



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

- › 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

Specifications

Operation Temperature -30 to +50°C (equivalent to 312 to

Range

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.)
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)
Filter Bandwidths	5, 10, 20, 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: <ul style="list-style-type: none"> › -30° 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	› < ±2% of reading (wind vector within ±5° of horizontal) › < ±3% of reading (wind vector within ±10° of horizontal) › < ±6% of reading (wind vector within ±20° 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° ($u_x = u_y \leq 1 \text{ m s}^{-1}$)

Measurement Rates

Data Logger Triggered	1 to 100 Hz
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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)	› 795 ms (with 5 Hz bandwidth filter) › 395 ms (with 10 Hz bandwidth filter) › 195 ms (with 20 Hz bandwidth filter) › 155 ms (with 25 Hz bandwidth filter)

Internal Monitor Measurements

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

SDM

-NOTE-	Used for data-logger-based data acquisition.
Bit Period	10 μs to 1 ms
Cable Length	› 7.6 m (25 ft) max (@ 10 μs bit period) › 76 m (250 ft) max (@ 1 ms 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	› 15 m (50 ft) max (@ 1 Mbps) › 122 m (400 ft) max (@ 250 kbps) › 853 m (2800 ft) max (@ 50 kbps)
Address Range	1 to 120
Bus Clocks per Sample	~300

For comprehensive details, visit: www.campbellsci.com/csats3b 



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