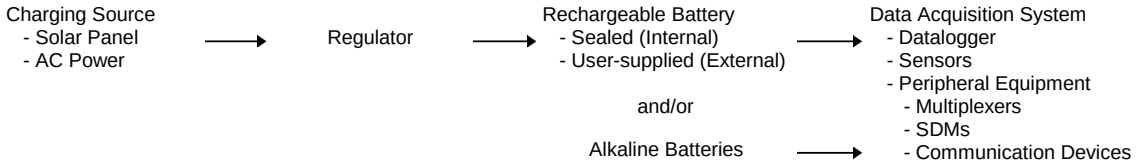
Power Supplies

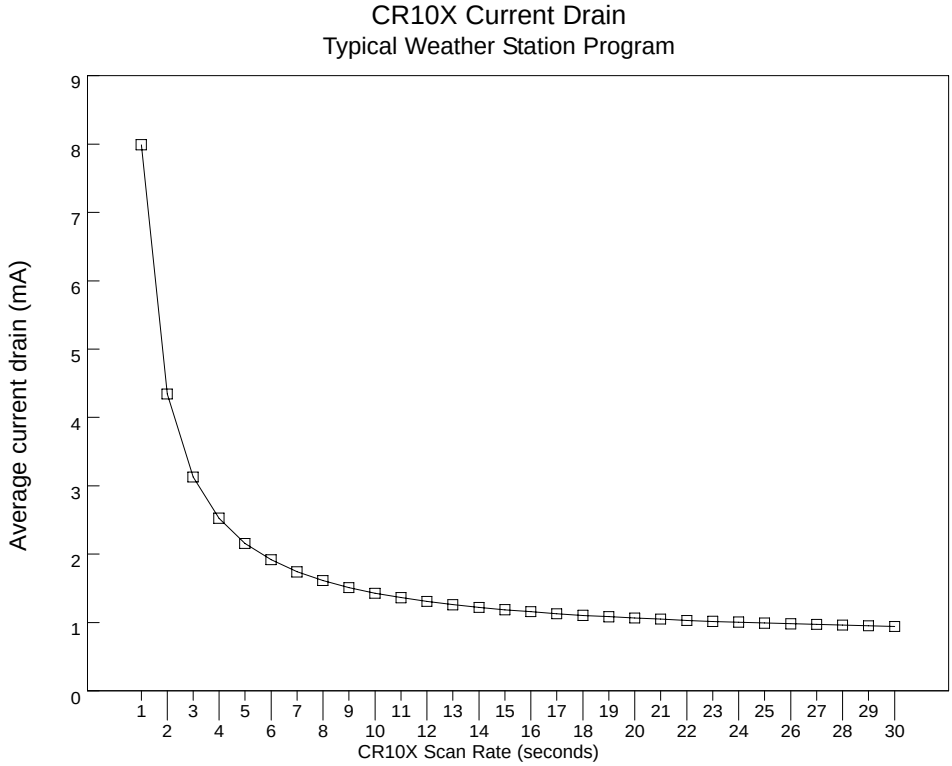
Batteries, Solar Panels, ac Chargers

Campbell Scientific's (CSI) 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 power or 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 brochure briefly describes the equipment available to power CSI data acquisition systems. For more information, please download a copy of our Power Supply Application Note from our Web site.*

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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.

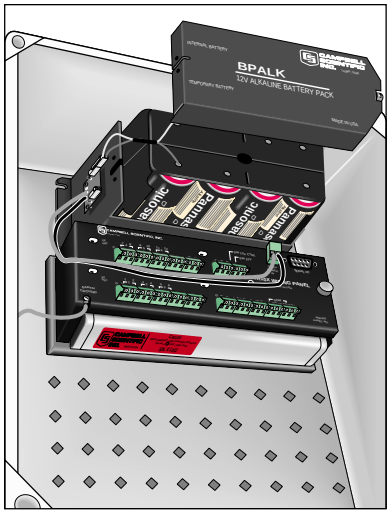
For example, if the station is called once a day (1440 min) for 5 minutes via telephone (COM200 modem), the current drain is:

State	Duration (min)	Current Drain (mA)
Active:	5	140(COM200) + 13 (CR10X) = 153
Quiescent:	1435	0.1

$$\text{Current Drain} = \frac{(5\text{ min})(153\text{ mA}) + (1435\text{ min})(0.1\text{ mA})}{(1440\text{ min})} = 0.63\text{ mA}$$

Assuming negligible power consumption by the meteorological sensors, the system's average current drain is: 1.61 mA + 0.63 mA = 2.24 mA or 0.00224 A

Batteries



The BPALK power supply (exploded view shown) uses eight "D" cell batteries to power the CR10X (shown), CR10, CR510, or CR500. Both units shown mounted in an ENC 12/14 enclosure.

Alkaline Batteries

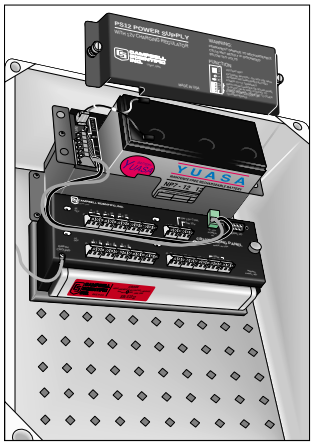
Eight "D" cell alkaline batteries power the CR510, CR500, CR10(X), and 21X dataloggers; ten power the CR23X. These batteries are NOT rechargeable. The alkaline batteries have a nominal rating of 7.5 Ahrs at 20°C; the amp hour rating decreases with temperature extremes. Alkaline batteries may leak when used outside the temperature range of -25° to +50°C. Allowing the battery voltage to drop below 9.6 V can also cause leakage.

For the above weather station with a system current drain of 0.00224 A, the alkaline batteries theoretically last:
(7.5 Ahrs) / (0.00224 A) ≅ 3348 hours or about 140 days

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

Datalogger's Sealed Rechargeable Batteries

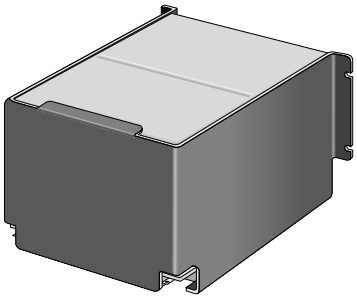
Sealed rechargeable batteries are used with the CR510, CR500, CR10(X), CR7, CR23X, CR5000, and 21XL dataloggers. The nominal rating for the CR510, CR500, CR10(X), CR23X, and CR5000, batteries is 7.0 Ahrs. The 21XL and CR7's batteries have a nominal rating of 2.5 Ahrs. These batteries should be float-charged by ac power or a solar panel. The CR23X and CR5000's batteries can also be float-charged by vehicle power; a DCDC18R Boost Regulator is required.



The PS12LA (exploded view shown) is a rechargeable power supply for the CR10(X), CR510, or CR500.

Larger Sealed Rechargeable Batteries

Our BP12 and BP24 battery packs provide more power for systems that have high current drain equipment (e.g., satellite transmitters). The BP12 and BP24 have nominal ratings of 12 and 24 Ahrs, respectively. These batteries typically use a CH12R charging regulator, and should be float-charged with ac power or a solar panel. The current drain of some systems may require ac power or a deep-cycle RV battery.



The BP24 provides more power for high current drain systems.

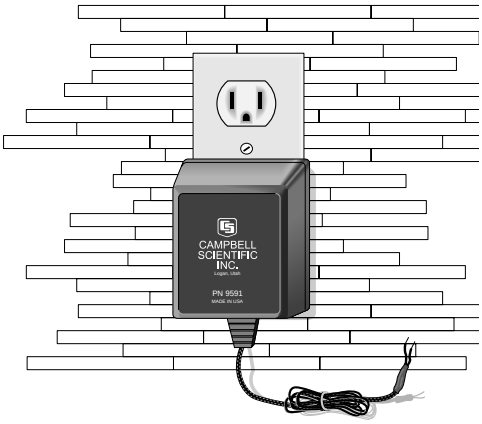
Regulators

A charging regulator must be used to connect rechargeable batteries with a charging source. The MSX10R, MSX20R, MSX64R, and MSX128R solar panels include a regulator and can be connected directly to an external rechargeable battery. AC transformers and unregulated solar panels (MSX10, MSX20) must be connected to a regulator such as the PS12LA, CR5000 base, CR23X base, 21XL base, PS512M, CH12R, CH512R, or CR7 solar panel input. Our regulators provide built-in temperature compensation to optimize battery performance.

Charging Sources

AC

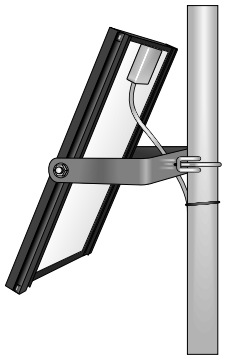
AC transformers and charging regulators that convert 110 Vac to 16 Vdc are used to recharge sealed rechargeable batteries. In areas where the power exceeds 120 Vac, a step-down transformer is required (e.g., VC273 or CR7's ENC 7F enclosure).



The 9591 wall charger allows you to use ac power to recharge the rechargeable batteries for the CR10(X), CR510, and CR500 dataloggers.

Solar Panels

The solar panels charge batteries by converting sunlight into direct current. The MSX10 and MSX20 are unregulated solar panels that must be connected to one of the regulators mentioned on the previous page. The MSX10R, MSX20R, MSX64R, and MSX128R include a regulator allowing them to be directly connected to a user-supplied external battery. The MSX10 sources sufficient current for many of our systems. Please note that the MSX10R and MSX20R regulated solar panels have an 2 mA continuous current drain; the MSX64R and MSX128R draw <3 mA. Solar panel specifications are listed below:



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

	MSX10/MSX10R	MSX20/MSX20R	MSX64R	MSX128R
Voltage @ Peak	17.5	17.1	17.5	17.5
Current @ Peak, amps	0.57	1.17	3.66	7.32
Peak Power, Watts	10	20	64	128

NOTE: *Specifications assume a 1 kilowatt per square meter illumination and a solar panel temperature of 25°C (77°F). Individual panels may vary up to 10%. The output panel voltage increases as the panel temperature decreases.*

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