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

For comprehensive details, visit: www.campbellsci.com/ec150
**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$_2$ Density (mg/m$^3$)
- H$_2$O Density (g/m$^3$)
- Gas Analyzer Diagnostic
- Ambient Temperature (°C)
- Atmospheric Pressure (kPa)
- CO$_2$ Signal Strength
- H$_2$O Signal Strength
- Source Temperature (°C)

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

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**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>-30° to +50°C</td>
</tr>
<tr>
<td>Calibrated Pressure Range</td>
<td>70 to 106 kPa</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>10 to 16 Vdc</td>
</tr>
<tr>
<td>Power</td>
<td>5 W (steady state and power up) at 25°C</td>
</tr>
<tr>
<td>Measurement Rate</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Output Bandwidth</td>
<td>5, 10, 12.5, or 20 Hz (user-programmable)</td>
</tr>
<tr>
<td>Output Options</td>
<td>SDM, RS-485, USB, analog (CO$_2$ and H$_2$O only)</td>
</tr>
<tr>
<td>Auxiliary Inputs</td>
<td>Air temperature and pressure</td>
</tr>
<tr>
<td>Gas Analyzer/Sonic Volume Separation</td>
<td>5.0 cm (2.0 in.)</td>
</tr>
<tr>
<td>Warranty</td>
<td>3 years or 17,500 hours of operation (whichever comes first)</td>
</tr>
<tr>
<td>Cable Length</td>
<td>3 m (10 ft) from EC150 and CSAT3A to EC100</td>
</tr>
<tr>
<td>Weight</td>
<td>1.7 kg (3.7 lb) for CSAT3A head and cables</td>
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<tr>
<td></td>
<td>2.0 kg (4.4 lb) for EC150 head and cables</td>
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<tr>
<td></td>
<td>3.2 kg (7.1 lb) for EC100 electronics</td>
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</tbody>
</table>

**Gas Analyzer - CO$_2$ Performance**

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

**Accuracy**

- 1% (standard deviation of calibration residuals)
- Assumes the following: the gas analyzer was properly zero and spanned using the appropriate standards; CO$_2$ span concentration was 400 ppm; H$_2$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.

**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)
Gas Analyzer - H₂O Performance

**Gain Drift with Temperature** ±0.1% of reading/°C (maximum)

**Cross Sensitivity (maximum)** ±1.1 x 10⁻⁴ mol CO₂/mol H₂O

**Accuracy**

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

- 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.

- 2% (standard deviation of calibration residuals)

- **Precision RMS (maximum)** 0.004 g/m³ mmol/mol (0.006 mmol/mol)

- Nominal conditions for precision verification test: 25°C, 86 kPa, 400 μmol/mol CO₂, 12°C dewpoint, and 20 Hz bandwidth.

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

**Zero Drift with Temperature** ±0.037 g/m³/°C (±0.05 mmol/mol/°C) (maximum)

**Gain Drift with Temperature** ±0.3% of reading/°C (maximum)

**Cross Sensitivity (maximum)** ±0.1 mol H₂O/mol CO₂

Sonic Anemometer - Accuracy

**Offset Error**

- ±0.7° while horizontal wind at 1 m s⁻¹ (for wind direction)
- < ±4.0 cm s⁻¹ (for uz)
- < ±8.0 cm s⁻¹ (for uₓ, uy)

**Gain Error**

- < ±2% of reading (for wind vector within ±5° of horizontal)
- < ±3% of reading (for wind vector within ±10° of horizontal)
- < ±6% of reading (for wind vector within ±20° of horizontal)

**Measurement Precision RMS**

- 0.025°C (for sonic temperature)
- 1 mm s⁻¹ (for uy)
- 0.5 mm s⁻¹ (for uz)
- 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 100K6A1IA

**Total Accuracy** ±0.15°C (-30°C to +50°C)