



CR6

Measurement and Control Datalogger

All CR6 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

Twelve universal (U) terminals may be configured to make analog voltage, ratiometric, or static vibrating-wire and thermistor measurements.

VOLTAGE MEASUREMENTS (U1 – U12)

Up to six differential or 12 single-ended terminals configured for voltage measurements using a 24-bit Adc, one at a time.

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: ±2 nA typical @ 25°C

RANGE AND RESOLUTION:

Notch Frequency (f _m) (Hz)	Range ² (mV)	Typical Resolution ³ (Diff. w/Input Reversal)		Typical Resolution ³ (Diff. w/o Input Reversal)	
		Effective Resolution		Effective Resolution	
		RMS μV	bits	RMS μV	bits
15000	±5000	20	19	30	18
	±1000	4	19	5.5	18
	±200	1.6	18	1.8	17
50/60	±5000	1.2	23	5.0	20
	±1000	0.24	23	1.1	20
	±200	0.10	22	0.24	20
5	±5000	0.6	24	4.9	20
	±1000	0.12	24	1.0	20
	±200	0.05	23	0.22	20

ACCURACY:⁴

0° to 40°C	-40° to 70°C	-55° to +85°C
±(0.03% of reading + offset)	±(0.04% of reading + offset)	±(0.045% of reading + offset)

OFFSETS:

Range (mV)	With Input or Excitation Reversal (μV)	Without Input or Excitation Reversal (μV)	Single-Ended (μV)
±5000	±40	±70	±140
±1000	±10	±30	±60
±200	±3	±5	±10

MEASUREMENT SPEED: (default settling time of 500 μs)⁵

f _m (Hz)	Multiplexed Measurement			
	w/Input Reversal		w/o Input Reversal	
	Time (ms)	Rate (Hz)	Time (ms)	Rate (Hz)
15000	2.8	354	1.4	694
60	36	27.7	18.1	55
50	42.7	23	21.3	46
5	402.7	2.4	201.4	4.9

RATIOMETRIC MEASUREMENTS (U1 – U12)

Resistance measurements for four- and six-wire full bridge and two-, three-, and four-wire half bridge using voltage excitation or direct resistance measurements using current excitation. Excitation polarity reversal minimizes dc error.

ACCURACY:^{6,7}

- ±(0.015% of voltage measurement + offset), 0° to 40°C
- ±(0.025% of voltage measurement + offset), -40° to 70°C
- ±(0.03% of voltage measurement + offset), -55° to 85°C

VOLTAGE AND CURRENT EXCITATION (U1 – U12)

Up to 12 terminals configured for voltage or current excitation using 12-bit Dac, active only during ratiometric measurement, one at a time.

Excitation Mode	Range	Resolution	Maximum Source/Sink Current	Compliance Voltage
Voltage (Vx)	±2.5 V	0.6 mV	±25 mA	NA
Current (Ix)	±2.0 mA	0.6 μA	NA	±5 V

ABSOLUTE ACCURACY:⁸

Excitation Mode	0° to 40°C	-40° to 70°C	-55° to +85°C
Vx	±(0.1% of setting + 1.2 mV)	±(0.1% of setting + 1.5 mV)	±(0.1% of setting + 1.6 mV)
Ix	±(0.11% of setting + 2.0 μA)	±(0.12% of setting + 2.5 μA)	±(0.13% of setting + 3.0 μA)

STATIC VIBRATING-WIRE MEASUREMENTS (U1 – U12)

Up to six static vibrating wire measurements without thermistor measurements or three with thermistor measurements. A U-terminal pair both excites and measures vibrating-wire transducers. Up to ±6 V (12 V peak-to-peak) logarithmic sine-wave-frequency excitation, programmable from 100 Hz to 6.5 kHz followed by frequency-domain measurements, one at a time.

INPUT RESISTANCE: 4.75 kΩ

Range	Resolution	Accuracy
±200 (mV) DF	0.001 (Hz RMS)	±0.013% of reading

THERMISTOR MEASUREMENTS (U1 – U12)

INPUT RESISTANCE: 5 kΩ ±0.1%, 10 ppm/C completion resistor.

Input Range	Measurement Resolution	Accuracy
±5000 (mV) SE	0.001 (Ω RMS)	±0.25% of reading

MEASUREMENT SPEED: Each vibrating-wire and thermistor measurement takes less than 2 s.

PERIOD AVERAGE (U1 – U12)

Up to 12 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 cycle to be measured

RANGE DEPENDENT ON INPUT

Voltage Gain	Minimum peak-to-peak Signal ⁹	Maximum peak-to-peak Signal	Minimum Pulse Width (μs)	Maximum Frequency (kHz) ¹⁰
1	500	10	2.5	200
2.5	50	2	10	50
12.5	10	2	62	8
64	2	2	100	5

¹ Valid notch frequencies: 5 Hz to 93 kHz.

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

³ Effective resolution (ER) in bits is computed from ratio of full-scale range to RMS resolution.

⁴ Accuracy does not include the sensor and measurement noise.

⁵ Minimum settling time is 100 μs.

⁶ Assumes excitation reversal for excitation voltage < 1000 mV and excitation current < 1 mA, not including bridge resistor errors and sensor and measurement noise.

⁷ See manual for details on estimating measurement accuracy for the various ratiometric measurement instructions. For resistance instruction the excitation current, I_x, is internally measured across a 200 Ω, ±0.005% @ 25°C, 2 ppm/C TCR internal resistor with resulting sensor resistance determined from V_S / I_x.

⁸ Ratiometric accuracy, rather than absolute accuracy, determines overall measurement accuracy of ratiometric resistance measurements.

⁹ With signal centered around datalogger ground.

¹⁰ The maximum frequency = 1/(twice minimum pulse width) for 50% duty cycle signals.



PULSE COUNTING

Four C and twelve U terminals have independent 32-bit counters and may be configured for switch closure or high-frequency-pulse inputs. All even U terminals may also be configured as low-level ac inputs. Terminals are configured as pairs with options for pull-up or pull-down and 5 V logic levels (high > 3.5 V, low < 1.5 V) or 3.3 V logic levels (high > 2.0 V, low < 0.8 V).

MAXIMUM INPUT VOLTAGE: ± 20 Vdc

MAXIMUM COUNTS PER SCAN: 2³²

INPUT RESISTANCE: 5 k Ω

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

SWITCH CLOSURE (C1 - C4 and U1 - U12)

MINIMUM SWITCH CLOSED TIME: 5 ms

MINIMUM SWITCH OPEN TIME: 6 ms

MAXIMUM BOUNCE TIME: 1 ms open w/o being counted

MAXIMUM INPUT FREQUENCY: 150 Hz

HIGH-FREQUENCY (C1 - C4 and U1 - U12)

MAXIMUM INPUT FREQUENCY: 1 Mhz

LOW-LEVEL AC (U2, U4, U6, U8, U10, U12)

Up to 6 terminals configured for low-level ac measurements.

RANGE: (dependent on sine wave input)¹¹

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

INPUT HYSTERESIS: 12 mV @ 1 Hz

VOLTAGE OUTPUT

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

Two independent outputs provide unregulated 12 V (battery voltage) source under program control. Thermal fuse hold current = 1.60 A @ -40°C, 1.10 A @ 20°C, 0.64 A @ 70°C, 0.50 A @ 85°C.

5V AND 3.3V (C1 - C4 AND U1 - U12)

Terminal	5 V Source (mA @ 3.5 V)	3.3 V Source (mA @ 1.85 V)
C1 to C4	11	11
U odd	20	20
U even	10	10

TOTAL SYSTEM CURRENT: Thermal fuse hold current = 3.80 A @ -40°C, 2.50 A @ 20°C, 1.35 A @ 70°C, 1.00 A @ 85°C.

COMMUNICATIONS

ETHERNET PORT:

RJ-45/ jack
10/100Base-TX, full and half duplex Auto-MDIX
Magnetic isolation and TVS surge protection

INTERNET PROTOCOLS:

Ethernet, PPP, CS I/O IP, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS, DHCP Client, SLAAC, DNS Client, SNMPv1, NTP, Telnet, HTTP/HTTPS, FTP/FTPS, SMTP/TLS, POP3/TLS

ADDITIONAL PROTOCOLS SUPPORTED:

PakBus, PakBus Encryption, CPI, SDM, SDI-12, Modbus RTU, Modbus ASCII, Modbus TCP/IP, DNP3, NTCIP, NMEA 0183. Custom user definable over serial, TCP, and UDP

DATA FILE FORMATS:

CSV, XML, JSON, binary, encrypted

USB:

USB micro-B device only, 2.0 full-speed 12 Mbps, for computer connection.

CS I/O:

Interfaces with Campbell Scientific peripherals.

CPI:

RJ-45, interface to Campbell Scientific CDM measurement peripherals and sensors

RS-232 (RS-232, C1/C2, C3/C4):

3 independent Tx/Rx pairs. RS-232 on the CPI port includes DTR/CTS.

0 - 5 V SERIAL (U1 to U12, C1 to C4):

8 independent Tx/Rx pairs

RS-485 (C1 to C4):

1 full duplex or 2 half duplex

SDI-12 (U1, U3, U5, U7, U9, U11, C1, C3):

8 independent SDI-12 V1.3 compliant terminals configurable as sensor or recorder

SYSTEM

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

MEMORY

CPU DRIVE / PROGRAMS: 1 MB flash

USR DRIVE / DATA: 4 MB SRAM (battery backed)

CRD DRIVE / DATA REMOVABLE MICROS: up to 16 GB (SLC Industrial)

OPERATING SYSTEM (OS): 6 MB flash

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

CLOCK RESOLUTION: 1 ms

PROGRAM EXECUTION: 1 ms to one day

POWER REQUIREMENTS

CHARGER INPUT (CHG): 16 to 32 Vdc, 1.2 A maximum. Power converter or 20 W solar panel input

EXTERNAL BATTERIES (BAT): 12 Vdc VRLA, 2 to 24 Ah battery typical

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

TYPICAL POWER REQUIREMENTS (assumes 12 Vdc on BAT terminals (+2 mA if using CHG terminals))

SLEEP: <1 mA

ACTIVE 1 HZ SCAN: 3 mA

ACTIVE 20 HZ SCAN: 67 mA

ETHERNET 1 MINUTE: Active + 1 mA

ETHERNET IDLE: Active + 4 mA

ETHERNET LINK: Active + 47 mA

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

COMPLIANCE

CE: EMC directive 2004/108/EC and product standard BS EN 61326:2013

SHOCK: MIL-STD 810G method 516.6

VIBRATION: MIL-STD 810G method 514.6

PROTECTION: IP50

PHYSICAL

DIMENSIONS: 188 x 102 x 61 mm (7.4 x 4.0 x 2.4 in); additional clearance required for cables and leads

WEIGHT/MASS: 0.42 kg (0.92 lb)

MATERIAL:

CASE: High-impact-resistant polycarbonate and UV-resistant TPE, recycle code 7

DUST PLUGS: UV-resistant TPE

WARRANTY

Three years against defects in materials and workmanship.

¹¹ AC coupling removes ac offsets up to ± 0.05 V.

PROGRAMMABLE TERMINALS

Twelve U terminals and four C terminals are programmable as pairs for the following functions.

ANALOG INPUT

Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Single Ended					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Differential					H	L	H	L	H	L	H	L	H	L	H	L	6
Period Average					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Vibrating Wire					✓		✓		✓		✓		✓		✓		6
Thermistor					✓		✓		✓		✓		✓		✓		6

ANALOG OUTPUT

Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Switched-Voltage Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
Switched-Current Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12

DIGITAL I/O

Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
RS-232	Tx	Rx	Tx	Rx													2
RS-485 (Half Duplex)	A-	B+	A-	B+													2
RS-485 (Full Duplex)	Tx-	Tx+	Rx-	Rx+													1
RS-232 TTL	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	8
SDI-12	✓		✓		✓		✓		✓		✓		✓		✓		8
SDM	DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE		1
General I/O Pair	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
5 V or 3.3 V Source	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Pulse-Width Modulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Timer I/O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Interrupt	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16

PULSE COUNTING

Function	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	Max
Switch Closure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
High Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Low Level AC						✓		✓		✓		✓		✓		✓	6

TERMINAL PAIR USE EXAMPLES

1. If U1 is programmed for analog input or output, its associated pair, U2, may only be used as an analog input or output.
2. If U6 is programmed as a low level ac pulse connection, its associated pair, U5, may only be used for digital I/O or pulse counting.