



CR300-Series

Measurement and Control Dataloggers

All CR300-series dataloggers are tested and guaranteed to meet electrical specifications in a standard -40° to $+70^{\circ}\text{C}$ non-condensing environment. Datalogger recalibration is recommended every three years. System configuration and critical specifications should be confirmed with Campbell Scientific before purchase.

ANALOG (SE1 – SE6, DIFF 1H/1L – DIFF 3H/3L)

Six single-ended (SE) or three differential (DIFF) inputs individually configurable for voltage, thermocouple, current loop, ratiometric, and period average measurements, using a 24-bit ADC. One channel at a time is measured in numeric succession.

VOLTAGE MEASUREMENTS

INPUT RESISTANCE: $5\text{ G}\Omega$ ($f_{NI} = 50/60$), $300\text{ M}\Omega$ ($f_{NI} = 4000$)

INPUT LIMITS: -100 mV to $+2500\text{ mV}$

SUSTAINED INPUT VOLTAGE WITHOUT DAMAGE: $-6\text{ V}/+9\text{ V}$ (SE1, SE2), $\pm 17\text{ V}$ (SE3 to SE6)

DC COMMON MODE REJECTION: $> 120\text{ dB}$ with input reversal ($\geq 90\text{ dB}$ without input reversal)

NORMAL MODE REJECTION: $> 71\text{ dB}$ @ 50 Hz , $> 74\text{ dB}$ @ 60 Hz

INPUT CURRENT: $\pm 0.8\text{ nA}$ ($f_{NI} = 50/60$), $\pm 13\text{ nA}$ ($f_{NI} = 4000$), typical at 25°C

RANGE AND TYPICAL EFFECTIVE RESOLUTION:

Notch Frequency (f_{NI}) (Hz)	Range ¹ (mV)	Typical Resolution ² (Differential w/Input Reversal)		Typical Resolution ² (Differential w/o Input Reversal)	
		RMS μV	bits	RMS μV	bits
4000	-100 to $+2500$	23	16.8	33	16.3
	-34 to $+34$	3.0	14.5	4.2	14.0
400	-100 to $+2500$	3.8	19.4	5.4	18.9
	-34 to $+34$	0.58	16.8	0.82	16.3
50/60	-100 to $+2500$	1.6	20.6	2.3	20.1
	-34 to $+34$	0.23	18.2	0.33	17.7

ACCURACY:^{4,3}

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

OFFSETS:

Range (mV)	Differential with Input Reversal (μV)	Differential without Input Reversal (μV)	Single-Ended (μV)
-100 to $+2500$	± 20	± 40	± 60
-34 to $+34$	± 6	± 14	± 20

MULTIPLEXED MEASUREMENT TIME: ((multiplexed measurement time (ms) + settling time) * reps + 0.8 ms)

f_{NI} (Hz)	Multiplexed Measurement Time (ms)	
	w/Input Reversal	SE or w/o Input Reversal
4000	2.9	1.4
400	14.6	7.3
50/60	103	51.5

MEASUREMENT SETTLING TIME: $500\text{ }\mu\text{s}$, default

RATIOMETRIC MEASUREMENTS (SE1 – SE6)

Resistance measurements for four- and six-wire full bridge circuits and two-, three-, and four-wire half bridge circuits using voltage excitation.

RATIOMETRIC ACCURACY:^{4,5}

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

PERIOD AVERAGE MEASUREMENTS

Up to four analog inputs may be configured for period averaging.

ACCURACY: $\pm(0.01\%$ of reading + resolution), where resolution is $(0.13\text{ }\mu\text{s} / \text{number of cycles to be measured})$

FREQUENCY RANGE: 5 Hz to 200 kHz

CURRENT MEASUREMENTS

Two analog inputs may be configured as independent 0 to 20 mA or 4 to 20 mA current loop inputs (not isolated) measured one at a time using a 24-bit ADC.

ACCURACY:

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

PULSE COUNTING

SWITCH CLOSURE (P_SW)

MINIMUM SWITCH CLOSED TIME: 3 ms

MINIMUM SWITCH OPEN TIME: 3 ms

MAXIMUM BOUNCE TIME: 1 ms open w/o being counted

MAXIMUM INPUT FREQUENCY: 150 Hz

MAXIMUM INPUT VOLTAGE: $\pm 17\text{ Vdc}$

SWITCH CLOSURE (C1, C2)⁶

MAXIMUM INPUT FREQUENCY: 150 Hz

MINIMUM SWITCH OPEN TIME: 3 ms

HIGH-FREQUENCY (C1, C2, SE1 – SE4, P_SW, P_LL)

C1-C2: 3 kHz , maximum,

SE1-SE4: 35 kHz , maximum

P_SW: 35 kHz , maximum

P_LL: 20 kHz , maximum

LOW-LEVEL AC (P_LL)

INPUT HYSTERESIS: 12 mV @ 1 Hz

MAXIMUM AC INPUT VOLTAGE: $\pm 20\text{ V}$

RANGE (dependent on sine wave input)⁷

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

¹Range overhead of $\sim 10\%$ beyond range guarantees that full-scale values will not cause over range.

²Effective resolution (ER) in bits is computed from ratio of full-scale range to RMS resolution.

³Accuracy does not include the sensor and measurement noise.

⁴Assumes input reversal for differential measurements not including bridge resistor errors and sensor and measurement noise.

⁵Ratiometric accuracy, rather than absolute accuracy, determines overall measurement accuracy of ratiometric resistance measurements.

⁶Requires an external $100\text{ k}\Omega$ resistor connected from the terminal to BAT+.

⁷AC coupling removes ac offsets up to $\pm 0.05\text{ V}$.

More info: 435.227.9120

campbellsci.com/cr310



DIGITAL (C1, C2, SE1–SE4, P_SW)

Up to seven terminals may be configured for digital input or output.

Terminal	High State	Low State	Current Source	Sustained Input Voltage w/o Damage
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 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

VOLTAGE OUTPUT

SWITCHED 12 V (SWV)⁸

One output 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. 1200 mA @ -40 °C.

0.15 TO 5 V ANALOG OUTPUTS (VX1, VX2)⁹

Two terminals configured for 150 to 5000 mV continuous analog output or voltage excitation using 12-bit Dac.

Range	Resolution	Maximum Source/Sink Current
150 to +5000 mV	4.5 mV	50 mA total, concurrent or individually

DEDICATED COMMUNICATION INTERFACES

USB: Micro-B device for computer connectivity

RS-232: female RS-232, 9-pin interface

ETHERNET PORT (CR310 only): RJ-45, 10/100 Mbps, full or half duplex, Auto-MDIX, magnetic isolation and TVS surge protection

PROTOCOLS

INTERNET PROTOCOLS: PPP, RNDIS, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS, DNS, DHCP, SLAAC, NTP, Telnet, HTTP(S), SMTP/TLS, POP3/TLS

ADDITIONAL PROTOCOLS: PakBus, PakBus Encryption, SDI-12, Modbus RTU/ASCII/TCP, DNP3, NMEA 0183, I2C, SPI, custom user definable over serial, UDP

DATA FILE FORMATS: CSV, XML, JSON, binary, encrypted

SERIAL (C1, C2): 0 to 5 V output, 1200 to 115.2k bps

SDI-12 (C1, C2): Two independent SDI-12 V1.3 compliant terminals configurable as sensor or recorder

INTEGRATED COMMUNICATION DEVICES

CELLULAR MODEM (-CELL200, -CELL205, or -CELL210 OPTION)

-CELL200 OPTION (International¹⁰):

Technology	Frequency Bands (MHz)	Maximum Data Rate	
		Downlink	Uplink
UMTS/HSPA+ (3G)	800, 850, 900, 1900, 2100	7.2 Mbps	5.7 Mbps
GSM/GPRS/EDGE (2G)	850, 900, 1800, 1900	236.8 kbps	236.8 kbps

-CELL205 OPTION (North America; AT&T, T-Mobile¹¹):

Technology	Frequency Bands (MHz)	Maximum Data Rate	
		Downlink	Uplink
LTE Cat 1 (4G)	700, 850, 1700/2100 (AWS-1), 1900	10.2 Mbps	5.2 Mbps
UMTS/HSPA+ (3G)	850, 1700/2100 (AWS), 1900	7.2 Mbps	5.7 Mbps

-CELL210 OPTION (United States; Verizon only):

Technology	Frequency Bands (MHz)	Maximum Data Rate	
		Downlink	Uplink
LTE Cat 1 (4G)	700, 850, 1700, 1900, 2100	10.2 Mbps	5.2 Mbps

ANTENNA CONNECTOR: SMA

SIM SLOT: Industry standard 3FF micro-SIM

RADIO (-RF407, -RF412, -RF422, or -RF427 OPTION)

RADIO TYPE:

-RF407, -RF412, and -RF427 Options	-RF422 Option
Frequency Hopping Spread Spectrum Radios (FHSS)	SRD860 Radio with Listen before talk (LBT) and Automatic Frequency Agility (AFA)

TRANSMIT:

	-RF407 Option	-RF412 Option	-RF422 Option	-RF427 Option
Output Power	5 to 250 mW, user selectable		2 to 25 mW, user selectable	5 to 250 mW, user selectable
Frequency	902 to 928 MHz (US, Canada)	915 to 928 MHz (Australia, New Zealand)	863 to 870 MHz (European Union)	902 to 907.5 MHz, 915 to 928 MHz (Brazil)
Channel Capacity	Eight 25-channel hop sequences sharing 64 available channels	Eight 25-channel hop sequences sharing 31 available channels	Ten 30-channel hop sequences	Eight 25-channel hop sequences sharing 43 available channels
RF Data Rates	200 kbps	200 kbps	10 kbps	200 kbps

RECEIVE SENSITIVITY:

-RF407, -RF412, and -RF427 Options	-RF422 Option
-101 dBm	-106 dBm

ANTENNA CONNECTOR: Reverse Polarity SMA (RPSMA)

WLAN (-WIFI OPTION)

MAXIMUM POSSIBLE THROUGHPUT: 30 Mbps

MAXIMUM POSSIBLE OVER-THE-AIR DATA RATES:

802.11b	802.11g	802.11n
up to 11 Mbps	up to 54 Mbps	up to 72 Mbps

OPERATING FREQUENCY: 2.4 GHz, 20 MHz bandwidth

ANTENNA CONNECTOR: Reverse Polarity SMA (RPSMA)

SUPPORTED STANDARDS: IEEE 802.11 b/g/n, IEEE 802.11d/e/i, 802.1X, WEP, WPA/WPA2-Personal and Enterprise

OPERATIONAL MODES: Client or Access Point

TRANSMIT POWER: 7 to 18 dBm

Rx SENSITIVITY: -97 dBm

SYSTEM

PROCESSOR: ARM Cortex M4 running at 144 MHz

MEMORY

CPU DRIVE / PROGRAMS: 80 MB flash

DATA: 30 MB flash

OPERATING SYSTEM (OS): 2 MB flash

CLOCK ACCURACY: ±1 min. per month

CLOCK RESOLUTION: 1 ms

PROGRAM EXECUTION: 100 ms to one day

POWER REQUIREMENTS

PROTECTION: Surge, over-voltage, over-current, and reverse power protected

CHARGER INPUT (CHG): 16 to 32 Vdc, current limited at 0.9 A. Power converter or solar panel input.

EXTERNAL BATTERIES (BAT): 10 to 18 Vdc input, lead-acid 7 Ah battery, typical

INTERNAL LITHIUM BATTERY: 3 V coin cell CR2016 (Energizer) for battery-backed clock. 6 year life with no external power source.

AVERAGE CURRENT DRAIN @ 12 Vdc

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 LINK ACTIVE (CR310 only): Active + 51 mA

ETHERNET LINK IDLE (CR310 only): 32 mA

⁸ Not operational under USB power only.

⁹ Range reduced to 0 to 2500 mV when under USB power.

¹⁰ Confirm modem compliance for country/carrier where services are needed.

¹¹ The -CELL200 option is not compatible with a Verizon cellular network.

CELLULAR MODEM

ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc

	-CELL200 Option	-CELL205 Option	-CELL210 Option
Idle (connected to network, no data transfer)	2 mA minimum, 10 mA average	2 mA minimum, 14 mA average	2 mA minimum, 28 mA average
TX/RX	20 mA minimum, 105 mA average	20 mA minimum, 75 mA average	20 mA minimum, 90 mA average

RADIO

AVERAGE ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc

	-RF407, -RF412, RF427 Options	-RF422 Option
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	2.5 mA
Idle 4 s Power Mode	1.5 mA	1.5 mA

WI-FI

AVERAGE ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc

Mode	-WIFI Option
Client Mode	7 mA idle, 70 mA communicating
Access Point Mode	62 mA idle, 70 mA communicating
Sleep (disabled using IPNetPower() or DevConfig setting)	4 mA

ON-BOARD RADIO:

-RF407 Option	-RF412 Option	-RF422 Option	-RF427 Option
United States: FCC Part 15.247: MCQ-XB900HP Industry Canada (IC): 1846A-XB900HP Mexico IF: RCPDIXB15-0672-A2	ACMA RCM United States: FCC Part 15.247: MCQ-XB900HP Industry Canada (IC): 1846A-XB900HP	View EU Declaration of Conformity at: www.campbellsci.com/cr300 www.campbellsci.com/cr310	Brazil ANATEL standards in Resolution No. 506: 08335-17-10644 (available soon)

ON-BOARD WIFI¹² (-WIFI OPTION):

UNITED STATES FCC ID: XF6-RS9113SB

INDUSTRY CANADA (IC): 8407A-RS9113SB

PHYSICAL

DIMENSIONS (additional clearance required for cables and leads)

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-CELL2XX/RF4XX/WIFI: 249.5 g (0.55 lb)

CR310: 288 g (0.64 lb)

CR310-CELL2XX/RF4XX/WIFI: 306 g (0.68 lb)

MATERIAL

CASE: Powder-coated aluminum

WARRANTY

Three years against defects in materials and workmanship.

¹² The user is responsible for emissions if changing the antenna type or increasing the gain.

COMPLIANCE INFORMATION

VIEW EU DECLARATION OF CONFORMITY:

CR300, CR300-CELL200, or CR300-WIFI: www.campbellsci.com/cr300

CR310, CR310-CELL200, or CR310-WIFI: www.campbellsci.com/cr310

SHOCK AND VIBRATION: ASTM D4169-09

PROTECTION: IP30

TERMINAL FUNCTIONS

Each terminal may only take on one function.

Analog Input	C1	C2	P_SW	P_LL	VX1	VX2	SE1	SE2	SE3	SE4	SE5	SE6	RS-232	SW12V	Ethernet	Max
Single Ended Voltage							✓	✓	✓	✓	✓	✓				6
Differential Voltage							H	L	H	L	H	L				3
Ratiometric Bridge							✓	✓	✓	✓	✓	✓				6
Thermocouple							✓	✓	✓	✓	✓	✓				6
Current Loop							✓	✓								2
Period Average							✓	✓	✓	✓						4
Analog & Voltage Output ¹³	C1	C2	P_SW	P_LL	VX1	VX2	SE1	SE2	SE3	SE4	SE5	SE6	RS-232	SW12V	Ethernet	Max
Switched-Voltage Excitation					✓	✓										2
3.3 Vdc			✓		✓	✓	✓	✓	✓	✓						7
5 Vdc	✓	✓			✓	✓										4
12 Vdc														✓		1
Communications/Digital I/O	C1	C2	P_SW	P_LL	VX1	VX2	SE1	SE2	SE3	SE4	SE5	SE6	RS-232	SW12V	Ethernet	Max
SDI-12	✓	✓														2
RS-232													✓			1
RS-232 0-5 V out	Tx	Rx														1
GPS Time Sync	✓	✓					✓	✓	✓							5
GPS NMEA Sentences	Rx	Rx											Rx			3
General I/O	✓	✓	✓				✓	✓	✓	✓						7
Pulse-Width Modulation							✓	✓	✓	✓						4
Interrupt	✓	✓					✓	✓	✓							5
10/100 Ethernet, non-POE															CR310 only	1
Pulse Counting	C1	C2	P_SW	P_LL	VX1	VX2	SE1	SE2	SE3	SE4	SE5	SE6	RS-232	SW12V	Ethernet	Max
Switch Closure	✓	✓	✓													3
High Frequency	✓	✓	✓	✓			✓	✓	✓	✓						8
Low Level AC				✓												1
Quadrature Input	A	B					A	B								2

¹³ SE1 to SE4, P_SW, C1, and C2 have limited drive capacity.



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