GRANITE 10 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
- **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 10 Solid State Drive (SSD):

- **SSD**: Enhanced MLC
- **SSD (XD)**: SLC
- **Total onboard**: 128 GB
- **Humidity**: 8% to 95%, non-condensing
- **JESD219A client work load**: 172 86 terabytes written (TBW) (standard)
- **Random write**: 1828 TBW (XD)
- **Sequential write**: 10666 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**: 175 mA (standard version); 212.5 mA (XD)
- **Maximum sustained write power consumption at 12 VDC**: 316.7 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 7.5 cm (8.4 x 4.7 x 3.0 in); additional clearance required for cables, wires, and antennas.

**Weight/Mass**: 1.2 kg (2.7 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 LS902S) 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(), SDII2Recorder(), WaitDigTrig()). For example, if C1 is used for SDII2Recorder(), 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 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\(^1\), RS-232\(^2\), RS-422\(^3\), RS-485\(^4\), 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:

<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

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\(1\)Universal Asynchronous Receiver/Transmitter for asynchronous serial communications.
\(2\)Recommended 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.
\(3\)Communications protocol similar to RS-485. Most RS-422 sensors will work with RS-485 protocol.
\(4\)Recommended Standard 485. A standard defining how two computing devices can communicate with each other.
\(5\)Synchronous 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.
\(6\)Serial Data Interface at 1200 baud. Communication protocol for transferring data between the data logger and SDI-12 compatible smart sensors.
\(7\)Inter-Integrated Circuit is a multi-master, multi-slave, packet switched, single-ended, serial computer bus.
\(8\)Serial 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:** CAN, CAN FD, 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 v1.4.

**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.

**CAN:** Four general purpose ports, CAN 2.0 up to 1 Mbps, or CAN FD up to 5 Mbps. Screw terminal or DSUB 15-pin connections. Supports DBC files.

**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 dBi), 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.
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