



## Innovative Design

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

### Overview

Campbell Scientific's EC150 is an integrated in-situ open-path analyzer and sonic anemometer specifically designed for eddy covariance flux measurements. It simultaneously measures

absolute carbon dioxide and water vapour densities, air temperature, barometric pressure and three-dimensional wind speed and sonic air temperature.

### Benefits and Features

- › Unique optical configuration allows for a slim aerodynamic shape with minimal wind distortion
- › Measurements are temperature compensated without active heat control
- › Analyzer and sonic anemometer measurements are synchronized by a common set of electronics
- › Low power consumption; suitable for solar power applications
- › Low noise
- › Maximum output rate of 50 Hz with 25 Hz bandwidth
- › Tolerant to window contamination
- › 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
- › Rain: Innovative signal processing and transducer wicks considerably improve performance of the anemometer during precipitation events

### Outputs

#### CSAT3A

- › U<sub>x</sub> (m/s)\*
- › U<sub>y</sub> (m/s)\*
- › U<sub>z</sub> (m/s)\*
- › Sonic Temperature (°C)\*
- › Sonic Diagnostic\*

#### EC150

- › 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)

## General Specifications<sup>a</sup>

**Operating Temperature Range:** -30° to +50°C

**Calibrated Pressure Range:** 70 to 106 kPa

**Input Voltage:** 10 to 16 Vdc

**Power @ 25°C:** 5 W (steady state and power-up)

**Measurement Rate:** 60 Hz

**Output Bandwidth:** 5, 10, 12.5, or 20 Hz user programmable

**Output Options:** SDM, RS-485, USB, analogue (CO<sub>2</sub> and H<sub>2</sub>O only)

**Auxiliary Inputs:** air temperature and pressure

### Dimensions

**Analyzer:** 13.8 cm x 7.4 cm x 10.1 cm (12.8 in x 2.9 in x 4.0 in)

**Electronics:** 24.1 cm x 35.6 cm x 14 cm (9.5 in x 14 in x 5.5 in)

### Weight:

**EC150 Head and Cables:** 2.0 kg (4.4 lb)

**CSAT3A Head and Cables:** 1.7 kg (3.7 lb)

**EC100 Electronics:** 3.2 kg (7 lbs)

**Cable Length:** 3 m (10 ft) from EC150/CSAT3A head to EC100

**Gas Analyzer/Sonic Volume Separation:** 5 cm (2.0 in)

**Warranty:** 3 years or 17,500 hours of operation, whichever comes first.

## Gas Analyzer Specifications<sup>a,b</sup>

➤ Path Length: 15.37 cm (6.05 in)

### Performance

|  | CO <sub>2</sub>   | H <sub>2</sub> O                                |
|--|---|---|
| <b>Accuracy<sup>c</sup></b>                  | 1% <sup>d</sup>   | 2% <sup>d</sup>                                 |
| <b>Precision RMS (maximum)<sup>c</sup></b>   | 0.2 mg/m <sup>3</sup> (0.15 μmol/mol)                             | 0.004 g/m <sup>3</sup> (0.006 mmol/mol)         |
| <b>Calibrated Range</b>                      | 0 to 1000 μmol/mol <sup>f</sup>                                   | 0 to 72 mmol/mol (37°C dew point)               |
| <b>Zero Drift with Temperature (maximum)</b> | ±0.55 mg/m <sup>3</sup> /°C (±0.3 μmol/mol/°C)                    | ±0.037 g/m <sup>3</sup> /°C (±0.05 mmol/mol/°C) |
| <b>Gain Drift with Temperature (maximum)</b> | ±0.1% of reading/°C   | ±0.3% of reading/°C                             |
| <b>Cross Sensitivity (maximum)</b>           | ±1.1 x 10 <sup>-4</sup> mol CO <sub>2</sub> /mol H <sub>2</sub> O | ±0.1 mol H <sub>2</sub> O/mol CO <sub>2</sub>   |

## Sonic Anemometer Specifications<sup>a</sup>

### Measurement Path

- Vertical: 10.0 cm (3.9 in.)
- Horizontal: 5.8 cm (2.3 in.)

### Transducer Diameter

- 0.64 cm (0.25 in.)

### Range

- u<sub>x</sub>: ±30 m s<sup>-1</sup>
- u<sub>y</sub>: ±60 m s<sup>-1</sup>
- u<sub>z</sub>: ±8 m s<sup>-1</sup>
- T<sub>s</sub>: -50° to +60°C
- Wind Direction: ±170°

### Accuracy<sup>g</sup>

- Offset Error
  - u<sub>x</sub>, u<sub>y</sub>: <±8.0 cm s<sup>-1</sup>
  - u<sub>z</sub>: <±4.0 cm s<sup>-1</sup>
  - Wind Direction: ±0.7° while horizontal wind at 1 m s<sup>-1</sup>
- Gain Error
  - Wind Vector within ±5° of horizontal: <±2% of reading
  - Wind Vector within ±10° of horizontal: <±3% of reading
  - Wind Vector within ±20° of horizontal: <±6% of reading
- Measurement Precision RMS
  - u<sub>x</sub>, u<sub>y</sub>: 1 mm s<sup>-1</sup>
  - u<sub>z</sub>: 0.5 mm s<sup>-1</sup>
  - Sonic Temperature: 0.025°C
  - Wind Direction: 0.6°

## Barometer Specifications<sup>a</sup>

|                         | -BB Basic Barometer  | -EB Enhanced Barometer (Vaisala PTB110) |
|-------------------------|--|---|
| <b>Total Accuracy</b>   | ±3.7 kPa at -30°C, falling linearly to ±1.5 kPa at 0°C, (-30° to 0°C), ±1.5 kPa (0° to 50°C) | ±0.15 kPa (-30° to +50°C)               |
| <b>Measurement Rate</b> | 10 Hz  | 1 Hz                                    |

## Ambient Temperature Specifications<sup>a</sup>

➤ Manufacturer: BetaTherm 100K6A11A

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

<sup>a</sup>Subject to change without notice.

<sup>b</sup>A temperature of 20°C and pressure of 101.325 kPa was used to convert mass density to concentration.

<sup>c</sup>Assumes 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.

<sup>d</sup>Standard deviation of calibration residuals.

<sup>e</sup>Nominal conditions for precision verification test: 25°C, 86 kPa, 400 μmol/mol CO<sub>2</sub>, 12°C dewpoint, and 20 Hz bandwidth.

<sup>f</sup>0 to 3,000 μmol/mole available upon request.

<sup>g</sup>The accuracy specification for the sonic anemometer is for wind speeds <30 m s<sup>-1</sup> and wind angles between ±170°.



80 Hathern Road, Shephed, LE12 9GX UK | +(0)1509 828888 | sales@campbellsci.co.uk | www.campbellsci.eu  
UK | AUSTRALIA | BRAZIL | CANADA | CHINA | COSTA RICA | FRANCE | GERMANY | SE ASIA | SOUTH AFRICA | SPAIN | USA

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# Ordering Information

## Flux Sensors

**EC150** CO<sub>2</sub> and H<sub>2</sub>O Open-Path Gas Analyzer

### Sensing Heads Options (must choose one)

- GH Gas Analyzer Only
- SH CSAT3A and Gas Analyzer

### Pressure Sensor Option (must choose one)

- BB Basic Barometer
- EB Enhanced Barometer

## Carrying Cases

**10822** EC150 Carrying Case without foam insert. It holds the gas analyzer alone.

**009505-002** CSAT3A Carrying Case without foam insert\*.

\*A foam insert is included with the respective sensor. If these carry cases are not ordered the sensors are supplied with the foam in cardboard boxes.

## Cables

For the following cables, specify the length required, in metres. A 10 m length is recommended. Connectors can be fitted if required when wired to a datalogger enclosure.

**CABLEPCBL** Two-conductor, 16-AWG cable with a Santoprene® jacket is used to power the EC150.

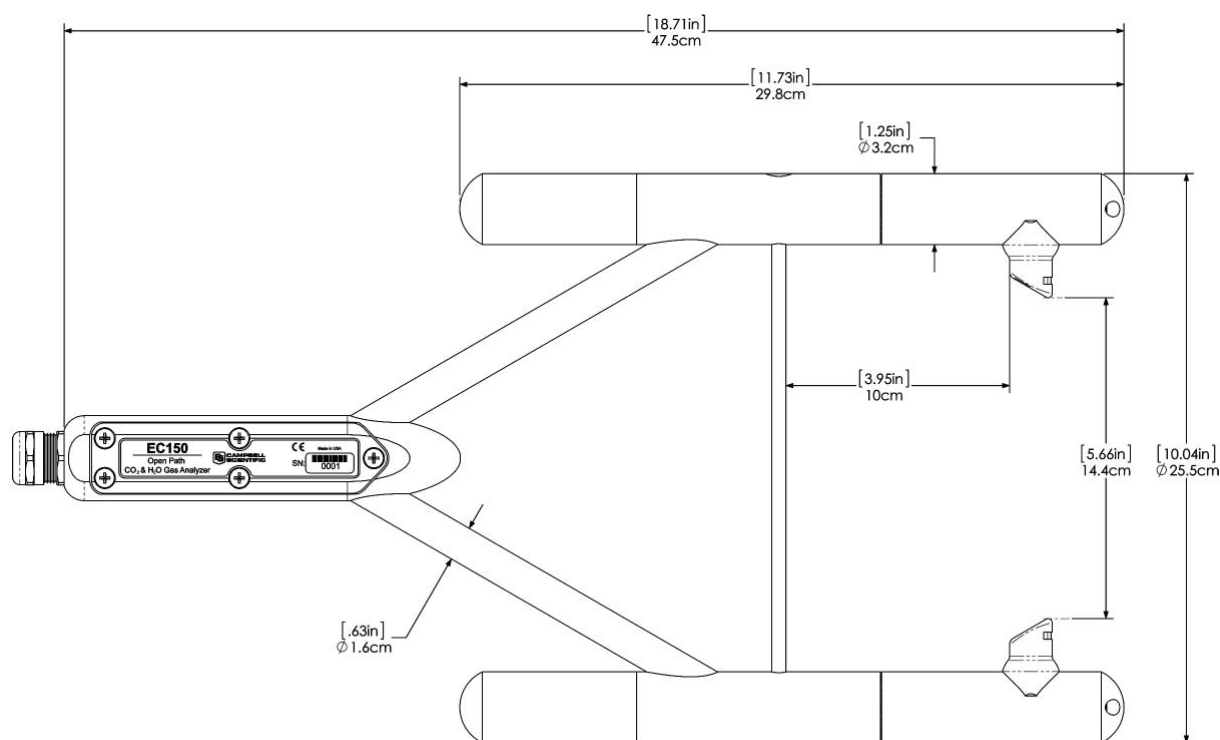
**CABLE4CBL** Four-conductor, 22-AWG cable with drain wire and Santoprene jacket is used to attach the SDM or Analogue Output connector on the EC150 electronics box.

**CABLE5CBL** Five-conductor, 24-AWG cable with drain wire and Santoprene jacket is recommended for connecting the EC150 with an MD485 multidrop modem.

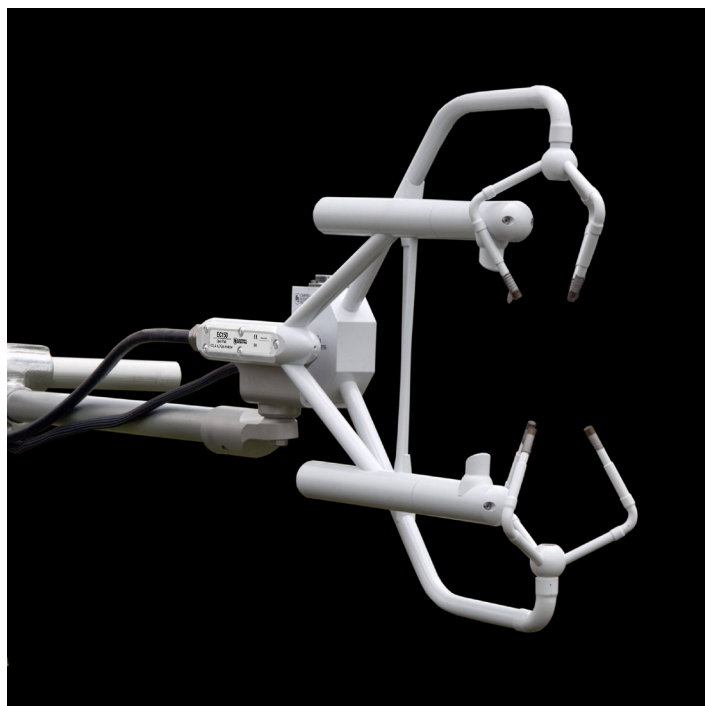
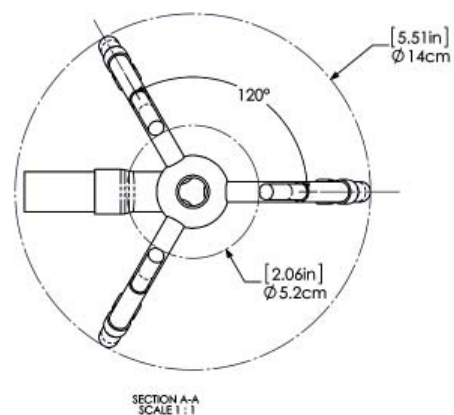
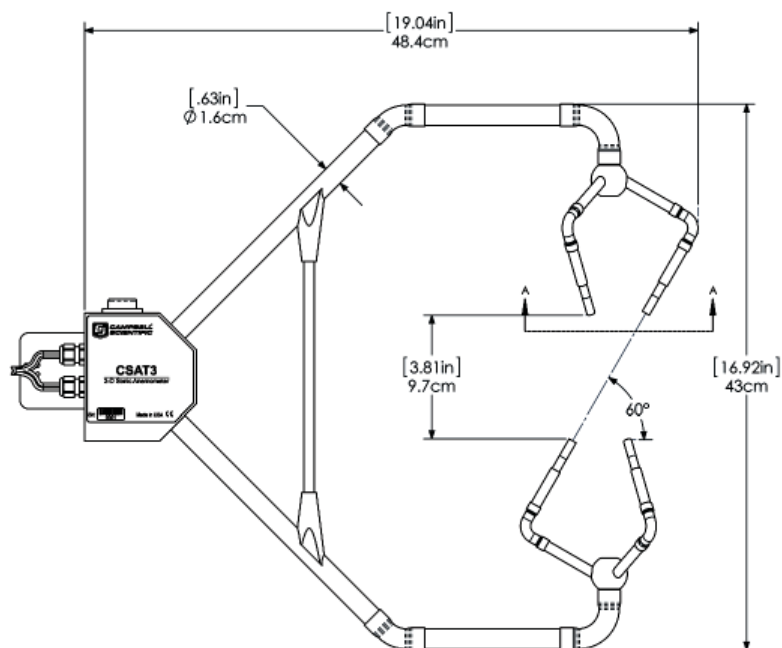
## Zero and Span Accessories

**010828** EC150 Zero and Span Shroud Kit

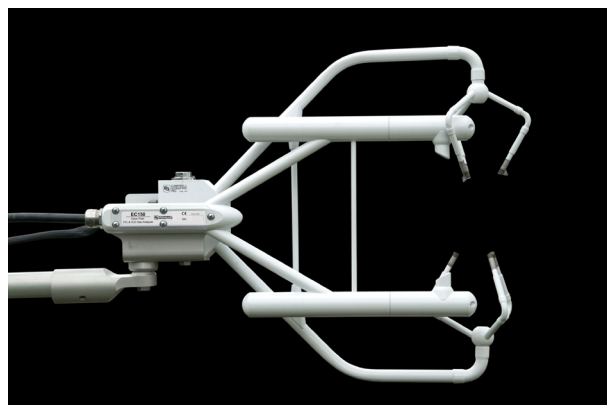
**010829** EC150 Lab Stand Kit



Dimensions of EC150 analyzer head



*EC150 gas analyzer with CSAT3A Sonic Anemometer Head*



*EC150 gas analyzer with CSAT3A Sonic Anemometer Head*