

Dataloggers / Wireless Sensors

CR200-Series¹



Input/Output Connections:

Measure, communicate with, and power sensors.

Antenna Connector:

Connects to a whip antenna or an antenna cable (CR206, CR211, and CR216 only).

RS-232 Port: Supports communications with a computer. The CR295 has a second serial port dedicated for satellite communications.

LEDs: Indicate datalogger is scanning, transmitting, or receiving.

General Description

The CR200-series dataloggers are small measurement and control devices that measure sensors and process the results. 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

Gas discharge tubes provide rugged electrostatic discharge protection for the inputs. 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. Please note that differential measurements are not supported.

Models/Communications

All of the models can communicate with a PC via direct connect, NL100 Ethernet Interface, MD485 multidrop modem, and our digital cellular modems. Data can also be viewed on the CD295 DataView II display or a PDA (PConnect or PConnectCE software required). Other communications supported are model dependent:

- **CR200**—base model (i.e., only supports direct connect, Ethernet, digital cellular modems, MD485 multidrop modems, CD295 DataView displays, and PDAs).
- **CR206**—includes an internal 915 MHz spread spectrum radio that transmits data to another CR206 logger or an RF401 radio². The 915 MHz frequency is used in the US/Canada.
- **CR211**—includes an internal 922 MHz spread spectrum radio that transmits data to another CR211 logger or an RF411 radio². The 922 MHz frequency is used in Australia/Israel.
- **CR216**—includes an internal 2.4 GHz spread spectrum radio that transmits data to another CR216 logger or an RF416 radio². The 2.4 GHz frequency can be used in many countries worldwide.
- **CR295**—includes an additional 9-pin serial port and an instruction set that allows communications with the TX312 HDR GOES satellite transmitter. The CR295 does not support radio telemetry and calculation of evapotranspiration.

Program/Data Storage³

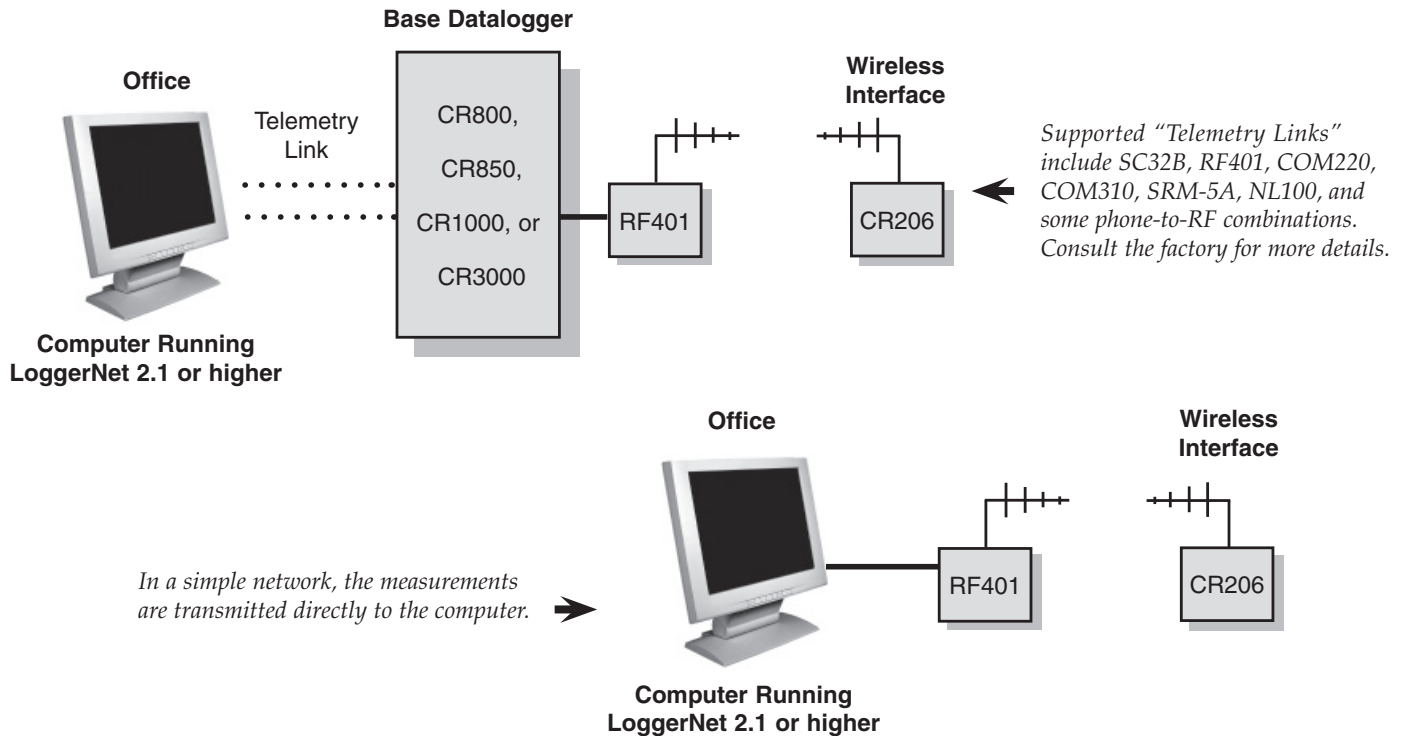
Programs and data are stored in a non-volatile Flash memory. Final storage has 512 kbytes of memory that provides approximately 128,000 data points in the table-based memory structure.

¹The CR206, CR211, and CR216 dataloggers replaced the CR205, CR210, and CR215 dataloggers on September 15, 2005. The newer dataloggers reflect changes incorporated in the RF401, RF411, and RF416 Spread Spectrum Radios, which replaced the RF400, RF410, and RF415 radios in May 2005. The newer dataloggers can be configured to be used in systems that contain the retired dataloggers and retired radios.

²The factory default settings for the logger do not match the settings for the RF401-series radio; therefore, the logger and radio must be reconfigured before communications can take place. The "Quick Reference Guide for Setting Up RF401-to-CR206 Communications" application note provides more information (see www.campbellsci.com/app-notes).

³Campbell Scientific is increasing the final storage memory from 128 kbytes to 512 kbytes. Dataloggers with the increased memory have 512k on their label.

CR206/RF401-based Wireless Sensor Networks



Wireless Sensor Networks

The CR206, CR211, and CR216 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 CR206/RF401-based wireless sensor networks. Our CR211/RF411-based and CR216/RF416-based networks are similar. All wireless sensor networks require LoggerNet 2.1 or higher software. The base datalogger must use the PAKBUS communication protocol (e.g., CR800, CR850, CR1000, CR3000). The PAKBUS protocol was optional for our retired CR510, CR10X, and CR23X dataloggers; the PAKBUS operating system is available, at no charge, from www.campbellsci.com/downloads for these dataloggers.

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 obtained, 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 obtained, at no charge, from: www.campbellsci.com/downloads

PC400

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

LoggerNet 2.1 or higher

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

Enclosures

Applications with minimal power requirements can use the ENC200 enclosure to house the datalogger 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.

The ENC200 cannot house a barometer or a battery that is larger than the #16869. However, an ENC10/12 or ENC12/14 enclosure is adequate for most CR200-, CR206-, CR211-, or CR216-based systems. An ENC16/18 enclosure can house a CR295-based system.

Power Supply

Sealed rechargeable battery options for the CR200, CR206, CR211, or CR216 include the #17365 7 Ahr battery and the #16869 0.8 Ahr battery. These batteries should be recharged either with a solar panel or ac wall charger. Campbell Scientific offers the SP5-L 5-Watt Solar Panel that attaches directly to the datalogger's terminal strip, and the SP5 5-Watt Solar Panel that plugs into the ENC200's power connector. AC wall charger options are the #15988 wall charger that attaches directly to the datalogger's terminal strip, and the #16876 wall charger that plugs into the ENC200's power connector.

Typical power supply for a CR295-based system consists of a BP12 12 Ahr or BP24 24 Ahr battery pack, CH100 regulator, and SP10 10-Watt or SP20 20-Watt solar panel.

Antenna Options

CR206 and CR211 Antennas

- **14204**—0 dBd, omnidirectional ½ wave whip, jointed, adjustable from 0° to 90°. Connects directly to the 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.
- **14221**—3 dBd, omnidirectional with mounts; requires an antenna cable to connect to the datalogger.
- **14201**—9 dBd, Yagi with mounts; requires an antenna cable to connect to the datalogger.



The 14201 Yagi antenna is intended for longer transmission distances.

CR216 Antennas

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

Antenna Cables

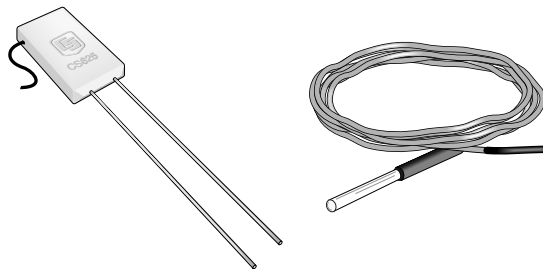
- **COAXRPSMA-L**—low-loss RG58 cable that is recommended for lengths less than 10 feet.
- **COAXNTN-L**—low-loss RG8 cable that is recommended for lengths greater than 10 feet; requires a 14962 or 16982 surge protector kit.

Antenna Surge Protector Kits

- **14462**—Surge Protector Kit for the CR211 or CR206; requires the COAXNTN-L cable.
- **16982**—Surge Protector Kit for CR216; requires the COAXNTN-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 dataloggers can measure are listed below:

- **AC Current**—CS15 Current Transformer.
- **Barometric Pressure**—CS100 and CS106 barometers.
- **Leaf Wetness**—237 and LWS leaf wetness sensors.
- **Multiparameter**—WXT510 Weather Transmitter.
- **Precipitation**—TE525, TE525WS, TE525MM, TB4, CS700, and 385 tipping bucket rain gages.
- **Relative Humidity**—CS215, HMP50, and HMP45C Air Temperature and Relative Humidity probes.
- **Snow Depth**—SR50A Sonic Ranging Sensor.
- **Soil Volumetric Water Content**—CS625 reflectometer, EnviroSMART, and EasyAG II. *Our CS616 and CS620 sensors are not compatible.*
- **Solar Radiation**—CS300 Pyranometer. *Our LI200X, LI190SB, LP02, CMP3, NR-LITE, NR01, CNR1, and CNR2 probes are not compatible.*
- **Temperature**—109 thermistor. *Other temperature probes listed on our price lists including our 107/108 thermistors and thermocouples are not compatible.*
- **Water Level**—SR50A Sonic Ranging Sensor, CS410 Shaft Encoder, and SDI-12 transducers (CS408, CS445). *Our DB1 Double Bubbler and non-SDI-12 transducers (CS420, CS425, CS431, CS440) are not compatible.*
- **Water Quality**—109 Temperature Probe, CS511 Dissolved Oxygen Probe, OBS-3+ Turbidity Probe, and SDI-12 water quality probes. *Our CS547A, CSIM11, and CSIM11-ORP probes are not compatible.*
- **Wind Speed and Direction**—014A, 034B, 03101, 03001, 05103, 05106, 05305, and WindSonic4 sensors. *The WindSonic1 and CSAT3 are not compatible.*

Note: The CR200-series dataloggers cannot make differential measurements and are not compatible with the geographic position, fuel moisture/temperature, surface temperature, strain, soil matric water potential, 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; non-condensing environment required. We recommend that you confirm system configuration and critical specifications with Campbell Scientific before purchase.

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)/(2.5 Vdc)

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

Minimum Pulse Width: 320 μ s

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: C1 and C2 can be used for switch closure using the battery voltage and a 20 k Ω 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 (CR206), 922 MHz (CR211), or 2.4 GHz (CR216)

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 transmission 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: 512 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)

MAX. CONTINUOUS BATTERY CHARGING CURRENT: 0.9 A @ 20°C; 0.65 A @ 50°C

RECOMMENDED BATTERIES: 12 Vdc, 7Ahr or smaller sealed rechargeable battery when connected to the on-board charging circuit. Using larger batteries with the datalogger's built-in charger may result in excessive PC board heating. This is especially a concern when the battery is deeply discharged or failing with a shorted cell.

Alkaline cells, lithium, or other non-rechargeable battery types may be connected if the charging circuit is not used (i.e. nothing connected to Charge terminals).

CHARGER INPUT VOLTAGE: 16 to 22 Vdc

SOLAR PANEL: 10 W or smaller when using on-board charging circuit.

WALL CHARGER: 1 A or smaller when using on-board charging circuit.

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 (CR206, CR211), ~ 36 mA (CR216)

Radio transmit ~ 75 mA (CR206, CR211, CR216)

AVERAGE CONTINUOUS CURRENT DRAIN:

Radio always on ~ 20 mA (CR206, CR211), ~ 36 mA (CR216)

Radio in 1 s duty cycle ~ 2.2 mA (CR206, CR211), ~ 4 mA (CR216)

Radio in 8 s duty cycle ~ 0.45 mA (CR206, CR211), ~ 0.8 mA (CR216)

CE COMPLIANCE (as of 03/02)

CE COMPLIANT DATALOGGERS: CR200, CR206, CR211, CR216

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

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)

WEIGHT:

CR200 or CR295: 8.5 oz (242 g)

CR206, CR211, or CR216: 9.5 oz (271 g)

CUSTOM CASE: available for OEM applications; contact Campbell Scientific

WARRANTY

One year covering parts and labor.

