CR300-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.

System specifications

Processor: ARM Cortex M4 running at 144 MHz

Memory:

- CPU Drive: 80 MB serial flash
- Data Storage: 30 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: 756 KB RAM

> **NOTE:**
> CR300-Series dataloggers with serial numbers 2812 and older have a 5 MB CPU drive and 10 MB serial flash storage. CR300-Series data loggers with serial numbers 2813 and newer, and all CR310 dataloggers have an 80 MB CPU drive and 30 MB serial flash storage.

Program Execution Period: 100 ms to 1 day

Real-Time Clock:

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

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

Physical specifications

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

- **CR300**: 13.97 x 7.62 x 4.56 cm (5.5 x 3.0 x 1.8 in)
- **CR310**: 16.3 x 8.4 x 5.6 cm (6.4 x 3.3 x 2.2 in)

Weight/Mass:

- **CR300**: 242 g (0.53 lb)
- **CR300-WIFI/RF407/RF412/RF422**: 250 g (0.55 lb)
- **CR310**: 288 g (0.64 lb)
- **CR310-WIFI/RF407/RF412/RF422**: 306 g (0.68 lb)

Case Material: Powder-coated aluminum

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.

Charger Input (CHG+ and CHG- terminals):

- 16 to 32 VDC
- Current limited to 0.9 A maximum
- Power converter or solar panel input

External Batteries (BAT+ and BAT- terminals):

- 10 to 18 VDC input
- 12 VDC, lead-acid 7 Ah battery, typical

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**: 1.5 mA
- **Active 1 Hz scan w/ one analog measurement**: 5 mA
- **CR300 Active** (Processor always on): 23 mA
- **CR310 Active** (Processor always on): 36 mA
- **Serial** (RS-232): Active + 5 mA
- **Ethernet power requirements** (CR310 Only):
  - **Ethernet idle**: Active + 5 mA
  - **Ethernet linked**: Active + 20 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 SW12V terminal 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.
  - -CELL200 average = 10 mA
  - -CELL205 average = 14 mA
  - -CELL210 average = 28 mA
  - -CELL215 average = 14 mA
  - -CELL220 average = 14 mA
  - -CELL225 average = 14 mA
- **Transfer/Receive**:
  - -CELL200 average = 105 mA
  - -CELL205 average = 75 mA
  - -CELL210 average = 90 mA
  - -CELL215 average = 75 mA
  - -CELL220 average = 75 mA
  - -CELL225 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[1] (A)
–40°	5.8
20°	3.7
70°	2.0
[1] Limited by self-resetting thermal fuse	

VX: Two independently configurable voltage terminals (VX1-VX2). VX outputs are produced by a 12-bit DAC[1]. 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.

SW12V: Provides unregulated 12 VDC power with voltage equal to BAT+ input voltage. SW12V is disabled when operating on USB power only. A thermal fuse regulates current sourcing.

- **Thermal Fuse Hold Current** (Overload causes voltage drop. Disconnect and let cool to reset. Operate at limit if the application can tolerate some fluctuation.):
  - 1200 mA @ -40 °C
  - 1100 mA @ 20 °C
  - 830 mA @ 70 °C

Analog measurement specifications

6 single-ended (SE) or 3 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 – 3H/3L
- **Single-Ended Configuration**: SE1 – SE6

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-SE6: ±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:

- ±.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)

[1]Digital to analog conversion. The process that translates digital voltage levels to analog values.

Analog Range and Resolution:

		Differential with input reversal		Single-ended and differential without input reversal	
Notch frequency (f_{N1}) (Hz)	Range[1] (mV)	RMS (µV)	Bits[2]	RMS (µV)	Bits[2]
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
50/60[3]	–100 to +2500 –34 to +34	1.6 0.23	20.6 18.2	2.3 0.33	20.1 17.7

[1] Range overhead of ~10% on all ranges guarantees that full-scale values will not cause over range

[2] Typical effective resolution (ER) in bits; computed from ratio of full-scale range to RMS resolution.

[3] 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: ±(0.04% of measurement + offset)
- –40 to 70 °C: ±(0.1% of measurement+ offset)

Voltage Measurement Accuracy Offsets:

	Typical offset (µV RMS)		
Range (mV)	Differential with input reversal	Differential without input reversal	Single-ended
–100 to +2500	±20	±40	±60
–34 to +34	±6	±14	±20

Measurement Settling Time: 10 µs to 50 ms; 500 µs 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
Example fN1[1] (Hz)	Time[2] (ms)	Time[2] (ms)
4000	2.9	1.4
400	14.6	7.3
50/60	103	51.5

[1] Notch frequency (1/integration time).

[2] Default settling time of 500 µs 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**: ±(0.05% of voltage measurement + offset)
- **–40 to 70 °C**: ±(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[1].

Terminals: SE1-SE2

Range: 0 to 25 mA

Accuracy:

- **0 to 40 °C**: ±0.14% of reading
- **–40 to 70 °C**: ±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 kΩ 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

[1]Analog to digital conversion. The process that translates analog voltage levels to digital values.

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: 3 kHz

Low-level AC input

Terminals: P_LL

Maximum Input Voltage: ±20 VDC

DC-offset Rejection: Internal AC coupling eliminates DC-offset voltages up to ±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 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

Accuracy: ±(0.01% of measurement + resolution), where resolution is 0.13 µs divided by the number of cycles to be measured

Voltage Range: 0 to 3.3 V

Minimum Pulse Width: 2.5 µs

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 3.3V input	0 V	10 mA at 3.5 V	–10 V, +15 V
SE1 SE2	3.3 V	0 V	100 µA at 3.0 V	–6 V, +9 V
SE3 SE4 P_SW	3.3 V	0 V	100 µA at 3.0 V	±17 V

Pulse-width modulation

Terminals:

- SE1-SE4

Period Maximum: 2047 ms

Resolution

- 0 – 5 ms: 83.33 ns or 12 MHz
- 5 – 325 ms: 5.00 µs or 200 kHz
- > 325 ms: 31.25 µs or 32 kHz

Communications specifications

Ethernet Port (CR310 Only): RJ45 jack, 10/100Base Mbps, full and half duplex, Auto-MDIX, magnetic isolation, and TVS surge protection.

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

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

USB Device: Micro-B device for computer connectivity

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

RS-232: Female RS-232, 9-pin interface, 1200 to 115.2 kbps

Cellular option specifications

Cell Technology:

Option	Cellular Protocol
-CELL200	3G, 2G
-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 Terminal: SMA

SIM Slot: Industry standard 3FF micro-SIM (6 position / contacts)

Wi-Fi option specifications

WLAN (Wi-Fi) (CR300-WIFI only)

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 (Europe, Middle East, and Africa)
- **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

Maximum nodes in network

- **RF407**, **RF412**, and **RF427**: 50
- **RF422**: 20

Standards compliance specifications

View compliance and conformity documents at www.campbellsci.com/cr300 and www.campbellsci.com/cr310.

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/cr300 and www.campbellsci.com/cr310.

RF427 Option: Brazil ANATEL standards in Resolution No. 506: 08335-17-10644. View the RF427 Brazilian Certificate of Conformity at www.campbellsci.com/cr300 and www.campbellsci.com/cr310.

WIFI Option

- 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 ┌1┐ H L		3 4 ┌2┐ H L		5 6 ┌3┐ H L	
Single-Ended Voltage	✓	✓	✓	✓	✓	✓
Differential Voltage	H	L	H	L	H	L
Ratiometric/Bridge	✓	✓	✓	✓	✓	✓
Thermocouple	✓	✓	✓	✓	✓	✓
Current Loop	✓	✓				

Pulse counting terminal functions

	C1	C2	P_SW	P_LL	SE1	SE2	SE3	SE4	SE5	SE6
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	SW12V
3.3 VDC			✓	✓	✓	✓	
5 VDC	✓	✓		✓	✓		
BAT +							✓

Communications terminal functions

	C1	C2	SE1-3	RS-232
SDI-12	✓	✓		
RS-232				✓
RS-232 0-5V	✓	✓		
GPS Time Sync	✓	✓	✓	
GPS NMEA Sentences	Rx	Rx		Rx
Communications functions also include Ethernet (CR310 only) and USB				

Digital I/O terminal functions

	C1	C2	P_SW	SE1	SE2	SE3	SE4	SE5	SE6
General I/O	✓	✓	✓	✓	✓	✓	✓		
Pulse-Width Modulation Output				✓	✓	✓	✓		
Interrupt	✓	✓		✓	✓	✓			

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