<MENU>

2. CALIBRAT 20mA x This item allows calibration of the 20 mA output signal. Use the <ROLL> key to set the output to exactly 20.0 mA using a reference meter. Use the <SAVE> key to save any change.

<MENU>

3. CALIBRAT 5V x This item allows calibration of the 5 Vdc output signal. Use the <ROLL> key to set the output to exactly 5.0 Vdc using a reference meter. Save using the <SAVE> key.

4. RESTORE DEFAULTS Press the <SAVE> key here to restore all factory defaults to their original settings as when shipped from the factory.

<MENU> Returns to normal operation.

**Modbus Introduction** (Modbus communication is optional and the correct device must be ordered to have this capability) Modbus is a widely used network protocol in industrial manufacturing environments. The CO detector is set to communicate 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. Users may select the desired mode along with the other communication parameters (baud rate, parity bit, etc.) using the ModBus menu. For details of the Modbus protocol, see the document titled *CO 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(-).

It is recommended that a 121 ohm resistor be connected in parallel to the A(-) and B(+) terminals if the CO device is at the end of the network. Also, the ground wire of the twisted shielded pair should be connected to earth ground if the device is at the end of the network and it's master is not grounded.

All communication wires should be twisted shielded pair and the total length should less than 4000 feet (1220 meters).

**Modbus Trouble-shooting**

The CO 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, 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 factory default Modbus baud rate is 9600. If this is not correct, use the menu as described above to change the baud rate to the correct setting.

The factory default Modbus transmission mode is RTU. If this is not correct, use the menu as described above to change the transmission mode to ASCII.

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

The factory default Modbus stop bits is 1. If this is not correct, use the menu as described above to change the stop bit setting to 2. For some configurations, it will not change, i.e. the value is fixed.

The factory default Modbus CRC value is A001. The menu can be used to change this setting as described above. This setting only applies to RTU mode and has no effect in ASCII mode. It is the RTU mode CRC polynomial setting and can be changed between A001 (CRC-16 reverse), 1021 (CITT), 8005 (CRC-16) or 8408 (CITT reverse).

Finally, the factory default Modbus delay is set to minimum (MI). The menu can be used to change this setting as described above. This is the slave response delay setting and can be changed from minimum to 350ms. Here, the minimum delay means just more than 3.5 character time delays, 4ms for 9600 baud rate for example.

**Calibration**

The transmitter features a replaceable sensor module that is pre-calibrated and independent of the main transmitter circuit board. This means that the sensor module can simply be unplugged and a new calibrated module can be installed. This sensor swap requires no tools and can be completed in seconds. Simply disconnect the device power, unplug the old sensor module, install the new module and reconnect the device power. Ensure the module connector is properly aligned before applying power again. There is no need to make any adjustments or apply gas to the transmitter using the sensor swap method.

If necessary, the 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 gas (250 ppm CO in air), a tank pressure regulator with flow restrictor and the necessary tubing with a cap to cover to the sensor. Calibration can be done at 20-27 °C.

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 two metal tabs on the LCD point towards the CO sensor module** then restore the power. Verify that the device and LCD are operating correctly.

The sensor must be continuously powered for at least 1/2 hour prior to calibration. Calibrate the sensor first in clean air with no CO gas present. Simply adjust the ZERO pot on the sensor board until a display of 0-1 ppm is shown.

Turn the regulator on/off knob fully off and attach it to the 250 ppm gas bottle and firmly tighten it by hand. Moisten the sponge and squeeze out any excess water. Place the sponge in the cap so that it will not touch the sensor but does not plug the hole in the side of the cap. Hold the cap over the sensor. Slowly turn the valve knob on the regulator to let the gas begin flowing. The regulator will restrict the flow rate to the specified 200 ml/min and the sponge will ensure the gas is in the right humidity range. Wait for 5 minutes and then adjust the SPAN pot on the sensor board until the LCD displays 250 PPM. Close the valve on the tank and take the cap off from the sensor. Calibration is complete.

**Specifications**

Measurement . . . . .	Choice of two sensors, Electrochemical or Electrochemical Economy models
Sample Method . . . . .	Diffusion or flow through, sample tube for duct
Measurement Range . . . . .	0-500 ppm for electrochemical standard (0-250 ppm optional), 0-300 ppm for electrochemical economy standard (0-100, 0-150 and 0-400 ppm optional)
Standard Accuracy . . . . .	± 5 ppm or ± 5% of reading (whichever is greater) for electrochemical economy 0-50 °C (32-122 °F), 15-90 %RH
Operating Conditions . . . . .	-20-50 °C (-4 -122 °F), 15-90 %RH (0-99 %RH intermittent), 0.9-1.1 atm
Stability . . . . .	< 5% signal loss/year
Response Time . . . . .	< 35 seconds for 90 % step change
Typical Area Coverage . . . . .	700 m <sup>2</sup> (7500 ft <sup>2</sup> )
Power Supply . . . . .	15 – 30 Vac/dc (non-isolated half-wave rectified)
Consumption . . . . .	80 mA max @ 24 Vdc, 150 mA max @ 24 Vac (with all options on)
Protection Circuitry . . . . .	Reverse voltage protected, output limited and transient protected
Output Signal . . . . .	4-20 mA active, 0-5 or 0-10 Vdc jumper selectable
Output Drive Capability . . . . .	500 ohms max for current output, 10 Kohm min for voltage output
Optional Relay Outputs . . . . .	Form C contacts (N.O. and N.C.), 5 Amps @ 250 Vac, 5 Amps @ 30 Vdc
Relay 1 Trip Point . . . . .	Programmable 25, 40-350 ppm in 10 ppm increments
Relay 2 Trip Point . . . . .	Programmable 100-400 ppm in 10 ppm increments
Relay Hysteresis . . . . .	Programmable 10, 15, 25, 50 or 75 ppm
Relay Delay . . . . .	Programmable 0, 1, 2, 3, 4 or 5 minutes
Optional LCD Display . . . . .	1 ppm resolution, 1.1" w x 0.5" h (28 x 13 mm), alpha-numeric 2 line x 8 characters
Optional Buzzer alarm . . . . .	85db @ 10 feet
Buzzer Trip Point . . . . .	Programmable 50-400 ppm in 10 ppm increments
Buzzer Delay . . . . .	Programmable 0, 1, 2, 3, 4 or 5 minutes
Programming and Selection . . . . .	Via internal push-buttons and jumpers or optional Modbus communication
Wiring Connections . . . . .	Screw terminal block (14 to 22 AWG)
Enclosures . . . . .	Wall or duct enclosure with sample tube, 4.8" w x 7.2" h x 2.2" d (122 x 183 x 56 mm)
Agency Approvals . . . . .	Sensor is a UL Recognized Component for ANSI/UL-2034 and UL-2075, E240671

