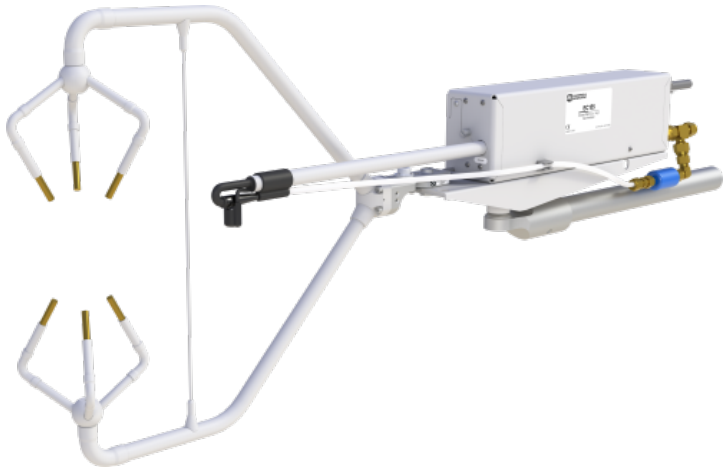
CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

EC155

Closed-Path CO2/H2O Gas Analyzer



Now with Vortex Technology

Use as part of closed-path eddy-covariance system

Overview

Campbell Scientific's EC155 closed-path analyzer incorporates vortex technology for reduced maintenance, an absolute pressure sensor in the sample cell for more accurate measurements, and a sample cell with improved corrosion protection. The EC155 can be combined with the CSAT3A sonic anemometer, as shown in the main image. The revised CSAT3A has a more aerodynamic and rigid design.

The EC155 is ordered as part of a CPEC300-series system (CPEC300, CPEC306, or CPEC310), which also includes the sample pump, data logger, optional valve module, and optional scrub module to provide a zero air source. The EC155 with anemometer simultaneously measures absolute carbon dioxide and water vapor mixing ratio, sample cell temperature and pressure, and three-dimensional wind speed and sonic air temperature.

Benefits and Features

- Vortex Intake (U.S. Pat. No. 9,217,692) greatly reduces maintenance frequency compared to traditional in-line filters
- Heated inlet increases protection against condensation
- More accurate pressure measurements with the new sample cell absolute pressure sensor
- Fully integrated, detachable intake
- Improved corrosion protection with stainless-steel sample cell
- Improved sonic temperature from more rigid CSAT3 geometry
- Stream-lined, aerodynamic CSAT3A mounting
- Slim aerodynamic shape with minimal wind distortion
- Analyzer, sample cell, and sonic anemometer measurements have matched bandwidths and are synchronized by a common set of electronics
- Low power consumption; suitable for solar power applications
- Low noise
- Small sample cell for excellent frequency response
- Integrated zero/span connection for simplified field zero/span
- Field rugged
- Field serviceable
- Factory calibrated over wide range of CO_2, H_2O, pressure and temperature in all combinations encountered in practice
- Extensive set of diagnostic parameters
- Fully compatible with Campbell Scientific data loggers; field setup, configuration, and field zero and span can be accomplished directly from the data logger
- Rain: innovative signal processing and transducer wicks considerably improve performance of the anemometer during precipitation events

Technical Description

The EC155 has the following outputs:

- U_x (m/s) *
- U_y (m/s) *
- U_z (m/s) *
- Sonic Temperature (°C) *
- Sonic Diagnostic *
- CO_2 Mixing Ratio (µmol/mol)
- H_2O Mixing Ratio (mmol/mol)
- Gas Analyzer Diagnostic
- Cell Temperature (°C)
- Cell Pressure (kPa)
- CO_2 Signal Strength
- H_2O Signal Strength
- Differential Pressure (kPa)
- Source Temperature (°C)

**Requires a CSAT3A Sonic Anemometer Head.*

Specifications

Operating Temperature Range	-30° to +50°C
Operating Pressure	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_2O only)
Auxiliary Inputs	Air temperature and pressure
EC100 Barometer Accuracy	▸ ±1.5 kPa (> 0°C), increasing linearly to ±.3.7 kPa at -30°C (basic) ▸ ±0.15 kPa (-30° to +50°C) (enhanced)
Sample Intake/Sonic Volume Separation	15.6 cm (6.1 in.)
Warranty	3 years or 17,500 hours of operation (whichever comes first)
Cable Length	3 m (10 ft) from EC155/CSAT3A to EC100
Weight	▸ 0.4 kg (0.9 lb) for mounting hardware ▸ 3.9 kg (8.5 lb) for EC155 head and cables ▸ 1.7 kg (3.7 lb) for CSAT3A head and cables ▸ 3.2 kg (7 lb) for EC100 electronics

Gas Analyzer

Sample Cell Thermistor Accuracy	± 0.15°C (-30° to +50°C)
Sample Cell Pressure Accuracy	± 1.5 kPa (> 0°C), increasing linearly to ±3.7 kPa at -30°C

Gas Analyzer - CO_2 Performance

Accuracy	▸ Assumes the following: the gas analyzer was properly zero and spanned using the appropriate standards; 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 ±6°C from the zero/span temperature; and ambient temperature is within the gas analyzer operating temperature range. ▸ 1% (Standard deviation of calibration residuals.)
Precision RMS (maximum)	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/mol available upon request.)
Zero Drift with Temperature (maximum)	±0.3 µmol/mol/°C
Gain Drift with Temperature (maximum)	±0.1% of reading/°C
Cross Sensitivity (maximum)	±1.1 x 10^{-4} mol CO_2 /mol H_2O

Gas Analyzer - H_2O Performance

Accuracy	❱ Assumes the following: the gas analyzer was properly zero and spanned using the appropriate standards; 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 ±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)	0.006 mmol/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 72 mmol/mol (38°C dewpoint)
Zero Drift with Temperature (maximum)	±0.05 mmol/mol/°C
Gain Drift with Temperature (maximum)	±0.3% of reading/°C
Cross Sensitivity (maximum)	±0.1 mol H_2O/mol CO_2

Sonic Anemometer - Accuracy

-NOTE-	*The accuracy specification for the sonic anemometer is for wind speeds < 30 m s^{-1} and wind angles between ±170°.*
Offset Error	❱ < ±4.0 cm s^{-1} (for u_z) ❱ ±0.7° while horizontal wind at 1 m s^{-1} (for wind direction) ❱ < ±8.0 cm s^{-1} (for u_x, u_y)
Gain Error	❱ < ±6% of reading (for wind vector within ±20° of horizontal) ❱ < ±2% of reading (for wind vector within ±5° of horizontal) ❱ < ±3% of reading (for wind vector within ±10° of horizontal)
Measurement Precision RMS	❱ 0.6° (for wind direction) ❱ 0.025°C (for sonic temperature) ❱ 0.5 mm s^{-1} (for u_z) ❱ 1 mm s^{-1} (for u_x, u_y)

CAMPBELL SCIENTIFIC
80 Hathern Road, Shepshed, LE12 9GX UK | +(0)1509 828888 | sale@campbellsci.co.uk | www.campbellsci.eu
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