



Innovative Design

Use as part of open-path eddy-covariance systems or as a stand-alone IRGA

Overview

Campbell Scientific's EC150 is an open-path analyzer specifically designed for eddy-covariance carbon and water flux measurements. As a stand-alone analyzer, it simultaneously measures absolute carbon-dioxide and water-

vapor densities, air temperature, and barometric pressure. With the optional CSAT3A sonic anemometer head, three-dimensional wind speed and sonic air temperature are measured.

Benefits and Features

- › New conformal coating helps protect sonic transducers in corrosive environments
- › Unique optical configuration gives a slim aerodynamic shape with minimal wind distortion
- › Analyzer and sonic anemometer measurements are synchronized by a common set of electronics
- › Maximum output rate of 60 Hz with 20 Hz bandwidth
- › Low power consumption; suitable for solar power applications
- › Low noise
- › Measurements are temperature compensated without active heat control
- › Angled windows to shed water and are tolerant to window contamination
- › Field rugged
- › Field serviceable
- › Factory calibrated over wide range of CO₂, H₂O, pressure, and temperature in all combinations encountered in practice
- › Extensive set of diagnostic parameters
- › Fully compatible with Campbell Scientific dataloggers; field setup, configuration, and field zero and span can be accomplished directly from the datalogger
- › Speed of sound determined from three acoustic paths; corrected for crosswind effects
- › Innovative signal processing and transducer wicks considerably improve performance of the anemometer during precipitation events



Detailed Description

The CSAT3A has the following outputs:

- › U_x (m/s)*
- › U_y (m/s)*
- › U_z (m/s)*
- › Sonic Temperature (°C)*
- › Sonic Diagnostic*

The EC150 has the following outputs:

- › CO₂ Density (mg/m³)

- › H₂O Density (g/m³)
- › Gas Analyzer Diagnostic
- › Ambient Temperature (°C)
- › Atmospheric Pressure (kPa)
- › CO₂ Signal Strength
- › H₂O Signal Strength
- › Source Temperature (°C)

*The first five outputs require the CSAT3A Sonic Anemometer Head.

Specifications

Operating Temperature Range	-30° to +50°C
Calibrated Pressure Range	70 to 106 kPa
Input Voltage Range	10 to 16 Vdc
Power	5 W (steady state and power up) at 25°C
Measurement Rate	60 Hz
Output Bandwidth	5, 10, 12.5, or 20 Hz (user-programmable)
Output Options	SDM, RS-485, USB, analog (CO ₂ and H ₂ O only)
Auxiliary Inputs	Air temperature and pressure
Gas Analyzer/Sonic Volume Separation	5.0 cm (2.0 in.)
Warranty	3 years or 17,500 hours of operation (whichever comes first)
Cable Length	3 m (10 ft) from EC150 and CSAT3A to EC100
Weight	<ul style="list-style-type: none"> › 1.7 kg (3.7 lb) for CSAT3A head and cables › 2.0 kg (4.4 lb) for EC150 head and cables › 3.2 kg (7.1 lb) for EC100 electronics

Gas Analyzer

Path Length	15.37 cm (6.05 in.) A temperature of 20°C and pressure of 101.325 kPa was used to convert mass density to concentration.
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Gas Analyzer - CO₂ Performance

-NOTE-	A temperature of 20°C and pressure of 101.325 kPa was used to convert mass density to concentration.
Accuracy	<ul style="list-style-type: none"> › 1% (standard deviation of calibration residuals) › Assumes the following: the gas analyzer was properly zero and spanned using the appropriate standards; CO₂ span concentration was 400 ppm; H₂O span dewpoint was at 12°C (16.7 ppt); zero/span temperature was 25°C; zero/span pressure was 84 kPa; subsequent measurements made at or near the span concentration; temperature is not more than ±6°C from the zero/span temperature; and ambient temperature is within the gas analyzer operating temperature range.
Precision RMS (maximum)	0.2 mg/m ³ (0.15 μmol/mol) Nominal conditions for precision verification test: 25°C, 86 kPa, 400 μmol/mol CO ₂ , 12°C dewpoint, and 20 Hz bandwidth.
Calibrated Range	0 to 1,000 μmol/mol (0 to 3,000 μmol/mole available upon request.)
Zero Drift with Temperature (maximum)	±0.55 mg/m ³ /°C (±0.3 μmol/mol/°C)

Gain Drift with Temperature $\pm 0.1\%$ of reading/ $^{\circ}\text{C}$
(maximum)

Cross Sensitivity (maximum) $\pm 1.1 \times 10^{-4}$ mol CO_2 /mol H_2O

Gas Analyzer - H_2O Performance

-NOTE- A temperature of 20°C and pressure of 101.325 kPa was used to convert mass density to concentration.

Accuracy
 H_2O span dewpoint was at 12°C (16.7 ppt); zero/span temperature was 25°C ; zero/span pressure was 84 kPa; subsequent measurements made at or near the span concentration; temperature is not more than $\pm 6^{\circ}\text{C}$ from the zero/span temperature; and ambient temperature is within the gas analyzer operating temperature range.
 CO_2 span concentration was 400 ppm;
 H_2O span dewpoint was at 12°C (16.7 ppt); zero/span temperature was 25°C ; zero/span pressure was 84 kPa; subsequent measurements made at or near the span concentration; temperature is not more than $\pm 6^{\circ}\text{C}$ from the zero/span temperature; and ambient temperature is within the gas analyzer operating temperature range.
 2% (standard deviation of calibration residuals)

Precision RMS (maximum) 0.004 g/m^3 mmol/mol (0.006 mmol/mol)

Nominal conditions for precision verification test: 25°C , 86 kPa, 400 $\mu\text{mol}/\text{mol}$ CO_2 , 12°C dewpoint, and 20 Hz bandwidth.

Calibrated Range 0 to 72 mmol/mol (38°C dewpoint)

Zero Drift with Temperature ± 0.037 $\text{g}/\text{m}^3/^{\circ}\text{C}$ (± 0.05 mmol/mol/ $^{\circ}\text{C}$)

Gain Drift with Temperature $\pm 0.3\%$ of reading/ $^{\circ}\text{C}$
(maximum)

Cross Sensitivity (maximum) ± 0.1 mol $\text{H}_2\text{O}/\text{mol}$ CO_2

Sonic Anemometer - Accuracy

Offset Error
 $\pm 0.7^{\circ}$ while horizontal wind at 1 m s^{-1} (for wind direction)
 $< \pm 4.0$ cm s^{-1} (for u_z)
 $< \pm 8.0$ cm s^{-1} (for u_x, u_y)

Gain Error
 $< \pm 2\%$ of reading (for wind vector within $\pm 5^{\circ}$ of horizontal)
 $< \pm 3\%$ of reading (for wind vector within $\pm 10^{\circ}$ of horizontal)
 $< \pm 6\%$ of reading (for wind vector within $\pm 20^{\circ}$ of horizontal)

Measurement Precision RMS
 0.025°C (for sonic temperature)
 1 mm s^{-1} (for u_x, u_y)
 0.5 mm s^{-1} (for u_z)
 0.6° (for wind direction)

Speed of Sound Determined from 3 acoustic paths (corrected for crosswind effects)

Rain Innovative ultrasonic signal processing and user-installable wicks considerably improve the performance of the anemometer under all rain events.

Ambient Temperature

Manufacturer BetaTherm 100K6A11A

Total Accuracy $\pm 0.15^{\circ}\text{C}$ (-30°C to $+50^{\circ}\text{C}$)

For comprehensive details, visit: www.campbellsci.com/ec150



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