



Precision Measurements

Best instrument for flux and other turbulence research projects

Overview

Campbell Scientific's CSAT3 3D Sonic Anemometer is the 3D 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 speed of sound (c) are measured and output at a maximum rate of 60 Hz. Analog outputs and two types of digital outputs are provided.

Measurements can be triggered from three sources:

- › Datalogger's SDM command
- › CSAT3's internal clock
- › PC-generated RS-232 command

The SDM protocol supports a group trigger for synchronizing multiple CSAT3s.

Benefits and Features

- › Innovative design provides precision turbulence measurements with minimal flow distortion
- › Can be combined with EC150 or EC155 gas analyzers giving near complete collocation for eddy-covariance measurements
- › Compatible with most Campbell Scientific dataloggers
- › Measurements can be used to calculate momentum flux and friction velocity
- › Campbell Scientific's fine wire thermocouples are an option for fast-response temperature measurements
- › Field rugged
- › Rain: Innovative signal processing and transducer wicks considerably improves performance of the anemometer during rain events
- › Sealed sonic transducers and electronics



Specifications

Measurements

- › Outputs: u_x, u_y, u_z, c (u_x, u_y, u_z are wind components referenced to the anemometer axes; c is speed of sound)
- › Speed of Sound: Determined from three acoustic paths; corrected for crosswind effects
- › Measurement Rate: programmable from 1 to 60 Hz, instantaneous measurements; two over-sampled modes are block averaged to either 20 Hz or 10 Hz

Measurement Precision RMS^a

- › u_x, u_y : 1 mm s⁻¹ rms
- › u_z : 0.5 mm s⁻¹ rms
- › c : 15 mm s⁻¹ (0.025°C) rms
- › Wind Direction: 0.06° rms

Accuracy^b

- › Offset error: $< \pm 8.0 \text{ cm s}^{-1}$ (u_x, u_y), $< \pm 4.0 \text{ cm s}^{-1}$ (u_z)
- › Gain Error
Wind Vector within $\pm 5^\circ$ of horizontal: $< \pm 2\%$ of reading
Wind Vector within $\pm 10^\circ$ of horizontal: $< \pm 3\%$ of reading
Wind Vector within $\pm 20^\circ$ of horizontal: $< \pm 6\%$ of reading
- › Wind Direction: $\pm 0.7^\circ$ at 1 m s⁻¹ for horizontal wind

Output Signals

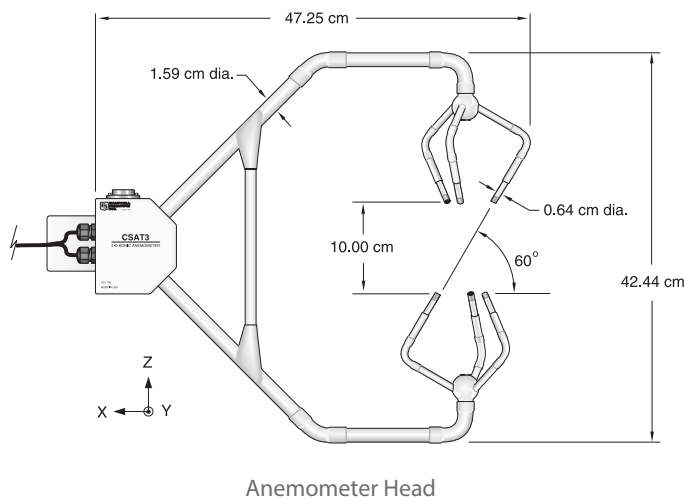
- › Digital SDM: CSI 33.3 k bps serial interface for datalogger/sensor communication. Data type is 2 B integer per output plus 2 B diagnostic

Digital RS-232

- › Baud rate: 9600, 19200 bps
- › Data type: 2 B integer per output plus 2 B diagnostic

Analog

- › Number of outputs: 4
- › Voltage range: $\pm 5 \text{ V}$
- › Number of bits: 12



Reporting Range

- › Analog Outputs:

Output	Reporting Range	LSB
u_x, u_y	$\pm 30 \text{ m s}^{-1}, \pm 60 \text{ m s}^{-1}$	15 mm s ⁻¹ , 30 mm s ⁻¹
u_z	$\pm 8 \text{ m s}^{-1}$	4 mm s ⁻¹
c	300 to 366 m s ⁻¹ (-50° to +60°C)	16 mm s ⁻¹ (0.026°C)

SDM and RS-232 Digital Outputs

- › Full scale wind: $\pm 65.535 \text{ m s}^{-1}$ autoranging between four ranges; least significant bit is 0.25 to 2 mm s⁻¹
- › Speed of Sound: 300 to 366 m s⁻¹ (-50° to +60°C); least significant bit is 1 mm s⁻¹ (0.002°C)

Physical Description

- › Measurement Path Length: 10.0 cm vertical; 5.8 cm horizontal
- › Path Angle from Horizontal: 60 degrees
- › Transducer: 0.64 cm diameter
- › Transducer Mounting Arms: 0.84 cm diameter
- › Support Arms: 1.59 cm diameter

Dimensions

- › Anemometer head: 47.3 cm (l) x 42.4 cm (h)
- › Electronics box: 26 x 16 x 9 cm

Weight

- › Anemometer head: 1.7 kg (3.7 lb)
- › Electronics box: 3.8 kg (8.4 lb)

Materials

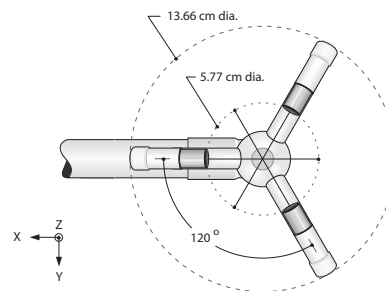
- › Anemometer head: stainless steel tubing
- › Electronics box: cast aluminum

Environmental

- › Operating Temperature: -30° to +50°C

Power Requirements

- › Voltage Supply: 10 to 16 Vdc
- › Current: 200 mA @ 60 Hz measurement rate; 100 mA @ 20 Hz measurement rate



Lower Transducer Assembly Top View

^aResolution values are for instantaneous measurements made on a constant signal; noise is not affected by sample rate.

^bAccuracy specifications assume -30° to +50°C operating range; wind speeds $< 30 \text{ m s}^{-1}$; wind angles between $\pm 170^\circ$.

