CR3000 Specifications

Electrical specifications are valid over a -25° to +50°C, non-condensing environment, unless otherwise specified. Recalibration recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS *(SE1–SE28 or DIF1–DIF14)*

14 differential (DIFF) or 28 single-ended (SE) individually configured input channels. Channel expansion provided by optional analog multiplexers.

RANGES, RESOLUTION: Basic resolution (Basic Res) is the resolution of a single A/D conversion. A DIFF measurement with input reversal has better (finer) resolution by twice than Basic Res.

Range (mV)[1]	DF Res (µV) [2]	Basic Res (µV)
±5000	83.33	167
±1000	16.67	33.4
±200	3.33	6.67
±50	0.83	1.67
±20	0.33	0.67

[1]Range overhead of ~9% on all ranges guarantees full-scale voltage will not cause over range.

[2]Resolution of DF measurements with input reversal.

ANALOG INPUT ACCURACY[3]:

±(0.04% of reading + offset), 0° to 40°C
±(0.07% of reading + offset), -25° to 50°C
±(0.09% of reading + offset), -40° to 85°C (-XT only)

[3]Accuracy does not include sensor and measurement noise. Offsets are defined as:

Offset for DIFF w/input reversal = 1.5·Basic Res + 1.0 µV
Offset for DIFF w/o input reversal = 3·Basic Res + 2.0 µV
Offset for SE = 3·Basic Res + 5.0 µV

ANALOG MEASUREMENT SPEED:

Integration Type/ Code	Integration Time	Settling Time	Total Time[4] SE w/ No Rev	Total Time[4] DF w/ Input Rev
250	250 µs	200 µs	~0.7 ms	~1.4 ms
60 Hz[5]	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz[5]	20.00 ms	3 ms	~23 ms	~46 ms

[4]Includes 250 µs for conversion to engineering units.

[5]AC line noise filter.

INPUT NOISE VOLTAGE: For DIFF measurements with input reversal on ±20 mV input range; digital resolution dominates for higher ranges.

250 µs Integration: 0.4 µV RMS
50/60 Hz Integration: 0.19 µV RMS

INPUT LIMITS: ±5 Vdc

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

INPUT VOLTAGE RANGE W/O MEASUREMENT CORRUPTION: ±8.6 Vdc max.

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±120 nA @ 85°C

INPUT RESISTANCE: 20 GΩ typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):

±0.3°C, -25° to 50°C;
±0.8°C, -40° to 85°C (-XT only)

ANALOG OUTPUTS *(Vx1-Vx4, Ix1-Ix3, CAO1, CAO2)*

4 switched voltage and 3 switched current outputs sequentially active during measurement. Two continuous outputs.

Channel	Range	Res.	Current Source/ Sink	Compliance Voltage
VX 1-4	±5 V	0.17 mV	±50 mA	N/A
IX 1-3	±2.5 mA	0.08 µA	N/A	±5 V
CAO	±5 V	0.17 mV	±15 mA	N/A

ANALOG OUTPUT ACCURACY (VX and CAO):
±(0.04% of setting + 0.5 mV), 0° to 40°C
±(0.07% of setting + 0.5 mV), -25° to 50°C
±(0.09% of setting + 0.5 mV), -40° to 85°C (-XT only)

ANALOG OUTPUT ACCURACY (IX):
±(0.1% of setting + 0.5 µA), 0° to 40°C
±(0.13% of setting + 0.5 µA), -25° to 50°C
±(0.15% of setting + 0.5 µA), -40° to 85°C (-XT only)

VX FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 5000 mV square wave for exciting vibrating wire transducers.

PERIOD AVERAGE

Any of the 28 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading+resolution), where resolution is 68 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	Input Range (±mV)	Signal (peak to peak) Min. (mV) [6]	Signal (peak to peak) Max (V)[7]	Min Pulse Width (µV)	Max[8] Freq (kHz)
1	1000	500	10	2.5	200
5	25	10	2	10	50
20	7.5	5	2	62	8
50	2.5	2	2	100	5

[6]Signal centered around Threshold (see PeriodAvg() instruction).

[7]Signal centered around ground

[8]The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

RATIOMETRIC MEASUREMENTS

MEASUREMENT TYPES: Provides ratiometric resistance measurements using voltage or current excitation. Four switched voltage excitation outputs are available for measurement of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Three switched current excitation outputs are available for direct resistance measurements. Optional excitation polarity reversal minimizes dc errors.

RATIOMETRIC MEASUREMENT ACCURACY[9, 10, 11]:
±(0.02% of voltage reading + offset[12]), 0° to 40°C
±(0.025% of voltage reading + offset[12]), -25° to 50°C
±(0.03% of voltage reading + offset[12]), -40° to 85°C

[9] Accuracy specification assumes excitation reversal for excitation voltages < 500 mV and excitation currents < 500 µA. Assumption does not include bridge resistor errors and sensor and measurement noise.

[10]For Resistance() instruction, the sensor resistance is determined from VS / IX, where excitation current IX is measured across a 1000 Ω, ±0.005% at 25°C, 2 ppm•°C^{-1} TCR internal resistor.

[11]Estimated accuracy, ΔX (where X is value returned from measurement with Multiplier =1, Offset = 0):
BrHalf() instruction: $\Delta X = \Delta V_i/V_x$
BrFull() instruction $\Delta X = 1000 \cdot \Delta V_i/V_x$, expressed as mV•V^{-1}.
ΔV^{-1} is calculated from the ratiometric measurement accuracy. See Resistance Measurements Section in the manual for more information.

[12]Offset definitions:
Offset for DIFF w/input reversal = 1.5•Basic Res + 1.0 µV
Offset for DIFF w/o input reversal = 3•Basic Res + 2.0 µV
Offset for SE = 3•Basic Res + 5.0 µV
Excitation reversal reduces offsets by a factor of two.

PULSE COUNTERS *(P1-P4)*

4 inputs individually selectable for switch closure, high frequency pulse, or low-level AC. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.8 x 10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW LEVEL AC MODE: Internal AC coupling removes dc offsets up to ±0.5 Vdc.

Input Hysteresis: 12 mV RMS @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

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

DIGITAL CONTROL PORTS *(C1-C8, SDM)*

8 ports software selectable as binary inputs or control outputs. Provide on/off, pulse width modulation, edge timing, subroutine interrupts / wake up, switch-closure pulse counting, high-frequency pulse counting, asynchronous communications (UARTs), and SDI-12 communications.

LOW FREQUENCY MODE MAX: <1 kHz

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 Ω

INPUT STATE: high 3.8 to 16 V; low -8.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kΩ with < 6.2 Vdc; 220 Ω with inputs ≥6.2 Vdc

SERIAL DEVICE / RS-232 SUPPORT: 0 to 5 Vdc UART

ADDITIONAL DIGITAL PORTS: SDM-C1, SDM-C2, SDM-C3 are dedicated for measuring SDM devices.

SWITCHED 12 V *(SW12V)*

2 independent 12 Vdc unregulated sources switched on and off under program control. Thermal fuse hold current = 900 mA at 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

EU DECLARATION OF CONFORMITY

VIEW EU DECLARATION OF CONFORMITY AT:
www.campbellsci.com/cr3000

COMMUNICATION

RS-232 PORTS:
DCE 9-pin (electrically isolated): for computer connection or connection of modems not manufactured by Campbell Scientific.
COM1 to COM4: 4 independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 Vdc UART
Baud Rate: Selectable from 300 to 115.2k bps.
Default Format: 8 data bits; 1 stop bit; no parity
Optional Format: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with telecommunication peripherals manufactured by Campbell Scientific.

SDI-12: Digital Control ports C1, C3, C5, and C7 are individually configurable and meet SDI Standard v 1.3 for datalogger mode. Up to 10 SDI-12 sensors are supported per port.

PERIPHERAL PORT: 40-pin interface for attaching CompactFlash or Ethernet peripherals

PROTOCOLS SUPPORTED: PakBus, AES-128 Encrypted PakBus, Modbus, DNP3, FTP, HTTP, XML, HTML, POP3, SMTP, Telnet, NTCIP, NTP, Web API, SDI-12, SDM.

SYSTEM

PROCESSOR: Renesas H8S 2674 (16-bit CPU with 32-bit internal core)

MEMORY: 2 MB of flash for operating system; 4 MB of battery-backed SRAM for CPU usage, program storage and final data storage

REAL-TIME CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional

REAL-TIME CLOCK RESOLUTION: 10 ms

SYSTEM POWER REQUIREMENTS

VOLTAGE: 10 to 16 Vdc

RECHARGEABLE BASE INPUT: 17 to 24 Vdc or 18 V RMS ac

INTERNAL BATTERIES: 1200 mAh lithium battery for clock and SRAM backup. Typically provides 3 years of backup. Optional 7 Ah rechargeable battery plus base available as primary power supply.

EXTERNAL BATTERIES: Optional 12 Vdc nominal alkaline and rechargeable available. Power connection is reverse polarity protected.

TYPICAL CURRENT DRAIN @ 12 Vdc:
Sleep Mode: < 2 mA
1 Hz Sample Rate (one fast SE measurement): 3 mA
100 Hz Sample Rate (one fast SE measurement): 10 mA
100 Hz Sample Rate (one fast SE measurement w/RS-232 communications): 38 mA
Active integrated keyboard display adds 1 mA (42 mA with backlight on).

PHYSICAL SPECIFICATIONS

DIMENSIONS: 24.1 x 17.8 x 9.6 cm (9.5 x 7.0 x 3.8 in); additional clearance required for cables and leads.

WEIGHT:

Base Type	Mass (kg)	Weight (lb)
Low profile	1.6	3.6
Rechargeable	4.8	10.7

WARRANTY

3 years against defects in materials and workmanship.

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January 4, 2018