



CR300

Measurement and Control Datalogger

All CR300 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

Six terminals may be configured to make analog voltage or ratiometric measurements or configured as digital I/O.

VOLTAGE MEASUREMENTS (SE1 – SE6)

Up to three differential or six single-ended terminals configured for voltage measurements using a 24-bit Adc, one at a time.

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

INPUT LIMITS: $-100\ \text{mV}$ 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: $> 71\ \text{dB}$ @ $50\ \text{Hz}$, $> 74\ \text{dB}$ @ $60\ \text{Hz}$

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

RANGE AND RESOLUTION:

| Notch Frequency (f_{NI}) (Hz) | Range ¹ (mV) | Typical Resolution ² (Differential w/ Input Reversal) | | Typical Resolution ² (Differential w/o Input Reversal) | |
|--|-------------------------|--|------|---|------|
| | | Effective Resolution | | Effective Resolution | |
| | | 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 |

MEASUREMENT SPEED: (multiplexed measurement time (ms) * 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 |

DEFAULT SETTling TIME: $500\ \mu\text{s}$

RATIOMETRIC MEASUREMENTS (SE1 – SE6)

Resistance measurements for four- and six-wire full bridge and two-, three-, and four-wire half bridge 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) |

CURRENT MEASUREMENTS (SE1, SE2)

Two analog inputs may be configured as independent 0 to $20\ \text{mA}$ or 4 to $20\ \text{mA}$ current loop inputs (not isolated) measured one at a time using the 24-bit Adc

ACCURACY:

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

DIGITAL

PERIOD AVERAGE (SE1 – SE4)

Up to four analog inputs can be used for period averaging, one at a time.

ACCURACY: $\pm(0.01\%$ of reading + resolution), where resolution is $13\ \text{ns}$ divided by the specified number of cycles to be measured.

FREQUENCY RANGE: $5\ \text{Hz}$ to $200\ \text{kHz}$

VOLTAGE THRESHOLD: counts cycles on transition from $<0.9\ \text{Vdc}$ to $>2.1\ \text{Vdc}$

DIGITAL I/O (SE1 – SE4, P_SW)

I/O HIGH STATE: $3.3\ \text{V}$

I/O LOW STATE: $0\ \text{V}$

DRIVE CURRENT @ $3.0\ \text{V}$: $100\ \mu\text{A}$

MAXIMUM INPUT VOLTAGE: $-6\ \text{V}/+9\ \text{V}$ (SE1, SE2), $\pm 17\ \text{V}$ (SE3, SE4, P_SW)

DIGITAL I/O (C1, C2)

I/O HIGH STATE: $5.0\ \text{V}$ (output); $3.3\ \text{V}$ logic (input)

I/O LOW STATE: $0\ \text{V}$

DRIVE CURRENT @ $3.5\ \text{V}$: $10\ \text{mA}$

MAXIMUM INPUT VOLTAGE: $-10\ \text{V}/+15\ \text{V}$

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.



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: ± 17 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)

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 |

INPUT HYSTERESIS: 12 mV @ 1 Hz
MAXIMUM AC INPUT VOLTAGE: ± 20 V

VOLTAGE OUTPUT

SWITCHED 12 V (BATTERY)⁸

One output provides unregulated 12 V (battery voltage) source under program control. Thermal fuse hold current = 1200 mA @ 0°C, 1100 mA @ 20°C, 830 mA @ 60°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 |

COMMUNICATIONS

INTERNET PROTOCOLS: PPP, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS, DHCP, SLAAC, DNS Client, SNMP, NTP, Telnet, HTTP/HTTPS, FTP/FTPS, SMTP/TLS, POP3/TLS

ADDITIONAL PROTOCOLS SUPPORTED: PakBus, PakBus Encryption, SDI-12, Modbus RTU/ASCII/TCP, DNP3/TCP, NTCIP, NMEA 0183. Custom user definable over serial, TCP, and UDP

DATA FILE FORMATS: CSV, XML, JSON, binary

USB: USB micro-B device only, 2.0 full-speed 12 Mbps, for computer connection.

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

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

⁶ Requires an external 100 k Ω resistor connected from the terminal to BAT+.

⁷ AC coupling removes ac offsets up to ± 0.05 V.

⁸ Not operational under USB power only.

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

ON-BOARD RADIO

RADIO TYPE:

| CR300-RF407, CR300-RF412 | CR300-RF422 |
|---|--|
| Frequency Hopping Spread Spectrum Radios (FHSS) | SRD860 Radio with Listen before talk (LBT) and Automatic Frequency Agility (AFA) |

TRANSMIT:

| | CR300-RF407 | CR300-RF412 | CR300-RF422 |
|------------------|--|--|---------------------------------|
| Output Power | 5 to 250 mW, user selectable | | 2 to 25 mW, user selectable |
| Frequency | 902 to 928 MHz (US, Canada) | 915 to 928 MHz (Australia, New Zealand) | 863 to 870 MHz (European Union) |
| 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 |
| RF Data Rates | 200 kbps | 200 kbps | 10 kbps |

RECEIVE SENSITIVITY:

| CR300-RF407, CR300-RF412 | CR300-RF422 |
|--------------------------|-------------|
| -101 dBm | -106 dBm |

ANTENNA CONNECTOR: Reverse Polarity SMA (RPSMA)

WLAN (CR300-WIFI only)

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

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

EXTERNAL BATTERIES (BAT): 12 Vdc, 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.

TYPICAL POWER REQUIREMENTS

SLEEP: 1.5 mA

ACTIVE 1 HZ SCAN WITH ONE ANALOG MEASUREMENT: 5 mA

ACTIVE PROCESSOR ALWAYS ON: 23 mA

USB POWER (USB): For programming and limited functionality.

