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## CR200X-Series

Dataloggers / Wireless Sensors

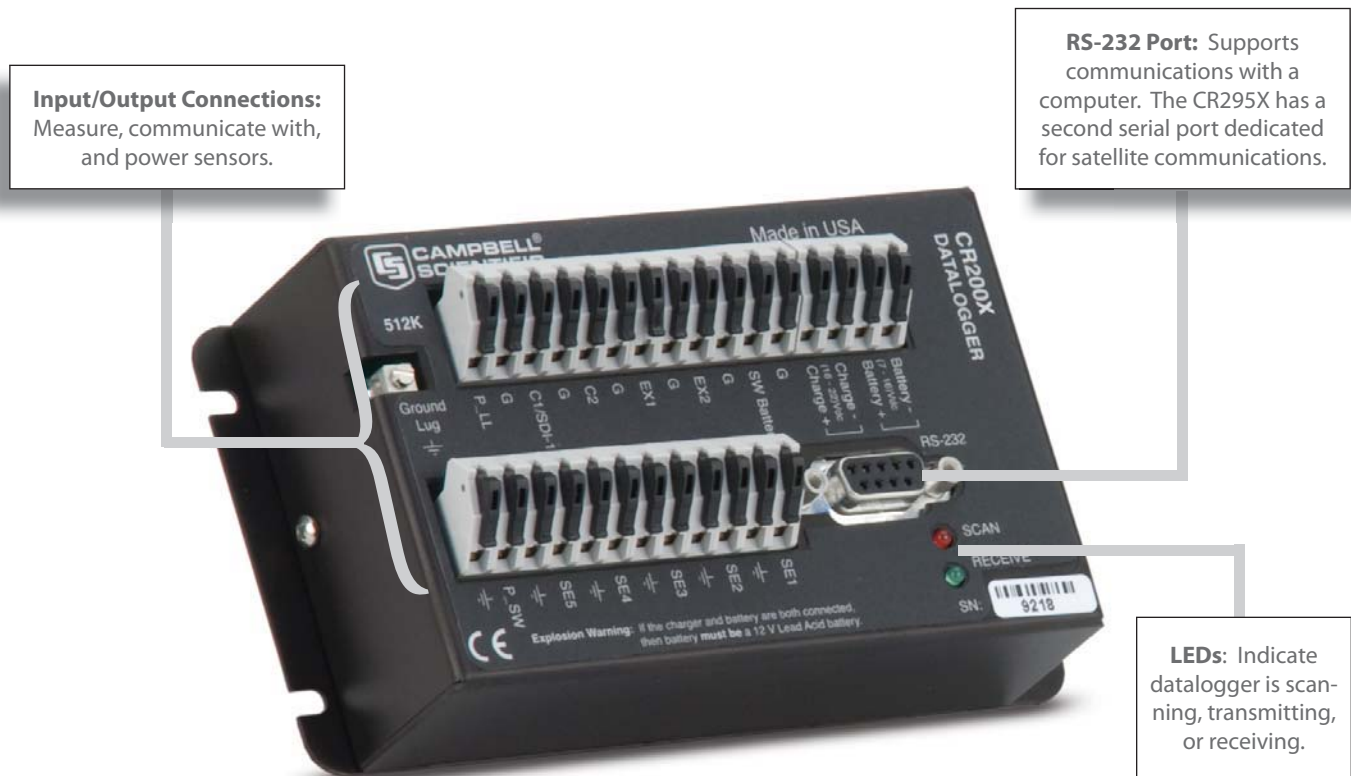
Small, Rugged,

Lower-Cost

Dataloggers

# CR200X-Series<sup>1</sup>

## Dataloggers / Wireless Sensors



### Features

- Campbell Scientific's smallest, lowest cost datalogger
- Optimal for measuring one or two simple sensors
- 512 kbytes of Flash final storage memory; approximately 128,000 data points
- Fastest scan rate of once per second
- 12-bit analog to digital conversions
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- Battery-backed SRAM and clock that ensure data, programs, and accurate time are maintained while a CR200X-series datalogger is disconnected from the main power source
- PAKBus<sup>®</sup> communication protocol used, which is a simplified variation of Internet protocols.

### Input/Output Channels

Gas discharge tubes provide rugged electrostatic discharge protection for the inputs. The CR200X-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.

### Program/Data Storage

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.

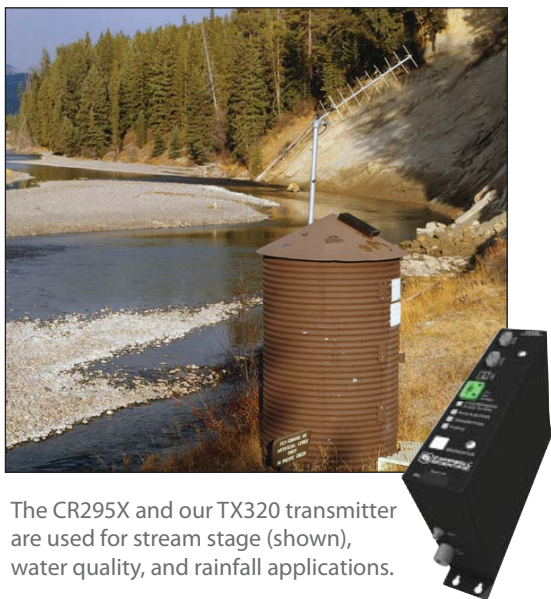
<sup>1</sup>The CR200X-series dataloggers replaced the CR200-series dataloggers in December 2009. The CR200X-series datalogger allows 128 public variables instead of 48 and allows eight tables instead of four. The compiled CRBasic program of a CR200X-series datalogger can be two times larger than the compiled CRBasic program of a CR200-series datalogger. For the CR200X series, all supported CRBasic instructions are in a single operating system version.

## 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, Archer-PCon Field PC, or a user-supplied PDA (PConnect or PConnectCE software required).

Other communications supported are model dependent:

- **CR200X**—base model (i.e., only supports direct connect, Ethernet, digital cellular modems, MD485 multidrop modems, CD295 DataView II displays, Archer-PCon Field PC, and user-supplied PDAs).
- **CR206X**—includes an internal 915 MHz, 100 mW spread spectrum radio that transmits data to another CR206(X) datalogger, an RF401 radio\*, or an RF430 radio. The 915 MHz frequency is used in the US and Canada.
- **CR211X**—includes an internal 922 MHz, 100 mW spread spectrum radio that transmits data to another CR211(X) datalogger, an RF411 radio\*, or an RF431 radio. The 922 MHz frequency is used in Australia and Israel.
- **CR216X**—includes an internal 2.4 GHz, 50 mW spread spectrum radio that transmits data to another CR216(X) datalogger, an RF416 radio\*, or an RF432 radio. The 2.4 GHz frequency can be used in many countries worldwide.
- **CR295X**—includes an additional 9-pin serial port that allows communications with the TX320 HDR GOES satellite transmitter.



The CR295X and our TX320 transmitter are used for stream stage (shown), water quality, and rainfall applications.

## Program Development Tools



Short Cut is available from our website (at no charge) and Resource CD. It is also bundled with PC200W, PC400, and LoggerNet Software.

The programming language of the CR200X-series dataloggers 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](http://www.campbellsci.com/downloads)

## Communication & Data Collection Tools

### PC200W

PC200W, our starter communications software, supports direct communications between a PC and a CR200X-series datalogger and provides numeric display of measurements. PC200W can be obtained, at no charge, from: [www.campbellsci.com/downloads](http://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.

\*The factory default settings for the logger may 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](http://www.campbellsci.com/app-notes)).

## Enclosures

Applications with minimal power requirements can use the ENC200 enclosure to house the datalogger and the #16869 sealed rechargeable battery. This 6.7-in x 5.5-in x 3.7-in enclosure has one power connector, one antenna connector, and five compression fittings.



At left, an ENC200 enclosure houses a CR206 datalogger and a 16869 battery. This very small enclosure has connectors for the SP5 solar panel and an antenna.

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 CR200X, CR206X, CR211X, or CR216X-based systems. An ENC16/18 enclosure can house a CR295X-based system.

## Power Supply

Sealed rechargeable battery options for the CR200X, CR206X, CR211X, or CR216X 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.

The SP5 and SP5-L capture solar energy via a 72-square inch surface area. These solar panels are suitable for sites with good exposure to sunlight and systems with low power requirements.

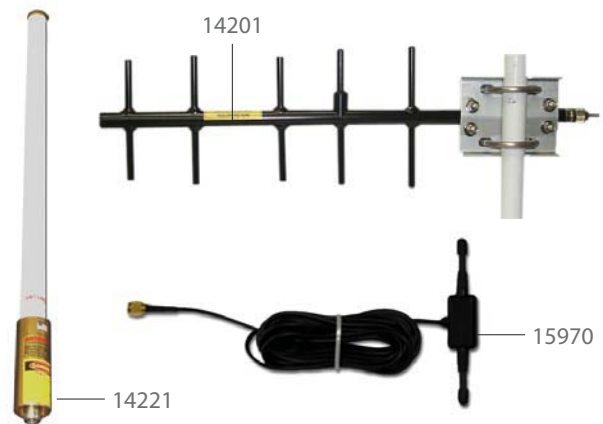


Typical power supply for a CR295X-based system consists of a BP12 12-Ahr or BP24 24-Ahr battery pack, CH100 or CH200 regulator, and SP10 10-Watt or SP20 20-Watt solar panel.

## Antennas and Antenna Accessories

### CR206X and CR211X 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.



Above are antennas used with the CR206X and CR211X dataloggers. The 14201 Yagi antenna is intended for longer transmission distances.

### CR216X 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.

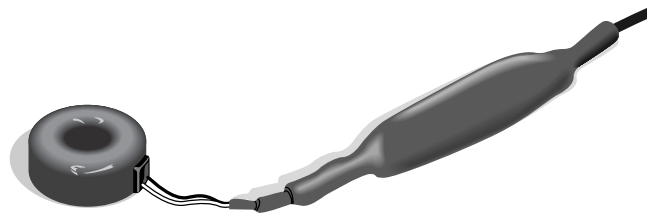
### Antenna Surge Protector Kits

- **14462**—Surge Protector Kit for the CR206X or CR211X; requires the COAXNTN-L cable.
- **16982**—Surge Protector Kit for CR216X; requires the COAXNTN-L cable.

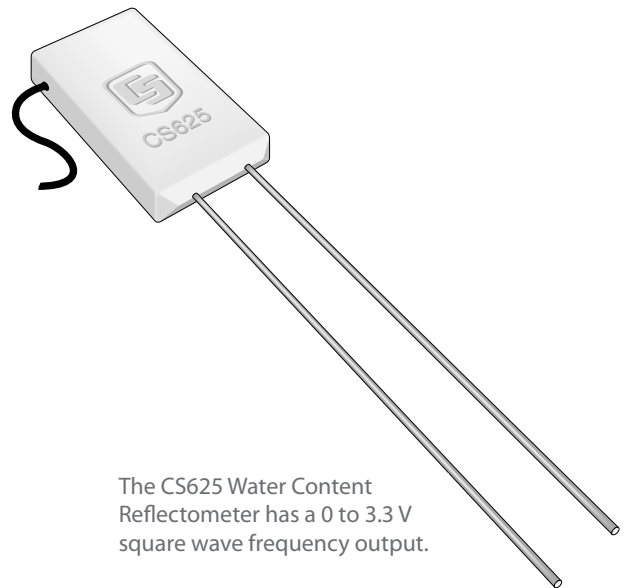
## Compatible Sensors\*\*

The CR200X-series dataloggers can measure a variety of sensors including SDI-12 sensors and 4 to 20 mA sensors. The parameters and sensors in which the CR200X series can measure are listed below:

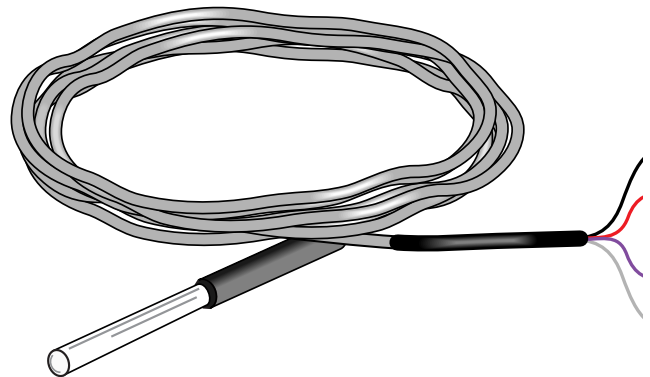
- **AC Current**—CS15 Current Transformer. *Our CS10 is not compatible.*
- **Barometric Pressure**—CS100 and CS106 barometric pressure sensors.
- **Evaporation**—255-100 Evaporation Gauge.
- **Leaf Wetness**—237 and LWS leaf wetness sensors.
- **Multiparameter**—WXT520 Weather Transmitter.
- **Precipitation**—TE525, TE525WS, TE525MM, TB4, TB4MM, CS700, and 52202 tipping bucket rain gages.
- **Relative Humidity**—CS215, HMP60, HMP45C, and HMP155A air temperature and relative humidity probes.
- **Snow Depth**—SR50A Sonic Ranging Sensor.
- **Soil Volumetric Water Content**—EasyAG probe, EnviroSCAN probe, CS650 reflectometer, and CS625 reflectometer. *Our CS616 is not compatible.*
- **Solar Radiation**—CS300 Pyranometer. *Our LI200X, LI190SB, LP02, CMP3, NR-LITE2, NR01, CNR4, and CNR2 probes are not compatible.*
- **Temperature**—109, 109SS, and 110PV thermistors. *Other temperature probes listed on our price lists including our 107/108 thermistors and thermocouples are not compatible.*
- **Water Level**—CS450, CS455, and CS460 pressure transducers; CS410 Shaft Encoder; CS470 and CS471 compact bubblers; CS475, CS476, and CS477 pulse radar sensors, and SR50A Sonic Ranging Sensor. *Our CS431 pressure transducer is not compatible.*
- **Water Quality**—CS525 ISET pH probe, OBS-3+ turbidity probe, OBS3A turbidity probe, CS511 Dissolved Oxygen Probe, 109 Temperature Probe, and 109SS Temperature Probe. *Our CS547A, CSIM11, CSIM11-ORP, 107, and 108 probes are not compatible.*
- **Wind Speed and Direction**—014A, 034B, 03101, 03002, 05103, 05106, 05305, 27106T, and WindSonic4 sensors. *The WindSonic1 and CSAT3 are not compatible.*



The CS15 consists of a CR Magnetic's CR8459 Current Transformer that was modified to measure the approximate current over a 0 to 125 A range.



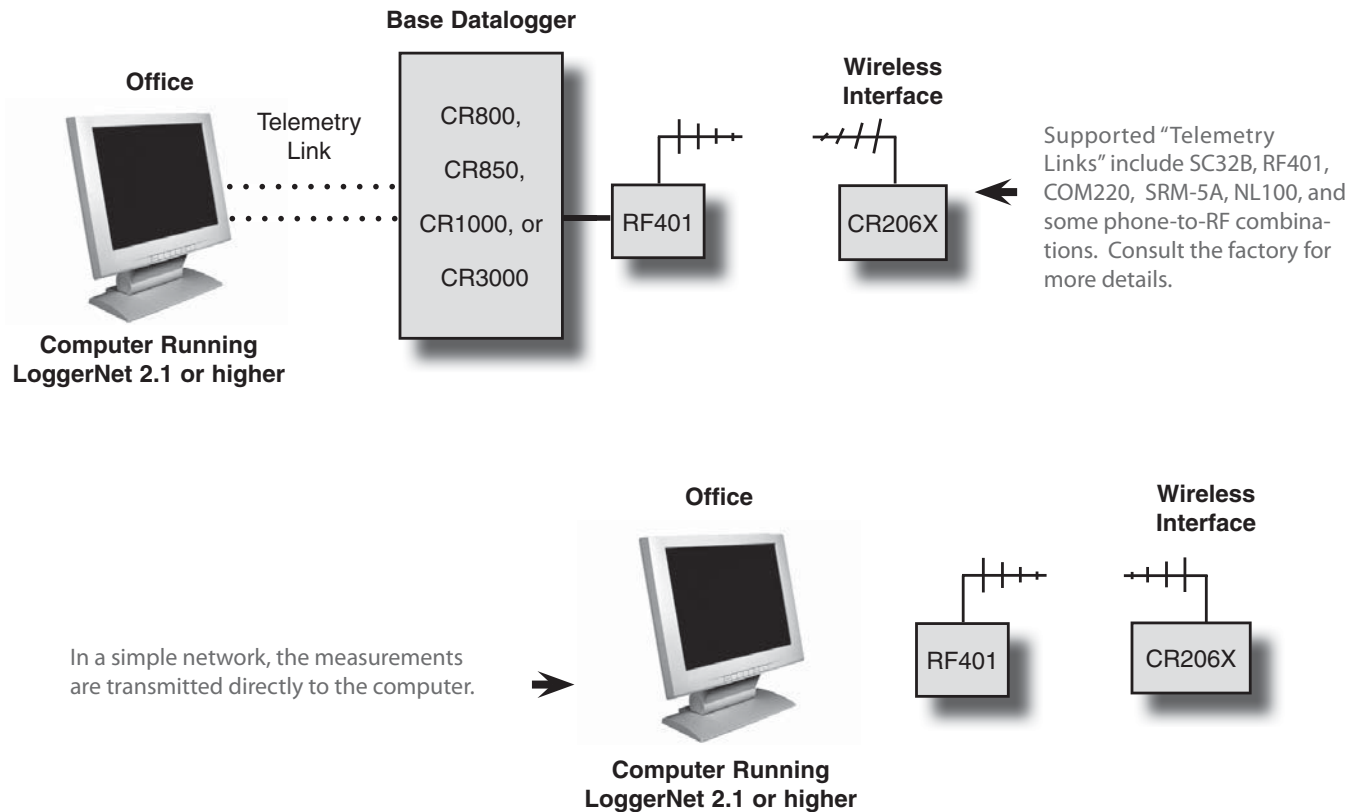
The CS625 Water Content Reflectometer has a 0 to 3.3 V square wave frequency output.



The 109 thermistor can measure air, water, or soil temperature from -50° to +70°C. This probe outputs a signal of 0 to 2.2 volts.

\*\*The CR200X-series dataloggers can not make differential measurements. They are not compatible with the freezing-rain/ice, fuel moisture/temperature, geographic position, present weather, soil heat flux, soil matric water potential, and strain sensors listed on our price lists. Campbell Scientific's SDM devices and multiplexers are also not supported.

## CR206/RF401-based Wireless Sensor Networks



## Applications

### Wireless Sensor Networks

The CR206X, CR211X, and CR216X 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 CR206X/RF401-based wireless sensor networks. Our CR211X/RF411-based and CR216X/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](http://www.campbellsci.com/downloads) for these dataloggers.

### Other Applications

- **Aquaculture**—monitors and records water quality around the clock providing continuous data that can be used to identify trends and improve production.
- **Rural Water**—provides continuous monitoring of the water system regardless of time of day or time of year. All monitored sites can be networked into one integrated system.
- **Water Level/Flow**—measures level in many environments including wells, dams, streams, weirs, and water treatment or wastewater treatment plants. Compatible with shaft encoder, pressure transducers, compact bubblers, radar water level sensors, and sonic ranging sensor.
- **Water Quality**—monitors and records water temperature, pH, dissolved oxygen, and turbidity.
- **Wind Energy**—can be deployed in a wireless network configuration to provide cost effective monitoring at each level of a wind assessment tower while avoiding long cables.

# CR200X-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  $\mu$ 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 (VX1 AND VX2):

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

Accuracy:  $\pm 25$  mV on +2.5 Vdc range,  $\pm 125$  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  $\mu$ 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:  $\pm 20$  V

*Note: C1 and C2 can be used for switch closure using the battery voltage and a 100 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 (CR206X), 922 MHz (CR211X), or 2.4 GHz (CR216X)

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

Transmitter Power Output:

100 mW (CR206X, CR211X);

50 mW (CR216X)

### 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<sup>®</sup> packet switching network protocol

## CLOCK ACCURACY

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

## CPU AND STORAGE

FINAL STORAGE: 500 kbyte Flash, data format is 4 bytes per data point (table-based)

SRAM: 8 kbytes

COMPILED PROGRAM STORAGE: up to 19.6 kbyte depending on structure of CRBasic program

OPERATING SYSTEM FLASH: 106 kbyte

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)

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

RECOMMENDED BATTERIES: 12 Vdc, 7 Hr 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:  $\sim 0.2$  mA

### ACTIVE CURRENT DRAIN:

No radio  $\sim 3$  mA

Radio receive  $\sim 20$  mA (CR206X, CR211X),  $\sim 36$  mA (CR216X)

Radio transmit  $\sim 75$  mA (CR206X, CR211X, CR216X)

### AVERAGE CONTINUOUS CURRENT DRAIN:

Radio always on  $\sim 20$  mA (CR206X, CR211X),  $\sim 36$  mA (CR216X)

Radio in 1 s duty cycle  $\sim 2.2$  mA (CR206X, CR211X),  $\sim 4$  mA (CR216X)

Radio in 8 s duty cycle  $\sim 0.45$  mA (CR206X, CR211X),  $\sim 0.8$  mA (CR216X)

## CE COMPLIANCE (as of 03/02)

CE COMPLIANT DATALOGGERS: CR200X, CR206X, CR211X, CR216X

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;  $\pm 8$  kV air,  $\pm 4$  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 in x 3 in x 2 in; 14.0 cm x 7.6 cm x 5.1 cm

### WEIGHT:

CR200X or CR295X: 8.5 oz (242 g)

CR206X, CR211X, or CR216X: 9.5 oz (271 g)

CUSTOM CASE: available for OEM applications; contact Campbell Scientific

## WARRANTY

Three year covering parts and labor.

