



# **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.



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.

## 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.

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

**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:** 5.9 x 2.4 x 1.77 in. (15 x 6 x 4.5 cm)

**Weight:** 9.6 oz (270 g)



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  $\mu$ A with 15 minute polling

**Measurements:**

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

**Dimensions**

**Body:** 5.7 x 2.4 x 1.77 in.  
(14.5 x 6 x 4.5 cm)  
**Rod Length:** 4.7 in. (12 cm)  
**Weight:** 7.6 oz (216 g)



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  $\mu$ A 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:**  $\pm(0.02\%$  of reading + 2  $\mu$ V)  
**-35° to + 70°C:**  $\pm(0.05\%$  of reading + 2  $\mu$ V)

**Resolution:** 0.3  $\mu$ V

**Excitation Voltage:** 2.5V, 3.3 V, 5.0 V; 20 mA maximum

**Excitation Voltage Accuracy**

**-35° to + 70°C:**  $\pm 2\%$

**Bridge Measurement Accuracy (+2.5 V excitation only)**

**0° to + 50°C:**  $\pm(0.03\%$  of reading + 3  $\mu$ V)  
**-35° to + 70°C:**  $\pm(0.07\%$  of reading + 3  $\mu$ V); 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:**

$\pm 0.2^\circ\text{C}$

**Dimensions:**

5.9 x 2.4 x 1.77 in.  
(15 x 6 x 4.5 cm)

**Weight:**

6.5 oz (184 g)



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



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

