CR300-Series Specifications

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, Buffers, System Memory, Program Memory, Table Memory, Program Variables: 756 KB RAM

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: 16.26 x 7.62 x 5.68 cm (6.4 x 3.0 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 CR2016 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 with One Analog Measurement: 5 mA
- Serial (RS-232): Active + 25 mA
- Active (Processor Always On): 23 mA
- Ethernet Power Requirements (CR310 Only):
  - Ethernet Idle: 32 mA
  - Ethernet Link: Active + 51 mA

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

Program Execution: 100 ms to 1 day
Real-Time Clock:
- Battery backed while external power is disconnected
- Resolution: 1 ms
- Accuracy: ±1 minute per month

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

Campbell Scientific, Inc.
May 14, 2019

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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 – VX2 range is reduced to 150 to 2500 mV; the SW12V terminal will not be operational; voltage output for the control terminals (C1, C2) is limited to 4.75 V, and current output for the control terminals (C1, C2) is limited to 8 mA.

Cellular Average Additional Current Contribution at 12 VDC:
- **Idle**: Connected to network, no data transfer.
  - -CELL200 minimum = 2 mA, average = 10 mA
  - -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
- **Transfer/Receive**:
  - -CELL200 minimum = 20 mA. Average = 105 mA
  - -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

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
- **Sleep**: < 0.1 mA

RF Average Additional Current Contribution at 12 VDC

<table>
<thead>
<tr>
<th></th>
<th>-RF407, -RF412, -RF427</th>
<th>-RF422</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit</td>
<td>&lt; 80 mA</td>
<td>20 mA</td>
</tr>
<tr>
<td>Idle On</td>
<td>12 mA</td>
<td>9.5 mA</td>
</tr>
<tr>
<td>Idle 0.5 s Power Mode</td>
<td>4 mA</td>
<td>3.5 mA</td>
</tr>
<tr>
<td>Idle 1 s Power Mode</td>
<td>3 mA</td>
<td>2 mA</td>
</tr>
<tr>
<td>Idle 4 s Power Mode</td>
<td>1.5 mA</td>
<td>1.5 mA</td>
</tr>
</tbody>
</table>

Power output specifications

**VX**: Two independently configurable voltage terminals (VX1-VX2). When providing voltage excitation, a single 12-bit DAC\(^1\) shared by all VX outputs produces a user-specified voltage during measurement only. 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**: 4.5 mV
- **Maximum Source Current**: 50 mA total, concurrently or independently.

**SW12V**: Provides unregulated 12 VDC power with voltage equal to the Power Input supply voltage. SW12V is disabled when operating on USB power only. A thermal fuse regulates current sourcing.

\(^1\)Digital to analog conversion. The process that translates digital voltage levels to analog values.

**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 measurements 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 Limits**: -100 to +2500 mV

- **Sustained Input Voltage without Damage**:
  - SE 1-2: – 6 V, +9 V
  - SE 3-6: ±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)
  - ±0.13 nA typical ($f_{N1} = 4000$ Hz)

- **Filter First Notch Frequency ($f_{M1}$) Range**: 50/60, 400, 4000 Hz (user specified)
Analog Range and Resolution:

<table>
<thead>
<tr>
<th>Notch Frequency (f_{N1}) (Hz)</th>
<th>Range (^1) (mV)</th>
<th>RMS (µV)</th>
<th>Bits (^2)</th>
<th>RMS (µV)</th>
<th>Bits (^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>-100 to +2500</td>
<td>23</td>
<td>16.8</td>
<td>33</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>3.0</td>
<td>14.5</td>
<td>4.2</td>
<td>14.0</td>
</tr>
<tr>
<td>400</td>
<td>-100 to +2500</td>
<td>3.8</td>
<td>19.4</td>
<td>5.4</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>0.58</td>
<td>16.8</td>
<td>0.82</td>
<td>16.3</td>
</tr>
<tr>
<td>50/60 (^3)</td>
<td>-100 to +2500</td>
<td>1.6</td>
<td>20.6</td>
<td>2.3</td>
<td>20.1</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>0.23</td>
<td>18.2</td>
<td>0.33</td>
<td>17.7</td>
</tr>
</tbody>
</table>

\(^1\) 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:

<table>
<thead>
<tr>
<th>Range (mV)</th>
<th>Differential with Input Reversal</th>
<th>Differential without Input Reversal</th>
<th>Single-Ended</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100 to +2500</td>
<td>±20</td>
<td>±40</td>
<td>±60</td>
</tr>
<tr>
<td>-34 to +34</td>
<td>±6</td>
<td>±14</td>
<td>±20</td>
</tr>
</tbody>
</table>

Measurement Settling Time: 20 µs to 600 ms; 500 µs default

Multiplexed Measurement Time:

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

Resistance measurements 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 RevD1 ff. 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)

Period-averaging measurement specifications

Terminals: SE terminals 1-4

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

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. One channel at a time is measured. Current is measured using a 24-bit ADC\(^1\).

Terminals: SE1 and 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.

<table>
<thead>
<tr>
<th>Example fN1 (^1) (Hz)</th>
<th>Time (^2) (ms)</th>
<th>Time (^2) (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>2.9</td>
<td>1.4</td>
</tr>
<tr>
<td>400</td>
<td>14.6</td>
<td>7.3</td>
</tr>
</tbody>
</table>

\(^1\) Analog to digital conversion. The process that translates analog voltage levels to digital values.
Switch-closure input

Terminals:
- P_SW
- C1-C2 (Requires an external 100 kΩ resistor connected from the terminal to BAT+.)

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:
- SE terminals 1-4
- P_LL
- P_SW
- C1-C2

Maximum Input Frequency:
- SE 1-4: 35 kHz
- P_LL: 20 kHz
- P_SW: 35 kHz
- C1-C2: 3 kHz

Low-level AC input

Terminal: 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:

<table>
<thead>
<tr>
<th>Sine wave (mV RMS)</th>
<th>Range (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.0 to 20</td>
</tr>
<tr>
<td>200</td>
<td>0.5 to 200</td>
</tr>
<tr>
<td>2000</td>
<td>0.3 to 10,000</td>
</tr>
<tr>
<td>5000</td>
<td>0.3 to 20,000</td>
</tr>
</tbody>
</table>

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

Digital input/output specifications

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

Terminals:
- SE terminals 1-4
- P_SW
- C1-C2

<table>
<thead>
<tr>
<th>Terminal</th>
<th>High State</th>
<th>Low State</th>
<th>Current Source</th>
<th>Maximum Input Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>5.0 V output 3.3V input</td>
<td>0 V</td>
<td>10 mA at 3.5 V</td>
<td>−10 V, +15 V</td>
</tr>
<tr>
<td>C2</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3.0 V</td>
<td>−6 V, +9 V</td>
</tr>
<tr>
<td>SE1</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3.0 V</td>
<td>±17 V</td>
</tr>
<tr>
<td>SE2</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3.0 V</td>
<td>±17 V</td>
</tr>
</tbody>
</table>

Pulse-width modulation specifications

Terminals: SE terminals 1-4

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, 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, UDP

USB Device: Micro-B device for computer connectivity

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

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

Cellular option specifications

Cell Technology:

<table>
<thead>
<tr>
<th>Option</th>
<th>Cellular Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>-CELL200</td>
<td>3G, 2G</td>
</tr>
<tr>
<td>-CELL205</td>
<td>4G LTE with automatic 3G fallback</td>
</tr>
<tr>
<td>-CELL210</td>
<td>4G LTE CAT-1</td>
</tr>
<tr>
<td>-CELL215</td>
<td>4G LTE with automatic 3G fallback</td>
</tr>
<tr>
<td>-CELL220</td>
<td>4G LTE with automatic 3G fallback</td>
</tr>
</tbody>
</table>

Antenna Terminal: SMA

SIM Slot: Industry standard 3FF micro-SIM
The -CELL200 option is not compatible with a Verizon cellular network.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate Downlink</th>
<th>Maximum Data Rate Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMTS/HSPA+ (3G)</td>
<td>800, 850, 900, 1900, 2100</td>
<td>7.2 Mbps</td>
<td>5.7 Mbps</td>
</tr>
<tr>
<td>GSM/GPRS/EDGE (2G)</td>
<td>850, 900, 1800, 1900</td>
<td>236.8 Kbps</td>
<td>236.8 Kbps</td>
</tr>
</tbody>
</table>

The -CELL205 option is not compatible with a Verizon cellular network.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate Downlink</th>
<th>Maximum Data Rate Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE CAT-1 (4G)</td>
<td>700, 850, 1700/2100 (AWS-1), 1900</td>
<td>10.2 Mbps</td>
<td>5.2 Mbps</td>
</tr>
<tr>
<td>UMTS/HSPA+ (3G)</td>
<td>850, 1700/2100 (AWS), 1900</td>
<td>7.2 Mbps</td>
<td>5.7 Mbps</td>
</tr>
</tbody>
</table>

The -CELL210 option is not compatible with a Verizon cellular network.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate Downlink</th>
<th>Maximum Data Rate Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE CAT-1 (4G)</td>
<td>700, 850, 1700, 1900, 2100</td>
<td>10.2 Mbps</td>
<td>5.2 Mbps</td>
</tr>
</tbody>
</table>

The -CELL215 option is not compatible with a Verizon cellular network.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate Downlink</th>
<th>Maximum Data Rate Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE CAT-1 (4G)</td>
<td>2100(B1), 1800(B3), 850(B5), 2600(B7), 900(B8), 800(B20)</td>
<td>10.0 Mbps</td>
<td>5.0 Mbps</td>
</tr>
</tbody>
</table>

The -CELL220 option is not compatible with a Verizon cellular network.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate Downlink</th>
<th>Maximum Data Rate Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE 2100(B1), 1800(B3), 850(B5), 2600(B7), 900(B8), 800(B28) WCDMA 2100 (B1), 850(B5)</td>
<td>LTE 10.0 Mbps WCDMA 384 Kbps</td>
<td>LTE 5.0 Mbps WCDMA 384 Kbps</td>
<td></td>
</tr>
</tbody>
</table>

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 (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


Shock and Vibration: ASTM D4169-09
Protection: IP30

EMI and ESD protection:

- **Immunity:** Meets or exceeds following standards:
  - **ESD:** per IEC 61000-4-2; ±8 kV air, ±4 kV contact discharge
  - **RF:** per IEC 61000-4-3; 3 V/m, 80-1000 MHz
  - **EFT:** per IEC 61000-4-4; 1 kV power, 500 V I/O
  - **Surge:** per IEC 61000-4-5; 1 kV power and I/O
  - **Conducted:** per IEC 61000-4-6; 3 V 150 kHz-80 MHz

- 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 Declarations of Conformity at

**WiFi Option**

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

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

**Warranty**

**Standard:** Three years against defects in materials and workmanship.