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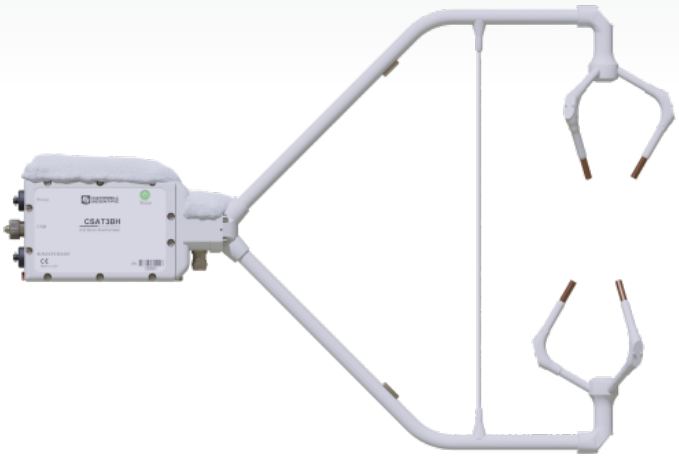
WHEN MEASUREMENTS MATTER

CSAT3BH

Heated, 3-D Sonic Anemometer with Integrated Electronics



Easy-to-Use Sonic Anemometer with Smart Heater Option

Provides continuous, reliable data year-round in harsh environments

Overview

The CSAT3BH is ideal for stations that are deployed in cold climates. The easy-to-use CSAT3BH sonic anemometer features smart heating that delivers just the right amount of heat to keep the instrument free of ice and snow, enabling continuous and reliable measurements in cold environments. The CSAT3BH is designed to prevent ice accumulation on the sensor, avoiding prolonged periods of data loss.

The CSAT3BH features variable power, only delivering power when needed—as opposed to the common method of providing two-way heating (on/off). Moreover, there are real-time data flags when the heaters are turned on, which is crucial to post-processing your data files.

The CSAT3BH is a heated version of the CSAT3B 3-D Sonic Anemometer with Integrated Electronics. The specifications of the CSAT3BH are the same as the CSAT3B with regard to wind measurements.

Benefits and Features

- New conformal coating helps protect sonic transducers in corrosive environments
- Two-zone heating to keep both the transducers and body of the sonic anemometer free of snow and ice
- Heating controller using environmental feedback to ensure power budgeting
- Streamlined heater integration to ensure maintenance of sonic aerodynamics
- Integrated data flagging, providing critical information when heaters were operational

Detailed Description

The CSAT3BH provides integrated two-zone smart heating:

- Zone 1 consists of the arms and strut.
- Zone 2 provides heating to all the transducers.

The smart heating uses environmental conditions and a controller to apply variable heating to the sonic anemometer to keep the body and transducers free of ice and snow. The CSAT3BH is designed to prevent ice from forming on the arms and fingers of the system. The block has no heating in it. The CSAT3BH has a separate controller that is used to control the

heating algorithm of the sensor. The controller requires a temperature/RH input. There is an ambient temperature and relative humidity sensor that is standard for use with the controller, or the data can be provided through a user-supplied temperature/RH sensor.

Physical

The CSAT3H heater controller is a polycarbonate enclosure sized 20.32 x 25.4 x 15.24 cm (8 x 10 x 6 in.). The enclosure uses connectors for incoming power, heaters, temperature sensors, temperature/RH, RS-485(2), and USB.

Electrical

The heaters are controlled on two zones and require 150 W at full power. The controller controls the heaters by increasing or decreasing the voltage to get the appropriate wattage to keep ice from forming on the sensor.

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.)
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	1.9 kg (4.2 lb)
Anemometer Dimensions	63.1 x 12.3 x 43.3 cm (24.8 x 4.9 x 17.0 in.)

Power Requirements

Anemometer Voltage Requirement	9.5 to 32 Vdc
Current Required for 10 Hz Measurement Rate	❱ 65 mA (@ 24 Vdc) ❱ 110 mA (@ 12 Vdc)
Current Required for 100 Hz Measurement Rate	❱ 80 mA (@ 24 Vdc) ❱ 145 mA (@ 12 Vdc)
Heaters	6.2 A (@ 24 Vdc)
Arms and Strut	❱ 2.46 A at maximum heating (@ 24 Vdc) ❱ 0.74 A nominal (@ 24 Vdc)
Transducer Fingers	❱ 3.75 A at maximum heating (@ 24 Vdc) ❱ 1.13 A nominal (@ 24 Vdc)
Total System Power	❱ 6.2 A at maximum heating (@ 24 Vdc) ❱ 1.86 A nominal (@ 24 Vdc)
Controller Current Required	30 mA (heaters off [quiescent] @ 24 Vdc)

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	❱ < ±3% of reading (wind vector within ±10° of horizontal) ❱ < ±2% of reading (wind vector within ±5° 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° ($u_x = u_y \leq 1$ 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)	❱ 395 ms (with 10 Hz bandwidth filter) ❱ 795 ms (with 5 Hz bandwidth filter) ❱ 155 ms (with 25 Hz bandwidth filter) ❱ 195 ms (with 20 Hz bandwidth filter)

Internal Monitor Measurements

Update Rate	2 Hz
Inclinometer Accuracy	±1°
Relative Humidity Accuracy	❱ ±7% (over 90 to 100% range) ❱ ±7% (over 0 to 10% 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	❱ 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	❱ 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 anemometer 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 anemometer configuration or PC-based data acquisition.*
Connection Speed	USB 2.0 full speed 12 Mbps
Cable Length	5 m (16.4 ft) maximum