CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

CWB100, CWS220 CWS655 and CWS900 Wireless Sensor Networks

Key Features

Low power

Low maintenance

Can be used in situations where other cabled sensors would be impractical

Connects to a wide variety of sensors

Communicates with all the wireless sensors in the network using its own sensor network protocol

Data transfer from the sensors to the datalogger by the fastest and lowest power method available

Why Wireless?

There are situations when it is desirable to make measurements in locations where the use of cabled sensors is problematic. Protecting cables by running them through conduit or burying them in trenches is time consuming, labour intensive, and sometimes not even possible. Local fire codes may preclude the use of certain types of sensor cable inside buildings. In some applications measurements need to be made at distances where long cables decrease the quality of the measurement or are too expensive. There are also times when it is important to increase the number of measurements being made but the datalogger does not have enough available channels left for attaching additional sensor cables.

Each of the above instances can be resolved with a Campbell Wireless Sensor Network (CWSN). A CWSN provides a reliable, low maintenance, low power method for making measurements in applications where cabled sensors are impractical or otherwise undesirable.

What is it?

A CWSN consists of a CWB100 Wireless Base Station and one or more wireless sensors. The base station serves as the gateway to the network, communicating with a Campbell Scientific CR800-series, CR1000, or CR3000 datalogger via a control port as specified in the CRBasic CWB100() instruction.

The base station communicates with all of the wireless sensors in the network using its own sensor network protocol. Any sensor can serve as a RF repeater to communicate with other wireless sensors. A sensor can route its transmissions through up to three other sensors on the way back to the base station.

Wireless sensors include the CWS900, CWS220 and CWS655. The CWS900 allows a sensor with a special connector to be used in a wireless sensor network. The CWS220 Wireless Infrared Radiometer provides a non-contact means of measuring the surface temperature of an object.

The CWS655 Wireless Water Content Reflectometer measures volumetric soil water content, electrical conductivity (EC), dielectric permittivity and ambient temperature of soils.

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How does it work?

The CWB100 Wireless Base Station and one or more wireless sensors are first configured using Campbell Scientific's Wireless Sensor Planner, Network Planner or Device Configuration Utility (DevConfig) Software. Wireless sensors interface with the PC for configuration via the A205 CWS Sensor to PC Interface. One A205 is required per wireless system.

The datalogger is programmed to interface with the CWB100 and determine a polling interval. The sensors are synchronized to measure at the top of the datalogger's scan interval. The base station polls all sensors and stores the collected data early enough that it can transfer the data as soon as the datalogger requests it. This minimizes the amount of time the datalogger needs to wait for a response from the network through the CWB100 base station.

At the start of each polling interval, the datalogger polls the base station, and sensor values are transferred to the datalogger for storage. This method of data transfer from the sensors to the datalogger provides the fastest and lowest power method available.

The CWB100 base station serves as a gateway to the network. It comes with a bracket for mounting it to an enclosure backplate.

The CWS655 water content reflectometer measures volumetric soil water content, electrical conductivity (EC), dielectric permittivity, and ambient temperature of soils or other porous media.

Typical RF Range

Location	Base Height	Sensor Height	RF Range
Dense Corn Field 2.1 m (7 ft) tall	1.2 m (4 ft)	0.9 m (3 ft)	152 m (500 ft)
	1.2 m (4 ft)	0.0 m (0 ft)	131 m (430 ft)
Inside Industrial Building	1.2 m (4 ft)	0.9 m (3 ft)	> 76 m (250 ft)
Mixed Juniper/Maple Forest	1.2 m (4 ft)	0.9 m (3 ft)	156 m (513 ft)
	1.2 m (4 ft)	0.0 m (0 ft)	103 m (340 ft)
Residential Street (Line of Sight)	1.2 m (4 ft)	0.9 m (3 ft)	392 m (1285 ft)
	1.2 m (4 ft)	0.0 m (0 ft)	329 m (1080 ft)

The CWS900 connects to a variety of sensors, providing them with wireless capability. Sensors that can be connected to the CWS900 include tipping bucket rain gauges, wind sensors and temperature and relative humidity probes.

Antenna options for the European CWB100E 868 MHz base station include:

009964 868 MHz 0dBd Omni ½ Wave Whip Antenna w/Right Angle
009962 Broadband Omni Waterproof Enclosure Mount Antenna

Antenna options for US and Australian 900MHz versions:

#15730 900MHz 0dBd Omni 1/4 Wave Whip Antenna w/Right Angle
#15731 900MHz 0dBd Omni 1/4 Wave Whip Antenna, Straight 2 inches Tall
#14204 900MHz 0dBd Omni 1/2 Wave Whip Antenna
#15970 900MHz 1dBd Dipole Antenna w/Adhesive Mount
#14221 900MHz 3dBd Omni Antenna
#14201 900MHz 9dBd Yagi Antenna

Specifications

Operating Ranges
Temperature: -25° to +50°C
Relative Humidity: 0 to 100%, non-condensing

Power supply for sensors: 2 AA batteries with a battery life of 1 year assuming sensor samples taken every 10 min. Optional solar charging available.

Weather resistance: IP67 rating for sensors and battery pack (battery pack must be properly installed); each sensor is leak tested.

Internal 25 mW FHSS Radio

Radio Description:

Model	Where Used	Frequency	FHSS Channels
CWS220E, CWS655E, CWS900E, CWB100E	Europe	868-869 MHz (Bands g1 & g2)	16
CWS220, CWS655, CWS900, CWB100	U.S. Canada	902 to 918 MHz	50

Transmitter Power Output: 25 mW (+14 dBm)
Receiver Sensitivity: -110 dBm (0.1% frame error rate)
Typical Current Drain
Standby: 3 µA
Receiving: 18 mA typical (full run)
Transmitting: 45 mA
Average Operating Current with 1-s Access Time: 5 µA
Quality of Service Management: RSSI
Additional Features: GFSK modulation, data interleaving, forward error correction, BCH (31,21), data scrambling

CWB100-series Base Station

Power: 4.5 to 22 Vdc
Typical Current Drain @ 12 Vdc
Standby: <1 mA
Receiving: 10 mA
Transmitting: 20 mA
Communication: Serial Protocol or USB
Terminal Block Connector: Bi-directional serial datalogger connection
USB Port: Computer connection for configuration
Antenna: RPSMA antenna connection
Memory: Can store data table for up to 50 wireless sensors.
Dimensions (including mounting bracket): 10.8 x 4.4 x 4.4 cm (4.25 x 1.75 x 1.75 in.)
Weight: 140 g (5 oz)

CWS220-series Infrared Radiometer

Average Current Drain: 300 µA with 15 minute polling
Absolute Accuracy: ±0.2°C @ -10° to +65°C; ±0.5°C @ -40° to +70°C
Repeatability: ±0.05°C @ -10° to +65°C; ±0.1°C @ -40° to +70°C
Response Time: <1 s to changes in target temperature
Wavelength Range: 8 to 14 µm (corresponds to atmospheric window)
Field of View (FOV): 22° half angle
Dimensions: 15 x 6 x 4.5 cm (5.9 x 2.4 x 1.77 in.)
Weight: 270 g (9.6 oz)

CWS655-series Water Content Reflectometer

Average Current Drain: 300 µA with 15 minute polling
Accuracy
Water Content: ±2% when using Topps equation
Electrical Conductivity: ±(5% of reading + 0.05 dS/m)
Temperature: ±0.2°C
Dimensions
Body: 14.5 x 6 x 4.5 cm (5.7 x 2.4 x 1.77 in)
Rod Length: 12 cm (4.7 in)
Weight: 216 g (7.6 oz)

CWS900-series Configurable Wireless Sensor Interface

Compatible Datalogger Operating Systems
CR800-Series: CR800.Std.12 and higher
CR1000: CR1000.Std.21 and higher
CR3000: CR3000.Std.14 and higher
Compatible Sensors: Sensors with the -CWS cable termination option. A sensor can also be connected with the CWS900 via the A150 Desiccant Case.
Average Current Drain: 300 µA with 15 minute polling (depending on attached sensor)
Analogue Channels
Single-Ended: SE1, SE2, SE3
Differential: DF1
Analogue Input Range: -1 to + 2.5 Vdc
Accuracy
0° to + 50°C: ±(0.02% of reading + 2 µV)
-35° to + 70°C: ±(0.05% of reading + 2 µV)
Resolution: 0.3 µV
Excitation Voltage: 2.5V, 3.3V, 5.0V; 20 mA maximum
Excitation Voltage Accuracy
-35° to + 70°C: ±2%
Bridge Measurement Accuracy (+2.5V excitation only)
0° to + 50°C: ±(0.03% of reading + 3 µV)
-35° to + 70°C: ±(0.07% of reading + 3 µV); not including sensor and measurement noise, and external bridge resistor errors
Low Level AC Input: 20 mV minimum; 10 kHz maximum frequency
Switch Closure
Maximum Count Rate: 100 Hz
Minimum Open Time: 5 ms
Minimum Closed Time: 5 ms
Maximum Bounce Time: 4 ms
Temperature Accuracy: ±0.2°C
Dimensions: 15 x 6 x 4.5 cm (5.9 x 2.4 x 1.77 in.)
Weight: 184 g (6.5 oz)

Note: The internal radios in the wireless sensors are designed for extreme low power consumption rather than to move a lot of data quickly. It takes 15 to 30 seconds per hop when moving data from a sensor, through a sensor used as a repeater, and ending up at the base radio. Going through three repeaters could take a data packet anywhere from 45 to 90 seconds to get to the base radio.