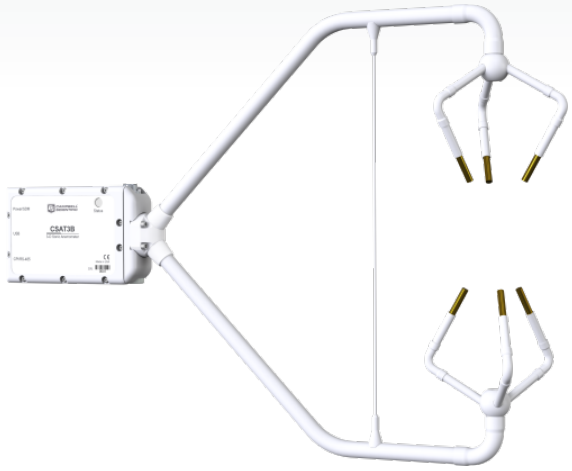
CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

CSAT3B

3-D Sonic Anemometer with Integrated Electronics



Precision Measurements

Designed for flux and other turbulence research projects

Overview

Campbell Scientific's CSAT3B 3-D Sonic Anemometer is an update and replacement to the original CSAT3, and remains the 3-D sonic anemometer of choice for eddy-covariance measurements. It has an aerodynamic design, a 10 cm vertical measurement path, operates in a pulsed acoustic mode, and withstands exposure to harsh weather conditions. Three orthogonal wind components (u_x, u_y, u_z) and the sonic temperature (T_s) are measured and output at a maximum rate of 100 Hz.

The most conspicuous innovation of the new design is the elimination of the electronics box. Instead, the electronics are packaged inside the mounting block of the CSAT3B head. This design feature makes installation easier and offers greater flexibility in instrument placement.

Measurements can be triggered from three sources:

- Data logger SDM command
- Data logger CPI command
- CSAT3B internal clock

The SDM and CPI protocols both support mechanisms for synchronizing multiple CSAT3Bs.

Benefits and Features

- New conformal coating helps protect sonic transducers in corrosive environments
- Integrated electronics that provide easy mounting of a single piece of hardware
- Integrated inclinometer
- High-precision measurements ideal for turbulence and eddy-covariance studies
- An improved design with a thin, aerodynamic support strut close to the ends of the sensor arms, creating greater rigidity and improved accuracy of sonic temperature
- Data logger sampling supported for any frequency between 1 and 100 Hz
- New CPI communications for more robust, higher bandwidth measurements
- Multiple communication options including SDM, CPI, USB, and RS-485
- Internal temperature and humidity measurements with easily replaced desiccant
- Version 5 algorithm for calculating data outputs; combines the signal sensitivity of version 3 with the rain performance of version 4
- Includes options to filter high frequencies for applications requiring analysis of non-aliased spectra

Specifications

Sensor	3-dimensional sonic anemometer
Measurement Description	Highest-quality wind speed and direction
Operating Temperature Range	-40 to +50°C (equivalent to 305 to 368 m s^{-1} in speed of sound)
Outputs	u_x, u_y, u_z, T_s (u_x, u_y, u_z are wind components referenced to the anemometer axes; T_s is sonic temperature in degrees Celsius.)
Signal Type/Output	SDM, CPI, USB, RS-485
Speed of Sound	Determined from three acoustic paths. (Corrected for crosswind effects.)
Wind Direction Range	2.5 to 357.5° in CSAT3B coordinate system (0 to 360° customized)
Range	± 65 m s^{-1} (full-scale wind)
Filter Bandwidths	5, 10, or 25 Hz
Measurement Path Length	10.0 cm (3.9 in.) vertical; 5.8 cm (2.3 in.) horizontal
Transducer Angle from Horizontal	60 degrees
Transducer Diameter	0.64 cm (0.25 in.)
Transducer Mounting Arm Diameter	0.84 cm (0.33 in.)
Support Arm Diameter	1.59 cm (0.63 in.)
Anemometer Head Weight	1.45 kg (3.2 lb)
Anemometer Dimensions	60.64 x 12.2 x 43.0 cm (23.87 x 4.8 x 16.9 in.)

Wind Accuracy

-NOTE-	*Accuracy specifications assume the following:* › *-40° to +50°C operating range* › *Wind speeds < 30 m s^{-1}* › *Wind angles between ±170°*
Maximum Offset Error	< ±8.0 cm s^{-1} (u_x, u_y), < ±4.0 cm s^{-1} (u_z)
Maximum Gain Error	› < ±6% of reading (wind vector within ±20° of horizontal) › < ±3% of reading (wind vector within ±10° of horizontal) › < ±2% of reading (wind vector within ±5° of horizontal)

Measurement Resolution

u_x, u_y	1 mm s^{-1} rms
u_z	0.5 mm s^{-1} rms
T_s	0.002°C RMS (at 25°C)
Wind Direction	< 0.058° ($u_x = u_y \leq 1$ m s^{-1})

Measurement Rates

Data Logger Triggered	1 to 100 Hz
Unprompted Output (to PC)	10, 20, 50, or 100 Hz
Internal Self-Trigger Rate	100 Hz

Measurement Delay

Data Logger Triggered (no filter)	1 trigger period (1 scan interval)
Unprompted Output (no filter)	10 ms
Filtered Output (data-logger-prompted or unprompted to PC)	› 155 ms (with 25 Hz bandwidth filter) › 795 ms (with 5 Hz bandwidth filter) › 395 ms (with 10 Hz bandwidth filter)

Internal Monitor Measurements

Update Rate	2 Hz
Inclinometer Accuracy	±1°
Relative Humidity Accuracy	› ±7% (over 0 to 10% range) › ±7% (over 90 to 100 % range) › ±3% (over 10 to 90% range)
Board Temperature Accuracy	±2°C

SDM

-NOTE-	*Used for data-logger-based data acquisition.*
Bit Period	10 µs to 1 ms
Cable Length	› 76 m (250 ft) max (@ 1 ms bit period) › 7.6 m (25 ft) max (@ 10 µs bit period)
Address Range	1 to 14
Bus Clocks per Sample	~200

CPI

-NOTE-	*Used for data-logger-based data acquisition.*
Baud Rate	50 kbps to 1 Mbps
Cable Length	❱ 853 m (2800 ft) max (@ 50 kbps) ❱ 122 m (400 ft) max (@ 250 kbps) ❱ 15 m (50 ft) max (@ 1 Mbps)
Address Range	1 to 120
Bus Clocks per Sample	~300

RS-485

-NOTE-	*Used for configuration or PC-based data acquisition.*
Baud Rate	9.6 kbps to 115.2 kbps
Cable Length	❱ 610 m (2000 ft) max (@ 9.6 kbps) ❱ 305 m (1000 ft) max (@ 115.2 kbps)
Bus Clocks per Sample	~500 (ASCII formatted)

USB

-NOTE-	*Used for configuration or PC-based data acquisition.*
Connection Speed	USB 2.0 full speed 12 Mbps
Cable Length	5 m (16.4 ft) maximum

Power Requirements

Voltage Supply	9.5 to 32 Vdc
Current at 10 Hz Measurement Rate	❱ 65 mA (@ 24 Vdc) ❱ 110 mA (@ 12 Vdc)
Current at 100 Hz Measurement Rate	❱ 80 mA (@ 24 Vdc) ❱ 145 mA (@ 12 Vdc)

For comprehensive details, visit: www.campbellsci.com/csat3b

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