



## **Model CD-AD**



**Microprocessor-based, Infrared  
Environmental CO<sub>2</sub> Sensor**

## **Operator's manual**

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**Date**

<b>12/1/02</b>	Initial Preliminary Release
<b>9/9/2005</b>	Removed thermistor feature & 'prelim' designator
<b>10/7/08</b>	Changed Fig2 for CD-AD+
<b>12/7/10 (V6)</b>	Changed gas cal instructions to work with all versions of firmware.
<b>2/9/11 (V7)</b>	Corrected SCFM flow rate for calibration to .002 to .004.

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## **Introduction**

The Kele Model CD-AD is a non-dispersive infrared analyzer for measuring environmental CO<sub>2</sub> concentration in ventilation systems and indoor living spaces. Its measurement range of 0 - 5000 ppm (parts per million; 1000 ppm = 0.1%) covers the range required to monitor compliance with ASHRAE or other ventilation efficiency standards.

Packaged in a compact, distinctively styled enclosure, the Model CD-AD can be discreetly installed anywhere from the board room to the boiler room. Standard center wiring access and fully floating outputs make installation a snap.

The Model CD-AD 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.

Terminals for connection to an optional thermistor are available. With the correct thermistor installed A direct temperature input can be provided to the controller.

A simple one-point calibration procedure and a built-in calibration port that requires no special fittings or adapters make the Model CD-AD simple to maintain.

## **Displays and Indicators**

The basic Model CD-AD 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<sub>2</sub> limit, and blinks whenever the concentration is above the limit.

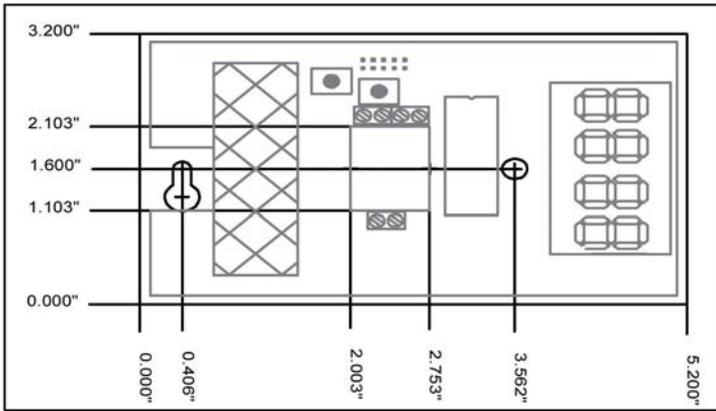
The standard factory high limit is 1000 ppm, but can be easily adjusted in the field. The procedure for adjusting the high CO<sub>2</sub> limit is described on page 11.

The display option adds a 4 digit liquid crystal display (LCD) to the front panel. The display shows the measured CO<sub>2</sub> 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	0 - 5000 ppm CO <sub>2</sub>	
Typical drift (per year)	±75 ppm (@ 1200ppm)	
Accuracy	±5% of reading or ±75 ppm, whichever is greater	
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 <sub>RMS</sub> AC, 18 - 30 VDC	
Power consumption	Less than 2W @ 24 VAC	
Calibration adjustments	Span only (offset electronically nulled)	
Calibration verification time	10 minutes typical	
Dimensions	5.2" x 3.2" x 1.4"	
Voltage output (linear)	0 - 10 volts DC standard	
Current output (linear)	4 - 20 mA (R <sub>L</sub> ≤ 500Ω)	
Warm-up time	3 minutes	
Weight	6.5 Oz. (.35 Kg)	
Optional Digital Display	4 digit, .35" LCD	
Optional High Limit Contact	setpoint range	0 to full scale
	contact polarity	jumper selectable
	contact rating	2A @ 24 VAC
Operating life expectancy	10 years typical	
Warranty	18 months, parts and labor through repair or exchange	

## Installation



**Figure 1:** *Kele Model CD-AD Mounting Dimensions*

### Cover Removal

To open the Model CD-AD 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.

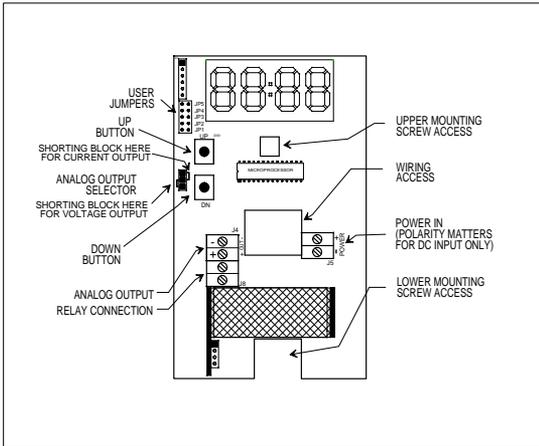
The locations of controls and terminals on the main circuit board are shown in the Figure 2 on page 4.

### Mounting

The Model CD-AD 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 CD-AD. Wiring enters the chassis through the cutout in the center of the unit.



**Figure 2:** Model CD-AD Component Locations

### **Power Supply**

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

**The model CD-AD 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 CD-AD provides either a 0 - 10 volt or a 4 - 20 mA current loop output at the two terminals of the analog output connector shown in Figure 2.

The type of analog output is determined by the setting of the analog output selector shown in Figure 2.

The analog output of the Model CD-AD 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 outboard and middle pins of the analog output selector are connected with the shorting block, a voltage output appears between the two terminals marked ANALOG OUTPUT. The output voltage increases linearly from 0 volts at the low output threshold to 10 volts at the high output threshold. The unit is shipped from the factory with the low output threshold at 0 ppm and the high output threshold at 2000 ppm. See the *Analog Output Range Adjustment* section on page 7 to change the analog output range limits.

### Current

When the inboard and middle 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 the low output threshold to 20 mA at the high output threshold. The unit is shipped from the factory with the low output threshold at 0 ppm and the high output threshold at 2000 ppm. See the *Analog Output Range Adjustment* section on page 7 to change the analog output range limits.

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

### **Verifying Voltage or Current Output Connection**

After the voltage or current output of the Model CD-AD is connected to a controller or indicator, the following check should be performed to ensure that the connection has been properly established and the Model CD-AD is transmitting the correct values:

1. **Be sure that the output select jumper is set correctly for voltage or current output. If this is not done first, the following check may produce incorrect results.**

**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 JP4 (see Figure 2). The display (if present) will show 'SEL'

2. Momentarily closing JP5 will set the unit to full scale output (10V or 20mA). Do not press the buttons on the unit as this will affect the output calibration.

If the receiving device does not indicate a full scale reading after JP5 is closed, verify that the wiring is correct.

3. Remove the shorting block from JP4 and restore it to its original position at jumper JP5. The Model CD-AD will reset and its output now corresponds to the actual detected CO<sub>2</sub> concentration.

### **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.

### **Analog Output Range Adjustment**

<p>This section refers to advanced features of the CD-AD. 2000 ppm users need not perform this adjustment.</p>
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The Model CD-AD ships from the factory set for an analog output range of 0 to 2000 ppm. This range can be changed to any sub-range between 0 and 5000 ppm by changing two parameters:

The **low output threshold** is the concentration at which the analog output will begin to rise. The factory default low output threshold value is 0.

The **high output threshold** is the concentration at which the analog output reaches its maximum value. The factory default high output threshold value is 2000.

For example, a particular application may require the analog output to remain at 0V or 4.0 mA until the gas concentration reaches 500 ppm, then reach 10V or 20 mA at a concentration of 1000 ppm. In this example the analog output would scale across this 500 ppm sub-range so that the analog output would be at half scale (5V or 12 mA) at 750 ppm.

To change the analog output range use the following procedure:

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 JP4 (see Figure 2 on page 4). The display (if present) will show 'SEL'.
2. The display (if present) will show 'SEL'. Momentarily closing a jumper selects which value to change. If the wrong jumper is selected simply open JP4 to restart the unit and begin again.

3. Select the low output threshold by momentarily closing JP1.  
If the display is present it will show the current low display threshold. If there is no display the value can be displayed using a meter connected to the analog output. In this calibration mode the analog output is 10,000 ppm at full scale (i.e. 10.0 volts or 20.0 mA). If the voltage output is selected, this scaling corresponds to 1 ppm per millivolt or 1000 ppm per volt.
4. Use the 'UP' and 'DOWN' buttons to adjust the low output threshold to the desired value. In the example this would be set to 500.
5. Remove the shorting block from JP4 to save the value; the unit will reset itself.
6. Reconnect JP4. The display (if present) will show 'SEL'. Select the high output threshold by momentarily closing JP2.  
If present, the display will show the high output threshold. If there is no display use a volt meter as described in step 3.
7. Use the 'UP' and 'DOWN' buttons to adjust the high output threshold to the desired value. In the example this would be set to 1000.
8. Remove the shorting block from JP4 and restore it to its original position at jumper JP5. The Model CD-AD will reset and its output will now only change when the gas concentration is within the range selected. Below this range the output remains low, above this range the output remains high.

## Altitude Correction

The Model CD-AD is factory-calibrated for operation at sea level. When operated at higher elevations, the calibration must be adjusted by the amount shown in the altitude correction table to the right.

### **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 CD-AD stabilize to the ambient CO<sub>2</sub> concentration, and record the reading in ppm.
2. Multiply the reading by the scale factor corresponding to the operating altitude in the altitude correction table.

<b>ALTITUDE CORRECTION TABLE</b>	
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

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 CD-AD's cover (see cover removal procedure on page 3).
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 4). Use the 'UP' and 'DOWN' buttons to change the concentration to the value just calculated.

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 6).

## **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<sub>2</sub> 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 is available from the factory.

To verify the Model CD-AD's calibration, proceed as follows:

1. Remove the front cover of the unit (see procedure on page 3).
2. If there is no display on the unit being calibrated, connect a current or volt meter to the analog output terminals. Check the setting of the analog output selector (see Figure 2 on page 4) to determine whether the unit is set for voltage or current output.
3. Remove the dust cover from the calibration nipple, attach a flexible tube and establish a flow of between 50 and 100 cc/min (0.002 to 0.004 SCFM) of calibration gas through the sensor. Allow approximately two minutes for the reading to stabilize.
4. If the reading differs by less than  $\pm 50$  ppm from the known concentration of the calibration gas, no adjustment is recommended; proceed directly to step 7.

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 4).

5. Use the 'UP' and 'DOWN' buttons (see Figure 2 on page 4) to adjust the reading.
6. 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.
7. 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 6).

## **High CO<sub>2</sub> Limit**

An adjustable high CO<sub>2</sub> limit is a standard feature of the model CD-AD. The front panel LED changes from steady to blinking when the indicated concentration is above the high CO<sub>2</sub> limit value. An optional contact closure is available which opens or closes when the high limit is exceeded.

### **Adjusting the High CO<sub>2</sub> Limit**

The setpoint value is adjusted by closing jumper JP3 (see Figure 2 on page 4). If the display is present when JP3 is closed it will show the current high limit setpoint in ppm CO<sub>2</sub>.

If there is no display this setting can be adjusted by using a meter connected to the output. In this calibration mode the analog output is 10,000 ppm at full scale (i.e. 10.0 volts or 20.0 mA). If the voltage output is selected, this scaling corresponds to 1ppm per millivolt or 1 volt per 1000 ppm.

The setpoint 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.

The setpoint hysteresis is approximately 40 ppm.

## **Optional High Limit Contact**

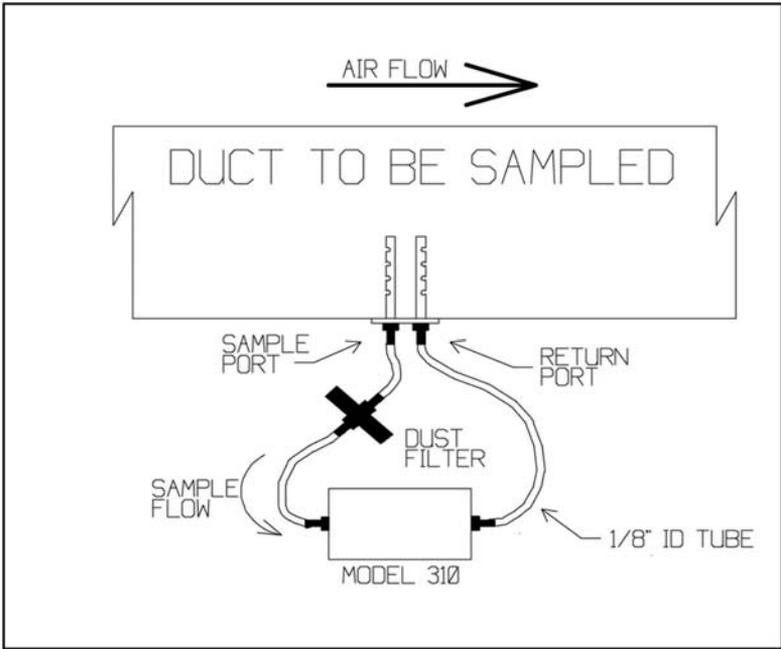
The high CO<sub>2</sub> limit option provides a dry (i.e. unpowered) contact closure that activates when the detected concentration rises above the high CO<sub>2</sub> limit. The high limit is adjustable from 0 to full scale of the unit

### **Setting High Limit Contact Polarity**

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

<b>Jumper JP5</b>	<b>Relay Operation</b>
OPEN	normally closed opens above setpoint
CLOSED (factory default)	normally open closes 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 removed; it is required during the calibration procedure.



**Figure 3:** *Duct Sampling Schematic*

## **Duct Sampling Option**

### **Overview**

The duct sampling option is used to divert a portion of the duct airflow through the Model CD-AD. The difference between the total pressure at the upstream sample port and the static pressure at the downstream return port propels the sample stream. Minimum recommended flow rate is 200 feet per minute.

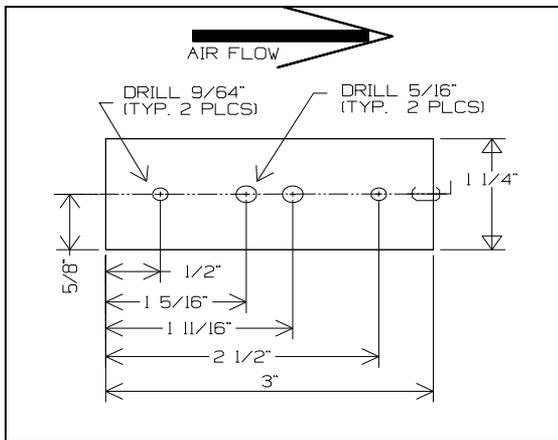
A Model CD-AD with the duct sample option has a sample draw adapter fitted to the bottom of its enclosure. The duct probe assembly is connected to tubing nipples on the adapter.

### Duct Kit Contents

- |                       |                             |
|-----------------------|-----------------------------|
| 1 dust filter         | 2 sheet metal screws        |
| 1 duct probe assembly | 2 lengths of 1/8" ID tubing |

### Duct Kit Installation

- 1) Select a point along the duct where the probe assembly can be installed into unrestricted airflow without interfering with any internal duct components such as dampers, radiators, etc.
- 2) Mark and drill the four holes for the duct probe as shown in Figure 4. The centerline must be parallel to the air flow through the duct.
- 3) Install the duct probe assembly through the holes just drilled. **The sample port must be on the upstream side.** Secure the probe assembly in place with the two sheet metal screws.
- 4) Connect the open ends of the two tubes from the probe assembly to the two sample ports on the base of the Model CD-AD. It makes no difference which tube is connected to which port on the Model 310.



**Figure 4:** *Duct Probe Installation Dimensions*

## **Disclaimers and Notices**

### **Safety Critical Applications**

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

### **Limited Warranty and Remedies.**

Kele warrants to Buyer of the Kele Model CD-AD 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 Kele. 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 Kele; or
- Problems that arise from lack of compatibility between Kele' 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 Kele' Products, and the purposes for which Kele' Products are used are appropriate and compatible with those Products.

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To obtain service under this warranty, unless Kele 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 Kele determines that a returned Product does not conform to the warranty in this section, it will either repair or replace that Product, at Kele's discretion, and will ship the Product back to Buyer free of charge. At Kele's option, Kele 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.

