



CR1000X

Measurement and Control Datalogger

All CR1000X dataloggers are tested and guaranteed to meet electrical specifications in a standard -40° to +70°C or extended -55° to +85°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 (SE1 – SE16, DIFF1 – DIFF8)

16 single-ended (SE) or 8 Differential (DIFF) inputs individually configurable for voltage, thermocouple, ratiometric, and period average measurements, using a 24-bit ADC and performed one at a time.

VOLTAGE MEASUREMENTS

INPUT RESISTANCE: 20 GΩ typical

INPUT LIMITS: ±5 V

SUSTAINED INPUT VOLTAGE WITHOUT DAMAGE: ±20 Vdc

DC COMMON MODE REJECTION: > 120 dB with input reversal (≥ 86 dB without input reversal)

NORMAL MODE REJECTION: > 70 dB @ 60 Hz

INPUT CURRENT: ±1 nA typical @ 25°C

FILTER FIRST NOTCH FREQUENCY (f_{N1}) RANGE: 0.5 Hz to 31.25 kHz

RANGE AND TYPICAL EFFECTIVE RESOLUTION:

| Notch Frequency (f_{N1}) ¹ (Hz) | Range ² (mV) | Typical Resolution, μ V RMS (DIFF w/Input Reversal) | Typical Resolution, μ V RMS (SE or DIFF w/o Input Reversal) |
|--|-------------------------|---|---|
| 15000 | ±5000 | 8.2 | 11.8 |
| | ±1000 | 1.9 | 2.6 |
| | ±200 | 0.75 | 1.0 |
| 50/60 ³ | ±5000 | 0.6 | 0.88 |
| | ±1000 | 0.14 | 0.2 |
| | ±200 | 0.05 | 0.08 |
| 5 | ±5000 | 0.18 | 0.28 |
| | ±1000 | 0.04 | 0.07 |
| | ±200 | 0.02 | 0.03 |

ACCURACY (does not include sensor or measurement noise):

| 0° to 40°C | -40° to 70°C | -55° to 85°C |
|------------------------------|------------------------------|------------------------------|
| ±(0.04% of reading + offset) | ±(0.06% of reading + offset) | ±(0.08% of reading + offset) |

OFFSETS:

| Range (mV) | DIFF w/Input Reversal (μ V) | SE or DIFF w/o Input Reversal (μ V) |
|------------|----------------------------------|--|
| ±5000 | ±0.5 | ±2 |
| ±1000 | ±0.25 | ±1 |
| ±200 | ±0.15 | ±0.5 |

MULTIPLEXED MEASUREMENT TIME: (450 μ s + settling time + (1/ f_{N1})) * reps

| Example f_{N1} (Hz) ⁴ | Multiplexed Measurement Time (ms) w/ 500 μ s settling time | |
|------------------------------------|--|-------------------------------|
| | DIFF w/Input Reversal | SE or DIFF w/o Input Reversal |
| 15000 | 2.04 | 1.02 |
| 60 | 35.24 | 17.62 |
| 50 | 41.9 | 20.95 |
| 5 | 401.9 | 200.95 |

MEASUREMENT SETTLING TIME: 20 μ s to 600 ms; 500 μ s default

RATIOMETRIC MEASUREMENTS

Resistance measurements for four- and six-wire full bridge and two-, three-, and four-wire half bridge using voltage excitation. Excitation polarity reversal available to minimize dc error.

ACCURACY:^{5,6}

- ±(0.01% of reading + offset), 0° to 40°C
- ±(0.015% of reading + offset), -40° to 70°C
- ±(0.02% of reading + offset), -55° to 85°C

PERIOD AVERAGE MEASUREMENTS

Up to 16 analog inputs can be used for period averaging.

ACCURACY: ±(0.01% of reading + resolution), where resolution is 130 ns divided by the specified number of cycles to be measured.

RANGE DEPENDENT ON INPUT

| Gain Code | Minimum peak-to-peak Signal (mV) ⁷ | Maximum peak-to-peak Signal (V) ⁸ | Minimum Pulse Width (μ s) | Maximum Frequency (kHz) ⁹ |
|-----------|---|--|--------------------------------|--------------------------------------|
| 0 | 500 | 10 | 2.5 | 200 |
| 1 | 50 | 2 | 10 | 50 |
| 2 | 10 | 2 | 62 | 8 |
| 3 | 2 | 2 | 100 | 5 |

VOLTAGE EXCITATION (VX1 – VX4)

Four independently configurable voltage sources that can operate in one of two modes: Switched Excitation mode or Switched Regulated Voltage Supply. In Switched Excitation mode, a single 16-bit digital-to-analog converter (DAC) shared by all VX outputs produces a user-specified voltage during measurement only. In Switched Regulated Voltage Supply mode, the port can continuously provide either 3.3 Vdc or 5 Vdc.

| | Range (V) | Resolution | Accuracy ^{6,10} | Maximum Source/Sink Current (mA) ¹¹ |
|---------------------|-----------|-------------|---------------------------|--|
| Voltage Excitation | ±4 | 0.06 mV | ±(0.1% of setting + 2 mV) | ±40 |
| Switched, Regulated | +3.3 or 5 | +3.3 or 5 V | ±5% | 50 |

PULSE COUNTING (P1, P2)

Two inputs individually configurable for switch closure, high-frequency pulse, or low-level AC measurements. Independent 32-bit counter for each input. See also C1 - C8 for additional switch closure and high-frequency measurement inputs.

MAXIMUM INPUT VOLTAGE: ±20 Vdc

ACCURACY: ±(0.02% of reading +1/scan)

SWITCH CLOSURE INPUTS

PULL-UP RESISTANCE: 100 kΩ to 5 V

EVENT: Low (<0.8 V) to High (>2.5 V)

MINIMUM SWITCH CLOSED TIME: 5 ms

MINIMUM SWITCH OPEN TIME: 6 ms

MAXIMUM BOUNCE TIME: 1 ms open without being counted

HIGH-FREQUENCY INPUTS

PULL-UP RESISTANCE: 100 kΩ to 5 V

EVENT: Low (<0.8 V) to High (>2.5 V)

INTERNAL PULL-UP RESISTANCE: 100 kΩ to 5 V

MAXIMUM INPUT FREQUENCY: 250 kHz

LOW-LEVEL AC INPUTS

MINIMUM RESISTANCE: 10 kΩ to G

DC-OFFSET REJECTION: Internal AC coupling eliminates DC-offset voltages up to ±0.5 Vdc

INPUT HYSTERESIS: 12 mV @ 1 Hz

RANGE:

| Sine Wave (mV RMS) | Input Frequency 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 (C1 – C8)

Eight ports configurable for digital input and output including status high/low, pulse width modulation, external interrupt, edge timing, switch closure pulse counting, high-frequency pulse counting, UART, RS-232, RS-485, SDM, SDI-12, I2C, and SPI function. Ports are configurable in pairs for 5 V or 3.3 V logic for some functions.

MAXIMUM INPUT VOLTAGE: ± 20 Vdc

LOGIC LEVELS AND DRIVE CURRENT:

| Terminal Pair Configuration | Logic Low | Logic High | Current Source |
|-----------------------------|--------------|--------------|----------------|
| 5 V | ≤ 1.5 V | ≥ 3.5 V | 10 mA @ 3.5 V |
| 3.3 V | ≤ 0.8 V | ≥ 2.5 V | 10 mA @ 1.85 V |

SWITCH CLOSURE INPUTS

ACCURACY: $\pm(0.02\%$ of reading + 1/scan)

RESISTANCE: Port pair configurable with 100 k Ω pull-up or pull-down

SOFTWARE DEBOUNCE TIME: 3 ms

MAXIMUM BOUNCE TIME: 1 ms open without being counted

MAXIMUM INPUT FREQUENCY: 150 Hz

HIGH-FREQUENCY INPUTS

ACCURACY: $\pm(0.02\%$ of reading + 1/scan)

RESISTANCE: Port pair configurable with 100 k Ω pull-up or pull-down

MAXIMUM INPUT FREQUENCY: 1 MHz

EDGE TIMING

MAXIMUM INPUT FREQUENCY: ≤ 2.3 KHz

RESOLUTION: 500 ns

RESISTIVE GROUND (RG1 – RG2)

Two resistance-to-ground inputs that can be used for non-isolated 0-20 mA and 4-20 mA current loop measurements or for terminating the ground reference of an RS-485 serial connection.

MAXIMUM INPUT VOLTAGE: ± 16 V

RESISTANCE TO GROUND: 101 Ω

CURRENT MEASUREMENT SHUNT RESISTANCE: 10 Ω

MAXIMUM CURRENT MEASUREMENT RANGE: ± 80 mA

ABSOLUTE MAXIMUM CURRENT: ± 160 mA

CURRENT MEASUREMENT RESOLUTION: ≤ 20 nA

CURRENT MEASUREMENT ACCURACY: $\pm(0.1\%$ of reading + 100 nA)
@ -40° to 70°C

5V OUTPUT (5V)

One regulated 5V output ($\pm 5\%$) with a current limit of 230 mA. Output is shared with CS I/O DB9 5V output. See also VX1 – VX4 for additional regulated voltage outputs.

12V OUTPUT (12V, SW12-1, SW12-2)

Three unregulated 12 Vdc outputs with voltage equal to the Power Input supply voltage. Two levels of thermal fuses regulate current sourcing. In total (12V + SW12-1 + SW12-2) the hold current is limited to 2.68 A @ -40°C, 0.96 A @ 80°C. SW12-1 and SW12-2 can be independently set under program control. Each SW12 has a hold current limited to 1.3 A @ -40°C, 0.47 A @ 80°C.

DEDICATED COMMUNICATION INTERFACES

USB: Micro-B device for computer connectivity

CS I/O: 9-pin D-sub multidrop interface to Campbell Scientific CS I/O peripherals

RS-232/CPI: A single RJ-45 interface that can operate in one of two modes, RS-232 or CPI. RS-232 used to connect computer, sensor, or communication devices serially. CPI used to interface to Campbell Scientific CDM measurement expansion modules and sensors.

ETHERNET PORT: RJ-45, 10/100 Mbps, full or half duplex, Auto-MDIX, magnetic isolation and TVS surge protection

PROTOCOLS

INTERNET PROTOCOLS: Ethernet, PPP, CS I/O IP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS, DNS, DHCP, SLAAC, SNMPv2, NTP, Telnet, HTTP(S), FTP(S), SMTP/TLS, POP3/TLS

ADDITIONAL PROTOCOLS: PakBus, PakBus Encryption, CPI, SDM, SDI-12, Modbus RTU / ASCII / TCP, DNP3, NTCP, NMEA 0183, I2C, SPI, Custom user definable over serial, TCP, and UDP

DATA FILE FORMATS: CSV, XML, JSON, binary, encrypted, custom user definable

POWER REQUIREMENTS

PROTECTION: Reverse polarity protected; overvoltage protected up to 30 Vdc

VOLTAGE INPUT: 10 to 16 Vdc

INPUT CURRENT LIMIT @ 12 VDC: 4.35 A @ -40°C, 1.56 A @ 85°C

AVERAGE CURRENT DRAIN @ 12 VDC:

IDLE: < 1 mA

ACTIVE 1 HZ SCAN: 1 mA

ACTIVE 20 HZ SCAN: 55 mA

SERIAL ACTIVE (RS-232/RS-485): Active + 25 mA

ETHERNET POWER MODE 1 MINUTE: Active + 1 mA

ETHERNET LINK ACTIVE: Active + 48 mA

SYSTEM

PROCESSOR: Renesas RX63N (32-bit with hardware FPU, running at 100 MHz)

MEMORY: 128 MB Flash + 4 MB SRAM (battery backed)

DATA STORAGE: 4 MB SRAM + 72 MB flash

DATA STORAGE EXPANSION: removable microSD flash memory; up to 8 GB

PROGRAM EXECUTION: 1 ms to one day

REAL-TIME CLOCK: Battery backed while external power is disconnected

RESOLUTION: 1 ms

ACCURACY: ± 3 min. per year. Optional GPS correction to 10 μ s

INTERNAL LITHIUM BATTERY: AA, 2.4 Ah, 3.6 Vdc (Tadiran TL 5903/S) for battery-backed memory and clock only. 3 year life with no external power source

WIRING PANEL TEMPERATURE: A 10K3A1A BetaTHERM thermistor, located between the two rows of analog input channels, is measured when reporting wiring panel temperature.

COMPLIANCE INFORMATION

VIEW EU DECLARATION OF CONFORMITY AT:

www.campbellsci.com/cr1000x

PHYSICAL

DIMENSIONS: 23.8 cm x 10.1 cm x 6.2 cm (9.4 in x 4.0 in x 2.4 in); additional clearance required for cables and leads

WEIGHT/MASS: 0.86 kg (1.9 lb)

WARRANTY

Three years against defects in materials and workmanship.

¹ Valid notch frequencies: 0.5 Hz to 31.25 kHz.

² Range overhead of $\sim 5\%$ on all ranges guarantees that full-scale values will not cause over range.

³ 50/60 correspond to rejection of 50 and 60 Hz ac power mains noise.

⁴ Notch frequency (1/integration time).

⁵ Assumes input reversal for differential measurements along with excitation reversal for excitation voltage < 1000 mV, not including bridge resistor errors or sensor and measurement noise.

⁶ Ratiometric accuracy, rather than absolute accuracy, determines overall measurement accuracy of ratiometric resistance measurements.

⁷ Minimum signal centered around specified period average threshold.

⁸ Maximum signal centered around datalogger ground.

⁹ The maximum frequency = $1/(\text{twice minimum pulse width})$ for 50% duty cycle signals.

¹⁰ Valid over -55 to +85 °C temperature range.

¹¹ Exceeding current limits causes voltage output to become unstable. Voltage should stabilize when current is reduced to within stated limits.

TERMINALS

| Analog Input Function | SE1 | SE2 | SE3 | SE4 | SE5 | SE6 | SE7 | SE8 | SE9 | SE10 | SE11 | SE12 | SE13 | SE14 | SE15 | SE16 | RG1 | RG2 | Max |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|-----|-----|-----|
| Single Ended | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | 16 |
| Differential | H | L | H | L | H | L | H | L | H | L | H | L | H | L | H | L | | | 8 |
| Ratiometric Bridge | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | 16 |
| Thermocouple | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | 16 |
| Current Loop | | | | | | | | | | | | | | | | | ✓ | ✓ | 2 |
| Period Average | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | 16 |

| Analog Output Function | VX1 | VX2 | VX3 | VX4 | 5 V | 12V | SW12V-1 | SW12V-2 | Max |
|-----------------------------|-----|-----|-----|-----|-----|-----|---------|---------|-----|
| Switched-Voltage Excitation | ✓ | ✓ | ✓ | ✓ | | | | | 4 |
| 5 V Source | ✓ | ✓ | ✓ | ✓ | ✓ | | | | 5 |
| 3.3 V Source | ✓ | ✓ | ✓ | ✓ | | | | | 4 |
| 12 V Source | | | | | | ✓ | ✓ | ✓ | 3 |

| Communication Function | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | RS-232/CPI | USB | Ethernet | CS I/O | Max |
|------------------------|------|------|--------|-----|------|------|--------|------|------------|-----|----------|--------|-----|
| SDI-12 | ✓ | | ✓ | | ✓ | | ✓ | | | | | | 4 |
| GPS Time Sync | PPS | Rx | | | | | | | | | | | 1 |
| TTL (0 to 5 V) | Tx | Rx | Tx | Rx | Tx | Rx | Tx | Rx | | | | | 4 |
| LVTTTL (0 to 3.3 V) | Tx | Rx | Tx | Rx | Tx | Rx | Tx | Rx | | | | | 4 |
| RS-232 | | | | | | | | | ✓ | | | | 3 |
| RS-485 (Half Duplex) | | | | | A(-) | B(+) | A(-) | B(+) | | | | | 2 |
| RS-485 (Full Duplex) | | | | | Tx- | Tx+ | Rx- | Rx+ | | | | | 1 |
| I2C | SCL | SDA | SCL | SDA | SCL | SDA | SCL | SDA | | | | | 4 |
| SPI | SCLK | MOSI | MISO | | SCLK | MOSI | MISO | | | | | | 2 |
| SDM ¹² | DATA | CLK | ENABLE | | DATA | CLK | ENABLE | | | | | | 1 |
| CPI/CDM | | | | | | | | | ✓ | | | | 1 |
| USB | | | | | | | | | | ✓ | | | 1 |
| Ethernet | | | | | | | | | | | ✓ | | 1 |
| CS I/O | | | | | | | | | | | | ✓ | 1 |

| Digital I/O Function | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | Max |
|-------------------------------|----|----|----|----|----|----|----|----|-----|
| General I/O Pair | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 8 |
| Pulse-Width Modulation Output | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 8 |
| Timer Input | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 8 |
| Interrupt | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 8 |

| Pulse Counting Functions | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | P1 | P2 | Max |
|--------------------------|----|----|----|----|----|----|----|----|----|----|-----|
| Switch Closure | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 10 |
| High Frequency | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 10 |
| Low Level AC | | | | | | | | | ✓ | ✓ | 2 |

¹² SDM can be on either C1 to C3 or C5 to C7, but not both at the same time.

Supported By:



edaphic scientific

environmental research & monitoring equipment

Edaphic Scientific Pty Ltd

www.edaphic.com.au

info@edaphic.com.au

Ph: 1300 430 928