

Other Applications

- Aerospace/aviation—has endured the rigors of space travel and provided acceleration, structural, and equipment performance measurements.
- Geotechnical—measures tilt, convergence, displacement, geographic position, strain, load, vibration, overburden, level, flow, creep, and force for slope stability, subsidence, seismicity studies, structural restoration, or site assessment applications.
- Mining—monitors mine ventilation, slope stability, convergence, and equipment performance.
- Machinery testing—provides temperature, pressure, RPM, velocity, power, acceleration, position, torque, and strain measurements.
- Laboratory—can serve as a monitoring device to record parameters over time and can also be used to regulate and control test conditions.



Our dataloggers measured the effects of gravity on a test structure aboard a NASA low-gravity flight. Photo credit: NASA.

General CR9000 & CR9000C Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; testing over -40° to +70°C available as an option, excluding batteries. Non-condensing environment is required. To maintain specifications, Campbell Scientific recommends recalibrating dataloggers every two years.

9031 CPU MODULE

PROCESSORS: Main CPU is 32-bit with on-chip floating point unit. Measurements, timing, and setup done by hardware task sequencer with DMA type transfer to CPU memory.

MEMORY: 2 MB Flash EEPROM, 2 MB Static RAM

9011 POWER SUPPLY MODULE

VOLTAGE: 9.6 to 18 Vdc

TYPICAL CURRENT DRAIN: Base system with no modules is 500 mA active; 300 mA standby. Current drain of individual I/O modules varies. Refer to specifications for each I/O module for specific values. Power supply module can place the system in standby mode by shutting off power to the rest of the modules.

DC CHARGING: 9.6 to 18 Vdc input charges internal batteries at up to 2 A rate. Charging circuit includes temperature compensation.

INTERNAL BATTERIES: Sealed rechargeable with 14 Ahr (7 Ahr for the CR9000C) capacity per charge.

EXTERNAL BATTERIES: External 12 V batteries can be connected.

9041 A/D and AMPLIFIER MODULE

A/D Conversions: 16-bit, 100 kHz

PC9000(C) INTERFACES

PLA100

TYPICAL CURRENT DRAIN: 50 mA, supplied by the CR9000(C)

SIZE (excluding cable): 2.25" x 0.5" x 4.0"
(5.7 x 1.3 x 10.2 cm)

CABLE LENGTH: Specified, in feet, by the user, 50 ft maximum length

WEIGHT: 2.5 lb (0.11 kg)

TL925

TYPICAL CURRENT DRAIN: 50 mA, supplied by the CR9000(C)

BAUD RATE: 300 bps to 115.2 kbps with auto baud detection.

SIZE: 2.1" x 1.0" x 6.8" (5.3 x 2.5 x 17.3 cm)

WEIGHT: 2.5 lb (0.11 kg)

TRANSIENT PROTECTION

All analog and digital inputs and outputs use gas discharge tubes and transient filters to protect against high-voltage transients. Digital I/Os also have over-voltage protection clamping.

PHYSICAL SPECIFICATIONS

Size

Lab Enclosure: 15.75"L x 9.75"W x 8"D
(40 x 24.8 x 20.3 cm)

Fiberglass Enclosure: 18"L x 13.5"W x 9"D
(45.7 x 34.3 x 22.9 cm)

CR9000C: 10"L x 11"W x 9"D
(25.4 x 27.9 x 22.9 cm)

Weight

Lab Enclosure: 30 lbs including modules (13.6 kg)

Fiberglass Enclosure: 42 lbs including modules (19.1 kg)

CR9000C: 27 lbs including modules (12.3 kg)

Replacement Batteries: 6.4 lbs (2.9 kg)

Additional Modules: 1 lb each (0.5 kg)

WARRANTY

Three years against defects in materials and workmanship.

We recommend that you confirm system configuration and critical specifications with Campbell Scientific before purchase.

CR9000 & CR9000C I/O Module Specifications

CR9050(E) and CR9051E ANALOG INPUT MODULE with RTD

INPUT CHANNELS PER MODULE: 14 differential or 28 single-ended.

RANGE AND RESOLUTION:

Input Range (mV)	Resolution (1 A/D count) (μ V)	Input Noise (μ V RMS)	Max Sample Rates (kHz)
± 5000	158.0	105	100
± 1000	32.0	35	100
± 200	6.3	7	50
± 50	1.6	4	50

Input Range (mV)	Input Noise CR9050(E) (μ V RMS)	Input Noise CR9051E (μ V RMS)
± 5000	105	130
± 1000	35	35
± 200	7	7
± 50	4	4

Note: Measurement averaging provides lower noise and better resolution.

ACCURACY OF VOLTAGE MEASUREMENTS:

Single-Ended & Differential:

$\pm(0.07\%$ of reading + 4 A/D counts) -25° to $+50^\circ\text{C}$
 $\pm(0.14\%$ of reading + 4 A/D counts) -40° to $+70^\circ\text{C}$

Dual Differential:

(two measurements with input polarity reversed)
 $\pm(0.07\%$ of reading + 1 A/D count) -25° to $+50^\circ\text{C}$
 $\pm(0.14\%$ of reading + 1 A/D count) -40° to $+70^\circ\text{C}$

COMMON MODE RANGE: ± 5 V

DC COMMON MODE REJECTION: >120 dB

INPUT RESISTANCE: 2.5 gigaohms typical

MAXIMUM INPUT VOLTAGE WITHOUT

DAMAGE: ± 20 V CR9050(E), -40 to $+50$ V CR9051E

TYPICAL CURRENT DRAIN: 25 mA active

Resistance & Conductivity Measurements

(Also requires 9060 Excitation Module)

ACCURACY: $\pm(0.04\%$ of reading + 2 A/D counts) limited by accuracy of external bridge resistors.

MEASUREMENT TYPES: 6-wire and 4-wire full bridge, 4-wire, 3-wire, and 2-wire half bridge. Uses excitation reversal to remove thermal EMF errors.

CR9052 ANTI-ALIAS FILTER MODULE

INPUT CHANNELS PER MODULE: six differential

CONTINUOUS EXCITATION CHANNELS PER MODULE: 12 (6 current, 6 voltage)

TYPICAL CURRENT DRAIN: 400 mA + $1.5 \cdot [I_{ex}]$, where I_{ex} is the sum of excitation currents provided by all channels.

Refer to the CR9052 product literature for a complete listing of specifications.

CR9055(E) 50 V-ANALOG INPUT MODULE

INPUT CHANNELS PER MODULE: 14 differential or 28 single-ended.

RANGE AND RESOLUTION:

Input Range (V)	Resolution (1 A/D count) (μ V)	Input Noise (μ V RMS)	Max Sample Rates (kHz)
± 50	1580	1050	100
± 10	320	350	100
± 2	63	85	50
± 0.5	16	60	50

Note: Measurement averaging provides lower noise and better resolution.

ACCURACY OF VOLTAGE MEASUREMENTS:

Single-Ended & Differential:

$\pm(0.1\%$ of reading + 4 A/D counts) -25° to $+50^\circ\text{C}$
 $\pm(0.2\%$ of reading + 4 A/D counts) -40° to $+70^\circ\text{C}$

Dual Differential:

(two measurements with input polarity reversed)
 $\pm(0.1\%$ of reading + 1 A/D count) -25° to $+50^\circ\text{C}$
 $\pm(0.2\%$ of reading + 1 A/D counts) -40° to $+70^\circ\text{C}$

COMMON MODE RANGE: ± 50 V

DC COMMON MODE REJECTION: >62 dB

INPUT RESISTANCE: 100 Kohms typical

MAXIMUM INPUT VOLTAGE WITHOUT DAMAGE: ± 150 V

TYPICAL CURRENT DRAIN: 15 mA active

CR9058E ISOLATION MODULE

INPUT CHANNELS PER MODULE: 10 isolated, differential; each channel has its own isolation ground for shielded cable connection.

RANGE, RESOLUTION, AND INPUT RESISTANCE:

Input Range (Vdc)	Resolution w/o Averaging (μ V)	Resolution w/ Averaging (μ V)	Input Resistance (Kohms)
± 2	± 10	± 2	10,000
± 20	± 100	± 20	88.9
± 60	± 300	± 60	269

ACCURACY: $\pm 0.02\%$ of Full Scale Range over -40° to $+70^\circ\text{C}$

MINIMUM SCAN TIME PER MODULE:

VoltDiff: 1285 μ s (778 samples per second) + integration time for no input reversal (RevDiff=0); or 2990 μ s (334 samples per second) + integration time with input reversal (RevDiff=1)

TCDiff (range parameter set to V2C): 2570 μ s (389 samples per second) + integration time for no input reversal (RevDiff=0); or 4275 μ s (233 samples per second) + integration time with input reversal (RevDiff=1).

MAXIMUM CONTINUOUS VOLTAGE W/O DAMAGE:

Input Range (Vdc)	H or L to ISO Ground (Vdc)	ISO Ground to System Ground (Vdc)	H or L to System Ground (Vdc)
± 2	± 208	± 109	± 360
± 20	± 223	± 121	± 360
± 60	± 448	± 233	± 360

MAXIMUM ESD VOLTAGE ON INPUTS: ± 5000 V

CR9060 EXCITATION MODULE

TYPICAL CURRENT DRAIN:

108 mA quiescent, 125 mA active

Analog Outputs

ANALOG OUTPUTS PER MODULE:

10 switched, 6 continuous

SWITCHED: Provides excitation for resistance measurements. Only one output can be active at a time.

CONTINUOUS: All outputs can be active simultaneously.

RANGE: ± 5 V

ACCURACY: $\pm(0.2\%$ of output ± 4 mV)

RESOLUTION: 12-bit A/D (2.4 mV)

OUTPUT CURRENT: ± 50 mA

Digital Control Outputs

CONTROL CHANNELS PER MODULE: 8

OUTPUT VOLTAGES (no load):

High: 5.0 V ± 0.2 V

Low: < 0.2 V

OUTPUT RESISTANCE: 100 ohms

CR9071E COUNTER & DIGITAL I/O MODULE

Counter Channels

COUNTER CHANNELS PER MODULE: 12

MAXIMUM COUNTS PER INTERVAL: 2^{32} Maximum counts per interval should never be reached because with a maximum input frequency of 1 MHz, the 32-bit counter will go 71.58 minutes before it rolls over. The maximum CR9000 scan rate is 1 minute.

SWITCH CLOSURE MODE (4 channels)

Minimum switch closed time: 5 ms

Minimum switch open time: 6 ms

Maximum bounce time: 1 ms open without being counted

HIGH FREQUENCY MODE (all channels)

Minimum pulse width: 500 ns

Maximum input frequency: 1 MHz

Thresholds: Pulse counted on transition from below 1.5 V to above 3.5 V

Maximum input voltage: ± 20 V

LOW LEVEL AC MODE (8 channels)

Input hysteresis: 10 mV

Minimum ac voltage: 25 mV RMS

Maximum input voltage: ± 20 V

Frequency range:

(mV RMS)	RANGE (Hz)
25 mV	1 to 10,000
≥ 50 mV	0.5 to 20,000

Digital Inputs/Outputs

I/O CHANNELS PER MODULE: 16

OUTPUT VOLTAGES (no load)

High: 5.0 V ± 0.2 V

Low: < 0.2 V

OUTPUT RESISTANCE: 320 ohms

Input State

High: 3.5 to 5 V

Low: -0.5 to 1.2 V

Input Resistance: 100 KOHms

Interval Measurement

I/O CHANNELS:

Resolution is the scan rate

PULSE CHANNELS

Maximum interval: 1 minute

Resolution: ± 40 ns

CR9080 PCMCIA and MEMORY MODULE

PCMCIA CARD INTERFACE: Accepts two Type I/II, or one Type III SRAM or ATA Flash Memory Cards.

SERIAL I/O: Allows serial communications with CSI peripherals at up to 115,200 bps.

TYPICAL CURRENT DRAIN: 300 mA active

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