

Measurement Device / Wireless Sensors

CR200 Family

Input/Output Connections
Measure, communicate with,
and power sensors.

RS-232 Port
Supports communica-
tions with a computer.

LEDs
Indicate datalogger is
scanning, transmit-
ting, or receiving.

Antenna Connector
Connects to a whip antenna
or an antenna cable (CR205,
CR210, and CR215 only).



General Description

The CR200-series dataloggers are small measurement and control devices that measure sensors, process the results, and transmit data via their on-board spread spectrum radio (model dependent). These loggers have an operating temperature range of -40° to +50°C, a 12-bit A/D converter, a battery-backed clock, a 1 Hz scan rate, and a table-based memory structure. They communicate using the PakBus® protocol, which is a simplified variation of Internet protocols.

Input/Output Channels

The CR200-series loggers have five single-ended analog inputs, one switch closure pulse input, one low level ac pulse input, two control ports, two excitation channels (2.5 or 5 V), and one switched battery output. One of the control ports can be used as an SDI-12 port. Input voltage range is 0 to +2500 mV with 0.6 mV resolution. Differential measurements are not supported.

Program/Data Storage

Programs and data are stored in a non-volatile Flash memory. Approximately 32,000 data points can be stored in the table-based memory structure.

Models/Communications

All of the models can communicate with a PC via direct connect, Ethernet, multidrop modems, and digital cellular modems. Data can also be viewed on the CD295 DataView display or a PDA (PConnect or PConnectCE software required). Other communication options are model specific:

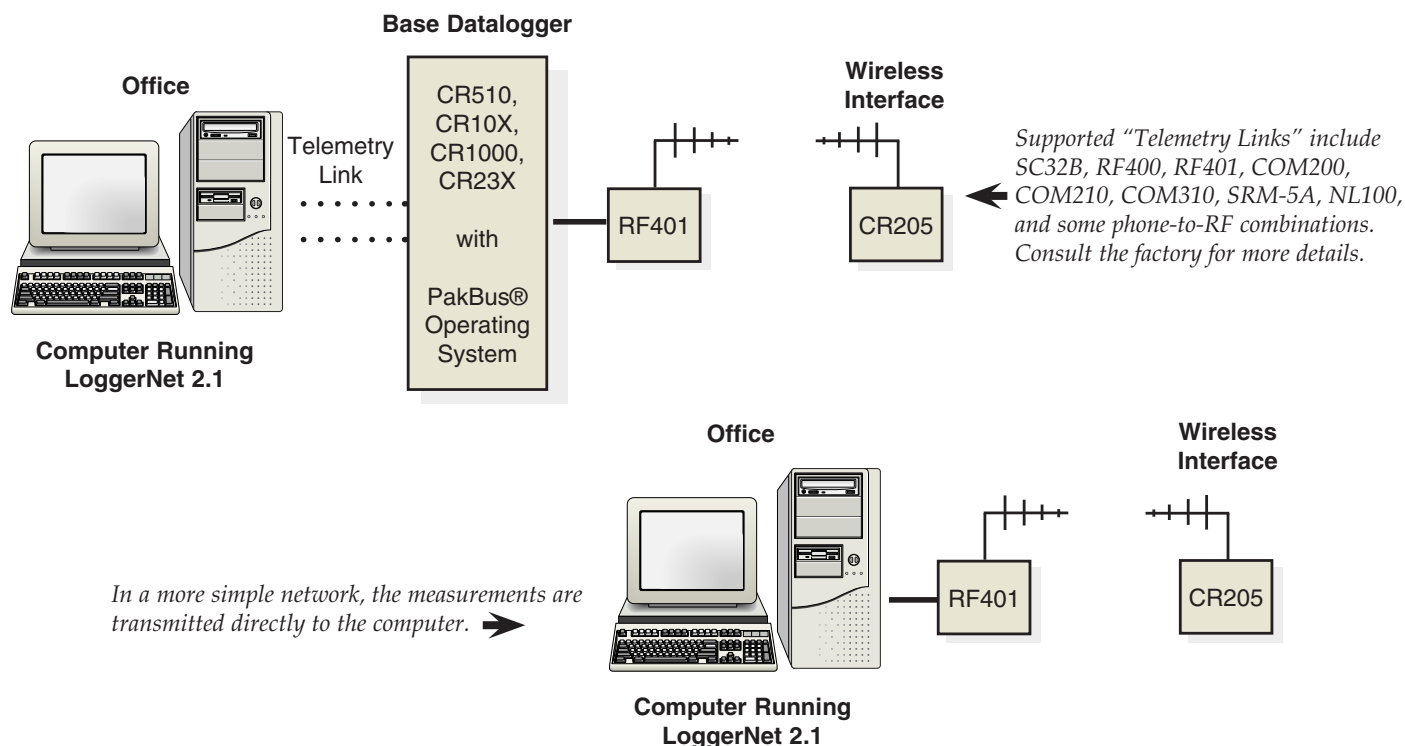
- **CR200**—base model (i.e., only supports direct connect, Ethernet, digital cellular modems, multidrop modems, CD295 DataView displays, and PDAs).
- **CR205**—includes an on-board 915 MHz Spread Spectrum Radio for transmitting data to another CR205 datalogger, an RF400 radio, or an RF401 radio. The 915 MHz frequency is used in the US/Canada.
- **CR210**—includes an on-board 922 MHz Spread Spectrum Radio for transmitting data to another CR210 datalogger, an RF410 radio, or an RF411 radio. The 922 MHz frequency is used in Australia/Israel.
- **CR215**—includes an on-board 2.4 GHz Spread Spectrum Radio for transmitting data to another CR215 datalogger, an RF415 radio, or an RF416 radio. The 2.4 GHz frequency can be used in many countries worldwide.



CAMPBELL SCIENTIFIC, INC.

815 W. 1800 N. • Logan, Utah 84321-1784 • (435) 753-2342 • FAX (435) 750-9540 • www.campbellsci.com

CR206/RF401-based Wireless Sensor Networks



Program Development Tools

The programming language of the CR200-series loggers is CRBasic. Datalogger programs are developed using a program editor (programs cannot be created or edited in the datalogger). Program editors that can be used with these dataloggers include the CRBasic editor and Short Cut. The CRBasic editor is included in our PC400 and LoggerNet Datalogger Support Software. Short Cut can be downloaded, at no charge, from www.campbellsci.com/downloads.

Communication and Data Collection Tools

PC200W

PC200W, our starter communications software, supports direct communications between a PC and a CR200-series datalogger and provides numeric display of measurements. PC200W can be downloaded, at no charge, from www.campbellsci.com/downloads.

PC400

PC400 Datalogger Support Software supports programming, manual data collection, and data display. Both direct and telecommunications are supported.

LoggerNet 2.1 or later

Besides providing all of PC400's functions, LoggerNet Datalogger Support Software supports automatic data collection and PAKBUS® routing.

Wireless Sensor Networks

The CR205, CR210, and CR215 can be used in a wireless sensor network. Wireless sensor networks are appealing because they are often more economical than trenching, laying conduit, and pulling wire. In some applications, cabled sensors are impractical due to man-made or natural causes, including construction, lightning, moving platforms, agricultural production, or bodies of water.

The diagrams at the top of the page depict our CR205/RF401-based wireless sensor networks. Our CR210/RF411-based and CR215/RF416-based networks are similar. All wireless sensor networks require LoggerNet 2.1 or higher software. Base dataloggers must have a PAKBUS operating system installed, which is available from: www.campbellsci.com/downloads

Enclosures

Applications with minimal power requirements can use the ENC200 enclosure to house the logger and the #16869 sealed rechargeable battery. This 6.7" x 5.5" x 3.7" enclosure has one power connector, one antenna connector, and five compression fittings. A larger enclosure such as our ENC 10/12 or ENC 12/14 is required to house a barometer or a larger battery.

Power Supply

Sealed rechargeable battery options include the #17365 12 V, 7 Ahr battery and the #16869 12 V, 0.8 Ahr battery. These batteries should be recharged either with a solar panel or ac power. Campbell Scientific offers 1.6 W (SP1.6-L, SP1.6) and 5 W (SP5-L, SP5) solar panels. The SP1.6-L and SP5-L solar panels connect directly to the datalogger's terminal strip, and the SP1.6 and SP5 plug into the ENC200's power connector. Recharging the battery via ac power requires either the #15988 or #16876 wall charger. The #15988 charger connects directly to the logger's terminal strip, and the #16876 charger plugs into the ENC200's power connector.

Antenna Options

CR205 and CR210 Antennas

- **14204**—0 dBd, omnidirectional ½ wave whip, jointed, adjustable from 0° to 90°. Connects directly to datalogger; no antenna cable needed.
- **15970**—1 dBd, dipole supplied with window/wall mount and a 10 foot RG-174 cable for connecting to the datalogger.
- **14203**—3 dBd with cable clamp mounts; requires an antenna cable to connect to datalogger.
- **14201**—9 dBd, Yagi with mounts; requires an antenna cable to connect to datalogger.



The 14201 Yagi antenna is intended for longer transmission distances.

CR215 Antennas

- **16005**—0 dBd, ½ wave whip articulating. Connects directly to datalogger; no antenna cable needed
- **16755**—13 dBd, Yagi with mounts; requires antenna cable

Antenna Cables

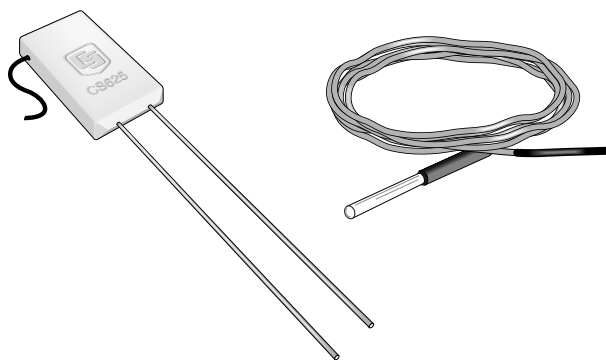
- **COAX RPSMA**—low-loss RG58 cable that is recommended for lengths less than 10 feet
- **COAX NTN**—low-loss RG8 cable that is recommended for lengths greater than 10 feet; requires a surge protector kit.

Antenna Surge Protector Kits

- **14962**—Surge Protector Kit for CR210 and CR205; requires COAX NTN-L cable.
- **16982**—Surge Protector Kit for CR215; requires COAX NTN-L cable.

Compatible Sensors

The CR200-series loggers can measure a variety of sensors including SDI-12 sensors and 4 to 20 mA sensors.



The CS625 (left) and 109 (right) probes were developed specifically for use with the CR200-series dataloggers.

The parameters and sensors in which the CR200-series loggers can measure are listed below:

- **Barometric Pressure**—CS100, CS105, and CS115 barometers
- **Precipitation**—CS700, TE525, TE525WS, TE525MM, and 385 tipping bucket rain gauges
- **Relative Humidity**—CS215, HMP50, and HMP45C Air Temperature and Relative Humidity probes
- **Snow Depth**—SR50 Ultrasonic Distance Sensor
- **Soil Volumetric Water Content**—CS625 Water Content Reflectometer. *Our CS616 and CS620 sensors are not compatible.*
- **Soil Water Potential**—257 Matric Potential Block. *Our 229 sensor is not compatible.*
- **Solar Radiation**—CS300 Pyranometer. *Our LI200X, LI190SB, CM3, SP-LITE, NR-LITE, CNR1, and Q7.1 probes are not compatible.*
- **Temperature**—109 Temperature Probe. *Other temperature probes listed on our price lists including our 107/108 probes and thermocouples are not compatible.*
- **Water Level**—SR50 Ultrasonic Distance Sensor, shaft encoders, and SDI-12 transducers (CS408, CS445). *Our DB1 Double Bubbler, and non-SDI-12 transducers (CS400, CS405, CS420, CS425, and CS431) are not compatible.*
- **Water Quality**—109 Temperature Probe and SDI-12 water quality probes. *Our CS547A, CS512, CSIM11, CSIM11-ORP, and OBS-3 probes are not compatible.*
- **Wind Speed and Direction**—014A, 034B, 03101, 03001, 05103, 05106, 05305, CS800, and WindSonic sensors. *The CSAT3 3-D Sonic Anemometer is not compatible.*

Note: The CR200-series dataloggers cannot make differential measurements and are not compatible with the duff moisture, fuel moisture/temperature, geographic position, leaf wetness, and soil heat flux sensors listed on our price lists. Campbell Scientific's SDM devices and multiplexers are also not supported.

CR200-series Datalogger Specifications

Electrical specifications are valid over a -40° to +50°C range unless otherwise specified.

ANALOG INPUTS; DIGITAL I/O

Channels SE1 to SE5 can be individually configured for single-ended measurement or digital I/O.

SINGLE-ENDED MEASUREMENT (SE1 TO SE5):

Analog Input Range: $0 \leq V < 2.5$ Vdc

Measurement Resolution: 0.6 mV

Measurement Accuracy

Typical: $\pm(0.25\%$ of reading + 1.2 mV offset)
over -40° to +50°C

Worst-case: $\pm(1\%$ of reading + 2.4 mV offset)
over -40° to 50°C

DIGITAL I/O (SE1 TO SE5):

Input/Output High State: 2.1 to 3.3 Vdc

Input/Output Low State: <0.9 Vdc

Output High State: 3.3 V (no load)

Drive Current: 220 μ A @ 2.7 Vdc

Maximum Input Voltage: 4 Vdc

HALF BRIDGE MEASUREMENTS:

Accuracy: Relative to the excitation.

Using +2.5 Vdc excitation, is
 $\pm(0.06\%$ of reading + 2.4 mV)

PERIOD AVERAGING (SE1 TO SE4):

Maximum Input Voltage: 4 Vdc

Frequency Range: 0 to 150 kHz

Voltage Threshold: counts cycles on transition
from <0.9 Vdc to >2.1 Vdc

EXCITATION CHANNELS (EX1 AND EX2):

Range: Programmable 0, 2.5, 5 Vdc, or
off (floating)

Accuracy: ± 25 mV on +2.5 Vdc range, ± 125 mV
on +5.0 Vdc range

Maximum Current: 25 mA on +2.5 Vdc range,
10 mA on +5.0 Vdc range

CONTROL PORTS (C1 AND C2)

DIGITAL I/O:

Voltage Level When Configured as Input:
<0.9 Vdc (low state) to >2.7 Vdc (high state)

Voltage Level When Configured as Output:
0 V (low state), 5 Vdc (high state) (no load)

Logic Level: TTL

Drive Current: 1.5 mA @ 4.5 V

SDI-12: SDI-12 sensors connect to C1

PULSE COUNTERS

SWITCH CLOSURE (P_SW):

Maximum Count Rate: 100 Hz

Minimum Switch Open Time: 5 ms

Minimum Switch Closed Time: 5 ms

Maximum Bounce Time: 4 ms

PULSE COUNT (P_SW, C1, AND C2):

Voltage Threshold: count on transition from
<0.9 V to >2.7 Vdc

Maximum Input Frequency: 1 kHz

Max Input Voltage: C1 & C2 (6.5 V), P_SW (4 Vdc)

LOW LEVEL AC (P_LL):

Voltage Threshold: <0.5 to >2 V

Minimum Input: 20 mV RMS

Maximum Frequency: 1 kHz

Maximum Input: ± 20 V

Note: P_LL, C1, & C2 can be used for switch
closure using the battery voltage and a
20 kOhm pull-up resistor. If the dc offset is
>0.5 V, then AC coupling is required.

COMMUNICATIONS

SERIAL INTERFACE: Female RS-232 9-pin interface
for logger-to-PC communications

ON-BOARD SPREAD SPECTRUM RADIO:

Frequency: 915 MHz (CR205), 922 MHz (CR210),
or 2.4 GHz (CR215)

Transmission Range: 1 mile with 0 dBd $\frac{1}{4}$ wave
antenna (line-of-sight) and 900 MHz radios;
0.6 miles (1 km) with 0 dBd $\frac{1}{2}$ wave antenna
(line-of-sight) and 2.4 GHz radio;
up to 10 miles with higher gain antenna
(line-of-sight)

RF4XX used as a base station radio

AVAILABLE RADIO TRANSMISSION MODES:

Always on, program controlled

Cycle Time: 1 or 8 s cycles; on for 100 ms every
period; checks for incoming communication

Scheduled Transmission Time: off until transmis-
sion time

PAKBus[®] packet switching network protocol

CLOCK ACCURACY

8.2 minutes/month @ -40° to +50°C; 1 minute/month
@ +25°C

CPU AND STORAGE

FINAL STORAGE: 128 kbyte Flash, data format
is 4 bytes per data point (table-based)

PROGRAM STORAGE: 6.5 kbyte Flash

FASTEST SCAN RATE: once per second

SWITCHED BATTERY (SW BATTERY)

Switched under program control; 300 mA minimum
current available

POWER

BATTERY VOLTAGE RANGE: 7 to 16 Vdc (can
program datalogger to measure internal battery
voltage)

BATTERY: 12 Vdc sealed rechargeable with on-board
charging circuit. Alkaline cells, lithium, or other
non-rechargeable battery types may be
connected if the charging circuit is not used
(i.e. nothing connected to charging terminals).

CHARGER INPUT VOLTAGE: 16 to 22 Vdc

SHELF LIFE OF CLOCK'S BACKUP BATTERY:
5 years

CURRENT DRAIN (@12 V)

QUIESCENT CURRENT DRAIN:

No Radio or Radio Powered Off: ~ 0.2 mA

ACTIVE CURRENT DRAIN:

No radio ~ 3 mA

Radio receive ~ 20 mA (CR205, CR210),
 ~ 36 mA (CR215)

Radio transmit ~ 75 mA (CR205, CR210,
CR215)

AVERAGE CONTINUOUS CURRENT DRAIN:

Radio always on ~ 20 mA (CR205, CR210),
 ~ 36 mA (CR215)

Radio in 1 s duty cycle ~ 2.2 mA (CR205,
CR210), ~ 4 mA (CR215)

Radio in 8 s duty cycle ~ 0.45 mA (CR205,
CR210), ~ 0.8 mA (CR215)

CE Compliance (as of 03/02)

STANDARD(S) TO WHICH CONFORMITY IS

DECLARED: EN55022: 1995 and EN61326: 1998

EMI and ESD Protection

IMMUNITY: Meets or exceeds following standards:

ESD: per IEC 1000-4-2; ± 8 kV air, ± 4 kV contact
discharge

RF: per IEC 1000-4-3; 3 V/m, 80-1000 MHz

EFT: per IEC 1000-4-4; 1 kV power, 500 V I/O

Surge: per IEC 1000-4-5; 1 kV power and I/O

Conducted: per IEC 1000-4-6; 3 V 150 kHz-80 MHz

Emissions and immunity performance criteria available
on request.

PHYSICAL

CASE DESCRIPTION: Aluminum with spring-loaded
terminals

DIMENSIONS (including terminals): 5.5" x 3" x 2"
(14.0 x 17.6 x 5.1 cm)

CUSTOM CASE: available for OEM applications;
contact Campbell Scientific

WEIGHT:

CR200: 8.5 oz (242 g)

CR205, CR210, or CR215: 9.5 oz (271 g)

CUSTOM CASE: available for OEM applications;
contact Campbell Scientific

WARRANTY

One year covering parts and labor.



CAMPBELL SCIENTIFIC, INC.

815 W. 1800 N. • Logan, Utah 84321-1784 • (435) 753-2342 • FAX (435) 750-9540
Offices also located in: Australia • Brazil • Canada • England • France • South Africa • Spain

Copyright © 2001, 2005
Campbell Scientific, Inc.
Printed August 2005