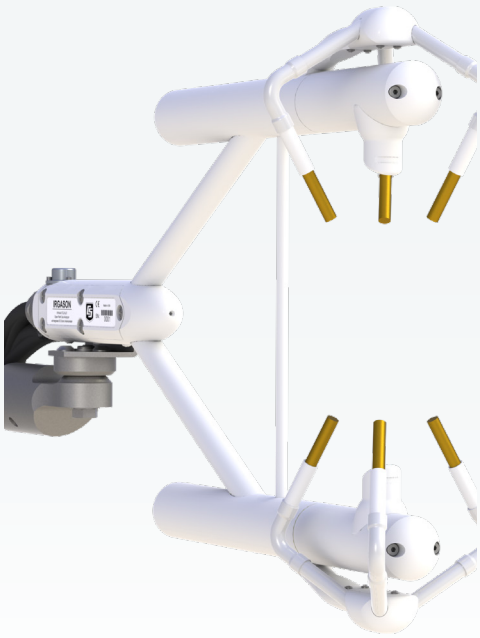
IRGASON®

Integrated CO_2 and H_2O Open-Path Gas Analyzer and 3-D Sonic Anemometer

Patented Design

Gas analyzer and sonic anemometer in one sensor



Overview

Campbell Scientific's IRGASON® fully integrates the open-path analyzer and sonic anemometer. Designed specifically for eddy-covariance carbon and water flux measurements, the patented design is easier to install and use than separate sensors and provides increased measurement accuracy. The IRGASON simultaneously measures absolute carbon dioxide and water vapor, air temperature, barometric pressure, three-dimensional wind speed, and sonic air temperature.

For more information about the benefits of having a collocated measurement, refer to the poster "Improved eddy flux measurements by open-path gas analyzer and sonic anemometer co-location."

U.S. patent D680455

Benefits and Features

- New conformal coating helps protect sonic transducers in corrosive environments
- Combined support structure causes less flow distortion than two separate sensors
- Truly collocated gas analyzer and sonic anemometer measurements avoid flux loss due to sensor separation
- Synchronized gas analyzer and sonic anemometer measurements avoid the need to correct for time lag
- Low power consumption; suitable for solar power applications
- Temperature-compensated measurements without active heat control
- Low noise
- Maximum output rate of 60 Hz with 20 Hz bandwidth
- Angled windows to shed water; tolerant to window contamination
- 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 data logger
- Sonic temperature determined from three acoustic paths; corrected for crosswind effects
- Innovative signal processing and transducer wicks considerably improve performance of anemometer during precipitation events

Detailed Description

The IRGASON has the following outputs:

- U_x (m/s)
- U_y (m/s)
- U_z (m/s)
- Sonic Temperature (°C)
- Sonic Diagnostic
- CO_2 Density (mg/m³)
- H_2O Density (g/m³)
- Gas Analyzer Diagnostic
- Ambient Temperature (°C)
- Atmospheric Pressure (kPa)
- CO_2 Signal Strength
- H_2O Signal Strength
- Source Temperature (°C)

Specifications

Patent	U.S. Patent No. D680455
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_2O only)
Auxiliary Inputs	Air temperature and pressure
Warranty	3 years or 17,500 hours of operation (whichever comes first)
Cable Length	3 m (10 ft) from IRGASON to EC100
Weight	▪ 2.8 kg (6.1 lb) for IRGASON 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.

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	▪ Assumes the following: gas analyzer was properly zero and spanned using 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 span concentration; temperature is not more than ±6°C from zero/span temperature; and ambient temperature is within gas analyzer operating temperature range ▪ 1% (standard deviation of calibration residuals)

Specifications

Gas Analyzer - CO_2 Performance (continued)

Precision RMS (maximum)	0.2 mg/m³ (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)	±0.55 mg/m³/°C (±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

-NOTE-	*A temperature of 20°C and pressure of 101.325 kPa was used to convert mass density to concentration.*
Accuracy	▪ Assumes the following: gas analyzer was properly zero and spanned using 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 span concentration; temperature is not more than ±6°C from zero/span temperature; and ambient temperature is within gas analyzer operating temperature range ▪ 2% (standard deviation of calibration residuals)
Precision RMS (maximum)	0.004 g/m³ (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)	±0.037 g/m³/°C (±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

Specifications

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	▪ < ±8.0 cm s^{-1} (for u_x, u_y) ▪ < ±4.0 cm s^{-1} (for u_z) ▪ ±0.7° while horizontal wind at 1 m s^{-1} (for wind direction)
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	▪ 1 mm s^{-1} (for u_x, u_y) ▪ 0.5 mm s^{-1} (for u_z) ▪ 0.025°C (for sonic temperature) ▪ 0.6° (for wind direction)
Speed of Sound	Determined from three acoustic paths (corrected for crosswind effects)
Rain	Innovative signal processing and transducer wicks considerably improve performance of anemometer during precipitation events

Basic Barometer (option -BB)

Total Accuracy	▪ ±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)
Measurement Rate	10 Hz

Enhanced Barometer (option -EB)

Manufacturer	Vaisala PTB110
Total Accuracy	±0.15 kPa (-30° to +50°C)
Measurement Rate	1 Hz

Ambient Temperature

Manufacturer	BetaTherm 100K6A1IA
Total Accuracy	±0.15°C (-30° to +50°C)