

# CR1000 Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years. We recommend that the system configuration and critical specifications are confirmed with Campbell Scientific before purchase.

## PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

## ANALOG INPUTS (SE1-SE16 or DIFF1-DIFF8)

8 differential (DF) or 16 single-ended (SE) individually configured. Channel expansion provided by AM16/32B and AM25T multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single conversion. Resolution of DF measurements with input reversal is half the Basic Res.

Range (mV) <sup>1</sup>	DF Res (μV) <sup>2</sup>	Basic Res (μV)
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

<sup>1</sup>Range overhead of ~9% on all ranges guarantees that full-scale values will not cause over range.

<sup>2</sup>Resolution of DF measurements with input reversal.

## ACCURACY<sup>3</sup>:

±(0.06% of reading + offset), 0° to 40°C

±(0.12% of reading + offset), -25° to 50°C

±(0.18% of reading + offset), -55° to 85°C (-XT only)

<sup>3</sup>Accuracy does not include the sensor and measurement noise. The offsets are defined as:

Offset for DF w/input reversal = 1.5-Basic Res + 1.0 μV

Offset for DF w/o input reversal = 3-Basic Res + 2.0 μV

Offset for SE = 3-Basic Res + 3.0 μV

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range; digital resolution dominates for higher ranges.

250 μs Integration: 0.34 μV RMS

50/60 Hz Integration: 0.19 μV RMS

## ANALOG MEASUREMENT SPEED:

Integra- tion Type/ Code	Integra- tion Time	Settling Time	Total Time <sup>5</sup>	
			SE w/ No Rev	DF w/ Input Rev
250	250 μs	450 μs	~1 ms	~12 ms
60 Hz <sup>4</sup>	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz <sup>4</sup>	20.00 ms	3 ms	~25 ms	~50 ms

<sup>4</sup>AC line noise filter.

<sup>5</sup>Includes 250 μs for conversion to engineering units.

INPUT LIMITS: ±5 V

DC COMMON MODE REJECTION: >100 dB

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

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

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 Gohms typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements): ±0.3°C, -25° to 50°C ±0.8°C, -55° to 85°C (-XT only)

## ANALOG OUTPUTS (Vx1-Vx3)

3 switched voltage, active only during measurement, one at a time.

RANGE AND RESOLUTION: Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

V<sub>x</sub> ACCURACY: ±(0.06% of setting + 0.8 mV), 0° to 40°C ±(0.12% of setting + 0.8 mV), -25° to 50°C ±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

V<sub>x</sub> FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 2500 mHz square waves for exciting vibrating wire transducers.

CURRENT SOURCING/SINKING: ±25 mA

## RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR1000 provides ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation using any of the 3 switched voltage excitations eliminates dc errors.

VOLTAGE RATIO ACCURACY<sup>6</sup>: Assuming excitation voltage of at least 1000 mV, not including bridge resistor error.

±(0.04% of voltage reading + offset)/V<sub>x</sub>

<sup>6</sup>Accuracy does not include the sensor and measurement noise. The offsets are defined as:

Offset for DF w/input reversal = 1.5-Basic Res + 1.0 μV

Offset for DF w/o input reversal = 3-Basic Res + 2.0 μV

Offset for SE = 3-Basic Res + 3.0 μV

Offset values are reduced by a factor of 2 when excitation reversal is used.

## PERIOD AVERAGE

Any of the 16 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading + resolution), where resolution is 136 ns divided by the specified number of cycles to be measured.

## INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	Input Range (±mV)	Signal (peak to peak) <sup>7</sup>		Min Pulse Width (μV)	Max <sup>8</sup> Freq (kHz)
		Min. (mV)	Max (V)		
1	2500	500	10	2.5	200
10	250	10	2	10	50
33	25	5	2	62	8
100	2.5	2	2	100	5

<sup>7</sup>With signal centered at the datalogger ground.

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

## PULSE COUNTERS (P1-P2)

(2) inputs individually selectable for switch closure, high frequency pulse, or low-level ac. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.7x10<sup>6</sup>

## 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 AC offsets up to ±0.5 V.

Input Hysteresis: 12 mV @ 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 I/O PORTS (C1-C8)

8 ports software selectable, as binary inputs or control outputs. Also provide edge timing, subroutine interrupts/wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UART), SDI-12 communications, and SDM communications.

HIGH-FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

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

OUTPUT RESISTANCE: 330 ohms

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

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kohms

## SWITCHED 12 V (SW-12)

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

## CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

## COMMUNICATIONS

RS-232 PORTS:

9-pin: DCE port for battery-powered computer or non-CSI modem connection.

COM1 to COM4: Four independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 VUART

Baud Rates: selectable from 300 bps to 115.2 kbps.

Default Format: 8 data bits; 1 stop bits; no parity

Optional Formats: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with CSI peripherals

SDI-12: Digital control ports 1, 3, 5, and 7 are individually configured and meet SDI-12 Standard version 1.3 for datalogger mode. Up to ten SDI-12 sensors are supported per port.

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

PROTOCOLS SUPPORTED: PakBus, Modbus, DNP3, FTP, HTTP, XML, POP3, SMTP, Telnet, NTCIP, NTP, SDI-12, SDM

## CPU AND INTERFACE

PROCESSOR: Renesas H8S 2322 (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 data storage.

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

## SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc (reverse polarity protected)

EXTERNAL BATTERIES: 12 Vdc nominal

TYPICAL CURRENT DRAIN:

Sleep Mode: 0.7 mA (0.9 mA max.)

1 Hz Sample Rate (1 fast SE meas.): 1 mA

100 Hz Sample Rate (1 fast SE meas.): 16.2 mA

100 Hz Sample Rate (1 fast SE meas. w/RS-232 communication): 27.6 mA

Optional Keyboard Display On (no backlight): add 7 mA to current drain

Optional Keyboard Display On (backlight on): add 100 mA to current drain

Optional Keyboard Display On (backlight on): add 100 mA to current drain

## PHYSICAL

DIMENSIONS: 9.4" x 4" x 2.4" (23.9 x 10.2 x 6.1 cm); additional clearance required for serial cable and sensor leads.

WEIGHT: 2.1 lbs (1 kg)

## WARRANTY

3-years against defects in materials and workmanship.

