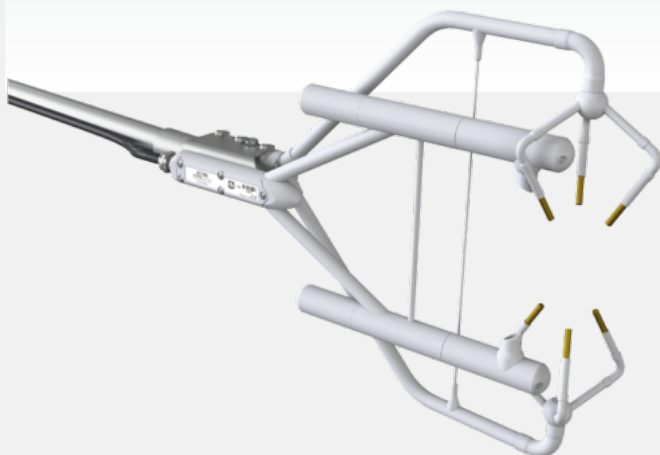




EC150

CO<sub>2</sub>/H<sub>2</sub>O Open-Path Gas Analyzer

## 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 CO<sub>2</sub>, H<sub>2</sub>O, 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:

- › CO<sub>2</sub> Density (mg/m<sup>3</sup>)

- › H<sub>2</sub>O Density (g/m<sup>3</sup>)
- › Gas Analyzer Diagnostic
- › Ambient Temperature (°C)
- › Atmospheric Pressure (kPa)
- › CO<sub>2</sub> Signal Strength
- › H<sub>2</sub>O 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 <sub>2</sub> and H <sub>2</sub> 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"> <li>› 1.7 kg (3.7 lb) for CSAT3A head and cables</li> <li>› 2.0 kg (4.4 lb) for EC150 head and cables</li> <li>› 3.2 kg (7.1 lb) for EC100 electronics</li> </ul>

### 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 - CO<sub>2</sub> 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"> <li>› 1% (standard deviation of calibration residuals)</li> <li>› Assumes the following: the gas analyzer was properly zero and spanned using the appropriate standards; CO<sub>2</sub> span concentration was 400 ppm; H<sub>2</sub>O 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.</li> </ul>
Precision RMS (maximum)	0.2 mg/m <sup>3</sup> (0.15 μmol/mol)  Nominal conditions for precision verification test: 25°C, 86 kPa, 400 μmol/mol CO <sub>2</sub> , 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 <sup>3</sup> /°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  $\text{CO}_2$ /mol  $\text{H}_2\text{O}$

### Gas Analyzer - $\text{H}_2\text{O}$ Performance

*-NOTE- A temperature of  $20^{\circ}\text{C}$  and pressure of  $101.325$  kPa was used to convert mass density to concentration.*

Accuracy   
  $\text{H}_2\text{O}$  span dewpoint was at  $12^{\circ}\text{C}$  (16.7 ppt); zero/span temperature was  $25^{\circ}\text{C}$ ; 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.   
  $\text{CO}_2$  span concentration was 400 ppm;   
  $\text{H}_2\text{O}$  span dewpoint was at  $12^{\circ}\text{C}$  (16.7 ppt); zero/span temperature was  $25^{\circ}\text{C}$ ; 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  $\text{g}/\text{m}^3$  mmol/mol (0.006 mmol/mol)

Nominal conditions for precision verification test:  $25^{\circ}\text{C}$ , 86 kPa, 400  $\mu\text{mol}/\text{mol}$   $\text{CO}_2$ ,  $12^{\circ}\text{C}$  dewpoint, and 20 Hz bandwidth.

Calibrated Range 0 to 72 mmol/mol ( $38^{\circ}\text{C}$  dewpoint)

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

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

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

### Sonic Anemometer - Accuracy

Offset Error   
  $\pm 0.7^{\circ}$  while horizontal wind at 1  $\text{m s}^{-1}$  (for wind direction)   
  $< \pm 4.0$   $\text{cm s}^{-1}$  (for  $u_z$ )   
  $< \pm 8.0$   $\text{cm s}^{-1}$  (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   
  $0.025^{\circ}\text{C}$  (for sonic temperature)   
 1  $\text{mm s}^{-1}$  (for  $u_x, u_y$ )   
 0.5  $\text{mm s}^{-1}$  (for  $u_z$ )   
  $0.6^{\circ}$  (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  $\pm 0.15^{\circ}\text{C}$  ( $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ )

For comprehensive details, visit: [www.campbellsci.com/ec150](http://www.campbellsci.com/ec150)



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