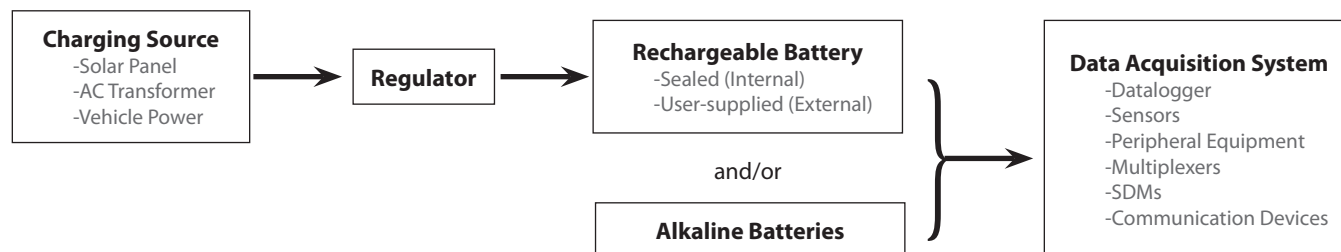# CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Power Supply Overview
Batteries, Regulators, Charging Sources

Campbell Scientific's data acquisition systems are powered by reliable, inexpensive 12 Vdc sources.[a] Power consumption by our dataloggers, peripherals, and sensors is minimal, allowing extended operation from our standard sealed rechargeable battery or set of alkaline cells. Systems that require more power can be supplemented with external rechargeable batteries, regulators, and charging sources (ac transformer, solar panels). The diagram above depicts the interaction of the components in a power supply system.

Charging Source
- Solar Panel
- AC Transformer
- Vehicle Power

Regulator

Rechargeable Battery
- Sealed (Internal)
- User-supplied (External)

and/or

Alkaline Batteries

Data Acquisition System
- Datalogger
- Sensors
- Peripheral Equipment
- Multiplexers
- SDMs
- Communication Devices

Calculating Power Consumption

The system's power consumption can be approximated by calculating the average current required by the datalogger, sensors, and peripheral equipment (multiplexers, SDMs, and communication devices). This average current drain is primarily determined by the percentage of time spent in an active versus quiescent state, which can be approximated from the datalogger's scan rate (Execution Interval) and the program length. Please note that short scan rates dramatically affect average current drain (see graph below).

Current Drain of Typical Weather Station
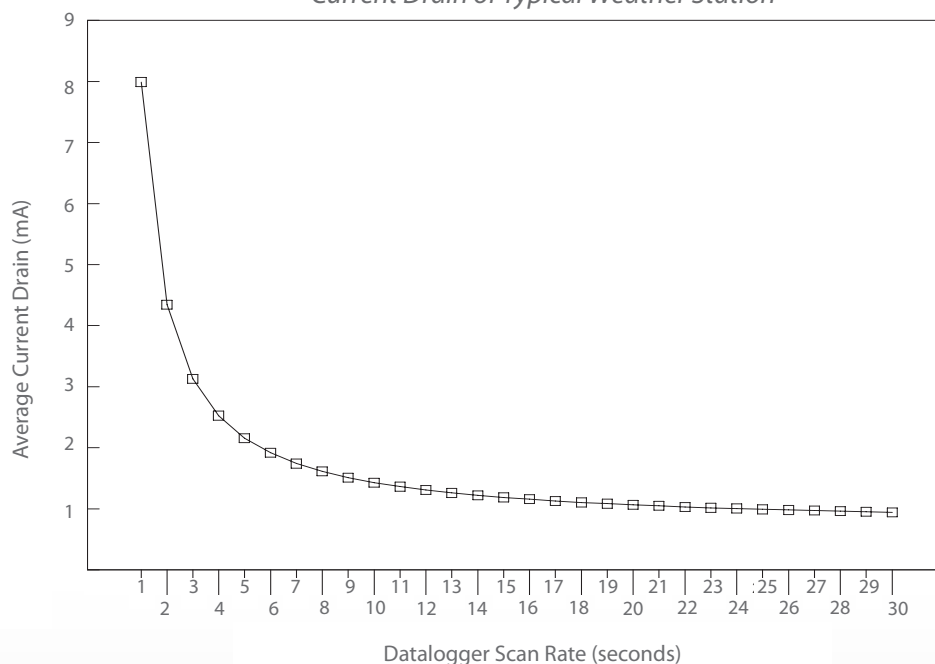
Average Current Drain (mA) vs. Datalogger Scan Rate (seconds)

questions & quotes: **435.227.9120**

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Example Calculation

In applications where the scan rate is in excess of 30 seconds, the datalogger's average current drain approaches the quiescent drain. For example, a CR1000-based weather station measuring standard meteorological sensors at a thirty second (30 s) scan rate has an average current drain of:

State	Duration (seconds)	Current Drain (mA)
Active	0.2	10
Quiescent	29.8	0.6

CR1000 Average Current Drain $= \dfrac{(0.2\ s)(10\ mA) + (29.8\ s)(0.6\ mA)}{30\ s}$

$= 0.66\ mA$

Communication with the station for data retrieval, monitoring, or program transfer also consumes power as the datalogger goes into a processing state, and activates the communication device.

To conserve power, Campbell Scientific's modem devices are active only during communication.

For example, if the station is called once a day (1440 min) for 5 minutes via telephone (COM220 modem), the current drain is:

State	Duration (minutes)	Current Drain (mA)
Active	5	30 (COM220) + 10 (CR1000) = 40
Quiescent	1435	0.012

Current Drain $= \dfrac{(5\ min)(40\ mA) + (1435\ min)(0.012\ mA)}{1440\ min.}$

$= 0.15\ mA$

Assuming negligible power consumption by the meteorological sensors, the system's average current drain is:

0.66 mA + 0.15 mA = 0.81 mA or 0.00081 A

Alkaline 12 Vdc Batteries

The availability of alkaline batteries makes them attractive for short-term applications where the batteries can be replaced quickly and easily.

Campbell Scientific offers the ALK7 and BPALK alkaline battery packs. The ALK7 is typically used with the CR310 or CR300 dataloggers. This battery pack uses eight, user-supplied D-cell batteries to provide a nominal rating of 7 Ah.

The BPALK typically powers a CR800, CR850, CR1000X, or CR1000 datalogger and has a 7.5 Ah nominal rating. It includes eight D-cell batteries and a 12 V backup battery pack that uses eight, user-supplied AA-cell batteries.

The CR3000 datalogger can have an alkaline battery base as part of its integrated package. A CR3000 with this battery base is powered by 10 D cells that provide a nominal rating of 10 Ah.

Alkaline batteries are not rechargeable, and their Amp-hour ratings decrease with temperature extremes. Alkaline batteries may leak when used outside the temperature range of -25° to +50°C, or when the battery voltage drops below 9.6 V.
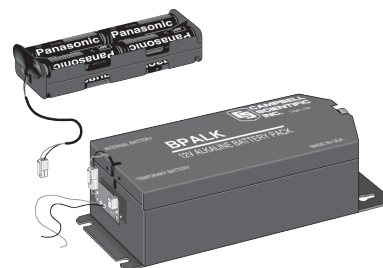
For the above weather station with a system current drain of 0.00081 A, the BPALK alkaline batteries theoretically last:

7.5 Ah/0.00081 A = 9259 hrs or about 385 days

In practice, we suggest monitoring battery voltage to determine actual replacement time.

Rechargeable 12 Vdc Batteries

The rechargeable base is ordered as an option for the CR3000 datalogger.

All of our dataloggers can be powered by a rechargeable power supply that consists of a rechargeable battery, regulator circuitry, and charging source (typically an ac wall charger or solar panel).

For our CR3000 datalogger, the rechargeable battery base is part of their integrated package. The rechargeable base consists of regulator circuitry and a rechargeable battery with a nominal rating of 7.0 Ah.

Integrated Power Supplies

PS150 and PS200

Campbell Scientific's PS150 and PS200 are integrated power supplies for our CR800, CR850, CR1000X, and CR1000 dataloggers. They consist of regulator circuitry, connectors for attaching a charging source (e.g., wall charger, solar panel), and a sealed rechargeable battery that has a nominal rating of 7.0 Ah. The PS150 and PS200 are micro-controller-based smart chargers with temperature compensation that optimizes battery charging and increases the battery's life. Two input terminals enable simultaneous connection of two charging sources.

The PS200 also includes RS-232 and SDI-12 terminals that allow the PS200 to convey charging parameters to a datalogger. These measured parameters can be used to compute net charging currents, battery health, and power budgets for improved site management.
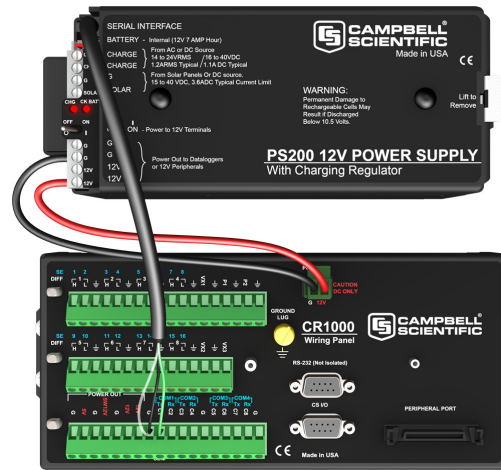
The PS200 can provide real-time measurements of charge input voltage, battery voltage, on-board temperature, battery current, and load current.

PS24 and PS84

The PS24 and PS84 are ideal if the power supply will be housed in a separate enclosure. The PS24 consists of a 24 Ah battery, CH150 or CH200 regulator, enclosure mounting bracket, and a 10-inch-by-12-inch enclosure. The PS84 consists of an 84 Ah battery, enclosure mounting bracket, a 14-inch-by-16-inch enclosure, and either the 18529 Sunsaver or CH200 regulator.

Sealed Rechargeable Batteries with Mounts

The BP7, BP12, BP24, and BP84 consist of a rechargeable battery, enclosure mounting bracket, and cables. The BP7 is a 7 Ah battery that typically connects to the onboard regulator circuitry included on the CR310, CR300, or CR6 dataloggers. It is also used with a CR800, CR850, CR1000X, or CR1000 when the battery needs to be mounted under the 31143 Hinged Stack Bracket. To use the BP7 to power a CR800, CR850 CR1000X, or CR1000, you need the 22024 cable and a CH150 or CH200 regulator.

The BP12, BP24, and BP84 batteries are for powering systems that have higher current drain equipment[b] such as satellite transmitters. These batteries must be connected to a regulator.

Regulators

Regulators control the current flowing to the battery and prevent the battery current from flowing to the charging source. Internal regulator circuitry is included with our PS150 and PS200 power supplies; SP10R and SP20R solar panels; CR6, CR310, and CR300 dataloggers; and the CR3000 rechargeable battery base.

A stand-alone regulator must be used with our BP12, BP24, and BP84 batteries as well as our SP50 and SP90 solar panels. The BP12 and BP24 batteries can use either a CH150 or CH200 regulator. The CH150 regulator is for standard applications, and the CH200 includes terminals that allow the CH200 to convey charging parameters to a datalogger. The SP50, SP90, and BP84 can use either the CH200 or 18529 Sunsaver regulator.

Charging Source

AC Power Converters[c]

Power converters charge sealed rechargeable batteries by using power from external ac power lines. The 29796 converts 100 to 240 Vac to a regulated 24 Vdc. On one end, the 29796 has a plug that inserts into an ac wall socket, and on the other end, it has pigtails that attach to the power supply terminals.

The 22110 wall charger is used with our prewired enclosures. On one end, the 22110 has a plug that inserts into an ac wall socket, and on the other end, it has a connector that attaches to the prewired enclosure. The 22110 outputs 24 Vdc at 1.67 A and accepts 100 to 240 Vac.

The 29796 (left) and 22110 come standard with a USA/Canada plug, and have an option for a kit that supports international use.

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[b]The current drain of some systems may require ac power or a user-supplied deep-cycle RV battery.

[c]This document only discusses the wall chargers used with the datalogger power supply. Wall chargers for other devices are discussed in the brochure of those devices.
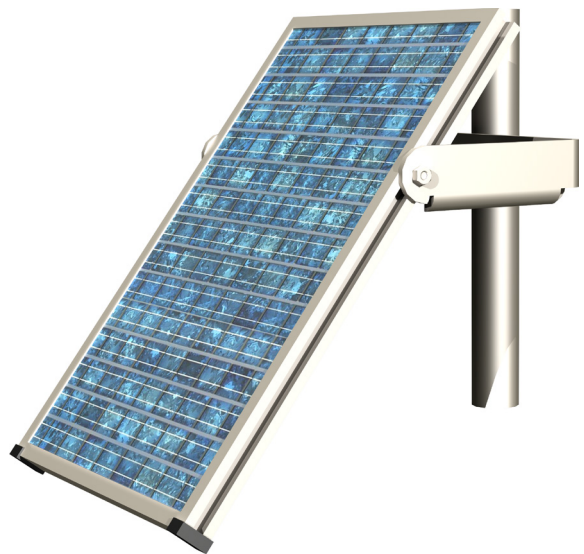
Solar Panels

Solar panels charge batteries by converting sunlight into direct current. Campbell Scientific's SP10 10 W and SP20 20 W solar panels can recharge the battery of a PS150, PS200, BP7, BP12 (requires CH150 or CH200), BP24 (requires CH150 or CH200), or CR3000. The SP10R 10 W and SP20R 20 W solar panels include an internal regulator, and are intended for recharging a user-supplied, deep-cycle RV battery.

The SP50 50 W and SP90 90 W solar panels are offered for systems that require high-power solar panels. These solar panels need to be connected to either a CH200 regulator or 18529 Morningstar SunSaver regulator. Two SP50-L or SP90-L solar panels can be connected to one 18529 regulator to double the wattage available.

Vehicle Power

Vehicle power can recharge the CR3000's sealed rechargeable batteries if the DCDC18R Boost Regulator is used. Our DCDC18R increases the vehicle's supply voltage (11 to 16 Vdc) to charging levels required by the datalogger base (18 Vdc).

Solar panels are convenient charging sources for applications where ac power is not available, unreliable, or expensive.

Power Supply Adapters

Campbell Scientific offers two adapters that fasten onto our PS150, PS200, CH150, and CH200.

The A100 and A150 cannot be used at the same time.

The A100 is for powering peripherals and external devices at non-datalogger sites such as repeater stations. When the A100 adapter is connected a power supply, it can source both 5 Vdc and 12 Vdc. When used with a CH150 or CH200 regulator, either a BP12 or BP24 battery pack is also required at the non-datalogger site.

The A105 adapter adds four 12 V terminals and four ground terminals to the PS150, PS200, CH150, or CH200. The extra terminals make it easier to wire multiple continuously powered 12 Vdc devices to the power supply.