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

- Harsh Sonic Environment Option adds conformal coating to transducers to better withstand 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

For comprehensive details, visit: [www.campbellsci.com/csat3b](http://www.campbellsci.com/csat3b)
### Specifications

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

### Measurement Resolution

- \(u_x, u_y\) 1 mm s\(^{-1}\) rms
- \(u_z\) 0.5 mm s\(^{-1}\) rms
- \(T_s\) \(\pm 0.002\)°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 \(\pm 1°\)
- Relative Humidity Accuracy
  - \(\pm 7%\) (over 0 to 10% range)
  - \(\pm 7%\) (over 90 to 100% range)
  - \(\pm 3%\) (over 10 to 90% range)
- Board Temperature Accuracy \(\pm 2°C\)

### 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 \(~ 200\)

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### CPI

- **NOTE-** Used for data-logger-based data acquisition.

<table>
<thead>
<tr>
<th><strong>Baud Rate</strong></th>
<th>50 kbps to 1 Mbps</th>
</tr>
</thead>
</table>
| **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.

<table>
<thead>
<tr>
<th><strong>Baud Rate</strong></th>
<th>9.6 kbps to 115.2 kbps</th>
</tr>
</thead>
</table>
| **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.

<table>
<thead>
<tr>
<th><strong>Connection Speed</strong></th>
<th>USB 2.0 full speed 12 Mbps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Length</strong></td>
<td>5 m (16.4 ft) maximum</td>
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</table>

### Power Requirements

<table>
<thead>
<tr>
<th><strong>Voltage Supply</strong></th>
<th>9.5 to 32 Vdc</th>
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</table>
| **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) |

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