

User Manual: TR9277-EO



Overview

The TR9299-EO is a wall mounted, wireless communicating, Temperature, RH and CO₂ sensor that derives its power from harvesting ambient indoor light. The CO₂ measurement is also automatically altitude corrected using a very sensitive (\pm 3ft) absolute pressure sensor. The device can also be populated with a button battery (not included) to provide backup power for up to 5 years of operating time. The product is designed to operate with 3rd party receivers, controllers and gateways designed for EnOcean compatible wireless networks.

There are different versions of the TR9299-EO available depending on the radio frequency used.

- TR9277-EO-A : 902 MHz for North America applications
- TR9277-EO-B: 868 MHz for applications in Europe and China
- TR9277-EO-C: 928 MHz for applications in Japan (Not currently available).
- TR9277-EO-D: 315 MHz for applications in Asia

NOTE: The TR9277-EO is a solar powered device that absorbs solar energy storing it for use during low light periods. Before assigning this transmitter to a receiver/ controller, the device should be exposed to a good light source for a minimum of 2 hours.

NOTE: It is highly recommended that a CR2032 Coin cell battery be installed in the transmitter for installation and commissioning. If left in the transmitter it will provide a long-term battery backup.

Link To Product Datasheet: www.AirTest.com/support/datasheet/TR9277eo.pdf

TR9277-EO
Light Harvesting CO₂, Temperature and Humidity Sensor Manual

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1. Light Harvesting Transmitter Description

The TR9277-EO is a wireless, energy-harvesting sensor that measures the following parameters:

- Temperature: monitors room temperature in the range of 0-51°C (32° - 124°F).
- Relative humidity in the range of 0-100% .
- Carbon dioxide (CO₂) in the range of 0-2000 ppm (pressure attitude corrected for increased accuracy).

A button on the lower right edge of the sensor body can be used to go into test mode (when the button is held down, see “Test Operating Modes”).

The TR9277-EO transmits to a receiver, controller or gateway that is typically used for environmental control of a conditioned space. The TR9277-EO and receiving device must be within range, preferably in the same room and installed within 80’ (24.4 m) of each other. For applications exceeding 50’ (15.2 m) range, greater care must be taken to insure proper reception of the sensors transmissions at the receiver, refer to sections “Test Operating Modes” and ‘Installing Wireless Devices”.

Even with a brief exposure to light the sensor will operate; however for best results the sensor should be mounted in a location with exposure of 4 hours of natural or artificial light on a daily basis.

The TR9277-EO transmits status telegrams that contain the information defined within an equipment profile. The profile for this device is **A5-09-04**. Other profiles are in development to allow utilization of the on-board pressure sensor and a dew point output.

2. Operation

In order to best manage power, the transmitting interval of the TR9299-EO is automatically managed dependent on ambient light levels, rate of measurement change and amount of power stored in the sensor. Telegrams are sent at the following intervals:

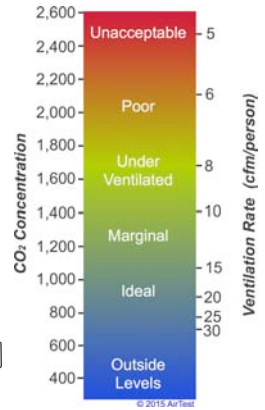
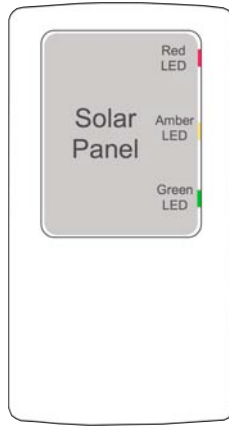
- If the temperature change between last transmitted value and the current sample is > 0.6°C (1.1°F), the sensor will transmit immediately.
- If the RH value change between last transmitted value and the current sample is > 3%, the sensor will transmit immediately.
- If the CO₂ value change between samples is > 200 ppm, the sample and heartbeat rate shall adjust to 300 sec (5 min) for 1 sample period
- The CO₂ sample rate value is derived from three consecutive readings from the COZIR sensor averaged with the previous transmitted value, level 1 and 2 only. For level 3, only the 3 readings taken during the current sample are averaged.

Ambient Light	Temp/ RH/ Dew Point Sampling Rate	CO2 Sampling Rate	Heartbeat Rate
> 200 lux (18.5 FC)	16 sec	300 sec (5 min)	300 sec (5 min)
< 200 lux (18.5 FC)	32 sec	600 sec (10 min)	600 sec (10 min)
< 50 lux for 16 hours	64 sec	1200 sec (20 min)	1200 sec (20 min)

3. CO₂ LED Indication

There are 3 LEDs located on the right side of the solar panel. The TR9277-EO will provide an indication of the current CO₂ measurement range by flashing every 15 seconds (with sufficient light, > 5 foot-candles or 50 lux). Ranges indicated by the flash are as follows:

- Green=< 1100 ppm (Good ventilation/air quality)
- Yellow= 1100-1,500 ppm (marginal ventilation/air quality)
- Red= >1,500 ppm (low ventilation & potentially poor air quality)
- Note: These LEDs are also used for the test function modes of the sensor.



It is to take and read a current CO₂ value by pressing the function button on the side of the unit and interpreting the LED flashes into a CO₂ concentration where a LED Blink has the following value: Green blinks = 500 ppm/blink, Amber blinks = 100 ppm/blink, Red blinks = 25 ppm/blink

4. Installation

The TR9299-EO can be mounted on any surface; glass, stone, concrete, wallboard, cubicle partitions, etc. The sensor can be mounted using screws (not supplied) through the removable back plate (2 keyholes or using double-sided tape or Velcro™ (not supplied)).

The mounting location of the wireless transmitter is important, as this will directly affect the receiver's reception of the telegrams. Before installing, refer to following sections in the guide detailing the installation of wireless devices, layout tips and the test operation modes.

1. The TR9277-EO has a removable back plate. The back plate has a security feature which requires a tool for the removal of the device from the back plate. To remove the back plate, insert a flat head screw driver, into the slot and exert torque on the key tab to separate the back plate from the housing body as shown in the photos. Once the tab is free, pull the body away from the back plate.
2. Mount the back plate to a bracket or the wall surface in a vertical orientation with the plastic key on the bottom. There are keyholes in the back plate that mate with standard electrical box screw patterns. Alternatively, you can mount the sensor using double sided tape or Velcro® (not supplied).
3. Once the back plate has been secured to the wall or mounting bracket, align the two top alignment tabs on the back plate with the temperature sensor body and press the lower edge over the plastic key until it clicks in place.



5. Linking the TR9277-EO Sensor to a Receiver

This process requires the controller or receiver to be mounted and powered and within range of the TR9277-EO sensor to be linked.

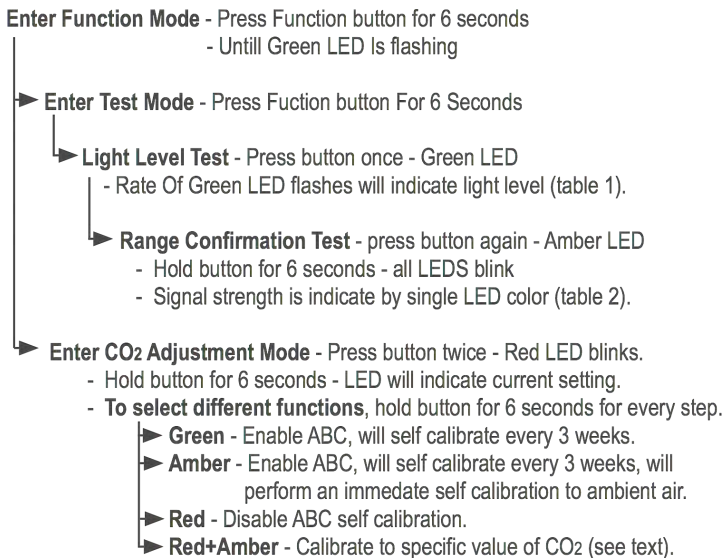
The sensor is a solar powered device that absorbs energy through a solar panel storing it for use during low light periods. Before assigning the sensor to a receiver/controller, the device must be exposed to a good light source for a minimum of 2 hours, or install the optional start assist battery (not supplied).

1. Remove the sensor from the back plate by pressing in on the tab on the bottom of the sensor and pulling away from the back plate.
2. Activate LEARN or LINK mode at the receiver, if necessary refer to the manufacturers documentation.
3. Press the temperature sensors Link (Teach) button.
4. Deactivate LEARN mode at the receiver.



6. Using The Adjustment and Test Functions

The TR9277-EO uses a single button interface to allow installers and users to make adjustments to the sensor and utilize built-in test functions. Pressing the "function" button at the right side of the sensor at different intervals allows navigation to different functions. Feedback is provided by observing the color and sequence the LEDs at the side of the solar panel (see section 3). A navigation chart is provided below with more detailed instructions provided in the sections following.



7. Test Operating Modes

Ensure the TR9277-EO is fully charged before entering test modes. Inserting a battery during test modes is also recommended. The following tests can be selected when in test mode.

7.1 Light Level Test

This test provides visual feedback of the immediate energy produced by the solar panel.

1. To enter Light Level Test mode, press and hold the occupancy/ test button for 6 seconds. The **Green** LED will begin to blink.
2. Press the test button again for 6 seconds to select Light Level Test. The **Green** LED will blink in accordance to the light level it is detecting. There will be a 2 second lag time.
3. Hold the sensor in the location you are thinking of installing the sensor and check the light level using the chart below.
4. The test will repeat every 2 seconds and run for a duration of 100 seconds. You may quit the test at any time by pressing the test button for 6 seconds.

Note: Entering test mode section: If the **Red** LED blinks (no **Green** LED) after you have released the test mode button, place the sensor under a lamp with at least 100 foot-candles (1000 lux) for 1 hour before retrying.

Table 1: Light Level Test Table

The green LED will blink according to the energy produced by the solar cell

Blinks	Approx Lux	Foot Candles	Time to Fully Charge	Discharge In Dark
0	0	< 4.6	Non operational	n/a
1	50-100	4.6 – 9.3	Operational	n/a
2	100-200	9.3 – 18.6	32 hours to full charge	72 hours
3	200-500	18.6 – 246.5	16 hours to full charge	72 hours
4	500-1000	46.5 - 92.9	8 hours to full charge	72 hours
5	1000+	+ 92.9	4 hours to full charge	72 hours

The time to fully charge is based on the storage capacitor charging from a non-operational condition. Discharge time indicates how long a fully charged sensor will operate in the dark. The test will repeat every 2 seconds and run for a duration of 100 seconds. You may quit the test at any time by pressing the test button for 6 seconds.

7.2 Range Confirmation Test (Insertion of a battery is highly recommended)

This test provides visual feedback of the sensors signal strength by a linked receiver with range confirmation capability (only “F series” controllers have range confirmation ability). One and only one receiver can be linked to the sensor for proper operation of the test. (Disable repeaters in range for proper test operation).

1. To enter Range Confirmation Test mode, press and hold the occupancy/ test button for 6 seconds. The green led will begin to blink.

2. A quick press and release of the button at this point will allow you to select between light level test (**Green** LED) and range confirmation test (amber). When the **Amber** LED is blinking, go to step 3. (If the 3 LEDs fail to blink during this test, place under a lamp with at least 100 fc (1000 lux) for 1 hour before retrying.)
3. Press and hold the test button again for 6 seconds to select Range Confirmation Test.

All three LED's can blink in this test mode when the sensor transmits or receives a Range Confirmation Telegram. The sensor will display the signal strength status for 5 seconds, see table below.

Table 2: Range Confirmation Test Table

<i>LED</i>	<i>Signal Strength</i>
Green	> -70 dbm
Amber	< -70 dbm, > -80 dbm
Red	< -80 dbm

The test will repeat every 10 seconds and run for a duration of 3 minutes. You may quit the test at any time by pressing the occupancy/test button for 6 seconds.

7.3 CO₂ Sensor Calibration & Set Up

There are two types of adjustments that can be made to the CO₂ sensor:

- Turn off or on the Automatic Background Calibration (ABC) feature.
- Commissioning/Calibrating the sensor to outside air or a known value.

7.3.1 Automatic Background Calibration Activation

The **Automatic Background Calibration (ABC)** is a feature that looks at the lowest level of CO₂ that occurs over a 3 week period and assumes it is an outside background level of 420 ppm. This feature works best where the space being monitored is periodically unoccupied for 8 hours or more in evenings or weekends at least once in a typical 3 week period. When in this mode there should be no need to calibrate the sensor over its operating life. The ABC feature is on by default.

If the space being monitored is occupied 24/7 or is an industrial or greenhouse operation where elevated CO₂ levels may be sustained over long periods of time, then the ABC feature should be turned off.

7.3.2 Calibration/Commissioning Modes (Insertion of a battery is highly recommended)

It is recommended that the installer perform an ambient air calibration of the TR9277-EO as part of the installation process. This process takes 10–15 minutes and can be performed on site or prior to visiting the site. Multiple sensors can be calibrated at the same time.

1. Place the sensor(s) in outside air above 32°F (0°C), and out of direct sunlight for 10 to 15 minutes. Avoid breathing in the vicinity of the sensor during this process.
2. Follow the process outlined below for performing an ambient air calibration. Again avoid breathing directly on the sensor when activating the function button.
3. Once calibration is initiated, the Amber LED will blink rapidly. Put the sensor down and stay away from the area for 2 minutes while the calibration process occurs.
4. Once the calibration is complete the Green LED will blink 10 times and return to normal operating mode.

There is also an option to set a specific value for the CO₂ sensor to calibrate to. The process for doing this is explained in detail below. It is important to note that any calibrations should be done so that the air around the sensor is at the concentration to be used for calibration. Flowing calibrated gas through a tube to the inside of the sensor is not a valid or accurate method of calibration.

For commissioning purposes, the best way to evaluate the sensor is to compare the sensor to a hand held CO₂ sensor that has recently been calibrated at approximately the same altitude (\pm 500 ft).

7.3.3 Making Adjustments To The CO₂ Sensor:

Enter Function Mode - Press Function button for 6 seconds
- Untill Green LED Is flashing

- ▶ **Enter CO₂ Adjustment Mode** - Press button twice - Red LED blinks.
 - Hold button for 6 seconds - LED will indicate current setting.
 - **To select different functions**, hold button for 6 seconds for every step.
 - ▶ **Green** - Enable ABC, will self calibrate every 3 weeks.
 - ▶ **Amber** - Enable ABC, will self calibrate every 3 weeks, will perform an immedate self calibration to ambient air.
 - ▶ **Red** - Disable ABC self calibration.
 - ▶ **Red+Amber** - Calibrate to specific value of CO₂ (see text).

1. Enter into the function mode selection menu using the function mode button, holding in for about 6 seconds. The Green LED will begin to blink.
2. To enter the CO₂ adjustment mode pressing the test mode button twice... the **Red** LED begins blinking then, press and hold (about 6 seconds) the test mode button.
3. The LED will indicate if ABC is on (**Green** LED) or if it is off (**Red** LED).
4. Use the function button to select the function. To do this, press and hold the test mode button about 6 seconds to step through each option. The options are as follows:
 - **Green LED** = enable ABC, will self-calibrate every 3 weeks, dependent upon continuous operation via battery or solar power
 - **Amber LED** = will continue to self-calibrate every 3 weeks plus will force an immediate calibration. Self-calibration takes < 2 minutes. The amber LED will blink at a fast rate during this process. When complete the green led will blink 10 times and then the process will end.
 - **Red LED** = disable self-calibration
 - **Red + Amber LEDs** = calibrate to absolute value. Absolute value calibration allows the user to select a CO₂ value with 25 ppm resolution.
 - Green blinks = 500 ppm
 - Amber blinks = 100 ppm
 - Red blinks = 25 ppm

The sensor will display the current value (pressure compensated) in blinks once entering into this mode (green then amber then red). The user must press the test mode button to increase the ppm value or the teach button (on the back) to decrease the value (also pressure compensated) in 25 ppm increments. The background ppm level is set to 420 ppm.

8. Installing or Replacing the Battery

The battery is not required for normal operation when the RTS receives adequate natural or artificial light. The battery can be used during installation (start assist). Note: A battery is not provided with the sensor. The battery has enough power to run the sensor for 5 years without light.

1. Remove the sensor from the back plate by pressing the key on the lower edge of the sensor body and pull the body away from the back plate.
2. To remove old battery: Using a small flat head screwdriver or pen as a lever, insert pointed end under the clear plastic battery retaining clip's edge and pop the clip off.
3. Install or replace the battery in the clip with a new CR2032 coin cell battery insuring the positive side (+) will be facing up.
4. Align the two straight edges of the retaining clip with the battery holder and press the clip in with your finger.



9. Guidelines for Installing Wireless Devices

Careful planning is needed when locating the receivers and transmitters based on the construction materials in the space and possibility of tenant's furniture disrupting the transmissions.

The CO2 sensor should be installed in the space where the receiver is mounted and connected to the temperature control equipment however the signal will travel through material barriers. Refer to the tables below for range considerations with building materials that reduce the radio signal power.

Material	Attenuation
Wood	0 - 10%
Plaster	0 - 10%
Glass	0 - 10%
Brick	5 - 35%
MDF	5 - 35%
Ferro concrete	10 - 90%
Metal	90 - 100%
Aluminum	90 - 100%

Material	Radio Range-typical
Line of sight:	80' (24m) corridors
Line of sight:	150' (46m) open halls
Plasterboard:	80' (24m) through 3 walls
Brick	33' (10m) through 1 wall
Ferro concrete	33' (10m) through 1 wall
Ceiling:	Not Recommended

Wireless System Layout Hints:

- Avoid locating transmitters and receivers on the same wall.
- Avoid locating transmitters and receivers where the telegrams must penetrate walls at acute angles. This increases the material the telegram must pass through reducing the signal power.
- Avoid large metal obstructions as they create radio shadows. Place receivers in alternate locations to avoid the shadow or use repeaters to go around the obstacle.
- Do not locate receivers close to other high frequency transmitters. Leave at least 3' (1 m) between the receiver and any other source of interference including, ballasts, LED drivers, computers, video equipment, Wi-Fi/LAN routers, GSM modems and monitors. Transmitters are not affected by these sources of interference.

10. Product Specifications

Sensors

Carbon Dioxide

Technology: Ultra Low Power, LED based NDIR

Measurement Range: 0-2000 ppm

Accuracy: ± 50 ppm

Altitude/Pressure Compensation: Built-in correction

Self-Calibration: Automatic Background Calibration

Resolution: 1 data byte (0-200 decimal), 10 ppm

Temperature

Range: 0°C to 51°C (32°F to 124°F)

Accuracy: $\pm 0.3^\circ\text{C}$ ($\pm 0.5^\circ\text{F}$)

Resolution: 1 data byte (0-255 decimal), 0.2°C (0.36°F)

Relative Humidity

Range: 0% to 100% RH

Accuracy: $\pm 3\%$ RH... 10-90%, $\pm 7\%$... 0-10%, 90-100%

Resolution: 1 data byte (0-200 decimal), 0.5%

Power Supply

Type: Integrated Solar Panel

Operational Light Levels: 50 lux

Minimum Charge Time before Operation: 10 min @ 200 lux

Charging Light Level: 200 lux

Maintain Operating Life Level: 200 lux for 6 hours

Maximum Charge Time: 16 hours @ 200 lux

Operating Life From Full Charge: 72 hrs @ 0.0 lux

Battery: for backup, start assist & test mode. Use high quality CR2032 coin cell (not included).

Typically will provide 5 year operating life in zero light conditions.

General

Weight: 115 g, (4 oz)

Mounting: screws or double sided tape (not included)

Listing: FCC Part15.231- Remote control transmitter,
Industry Canada RSS-210, RoHS compliant.

11. AirTest Contact Information

AirTest Technologies Inc.

1520 Cliveden Ave, Unit 9, Delta BC Canada V3M 6J8

www.AirTest.com

sales@AirTest.com

P: 604 517-3888, TF: 888 855-8880, F: 604 517-3888

12. Product Warranty

AirTest Technologies Inc. (AIRTEST) warrants The TR9277-EO to be free of defects in materials and workmanship for 5 years for all AIRTEST transmitter and control products. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of AIRTEST's control. Components which wear are not warranted, including but not limited to switches, displays, batteries and calibration. AIRTEST's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This warranty does not cover calibration of the sensors.

If the unit should malfunction, it must be returned to the factory for evaluation. Contact AirTest Technologies to determine if a product problem is a Warranty or repair issue (1-604 517-3888). Prior to sending any product back to AIRTEST you must contact us to receive a Return Materials Authorization Number (RMA #). This number must be marked clearly on the outside of the package you are sending. Packages without RMA # may be returned to sender unopened. Upon examination by AirTest Technologies, if the unit is found to be defective according to the WARRANTY, at AIRTEST's discretion, it will be repaired or replaced at no charge. If the product is found not to be covered by the WARRANTY, the customer will be offered the opportunity pay for repair of the damaged unit. All shipping costs are the responsibility of the customer.

AIRTEST is pleased to offer suggestions on the use of its various products. However, AIRTEST neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by AIRTEST, either verbal or written. AIRTEST warrants only that the parts manufactured by it will be as specified and free of defects. AIRTEST MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of AIRTEST with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall AIRTEST be liable for consequential, incidental or special damages.

13. Regulatory Statements

FCC Part 15.231 (315 and 902 MHz models only)

Contains FCC ID: SZV-STM300C or SZV-STM300U

Contains IC: 5713A-STM300C or 5713A-STM300U

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (i.) this device may not cause harmful interference and
- (ii.) this device must accept any interference received, including interference that may cause undesired operation.

IC RSS-210: (315MHz and 902 MHz models only)

ARIB STD-T108 Japanese Type Approval (928 MHz models only)

