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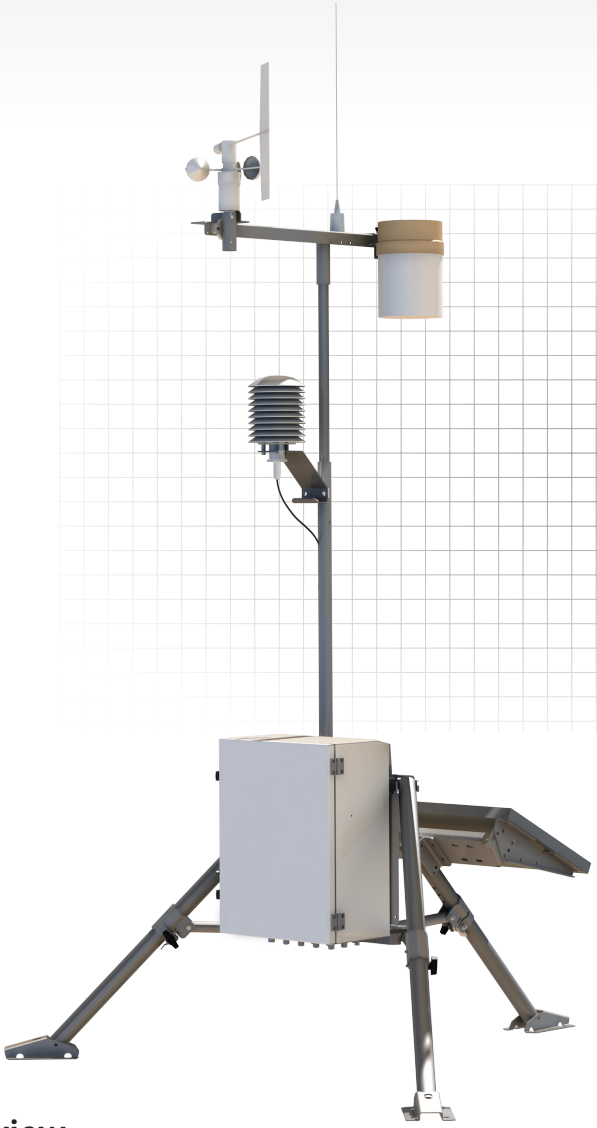
WHEN MEASUREMENTS MATTER

RAWS-F

Remote Automated Weather Station, Fire Weather



Quick Setup

Ready for use in as little as 10 minutes, without tools

Measurements

- *Wind speed*
- *Wind direction*
- *Air temperature*
- *Relative humidity*
- *Precipitation*
- *Solar radiation*
- *Barometeric Pressure (option -QB)*

Overview

Our RAWS-F Fire Weather Quick Deployment Station is ideal for prescribed burns or other temporary installations. Each RAWS-F station is preprogrammed to monitor wind speed and direction, air temperature and relative humidity, precipitation, barometric pressure, and solar radiation. This program complies with the National Fire Danger Rating System (NFDRS) weather station standards.

Benefits and Features

- CR1000-based system
- Monitors, records, and transmits meteorological data relevant to fire danger prediction
- Ideal for prescribed burns or other temporary installations
- Outside of the enclosure has color-coded, keyed connectors for attaching sensors
- Metal connector caps are chained to the connector panel
- Preprogrammed to monitor wind speed and direction, air temperature and relative humidity, precipitation, barometric pressure, and solar radiation sensors
- Complies with the National Fire Danger Rating System (NFDRS) weather station standard
- Four additional connectors can be incorporated into the panel

Standard Components

1. CR1000 Measurement and Control Datalogger
2. 7 Ah rechargeable battery (option -7) or 24 Ah rechargeable battery (option -24)
3. CS300-QD Solar Radiation Sensor (behind rain gage)
4. HC2S3-QD Air Temperature and Relative Humidity Probe
5. TE525-QD Tipping Bucket Rain Gage
6. Wind Sensor (option -MW 034B-QD Wind Set is shown at right)
7. SP20-QD 20 W Solar Panel shown (included with option -24); SP10-QD 10 W solar panel is included with option -7.
8. CS100 Barometer (option -QB)
9. 6 ft Tripod
10. Environmental Enclosure, 14 x 18 in
11. Transport Cases

Customizations

Sensors

Besides the connectors for the standard sensors, the RAWS-F includes a connector for:

- CS516-QD Fuel Moisture/Temperature Sensor

The RAWS-F connector panel can be customized for additional sensors such as:

- Stream flow
- Snow depth
- Water depth
- Soil moisture/soil temperature

Communications

Compatible communication equipment include telephones, digital cellular transceivers, and radios.

Power

The 18897 wall charger can recharge the RAWS-F battery during off-season, winter-time storage. This wall charger has a 24 Vac, 1.67 A output and a 110 to 240 Vac input.

WindSonic-QD 2-D ultrasonic anemometer (ordered as Wind Sensor option -GW).

Connector Panel

CS516 -QD Fuel Sensor (ordered separately)

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CS301
Pyranometer

Accurate and Dependable

Ideal for long-term deployment in harsh conditions

Overview

The CS301, manufactured by Apogee Instruments, measures total sun and sky solar radiation for solar, agricultural, meteorological, and hydrological applications. Its spectral range of 360 to 1120 nanometers encompasses most of the short-wave radiation that reaches the Earth's surface. Because the CS301 connects directly to Campbell Scientific data loggers, the output of this pyranometer can be collected on site, as well as remotely.

This pyranometer features an IP67-rated, marine-grade 316L connector that allows the user to easily swap sensors for recalibration or to replace damaged cables.

Benefits and Features

- Compatible with most Campbell Scientific data loggers
- Designed for continuous, long-term, unattended operation in adverse conditions
- Measurement waveband of 360 to 1120 nm
- Dome-shaped head prevents water from accumulating on the sensor head

Detailed Description

The CS301 uses a silicon photovoltaic detector mounted in a cosine-corrected head to provide solar radiation measurements. Its dome-shaped head prevents water from accumulating on the sensor head. To eliminate internal condensation, the sensor head is potted solid and the cable is shielded with a rugged Santoprene casing. The CS301 is calibrated against a Kipp & Zonen CM21 thermopile pyranometer to accurately measure sun plus sky radiation.

Specifications

Sensor	Silicon photovoltaic detector mounted in a cosine-corrected head
Measurement Description	Measures sun plus sky radiation
ISO Classification	Class C (second class)
Light Spectrum Waveband	360 to 1120 nm (wavelengths where response is 10% of maximum)

Measurement Range	0 to 2000 W/m^2 (full sunlight ≈1000 W/m^2)
Output Range	0 to 400 mV (full scale output)
Absolute Accuracy	±5% for daily total radiation
Spectral Range	360 to 1120 nm
Calibration Factor	5 W/m^2/mV
Cosine Correction Error	±5% at 75° zenith angle; ±2% at 45° zenith angle
Temperature Response	0.04 ± 0.04% per °C
Response Time	< 1 ms
Long-Term Stability	< 2% per year
Operating Temperature Range	-40° to +70°C
Relative Humidity Range	0 to 100%
Sensitivity	0.2 mV/W/m^2
Diameter	2.4 cm (0.9 in.)
Height	2.5 cm (1.0 in.)
Weight	65 g (2.3 oz) with 2-m (6.6-ft) lead wire

For comprehensive details, visit: www.campbellsci.com/cs301

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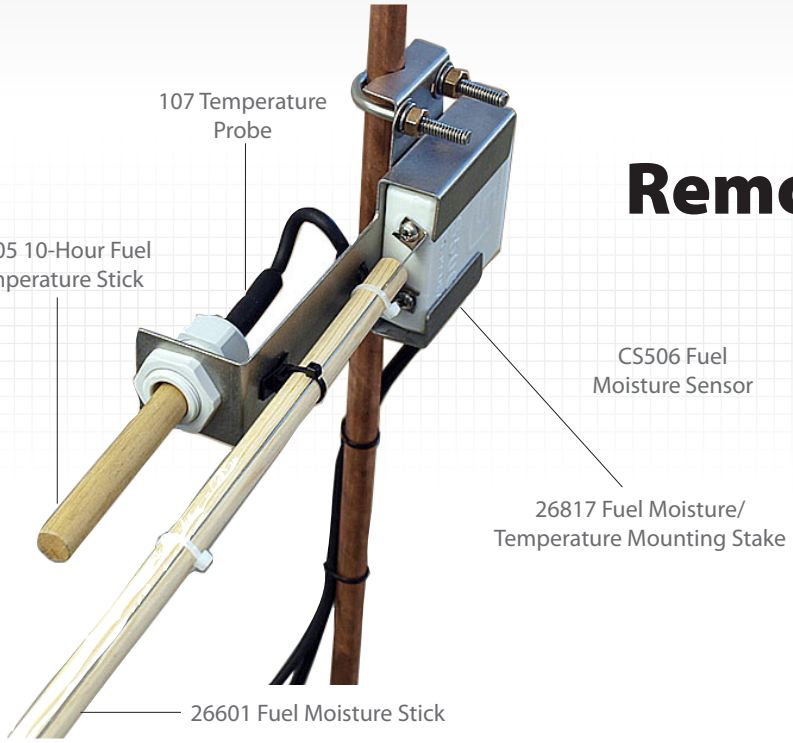
WHEN MEASUREMENTS MATTER

CS205/107, CS506, CS516

10-Hour Fuel Temperature/ Moisture Sensors



Remote Measurements

Monitors forest-fire factor; ideal for use with RAWS

Overview

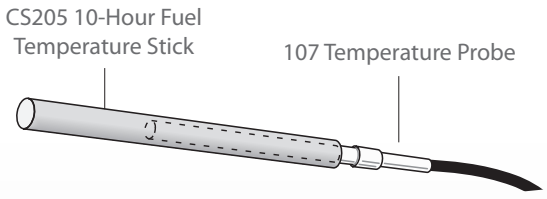
Campbell Scientific offers sensors that emulate and measure the moisture content and temperature of similarly-sized twigs on the forest floor. These 10-hour fuel moisture and fuel temperature sensors are often incorporated in our pre-configured or custom fire-weather stations. When connected to a datalogger with telemetry capability, the user can automatically monitor changing fuel conditions without having to visit the measurement site.

Benefits and Features

- Compatible telemetry options include spread spectrum radios, narrow-band radios, cellular phones, and satellite transmitters
- Can automatically monitor changing fuel conditions without having to visit the measurement site
- Compatible with most Campbell Scientific dataloggers*

CS205/107 Fuel Temperature

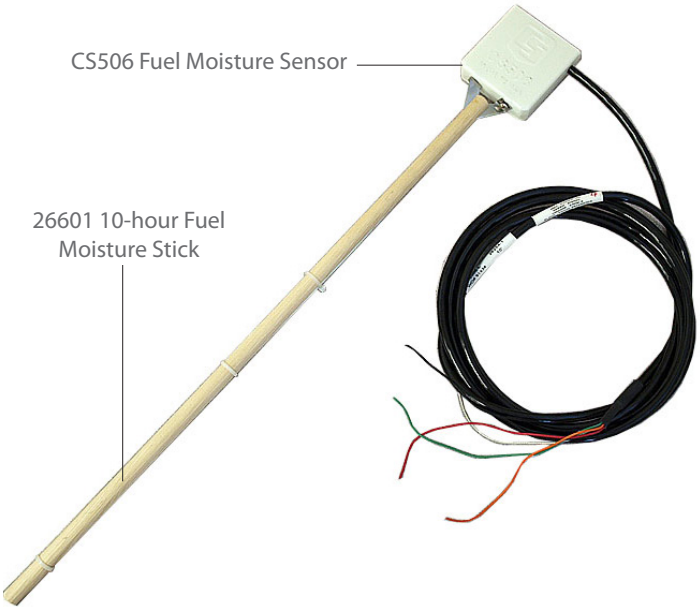
To measure fuel temperature, both the CS205 Fuel Temperature Stick and a 107 Temperature Probe are required. The CS205 provides a ponderosa pine dowel that is fabricated to USFS specifications. A hole is bored into one end of the dowel, where our thermistor-based 107 probe is inserted. The 107 measures the temperature inside of the dowel. The CS205 and the 107 are sold separately.



A transparent view shows a 107 temperature probe inserted inside of the CS205 10-hour Fuel Temperature Stick.

**Our fuel moisture sensors are not compatible with the CR200(X)-series dataloggers.*

Fuel Moisture



The CS506 Fuel Moisture Sensor requires the purchase of a 26601 10-hour Fuel Moisture Stick.

CS506 Fuel Moisture Sensor

Our fuel moisture sensor, the CS506, reports the status of small-diameter (10-hour) forest fire fuels as percent moisture by weight (1%=1 g water/100 g dry fuel). It consists of an epoxy-encapsulated electronics package that uses time-domain reflectometry (TDR) technology to measure the moisture content of the 26601 10-hour Fuel Moisture Stick. The sensor produces a ±0.7 Vdc square-wave frequency that is read using an analog or pulse channel on a Campbell Scientific datalogger. The datalogger then converts the frequency measurement to percent fuel moisture via a quadratic calibration.

26601 10-Hour Fuel Moisture Stick

The 26601 10-hour Fuel Moisture Stick consists of a ponderosa-pine dowel fabricated to USFS specifications. It has a 0.5 in. diameter and a 20 in. length—the same dimensions as those used on the traditional weighing fuel moisture racks. Each dowel has undergone two additional sorts to optimize probe-to-probe repeatability and to allow probe interchangeability without individual calibration. The response of the CS506 sensor is similar to the traditional weighing racks because the entire dowel surface is exposed for moisture exchange.

26817 Fuel Moisture/Temperature Mounting Stake

The 26817 Mounting Stake is often used to mount the sensors in the field. This stake places the CS506/26601 and the CS205/107 probes twelve inches above the forest floor. Because the probes are mounted parallel to each other, shadowing is minimized. Cable ties are included for securing the cables to the side of the stake.

CS516 Fuel Sensors for RAWS Stations

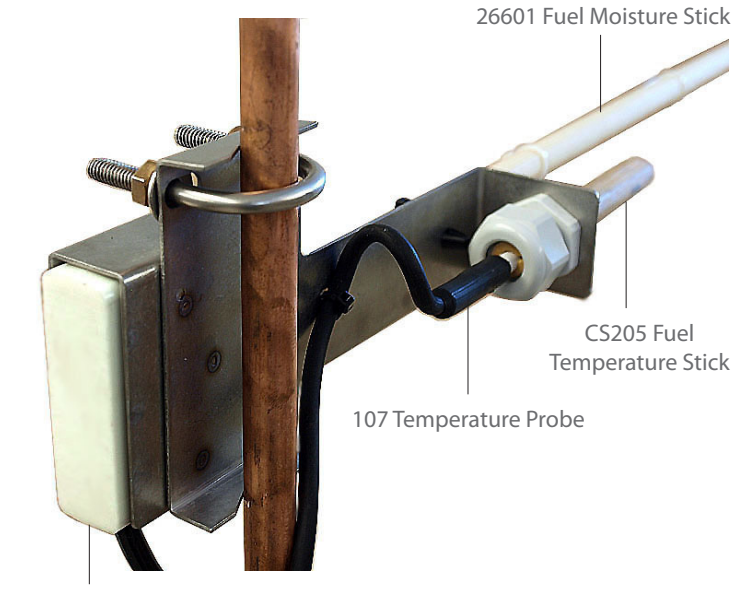
The CS516-QD and CS516-LQ are intended for our Remote Automated Weather Stations (RAWS). They consist of a CS506 Fuel Moisture Sensor, a 26601 10-hour Fuel Moisture Stick, a CS205 Fuel Temperature Stick, and a 107 Thermistor mounted on a 26817 Fuel Moisture/Temperature Mounting Stake.

CS516-QD

With the CS516-QD, the cables for the CS506 and 107 sensors have a 12 ft length and are fitted with a military-style connector. The connector attaches to the enclosure of a RAWS-F Quick Deployment Fire Weather Station.

CS516-LQ

With the CS516-LQ, the cables for the CS506 and 107 sensors are also fitted with a military-style connector, but the cables have a user-specified length. The CS516-LQ is intended to be used with the RAWS-P Permanently Mounted Station.



This view shows how the instruments fit into the 26817 Fuel Moisture/Temperature Mounting Stake.

Replacement Dowels

The dowels of the fuel moisture stick (p/n 26601) and fuel temperature stick (model CS205) are easily replaced in the field with a Phillips screwdriver and an adjustable wrench. Customers should replace the dowels each spring; more frequent replacements may be required in some environments. The more wet/dry cycles the dowels experience, the more frequently they will need to be replaced.

The dowels can be easily replaced using a Phillips screwdriver and an adjustable wrench. The CS205 is shown at left.

Ordering Information

Fuel Temperature

Must order both a fuel temperature stick and a temperature probe. Typically the fuel temperature stick/sensor is measured along side a fuel moisture sensor/stick. The sensors can be mounted side-by-side on a Fuel Moisture & Temperature Mounting Stake.

CS205 10-hour Fuel Temperature Stick (requires a 107 temperature probe; see below)

Temperature Probe

107 Temperature Probe (-35° to +50°C) Must choose a cable length option and cable termination option (see below).

Cable Length Options (choose one)

-10 10 ft (3 m) cable length.

-17 17 ft (5 m) cable length.

-33 33 ft (10 m) cable length (recommended)

-50 50 ft (15 m) cable length

-U-L User-defined cable length. Enter length, in ft, after the -L.

Cable Termination Options for 107 (choose one)

-PT Cable terminates in stripped and tinned leads for direct connection to datalogger's terminals.

-PW Cable terminates in a connector for attachment to a prewired enclosure.

-C Cable terminates in a connector for attachment to a ET107 station or CS110 electric field meter.

Fuel Moisture

Must order both a fuel moisture stick and a moisture probe. Typically the fuel moisture stick/sensor is measured along side a fuel temperature sensor/stick. The sensors can be mounted side-by-side on a Fuel Moisture & Temperature Mounting Stake.

26601 10-hour Fuel Moisture Stick (requires a CS506-L Fuel Moisture Sensor; see below)

Fuel Moisture Probes (choose one)

CS506-L Fuel Moisture Sensor/10-hour Fuel Moisture Stick with user-specified cable length. Enter cable length, in feet, after the -L; standard length is 25 ft. Must choose a cable termination option (see below).

Cable Termination Options for CS506-L (choose one)

-PT Cable terminates in stripped and tinned leads for direct connection to datalogger's terminals.

-PW Cable terminates in a connector for attachment to a prewired enclosure.

Mounting Stake

10974 Fuel Moisture & Temperature Mounting Stake

Replacement Dowels

26601 10-hour Fuel Moisture Stick

CS205 10-hour Fuel Temperature Stick

RAWS Station Products

The CS516 attaches to the connectors labeled FM/FT on the RAWS connector panel.

Fuel Sensors for RAWS Stations

CS516-QD Fuel Moisture & Temperature Sensor for the RAWS-F Quick Deployment Fire Weather Station. Sensors have a 12-ft cable length and are mounted on the 10974 mounting stake.

CS516-LQ Fuel Moisture & Temperature Sensor for the RAWS-P Permanently Mounted Station; must specify a fuel moisture sensor cable length and a temperature sensor cable length (see below). The sensors are mounted on the 10974 mounting stake.

Cable lengths for the CS516-LQ

Recommended cable lengths are 25, 50, 75, or 100 ft (8, 15, 23, or 31 m).

-LQ Fuel moisture sensor cable length. Enter the cable length, in feet, after the -LQ.

-LT Temperature sensor cable length. Enter the cable length, in feet, after the -LT.

Specifications

CS506 Fuel Moisture Sensor

- Operating Range: 0 to 70% moisture content
- Fuel Moisture Accuracy:

Range	Worst Case	RMS Error
0 to 10%	±1.25%	±0.74%
10 to 20%	±2%	±0.9%
20 to 30%	±3.4%	±1.94%
30 to 50%	±4.11%	±2.27%

- Power Supply: 5 to 18 Vdc
- Enable Voltage: off at 0 Vdc (< 1 Vdc); on at 5 Vdc (> 4 Vdc; maximum 18 Vdc)
- Current Consumption
  Active: 65 mA
  Quiescent: 45 µA
- Output Signal: ±0.7 Vdc square wave with an output frequency of approximately 31 to 58 kHz
- View EU Declaration of Conformity documentation at: www.campbellsci.com/cs506-l
- Dimensions: 10.16 x 6.35 x 1.91 cm (4 x 2.5 x 0.75 in)

26601 10-Hour Fuel Moisture Stick

- Material: Ponderosa Pine
- View EU Declaration of Conformity documentation at: www.campbellsci.com/pn26601
- Diameter: 1.3 cm (0.5 in)
- Length: 50.8 cm (20 in)
- Weight: 45 g (0.1 lb)

107 Fuel Temperature Sensor

- Tolerance: ±0.2°C over 0° to 50°C range
- Temperature Measurement Range: -35° to +50°C
- Steinhart-Hart Equation Error (CRBasic loggers only): ≤±0.01°C over measurement range
- Polynomial Linearization Error (Edlog loggers only):
  107: Typically <±0.5°C over measurement range
  108: Typically <±0.5°C over -5° to +90°C range
- Time Constant in Air: 30 to 60 s in a wind speed of 5 m s^{-1}
- Maximum Cable Length: 305 m (1000 ft)
- Length: 10.4 cm (4.1 in)
- Diameter: 0.76 cm (0.3 in)
- Weight with 10-ft cable: 136 g (5 oz)

CS205 10-Hour Temperature Stick

- Material: Ponderosa Pine
- Diameter: 1.3 cm (0.5 in)
- Length: 11.4 cm (4.5 in)
- Weigh of stick only: 9.07 g (0.32 oz)

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GPS16X-HVS

GPS Receiver with Integrated Antenna

Position and Time

Precision time synchronization

Overview

The GPS16X-HVS is a global positioning system (GPS) receiver that provides position, velocity, and timing information. Campbell Scientific configures the GPS16X-HVS and modifies its cable so that the receiver can more easily interface with our data loggers.

Benefits and Features

- Supports real-time WAAS or RTCM corrections for accuracy of 3 to 5 m
- Attaches directly to a CR300-series, CR6, or CR1000X, regardless of functionality
- Connects directly to a CR800, CR850, CR1000, or CR3000 datalogger when PPS time-synchronizing functionality is not used.
- Processes data from up to 12 satellites depending on the number of satellites viewable above the horizon
- Allows the data logger clock to be set to the highly accurate GPS time
- Configured by Campbell Scientific to output RMC and GGA data strings at 38400 bps
- Extremely accurate timing pulse (PPS) can be used to synchronize time between the data logger and other instruments

Detailed Description

The GPS16X-HVS, manufactured by Garmin International, consists of a receiver and an integrated antenna. It receives signals from orbiting Global Positioning System (GPS) satellites and then uses the signals to calculate position and velocity. The GPS16X-HVS also provides a highly accurate one-pulse-per-second (PPS) output for precise timing measurements.

Default settings are typically used. The default settings and options are changed using GPS16 software, which is available, at no charge, from the Garmin website (www.garmin.com).

Additional hardware is required to connect the GPS16X-HVS to the computer running the GPS16 software (see Ordering Information for more information).

By default, the instruction expects the GPS unit to be set up at 38400 baud, outputting the GPRMC and GPGGA sentences once per second. The data logger expects the start of the second to coincide with the rising edge of the PPS signal. If there is no PPS signal or if the required sentences come out at

less than once per second, the data logger will not update its clock.

GPS units with lower baud rates can be used with the GPS instruction, but the baud rate has to be set for the relevant Com port it is to be connected to either in the data logger settings or by including a SetStatus command after the BeginProg instruction in the program (for example, SetStatus("BaudrateCOM4",19200)). Baud rates below 2400 bps will not work, as the GPS unit will not be able to transmit the two GPS sentences once per second reliably. Similar problems can be encountered even at higher baud rates if too many optional GPS strings are selected to be output.

Specifications

Receiver	WAAS enabled. 12 parallel channel GPS receiver continuously tracks and uses up to 12 satellites (up to 11 with PPS active) to compute and update the position.
Update Rate	Factory set to 1 s between updates. (Programmable from 1 to 900 s.)
PPS Output	1 Hz pulse; 1 µs accuracy (Width factory set to 100 ms.)
Baud Rate	Factory set to 38400 bps.
Operating Temperature Range	-30° to +80°C
Storage Temperature Range	-40° to +80°C
Operating Voltage Range	8 to 40 Vdc
Current Drain	65 mA active (@ 12 Vdc)
Velocity Accuracy	0.1 knot RMS steady state
Cable Length	4.57 m (15 ft)
Diameter	9.1 cm (3.58 in.)
Height	4.2 cm (1.65 in.)
Weight	332 g (12 oz)

Position Accuracy (95% typical)

GPS Standard Positioning Service (SPS)	< 15 m
DGPS (USCG/RTCM) Correction	3 to 5 m
DGPS (WAAS) Correction	< 3 m

Acquisition Times

Reacquisition	< 2 s
Hot	~1 s (all data known)
Warm	~38 s (initial position, time and almanac known, ephemeris unknown)
Cold	~45 s

For comprehensive details, visit: www.campbellsci.com/gps16x-hvs

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HygroVue10

Digital Temperature and Relative Humidity Sensor with M12 Connector

Rugged, Reliable, and Flexible

Simple to use and easy to maintain

Overview

The HygroVue™10 offers a combined temperature and relative humidity element in an advanced digital sensor that is ideal for weather networks. The electronics within the sensor provide accurate measurements, and the sensor is easy to use. The digital SDI-12 output allows a simple connection and measurement by many data logging systems. Another benefit is that this digital output avoids the extra errors associated with measuring analog sensors.

A hydrophobic sintered filter prevents dirt and water from entering the cap. The filter is designed to be resistant to wind-driven rain. A secondary PTFE membrane filter is bonded to the surface of the sensor element to prevent finer dust and mold from directly influencing the measurements.

Because the sensor housing is designed to withstand permanent exposure to various weather conditions and to fit inside a range of radiation shields (including compact shields), the HygroVue 10 is truly suitable for a wide range of monitoring applications.

The HygroVue 10 uses a latest-generation, Swiss-made, combined relative humidity and temperature element based on CMOSens® technology that offers good measurements, accuracy, and stability. Each element of the HygroVue 10 is individually calibrated with the calibration corrections stored on the chip. You can easily change the sensor element in the field, which reduces your downtime and calibration costs.

Benefits and Features

- Uses a combined, pre-calibrated digital humidity and temperature element
- Field-changeable element for fast, on-site recalibration
- Digital SDI-12 output, allowing long cables with no added errors
- Simple data logger programming
- Low power consumption
- Wide operating voltage
- Rugged design with potted electronics
- Standard M12 connector with IP67 sealing rating

Detailed Description

Mounting

When you use the HygroVue 10 outdoors, it is standard practice to install the sensor within a housing, known as a

shield. The shield prevents solar radiation from heating the sensor and creating measurement errors. The radiation shield also provides a degree of protection from adverse weather, such as hail or driving rain. The most common type of shield is a relatively small, naturally ventilated screen that is low maintenance and requires no power.

The HygroVue 10 is specifically designed for field use with dimensions to suit common radiation shields. (Campbell Scientific recommends the RAD10E 10-Plate Solar Radiation Shield.) You can mount the RAD10E on vertical or horizontal poles.

Field Calibration

Calibration is easy to carry out by simply changing the sensor element. As each sensor element is individually calibrated, no further adjustments of the sensor are required. This means that when you change the element, it returns the sensor to the factory calibration state for both temperature and humidity—without interrupting your measurement collection for long periods.

Specifications

Sensing Element	SHT35 modified by Campbell Scientific
Communication Standard	SDI-12 V1.4 (responds to a subset of commands)
Supply Voltage	7 to 28 Vdc
EMC Compliance	Tested and conforms to IEC61326:2013.
Standard Operating Temperature Range	-40° to +70°C
Main Housing Material	UV stable, white PET-P
Electronics Sealing Classification	IP67
Sensor Protection	Outer glass-filled polypropylene cap fitted with a stainless-steel mesh dust filter with nominal pore size of < 30 µm. The sensor element has a PTFE protective film with a filtration efficiency of > 99.99% for particles of 200 nm or larger size.
Sensor Connector	M12, male, 4-pole, A-coded
Cable	Polyurethane sheathed, screened cable, nominal diameter 4.8 mm (0.19 in.)
Field-Replaceable Chip or Recalibrate	Field-replaceable chip
Sensor Cap Diameter	12.5 mm (0.5 in.)
Body Diameter at Connector	18 mm (0.7 in.)
Length	180 mm (7.1 in.) without cable fitted
Sensor Body Weight	50 g (1.8 oz)
Weight	250 g (8.8 oz) with 5 m (16.4 ft) cable

Relative Humidity	
Measurement Range	0 to 100% RH
Accuracy	❱ ±2% (at 25°C, over the range 80 to 100% RH) ❱ *-NOTE- The accuracy figures quoted are the 95% confidence limits relative to factory standards.* ❱ ±1.5% (at 25°C, over the range 0 to 80% RH)
Short-Term Hysteresis	< ±1% RH
Additional Errors at Other Temperatures	< ±1% RH (over -40° to +60°C)
Long-Term Stability	±0.5% per year (maximum drift in clean air conditions)
Reported Resolution	0.001% RH
Repeatability	0.05% RH (3σ noise level)
Response Time with Filter	< 20 s (63% response time in still air)

Air Temperature	
Measurement Range	-40°C to +70°C
-NOTE-	*The accuracy figures quoted are the 95% confidence limits relative to factory standards.*
Accuracy	❱ ±0.1°C (over the range 20 to 60°C) ❱ ±0.2°C (over the range -40 to +70°C)
Long-Term Drift	< 0.03°C per year
Reported Resolution	0.001°C
Repeatability	0.04°C (3σ noise level)
Response Time with Filter	< 130 s (63% response time in air moving at 1 m/s)
Calibration Traceability	NIST and NPL standards

Maximum Current Drain

Quiescent	50 µA
During Measurement	0.6 mA (takes 0.5 s)

For comprehensive details, visit: www.campbellsci.com/hygrovue10

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TE525WS-L

Rain Gage with 8 in. Orifice

Conforms to National Weather Service Recommendation

Overview

The TE525WS, manufactured by Texas Electronics, is a tipping bucket rain gage that conforms to the National Weather Service recommendation for an 8 in. funnel orifice. It measures rainfall in 0.01 in. increments. This tipping bucket is compatible with all Campbell Scientific data loggers, and it is widely used in environmental monitoring applications.

Benefits and Features

- Compatible with most Campbell Scientific data loggers
- Accuracy is ±1 percent at rates up to 1 in./hr
- High precision—tips at 0.01-in. increments
- Directly compatible with the CS705 Snowfall Adapter allowing the TE525WS to measure the measure the water content of snow
- Conforms to the National Weather Service recommendation for an 8-inch funnel orifice
- Compatible with the CWS900-series interfaces, allowing it to be used in a wireless sensor network

Detailed Description

The TE525WS funnels precipitation into a bucket mechanism that tips when filled to its calibrated level. A magnet attached to the tipping mechanism actuates a switch as the bucket tips. The momentary switch closure is counted by the pulse-counting circuitry of our data loggers.

Specifications

Sensor Type	Tipping bucket with magnetic reed switch
Material	Anodized aluminum
Operating Temperature Range	0° to 50°C
Resolution	1 tip
Volume per Tip	8.24 ml/tip (0.28 fl. oz/tip)

Rainfall per Tip	0.254 mm (0.01 in.)
Measurement Uncertainty	1.0% up to 50 mm/h (2 in./h)
Cable Type	2-conductor shielded
Orifice Diameter	20.3 cm (8 in.)

Dimensions	21 x 21 x 26.7 cm) (8.25 x 8.25 x 10.5 in.)
Cable Weight	0.1 kg (0.2 lb) per 3.05 m (10 ft) length
Tipping Bucket Weight	1.0 kg (2.2 lb)

For comprehensive details, visit: www.campbellsci.com/te525ws-l

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WINDSONIC4-QD

2-D Sonic Wind Sensor with SDI-12 Output for RAWS-F Stations

Overview

The WindSonic4-QD is a two-dimensional ultrasonic anemometer for measuring wind speed and direction. This sensor provides an alternative to the 034B-QD, a traditional mechanical cup and vane anemometer. Unlike mechanical anemometers, there are no moving parts to be periodically replaced—minimizing routine maintenance costs.

WindSonics are manufactured by Gill Instruments Ltd.

Detailed Description

The WindSonic4 uses two pairs of orthogonally oriented transducers to sense the horizontal wind. The transducers bounce the ultrasonic signal from a hood, thus minimizing the effects of transducer shadowing and flow distortion.

The WindSonic4-QD outputs an SDI-12 signal that is read by the RAWS-F's on-board CR1000M module. This sensor provides an alternative to the 034B-QD, a traditional mechanical cup and vane anemometer. Unlike mechanical anemometers, there are no moving parts to be periodically replaced—minimizing routine maintenance costs.

Specifications

Operating Humidity	< 5% to 100% RH
Operating Temperature	-35° to +70°C
Storage Temperature	-40° to +80°C (typical)
Input Voltage	9 to 30 Vdc
Typical Current Drain	< 10 mA (@12 V)
Measurement Frequency	40 Hz block averaged to a 1 Hz output frequency
Outputs Parameters	Polar (direction and speed) or orthogonal (U_x and U_y wind)
Output Signal	SDI-12 version 1.3
Diameter	14.2 cm (5.6 in.)
Cable Length	2.74 m (9 ft)
Length	16.0 cm (6.3 in.)
Weight	0.5 kg (1.1 lb)

Wind Direction

Range	0º to 359° (no dead band)
Accuracy	±3°
Resolution	1°

Wind Speed

Range	0 to 60 m/s
Accuracy	±2% (@ 12 m/s)
Resolution	0.01 m/s

For comprehensive details, visit: www.campbellsci.com/windsonic4-qd

CAMPBELL SCIENTIFIC®
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AUSTRALIA | BRAZIL | CANADA | CHINA | COSTA RICA | FRANCE | GERMANY | THAILAND | SOUTH AFRICA | SPAIN | UK | USA

CR1000 Specifications

Electrical specifications are valid over a -25° to +50°C, non-condensing environment, unless otherwise specified. Recalibration recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS (SE1-SE16 or DIFF1-DIFF8)

8 differential (DF) or 16 single-ended (SE) individually configuredinput channels. Channel expansion provided by optional analog multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single A/D conversion. A DF measurement with input reversal has better (finer) resolution than Basic Res.

Range (mV)[1]	*DF Res (µV)*[2]	*Basic Res (µV)*
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

[1]Range overhead of ~9% on all ranges guarantees that full-scale values will not cause over range.

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:
±(0.06% of reading + offset), 0° to 40°C
±(0.12% of reading + offset), -25° to 50°C
±(0.18% of reading + offset), -55° to 85°C (-XT option only)

[3]Accuracy does not include the sensor and measurement noise. Offsets are defined as:
Offset for DF w/input reversal = 1.5•Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3•Basic Res + 2.0 µV
Offset for SE = 3·Basic Res + 3.0 µV

ANALOG MEASUREMENT SPEED:

Integration Type/Code	*Integration Time*	*Settling Time*	*Total Time*[4] *SE w/ No Rev*	*Total Time*[4] *DF w/ Input Rev*
250	250 µs	3 ms	~1 ms	~12 ms
60 Hz[5]	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz[5]	20.00 ms	3 ms	~25 ms	~50 ms

[4]Includes 250 µs for conversion to engineering units.

[5]AC line noise filter.

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range (digital resolution dominates for higher ranges).
250 µs Integration: 0.34 µV RMS
50/60 Hz Integration: 0.19 µV RMS

INPUT LIMITS: ±5 Vdc

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

INPUT VOLTAGE RANGE W/O MEASUREMENT CORRUPTION: ±8.6 Vdc max.

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 GΩ typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):
±0.3°C, -25° to 50°C
±0.8°C, -55° to 85°C (-XT option only)

ANALOG OUTPUTS (VX1-VX3)

3 switched voltage, sequentially active only during measurement.

RANGE AND RESOLUTION:

Channel	*Range*	*Resolution*	*Current Source/Sink*
(VX 1–3)	±2.5 Vdc	0.67 mV	±25 mA

ANALOG OUTPUT ACCURACY (VX):
±(0.06% of setting + 0.8 mV), 0° to 40°C
±(0.12% of setting + 0.8 mV), -25° to 50°C
±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

VX FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 2500 mv square waves for exciting vibrating wire transducers.

PERIOD AVERAGE

Any of the 16 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading + resolution), where resolution is 136 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	*Input Range (±mV)*	*Signal (peak to peak) Min. (mV)*[6]	*Signal (peak to peak) Max (V)*[7]	*Min Pulse Width (µV)*	*Max*[8] *Freq (kHz)*
1	250	500	10	2.5	200
10	25	10	2	10	50
33	7.5	5	2	62	8
100	2.5	2	2	100	5

[6]Signal centered around Threshold (see PeriodAvg() instruction).

[7]With signal centered at the datalogger ground.

[8]The maximum frequency = 1/(twice minimum pulse width) for 50% of duty cycle signals.

RATIOMETRIC MEASUREMENTS

MEASUREMENT TYPES: Provides ratiometric resistance measurements using voltage excitation. 3 switched voltage excitation outputs are available for measurement of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Optional excitation polarity reversal minimizes dc errors.

RATIOMETRIC MEASUREMENT ACCURACY:[9,10, 11]
±(0.04% of Voltage Measurement + Offset)

[9]Accuracy specification assumes excitation reversal for excitation voltages < 1000 mV. Assumption does not include bridge resistor errors and sensor and measurement noise.

[10]Estimated accuracy, ΔX (where X is value returned from the measurement with Multiplier = 1, Offset = 0):
BrHalf() instruction: $\Delta X = \Delta V_r/V_x$
BrFull() instruction $\Delta X = 1000 \cdot \Delta V_r/V_x$, expressed as mV•V^{-1}.
ΔV^{-1} is calculated from the ratiometric measurement accuracy. See Resistance Measurements Section in the manual for more information.

[11]Offsets are defined as:
Offset for DIFF w/input reversal = 1.5•Basic Res + 1.0 µV
Offset for DIFF w/o input reversal = 3•Basic Res + 2.0 µV
Offset for SE = 3•Basic Res + 3.0 µV
Excitation reversal reduces offsets by a factor of two.

PULSE COUNTERS (P1-P2)

2 inputs individually selectable for switch closure, high frequency pulse, or low-level ac. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.7x10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH-FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW-LEVEL AC MODE: Internal ac coupling removes ac offsets up to ±0.5 Vdc.
Input Hysteresis: 12 mV RMS @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

Sine Wave (mV RMS)	*Range(Hz)*
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS (C1-C8)

8 ports software selectable, as binary inputs or control outputs. Provide on/off, pulse width modulation, edge timing, subroutine interrupts / wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UARTs), and SDI-12 communications. SDM communications are also supported.

LOW FREQUENCY MODE MAX: <1 kHz

HIGH-FREQUENCY MODE MAX: 400 kHz

SWITCH-CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 Ω

INPUT STATE: high 3.8 to 16 V; low -8.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kΩ with inputs <6.2 Vdc
0.220 kΩ with inputs ≥6.2 Vdc

SERIAL DEVICE/RS-232 SUPPORT: 0 TO 5 Vdc UART

SWITCHED 12 VDC (SW-12)

1 independent 12 Vdc unregulated source is switched on and off under program control. Thermal fuse hold current = 900 mA at 20°C, 650 mA at 50°C, 360 mA at 85°C.

COMPLIANCE INFORMATION

VIEW EU DECLARATION OF CONFORMITY AT:
www.campbellsci.com/cr1000
www.campbellsci.com/cr1000kd

COMMUNICATIONS

RS-232 PORTS:
DCE 9-pin: (not electrically isolated) for computer connection or connection of modems not manufactured by Campbell Scientific.
COM1 to COM4: 4 independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 Vdc UART
Baud Rates: selectable from 300 bps to 115.2 kbps.
Default Format: 8 data bits; 1 stop bits; no parity
Optional Formats: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with telecommunications peripherals manufactured by Campbell Scientific.

SDI-12: Digital control ports C1, C3, C5, and C7 are individually configured and meet SDI-12 Standard v 1.3 for datalogger mode. Up to 10 SDI-12 sensors are supported per port.

PERIPHERAL PORT: 40-pin interface for attaching CompactFlash or Ethernet peripherals

PROTOCOLS SUPPORTED: PakBus, AES-128 Encrypted PakBus, Modbus, DNP3, FTP, HTTP, HTML, POP3, PPP, SMTP, Telnet, NTCIP, NTP, SDI-12, SDM, TLS.

SYSTEM

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core running at 7.3 MHz)

MEMORY: 2 MB of flash for operating system; 4 MB of battery-backed SRAM for CPU usage and final data storage; 512 kB flash disk (CPU) for program files.

REAL-TIME CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional.

REAL-TIME CLOCK RESOLUTION: 10 ms

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

INTERNAL BATTERIES: 1200 mAh lithium battery for clock and SRAM backup that typically provides three years of backup

EXTERNAL BATTERIES: Optional 12 Vdc nominal alkaline and rechargeable available. Power connection is reverse polarity protected.

TYPICAL CURRENT DRAIN at 12 Vdc:
Sleep Mode: < 1 mA
1 Hz Sample Rate (1 fast SE measurement): 1 mA
100 Hz Sample Rate (1 fast SE measurement): 16 mA
100 Hz Sample Rate (1 fast SE measurement w/RS-232 communication): 28 mA
Active external keyboard display adds 7 mA (100 mA with backlight on).

PHYSICAL

DIMENSIONS: 23.9 x 10.2 x 6.1 cm (9.4 x 4 x 2.4 in); additional clearance required for cables and leads.

MASS/WEIGHT: 1 kg / 2.1 lb

WARRANTY

3 years against defects in materials and workmanship.