

GRANITE 9 Specifications



Data Acquisition
System

Electrical specifications are valid over a -40 to +70 °C, non-condensing environment, unless otherwise specified. Extended electrical specifications (noted as XD in specifications) are valid over a -55 to +85 °C non-condensing environment. Recalibration is recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

System specifications	1
Physical specifications	1
Power requirements	1
Power output specifications	2
Pulse measurement specifications	2
Digital input/output specifications	2
Communications specifications	3
Standards compliance specifications	4
Warranty	4

System specifications

Processor: NXP iMX6 Quad core running at 1 GHz

Memory:

- 2 GB DDR SDRAM
- 8 GB eMMC NAND OS storage
- 128 MB NOR FLASH
- 4 MB SRAM battery backed
- Data storage expansion: Removable microSD flash memory, up to 16 GB
- USB host provides for portable data storage on a mass storage device (MSD) formatted as FAT32. Not intended for long term unattended data storage other than what is available with [TableFile\(\)](#).

GRANITE 9 Solid State Drive (SSD):

- **SSD:** Enhanced MLC
- **SSD (XD):** SLC
- **Total onboard:** 64 GB
- **Humidity:** 8% to 95%, non-condensing
- **JESD219A client work load:** 86 terabytes written (TBW) (standard)
- **Random write:** 914 TBW (XD)
- **Sequential write:** 5333 TBW (XD)
- **Block PE cycle:** 100000 (XD)
- **Data Retention at 40 °C:** 10 years with 10% PE cycle (XD)

- **MTBF (hours) at 25 °C:** 1,500,000 (standard); 2,000,000 (XD)
- **Typical power consumption at 12 VDC:** 120.8 mA (standard); 191.7 mA (XD)
- **Maximum sustained write power consumption at 12 VDC:** 295.8 mA (XD only)

Real-Time Clock:

- Battery backed while external power is disconnected
- **Resolution:** 1 ms
- **Accuracy:** ±3 min. per year
- **GPS Phase Lock** to within 200 nS if used

GPS:

- SMA Female 50 Ω input impedance
- Active antenna design, 3.3 Vdc
- 25 dBm maximum input
- Integrated SAW filtering and jam resistance
- 1 S time-to-fix during normal operation
- 35 S time-to-fix on power up or reboot
- 13 min. for leap second, once per day auto
- PPS ± 1 μS to full UTC second
- Receive sensitivity -161 dBm

Wiring Panel Temperature: Measured using a thermistor, located on the main processor board.

Physical specifications

Case Material: Stainless Steel 304 and Aluminum 6061

Dimensions: 21.4 x 12.0 x 5.0 cm (8.4 x 4.7 x 2.0 in); additional clearance required for cables, wires, and antennas.

Weight/Mass: 1.0 kg (2.2 lb)

Power requirements

Protection: Power inputs are protected against surge, over-voltage, over-current, and reverse power. IEC 61000-4 Class 4 level.

Power In Terminal:

- **Voltage Input:** 9.6 to 32 VDC
- **Input Current Limit at 12 VDC:**
 - Total system current is fused at 5 A with replaceable automotive mini-blade fuse

Internal Lithium Battery: 1/2AA, 1.2 Ah, 3.6 VDC (Tadiran L5902S) for battery-backed memory and clock. 5-year life with no external power source.



Average Current Drain:

- **Active:** ~6 Watts
 - 24 V input: 255 mA input
 - 12 V input: 495 mA input

Vehicle Power Connection: When primary power is pulled from the vehicle power system, a second power supply OR charge regulator may be required to overcome the voltage drop at vehicle start-up.

Wi-Fi Additional Current Contribution at 12 VDC:

Mode	Wi-Fi Option
Client Mode	7 mA idle, 70 mA communicating
Access Point Mode	62 mA idle, 70 mA communicating
Sleep	<1 mA

Power output specifications

System power out limits (when powered with 12 VDC)

Total system current is fused at 5 A with replaceable automotive mini-blade fuse

12 V and SW12 power output terminals

12V, SW12-1, and SW12-2: Provide 12 VDC power $\pm 10\%$ when the power input supply voltage is ≥ 13.7 VDC. When the supply voltage is < 13.7 V the output voltage will be at least the supply voltage minus 1.7 volts.

SW12-1 and SW12-2 can be independently set to a regulated 12 V under program control.

SW12 current limit: 1100 mA

12 VDC outputs limited to 3300 mA, which is shared by all 12 V outputs including 12V, SW12-1, SW12-2 and CS I/O pin 8.

5 V fixed output

5V: One regulated 5 V output. Supply is shared between the 5V terminal and CS I/O pin 1.

- **Voltage Output:** Regulated 5 V output ($\pm 5\%$)
- **Current Limit:** 250 mA

C as power output

- C Terminals:
 - **Output Resistance (R_o):** 150 Ω
 - **5 V Logic Level Drive Capacity:** 10 mA @ 3.5 VDC
 - **3.3 V Logic Level Drive Capacity:** 10 mA @ 1.8 VDC

CS I/O pin 1

5 V Current Limit: 250 mA

CS I/O pin 8

12 V Current Limit: 1100 mA

Pulse measurement specifications

NOTE:

Conflicts can occur when a control port pair is used for different instructions (`TimerInput()`, `PulseCount()`, `SDI12Recorder()`, `WaitDigTrig()`). For example, if C1 is used for `SDI12Recorder()`, C2 cannot be used for `TimerInput()`, `PulseCount()`, or `WaitDigTrig()`.

Maximum Input Voltage: ± 20 VDC

Maximum Counts Per Channel: 2^{32}

Maximum Counts Per Scan: 2^{32}

Input Resistance: 5 k Ω

Accuracy: $\pm(6$ ppm of reading + 0.00001)

Switch closure input

Terminals: C1-C8

Pull-Down Resistance: Configurable in terminal pairs with 100 k Ω

Pull-Up Resistance: Configurable in terminal pairs with 100 k Ω (weak) or 2.2 k Ω (strong)

Maximum Input Frequency: 250 Hz

Minimum Switch Closed Time: 1 ms

Minimum Switch Open Time: 1 ms

Maximum Bounce Time: 1 ms open without being counted

Software Debounce Time: 1 ms

High-frequency input

Terminals: C1-C8

Pull-Down Resistance: Configurable in terminal pairs with 100 k Ω

Pull-Up Resistance: Configurable in terminal pairs with 100 k Ω (weak) or 2.2 k Ω (strong)

Maximum Input Frequency: 1 MHz

Low-level AC input

DC-offset rejection: Internal AC coupling eliminates DC-offset voltages up to ± 0.05 VDC

Input Hysteresis: 12 mV at 1 Hz

Low-Level AC Pulse Input Ranges:

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 input/output specifications

Terminals configurable for digital input and output (I/O) including status high/low, pulse width modulation, external

interrupt, edge timing, switch closure pulse counting, high-frequency pulse counting, UART¹, RS-232², RS-422³, RS-485⁴, SDM⁵, SDI-12⁶, I2C⁷, and SPI⁸ function. Terminals are configurable in pairs for 5 V or 3.3 V logic for some functions.

NOTE:

Conflicts can occur when a control port pair is used for different instructions (`TimerInput()`, `PulseCount()`, `SDI12Recorder()`, `WaitDigTrig()`). For example, if C1 is used for `SDI12Recorder()`, C2 cannot be used for `TimerInput()`, `PulseCount()`, or `WaitDigTrig()`.

Terminals: C1-C8

Maximum Input Voltage: ±20 V

Logic Levels and Drive Current:

Terminal Pair Configuration	5 V Source	3.3 V Source
Logic low	≤ 1.5 V	≤ 0.8 V
Logic high	≥ 3.5 V	≥ 2.5 V

Edge timing

Terminals: C1-C8

Maximum Input Frequency: 1 MHz

Resolution: 20 ns

Edge counting

Terminals: C1-C8

Maximum Input Frequency: 1 MHz

Quadrature input

Terminals: C1-C8 can be configured as digital pairs to monitor the two sensing channels of an encoder.

Maximum Frequency: 500 kHz

Resolution: 20 ns or 50 MHz

Pulse-width modulation

Modulation Voltage: Logic high

Maximum Period: 43 seconds

Resolution: 10 ns

Maximum time between counter or timer instructions

- 86 seconds

Communications specifications

Ethernet Port: RJ45 jack, 10/100/1000 Base Mbps, full and half duplex, Auto-MDIX, magnetic isolation, and TVS surge protection, IEEE 802.3 compliant.

Internet Protocols: Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, Telnet, HTTP(S), SFTP, FTP(S), POP3/TLS, NTP, SMTP/TLS, SNMPv3, CS I/O IP

Additional Protocols: CPI, EPI, PakBus, PakBus Encryption, SDM, SDI-12, Modbus RTU / ASCII / TCP, DNP3, custom user definable over serial, UDP, NTCIP, NMEA 0183, I2C, SPI

USB Device: Micro-B device for computer connectivity

USB Host: USB 2.0 full speed host 12 Mbps, Type-A for mass storage devices

CS I/O: 9-pin D-sub connector to interface with Campbell Scientific CS I/O peripherals.

0 – 5 V Serial(C1 to C8): Eight independent TX/RX pairs

SDI-12 (C1, C3, C5, C7): Four independent SDI-12 compliant terminals are individually configured and meet SDI-12 Standard v 1.4.

RS-485 (C1 to C8): Two full duplex or four half duplex. Optional 120 Ohm termination resistor between pairs.

RS-422 (C1 to C8): Two full duplex or four half duplex. Use RS-485 configuration.

RS-232 (C1 to C8): Four independent Tx/Rx pairs.

CPI A/B and RS-232 A/B: Two RJ45 module ports that can operate in one of two modes: CPI or RS-232. CPI interfaces with Campbell Scientific CDM measurement peripherals and sensors. RS-232 connects, with an adapter cable, to computer, sensor, or communications devices serially.

EPI: One EPI bus. 100 Mbps data rate. IEEE 1588 synchronization to 50 ns. 100 m (330 ft) maximum cable length per network connection. Up to 15 devices. EPI is a proprietary interface for communications between Campbell Scientific data loggers and Campbell Scientific CDM peripheral devices. It is based on Ethernet and IEEE 1588 Precision Time Protocol. It consists of a physical layer definition and a data protocol.

CPI: Two independent CPI buses. Up to 1 Mbps data rate each. Synchronization of devices to 5 μs. Total cable length up to 610 m (2000 ft). Up to 20 devices per bus. CPI is a proprietary interface for communications between Campbell Scientific data loggers and Campbell Scientific CDM peripheral devices. It consists of a physical layer definition and a data protocol.

Wireless: Wi-Fi

Hardwired: Multi-drop, short haul, RS-232, fiber optic

¹Universal Asynchronous Receiver/Transmitter for asynchronous serial communications.

²Recommended Standard 232. A loose standard defining how two computing devices can communicate with each other. The implementation of RS-232 in Campbell Scientific data loggers to computer communications is quite rigid, but transparent to most users. Features in the data logger that implement RS-232 communication with smart sensors are flexible.

³Communications protocol similar to RS-485. Most RS-422 sensors will work with RS-485 protocol.

⁴Recommended Standard 485. A standard defining how two computing devices can communicate with each other.

⁵Synchronous Device for Measurement. A processor-based peripheral device or sensor that communicates with the data logger via hardware over a short distance using a protocol proprietary to Campbell Scientific.

⁶Serial Data Interface at 1200 baud. Communication protocol for transferring data between the data logger and SDI-12 compatible smart sensors.

⁷Inter-Integrated Circuit is a multi-master, multi-slave, packet switched, single-ended, serial computer bus.

⁸Serial Peripheral Interface - a clocked synchronous interface, used for short distance communications, generally between embedded devices.

Satellite: GOES, Argos, Inmarsat Hughes, Iridium

Wi-Fi specifications

WLAN (Wi-Fi)

Maximum Possible Over-the-Air Data Rates: <11 Mbps over 802.11b, <54 Mbps over 802.11g, <72 Mbps over 802.11n

Operating Frequency: 2.4 GHz, 20 MHz bandwidth

Antenna Connector: Reverse Polarity SMA (RPSMA)

Antenna (shipped with data logger): 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 b/g/n, WPA/WPA2-Personal, WPA/WPA2-Enterprise Security, WEP

Client Mode: WPA/WPA2-Personal and Enterprise, WEP

Access Point Mode: WPA2-Personal

Receive Sensitivity: -97 dBm

Standards compliance specifications

View EU Declarations of Conformity at www.campbellsci.com/granite9.

EMI and ESD protection:

- **Immunity:** Meets or exceeds following standards:
 - **ESD:** per IEC 61000-4-2; ±15 kV air, ±8 kV contact discharge
 - **Radiated RF:** per IEC 61000-4-3; 10 V/m, 80-1000 MHz
 - **EFT:** per IEC 61000-4-4; 4 kV power, 4 kV I/O
 - **Surge:** per IEC 61000-4-5; 4 kV power, 4kV I/O
 - **Conducted RF:** per IEC 61000-4-6; 10 V power, 10 V I/O
- Emissions and immunity performance criteria available on request.
- United States FCC ID: XF6-RS9113SB
- Industry Canada (IC): 8407A-RS9113SB

NOTE:

The user is responsible for emissions if changing the antenna type or increasing the gain.

Warranty

Standard: Three years against defects in materials and workmanship.

Extended (optional): An additional two years. against defects in materials and workmanship, bringing the total to 5 years.



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