ANALOG (SE1 – SE6, DIFF 1H/1L – DIFF 3H/3L)

Six single-ended (SE) or three differential (DIFF) inputs individually configurable for voltage, thermocouple, current loop, ratiometric, and period average measurements, using a 24-bit ADC. One channel at a time is measured in numeric succession.

VOLTAGE MEASUREMENTS

INPUT RESISTANCES GΩ (fN1 = 50/60), 300 MΩ (fN1 = 4000)
INPUT LIMITS: -100 mV to +2500 mV
SUSTAINED INPUT VOLTAGE WITHOUT DAMAGE: ±9 V (SE1, SE2), ±17 V (SE3 to SE6)
DC COMMON MODE REJECTION: > 120 dB with input reversal (≥90 dB without input reversal)
NORMAL MODE REJECTION: > 71 dB @ 50 Hz, > 74 dB @ 60 Hz
INPUT CURRENT: ±0.8 nA (fN1 = 50/60), ±13 nA (fN1 = 4000), typical at 25 °C

RANGE AND TYPICAL EFFECTIVE RESOLUTION

<table>
<thead>
<tr>
<th>Notch Frequency (fN1) (Hz)</th>
<th>Typical Resolution (Different  w/ Input Reversal)</th>
<th>Typical Resolution (Different  w/o Input Reversal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMS µV</td>
<td>bits</td>
</tr>
<tr>
<td>4000</td>
<td>-100 to +2500</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>3.0</td>
</tr>
<tr>
<td>400</td>
<td>-100 to +2500</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>0.58</td>
</tr>
<tr>
<td>50/60</td>
<td>-100 to +2500</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>-34 to +34</td>
<td>0.23</td>
</tr>
</tbody>
</table>

ACCURACY:

<table>
<thead>
<tr>
<th>Range (ºC)</th>
<th>Resolution (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0º to 40ºC</td>
<td>± (0.04% of reading + offset)</td>
</tr>
<tr>
<td>-40º to 70ºC</td>
<td>± (0.1% of reading + offset)</td>
</tr>
</tbody>
</table>

OFFSETS:

<table>
<thead>
<tr>
<th>Range (mV)</th>
<th>Differential with Input Reversal (µV)</th>
<th>Differential without Input Reversal (µV)</th>
<th>Single-Ended (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100 to +2500</td>
<td>±20</td>
<td>±40</td>
<td>±60</td>
</tr>
<tr>
<td>-34 to +34</td>
<td>±6</td>
<td>±14</td>
<td>±20</td>
</tr>
</tbody>
</table>

MULTIPLEXED MEASUREMENT TIME (multiplexed measurement time (ms) + settling time) * reps + 0.8 ms

PERIOD AVERAGE MEASUREMENTS

Up to four analog inputs may be configured for period averaging.
ACCURACY: ±(0.01% of reading + resolution), where resolution is (0.13 µs / number of cycles to be measured)
FREQUENCY RANGE: 1 Hz to 200 kHz

CURRENT MEASUREMENTS

Two analog inputs may be configured as independent 0 to 20 mA or 4 to 20 mA current loop inputs (not isolated) measured one at a time using a 24-bit ADC.
ACCURACY:

<table>
<thead>
<tr>
<th>Range (ºC)</th>
<th>Resolution (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0º to 40ºC</td>
<td>± 0.14% of reading</td>
</tr>
<tr>
<td>-40º to 70ºC</td>
<td>± 0.26% of reading</td>
</tr>
</tbody>
</table>

PULSE COUNTING

SWITCH CLOSURE (P_SW)

MINIMUM SWITCH CLOSED TIME: 3 ms
MINIMUM SWITCH OPEN TIME: 3 ms
MAXIMUM BOUNCE TIME: 1 ms open w/o being counted
MAXIMUM INPUT FREQUENCY: 150 Hz
MAXIMUM INPUT VOLTAGE: ±17 Vdc

SWITCH CLOSURE (C1, C2)

MAXIMUM INPUT FREQUENCY: 150 Hz
MINIMUM SWITCH OPEN TIME: 3 ms

HIGH-FREQUENCY (C1, C2, SE1 – SE4, P_SW, P_LL)

C1-C2: 3 kHz, maximum, SE1-SE4: 35 kHz, maximum, P_SW: 35 kHz, maximum, P_LL: 20 kHz, maximum

LOW-LEVEL AC (P_LL)

INPUT HYSERESIS: 12 mV @ 1 Hz
MAXIMUM AC INPUT VOLTAGE: ±20 V
RANGE (dependent on sine wave input):

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Range (mV RMS)</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>

RATIO METRIC MEASUREMENTS (SE1 – SE6)

Resistance measurements for four- and six-wire full bridge circuits and two-, three-, and four-wire half bridge circuits using voltage excitation.

RATIOMETRIC ACCURACY:

<table>
<thead>
<tr>
<th>Range (ºC)</th>
<th>Resolution (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0º to 40ºC</td>
<td>±0.03% of voltage measurement + offset</td>
</tr>
<tr>
<td>-40º to 70ºC</td>
<td>±0.06% of voltage measurement + offset</td>
</tr>
</tbody>
</table>

1Range overhead of ~10% beyond range guarantees that full-scale values will not cause over range.
2Effective resolution (ER) in bits is computed from ratio of full-scale range to RMS resolution.
3Accuracy does not include the sensor and measurement noise.
4Assumes input reversal for differential measurements not including bridge resistor errors and sensor and measurement noise.
5Ratiometric accuracy, rather than absolute accuracy, determines overall measurement accuracy of ratiometric resistance measurements.
6Requires an external 100 kΩ resistor connected from the terminal to BAT+.
7AC coupling removes ac offsets up to ±0.05 V.
**DIGITAL (C1, C2, SE1 – SE4, P_SW)**

Up to seven terminals may be configured for digital input or output.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>High State</th>
<th>Low State</th>
<th>Current Source</th>
<th>Sustained Input Voltage w/o Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>SE1, SE2</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>SE3, SE4, P_SW</td>
<td>3.3 V</td>
<td>0 V</td>
<td>100 µA at 3 V</td>
<td>±17 V</td>
</tr>
</tbody>
</table>

**VOLTAGE OUTPUT**

**SWITCHED 12 V (SWV)**

One output provides unregulated 12 Vdc power with voltage equal to the power input supply voltage. SWV12V is disabled when operating on USB power only. A thermal fuse regulates current sourcing. 1 200 mA @ -40 °C.

**0.15 TO 5 V ANALOG OUTPUTS (MX1, MX2)**

Two terminals configured for 150 to 5000 mV continuous analog output or voltage excitation using 12-bit DAC. 4.5 mV 100 µA at 3 V 10 mA at 3.5 V –10 V, +15 V

**DEDICATED COMMUNICATION INTERFACES**

**USB:** Micro-B device for computer connectivity

**RS-232:** female RS-232, 9-pin interface

**ETHERNET PORT (CR310 only):** RJ-45, 10/100 Mbps, full or half duplex, Auto-MDIX, magnetic isolation and TVS surge protection

**PROTOCOLS**

INTERNET PROTOCOLS: PPP, RNDIS, ICMP/Ping, Auto-IP/APIPA, IPv4, IPv6, UDP, TCP, TLS, DNS, DHCP, SLAAC, NTP, Telnet, HTTP(s), FTP(s), SMTP/TLS, POP3/TLS ADDITIONAL PROTOCOLS: PakBus, PakBus Encryption, SDI-12, Modbus RTU/ASCII/TCP, DNP3, NWEA 0183, 12C, SPI, custom user definable over serial, UDP DATA FILE FORMATS: CSV, XML, JSON, binary, encrypted

**SERIAL (C1, C2):** 0 to 5 V output, 1200 to 115.2 kbps

**SDI-12 (C1, C2):** Two independent SDI-12 V1.3 compliant terminals configurable as sensor or recorder

**INTEGRATED COMMUNICATION DEVICES**

**CELLULAR MODEM (–CELL200, –CELL205, or –CELL210 OPTION)**

- **CELL200 OPTION (International):**
<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMTS/HSPA+ (3G)</td>
<td>800, 850, 900, 1900, 2100</td>
<td>5.7 Mbps</td>
</tr>
<tr>
<td>GSM/GPRS/EDGE (2G)</td>
<td>850, 900, 1800, 1900</td>
<td>236.8 kbps</td>
</tr>
</tbody>
</table>

- **CELL205 OPTION (North America; AT&T, T-Mobile):**
<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE Cat 1 (4G)</td>
<td>700, 850, 1700/2100 (AWS-1), 1900</td>
<td>5.7 Mbps</td>
</tr>
<tr>
<td>UMTS/HSPA (3G)</td>
<td>850, 1700/2100 (AWS), 1900</td>
<td>236.8 kbps</td>
</tr>
</tbody>
</table>

- **CELL210 OPTION (United States; Verizon only):**
<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency Bands (MHz)</th>
<th>Maximum Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE Cat 1 (4G)</td>
<td>700, 850, 1700, 1900, 2100</td>
<td>5.2 Mbps</td>
</tr>
</tbody>
</table>

**ANTENNA CONNECTOR:** SMA

**SIM SLOT:** Industry standard 3FF micro-SIM

**RADIO (–RF407, –RF412, –RF422, or –RF427 OPTION)**

**RADIO TYPE:**

- **-RF407, –RF412, and –RF427 Options**
  - Frequency Hopping Spread Spectrum Radios (FHSS)
  - SPDR860 Radio with Listen before talk (LBT) and Automatic Frequency Agility (AFA)

- **-RF422 Option**
  - SRD860 Radio with Listen before talk (LBT) and Automatic Frequency Agility (AFA)

**RECEIVE SENSITIVITY:**

- **-RF407, –RF412, and –RF427 Options**
  - –RF422 Option

**ANTENNA CONNECTOR:** Reverse Polarity SMA (RPSMA)

**WLAN (–WIFI OPTION)**

**MAXIMUM POSSIBLE THROUGHPUT:** 30 Mbps

**MAXIMUM POSSIBLE OVER-THE-AIR DATA RATES:**

<table>
<thead>
<tr>
<th>802.11g</th>
<th>802.11n</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 11 Mbps</td>
<td>up to 54 Mbps</td>
</tr>
<tr>
<td>up to 72 Mbps</td>
<td></td>
</tr>
</tbody>
</table>

**OPERATING FREQUENCY:** 2.4 GHz, 20 MHz bandwidth

**ANTENNA CONNECTOR:** Reverse Polarity SMA (RPSMA)

**SUPPORTED STANDARDS:** IEEE 802.11 b/g/n, IEEE 802.11d/e/i, 802.1X, WEP, WPA/WPA2-Personal and Enterprise

**OPERATIONAL MODES:** Client or Access Point

**TRANSMIT POWER:** 7 to 18 dBm

**Rx SENSITIVITY:** -97 dBm

**SYSTEM**

**PROCESSOR:** ARM Cortex M4 running at 144 MHz

**MEMORY**

**CPU DRIVE / PROGRAMS:** 80 MB flash

**DATA:** 30 MB flash

**OPERATING SYSTEM (OS):** 2 MB flash

**CLOCK ACCURACY:** ±1 min. per month

**CLOCK RESOLUTION:** 1 ms

**PROGRAM EXECUTION:** 100 ms to one day

**POWER REQUIREMENTS**

**PROTECTION:** Surge, over-voltage, over-current, and reverse power protected

**CHARGER INPUT (CHG):** 16 to 32 Vdc, current limited at 0.9 A. Power converter or solar panel input.

**EXTERNAL BATTERIES (BAT):** 10 to 18 Vdc input, lead-acid 7 Ah battery, typical

**INTERNAL LITHIUM BATTERY:** 3 V coin cell CR2016 (Energizer) for battery-backed clock. 6 year life with no external power source.

**AVERAGE CURRENT DRAIN @ 12 Vdc**

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>CURRENT DRAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDLE: 1.5 mA</td>
<td>ACTIVE 1 HZ SCAN WITH ONE ANALOG MEASUREMENT: 5 mA</td>
</tr>
<tr>
<td>SERIAL (RS-232): Active + 25 mA</td>
<td>ACTIVE (PROCESSOR ALWAYS ON): 23 mA</td>
</tr>
<tr>
<td>POWER REQUIREMENTS</td>
<td>ETHERNET LINK ACTIVE (CR310 only): Active + 51 mA</td>
</tr>
<tr>
<td>ETHERNET LINK IDLE (CR310 only): 32 mA</td>
<td></td>
</tr>
</tbody>
</table>

---

8 Not operational under USB power only.

9 Range reduced to 0 to 2500 mV when under USB power.

10 Confirm modem compliance for country/carrier where services are needed.

11 The -CELL200 option is not compatible with a Verizon cellular network.
### TERMINAL FUNCTIONS

Each terminal may only take on one function.

<table>
<thead>
<tr>
<th>Analog Input</th>
<th>C1</th>
<th>C2</th>
<th>P_SW</th>
<th>P_LL</th>
<th>VX1</th>
<th>VX2</th>
<th>SE1</th>
<th>SE2</th>
<th>SE3</th>
<th>SE4</th>
<th>SE5</th>
<th>SE6</th>
<th>RS-232</th>
<th>SW12V</th>
<th>Ethernet</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Ended Voltage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6</td>
</tr>
<tr>
<td>Differential Voltage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3</td>
</tr>
<tr>
<td>Ratiometric Bridge</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6</td>
</tr>
<tr>
<td>Current Loop</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2</td>
</tr>
<tr>
<td>Period Average</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4</td>
</tr>
<tr>
<td>Analog &amp; Voltage Output 12</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6</td>
</tr>
</tbody>
</table>

12 SE1 to SE4, P_SW, C1, and C2 have limited drive capacity.

### RADIO

**CELLULAR MODEM**

**ADDITIONAL CURRENT CONTRIBUTION @ 12 Vdc**

<table>
<thead>
<tr>
<th>Option</th>
<th>-CELL200</th>
<th>-CELL205</th>
<th>-CELL210</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle (connected to network, no data transfer)</td>
<td>2 mA minimum, 10 mA average</td>
<td>2 mA minimum, 14 mA average</td>
<td>2 mA minimum, 28 mA average</td>
</tr>
<tr>
<td>TX / RX</td>
<td>20 mA minimum, 105 mA average</td>
<td>20 mA minimum, 75 mA average</td>
<td>20 mA minimum, 90 mA average</td>
</tr>
</tbody>
</table>

**ON-BOARD WIFI**

**(-WIFI OPTION)**

**UNITED STATES FCC ID:** XF6-RS9113SB

**INDUSTRY CANADA (IC):** 8407A-RS9113SB

### PHYSICAL

**DIMENSIONS** (additional clearance required for cables and leads)

- CR300: 13.97 x 7.62 x 4.56 cm (5.5 x 3.0 x 1.8 in)
- CR310: 16.26 x 7.62 x 5.68 cm (6.4 x 3.0 x 2.2 in)

**WEIGHT/MASS**

- CR300: 242 g (0.53 lb)
- CR300-CELL2XX/RF4XX/WIFI: 249.5 g (0.55 lb)
- CR310: 288 g (0.64 lb)
- CR310-CELL2XX/RF4XX/WIFI: 306 g (0.68 lb)

### MATERIAL

- CASE: Powder-coated aluminum

### WARRANTY

Three years against defects in materials and workmanship.

12 The user is responsible for emissions if changing the antenna type or increasing the gain.
Global Sales & Support Network
A worldwide network of companies to help meet your needs

Australia
Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil
Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada
Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China
Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com

Costa Rica
Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France
Location: Antony, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany
Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

Southeast Asia
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Phone: 66.2.719.3399
Email: thitipongc@campbellsci.asia
Website: www.campbellsci.asia

Spain
Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

UK
Location: Shepshed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA
Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com

Campbell Scientific group companies
Sales representatives

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