CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

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_{N1}) (Hz)	Range[2] (mv)	Typical Resolution[3] (Differential w/Input Reversal)		Typical Resolution[3] (Differential 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
±(0.04% of reading + offset)	±(0.06% of reading + offset)	±(0.08% of reading + offset)

OFFSETS:

Range (mV)	Differential with Input Reversal (µV)	Single-Ended or Differential without Input Reversal (µV)
±5000	±10	±40
±1000	±5	±12
±200	±2	±6

MEASUREMENT SPEED: INT(multiplex measurement time *(reps + 1) + 2 ms)

f_{N1} (Hz)	Multiplexed Measurement Time (ms)	
	w/Input Reversal	w/o Input Reversal
15000	2.8	1.4
60	36	18.1
50	42.7	21.3
5	402.7	201.4

DEFAULT SETTLING TIME: 500 µs[5]

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]
±(0.02% 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)	±2.5 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

MEASUREMENT SPEED: Each vibrating-wire and thermistor measurement takes less than 1 s.

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

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 (mV)[9]	Maximum peak-to-peak Signal (V)	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 input reversal for differential measurements along with 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.

CURRENT MEASUREMENTS[11]

One analog input may be configured as an independent 0 to 20 mA or 4 to 20 mA current loop input (not isolated) measured one at a time using 24-bit Adc.

ACCURACY:

0° to 40℃	-40° to 70℃
± 0.14% of reading	± 0.26% of reading

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: 2^{32}
INPUT RESISTANCE: 5 kΩ
ACCURACY: ±(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)[12]

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℃, 1.10 A @ 20℃, 0.64 A @ 70℃, 0.50 A @ 85℃.

5 V AND 3.3 V (C1 - C4 AND U1 – U12)

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

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

COMMUNICATIONS

ETHERNET PORT: RJ45/ 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
V1.4 compliant terminals configurable as sensor or recorder

ON-BOARD RADIO

RADIO TYPE:

-RF407, -RF412, -RF427, and -RF451	-RF422
Frequency Hopping Spread Spectrum Radios (FHSS)	SRD860 Radio with Listen before talk (LBT) and Automatic Frequency Agility (AFA)

TRANSMIT:

	CR6-RF407	CR6-RF412	CR6-RF422	CR6-RF427	CR6-RF451
Output Power	5 to 250 mW, user selectable		2 to 25 mW, user selectable	5 to 250 mW, user selectable	10 to 1000 mW, user selectable
Frequency	902 to 928 MHz (US, Canada)	915 to 928 MHz (Australia, New Zealand)	863 to 870 MHz (European Union)	902 to 907.5 MHz, 915 to 928 MHz (Brazil)	902 to 928 MHz
Channel Capacity	Eight 25-channel hop sequences sharing 64 available channels	Eight 25-channel hop sequences sharing 31 available channels	Ten 30-channel hop sequences	Eight 25-channel hop sequences sharing 43 available channels	50 to 111, user selectable
RF Data Rates	200 kbps	200 kbps	10 kbps	200 kbps	115.2 or 153.6 kbps

RECEIVE SENSITIVITY:

-RF407, -RF412, and -RF427	CR6-RF451	CR6-RF422
-101 dBm	-108 dBm at 115.2 kbps for 10^{-4} BER; -103 dBm at 153.6 kbps for 10^{-4} BER	-106 dBm

ANTENNA CONNECTOR: Reverse Polarity SMA (RPSMA)

WLAN (CR6-WIFI only)
COMMUNICATION RATE: 54 Mbps
FREQUENCY: 2.4 GHz
ANTENNA CONNECTOR: RPSMA
ANTENNA: pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional. Features an articulating knuckle joint that can be oriented vertically or at right angles.
SUPPORTED TECHNOLOGIES: 802.11 a/b/g/n, WPA/WPA2-Personal, WPA/WPA2-Enterprise Security, WEP
CLIENT MODE: WPA/WPA2-Personal and Enterprise, WEP
ACCESS POINT MODE: WPA2-Personal
TRANSMIT POWER: 7 to 18 dBm
Rx SENSITIVITY: -97 dBm

SYSTEM

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

MEMORY:[11]
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

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

CLOCK RESOLUTION: 1 ms

PROGRAM EXECUTION: 1 ms to one day

POWER REQUIREMENTS

CHARGER INPUT (CHG): 16 to 32 Vdc, current limited at 1.2 A @ 20℃. Power converter or solar panel input

EXTERNAL BATTERIES (BAT): 12 Vdc, valve-regulated, lead-acid (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

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[11] *This information applies to CR6 dataloggers with serial numbers 7502 and newer. These dataloggers have two blue stripes on the label.*

[12] *AC coupling removes ac offsets up to ±0.05 V.*

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

Wi-Fi (CR6-WIFI only)
AVERAGE ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc

Mode	-WIFI Option
Client Mode	7 mA idle, 70 mA communicating
Access Point Mode	62 mA idle, 70 mA communicating
Sleep (disabled using IPNetPower() or DevConfig setting)	<1 mA

ON-BOARD RADIO
AVERAGE ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc

	CR6-RF407, CR6-RF412, CR6-RF427	CR6-RF451	CR6-RF422
Transmit	< 80 mA	650 mA	20 mA
Idle On	12 mA	15 mA	9.5 mA
Idle 0.5 s Power Mode	4 mA		3.5 mA
Idle 1 s Power Mode	3 mA		2.5 mA
Idle 4 s Power Mode	1.5 mA		1.5 mA

COMPLIANCE INFORMATION

VIEW EU DECLARATION OF CONFORMITY FOR THE CR6 AND CR6-WIFI AT: www.campbellsci.com/cr6

SHOCK: MIL-STD 810G method 516.6

VIBRATION: MIL-STD 810G method 514.6

PROTECTION: IP50

ON-BOARD WIFI[13] (CR6-WIFI Only):
UNITED STATES FCC ID: XF6-RS9113SB
INDUSTRY CANADA (IC): 8407A-RS9113SB)

ON-BOARD RADIO:

CR6-RF407	CR6-RF412	CR6-RF422	CR6-RF427	CR6-RF451
United States: FCC Part 15.247: MCQ-XB900HP; Industry Canada (IC): 1846A-XB900HP; Mexico IF: RCPDIXB15-0672-A2	ACMA RCM; United States: FCC Part 15.247: MCQ-XB900HP; Industry Canada (IC): 1846A-XB900HP	View EU Declaration of Conformity at: www.campbellsci.com/cr6	Brazil ANATEL standards in Resolution No. 506: 08335-17-10644	United States: FCC ID: KNYAMM0921TT; Industry Canada (IC): 2329B-AMM0921TT

PHYSICAL

DIMENSIONS: 21 cm x 10.2 cm x 5.7 cm (8.3 in x 4.0 x 2.2 in); additional clearance required for cables and leads

WEIGHT/MASS:
CR6: 0.42 kg (0.92 lb)
CR6-WIFI: 0.50 kg (1.10 lb)
CR6-RF451: 0.52 kg (1.15 lb)
CR6-RF407/412/422/427: 0.51 kg (1.13 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.

[13] *The user is responsible for emissions if changing the antenna type or increasing the gain.*

PROGRAMMABLE TERMINALS

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

Analog Input	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	RG	RS-232/CPI	Max
Single Ended					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			12
Differential					H	L	H	L	H	L	H	L	H	L	H	L			6
Period Average					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			12
Vibrating Wire					✓		✓		✓		✓		✓		✓				6
Current Loop															✓				1
Thermistor					✓		✓		✓		✓		✓		✓				6

Analog Output	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	RG	RS-232/CPI	Max
Switched-Voltage Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			12
Switched-Current Excitation					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			12

Communications	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	RG	RS-232/CPI	Max
SDI-12	✓		✓		✓		✓		✓		✓		✓		✓				8
GPS Time Sync	Tx	Rx	Tx	Rx	PPS	Rx													1
TTL 0 to 5 V	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx			8
LVTTL 0 to 3.3 V	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx	Tx	Rx			8
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
I2C	SDA	SCL	SDA	SCL	SDA	SCL	SDA	SCL	SDA	SCL	SDA	SCL	SDA	SCL	SDA	SCL			8
SPI	MOSI	SCLK	MISO		MOSI	SCLK	MISO		MOSI	SCLK	MISO		MOSI	SCLK	MISO				4
SDM	DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE		DATA	CLK	ENABLE				1
CPI/CDM																		✓	1

Digital I/O	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	RG	RS-232/CPI	Max
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	C1	C2	C3	C4	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	RG	RS-232/CPI	Max
Switch Closure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			16
High Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			16
Low Level AC					✓		✓		✓		✓		✓		✓				6

Terminal Use Examples and Notes
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. *Triggering conflicts can occur when companion ports are used for different triggering instructions (TimerInput, PulseCount, SDI12Recorder, WaitDigTrig). For example, if U3 is used for the SDI12Recorder instruction, U4 cannot be used in the TimerInput, PulseCount, or WaitDigTrig instructions.*
3. *Only one trio of channels can be programmed as an SDM connection. For example, if channels C1–C3 are used for an SDM connection, you cannot connect another SDM on any of the other channels.*

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

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