GRANITE 9 Specifications

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**
  - Processor: NXP iMX6 Quad core running at 1 GHz
- **Physical specifications**
- **Power requirements**
- **Power output specifications**
- **Pulse measurement specifications**
- **Digital input/output specifications**
- **Communications specifications**
- **Standards compliance specifications**
- **Warranty**

**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
- JEsd2'19A 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:**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Wi-Fi Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client Mode</td>
<td>7 mA idle, 70 mA communicating</td>
</tr>
<tr>
<td>Access Point Mode</td>
<td>62 mA idle, 70 mA communicating</td>
</tr>
<tr>
<td>Sleep</td>
<td>&lt;1 mA</td>
</tr>
</tbody>
</table>

**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 ±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 (±5%)
- **Current Limit:** 250 mA

**C as power output**

- **C Terminals:**
  - **Output Resistance (R):** 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() and C2 cannot be used for TimerInput(), PulseCount(), or WaitDigTrig().

**Maximum Input Voltage:** ±20 VDC

**Maximum Counts Per Channel:** 2³²

**Input Resistance:** 5 kΩ

**Accuracy:** ±(6 ppm of reading + 0.00001)

**Switch closure input**

- **Terminals:** C1-C8
  - **Pull-Down Resistance:** Configurable in terminal pairs with 100 kΩ
  - **Pull-Up Resistance:** Configurable in terminal pairs with 100 kΩ (weak) or 2.2 kΩ (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 kΩ
  - **Pull-Up Resistance:** Configurable in terminal pairs with 100 kΩ (weak) or 2.2 kΩ (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:**

<table>
<thead>
<tr>
<th>Sine wave (mV RMS)</th>
<th>Range (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.0 to 20</td>
</tr>
<tr>
<td>200</td>
<td>0.5 to 200</td>
</tr>
<tr>
<td>2000</td>
<td>0.3 to 10,000</td>
</tr>
<tr>
<td>5000</td>
<td>0.3 to 20,000</td>
</tr>
</tbody>
</table>

**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, UART\textsuperscript{1}, RS-232\textsuperscript{2}, RS-422\textsuperscript{3}, RS-485\textsuperscript{4}, SDM\textsuperscript{5}, SDI-12\textsuperscript{6}, I2C\textsuperscript{7}, and SPI\textsuperscript{8} 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:**

<table>
<thead>
<tr>
<th>Terminal Pair Configuration</th>
<th>5 V Source</th>
<th>3.3 V Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic low</td>
<td>≤ 1.5 V</td>
<td>≤ 0.8 V</td>
</tr>
<tr>
<td>Logic high</td>
<td>≥ 3.5 V</td>
<td>≥ 2.5 V</td>
</tr>
</tbody>
</table>

**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

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.

**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
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**


**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, 4 kV 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.