PRODUCT MANUAL

Power Supply

PS200/CH200

12 V Charging Regulators

Revision: 12/2025
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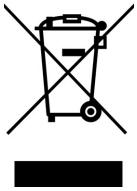
Please read first

About this manual

Please note that this manual was produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this. In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to Europe, Middle East, and Africa (EMEA) or Asia Pacific (APAC) users. Differences include the U.S. standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for EMEA or APAC use. Please note, however, *that when a power supply adapter is ordered from Campbell Scientific it will be suitable for use in your country*.

Reference to some radio transmitters, digital cell phones and aerials (antennas) may also not be applicable according to your locality. Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the EMEA or APAC market; in some cases alternatives are offered.

Recycling information for countries subject to WEEE regulations 2012/19/EU



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility, per The Waste Electrical and Electronic Equipment (WEEE) Regulations 2012/19/EU. Campbell Scientific can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories. For further support, please contact Campbell Scientific, or your local agent.

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PS200/CH200 12 V Charging Regulators

1. Introduction

The PS200 is a 12 volt power supply that includes a rechargeable 7 amp hour valve-regulated lead-acid (VRLA) battery and charging regulator. The CH200 is a charging regulator for an external rechargeable 12 V VRLA battery such as the BP12 or BP24 offered by Campbell Scientific, Inc. Charging power for these charging regulators is typically supplied by an unregulated solar panel, AC/AC transformer, or AC/DC converter.

The PS200/CH200 are smart chargers that provide two-step constant voltage charging with temperature compensation for optimal charging and battery life. A maximum power point tracking algorithm is incorporated for solar inputs to maximize available solar charging resources.

The PS200/CH200 are compatible with the A100 null-modem adapter and the A105 adapter for additional 12 V output terminals. The A100 Null Modem Adapter connects and powers two Campbell Scientific peripherals via two CS I/O 9-pin connectors configured as a null modem. This is useful in linking different communications technologies; e.g., telephone to radio, at sites that do not have a datalogger. The A105 Additional 12 V Terminals Adapter may be used to provide additional 12 V and ground terminals where the power supply is used to power several devices.

The PS200/CH200 charging regulators are termed series regulators, because the regulators are placed in series between the charging source and the load. As batteries become closer to fully charged, series regulators reduce the current drawn from the charging source, to where the charging source may be completely unloaded if full-charge is reached. While this unloading of the charging source is acceptable for solar panels, AC/AC transformers and AC/DC converters, it is undesirable for wind turbines because of the resulting free spinning when unloaded. Consequently, series charging regulators, including the PS200/CH200, should not be used to regulate the output of wind turbines without the inclusion of a way to load the turbine when the batteries require little or no charging current.

The PS200/CH200 chargers have several safety features intended to protect the charging source, battery, charger, and load devices. Both the SOLAR – G and CHARGE – CHARGE input terminals incorporate hardware current limits and polarity reversal protection. There is a 1.85 Amp failsafe self-resettable thermal fuse in series with the CHARGE – CHARGE inputs in the event of a catastrophic AC/AC or AC/DC charging source failure. There is a 4 Amp self-resettable thermal fuse in series with the 12 V output terminals of the charger in the event of an output load fault. The PS200/CH200 incorporate battery reversal protection, which is catastrophic for most chargers. ESD and surge protection are incorporated on all inputs and outputs of the PS200/CH200.

2. Precautions and Tips

Under normal charging conditions with sealed VRLA batteries, hydrogen and oxygen gasses are produced in relatively small quantities, most of which later recombines back into water. Aggressive overcharging produces excess hydrogen and oxygen gasses, resulting in gas venting by means of a pressure activated valve. Hydrogen gas emitted from VRLA batteries must not be allowed to accumulate, as it could form an explosive mixture. Fortunately, hydrogen gas is difficult to contain in anything but a metal or glass enclosure.

WARNING

Never put VRLA batteries in an enclosure that does not allow emitted hydrogen gas to be dispersed.

VRLA batteries are capable of providing high surge currents. The 12 V output terminals of the PS200/CH200 are fused with a 4 A self-resettable thermal fuse, but there is no fusing for inadvertent bridging of the battery terminals. Accidental shorting of battery terminals by metallic objects, such as watchbands, can cause severe burns due to rapid heating and is also a fire hazard.

VRLA battery manufacturers state that “Heat Kills Batteries”. While the PS200/CH200 can operate from –40°C to +60°C, optimum battery life is achieved with battery operating temperatures ranging from 5°C to 35°C[i], per manufacturer’s recommendations[1]. The PS200/CH200 offer temperature compensation of the battery charging voltage based on a temperature measurement inside the PS200/CH200 cases. The CH200 internal temperature measurement likely will not accurately represent battery temperature for charge voltage compensation unless the battery is in close proximity to the CH200. The PS200/CH200 serial interface can be used to input an independently measured battery temperature for improved charging temperature compensation when the charger temperature is different than the battery temperature (see Section 6.2.3.1, *Write Remote Battery Temperature to PS200/CH200*, and Section 6.2.3.2, *Restore Internal Battery Temperature Measurement*, for SDI-12 programming examples and Section 6.3.3.2, *Write Remote Battery Temperature to PS200/CH200*, and Section 6.3.3.3, *Restore Internal Battery Temperature Measurement*, for RS-232 programming examples).

With rechargeable batteries, a charge → discharge → re-charge event is termed a cycle. In general the most important factor for the service life of a battery is depth of discharge[1]. For example, decreasing the depth of each discharge from 100% to 50% approximately doubles the number of useful cycles available from the battery[1].

[i] Genesis Application Manual – Genesis NP and NPX Series US-NP-AM-002, June 2006.

CAUTION Leaving a lead-acid battery in a discharged state for prolonged periods of time results in the undesirable growth of large sulfate crystals (sulfation) that are detrimental to battery performance.

VRLA batteries self-discharge at approximately 3% of rated capacity per month at room temperature[1]. A 3% of rated capacity per month self-discharge results in 100% discharge in approximately 33 months (≈ 3 years) for a battery stored at room temperature. Self-discharge increasing with increasing storage temperature.

NOTE Periodic recharging of stored batteries every few months is recommended to prevent irreversible sulfation due to prolonged time in a discharged state.

3. Quick Start

The PS200/CH200 modules are designed to handle extreme conditions and have the ability to transmit charging, load, and battery voltage and current information directly to a datalogger using special SDI-12 or RS-232 commands and associated communication cables. Using datalogger programming the data from the PS200/CH200 can be used to calculate a power budget for the entire system and help to remotely pin point any power problems. These cables are not required for normal operation and the modules are ready to use right out of the box. The modules have been designed with mounting holes on one inch centers for mounting to a standard Campbell Scientific enclosure back plate — see the enclosure manual for mounting suggestions. See FIGURE 3-1 through FIGURE 3-3 for typical enclosure installations using a PS200/CH200.

By default, the CH200 module is programmed with a battery capacity of zero Amp-hours (Ah). This sets the charger to charge at a lower current rate. A battery capacity must be configured into the CH200 to enable the more aggressive two-step constant voltage charging scheme. See Section 6.1.2, *Settings Editor Tab*, for making changes using Device Configuration Utility and a change battery capacity example program at *www.campbellsci.com/downloads/ps200-example-programs*.

NOTE FIGURE 3-1 through FIGURE 3-3 show PS200/CH200 installations using a SDI-12 communication cable. A SDI-12 communication cable is not required for normal operation.

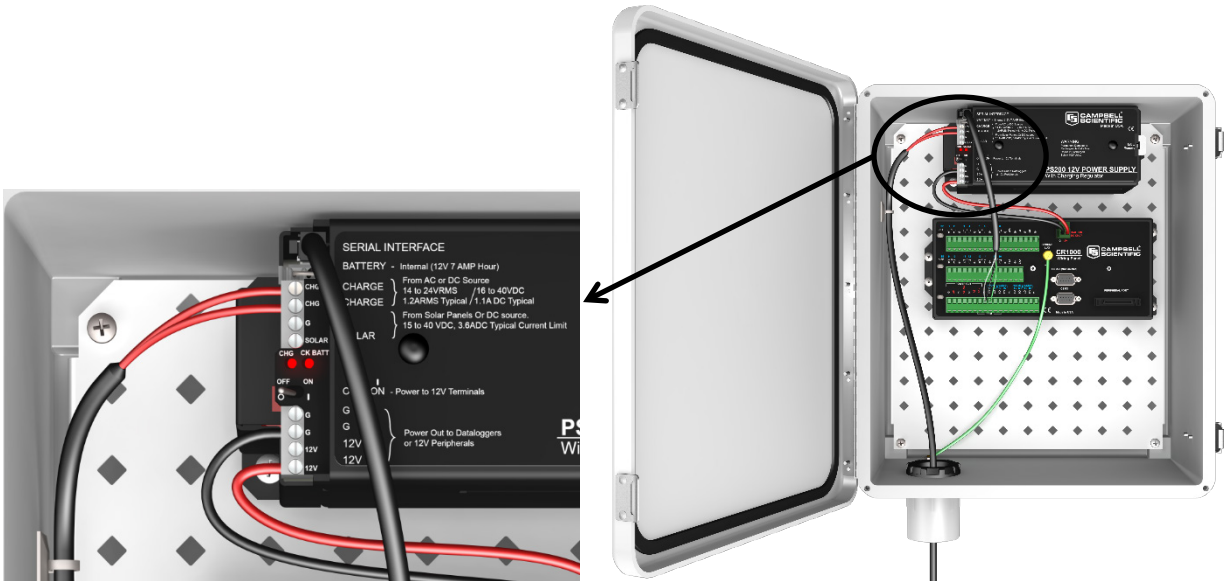


FIGURE 3-1. The PS200 connected to a CR1000 and AC power

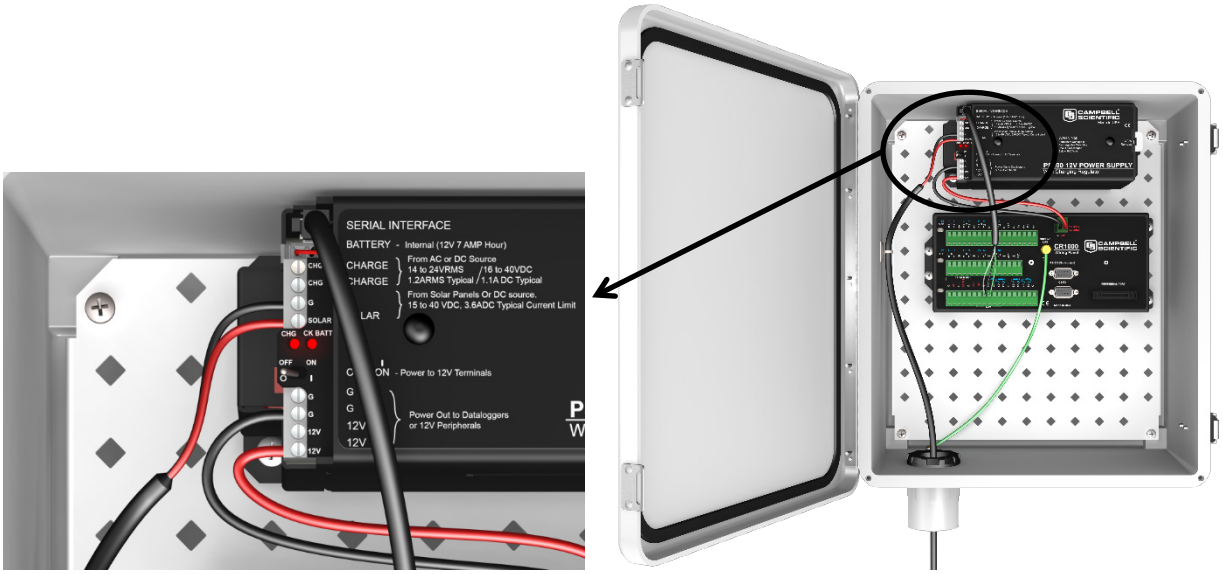


FIGURE 3-2. The PS200 connected to a CR1000 and solar panel

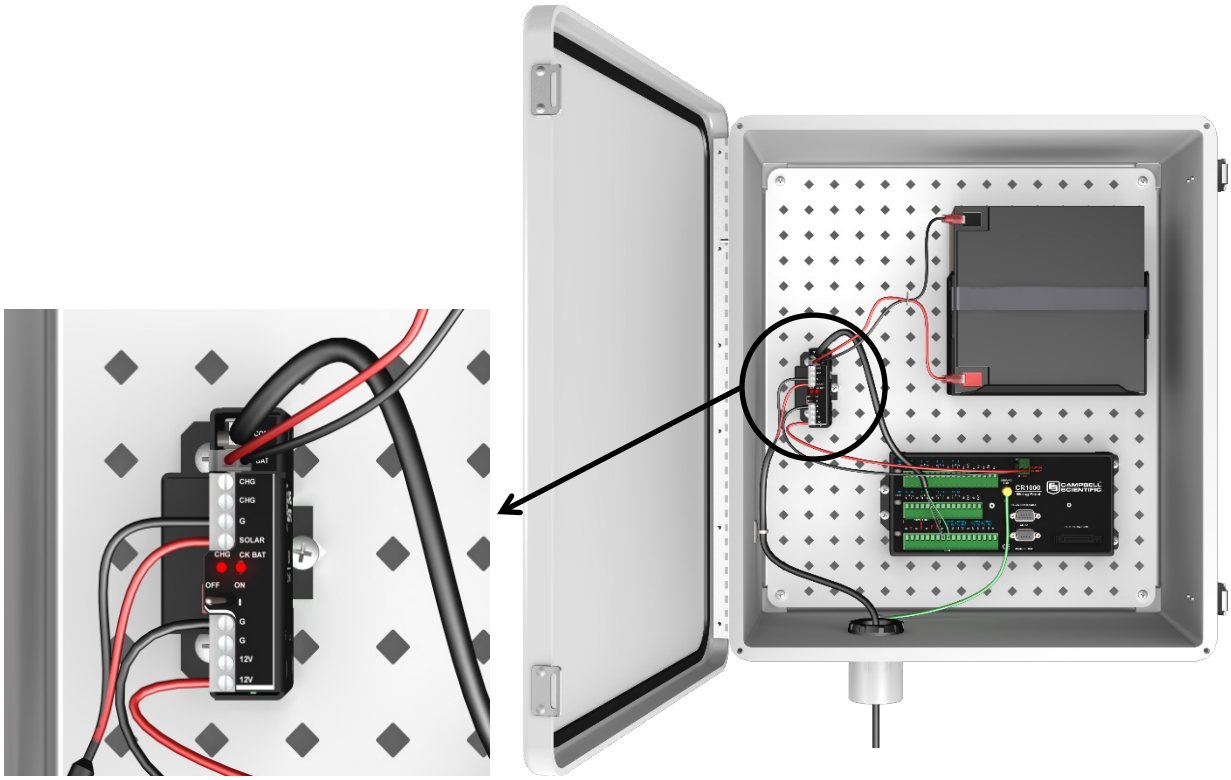


FIGURE 3-3. CH200 connected to BP24 battery pack and CR1000

3.1 Connecting Power

WARNING

Although the power supply and battery are low voltage, they do have the ability to supply a high current and could potentially heat up a metal ring, watch band, or bracelet enough to burn skin or melt metal when shorted. Remove rings, watches, or bracelets before hooking up power and connecting a battery.

Unlike earlier Campbell Scientific power supplies, the CH/PS200 can have both solar and AC power hooked up simultaneously.

Flip the power supply switch to "Off" before hooking up power to the power supply.

NOTE

The switch on the CH/PS200 only controls power going to the "12V" and "G" terminal blocks. The battery is continuously charged regardless of the switch setting as long as a charging voltage is present.

3.1.1 Solar Panel

WARNING

To prevent sparking while wiring up the solar panel, either lay the solar panel face down on its packing box or cover it with something fairly opaque to block the sunlight while wiring up the panel.

Connect the BLACK (negative) lead from the solar panel to the terminal block marked "G" that is directly adjacent to the "SOLAR" terminal block. Connect the RED (positive) lead from an unregulated solar panel to the terminal block marked "SOLAR". See FIGURE 3-4.

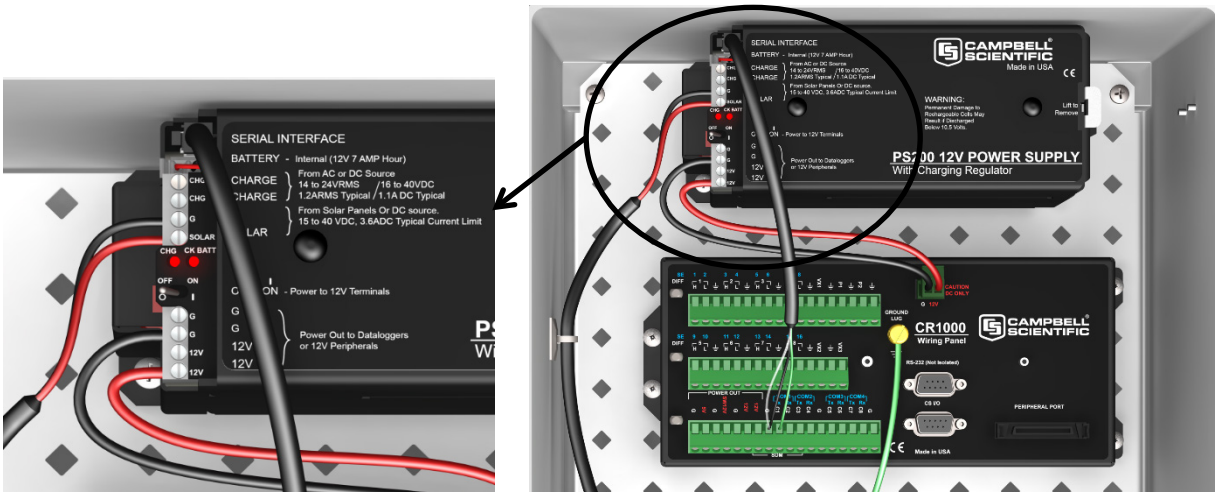


FIGURE 3-4. Solar panel connections on PS200

3.1.2 AC/DC Power

Double check the input voltages coming in to the charger/regulator with a volt meter.

AC Input Voltage: 14 to 24 VAC RMS
DC Input Voltage: 15 to 40 VDC

WARNING

Exceeding the voltages listed above will damage the power supply.

Disconnect the primary side of the AC/DC power before connecting wires to the PS200.

Connect the secondary power supply leads to the two terminal blocks marked "CHG". There is no polarity on the "CHG" terminal blocks, so it does not matter which wire goes to which "CHG" terminal block, but make sure there is only ONE wire per block. See FIGURE 3-5.

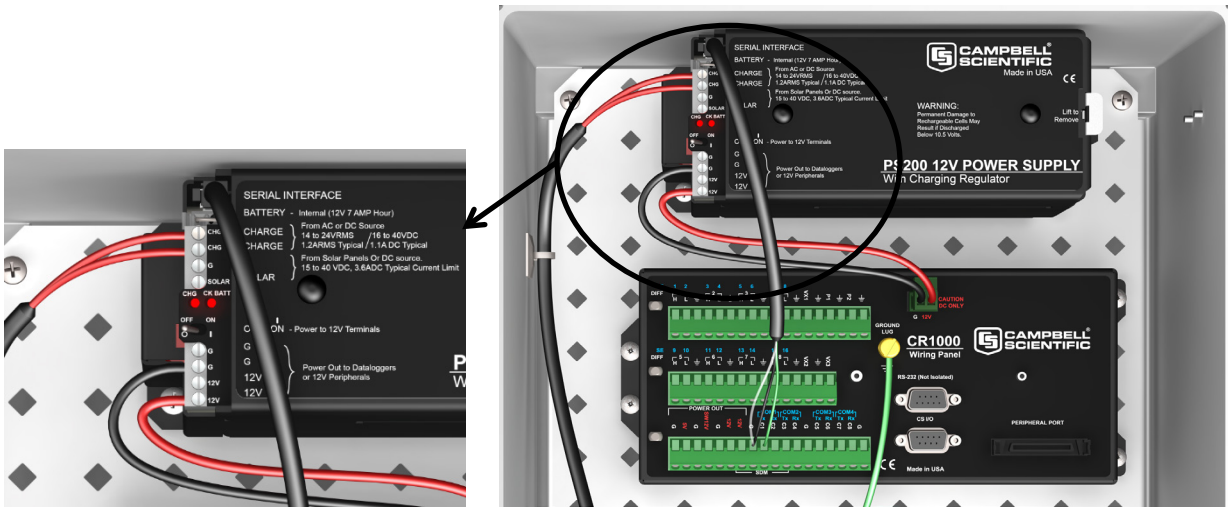


FIGURE 3-5. AC power connections on PS200

3.2 Plug In the Battery

The battery used with the PS200 is shipped inside of the PS200 case if the power supply is NOT installed inside an enclosure. If the PS200 is mounted inside an enclosure then the battery will be located separately packed in one of the packing boxes. This is done to minimize any damage that could occur if the power supply should get loose from its mounts inside the enclosure during shipment. The battery will NOT be plugged into the PS200. This is done to minimize discharging the battery.

To remove the lid from the PS200, pull up on the PS200 lid latch and slide the lid off as shown in FIGURE 3-6 and FIGURE 3-7.

WARNING

Do not remove the tape holding the battery wiring harness to the top of the battery! The tape is used to keep the battery wiring harness out of the way of the rubber bumpers on the inside of the lid.

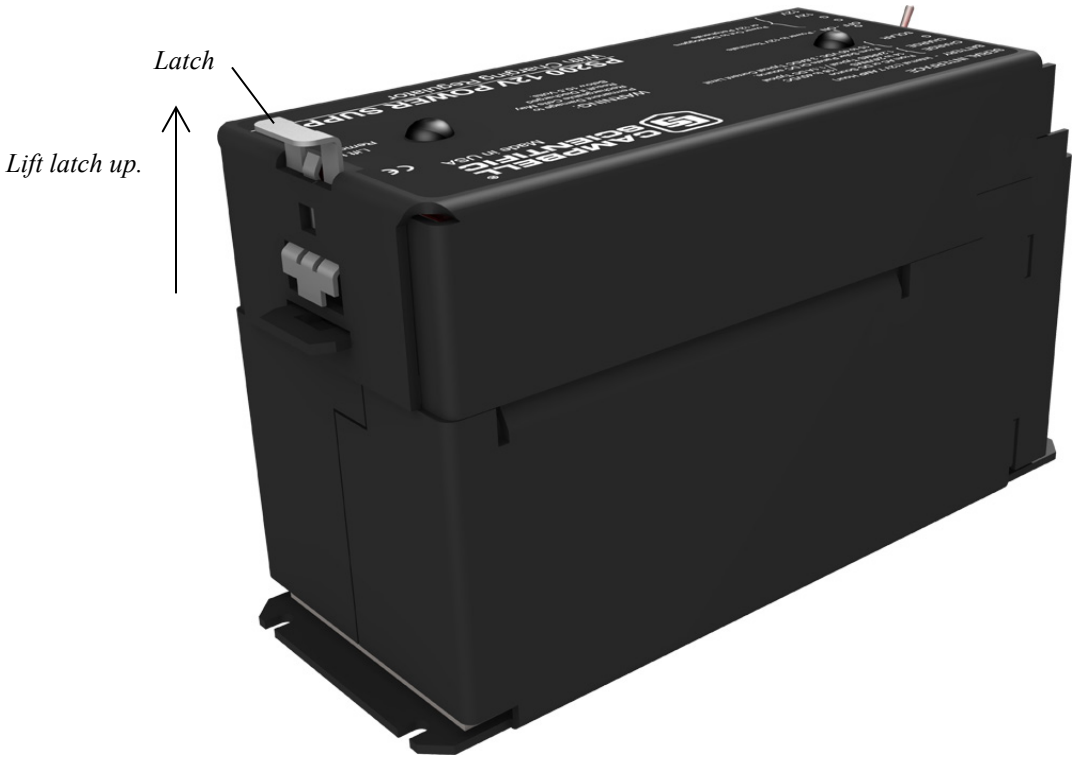


FIGURE 3-6. Lift latch up on PS200

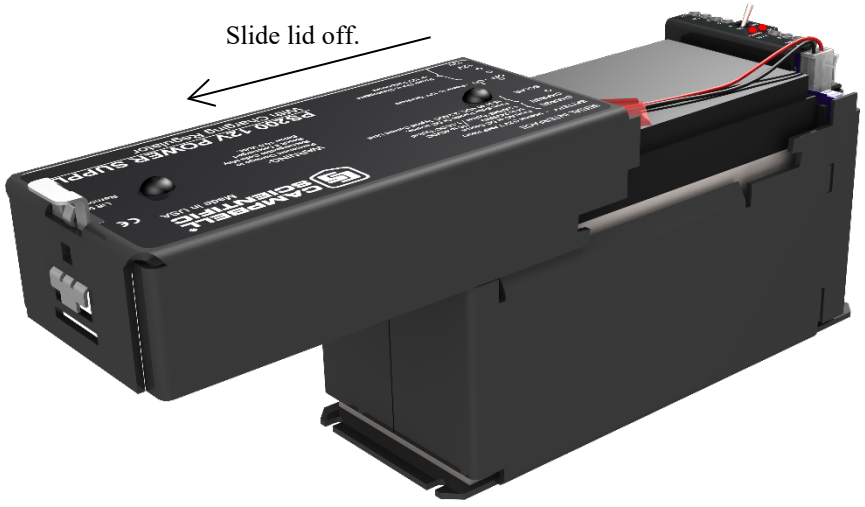


FIGURE 3-7. Slide PS200 lid off

Plug the battery into the connector marked “BATT”. This connector is polarized and will only allow the mating connector to be plugged in one way. Push the connector all the way in until it locks in place.

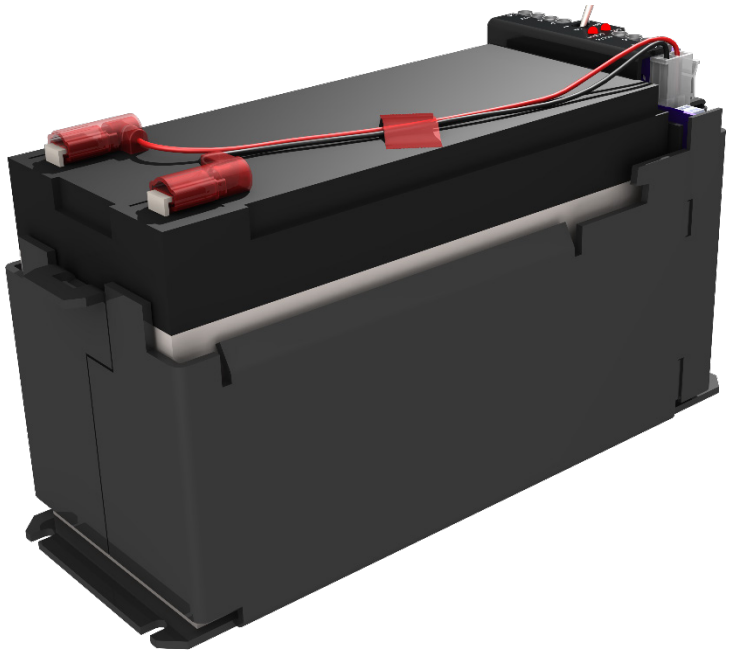


FIGURE 3-8. Wiring harness plugged into battery connector

NOTE When connecting the battery the "CHG" LED will briefly flash red and then go out.

3.3 Hook Up Power to Datalogger

Both the PS200 and the CH200 come with a 1 foot black wire attached to one of the **G** terminal blocks and a 1 foot red wire attached to one of the **12V** terminal blocks. Attach the red wire from the power supply to the datalogger Power terminal block marked 12V (Campbell Scientific part number 3768). Attach the black wire from the power supply to the datalogger Power terminal block marked "G".

3.4 Hook Up Communication Cable to Datalogger If Used

Skip this step if a CH/PS200 communication interface cable is not being used. Plug the power supply SDI-12 or RS-232 communication cable to the connector marked "COMM". This cable is polarized and will only plug in one way. Push the connector all the way into the mating connector until it locks in place. Wire the leads into the appropriate datalogger channels. An example of SDI-12 wiring is shown in FIGURE 6-6. An example of RS-232 wiring is shown in FIGURE 6-7.

NOTE This cable is NOT required for normal operation of the power supply! It is only required if the datalogger has been programmed to collect information from the power supply. See Section 6.2, *SDI-12*, and Section 6.3, *RS-232 Interface*, for how to use these cables.

3.5 Turn On the Charging Source

Turn on the power going to the charging source or uncover the solar panel. The "CHG" LED should flash green approximately every 4 to 5 seconds if all incoming connections are correct and there is an adequate charging voltage present.

3.6 Turn On Power to the Datalogger

Flip the switch on the PS200/CH200 supply to "On". Verify voltage to the datalogger with a volt meter, or use a key pad display, or connect to the datalogger with a laptop or PDA to make sure the datalogger is running correctly.

3.7 LED Indicators

As previously mentioned, the PS200/CH200 has two LED indicators, the CHARGE LED and the CHECK BATTERY LED. The following tables illustrate the various conditions and associated colors for the CHARGE and CHECK BATTERY LEDs.

TABLE 3-1. CHARGE LED

Condition	Color
No Valid Charge Source	Off
Valid Charge Source & Charging Battery	Flashing Green
Valid Charge Source but Battery being Discharged	Flashing Orange
Regulator Fault Detected	Flashing Red
Waiting for New Operating System (Section 6.2.2, *SDI-12 Measurements*)	Solid Red
Transferring Operating System	Solid Green

TABLE 3-2. CHECK BATTERY LED

Condition	Color
Battery Voltage > 11.5 V	Off
10.5 V ≤ Battery Voltage ≤ 11.5 V	Flashing Orange
Battery Fault Detected OR Battery Voltage < 10.5 V	Flashing Red

4. Specifications

(CHARGE - CHARGE terminals) AC or DC Source:	AC – (18 to 24) VRMS with 1.2 ARMS maximum DC – (16 to 40) VDC with 1.1 A DC maximum
(SOLAR - ⏚ terminals) Solar Panel or Other DC Source[1]:	15 to 40 VDC Maximum Charging Current: 3.6 ADC typical 2.8 ADC to 4.3 ADC depending on individual charger
Battery Charging[2]	
Two-step temperature compensated constant- voltage charging for valve-regulated lead-acid batteries:	CYCLE Charging: Vbatt(T) = 14.70 V – (24 mV)·(T – 25°C) FLOAT Charging: Vbatt(T) = 13.65 V – (18 mV)·(T – 25°C) ±1% Accuracy on charging voltage over –40° to +60°C range
Operational Temperature Range[3]:	–40° to +60°C
Measurements	
Average Battery Voltage:	± (1% of reading +15mV) over -40° to +60°C range
Average Battery/Load Current[4] Regulator Input Voltage:	±(2% of reading +2mA) over -40° to +60°C range
Solar[5]:	±(1% of reading -0.25V)/- (1% of reading +1V) over -40 to +60°C range
Continuous[6]:	±(1% of reading -0.5V)/- (1% of reading +2V) over -40° to +60°C range
Charger Temperature:	± 2°C
Power Out (+12 terminals)	
Voltage:	Unregulated 12 V from Battery
4 A Self-Resettable Thermal Fuse Hold Current Limits:	> 4 A @ < 20°C 4.0 A @ 20°C 3.1 A @ 50°C 2.7 A @ 60°C
Quiescent Current	
No Charge Source Present:	300 µA Maximum
No Battery Connected:	2 mA Maximum
Physical Specifications	
PS200:	10.6 cm (4.2 in) tall, 19.3 cm (7.5 in) long, 7.6 cm (3 in) wide
CH200:	10.0 cm (3.9 in) tall, 7.5 cm (3 in) long, 3.7 cm (1.5 in) wide

Compliance: View the EU Declaration of Conformity at *www.campbellsci.com/ch200* or *www.campbellsci.com/ps200*

1. Battery voltages below 8.7 V may result in < 3.0 A current limit because of foldback current limit.

2. Cycle and Float charging voltage parameters are programmable with the default values listed.

3. VRLA battery manufacturers state that "heat kills batteries" and recommend operating batteries ≤ 50°C.

4. Impulse type changes in current may have an average current error of ±(10% of reading + 2 mA).

5. 1.0 V negative offset is worst-case due to reversal protection diode on input. Typical diode drop is 0.35 V.

6. 2.0 V negative offset is worst-case due to two series diodes in AC full-bridge. Typical diode drops are 0.35 each for 0.7 V total.

4.1 Battery Packs

Battery Pack Model	Amp-Hour Capacity (Ah)	*Operating Temperature Range (ºC)	Battery Family
PS200	7	Charge: –15 to +50 Discharge: –20 to +60	EnerSys/Genesis
BP12	12	Charge: –15 to +50 Discharge: -20 to +60	EnerSys/Genesis
BP24	24	Charge: –15 to +50 Discharge: –20 to +60	EnerSys/Genesis
BP84	84	–40 to +71	Concorde Sun Xtender
* Battery specifications shown are from the manufacturer. The PS200/CH200 contains charging algorithms that optimize battery charging over the range of –40°C to +50°C. Battery usage outside of manufacturer specifications could have unknown effects on the life of the battery.			

WARNING

Battery life is shortened if the battery is allowed to discharge below 11.5 V.

4.2 Charging Sources

Campbell Scientific Solar Panels				
	SP10	**SP20**	**SP50**	**SP90**
Peak Power	10 W	20 W	50 W	90 W
Voltage @ Peak Power	16.8 V	16.8 V	17.5 V	17.8 V
Current @ Peak Power	0.59 A	1.19 A	3.9 A	4.8 A

Notes:

1. Specifications assume a 1 kilowatt per square meter illumination and a solar panel temperature of 25°C (77°F).
2. Individual panels may vary up to 10%.
3. The output panel voltage increases as the panel temperature decreases, which is in the same direction as the recommended VRLA battery charging voltage change with temperature.
4. Higher latitudes and less sun hours during winter months might require a larger panel than what is required to keep the battery charged during the summer.

AC/DC Transformer with Interchangeable Blades: Campbell Scientific Model No. 29796-US

Input Voltage: 100 – 240 VAC

Input Frequency: 47 – 63 Hz

Output Voltage: 24 Vdc

Output Current (max): 1.67 A

Protection: Unit will auto-recover upon removal of fault.

UL Approval: UL60950-1 2nd Edition

Unit has interchangeable blades. Unit ships with US/Canada plug installed.

For international orders select option 29798 –IP for international blades. International blade selection contains blades for Australia/New Zealand, UK, Europe/South America, Korea, Argentina, China, & India/South Africa.

AC/DC DIN Rail Mount Power Adapter: Campbell Scientific Model No. 28370

Input Voltage: 85 – 240 VAC or 90 – 350 VDC

Input Frequency: 45 – 65 Hz

Output Voltage: 24 Vdc

Output Current:	3.8A (–25°C to +70°C)
Protection:	3.15A internal slow-blow fuse
UL Approval:	UL/C-UL listed UL 508. UL/C-UL Listed 1604 Class I, Division 2, Groups A, B, C, D

NOTE Both of the recommended chargers have dc voltage output which can be used on either the CHARGE/CHARGE or SOLAR/G terminal blocks. Maximum input charging current on the CHARGE/CHARGE terminal blocks is limited to 1.1 Adc. Maximum input charging current on the SOLAR/G terminal blocks is limited to 3.6 Adc.

CHARGE/CHARGE terminal blocks have no polarity. Power wires from the charging source can be connected in any fashion. The PS200/CH200 will only float charge a battery with power connected to the CHARGE/CHARGE terminal blocks which is fine when using an AC/DC charging source.

SOLAR/G terminal blocks do have a polarity that must be followed when wiring up either of the AC/DC devices. Positive wire goes to the terminal block marked SOLAR. Negative wire goes to the terminal block marked G. Higher power throughput makes this an attractive option. It will float charge a battery but it will also try to quick charge as well depending on the needs of the battery.

4.3 Communication Interface Cables

The PS200/CH200 does not by default come with interface cables. Cables must be ordered separately. Communication cables are needed if changes to the default settings of the PS200/CH200 are required or if you wish to take advantage of the data coming from the PS200/CH200 using advanced programming techniques. See the cable listings below for the different cable types and how they are used.

RS-232 Interface cable – 6 foot length: Campbell Scientific Item No. 20770. This cable terminates in a 9-pin RS-232 serial connector for connecting to a computer and used to configure the PS200/CH200 using Device Configuration Utility (see Section 6.1, *Configuring the PS200/CH200 Using Campbell Scientific Device Configuration Utility*) or terminal emulation (see Section 6.1.3, *Terminal Tab*). This cable could be used to connect to the datalogger's RS-232 port but would also require a null modem cable such as Campbell Scientific Item No. 18663.

SDI-12 Interface Cable – 2 foot length: Campbell Scientific Item No. 20769. Terminates in wires. See Section 6.2, *SDI-12*, for programming and wiring instructions.

Tx/Rx Datalogger RS-232 Interface Cable – 2 foot length: Campbell Scientific Item No. 25356. Terminates in wires. See Section 6.3, *RS-232 Interface*, for programming and wiring instructions.

4.4 Communication Cable Interface Connector Pin-Out

The communication connector has four pins. The following drawing shows the connector pin-out as viewed looking at the connector.

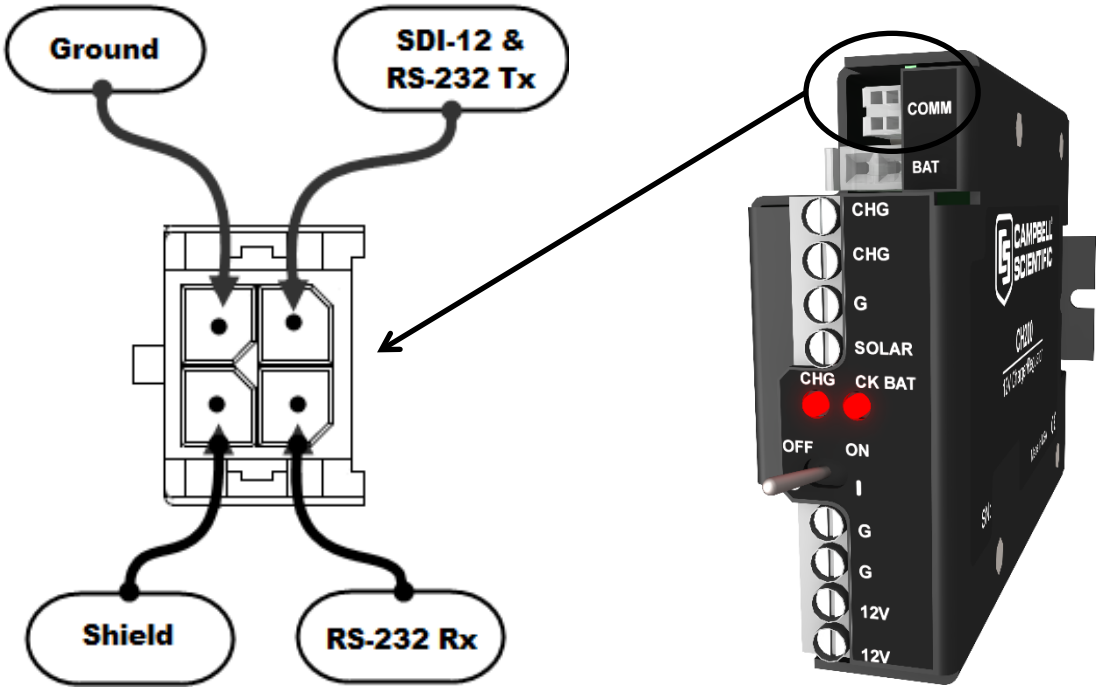


FIGURE 4-1. Communication connector pin-out

5. Operational Overview

A simplified schematic of the CH/PS200 charging regulator is illustrated in FIGURE 5-1. A 12-V 7Amp-hr rechargeable battery is included with the PS200, whereas the user provides the rechargeable battery, such as the BP12 or BP24 offered by Campbell Scientific, Inc., for the CH200. See Section 4.1, *Battery Packs*, for rechargeable batteries offered for the CH200 by Campbell Scientific.

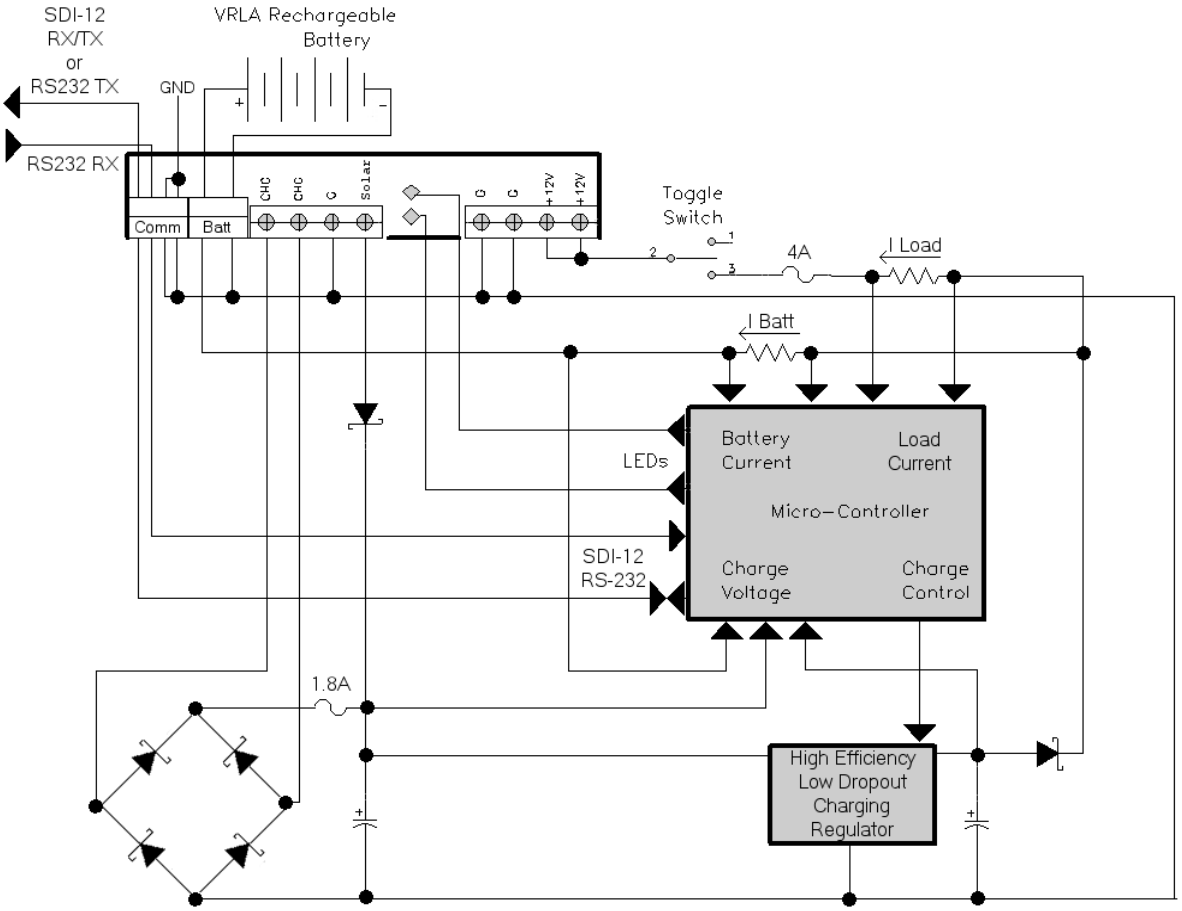


FIGURE 5-1. PS200/CH200 schematic

Charging power for the PS200/CH200 is typically supplied by an unregulated solar panel, AC/AC transformer, or AC/DC converter. As illustrated in FIGURE 4-1, the CHARGE – CHARGE terminals are connected to a diode bridge, accommodating either AC or DC voltages from a charge source. Because of the diode bridge, polarity does not matter when connecting sources to the CHARGE – CHARGE input terminals. In order to protect AC/AC or AC/DC sources when charging discharged batteries, the CHARGE – CHARGE input terminals offer an approximately 1.1 amps DC (1.2 A RMS) current limit. The SOLAR – G input terminals are intended for connection to solar panels, or other high-current DC sources. Polarity definitely matters on the DC only SOLAR – G input terminals, with positive connected to SOLAR and the return or negative connected to G, with reversal protection included. The SOLAR – G input terminals have an input current limit of approximately 3.6 amps, making the PS200/CH200 well suited for 70 watt or smaller solar panels. The PS200/CH200 can be simultaneously powered from both the CHARGE – CHARGE and SOLAR – G input terminals, as the internal diodes will route power from the source with the highest input voltage. This allows for an AC mains powered application with a solar panel for back-up. If the reverse is needed – solar power as the primary supply and AC as the secondary supply – then a solar panel should be used with a 24 vdc output and an AC, or AC to DC, source with a voltage output less than the solar panel voltage.

An AC/DC converter charge source could be connected to either the CHARGE – CHARGE input terminals or the SOLAR - G input terminals. The best input terminals to use with a given AC/DC converter should be based on the converters output current capability. For example, the CHARGE – CHARGE input terminals provide a user programmable current limit, with a maximum limit of 2.0 A DC for the charging source. Whereas the SOLAR - G input terminals have a fixed 3.6 A DC typical current limit, providing faster battery charging for a charge source that can deliver up to 3.6 A DC current without damage.

The SOLAR – G terminals are optimal for solar panels because of the high-current charging capability when solar resources are available. A Maximum Power Point Tracking algorithm is also utilized when the PS200/CH200 detects the charging source is connected to the SOLAR input. Whereas, powering from the CHARGE – CHARGE terminals is preferable if a continuous charge source is available because of better overload protection of the charge source and less aggressive battery charging which is preferable for a continuous charge source.

The +12 V output terminals are intended to power a datalogger and any peripherals. Power to these output terminals is controlled by a toggle switch, with the total output current limited by a 4 amp self-resettable thermal fuse (see Section 4, *Specifications*, for hold current limits at various temperatures). The A105 Additional 12 V Terminals Adapter may be used to provide extra 12 V and ground terminals where the power supply is used to power several devices, noting that the hold current limit on the 4 amp self-resettable thermal fuse still applies.

Each battery family has a unique charging algorithm which takes into account battery temperature to calculate the correct charging voltage to maintain the battery. The source of the temperature used by default is the temperature of the charger itself with the assumption that the charger resides in the same enclosure with the battery and the two temperatures will be similar. If the battery used by this system is located in separate enclosure it is advised to put a temperature sensor on the battery, or close to it, that is read by a datalogger connected to the PS200/CH200 and send this temperature information to the module using the appropriate SDI-12 (see Section 6.2.3.1, *Write Remote Battery Temperature to PS200/CH200*, and Section 6.2.3.2, *Restore Internal Battery Temperature Measurement*) or RS-232 (see Section 6.3.3.2, *Write Remote Battery Temperature to PS200/CH200*, and Section 6.3.3.3, *Restore Internal Battery Temperature Measurement*).

The PS200/CH200 have two flashing LED indicators, the CHARGE LED and the CHECK BATTERY LED. See TABLE 3-1 and TABLE 3-2 for details on the various conditions and associated colors for these two indicator LEDs.

Communication with the CH/PS200 is accomplished through the COMM port to either a datalogger or computer. Datalogger communication can be done via a SDI-12 interface cable (item# 20769) as indicated in FIGURE 6-6, or an RS-232 TX/RX interface cable (item #25356) as indicated in FIGURE 6-7. Communication to a computer requires a RS-232 interface cable (item# 20770) that terminates in a standard 9-pin connector. See Section 6.2, *SDI-12*, and Section 6.3, *RS-232 Interface*, for details of using these cables and programming examples where required.

6. User Interface

Unlike any other power supply that Campbell Scientific has ever built the PS200/CH200 has the unique ability to send a wealth of information back to the user to observe and manage power requirements and possible problems. It can also be configured to work with a wide range of batteries and input power supplies and test the existing battery system for possible shorting and sulfation problems.

NOTE If viewing this manual as a PDF file all the datalogger programming examples can be highlighted, copied, and pasted directly into the CRBasic editor.

The PS200/CH200 can be used directly from the factory without any configuration or communication interface. Programming examples are provided in this manual but can also be downloaded directly from Campbell Scientific's web site (*www.campbellsci.com/downloads*). For those who wish to take advantage of some of the additional features of the PS200/CH200, however, the PS200/CH200 supports four kinds of serial communication:

1. Campbell Scientific software, Device Configuration Utility (DevConfig), via RS-232 by which PS200/CH200 settings can be viewed and changed. Or, an upgraded operating system can be sent to a PS200/CH200. Also, battery voltage, battery current, load current, input voltage, input current, temperature, charge state, charge source (solar or continuous), and a check battery flag can be viewed. DevConfig may be downloaded free of charge from Campbell Scientific's web site (*www.campbellsci.com/downloads*). See Section 6.1, *Configuring the PS200/CH200 Using Campbell Scientific Device Configuration Utility*.

2. A simple text based interface via RS-232 that can be used with Microsoft Hyper Terminal or Campbell Scientific DevConfig terminal screen. Battery voltage, battery current, load current, input voltage, input current, temperature, charge state, charge source (solar or continuous), and a check battery flag can be viewed. Also, the SDI-12 address of a PS200/CH200 can be changed via the text based interface. See Section 6.1.3, *Terminal Tab*.

3. SDI-12 by which the PS200/CH200 performs as an "SDI-12 sensor" according to the SDI-12 standard (*www.sdi-12.org*). Battery voltage, battery current, load current, input voltage, input current, temperature, charge state, charge source (solar or continuous), and a check battery flag can be read from a PS200/CH200 via SDI-12 using the Campbell Scientific CRBasic instruction "SDI12Recorder" (Campbell Scientific CR1000 datalogger program examples in Section 6.2.2, *SDI-12 Measurements*). See Section 6.2, *SDI-12*, for an in-depth explanation.

4. RS-232 communications specifically designed to work with a Campbell Scientific datalogger and a Campbell Scientific datalogger program using CRBasic commands "SerialOut" and "SerialIn" (Campbell Scientific CR1000 datalogger program example in Section 6.3.4, *Datalogger Programming for RS-232 Communication to the PS200/CH200*). Battery voltage, battery current, load current, input voltage, input current, temperature, charge state, charge source (solar or continuous), and some

other charge control parameters normally not of interest to the user can be viewed. See Section 6.3, *RS-232 Interface*, for an in-depth explanation.

The advantage of SDI-12 over RS-232 is that many sensors can share a single datalogger SDI-12 port, whereas, RS-232 is limited to one device per port. The advantage of RS-232 over SDI-12 is that its speed can be faster than SDI-12. Datalogger programming for SDI-12 is usually simpler than programming for a RS-232 device.

All PS200/CH200 serial communications are via its four-pin COMM connector. The PS200/CH200 will detect which of the four kinds of serial communications is being used and will reconfigure itself accordingly.

Some configurations of the PS200/CH200 can also be done via a datalogger using RS-232 or SDI-12 commands but require knowledge of CRBasic programming. See Section 6.2, *SDI-12*, for SDI-12 programming examples and Section 6.3, *RS-232 Interface*, for datalogger RS-232 programming.

6.1 Configuring the PS200/CH200 Using Campbell Scientific Device Configuration Utility (DevConfig)

The easiest way to configure the PS200/CH200 is using Device Configuration Utility and a computer. The only way to update the operating system in a PS200/CH200 is via Device Configuration Utility.

To use Device Configuration Utility the PS200/CH200 must have power and a Campbell Scientific RS-232 interface cable (item #20770) (see FIGURE 6-1). Some key features of DevConfig include:

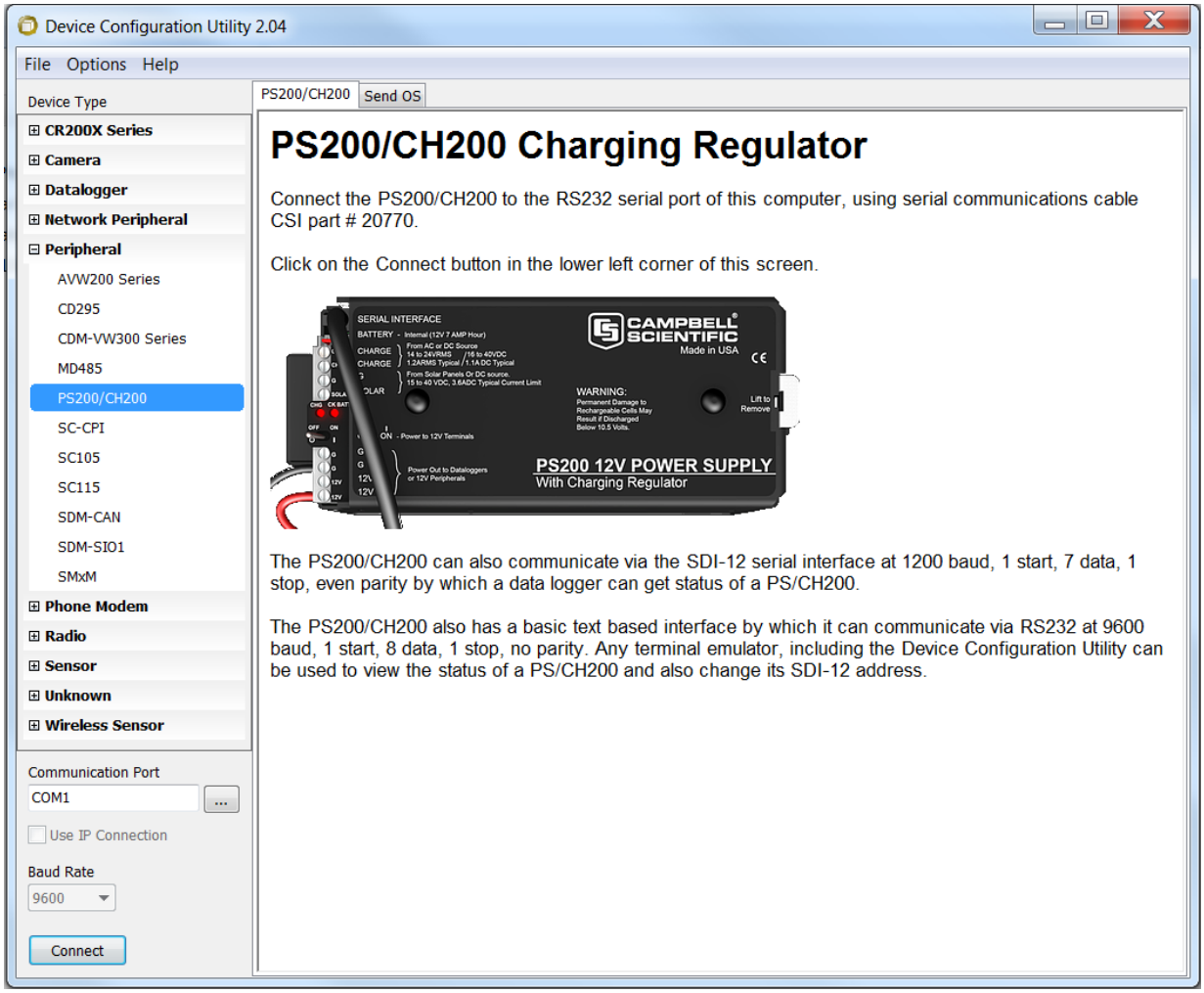
- Supports direct serial connections between the PC and devices.
- Sends operating systems to supported device types.
- Provides a reporting facility where a summary of the current configuration of a device can be shown on the screen and printed. This configuration can also be saved to a file and used to restore the settings in the same or a replacement device.
- Help for DevConfig is shown as prompts and explanations on its main screen.
- Updates to DevConfig are available from Campbell Scientific's web site, *www.campbellsci.com/downloads*. These may be installed over older versions.
- All screen shots used in this manual are from Device Configuration Utility version 2.04.

NOTE Before opening DevConfig, close other software on the computer that uses the computer's serial (COM) ports (e.g., LoggerNet, PC400, or PC200W).

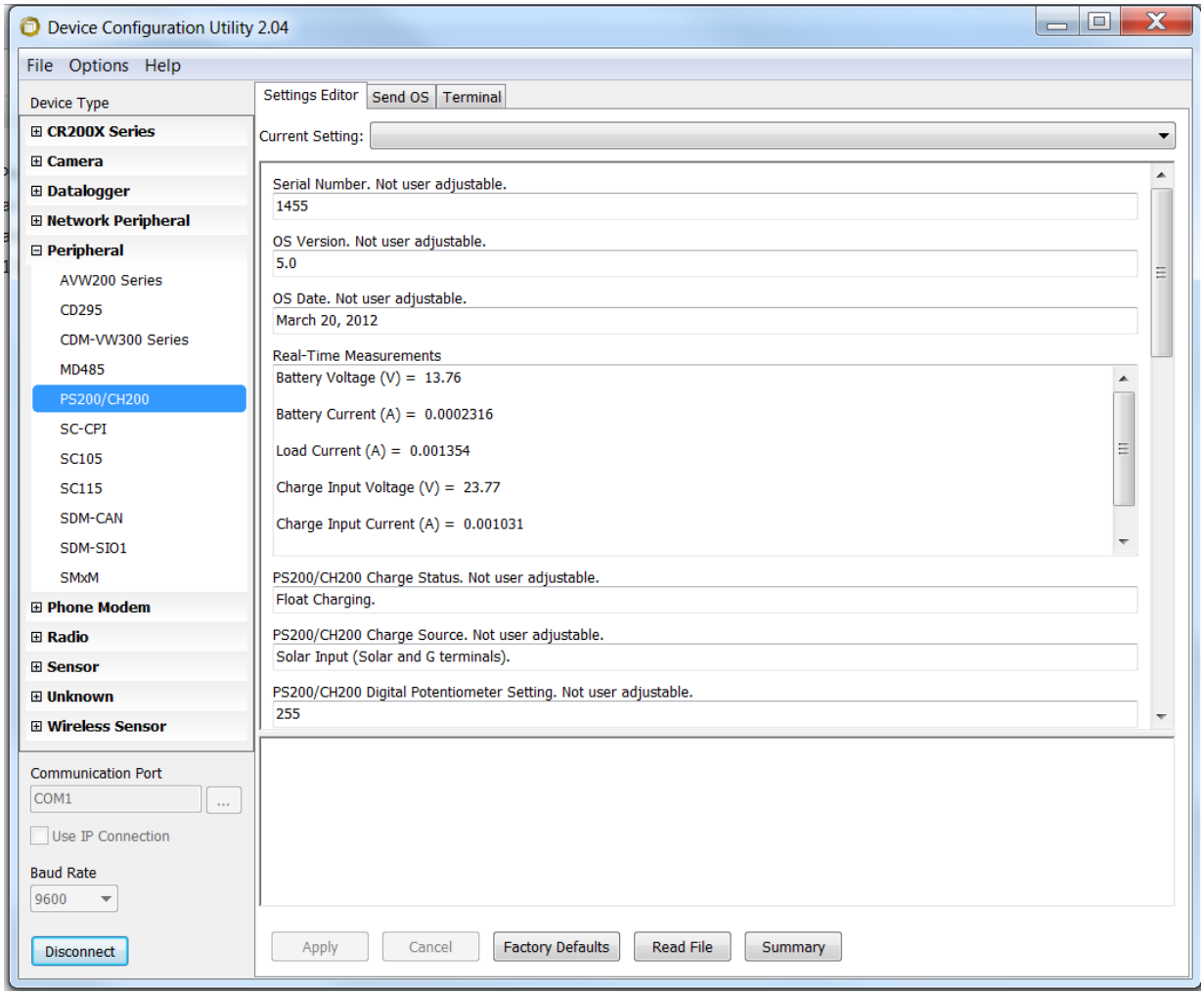
FIGURE 6-1. PS200 20770 serial cable

6.1.1 Main DevConfig Screen

The DevConfig window is divided into two main sections: the device selection panel on the left side and device-specific tabs on the right side. Click on the PS200/CH200 device name from the list on the left, for which a list of installed RS-232 serial ports (COM1, COM2, etc.) will appear. The PS200/CH200 has a fixed baud rate of 9600. The page for each device presents instructions about how to set up the device to communicate with DevConfig.



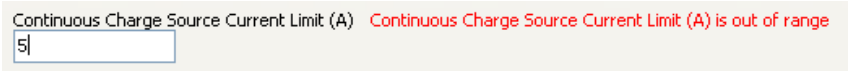
When the user clicks on the Connect button, the device type, serial port, and baud rate selector controls become disabled and, if DevConfig is able to connect to the PS200/CH200, the button will change from "Connect" to "Disconnect". The Display will change to:



6.1.2 Settings Editor Tab

Not all settings can be changed. Grayed out fields cannot be changed. To change a setting, select the field to be changed, type in a new value and press Enter. If the value entered is not within an acceptable range, a message in red lettering will appear to the right of the entered value. Real time values can be viewed while in this screen. These values are updated every second.

An example of an incorrect value entered in for the continuous charging source current is shown below.

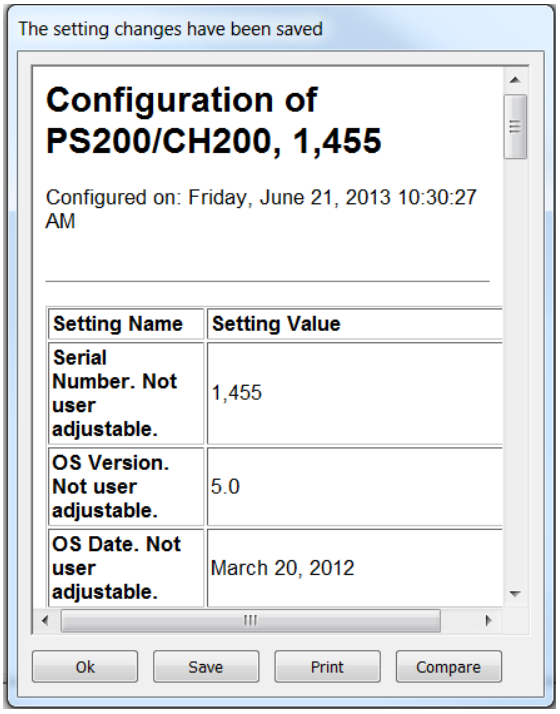


The bottom of the Settings Editor displays help for the selected setting. The **Apply** and **Cancel** button will become active when a setting is changed. An asterisk (*) will also appear next to values that have been changed.

Clicking the **Factory Defaults** button on the Settings Editor will send a command to the PS200/CH200 to revert to its factory default settings (PS200/CH200 factory made calibration values and other "read only" values are not affected).

The **Read File** can be used for restoring settings from a file that was created earlier. The settings from the saved file are immediately sent to the PS200/CH200.

Edit settings as needed, click on the **Apply** button; or, if no changes were made, click on the **Summary** button; and, if the PS200/CH200 accepts the settings, a configuration summary dialogue will appear. The user will have a chance to save the settings so that **Read File** can be used later and/or print the settings for the device:



Click on the **Ok** button to return to the settings editor if no changes were made or to the main screen if changes were made.

TABLE 6-1. PS200/CH200 Settings

Setting	Description
Serial Number	Displays the PS200/CH200serial number. This setting is set at the factory and cannot be edited.
OS Version	Displays the PS200/CH200 operating system version. Visit the web site, *www.campbellsci.com/downloads* , to determine whether a newer operating system is available.
OS Date	Displays the last revision date of the operating system presently in the PS200/CH200.
Real-Time Measurements	Real-Time Measurements (not user adjustable except where indicated) include: **Battery Voltage (V)** indicates the present battery charge voltage. **Battery Current (A)** indicates current being supplied to, or drawn from, the battery. A positive reading means the battery is charging. A negative reading means the battery is discharging. **Load Current (A)** indicates current being supplied to the load connected to the PS/CH200. **Charge Input Voltage (V)** indicates the DC voltage going into the regulation circuitry. If an AC source is being used to supply power to the PS200/CH200, then this voltage is the rectified DC voltage. **Charge Input Current (A)** indicates current at the PS200/CH200 current input, which can be coming from the SOLAR terminals or from the CHG terminals.
PS200/CH200 Charge Status	Displays the PS200/CH200 present state of charging. One of these text strings will be displayed: "Not Charging." (No charging source detected.) "Current Limited Charging." "Cycle Charging." "Float Charging." "Battery Test Mode." (See Section 6.2.3.3, *Change Battery Capacity Value in PS200/CH200*, for SDI-12 battery test mode and Section 6.3.3.5, *Enter Battery Test Stat*, for RS-232 battery test mode.) "Internal Fault Detected. SERVICE REQUIRED."
PS200/CH200 Charge Source	Displays the PS200/CH200 active charging source. One of these text strings will be displayed: "No Detectable Charge Source." "Solar Input (Solar and G terminals)." "Continuous Source Input (CHG CHG terminals)."
PS200/CH200 Digital Potentiometer	Displays the present value being sent to the PS200/CH200 battery voltage control digital potentiometer. This value is not in volts but sets the battery voltage control according to the formula: battery voltage target = K / (DPot + L).

TABLE 6-1. PS200/CH200 Settings	
Battery Capacity	**(Ah)** is the user entered battery capacity. Cycle charging is disabled if set to 0 Ah. PS200 default = 7 Ah. CH200 default = 0 Ah. Set to 24 Ah for BP24. Set to 12 Ah for BP12. Set to 84 Ah for BP84. Change **Battery Family** to match battery model. Set **Battery Family** to "EnerSys/Genesis NP" for BP12 & BP24 batteries. Set **Battery Family** to "Concorde Sun Xtender" for the BP84 battery. For non-Campbell Scientific batteries put in the Amp-Hour rating to match the battery capacity being used. Set **Battery Family** to "Custom Battery". See Section 6.1.2.1, *Battery Families*, for more settings information.
Battery Family	This field displays which battery family type the PS200/CH200 is configured to use. Available battery types are selected using a drop-down menu. See Section 6.1.2.1, *Battery Families*, for more information.
Custom Battery Cycle C_0 25ºC Cycle Charge Voltage (V)	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Cycle C_2 First Order Coefficient (mV/ºC)	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Cycle C_2 Second Order Coefficient $(mV/ºC)^2$	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Float C_0 25º Cycle Charge Voltage (V)	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Float C_2 First Order Coefficient (mV/ºC)	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Float C_2 Second Order Coefficient $(mV/ºC)^2$	This field will allow changes made to it when "Custom Battery" is selected for the battery family. This field will be grayed out for any other battery family types and not allow changes made to it. See battery manufacturer information for correct values. See FIGURE 6-3.
Custom Battery Minimum Charge Voltage (V)	Minimum voltage that the PS200/CH200 will put across a battery configured as "Custom Battery" in the **Battery Family** field. Voltage applied across a battery is dependent on temperature. The higher the battery temperature the lower the voltage applied across the battery.

TABLE 6-1. PS200/CH200 Settings

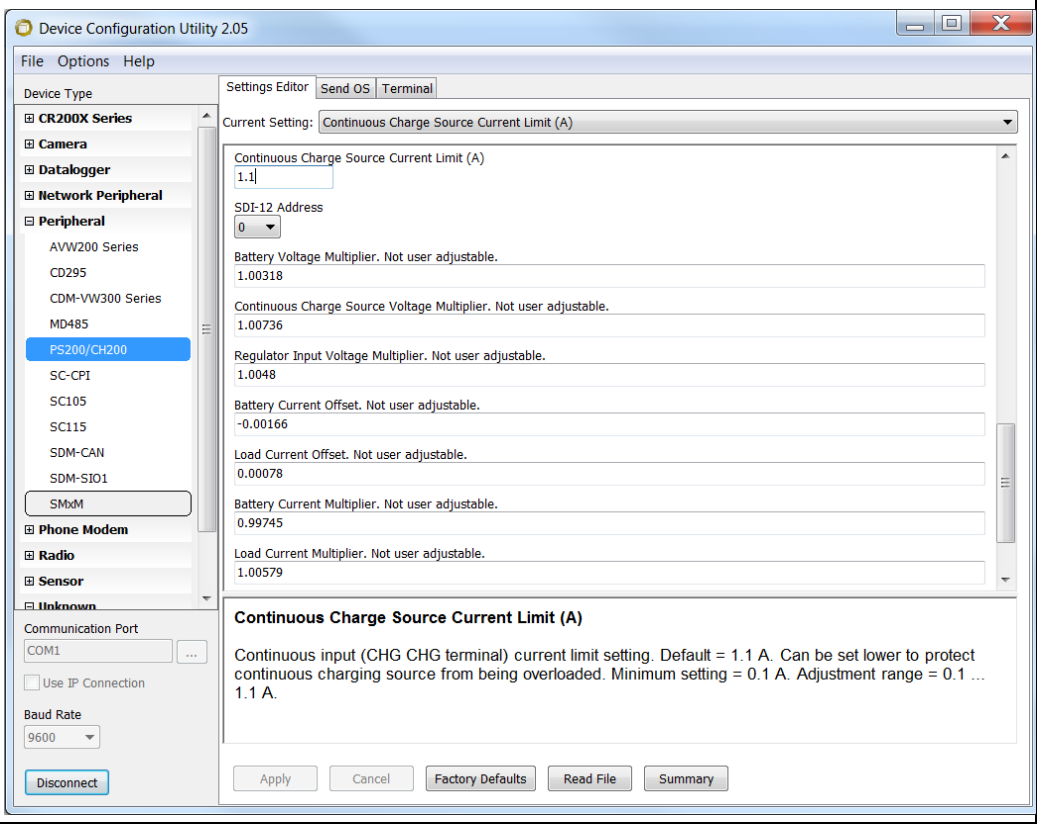
Continuous Charge Source Current Limit (A)	The maximum amount of current applied to the battery while being float charged. User adjustable for any battery family. Default value is 1.1 Amps. 
SDI-12 Address	Allows the user to set the SDI-12 address of the PS200/CH200. Factory default for this address is 0. Each SDI-12 sensor connected to a port of an SDI-12 recorder (datalogger) should have a unique SDI-12 address. See Section 6.2, *SDI-12*.
Battery Voltage Multiplier. Not user adjustable.	Calibration multiplier for battery voltage measurement. “Factory Defaults” button does not affect calibration values.
Continuous Charge Source Voltage Multiplier. Not user adjustable.	Calibration multiplier for continuous source voltage measurement. “Factory Defaults” button does not affect calibration values.
Regulator Input Voltage Multiplier. Not user adjustable.	Calibration multiplier for regulator input voltage measurement. “Factory Defaults” button does not affect calibration values.

TABLE 6-1. PS200/CH200 Settings	
Battery Current Offset. Not user adjustable.	Calibration offset for battery current measurement. "Factory Defaults" button does not affect calibration values.
Load Current Offset. Not user adjustable.	Calibration offset for load current measurement. "Factory Defaults" button does not affect calibration values.
Battery Current Multiplier. Not user adjustable.	Calibration multiplier for battery current measurement. "Factory Defaults" button does not affect calibration values.
Load Current Multiplier. Not user adjustable.	Calibration multiplier for load current measurement. "Factory Defaults" button does not affect calibration values.
Digital Potentiometer K Value. Not user adjustable.	K calibration value for charge voltage control by means of digital potentiometer. DPOT = K/VTARG-L. "Factory Defaults" button does not affect calibration values.
Digital Potentiometer L Value. Not user adjustable.	L calibration value for charge voltage control by means of digital potentiometer. DPOT = K/VTARG-L. "Factory Defaults" button does not affect calibration values.

Press F5 to refresh the Settings Editor.

6.1.2.1 Battery Families

The PS200/CH200 has charging algorithms built in to handle the EnerSys/Genesis NP series of batteries (CS models PS200, BP12, and BP24), EnerSys/Genesis Cyclon Series, Concorde Sun Xtender (BP84), or custom algorithms entered in by the user. The PS200/CH200 uses a second order polynomial to make the correct battery charging adjustments for known battery families and charging cycles. Click on the down arrow to the far right of "Battery Family" to access the drop down menu of battery families. See FIGURE 6-2.

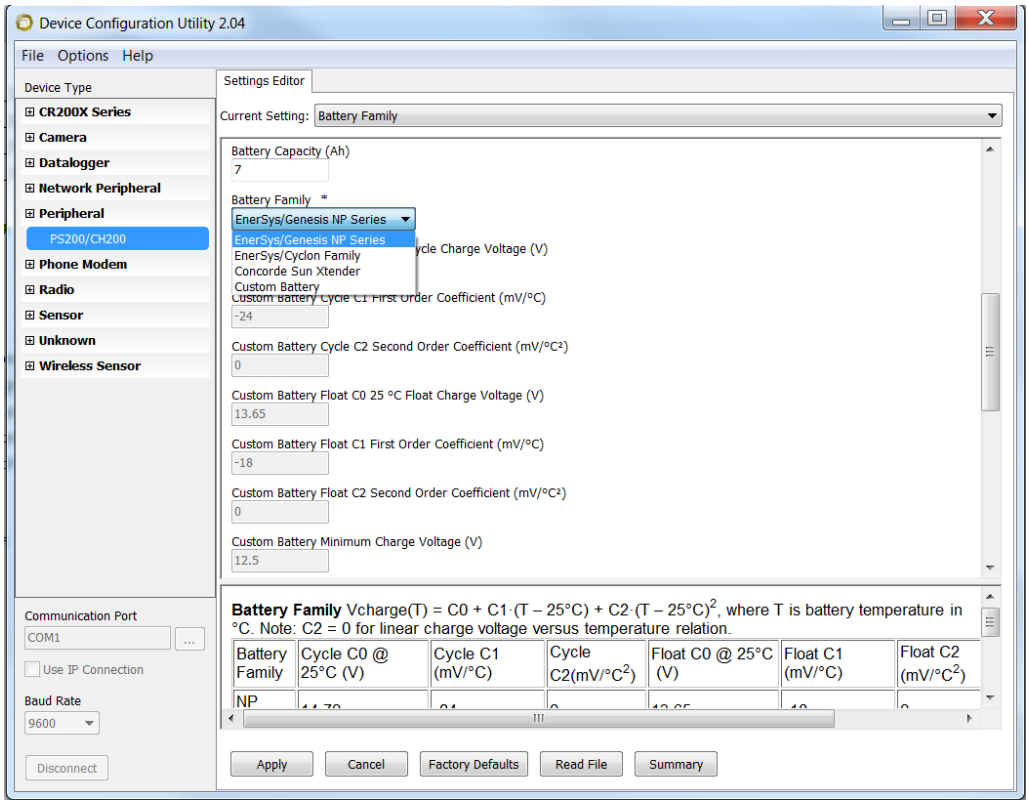


FIGURE 6-2. Battery family dropdown menu

The PS200 is configured at the factory to work with the EnerSys/Genesis 7 Ah battery algorithm.

For a CH200 change the “Battery Family” to match the battery family being used. The CH200 is by default sent from the factory with a battery capacity of zero (0) and a battery family of EnerSys/Genesis NP Series. Setting the battery capacity at zero (0) forces the charger to only float charge the battery. Battery capacity must be changed to allow cycle charging and the charging source must be a DC voltage on the SOLAR and G terminal blocks. TABLE 6-2 shows the default settings for each of the battery families.

TABLE 6-2. Battery Specifications

$V_{charge}(T) = C_0 + C_1(T\text{-}25°C) + C_2(T\text{-}25°C)^2$, where T = Battery temperature in °C.

Note: $C_2 = 0$ for linear charge voltage vs. temperature relation.

Battery Family	Cycle C_0 @ 25°C (V)	Cycle C_1 (mV/°C)	Cycle C_2 (mV/°C)^2	Float C_0 @ 25°C (V)	Float C_1 (mV/°C)	Float C_2 (mV/°C)^2	Minimum Voltage (V)
EnerSys/ Genesis NP Series	14.70	–24	0	13.65	–18	0	12.5
EnerSys/ Genesis Cyclon Series	14.70	–24	0.24	13.65	–24	0.24	13.2
Concorde Sun Xtender	14.31	–24	0.24	13.29	–24	0.24	13.0
Custom User Settable	User set. Default = 14.70	User set. Default = –24	User set. Default = 0	User set. Default = 13.65	User set. Default = –18	User set. Default = 0	User set. Default = 12.5

NOTE If "Custom Battery" is selected from the list you might have to change the Custom Battery settings. See manufacturer specifications for correct charging information.

The PS200/CH200 is designed to charge lead-acid batteries only. Lead-acid batteries come in basically three styles of construction. The first two styles are a VRLA battery (valve-regulated lead-acid battery) usually called "Maintenance Free". The construction of a VRLA battery does not require the addition of water to the cells and vents less gas than flooded lead-acid batteries.

- Absorbed Glass Mat (AGM) maintenance free battery. This style of battery has the electrolyte (acid) absorbed and trapped in a glass fiber mat which is sandwiched between lead plates. This battery is sealed. No water or acid can be added and the design allows the battery to be mounted in any position. This style battery is also called "starved-electrolyte".

- Gel Cell maintenance free battery. This battery has the electrolyte (acid) mixed with silica dust to form an immobilized gel which is then sandwiched between lead plates. This battery is sealed. No water or acid can be added. This type of battery can be sensitive to how it's mounted. See manufacturer for details.

- Flooded Cell. Commonly used for automotive applications. Deep cycle marine batteries are usually flooded cell batteries. Uses a liquid electrolyte and does require the addition of water over time. This battery can only be mounted upright.

- Each battery family requires a different charging algorithm and there could also be differences from manufacturer to manufacturer of the same style of battery. For example, Campbell Scientific sells VRLA AGM style batteries from two different manufacturers — EnerSys/Genesis (PS200, BP12, and BP24) and Concorde (BP84) — yet both batteries require a different charging algorithm. The charging algorithm applied to a family of batteries from a specific manufacturer is dependent on battery temperature and whether the battery is cycle charged (fast charged) or float charged. Each manufacturer will have a recommended charging algorithm for both methods. Cycle charging puts a higher voltage across the battery for a short period of time forcing the battery to take in more current and charge faster. Cycle charging is recommended for systems running on solar panels so the maximum amount of current is moved into the battery as quickly as possible. Battery Amp-Hour capacity must be known when cycle charging in order to switch over to float charging at the correct point in the charging cycle so as not to overcharge and damage the battery. Float charging puts a lower voltage across the battery and is Amp-Hour independent.

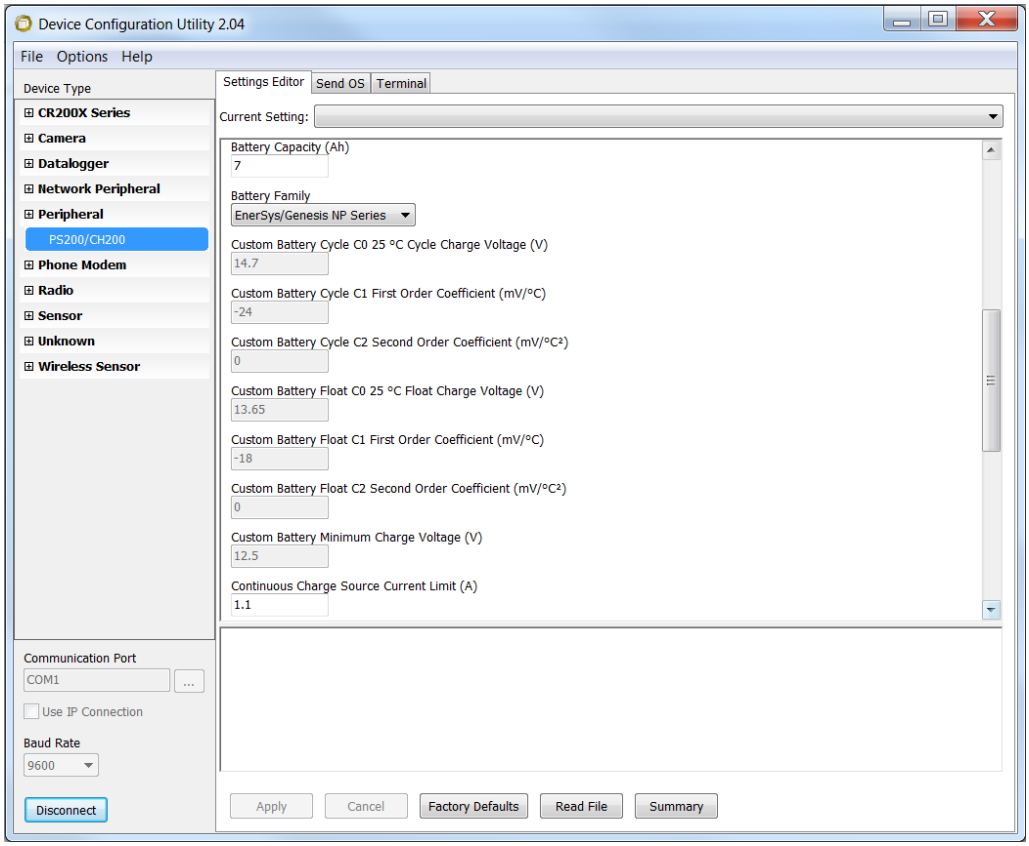


FIGURE 6-3. Device Configuration Utility settings editor

6.1.3 Terminal Tab

Click on the "Terminal" tab to invoke the PS200/CH200 terminal interface.

Only the SDI12 address can be changed from this window. (Or, Windows Hyper Terminal could be used. See Section 6.3.1, *Text Based Interface*.) A screen similar to the following should appear:

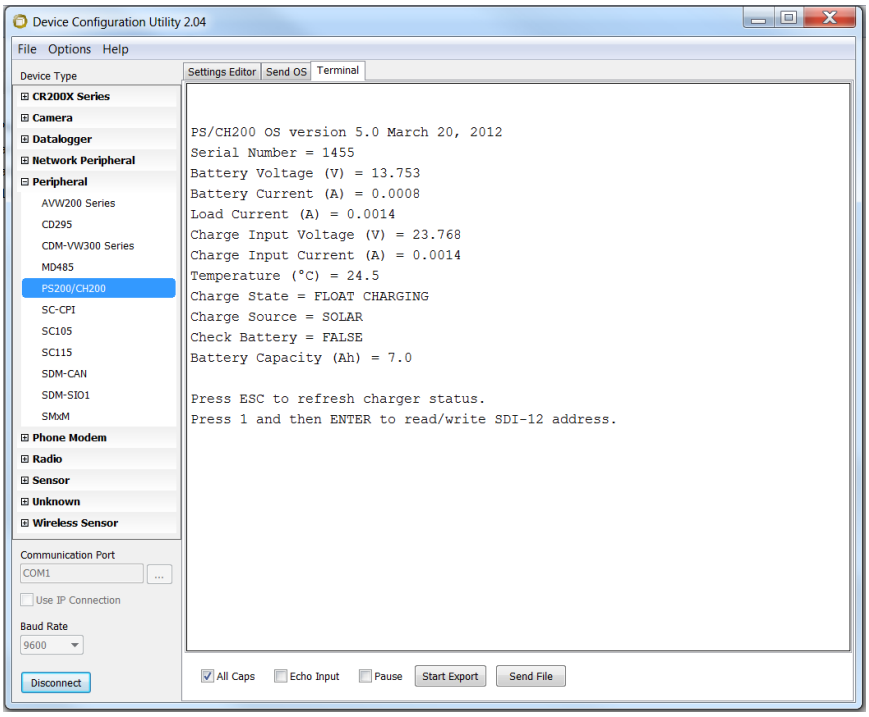


FIGURE 6-4. Device Configuration Utility terminal tab

Press ESC (may have to press ESC twice) to invoke the PS200/CH200 RS-232 text based interface. For more on the text based interface, see Section 6.3.1, *Text Based Interface*.

6.1.4 Send OS Tab — Downloading an Operating System

Having to send a new operating system is rare but can be done easily using Device Configuration Utility and the RS-232 interface cable Item No. 20770.

Get the Latest Operating PS200/CH200 Operating System

The latest operating system for the PS200/CH200 is available from the Campbell Scientific website at *www.campbellsci.com*. From the home page select "Support". From the pop-up menu select "Downloads". Search for "PS200". This file will be an executable file that will automatically install itself into the correct folders. Run the file on the computer that will be used to connect to the PS200/CH200.

Load The Operating System Into the PS200/CH200

Make sure the PS200/CH200 has power and connect it to the computer used to send the new operating system. Open Device Configuration Utility after the

operating system has been downloaded on the computer. Select a PS200/CH200 from the list on the left hand side of the Device Configuration Utility. Select the tab at the top marked “Send OS”. Click on the “Start” button at the bottom of the screen. A dialog box marked “Select the operating system to send” should appear. If the operating system was stored on the computer as shown above then navigate to the “C:\Campbellsci\LIB\OperatingSystems” folder. Select the file “CH200.a43” and click on the “Open” button. If you stored the file somewhere else on this computer then go find it and open it. The LED indicator on the PS200/CH200 marked “CHG” should change from red to green indicating the module is receiving a new operating system. This will take a few minutes. DO NOT disconnect from the PS200/CH200 during this process. When the operating system has been successfully sent the green LED will go out. Device Configuration Utility will also bring up a window showing the new operating system was successfully sent.

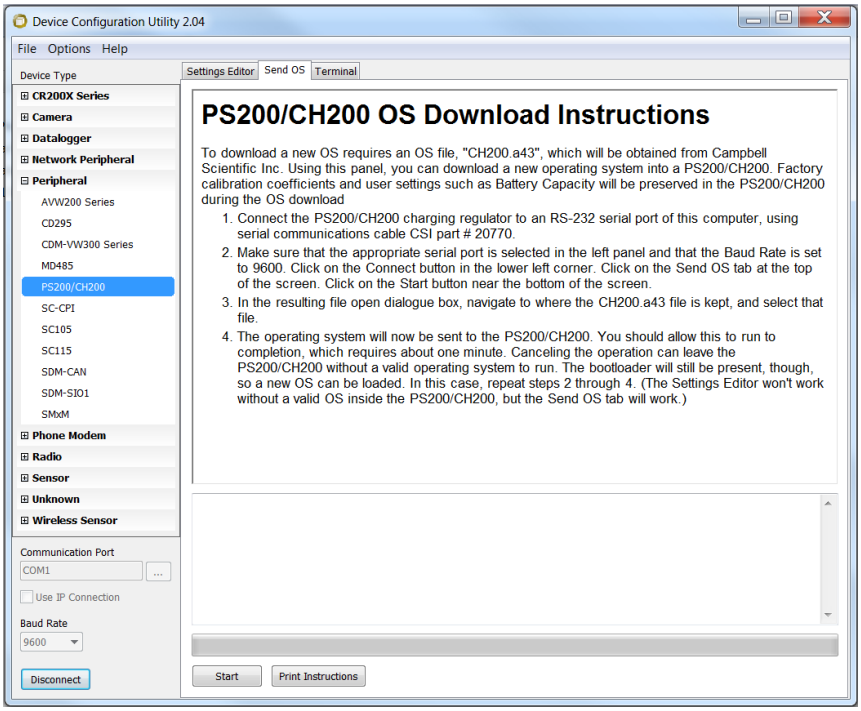


FIGURE 6-5. Downloading a new operating system

6.2 SDI-12

SDI-12 is a serial communications standard specifically designed for reading measurements from multiple measurement sensors to a “data recorder”, which in this context is synonymous with datalogger. For a complete technical definition of the SDI-12 protocol, go to the web site, *www.sdi-12.org*.

The PS200/CH200 is an SDI-12 sensor compliant with version 1.3 of the standard, and Campbell Scientific loggers are capable of acting as SDI-12 recorders. A Campbell Scientific datalogger or other SDI-12 recorder can be connected to a PS200/CH200 via the cable Campbell Scientific part # 20769. SDI-12 uses only one wire and a ground for serial communications. The

Campbell Scientific CR1000 datalogger, for example, has four SDI-12 ports on control ports 1, 3, 5, and 7.

Campbell Scientific Item #20769 SDI-12 Cable Wiring (see FIGURE 6-6)

Green: Control port used for SDI-12 communication. (CR1000 odd numbered control ports)

Black: G

Clear: G

NOTE

All SDI-12 sensors take time to reply back to a request for data. It is recommended to put any SDI-12 instructions in a "slow sequence" to minimize interrupting the main program.

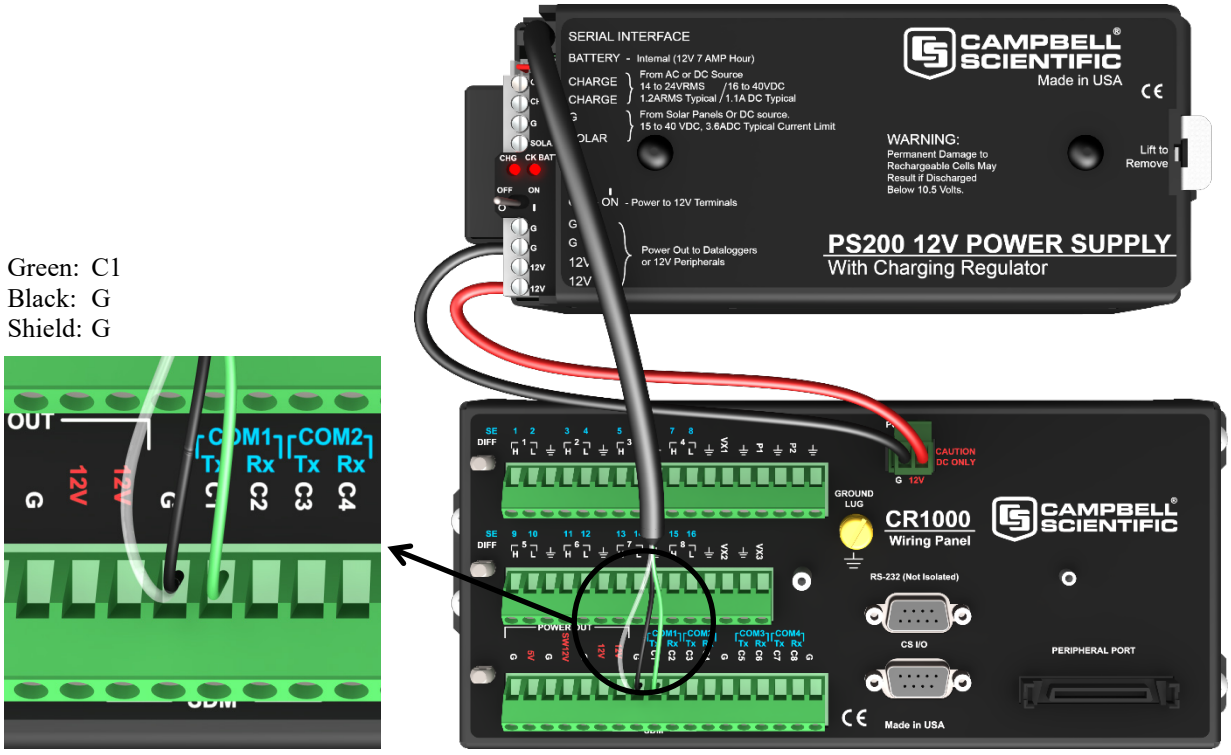


FIGURE 6-6. PS200 connected to a CR1000 via SDI-12

6.2.1 SDI-12 Address

The SDI-12 standard is designed so that multiple SDI-12 sensors can be connected in parallel to a common SDI-12 port of an SDI-12 recorder (datalogger). Each of the SDI-12 sensors is assigned a unique SDI-12 address. Valid addresses are 0 through 9, A through Z, and a through z. From the factory a PS200/CH200 has an SDI-12 address of 0. There are three different means by which a PS200/CH200 SDI-12 address can be changed:

1. Campbell Scientific DevConFig. (See Section 6.1.2, *Settings Editor Tab*.)
2. The RS-232 text based interface. (See Section 6.1.3, *Terminal Tab*.)

3. Via SDI-12 according to the SDI-12 standard.

Normally Device Configuration Utility (see Section 6.1.2, *Settings Editor Tab*) or the RS-232 text based interface (see Section 6.1.3, *Terminal Tab*) is used to change the SDI-12 address of a PS200/CH200. The SDI-12 address is usually set once and then seldom if ever changed again. The SDI-12 address stored in the PS200/CH200 is saved in "nonvolatile" memory and will not be lost by power cycling the device. If required a CR1000 or newer table based datalogger can be used to send a new SDI-12 address to the PS200/CH200. An example program for changing the SDI-12 address is available at *www.campbellsci.com/downloads/ps200-example-programs*.

If a datalogger program is created to set the SDI-12 address of a PS200/CH200 or other SDI-12 sensor via SDI-12, the program can only be used for one SDI-12 sensor at a time. All other sensors must be disconnected from that SDI-12 port of the datalogger.

6.2.2 SDI-12 Measurements

The PS200/CH200 reports 9 measurements via the SDI-12 M! command, as described below. Because SDI-12 is a low speed standard, this M! command should only be used in a slow sequence with a scan rate of 2 seconds or longer. Individual measurements using M1! through M6! (described below) can be used in scan rates of 1 second. Note: If you are using a CR2XX datalogger, the OutString parameter is entered as aMx! without quotes, where a is the associated SDI-12 Recorder address and x is 1…6.

NOTE Older CR10(X) and CR23X dataloggers will only work with aMx! commands.

Recorder: M0! Return All Main Values.

PS200/CH200 measurements:
1 - Battery Voltage (V).
2 - Battery Current (A).
3 - Load Current (A).
4 - Charge Input Voltage (V).
5 - Charge Input Current (A).
6 - Temperature (°C).
7 - Charge state (-1 = regulator fault, 0 = no charge, 1 = current limited charging, 2 = cycle charging, 3 = float charging, 4 = battery test).
8 - Charge Source (0 = none, 1 = solar, 2 = continuous).
9 – Check Battery (0 = normal, 1 = Check Battery - indicates battery voltage not increasing after significant charging).

The SDI-12 commands "Mx!" with x = 1...6 can be used to select different subsets of the above measurements, as described below:

Recorder: M1! Return Battery Voltage, Battery and Load Current.

PS200/CH200 measurements:
1 - Battery Voltage (V).
2 – Battery Current (A).
3 – Load Current (A).

Recorder: M2! Return Battery Voltage, Battery and Load Current and Temperature.

PS200/CH200 measurements:
1 - Battery Voltage (V).
2 – Battery Current (A).
3 – Load Current (A).
4 – Temperature (°C)

Recorder: M3! Regulator Input and Output Parameters and Temperature.

PS200/CH200 measurements:
1 - Battery Voltage (V).
2 – Battery Current (A).
3 – Load Current (A).
4 - Charge Input Voltage (V).
5 - Charge Input Current (A).
6 - Temperature (°C).

Recorder: M4! Return Charge Input Voltage and Current and Temperature.

PS200/CH200 measurements:
1 – Charge Input Voltage (V).
2 - Charge Input Current (A).
3 - Temperature (°C).

Recorder: M5! Return Charge State, Charge Source and Check Battery.

PS200/CH200 measurements:
1 - Charge State (-1 = regulator fault, 0 = no charge, 1 = current limited charging, 2 = cycle charging, 3 = float charging, 4 = battery test).
2 - Charge Source (0 = none, 1 = solar, 2 = continuous).
3 – Check Battery (0 = normal, 1 = Check Battery – indicates battery voltage not increasing after significant charging).

Recorder: M6! Return Target Battery Voltage, Battery Capacity, Qloss and Digital Pot Setting.

1 – Target Battery Voltage (V)
2 – Digital Pot Setting
3 – Battery Capacity (Ah)
4 – Qloss (Ah)

A zero out QLoss SDI-12 program example is available at *www.campbellsci.com/downloads/ps200-example-programs*.

Recorder: M7! Available for future use.

Recorder: M8! Available for future use.

Recorder: M9! Available for future use.

A programming example that acquires all 9 measurements once per minute from a PS200/CH200 is available at *www.campbellsci.com/downloads/ps200-example-programs*. Note that the PS200/CH200 does internal averaging of the voltage, current, and temperature measurements, with an averaging period that is set by the scan rate.

6.2.3 SDI-12 Extended Commands

The response to all of the commands in this section is **aOK**, where 'a' is the SDI-12 address of the PS200/CH200.

Downloadable example programs using the extended commands are available at *www.campbellsci.com/downloads/ps200-example-programs*.

6.2.3.1 Write Remote Battery Temperature to PS200/CH200

aXTmm.dd! command overrides the internal temperature measurement, where 'a' is the PS200/CH200's SDI-12 address and mm.dd refers to an ASCII string of numerals with a decimal point of temperature in degrees Centigrade within -40 and 100°C. This command overrides the PS200/CH200 internal temperature measurement for 15 minutes or until canceled by a temperature restore command. The temperature value is used in calculating the optimal battery charge voltage.

6.2.3.2 Restore Internal Battery Temperature Measurement

aXTR! Restore to internal PS200/CH200 battery temperature, where 'a' is the SDI-12 address of the PS200/CH200.

Undo what was done with the **XTmm.dd! c**ommand.

6.2.3.3 Change Battery Capacity Value in PS200/CH200

aXCmm.d! Enter battery capacity, where 'a' is the PS200/CH200's SDI-12 address and mm.d is ASCII representation of battery capacity in Ah.

To use the quicker dual rate charging scheme in the PS200/CH200 a value other than zero must be entered into the battery capacity field. BUT! This value needs to be the actual amp-hour capacity of the battery being used or the charger will not charge correctly. This instruction allows the user to change the battery capacity in the field if they find themselves swapping out batteries with a different amp-hour capacity model.

6.2.3.4 Enter Battery Test State

aXB! Enter battery test state with 90 second time out, where 'a' is the SDI-12 address of the PS200/CH200.

Use this instruction to cause the system to run strictly on battery voltage and test the battery for sulfation or other issues.

This command can be used in a datalogger program to test a battery connected to a PS200/CH200. This command instructs a PS200/CH200 to set its charging voltage to 11.5 VDC for 90 seconds. Generally, the battery voltage will be greater than 11.5 VDC, so this command momentarily causes a PS200/CH200 to stop charging the battery. Then, the datalogger program can analyze the battery charging capacity. Because the BATT_TEST command stays in effect for only 90 seconds, the datalogger program must issue the BATT_TEST command more frequently than once per 90 seconds for as long as the test is to last.

6.2.3.5 Zero Out Qloss (Battery Charge Deficit)

aXRQ! Set Qloss to zero, where 'a' is the SDI-12 address of the PS200/CH200.

Qloss will not automatically set itself back to zero unless it has been trying to cycle charge a battery for eight hours or more. Qloss is a handy way to monitor the charge/discharge characteristics of a system but occasionally it might need to be set back to zero.

6.2.3.6 Power Usage

Although this is not an instruction in and of itself the ability to calculate power usage by the battery and the system is a very powerful capability of the PS200/CH200. Measuring and storing power usage is useful to determine system power requirements (power budget) and help to identify devices using too much power.

An example program about station power usage is available at *www.campbellsci.com/downloads/ps200-example-programs*.

6.3 RS-232 Interface

6.3.1 Text Based Interface

The PS200/CH200 has a simple text based interface via RS-232 that can be used with HyperTerminal or Campbell Scientific DevConfig terminal screen. Battery Voltage (V), Battery Current (A), Load Current (A), Charge Input Voltage (V), Charge Input Current (A), Temperature (°C), Charge State, Charge Source (solar or continuous), Check Battery flag (True or False) and Capacity (Ah) can be viewed. Also, the SDI-12 address of a PS200/CH200 can be changed via the text based interface.

The cable Campbell Scientific part # 20770 connects a PS200/CH200 to an RS-232 COM port of a computer for use with the text based interface or Campbell Scientific DevConfig.

The RS-232 settings are:

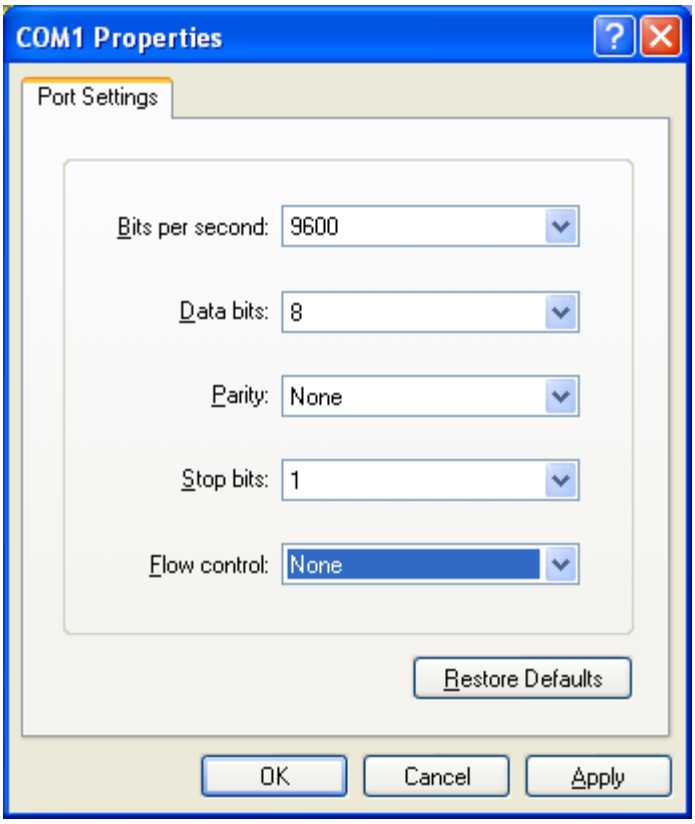
Bits per second:	9600
Data bits:	8
Parity:	None
Stop bits:	1
Flow Control:	None

To use Microsoft Hyper Terminal on a computer running Microsoft Windows XP, for example, click on Start, All Programs, Accessories, Communications, Hyper Terminal. A dialog box will open:

Pick a name for the connection, such as “CH200”.

Click on Ok, and then select the COM port to use with the PS200/CH200:

Click on OK, and then set the COM port settings:

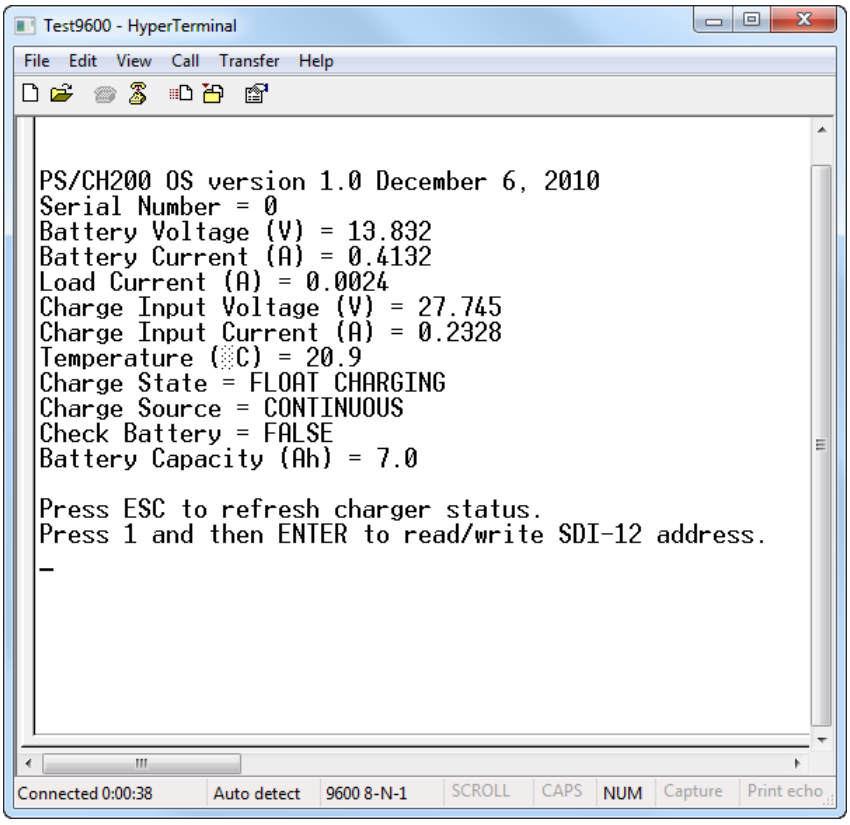


Click on Apply and then OK, and the terminal screen should open. Click inside the terminal screen and press ESC (may have to press ESC twice).

To refresh the charger status screen, press ESC.

To change the SDI-12 address of the PS200/CH200, press 1 and then Enter.

Also, as shown in Section 6.2.2, *SDI-12 Measurements*, the PS200/CH200 RS-232 text based interface can be viewed from within Campbell Scientific DevConfig.



6.3.2 RS-232 Communications with a Campbell Scientific Datalogger

The Campbell Scientific CRBasic commands “SerialOut” and “SerialIn” are designed for RS-232 communications in general and can be used with a PS200/CH200 to read battery voltage (V), battery current (A), load current (A), charge input voltage (V), charge input current (A), temperature (°C), charge state, charge source (solar or continuous), and a check battery flag (true or false).

All PS200/CH200 serial communications are via its four-pin connector. There are two RS-232 interface cables that can be used to connect a datalogger to the PS200/CH200.

To use the RS-232 9-pin connector on the face of the datalogger use RS-232 serial cable item# 20770 with an additional null modem cable such as Campbell Scientific item# 18663.

To use control ports configured as RS-232 serial ports (COM1 – COM4) use Campbell Scientific item # 25356.

Campbell Scientific Item #25356 RS-232 Datalogger Cable Wiring (see FIGURE 6-7)

Green: Tx COM Port
White: Rx COM Port
Black: G
Clear: G

The RS-232 settings are:

Bits per second:	9600
Data bits:	8
Parity:	None
Stop bits:	1
Flow Control:	None

Green: C1 (Tx)
White: C2 (Rx)
Black: G
Shield: G

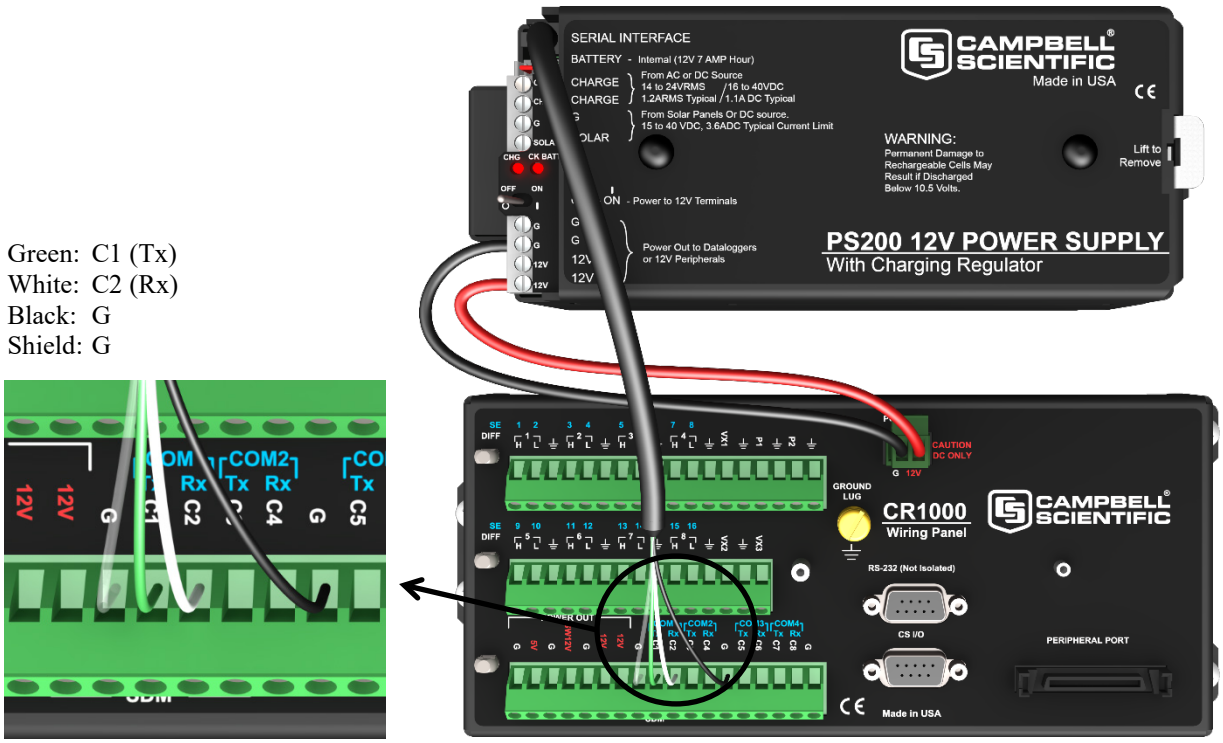


FIGURE 6-7. PS200 connected to a CR1000 via RS-232

The PS200/CH200 will answer via RS-232 when commanded by an RS-232 host. The host initiates communication by sending an ASCII command string (ASCII '>'). Communication must be terminated with a carriage return, denoted below by <CR> which is the ASCII hexadecimal character 0D. The PS200/CH200 response string will begin with the ASCII '*' character followed by the requested data strings separated by commas and then two check sum characters and finally the string termination character, hexadecimal 00. The check sum characters are computed within the PS200/CH200 and deciphered by the datalogger using the CRBasic instruction "CheckSum (ch200string,5,0)". A correct check sum will produce a result of zero. A non-zero result would indicate that transmission error(s) occurred. See more about how to use the check sum instruction below.

6.3.3 RS-232 Host (Datalogger) Command Strings and PS200/CH200 Response Strings

Example programs about using RS-232 command strings are available at *www.campbellsci.com/downloads/ps200-example-programs*.

6.3.3.1 Read Status

Host command string: **RD_STAT><CR>**

PS200/CH200 response string: ***,nnnn,nnnn,….,cc0**

where "nnnn" refers to ASCII character strings that are separated by ASCII commas, "cc" is a two-character CRC nullifier, and 0 is the string terminator. The PS200/CH200 character strings occur in the following order (the sequence order numbers shown below do not occur in the character strings):

1 – Battery Voltage, 2 – Battery Current, 3 – Load Current,
4 – Charge Input Voltage, 5 – Charge Input Current, 6 – Temperature,
7 – Charge State, 8 – Charge Source, 9 – Check Battery.

The character strings are numerical values expressed in ASCII numerals and decimal points except for Charge State and Charge Source, which appear as ASCII letter strings.

The Charge State string will be one of these character strings:

REGULATOR FAULT
NO CHARGE
CURRENT LIMITED
CYCLE CHARGING
FLOAT CHARGING
BATTERY TEST

The Charge Source string will be one of these character strings:

NONE
SOLAR
CONTINUOUS

6.3.3.2 Write Remote Battery Temperature to PS200/CH200

Host command string: **WR_BT(mm.dd)> <CR>**

where **mm.dd** refers to an ASCII string of numerals with a decimal point of temperature in degrees Centigrade within -40 and 100 that overrides the PS200/CH200 internal temperature measurement for 15 minutes or until canceled by a temperature restore command. The temperature value is used in calculating the optimal battery charge voltage.

PS200/CH200 response string

***Battery Temperature = nnnn,cc0**

where **nnnn** refers to the ASCII numerical value string just sent from the host, and **"cc"** is a two-character CRC nullifier, and 0 is the string terminator.

6.3.3.3 Restore Internal Battery Temperature Measurement

Host command string: **RS_INTBT> <CR>**

PS200/CH200 response string: ***OKcc0**

where **"cc"** is a two-character CRC nullifier, and 0 is the string terminator.

6.3.3.4 Change Battery Capacity Value in PS200/CH200

Host command string: **WR_BC(xx.xx)> <CR>**

This command sets the battery capacity in Ah, which the PS200/CH200 uses in its charging algorithm.

PS200/CH200 response string: ***Battery capacity = xx.xx <crc> <CR> <LF>**.

6.3.3.5 Enter Battery Test State

Host command string: **BATT_TEST> <CR>**

This command can be used in a datalogger program to test a battery connected to a PS200/CH200. This command instructs a PS200/CH200 to set its charging voltage to 11.5 VDC for 90 seconds. Generally, the battery voltage will be greater than 11.5 VDC, so this command momentarily causes a PS200/CH200 to stop charging the battery. Then, the datalogger program can analyze the battery charging capacity. Because the BATT_TEST command stays in effect for only 90 seconds, the datalogger program must issue the BATT_TEST command more frequently than once per 90 seconds for as long as the test is to last.

PS200/CH200 response string: ***OKcc0**

where **"cc"** is a two-character CRC nullifier, and 0 is the string terminator.

6.3.3.6 Zero Out Qloss

Host command string: **RESET_QLOSS> <CR>**

PS200/CH200 response string: ***OKcc0**

where **"cc"** is a two-character CRC nullifier, and 0 is the string terminator.

6.3.3.7 Read Special PS200/CH200 Settings and Variables

Host command string: **RD_SPECIAL> <CR>**

PS200/CH200 response string: ***,nnnn,nnnn,….,cc0**

where "nnnn" refers to ASCII character strings that are separated by ASCII commas, "cc" is a two-character CRC nullifier, and 0 is the string terminator. The PS200/CH200 character strings occur in the following order (the sequence order numbers shown below do not occur in the character strings):

1 - Target Battery Voltage, 2 - Digital Pot Setting, 3 - Capacity, 4 – Qloss, 5 - Continuous Input Volts.

The character strings are numerical values expressed in ASCII numerals and decimal points except for Charge State and Charge Source, which appear as ASCII letter strings.

6.3.3.8 Power Usage

Although this is not an instruction in and of itself the ability to calculate power usage by the battery and the system is a very powerful capability of the PS200/CH200. Measuring and storing power usage is useful to determine system power requirements (power budget) and help to identify devices using too much power.

6.3.4 Datalogger Programming for RS-232 Communication to the PS200/CH200

The normal condition for the PS200/CH200 is that it expects SDI-12 communication, so when the host first sends RS-232 characters, the first character might be missed. Therefore, the host should initiate RS-232 communication by sending two backspace characters (hexadecimal 08). See the example below.

```
'Subroutine sends two back space characters to the PS/CH200 to
 'wake it up and switch over to RS-232 mode.
Sub WAKEUP
  SerialOut (COMPRT,CHR(&H08),"",1,3)
  SerialOut (COMPRT,CHR(&H08),"",1,3)
EndSub
```

In processing the strings from a PS200/CH200, use the CRBasic instruction "SerialIn" and then use the instruction "SplitStr" to separate the numerical values into individual values. The CRBasic instruction "Checksum" can optionally be used to validate data from a PS200/CH200. If "CheckSum" is to be used, two successive "SerialIn" instructions should be used—one to discard everything up to and including the "*" character which starts a PS200/CH200 response string, and another to obtain all the characters after the "*" up to and including the string terminator character, zero.

An example CRBasic program that reads the status information from a PS200/CH200 using RS-232 is available at *www.campbellsci.com/downloads/ps200-example-programs*.

7. Charging Details

7.1 Charging Algorithm

The PS200/CH200 offers both Continuous and Solar charging inputs. The Continuous charging input has a user adjustable input current limit with a maximum (default) value of 1.1 A DC to help protect AC/AC transformers and AC/DC converters. The 3.6 ADC typical current limit of the PS200/CH200 Solar charging input is well suited for 70 W solar panels. Typical Continuous charging inputs would be AC/AC transformers or AC/DC converters in which

a charge voltage is continuously applied except for line power outages. When powered from a Continuous charging input, the PS200/CH200 tries to maintain the battery at a float charge voltage, which can continue indefinitely without overcharging the battery.

When powered from a Solar charging input, the PS200/CH200 utilizes a two-step constant voltage charging algorithm, which is the preferred method for rapidly charging VRLA batteries[1]. When powered from the Solar charging input, the battery charge deficit (Qloss) is compared to the specified battery capacity in order to determine if aggressive cycle charging is necessary. Cycle charging is then utilized if Qloss is determined to be greater than 20% of the battery capacity. Upon detection that the battery is near full charge, the constant voltage charging level is reduced from the aggressive cycle charging voltage to the non-aggressive float charge voltage to prevent overcharging and unwanted gassing of the battery.

In the PS200, the battery capacity is set to 7 Ah hours at the factory, whereas the battery capacity is left at the default value of 0 Ah in the CH200 where the user provides the battery. If the battery capacity is left at the default value of zero, then Qloss always equals 0, which disables cycle charging. Consequently, CH200 users must enter in the battery capacity in order to enable the aggressive cycle charging capability of the two-step constant voltage charging algorithm.

Discharged VRLA batteries can initially accept large charging currents, often resulting in the charger being unable to initially maintain a constant voltage because of current limiting by the charge source or the charger itself. As a result, a typical two-step constant voltage charging cycle usually consists of three distinct stages; a current limited charge stage, a constant cycle voltage charge stage, and a constant float voltage charge stage, as illustrated in FIGURE 7-1. The current limited stage and/or the constant cycle charge voltage stage may not occur if the battery size is small relative to the current capability of the charge source, or if the battery is near full charge at the beginning of a charge cycle.

Normally cycle charging terminates and float charging begins when Qloss has been reduced to zero. Two exceptions exist, both of which help prevent overcharging of the battery. One exception to this normal cycle to float transition occurs if cycle charging has been on-going for 8 hours without interruption, indicating some sort of battery problem. In this case cycle charge will be terminated and Qloss will be zeroed. The other exception to the normal cycle to float transition when Qloss has been reduced to zero occurs if during cycle charging the battery charge current is reduced to below C/100, where C is the user entered battery capacity. This condition indicates the charger is trying to aggressively cycle charge a fully charged battery, perhaps because a new fully charged battery was swapped in replacing an old battery which suffered from a significant Qloss. During cycle charging if the battery charge current falls below C/100, then cycle charge will be terminated and Qloss will be set to zero (0).

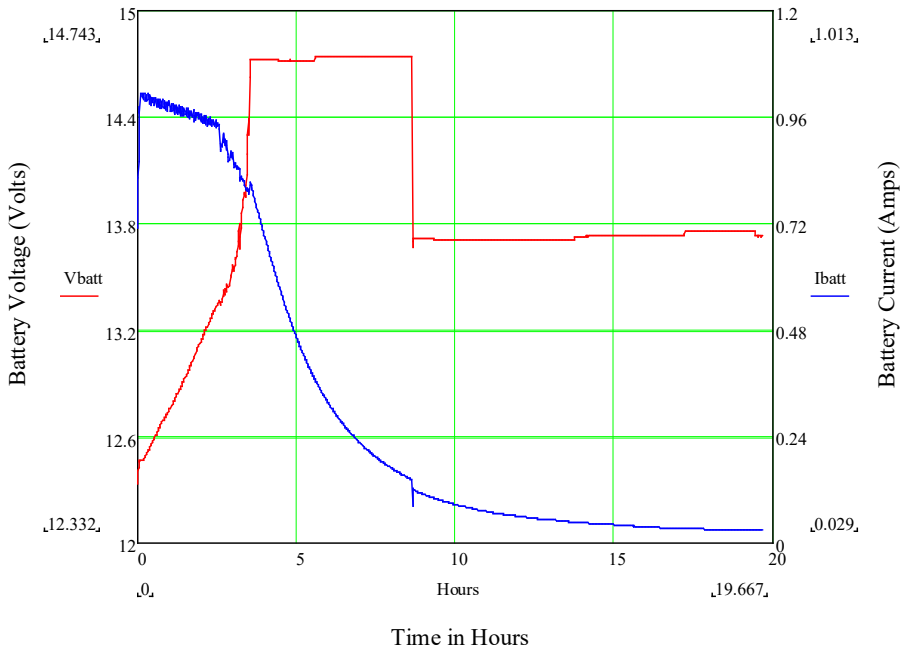


FIGURE 7-1. 2 step constant voltage battery charging by PS200/CH200

7.2 Maximum Power Point Tracking

The current and power versus voltage for a 70 W solar panel are illustrated in FIGURE 7-2. As can be seen from the figure, a Maximum Power Point of operation exists for solar panels. Adjusting the load on the solar panel so it operates at this Maximum Power Point is referred to as Maximum Power Point Tracking (MPPT). MPPT is beneficial when insufficient power is available from the charge source, which is the case during current limited charging. The somewhat noisy charging current and voltage observed in FIGURE 7-1 during the initial current limited charging stage is due to the MPPT algorithm of the PS200/CH200 searching for the maximum power point of the associated solar panel.

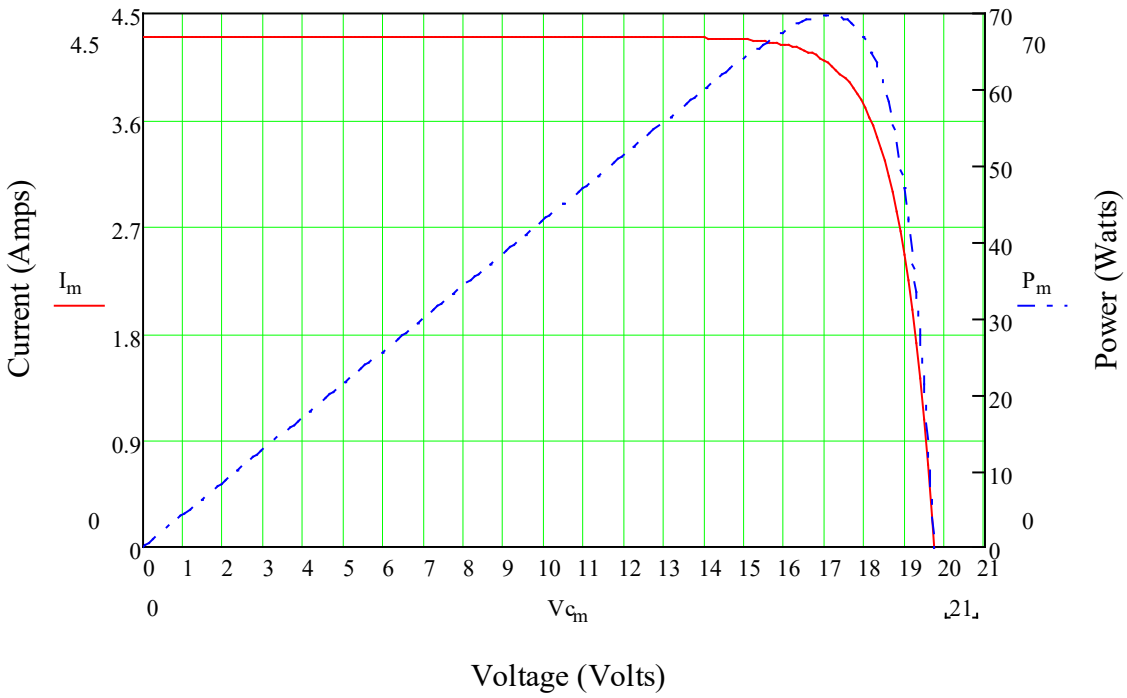


FIGURE 7-2. 70 W solar panel I – V and power characteristics

8. A100 Null Modem Adapter

The A100 adapter has two 9-pin CS I/O ports with a null modem between them. The ports are used to connect two 9-pin devices (e.g., modems or RF radios) that would normally be connected to the CS I/O port of a Campbell datalogger. The charger supplies 12 volts and 5 volts to the appropriate pins on the connector for powering the connected devices. This functionality is required in a station where a datalogger will not be present, such as a phone-to-RF base station. The A100 cannot be used as a null modem between two RS-232 devices.

FIGURE 8-1. Null modem connections

FIGURE 8-2. PS200 with A100 module using a COM220 and RF450

9. A105 Additional 12 V Terminals Adapter

The A105 adapter adds four 12 V terminals and four ground terminals to a PS200/CH200 charging regulator. The extra terminals make it easier to wire multiple continuously powered 12 Vdc devices to the power supply.

FIGURE 9-1. A105 adapter

10. References

1 – Genesis Application Manual – Genesis NP and NPX Series US-NP-AM-002, June 2006.

Limited warranty

Covered equipment is warranted/guaranteed against defects in materials and workmanship under normal use and service for the period listed on your sales invoice or the product order information web page. The covered period begins on the date of shipment unless otherwise specified. For a repair to be covered under warranty, the following criteria must be met:

1. There must be a defect in materials or workmanship that affects form, fit, or function of the device.

2. The defect cannot be the result of misuse.

3. The defect must have occurred within a specified period of time; and

4. The determination must be made by a qualified technician at a Campbell Scientific Service Center/ repair facility.

The following is not covered:

1. Equipment which has been modified or altered in any way without the written permission of Campbell Scientific.

2. Batteries; and

3. Any equipment which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact to determine which Campbell Scientific office serves your country. For directions on how to return equipment, see Assistance.

Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

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Campbell Scientific will, as a default, return warranted equipment by surface carrier prepaid. However, the method of return shipment is at Campbell Scientific's sole discretion. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This warranty and the Company's obligation thereunder is in lieu of all other

warranties, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

In the event of any conflict or inconsistency between the provisions of this Warranty and the provisions of Campbell Scientific's Terms, the provisions of Campbell Scientific's Terms shall prevail. Furthermore, Campbell Scientific's Terms are hereby incorporated by reference into this Warranty. To view Terms and conditions that apply to Campbell Scientific, Logan, UT, USA, see Terms and Conditions. To view terms and conditions that apply to Campbell Scientific offices outside of the United States, contact the regional office that serves your country.

Assistance

Products may not be returned without prior authorization. Please inform us before returning equipment and obtain a **return material authorization (RMA) number** whether the repair is under warranty/guarantee or not. See Limited warranty for information on covered equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact to determine which Campbell Scientific office serves your country.

When returning equipment, a RMA number must be clearly marked on the outside of the package. Please state the faults as clearly as possible. Quotations for repairs can be given on request.

It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment. In support of this policy, when equipment is returned to Campbell Scientific, Logan, UT, USA, it is mandatory that a "Declaration of Hazardous Material and Decontamination" form be received before the return can be processed. If the form is not received within 5 working days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. For details on decontamination standards specific to your country, please reach out to your regional Campbell Scientific office.

> NOTE:
> All goods that cross trade boundaries may be subject to some form of fee (customs clearance, duties or import tax). Also, some regional offices require a purchase order upfront if a product is out of the warranty period. Please contact your regional Campbell Scientific office for details.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a hardhat and eye protection, and take other appropriate safety precautions while working on or around tripods and towers.
- Do not climb tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- You can be killed or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in contact with overhead or underground utility lines.
- Maintain a distance of at least one-and-one-half times structure height, 6 meters (20 feet), or the distance required by applicable law, whichever is greater, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.

- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

Use and disposal of batteries

- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

Avoiding unnecessary exposure to radio transmitter radiation

- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

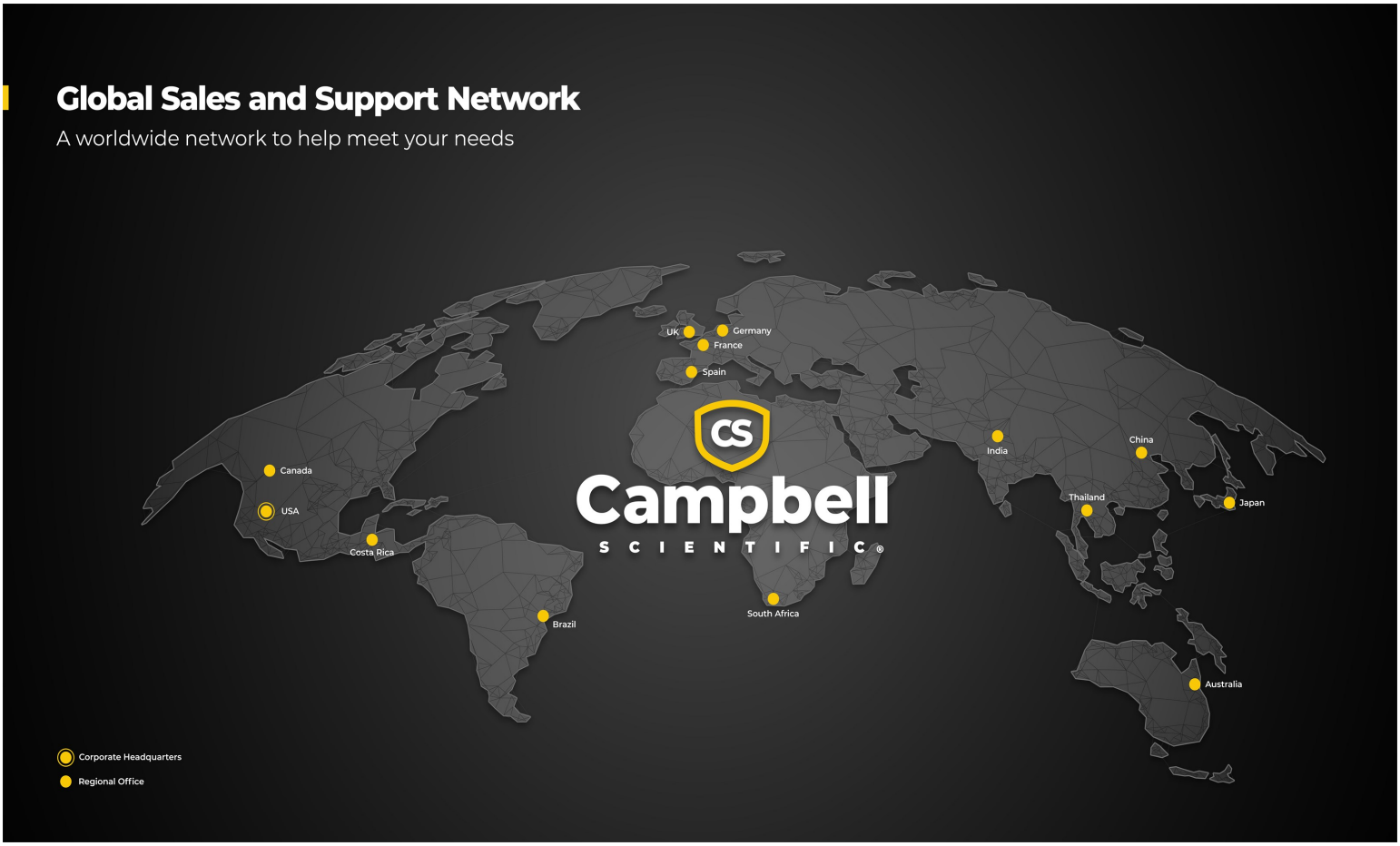
Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

Global Sales and Support Network

A worldwide network to help meet your needs



Campbell Scientific Regional Offices

Australia

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

Brazil

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Email:	vendas@campbellsci.com.br
Website:	www.campbellsci.com.br

Canada

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