

# CR350-Series Specifications



Datalogger

Electrical specifications are valid over a -40 to +70 °C, non-condensing environment, unless otherwise specified. Recalibration is recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

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## System specifications

**Processor:** ARM Cortex M4 running at 120 MHz

### Memory:

- CPU Drive: 50 MB serial flash
- Data Storage: 50 MB serial flash
- Operating System: 2 MB flash
- Settings, Calibration, TLS Certificates and Key, System Information: 3 MB serial flash
- Background Tasks and Table Information, Buffers, System Memory, Program Variables: 7 MB RAM

**Program Execution Period:** 100 ms to 1 day

### Real-Time Clock:

- Battery backed while external power is disconnected
- **Resolution:** 1 ms
- **Accuracy:** ±3 min. per year

**Wiring Panel Temperature:** Measured using a sensor, located on the processor board.

## Physical specifications

**Dimensions** (additional clearance required for cables, wires and antennas):

- **CR350:** 16.3 x 8.4 x 5.6 cm (6.4 x 3.3 x 2.2 in)

### Weight/Mass:

- **CR350:** 288 g (0.64 lb)
- **CR350-WIFI/RF407/RF412/RF422:** 306 g (0.68 lb)

**Case Material:** High-impact-resistant polycarbonate, recycle code 7

## Power requirements

Power specifications for a communications option are shown within the specifications section for that option.

**Protection:** Power inputs are protected against surge, over-voltage, over-current, and reverse power. IEC 61000-4 Class 4 level.

### Charge Terminal Characteristics (CHG+ and CHG-):

- Input from power converter or solar panel, typical
- Voltage input 16 to 32 VDC
- Current limit at 1.1 A

### Battery Terminal Characteristics (BAT+ and BAT-):

- Input from external battery 12 VDC, 7 Ah lead-acid, typical
- Voltage input 10 to 18 VDC
- Current limit at 3.7 A

**Internal Lithium Battery:** 3 V coin cell CR2025 for battery-backed clock. 6-year life with no external power source.

### Average Current Drain:

Assumes 12 VDC on BAT terminals — add 2 mA if using CHG terminals.

- **Idle:** 0.5 mA
- **Active 1 Hz scan w/ one analog measurement:** 1.5 mA
- **Active** (Processor always on): 8 mA
- **Serial** (RS-232): Active + 5 mA

**USB Power:** Functions that will be active with USB 5 VDC include sending programs, adjusting data logger settings, and making some measurements. If USB is the only power source, then the VX1 and VX2 ranges are reduced to 150 to 2500 mV. The SW1, SW2, and 12V terminals will not be operational. For the control terminals (C1, C2), voltage output is limited to 4.75 V.

### Cellular Average Additional Current Contribution at 12 VDC:

- **Idle:** Connected to network, no data transfer.
  - -CELL205 minimum = 2 mA, average = 14 mA
  - -CELL210 minimum = 2 mA, average = 28 mA
  - -CELL215 minimum = 2 mA, average = 14 mA



- -CELL220 minimum = 2 mA, average = 14 mA
- -CELL225 minimum = 2 mA, average = 14 mA
- **Transfer/Receive:**
  - -CELL205 minimum = 20 mA, average = 75 mA
  - -CELL210 minimum = 20 mA, average = 90 mA
  - -CELL215 minimum = 20 mA, average = 75 mA
  - -CELL220 minimum = 20 mA, average = 75 mA
  - -CELL225 minimum = 20 mA, average = 75 mA

#### Wi-Fi Additional Current Contribution at 12 VDC:

- **Client mode communicating:** 70 mA typical
- **Client mode idle:** 7 mA typical
- **Access point mode communicating:** 70 mA
- **Access point mode idle:** 62 mA typical
- **Idle:** <0.1 mA

#### RF Average Additional Current Contribution at 12 VDC

	-RF407, -RF412, -RF427	-RF422
Transmit	< 80 mA	20 mA
Idle On	12 mA	9.5 mA
Idle 0.5 s Power Mode	4 mA	3.5 mA
Idle 1 s Power Mode	3 mA	2 mA
Idle 4 s Power Mode	1.5 mA	1.5 mA

## Power output specifications

System power out limits (when powered with 12 VDC):

Temperature (°C)	Current Limit <sup>1</sup> (A)
-40°	5.8
20°	3.7
70°	2.0

<sup>1</sup> Limited by self-resetting thermal fuse

**12V:** Provide unregulated 12 VDC power with voltage equal to BAT+ input voltage. Disabled when operating on USB power only. Current output limited by thermal fuses. Two 12V terminals share one thermal fuse up to 2.5 A @ 20 °C.

- **Terminals:**
  - **12V:** two terminals, always on
  - **SW1 and SW2:** switched under program control, current limit at 2.1 A each

**VX:** Two independently configurable voltage terminals (VX1-VX2). VX outputs are produced by a 12-bit DAC<sup>1</sup>. VX terminals can also be used to supply a switched, regulated 5 VDC power source to power digital sensors and toggle control lines.

- **Range:** 150 to 5000 mV
- **Resolution:** 1.6 mV
- **Maximum Source Current:** 50 mA total, concurrently or independently.

<sup>1</sup>Digital to analog conversion. The process that translates digital voltage levels to analog values.

## Analog measurement specifications

4 single-ended (SE) or 2 differential (DIFF) terminals individually configurable for voltage, thermocouple, current loop, ratiometric, and period average measurements, using a 24-bit ADC. One channel at a time is measured.

### Voltage measurements

**Terminals:**

- **Differential Configuration:** DIFF 1H/1L – 2H/2L
- **Single-Ended Configuration:** SE1 – SE4

**Input Resistance:**

- 5 GΩ typical ( $f_{N1} = 50/60$  Hz)
- 300 MΩ typical ( $f_{N1} = 4000$  Hz)

**Input Voltage Limits:** -100 to +2500 mV

**Sustained Input Voltage without Damage:**

- SE1-SE2: -6 V, +9 V
- SE3-SE4: ±17 V

**DC Common Mode Rejection:**

- >120 dB with input reversal
- ≥90 dB without input reversal

**Normal Mode Rejection:**

- >71 dB at 50 Hz
- >74 dB at 60 Hz

**Input Current @ 25 °C:**

- ±0.08 nA typical ( $f_{N1} = 50/60$  Hz)
- ±13 nA typical ( $f_{N1} = 4000$  Hz)

**Filter First Notch Frequency ( $f_{N1}$ ) Range:** 50/60, 400, 4000 Hz (user specified)

**Analog Range and Resolution:**

Notch Frequency ( $f_{N1}$ ) (Hz)	Range <sup>1</sup> (mV)	Differential with Input Reversal		Single-Ended and Differential without Input Reversal	
		RMS (μV)	Bits <sup>2</sup>	RMS (μV)	Bits <sup>2</sup>
4000	-100 to +2500 -34 to +34	23 3.0	16.8 14.5	33 4.2	16.3 14.0
400	-100 to +2500 -34 to +34	3.8 0.58	19.4 16.8	5.4 0.82	18.9 16.3

		Differential with Input Reversal		Single-Ended and Differential without Input Reversal	
Notch Frequency ( $f_{N1}$ ) (Hz)	Range <sup>1</sup> (mV)	RMS ( $\mu$ V)	Bits <sup>2</sup>	RMS ( $\mu$ V)	Bits <sup>2</sup>
50/60 <sup>3</sup>	-100 to +2500 -34 to +34	1.6 0.23	20.6 18.2	2.3 0.33	20.1 17.7

<sup>1</sup> Range overhead of ~10% on all ranges guarantees that full-scale values will not cause over range

<sup>2</sup> Typical effective resolution (ER) in bits; computed from ratio of full-scale range to RMS resolution.

<sup>3</sup> 50/60 corresponds to rejection of 50 and 60 Hz ac power mains noise.

**Accuracy** (does not include sensor or measurement noise):

- 0 to 40 °C:  $\pm(0.04\%$  of measurement + offset)
- -40 to 70 °C:  $\pm(0.1\%$  of measurement+ offset)

**Voltage Measurement Accuracy Offsets:**

Range (mV)	Typical Offset ( $\mu$ V RMS)		
	Differential with Input Reversal	Differential without Input Reversal	Single-Ended
-100 to +2500	$\pm 20$	$\pm 40$	$\pm 60$
-34 to +34	$\pm 6$	$\pm 14$	$\pm 20$

**Measurement Settling Time:** 10  $\mu$ s to 50 ms; 500  $\mu$ s default

**Multiplexed Measurement Time:**

Measurement time = (multiplexed measurement time + settling time) • reps + 0.8 ms

	Differential with Input Reversal	Single-Ended or Differential without Input Reversal
<b>Example <math>f_{N1}</math><sup>1</sup> (Hz)</b>	<b>Time<sup>2</sup> (ms)</b>	<b>Time<sup>2</sup> (ms)</b>
4000	2.9	1.4
400	14.6	7.3
50/60	103	51.5

<sup>1</sup> Notch frequency (1/integration time).

<sup>2</sup> Default settling time of 500  $\mu$ s used.

## Resistance measurement specifications

The data logger makes ratiometric-resistance measurements for four- and six-wire full-bridge circuits and two-, three-, and four-wire half-bridge circuits using voltage excitation.

**Accuracy:**

Assumes input reversal for differential measurements  
**RevDiff.** Does not include bridge resistor errors or sensor and measurement noise.

- 0 to 40 °C:  $\pm(0.05\%$  of voltage measurement + offset)
- -40 to 70 °C:  $\pm(0.06\%$  of voltage measurement + offset)

## Current-loop measurement specifications

Two analog inputs terminals may be configured as independent, non-isolated 0-20 mA or 4-to-20 mA current-loop inputs referenced to ground. One channel at a time is measured. Current is measured using a 24-bit ADC<sup>1</sup>.

**Terminals:** SE1-SE2

**Range:** 0 to 25 mA

**Accuracy:**

- 0 to 40 °C:  $\pm 0.14\%$  of reading
- -40 to 70 °C:  $\pm 0.26\%$  of reading

## Pulse measurement specifications

Terminals are individually configurable for switch closure, high-frequency pulse, or low-level AC measurements.

## Switch-closure input

**Terminals:**

- P\_SW
- C1-C2 (Requires an external 100 k $\Omega$  resistor connected from the terminal to VX1 or VX2.)
- SE1-SE4 (Requires an external 100 k $\Omega$  resistor connected from the terminal to VX1 or VX2.)

**Maximum Input Frequency:** 150 Hz

**Minimum Switch Closed Time:** 3 ms

**Minimum Switch Open Time:** 3 ms

**Maximum Bounce Time:** 1 ms open without being counted

## High-frequency input

**Terminals:**

- SE1-SE4
- P\_LL
- P\_SW
- C1-C2

**Maximum Input Frequency:**

- SE1-SE4: 35 kHz
- P\_LL: 20 kHz
- P\_SW: 35 kHz
- C1-C2: 35 kHz

## Low-level AC input

**Terminal:** P\_LL

**Maximum Input Voltage:**  $\pm 20$  VDC

<sup>1</sup>Analog to digital conversion. The process that translates analog voltage levels to digital values.

**DC-offset Rejection:** Internal AC coupling eliminates DC-offset voltages up to  $\pm 0.05$  VDC

**Input Hysteresis:** 12 mV at 1 Hz

**Low-Level AC Pulse Input Ranges:**

Sine wave (mV RMS)	Range (Hz)
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

## Quadrature input

**Terminals:** SE1 and SE2, SE3 and SE4, or C1 and C2 can be configured as digital terminal pairs to monitor the two sensing channels of an encoder.

**Maximum Frequency:** 2.5 kHz

## Period-averaging measurement specifications

**Terminals:**

- SE1-SE4
- C1-C2

**Accuracy:**  $\pm(0.01\%$  of measurement + resolution), where resolution is  $0.13 \mu\text{s}$  divided by the number of cycles to be measured

**Voltage Range:** 0 to 3.3 V

**Minimum Pulse Width:** 33 ns

**Voltage Threshold:** Counts cycles on transition from  $<0.9$  VDC to  $>2.1$  VDC

## Digital input/output specifications

Up to seven terminals may be configured for digital input or output (I/O).

**Terminals:**

- SE1-SE4
- P\_SW
- C1-C2

**Digital I/O Voltage Levels:**

Terminal	High State	Low State	Current Source	Maximum Input Voltage
C1 C2	5.0 V output 3.3 V input	0 V	10 mA at 3.5 V	-10 V, +15 V
SE1 SE2	3.3 V	0 V	100 $\mu\text{A}$ at 3.0 V	-6 V, +9 V
SE3 SE4 P_SW	3.3 V	0 V	100 $\mu\text{A}$ at 3.0 V	$\pm 17$ V

## Pulse-width modulation

**Terminals:**

- SE1-SE4
- C1

**Period Maximum:** 2047 ms

**Resolution**

- 0 – 5 ms: 83.33 ns or 12 MHz
- 5 – 325 ms: 5.00  $\mu\text{s}$  or 200 kHz
- > 325 ms: 31.25  $\mu\text{s}$  or 32 kHz

## Communications specifications

**Internet Protocols:** Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, Telnet, HTTP(S), FTP(S), POP3/TLS, NTP, SMTP/TLS, MQTT

**Additional Protocols:** PakBus, PakBus Encryption, SDI-12, Modbus RTU / ASCII / TCP, DNP3, custom user definable over serial

**USB:** Type C 2.0. Full speed: 12 Mbps. Operates as:

- Device for computer communications
- Host for mass storage devices

**SDI-12 (C1, C2):** Two independent SDI-12 compliant terminals are individually configured and meet SDI-12 Standard v 1.4.

**RS-232:**

- COMRS232:** Female RS-232, 9-pin interface, 1200 to 115.2 kbps
- COM1 (C1,C2):** TTL or RS-232 logic
- COM2 - COM3:** Two independent RS-232 Rx/Tx pairs

**RS-485 (COM2 - COM3):** Two independent RS-485 half duplex or one full duplex

## Cellular option specifications

**Cell Technology:**

Option	Cellular Protocol
-CELL205	4G LTE with automatic 3G fallback
-CELL210	4G LTE CAT-1
-CELL215	4G LTE with automatic 3G fallback
-CELL220	4G LTE with automatic 3G fallback
-CELL225	4G LTE

See

<https://s.campbellsci.com/documents/us/miscellaneous/Cellular%20Modem%20Frequency%20Bands.pdf> for a complete list of supported frequency bands.

**Antenna:** Two SMA connectors, one for TX/RX, one for diversity RX

**SIM Slot:** Industry standard 3FF micro-SIM (6 position / contacts) (not externally accessible)

## Wi-Fi specifications

WLAN (Wi-Fi)

**Maximum Possible Over-the-Air Data Rates:** <11 Mbps over 802.11b, <54 Mbps over 802.11g, <72 Mbps over 802.11n

**Operating Frequency:** 2.4 GHz, 20 MHz bandwidth

**Antenna Connector:** Reverse Polarity SMA (RPSMA)

**Antenna** (shipped with data logger): Unity gain (0 dBd), 1/2 wave whip, omnidirectional. Features an articulating knuckle joint that can be oriented vertically or at right angles

**Supported Technologies:** 802.11 b/g/n, WPA/WPA2-Personal, WPA/WPA2-Enterprise Security, WEP

**Client Mode:** WPA/WPA2-Personal and Enterprise, WEP

**Access Point Mode:** WPA2-Personal

**Receive Sensitivity:** -97 dBm

## RF radio option specifications

**Antenna Terminal:** Reverse Polarity SMA (RPSMA)

### Radio Type

- **RF407, RF412, and RF427:** Frequency Hopping Spread Spectrum (FHSS)
- **RF422:** SRD860 Radio with Listen before Talk (LBT) and Automatic Frequency Agility (AFA)

### Frequency

- **RF407:** 902 to 928 MHz (US, Canada)
- **RF412:** 915 to 928 MHz (Australia, New Zealand)
- **RF422:** 863 to 870 MHz (European Union)
- **RF427:** 902 to 907.5 MHz/915 to 928 MHz (Brazil)

**Transmit Power Output** (software selectable)

- **RF407 and RF412:** 5 to 250 mW
- **RF422:** 2 to 25 mW
- **RF427:** 5 to 250 mW

### Channel Capacity

- **RF407:** Eight 25-channel hop sequences sharing 64 available channels.
- **RF412:** Eight 25-channel hop sequences sharing 31 available channels.
- **RF422:** Ten 30-channel hop sequences (default), software configurable to meet local regulations; 10 sequences for reducing interference through channel hop.
- **RF427:** Eight 25-channel hop sequences sharing 43 available channels.

### Receive Sensitivity

- **RF407, RF412, and RF427:** -101 dBm
- **RF422:** -106 dBm

### RF Data Rate

- **RF407, RF412, and RF427:** 200 kbps
- **RF422:** 10 kbps

## Standards compliance specifications

View EU Declarations of Conformity at [www.campbellsci.com/cr350](http://www.campbellsci.com/cr350).

**Shock and Vibration:** ASTM D4169

**Protection:** IP30

**EMI and ESD protection:**

- **Immunity:** Meets or exceeds following standards:
  - **ESD:** per IEC 61000-4-2; ±15 kV air, ±8 kV contact discharge
  - **Radiated RF:** per IEC 61000-4-3; 10 V/m, 80-1000 MHz
  - **EFT:** per IEC 61000-4-4; 4 kV power, 4 kV I/O
  - **Surge:** per IEC 61000-4-5; 4 kV power, 4kV I/O
  - **Conducted RF:** per IEC 61000-4-6; 10 V power, 10 V I/O
- Emissions and immunity performance criteria available on request.

### RF407 Option

- United States FCC Part 15.247: MCQ-XB900HP
- Industry Canada (IC): 1846A-XB900HP
- Mexico IF: RCPDIXB15-0672-A1

### RF412 Option

- ACMA RCM
- United States FCC Part 15.247:
- MCQ-XB900HP
- Industry Canada (IC): 1846A-XB900HP

**RF422 Option:** View EU Declaration of Conformity at [www.campbellsci.com/cr350](http://www.campbellsci.com/cr350).

**RF427 Option:** Brazil ANATEL standards in Resolution No. 506: 08335-17-10644. View the RF427 Brazilian Certificate of Conformity at [www.campbellsci.com/cr350](http://www.campbellsci.com/cr350).

### Wi-Fi

- United States FCC ID: XF6-RS9113SB
- Industry Canada (IC): 8407A-RS9113SB

### Cellular Option:

- Industry Canada (IC): 10224A-201611EC21A

#### NOTE:

The user is responsible for emissions if changing the antenna type or increasing the gain.

## Warranty

Three years against defects in materials and workmanship.

## Terminal functions

Analog input terminal functions				
SE DIFF	1 2 I <sup>1</sup> H L		3 4 I <sup>2</sup> H L	
Single-Ended Voltage	✓	✓	✓	✓
Differential Voltage	H	L	H	L
Ratiometric/Bridge	✓	✓	✓	✓
Thermocouple	✓	✓	✓	✓
Current Loop	✓	✓		

Pulse counting terminal functions								
	C1	C2	P_SW	P_LL	SE1	SE2	SE3	SE4
Switch-Closure	✓	✓	✓		✓	✓	✓	✓
High Frequency	✓	✓	✓	✓	✓	✓	✓	✓
Low-level AC				✓				
Quadrature	✓	✓			✓	✓	✓	✓
Period Average	✓	✓			✓	✓	✓	✓

Analog output terminal functions		
	VX1	VX2
Switched Voltage Excitation	✓	✓

Voltage output terminal functions								
	C1	C2	SE1-4	VX1	VX2	P_SW	12V	SW1 SW2
3.3 VDC			✓	✓	✓	✓		
5 VDC	✓	✓		✓	✓			
BAT +							✓	✓

Communications terminal functions						
	C1	C2	SE1-3	RS-232	COM2	COM3
SDI-12	✓	✓				
RS-232				✓	✓	✓
RS-232 0-5V	✓	✓				
GPS Time Sync	✓	✓	✓			
GPS NMEA Sentences	Rx	Rx		Rx		
RS-485 Half duplex					✓	✓
RS-485 Full duplex					✓	

Communications functions also include USB

Digital I/O terminal functions							
	C1	C2	P_SW	SE1	SE2	SE3	SE4
General I/O	✓	✓	✓	✓	✓	✓	✓
Pulse-Width Modulation Output	✓			✓	✓	✓	✓
Interrupt	✓	✓	✓	✓	✓	✓	✓



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