

# 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 30 min. @ 10 ms increments

## ANALOG INPUTS

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

Input Range (mV) <sup>1</sup>	Input Referred Noise Voltage	
	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% exists on all ranges to guarantee 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

<sup>3</sup>The sensor and measurement noise are not included and the offsets are the following:

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

## MINIMUM TIME BETWEEN VOLTAGE

MEASUREMENTS: Includes the measurement time and conversion to engineering units. For voltage measurements, the CR1000 integrates the input signal for 0.25 ms or a full 16.66 ms or 20 ms line cycle for 50/60 Hz noise rejection. DF measurements with input reversal incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors and therefore take twice as long.

250 µs Analog Integration: ~1 ms SE  
1/60 Hz Analog Integration: ~20 ms SE  
1/50 Hz Analog Integration: ~25 ms SE

COMMON MODE RANGE: ±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

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.

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)

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.

RATIO ACCURACY<sup>3</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>3</sup>The sensor and measurement noise are not included and the offsets are the following:

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 AVERAGING MEASUREMENTS

The average period for a single cycle is determined by measuring the average duration of a specified number of cycles. The period resolution is 192 ns divided by the specified number of cycles to be measured; the period accuracy is ±(0.01% of reading + resolution). Any of the 16 SE analog inputs can be used for period averaging. Signal limiting are typically required for the SE analog channel.

INPUT FREQUENCY RANGE:

Input Range	Signal (peak to peak) <sup>4</sup>		Min. Pulse W.	Max <sup>5</sup> Freq.
	Min	Max		
±2500 mV	500 mV	10 V	2.5 µs	200 kHz
±250 mV	10 mV	2 V	10 µs	50 kHz
±25 mV	5 mV	2 V	62 µs	8 kHz
±2.5 mV	2 mV	2 V	100 µs	5 kHz

<sup>4</sup>The signal is centered at the datalogger ground.

<sup>5</sup>The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

## PULSE COUNTERS

Two 24-bit inputs selectable for switch closure, high-frequency pulse, or low-level AC.

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: 16 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

8 ports software selectable, as binary inputs or control outputs. C1-C8 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 PULSE 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 ohms

INPUT STATE: high 3.8 to 5.3 V; low -0.3 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kohms

## SWITCHED 12 V

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.

## SDI-12 INTERFACE SUPPORT

Control ports 1, 3, 5, and 7 may be configured for SDI-12 asynchronous communications. Up to ten SDI-12 sensors are supported per port. It meets SDI-12 Standard version 1.3 for datalogger mode.

## CE COMPLIANCE

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

## CPU AND INTERFACE

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core)

MEMORY: 2 Mbytes of Flash for operating system; 4 Mbytes of battery-backed SRAM for CPU usage, program storage and data storage.

SERIAL INTERFACES: CS I/O port is used to interface with Campbell Scientific peripherals; RS-232 port is for computer or non-CSI modem connection.

PARALLEL INTERFACE: 40-pin interface for attaching data storage or communication peripherals such as the CFM100 module

BAUD RATES: Selectable from 300 bps to 115.2 kbps. ASCII protocol is one start bit, one stop bit, eight data bits, and no parity.

CLOCK ACCURACY: ±3 min. per year

## SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc (reverse polarity protected)

TYPICAL CURRENT DRAIN:

Sleep Mode: ~0.6 mA  
1 Hz Scan (8 diff. meas., 60 Hz rej., 2 pulse meas.)  
w/RS-232 communication: 19 mA  
w/o RS-232 communication: 4.2 mA  
1 Hz Scan (8 diff. meas., 250 µs integ., 2 pulse meas.)  
w/RS-232 communication: 16.7 mA  
w/o RS-232 communication: 1 mA  
100 Hz Scan (4 diff. meas., 250 µs integ.)  
w/RS-232 communication: 27.6 mA  
w/o RS-232 communication: 16.2 mA

CR1000KD CURRENT DRAIN:

Inactive: negligible  
Active w/o backlight: 7 mA  
Active w/backlight: 100 mA

EXTERNAL BATTERIES: 12 Vdc nominal

## PHYSICAL SPECIFICATIONS

MEASUREMENT & CONTROL MODULE SIZE: 8.5" x 3.9" x 0.85" (21.6 x 9.9 x 2.2 cm)

CR1000WP WIRING PANEL SIZE: 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

Three years against defects in materials and workmanship.

