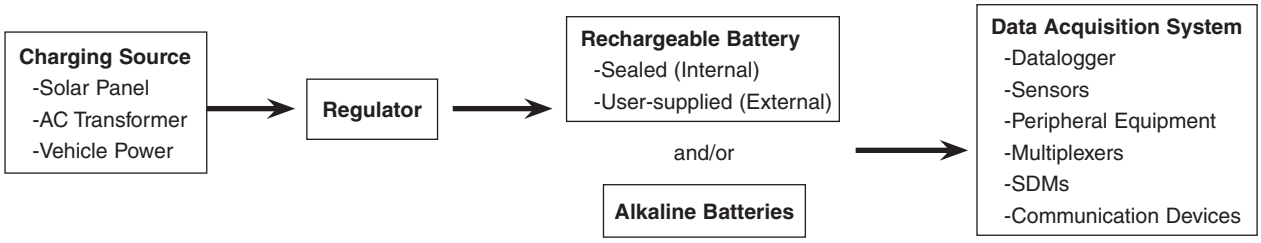
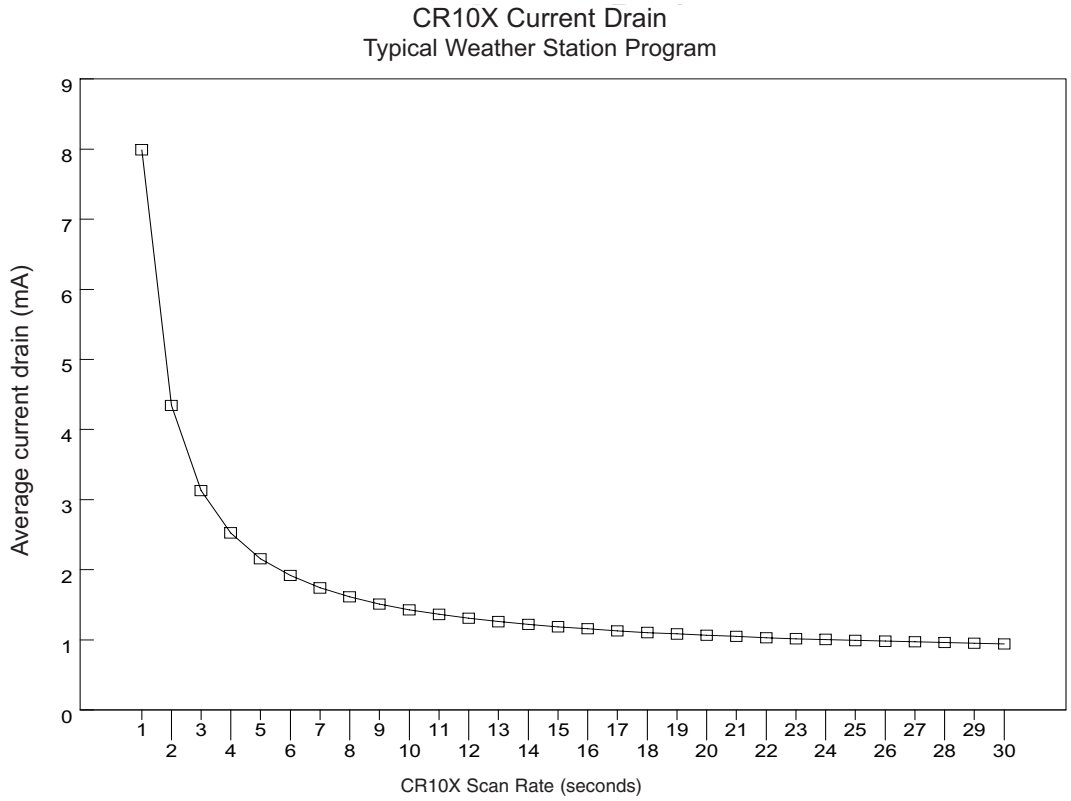
Power Supplies
Batteries, Solar Panels, AC Transformers

Campbell Scientific's data acquisition systems are powered by reliable, inexpensive 12 Vdc sources.* 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 below depicts the interaction of the components in a power supply system.



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).



**This product literature briefly describes the equipment available to power Campbell Scientific data acquisition systems. For more information, please download a copy of our Power Supply Application Note from our Web site.*

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 CR10X-based weather station measuring standard meteorological sensors at a thirty second (30 s) scan rate has an average current drain of:

State	Duration (s)	Current Drain (mA)
Analog Measurement:	0.2	46
Processing:	0.03	13
Quiescent:	29.77	1.3

$$\text{CR10X's Average Current Drain} = \frac{(0.2\text{ s})(46\text{ mA}) + (0.03\text{ s})(13\text{ mA}) + (29.77\text{ s})(1.3\text{ mA})}{30\text{ s}} = 1.61\text{ mA}$$

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 (COM210 modem), the current drain is:

State	Duration (min)	Current Drain (mA)
Active:	5	160(COM210) + 13 (CR10X) = 173
Quiescent:	1435	0.1

$$\text{Current Drain} = \frac{(5\text{ min})(173\text{ mA}) + (1435\text{ min})(0.12\text{ mA})}{(1440\text{ min})} = 0.72\text{ mA}$$

Assuming negligible power consumption by the meteorological sensors, the system's average current drain is: 1.61 mA + 0.72 mA = 2.33 mA or 0.00233 A

12 Vdc Batteries

Alkaline Batteries

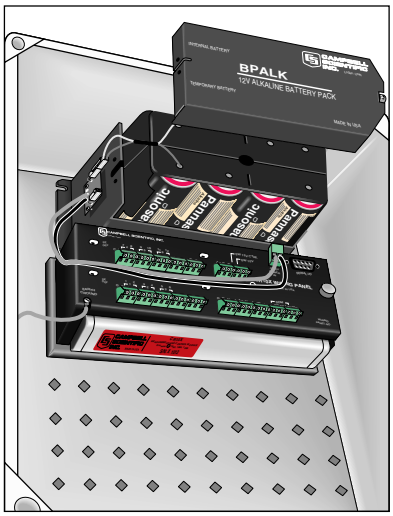
For powering our CR510, CR800, CR850, CR10X, or CR1000 dataloggers, the BPALK Alkaline Battery Pack contains eight “D” cells that provide a nominal rating of 7.5 Ahrs. The CR3000-ALK, as part of its integrated package, has 10 “D” cells that provide a nominal rating of 10 Ahrs. An alkaline power supply option is not available for our CR7, CR5000, and CR9000X(C) dataloggers; they use sealed rechargeable batteries or ac power.

Please note that 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 0.00233 A, the alkaline batteries theoretically last:

(7.5 Ahrs)/(0.00233 A) ≈ 3219 hours or about 134 days

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



The BPALK Alkaline Battery Pack includes eight “D” cell batteries for powering a CR10X, CR510, CR800, CR850, or CR1000 datalogger. At right is a CR10X and an exploded view of the BPALK are shown mounted in an ENC12/14 enclosure.

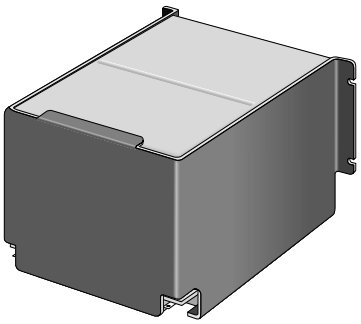
Sealed Rechargeable Batteries for Standard Applications

For powering our CR510, CR800, CR850, CR10X, and CR1000 dataloggers, the PS100 Power Supply consists of a sealed rechargeable battery and a regulator. Our CR3000-RC, CR5000-RC, CR7, and CR9000X(C) dataloggers include sealed rechargeable batteries as part of their integrated package. Battery nominal ratings are 7.0 Ahrs for the PS100, CR3000-RC, CR5000-RC, and CR9000XC, 2.5 Ahrs for the CR7, and 14 Ahrs for the CR9000X. All rechargeable batteries should be connected to a charging source—typically a solar panel or ac transformer. The CR3000 and CR5000's batteries may also be float-charged via vehicle power.

The PS100 is used with our CR510, CR800, CR850, CR10X, or CR1000 dataloggers. It includes a rechargeable battery and a regulator.

Sealed Rechargeable Batteries for High Current Drain Applications

Options for powering systems that have high current drain equipment such as cellular phones or satellite transmitters include the BP12 Battery Pack, BP24 Battery Pack, and the PS24 Power Supply. The BP12 and BP24 have nominal ratings of 12 and 24 Ahrs, respectively. They must be connected to a regulator—typically the CH100. The PS24 Power Supply is comprised of the BP24 battery, CH100 regulator, and a 10" x 12" environmental enclosure. Our larger rechargeable batteries are float-charged via a solar panel or ac transformer. Please note that the current drain of some systems may require ac power or a user-supplied deep-cycle RV battery.



The BP24 battery pack provides more power for high current drain systems.

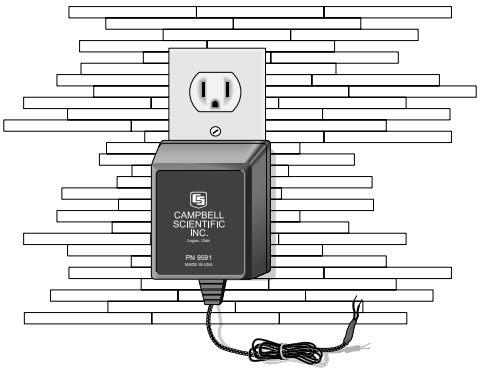
Regulators

A regulator is required to connect rechargeable batteries with a charging source (e.g., solar panel, ac transformer). Regulators control the current flowing to the battery and prevent the battery current from flowing to the charging source. Our CR3000-RC, CR5000-RC, CR7, and CR9000X(C) dataloggers have a regulator integrated into their base. Our CR510, CR800, CR850, CR10X, and CR1000 dataloggers typically use the PS100 Power Supply, which provides both a regulator and a rechargeable battery. The CH100 has a regulator that is similar to the PS100 but does not include a rechargeable battery. It is usually used with our BP12 or BP24 battery packs and is included with the PS24 Power Supply. The SP10R and SP20R solar panels have an on-board regulator and therefore connect directly to a user-supplied RV battery. The SP65 Solar Panel connects to the #18529 Morningstar SunSaver regulator, which must be housed in an environmental enclosure. All of our regulators provide built-in temperature compensation that optimize battery performance.

Charging Sources

AC Power

Campbell Scientific offers the #9591 and #14014 transformers for recharging sealed rechargeable batteries via ac power. One end of the transformer plugs into a wall ac outlet while the other end connects to the PS100 Power Supply, CH100 regulator, or the battery base of a CR3000, CR5000, CR7, or CR9000X(C) datalogger. The #9591 transformer may be used in the United States and in other countries where the ac outlet sources 110 Vac. The #14014 is generally used instead of the #9591 when local ac power is provided at voltages other than 110 Vac; it accepts ac power in the range of 90 to 264 Vac @ 47-63 Hz.

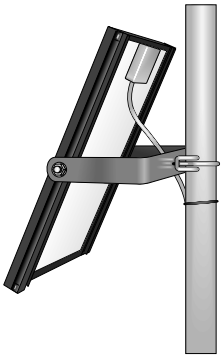


AC transformers such as the #9591 and #14014 charge sealed rechargeable batteries via ac power.

Solar Power

Solar panels charge batteries by converting sunlight into direct current. Our SP10 and SP20 solar panels connect to the PS100 Power Supply, CH100 regulator, or the battery base of a CR3000, CR5000, CR7, or CR9000X(C) datalogger. The SP10R and SP20R include an on-board regulator allowing them to be directly connected to a user-supplied RV battery. The SP65 connects to the #18529 Morningstar SunSaver regulator.

Please note that the SP10R and SP20R regulated solar panels have a 2 mA continuous current drain; the Morningstar SunSaver regulator draws a continuous current drain of 6 to 10 mA. Solar panel specifications are listed below:



Solar panels are convenient charging sources for applications where ac power is not available, unreliable, or expensive. The SP10 sources sufficient current for many of our systems.

	SP10/SP10R	SP20/SP20R	SP65
Voltage @ Peak	16.8	16.8	17.6
Current @ Peak, amps	0.59	1.19	3.69
Peak Power, Watts	10	20	65

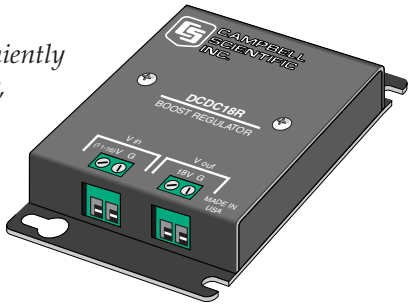
NOTES:

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.*
4. *Two SP65 solar panels may be connected to provide 130 W peak power.*

Vehicle Power

Vehicle power can recharge the CR3000 or CR5000'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 (18 Vdc).

The DCDC18R's case can be conveniently attached to the side of the datalogger, adjacent to its charger input.



Power Supply Adapters

These adapters are intended for specialized applications. For powering peripherals and external devices at non-datalogger sites such as repeater stations, an A100 adapter connected to either a PS100 Power Supply or CH100 regulator is used to source both 5 Vdc and 12 Vdc. When used with a CH100 regulator, either a BP12 or BP24 battery is also required at the non-datalogger site. The A105 adapter increases the number of 12 V and ground terminals available on the PS100 Power Supply or CH100 regulator.