AirSense
Model 310en

Infrared Environmental CO_2 Sensor

Operator's manual

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Preface

This manual describes the Model 310en of the AirSense 310 Carbon Dioxide sensor family. The 310en, while similar in external appearance and operation to previous 310e models, has a slightly modified feature set and differences in the location and operation of the user interface.

Model Identification

Because of its similarity to previous models, the Model 310en is most easily identified by the prefix "**M310en**" on the unit's serial number tag visible on the sensor circuit board when the cover is removed.

All other AirSense 310e series sensors are covered in the *AirSense Model 310e Operator's Manual*.

Introduction

The AirSense Model 310en is a non-dispersive infrared analyzer for measuring environmental CO_2 concentration in ventilation systems and indoor living spaces. Its default measurement range of 0 - 2000 ppm (parts per million; 1000 ppm = 0.1%) covers the range required to monitor compliance with ASHRAE or other ventilation efficiency standards. For specialty applications the measurement range can be easily increased up to 5000 ppm.

Packaged in a compact, distinctively styled enclosure, the Model 310en can be discreetly installed anywhere from the board room to the boiler room. Standard center wiring access, fully floating outputs and power/signal mis-wiring protection make installation a snap.

The Model 310en provides several output alternatives. A voltage or 4 - 20 mA current output is standard. An optional LCD readout is available. An optional relay contact can be configured to open or close above a user-adjustable setpoint.

Displays and Indicators

The Model 310en has a single green LED on the front panel which illuminates whenever the unit is operating. This LED is on steadily when the measured concentration is below the high CO_2 limit, and blinks whenever the concentration is above the limit.

The standard factory high CO_2 limit is 1000 ppm, but can be adjusted in the field. The procedure for adjusting the high CO_2 limit is described on page 7.

The display option adds a 4 digit liquid crystal display (LCD) to the front panel. The display shows the measured CO2 concentration in parts per million (ppm). 1000 parts per million equals 0.1%.

Specifications

Operating principle		Non-dispersive infrared (NDIR)
Gas sampling method		Diffusion or sample draw
Measurement range		400 - 2000 ppm CO_2 (standard) Field adjustable to 5000 ppm
Typical drift (per year)		±75 ppm (@ 1200ppm)
Accuracy		±5% of reading or ±75 ppm,
Repeatability		±20 ppm
Recommended Calibration Interval		Five Years
Response time		Less than 1 minute
Operating temperature range		0 to 50 ° C
Operating humidity range		0 - 90% RH (non condensing)
Storage temperature		-30 to + 60 ° C
Power requirements		20 - 28 V_{RMS} AC, 18 - 30 VDC
Power consumption		Less than 2W @ 24 VAC
Calibration verification time		10 minutes typical
Dimensions		5.2" x 3.2" x 1.4"
Voltage output (linear)		0 - 10 volts DC
Current output (linear)		4 - 20 mA ($R_L \leq 500\Omega$)
Warm-up time		3 minutes
Weight		6.5 Oz. (.35 Kg)
Optional Digital Display		4 digit, .35" LCD
Optional	setpoint range	0 to full scale
High Limit	contact polarity	jumper selectable
Contact	contact rating	2A @ 24 VAC
Operating life expectancy		10 years typical
Warranty		18 months, parts and labor through repair or exchange

Installation

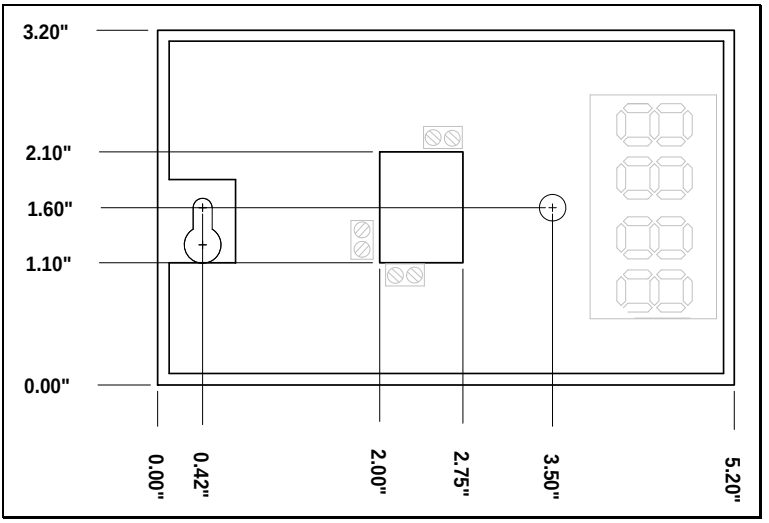

Figure 1: *AirSense Model 310en Mounting Dimensions*

Cover Removal

To open the Model 310en use a coin in the slot on the bottom to release the snap. Lift the cover up slightly to disengage the closure and remove cover with a downward motion to clear the catch at the top of the unit.

The locations of controls and terminals on the main circuit board are shown in the Figure 2 on page 5.

Mounting

The Model 310en is designed for flush mounting with two fasteners. The locations of the mounting points (shown in Figure 1) allow direct mounting on a standard simplex (single circuit) junction box. There is a wiring cutout in the center of the unit near the terminal strips.

Wiring

This section describes the external connections to the Model 310en. Figure 2 shows the location of the components described in the following sections.

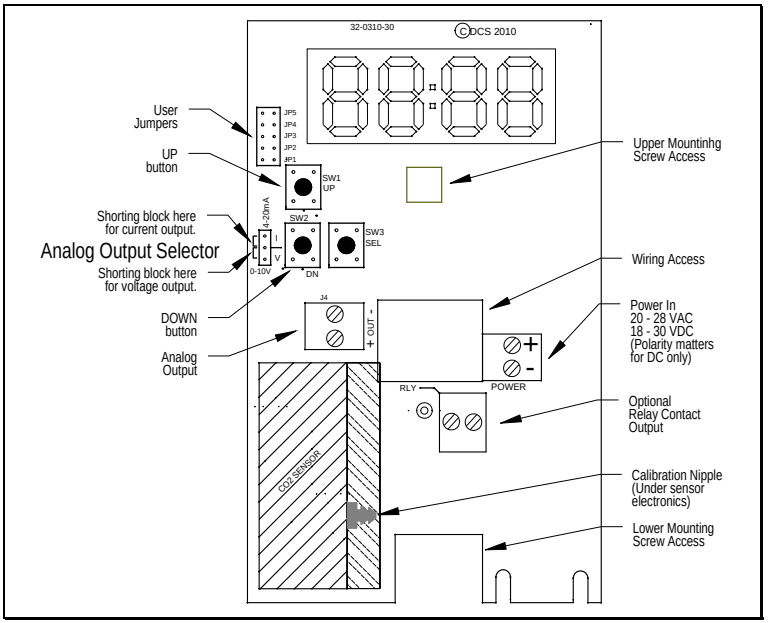

Figure 2: *Model 310en Component Locations*

Power Supply

The Model 310en is not a loop powered device

The Model 310en will operate from an AC or DC input voltage between the values called out in the specifications on page 3. The power supply leads are connected to the two-terminal power connector. shown in Figure 2.

The Model 310en must never be connected directly to line power. Operation at voltages higher than specified will damage the unit and void the warranty.

When operating from DC power, the polarity of the power leads must be as shown in Figure 2. Reversed polarity

connection will not damage the unit, but will make it inoperable until the connection is reversed.

Signal Output

The Model 310en provides either a 0 - 10 volt or a 4 - 20 mA current loop output at the two terminals of the analog output connector. The type of analog output is determined by the setting of the analog output selector.

The unit is shipped from the factory with the top-of-scale set to 2000 ppm. See the *Analog Top-of-Scale Adjustment* section on page 9 to change the analog output range limits.

The analog output of the Model 310en is completely isolated from the power supply. The common outputs of multiple units can be connected together with no interaction regardless of power supply hook-up.

Voltage

When the two bottom pins of the analog output selector are connected with the shorting block, a voltage output appears at the terminals marked ANALOG OUTPUT. The output voltage increases linearly with CO_2 concentration from 0 volts at 0 ppm to 10 volts at the top-of-scale concentration.

Current

When the two top pins of the analog output selector are connected with the shorting block, a current output appears between the two terminals marked ANALOG OUTPUT. The output current increases linearly from 4 mA at 0 ppm to 20 mA at the top-of-scale concentration. The unit is shipped from the factory with the top-of-scale set to 2000 ppm. See the *Analog Top-of-Scale Adjustment* section on page 9 to change the top-of-scale value.

If the total resistance between the two terminals exceeds the specified maximum loop resistance, the output current may be erroneously low at high concentrations.

Cover Replacement

Engage the top center of the cover under the latch at the top of the base, then press the bottom of the cover onto the base until it latches.

Field Adjustments

This section describes the features that can be field configured and the procedures to make these changes. All these procedures require the closing of one and sometimes two jumpers.

When making adjustments to units without displays, the current setting of the value being adjusted is reported by the analog output. If there is no display, the procedures below assume that the unit is set to voltage output and only a volt meter is connected to the analog output terminal.

Note that the scaling of the analog output is not always the same.

High CO_2 Limit Adjustment

An adjustable high CO_2 limit is a standard feature of the Model 310en. The front panel LED changes from steady to blinking when the indicated concentration is above the high CO_2 limit value. An optional contact closure is available which actuates when the high limit is exceeded.

The High CO_2 Limit value is adjusted as follows:

1. **Note whether the shorting block at jumper JP5 is covering both pins or only a single pin**, then borrow the shorting block and slide it over the two pins of jumper JP3 (see Figure 2 on page 5).
2. If the display is present when JP3 is closed it will show the current high limit setpoint in ppm CO_2.

   If there is no display the current value of the high CO_2 limit is reported by the analog output scaled at 500 ppm/Volt. A high CO_2 limit of 1000 ppm is indicated by and output voltage of 2.0 volts.

3. The high CO_2 limit value is adjusted with the 'UP' and 'DOWN' buttons while JP3 is closed. When JP3 is opened, the new relay setpoint takes effect and is stored in non-volatile memory.
4. Remove the shorting block from JP3 to save the value, and restore the shorting block to its original position on JP5.

High CO_2 Limit Hysteresis Adjustment

The default high CO_2 limit hysteresis is approximately 40 ppm and can be inspected and adjusted between 0 and 200 ppm as follows:

1. **Note whether the shorting block at jumper JP5 is covering both pins or only a single pin**, then borrow the shorting block and slide it over the two pins of jumper JP3 (see Figure 2 on page 5). Use a narrow-bladed screwdriver or the like to momentarily connect the two pins of JP1 while JP3 is closed.
2. If the display is present it will show the current high CO_2 limit hysteresis value in ppm CO_2.

   If there is no display the current value of the high CO_2 limit hysteresis is reported by the analog output scaled at 20 ppm/Volt. A high CO_2 limit hysteresis of 40 ppm is indicated by and output voltage of 2.0 volts.
3. The high CO_2 limit hysteresis value is adjusted with the 'UP' and 'DOWN' buttons while JP3 is closed.
4. Remove the shorting block from JP3 and return it to its previous position over one or both pins of jumper JP5. When the jumper is opened, the new High CO_2 Limit Hysteresis setpoint takes effect and is stored in non-volatile memory.

Analog Top-of-Scale Adjustment

> This section refers to advanced features of the Model 310en. 2000 ppm full scale users need not perform this adjustment.

Unless explicitly ordered otherwise, the Model 310en ships from the factory set for an analog output range of 0 to 2000 ppm.

The top-of-scale concentration (i.e. the concentration at which the analog output is at its maximum value) can be adjusted between 500 and 5000 ppm.

To change the top-of-scale value use the following procedure:

1. **Record whether the shorting block at jumper JP5 is covering both pins or only a single pin**, then borrow the shorting block and slide it over the two pins of jumper JP4 (see Figure 2 on page 5).
2. If the display is present it will show the current top-of-scale value in ppm.

   If there is no display the current top-of-scale value is indicated by the analog output at a scaling of 500 ppm/volt.
3. Use the 'UP' and 'DOWN' buttons to adjust the top-of-scale to the desired value. A top-of-scale setting of 5000 ppm corresponds to an output voltage of 10 volts.
4. Remove the shorting block from JP4 to save the value, and restore the shorting block to its original position on JP5.

Altitude Correction Considerations

The Model 310en is factory-calibrated for operation at sea level. When operated at higher elevations, the calibration will correct for altitude as the unit detects outside air concentration

In applications where the detected CO_2 concentration does not routinely fall close to outside-air levels, the procedure below can be used to set the operating elevation.

Beware that this procedure works only on units that are calibrated for sea level operation.

ALTITUDE CORRECTION TABLE	
Altitude [feet]	Multiplication Factor
0	1.0
500	1.02
1000	1.03
1500	1.05
2000	1.07
2500	1.08
3000	1.10
3500	1.12
4000	1.14
4500	1.16
5000	1.18

Altitude Correction Procedure

To adjust the calibration of a unit currently calibrated for sea level operation to a new altitude proceed as follows:

1. Let the Model 310en stabilize to the ambient CO_2 concentration, and record the reading in ppm. If the reading is greater than 1500 ppm, wait for a lower reading before performing this procedure.
2. Multiply the reading by the scale factor corresponding to the operating altitude in the altitude correction table.

   For instance if the unit is operating at an altitude of 4000 ft, the scale factor from the table is 1.14. If the concentration reads 420 ppm, multiply 420 times 1.14 giving 478 ppm. Adjust the display to read 480.
3. Remove the Model 310en's cover (see cover removal procedure on page 4).
4. **Note whether the shorting block at jumper JP5 is covering both pins or only a single pin**, then borrow the shorting block and slide it over the two pins of jumper JP2 (see Figure 2 on page 5). Use the 'UP' and 'DOWN'

buttons to change the indicated concentration to the value just calculated.

If there is no display the indicated concentration is reported by the analog output with a scaling of 200 ppm/volt.

5. Remove the shorting block from jumper JP2 and return it to its previous position over one or both pins of jumper JP5.
6. Replace the cover (see procedure on page 7).

Calibration

This section describes the calibration verification procedure and calibration adjustment procedures.

Verification Procedure

A quick but approximate calibration verification can be done by supplying the unit with outside air and letting the reading stabilize. CO_2 concentrations in outside air are typically between 375 and 450 ppm.

A more accurate calibration check requires the use of calibration gas of known concentration. 2000 ppm calibration gas is recommended A calibration kit that includes a digital display is available from the factory.

To verify the Model 310en's calibration, proceed as follows:

1. Remove the front cover of the unit (see procedure on page 4).
2. If there is no display on the unit being calibrated, connect a meter to the analog output terminals. Check the setting of the analog output selector (see Figure 2 on page 5) to determine whether the unit is set for voltage or current output.
3. Locate the calibration nipple under the sensor's circuit board as shown in Figure 3.

4. Remove the dust cover from the barbed calibration nipple by grasping its top with a pair of needle-nose pliers and pulling straight back.

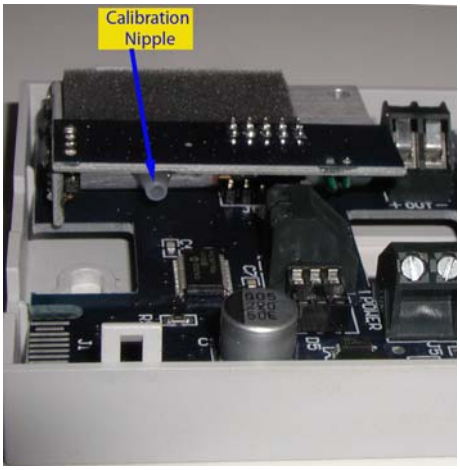

Figure 3: Showing location of calibration nipple

5. Attach a 1/8 " ID flexible tube to the nipple and establish a flow of between 50 and 100 cc/min (0.002 to 0.004 SCFM) of 2000 ppm or or lower concentration calibration gas through the sensor. Allow approximately two minutes for the reading to stabilize.
6. If the reading differs by less than ± 50 ppm from the known concentration of the calibration gas, no adjustment is recommended; proceed directly to step 9.

   Otherwise **note whether the shorting block at jumper JP5 is covering both pins or only a single pin**, then borrow the shorting block and slide it over both pins of jumper JP2 (see Figure 2 on page 5).
7. Use the 'UP' and 'DOWN' buttons (see Figure 2 on page 5) to adjust the reading.
8. When the reading agrees with the concentration of the calibration gas, remove the shorting block on jumper JP2, and replace in its original position at jumper JP5.
9. Turn off the calibration gas flow, disconnect the gas tubing from the calibration nipple and replace its dust cover. Remove the meter leads from the terminal strip and replace the front cover (see procedure on page 7).

Optional High Limit Contact Relay

The high CO_2 limit relay option provides a dry (i.e. unpowered) contact closure that activates when the detected concentration rises above the high CO_2 limit. The high limit is adjustable from 0 to 5000 ppm.

Setting High Limit Contact Polarity

The polarity of the high limit contact is set with jumper JP5 as shown in the table below.

Jumper JP5	Relay Operation
CLOSED (factory default)	normally open closes above setpoint
OPEN	normally closed opens above setpoint

To open jumper JP5 remove the shorting block from the two pins, and replace it so that it engages only a single pin of the jumper. The shorting block should not be discarded; it is required for all field calibration procedures.

Disclaimers and Notices

Operational Limitations

The standard Model 310en has the following operational limitations:

1. The unit is not intended for routine operation at CO_2 concentrations below 400 ppm.
2. The unit expects to see outside-air CO_2 concentrations for at least a few hours every few weeks.

For CO_2 sensing applications where these two limitations can not be met, contact Digital Control Systems for guidance on achieving maximum accuracy under these conditions.

Safety Critical Applications

DCS products are not designed, intended or authorized for use in life safety systems or devices where failure of the Model 310en to perform to specification may be reasonably expected to result in significant risk of injury or death.

Limited Warranty and Remedies.

DCS warrants to Buyer of the AirSense Model 310en that for 18 months from the date of shipment of Products to the Buyer that Products will substantially conform with the product specifications agreed to by DCS. This warranty is not transferable.

This warranty does not cover:

- Defects due to misuse, abuse, or improper or inadequate care, service or repair of Products;
- Defects due to modification of Products, or due to alteration or repair by anyone other than DCS; or
- Problems that arise from lack of compatibility between DCS' Products and other components used with those Products or the design of the product into which Products are incorporated. Buyer is solely responsible for determining whether Products are appropriate for Buyer's purpose, and for ensuring that any product into

which Products are incorporated, other components used with DCS' Products, and the purposes for which DCS' Products are used are appropriate and compatible with those Products.

The warranty in this section is in lieu of all other warranties, express or implied. DCS expressly disclaims all implied warranties, including the warranties of merchantability and fitness for a particular purpose. DCS is not responsible in any way for damage to a product, property damage or physical injury resulting in whole or in part from (1) improper or careless use, (2) unauthorized modifications, or (3) other causes beyond DCS' control. In no event is DCS liable to the buyer or any other person for cost of procurement of substitute goods, loss of profits, or for any other special, incidental or consequential damages.

To obtain service under this warranty, unless DCS agrees otherwise, Buyer must obtain a returned material authorization (RMA) number from the factory, pack any nonconforming Product carefully, and ship it, postpaid or freight prepaid, to the address provided when the RMA number is issued. Buyer must include a brief description of the nonconformity. Any actions for breach of this warranty must be brought within six months of the expiration of this warranty.

If DCS determines that a returned Product does not conform to the warranty in this section, it will either repair or replace that Product, at DCS' discretion, and will ship the Product back to Buyer free of charge. At DCS' option, DCS may choose to refund to Buyer the purchase price for a nonconforming Product instead of repairing or replacing it.

Units returned for service under this warranty and determined on examination to be operating properly are subject to a service charge.