# CD-P00-U Series Duct Carbon Dioxide Transmitter Installation Guide

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## Introduction

The CD-P00-U Series Duct $CO_2$ Transmitter uses a highly accurate and reliable nondispersive infrared (NDIR) sensor in an IP67 (NEMA 4) enclosure with a hinged and gasketed cover and sampling probe for duct applications to monitor $CO_2$ levels. The sensor uses dual channel optics and LTA (longterm adjustment) signal processing technology to deliver industry leading longterm accuracy and reliability. These technology features ensure optimum measurement stability for both periodic and constant occupancy applications, so the device is equally suitable for return-air investment from the classroom or the hospital room.

Standard features include:

- Versatile field-selectable output signal of 4 mA to 20 mA, 0 VDC to 5 VDC, or 0 VDC to 10 VDC
- Programmable $CO_2$ measurement span
- Backlit alpha-numeric LCD
- Easy menu operation for configuration

Optional feature:

- Resistive temperature sensor output with LCD temperature display in °C or °F

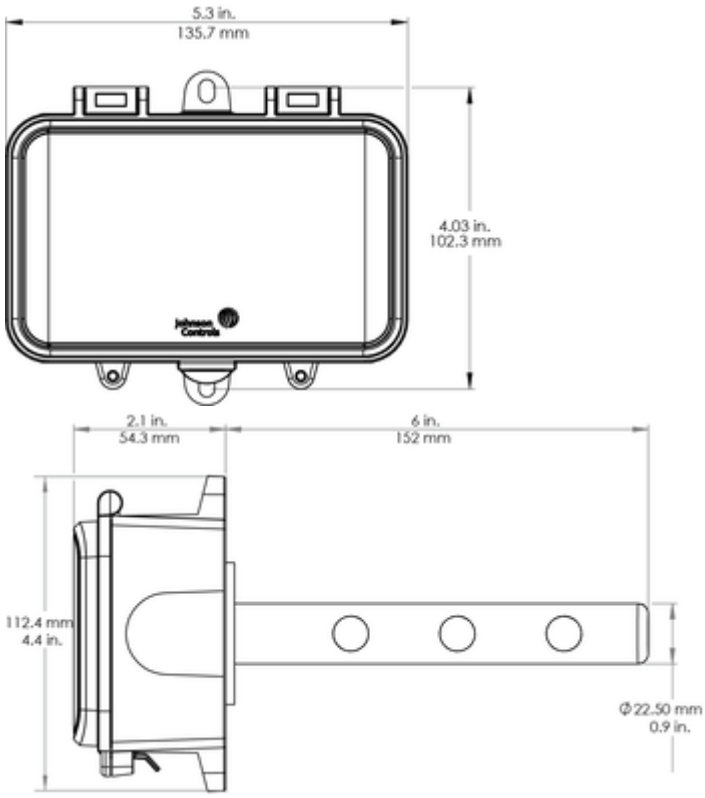
**Figure 1. CD-P00-U Series Duct Carbon Dioxide Transmitter**

WARNING

Do not use in an explosive or hazardous environment, with combustible or flammable gases, as a safety or emergency stop device, or in any other application where failure of the product could result in personal injury. Take electrostatic discharge precautions during installation and do not exceed the device ratings. De-energize the power supply prior to installation. This device is intended for indoor air conditioned spaces, contact factory, or other applications. This product is not intended for life-safety applications.

# Dimensions

**Figure 1. Dimensions of the CD-P00-U Series Duct Carbon Dioxide Transmitter**




# Before installation

Read the installation instructions carefully before you install and commission the device. Failure to follow these instructions may result in product damage.

**Note:** This $CO_2$ sensor incorporates a self-calibration feature to correct $CO_2$ sensor drift. Use the self-calibration feature for applications where the $CO_2$ is exposed to fresh air (400 ppm) at least 1 h each day. If the monitored space has 24 h occupancy or consistently maintains higher or lower levels of $CO_2$, turn off the self-calibration feature and perform a yearly calibration. If you disable the self-calibration feature at installation time without an allowance for the 7 day auto-calibration cycle, then perform a manual calibration to ensure the accuracy of the device.

# Mounting

# Procedure

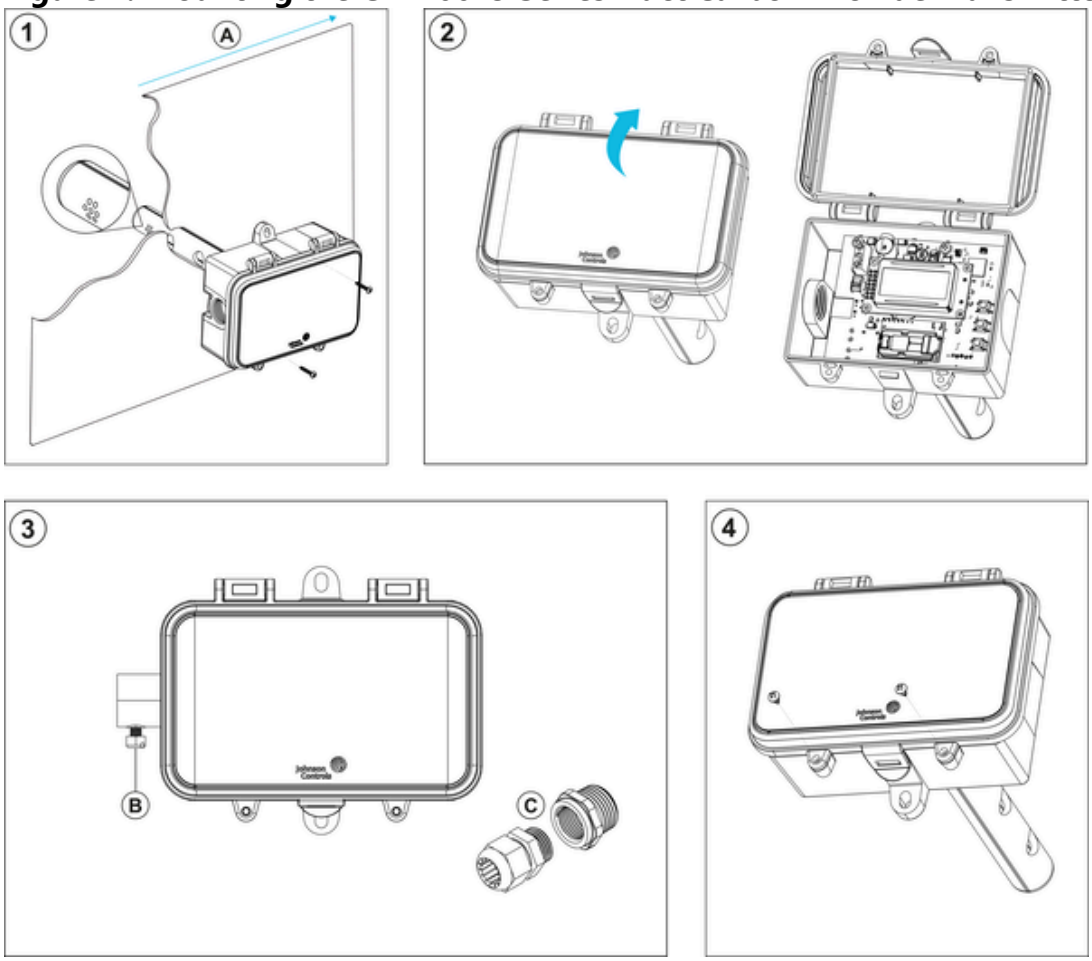
The duct type sensor installs on the outside of a return air duct with the sampling tube inserted into the duct. Use the included foam plug to prevent air from entering the enclosure through the conduit, which may cause an incorrect reading.

Mount the sensor in an easily accessible location in a straight section of duct at least five feet from corners or other items that may cause disturbances in the air flow. Avoid areas that expose the detector to vibrations or rapid temperature changes.

The duct $CO_2$ detector principle of operation is based on the Venturi effect of the probe that extends into the HVAC duct. The flow of air through the duct is forced into the vent holes on one side of the probe, into the enclosure, over the $CO_2$ sensor and is then drawn back out of the enclosure through the probe vent holes on the opposite side.

**Note:** To ensure correct temperature readings, if present, install the temperature inlet on the probe directly into the airflow. See Step 1 of the following figure.

**Figure 1. Mounting the CD-P00-U Series Duct Carbon Dioxide Transmitter**




| Callout | Description |
|---|---|
| A | Direction of airflow |
| B | EMT connector, included |
| C | Thread adapter and cable gland fitting, not included |

1. Drill or punch a 7/8 in. (23 mm) or 1 in. (26 mm) hole in the duct at the preferred location and insert the probe into the hole to mark the enclosure mounting holes. Remove the unit and drill the two mounting holes.
2. Clean all drilled holes of debris before you mount the device. Mount the enclosure to the duct with two sheet metal screws such that the duct air flow is parallel with the vent holes in the probe and air flows directly into the probe

holes. To prevent air leaks, ensure the gasket compresses around the probe between the device enclosure and the air duct. See Step 1 of Figure 1.

3. The enclosure has a hinged cover with a latch. To open the cover, pull slightly on the latch on the bottom of the enclosure and at the same time, pull on the cover. See Step 2 of Figure 1.
4. A 1/2 in. (13 mm) NPT threaded connection hole is provided in the side of the enclosure. Screw in an EMT connector or cable gland connector until tight. Use a weatherproof conduit or cable gland fitting. There is an optional 1/2 in. (13 mm) NPT to M16 thread adapter and cable gland fitting. See Step 3 of Figure 1.
5. Two security screws are provided for the installation to help secure the cover after the completion of settings and wiring connections. See Step 4 of Figure 1.

# Wiring

**Important:**

- Deactivate the power supply until you make all connections to the device to prevent electrical shock or equipment damage.
- Use 16 AWG to 22 AWG shielded wiring for all connections
- Do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors.
- Only ground the shield at the controller end.
- Pull at least 6 in. (152 mm) of wire into the enclosure and complete the wiring connections according to the wiring diagram. See the following figure.

**Figure 1. Connector layout for non-temperature sensor model**

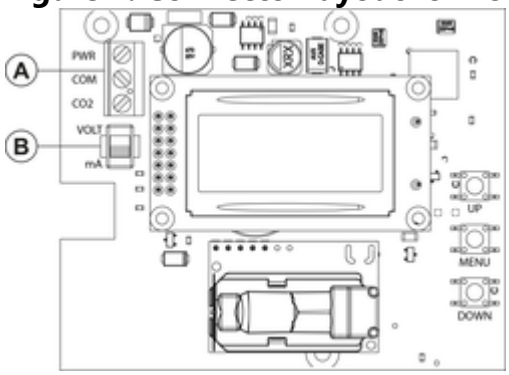
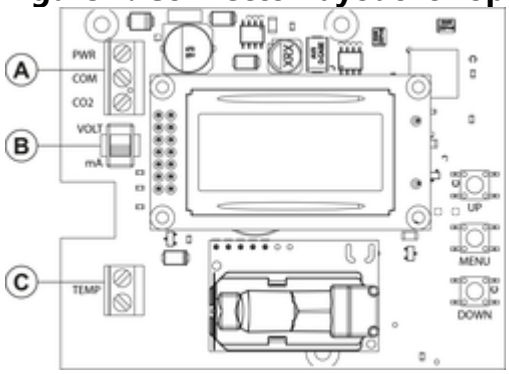


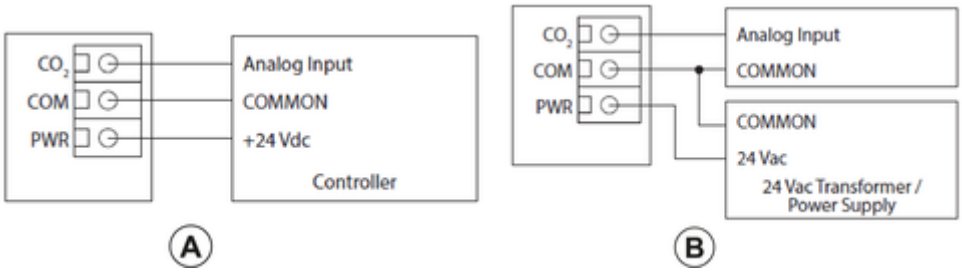

**Figure 2. Connector layout for optional temperature sensor model**



| Callout | Description |
|---|---|
| A | See Figure 3. |
| B | See Figure 4. |
| C | See Figure 5. |

This is a 3-wire sourcing device. Connect the plus DC or the AC voltage hot side to the PWR terminal and connect the COM to the COM terminal. The device is reverse voltage-protected and does not operate if connected backwards. The device has a half-wave power supply so the supply COM is the same as the signal COM. You can connect several devices to one power supply and the output signals all share the same COM. Use caution when you ground the secondary of a transformer or when you wire multiple devices to ensure the ground point is the same on all devices and the controller. See the following figure.

**Figure 3. Wiring for all output signals**

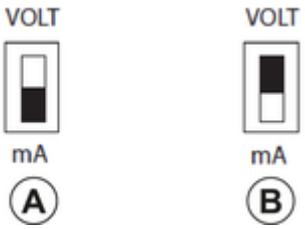



| Callout | Description |
|---|---|
| A | Wiring for $CO_2$ output signal and 24 VDC power from controller |
| B | Wiring for all output and external 24 VAC power transformer or external 24 VAC power supply |

The $CO_2$ analog output is available on the $CO_2$ terminal. This signal is switch-selectable for either 4 mA to 20 mA or voltage output of 0 VDC to 5 VDC or 0 VDC to 10 VDC and connects to the controller analog output. See Figure 4. Check the controller analog input to determine the correct connection before you apply power. The COM terminal references both current and voltage signals. The current output operates in the active mode and does not require a loop power supply.

**Important:** The transmitter generates the signal current. To prevent damage to the device, do not connect the transmitter to a powered input.

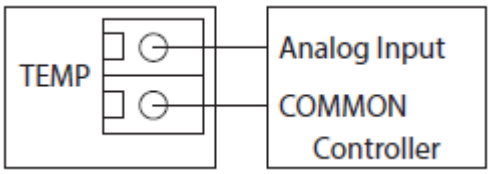
**Figure 4. Signal selector**



| Callout | Description |
|---|---|
| A | Current, 4 mA to 20 mA |
| B | Voltage, 0 VDC to 5 VDC or 0 VDC to 10 VDC |

The optional 2-wire temperature sensor output is available with various RTDs and thermistors to suit all control applications and is available on the TEMP terminals. See the following figure.

**Figure 5. TEMP terminals**




# Output scaling

The $CO_2$ output signal is scaled such that 4 mA to 20 mA, 0 VDC to 5 VDC, or 0 VDC to 10 VDC equals 0 ppm to 2000 ppm by default. You can change the signal span through the Setup Menu from 1000 to 10,000 ppm in 500 ppm increments.

# Start-up mode

Verify that the device is correctly wired and that the connections are tight. Ensure that the mA or VOLT switch is set for the correct signal type. Apply power and the LCD indicates the software version number, the output signal type, and then the sensor begins a 1 min warm-up countdown. When the warm-up time expires, the device enters normal mode.

# Normal mode

The sensor begins reading the $CO_2$ level, and temperature if you install the optional sensor, outputs the correct analog signal and displays the values on the LCD. The keypad is monitored and, if you press the MENU button, the device enters the Setup Menu. Access the Setup Menu to configure the device for the required operation.

# Using the setup menu

# Procedure

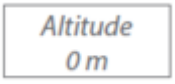
The device has several parameters that you configure locally through the Setup Menu with the keypad and internal LCD. Any changes made save in non-volatile memory and restore in case of a power loss. You can access the Setup Menu at any

time after the start-up mode and, if there is 5 min of inactivity, the Setup Menu closes, and normal operation continues.

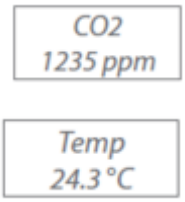
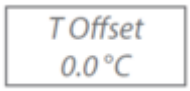
To set up the device parameters, complete the following steps:

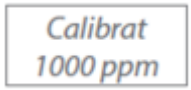
1. To enter the first step of the Setup Menu, press and release the MENU button.
2. Press the MENU button a second time to save the setting and advance to the next step. Each press of the MENU button saves the current setting and advances to the next menu item.
3. Press the UP or DOWN buttons to scroll through the available options to change the program variables. In the following table, the Specification column shows the LCD display and the default value.

**Table 1. CD-P00-U Series Duct Carbon Dioxide Transmitter setup menu**

| Specification | Description |
|---|---|
| Span<br>  | The $CO_2$ span value controls the analog output scaling. Use UP or DOWN to change the $CO_2$ span from 1000 ppm to 10,000 ppm in 500 ppm increments. If $CO_2$ span = 2000 ppm, then the output signal is scaled 0 ppm to 2000 ppm = 0 VDC to 10 VDC. The factory default is 2000 ppm. |
| Self-calibration<br>  | An enabled Self-Cal feature requires exposure of the sensor to fresh air (400 ppm) for at least 1 h every 24 h. When first installed, the sensor requires a minimum of 7 days of operation with daily fresh air exposure to enable the algorithm to adjust for self-calibration. The default status for the device is Self-Cal enabled ON. If you disable this feature, perform a manual calibration to ensure accuracy of the device. |
| Altitude<br>  | The Altitude value enables $CO_2$ compensation for local atmospheric pressure and altitude and ensures the highest $CO_2$ accuracy. Use UP or DOWN to change the altitude from 0 m to 2550 m in 50 m steps. The factory default is 0 m, which is sea level. |
| Output voltage span<br>  | The V Output value controls the analog output voltage span if the PCB switch is set to VOLT. Use UP or DOWN to set V Output to either 0 VDC to 5 VDC or 0 VDC to 10 VDC. This setting has no effect if the PCB switch is set to mA. The factory default is 0 VDC to 10 VDC. |
| Output signal direction | The Output value controls the analog output signal direction. Use UP or DOWN to change the setting from Direct (4 mA to 20 |

| Specification | Description | | |
|---|---|---|---|
| Output Direct | mA, 0 VDC to 5 VDC, or 0 VDC to 10 VDC) to Reverse (20 mA to 4 mA, 5 VDC to 0 VDC, or 10 VDC to 0 VDC) if you require the reverse action. The factory default is Direct. | | |
| Output test<br>Output Test OFF | The Output Test value controls the analog output signal for testing purposes. Use UP or DOWN to toggle the output signal to OFF (normal operation), MIN (minimum output) or MAX (maximum output). The actual output signal depends on the PCB switch position (mA or VOLT) and the V Output setting for voltage operation. Press MENU to set it back to OFF and advance. The factory default is OFF. | | |
| Temperature units, only for temperature models<br>Temp Units °C | Use the Temp Units setting to select °C or °F display of temperature. Use UP or DOWN to select. The factory default is °C. | | |
| Display<br>Display CO2 ppm | Use the display to control what information displays on the LCD. The selections depend on the installed options. Use UP or DOWN to select either $CO_2$ ppm, Temp, $CO_2$ and Temp, Rotate, or None. The factory default is $CO_2$ ppm. For a basic $CO_2$ only device, the selection is limited to $CO_2$ ppm or None. | | |
| | $CO_2$ ppm | Only the actual ppm value of the $CO_2$ reading displays. | CO2 1235 ppm |
| | Temp | Only temperature displays, °C or °F depends on units setting | Temp 24.3 °C |
| | $CO_2$ and Temp | $CO_2$ ppm and temperature both display at the same time | 1235 ppm 24.3 °C |

| Specification | Description | | |
|---|---|---|---|
| | Rotate | All available sensor readings rotate at 2 s intervals |  |
| | None | No measurement information displays in normal mode and the menu still displays in Setup Menu mode. | |
| Backlight<br>  | Use the BackLite setting to control how the LCD backlight functions. Use UP or DOWN to select either Auto, Off, or On. In Auto mode, the backlight only lights when you access a menu or when you press a key, Off means the backlight is always off, and On means the backlight is always on. The factory default is Auto. | | |
| Temperature offset, only on temperature sensor models<br>  | The T Offset value enables calibration of the temperature value that displays on the LCD. The units (°C/°F) follow the Temp Units setting. Use UP or DOWN to add or subtract an offset from the temperature value. The range is -5.0°C to 5.0°C (-9.0°F to 9.0°F) in 0.1° increments. The factory default is 0.0°C. | | |
| $CO_2$ calibration<br>  | The calibration reference screen enables the user to set the calibration gas level to calibrate the sensor. Use UP and DOWN to adjust the ppm value of calibration gas. The min value is 400 ppm, the max value is 2000 ppm. Increment value is 50 ppm for each step. Press MENU to save and advance. If no calibration gas is available, expose the sensor to fresh outdoor air and calibrate with 400 ppm value. Another method is to use a calibrated unit as a reference to determine the $CO_2$ ambient level and adjust the calibration setting to the required value. | | |

| Specification | Description |
| --- | --- |
| $CO_2$ calibration<br>  | Use the calibration screen to perform calibration of the sensor. To perform calibration of the sensor, place the calibration hood over sensor housing and apply calibration gas. Wait for several min and then press and hold UP or DOWN for five s until the display shows Calibrat Done or Calibrat Fail. See Calibration for more details. |

4. For each setting, press and release the MENU button to save the setting to memory and advance to the next menu item.

# Calibration

# Procedure

Calibration with gas requires a field calibration kit with pressure regulator, tubing, sensor adapter, and a bottle of $CO_2$ gas. Apply the certified calibration gas directly to the $CO_2$ sensor to perform a gas calibration. To calibrate the sensor, complete the following steps:

1. Connect a length of tubing between the regulator output and the sensor adapter hood.
2. Ensure to turn off the regulator knob and then hand tighten the regulator to the $CO_2$ gas bottle.
3. Remove the cover of the device to expose the gas sensor.
4. Carefully install the sensor adapter hood over the $CO_2$ sensor on the PCB. To ensure a stable ppm $CO_2$ environment during calibration, ensure the adapter fits snuggly and securely over the sensor and remains in place during the entire calibration cycle.
5. Turn the regulator knob on to enable gas to flow to the sensor. The $CO_2$ reading on the LCD begins to approach the ppm level of the calibration gas.
6. Wait 3 min to 5 min until the $CO_2$ reading stabilizes.
7. Enter the Setup Menu and use the MENU key to advance to the Calibrat item.
8. Press and hold either UP or DOWN for 5 s to start the gas calibration.
9. The LCD indicates Calibrat Done if the process is successful or displays Calibrat Fail if you need to repeat the process.
10. When calibration completes, press MENU to return to normal operation, shut off the gas supply, and remove the sensor adapter.

# Technical specifications

**Table 1. CD-P00-U Series Room Carbon Dioxide Transmitter technical specifications**

| Specification | Description | |
|---|---|---|
| Purpose of control | Operating control | |
| Action | Type 1 | |
| Pollution degree | 2 | |
| Impulse voltage | 330 V | |
| Gas type detected | $CO_2$ | |
| Sensor type | Dual channel NDIR | |
| Sensor accuracy | ±30 ppm + 3% of measured value | |
| Measurement range | 0 ppm to 2000 ppm (default), adjustable 1000 ppm to 10,000 ppm | |
| Pressure dependency | ±2.5 ppm/°C | |
| Response time | 20 s (T63) | |
| Warm-up time | 1 min | |
| Sensor lifespan | > 15 years | |
| Transmitter accuracy | ±0.25% of span including linearity, hysteresis, and repeatability | |
| Power supply | 24 VDC ±20% or 24 VAC ±10%, non-isolated half-wave rectified | |
| Protection circuitry | Reverse voltage-protected and transient-protected | |
| Input voltage effect | Negligible over specified operating range | |
| Output signal type | 4 mA to 20 mA (3-wire), 0 VDC to 5 VDC, 0 VDC to 10 VDC, field-selectable | |
| Current consumption | Current | 75 mA @ 24 VDC max, 150 mA @ 24 VAC max |
| | Voltage | 50 mA @ 24 VDC max, 100 mA @ 24 VAC max |
| Output drive @ 24 VDC | Current | 550 ohm maximum |
| | Voltage | 10k ohm minimum |
| Ambient operating range | 32°F to 122°F (0°C to 50°C), 0% RH to 90% RH, noncondensing | |
| Storage conditions | -40°F to 158°F (-40°C to 70°C), 0% RH to 95% RH, noncondensing | |
| LCD display units | ppm for $CO_2$, °C/°F | |
| Display range | 0 ppm to 10,000 ppm, 32°F to 122°F (0°C to 50°C) | |

| Specification | | Description | |
|---|---|---|---|
| Display size, H x W | | 0.6 in. x 1.4 in. (15 mm x 35 mm) | |
| Digit height | | 2-line x 8 characters | |
| Optional temperature sensor | Sensor type | 10k ohm Type 2, NTC thermistor | |
| | | 1k ohm platinum, IEC 751, 385 Alpha, thin film | |
| | Sensor accuracy | Thermistor | ±0.36˚F (±0.2°C) @ 77°F (25°C) |
| | | Platinum RTD | ±0.54˚F (±0.3°C) @ 32°F (0°C) |
| | Output | 2-wire resistive | |
| Enclosure material | | Polycarbonate | |
| Enclosure rating | | IP65 (NEMA 4) with security screw installed | |
| Dimensions | Enclosure, H x W x D | 4.4 in. x 5.3 in. x 2.1 in. (112.4 mm x 135.7 mm x 54.3 mm) | |
| | Probe, L x D | 6 in. x 0.9 in. (152 mm x 22.5 mm) | |
| Wiring | | Screw terminal block, 14 AWG to 22 AWG | |
| Country of origin | | Canada | |
| Compliance  | | CE Mark - Johnson Controls declares that this product is in Compliance with the essential requirements and other relevant provisions of the EMC Directive and RohHS Directive. | |

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.