CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

CWB100, CWS220, CWS655 & CWS900

Wireless Sensor Networks

CWB100, CWS220, CWS655 & CWS900

Wireless Sensor Networks

General Description

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, labor 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. Up to four CWB100s can be connected to one CR1000 or CR3000; up to two CWB100s can be connected to one CR800.

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

The base station communicates with all of the wireless sensors in the network using its own sensor network protocol. Any sensor can serve as an 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 provides a non-contact means of measuring the surface temperature of an object; the 26054 bracket is used to mount the CWS220 radiometer to a mast or pole. The CWS655 measures volumetric soil water content, electrical conductivity (EC), dielectric permittivity, and ambient temperature of soils.

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 A205 interfaces a wireless sensor with a PC, allowing the sensor to be configured. 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.

Note: *The internal radios in the wireless sensors were not designed 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.*

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)

Specifications

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

Power: 2 AA batteries with a battery life of one year assuming sensor samples taken every 10 minutes. 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
CWS220, CWS655, CWS900, CWB100	U.S. Canada	902 to 918 MHz	50
CWS220A, CWS655A, CWS900A, CWB100A	Australia, New Zealand	920 to 928 MHz	50
CWS220E, CWS655E, CWS900E, CWB100E	Europe	868 MHz	16

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: 15 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.

Max. Number of CWB100s connected to one logger: 4 (CR1000, CR3000), 2 (CR800); datalogger must have OS 24 to connect multiple CWB100s

Dimensions including mounting bracket: 10.8 x 4.4 x 4.4 cm. (4.25 x 1.75 x 1.75 in)

Weight: 5 oz (140 g)

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)

The CWS220 incorporates Apogee Instrument's SI-111 infrared sensor to provide a non-contact means of measuring the surface temperature of an object.

Specifications Continued

CWS655-series Water Content Reflectometer

Average Current Drain: 300 µA with 15 minute polling

Measurements:

	Range	Precision	Accuracy
Bulk Electrical Conductivity	0 to 8 dS/m	0.5% of BEC	±(5% of reading + 0.05 dS/m)
Relative Dielectric Permittivity	1 to 81	<0.02	***1 to 40 range:*** ±(2% of reading + 0.6) for solution electrical conductivity ≤8 dS/m
			40 to 81 range: ±1.4 for solution electrical conductivity ≤2.8 dS/m
Volumetric Water Content using Topp Equation	5% to 50%	<0.05%	±3% VWC typical in mineral soils that have solution electrical conductivity ≤3 dS/m
Soil Temperature	-10° to +70°C	± 0.02°C	±0.5°C for probe body buried in soil

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)

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

CWS900-series Configurable Wireless Sensor Interface

Compatible Datalogger Operating Systems

CR800-Series: CR800.Std.21 and higher

CR1000: CR1000.Std.21 and higher

CR3000: CR3000.Std.21 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)

Analog Channels

Single-Ended: SE1, SE2, SE3

Differential: DF1

Analog 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, 3.3 V, 5.0 V; 20 mA maximum

Excitation Voltage Accuracy

-35° to + 70°C: ±2%

Bridge Measurement Accuracy (+2.5 V 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: 5.9 x 2.4 x 1.77 in. (15 x 6 x 4.5 cm)

Weight: 6.5 oz (184 g)

An optional solar cell (at left) is available for recharging wireless sensor batteries.

Sensors that can be connected to the CWS900 include rain gages, wind sensors, and temperature and relative humidity probes.

Printed June 2012