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GETTING STARTED...

To select a solar electric system for your home or RV, you need to know what the major parts are called, what they do, and how they work together. Here is a quick overview followed by drawings explaining the whole process. Individual parts will be described in more detail within each section of the catalog.

THE PROCESS

Sun shining on solar modules produces DIRECT CURRENT electricity, or DC, the only kind of power stored in batteries. Often this is 12 volt DC, the standard used in cars and RVs. Larger systems may be designed for 24 volt DC, or sometimes 48 volt DC. This just means combining the same 12v solar modules in pairs for 24 volts, or groups of four to get 48 volts. Windmills and micro-hydro generators in this catalog also produce DC for charging batteries.

This DC power is stored in DEEP CYCLE LEAD-ACID BATTERIES, which give back the electricity as needed, even when no power is being produced. Like a bank account, power put into batteries over a period of time can be taken out more quickly if a lot is needed. Like a bank account the total amount of power you withdraw cannot be more than you put in, or the account will be depleted. Moreover, lead-acid batteries need to be frequently 100% fully charged to remain in good condition. They should never be drawn completely down to empty. Because of these needs, to get the most years from your batteries requires some supervision by the owner.

The INVERTER is a major component that converts the 12, 24, or 48 volt DC current from the battery into 120 volt AC current, the same as utility power for standard household lights, outlets, and appliances. Most solar homes use primarily 120 volt AC produced by the inverter. A few DC circuits are usually added where using DC can save a lot of energy. Sometimes a small solar electric RV, boat, or cabin may have no inverter, and use only DC wiring and appliances.

If there are a number of consecutive days without sunshine, the owner, being aware of the weather, checks the batteries. If the charge level is low, an engine driven generator may be started to recharge the batteries in order to keep the whole system working. A battery charger plugs into 120 volt AC from the generator producing low voltage DC to charge the battery. The generator is shut down after the batteries have been recharged. This process is automated in some power systems. (Battery chargers in Recreational Vehicles are called converters).

THE HARDWARE

SOLAR MODULES are installed in groups of 1 to 18+ modules on a solar mount, which in turn attaches to a building, to the roof of an RV, or atop a metal post in the yard. Together this is called a solar array. Each solar module is wired to the other modules in that array by sunlight tolerant solar interconnect wiring. Several arrays may be wired to a solar combiner box where they are all connected to heavier underground wires taking the power to the battery and equipment room.

A **CHARGE CONTROLLER** is a small wall mounted component receiving the power from solar, wind, or micro-hydro generators, and **controlling the flow of power to the battery.** To prevent battery damage from overcharging, the charge control automatically cuts back, stops, or diverts the charge when batteries become full. A charge control may have manual control switches and may have meters or lights to show the status of the charging process. MPPT charge controllers can step down high voltage arrays to a lower voltage for your battery bank, allowing you to use larger wattage/higher voltage modules.

BATTERIES receive and store DC electrical energy, and can instantly supply large surges of stored electricity as needed to start or run heavy power appliances that the solar panels or hydro electric generator alone could not power. This large power capability can be a fire hazard just like utility company power, so fuses and circuit breakers on every circuit connected to a battery are essential. Battery size is chosen for both surge power requirements and for the amount of reserve power needed. Typically, 2 to 12 square feet of batteries weighing 150 to 5000 pounds are enclosed in a battery box with a vent pipe to the outside.

The **INVERTER** is the major electronic component of a power system. It converts DC power stored in batteries to 120 volt AC, or 120/240V household power. Short, heavy cables with a large fuse or circuit breaker carry battery power to the inverter. After conversion to AC, power from the inverter usually connects into the circuit breaker box of the house in place of utility lines. The house breaker box routes power to lights, appliances, and outlets of the house. **The inverters we offer for home power come in ratings from 400 to 6000 watts.**

A **STANDBY INVERTER/CHARGER** is an inverter that also has a battery charger and transfer relay built in. When the input terminals of a standby inverter/charger **receive power from an outside source of AC (a generator or utility power)** the inverter stops producing AC power from the batteries, and instead passes generator or utility AC power straight through to the house. At the same time it uses the generator or utility power to recharge the batteries. Some standby inverters even auto-start the generator when batteries need charging. A separate battery charger can be used instead of (or in addition to) a standby inverter/charger.

An **ENGINE GENERATOR** producing 120 or 240 volt AC power is usually part of the system. This is a second source of AC power and a backup for charging the battery when there is a shortfall in solar or wind power, a temporary need for additional power for construction or visitors, or in case of breakdown of other equipment. Just starting the generator begins the standby inverter charging process. The best generators start automatically or by push-button from the house.

A generator is located outside, usually in its own shed at least 30 feet away to avoid noise. For reasons of health and safety, it should not go in a basement or garage. 120/240 volt AC power from the generator goes through a circuit breaker, then is wired into the power room to run battery charger/s as well as supply the AC power to the house whenever the generator runs. Since both battery charger and AC transfer relay are usually part of a standby inverter, the generator power usually connects only to the AC INPUT terminals of the inverter, not to the house breaker box.

Continued

A few special lower cost generators are made to produce only battery charging DC voltage instead of AC. These send DC power directly to the battery.

FUSES or CIRCUIT BREAKERS are necessary in all DC wiring between the batteries and other power system components described, but not shown in the drawing. This prevents fires and equipment damage in event of a malfunction. Breakers may be separate components in their own box, or might be built into a power center. In contrast, the AC breaker box for household wiring is part of the house wiring, not usually included with power generating equipment.

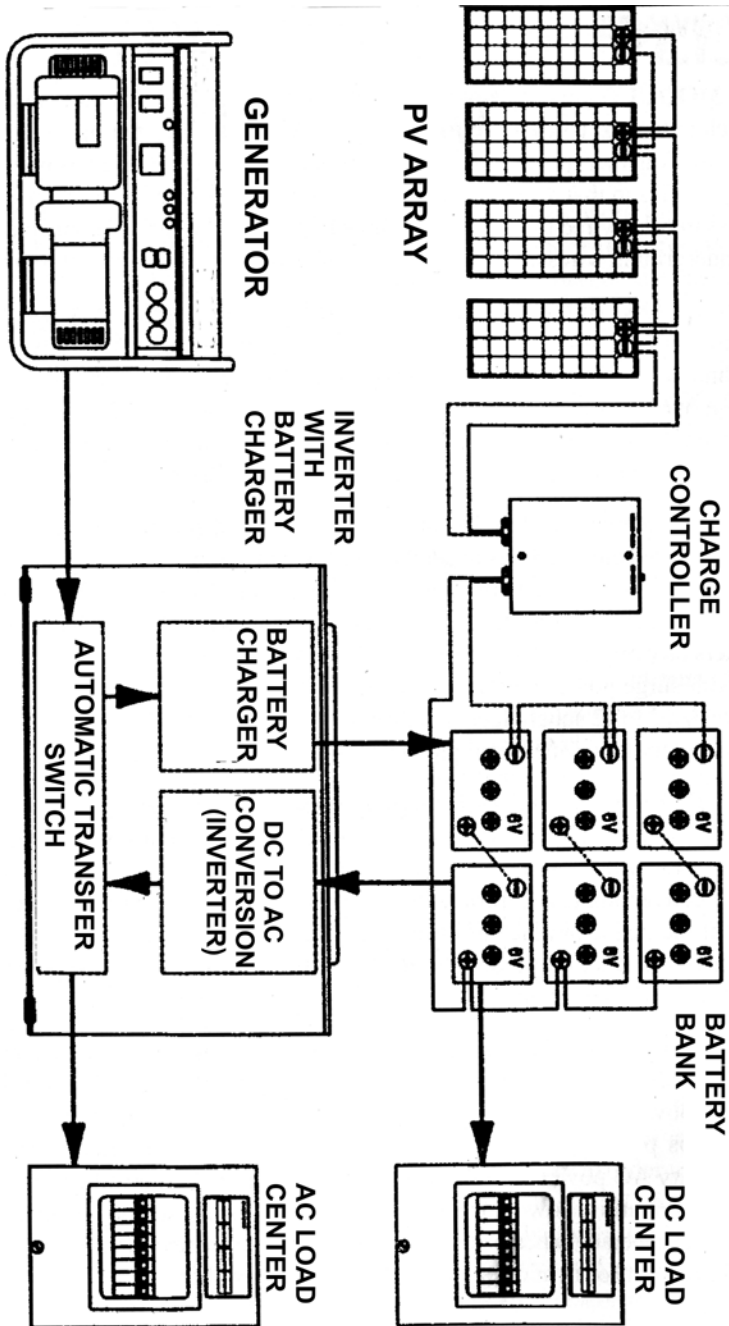
METERS, like the gas and temperature gauges in a car, are necessary to show everything is working. Solar charge indicating meters are often built into the charge controller to confirm the charging process instantly. Other meters show how much power is being consumed, and confirm how much power is available. These battery system monitors can be located in the power room, or at a convenient spot in the home for easier checking.

A **POWER CENTER** is a product including system meters, DC circuit breakers, and wiring connections for batteries, inverter, solar and other charging sources. Power centers are easier to install and to pass building code than would be selecting, buying, and installing all those parts separately. The power room is simplified, with just a few main components: powercenter with charge control attached, a standby inverter-charger, and a battery box on the floor. Some powercenters, like the Outback or Xantrex XW, are shipped as a completely assembled power system.

Solar Array and Vineyard by James Loveland



DIAGRAM OF A TYPICAL OFF-GRID SYSTEM WITH GENERATOR



From book: PV/Generator Hybrid System for your PV Home sold at back of this catalog

HOMEMADE ELECTRICITY

THE OFF-GRID REMOTE HOME



OFF-THE-GRID homes are usually in remote locations where utilities are not available. Pictured right is the Lewis Cooper home and below is the home of Kip Drobish.



YOUR OWN INDEPENDENT POWER SYSTEM can provide most electric conveniences at a remote home site, where bringing in utility lines would be impossible or prohibitively expensive. Just extending utility power 1/4 mile or more to reach a home site can cost \$15,000 and up, and that's before you get any power. Equipment to produce your own solar electric power may cost less. If power lines are not near your land you can choose clean renewable resources, boats and recreational vehicles can use the same equipment on a smaller scale.

NATURAL AND FREE ENERGY already on your site in sunlight, wind, or falling water can be converted to electricity. We specialize in power entirely from solar, wind, or micro-hydro, plus generator backup in climates short on sunshine.

WE USE IT! For over 30 years, Backwoods has specialized in off-grid power for the remote home. For years Backwoods Solar was entirely powered by equipment from this catalog, and currently most Backwoods Solar employees power a home or a portion of their home with our products. At Backwoods Solar you are talking to people who use the equipment every day.

THIS BOOKLET INTRODUCES BEGINNERS to the joy of making your own power. The first 30 pages explain how to do it, what you need, how to prepare a house to use solar electricity, and the approximate cost for several examples.

The second section of the catalog contains all of our equipment and prices, with more explanation on each class of product. Towards the back of the catalog, you'll find order blanks and shipping information, followed by instructional books, DVDs & videos.

There really is no limit to the size of your power system, however limiting and taking steps to conserve energy and reducing your electrical use will minimize and reduce the cost of your renewable energy system.

HOMEMADE ELECTRICITY

THE OFF-GRID REMOTE HOME

Rather than major life-style changes, we keep most advantages electricity offers while consuming only a small percentage of the power others use. Here is how:

The amount of power your system generates depends on the natural energy resources at your location and on how much equipment you install to gather that energy. How much benefit you receive from that energy depends on careful selection of lights and appliances for maximum energy efficiency and on your conservation habits. That means using special lights, refrigerators, and freezers that use about 1/4 as much power. It means using natural gas or propane for major heat production in cooking, water heating, clothes drying, and home heating. (Try to include passive solar home design and perhaps some wood heat). We install extra switches to cut power off phantom electric loads, that is, things like stereo, TV, garage door openers, and office equipment, all of which consume power even when not turned on. We often wire doorbells, wireless phones, and motion sensor lights to DC power direct from the house battery bank, to use no power when idling. We use motion sensor and timer switches for outdoor lights. We use heating systems that distribute heat without pumps or blowers. Cooling is evaporative instead of air conditioning. We learn how to get the most benefit from the fewest kilowatt-hours. In short:

1. Design the whole house (water, heat, power) for low energy use.
2. Carefully select very special low energy lights and appliances.
3. Eliminate energy waste in appliances, and from human carelessness.

After meeting those three measures, a practical, affordable solar electric system (or wind, or micro-hydro) can provide electricity for a comfortable home.

Prior to moving, just five kilowatt hours per day ran Backwoods Solar's business, shop, and Steve and Elizabeth Willey's home. The business used four computers all day, lights for 4-5 workers, photocopy machine, postage machine, phone, fax, and paging system, business communication radio, and electrical workbench. The home included lights, microwave oven, range hood, juicer, refrigerators, freezer, TV, satellite, VCR/DVD, stereos, clothes washer, deep well pump, compost toilet fan, built-in whole house vacuum system, fans, electric lawn mower, electric rototiller & electric weed eater, plus a mechanical shop building full of power tools.

EFFICIENCY IN YOUR OFF-GRID HOME

Most household appliances and lights use only a little electricity easily supplied by the sun, wind, or micro-hydro. Solar electric homes convert most of their power to 120 volt AC, to use as needed for household appliances and lights. Most common uses are lights, water pump, TV-VCR/DVD-satellite, computer, stereo, vacuum cleaner, kitchen appliances, sewing machine, power tools, and office equipment. Even high wattage appliances like microwave oven, hair drier, toaster, and clothes washer consume little power because their actual running time is short. Water pumps including deep well pumps up to 1/2 horsepower are used. Electric refrigerators and freezers are selected carefully to save energy in a solar home; also gas and small DC powered refrigerators are used.

WHAT YOU SHOULD AVOID IN YOUR OFF-GRID HOME

NO MAJOR ELECTRIC HEATING or COOLING APPLIANCES:

Electric heat, electric hot water, electric cook stove, electric heated clothes dryer, and air conditioner account for 80 percent of typical monthly utility bills. It is absolutely NOT practical to operate these major appliances with electricity. These use from twenty to one hundred times the power your TV uses. Other fuels produce heat at much lower cost. Use wood or propane fueled furnaces, propane cook stoves and water heaters; use gas fired clothes dryers (or just a rope in the sun). Build homes with passive solar heat design to save heating fuel for the rest of your life. Later in this section, we give advice on wise selection of major appliances.

AVOID MOST LARGE REFRIGERATORS AND FREEZERS:

Many refrigerators have poor insulation and run long hours every day. Most still use well over 1.5 kilowatt hours per day, over 450 kilowatt hours a year. Careful shopping can turn up a few models using less power. Special electric refrigerators and freezers designed for solar powered homes use much less, and are shown in this catalog. These highly insulated units can save at least 50% of the energy consumed by ordinary refrigerators. The added cost of more efficient appliances is less than the added cost of a larger power system to cover the use of inefficient appliances. Propane refrigerators, also in this catalog, can lower start-up costs.

AIR CONDITIONING is too energy intensive to be practical other than a window unit in a very large solar power system. Evaporative cooling – swamp coolers – work well in non-humid areas.

STATE OF THE ART SOLAR ELECTRIC HOMES TODAY



Thirty years ago, independent home power meant designing and building your own equipment. Today, it doesn't have to be a full time hobby, though it still can be fun. Home power system designs and components are standardized. Common problems have been solved by the experience of thousands of solar, wind, or water powered home owners. All the equipment is readily available, from a basic starter setup for lights and TV in

a small cabin, to a full AC powered home and business. A good power system may consist of just 3 or 4 integrated components that building inspectors easily approve.

STILL — Independent electrical power is not quite a 'turnkey' appliance like a central heating system with sales and service people knocking at your door. Many independent homes are in remote places, where the owner is the prime decision maker, meter reader, and service person. A practical solar electric system requires some owner participation in planning, management, and maintenance. The owner-builder who understands batteries and equipment will have a better working system, save money, and become more self-reliant.

The main responsibility is managing your batteries, that is, making sure the batteries get fully recharged each week, and rarely discharged below 50 or 60%. This is done by watching the meters and if needed, running the generator to supplement shortfalls due to extended no-sun weather. About once every month or two, one battery cell should be checked with an hydrometer, a glass tube and rubber bulb device with a float, that reads the condition of battery fluid. At the same time, the battery tops should be wiped clean and dry with a paper towel. Several times a year you check every cell, and add distilled water to the battery cells to maintain the correct fluid level. An extra charge process called equalizing is sometimes required to restore weak battery cells to normal. Batteries have limited life, and need to be replaced every 5 to 15 years (depending on type) no matter how well you care for them.

Solar modules last well over 25 years with little maintenance. Warranty is 20 or 25 years on most modules sold at Backwoods Solar.

Electronic components are also long lived, but like TV sets, can fail unexpectedly, or be damaged by lightning or by incorrect installation. Most carry a 1 or 2 year warranty.



WHAT WILL REMOTE POWER COST?

Hank Strong Home



Because life-styles and power usage vary so widely between individuals, a rural solar electric home can be set up anywhere from \$2,500 to \$53,000. Most often our customers spend between \$6,500 and \$18,000. Cost varies with amount of power needed, and also with the average daily sunshine hours for your location and climate. Northern areas with overcast snowy winters need a lot more solar modules and batteries than homes in New Mexico or Arizona, though both may use the same amount of power. The quantity of power you need relates to the number of people in the house more than to the square footage of the home.

Windmill generators can be used together with solar, to generate power in more varieties of weather. On a site with wind speeds measured and confirmed, wind generation used together with solar can reduce the total cost of the power system.

Micro-Hydro power is the best choice and lowest cost power source for those few sites with the required water resource. If there is a small stream dropping 20 feet or more in elevation across your land, or a larger stream dropping 5 feet, water power may be possible. You might generate all the power you need from a micro-hydro turbine for as little as \$5000 complete, or as much as \$16,000, plus the cost of the pipe line.

Backwoods Solar can help you choose and estimate the cost of the right equipment if you let us know how many people are in the house, something of the life-styles, the appliances, whether there is a home-business activity, and anything else affecting power usage. The above estimates do not include a backup generator which can range from \$3500 to \$10,000 depending on size and quality.

WHERE TO PUT IT?



Batteries, inverter, and electronic controls should be installed in a utility room inside or near the residence. Electronic equipment mounts on 4 to 5 feet of wall within 8 to 10 foot cable length from the batteries. Equipment could be installed on the outside wall of a separate battery closet. Batteries take 2 to 15 square feet of floor space within the cable length from wall mounted equipment, and should be beside, rather than directly in front of wall mounted equipment. Allow ample working room to check batteries, and avoid cramping everything in a tiny closet. Electronic components need the same environment as a computer, TV, or stereo: a place that is clean, and away from moisture condensation.

Batteries should not be accessible to children or others unfamiliar with their hazards. Flooded lead acid batteries emit minimal amounts of flammable, (nonpoisonous) hydrogen and oxygen gas when charging, so should be enclosed in a box vented to outside by plastic pipe. They should stay above freezing but avoid temperatures over 100 degrees F. An outside battery and equipment shed may be used in moderate climates, but avoid putting batteries on a wood floor vibrated by the generator engine.

Distance from the power room to generator and to the house AC circuit breaker panel is not critical. A generator should be in its own shed some distance away, to avoid the noise.

Distance from power room to solar module location is limited, as explained in the chapter on mounting solar modules. Modules are best pole mounted, or can be roof mounted if trees and buildings prevent good sunlight at ground level.

APPLIANCE SELECTION IN OFF GRID HOMES

Here are important points about selection of appliances and some wiring tips for solar electric homes. This is a little different than you might expect for utility connected homes, and the difference is essential. Be sure you understand these pages before shopping for appliances. Your electrician should understand these points when planning the wiring. Call Backwoods Solar if you have questions.

LIGHTING

Lighting uses less power, if you have lots of local area “task” lights rather than a big central light. Use 15 - 20 watt fluorescent lights under cabinets close to the kitchen counter. Use a separate wall switch for each wall/ceiling light so you can turn on lighting precisely where needed. Several small lights save energy by giving more flexibility than one large central light.

Screw in light bulbs should be mostly **compact fluorescent lights** using about one quarter the power of regular bulbs while giving the same brightness and color. Get only electronic ballast models; they do NOT flicker. Light dimmers should not be used unless you have a sine wave inverter and the bulb specifically states dimming is OK.

Timer light switches are great for lights turned on and often forgotten, as in children’s rooms, closets, stairwells, and particularly basement and outdoor lights. Timers keep the peace when lights are frequently forgotten. The tap of a electronic timer button or a wind up light switch timer starts the light and sets the run time you choose from a few seconds to an hour, after which the light goes out. Windup light switch timers are in the lighting section of the catalog.

Motion sensing lights outdoors are great for arrival and departure. An AC motion detector will not turn lights on when needed unless you force your inverter to run full time. If the inverter is at idle (search) mode, the sensor will not work. A 12 volt DC powered motion sensor in this catalog is the answer. It's on duty all night with almost no power use.

WALL CLOCKS & TIMERS

Clocks should be quartz type, battery powered, not plug-in AC powered. Timers for automation or wake-up radio should be DC powered, not AC. Several timers are available in this catalog.

COMPUTERS

Windows based PC computers run on any inverter and at this time, and we believe that Apple/Macintosh computers do not require a “true sine wave” inverter.

Laptop/notebook computers use internal batteries, and recharge from any small inverter using just 20 to 50 watts AC power. Most manufacturers offer an optional car cord to operate directly from a 12 volt battery at very low power.

Laser printers (and most photocopy machines) can be damaged by modified wave (not true sine wave) inverters. Inkjet and dot matrix printers are no problem, and use very little power. HP Laserjet printers automatically idle to just a few watts between printing, or a switch can be used to shut your printer off. An outlet strip should be used to switch off all computer equipment after shut-down to prevent phantom load leakage.

For best results, we recommend that the whole home/office be powered by a **large true sine wave inverter**. Alternatively, one of the smaller true sine wave inverters may be added for your sensitive electronics, and a separate circuit run from it in the battery room to an outlet by those devices.

REFRIGERATOR / FREEZER

Many standard refrigerators and freezers use so much power that battery charge is depleted very quickly. **It is not practical to use most standard electric refrigerators or freezers with independent power** unless you have a powerful water turbine generator. Super efficient refrigerators designed and tested for solar power, listed in this catalog, operate on less than half the usual power. Some carefully selected Energy Star rated conventional refrigerators using under 400 - 450 kilowatt hours a year may be acceptable.

CLOTHES WASHER

Most clothes washers work fine with a minimum 1500 watt inverter. They consume 800 watts while running. A starting surge of about 3000 watts is required. A motor start capacitor can be added to any washer that has a start winding wire on the motor to lower the starting surge. Order item A-CAPACITOR: \$20

New horizontal axis washers by Kenmore, LG, Whirlpool, Frigidaire and Maytag use much less power, less water, and less soap. Some of them require a sine wave inverter, will not run on a generator, and void their warranty when used with generator or inverter power.

Propane heated clothes dryers can be used; 240v AC electric heated dryers cannot be used.

KITCHEN STOVE

Electric stoves are out. Propane or natural gas stoves with gas pilot light need no power at all. Optional spark ignition burners use very little power and work fine with inverters. **DO NOT BUY** a gas range with a glow-bar in the oven. It is an electric red-hot pilot bar that consumes 400 watts while the oven is used! Instead, look for one of two types of pilot light oven. An oven with regular gas flame pilot light is simplest. Or an oven that lights a burner by electric spark only when the oven is started, and then the burner goes off when the oven is finished heating. Both types are available on the Peerless Premier propane ranges sold in this catalog. Also the AC clocks in some ranges are phantom loads, keeping the inverter running full time. If so, disconnect wires to the clock so you can plug in the stove to use the oven light and spark igniters. Range hoods with light and vent fan work fine with inverters. Be sure to put a compact fluorescent bulb in it.

DISH WASHER

Dishwashers work fine, with one caution. There might be two high power heaters, one to dry the dishes and sometimes one to superheat incoming water. You should be able to disconnect or switch off these heaters to save a lot of power.

WATER PUMP

DC pumps use very little power and can pump to well depths of 200 to 800+ feet. Our 1/2 hp 120 volt AC pump can operate from inverter power and lift water 300 feet. And we even have a pump, the Grundfos SQ Flex, which accepts either AC or DC input and can lift water up to 820'. Avoid 220 volt models or higher horsepower than you actually need. The water pump section in this catalog has more information.

STEREO, TV, VCR, SATELLITE TV

A 19 or 20 inch TV uses about 85 watts and works with any inverter. Some larger screens can use twice as much power. VCR and some satellite units use only 20 watts. **SATELLITE TV works great on inverter power.** A Direct Satellite System (DSS) uses about 15 watts. STEREO of good quality usually works with any inverter. TVs, VCRs and stereos with remote control are phantom loads, and still consume power when switched off. It is important to use a wall switch, or a switched outlet strip to cut all power from this equipment when not in use. A few large screen TVs and sensitive audio gear require true sine wave power.

CORDLESS PHONE, MESSAGE MACHINE and FAX

Cordless phones typically work on direct 12 volt DC, very low power, to avoid keeping the inverter on 24 hours for so small a load. The DC-Isolator in the 12v Appliance section should remove line static associated with conflicting grounds. To determine if the cordless phone or answering machine of your choice is compatible with DC power, you need to look at the machine's wall cube that plugs into a 120v AC outlet. This cube will describe in writing the power needs of the phone or answering machine. It should state 120v AC input and then the output that gets delivered to the machine. The output you want is 9-15 volts DC.

Phone message machines use small amounts of AC 24 hours a day which adds up to a large load. As just described, a few message machines can be converted to operate direct from 12 volts for very low power use. Again you will need the DC-Isolator to avoid static.

TELEPHONE BEYOND THE LINES

If phone lines cannot reach your site, a radio relay phone link up to 15 miles line-of-sight can connect you to the nearest phone line. The radio link brings in phone, modem, answer machine or fax. Or a cell phone with a boosting antenna or amplifier may be the answer. Backwoods Solar does not sell this equipment. One source is KootenaiRadio@netw.com.

INTERNET

Direcway and Starband offer high speed satellite internet services, no phone line required. An excellent choice in most remote areas for off-grid homes.

AIR CONDITIONING

Many people actually have too much solar electric generating capacity during the summer months. Many times we hear people say that they're fully charged by 11 am. A small window A/C unit that can cool several hundred square feet can run for about 6 hours on a sunny day with 1000 watts of solar modules. Make sure to choose an Energy Star rated appliance and a true sine wave inverter. When Backwoods was located at the Wiley's home, we had extra energy during the hot months of July and August and we were able to power an office A/C unit. It can make a very hot room or two bearable given the right situation. For those with smaller systems evaporative cooling works, except where very humid. Low energy 12 and 24 volt DC coolers are listed in our DC appliance section.

WATER HEATING

Electric water heaters are out. **Use a natural gas or propane heater** from plumbing and hardware stores. Get one with a pilot light, not glow-bar ignition. Vent all gas appliances straight out through the roof. Avoid power wall vents that seem easy to install but use substantial power ever after. Or use a Bosch instant tankless water heater shown in the non-electric appliance section of this catalog. The tankless instant water heater saves gas. A wood fired hot tub heater is also in the non-electric appliance section.



HEATER - FURNACE - HOT WATER FLOOR HEAT

Use propane, natural gas, oil, or wood heaters and furnaces, never electric heat. Electric heat pumps also use substantial amounts of energy, less than resistance heat, but way too much for independent power. They are reversible air conditioners. Also beware of ducted forced air and blowers. Common in manufactured homes, the blower takes much more power than can be justified.

Cozy brand propane direct-vent (through the wall) heaters in the non-electric appliance section of this catalog save fuel because each room can have its own heater and wall thermostat. No circulation blowers are needed so they work with no electric power. This is the easiest and lowest cost heating installation.

Wood or gas furnaces located on bottom floor or basement in a multistory home allow heated air to rise by convection from lower to higher floors without powered fans or ducted blowers. Larger ducts for natural convection circulation can work with no power blower needed, or a very low power quiet DC fan from our DC appliance section to boost output. Our no power Caframo Ecofan or low power fans can also increase efficiency of gas heaters or wood stoves by moving air over the surface. Some home designs add a space along side a masonry chimney as a hot air duct to the upper floors, and perhaps also run water pipes through it. Each stairway should have a door to control rise of heated air.

Floor heating by hot water circulation requires power to circulate water. Use of 1/2 inch or larger floor pipes allows a lower power pump. Use separate DC circulating pumps found in the Pump section of the catalog and control each by a thermostat for its zone, rather than zone valves. We have seen problems using special boiler systems & zone valves. We have seen success using tank gas hot water heaters or the wood fired boilers that heat water directly in the storage tank. You can also warm water beds and compost toilets by circulating hot water from the tank through coiled pipes under them and back again. Remember floor circulation heating puts added demands on your power supply at the season when you have the least power. See Home Power Magazine issue 79 page 36 for more details.



The Hatcher Family

PHANTOM LOADS

APPLIANCES THAT STEAL YOUR POWER – EVEN WHEN THEY ARE TURNED OFF

Some appliances need to be disconnected from power as completely as pulling the plug, when not in use. Remote control TV, VCR, DVD, stereo, microwave oven and office equipment (computers, fax, etc.) may use a little power 24 hours a day, even when switched off! These are called “phantom loads”, and taken together, keep an inverter turned on and waste a lot of power if not remedied.

The cure is to have lots of wall switches to shut off power to outlets. This is easier than actually pulling the plugs every time. The stereo and TV and much of your office equipment should use switched outlets to disconnect at night, or whenever not used. In houses without such wall switches, the extension cord/outlet strip with built in on/off switch is an easy way to disconnect phantom loads.

SHOP & POWER TOOLS

Most hand-held power tools operate on 800 to 1500 watt inverters. Larger power equipment like table and radial saws usually work with 2500 watt inverters, though sometimes the motor belt needs to be slipped for easier starting on the largest equipment. Sinewave inverters work best for really large equipment. Wire feed welders and air compressors usually require 3500 watt or larger 4000 watt inverter. Select small wattage tool motors or use a generator to power larger ones. Cordless tool rechargers without a wall cube transformer plug must have true sine wave inverter power, and may be ruined on modified waveform inverters.

WIRING A HOUSE FOR ENERGY EFFICIENCY

AC BREAKER BOX: An inverter produces 120 volt AC. Normally no 240 volt AC will be used in the house, only 120 volt AC. So you just feed the same 120 volt hot wire to both legs of the AC breaker box. Since most inverters are limited to 20 to 60 amps maximum output, you don't need a 200 amp main breaker. Eliminate the expensive main breakers by "back feeding" the entire box through two of the load breakers, one for each "leg" of the breaker box. This passes electrical code. 120v only systems CANNOT utilize the multi-branch circuit wiring technique.

GENERATOR AC WIRING: Power from the generator should go into the power equipment area on a separate wire, (never fed back through the same wire that carries inverter power out to the generator location). Mark this wire generator direct. This will supply generator power to battery chargers and/or the AC input connection of the standby inverter - battery charger. Do NOT connect the generator output directly to the house circuit breaker box because inverter power is connected there. The generator direct wire goes only to the AC IN terminals of the standby inverter, and to any special generator direct outlets put in the power room for other battery chargers. Standby option on the inverter will automatically switch generator power through to house circuits when the generator runs. When the generator is shut down, household circuits automatically switch back to inverter power.

You may also want to run a generator direct wire to its own outlet in the garage, shop, or elsewhere, to plug in automobile battery chargers and block heaters, welder, air compressor, or any item you do not want to run except when the generator is on. Also run a generator direct line for any 240 volt power you might use directly from the generator, like a very deep well pump. No need for separate generator and inverter wiring elsewhere in your home, because generator power automatically comes through the regular wiring when the generator runs.

TELEPHONE and METERING WIRES in your home should be kept far from AC wires because non-sine wave inverter models may add a buzz on your phone and interfere with metering if their wires run close to each other for any length. Try shielded, twisted pair telephone cables with the shield connected to ground to minimize this common noise problem.

SMOKE DETECTORS should be battery powered only. They are available with 9-year lithium batteries. Hard wired smoke detectors are constant loads.

SPECIAL PURPOSE 12 or 24 VOLT DC CIRCUITS: Plan a few DC circuits in the house for those items that can save energy by using DC power directly from your battery. One DC outlet to each room is usually enough, and special circuits for specific “low power, long hour” applications. Things that use DC efficiently are: rechargeable flashlights, cellular phone, cordless tools, standard doorbell (runs on DC), motion sensing lights at entrances (they can operate whether the AC power inverter is active or not), intercom or paging system, alarm system, DC converted phone/answering machine, DC converted cordless phone, 2 way radio, and portable stereo. DC powered energy-saving refrigerators, water pumps, fans and ceiling fans as well as DC hot water circulating pumps used for floor heating systems, water-bed heating, or compost toilet heating also need their own DC circuit.

24 OR 48 VOLT SYSTEMS CAN GIVE 12 VOLT POWER

Use 12 volt DC applications from a 24 or 48 volt battery by using the BATTERY EQUALIZER or a converter from our hardware section.

DC OUTLETS are not standardized. Beware of the old RV cigarette lighter plug. They are poor quality and don't meet building code in houses. Use standard 240 volt 20 amp AC outlets (like 120 volt except one prong is turned sideways). These pass code inspection used as DC outlets if there are no actual 240 volt outlets in the same house. They fit the same outlet boxes and cover plates as regular 120 volt AC outlets, and easily attach to wire with a screwdriver. These are listed in our hardware pages as O-DC OUTLET and O-DC PLUG.

To figure the correct wire size for 12 and 24 volt DC circuits, use the wire size chart in this catalog with the solar module mounts and wiring. Generally, use 12 gauge wire up to 35 feet or 10 gauge for runs up to 50 or 60 feet. (Stranded wire or solid wire of the same gauge carry the same amperes, AC or DC).

ADDITIONAL WIRING

Larger gauge wires will be needed from the solar module area to the battery room. A battery monitor meter like our M-TRIMETRIC can be located remotely in the living area by running 4 conductor twisted pair intercom wire. Perhaps a 4 conductor 14 to 18 gauge cable for a control to start and stop the generator from the house or shop. Also wire a generator start control to the battery room because some inverters can start the generator automatically when battery charge is low. Remember, all the usual extras are more difficult to add after the house is built: TV antenna cables, extra telephone wires and outlets, speaker wires for stereo, doorbell buttons, intercom, alarm or other special wiring.



TWO STARTING DECISIONS

12 VOLTS, 24 VOLTS, or 48 VOLTS?

Battery voltage is difficult to change after your system is built. Choose carefully.

12 volt systems are simple and standard in most vehicles, RVs, and boats. If you want a small, simple power system, 12 volts will be the easiest. You can use 12 volt DC directly in very small systems, and add 120 volt AC with an inverter.

24 volt battery systems have some technical advantages. **SYSTEM SIZE:** If you think you will have **more than 720 watts of solar modules, consider 24 volts.** A technical advantage is that 24 volt wires can run longer distances. If you must place solar modules over 75 feet from your home for adequate sun exposure, or if your wind generator or hydro turbine is over 300 feet away, choose 24 volts. Most of your power will be changed to 120 volt AC power. Voltage converters are available to run 12 volt DC equipment from 24 volt batteries.

48 volts has great advantage if longer wire runs of up to 400 feet is unavoidable to reach the only good solar location. There is a limited selection of 48 volt inverters, but these are the best quality, and suited for larger power systems. Converters are available to get 12 volts DC from a 48 volt battery system.

MPPT Charge controls by Outback, Xantrex, Midnite, and Morningstar can charge a 12, 24 or 48 volt battery from a much larger solar array allowing power systems of any battery voltage to reach longer distances to place solar modules in the best sun location.

SEPARATE PARTS OR A POWER CENTER?

A **PREFABRICATED POWER CENTER** is the other choice to decide on at the outset. They cost a little more than separate hardware and components of equal quality but can save as much in cost of design and installation. You get a clean, safe, electrical system with just 3 components in the power room: standby inverter/charger, a power center with charge control, and the batteries. A power center may be the only way to pass your local building code inspection. Consider your long term goals. Separate components are suitable for the smallest systems, and may allow budgeting for an additional solar module. But if you will be increasing the power of your system over the years, a power center approach is safer and neater; makes expansion easy; and are designed with UL listed components and passes electrical codes.

OFF-GRID LOAD CALCULATION

TO CALCULATE HOW MUCH POWER YOU WOULD USE:

Start by finding how many watts each appliance needs. Be sure you use watt figures from special energy-efficient appliances recommended for solar electric homes, like compact fluorescent bulbs and solar-electric designed refrigerators. Do not add appliances that should be propane fueled.

Then multiply listed watts of each appliance by the number of hours per day, on average, that appliance runs. This gives watt-hours per day for that light or appliance. Do this for each appliance. The total for all appliances is your total watt-hours needed each day.

Figures below show some appliances commonly used in independent solar homes. Substitute your own daily hours for each and add other appliances not listed. Refrigerators come on and off on demand by thermostat, so running time per day is not known. Our Kill-a Watt meter will accurately test watt-hours used per day for any AC appliance up to 1875 watts.

APPLIANCE	WATTS	HOURS/DAY	WATT HOURS/DAY
Microwave oven average size	1260	1/4	315
Microwave, small, with timer knob	900	1/4	225
Food blender or processor	200	1/20	10
Toaster	1200	1/10	120
Clothes washer standard	700	3/4	525
Clothes washer	200	3/4	150
Vacuum Cleaner	550	1/4	138
Electric blanket	180	4	720
DC power bed-warmer	60	4	240
Refrigerator/freezer, standard			1500
Small apartment refrigerator 4 cu. ft.			945
12/24 volt RV NovaKool 4 cu. ft. with added insulation			300
10 cu. ft. freezer, standard			1000
Window air conditioner smallest	660	6	4000
Ceiling fan AC	60	6	360
Ceiling fan 12/24 volt DC	5 - 20	6	30 - 120
Water well pump 120 volt AC 100 gal/day	1000	1/3	350
Water well pump DC, 100 gal/day	100	1	100
Standard 60 watt light (not recommended)	60	4	240
Compact fluorescent bulbs equal to 60 watt	15	4	60
Computer	100	4	400
HP laser jet printer in operation	90	1/4	23
19" color TV	85	3	255
32" LCD TV	140	3	420
Satellite receiver	20	3	60
Quality stereo	40	4	160

More appliances are shown in books in back of this catalog, or see the label on each appliance.

SIZING OFF-GRID SOLAR POWER



LET'S BEGIN by finding the right size and cost for your power system. There is flexibility in design because the power you receive varies with seasonal changes in weather. Your own flexibility in energy usage, plus use of a backup generator allows you to adapt to temporary shortages, and the automatic charge control manages any overproduction. To get an idea of the equipment you need:

1. **SIX EXAMPLES** from smallest to largest power systems are described and priced on the pages ahead. Identify with one of these expandable designs for the **FASTEST** way to start. We will customize each Example to fit your needs!

2. **CALCULATE** how many watt hours you will need. Then find the number of solar modules to produce that much power in your climate. The method is summarized after the Examples. We also offer books at the end of this catalog which may help you through this figuring more easily than will our two pages.

3. **VISIT INDEPENDENTLY POWERED HOMES** in your area. Notice what works for folks with a life-style, family size, home, and climate like yours. The amount of electricity needed depends on the number of people in the house, their hobbies, business activities and conservation habits. Ask about their use of special energy saving appliances.

4. **CALL/WRITE US AT BACKWOODS SOLAR.** We will be glad to personally help you estimate your power and solar equipment needs. Write, call, or visit with us to discuss your life-style needs and let us suggest a power system.

Phone (208) 263-4290 M-F 8-5 Pacific Time; FAX (208) 265-4788
Email: info@backwoodssolar.com Website: www.backwoodssolar.com

SOLAR MODULES FOR OFF-GRID

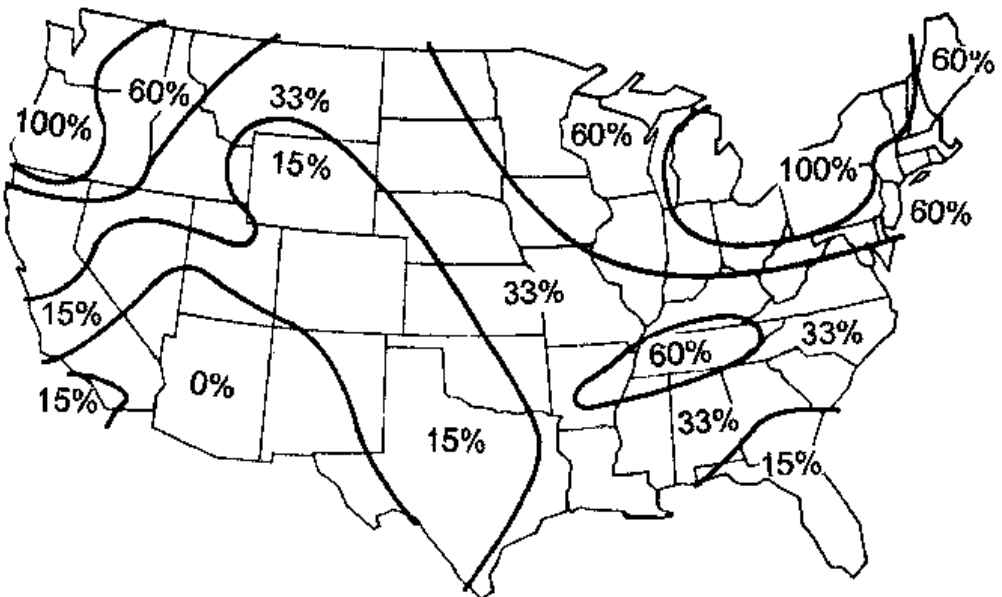
HOW MANY WATTS OF SOLAR MODULES ARE NEEDED?

On a fully sunny day, each solar module produces the equivalent of six hours of its maximum charging ability. Divide your total watt-hours needed each day by six. Theoretically, this calculation tells you how many rated watts of solar modules are needed to produce your day's power from a day's sunshine.

However we now add 50% more solar watts to allow for solar module derating (actual working watts is less than theoretical maximum rating) and for power loss in wiring, batteries and inverter. This gives the watts of solar you need to install if every day is fully sunny.

Since our location is not sunny every day, in the northwest corner of the U.S. we must add another 60% to 100% to the total in an attempt to make up for our cloudy, short winter days. The percentage to add for areas in the 48 states is shown on the U.S. map below. In the desert southwest showing 0%, nothing needs to be added.

This final number is the total rated solar watts you should install to meet your level of energy consumption on average in your climate. Because weather changes year to year, and because seasons vary more in some areas than in others, this estimate is a rough figure, but close enough to work. This process is explained in more detail, with work sheets, in books listed in back of this catalog. If you are sizing a system for a home with utility power, please reference page 28.



SIX OFF-GRID EXAMPLES

These six examples are not packaged kits, but suggestions of well balanced power systems to fit several levels of life-style and budget. Each is flexible in equipment choices. It's easy to start from one of the examples and make changes for your specific needs. Most people shopping at Backwoods Solar fit the middle examples #2 through #5.

Sizing your system is not terribly precise nor risky. Solar modules can be added any time, and a backup generator can supplement charging when there is a shortfall. You can start with a small system for a weekend cabin or a beginning family budget. When the family grows or the cabin becomes a full time home, you add more solar modules. If an upgrade of the charge controller or AC inverter is necessary, Backwoods Solar takes your trade-in if it was originally purchased here within a reasonable amount of time.

We caution against the temptation to start with generator, batteries and inverter while postponing solar modules until later. Start with enough solar modules to do the job. If budget requires, start with one half or a third, then add the rest in subsequent years. Even partial solar charging avoids battery problems and saves generator time by adding many hours of slow and easy charging.

EXAMPLES 1 THROUGH 6 ARE EACH DEFINED BY THE NUMBER OF WATTS OF SOLAR MODULES INCLUDED. Kilowatt-hours per day listed for each is a calculation of usable power produced on a sunny day in an average U.S. location. Summers will be higher, winters will be lower, depending on climate. The description of life-style and benefits with each example is based on experience with customers in the northwest U.S. climate. That same solar array will produce much more energy if located in the desert Southwest with more hours of sunshine.

COST for each example varies between the low and high shown, depending on specific choices among the equipment suggested. We have included the cost of battery cables, inverter cables and other incidentals that you will need in the power room that we can provide. We include required post mounts in the solar cost, which could be lower if roof mounts are used. Shipping and any tax is not in total.

Backup generators cost varies widely from \$3500 to \$10000. Many of our customers already own a generator. That cost is NOT added to the total in the examples, and you may need to allow for purchase of a backup generator.

EXAMPLES

#1 STARTER SOLAR POWER SYSTEM

\$1,200 – \$4,800

***produces about 0.25 - 1.0 usable
kilowatt-hours on a sunny day***

Minimum solar power for a small cabin, motor home, boat, or weekend retreat. A very conserving person can start with 65 to 125 watts of solar, to power a few 12 volt lights, and stereo. Closer to 250 watts of solar allows a lot more light, a 12 volt TV, 12 volt water pressure system and a small inverter for some power tools. Northern winters will require backup charging with a generator. One or two pairs of 6 volt deep cycle golf cart batteries make a 12 volt set.

SOLAR 65-250 WATTS: one Backwoods 110W or two KC135s & mounts

CHARGE CONTROL: C-12, or Mark 22, & fuse

BATTERIES: 2 to 4 Trojan T-105 and cables

DC BREAKER BOX: QO612 with two 20 amp breakers

INVERTER: None, or any up to Xantrex TR1512, cables, fuse

Add Battery Boost engine/alternator kit, or Honda EU3000 AC generator

#2 CONSERVING COTTAGE

\$4,000 – \$9,000

***produces about 1.5 - 2.0 usable
kilowatt-hours on a sunny day***

This cottage power system runs high efficiency lighting, TV, stereo, & DC water pumping. The AC power inverter runs color TV, VCR or satellite receiver, stereo, and limited use of vacuum, sewing machine, hand held power tools, computer, blender, and DC powered well pump. An AC generator is used for large appliances like clothes washer, AC deep well pump, and gives extra charge to the battery at the same time. Battery is usually 12 volt but can be 24 if expansion is intended.

SOLAR 375-500 WATTS: three-four Kyocera 135s & mounts

CHARGE CONTROL: Morningstar Tristar 45DD or Xantrex C40DD

METERS: Trimetric Battery Meter, optional but recommended

HARDWARE: solar and inverter fuses and connecting wires as needed
(consider a power center instead of the two lines above)

BATTERIES: 4 to 6 Trojan T-105 and cables

INVERTER/CHARGER: Xantrex TR1512 to TR2412 and cables

Recommended generator Honda EU3000

EXAMPLES

#3 CONSERVING FAMILY HOME

\$8,500 – \$15,000

produces about 3 usable kilowatt-hours on a sunny day

Year round home for 1 to 3 people. Provides 120 volt AC power for lighting, vacuum, washer, kitchen appliances & microwave, DC or 120 volt AC well pump, color TV, VCR, satellite receiver, stereo, computer, and hand-held power tools. There can be enough power for a small DC refrigerator in sunny climates. In northern winters, the generator supplements battery charging while doing laundry. This system could be set up with either 12 or 24 volt battery.

SOLAR 750 WATTS: six Kyocera 135s with mounts, wiring

POWERCENTER: with a charge control and cables

BATTERIES: 8 Trojan L-16RE, and cables

INVERTER/CHARGER: any 1500 watt to 2500 watt

Or consider our prefabricated Outback Flexware 500 Power system

Recommended Generator: Honda EU6500i or larger

#4 ACTIVE FAMILY SOLAR HOME

\$11,000 – \$18,500

produces about 4.5 usable kilowatt-hours on a sunny day

More power for a family of 3 or 4, or a home office. Includes the loads in Example #3 plus power for a SUNFROST refrigerator and energy efficient chest freezer, as well as extensive computer use. Washing machine and 120 volt well pump run from inverter AC, but uses generator backup if weather remains overcast. 24 volt battery is recommended especially if future expansion is planned to Example #5.

For 24 volt, remember to order solar modules in multiples of two; 6-volt batteries in multiples of 4.

SOLAR 1000 WATTS: eight Kyocera 135s with pole mount, wiring

POWERCENTER: with a charge control and cables

BATTERIES: 12 Trojan L-16RE and cables

INVERTER/CHARGER: 2000 to 4000 watt, true sine preferred

Or consider our prefabricated Outback Flexware 500 Power system

Recommended Generator: Honda EU6500i

EXAMPLES

#5 LARGE HOME / SMALL BUSINESS

\$19,000 - 28,000

produces about 6 - 7 usable kilowatt-hours on a sunny day

This system can run a small home business with office and computers all day, work bench and shop tools. Plus all the usual residential power described in Example #4. Battery voltage of 24 or 48 is recommended. A true Sine Wave inverter runs appliances like washing machines and power tools. Stereo, ceiling fans and appliances don't hum. Includes automatic generator start as batteries or loads require. A 24 volt system requires 6-volt batteries set up in multiples of 4, while 48 volt requires multiples of 8. This Example is simplified by factory assembled equipment.

SOLAR 1500 WATTS: twelve Kyocera 135s on 1-2 mounts, wiring
OUTBACK prefabricated Flexware 500 POWER SYSTEM with 1 or 2 inverters
BATTERIES: 12 Surrette 4KS21PS

#6 HIGHER POWER SYSTEM

\$30,000 +

produces about 8 or more usable kilowatt-hours on a sunny day

Quality plus higher power for a large family home and business, cottage industry, art studio, or shop. Backwoods Solar, when owned by the Willey's, eventually upgraded to 3000 watts of solar to relieve their sun-less winter power shortage and reduce generator running time. Resulting summer surplus allows a small window air conditioner during peak sun hours. True sine wave 7000 watts of AC power with both 120 and 240 volts. Choose a 48 volt battery bank.

SOLAR 2000+ WATTS: Any of the 135W or larger modules, depending on total size of the system, for non 12 or 24V modules, use an MPPT charge controller
OUTBACK prefabricated Flexware 500 POWER SYSTEM with 2 inverters
BATTERIES: 12 Surrette 4KS25PS

HOMEMADE ELECTRICITY

GRID-CONNECTED HOMES WITH UTILITY POWER

LOWER OR ELIMINATE YOUR UTILITY BILL

Many people ask about switching their home to independent power to get rid of their utility bill and this has become a reality because of the rapid decrease in solar module prices. In parts of the country where electricity prices are high, installing a grid-connected solar system is actually a good financial investment.

Determining the kilowatt-hours you consumed for a full year by looking at your utility bills will make it easy to determine the cost of a solar power system that will eliminate or reduce your bill. Every kilowatt of grid-connected solar will deliver 1,000 to 1,500 kilowatt-hours of electricity per year.

Most states allow net metering, which means you can run your electric meter backwards when you are making more power than you are using, giving you a credit for electricity you make on sunny days and allowing you to use the accumulated credit on cloudy days and at night. Many states offer rebates for installing solar power and the federal government offers grants and tax credits of up to 30% of the cost of the system. If the system is installed on a business there are more tax advantages. Given the extensive state and federal tax incentives in place, Backwoods Solar has added many grid-connected products to our catalog. We also feature some larger wattage modules that are perfect for this application. You can find all of your states incentives by logging onto www.dsireusa.org. This website has the most up to date information as well as links to many state and local organizations. Net metering can vary by each utility and in each state, so be sure to check out what is available in your area. Many of these programs and incentives require that a certified electrician sign off on the final installation and actually commission or turn on the system. Most utilities require an interconnection agreement that outlines specific requirements that utility has in regards to safety measures, power quality, permitting, insurance, net metering credits and billing.

Grid-connected solar systems are a very different than off-grid systems that we have been offering for the past 30 years. A solar power system on a utility connected home can both buy power from the utility when needed, and sell power to the utility when there is surplus produced. Most grid-connected systems do not use batteries, which is normally the part of an off-grid system that requires maintenance and eventually wears out. The utility serves the function of the system battery. Without a battery, costs are much less, and operation is simple, but a battery-less system does lose power anytime the utility has an outage.

When installing a grid-connected system, you will need to have the system inspected and all components should be UL listed, not having UL products can void the insurance policy on your home. All of the products that Backwoods carries for grid-tie installation are approved for this purpose and have UL or ETL listings.

Smart conservation and superefficient appliances described in this catalog can add additional benefits and cut down on the costs associated with a renewable energy system, before a home considers alternative energy. Every dollar spent on more efficient lighting and appliances and better energy use practices will save you several dollars on a solar power system.

Many people want their lives and their homes to demonstrate clean, renewable energy use, even where utility lines are easily available. The use of clean energy sources in places where conventional energy is available, educates our society about the reality of clean energy.

GRID-CONNECTED SYSTEMS

Energy efficiency improvements and radical conservation of electric use within the home should be included to reduce total power needs to just a few kilowatt hours per day. Then solar energy can substitute for much or perhaps all remaining power needs.

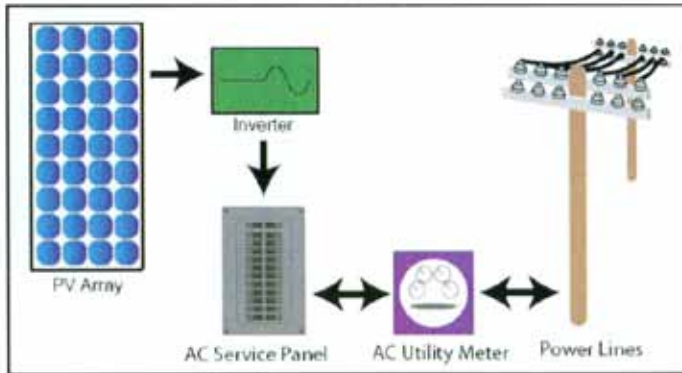
BACKUP FOR UTILITY POWER OUTAGE

Backwoods Solar can supply back-up systems to cover utility outages. Usually solar modules are not needed in utility backup systems, because sunshine tends to be scarce when weather knocks out utility lines. Our Xantrex XW system with batteries is a complete package for back up power and it also offers you the opportunity to sell power to the grid if that fits your design!

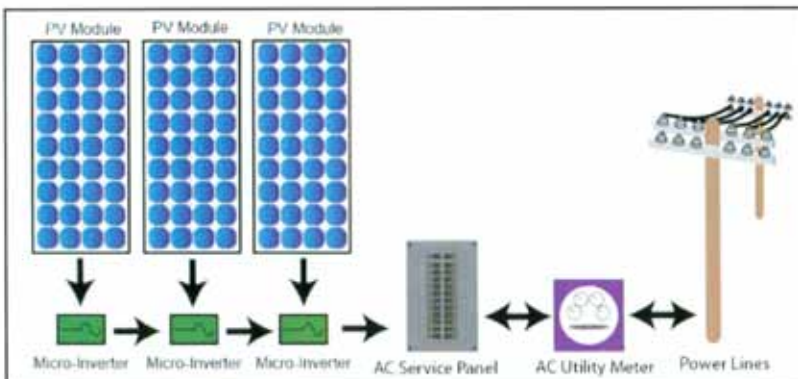
This standby inverter and battery system can automatically support a few selected emergency needs during short utility outages. When the utility fails, the system can instantly deliver power to a computer, cash register, pellet stove, or lights for frequent but short utility outages. Batteries are kept at full charge by utility power until an outage, at which time the inverter automatically takes over the selected emergency needs.

Additionally, a quiet, durable propane fueled generator set with a manual or automatic transfer switch can power the whole house during hours, days or even weeks of power outage emergency. No major conservation or wiring changes in the home will be required (but it is wise to add several propane fuel direct-vent room heaters). We can suggest the best quality, quiet, long-lived generator (and non-electric direct-vent gas heaters) to back up a conventional utility connected home during power outages. A local licensed electrician should install the transfer switch between a generator and your utility served circuits.

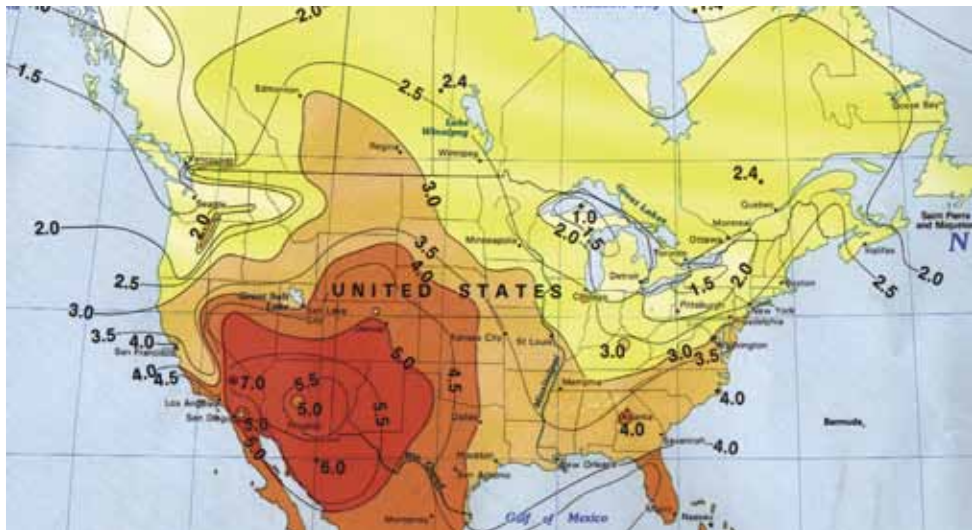
GRID TIE SYSTEM WITHOUT BATTERIES



GRID TIE SYSTEM w/ MICROINVERTERS & WITHOUT BATTERIES



SIZING YOUR GRID-TIE SYSTEM



Determining the size of your grid-tie system is much easier than an off-grid system as the utility company has kept all of the records for you. There are several ways that you can build a solar system of this type. You can start by finding out how many kWh you use on average per month, and creating a system that would cover all of your electricity bill. Once you have completed this, you may be surprised at how large a system this would be, or that you just don't have the roof or ground space to support a system like this. There may be ways to cut down on your electric use, or change out appliances within the home (see the off-grid section previously in this guide for references on making your home more energy efficient). If your utility has a tiered billing structure where you are billed a rate for baseline usage, and then higher rates for a percentage of power used above that baseline, you may be able to build a solar system that eliminates the overages and higher rates which equates to a greater savings per the investment. The following steps will help you determine the size of system you will need.

1. Find your monthly average electrical usage from your electricity bill. _____
This will be listed in kWh
2. Find your daily average electric use. _____
This will be your monthly average kWh divided by 30
3. Find your locations average peak sun hours per day _____
The above map has rough figures
4. Calculate the system size (AC kW) to cover 100% of your electric bill _____
Divide your daily average electric use in #2 by the figure in #3
5. Divide your result in #4 by .7 to get a derate factor for the components _____
in the system. This takes into consideration temperature, wire loss,
component inefficiencies, etc.
6. Multiply your result in #5 by 1000 to get watts of system. Divide the _____
wattage of the module that you would like to use into this number
to determine the number of modules you would need.

SAFETY AND LOCAL HELP

Whether or not you are subject to building codes, we urge you to do a safe and neat job. The reputation of renewable energy, and the resale value of your home are at stake. Learn about battery safety, fusing and grounding for your home. The owner-builder ultimately takes responsibility for the safety of the home by following building codes as well as individual responsibility and competence.

FUSING, at a **MINIMUM**, is **ESSENTIAL FOR FIRE SAFETY**. A fuse or circuit breaker is required for every single wire, large or small, connected to the positive of your battery. Un-fused wiring can start fires. Rework existing wiring that is unsafe or not properly fused. We can supply circuit breakers and power centers that are UL listed, as well as low priced separate fuses and holders (which will not pass code inspection unless installed in metal enclosures).

BUILDING INSPECTORS? Photovoltaic powered homes are included in the National Electric Code. Although smaller homes in remote areas are often ignored by building inspectors where there may be no local codes, in other areas, electrical inspectors do enforce wiring codes on every house with wires in it, no matter what the power source or voltage. It is a good idea to find out how 'off grid' homes are treated in your area. Cost of rewiring is much higher than the cost of doing it right the first time. Some off-grid items in this catalog may not pass building inspection in some areas. Where you do need to meet strict building codes, the easiest way is to follow your inspector's advice and use UL listed power centers and breaker boxes.

GET HELP AS NEEDED. Some electricians may not be familiar with low voltage equipment, but they can certainly help you with installation of conduit, underground cable, and wiring the home safely. Books on design and safety are at the end of this catalog.

See website <http://www.dsireusa.org/> for information on state loans, financial incentives, and tax breaks for solar installations throughout the United States.

Home Power Magazine is a great source of information about home-scale renewable energy and independent living technologies. Published bimonthly, it provides extensive product information, project case studies, buyer advice, how-to instruction, and much more. See their WebSite (www.homepower.com) or contact them at asktheexperts@homepower.com or (800) 707-6585.

Classes: Solar Energy International offers hands-on training in several locations. PO Box 715, Carbondale, Colorado. Phone (970) 963-8855, Fax (970) 963-8866. Email sei@solarenergy.org. Internet at www.solarenergy.org.



A SOLAR ELECTRIC MODULE WORKS LIKE A CAR BATTERY CHARGER...
EXCEPT INSTEAD OF PLUGGING IT INTO THE WALL,
YOU PUT IT OUT IN THE SUN.

PHOTOVOLTAIC or solar cells convert sunlight directly to electricity within wafer thin cells. Light “particles” called photons actually bounce electrons across a barrier, creating an electrical current. About 36 cells are built into a 4 to 12 square foot solar module. Cells are sealed within a tough resin between a tempered glass front and plastic or foil backing, then framed in aluminum rail. Considering cost and long lifetime of modules, we stock the most proven and reliable brands.

DIRECT SUNSHINE with no shadows is absolutely necessary for full power. Partial power is produced on overcast days, but any shadows falling directly on a solar module will reduce power, regardless of what some advertisements claim.

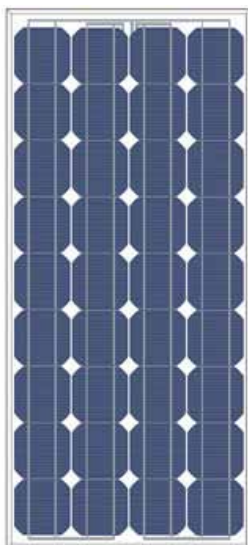
DURABILITY: First used over 40 years ago for space satellites, modules of that vintage still operate unless the glass has been broken or water has entered the seal. Life expectancy of solar modules is over 30 years. Most photovoltaic modules come with a 20 to 25 year warranty on power output and may last a lifetime.

THE AMOUNT OF POWER a solar array produces depends on the number of modules you use and the number of daily sunshine hours in your climate. Overcast days with only half normal brightness give half of normal power. Some climates allow much more power in summer than winter. Solar modules can be easily added to your array to increase power as your needs grow. Modules are rated by volts, watts, and amps. The AMP rating is the best indicator of the charging you get and is what you will see on your meter during ideal sun conditions.

Due to constantly changing wattages and pricing, we have listed some of our modules by brand only. Current wattages and pricing will be on our website, and printed on an insert that we include at the front of each catalog. We apologize for the inconvenience, give us a call and we will be happy to talk about what is available now.

ALPS & ET SOLAR NEW!

65, 95 & 135 (125 - 145) Watt, 12V



In answer to our customers requests to have a low price option for 12V battery charging and small off-grid systems we found the following modules, All have 156 mm polycrystalline cells with silver aluminum frames. The 65W module is the same footprint at the Kyocera 65W module, mounting holes are slightly different and you may need to redrill your rails if you are doing a replacement. These come with a 20 year performance warranty. Junction box with screw down terminals, use our O-SOLARCBLE. 65W is not UL listed.

The ET 95W Mono and 135W (125 - 145W) Poly modules are UL listed. Both feature have a 25 year warranty along with product insurance warranty. The ET modules that we stock are between 125 - 145 watts depending on availability All are made in China.

ITEM	Watts	Amps	Volts	Size inches	Weight	Price
S-SOLAR65	65	3.75	17.4	29.6 x 25.7	13.2 lbs	Call for Price
S-ET95	95	5.13	18.52	47.44 x 21.46	50 lbs	Call for Price
S-ET135	125-145	7.18 +/-	21.75+/-	58.3 x 26.6	29.06 lbs	Call for Price

SHIP VIA UPS in SMALL QUANTITIES, TRUCK FREIGHT for larger orders, call for freight quote

Prices may change between printings. We try to stay with the best prices, and match or better most sale prices that you find. If you see a lower currently advertised price, call us before you order and ask.

KYOCERA SOLAR

135 Watt, 12V

These advanced Photovoltaic modules have highly efficient multicrystal photovoltaic cells with a dark blue surface. Tempered glass front passes industry standard hail impact, wind, and salt mist tests. Anodized aluminum frames are sturdier than most in twisting strength. Power rating tolerance: +/- 5%. The KD135GX module utilizes MC4 cables; the KD135SX has a junction box that utilizes our O-SOLARI cable. Model sold is based on availability. Special discounts on pallet quantities available, please call. Power Output Warranty: 10-year 90% power warranty, 20-year 80% power warranty. UL Listed.



ITEM #	Watts	Amps	Volts	Size inches	Weight	Price
S-KD135	135	7.63	17.7	59.1 x 26.3	27.5 LBS	Call for Price

SHIP VIA UPS in SMALL QUANTITIES, TRUCK FREIGHT for larger orders, call for freight quote

NEW!

UPSOLAR

190 Watt, 24V



With the loss of the SolarWorld 24V modules, we searched for a module that would be appropriate for our customers expectations of quality and durability. We have tried several iterations, but are now stocking UpSolars 190W. 24V panel. They are a U.S. based company that out sources their manufacturing to China, following their very stringent manufacturing protocols. This means that you get a quality product with a lower cost per watt that can only be achieved through their vertically integrated partners.

Upsolar's Reinforced Module Warranty guarantees superior performance from our products. Whereas traditional warranties have only two trigger points over the course of 25 years, Upsolar offers six – occurring at years 3, 7, 12, 16, 20 and 25 – to ensure our customers benefit from premium value over the lifetime of their solar installations. Upsolar has teamed with PowerGuard Specialty Insurance Services to provide customers with a second level of product coverage. The 25-year, non-cancellable PowerCLIP warranty is backed by PowerGuard's network of trusted providers, each rated A (Excellent) or better by A.M. Best, meaning the warranty stays in place with or without Upsolar's involvement. Additionally, coverage takes effect immediately, whereas most policies require a waiting period.

ITEM #	Watts	Amps	Volts	Size inches	Weight	Price
S-UPSOLAR190	190	5.14	36.3	62.2 x 31.8	34 lbs	Call for Price

SHIP BY TRUCK FREIGHT ONLY call for freight quote

SMALL PV MODULES

Crystalline silicon



The 5, 10, and 20 watt modules are a tempered glass laminated, crystalline silicon based module with a sturdy aluminum frame. Ideal for directly powering small DC fans, fountain pumps, and fence chargers. The 20 watt module has a junction box with attachment points. The 10 watt has junction box and an anodized aluminum frame. The 5 watt module has a 12" cord connected to a sealed junction box. Warranty: 10 year limited. Made in China.

ITEM #	Watt	Amp	Volt	Inches	Weight	PRICE
S-SOLAR20	20	1.16	17.3	20.9" x 13.8"	5.4 LBS	\$126
S-SOLAR10	10	0.58	17.3	14.6" x 10.6"	2.54 LBS	\$76
S-SOLAR5	5	.29	17.3	11.8" x 7.5"	1.54 LBS	\$56

THESE MODULES SHIP FREE (UPS) IN LOWER 48 STATES

All other locations contact us for shipping arrangements

REC SOLAR PE-BLK

235, 240 Watt

Ranked SECOND in Photons Field Performance Test.

The REC Peak Energy Module delivers more power per square meter due to several design improvements. Introduction of three bus bars and improved contact between the cell and metal fingers, improves the electrical flow.

Committed to sustainability, REC modules have an industry leading energy payback time of one year. This is a result of innovations such as the new fluidized bed reactor (FBR) silicon production process which uses 80 to 90 percent less energy than traditional methods.

The REC PE Series utilizes 60 high efficiency, multicrystalline 6.14 inch (156mm) square cells. Specially treated tempered glass that provides outstanding performance in low-light conditions. Glass is rated to withstand 3/4 inch hailstones at 120 miles per hour. The modules are designed to withstand heavy snow and wind conditions.

Radox 4mm, twist lock connectors allow quick and easy inter-module connection, and system installation. The Radox output wiring provides for safer array wiring, and makes the REC PE Series compatible with the use of transformerless inverter technology. This insures that the REC PE Series is ready today to work with tomorrow's inverter technologies.

The REC PE Series generates reliable and environmentally friendly electricity. The cell and module production processes are designed to maximize recycling and reduce environmental impact. REC polysilicon is manufactured in the US (Moses Lake, WA and Butte, MT). REC wafers, cells and modules are manufactured in Singapore.



MINIMUM REQUIREMENTS FOR BATTERY CHARGING

MPPT Charge Controller

1 Module for 12V systems

2 modules for 24V systems

3 modules for 48V systems

ITEM	Watts	Peak Power Voltage	Peak Power Current	Open Circuit Voltage	Short Circuit Current	Price
S-REC235	235	29.8	7.9	37.4	8.3	Call for Price
S-REC240	240	30.4	7.9	37.7	8.4	Call for Price

Discounts available for pallet and truckload quantities. Just ask!

SHIP BY TRUCK FREIGHT ONLY call for freight quote

SOLARWORLD

240 & 250 Watt Sunmodules



These SolarWorld PV modules are designed for use in a wide variety of applications from off-grid residential systems using a MPPT charge controller to high-voltage grid-tie commercial systems. The modules use 60, six-inch semi-square mono-crystalline cells in series behind tempered glass within a silver aluminum frame. They have a sealed junction box with bypass diodes and 37.4 inch long output cables with Multi-Contact locking connectors (MC4). The Sunmodule is certified to the stringent safety and design requirements of ULI703 and IEC 61215. All US Sunmodules are currently produced in the ISO 9001:2000 certified Camarillo, California facility. SolarWorld also offers end-of-life module recycling for all Sunmodules.



SolarWorld bonds the tempered glass laminate deep into the aluminum frame with a continuous bead of silicone adhesive. This method guarantees exceptional rigidity for the entire module and prevents the frame from loosening or pulling away from the glass. UL Load rating is 75 pounds per square foot which shows that the module can withstand heavy accumulations of snow and ice.

Sunmodules have a +/-3% power tolerance and a 10-year 90% power warranty, 25-year 80% power warranty. 5 year manufacturers warranty.

MINIMUM REQUIREMENTS FOR BATTERY CHARGING

MPPT Charge Controller

1 Module for 12V systems

2 modules for 24V systems

3 modules for 48V systems

ITEM	Watts	Peak Power Voltage	Peak Power Current	Open Circuit Voltage	Short Circuit Current	Price
S-SW240	240	30.6V	7.86A	37.6V	8.22A	Call for Price
S-SW250	250	31.1V	8.05A	37.8V	8.28A	Call for Price

Discounts available for pallet and truckload quantities. Just ask!

SHIP BY TRUCK FREIGHT ONLY call for freight quote



SOLARWORLD

220 & 225 Watt Poly Modules

World class quality

Fully-automated production lines and seamless monitoring of the process and material ensure the quality that the company sets as its benchmark for its sites worldwide.

SolarWorld Plus sorting

Plus-sorting guarantees the highest system efficiency. Only modules that achieve the designated nominal performance or greater in performance tests are dispatched.

25 years linear performance guarantee*

SolarWorld guarantees a maximum degeneration in performance of 0.7% p.a. for more than 25 years – a clear additional benefit compared with the conventional two stage industry guarantees. In addition there is a product workmanship warranty that covers 5 years.

These modules are made in the United States to the same great standards we have seen over the years from SolarWorld.



MINIMUM REQUIREMENTS FOR BATTERY CHARGING

MPPT Charge Controller

1 Module for 12V systems

2 modules for 24V systems

3 modules for 48V systems

ITEM	Watts	Peak Power Voltage	Peak Power Current	Open Circuit Voltage	Short Circuit Current	Price
S-SW220	220	29.2V	7.54A	36.6V	8.08A	Call for Price
S-SW225	225	29.5V	7.63A	36.8V	8.17A	Call for Price

Discounts available for pallet and truckload quantities. Just ask!

SHIP BY TRUCK FREIGHT ONLY call for freight quote

SOLAR MODULE LOCATION

Solar modules must be outdoors in open, direct sunshine facing the noon sun direction. (Yes, we have seen modules installed in shade or even inside a barn!) Exposure to sunshine must be free of all shadows from trees, wires, buildings, etc. A shadow cast on a photovoltaic module will cut off much of its power (no matter what some advertisements claim).

Precise aim is not necessary. 95% of full power is produced within 20 degrees of the sun. As the sun rises and sets, modules aimed at the noon sun give full power from 10 a.m. to 2 p.m. Earlier and later sun is less direct, adding enough to make a full sunny day equivalent to on average across the county about 5 hours at a module's rated amperes.

Tilting to face the noon sun's elevation twice a year, spring & fall, charges more than fixed mounts. To shed snow, set winter tilt near vertical facing south. For fixed mounts, splitting the difference between summer and winter tilt angles will give you the best average solar production from your modules.

As the solar industry has grown and changed, additional concerns surrounding the proper mounting of solar modules, especially in roof mount applications, have arisen. Roof mounted solar arrays are the most common and many roofing companies have expressed concerns regarding how weatherproofing of installations is being handled. Maintaining the integrity of the roof, protecting all penetrations with proper sealants and flashing, and making sure that the roof itself is built to handle the load will assure you or the homeowner that the roof will not leak and will last the lifetime of the array. We sell roof mounts that either come with their own flashing and sealants or are compatible with QuickMount PV flashings. We highly recommend that if your modules will be mounted to a roof that has a warranty put in place by the roofing company, that you check first to make sure that what you are doing to the roof will not void that warranty, then use materials that will properly seal the roof penetrations and protect against leaks.



Photo courtesy of Joshua Galante of Altered Energy: SolarRacks ground mount system and REC modules

SOLAR MODULE LOCATION

TYPES OF SOLAR MOUNTS

POLE MOUNTS in the yard are easy to set up and adjust seasonally. They more easily pass electric code than mounts attached to buildings. Avoid the very largest mounts in high wind areas.

FIXED GROUND MOUNTS are usually larger arrays that cannot be seasonally tilted (see previous page). We work with Solar Racks to custom design large ground mount arrays. If you have property that is clear of shading and are lacking roof space for a larger array, a ground mount might be the right direction to go. Some inspectors may require a fence to encompass the installation to protect people and animals from coming in contact with high voltage wiring.

ROOF TOP OR SOUTH WALL MOUNTS can place modules high enough to avoid tree shadows. Chances of theft are less. Seasonal adjustment may be more difficult, and the electrical code may require a ground fault interrupter when installed on a dwelling. Our S-RAILS are economical mounts.

TRACKING MOUNTS automatically follow the sun from sunrise to sunset. Where there is a clear view to both horizons, tracking gives full power 10 - 12 hours a day. Gain is 35% to 50% in summer, useful for water pumping or refrigeration. Limit to 6 or 8 larger modules per mount for safety in high winds. Trackers do little to help winter shortage in northern U.S. The December sun barely moves 20 degrees from the noon position. If the sky is overcast, there's nothing to track. Then, the same money spent on extra modules buys more power year round, including gain on overcast days when tracking can't work.

S-RV1 mounts attach individual modules flat to the vehicle roof, or the S-RV RAILS hold 2 to 3 modules on a single rack attached to the roof only at 4 points. Tilting is not necessary if the RV follows sunny weather, but the full set of S-RAILS allows tilt-up on an RV.

SIMPLE R.V. MOUNTS



Four aluminum Z-strip brackets mount a panel flat to a wall, or on the roof of an RV or van. Module is elevated 3/4 inch for air and wire clearance. New design works with any module on the market that have back mounted holes drilled in the frame.

ITEM #	Description	# of Modules	Price
S-RV1	Single module RV roof mount	1	\$36

QUICKMOUNT PV FLASHING



ALL IN ONE WATERPROOF FLASHING- The Quick Mount PV product is an all-in-one waterproof flashing and mount designed to anchor modules to a new or existing roof. The flashing includes an attached standoff block and stainless steel hardware to attach with an L-foot to racking many racking companies. Can also be used with solar thermal panels as well. See our website for installation video.

CLASSIC COMPOSITION MOUNT- This is the standard composition mount. It is shown in a mill finish. It is available in mill finish, (special order) bronze anodized finish, and clear anodized finish. The flashing is 12" x 12" with 5' x 12" exposed, and 7" x 12" under the next rows of shingles. No roof cutting required. Works with all standard racking systems. 50 year life span. 100% code compliant. Maintains GAF and Owen's Corning product warranty. Made in the USA and Ontario Canada.



SHAKE MOUNT- The flashing is 18" x 18" with 5" x 18" exposed, 10" x 18" under the next row of shakes, and 3" x 18" is under the second shake above as well as under the tar paper. It is imperative to place the flashing under the tar paper to maintain a waterproof installation. It is simplest to remove the shakes directly above to both; find the rafter, as well as insure the flashing gets under the tar paper, then reset the removed shakes.

FLAT TILE MOUNT- The Flat Tile Mount is comprised of all aluminum mount and tile flashing cover. All hardware is included. The aluminum tile cover replaces one existing tile. It works with most tiles that measure from 11 1/2" to 12 3/8" wide and have a pan lip on the left side and a cover lip on the right side. Note: This product replaces the tile and limits access to the rafter. Attaching to the deck plywood can be done if approved by the AHJ. Or additional blocking must be installed for a secure structural attachment.



Quick Mount's New Roof Composition Mount is available by special order, this is best utilized in new home construction or during roof replacement.



ROOFING BAR FOR REMOVING NAILS

ITEM #	Description	Additional Shipping	Price Box of 12
S-QMP-COMP	Composition Shingle Flashing- Mill Finish	\$14	\$297
S-QMP-TILE	Flat Tile Mount & Flashing- Mill Finish	\$14	\$509
S-QMP-SHAKE	Shake Shingle Flashing- Mill Finish	\$14	\$357
S-QMP-NAIL	Roofing Bar for removing nails	\$10	\$42 ea

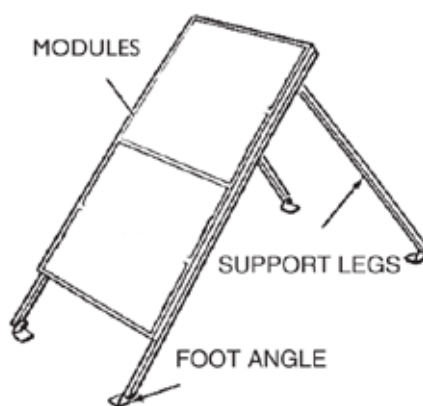


ROOF & WALL MOUNTS

Seasonally Adjustable Solar Mounts for Roof, Deck, Wall, Porch Railing or RV

Sturdy aluminum rails attach to and pivot on four feet which lag bolt to your roof, or to the south wall of the house, or on any horizontal deck. Adjusts to 3 seasonal tilts (most folks adjust only twice a year, for summer and winter). Also good on roofs of trailers and RVs where tilt-up with support legs are usually not needed.

All rails are 1-1/2" x 1/8" aluminum angle. Mounts include all stainless steel nuts & bolts for assembly and to attach modules to rails. Customer provides appropriate anchor bolts to attach the feet to your structure. With illustrated instructions.



S-RAILS: Adjustable module mount for 2 each solar modules. Rails are 68.5" long.

S-RAILS-LRG: Adjustable module mount for 2 each solar modules. Rails are 83.5" long.

S-RAILS SINGLE: Adjustable module mount for one solar module. Rails are 36" long.

S-RAILS-SNG-LRG: Adjustable module mount for one solar module. Rails are 44" long.

S-RV RAILS: Mount for 2 solar modules are 68.5" long, without tilt-up legs. Rails lay flat on roof with 4 feet.

ITEM #	Module Compatibility	# of Modules	Additional Shipping	Price
S-RAILS-SINGLE	Smaller 50 - 185W	1	UPS \$14	\$68
S-RAILS	Smaller 50 - 185W	2	UPS \$22	\$86
S-RAILS-SNG-LRG	RECs, SW	1	UPS \$14	\$78
S-RAILS-LRG	RECs, SW (3, KD135s)	2	UPS \$22	\$86
S-RVRAILS	Smaller 50 - 185W	2	UPS \$14	\$66
S-RVRAILS-LRG	RECs, SW (3, KD135s)	2	UPS \$18	\$76

SOLAR RACKS

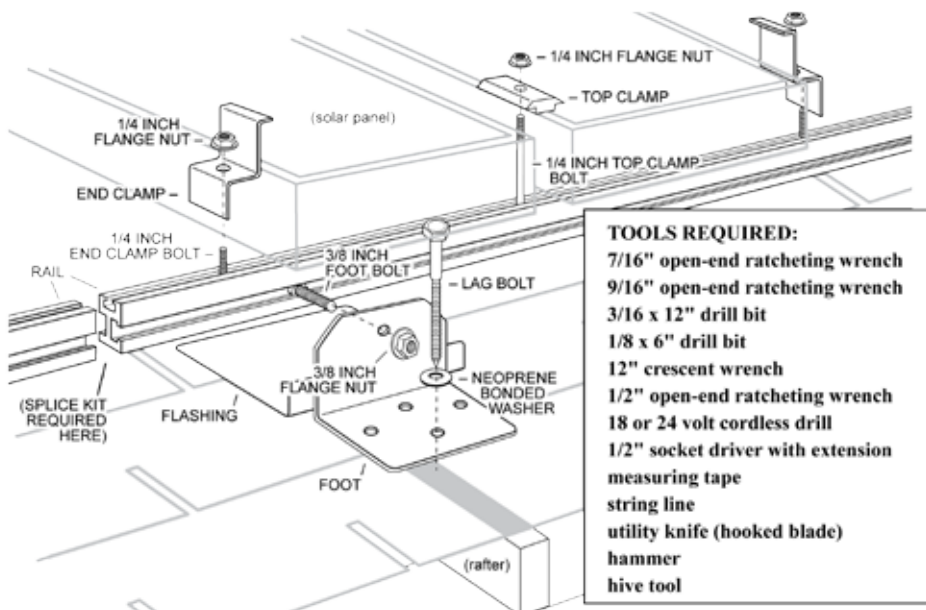


Solar Racks is a new product engineered and manufactured by a longtime solar installer in Northern California. They have taken the best of several different racking companies components and combined them based on what they know works in the field to develop a simple and comprehensive racking solution. All rails, hardware, flashing and sealants come conveniently packaged based on the number of modules that you are mounting in each row (see below). All racking components have an

engineering certification for wind loads up to 120 mph.

Advantages to the Solar Racks system:

- Solar Racks work with any thickness of panel.
- Solar Racks are designed for both horizontal and vertical layout and attach into the roof supports without any special equipment or alterations.
- Custom flashings are provided to insure water is diverted around any roof penetrations.
- Solar Rack roof attachments have higher butyl content for better adhesive and sealing ability.
- Product is made of stainless steel and aluminum to extend the life expectancy, instead of steel which will soon corrode. The thickness of all Solar Racks aluminum parts have been designed to extend the life of our product far beyond common hardware.
- Low profile rails will increase air flow under the solar modules which lowers the operating temperature and increases power production.



SOLAR RACKS

Racking systems are available for all modules over 100 watts in our catalog, and by special order for other modules on the market. Order multiple sets for larger systems. If you have any one row longer than 10 modules, call for a quote. Ground mount systems are also available. If using a standing seam metal roof and you would like non-penetrating clamps, costs will be 25% more, please call us for compatibility. Please add 8% sales tax for orders shipping to California.

Smaller size (SM) is for modules similar in size to the Kyocera 135W, Suntech and UpSolar. Larger size (LG) is for most 60 cell modules on the market, like REC and SolarWorld.

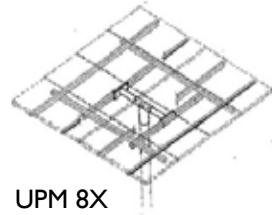
ITEM #	# of Modules in row	Additional Shipping	Price
S-SR-SM-03	3	FREIGHT	\$280
S-SR-SM-04	4	FREIGHT	\$290
S-SR-SM-05	5	FREIGHT	\$355
S-SR-SM-06	6	FREIGHT	\$430
S-SR-SM-07	7	FREIGHT	\$465
S-SR-SM-08	8	FREIGHT	\$540
S-SR-SM-09	9	FREIGHT	\$580
S-SR-SM-10	10	FREIGHT	\$615

ITEM #	# of Modules in row	Additional Shipping	Price
S-SR-LRG-03	3	FREIGHT	\$325
S-SR-LRG-04	4	FREIGHT	\$415
S-SR-LRG-05	5	FREIGHT	\$470
S-SR-LRG-06	6	FREIGHT	\$560
S-SR-LRG-07	7	FREIGHT	\$610
S-SR-LRG-08	8	FREIGHT	\$735
S-SR-LRG-09	9	FREIGHT	\$785
S-SR-LRG-10	10	FREIGHT	\$880

UNIVERSAL POST MOUNT



Absolutely the strongest mounts available for our full size modules.



Made by General Specialties, and highlighted by HomePower magazine in Issue 117, the Universal Post Mount incorporates welded and galvanized steel framework with 6061 aluminum rails. Grade 5 and 8 stainless steel hardware is included for mounting PV modules. Adjusts easily to seasonal sun angle. Designed for 100+ mph wind load (35+ lbs/sq. ft.). Vertical steel base pipe is not supplied but is available at most hardware/lumber supply stores.

Large Wattage Modules (REC, SW, etc)	24V modules (Suntech)	12V modules (BW/Kyocera)		Base Pipe I.D. Size	Pipe Schedule	ITEM	Additional Shipping	Price
		65W	110/135W					
2	2	3	3	4"	40/80	UPM-3X	\$45	\$302
-	3	4	4	4"	40/80	UPM-4X	\$62	\$440
3-4	4	6	6	5"	40/80	UPM-6X	Freight or \$123	\$665
-	6	8	8	6"	40/80	UPM-8X	\$136	\$850
5-6	8	12	10	6"	40/80	UPM-10X	CALL	\$1075
7-8	10	--	--	6"	40/80	UPM-10XHD	CALL	\$1365
-	-	15	12	6"	40/80	UPM-12X	CALL	\$1270
9-10	12	--	15	8"	40/80	UPM-12XHD	CALL	\$2550
11-12	15	--	18	8"	40/80	UPM-15X	CALL	\$2880
13-15	18	--	21	8"	40/80	UPM-18X	CALL	\$4610

Some installations may require a larger diameter pipe than listed above for any mount sized 10XHD or larger. An upgraded gimbal will need to be purchased to accommodate the larger pipe dimension. Must be ordered with mount.	Price
Upgrade 6" pipe gimbal to 8" pipe gimbal	\$200
Upgrade 8" pipe gimbal to 10" pipe gimbal	\$250

INSTALLATION RECOMMENDATIONS:

The diameter and schedule of pipe required will depend on the height of the pipe above and below ground and the model number of the mount. Your local building department may require the foundation for a PV array to be designed by a locally licensed structural engineer. Please contact us for more information or a copy of the manufacturer's pole and foundation instructions. A professional installer and your local building department should be consulted for the safest and most effective installation.

NEW! SIDE OF POLE MOUNTS



ITEM #	Module Compatibility	Pipe Size	# of Modules	Additional Shipping	Price
S-SOP-K	BW65, KD135, BW110	3", Sch 40	1	\$22	\$175
S-SOP-S	BW65, KD135, BW110	3", Sch 40	2	\$30	\$230
S-SOP-X	REC, SW, Schott, Suntech	3", Sch 40	1	\$22	\$195
Mount can accommodate a 4", Sch 40 pipe for taller installations add:					\$60

Steel pipe not included



UPM 8X

WATTSUN ACTIVE TRACKERS



Active trackers use electronic sensors and motor or actuator drives to track the sun from east to west. During partly cloudy days, the tracker fixes on the brightest area of the sky, capturing the maximum amount of sunlight possible. Tracking can increase power production from 10 - 50% depending on the season and location. They are especially effective in water pumping applications. Wattsun Azimuth trackers automatically

track the sun's path by rotating the PV array around the pipe, providing greater stability for larger arrays. The bottom edge of the array always remains parallel to the ground and requires less ground clearance than tilt and roll trackers. Wattsun's azimuth trackers provide nearly 270 degrees of rotational movement and can adjust from 5 to 75 degrees of elevational tilt.

WATTSUN AZ-125 TRACKER- This trackers comes standard with a single-axis tracker with manual seasonal tilt adjustment powered by a 24VDC drive motor running a high quality worm and gear drive. With the addition of the dual-axis option (order separately), this tracker can capture a greater percentage of the suns rays throughout the day.

WATTSUN AZ-225 TRACKER- This tracker is made for very large arrays. It can hold over 2 kW of solar modules. Powered by a sturdy 24VDC motor running a heavy duty ball bearing/worm gear drive. This tracker comes standard with the dual-axis option, enabling it to capture the maximum amount of solar energy. Mounts on a 8" or 10" schedule 40 steel pole. 10" poles will require an 8" section to be welded to the top.

These trackers are limited to the amount of modules that you can mount due to balance purposes. If your system voltage is not 24VDC, you will need a Wattsun voltage converter, see the optional accessories chart on the next page.

ITEM #	Pipe Size/ Schedule	Solar-World	REC	UpSolar	KD 135/ BW110	PRICE
S-WS-AZ125	6"	6	4,6	6	8, 10	\$3045
S-WS-AZ225-S	8"	9	8,9		15	\$5625
S-WS-AZ225-M	8"				16	\$5980
S-WS-AZ225-L	8"/80	12	12	12	20	\$6458

THESE SHIP FREIGHT, PLEASE CALL FOR QUOTE

WATTSUN ACTIVE TRACKERS



OPTIONAL ACCESSORIES

ITEM #	Description	Price
S-WS12-24V	Converter for 12VDC systems	\$125
S-WS48-24	Steps down 48VDC battery or 36VDC solar to 24V on one AZ-125	\$58
S-WSPUMP	Converter for 115-230VDC input from water pumping arrays. Needs to be mounted in rain tight box if outside	\$135
S-WSGRID	Allows grid to power tracker when a battery bank is not present. Needs to be mounted in a rain tight box if outside.	\$165
S-WSDUAL	Add automatic elevation tracking to the AZ-125 trackers- WITH ORDER	\$525
S-WSDUAL-RETROFIT	Add automatic elevation tracking to AN EXISTING AZ-125 tracker	\$755
S-WSCONTROL	Control allows the unit to be turned on or off to allow for manual rotation or adjusting for snow removal or laying flat in high winds	\$125

SUN TRACKER MOUNTS



ZOMEWORKS UNIVERSAL TRACK RACKS follow the sun through the day for more hours of full power generation. Solar heated Freon moves the tracker with no motors or mechanism. Effectively boosts summer power to help water pumping & refrigeration. Power is increased 35% to 50% in summer, but only 0% to 9% in winter. Lower

% applies to northern latitudes. Trackers are of little benefit for typical winter shortage. For improved winter power in the north, where sun moves little and overcast prevails, use more modules instead of a tracker. Tracker will not work in temperatures below 25 degrees. Maximum wind tolerance is 50 mph.

Vertical ground mount pipe is not included. Trackers mount on schedule 40 steel pipe, set 40% length in a concrete filled hole 4 or 5 times larger diameter than pipe itself. Trackers have 10 year warranty, but just 2 years on shock absorbers and bearings. Chart shows number of modules that fit on each rack. Built to order: 3-8 week lead time; 25% cancellation fee.

Model	Pipe Size	Solar-World	REC	Kyocera/BW		Up-Solar	PRICE
		All	All	BW65	KD 135/BW110	24V	
S-UTR020	2.5	1	1	1-2	1-2	1	\$740
S-UTRK40	3	1-2	2	3-4	3	2	\$1,500
S-UTRF64	6	2-3	3	5-10 7*&9*	4-6*	3-4	\$1,990
S-UTRF90	6	4-5*	4-5*	12	6-8	5	\$2,245
S-UTRF120	6	6*	6*	N/A	9*-11	6-7*	\$2,540
S-UTRF168	8	7-9*	7-9*	N/A	12-15*	8-10	\$3,765

*requires extra rail set ADD: \$335 more than shown

** requires extra rail sets ADD: \$665 more than shown

State which module will be used, to receive proper hardware.

All racks go truck freight; call for quote.

DUE TO CHANGING MODULE FRAME SPECIFICATIONS, PLEASE VERIFY WITH US THE MODULE TYPE AND QUANTITY SO THAT WE CAN DOUBLE CHECK MOUNTING OPTIONS BEFORE ORDERING.

WIRING SOLAR MODULES



Thanks to Ray Fallen

WIRING INDIVIDUAL SOLAR MODULES Once the panels are mounted, wires must be connected from each solar module to receive the power generated. Sunlight resistant flexible 10 gauge wires connect from each solar module junction box to a combiner box. You will find bulk wire, as well as pre-cut wires with terminal tips or MC cables and weather tight box seals in the following pages. A single panel is usually rated for 12 volt charging, but several of the larger ones are 24 volts. 12 volt panels can be wired in series, two for 24 volt battery charging or four in series for 48 volt battery charging. Likewise 24 volt panels can be series wired in pairs for 48 volt battery charging. Diagrams supplied with module purchase explains these connections. Larger modules that are outside the 12 & 24V models, can still be used for battery charging by incorporating a MPPT charge controller.

COMBINER BOX The combiner box mounts on the post of a pole mount, or under the eaves for a roof mount. Wires from the solar modules connect together in the combiner box. National Electric Code requires each panel or each series string of panels to be wired to its own circuit breaker or fuse if there are more than two strings in parallel. The OUTBACK combiner box with breakers makes wiring easier, provides a "switch" for separately testing each solar module, and isolates any faulty module or blown diode from the power of the whole solar array. Unfused combiner boxes with just a junction block for connecting the wires together are still available at low cost for arrays with two strings of modules in parallel.

GROUNDING THE ARRAY The aluminum frame of each solar module is required to be grounded to a ground rod below the array. This can be accomplished by using a lay-in-lug on each module and a single continuous copper wire that is also bonded to the rails. This rod should also be connected by heavy wire to any other ground rod in the system.

WIRING SOLAR MODULES



WIRE SIZE & DISTANCE: ARRAY TO BATTERY ROOM

Much larger wires for positive, negative, (and sometimes the ground rod) run from the combiner box/s to the battery room. These run in conduit from the box to underground, and often also in conduit the full distance underground. The wires are larger, and are limited in permissible length, because any voltage drop would reduce the solar charging. Arrays for 24 and especially for 48 volts are allowed much longer distances over smaller wires. A wire sizing chart to guide selection of wire gauge for each array voltage and distance is on the next page. When a given array is wired for double the voltage, current is reduced to half, making much longer wire runs acceptable.

VOLTAGE CONVERTING CHARGE CONTROLS

Recent breakthroughs in solar equipment have given us charge controllers that have the ability to accept power from a solar array wired for higher voltage, up to 250VDC, open circuit, and once it reaches the power room, convert it down to 12, 24, or 48 volts for the battery. This allows higher voltage and lower current in solar module wires, which allows longer wires of much smaller size between the array and battery room.

Solar To Battery Wire Size Tables

TO FIND SIZE REQUIRED FOR LESS THAN 2% POWER LOSS:

Read down the left-hand edge to the number showing solar amps or watts your wire will carry. Follow that line across to the right to find your wire length in feet from solar to batteries (one way distance). At the top of the column above your wire length is the minimum wire size (gauge) required. Smaller gauge = larger wire. You can go twice the listed distance where a 4% drop is acceptable. A 4-5% drop is acceptable between batteries and lighting circuits in most cases.

Buried DC cables must be copper, wet aluminum with DC corrodes quickly.

For more specific wiring calculations, consult page 205 in the back of this book.

Copper Wire Size and Length Table, 2% loss for 12 Volt Wiring										
AMPS	WATTS	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	4/0
DISTANCE IN FEET TO RUN WIRE IS BELOW, WIRE SIZE IS ABOVE										
4	48	17.5	27.5	45	72.5	114	180	290	360	580
6	72	12	17.5	30	47.5	75	120	193	243	380
8	96	8.5	15	22.5	35.5	57	90	145	180	290
10	120	7	12	18	28.5	45.5	72.5	115	145	230
15	180	4.5	7	12	19	30	48	76.5	96	150
20	240	3.5	5.5	9	14.5	22.5	36	57.5	72.5	116
25	300	2.8	4.5	7	11.5	18	29	46	58	92
30	360	2.4	3.5	6	9.5	15	24	38.5	48.5	77
40	480	---	2.8	4.5	7	11.5	18	29	36	56
50	600	---	2.3	3.6	5.5	9	14.5	23	29	46

Copper Wire Size and Length Table, 2% loss for 24 Volt Wiring										
AMPS	WATTS	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	4/0
4	96	35	55	90	145	228	360	580	720	1160
6	144	24	35	60	95	150	240	386	486	760
8	192	17	30	45	71	114	180	290	360	580
10	240	14	24	36	57	91	145	230	290	460
15	360	9	14	24	38	60	96	153	192	300
20	480	7	11	18	29	45	72	115	145	232
25	600	5.6	9	14	23	36	58	92	116	184
30	720	4.8	7	12	19	30	48	77	97	154
40	960	---	5.6	9	14	23	36	58	72	112
50	1200	---	4.6	7.2	11	18	29	46	58	92

Copper Wire Size and Length Table, 2% loss for 48 Volt Wiring										
AMPS	WATTS	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	4/0
4	192	70	110	180	290	456	720	1160	1440	2320
6	288	48	70	120	190	300	480	772	972	1520
8	384	34	60	90	142	228	360	580	720	1160
10	480	28	48	72	114	182	290	460	580	920
15	720	18	28	48	76	120	192	306	384	600
20	960	14	22	36	58	90	144	230	290	464
25	1200	11.2	18	28	46	72	116	184	232	368
30	1440	9.6	14	24	38	60	96	154	194	308
40	1920	---	11.2	18	28	46	72	116	144	224
50	2400	---	9.2	14.4	22	36	58	92	116	

WIRING SOLAR MODULES



READY-TO-USE SOLAR MODULE INTERCONNECTS O-SOLARCABLE is a 10 gauge pair of stranded copper, one red, one black, in a sunlight resistant jacket. Includes weather tight fitting at each end and soldered wire tips for easiest connection to Kyocera SX solar modules. The MC, Tyco, & Radox cables are a single 10 gauge conductor which gets cut in half.

ITEM #	Purpose/Description	Length	Price
O-SOLARCABLE	Join two modules together	36 inches	\$18
O-COMCABLE	Module to combiner box	10 feet	\$20
O-MC-CABLE	One male & one female MC plug end	30 feet	\$30
O-MC4-CABLE	One male & one female locking MC4 end	30 feet	\$30
O-TYCO-CABLE	One male & one female locking Tyco end	30 feet	\$30
O-RADOX-CABLE	One male & one female locking Radox end	30 feet	\$35
O-RADOX-F-ADPT	Radox Adapters- MC4 to Radox (Female)	6"	\$12
O-RADOX-M-ADPT	Radox Adapters- MC4 to Radox (Male)	6"	\$12

TWO CONDUCTOR JACKETED

10 gauge pair of stranded copper, one red, one black, in a sunlight resistant jacket. Use weatherproof fittings below. Allow about 30 inches per module, plus length to combiner box. For Kyocera SX modules, order 30 feet per module.

ITEM #	Length	Price
O-SOLAR-2	1 foot	\$1.40

SINGLE CONDUCTOR WIRE

Single 10 gauge stranded copper wire type XLP-USE, tough sunlight resistant insulation. Simplified connection between modules wired series to make higher voltage strings. Sold bulk: Red insulating sheath for positive and Black sheath for negative. Both red and black included.

ITEM #	Length	Price
O-SOLAR-1	1 foot	\$1

STAINLESS STEEL CABLE CLIP



Keeps cables neatly secured to the frame of module so that they do not hang below the array.

ITEM #	Quantity	Price
O-CLIP	Bag of 10	\$5.20

FLEXIBLE PLASTIC CONDUIT & WEATHER FITTINGS

ITEM #	Purpose/Description	Price
O-FLEXCOND	To run single 10 gauge wires inside, 20 foot roll	\$18
O-CONDUFIT	Seals conduit to module boxes	\$5 ea

Minimum shipping \$10 per whole order covers all items with no shipping listed



SOLAR COMBINER BOXES



SOLAR COMBINER BOX JOINS SOLAR MODULES TO LARGER CABLES to the battery room. Metal boxed terminal block mounts near solar array and combines wires from solar modules to the larger battery room cables. Connects maximum of eight positive and eight negative #10 gauge solar module wires to larger cables up to size #2/0. The terminal block has three separate circuits for positive, negative, and grounding wires. Or use to series connect two identical 12 volt arrays to make 24 volts. Eight inch square drip proof steel box. Includes cable entrance clamps and allen wrench for

terminal block. No fuses or lightning arrestor, combines modules directly together.

ITEM #	Shipping	Price
S-COMBINER	\$10	\$78

NEW! MidNite Combiners & Disconnect



Combiner boxes made from powder-coated aluminum, NEMA 3R rainproof combiners will accept DIN-rail mounted fuse holders for 600VDC arrays, or 150VDC and 300 VDC DIN-rail mounted breakers for low-voltage arrays. Plastic cover provides a dead front for safety. ETL listed, negative busbar and ground bar are included. Can be mounted at angles from 14 to 90 degrees. Breakers and fuseholders are not included but are the same as the ones used by the Outback Flexware combiners, see page 54. The MidNite Combiner and Disconnect is for use with 150 & 300VDC breakers. FULL LINE OF MIDNITE PRODUCTS ARE AVAILABLE.



COMBINER BOXES

ITEM #	Shipping	Price
S-MNPV-3	\$10	\$81
S-MNPV-6	\$10	\$99
S-MNPV-12	\$10	\$162

DISCONNECT

ITEM #	Shipping	Price
S-MNPV-6 DISCO	\$10	\$175



PV GROUNDING LUGS

Grounding lug for PV frames; accepts 4-14 awg. With SS screws and locking washers. You will need one lug per module within your system.



ITEM #	UOM	Price
O-PVLUG	EA	\$4
O-PVBAG	10	\$35

ITEM #	UOM	Price
O-WIRE-FIT	EA	\$3

Minimum shipping \$10 per whole order covers all items with no shipping listed



OUTBACK FLEXWARE

Two sizes for 8 or 12 PV Combiners breakers

- Order only breakers required
- Upgrade to more later
- Dead front for safe operation
- ETL listed NEMA 3R



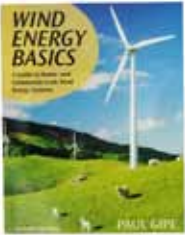
The FLEXware PV8 and FLEXware PV12 accommodate overcurrent protection requirements for off-grid and grid-connected applications. The DIN rail can be fitted with 150VDC circuit breakers for low-voltage PV arrays or 600VDC fuse holders for grid-tie arrays. These combiners replace the PSPV. Rated for NEMA-3R rainproof, the powder-coated aluminum chassis can be mounted on a wall, a sloped roof, or a pole. Dual output lugs allow connection for up to 2/0 AWG wire. An easily removable flame-retardant polycarbonate deadfront panel prevents accidental contact with live terminals. FWPV8 has one circuit and FWPV12 can be configured to have one or two circuits. Negative and ground terminal bus bars are included. The FWPV8 holds up to 8 circuit breakers or 6 fuse holders. The FWPV12 holds up to 12 breakers or 8 fuse holders. Fuses are typically used for combining high voltage array strings for battery-less grid-tie systems. Breakers or fuse size should be at least 1.56 x module short circuit amps and not greater than module series fuse rating. Both boxes are 15.2" high and 3.9" deep. The FWPV8 is 9.2" wide and weighs 4.4 pounds. The FWPV12 is 12.7" wide and weighs 5.9 pounds.

ITEM #	Purpose/Description	Additional Shipping	Price
S-OBFWPV8	8 Circuit Combiner Box	\$10	\$125
S-OBFWPV12	12 Circuit Combiner Box	\$12	\$179
S-OBPV-XX	Breaker for 6, 9, 10, 15, 20, 30, 60, 63 Amps		\$13
S-OBPV-GFP63	63A GFP Breaker		\$69
S-OB-FH	Fuse holder for KLKD fuse		\$20
S-OB-FUSE15	15 amp KLKD 600VDC fuse		\$12
S-OB-FUSE20	20 amp KLKD 600VDC fuse		\$12

WIND POWER

In a good area, a wind turbine can generate more power for its cost than solar modules. Both together can give steadier input since a wind turbine charges your batteries in storms when there is no sun, and at night. But beware of erecting a wind turbine where the wind is not strong and steady. Your area's wind-speed, as well as your immediate terrain, will determine how well the wind turbine performs. If in doubt, we suggest starting with solar modules, and checking the wind for a year. This will show whether to add a wind turbine or more solar modules. You will need at least 12 - 15 mph average year round wind-speeds for an optimal installation, and sites are not common.

Wind turbines must mount at least 30 feet above trees and obstructions for 300 feet around. They need non-turbulent air where a weather vane holds a steady direction. Charge controls for wind turbines are different than for solar. All wind turbines listed come with their own charge controls to connect directly to your battery, and they work alongside solar and generator charging.



Ask us for literature and advice on selecting a wind turbine. Any wind turbine delivery can be subject to delays.

Please consider our wind DVD or Wind Energy Basics book. Both cover the basics of using the wind to produce electricity, evaluating your site, and installation options. More details on these and other publications can be found in our education section near the back of this book.

ITEM #	Description	Price
EV-WIND	DVD; 63 minutes of essential advice	\$35
E-WINDBASIC	Wind Energy Basics Book, 224 pgs	\$29

To Measure Your Wind

The Wind Data Logger is designed to provide an affordable and easy-to-use solution for wind site evaluation and wind generator performance. It easily supports both simple and complex monitoring applications. The Wind Data Logger records wind speed, gust, and direction, as well as the time and date, temperature (if optional temperature sensor is added), battery voltage, and other important wind parameters. Capable of recording wind speed from up to three anemometers, it is ideal for more complex studies involving multiple wind speed instruments and other sensors.



Recording directly to a Secure Digital (SD™) card provides convenient data downloads and stores many months of data at 30 second intervals and years of data at longer logging intervals, resulting in fewer trips to retrieve data from the Wind Data Logger. For your convenience, a new file is created and saved to the card each day.

ITEM #	Description	Additional Shipping	Price
W-JARVISDLX	Jarvis Wind Data Logger	\$10	\$350

Minimum shipping \$10 per whole order covers all items with no shipping listed



WHISPER WINDMILLS



Whisper 200



Whisper 100

WHISPER TM is made by *Southwest Windpower*.

Newly designed in 2005, the Whisper 100 and 200 have field adjustable voltages, heavier bushings, and upgraded yaw shaft, and a four bearing spindle which increases their efficiency. They start to charge in 7 - 8 mph winds, and reach maximum power at 28 mph.

Each Whisper has only 3 moving parts, using no brushes in the alternator. The blades rotate the outer shell of permanent bar magnets around a stationary 3 phase AC winding, creating 3 phase AC, rectified to DC in the control box. It auto-protects it's self with an angle furling mechanism. Both units ship as 24 volt, but are user selectable for 12, 24, or 48 volts.

Blades are injection molded and fiber reinforced. Three blade propellers are quieter and better balanced than two blades. Five year warranty.

INCLUDES CHARGE CONTROL AND METER PANEL with diversion type battery charge control for the windmill, and a built in air heat load. Digital meters show battery volts and amp measurements for wind. Fuse included for controller to battery protection. Call for factory literature OR visit website: www.windenergy.com.

OUT OF TOWN SETTINGS/CHOICES:

- Leave Alone, activate stop switch if the wind is not blowing
- Divert potential excess energy to a dump load for the duration of your absence
- Remove the blades from the turbine
- Remove the turbine completely from the pole

Many modules and towers in stock and ready to ship from our warehouse

WHISPER WINDMILLS



Backwoods Solar includes the pictured optional digital display with this charge control diversion regulator.

WHISPER 100 & CONTROL

900 watts at 28 miles per hour. 3-blade 7 ft.. diameter molded fiber prop. Fits 2.5" schedule 40 pipe.

WHISPER 200 & CONTROL

More low wind speed power generated than Whisper 100. 1000 Watts at 28 mph. 3-blade 9 ft.. diameter molded fiber prop. Fits 2.5" schedule 40 pipe.

ITEM #	Description	Weight	Additional Shipping	Price
W-WHSPR100	24V (field adjust for 12 or 48V)	55 lbs	\$75	\$2,565
W-WHSPR200	24V (field adjust for 12 or 48V)	75 lbs	\$85	\$3,405

WHISPER PIPE TOWER & GUY WIRE KITS are available for these generators, or use Rohn antenna tower which is easy to climb on, or a wood phone pole with guy wires and a welded fitting at top for the windmill is economical.

WHISPER PIPE TOWER KITS include just hardware and guy wires. You supply pipe and ground anchors. Four heights available.

ITEM #	Description	Shipping	Price
W-TOWER30	30 Foot Tower Kit	call	\$835
W-TOWER50	50 Foot Tower Kit	call	\$1,225
W-TOWER65	65 Foot Tower Kit	call	\$1,384
W-TOWER80	80 Foot Tower Kit	call	\$1,935
W-AUGER48	48" Galvanized Augers: set of 4; for 30'/50' kits	call	\$240
W-AUGER60	60" Galvanized Augers: set of 4; for 65'/80' kits	call	\$390

HYDROPOWER

WATER TURBINES steadily charge 12, 24, or 48 volt batteries, working 24 hours a day every day. Compare this with solar modules in sunshine only 6 full-power hours a day, and that just on sunny days. A hydro generator producing 10 amperes round the clock matches the usable power generated by over 50 amps of solar modules. So cost is a lot lower with hydro. The rest of the power system is the same as for solar, except only diversion type charge controls are used with hydro. Pelton wheel generators (pictured above) use a small volume of water raised to high pressure by running downhill in a penstock (pipeline). Pressurized water shoots from nozzles to strike and spin the cupped wheel on an alternator. Other types of wheels and propellers handle water sites with less pressure (head) and more flow volume.



PERFORMANCE depends on the site more than on the cost. Greater water pressure at the nozzle, produced by more head (elevation change top end of pipe to bottom), brings more power. Greater water volume (gallons per minute) onto the wheel also brings more power. Sites with higher head are most desirable because they need less water, smaller pipe, fewer nozzles, cost less to install, and fare better in low water years.

Pipe size, number and size of nozzles, and choice of alternator depend on measurements of your site. There are many combinations of water volume and head, so best to contact us and describe your creek site. Tell us specifically:

1. What elevation change and across what distance of creek length?
2. How many gallons per minute flows minimum and maximum seasons?
3. What size, type, and length of pipe? (if already installed)
4. Wire distance from hydro plant (lower end of creek) to the home?

COST: A complete system with hydro generator, charge control, batteries and inverter costs between \$4000 - \$6500+ plus pipeline and installation.

HYDRO PLANNING TOOLS



ELEVATION SITE LEVEL is a low cost device to measure the feet of head on your stream by walking it just once. Starting at the bottom, looking uphill along the trail or stream, this site shows you a spot ahead on the trail that is the height of your eye - 5 feet higher than where you are standing. Go stand on that new spot and do it

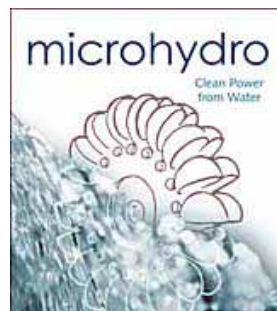
again to see a spot 10 feet above the starting spot. Continue through, and you get the total elevation change of your stream close enough to determine your hydro site merits.

ITEM #	Description	Price
W-SITE	Walk the stream once to find the elevation change	\$25

MICROHYDRO CLEAN POWER FROM WATER

by Scott Davis

ESSENTIAL READING! Highly illustrated and practical, This book covers both AC and DC systems, principles, design, site considerations, equipment options and more. 157 pages.

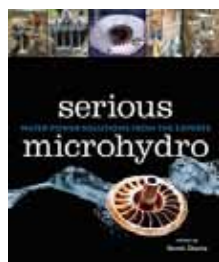


ITEM #	Description	Price
E-HYDROBK	Microhydro Clean Power Book	\$20

SERIOUS MICROHYDRO

by Scott Davis

Serious Microhydro brings you dozens of firsthand stories of energy independence covering a complete range of systems, from household pressure sites to higher pressure installations capable of powering a farm, business or small neighborhood. 336 pages.



ITEM #	Description	Price
E-SRSHYDRO	Serious Microhydro	\$29

RESIDENTIAL MICRO-HYDROPOWER with Don Harris

Don Harris has manufactured and designed micro-hydro electric systems for over 20 years from his shop in northern California. In this material, he discusses water powered electric generation for the individual home; how to judge the site; how to plan the pipeline; and how to select electrical equipment. He demonstrates various aspects of this process in the field and in his shop. Perhaps the best information available for the homeowner who may have hydropower capability.

ITEM #	Description	Price
EV-HYDRO	Hydro DVD; 44 Minutes	\$35

Minimum shipping \$10 per whole order covers all items with no shipping listed

HARRIS HPM MICRO-HYDRO

From 10 feet to 300 feet of head



**VIEWED FROM
UNDERNEATH**

**VIEWED AS
INSTALLED**



Don Harris and Dennis Ledbetter build hydro battery charging generators for a wide range of site conditions: minimum about **10 feet head to 300 feet**. It installs in a small shelter at the low end of a 2 to 6 inch diameter pipeline. The water intake at the upper end of the pipe requires a screen to keep leaves, rocks, or fish from entering. **One year warranty**

High pressure water jets through 1, 2, 3, or 4 nozzles to spin the pelton wheel using pressure built in the downhill drop of the pipe. The Hydro turbine includes a cast metal housing, nozzles, wheel, and alternator, and has a clip-on meter and necessary controls.

HARRIS HPM PERMANENT MAGNET BRUSHLESS ALTERNATOR OPTION (\$1150, pm alternator only)

Can be retrofitted to an existing unit that has a Motorcraft alternator. It will require redrilling of the hydro turbines base. The brushless alternator uses a permanent magnet rotor which has mechanically adjustable strength of magnetism. No brushes to wear out means lower maintenance chores, and the permanent magnets may **produce 10-30% more power** in most installations than the older style Motorcraft alternator based turbines.

Replacement Pelton Wheels are available for \$310, and replacement nozzles for \$7.

HARRIS HPM MICRO-HYDRO

The chart below shows watts generated with combinations of head and flow using the Harris HPM alternator. These watt numbers are conservative. To determine if your site is feasible, see if your site matches 25 watts or more on the chart. Then tell us the data requested on the previous pages and ask for our free hydro planning papers or purchase our hydro DVD.

EXAMPLE: A one nozzle HARRIS HPM turbine on smaller pipe with 75' of head and 18 gpm flowing through it will generate about 115 watts based on the chart. Likewise, 25' of head and 50 gpm produces the same power, but the increased flow requires larger pipe and a 4 nozzle turbine since each nozzle can only pass a maximum 20 gpm with 25' of head behind it.

Watts from Harris HPM alternator at various head and flow.

Gal. per Min.	Feet of Net Head						
	25	50	75	100	200	300	600
3					30	70	xx
6			25	35	100	150	xx
10		35	60	80	180	275	xx
15	20	60	95	130	260	400	xx
20	30	80	130	200	400	550	xx
30	50	125	210	290	580	850	xx
50	115	230	350	500	950	1400	
100	200	425	625	850	1500		
200	225	520	850	1300			

WINDINGS ARE CUSTOM SELECTED FOR YOUR SITE. Specify head, flow, pipe size and length, distance to home. Allow 6 weeks for delivery. **PRICE EXCEPTION:** California residents add 8% CA sales tax.

ITEM #	Description	Additional Shipping	Price
W-H1	One nozzle Harris HPM Hydro Turbine	\$50	\$1,850
W-H2	Two nozzle Harris HPM Hydro Turbine	\$50	\$1,950
W-H4	Four nozzle Harris HPM Hydro Turbine	\$50	\$2,200
W-FANKIT	Fan Kit, required for 500 watts or greater output		\$70
W-HYDROBASE	Plastic drain basin catches water discharged by the Harris and ES&D turbines. Harris Turbine rests on top	\$12	\$52
W-ESD-ADPTR	ES&D Adapter, this aluminum adapter bolts ONLY to the ES&D turbine & inserts in hydro base		\$75
W-BB-KIT	Brushes and bearings for Motorcraft alternator		\$12

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! HI-POWER

Low-Voltage Hydroelectric Generators



HI-Power is now offering a low-voltage brushless PM (permanent magnet) generator. This user-friendly unit requires no adjustments and is more efficient than car alternator types over a wider range of head and flow.

- Head range: 40 to 400 feet
- Flow range: 5 to 100 gpm
- Maximum power: 1500 watts with Controller; 1000W direct
- Efficiency: 30% to 70%
- Voltage options: 12V, 24V, 48V, 120VDC

HI-Power low-voltage hydroelectric generators are available in four voltages for direct battery charging, including the 48V and 120V units, which allow the use of smaller gauge wire between the generator and the battery. An MPPT charge controller such as the Midnite Classic can be used to efficiently step the voltage down for charging and regulating 12V, 24V or 48V batteries.

The sealed permanent magnet alternator is mounted on an anodized aluminum turgo housing with the 4-inch stainless steel Hartvigsen Turgo Runner. The external rectifier is water-cooled and all fasteners are stainless steel. It comes with an induction meter and 3 feet of 1-inch flexible hose per nozzle. Order multiple nozzles for convenient adjustment to varying flows. Alternator has two enclosed 6203 bearings which should be changed every 4-10 years, depending on use. Pictured with 3/4-inch brass nozzle holders. 1/2-inch plastic nozzle holders also available. Also available with Harris Pelton Runner by request. Base dimensions: 12" x 12". Skirt fits in 10.25". When ordering, specify battery voltage, transmission line length and size, flow, pressure, pipe size and length. It uses ES&D housing and wheel with PM alternator.

ITEM #	Description	Additional Shipping	Price
W-LVHYDRO-1	Low Voltage Hydro with one nozzle	\$50	\$1,450
W-LVHYDRO-2	Low Voltage Hydro with two nozzles	\$50	\$1,500
W-LVHYDRO-3	Low Voltage Hydro with three nozzles	\$50	\$1,550
W-LVHYDRO-4	Low Voltage Hydro with four nozzles	\$50	\$1,600
W-LVHYDRO-NOZZLE	Replacement Nozzles		\$15

ES&D STREAM ENGINE FOR 10' - 500' HEAD



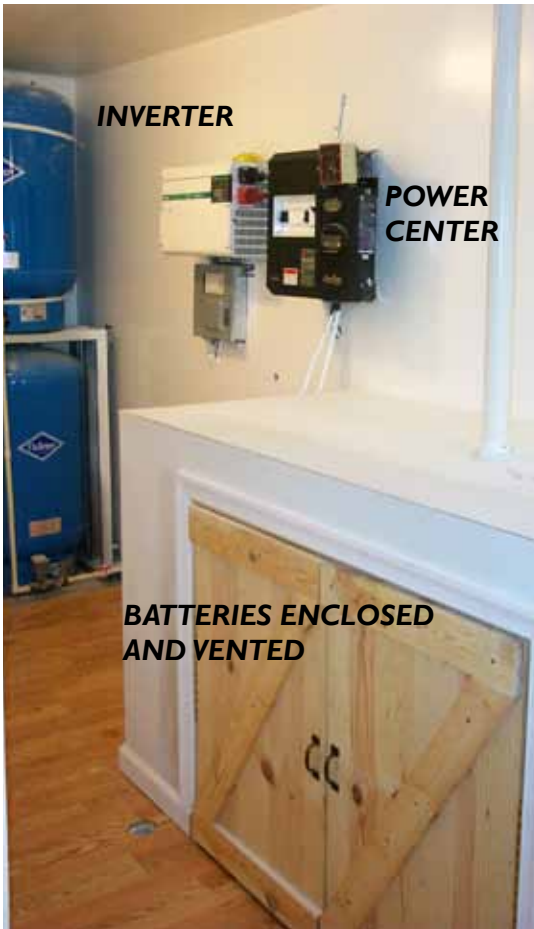
Brushless alternator on Turgo or Pelton wheel handles high flow/low head or low flow/high head sites. Unlike the Harris turbines, these turbines produce maximum output regardless of site parameters. With 10 feet head, 20 gpm gives 20 watts, 40 gpm gives 50 watts, 75 gpm gives 90 watts. At 20 feet head 10 gpm gives 15 watts, 40 gpm gives 100 watts, 75 gpm gives 180 watts. Standard for 12, 24, and 48 volts. Made in Canada. Two extra nozzles included. One year warranty.

ITEM #	Description	Price
W-STREAMSTNRD	ES&D, 2 Nozzle Standard Stream Engine Hydro, Uses Turgo Wheel	\$2,495
W-STREAMLOWFLOW	ES&D, 2 Nozzle Lowflow Stream Engine Hydro, Uses Pelton Wheel	\$2,495
W-STREAMNZ	Universal Nozzles for Stream Engine	\$35



Minimum shipping \$10 per whole order covers all items with no shipping listed

POWER ROOM EQUIPMENT



IN THE POWER ROOM, electricity from solar and/or wind goes through a charge controller and a fuse or circuit breaker, into the battery (hydro goes through a fuse or breaker directly to the battery and is regulated independently). From the battery, power goes through fuses or circuit breakers to DC house circuits, and through a large main fuse or breaker to the inverter/charger producing 120 volts AC. Meters show power produced, power used, and battery condition. This equipment mounts on the wall near the battery. The installer wires everything together into a functioning power system one of three ways:

COMPONENTS: Smaller power systems for cabins and recreational vehicles like examples #1 and #2 at the front of this catalog, use a few components custom assembled by the installer. These components are shown in this catalog.

POWER CENTER KIT: A single box contains all DC circuit breakers, fuses, shunts, and easy connection points for the cables from the solar modules, hydro and/or windmill, DC loads, remote

meters, batteries, and inverter. The charge controller and inverter often attach to the power center forming a single integrated unit. This approach eliminates the need to find, buy, and assemble all the hardware separately. It's a simplified standard design which saves labor and time installing. The result is a safe, clean looking battery room. Power center components typically meet National Electric Code and pass electrical inspection.

INTEGRATED POWER SYSTEM: The easiest method utilizes the OUTBACK FLEXWARE 500 power system. This ships in one piece, assembled on a single mounting plate. Included are all matched components as well as charge controller and 2000 to 7200 watts of inverter power. You just connect your solar array, batteries, generator, and house wiring. **HIGHLY RECOMMENDED.** Component systems such as the Midnite E-panel and Magnum Mini and full size panels allow for multiple inverter choices, and easy to wire connections with pre-wired AC and DC boxes at a lower cost.



OUTBACK FLEXWARE 500 POWER CENTER KIT

The Flexware 500 DC Power Center kit offers much more space than the Xantrex box for all your wiring needs. All breakers are in a single row on the front. Handles one or two inverters.

INCLUDES:

- Flexware 500 DC Breaker box
- One Inverter breaker: 175 or 250 amp
- Appropriate amperage breakers for solar
- One charge controller breaker
- Two 15 or 20 amp DC load breakers
- Remote mount Trimetric Meter
- Internal wiring harnesses
- Hardware for cable entrances; and
- Bushings to attach charge control.



BONDS TO INVERTER. The Flexware 500 DC accepts up to two Outback. DC conduit boxes required to conceal cabling. The Outback conduit boxes align perfectly with knockouts.

MORE SOLAR CONTROL. Appropriate amperage solar array breakers switch two arrays separately for comparison. A 60 or 80 amp breaker connects the charge controller to the battery. Additional charge controls can be added.

MORE BREAKERS Two 15 or 20 amp DC load breakers included. Space remains to add more for wind, hydro, loads, or additional solar controls.

INTERNAL SOLAR GROUND-FAULT PROTECTOR OPTION, when required by code, installs in three of the smallest breaker spaces.

ITEM #	Description	Additional Shipping	Price
For correct size breakers, tell us which charge control & inverter will be used			
C-PCFLEXKIT	Flexware 500 DC 175 or 250 Breakers	\$25	\$795
LA-302DC	Lightning arrestor: reduces surges from PV/DC loads		\$35
O-OBDC-GFP2	Ground Fault Protector- for 1 or 2 solar arrays, up to 80 amps each		\$129
O-OBDCXX	Additional DC Breakers: 5, 10, 15, 20, 30, 40, 50, 60, 80,100 amp (specify amp in item number)		\$25 ea
O-OBDC250	Second 250 amp breaker for second inverter		\$129
O-OBDC175	Second 175 amp breaker for second inverter		\$129
O-OBDC100	Large, Panel Mount 100 amp breaker for FM80 controller		\$57
M-AMP	Analog DC Ammeter for wind, hydro, or DC load amps. Fits in 2" knockout in side of box (except when two inverters are installed). Specify amp range 0-5, 10, 15, 30, or 50		\$25

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! MIDNITE E-PANELS

The Midnite Solar E-Panel is a quick and easy way to install most battery-based inverters. They come standard with the Midnite Surge Protectors and disconnects required to install your renewable energy systems. All units are ETL listed to UL and CSA standards for US and Canada. This does not include a Tri-Metric battery monitor, see page 123.

E-PANELS FOR OUTBACK

Outback VFX, FX, & GVFX inverters mount on a hinged door to keep the footprint as small as possible. The door is hinged on the left allowing the charge controller to be mounted on the right of the inverter. The STS version leaves room for the Outback AC box with surge arrestor for grid-tie applications and the AL-PLUS had room to mount and inverter and FM-60 or FM-80 on the door. Mounting brackets included. Main breakers, inverter cables, a 500A/50mV shunt for battery monitoring, a 175A AC power distribution block, a 50A AC-input disconnect for generator or utility, and a 50A AC bypass switch are included and pre-wired. Cutouts for mounting up to 6 additional 13mm-wide DIN rail breakers are provided, as are cut-outs for GFCI-style AC outlets, and 3-panel mount DC breaker slots.



E-PANELS FOR SCHNEIDER XW

The XW inverter is mounted directly above the E-panel and comes with a 250A inverter/battery breaker, AC inputs for generator & utility, knockouts for up to 7 DIN rail breakers and 12 panel mount breakers as well as a 500A shunt. Charge controllers mount to either side or both sides at once for dual controller systems. Additional busbars for AC inputs, AC output, neutral, ground, PV+ in, PV- in, Bat +, and Bat-, covered by a metal deadfront.

Other models are available for Outback, Xantrex/ Schneider, Samlex SL, Magnum, and Apollo TSW Inverters

ITEM #	Description	Additional Shipping	Price
C-MNE125AL-L	Outback 125A E-panel, White Aluminum	\$35	\$475
C-MNE175AL-L	Outback 175A E-Panel, White Aluminum	\$35	\$505
C-MNE250AL-L	Outback 250A E-Panel, White Aluminum	\$35	\$505
C-MNE125AL-P	Outback 125A E-Panel, Wide White Aluminum Chassis	\$35	\$540
C-MNE175AL-P	Outback 175A E-Panel, Wide White Aluminum Chassis	\$35	\$575
C-MNE250AL-P	Outback 250A E-Panel, Wide White Aluminum Chassis	\$35	\$575
C-MNE250XW	Schneider XW E-Panel	\$45	\$855

MINI MAGNUM PANEL SYSTEMS

The Mini Magnum Panel is an inclusive, easy-to-install panel designed to work with one Magnum MS-PAE, MS, or RD or other non-Magnum inverter/charger. It comes pre-wired for fast installation with easy access front-mounted breakers and a knockout for the digital remote display. It can be wired for 120VAC or 120/240VAC output. SEE PAGE 70 FOR LARGER PANEL SYSTEMS. PAE units come with a 5-year warranty.



Includes:

- One DC 175A or 250A breaker,
- One AC bypass breaker 30A dual pole or 60A single pole,
- One AC input breaker 30A dual pole or 60A single pole,
- One 500A/50mv DC shunt,
- DC buss bars for battery positive and negative and
- A din rail for optional DC mini breakers (will hold up to eight breakers).



ITEM #	AC Voltage	Compatible Inverters
I-ME-MMP250-30D	120/240	MS2012, MS4024, MS4024PAE, RD2212, RD3924
I-ME-MMP250-60S	120	MS2012, MS4024, RD2212, RD3924
I-ME-MMP175-30D	120/240	MS4448PAE, RD2824
I-ME-MMP175-60S	120	RD2824

ITEM #	Description	Additional Shipping	Price
I-ME-MMP250-30D	Magnum Mini Panel 250A DC, 30A AC Dual Pole	\$25	\$551
I-ME-MMP250-60S	Magnum Mini Panel 250A DC, 60A AC Single Pole	\$25	\$551
I-ME-MMP175-30D	Magnum Mini Panel 175A DC, 30A AC Dual Pole	\$25	\$551
I-ME-MMP175-60S	Magnum Mini Panel 175A DC, 60A AC Single Pole	\$25	\$551
I-ME-MMP-BP	Back Plate for wall mount	\$15	\$79
S-OBPVXX	6, 9, 10, 15, 20, 30, 60, 63 amp PV Breakers		\$13 ea
S-OBPV-GFP63	63A, Single Pole Ground Fault DC Breaker		\$69 ea

Minimum shipping \$10 per whole order covers all items with no shipping listed

OUTBACK FLEXWARE 500 POWER SYSTEM

PRE-ASSEMBLED and READY to USE!!



OUTBACK's Flexware 500 power system is an excellent value when compared to separate components plus their installation labor. Includes one or two inverters, the Outback Mate for programming, an Outback FM60 charge controller, AC and DC lightning arrestors, plus AC and DC power centers. You simply connect it to batteries, solar array, back-up generator, and home circuits. The assembly measures 52" x 20.5" x 12.5" deep.

OUTBACK INVERTERS offer 2000 to 3600 watts of true sine wave 120v AC power output. Two inverters can be selected for 4000 to 7200 watts and 240v AC output. If you start with a single inverter, you may add a second inverter & optional transformer later. These inverters are available either vented for higher power or totally sealed to eliminate dirt and salt-air corrosion. Battery charger, inverter/generator transfer switching, and a two-wire, automatic generator start feature are included.

OUTBACK MATE is an Outback system control which programs and monitors the charge control and all inverters. Trimetric battery meter is also included. Both can be installed remote from the system for easy access.

Flexware 500 DC contains the required DC breakers and the Trimetric's shunt. Flexware 500 AC accepts generator input and delivers inverter outputs through several circuit breakers. Optional AC outlets can be added later if needed.

An additional OUTBACK FM60 SOLAR CHARGE CONTROL handles 60 amps maximum output to the battery at 12, 24, or 48 volts with current boost by maximum power point tracking. And the FM60 can convert any higher voltage solar arrays (up to 150 volt open circuit, of five or six 12-volt modules in series) to charge any 12, 24, or 48 volt battery bank, making possible much greater distances and smaller wires from solar array to battery room. Options for adding a larger FM80, 80A charge controller are available.

All of single inverter systems utilize the dual inverter chassis, and includes some wiring to make adding a second inverter to your system easier.

OUTBACK FLEXWARE 500 POWER SYSTEMS

With One or Two Inverters

Assembled system includes (shown left to right in photo):

FLEXWARE 500 AC: AC breakers for inverter/s, generator, bypass, onboard outlet, + one AC load + a relay (VFX only) for 2-wire gen start and Midnite Surge Suppressors.

FX or VFX inverters: One or two inverters with all covers and HUB 4 adapter.

FLEXWARE 500 DC: DC breakers for inverter/s; 1 solar; 1 GFDI Breaker, two loads plus trimetric meter shunt, external relay for FM60 and Midnite Surge Suppressors.

MATE remote control & meter with 10' of CAT5 cable included (up to 1000' ok).

FLEXWARE 500 MP: powder coated aluminum mounting plate for system components
TRIMETRIC BATTERY METER with 25' of cable for remote monitoring.

BATTERY CABLES one pair of 10', 2/0 or 4/0 cable included per inverter.

Battery temperature sensor with 15' of sensing cable.

Trimetric Meter

Midnite Solar surge suppressors

X240 TRANSFORMER included with two inverters for full power at 120 or 240 volts.
X240 can be added to a single inverter system for 240v output: \$430.

ITEM #	Description	Additional Shipping	Price
FIRST: SELECT ONE OF THESE BASE SYSTEMS (additional configuration featuring 12V inverters and sealed inverters available for the same price.)			
PS-FP2-10-3648S	Single VFX3648 Inverter on Dual chassis	FREIGHT	\$4,295
PS-FP2-12-3524S	Single VFX3524 Inverter on Dual chassis	FREIGHT	\$4,295
PS-FP2-10-3648D	Dual VFX3648 Inverters	FREIGHT	\$5,695
PS-FP2-12-3524D	Dual VFX3524 Inverters	FREIGHT	\$5,695
C-PS2-CRATE	All systems require a crating fee		\$80

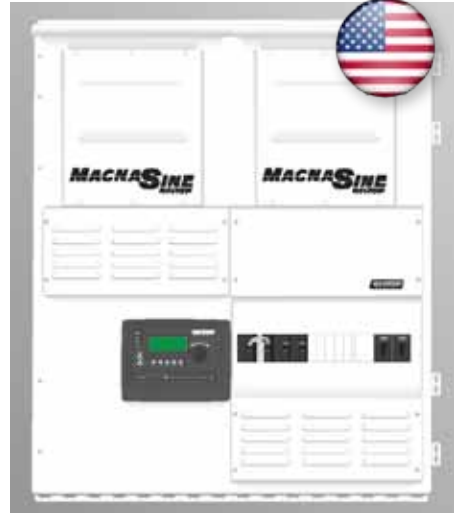
ITEM #	Description	Price
SECOND: CHOOSE THE CHARGE CONTROLLER PROPERLY SIZED FOR YOU SYSTEM. ALL PRICES INCLUDE INSTALLATION, MOUNTING PLATE AND BREAKER		
PS-OPTION-FM60	60A Charge Controller	\$675
PS-OPTION-FM80	80A Charge Controller	\$765

MAGNUM PANEL SYSTEMS

NEW! For Larger Magnum Systems

Designed for multiple inverter applications, the Magnum Panel (MP) enclosures are a new line of Panel Systems from Magnum Energy. Each of the inverter's required AC and DC disconnects and wire connection points are all together, and integrated in self-contained MMP enclosures.

The MP (Magnum Panel) enclosures have been specifically designed to combine all of the major components required for a high power renewable energy system — inverter/battery disconnect, AC overcurrent protection, grounding connections, and a full system inverter bypass switch as a convenient way to isolate the inverters for battery maintenance — into easy to install pre-wired enclosures. PAE systems come with 5-year warranty.



The MP Series enclosures feature convenient front panel operation, and with the recommended Router (**ME-RTR**), will allow you to easily set up, monitor, and operate up to four MS-PAE inverter/chargers together (must be identical models to parallel stack). In addition to saving time and money by providing a simple and convenient inverter installation, the MP enclosures ensure safety and reliability by providing a UL and CSA certified and code compliant system.

ITEM #	Description	Additional Shipping	Price
I-ME-MPSL-30D	Single Enclosure, Low Capacity, Dual 30A AC bypass/input breakers	\$55	\$720
I-ME-MPSL-60S	Single Enclosure, Low Capacity, Dual 60A AC bypass/input breakers	\$55	\$720
I-ME-MPSH-30D	Single Enclosure, High Capacity, Dual 30A AC bypass/input breakers	\$55	\$1,256
I-ME-MPSH-60S	Single Enclosure, High Capacity, Dual 60A AC bypass/input breakers	\$55	\$1,256
I-ME-MP-BPD	Back Plate Double for Dual Inverters	\$25	\$135
I-ME-MPS-30D	Extension Conduit Box	\$15	\$263
O-OBDCXX	Additional DC Breakers: 5, 10, 15, 20, 30, 40, 50, 60, 80 amp (specify amp in item number)		\$25 ea
S-OBPVXX	6, 9, 10, 15, 20, 30, 60, 63 amp PV Breakers		\$13 ea
S-OBPV-GFP63	63A, Single Pole Ground Fault DC Breaker		\$69 ea
I-ME-RTR	Router		\$320

CHARGE CONTROLLERS AS SEPARATE COMPONENTS

HOW TO SELECT A CHARGE CONTROL

Charge controllers regulate the output of solar modules, wind generators and hydroelectric generators to prevent overcharging of the battery. When battery voltage rises to a preset maximum, where the battery is completely charged, the control automatically reduces or stops the solar charge.

Some charge controllers are that simple, but most include some other features like volt & amp meters, voltage conversion, low battery load disconnect or night light timer.

TRADING - UP

If you outgrow the capacity of a smaller charge control, you can trade it in for a larger control at Backwoods, if it was originally purchased from us within a reasonable amount of time.

VOLT AND AMPERE RATING OF THE CONTROL

Select a control able to handle a little more than the amperes your solar modules are rated to generate. Though solar modules don't usually produce more than their rated amperes, they can momentarily produce 15% more on cold bright days. The electric code recommends leaving a 25% margin, that is, for a 47 amp solar array use a 60 amp control rather than a 50 amp control. And if you plan future expansion of your solar array, allow a lot more headroom to accommodate the added panels. Be sure the model you choose is designed for your battery voltage: 12, 24 or 48 volts. A given control will handle twice as many solar modules watts in a 24 volt system as in a 12 volt. Maximum power point tracking "Boost" and voltage converting controllers are rated for the boosted output to the battery, not the slightly lower solar input amperes.

FEATURES

Since a battery voltmeter and solar amp meter are needed to show that the battery is really getting charged, most controllers have those meters built in or optional. We always recommend a control with built-in amp meters and volt meters.

User-adjustable battery voltage set points is a feature of most controllers, so voltage can be set exactly for your battery type, temperature and age.

Battery Temperature Sensor is available for some to automatically adjust charge voltage for batteries exposed to large temperature changes.

Automatic or Manual equalization, used on flooded batteries gives an occasional overcharge to restore all cells to 100%. The equalization feature is not used on sealed AGM and Gel batteries.

HOW A CHARGE CONTROLLER WORKS

SERIES CHARGE CONTROLLERS – Connected between the charging source and the battery.

Pulse width modulation (PWM), used in all modern charge controllers uses 3-stages of operation to give the most charging possible for the day.

BULK charge is the first stage, where the maximum power available from the charging source is fed to the battery until it reaches a preset voltage.

ABSORPTION is the second stage charge where the maximum battery voltage is held by reducing the charge current just enough to never exceed the target voltage. Reduced current is done by high speed on and off pulsing, where the controlling "on" time versus the "off" time of each pulse determines the average charge current. During this stage of charging there will be some bubbling, or gassing of the battery electrolyte. This is necessary to maintain the health of flooded batteries.

FLOAT is a third stage where battery voltage is reduced after charge is complete. This avoids excessive evaporating of battery water and benefits battery life. When sealed, maintenance-free, AGM or gel type batteries are used, voltage set-points are lower to prevent gassing of the battery

DIVERSION CHARGE CONTROL – connected between a battery and dump load

Diversion charge Controllers are typically used when the charging source cannot be disconnected from the battery, such as wind generators or hydroelectric chargers.

Diversion controllers do not cut off current from the charging source at all. When the battery charges to the maximum set voltage, the diversion controller connects a "dump load" such as ceramic air heating resistors or water heating elements to the battery to dissipate the energy coming from the charging source. The controller adjusts its consumption rate to offset the excess charging exactly, and keep the battery voltage at, and never exceeding, the preset maximum voltage. If you use a windmill that does not have its own charge control, or use hydroelectric generating, a diversion control must be used, since those generators can be damaged if their charge is not absorbed in the batteries at all times. One diversion control handles a combination of solar, hydro and wind, so long as the total amps charge from all of them taken together is within its amp capacity.

MAXIMUM POWER POINT TRACKING (MPPT) CHARGE CONTROLLERS

MPPT charge controllers employ DC to DC conversion, which allows the solar array voltage to be higher than the voltage required to charge the batteries. Many years ago solar modules were designed to charge 12 volt batteries. These solar modules were built with 36 cells in series to have a peak power voltage of 16- 18 volts. Two of these modules could be wired in series to charge a 24 volt battery and four could be wired in series for a 48 volt battery. Modules with 72 cells were also available for 24 volt charging. When all modules were made this way, the simple PWM charge controllers described on the previous page worked fine. As grid connected solar became the prominent use for solar modules, cost became the most important factor in module design. This led to larger 60 cell modules, manufactured in a convenient size that could be carried by one person. These modules have a voltage too high for 12 volt battery charging and too low for 24 volt battery charging and are usually wired in series to get approximately 400 volts DC which is easy to convert to 240 volts AC for connection to the utility grid.

36 cell modules are available with power outputs up to 135 watts and 72 cell modules are available with power outputs up to 190 watts. These modules cost more per watt, but can be used with lower cost PWM charge controllers. It makes economic sense to use these modules on systems that required less than 700 watts. If the power required is greater than 700 watts, the cost savings on the solar modules and the wire between the modules and the batteries to pay the added cost of a MPPT charge controller.

MPPT charge controllers from Schneider (formerly Xantrex), Outback, Morningstar and Midnite Solar can operate with a maximum input voltage from a solar array of 150 volts, which can be used with three 60 cell modules in series. Other models from Midnite Solar can be used with arrays up to 250 volts allowing the use of six 60 cell modules in series.

An added advantage of using a higher voltage solar array made from modules wired in series is that much smaller wire can be used between the solar array and the charge controller without significant power loss. Every time you double the voltage in a wire, you can carry 4 times as much wattage with the same loss. This saving increases tremendously when you go from 15 volts in a wire to 150 volts.

When choosing an MPPT charge controller, the amp rating of the controller is the maximum amperage that it can supply to the battery being charged. To find this amperage, add the wattage of all modules in the array and divide by the battery voltage. For example, six 240 watt modules have a total wattage of 1440 watts. If you are charging a 12 volt battery, the charge controller amps required is 120 amps ($1440 / 12 = 120$). In this case you would need controllers with 60 amp or greater rating. If you were charging a 24 volt battery, only one 60 amp charge controller would be required. If you are using a 48 volt battery you could have an array of 2800 watts and still use a single 60 amp charge controller.

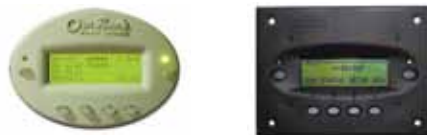
CHARGE CONTROLLER SELECTION

MPPT Charge Controllers					
MODEL	Amps	Digital Display	Web Enabled	Page	PRICE
Outback FM80	80	Yes	Yes	75	\$765
MidNite Classic 150	76-96	Yes	Yes	76	\$765
Schneider XWMPPT80	80	Yes	Yes	78	\$1,360
Midnite Classic 200	63-79	Yes	Yes	76	\$810
Midnite Classic 250	53-62	Yes	Yes	76	\$855
Outback FM60	60	Yes	Yes	75	\$675
Schneider XWMPPT60	60	Yes	Yes	78	\$585
Morningstar MPPT60	60	Yes	Yes	77	\$625
Morningstar MPPT45	45	Yes	Yes	77	\$495
Blue Sky SB2000E	25	Yes	No	83	\$250
PWM Charge Controllers					
MODEL	Amps	Digital Display	Voltages	Page	PRICE
Morningstar Tristar 60	60	Yes	12, 24, 48	79	\$230
Xantrex C60	60	Yes	12, 24	80	\$279
Morningstar Tristar 45	45	Yes	12, 24, 48	79	\$175
Xantrex C40	40	Yes	12, 24, 48	80	\$244
Xantrex C35	35	Yes	12, 24	80	\$209
Morningstar SunSaver 20	20	No	12, 24	82	\$91/\$95
Xantrex C12	12	No	12	81	\$110
Morningstar SunSaver 10	10	No	12, 24	82	\$66/\$73
Morningstar SunGuard	4.5	No	12	82	\$33
Diversion Loads					
MODEL	Type	Amps	Voltages	Page	PRICE
C-HL-12V	Air Heat	45	12	84	\$126
C-HL-24V	Air Heat	35	24	84	\$136
C-HL-48V	Air Heat	36	48	84	\$199
C-RESISTOR	Air	15	12	84	\$40
C-WTRLOAD1224	Water	30/60	15/30	84	\$125
C-WTRLOAD2448	Water	24/48	30/60	84	\$175

OUTBACK FLEXMAX 60 AND 80



Outback MATE & MATE 2
Optional Accessory



FM80: 16.25" x 6" x 4"; 12.2 lbs;
FM60: 14.5" x 6" x 6"; 12 pounds

The FLEXmax family of charge controllers is the latest innovation in Maximum Power Point Tracking (MPPT) charge controllers from OutBack Power Technologies. The innovative FLEXmax MPPT software algorithm is both continuous and active, increasing your photovoltaic array power yield up to 30% compared to non-MPPT controllers. Active cooling and intelligent thermal management cooling, both FLEXmax charge controllers can operate at their full maximum current rating, 60 Amps or 80 Amps respectively, in ambient temperatures as high as 104°F (40°C). Since the control can boost output current, solar input equal to 48 amps for the FM60 and 64 amps for the FLEXMax 80 is maximum recommended. Includes Multi-stage charging plus equalize: Bulk, Absorption, Float, and Equalize. On board 200 ma auxiliary output terminals.

The four-line 80 character, backlit LCD display standard on both OutBacks displays the PV system's performance. It is also used for easy programming and monitoring of the system's operation. Terminals accept up to 4 gauge wire.

Outback MATE system controller optional accessory connects to the FM60 or FM80 as a remote display. MATE can program and remote control Outback controllers and inverters, from a location 1000 feet distant. MATE includes a RS232 computer port for data logging and comes with a 10' & 6' cable. Surface mount version is oval in white, and flush mount is square in black. ETL Listed, 5 year warranty.

ITEM #	Description	Additional Shipping	Price
C-OB FM60	FM 60 Outback Charge Controller	\$20	\$610
C-OB FM80	FM80 Outback Charge Controller	\$20	\$700
I-OBMATE	Outback Mate System Controller- specify shape/color		\$295
C-OBTEMP	15" sensor compensates charge voltage to battery temp		\$29

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! MIDNITE CLASSIC



The MidNite Classic charge controller maximizes the flexibility and features available in a charge controller. At this time, the Classic is the only MPPT charge controller that features arc fault detection, a new 2011 NEC code requirement. These controllers also feature ground fault protection so that a separate GFP breaker assembly is not necessary. This allows for more breaker space in your DC box. There are three models available that accommodate solar arrays up to 150, 200, or 250VDC of operating voltage.

MPPT modes with user adjustable power curves for solar, wind or hydro are built in, along with a learning mode for self-optimization. No hub is required for stacking multiple units. They have two auxiliary outputs, a dry contact relay and a 12V output.

Each model comes with optional snap-on covers and hole plugs for sealing openings in dusty or salt-air environments, using them in this manner reduces output by about 20%.

ITEM #	Description	Additional Shipping	Price
C-MID-MPPT150	150V Midnite MPPT Charge Controller	\$20	\$765
C-MID-MPPT200	200V Midnite MPPT Charge Controller	\$20	\$810
C-MID-MPPT250	250V Midnite MPPT Charge Controller	\$20	\$855
C-MID-BTS	Midnite Battery Temperature Sensor		\$25

MORNINGSTAR TRISTAR MPPT



Morningstar's TriStar MPPT solar controller with TrakStar Technology™ is an advanced maximum power point tracking (MPPT) battery charger for off-grid photovoltaic (PV) systems up to 3kW. Both controllers can be used with arrays with a maximum open circuit voltage of 150 VDC and charge batteries between 8 and 72 VDC. A remote temperature sensor is included.

The controller provides the industry's highest peak efficiency of 99% and significantly less power loss compared to other MPPT controllers. The TriStar MPPT features a smart tracking algorithm that maximizes the energy harvest from the PV by rapidly finding the solar array peak power point with extremely fast sweeping of the entire I-V curve. This product is the first PV controller

to include on-board Ethernet for a fully web-enabled interface and includes up to 200 days of data logging. Optional TriStar meter and remote provide detailed operating data, alarms and faults and three LED's display system status.

Additional networking options are available. The MeterHub allows multiple Morningstar products to communicate over a Meterbus network to enable multiple controllers to share a single TriStar meter and display both single controller data as well as aggregated data for the entire system.

Weights 9.2 lbs, dimensions are 11.4" x 5.1" x 5.6". 5-year warranty. ETL Listed to UL 1741.

ITEM #	Description	Additional Shipping	Price
C-TSMPPT45	TriStar 45 Amp MPPT Charge Control	\$14	\$499
C-TSMPPT60	TriStar 60 Amp MPPT Charge Control- Web Enabled	\$20	\$625
C-TRISTARDD	TriStar Digital Display-2- Front Plate for unit		\$99
C-TRISTARRD	TriStar Digital Display-2- 98' cable		\$129
C-TSHUB1	MeterHub: Communications Network Hub		\$98

SCHNEIDER XW MPPT



XW MPPT60

THE SCHNEIDER XW MPPT60 has a two or three-stage charging process, with manual equalization to maximize system performance and maintain expected battery life.

With Maximum Power Point Tracking (MPPT) to deliver the maximum available power from a PV array to a battery bank. Controller has a configurable auxiliary power output

Easy to read, two-line, 16-character liquid crystal display (LCD) and four buttons for configuration and system monitoring in stand-alone applications.

A provided Battery Temperature Sensor (BTS) provides automatic temperature-compensated battery charging. The charge controller is able to communicate its settings and activity to other Xanbus-enabled devices

THE SCHNEIDER XWMPPT80 is the first PV battery charger to use DC input voltages up to 600V. This significantly decreases the current needed in the array to reduce wiring gauges and costs, increase string sizing of the array, and give you the ability to place the array farther from the battery bank. A PV array combiner isn't required for many installations, please check with us. It can be used with PV arrays with voltages ranging from 195 to 550 VDC and can support an output of up to 80 amps into the battery for battery voltages of 24 or 48 VDC. The PV open circuit voltage must not exceed 600 VDC.

Has a configurable auxiliary output to drive a relay for load control or to turn on devices such as a vent fan or indicator alarm Auxiliary output can be configured to perform only one function at a time. Built in PV ground fault protection allows code-compliant installation without the need for additional ground fault protection.

Standby and night-time power draws less than one watt.

5-year standard warranty



XW MPPT80

ITEM #	Description	Additional Shipping	Price
C-XWMPPT60	60A, 150VDC MPPT PV Charge Controller	\$20	\$585
C-XWMPPT80	80A, 600VDC High Voltage MPPT PV Charge Controller	\$20	\$1,360

MORNINGSTAR TRISTAR 45 OR 60

12, 24, or 48 Volts

Three function controller for solar battery charging, diversion regulation, or load control



CONSTANT CHARGE VOLTAGE: 3-Stage control method plus Equalization for up to 60 amps of regulation for 12 to 48 volt systems. Dip switches allow the user to accurately select **Bulk, Float, and Equalization Voltage** set points from 7 preconfigured options. Or a RS232 port allows connection to a PC for custom settings, data logging, and remote monitoring. Extensive self protecting electronic features.

NEW FEATURES added to latest version!

LIGHTING CONTROL MODE: may be custom set to turn lights on and off for loads up to 60 amps.

90 DAYS OF DATA LOGGING: record daily min/max voltages, amps, amp-hours, kWhrs, faults, alarms and many other parameters. Logged data can be viewed on a TriStar Meter2 (see previous page) or downloaded and graphed in MSView.

NETWORKING CAPABILITY with METERHUB

BATTERY EQUALIZING: automatically equalizes batteries once a month, or can be started manually anytime or disabled for sealed battery.

OPTIONAL DIGITAL DISPLAY: shows both charge amps and battery volts plus a count of amp-hours of charge since last reset. Also records high and low battery voltages since last reset. New screenshots have been added for logged data. **Highly recommended.**

AS A DIVERSION CONTROL: Tristar 45 or 60 can be used as diversion control for wind or hydro. To set up as diversion control, order air or water heat diversion resistors found at the end of this charge control section.

Built-in terminals accept wire size up to 2 gauge.

5 year warranty. UL Listed. Size: 10.3 h x 5.0 w x 2.8 d

ITEM #	Description	Additional Shipping	Price
C-TRISTAR45	TriStar 45 Charge Control	\$14	\$175
C-TRISTAR60	TriStar 60 Charge Control	\$14	\$230
C-TRISTARDD	Digital display for either controller		\$99
C-TRISTARRD	Remote digital display with 98' cable		\$129
C-TRISTARRT	30' plug in battery temperature sensor		\$30

Minimum shipping \$10 per whole order covers all items with no shipping listed

XANTREX CONTROL C-35, C-40, C-60

C35 is 35 Amps, 12 or 24 volt

C40 is 40 Amps, 12, 24, or 48 volt

C60 is 60 Amps, 12 or 24 volt

**3-stage voltage control for Solar; or
Diversion control for Hydro or Wind; or
Load Control**



Constant Charge Voltage: 3-Stage control method: full solar charge to Bulk Voltage you set as maximum, then tapers off charge in Absorption mode, just enough to keep batteries at, but not exceeding, the bulk voltage you set. After one hour at bulk voltage, a lower Float Voltage takes effect to prevent overcharge.

BATTERY EQUALIZING: Higher voltage automatically equalizes batteries once a month, or can be started manually anytime, or disabled for sealed batteries. Lights will flash from green to red to show equalization is in progress.

OPTIONAL DIGITAL DISPLAY of both charge amps and battery volts, plus counts amp-hours of charge since last reset. Highly recommended.

AS A DIVERSION CONTROL: C35, C40 & C60 can be used as diversion control for wind or hydro. To set up as diversion control, order air or water heat diversion resistors found at the end of this charge control section.

Built-in terminals accept wire size up to 2 gauge. For home or RV use. 2 year warranty. Size: 9"x 5"x 2".

ITEM #	Description	Additional Shipping	Price
C-35-DD	35 Amp Charge Control	\$12	\$209
C-40-DD	40 Amp Charge Control	\$12	\$244
C-60-DD	60 Amp Charge Control	\$12	\$279
Deduct \$99 from above pricing if a panel front digital display is not wanted			
I-TEMP	Optional 15' plug in battery temperature sensor		\$29
C-CM-R50	Remote Digital Display with 50' cable		\$115
C-CM-R100	Remote Digital Display with 100' CAT 5 cable		\$135
C-DVM	Digital Volt Meter panel display		\$99

Minimum shipping \$10 per whole order covers all items with no shipping listed

XANTREX 12 AMP CONTROL

12 volt only

High Quality with Special features for a small cabin, boat, RV, rentals, sign lighting, and more. No Meters.

Includes a TIMER for Sign / Anchor / Night Lights and Early Warning, then Disconnect of DC loads if Low Battery Voltage



Charge Control has 3 stage charging with bulk charge adjustable from 13 to 17 volts, float adjustable 12.5 to 14.5. Removable knobs on adjuster.

Low Voltage Disconnect: A load circuit for DC lights is protected from overload at 12 amps. If battery gets too low, power to this circuit cuts off until battery recovers. Cut-off and re-connect voltage is adjustable. LED flashes an on-off warning prior to disconnect, then disconnects 5 minutes later. Manual reset button allows one 10 minute grace period for operation of DC loads after disconnect. Flash and grace period can be disabled. A 2 minute delay postpones low voltage disconnect to avoid tripping on surges.

Night Light Timer for sign lighting, anchor light, etc. Turns light on at dark, and off after run duration from 10 minutes to 9.5 hours adjustable, or at dawn. Cancels if low voltage disconnect point is reached.

Automatic Equalization increases the charge by one volt above normal for two hours every 30 days, or immediately following any low battery disconnect. Can be disabled if sealed batteries are used. Lights will flash from green to red to show equalization is in progress.

Accepts solar and battery wires up to 10 gauge. Two year warranty. Size 4" x 6" x 1.5".

ITEM #	Description	Additional Shipping	Price
C-12	12 Amp Charge Control	\$10	\$110
I-TEMP	Optional 15' battery temperature sensor		\$29
O-BLOCK	Terminal block connects control to larger wires		\$9

MORNINGSTAR SUNGUARD

4.5 amp, 12V Only

Constant Voltage Charge Control

Very small charge control for single 75W, 36 cell panel (or smaller) and small battery. Constant voltage pulse width modulation. Regulates to constant 14.1 volts with temperature compensation. Six milliampere internal power consumption. No meters included, so these are best for fence chargers, small boats, radio repeater sites and other small unattended projects. Has wire leads, 2 solar, 2 battery. Not recommended for residential power system, because adding appropriate meters brings total cost higher than other small residential controls. Epoxy potted and sealed. 1-1/2" x 2" x 2-1/2".



FIVE YEAR WARRANTY.

ITEM #	Description	Price
C-SUNGUARD	12 Volt only, factory set to 14.1 voltage	\$33
O-BLOCK	5 terminal block splices control to wires up to 4 gauge	\$9

MORNINGSTAR SUNSAVER



The SunSaver is a very reliable small charge controller. Constant voltage pulse width modulation charging is a proven advance compared to the common on/off PV regulators. SunSavers are modifiable for sealed or flooded batteries. A rugged anodized aluminum case and epoxy encapsulated electronics enhance durability and longevity. A temperature compensation sensor in the charge controller varies full charge voltage with temperature.

May be used in parallel for higher current. They have LED charging and load control indicators in Low Voltage Disconnect (LVD) models. Settings are non-adjustable. Sealed setting is 14.1V, flooded setting is 14.4V. Low voltage disconnect happens at 11.6V, and reconnects when voltage gets to 12.6V. 5-year warranty. Dimensions: 6" x 2.2" x 1.3".

ITEM #	Description	Price
C-SS-10L-12	12 Volt, 10 Amp charging and LVD	\$66
C-SS-10L-24	24 Volt, 10 Amp charging and LVD	\$73
C-SS-20L-12	12 Volt, 20 Amp charging and LVD	\$91
C-SS-20L-24	24 Volt, 20 Amp charging and LVD	\$95



BLUE SKY BOOST 2000E

25 Amp, 12 Volt



Maximum Power Point Tracking converts the extra voltage in a solar module to increased charging amps. Solar current boost is highest in cold weather when batteries are low, and that is also the time many of us really need the advantage. Reverse Polarity protected. Actually Boosts PV Charging Amps, 3 year warranty, 4.6" high x 6.4" wide.

Two stage control, does bulk charge and absorb, no "float" stage. Output can be adjusted from 13 to 15

volts manually. Digital display offers battery voltage, PV array current, and output current information.

Flat metal panel mounts flush in recreational vehicle cabinet or use the optional wall surface mounting box for a small home system. Battery equalize function by a manual equalize button. Screw terminals for 10 AWG wire. Optional terminal block splices to wire up to 4 gauge.

ITEM #	Description	Additional Shipping	Price
C-BSE2000E	25 Amp RV/home control	\$10	\$260
C-BSEBOX	Wall mount box for 2000 control		\$35
C-BSE-TEMP	20' battery temp sensor for boost 2000		\$35
O-BLOCK	Terminal block connects control to larger wires		\$9

Backwoods Solar takes great pride in the fact that most of our technical sales people own and operate their own alternatively powered home. At least one of us uses or has used the controllers that we offer. Adjusting the charge controller that you have chosen is absolutely essential to the health of your battery bank. Please note that these controllers typically have default settings which are inappropriate for flooded lead acid batteries like the Trojan and Surrette batteries we sell. We will happily help you change those set points and guide you through the inner workings of your new controller. Feel free to ask!

Minimum shipping \$10 per whole order covers all items with no shipping listed

LOADS FOR DIVERSION



Budget Air Resistor



Water Heater Element

When diversion control is needed for hydro, wind, or a combination with solar, use these heater loads with a diversion regulator. Charge controls that can operate in diversion mode are Xantrex C series, Morningstar Tristar, Outback FM60 and FM80, Tristar MPPT, Midnite Classic, and Xantrex XM60.

DIVERSION never disconnects the charge source from the battery. The charge control connects to the battery and absorbs or "burns off" exactly enough power to offset any excess charging. These loads dissipate the surplus power into heated air or water. Diversion heat loads should be selected for at least as many amps as all charging sources combined, but must be within the maximum ampere rating of the charge control to be used.

ITEM #	Description	Additional Shipping	Price
AIR HEATER DIVERSION LOAD box as pictured with connection terminals			
C-HL-12V	Diversion Heat Load - 45A - 12V - 675W	\$14	\$126
C-HL-24V	Diversion Heat Load - 35A - 24V - 1000W	\$14	\$136
C-HL-48V	Diversion Heat Load - 36A - 48V - 2160W	\$14	\$199
<p>CERAMIC RESISTOR: 0.75-ohm resistor rated 300 watts maximum. Makes a 20 amp, 12-15 volt diversion load. Two connected in parallel is a 40 amp, 12-15 volt load. Two connected in series is a 24-30 volt, 20 amp load. Two series pairs makes a 40 amp, 24 volt load. Four connected in series is a 48-60 volt, 20 amp load</p>			
C-RESISTOR	Ceramic Resistor		\$40 ea
WATER HEATER LOADS: Fits most standard water tanks with 1" screw in element			
C-WTRLOAD1224	15 volt/30 or 60 amp, or 30 volt/30 amp		\$125
C-WTRLOAD2448	30 volt/24 or 48 amp, or 60 volt/24 amp		\$175
C-FLANGE	Adapter for square flange type water tank		\$28

BATTERIES

Battery care is your main responsibility with home made electricity. This is the one part of your power system likely to be harmed by neglect or misuse. Lead-acid batteries, the standard in home energy, should not discharge more than 50% and then ideally recharge to 100% promptly. They can be damaged by undercharging, continued overcharging, or contamination. Our E-Battery book is an essential guide to getting the most life from your batteries.

Sizing of 1000 to 2000 amp-hour 12 volt (or 1/2 that in 24 volt or 1/4 that in 48 volt) battery bank is desirable because a larger bank can accept faster charging by generator and give high power discharge for inverter surge without strain. In northern areas short on winter sunshine, more reserve before running down to the 50% level is also a benefit. Use our 6 Examples in the introduction of this catalog as a guide to battery size, or call for advice. In sunny southwest, a smaller battery bank is acceptable.

DEEP CYCLE lead acid batteries have thicker plates and lead-antimony support grids for years of over 50% deep cycle charge and discharge. Trojan T-105 Golf cart batteries and the L-16RE industrial batteries are the most common. Surplus industrial batteries may be deep cycle lead-antimony, or pure lead, or may be shallow cycle lead calcium construction.

Auto style batteries are for shallow cycling only. CAT, automobile, and truck batteries are NOT deep cycle and will not last long in home power. These have thinner plates and lead-calcium grids designed for less than 20% discharge and immediate recharge.

RV/MARINE This common 12 volt battery is designed about half way between a deep cycle and a shallow cycle, and has medium length of life.

SEALED BATTERIES Gel or AGM (absorbed glass matt) types damage easily from overcharge, and so should be used with a 3 stage charge control. Sealed batteries can be excellent deep cycle alternative energy batteries, cleaner and safer, but only if charging is precisely controlled. Since water cannot be replaced and hydrometer testing is not possible, they are considered special purpose batteries.

NICKEL CADMIUM (ALKALINE) BATTERIES: Unlike lead acid batteries, deep discharging and failure to recharge does not shorten battery life. However, used ones are often overpriced and defective. Cost is much higher than lead acid. Voltage swings higher when charging and lower when using. Charge efficiency (energy charged in versus energy returned to you) is low. Disposal and recycling can be difficult and costly. Be cautious of alkaline batteries.

FREE ACCESSORIES included with all new battery orders are the Battery Book, and a plastic hydrometer. Many batteries can be picked up or delivered free of charge depending on your location. Distant customers: give us a call for local pick-up locations at Trojan dealers in most of the U.S. with no shipping charges or tax.

Due to constant fluctuations of lead pricing, we have listed battery pricing as it stands at publication. Current pricing will be on our website at all times. We apologize for the inconvenience, give us a call and we will be happy to review pricing prior to purchase.

TROJAN BATTERIES

The Industry Standard and Longest Lasting Batteries in their Class!!

NEW!



T-105
1 year full warranty +
1 years prorated



LI6RE-B & LI6 2V
2 year full warranty +
3 more years prorated



INDUSTRIAL LINE
3 year full warranty +
5 more years prorated

Trojans smaller RE line has the best price per amp-hour of any quality mass produced consumer battery. T-105s only have a 1 year warranty, the T-105RE has a 2 year warranty. Trojan suggests 700 cycles to 80% DoD. T-105s are available for pick-up at Backwoods Solar.

Each battery is 6 volts, made of three 2-volt cells in one unit. Six volt batteries are series connected in pairs for 12 volts, or in a strings of four batteries for 24 volts or eight to make 48 volts. Then several of these series strings may be parallel connected to add more ampere-hour capacity. Interconnect diagrams are supplied. Life expectancy is 5+ years for the T-105RE; and 8 years for the LI6RE-B.

Trojan's Industrial line of batteries is comprised of removable 2-volt cells bundled in a secondary containment case to form single, high-capacity 4-volt and 6-volt battery solutions. Components of the individual cells are assembled in a rugged polypropylene housing designed to protect the internal plates from potential damage that may be caused during transport and installation. The removable 2-volt cells are easier to maintain and replace while the combined insulation of the dual container construction provides added protection against extreme temperatures. Trojan designed its Industrial line of batteries with stability in mind. Molded into the case design are dual handles that enable easy movement during transport and installation.

MODEL	VOLTS	AMP-HRS 20 hr	L	W	H	LBS	PRICE
B-T105	6	225	10	7	11	65	\$168
B-T105-RE	6	225	10.375	7.125	11.75	65	\$189
B-L16RE-B	6	370	12	7	18	118	\$394
B-IND23-4V	4	1233	23.375	10.25	24	370	\$1,105
B-IND29-4V	4	1570	26.6875	10.25	24	465	\$1,335
B-IND13-6V	6	673	23.375	10.25	24	315	\$1,040
B-IND17-6V	6	897	26.6875	10.25	24	415	\$1,175

Due to the global lead market, prices may vary across the country and are subject to change without notice

REMEMBER TO ORDER BATTERY INTERCONNECT CABLES

ROLLS/SURRETTE BATTERIES



This new generation of industrial, deep cycle, flooded lead acid battery offers high capacity and heavy duty plate grids which resist positive plate breakdown.

The plates are double insulated with glass mat and polyethylene envelope, eliminating the possibility of separator misalignment, cracked separators, and shorting.

Each 2 volt cell is built into its own lightweight container made of durable polypropylene. The cells are then assembled into a tough outer container with a removable lid. Even if this outer container cracked, acid spills are prevented and the battery still operates! The individual cells are bolted together allowing the battery to be disassembled and the cells individually removed for easy on-site installation. Free Battery book and Hydrometer!!

KS/CS/YS series rated at 3200 Cycles at a 50% Depth of Discharge, 10 Year Warranty: 3 years full warranty; 7 years pro-rated. Model B-S1380 & B-S530, 2 year free replacement warranty; 5 years pro-rated.

MODEL	VOLTS	AMP-HRS 20 hr	L	W	H	LBS	PRICE
B-S1380	2	1050	13.13	7.13	16.75	115	\$378
B-S530	6	400	12.5	7.13	16.75	117	\$374
B-2-KS-33PS	2	1766	13.75	8.32	24.82	208	\$915
B-2-YS-31PS	2	2430	15.5	9.25	31.63	285	\$1,275
B-4-KS-21PS	4	1104	15.75	9.38	24.75	267	\$1,145
B-4-KS-25PS	4	1350	15.75	10.63	24.75	315	\$1,432
B-6-CS-21PS	6	683	22.25	8.25	18.25	271	\$1,115
B-6-CS-25PS	6	820	22.25	8.25	18.25	318	\$1,285
B-8-CS-17PS	8	546	28.25	8.25	18.25	294	\$1,235
B-8-CS-25PS	8	820	28.25	11.25	18.25	424	\$1,700

**Due to the global lead market, prices may vary across the country
and are subject to change without notice
SHIPPING** via truck freight. Call for freight quote

Allow 4-6 weeks for delivery

**19", 4/0 BATTERY INTERCONNECT CABLES INCLUDED on KS,YS and
CS series!!**

CONCORDE SEALED BATTERIES



Completely sealed valve regulated Absorbed Glass Mat (AGM) battery. Non-spillable and maintenance free, never requires watering. No gas, it is all recombined within the battery. Exterior stays clean and safe. AGM has no problems like gel batteries separating from plates. Can be transported safely by air or any other means, and are exempt from D.O.T. hazardous material category, No UN labels required for international

air shipping. Recycle anywhere that processes automobile batteries. See a report on these in Home Power Magazine, issue 75, page 88. Sealed batteries require 3 stage charge control set exactly to manufacturer's instruction, and NO equalize charging. 12 month warranty after install, or 18 mo. from date of purchase. Expected life is 5 years at 30% depth of discharge.

ITEM #	Description	Additional Shipping	Price
B-2580L	12 volt, 20.76" x 10.8" x 9.73"H; 165 lbs; 258 Ah	Freight	\$679
B-2120L	12 volt, 20.76" x 8.7" x 9.76"H; 138 lbs; 212 Ah	Freight	\$568
B-1080	12 volt, 12.9" x 6.75" x 8.96"H; 70 lbs; 108 Ah	\$45 ea	\$310
B-890	12 volt, 12.9" x 6.75" x 8.96"H; 62 lbs; 89 Ah	\$45 ea	\$280
B-2240	6 volt, 10.28" x 7.06" x 9.99"H; 67 lbs, 224 Ah	\$45 ea	\$319
B-4050HT	6 volt, 11.64" x 6.95" x 15.73"H; 120 lbs; 405 Ah	Freight	\$599
B-9150	2 volt, 10.28" x 7.06" x 13"H; 94 lbs; 915 Ah	Freight	\$420

Due to the global lead market, prices may vary across the country and are subject to change without notice. REMEMBER TO ORDER BATTERY INTERCONNECT CABLES

BATTERY BOOK FOR YOUR PV HOME

by New England Solar

This 22 page booklet covers lead acid batteries, care and testing, and how to make them last longest. Hydrometer testing, voltage readings, and battery equalizing explained. We give this book free with each battery sale.



ITEM #	Description	Price
E-BATTERY	22 page book	\$10

NEW!

DEKA GEL & AGM BATTERIES

The Deka Solar series of batteries is designed to offer reliable, maintenance-free back-up power for grid-tied backup or remote access renewable energy applications where minimum maintenance is desirable. Deka gel and AGM batteries are the industry standard in grid-tied back-up power, with reliable performance. The quality of their products is recognized worldwide and has met the global requirements of ISO 9001 and ISO/TS 16949 certification standards. Deka is also a leader in innovative recycling and has met global environmental requirements of ISO 14001 certification standards. Deka makes recycling your battery convenient with a network of factory warehouses located throughout the United States and Canada that will return your battery for proper recycling.

2 year full replacement on monobloc GEL and 1 year on monobloc AGM batteries.



Batteries - Deka Sealed Batteries

ITEM #	Description	Additional Shipping	Price
B-DK-8G30H	GEL; 12 volt, 12.94" x 6.75" x 9.75"; 70 lbs; 97.6 Ah	Freight	\$282
B-DK-8G4DLTP	GEL; 12 volt, 20.75" x 8.5" x 10"; 127 lbs; 183 Ah	Freight	\$548
B-DK-8G8DLTP	GEL; 12 volt, 20.75" x 11" x 10"; 157 lbs; 225 Ah	Freight	\$667
B-DK-8GGC2	GEL; 6 volt, 10.25" x 7.13" x 10.88"; 69 lbs; 180 Ah	Freight	\$305
B-DK-8A27	AGM; 12 volt, 12.75" x 6.75" x 9.88"; 63 lbs; 92 AH	Freight	\$235
B-DK-8A4DLTP	AGM; 12 volt, 20.75" x 8.5" x 10"; 129 lbs; 198Ah	Freight	\$504
B-DK-8A8DLTP	AGM; 12 volt, 20.75" x 11" x 10"; 161 lbs; 245Ah	Freight	\$593
B-DK-8AGC2	AGM; 6 volt, 10.25" x 7.13" x 10.88"; 68 lbs; 190 Ah	Freight	\$270

Due to the global lead market, prices may vary across the country and are subject to change without notice. REMEMBER TO ORDER BATTERY INTERCONNECT CABLES

BATTERY ACCESSORIES

HYDROMETERS are the most accurate, direct and reliable indicators of battery state of charge. We include one O-HYDROMETER-1 with flooded battery purchases. Includes record sheet & instructions.



ITEM #	Description	Price
O-HYDROMETER-1	Plastic, temp compensated	\$20
O-HYDROMETER-2	Glass, temp compensated	\$40



O-HYDROMETER-1

BATTERY LUGS fit 5/16"-3/8" battery or shunt bolts. Allen screw clamps wires up to 2/0 or 4/0 in size, or many smaller wires down to 14 gauge. Allen wrench included with either lug. Not code compliant with finely stranded wire. Not recommended for mounting to terminals of flooded batteries



ITEM #	Description	Price
O-AU2/0	Dual	\$4
O-AU4/0	Single	\$7

WATER MISER BATTERY CAPS Condensing pellets within the flip top lid capture and return electrolyte into each cell. Reduces electrolyte mist and watering needs but distilled water levels must be monitored and adjusted accordingly. One cap per cell required. Considered flame arresting!

ITEM #	Description	Price
B-MISER	Water Miser Cap	\$6 ea

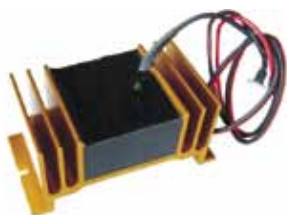


BATTERY TERMINAL COATING Keeps vapors, atomized battery acid, and air off battery terminals, bolts, and wire ends. 3-ounce bottle with applicator does all your battery bank and auto batteries too. ESSENTIAL for battery care!!

ITEM #	Description	Price
O-BATCOAT	Battery Coating	\$12

BATTERY ACCESSORIES

Battery Life Saver De-Sulfator



4.5 x 2.25 x 2.0 11.4 oz

Three year warranty (**only one per battery bank!**) This pulse style conditioner delivers a square wave frequency signal to each crystal of lead sulfate causing it to convert back into lead and sulfuric acid thus dissolving the crystal! The end result: **Extended Battery Life!** Use only on batteries that are severely depleted and beyond their warranty period as this unit can void some battery warranties.

ITEM #	Description	Price
Simply clips to main battery +/- terminals		
B-BLS 12/24	Draws 250 ma; 50% duty cycle	\$98
B-BLS 48	Draws 500 ma; 50% duty cycle	\$98

BATTERY INTERCONNECT CABLES

To connect individual batteries together. Total load divides equally among battery strings in parallel so 2 gauge may be adequate within each series string. Heavier 2/0 is for connections between ends of series strings. Heaviest 4/0 Shunt Cable connects battery negative to meter shunt. Eyelet lug on each end as pictured.



ITEM #	Description	Price
O-BIC-2	2 gauge copper, 15" with 5/16 bolt holes	\$10
O-BIC-2/0	Heavier 2/0 gauge copper, 16", 3/8 bolt holes	\$15
O-SHUNT 2/0-24	2/0 Copper, 24", 3/8 bolt holes	\$19
O-SHUNT 4/0-24	4/0 Copper, 24", 3/8 bolt holes	\$26
O-SHUNT 4/0-36	4/0 Copper, 36", 3/8 bolt holes	\$36
Shipping on cables to be determined		

Minimum shipping \$10 per whole order covers all items with no shipping listed

BATTERY BOX VENT FANS

Ready made 12, 24, or 48 volt fan in pipe section with back-draft damper for easy installation in your battery vent pipe. The automatic switch below will control a 12 or 24 volt fan. 12 and 24 volt models go in 2 inch PVC pipe. 48 volt model has a 2 inch pipe inlet and 3 inch outlet. One fan per 150 amps of charging recommended. Two year warranty.



ITEM #	Description	Price
O-PVENT-12	12 Volt, draws 3 Watts	\$74
O-PVENT-24	24 Volt, draws 3 Watts	\$74
O-PVENT-48	48 Volt, draws 6 Watts	\$98



Voltage controlled automatic switch runs DC vent fan when battery is at or above gassing voltage (14.0 and 28.0 volts). Holds fan on for 30 minutes after voltage drops below these levels, then shuts down. Green LED shows when fan is on. Draws no current when off; 125 ma when on. 50 amp capability. Red LED for over temp or low battery voltage. Fan **not** included. Same control for 12 or 24 volt. This cannot be used for a 48V system. Not adjustable. Limited lifetime warranty.

ITEM #	Description	Price
O-VENTCONTROL	12 or 24 Volt	\$84

LOW COST BATTERY VENT BRUSHLESS FAN



4-5/8" square brushless motors use little power. Can be installed on battery box or in vent pipe. Auxiliary relay option for Outback inverters can start and stop these based on battery voltage, or connect to the 12 volt control shown above for any 12 v system. Rated 40 to 90 cfm. Power draw varies with model & voltage: usually 3-5 watts.



ITEM #	Description	Price
A-MUFFAN12	12 Volt	\$15
A-MUFFAN24	24 Volt	\$15
A-MUFFAN48	48 Volt	\$15
A-FANGUARD	Removable metal guard	\$3

BATTERY CHARGERS

A battery charger converts AC power from the generator or from the power company into low voltage DC to charge a battery. During poor solar weather this avoids battery damage caused by extended periods of severe discharge.

Some AC generators have a built-in DC battery charge feature of only 3 to 10 amps. To be effective, one or more 30 to 100 ampere battery chargers should be connected to your AC generator to rapidly charge at the same time the generator runs a washing machine, well pump etc., making best use of costly generator time.

GENERATOR REQUIRED: Battery chargers need a full sine wave 120 volts AC to give their rated amount of charge. Most generators under \$2500 also have low peak voltage causing many chargers to give only a fraction of their claimed charge rate. This may be cured with our 10% voltage boost transformer listed with inverter accessories. Some generators can be adjusted for slightly higher speed to maintain 120 volts to compensate. Allow minimum generator size of 1 KW (1 kilowatt) per 30 amp 12-volt charger. Beware low cost 120/240 volt generators with only half rated wattage on each 120 volt circuit. Xantrex TR series inverter-chargers that are not true sine wave need a 3.5 KW or larger generator. **EXCEPTION:** We recommend Electronic Inverter-based variable speed generators like Honda EM5000i and EM7000i which should fully power battery chargers up to 120 amperes 12 volts (and 60 amps 24 volts) at full charge rate.

CHARGER SIZE AND TYPE: Compatibility of generator and charger can be a big problem. Battery chargers of 30 to 150 amperes built into True Sinewave "standby" inverter chargers, and the separate electronic chargers in this catalog work well with nearly any generator. *The Electronic Inverter generators described above work well with nearly any charger.*

Maximum charging amps should be about 10-20% of the total battery amp hour rating. Charging too fast can damage batteries. A 440 amp hour battery works well with a 40-80 ampere charger. Charge rate should taper to a much lower rate as the battery becomes fully charged. Several chargers can be used together to increase charge rate and reduce charge time, if battery size and rating of the generator allow. **NOTE:** Many automotive chargers list a high "boost" 200 amp or higher short term engine start surge, but this setting **CANNOT** function for charging home power batteries. Our E-BATTERY BOOK at the end of the catalog has more details.

Our BATTERY BOOSTER Engine-alternator kit is a low cost DC charging-only generator and is practical for smaller power systems.

BATTERY CHARGERS

***IOTA 12 volt 55 amp, 24 volt 25 amp,
and 24 volt 40 amp battery chargers***

Two year warranty.

***Works better than most chargers
with generator power.***

Size 7" x 6.5" x 3.5".

Accepts 2 gauge conductors.



Iota Engineering uses advanced switch mode technology in the production of this highly sophisticated electronic battery charger. The DLS series converter efficiently charges batteries with the full rated output. It then maintains the batteries by only putting into the battery bank what is required to maintain the selected voltage set point. Short circuit, overload, and thermally protected. These chargers are not a 3 stage charger. They do not have a float voltage function. They will achieve a bulk voltage set-point and maintain it until the AC input source is removed.

Historically, low and transient AC line voltage was a major cause of battery charger failure. The DLS series is protected against low line voltage as well as spikes coming from your AC power source. It also meets FCC criteria for minimizing radio and television equipment interference.

Model 5512 is a 740 watt "55 amp" 12 volt fully automatic electronic charger. Backwoods maximizes the voltage set points at either 14.8 or 15.4 volts. These set points are user selectable via a simple plug-in jack.

Model 2524 is a 675 watt "25 amp" 24 volt fully automatic electronic charger and Model 4024 (requires a special 120v AC 20 amp outlet) is an 1100 watt "40 amp" 24 volt version. Backwoods maximizes the voltage set points at either 28.8 or 29.9 volts. Plug-in jack selects voltage desired. 40-60 amp external fusing required for each model.

ITEM #	Description	Additional Shipping	Price
BC-IOTA5512	Iota 5512 Battery Charger, 740 Watt, 12V	\$15	\$185
BC-IOTA2524	Iota 2524 Battery Charger, 675 Watt, 24V	\$15	\$250
BC-IOTA4024	Iota 4024 Battery Charger, 1100 Watt/40A, 24V	\$15	\$395

GENERATORS

Our GENERATOR PHILOSOPHY: It's important to have a GOOD engine driven generator and then use it as LITTLE as possible.

ADVANTAGE: LOW INITIAL COST: During the dark snowy winters of many northern areas, you could not meet 100% power needs with solar even with 10 times more solar and batteries. For these situations, we design our power systems so 80 to 90% of your home's annual power needs come from solar generation and use other generation sources to make up the seasonal shortfall. Wind power and seasonal flow water power, can help but most often folks use an engine generator and a fast battery charger.

DISADVANTAGE: HIGHEST LONG TERM COST: Fuel, maintenance, and limited engine life plus pollution and noise make a generator the highest cost of all energy sources over time. So we want to shorten the hours a generator is used. Larger battery banks accept a charge faster than small ones, so with a large battery bank and high rate battery charger you store more energy in less generator time.

ALL THE EXTRA POWER YOU WANT, when you want it: There will be times when you want to use more power than your system is designed to produce. You may have sized the solar array conservatively, knowing you can add more modules at any time or you undersized your inverter with the knowledge that you could trade it in for a larger inverter in the future. In the meantime, high power demands for guests, or laundry, or building projects, or pumping a deep well can be met by a generator.

PROPANE, THE FUEL OF CHOICE: Propane fuel typically fits residential use better than gasoline or diesel. An alternatively powered home usually uses propane for water and space heating, cooking, clothes drying, etc. A propane generator is conveniently connected to the same propane tank as the home. A large tank filled with propane usually means no more running out of gas, handling fuel, or getting dirt or water into the fuel. Propane keeps longer than gasoline or diesel. The generator's engine runs clean and its oil stays cleaner, longer. Exhaust is also cleaner and produces less odor. Propane generators should start easily even in winter's cold without a choke, so starting and stopping remotely from inside the house year round is simple. As a result, propane generators tend to be the easiest to connect to an inverter based, automatic start system.

STATIONARY, QUIET, AND DURABLE: A generator dedicated to a home need not be portable; should run quietly; and should last a decade or two.

NEW! KOHLER GENERATORS



8.5 RES



14 RES

We are happy to offer a generator for off-grid use that comes with a limited warranty. The off-grid warranty covers USA and Canada, on units manufactured as of January 2011. Earlier units are not covered. The warranty is limited to 18 months or 1000 hours (whichever comes first); it includes parts and ONLY 200 miles of round trip travel; labor is NOT included. Per Kohler, the end user can install without voiding the warranty. We will continue to have the Start Up form sent to our supplier for their signature and submittal to Kohler. ALL models MUST have a 2 hour shop test, \$215.00 (not included in prices below, please add both items to your order).

This shop test includes: NG to LP conversion if needed; controller programming for two wire remote starting and power down; battery install; and whatever run time will then fit into the 2 hour time frame. If full output at 120V is needed, the PSX transformer listed below is available for these application.

8.5RES, 14RES do NOT include carb heater (120v AC; 38 watts) which is recommended for temps below 32 degrees F: \$100.00 (includes installation). Please add at the time of your order if needed. These units include Sound Enclosure (the 14/20 have a corrosion proof enclosure), Mounted Line Circuit Breaker; ADC-RES Digital Controller; Battery Charger; and Engine Starting Battery ALL models are UL-2200 listed.

POWER SPECIFICATIONS:

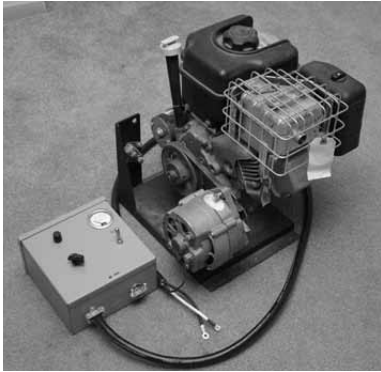
The 8.5 is 8500 watts with LP and 7000 watts with NG.

The 14: 14000 LP; 12000 NG

ITEM #	Description	Additional Shipping	Price
G-8.5RES	8.5 kW Generator (please specify fuel type)	FREIGHT	\$3,442
G-14RES	14 kW Generator (please specify fuel type)	FREIGHT	\$4,050
G-SHOPTEST	Mandatory Shop Test- PLEASE ADD TO ORDER		\$215
G-CARBHEATER	Carb Heater (120VAC)		\$100
I-OBPSX-240	Outback PSX 240, 6kva Transformer	\$32	\$485

BATTERY BOOSTER KIT

12 volt and 24 volt models



**16 x 16 x 18 inches
plus separate control box**

Run a low-cost engine driven car alternator to charge batteries when you don't need an expensive AC generator and large battery charger. Charge amps adjusts manually and holds your setting, will not taper off. Alternator delivers over 55 amps, or runs 40-45 amps at easy low engine speed (25 to 30 amps at 24 volts). Runs very quietly if adapted to a flex exhaust hose and automobile muffler. Charges many hours on a tank of gasoline.

ITEM #	Description	Additional Shipping	Price
COMPLETE KIT with ENGINE			
GK-KIT-12V	12 Volt, all components described below	\$65	\$935
GK-KIT-24V	24 Volt, with different parts for 24 Volt	\$65	\$955

ITEM #	Description	Additional Shipping	Price
SEPARATE COMPONENTS			
GK-NOENGINE	Kit, all parts except the engine. You can use most any horizontal shaft 3 - 6.5 hp engine	\$35	\$420/12V \$440/24V
GK-ENGINE	New 6.5 horsepower ELECTRIC start Briggs "INTEK" overhead valve engine, with float carb, cast iron bore, 3 qt tank runs 2.5 hrs at 40 A, low oil shutoff, 2 yr. warranty	\$30	\$580
GK-CONTROL	Control box for Delco, has switch, ammeter, adjustable charge amps, field fuse, alternator cable, and main fuse	\$10	\$185/12V \$205/24V
GK-BASE	Heavy steel mounting base with belt tension adjuster arm. Drilled, with bolts included to attach a 36.5 hp engine, start button and Delco Alt	\$18	\$140
GK-DELCO	Rebuilt 62A alternator, 6 mo warranty	\$10	\$72
GK-PB	Pulley and belt for engine. Specify 12 or 24V		\$65
GK-RHEOSTAT	Replacement 100W, 16 ohm rheostat		\$58

Minimum shipping \$10 per whole order covers all items with no shipping listed

FROM BATTERY POWER TO HOUSEHOLD AC POWER

A POWER INVERTER converts DC from your battery to 120 volt AC for lights, outlets and most appliances, without starting a generator.

DC OR AC APPLIANCES? Folks with the smallest solar power systems and few, simple appliances may have no inverter, and use low voltage DC for all lights, radio, TV, and water pump. People using the largest solar power systems sometimes use AC power from an inverter for everything. Usually it is most practical to use both inverter AC and some direct battery DC. AC is most practical for regular household outlets and lights, because most AC appliances are better quality, easier to find, and lower priced than 12 volt DC versions. But a few special DC appliances can save a great deal of energy. Items that drain a small amount of power over long hours can use far less if DC powered. These are ceiling fans, phone message machine, motion sensing lights, intercom, and alarms. See the House and Appliance section earlier in the catalog on selection of AC appliances that work best with inverters. This catalog features a special low power washing machine, refrigerators, freezers, lights, and 120 volt well pumps specially selected to work with inverters, to avoid excessively draining battery power. Also see the introductions to our Refrigerator section, DC Appliance section, Pump section and Lighting section for discussion of DC vs. AC applications.

GENERATOR POWER systems even without solar modules, benefit from inverters too. You can fast charge a large battery bank a few hours a day while the generator runs the water pump, clothes washer, shop tools etc. Later, when only a few watts are needed for lights or TV, the battery and inverter supply power without the generator. This way, power is available 24 hours a day at the turn of a switch but the generator runs only a few hours a day. This saves on generator maintenance, and life gets better! (But it is difficult to get batteries fully charged with just a generator, and serious battery problems are common with just a generator. Backwoods Solar advocates using primarily solar charging).

TRADE-UP TO A BETTER INVERTER: We accept trade-ins of used inverters bought at Backwoods when you need a larger or better model.

USED INVERTER trade-ins are often available. Call to inquire, or see the listings in Backwoods Bargains page in the newsletter section on our web site at www.backwoodssolar.com.

TRUE SINEWAVE OR MODIFIED SINEWAVE?

TRUE SINEWAVE inverters typically supply power of better quality than the power company, and work correctly with almost any standard AC appliance. Battery chargers in sinewave inverters work well with most generators. Xantrex XW series and Outback FX/VFX inverters can automatically start and stop a generator when extra battery charge is needed. A lower cost Morningstar or Samlex true sinewave inverter might be used for just one appliance that requires true sinewave power.

Modified sinewave is a sales term used for a modified square wave type of AC power which is not quite as good as power company electricity. Modified wave inverters are lowest cost, slightly more efficient, and almost all appliances work fine with them, though some may hum louder. However a few sewing machine speed controls, all front loading washing machines, and some dishwashers have difficulty on the modified sinewave. It can also damage photocopy machines, laser printers, and some cordless tool rechargers. Recently we found the first TV that would not run on any modified wave inverter. Battery chargers in Xantrex's TR series modified waveform inverters work extremely well with smaller generators and charge effectively.

SIZE of inverters range from under 100 to over 6000 watts with stacked inverters. This rating indicates the largest wattage appliance or combination of appliances the inverter can operate continuously and at the same time. Surge power rating is well above the normal power rating, to run larger appliances a short time, or start heavy motors. Determine the highest total wattage you want to run without starting a generator.

STANDBY CHARGER means the inverter becomes a battery charger when power is supplied to it from a generator or utility source. An automatic transfer switch within the standby inverter connects generator power thru to the house circuits to power your appliances while also using it to recharge the batteries.

EFFICIENCY of most inverters is 85 to 95%. Though 5 to 15 % of battery power is lost in converting DC to 110 volt AC, the cost savings in AC wiring and appliances over the cost of DC equipment often makes AC the better choice.

Search mode is a useful feature in some inverters to automatically shut down to nearly no power use whenever all appliances and lights are off.

INVERTER SELECTION

MODEL	Watts	Battery Charger	Battery Volts	Page	PRICE
True Sinewave Inverters					
Outback Radian	8000	yes	48	101	\$5,395
XW 6048	6000	yes	48	102	\$3,950
Magnum MS-PAE (parallel stackable)	4000/4400	yes	24/48	106	\$2,160
XW4024/4548	4000/4500	yes	24/48	102	\$3,240
Magnum MS4024	4000	yes	24	106	\$2,080
Outback VFX	3600	yes	48	104	\$2,295
Outback VFX	3500	yes	24	104	\$2,295
Outback VFX	2800	yes	12	104	\$2,295
Outback FX	3000	yes	48	104	\$2,125
Outback FX	2000/2500	yes	12/24	104	\$2,125
Magnum MS2012	2000	yes	12	106	\$1,720
Samlex 1500	1500	no	12/24	107	\$565
Samlex 1000	1000	no	12/24	107	\$425
Samlex 600	600	no	12	108	\$350
Sure Sine 300	300	no	12	108	\$285
Modified Wave Inverters					
Magnum RD3924	3900	yes	24	109	\$1,584
TR3624	3600	yes	24	110	\$1,285
Magnum RD2824	2800	yes	24	109	\$1,344
TR2400	2400	yes	12, 24	110	\$995
Magnum RD2212	2200	yes	12	109	\$1,168
TR1500	1500	yes	12,24	110	\$850
Magnum MM1512AE	1500	yes	12	109	\$720
XPower 1500	1500	no	12	112	\$172
XPower1000	1000	no	12	112	\$118
XPower800	640	no	12	112	\$90
XPower400	320	no	12	112	\$54
Grid Tied Inverters					
SMA	2 - 7kW	No	Page 114	Various	
Enphase	190/215W	No	Page 118	Various	
SolarEdge	3 - 7kW	No	Page 116	Various	

NEW! OUTBACK RADIAN



The new OutBack Power Technologies Radian Series GS8048 Inverter/Charger provides a comprehensive answer for grid interactive and stand-alone power systems. Based upon a proven foundation of reliable technology but engineered from the ground up to simplify the design, distribution, installation and implementation of energy storage, the standardized structure and integration with the GS Load Center make it easy to provide a successful solution to any power requirement, anywhere.

Incorporating a powerful DC to AC true sine-wave inverter, battery charger and dual AC inputs, its 120/240V split-phase voltage provides a total power solution which seamlessly integrates with traditional North American wiring practices.

The unique dual power module design provides high efficiency at both low and full power operation, while providing redundancy for critical applications. This modular design also allows easy field servicing of installed systems.

Complete system interface using the OutBack MATE3 and HUB Communications Manager enables the Radian Series GS8048 to be connected with other OutBack Power electronics providing industry leading integration and a robust, scalable power solution. Up to 10 units can be connected in parallel for systems up to 80 kW continuous output power.

The Radian Series utilizes a durable stainless steel face with a galvanized steel enclosure, providing you with OutBack's signature ruggedness, but with a sleek, compact and modern appearance.

ITEM #	Description	Additional Shipping	Price
I-OB-GS8048	8000 Watt, 48VDC, 120/240VAC Inverter	FREIGHT	\$5,395
I-OB-MATE3	Mate 3 System Display and Controller	\$10	\$535
I-OB-GSLC	GS Load Center for Radian Series	FREIGHT	\$675
I-OB-GSLC175-PV	Prewired with 175A inverter disconnect, GFDI & PV disconnects for 2 controllers, FLEXnetDC w/ 3 shunts, 120/240 inverter bypass, dual AC inputs	FREIGHT	\$1,525
I-OB-GSIOB	GS Bypass Kit, Split Phase 120/240 VAC	\$45	\$265
I-OB-GS-SBUS	DC Shunt Bus for GS Load Center		\$19
I-OB-PNL-50D-AC	50A 120/240VAC 2P Panel Mount Breaker		\$42

Minimum shipping \$10 per whole order covers all items with no shipping listed

XANTREX XW SERIES

A Battery Based Backup Power System
for both off-grid or grid-tied use

Backwoods Solar has historically focused on Off-Grid Systems. Yet the demand for battery back up systems for grid-connected folks is real and nationwide tax incentives for grid-connected PV systems are enticing. Therefore, we are happy to help those individuals that call us daily looking for just this solution.



The XW series will sell any excess energy to the grid and operate similarly to typical battery-less grid-tie solar systems but with the added benefit of being able to provide uninterrupted backup power during utility outages. If you are considering adding a solar power system to your home or business, incorporating a back-up power system as well is common sense.

The XW series offers integrated true sinewave inverter capability (<5% harmonic distortion) and a 60 amp maximum power point tracking PV charge controller (optional).

Inverter output ranges from 4000 to 6000 watts with 120/240v AC split-phase operation. 75% of the inverter's rated output can continuously support a 120v AC leg. Its 5 second surge ability is 200% of rated output. Peak efficiency is 95%; Power draw in search mode is <2 watts and averages 26 watts when on without a load. Two AC input sources (grid and/or generator) accepted to independently drive the integrated 60 amp automatic transfer switch.

RATED BATTERY CHARGING ABILITY

XW6048 = 100 amps; XW4548 = 85 amps; and the XW4024 = 150 amps.

The XW series wall mounted design is easy to install. Its Power Distribution Panel includes conduit box, double pole 60 amp AC input/output/bypass breakers as well as the main DC disconnect breaker. All internal wiring components, one ground and one AC neutral bus bar, and DC (+) and DC (-) bus bars included. Shunt not included but can be installed.

6048 (4024 & 4048 pending) can be 120 only with software download which is available with purchase of either the I-XWCOMTOOL or I-XWGATEWAY and connection to Xantrex website. The communications gateway connects the inverter and the system owner's computer. It logs performance data directly from the inverter, and transmits it to the included Yahoo Widget-based monitoring software for a simple and graphically rich view of system performance. In addition to data-logging, the Gateway offers a web page with the ability to configure automated email reports and fault status to the homeowner.

15' Battery temperature product included with XW inverters & charge controllers, if you need to replace this at any time, order our BC-TRUETEMP.

XANTREX XW SERIES

The XW series is monitored and programmed by a SCP system control panel (purchased separately). It plugs into the Xanbus network which can handle up to three inverters and/or four XW-MPPT charge controllers. (The inverter's LCD only indicates output power or charge current). The XW series can be purchased with or without the XW-MPPT PV charge controllers. These controllers have integrated ground fault protection; please reference page 78 for full specifications. They also offer a configurable 12v 200mA auxiliary output for load control via an external relay. Its front panel features a 2-line 16-character display and four buttons for configuration and system monitoring. Battery Temp sensor included. 14.5"hx5.75"wx5.5"d. 12lbs. (The XW-MPPT 60 & 80 will work with PV systems that do not use the XW series equipment).



Dimensions (h x w x d):

Inverter 21.5" x 16" x 9"; 125 lbs

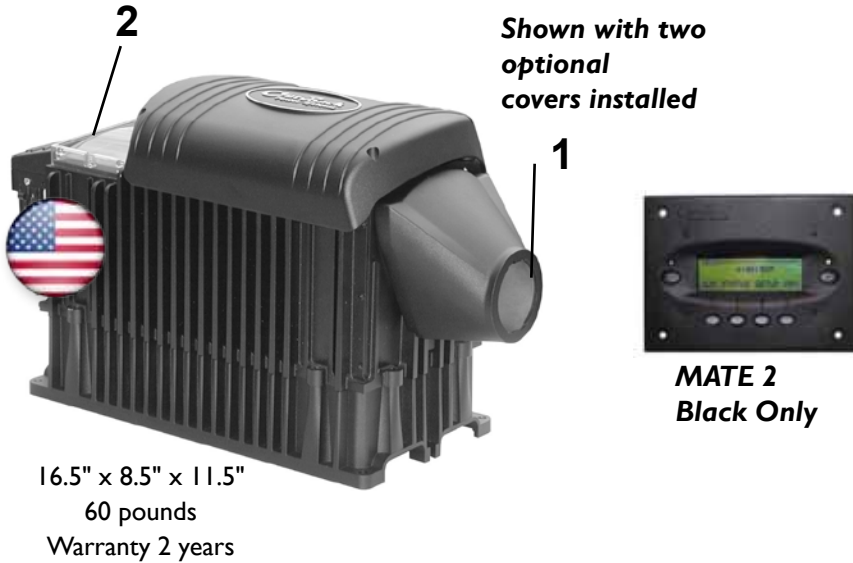
Power Distribution Panel 30" x 16" x 8.25"; 67 lbs

Conduit Box: 8.5" x 16" x 8.25"; 9 lbs; 5 year warranty

ITEM #	Description	Additional Shipping	Price
I-XW4024	4000 Watt, 24VDC, 120/240V AC Inverter	FREIGHT	\$3,240
I-XW4548	4500 Watt, 48VDC, 120/240V AC Inverter	FREIGHT	\$3,240
I-XW6048	6000 Watt, 48VDC, 120/240V AC Inverter	FREIGHT	\$3,950
I-XWPDP	Power Distribution Panel	\$45	\$1,200
I-XWSCP	System Control Panel		\$270
C-XWMPPT60	60A, 150VDC MPPT PV Charge Controller	\$20	\$585
C-XWMPPT80	80A, 600VDC High Voltage MPPT PV Charge Controller	\$20	\$1360
I-XWAGS	Automatic Generator Start Control		\$180
I-XWCOND-KIT	Connection Kit for 2nd inverter with cable and breakers	\$30	\$765
I-XW-COND-BOX	Conduit box only	\$20	\$225
I-XWGATEWAY	Wireless Communications Gateway	\$15	\$595
I-XWCOMTOOL	Wired Software Download Tool	\$15	\$395

Minimum shipping \$10 per whole order covers all items with no shipping listed

OUTBACK VFX AND FX INVERTERS



Shown with two optional covers installed

MATE 2
Black Only

16.5" x 8.5" x 11.5"
60 pounds
Warranty 2 years

Stackable for higher power. 12, 24, Or 48 volt systems.

The OUTBACK inverter is true sine wave, and includes battery charger and 60 amp automatic AC transfer relay plus automatic start and stop of your remote start back-up generator. One millisecond surge of 70 amps at 120v AC plus a 100ms surge of 50 amps each. This inverter can stand alone or two to eight may be combined for higher power. Includes an 8.4 watt auxiliary output relay. **Note:** Ham radio interference is a definite problem.

No-load power used is 3 watts when in automatic sleep-mode with no home power usage, or 20 watts if programmed to keep AC on full time. Peak efficiency is >90%. Operating temperature range: -40 to + 60 degrees C.

VFX vented models are higher power inverter-chargers, using fan cooling with screened insect proof vents in die-cast aluminum enclosure. **FX models** are quieter and completely sealed against dust and moisture and produce less radio interference. Die-cast aluminum housing. Unlike the VFX, the FX aux relay only controls the on board cooling fan.

The cover for Battery terminal posts is now included on all models. Battery Temperature Sensor is also include with all inverter purchases. AC and DC conduit adapters are optional and listed on the next page.

MATE METER and **CONTROLLER**, next page, is required to initially program inverter, charger, and generator-auto-start features.

OUR CUSTOM BUILT OUTBACK POWER SYSTEMS INCLUDE THESE INVERTERS! SEE PAGE 68 & 69

OUTBACK INVERTERS

OUTBACK MATE

Outback MATE is a programming input device as well as meter display for power room or remote mounting. It plugs into any VFX/FX inverter to program any of the adjustable settings for battery charging or start-up sensitivity, automatic start for an engine-generator etc. The same MATE also connects to the Outback FM60 charge controller as a remote meter and adjustment for FM60. To connect to more than one inverter or inverter and charge control at the same time, requires a HUB adapter. MATE Includes RS232 port & DB9 for computer datalogging. Includes 10' and 6' cable (max cable length: 300' of CAT 5 cable). **Each inverter requires battery cables with lug ends.**

MATE Oval: White
6" x 4.5" x 2"



Inverters: Off Grid - Outback/True Sine Wave

ITEM #	Description	Additional Shipping	Price
VENTED COOLED MODELS			
I-OB-VFX2812	2800 Watt, 12 Volt, 125 Amp charger	\$40	\$2,295
I-OB-VFX3524	3500 Watt, 24 Volt, 85 Amp charger	\$40	\$2,295
I-OB-VFX3648	3600 Watt, 48 Volt, 45 Amp charger	\$40	\$2,295
SEALED TURBO MODELS FOR HARSH CLIMATES			
I-OB-FX2012T	2000 Watt, 12 Volt, 100 Amp charger	\$40	\$2,125
I-OB-FX2524T	2500 Watt, 24 Volt, 55 Amp charger	\$40	\$2,125
I-OB-FX3048T	3000 Watt, 48 Volt, 35 Amp charger	\$40	\$2,125
I-OBMATE	Meter Display & Programming Device		\$295
I-OB-HUB4	Connects MATE to up to 4 inverters and/or FM60/ FX80 solar controls at the same time without switching any cables		\$195
I-OB-FXDCA	DC Conduit adapter- pictured prev page #1		\$45
I-OB-FXACA	Cover for AC Terminals, pictured prev page #2		\$45
I-X240	120/240 output or generator balancing	\$18	\$390

Minimum shipping \$10 per whole order covers all items with no shipping listed

MAGNUM ENERGY



The MS Series inverter/charger is a pure sine wave inverter designed specifically for the most demanding mobile and off-grid applications. The M4024-PAE and MS4048-PAE have 120/240VAC output, eliminating the need to stack two units or buy a transformer to run 240-volt loads. These units can also be wired in parallel.

Install the MS series in four easy steps: simply connect the inverter's output to your distribution circuits or electrical panel, connect AC power from the utility or generator to the inverters easy-to-reach terminal block, connect the batteries, and switch on the power. The lightweight aluminum

base and cover provide noise reduction and corrosion resistance. The MS Series has an RS-485 communication port for network connection and a remote control port. The extra large AC-access cover with terminal screw block and 360 degree DC connection terminals with covers make the inverter wiring accessible when it needs to be. It has an on/off switch with an easy to read LED indicator. All models have a 50 A transfer relay. MS inverters (without PAE) can be series stacked, using the ME-SSI (special order \$57), for 120/240VAC operations, the PAE versions can be parallel stacked. PAE models require a 240V AC input for battery charging. Battery temperature sensor included. Inverters are 13/75" x 12.65" x 8" and weigh between 43 and 58 pounds. 3-year warranty.

ITEM #	Input Voltage	Continuous Power	AC Surge Amps (1 msec)	Battery Charging Maximum	Additional Shipping	Price
I-ME-MS2012	12	2000 Watts	50	100	\$40	\$1,720
I-ME-MS4024	24	4000 Watts	120	105	\$40	\$2,080
I-ME-MS4024PAE	24	4000 Watts	120	105	\$40	\$2,160
I-ME-MS4448PAE	48	4400 Watts	120	60	\$40	\$2,160

OPTIONAL EXTRAS

ITEM #	Description	Price
I-ME-AGS-N	Magnum Auto Gen Start. Allows operation with ME-RC50 Remote	\$264
I-ME-RC50	Required for programming of critical settings on inverter	\$184
I-ME-ARC50	Magnum Advanced Remote recommended for use with AGS	\$239
I-ME-BMK	Magnum Battery Monitoring Kit	\$175

Full line of Magnum products available

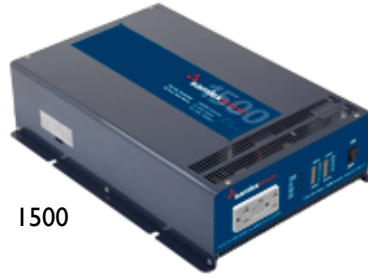
Remember: Each inverter requires battery/inverter cables with lug ends

Minimum shipping \$10 per whole order covers all items with no shipping listed

SAMLEX SMALL INVERTERS



1000K



1500

True sine wave voltage inverters provide clean, stable power for computers, radio equipment, home theater, stereo, marine equipment and other applications that are sensitive to AC voltage irregularity. These inverters do not include an automatic transfer switch and they absolutely cannot be connected to a 120V AC breaker box with a bonded neutral ground. The 1000K, 12V auto-shuts down at 15.3 volts (30.6 for the 24V), which may complicate the equalizing process by a solar/hydro/wind source, and the 1500, 12V auto-shuts down at 17.1 volts (34.2 for the 24V)

Design Features

- Power ON / OFF remote control available for both models, comes with 10' feet of cable or you can provide an up to 50' CAT5 cable of your own (Model S-R8 \$35)
- Isolated input and output
- Thermostatically controlled cooling fan
- Advanced microprocessor design
- Output voltage and frequency switch selectable Protections: overload / short circuit, reverse polarity (fuse), over / under input voltage, over temperature
- Built in voltage and wattage meters
- LED indicators for power status
- True sine wave output (THD < 3%)

1000K inverters are 15.1" x 7.2" x 3.5" and weigh 8.8 pounds. 1500 inverters are 15.4" x 10.8" x 4.1" and weigh 15.5 pounds. Both have a 2-year warranty.

ITEM #	Description	Additional Shipping	Price
I-SAM1000K-112	Samlex Inverter 12VDC, Output 110VAC, 1000 Watts, 3W idle draw UL Listed	\$25	\$425
I-SAM1000K-124	Samlex Inverter 24VDC, Output 110VAC, 1000 Watts, 4W idle draw UL Listed	\$25	\$425
I-SAM1500-112	Samlex Inverter 12VDC, Output 120VAC, 1500 Watts, 1.5W idle draw UL Listed	\$25	\$565
I-SAM1500-124	Samlex Inverter 24VDC, Output 120VAC, 1500 Watts, 1.5W idle draw UL Listed	\$25	\$565

SMALLER TRUE SINE WAVE INVERTERS

SAMLEX



12" x 7" x 3" 5.4 lbs
UL Listed

MORNINGSTAR



8.4" x 6" x 4" 10 lbs
UL Listed

A Small True Sine Wave Inverter can solve the problem of a few low-wattage appliances that require only true sine wave power, without upgrading your whole-house inverter to true sine wave. A small inverter can be dedicated to just the computers, a computerized sewing machine or recording equipment. Newly designed for heavy-duty industrial and commercial applications, the Samlex 600 has two, on board, GFCI protected outlets. Equally robust, the Sure Sine 300 must be hard-wired. Both models offer extensive electronic protection against reverse polarity, overload, short circuit, over/under input voltage, and over temp. **Two year warranty.**

ITEM #	Description	Additional Shipping	Price
I-SAMLEX600 600 Watts 12V	600 watts continuous, 680 watts for 3 minutes, and an 800 watt surge. Includes battery terminal lugs that you crimp to 4 gauge copper wire that you provide. Use a 100 amp fuse in the (+) battery cable. No load current consumed is 0.87 amps. Do not connect to an AC breaker panel. On board load controlled cooling fan. Rated operating range: 0° to +30° C (+/-10%). Input voltage: 10.5-15.0	\$15	\$350
I-SURESINE300 300 Watts 12V	300 watts continuous and a 15 minute 600 watt surge. Battery terminals accept 2 gauge copper wire. Use a 100 amp fuse in the (+) battery cable. Current consumed while powering a load is 0.45 amps. With no load, a standby mode is entered which reduces current draw to 0.055 amps. OK to connect to an AC breaker panel. Designed such that an onboard cooling fan is not required. Rated operating range: -40° to +45° C. Input voltage: 10.0-15.5	\$15	\$285

MAGNUM ENERGY



RD SERIES



REMOTE



MM-AE SERIES

The MM-AE series 12VDC inverter/charger is a modified sine wave inverter designed to accommodate entertainment systems and small appliances in smaller RV's, boats and cabins. They are versatile, easy-to-use, and lightweight. Each MM-AE model uses Magnum's PFC (power factor corrected) charger, which uses less energy from a generator than a standard charger - using 25 - 30% less AC current than standard chargers. Battery temperature sensor is included. 2 year warranty. Dimensions 16.6" x 8.4" x 4.7", weights 20 pounds.

The RD series inverter/chargers are designed specifically for off-grid use. The PFC battery charger efficiently charges your batteries even at low AC voltage from low-cost generators, which the modified sine wave inverter keeps the costs down. Additionally the included battery temperature sensor works with the charger for optimum battery charging. Install the RD Series in four easy steps: Simply connect the inverter's output to your distribution circuits or electrical panel, connect your power cable (AC) to the inverter's easy-to-reach terminal block, connect the batteries, and switch on the power. The ME-RC50 controller is required for inverter programming. 2 year warranty. Dimensions: 13.75" x 12.65" x 8", inverters weigh between 38 and 45 pounds.

ITEM #	Input Voltage	Continuous Power	AC Surge Amps (1 msec)	Battery Charging Maximum	Additional Shipping	Price
I-ME-MM1512AE	12	1500 Watts	42	70	\$35	\$720
I-ME-RD2212	12	2200 Watts	60	110	\$40	\$1,168
I-ME-RD2824	24	2800 Watts	100	80	\$40	\$1,344
I-ME-RD3924	24	3900 Watts	150	105	\$40	\$1,584

OPTIONAL EXTRAS

ITEM #	Description	Price
I-ME-AGS-N	Magnum Auto Gen Start. Allows operation with either remote	\$264
I-ME-RC50	Allows access and programming of critical settings on inverter	\$184
I-ME-ARC50	Magnum Advanced Remote recommended for use with AGS	\$239
I-ME-BMK	Magnum Battery Monitoring Kit	\$175

MODIFIED WAVE XANTREX TR SERIES

Size: 8-1/2 x 7-1/4 x 21"
Mounts to 16" studs on wall
Weight: 35 to 45 lbs
12 or 24 volts



TR Series Xantrex inverters: 1500 watt, 2400 watt, or 3600 watt continuous power plus surge to double for motor starting (triple surge in 24 volt models). Efficiency is 95% top, 85% at full power.

SEARCH MODE means automatic idle when the last AC lamp or appliance is shut off. TR automatically shuts down at 15.5 volts, which may complicate the equalizing process by a solar/hydro/wind source. When in standby mode these inverters use only 4.2 - 4.8 watts. When you turn on a light or appliance it starts up again. Start-up sensitivity is adjustable. Idle on load: 25 watts

TR has an internal thermostat controlled fan to cool only when needed. Certified UL standard for National Electric Code. TWO year factory warranty.

STANDBY battery charger with 30 amp generator transfer relay is included in all TR series. When you start the generator or plug into utility power, Standby feature automatically charges the battery and switches generator or utility power directly through for your use while batteries charge. When the generator or grid power stops, it switches back to inverter power. Optional temperature probe attaches to battery, to correct charging voltage for battery temperature. Max AC input: 50-60 amps

Note: Unlike the DR series standby battery charger option, the TR's battery charge should deliver 100% of its charge rate if used with a lower quality generator having low peak AC voltage.

15' Battery temperature product included with TR inverter, if you need to replace this at anytime, order our BC-TRUETEMP.

MODIFIED WAVE XANTREX TR SERIES

1500 WATT continuous power inverter runs TV, household lights, computers, stereo, vacuum cleaner, and most small appliances all at the same time. Large loads like washing machine, microwave oven, and circular saw will run only one at a time, but with many small appliances running too.

2400 WATT continuous power rating. Like 1500, but runs 2 large appliances at same time. Will run 1/3 or 1/2 horse 120 volt AC relay-surge-start well pump.

3600 WATT continuous power rating. Extra margin to power large loads and shop tools. Runs well pump and most washing machines together.

Backwoods Solar takes trade-ins of inverters in our catalog toward purchase of a new inverter.

Remember: Each inverter requires battery cables with lug ends.

ITEM #	Input Voltage	Continuous Power	AC Surge Amps	Battery Charging Maximum	Additional Shipping	Price
I-TR1512	12	1500 Watts	28	70	\$40	\$850
I-TR1524	24	1500 Watts	40	35	\$40	\$850
I-TR2412	12	2400 Watts	52	100	\$40	\$995
I-TR2424	24	2400 Watts	72	70	\$40	\$995
I-TR3624	24	3600 Watts	100	70	\$40	\$1,285

OPTIONAL EXTRAS

ITEM #	Description	Price
I-TRCB	Conduit box with knockouts, fits DC and/or AC end	\$225
I-TRRC-50	Remote on/off control with status lights and 50' cable	\$135
Cable kit for Stacking (syncing) two TR inverters included for FREE! (two identical TR inverters can stack together to make a split 120/240 volt output)		
A-CAPACITOR	Added to most standard washing machines will reduce starting surge	\$20

Minimum shipping \$10 per whole order covers all items with no shipping listed

MODIFIED WAVE SMALL 12 VOLT INVERTERS BY XANTREX



XPower 400



XPower 1500

These modified sine wave inverters are low cost starter models. All these inverters feature manual On/Off switch, power on LED, low battery alarm at 10.7 volts, Low battery cut-out at 10.0 volts, shut down upon overload or overvoltage of 15.5. All have a 90% efficiency rating. Fans will make noise. Small inverters can cause more radio and TV static than higher quality inverters. Now with a 1 year Warranty!! CAUTION: NEVER connect these inverters to a circuit or breaker box with a bonded neutral and ground!!

ITEM #	Description	Additional Shipping	Price
I-XPOWER400	320W continuous, 700W surge. .25 A idling. Includes two power cables, one with clips and one with cig lighter plug. Two AC outlets. No Remote available. Size: 6.7"x3.6"x9.25", Weight 2.2 lbs	\$10	\$54
I-XPOWER1000	1000W continuous, 2000W surge. .3 Amp idling. Two GFCI AC outlets. On/Off Remote Included. 12.3"x5.9"x2.8", 4.4 lbs	\$14	\$118
I-XPOWER1500	1500W continuous, 3000W surge. .3 Amp idling. Two GFCI AC outlets. On/Off Remote Included. 15"x5.9"x3", 5.9 lbs	\$18	\$172

XPOWER1000 & 1500: Use with BC10-2/0 inverter cables and O-INLINE200 fuse

INVERTER BATTERY CABLES

Inverter performance and safety depend on using cables sized for very high battery currents, in lengths no longer than 10 feet. The cable end terminals and inverter bolt connections must be tight or enough heat can be generated to melt the cables and inverter input bolts, and start fires.

These large cables are finely stranded copper for flexibility, with lug ends industrially pressed on to fit terminal bolts on inverters. Always use a circuit breaker or fuse, in the positive battery cable between your battery bank and inverter.

Powercenters use just one set of DC cables to both the battery and inverter where a 10 foot long pair of cables is usually enough.

Some Xantrex XPower and Samlex inverters include cable connector studs on their inverters. A single BC10-2 or BC10-2/0 cable can be cut in half to make a pair of battery cables having terminals only at battery end, to fit these inverters.

ITEM #	Description	Additional Shipping	Price
Cable plugs, one positive and one negative (except single BC 10-2)			
FOR MANY INVERTERS THAT ARE SMALLER THAN 1000 WATTS			
I-BC10-2	Copper, 2 gauge 10' pair, lugs on all ends	\$14	\$75
I-BC2-SINGLE	Single cable: cut it in half for inverter with clamps	\$12	\$38
FOR INVERTERS THAT ARE 12V 1000-1500 WATTS; 24V 2000-3000 WATTS; 48V 3600-4000 WATTS			
I-BC10-2/0	Copper, 2/0 gauge, 10' pair, lugs on all ends	\$15	\$115
I-BC2/0-SINGLE	Single cable: cut it in half for inverter with clamps	\$13	\$65
FOR INVERTERS THAT ARE 12V OVER 1500 WATTS; 24V OVER 3000 WATTS; 48V OVER 4000 WATTS			
I-BC10-4/0	Copper, 4/0 gauge, 10' pair, lugs on all ends	\$17	\$178
I-BC4/0-SINGLE	Single cable: cut in half for inverter with clamps	\$14	\$95

Minimum shipping \$10 per whole order covers all items with no shipping listed

SMA-SUNNY BOY

2000HFUS / 2500HFUS / 3000HFUS

Designed for easy installation, simple communication and maximum performance. With high efficiency, a slimline enclosure and reduced weight, the Sunny Boy HF series of inverters can be mounted in between wall studs, making it perfect for new construction and space constrained remodels. Installation is made simple by automatic grid detection, field configuration for positive ground and a wide input voltage range of 175 to 600 volts, which provides increased system flexibility. The graphic display and wireless Bluetooth® communication system also makes the new Sunny Boy easy to use.



3000US/4000US & 5000US/6000US/7000US

The Sunny Boy “US” have been updated with SMA’s most advanced technology and are designed specifically to meet the new IEEE 1547 requirements. Their compact design makes them ideal for light commercial or residential use and the integrated string combiner and DC disconnect makes installation more cost effective. They are field configurable for positive ground systems making them more versatile than ever.



Increased efficiency means better overall performance from your solar system. Each are engineered and built to last and come with a standard ten year warranty. Sunny Boy inverters are trusted worldwide for their reliability and longevity in many grid tie systems.



Increased efficiency means better overall performance from your solar system. Each are engineered and built to last and come with a standard ten year warranty. Sunny Boy inverters are trusted worldwide for their reliability and longevity in many grid tie systems.

Sunny Island 5048-US

NEW!

The Sunny Island 5048-US is a bi-directional battery-based inverter/charger that be used completely off-grid, or for battery backup in grid-tie systems with Sunny Boy grid-tie inverters. This is done as an “AC-Coupled” system, where the AC output of Sunny Boy grid-tie inverters is connected to a critical-loads subpanel (rather than the main panel). The subpanel is also connected to the AC output of one or more Sunny Island inverters. More detailed information about AC Coupled systems can be found on our website.



Sunny Boy Accessories

SUNNY BEAM: The new Sunny Beam features Bluetooth wireless technology for improved performance and versatility. It communicates wirelessly with up to 12 Sunny Boy inverters and graphically displays all the key performance data of your solar system. It features fully automatic system monitoring, including an audible alert signal and it is powered by an integrated solar module and rechargeable battery. It can simultaneously display power output, daily energy production and the total energy production of the system. Up to a hundred days of system performance data can be recorded and stored, and then simply transferred to a PC via a USB interface. All HFUS inverters are set up to communicate with the Sunny Beam. For all other SMA inverters, order a Bluetooth Piggyback card for each inverter to be monitored. Sunny Beam includes a standard 5-year warranty.



ITEM #	Description	Additional Shipping	Price
I-SB2000HFUS	Sunny Boy 2000 High Frequency Inverter	\$35	\$2,126
I-SB2500HFUS	Sunny Boy 2500 High Frequency Inverter	\$35	\$2,196
I-SB3000HFUS	Sunny Boy 3000 High Frequency Inverter	\$35	\$2,266
I-SB3000US	Sunny Boy 3000US Inverter	\$35	\$2,250
I-SB4000US	Sunny Boy 4000US Inverter	\$35	\$2,785
I-SB5000US	Sunny Boy 5000US Inverter	\$35	\$3,645
I-SB6000US	Sunny Boy 6000US Inverter	\$35	\$3,885
I-SB7000US	Sunny Boy 7000US Inverter	\$35	\$4,235
I-SI5048US	Sunny Island 5048US Inverter	\$35	\$5,290
I-SB-BEAM	Sunny Beam Wireless Monitor		\$325
I-SB-PBCARD	Sunny Beam Bluetooth Piggy Back Card		\$185

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW!

SOLAREGE Grid Tie Inverter System



On typical grid connected installations, the system is made up of “strings” of solar modules wired in series to achieve a voltage that matches an inverter’s input voltage specification. All strings of modules in a system must contain the same number of modules. Most grid-tied inverters allow 9 to 12 typical 60 cell modules to be used in each string. This severely restricts how many modules used in a PV system and as soon as the modules are connected in series the wires from the modules to the inverter start carrying potentially lethal voltage whenever the sun is out.

The SolarEdge system consists of PowerBoxes™ which perform module-level MPPT, a highly reliable inverter, and a web portal for module-level monitoring and fault detection.

In a SolarEdge system, a PowerBox is mounted behind and connected to each module. At least 8 PowerBoxes must be used, so your system can start as small at 8 modules with wattages up to 350W each. The output of the PowerBoxes are wired in series “strings” just like a typical grid connected system, but strings can be made of 8 to 25 modules and several strings of different numbers of modules may be connected to the same SolarEdge inverter. This allows the homeowner to put as many solar modules on a roof that can fit in allowable space.

Modules can be partially shaded and can even be on different planes of the roof. Different brands and wattage modules can be used in the same string, making it easy to add to an existing system later or to replace a failed or broken module.

When the modules with PowerBoxes are installed, the installer can safely handle the wiring because there is only one volt output per module until they are connected to the inverter and the inverter is turned on. The installer will know if the wiring is correct by counting the modules and making sure there is one volt per module in each string. This allows for the quantity in series and the polarity to be easily verified.

If maintenance is required, you can turn off the inverter and the output again drops to one volt per module. This also eliminates the risk to firefighters because turning off AC power to a building turns off the inverter and this drops the module strings to safe low voltage.



SolarEdge’s module-level monitoring allows the installer and homeowner to see the output of each module on SolarEdge’s web site or through a smart phone application, and can even email the customer or installer when there is a problem with any module in the system.

The best part is that a PV system with SolarEdge PowerBoxes and a Solar Edge inverter costs no more than a system with a conventional string inverter and monitoring equipment and actually costs less than micro-inverter systems that offer similar features.

To design a system, measure the roof or installation location and see how many PV modules you can fit in the available space. Order one PowerBox per module. The inverters work with 208 and 240 VAC systems (because the MPPT and voltage management is handled by the PowerBoxes), have built-in AC and DC Disconnects, weigh 52 pounds, and are 97.5% CEC weighted efficient. Order the appropriate SolarEdge inverter by choosing one with a power output equal to at least 90% of the total wattage of all of the modules in the systems. SolarEdge makes inverters with AC outputs of 3.3, 3.8, 5, 6 and 7 kilowatts. For systems larger than 7 kW, use multiple inverters. The system also offers optional wireless inverter connectivity for simpler installation, free of Ethernet or RS485 cabling. ETL Listed to UL 1742 for the US and Canada. 25-year warranty for the PowerBoxes and 12-year warranty for the inverter (extendable to 20 years).

ITEM #	Description	Additional Shipping	Price
I-SE3300	SolarEdge 3.3kW Inverter	FREIGHT	\$1,700
I-SE3800	SolarEdge 3.8kW Inverter	FREIGHT	\$1,745
I-SE5000	SolarEdge 5kW Inverter	FREIGHT	\$1,876
I-SE6000	SolarEdge 6kW Inverter	FREIGHT	\$1,940
I-SE-PBMC4	PowerBox with MC4 Connector	FREIGHT	\$101
I-SE-PBTYCO	PowerBox with Tyco Connector	FREIGHT	\$101
I-SE-PBRADOX	PowerBox with Radox Connector	FREIGHT	\$101
O-MC4-CABLE	One needed for each string of PowerBoxes final wiring to inverter		\$30

PLEASE CALL FOR FREIGHT QUOTE
Additional components and 3-phase inverters
available, just ask

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! ENPHASE ENERGY

GRID-CONNECTED MICRO-INVERTER



Most grid-connected solar energy installations use a single centralized inverter to convert the DC output from multiple solar modules into AC power. The Enphase Energy micro-inverter system mounts behind a solar panel and converts the DC output of the solar module into grid-compliant AC power. This simplifies the installation, increases efficiency, avoids high voltage DC wiring and the requirements for conduit and DC switchgear. Micro-inverters allow the home owner to add to their system as budget allows, starting small and growing the size of the system over time.

Depending on the inverter you choose, the I90 or 215, there are several installation options available. We are happy to help make choosing the right components for your installation easy, just give us a call. The M190 utilizes an AC Branch Circuit Install Kit and allows for 15 inverters to be wired to a single 15A double-pole breaker in your service panel. The M215 utilizes specific trunk cables with plug in connectors along the length of the array. Depending on the wattage of your module, you will want to choose the inverter that maximizes the performance output to avoid clipping. Warranty is 25 years.

The Envoy communications gateway collects performance information for each solar module in a user's system and transmits data to the Enlighten™ website, where users can view their solar power system performance. The Envoy can be plugged into a 120v AC outlet. Enphase Micro-inverters transmit data over the existing power line, so no additional wiring is required. Simply connect an Ethernet cable from the Envoy into a broadband router. Monitoring is provided free. The Enlighten website provides information on solar system performance. A graphical representation of the solar array provides information on the status of each module.



ITEM #	Description	Additional Shipping	Price
I-ENPHASE-190	190-220 Watt with MC4 or Tyco cables, 240VAC	\$12	\$215
I-ENPHASE-215	200 - 250 Watt Inverter, 240VAC	\$12	\$215
I-ENVOY	Standard monitoring package with renewable option	\$12	\$347
I-ENVOYLIFE	Enphase Communications Gateway	\$12	\$470

ENPHASE ENERGY

GRID-CONNECTED MICRO-INVERTER INSTALLATION DIAGRAM



1. Enphase Micro-Inverter system mounts to racking beneath each solar module
2. AC power and performance data sent via AC wiring to the load center and communications gateway
3. Envoy Communications Gateway
4. Standard Ethernet Router
5. Enphase Enlighten Monitoring can be viewed from any web browser and provides monitoring and analysis of system performance

CABLES & ACCESSORIES

ITEM #	Description	Price
I-ENGAGE-LDSP	Trunk Cable for Landscape Installations-M215 (per connection port)	\$37
I-ENGAGE-PORT	Trunk Cable for Portrait Installations-M215 (per connection port)	\$37
I-EN-TERMINATOR	Trunk Cable Terminator- M215	\$18
I-EN-CABLECLIP	Cable Clips (Bag of 100)- M215	\$71
I-EN-CAP	Watertight Sealing Caps for Trunk Cable- M215	\$4
I-EN-TOOL	Disconnect Tool- M215	\$6
I-ENPHASEAC	AC Branch Circuit Install Kit- For M190: 6 foot	\$68
I-ENPHASE6	6' AC Extension Cable	\$73
I-ENPHASE12	12' AC Extension Cable	\$92
I-ENPHASE20	20' AC Extension Cable	\$110

Minimum shipping \$10 per whole order covers all items with no shipping listed

VOLTAGE BOOST FOR BATTERY CHARGING



If your generator doesn't give at least 2/3 of the rated charge amps from automotive battery chargers or from modified wave Xantrex DR model inverter battery chargers, it's taking too long to get your battery fully charged. Generators costing under \$2500 lack in peak voltage. A voltage boost transformer can restore full charge amps and reduces charge time. Use a DC ammeter like M-Digamp or Trimetric to confirm the need for this cure. 10% BOOST.

Hard-wires between generator output and charger/inverter input. Not UL listed 5000 watt rated. 1 year warranty.

ITEM #	Description	Additional Shipping	Price
I-BOOST	Chargeboost Transformer	\$18	\$145

OUTBACK PSX-240 Transformer



This auto transformer can be used for step-up, step down, generator and split phase output balancing or as a series stacked inverter to load balancing transformer. Incorporating a transformer with 120v 30 amp primary and secondary side, a temperature activated cooling fan and a 25 amp dual breaker in a steel enclosure, the PSX-240 is ready for your custom 120 or 240 60 hz only system. Rated power is 6 kw.

ITEM #	Description	Additional Shipping	Price
I-OBPSX240	Outback PSX240 6kva Transformer	\$32	\$485

HOW TO SWITCH BETWEEN INVERTER AND GENERATOR

AC produced by an inverter is wired into the standard AC house wiring breaker box to distribute power to lights and outlets throughout the home. Sometimes an AC generator might be connected to the same house wiring. **DON'T DO IT!** Inverter and generator **must never be connected to the same wiring at the same time** or both can be damaged. Wire generator power to one circuit or outlet in the battery room and tag it "generator direct". This is where you plug in your battery chargers, or to connect the charger of an inverter. The inverter will automatically switch generator power thru to your house wiring when you start the generator, then switch it back to inverter power when generator stops.

If your inverter lacks the standby transfer option, you can plug your battery charger into the direct generator outlet, then use the transfer relay below to do the automatic switching between inverter and generator.

TRANSFER RELAY

TRANSFER RELAY switches your 120 volt AC house wiring between generator and inverter power sources automatically. Starting the generator causes transfer of home wiring from inverter to generator after a 20 second delay for warm-up. When you disconnect the generator, the relay transfers back to inverter power in 30 milliseconds. This prevents damage from accidental cross connection between inverter and generator. 2 year warranty.

30 amps at 120 volt AC or 50 amps at 120/240 volt AC.



Each Model measures
8.625 w x 8 h x 3.875 d

ITEM #	Description	Additional Shipping	Price
O-TS30	120V, 30Amp Transfer Relay	\$13	\$68
O-TS50	120/240V, 50Amp Transfer Relay	\$13	\$125

METER BASICS

Some people say they can't understand electricity because they can't see it. But we can't see into our car's gas tank either. We use a gas gauge to learn the fuel level. Likewise, meters take the mystery out of power systems. Here are the basics.

VOLT METERS show electrical pressure, to verify when batteries are fully charged or are very discharged, but they are less precise at indicating mid-levels of charge.

AMP (short for ampere) METERS show current flowing at the present time. Amperes is a rate of flow, like gallons per minute. Turn on a light and 2 amps begin to flow. Turn on a second and the flow increases to 4 amps so long as both are on. We use a digital ammeter to show total amperes being used. If it reads higher than expected, we look for lights or appliances accidentally left on.

Ammeters can also be connected to show NET BATTERY AMPS — balance of power going into or out of a battery. If solar is charging at 20 amps, and the TV is using 5 amps, the battery receives the difference, 15 amps. A net battery current meter shows +15 amps charge going to the battery. At night with just the TV on, this same meter shows negative 5 amps flow out of the battery.

AMP-HOURS is the total energy used over a period of time, just like total gallons of gasoline available in the tank (or used on a trip). Amp-Hours consumed are figured by the number of amps flowing multiplied by the number of hours it flows. A light using 2 amps, lit for 6 hours uses 12 amp hours. If lit for 30 minutes, it uses 1 amp hour. Your battery holds a certain number of amp-hours.

A BATTERY NET AMP-HOUR METER starts at a full battery and counts amp hours passing into and out of the battery. It keeps track of the running total so you know how much power is left in the battery. This is the closest thing to a fuel gauge yet to be invented for batteries. Batteries, like leaky gas tanks, lose a little power internally, where the meter can't measure it. To compensate, Battery Amp-Hour meters "fudge" the count lower by a certain percentage to match actual battery operation. These meters must be carefully programmed to match your battery. (See Trimetric meter on the next page).

A METER SHUNT is a calibrated brass block for measuring very large currents, up to 500 amperes. The shunt sends a small signal to a digital Ammeter or Amp-Hour meter. The signal can be sent on small wires, so the meter may be located some distance from the shunt, often in the living quarters for more convenient checking. All current going into or out of the battery passes through the shunt and is counted.

TRIMETRIC BATTERY METER



Model 2025 for 12, 24 or 48 Volt Systems

IF YOU HAVE JUST ONE METER, MAKE THIS THE ONE

Trimetric keeps a running total of power into or out of your battery and displays the present level of charge.

The Meter head mounts anywhere in the house for easy checking. Small wires run from the meter to a shunt near the battery.

The Trimetric meter reads:

VOLTS: this feature only can monitor 2 battery banks, accurate to 1/10 volt. For 12, 24, or 48 volts.

AMPS or WATTS: display measures the rate of energy going in or out of your batteries so you can check your charging systems, and also to see how much energy each of your appliances use.

AMP-HOURS: Your battery state of charge in amp-hours.

% Full: display will give you a quick indication of battery state-of-charge.

Also shows advanced functions: Flashing alarm reminds that battery needs charging or needs equalizing. Shows days elapsed since last full charge; amp hours cycled since last full charge; total amp hours cycled since battery was new; highest voltage since reset. Visit www.bogartengineering.com for more details.

1 year warranty. New Data logging feature records daily maximum battery voltage level, and minimum charging amps to check for proper charging levels for the last 5 days.

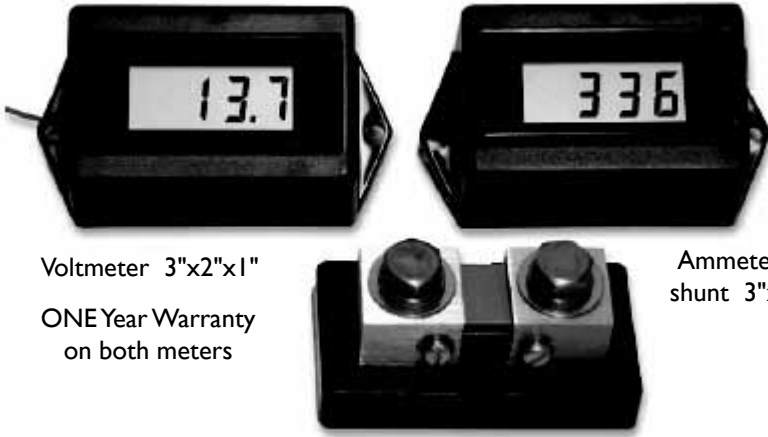


5" x 4 1/2"

ITEM #	Description	Additional Shipping	Price
M-TRIMETRICKIT	Kit includes all the parts needed to set up the meter -500 amp 50 millivolt shunt -24", 2/0 lug cable to connect your battery to the shunt -Terminal lug to attach charge and load wires to the shunt -Surface wall mount box for the meter head -Cable, 25 feet (or specify length) with 3 amp fuse connects meter to shunt & power	\$12	\$225
M-TRIONLY	Trimetric 2025 Meter head alone, no shunt or parts kit		\$180
M-SHUNT100	100A Shunt		\$29
M-SHUNT500	500A Shunt		\$29

Minimum shipping \$10 per whole order covers all items with no shipping listed

DIGITAL PANEL METERS



Voltmeter 3"x2"x1"
ONE Year Warranty
on both meters

Ammeter with
shunt 3"x2"x1"

Digital VOLTMETER

Battery voltage reads to one decimal point. Reads accurately 4.5-65 volts, for 12, 24, or 48 volt power systems. Can be installed a great distance from the battery with small connecting wire to battery. In surface mount box. Runs on milliamps, not a power user.

ITEM #	Description	Price
M-DIGVOLT	11-65V Voltmeter	\$58

DC DIGITAL AMMETER with shunt

Digital ammeter shows small item power usage for lights and electronics, as well as high power battery charger and inverter current. Small wires connect meter to shunt so meter can mount remote if desired. With 100 amp shunt, or with 500 amp shunt. 100 amp shows readings from 0.1 amp to 99.9 amps with one decimal place. 500 amp shunt reads 1 to 500 with no decimal place. You can't see such range or accuracy with analog pointer meters. ONLY works in (-) leg of your circuit due to common ground. Will read net amps. 65v DC maximum.

ITEM #	Description	Price
M-DIGAMP100	Digital Ammeter - 100A	\$78
M-DIGAMP500	Digital Ammeter - 500A	\$78
M-DIGAMP	Digital Ammeter ONLY	\$58

ANALOG (POINTER) METERS

12 Volt DC Analog Meter

Expanded scale (8-16v) for easier reading of normal battery voltage. +/- 5% accuracy. Mounts in 2-1/8" round hole. Dim: 3 3/16" W x 2 7/16" H x 0.5" thick face plate: Total depth: 1.75".



ITEM #	Description	Price
M-AVOLT	8-16V Analog Voltmeter	\$25

DC Analog Amp Meter

Indicates amperes charging or DC usage. Can handle 2x current for short periods of time. These come with appropriate shunts built in. Fits 2-1/8 round hole. 0-5, 0-10, 0-15, 0-30, or 0-50+/- 5% accuracy. **Please SPECIFY SCALE BY REPLACING "XX" with Amp rating.** Mounts in 2-1/8 inch round hole. Dim: 3.5" W x 3.0" H x 5/8" thick face plate: Total depth: 2.0".



ITEM #	Description	Price
M-AMP-XX	5, 10, 15, 30 or 50 Amp Meter	\$25

Round 60 Amp DC Meter

Small analog, low cost, not too accurate, to show output of battery charger. Mounts in 2-1/8" round hole.



ITEM #	Description	Price
M-60AMP	60 Amp DC Meter	\$15

Generator Monitor

Two analog meters read AC volts & frequency (generator speed). No installation, just plugs into your generator's AC outlet. Not accurate for most inverter waveforms.



ITEM #	Description	Price
M-GENTEST	Voltage and Hertz Generator Monitor	\$75

Minimum shipping \$10 per whole order covers all items with no shipping listed

PORTABLE DIGITAL TEST METER



VOLTS shows 2 decimal places up to 20 volts DC, and one decimal place up to 200 volts DC. This is important for checking battery condition, with tiny variations between some cells. Also 0-750v AC & 0-20 amps AC. AMPS reads 10 or 20 amps DC (actual amps depends on current model). Test the current of a solar module or many DC appliances.

OHMS and milliampere scales, audible continuity beep, diode test etc. This meter costs more than hobby types, and is very reliable. We send a brochure about using a test meter with each order. Or just ask for the Backwoods test meter instructions for free. Exact model may differ from this picture. Includes 9V battery. One Year Warranty.

ITEM #	Description	Price
M-DMM	Portable Digital Test Meter	\$54

AC WATT-HOUR METER



COMPARES POWER USAGE OF APPLIANCES

Plug this meter into 120 volt AC power and plug appliance into the meter. It registers how much power the appliance is using, and keeps total of kilowatt hours used since start of test. You know exactly how much power a freezer uses each day, or any other appliance up to 1875 watts. Once unplugged, the data stored is lost. Shows voltage, frequency, and power factor of power being used too. 0.2% accuracy. Max surge amps: 29; alarm sounds above 15 amps. ETL approved. 6 month warranty. LCD not backlit. Made in China.

ITEM #	Description	Price
M-KILLAWATT	AC Watt Hour Meter	\$35

ONE WEEK 12 / 24 VOLT TIMER SWITCH



A programmable timer makes your stereo into a wake up clock radio, or can turn on a fax, 2 way radio, heating system or a light during scheduled hours. It can cut off phone bells at night, operate grow lights, or start up a refrigerator for a weekend cabin, control a two-wire-start generator to pump water or charge batteries. Ordinary AC timers will not operate if an inverter is not constantly on. This timer runs on DC so it's always on duty even where there is no inverter. Or it can switch on an AC appliance which in turn starts up the inverter from search mode. Operating range to avoid LCD damage: +14° to 131° F.

Program is set by push buttons, with digital display screen also showing time of day. You can program up to 8 different "on" times per day. Each "on" time can operate any one day, all days of the week, Monday through Friday, Monday through Saturday, or just weekends. Has easy manual on-off switch.

Controls up to 10 amps AC, but only about 2 amps DC. We can supply a 30 amp external relay in order to control much higher current appliances. Order O-RELAY. This is not a plug in appliance. It must be wired like a switch, in series with power to appliance. Wiring diagrams also available.

This timer uses negligible battery power to run, 5-10 milliamps idle, 30 milliamps during "on" time. An internal watch battery maintains time and program if DC power is disconnected for weeks. One year warranty. Size under 3" square, 2" deep.

ITEM #	Description	Price
A-DIGTIME12	12 Volt Digital Programmable Timer	\$68
A-DIGTIME24	24 Volt Digital Programmable Timer	\$68
O-12VRELAY	12V, 30A DPDT Screw Term Relay (210ma coil)	\$45
O-24VRELAY	24V, 30A DPDT Screw Term Relay (210ma coil)	\$45

DC POWERED TIMERS

Timers for 12 or 24 volt DC. Very low power (30 milliamperes) used by DC units. We may be able to special order different time ranges or 120 volt AC models: \$72 per special order timer. Our O-RELAY on the previous page will allow timer to control up to 30 amps. Please specify relay voltage.



ONE SHOT You start it, then it turns off after a set time. Must time out before resetting.

Outdoor lighting or multiple switched lights. Like 3-way switching but you can have any number of light turn-on locations. Any button push turns lights on for set interval, then automatically goes off. Also can be used as automatic switch to run a water pump. "On" time adjustable range is 1 to 100 minutes. Other time ranges from 0.1 to 500 minutes available special order. 10 amps maximum, 5 amps recommended. One Year warranty.

ITEM #	Description	Price
A-TIMEERD12	12V Adjustable Off Timer (specify voltage)	\$64

CONTINUOUSLY CYCLING Timer repeats on-off-on-off endlessly.

On interval and off interval are separately adjustable from 1 to 100 minutes. Other time ranges under 1 second to over 500 minutes by special order. Connect to a DC or AC pump circuit to:

- Pump a few minutes with 10 minute rest cycles to match a slow well.
- Circulate just enough hot water to heat a floor, plant beds, or a water bed, and then rest the circulating pump while heat transfers from pipes. 10 amps maximum, 5 amps recommended. One Year warranty.

ITEM #	Description	Price
A-TIMEKRDR12	12V Repeating On & Off Timer (specify voltage)	\$64

DELAYED OFF Power waits a set time period after switch is turned to shut off. Does not need to time out before resetting

Uses: Two way radio in truck stays on so it can be called for 30 minutes after ignition is turned off, then goes off to save battery. Lights go out 5 minutes after switch is turned off so you can leave house or vehicle with outside light, then goes out to save battery. See also the wind up timers in lights section of catalog. Time range 1 to 100 minutes. Other ranges available special order. 10 amps maximum, 5 amps recommended. One Year warranty.

ITEM #	Description	Price
A-TIMEHRDB12/24	12V or 24V Delayed Off Timer (specify voltage)	\$64

Minimum shipping \$10 per whole order covers all items with no shipping listed

12 VOLTS FROM 24 OR 48 VOLT BATTERY



**94-96% efficient
draws 7 ma**

Homes with 24 and 48 volt battery systems sometimes need 12 volt power for:

DC motion detecting lights, Nicad battery rechargers, DeWalt/Makita cordless tool car chargers (AC tool chargers burn out on non-sine wave inverters), notebook computer car lighter charge cords, cellular phones.

With the battery voltage balancer you can tap 12 volts from a point on a 24 or a 48 volt battery, and the balancer keeps all cells equally charged. Power transfers from the untapped portion of the battery to the 12 volt portion being tapped to maintain perfect balance. 1 year warranty.

Because the equalizer has 24 hours a day to balance part time 12 volt consumption, a 20 amp equalizer will balance intermittent use of currents much higher than its own 20 amp transfer rate. Since the battery supplies the 12 volt power directly, short 12 volt surges are not limited by the converter's 20 amp rating. Power quality is much better than drawing 12 volts through a series converter.

ITEM #	Description	Price
EQ12/24-20	Balances 24V battery use to 12V power tap Covers 40 Amp average 12V load	\$195
EQ12/48-10	Balances 48V battery to use 12V power tap Covers 20 Amp average 12V load	\$215
EQ24/48-10	Balances 48V battery to use 24V power tap Covers 20 Amp average 24V load	\$215
Must add cross tie battery cables for multiple battery strings		

Additional models are available as a special order, please call with your specifications.

VOLTAGE CONVERTERS

The battery balancers on the previous page cannot be used as series converters to either raise or lower voltage. In their place Solar Converters offers a line of constant voltage and power point tracking devices for either step down or step up functions. These devices do not involve tapping the battery, so they have limited ampere ratings but they can be used with inductive loads. Use at the end of a long 24 or 48 volt wire to get 12 volts for an appliance to use 12-volt-only motion sensors, cell phone, or fountain pump. Or convert 12 volts up to 24 volts to run a Shurflo 9300 well pump at a higher flow rate or a ceiling fan full speed. 1 year warranty.

CONVERT a 12(or 24v) circuit to run a 24(or 48v) load

ITEM #	Description	Price
CV12/24-6	Converts 12V input to 24V output, 6 Amps max output	\$205
CV12/48-3	Converts 12V input to 48V output, 3 Amps max output	\$205
CV24/48-6	Converts 24V input to 48V output, 6 Amps max output	\$205

CONVERT a 24(or 48v) circuit to run a 12(or 24v) load

ITEM #	Description	Price
PPT12/24-20	Converts 24V input to 12V output, 20 Amps max output	\$210
PPT12/48-10	Converts 48V input to 12V output, 10 Amps max output	\$235
PPT24/48-10	Converts 48V input to 24V output, 10 Amps max output	\$235

Low Power Converters: Same function as above except much lower current limits and lower prices. 2 amp maximum current. Load (-) must be isolated from system ground! Warranty is 90 days by Zane International.

ITEM #	Description	Price
O-SOLDOWN2-12	12V in, Output adjusts from 3-12V	\$60
O-SOLDOWN2-24	24V in, Output adjusts from 5-25V	\$60
O-SOLDBLR	12V in, 24V out: runs DC ceiling fans faster	\$55

Stable lower or higher than battery voltage adjuster Sol Up has unique feature that boosts voltage when battery is too low. Also reduces voltage when battery goes too high during charging. Maintains exact output voltage to sensitive equipment like a cell phone. Takes 8-16 volt input range from battery, stable output is user adjustable as needed from 5 volts to 24 Volts. Two amp maximum current.

ITEM #	Description	Price
O-SOL-UP	12V in/ stable 12-24 out- 2 Amp	\$90

AC OR DC BREAKER BOX



13 x 9 x 4 inches

Square-D circuit breakers in their “QO” line are UL listed for 12 and 24 volt DC circuits or for 120/240 volt AC home or generator circuits, but use a separate unit, for DC and for AC. Do not mix voltages in a single box.

We stock model QO612LI00S, a six-circuit load center. We ship it with two 20-amp QO-120 breakers included. The remaining four empty breaker-slots may be filled with breakers of your choice from 10 to 60 amp maximum QO breaker size. The QO612 load center can be used for most DC lighting or appliance circuits, and even small inverters. Breakers can also be dedicated to your PV array as a convenient disconnect between array and controller or controller and battery bank as well as between your hydro input and battery bank. 60 amps is maximum breaker size.

ITEM #	Description	Additional Shipping	Price
O-QO612KIT	Load center with two 20A breakers	\$14	\$68
O-QOBRKR	10, 15, 20 or 30A, please specify		\$14
O-QOBRKR60	60A Breaker		\$18

MIDNITE DC QUAD BOX

This Midnite general use enclosure has room for 4 panel mount type breakers from 5 - 100A. We recommend using the DC Quad Box with the Magnum Mini Panel when a 80A or larger charge controller is used. This allows for a 100A panel mount breaker to be wired into the system.



ITEM #	Description	Additional Shipping	Price
O-MNEDCQUAD	Midnite DC Quad Box	\$14	\$55

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! INVERTER DISCONNECT

Main Battery Disconnect

DC Rated Circuit Breaker designed for connecting inverter to battery safely. All of the DC Disconnects come with either a 125, 175 or 250A/125VDC breaker and room for either 5 additional din rail mounted DC breakers, or 3 panel mount breakers. These can be used for many different DC loads, like charge controller disconnect battery status monitor feed, etc. Includes a grounding bus bar, 5/16" bonding battery minus stud. Mounting holes for a 500A shunt are built in.

ETL listed for US and Canada



Consider Making Your Own Powercenter. See the kits using the Outback FLEX DC, Midnite E-panels, or Magnum Mini Panel in the Power Center section.

ITEM #	Description	Additional Shipping	Price
O-MNDC125	125A DC Disconnect	\$20	\$185
O-MNDC175	175A DC Disconnect	\$20	\$212
O-MNDC250	250A DC Disconnect	\$20	\$212

AC & DC DISCONNECTS BY OUTBACK



Flexware 500 DC

ETL listed indoor enclosure
Includes:
ONE main inverter breaker: 100, 175, or 250 (please specify when ordering)
Knockouts for one more inverter breaker and 8 smaller load/input breakers or 5 small breakers plus GFP/2 ground fault protector.
500a 50mv DC current shunt
Battery (+) & (-) & ground bus bars
Jumper wire from (-) to ground
Knockouts on 5 surfaces for conduit, cable clamps, and MX60 grommets
18.2"H x 11.4"W x 12.1"D



Flexware 500 AC

ETL listed indoor enclosure
Includes:
Dual 60 amp 120/240 AC bypass breaker
Dual 60 amp 120/240 AC input breaker
Dual 60 amp 120/240 AC output breaker
Ground bus bar
One insulated AC neutral bus bar
Two insulated black AC Hot bus bars
Two insulated red AC Hot bus bars
Knockouts for 10 additional Outback AC breakers
Flex conduit to run between Flexware AC and Flexware DC boxes
18.2"H x 11.4"W x 12.1" D

ITEM #	Description	Additional Shipping	Price
O-FLEXDCBOX-100	Outback Flex 500 Box, 100A	\$18	\$335
O-FLEXDCBOX-175	Outback Flex 500 Box, 175A	\$18	\$395
O-FLEXDCBOX-250	Outback Flex 500 Box, 250A	\$18	\$395
O-FLEXAC	Outback Flexware AC breaker box	\$18	\$495
O-FLEXMP	Outback Flex 500 Mounting Plate	\$18	\$169

PLEASE FIND BREAKERS FOR THE MIDNITE DISCONNECT AND OUTBACK DISCONNECT ON THE NEXT PAGE

Minimum shipping \$10 per whole order covers all items with no shipping listed

Smaller breakers for the AC & DC knockouts in Flex 500 boxes featured on previous page

ITEM #	Description	Price
O-OBDC100	100A DC Breaker	\$57
O-OBDC175	175A DC Breaker	\$129
O-OBDC250	250A DC Breaker	\$129
O-FLEXCCB	Mounting bracket for one side mounted FM60	\$39
O-OBDC(Amp)	5,10, 20, 30, 40, 50, 60, 80 A DC Breakers	\$25
O-OBAC(Amp)	15, 20, 30, 50, 60 AC Single Pole Breakers	\$19
O-OBAC(Amp)-D	15, 20, 25, 30, 50 AC DOUBLE Pole Breakers	\$39
O-OBDC-GFP2	Outback Double Pole Breaker 80A/Pole GFP	\$129

SAFETY SWITCH DISCONNECT 240V AC, NEMA3R General Duty Switches

Many utilities require an AC disconnect between a grid-tie inverter and the AC Load center, close to the AC service entrance, with a visible and lockable handle. A 30A, 240V disconnect is good for up to 5kW at 240VAC and the 60A disconnect is good for up to 11kW. Use Class R fuses of the proper voltage and amperage for fused disconnects.



ITEM #	Description	Additional Shipping	Price
O-AC30FUSED-2	30A, 2-Pole Disconnect	\$15	\$90
O-AC30FUSED-3	30A, 3-Pole Disconnect	\$15	\$140
O-AC60FUSED-2	60A, 2-Pole Disconnect	\$15	\$140
O-FUSE-15	15A, Class R Fuse		\$9
O-FUSE-30	30A, Class R Fuse		\$9
O-FUSE-60	60A, Class R Fuse		\$9

DC RATED FUSES

WITH FUSE HOLDER FOR INVERTERS

Fuse blocks directly accept large inverter battery cables. A fuse and holder is basic protection against electrical fires from over-current in wiring. (Fuses and holders by themselves are not accepted by National Fire Code unless you install them in an approved metal box.) Replacement fuses available from Backwoods if you do not find them locally.



Enclosure with cable connectors



Class T fuse and cable terminals inside

400 Amp Class T Fuse in plastic enclosure For 1800-3000 watt 12 volt inverter or 3500-4000 watt 24 volt or 5500 watt 48 volt inverter. Accepts 4/0 cables. Includes allen wrench. Mounts on wall or inline on inverter cable.

ITEM #	Description	Price
O-INLINE400	400A Inline fuse holder and fuse	\$68
O-T400	400A Class T Fuse only	\$28

200 Amp Class T Fuse in plastic enclosure For 1000-1500 watt 12 volt inverter, or 2000-3000 watt 24 volt inverter, or 4000 watt 48 volt inverter. Accepts 4/0 cable. Includes allen wrench. Mounts on wall or inline on inverter cable.

ITEM #	Description	Price
O-INLINE200	200A Inline fuse holder and fuse	\$60
O-T200	200A Class T Fuse only	\$20



100 Amp Class R Fuse with wall mount holder for #2 wire. Not enclosed. For 600-800 watt 12 volt inverter or up to 1800 watt 24 volt inverter.



ITEM #	Description	Price
O-FB100	100A Fuseholder and fuse	\$48
O-FUSE100	100A Class R Fuse only	\$20

Minimum shipping \$10 per whole order covers all items with no shipping listed

SMALLER DC FUSES

15, 30, 40, and 60 AMP Fuses for solar controllers, DC pumps, refrigerators, lights. Every wire from your battery positive must be fused for safety. Select a fuse rated 125% to 150% over normal amps expected, and no higher than amp capability of smallest wire in circuit. These fuse holders have clamps for wire sizes up to 2 gauge. Also for inverters 400 watts & smaller.



ITEM #	Description	Price
O-FB60	40-60A Holder & Two 60A Class R Fuses	\$24
O-FB40	40-60A Holder & Two 40A Class R Fuses	\$24
O-FB30	30A Holder & 2 30A Class R fuses	\$24
O-FB15	15A Holder & 2 15A Class R fuses	\$24
O-FUSE:15,30,40,60	R15, R30, R40 or R60A Fuse Only	\$9 ea



SIX FUSE Block of six 15 amp auto type AGC glass fuses. Connect battery positive to brass bar of all fuses. Loads connect to each fuse. Low voltage DC only.

3 AMP IN-LINE FUSE & HOLDER with wires. For meters and small items.

ITEM #	Description	Price
O-SIXFUSE	Includes 6 fuses and 4 spares	\$18
O-INLINE	Inline 3A Fuse & Holder	\$3

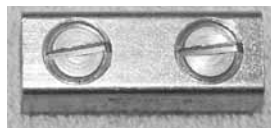
BATTERY LUGS fit 5/16"-3/8" battery terminal bolts. Connects many wires to battery. Also fits meter shunt. Connects wires 2/0 or 4/0 to 14 gauge in one or two set screw wiring clamps. Includes Allen wrench.

SPLICE BARREL joins wires up to 2 gauge. Set screws anchor each side.



AU2/0

AU4/0



SPLICE BARREL

ITEM #	Price
O-AU2/0	\$4
O-AU4/0	\$7
O-BARREL	\$7

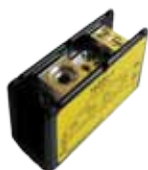
WIRE JUNCTION DEVICES



BAR CONNECTOR joins wires, 4 to 14 gauge. Set screws hold each wire. All metal, not insulated. Connects all wires together. Made for multiple ground wire terminal in equipment boxes. 12 terminals.

ITEM #	Description	Price
O-PK	Bar Connector for 12 Wires	\$15

INSULATED TERMINAL BLOCKS for large wires. Screw clamp for each wire. A single large cable up to #2/0 fits in one side. The other side holds four wires up to 4 gauge each, or 8 smaller wires. Allen wrench included.



SINGLE BLOCK: use one for positive wires and a second one for negative wires.

DOUBLE BLOCK: + and - combined in one.



TRIPLE BLOCK: +, -, and ground combined in one.

EXTRA LARGE SINGLE BLOCK has TWO 2/0, and SIX #4 wire positions.



TERMINAL BLOCK joins up to **FIVE PAIRS** of wires, each pair insulated from the others. Accepts 18 gauge to 4 gauge wires. Good for connecting small charge controls, LCB, pumps, or meter wires to heavier distance feeder wires. Five circuits, 85 amp maximum rated. Attaches to wall with screws included.



ITEM #	Description	Price
O-16220-1	Single Terminal Block	\$20
O-16220-2	Double Terminal Block	\$37
O-16220-3	Triple Terminal Block	\$43
O-16325-1	Larger Single Block	\$48
O-BLOCK	Terminal Block	\$9

DC OUTLET & PLUG Handles 20 amps, fits standard outlet box & cover. Takes 10 or 12 gauge wire on the screw terminals. These are actually heavy duty 240 volt outlets which pass building codes for DC wiring if there is no 240 volt in the house.



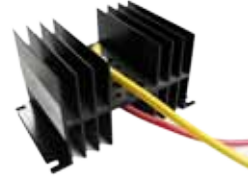
TOGGLE SWITCH 50 amp DC rated low voltage. SPDT. On-off-on, with screw terminals for wires.



ITEM #	Description	Price
O-DCOUTLET	Double Outlet for DC or 240AC	\$12
O-DCPLUG	Plug for DC or 240V AC, 20A, Three Prong	\$6
O-TOGGLE	50A DC Toggle Switch	\$8

DIODES

Mounted on large heat sink. Prevents reverse current flow. Diode function is built into solar charge controls. You don't need a separate diode for solar charging.



ITEM #	Description	Price
O-DIODE10	Rated 10A, up to 200V	\$24
O-DIODE30	Rated 30A, up to 150V	\$48
O-DIODE80	Rated 80A, up to 100V	\$48

Lightning Arrestors- AC, DC, 3 Phase AC

Lightning surge protector used on buried wires from solar, wind, hydro or between buildings. Protects equipment by diverting to ground any voltage surge above 100 volts picked up from close lightning hits. No conductivity below 100 volts. Takes repeated surges to 50,000 amps. One wire connects to your ground rod and two wires connect to cables from outside. (not UL Listed)



ITEM #	Description	Price
LA-302DC or AC	300V, Specify AC or DC	\$42
LA-303AC	3 Phase to 300V Lightning Arrestor	\$52
LA-602DC	600V DC Lightning Arrestor	\$52

NEW! MIDNITE SOLAR SURGE PROTECTOR



Soon to become the industry standard!

The MidNite Solar Surge Protector Device (MNSPD) is a Type I device, designed for indoor and outdoor applications. Engineered for both AC and DC electric systems, it provides protection to service panels, load centers or where the SPD is directly connected to the electronic device requiring protection. Maximum protection will only be achieved if the SPD is properly installed.

The MidNite Solar SPD is offered in three different voltages to maximize the required protection level. Protection is achieved by reducing the clamping voltage to a safe voltage

that your system can sustain without damaging any electronics in the system. By using the chart below, select the SPD's that provide the protection your system requires.

The MidNite SPD is a welcome replacement for less sophisticated arrestors that have been the mainstay of the industry for many years. Other din rail SPD's are physically small and typically can only provide 1/8th the protection of the MidNite product. When exposed to transients above their capability, permanent damage occurs. Din rail SPD's are always mounted inside of a box such as a PV combiner. When the din rail SPD fails from a near lightning strike, it just quits working. This means that it also quits protecting. Since it is locked away inside of a box, you have no way of knowing it has failed until your next lightning storm! The MidNite SPD is mounted on the outside and has blue LED's viewable from a distance that show your system is still protected. They are also built to last, in the case that the MNSPD does eventually wear out, they can easily be repaired.

The MidNite Solar SPD voltage rating should be chosen according to the nominal voltage of the system. Do not install an SPD with Maximum Continuous Operating Voltage (MCOV) below the nominal voltage of the system; this will deteriorate the SPD and making it unavailable when you most need it. The 115V SPD provides protection for battery circuits, the 300V SPD provides protection for the Classic & other charge controllers as well as off-grid PV combiners and 120/240VAC circuits. The 600V SPD is available as a special order item for Grid-Tie PV combiners and inverter input circuits.

ITEM #	Description	Additional Shipping	Price
LA-MID-SPD115	115V Surge Protector Device	\$10	\$102
LA-MID-SPD300	300V Surge Protector Device	\$10	\$102
LA-MID-SPD600	600V Surge Protector Device	\$10	\$102

Minimum shipping \$10 per whole order covers all items with no shipping listed

LIGHT WITH LESS POWER

Photovoltaics convert just 10% of sunlight's energy into electricity. Ordinary light bulbs convert only 10% of that electricity back into light (the rest becomes heat in the bulb). Because lighting is a major part of power used in solar homes, special high-efficiency bulbs saving 75% of the power are well justified.

ORDINARY INCANDESCENT BULBS are 10% efficient, wasting 90%.

QUARTZ HALOGENS are brighter incandescents, some have reflectors.

STANDARD FLUORESCENT TUBES give a lot more light for the power.

COMPACT FLUORESCENT BULBS (CF) give best light quality and efficiency because they make less heat and more light. Using one fourth the power of ordinary bulbs, a 15 watt CF has the brightness of a 60 watt incandescent. They run 4 times as long on the same power and give the same quality of light, without flickering, and should last 6 times as long. Total cost is much less than adding extra solar modules to run lower cost incandescents. Presently, most cannot use dimmer switches.

LED (light emitting diode) lamps are the newest lamp type. They have a much longer lifetime, rated 50,000 hours, and a ruggedness that exceeds all others. As little as half a watt can power them. Price/color is improving.

Bulbs used the most can save the most energy. Put efficient CF bulbs in lamps used 20 minutes at a time or more every day. Lights seldom used save only a little energy, so ordinary low cost bulbs are fine for closets and other rarely used fixtures. For best results, our DC CF bulbs must run a minimum of 20 minutes when turned on to properly heat up and due to start up surge, only install one light per switch.

Numerous wall switches controlling multiple low-watt lamps close to each work area give more choice in lighting so you can use less power. This is better than one switch that turns on all lights in a room, or one big light in the middle of a room. Lighter paint colors, with skylights and windows placed for day lighting greatly reduce lighting energy. Timer switches save energy for lights outdoors, in basements, and in children's rooms.

120 volt AC or 12 volt DC: 120 volt AC compact fluorescents are the best choice overall for a house. They are available in more sizes and shapes. AC wiring is easier and very standard. Even a 300 watt inverter will run lots of 15 watt lights (which give light equal to 60 watts).

But very small homes and cabins or recreational vehicles with total of 6 or less lights might best use 12 volt DC CF and LED lights. DC lights don't require an inverter, so use slightly less power.

12 VOLT DC MOTION SENSOR LIGHTS are always on duty to work whether inverter is running or not, and will not be accidentally left on.

NEW! FIREFLY

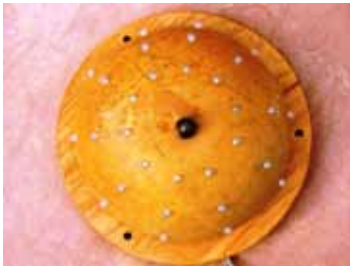
Solar Charged LED Desk Light

The Firefly 12 provides light the equivalent to a 15W bulb and offers a sturdy 1.0W solar panel. The Firefly can offer three people sufficient study light, light a small outdoor shop or light a 10ft x10ft room when placed on a wall hook. Includes 12 LED Lights; One Lamp is 5 times brighter than one kerosene lamp . The expected lifetime LEDs and battery (900 mAh) approximately 50,000 hours. Lighting Hours Runtime high setting: 4.5 hrs, Runtime low setting: 50 hrs. Warranty of 6 months for the lamp and 1 year for the solar panel Charging Time Lamp charges in 5 hours of direct sunlight, 1 hr charge =1 hr light. Wiring Panel Wire: 13 feet. Replacement LEDs and batteries available.



ITEM #	Description	Price
L-FIREFLY12	Firefly 12 LED Desk Light	\$32

MOONGLOW LED LIGHTS



Moonglow LED Lights are handmade in the USA. They are perfect for soft area lighting and, or counter top applications and come in 12 & 24 volt DC. Great for RVs, get away cabins, camping, small spaces, and developing countries where energy conservation is necessary. They are low wattage, decorative, and long lasting using Tennessee bamboo and Pennsylvania grown gourds. Each LED is expected to last for 50,000 hours, or approximately 30 YEARS!

Due to the unique placement of the LEDs, the Gourd Lights produce omnidirectional light. The smaller Bamboo Strip lights are perfect for under counter lighting, and soft area lighting in RV's and directional lighting in hallways. The larger model is approximately 3.5" W x 24" L x 2.5" H and incorporates 30 LED's and uses 2.27 watts DC



(105ma). The smaller models are approximately 3.5" W x 24" L x 2.5" H and use 1.7 watts DC (134ma) for the 10 LED version, and 1.33W (105ma) for the 15 LED version. The 15 & 30 LED Bamboo Strips are available in 12, 24 & 48V, the 10 LED Bamboo Strip is available in 12 and 24V only.

ITEM #	Description		Price
L-LEDGOURD-30	30 LED Gourd Light	\$15	\$124
L-BAMBOO-30	30 LED Bamboo Strip	\$15	\$91
L-BAMBOO-15	15 LED Bamboo Strip	\$15	\$72
L-BAMBOO-10	10 LED Bamboo Strip	\$15	\$66

COMPACT EVERLITE

Multi Purpose Lamp with Eight White LEDs



Solar panel: 6" x 5"
 6.5v 0.25 amp
 Lamp on table stands 6" tall
 1.3 lbs

2 YEAR WARRANTY!

A fully charged Everlite offers 12-18 hours of light. With 6 hours of full sun, our Compact Everlite will deliver another 6 hours of light. Each Compact Everlite includes a lamp with 8 bright, white LEDs; a solar module with 10' cord; and a rechargeable battery base. The replaceable battery is a 3.6v 1.5 ah NiMtHy. The lamp folds flat and slides into a track on the back of the module for travel.

All Night Indoor or Outdoor Light turns on at dusk via a photo sensor; runs all night long; and shuts off at dawn. A convenient night light for any area requiring dusk to dawn illumination. When folded flat the photo sensor switch is deactivated. 50,000 hour LEDs.

Desk or Wall Lamp You can also use the Everlite as a table lamp. Simply unplug the solar module for mobility; flip up the head of the lamp; and let it light your campsite or desk after dark. Doubles as a flashlight!!

ITEM #	Description	Additional Shipping	Price
L-EVERCOMP	Compact 8 LED Light w. PV module	\$10	\$60
OPTIONAL CORDS- recharge the Everlite from a 12V DC or 120V AC Outlet, or charge your cellphone, etc from the Everlite's battery.			
L-EVER-DC	12V DC Charging Cord w/ Cigarette Plug		\$15
L-EVER-AC	120V AC Everlite Charging Cord		\$13
L-EVERCELL	Everlite Cellphone Charging Adapter, 12V Auto Socket		\$17
L-EVERUSB	Connects panel or battery to electronic devices		\$17

"SUPER" BRIGHT 9V PAK-LITE

The Pak-Lite Story: manufactured by the off-grid Henry family of Oregon, the Pak-Lite story began when the Henry's oldest son, Barclay, decided to hike the entire Pacific Crest Trail from Mexico to Canada. Barclay asked his younger brother, Benjamin, to make him a small, lightweight flashlight that would last the whole trip without carrying extra batteries or bulbs. The patented Pak-Lite is the result. Weight: 1.5 oz Length: 2.4".



Each cap has two "Super" Bright White LEDs and a 3 way switch. The sealed switch offers high-off-low modes and a 100,000 time rating. Backwoods offers a black or a white/glow-in-the-dark cap and a **9v ultralife, lithium battery** with each Pak-Lite. On high with the lithium battery, our Pak-Lite will run at full brightness for 80+ hours and 1200 hours on low before it begins to dim. **The lithium battery has a 10 year shelf life.** The Henry's extend a Limited Lifetime warranty, battery is not covered by warranty.



Pak-Lite Accessory Kit



For Hands Free Operation!!



BELT CASE



LANYARD LOOP

Accessory Kit Includes:

Headband holder for up to 3 Pak-Lites

2" x 3" Belt Case

Lanyard Loop

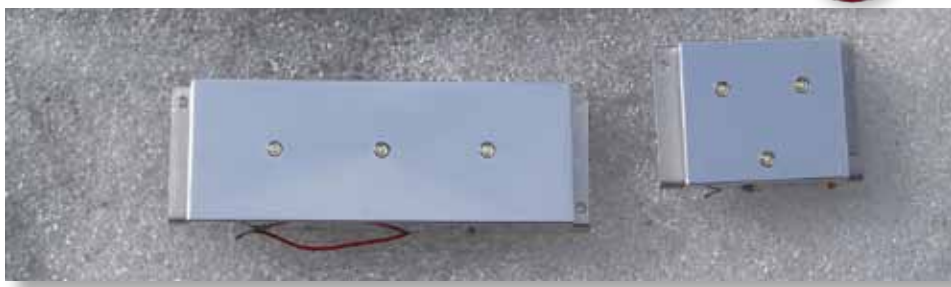
Self adhesive Velcro Strip

Battery Clip for wall or desk

Self adhesive Magnet strip

ITEM #	Description	Price
L-PAKBLACK	Super Bright 9V LED Pak-Lite	\$28
L-PAKWHITE	9V Glow-In-The-Dark Pak-Lite	\$30
L-PAKLITEKIT	Accessory Kit for 9V Pak-Lite	\$12

ULTRA-THIN SUPER BRIGHT 12V DC WHITE LEDS



The Mini Lux, Mighty Lux, and Ultra Lux are the brightest LED Luxeon fixtures we offer. Each polished aluminum fixture is designed for surface mounting and is constant current regulated. The Ultra Lux floods an area with brilliant light and only draws 370 ma and features an on board on/off switch. The Mighty Lux draws 300 ma and has an on board on-off switch. The Mini Lux draws 200 ma but does not have an on board switch. It requires a wall based on-off switch. These LEDS illuminate at an 120 degree angle of dispersion. One Year Warranty.

ITEM #	Description	Price
L-MINILUX	3" x 2" x 5/8", 90 Lmn Fixture	\$30
L-MIGHTYLUX	6" x 2" x 5.8", 150 Lmn Fixture	\$49

UNDER COUNTER LED STRIPS

18 LED's in a 3" circuit board strip, 1-2 watts each depending on battery voltage. Plugs daisy-chain together to build your own fixture or under-counter strips. This LED does not have a constant current regulator. Draws 140 ma @ 13.6v. 55 lumens.



ITEM #	Description	Price
L-LED18STRIP	LED Counter Strips	\$35



WHITE 12 VOLT DC LED's

Power Draw: Only 1/2 to 2 1/2 Watts!

Zero flicker. Zero radio noise. Longest life:10,000-50,000 hours. Mechanically rugged. Low temperature operation to - 40° F. Power so low you could leave one on 24 hours a day. The 6, 12, and Luxeons have constant current drivers and are made in the USA. One year warranty. Light is emitted upward from base like a flashlight, so these can screw into an outdoor floodlight fixture to make directional porch lights. Or in standard table lamp for night light spot on ceiling. The Luxeon is enough to read by in a fixture aimed close at the book. Color quality is moonlight white. Sockets should not get wet. 2.5”h x 2”w.



ITEM #	Description	Price
L-LED-6	Six LED's, 50ma draw, standard screw base, 18 lmns	\$16
L-LED-12	12 LED's, 100 ma draw, standard screw base, 36 lmns	\$28
L-LED-MR16	Bright 20 LED's with 2 pin base (not pictured)	\$15

The MR16 fits garden lights and some track light strips. 160 ma at 13.5V, 60 lmns. This LED does not have a constant current regulator so it should not be subjected to 14+ volts if possible.

LED LUXEON with 3 LED'S - Wider 120 degree dispersion. LUXEON LED'S deliver 30 lumens per LED. 10x more than the other LED's on this page. This fixture screws into any medium Edison base and offers the best general area lighting of the LED's on this page. Standard Luxeon is 90 lumens with a 200 ma draw.



ITEM #	Description	Price
L-LEDLUX	3 LED Luxeon	\$38

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW!

LED UNDER COUNTER LIGHTS



Introducing a beautiful white LED light for 12, 24, and 48 volt DC applications. 3.5" diameter anodized aluminum with frosted acrylic diffuser looks great in home and industrial applications alike. Perfect for under counter lighting, but also great for task and room lighting.

Integrated high efficiency driver with soft start and dimming capability. Pluggable power connectors allow for quick and easy wiring of multiple units. Output is approximately equal to a 30 watt incandescent bulb. (Results may vary.)

SPECIFICATIONS

Power: 5 watts
 Color: Warm white
 Luminosity: 250 lumens
 Viewing angle: 120 degrees
 Dimensions: Mounts in 3" hole, 2½" deep
 Weight: 7 ounces
 Input voltage: 6 to 60 volts DC
 Temperature range: -40°F to 200°F



ITEM #	Description	Shipping	Price
L-LED-RECESS	5 Watt Undercounter Light	\$10	\$80



Minimum shipping \$10 per whole order covers all items with no shipping listed

NIGHT WATCHMAN 12 VOLT DC PHOTOSWITCH

The Night Watchman Dusk to Dawn Controller will turn incandescent, halogen, or fluorescent lights ON in the evening within one half hour of sunset and OFF in the morning within one half hour of sunrise.

The waterproof Night Watchman is constructed is designed to be mounted outdoors and in a salty marine air environment.

Because power consumption is always a concern on battery powered systems, the Night Watchman is designed to use an extremely small amount of power in standby mode (0.15 mA). It consumes only 16 mA when on and it can handle up to 10 amps of 12V DC load current and a momentary surge of 600 watts.

Installation is simple with only three wires and an LED located beneath the Watchman's lantern indicates if the load is on. It is completely waterproof and measures 1" x 1" x 1" for surface mounting in an inconspicuous location. Made in USA. Two Year Warranty.



ITEM #	Description	Price
L-NITWATCH	12V DC Photoswitch	\$40

AC OR DC LIGHT SWITCH TIMER WHO KEEPS LEAVING THAT LIGHT ON?

TIMER SWITCH fits in standard wall switch box. A twist winds it up, then it clicks off when time expires. Perfect for children's room, closet, basement, outdoor sheds, garage and porch lights.



Only rated for AC up to 15 amps but it also works with DC up to 4 amps max. However, the switch is not DC rated.

ITEM #	Description	Price
O-TIMESWT15	Up to 15 minutes, wind up	\$28
O-TIMESWT30	Up to 30 minutes, wind up	\$28
O-TIMESWT60	Up to 60 minutes, wind up	\$28

Minimum shipping \$10 per whole order covers all items with no shipping listed

COMPACT FLUORESCENTS

12 or 24 Volt DC Ballast In Screw-Base



BULB with BALLAST in SCREW BASE, all one piece, makes an easy 12 or 24 volt DC compact fluorescent. These lights screw into the standard full size light socket of a table lamp, ceiling fixture, etc which gets connected to 12 or 24 volt DC. Just screw this in to replace 12 or 24 volt halogen or 12 or 24 volt energy gobbling incandescent bulbs. The life span of the lamp is more than 8,000 hours. The new version of CFL lamps is now regulated by a DC-preheating circuit which makes an extremely high number of switching cycles possible (IEC925). You can use the original switch on a lamp, or connect through a wall switch. These bulbs must stay on for 20 minutes whenever used to properly heat up and please, due to start up surge, only one light per switched circuit for longest life. (Socket must be wired correctly with + to tip.) Tested in minus 50 to 100 degrees F. One year warranty.

These compact fluorescent bulbs, like the AC powered models, give four times the brightness of a regular bulb of the same wattage. Proven to be very reliable. 7 watt uses about 1/2 amp. 11 watt uses just under 1 amp. The 18 watt is just over one amp, and 23 watt is just under 2 amps.

Choice of light color: available in a warm yellow(2700K) or cool white fuller spectrum(4100K) in all sizes. Minimum wire size: 10 gauge CU.

ITEM #	Description	Price
Specify cool (C) or warm (W) when ordering		
L-CF7 (C or W)	7 Watt, total length is 5 1/2", 350 lumens, 12V	\$11
L-CF15 (C or W)	15 Watt (Spiral), total length is 6", 925lumens, 12V	\$14
L-CF15 (C or W)	15 Watt (Sprial), total length is 6", 925 lumens, 24V	\$21
L-CF30 (C or W)	30 Watt, total length is 8", 1500 lumens, 12v	\$27

Minimum shipping \$10 per whole order covers all items with no shipping listed

12 VOLT DC FIXTURES

Compact Fluorescent Reflector Lamp



***A Bright light for serious work
Indoor/Outdoor***

Fixture is 9 inches wide, 4 inches high, about 6 inches out from wall depending on aim adjustment. Red wire is (+); Blue wire is (-). Minimum wire size: 10 gauge copper. One Fixture per switch.

Great for reading or work light. Mount over bed, above kitchen counter, or on the wall above your desk. Swivels and locks to any tilt with 180 degree adjustment. Includes bulb and ballast and a rectangular cover plate to mount the fixture on a standard electrical outlet box in a wall or ceiling.

These quality fixtures have SE13 watt 4 pin compact fluorescent bulbs and 12 volt DC ballasts using only one ampere of 12 volt DC. Cool spectrum light, no flicker. Weatherproof for outdoor use. One year warranty.

A customer reports that five of these fixtures adequately illuminate a 10' by 40' sign in the Nevada desert. 24V available by special order.

ITEM #	Description	Additional Shipping	Price
L-ELF	Specify WHITE, BLACK or GREEN	\$10	\$56

12 VOLT DC CF THIN LITE

Strong extruded aluminum wall or ceiling fixture. Compact size for under a counter, RV or computer work station. A good reading or bed light, with warm color 13 watt 4 pin SE compact bulb and electronic ballast included. On-off switch built in. Size: 9" x 4 1/2" x 1 1/2". Two year warranty.



ITEM #	Description	Price
L-949	13 Watt Compact Fluorescent Wall Fixture	\$44

12 VOLT DC GLOBE CEILING LIGHT

Round, frosted white, 6" glass globe for general area ceiling light. Includes TE-13 watt 4-pin cool white bulb and electronic ballast mounted in metal base with polished brass finish. Globe can be replaced with any 3.25" antique globe. One light per switch; minimum 10 gauge copper wire. One year warranty.



ITEM #	Description	Price
L-GLOBE-6	12V Globe Ceiling Fixture	\$56

MUSHROOM FIXTURE



Low profile mushroom shaped lens is made from high impact white acrylic. Energy efficient ceiling light for bath, kitchen, hallway. With electronic ballast and 4 pin warm yellow 13 watt compact light, or dual lights for 26 watt total. One circuit per switch; minimum 10 gauge CU. One year warranty.

ITEM #	Description	Additional Shipping	Price
L-1035M	12V Mushroom Light- Single SE 13W bulb	\$10	\$55
L-1040M	12V Mushroom Light- Two SE 13W bulbs	\$10	\$68

REPLACEMENT PARTS

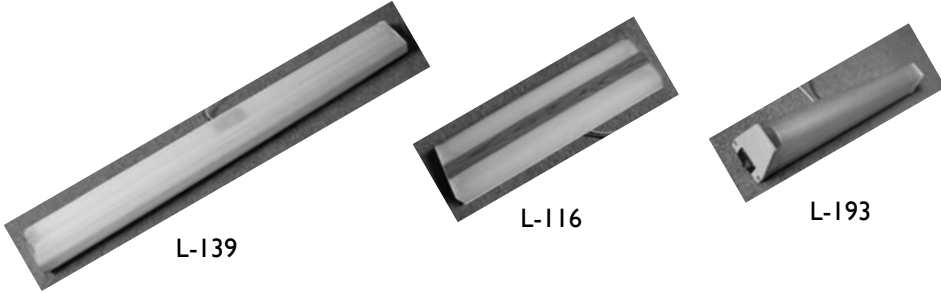
for 12 VOLT 4 PIN COMPACT FLUORESCENTS

ITEM #	Description	Price
L-SE13 (W or C)	13 Watt, 6.25" single loop, 4-pin bulb	\$9
L-TE13 (W or C)	13 Watt, 4" triple loop, 4-pin bulb	\$9
L-TE18 (W or C)	18 Watt, 4.5" triple loop, 4-pin bulb	\$9
L-SH12-13	SE/DE Electronic Ballast, 4-pin/13W bulbs	\$22

The L-SH12-13 is a hard wired ballast, it does not screw into a base

DC FLUORESCENT FIXTURES

Covered Straight Tube Fixtures With Switches



12 VOLT DC STRAIGHT TUBE FLUORESCENT FIXTURES are nearly as efficient as the compact fluorescents though quality of light is lower. These special fixtures use standard AC fluorescent tubes but contain a 12 volt DC electronic ballast. The high frequency ballast gives light without flicker but does interfere with AM radio and weak TV reception. These three models have radio noise filters. Warranty is two years on fixtures, not tubes. TUBES ARE INCLUDED.

These are surface mount fixtures with enclosed bulbs and a built-in on-off switch. Regular wall switches can be used to control these lights as well. Constructed of all aluminum with white plastic diffuser cover.

ITEM #	Description	Additional Shipping	Price
L-139	32W with one 48" F32TB/CW Tube: 2850 lumens	\$10	\$56
L-116	30W with two 18" F15T8/CW tubes: 1740 lumens	\$10	\$42
L-193	15W with one 18" F15T8/CW tube: 870 lumens	\$10	\$36

12V DC CIRCULAR FIXTURE



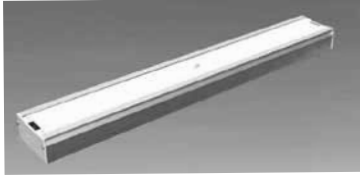
22 Watts, 1.6 amps. On-off switch in center, or use a wall switch instead. Includes one FC8T9 tube and electronic ballast. Replacement tubes are locally available but cost is twice that of straight tubes. 1100 Lumens. 2 year warranty.

ITEM #	Description	Additional Shipping	Price
L-109	12V Circular 22W fixture	\$10	\$42

Minimum shipping \$10 per whole order covers all items with no shipping listed

DC FLUORESCENT FIXTURES

Bare Straight Tube Fixtures



Anodized aluminum housing with 12 volt electronic ballast. No switch. These fixtures should connect to a standard wall switch. Ballast converts 12 volts DC to high voltage to use ordinary fluorescent tubes available anywhere. Includes AM radio interference reduction option. Two year ballast only warranty.

ITEM #	Description	Additional Shipping	Price
20 WATT FIXTURE: Uses 1.6 Amps. 24" long and produces 1250 lumens. Uses F20T12/CW tube			
L-151X	Without Tube, safer for shipping, tubes available locally	\$10	\$45
32 WATT FIXTURE: Uses 2.7 Amps. 48" long and produces 3150 lumens. New F-32T8 tube replaces less efficient F-40T8 tube			
L-153X	Without Tube, buy F-32T8 tubes locally	\$10	\$45

22 WATT CIRCULAR SCREW-IN

8 inch FC8T9 bulb attaches to an adapter containing a 12 volt electronic ballast. It all screws into the regular bulb socket of a table lamp or any bulb socket where there is 8" diameter clearance. Under 2 amperes. 2 year warranty.



ITEM #	Description	Additional Shipping	Price
L-108	Screw ballast & circular bulb	\$10	\$40
L-108/9BULB	Replacement 22W circular bulb only		\$9

Minimum shipping \$10 per whole order covers all items with no shipping listed

12 VOLT DC MOTION SENSING LIGHT SWITCH WITH TIMER



RAB motion and heat sensing switch is 12 volt DC powered so it works full time even if your inverter is in standby or off. Turns lights on at approach, and holds for adjustable time, 5 seconds to 12 minutes after motion stops. Sensitivity distance is adjustable, up to about 50 feet out, farther in colder weather. 70' wide

zone. Connect directly to any 12 volt light, or use a 12 volt relay to switch 120 volt lights. Set for night only operation, or use as security alarm, by setting for day/night operation. Switches 8 amps DC; uses only 7 milliamp at idle and 40 milliamps when active. Simple 3 wire hookup. Blue is (-); Brown is battery (+); and Black is load (+). **Caution: Do not use with DC Compact Fluorescents.**

Excellent Quality & Performance. 10 YEAR WARRANTY.

ITEM #	Description	Price
L-RAB	12V DC Motion Sensing Light	\$98

SMALL GOOSENECK LAMP

For 12 Volt DC power

LITTLE LITE HIGH INTENSITY LAMP is a high quality 12 volt DC, 18" flexible gooseneck with a 1' cord. Best for lighting a small area for computer work, or reading in bed. Flashlight size 5 watt (1/2 amp) halogen bulb has life of 240 hours at full intensity, greatly extended when lamp is slightly dimmed. All metal construction. Screws down to table or wall, or use the weighted base to make a movable table lamp.

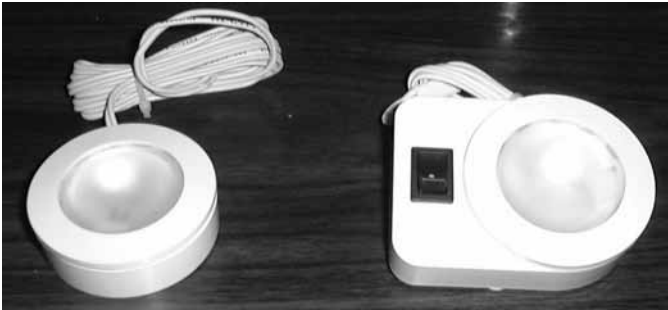


NEW LED model has 5-LED board, 3 white and 2 red for warm color, good for 5000 hours of light at 1/10 amp current. 2 Year Warranty.

ITEM #	Description	Price
L-LITTLELITE	Traditional model with halogen bulb	\$40
L-LITTLELED	5 Led 12v gooseneck lamp, 18"	\$64
L-LITTLEBASE	Weighted portable metal base	\$20
L-GOOSE-5	Replacement 5W halogen bulb (not for LED version)	\$7
L-1815BULB	1/4 Amp plain bulb for traditional Little Lite	\$1

Minimum shipping \$10 per whole order covers all items with no shipping listed

TINY HIGH INTENSITY HALOGEN 12 Volt DC Reading Lights



**COMPLETE
REFLECTOR FIXTURE
WITH BULB & WIRE**

Tiny, but very bright, these lamps make a surprisingly good reading light. Mount flat on back surface, hidden wood screws included. 20 watt halogen bulb and reflector with 5' of cord. Good under-cabinet kitchen light, or closet & stairs. Great in RVs because it is only one inch thick.

ITEM #	Description	Price
L-ES3	"D" shape with switch light fixture	\$38
L-ES1	2 1/2" round light fixture	\$18

12 AND 24V DC QUARTZ HALOGEN BULBS



Quartz halogen bulb within a glass tube. Each bulb screws into any standard lamp. These bulbs stay brighter and whiter than ordinary bulbs because filament deposits do not darken the hot quartz glass. They use far more energy than compact fluorescent bulbs but less than plain incandescent bulbs. For less used locations and outdoor lights. 3.25" long x 1.25" diameter.

ITEM #	Description	Price
L-Q20	12V, 20 Watts, under 2 Amps	\$11
L-Q35	12V, 35 Watts, 3 Amps	\$11
L-Q50	12V, 50 Watts, 4 Amps	\$11
L-Q35-24	24V, 35 Watts (other wattages not available)	\$16

Minimum shipping \$10 per whole order covers all items with no shipping listed

PLAIN 12 VOLT BULBS



Low cost but not efficient use of power. Used in seldom lit areas in closets or woodshed. Operate direct from 12 volt DC. Two of these may be wired in series for 24 volt, easier to obtain than 24 volt screw in bulbs.

ITEM #	Description	Price
L-25W	12V, 25 Watts, 2 Amp plain screw in bulb	\$4
L-50W	12V, 50 Watts, 4 Amp plain screw in bulb	\$4

TINY 12 AND 24 VOLT BULBS

3/8" Incandescent Bulb With Wire Leads

NIGHTLIGHT uses low power, low cost for low light. Just 0.2 ampere. Makes five night lights.

-OR-

BUILD A RECHARGER for small ni-cad batteries or cordless appliances from 12 volt power. These same lights limit charge current from house battery to flashlight/radio batteries. With instructions for charging AA thru D cells.



ITEM #	Description	Price
L-5TINY-12V	12V, 70 mA lights with leads	\$8
L-5TINY-24V	24V, 140 mA lights with leads	\$6

Backwoods Solar welcomes all new product idea suggestions. Many of the products you find in our catalog are only here as a result of our customers telling us about a product they've discovered that they think we should offer. Please let us know if you have an idea for a new product.

WATER SYSTEMS

A GRAVITY FLOW TANK, where possible, is the best domestic supply. Water is pumped to, and flows back from, a large tank uphill from the house. The tank should be at least 22 feet higher than the point of use, to get 10 pounds or more water pressure (2.3 feet elevation per pound of pressure). It should be buried to keep cool and avoid freezing. At the Willey's home there was no hill above them to site a tank so they put four 100 gallon tanks at the highest heated level (4th floor) of their tall home. Pressure is only 7 pounds at their 2nd-floor kitchen, but with 3/4" and larger pipes, and no small restrictive couplings to the faucets they get good flow and fine showers on 1st and 2nd floors. NOTE: Instant (tankless) gas water heaters require at least 15 to 30 pounds of pressure to operate properly.

A PRESSURE TANK stores pressurized water without an uphill or elevated tank. A pump pushes water into the tank, and that compresses captive air in the tank. The air provides continuous pressure for water delivery. The pump recharges water to the tank as needed. Since pressure tanks are small, they need refilling often. An inverter-powered, 120 volt AC deep well pump or DC powered surface pump can refill the tank as frequently as needed. Pressure tanks in sizes from 20 to over 80 gallons are sold at hardware and plumbing stores. A larger pressure tank reduces the on-off cycling of your pressurizing pump. Larger is better!

LARGER WATER STORAGE What if your AC pump must be high powered and perhaps 240 volt so it can run only on generator power? A larger water storage tank is needed so you start the generator only once a day or once a week to refill it, rather than starting it each time water is used. Large volume water storage, when no uphill tank is possible, can be done two ways:

1. Use several pressure tanks, enough for a day's water from one fill; or

2. Use a large buried tank near the house (or on a tower in non-freezing climates). This tank is filled by the well pump once a week or less, often using either a slow DC or fast AC pump. A second DC powered pump uses this tank to refill a small pressure tank in the house as often as needed as you consume water. This eliminates starting an AC pump often, or waiting for a slower DC submersible well pump to refill the pressure tank.

NOTE: DC Diaphragm pumps should never push water directly to your faucet without a pressure storage tank. It works, but more energy is used, and the pump and switch wear out quickly. Our EZ-SET-UP kit includes instructions for both plumbing and electrical connections for DC pumps with pressure tanks.

WATER PUMP SELECTION

Depth of your well or water source determines the type of pump.

SHALLOW WELL, spring, creek, or storage tank where water surface is within 10' of ground level, can use the Flowlight DC or Shurflo AC or DC powered booster pumps located at the surface to suck the water up to the pump, and then push it as much as 100' higher than the source and great horizontal distances. These pumps can pressurize a tank in your house for better delivery of water to fixtures. Each rated pound of pressurizing ability equals 2.3 feet vertical lift. Surface pumps must be protected from freezing. They can often be a hassle to keep primed.

DEEP WELLS 15 feet or more down to the water level cannot have the water sucked from the top of the well. Suction can lift water only about 15-20 feet. For deeper distance to water, a submersible pump must PUSH the water up.

DC POWERED submersible deep well pumps may be the best choice because they do not require large bursts of power or use the inverter at all. DC submersible pumps use only 20% as much energy per gallon pumped as an AC centrifugal pump. Most pump very slowly so do not deplete the water level in a slow recovery well. They can be powered direct by solar modules, without batteries. Or they can be powered by house batteries like any DC appliance, if the well is within about 200 feet distance from the house. The submersible pump will not freeze or lose its prime.

AC POWERED centrifugal pumps are faster and last many years with no repairs. But they use 4 to 8 times more power per gallon pumped than slow DC pumps. AC pumps use much of the full capacity of the inverter, and come on at unpredictable times. Pumping and running a washer at the same time may require a relay to pause the washer and give the pump priority when it runs. A submersible deep well pump with a 1/2 horsepower, 120 volt AC motor can pump a 300 foot well and be powered by a 2500 watt or larger inverter. If you use an AC pump with external start box, get 120 volt AC, 1/2 horsepower maximum. The start box must be relay start control, not solid state control, if used with a modified wave inverter. Solid state start works ok with true sine wave inverters. No-surge pumps are best, if depth to water in the well is within their range.

VERY DEEP WELLS with a water level down the hole more than 230' need a higher power pump. New Grundfos SQFlex submersible pumps lift up to 820'. Or a 240 volt AC pump might be used to fill a large tank once a week operating on generator power, or a large inverter and transformer, or two large inverters.

WATER PUMP SELECTION

Backwoods Solar designs and sells hundreds of deep well submersible pumping systems each year and with every system, we ask the same questions. In order to properly satisfy your water pumping needs, we need the following information from you:

- 1) How deep is your well or alternative water source
- 2) What is the static water level in the well (the static level is that height in the well to which the water rises under it's own pressure)
- 3) How many gallons per minute does your well produce
- 4) How many gallons per day do you need
- 5) Will you pump to a non-pressurized holding tank or to a pressure tank
- 6) In either situation, how many feet above the well head is the tank located
- 7) If a pressure tank is used, how many pounds of pressure will you ask the pump to create
- 8) Will you power the pump directly from a PV array which implies you only get water when the sun shines or
- 9) Will the pump be powered by a battery bank either DC direct or with AC from an inverter
- 10) If PV direct, how many feet from the array to the well head
- 11) If battery based, how many feet from the battery system to the well head

Given this information, we can quickly and successfully build an appropriate water delivery system for you. For those of you developing a well, or a spring, or other submersible situation, take a moment to answer the above questions; and then give us a call. We'll happily walk you through the details!



Joe and Sally Smith's home

GRUNDFOS SQ FLEX SUBMERSIBLE

This is the ultimate submersible pump for water lifts of up to 820 feet. They can be directly powered by solar or run on an inverter, a generator, a battery, the utility grid, or any combination of these sources. 30-300v DC and 90-240v AC can be used to run these pumps. (max draw: 8.4 amps). These pumps will operate at 230V, 50 Hz.

Eleven pump models can deliver from 4.5 GPM at 820 feet to 80 GPM at 10 feet of head with a 1.4 kilowatt solar array or less. Helical rotor pumps for high head applications will fit in a 3" or larger well and centrifugal pumps for low head applications fit in a 4" or larger well. The SQ Flex has built-in protection from dry-running, overload and overheating. PLEASE request spec sheets.

The SQ Flex pump can run on a solar array starting at 129 watts and 30 volts however 120 volts required for full output at any given array wattage. 2 wire + ground connections with no AC or DC polarity issues. 24 month warranty.

Optional Controls

The CU200 interface box communicates with the pump and monitors operating conditions. 5 watts. Built-in diagnostics indicate faults and dry-run conditions as well as a display of operating status and power consumption. Input terminals for Reverse logic float level switch. On board on/off switch.

The IO100 is a simple control box with cable terminations and a manual on/off switch. It is a great interface between a solar array and the pump to allow you to turn off the high voltage array when working on the pump.

The IO101 is an interface for using AC backup or a solar array. A 120v AC automatic transfer switch disconnects the solar array when AC power from a generator, utility connection, or inverter is present. When AC power stops, it automatically reconnects the array. Has on-off switch.



ITEM	Description	Additional Shipping	Price
P-SQFLEX	Grundfos SQ Flex Pump & Kit	\$24	\$2,325
P-IO50	SQFlex/PV On-Off Control Box		\$74
P-IO100	SQFlex AC/PV On-Off Control Box (previous model)		\$70
P-IO101	SQFlex AC/PV Interface Box		\$456
P-CU200	SQFlex Multi Purpose Interface		\$392
P-PS-SQO-REV	Reverse logic pressure switch for use with CU-200		\$105
P-SQWAR-LA	Extended 5 year warranty with LA302AC Lightning Arrestor (required)		\$195

Minimum shipping \$10 per whole order covers all items with no shipping listed

GRUNDFOS SQ PUMP

120V AC Submersible Well Pump No Start Surge

Deep well up to 260 feet depth to water



31.5"-39"
long

The SQ Grundfos pumps have a SOFT-START electronic control built into the motor. Start-up is slow and gentle over 2 seconds, requiring NO POWER SURGE. This pump runs from much smaller generators or modified sinewave inverters, and can have longer wire to the pump. Soft start also eliminates start-up twisting strain on plastic pipe. 24 month warranty.

Dry-run protection and over/under voltage protection are built in. Two-wire plus ground operation, no control box required. The pump body is smaller 2.68 inch diameter so it fits down a 3" or larger well pipe. It can operate in any position from horizontal to vertical and can pump from a storage tank.

Total lift of any pump is height between water surface down the well to the elevation where water is delivered to a non-pressurized tank. Reduce maximum lift by 92', if the pump is used to pressurize a bladder tank to 40 pounds.

5S models have 1" discharge port; 10S & 15S models have 1.25" port. Ask for a complete performance chart to aid in selection. Does not tolerate sandy water, voids warranty.

ITEM #	HP & Amp Draw	GPM at Feet of Lift	Additional Shipping	Price
P-5SQ05A180	1/2, 9.8A	5 at 180'	\$18	\$720
MAX CAPABILITY OF ABOVE		1.1 at 260'		
P-10SQ05A160	1/2, 9.8A	10 at 160"	\$18	\$720
MAX CAPABILITY OF ABOVE		5 at 200'		
P-15SQ05A110	1/2, 9.8A	15 at 110'	\$18	\$720
MAX CAPABILITY OF ABOVE		7.5 at 160'		
P-GFWAR-LA	Extended 5 year warranty with LA302AC Lightning Arrestor (required)			\$85

DC SUBMERSIBLE DEEP WELL SHURFLO 9300 PUMP

12/24 Volt DC Solar or Battery Powered
Fits a 4"(or larger) well casing.



Install and remove by hand using 1/2" (3/4" max) hose or plastic pipe, rope, and **our 2 conductor flat jacketed 10 gauge wire**. All diaphragm pumps have a higher maintenance than AC centrifugal pumps. Backwoods Solar used one on 12 volt battery power to lift water 150 feet out of a 4 inch well, and it lasted 8 years in domestic water service.

Uses 25 to 100 watts Made for 24 volts. 12 volts runs it at half speed and half water delivery but still full lifting depth. At 120 feet lift, current measures 3.4 amps from 24 volt battery or 2.9 amps from a 12 volt battery. One or two 85 watt solar modules can run it directly. Add a Linear Current Booster to increase hours of solar operation. 3000 hour brush life.

230 feet maximum lift from water surface in well to open tank. Can slowly fill a pressure tank (not recommended). Deduct 2.3' of lift for each pound of pressure required. Maximum submergence 100 feet below water. Slow pumping doesn't draw well down. Safety valve protects pump if line freezes. To double pump speed from a 12 volt battery, add our Constant Voltage driver. 3.75" diameter x 12" tall, 6 lbs. Warranty one year.

MODEL	Max Lift	Delivery @ 230 feet lift		Additional Shipping	Price
		12 volt	24 volt		
P-9300	230 feet	36 gal/hour 3.9 amps	82gal/hour 4.1 amps	\$12	\$745

Accessories and Replacement Parts

ITEM	Description	Additional Shipping	Price
P-SFWIRE	Flat jacketed 10 gauge 2-conductor wire seals water tight to plug on pump. Order enough to get to an above water splice, or to wellhead.		\$1.30/ft.
P-HOSE250	250' 1/2" drinking quality hose (also available by the foot for \$1 per foot)	\$22	\$195
P-9300REBUILD	Lower housing replacement, diaphragm & bearing		\$72
P-9300VALVES	Replacement Valve Kit		\$30
P-9300MOTOR	Replacement Motor Kit		\$169
P-9300BRUSH	Replacement Brushes		\$40
P-9300PLUG	Replacement wiring terminals/boots		\$90

Minimum shipping \$10 per whole order covers all items with no shipping listed

SOLAR SLOWPUMP

Slowpump is not submersible, but can draw water from shallow wells, springs, cisterns, tanks, ponds, rivers and streams, and push it as high as 450 vertical feet and through miles (kilometers) of pipeline. Slow pumping minimizes the size and cost of the solar array, wire and piping. Slowpump is less expensive than submersible DC pumps, and made in a much wider range of sizes. Wearing parts typically last 5 to 10 years. Overall life expectancy is 15 to 20 years. Dimensions: 5.7 x 15.5", weight 16 lbs. Warranty 1 year against defects in materials and workmanship.



Suction Capacity

20 vertical feet (6 m) at sea level – subtract 1 ft.. for every 1,000 ft. altitude (1 m for every 1,000 m). Pump should be placed as low as possible and gravity fed water is best.

Filtration Requirement

This pump cannot tolerate dirt. Water must be filtered clear. If water is very dirty, improve the source.

PV-Direct (non-battery) Requirements

The rated power of the PV array must exceed pump watts by 20% or more. Our table specifies actual PV watts needed. Performance specs in our table are at 15 and 30V DC. It's okay to power by a battery bank, but performance will be 20% less than our table specifies.

A linear current booster (controller) is required to start and run in low light.

Fittings

1300 Series: 1/2" female; 2500 Series: 3/4" male

Nominal operating voltage of 12 or 24 V, please specify when ordering

ITEM #	Lift (ft)	GPM	PV Watts	Max Lift (ft)	GPM	PV Watts	Additional Shipping	Price
P-1322	20	.51	27	440	.39	168	\$28	\$620
P-1308	20	1.25	30	400	1.0	198	\$28	\$620
P-1303	20	2.5	48	240	2.15	204	\$28	\$620
P-2507	20	4.0	57	140	3.65	195	\$28	\$650
ACCESSORIES								
P-FLOWFLTRKIT		10" Inline Filter with Cartridge					\$10	\$60
P-10FILTERS		Quantity 2, 10" Filters						\$14
P-DRSWITCH		Works with 2500 series						\$75
P-DRSWITCH-1300		For 1300 & 1400 series						\$70

Minimum shipping \$10 per whole order covers all items with no shipping listed

FLOWLIGHT BOOSTER PUMP

Shown with EZ Flow Kit and Filter
Pump: 16" x 5"; 15 lb

1 year warranty



This rotary vane pressure pump uses one third to one half the energy of a conventional AC pump, and eliminates the high starting surges that push inverters to the limit. The Standard Flowlight Model 2920 is available in 12, 24 or 48V and the 2920-AC is 120V AC. There is an additional 2930-48V unit available. Max suction: 10'. The Low Speed Flowlight Model 2910 is available in 12, 24, & 48V DC only. Max suction: 20.' (Suction decreases 1'/1000' of elevation on both models).

These 16.5" pumps are more powerful and much more durable than the less expensive Shurflo diaphragm pumps. Wearing parts are replaceable, and typically last 5 to 10 years. Overall life expectancy is 15 to 20 years. This pump is the best choice for pressurizing a full-time off-grid residence. A large pressure tank, locally available, must be used. If possible, avoid sucking water & do not let this pump run dry!

The Standard model can generate a maximum of 4.5 gpm while the Low Speed model will deliver up to 3.4 gpm. Each model can produce 65 psi if needed with maximum power draws of 170-260 watts.

The Easy Installation Kit and Inline Filter are considered essential equipment and will make this pump simple for anyone to install and service. The Installation Kit includes pressure switch, pressure gauge, check valve, drain valve, T fitting, shut-off valve and pipe nipples. Due to noise, Backwoods recommends installing in outdoor pump house.

ITEM	Description	Additional Shipping	Price
P-2910	Specify 12, 24, or 48V DC	\$28	\$670
P-2920	Specify 12, 24, or 48V DC	\$28	\$686
P-2920-AC	120V AC	\$28	\$872
P-2930-48V	48V DC	\$28	\$1,146
P-EZFLOWKIT	EZ Flow Kit	\$10	\$115
P-FLOWFLTRKIT	10" Inline Filter with Cartridge	\$10	\$60
P-10FILTERS	Quantity 2, 10" Filters		\$14
P-DRSWITCH	Dry Run Switch		\$75

Minimum shipping \$10 per whole order covers all items with no shipping listed

SHURFLO PRESSURE PUMP

**24V totally sealed shown
(120VAC and 12V not shown)**

**12" +/- LONG DEPENDING ON
MODEL**



Pumps and primes from a shallow well, creek, or tank where the pump is less than 12 feet above the water's surface.

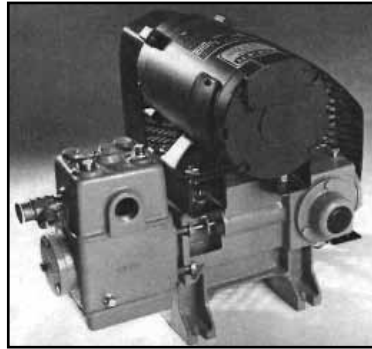
SHURFLO 2088 pumps: Can deliver 3 gallons per minute at 10 psi(23' of lift); 2.3 gallons per minute at 30 psi(66' of lift); and 2 gpm at its maximum 45 psi (about 100' of lift). Depending on operating pressure, the 12 volt pump uses 3 to 10 amps and the 24 volt pump uses 1.5 to 7 amps. 120 Volt AC model is lighter duty; can run from long wires; and be powered by a 400 watt inverter. 170 degrees F max. Cut-in psi: 25; cut-out psi: 45 These models outperform lower quality models sold for RV use.

Shurflo 2088s are the easiest small pumps to rebuild. Can run dry without harm. This 3-piston, rubber diaphragm pump has a built-in pressure switch, or use our better pressure switch on the pump accessories page. We include 1/2 inch hose barb fittings and hose clamps to connect pump inlet and outlet hoses, plus an in-line washable screen filter for the inlet hose. Bulk 1/2" hose in our Accessories pages. **One year warranty.**

ITEM	Description	Additional Shipping	Price
P-SF12	Shurflo 2088 12V DC pump, filter, fittings	\$14	\$175
P-SF24	Shurflo 2088 24V DC sealed pump, filter, fittings	\$14	\$210
P-SFAC	Shurflo 2088 120V AC deluxe pump, filter, fittings	\$14	\$150
EASY SET-UP KIT of hose, clamps, and water system diagrams; as well as Pressure Tanks and Pressure Switch , see ACCESSORIES page 169 & 170			
REPAIR PARTS FOR SHURFLO			
P-VALVE-SF	Replacement Valves		\$20
P-REBLD-SF	Shurflo 2088 diaphragm and wobble bearing		\$28
P-FILTER-SF	Replacement Filter, fits in-line with 1/2" intake hose		\$24
P-SFDCBRUSH	Shurflo 2088 replacement motor brushes- DC, 12V only		\$36
P-SFHEAD	Replacement pump head/includes pressure switch		\$35

SOLAR FORCE LONG LIFE PISTON PUMP

Pumps more water with less power. Out lasts 10 small diaphragm pumps. Tolerates dirty water. Life expectancy is 20 years with 2-6 year owner performed maintenance schedule. Cast iron body, brass cylinder and valve seats, oil bath crankcase, and pressure relief valve.



Lifts water from shallow wells. Foot valve is required for suction lift. Maximum 22 feet suction, and push to 230 feet (100 psi) or to standard pressure tank.

Critical minimum inlet size: 1.25"; outlet 1" female NPT.

Permanent magnet DC motor models available for battery or direct solar power. 12, 24, 48, or 90 volt DC, or 120 or 240 volt AC. Use battery models for home system. Use solar direct with panels and with 15 amp LCB for pumping with no home battery system nearby.

Dimensions are 23" x 13" x 16" Two year warranty.

REPLACEMENT PARTS ARE AVAILABLE ON ALL MODELS

SPECIFY MOTOR VOLTAGE and whether for battery or solar direct operation. 3020 & 3040 available 12, 24, 48 volt DC, or 120 AC, or direct solar.

ITEM	Description	Additional Shipping	Price
P-3020	Solar Force: 5 GPM, 100 PSI, 1/2 HP	\$95	\$1,899
P-3040	Solar Force: 9 GPM, 60 PSI, 1/2 HP	\$95	\$1,949
P-HDPRSWITCH	Heavy Duty Pressure Switch for 3020& 3040		\$95
UPGRADE	for PV Direct or 120V AC Models ADD		\$250
LINEAR CURRENT BOOSTERS ARE REQUIRED FOR SOLAR ARRAY DIRECT MODELS			
P-LCB-15	12/24V/15A, Linear Current Booster		\$230
P-LCB-30	12/24V/30A, Linear Current Booster	\$35 USPS only	\$410
P-LCB-48	48/10A Linear Current Booster	\$35 USPS only	\$270
P-FOOTVALVE	1.25" valve, required for suction lift		\$54

HOT WATER CIRCULATING

**IVAN LABS
"EL-SID"**



**MARCH
PUMP**



Low power, low pressure pumps circulate liquid in closed loop heating pipes. Hot water from solar water panel, wood stove or propane water heaters can be used to heat floors, or to heat radiators, even circulate under a water bed or compost toilet. 1/2" male threaded fittings. These pumps do not have check valves.

Use several small pumps, one for each zone, rather than zone valves and a bigger pump. DC circulating pumps use much less power than AC pumps, just 18 to 50 watts. These can be powered from batteries, or direct from a solar module. Remember, a closed loop system with no air pockets is balanced and has no head requirement for the pump except pipe friction. Easy open check valve advised.

March pumps are centrifugal low pressure, no valves or diaphragm to wear out. Water contact parts are brass. No shaft coupling or seal to leak because magnets couple the motor to impeller through the brass plate. Fluids can be as hot as 250 degrees F. Brush manufacturer claims motor brushes last 30-40,000 hours and are not replaceable. PV direct: 20-40 watt PV module.

Ivan Labs EL-SID pump uses March pump-head with direct electromagnetic drive, no shaft, bearings, brushes, or seals. 10 - 20 watts. Solar direct Ivan 10 uses 20 watt solar module, Ivan 20 uses 30 watt PV.

MODEL	Volt	Amp	Gal/Min flow at no head	Max unbalanced head	Additional Shipping	Price
P-MAR809-12	12	1.5	4.25	7'	\$10	\$215
P-MAR809-24	24	0.8	5.0	7'	\$10	\$215
P-M809HS-12	12	4	6.5	15'	\$10	\$230
P-M809HS-24	24	1.8	6.25	15'	\$10	\$230
P-IVAN 10PV	12	0.9	3	3.5'	\$10	\$220
P-IVAN 10-12B	12	0.45	3	3.5'	\$10	\$220
P-IVAN 10-24B	24	0.25	3	3.5'	\$10	\$260
P-IVAN 20-PV	12	1.5	5	7'	\$10	\$280
P-IVAN 20-12B	12	1.5	5	7'	\$10	\$280

One-year warranty on both brands.

Minimum shipping \$10 per whole order covers all items with no shipping listed

SMALL SUBMERSIBLE PUMP

FOR PORTABLE OR TEMPORARY JOBS

Miniature 12-volt submersible centrifugal pump. Quick low cost way to lift water. Under 2 inch diameter pump fits down well pipe, or toss into creek or water barrel. Amazon flows 4 gallons per minute, Congo flows 8 gpm, at low lift. Maximum lift 30 vertical feet at less than 1 gpm. Strong pressure for shower or garden nozzle. Not for pressure tank. Store out of water between use. Must not run dry. Amazon uses 5 amps, Congo 6 amps. Great performance; Estimated run time: 150 hours. One Year Warranty. 6.5" long x 1.6" diameter; comes with 13' of cable. 1 lb.



ITEM	Description	Price
P-AMAZON	Submersible Pump, 12V, with 1/2" hose barb	\$60
P-CONGO	Submersible Pump, 12V, with 3/4" hose barb	\$78

FOUNTAIN PUMP



This RULE brand pump powered by 12 volt battery is a 360-gallon-per-hour boat bailing pump. This simple centrifugal pump moves a lot of water, over 6 gallons per minute, but lifts less than 6 feet elevation. Centrifugal pumps can run dry without harm. Stainless steel motor shaft. Strainer on base picks up water without clogging and snaps off for cleaning. Pump is totally submersible. 2 amp draw at 12.0 volts and as much as 3+ amps at 14.5 volts. 6 month warranty only when battery powered, warranty does not cover pumps that are solar direct powered.

When powered directly by our 20 watt solar panel, it runs about two thirds speed. This makes a good garden fountain or simple solar demonstration for schools and fairs. 3" wide including barb x 3-1/2" tall with a 3/4" diameter hose barb; 11.4 oz; 2' 2 wire cord attached.

ITEM	Description	Price
P-RULE	Low Lift, 12V Fountain Pump	\$24

Minimum shipping \$10 per whole order covers all items with no shipping listed

SHURFLO PIRANHA PUMP

Smart. Reliable. Attractive. Efficient. Everything you are looking for in a bilge pump. The tough, high density nylon housing and heavy duty water cooled motor gives the SHURflo Bilge Pump unparalleled reliability. Installations are a snap with our unique swivel base plate and extended 6' tinned wire assembly. All Piranha™ Series Bilge Pumps have a removable cartridge for easy cleaning.

Four models are available all are continuous duty submersible pumps with a 6' tinned wire assembly. They have a removable cartridge for easy cleaning, a tough nylon housing, and an exclusive quick snap swivel base. Ignition protected.

Dimensions: 4.5" x 3", footprint 2 3/8" round, 1 1/8" opening. Backwoods recommends running the Piranha with one KC65. 3 year warranty from battery, PV direct, 6 months. Average brush life is 600 - 1000 hours.

Maximum lift is 8', draws 4 amps and delivering 500 gph, With no lift, if draws less than 1 amps and moves 1000 gph.



MODEL	Description	Volt	Max Amp	Gal/Min flow at no head	Price
P-SF-PIR1000	Piranha Bilge Pump	12	4	16.67	\$40

PUMP ACCESSORIES

TANK 1



TANK 2

SMALL PRESSURE TANKS The Shurflo diaphragm and Flowlight rotary vane pressure pumps should not connect directly to faucets without a pressure tank. We recommend using a 40 gallon or larger pressure tank (from local sources), or at minimum, one of these tiny air bladder tanks. It will cut noise and vibration from water flow, and stop pump switch chatter, so your pump and switch last longer. Maximum PSI is 125.

ITEM	Description	Additional Shipping	Price
P-TANK-1	Shurflo Accumulator Tank, 24 oz capacity	\$10	\$48
P-TANK-2	2 Gallon Pressure Tank	\$10	\$66

EASY SET UP KIT Recommended for Shurflo 2088 pumps. Four hose clamps and 15 feet of 1/2 inch hose for connecting pump to your plumbing. Hose reduces pump noise and prevents breakage of pump-head. Ten pages of wiring, plumbing, and repair instructions tell how to use pumps with pressure tanks and pressure switch.

ITEM	Description	Price
P-EZ	EZ Pump Kit for Shurflo 2088	\$25

HOSE: White drinking quality nylon cord reinforced hose will not flavor or poison water. 1/2 inch inside diameter fits Shurflo Booster Pumps and Shurflo submersible 9300 pump. Flexibility absorbs impulses from diaphragm pumps and quiets them.

ITEM	Description	Additional Shipping	Price
P-HOSE250	250 Foot Roll (also available by the foot for \$1 per foot)	\$22	\$195

PRESSURE TANK SWITCH: adjustable pressure, cleanable contacts. Mounts in plumbing near pressure tank. More durable than built-in Shurflo switches. Works with any AC or DC pump. Does not come with a wiring diagram.

ITEM	Description	Price
P-PS-SQD	20/40 psi default settings; 65 psi max	\$30
P-PS-SQD-REV	20/40 psi default settings: 65 psi max, reverse logic	\$105

Minimum shipping \$10 per whole order covers all items with no shipping listed

PUMP ACCESSORIES

LINEAR CURRENT BOOSTERS BY SOLAR CONVERTERS

Boosters track the maximum power point of solar modules (16V minimum!!).

Used with DC pumps powered directly by solar modules (without batteries). Makes pump start and run slowly in low light of morning or overcast when it otherwise would not start. Not water tight! Seal with silicone if needed. Includes connection for water level sensor.

ITEM	Description	Price
P-LCB-7	Linear Current Booster- 7 Amp input	\$105
P-LCB-15	Linear Current Booster- 15 Amp input, 12/24V	\$230
P-LCB-30	Linear Current Booster- 30 Amp input, 12/24V	\$410
P-LCB-48	Linear Current Booster- 10 Amp input, 48V	\$270

FLOAT SWITCH: Use with AC or DC pumps!!

Floating ball switch. Cord is tethered or weighted inside tank so that it comes tight, inverts the switch, when tank is full. We have one single pole double throw float switch which either turns pump off when tank is full, or turns pump off when source tank is empty. (If used to control LCB above, consult us for correct wiring because LCB reverses action of a float switch.) 2000' wire run with 18 gauge wire possible w/LCB. Use white and red wires to turn pump off when a tank is full. Use white and black wires to turn pump off before water source is dry.

ITEM	Description	Price
P-FLOAT	Float switch SPDT up/down	\$48

DRAIN BACK SOLENOID VALVE for DC pumps avoids freezing pipes. Valve closes when pump runs; opens to drain sloping pipes when pump is shut off. Call for application information. 12 or 24 volt; use 2 red wires; no polarity; 15 psi maximum

ITEM	Description	Price
P-VALVE12/24	Specify Voltage of 12V or 24V	\$120

PREMIER KITCHEN STOVE



30" Stainless front
Sealed burners
Accurate gas controls



SMK2400

No Electric Glow bar in oven

Sealed burners available

Natural gas or propane

Spark or pilot ignition.

Beware new gas stoves with a 500 watt electric glow bar in the oven that runs red hot whenever the oven is heating and consumes power rapidly. Peerless Premier kitchen stoves offer a convenient electronic spark to light the burners automatically, and to ignite a gas pilot in the oven only when the oven is used. Spark ignition uses just 2 watts AC power. Any inverter will do it, or select a plain pilot light model. A match can light any model.

Over 50 models are available including several stainless steel in 24, 30, and 36 inch widths. Porcelain units in white, biscuit, or black, 20, 24, 30, or 36 inch widths. The 30 and 36 inch cook-tops are 4, 5, or 6 burners, or built in griddle with cover. Sealed burners on some models have a one piece top. White or glass oven door with window & light. Burner tops have a lifetime warranty. Completely insulated oven saves gas. Made in USA. Request the free factory brochure with prices to select combinations of features and colors. All models ship with orifices set for natural gas. Easily switched to LP at your home, kit comes with stove when purchased. One year warranty on parts and service. Lifetime warranty on burners.

ITEM	Description	Price
PEERLESS	Porcelain Versions	\$410 - \$795
PEERLESS-SS	Stainless Steel Versions 24, 30, 36 in. available in 13 models	\$1,077 - \$1,799
PEERLESS-FRT	Freight on shipping each model	\$225 Res/\$175 Biz
GRIDDLE	For 24" & 30" Stainless models only (freight will be added if shipped separately)	\$179

**DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM
STOVES SHIP FREIGHT FROM MANUFACTURER**

WHEN TO USE DC APPLIANCES

The smallest power system, such as a cabin with a few lights, water pump and radio, might use only low voltage DC. Though most larger power systems use an inverter for 120 volt AC power for appliances, there are exceptions where special DC appliances save lots of energy and money, and avoid technical problems. Check our introductory chapter on selecting appliances for independent power.

BOTH AC and DC appliances, each where most appropriate, make a better working and less costly power system. Most AC inverters automatically turn off and save battery power at night or whenever no AC power is being used.

SOME DEVICES MUST BE ON DUTY 24 HOURS A DAY. DC from the main battery is better suited for those few items that need a trickle of power 24 hours a day. Examples are motion sensing outdoor light or alarm systems, cord-less, cell phone and message machines, clock-radio timers, a doorbell, aquarium/pond bubble aerators and smoke alarms. Turning those appliances off at night and when the house is vacant to save power defeats their purpose.

SOME DC APPLIANCES USE MUCH LESS POWER: Special DC model evaporator coolers, refrigerators, water pumps, fans, bed-warmers, rechargers for shavers, flashlights, and cordless tools use much less power with DC. AC models consume excessive power as they must keep an inverter on full time.

HOW DC CIRCUITS ARE SET UP: Most power centers have extra circuit breakers for safely connecting DC power from the battery. A circuit breaker or fuse on each wire is as important for DC as for AC. Our Square D "QO" series circuit breaker boxes are rated OK for low voltage DC. One DC outlet in each room of an otherwise AC home will cover most future needs. DC appliances are mostly low wattage, so most DC circuits can be installed with 10 gauge standard romex house wire. AC appliances must not be plugged into DC by mistake, or vice versa. The outlets for AC and DC must be different types. Don't use cigarette lighter plugs and sockets which are poor quality and do not meet building codes. Our 240 volt AC outlet, fits a conventional AC outlet box and outlet cover plate, and is legal for DC (if you have no 240 volt circuits in the house).

CONVERT BETWEEN 12, 24, or 48 VOLTS: Our EQ series of Battery Balancing devices allow 12 volts to be obtained from a 24 or 48 volt battery, or 24 volts from a 48 volt battery. We also offer step up or step down DC converters for similar applications.

NICAD/NIMH BATTERY CHARGER

AC or 12 Volt DC



Recharger for Nicad batteries size AAA, AA, C, D and 9V, manual discharge button available which allows batteries to be then recharged to avoid memory effect. With two channels available, different sized batteries can be charged simultaneously. Can only accommodate charging of 2 or 4 batteries, cannot charge one or three. Designed for charging both Nickel Metal Hydride (NiMH) and Nickel Cadmium (NiCad) batteries. Comes with an AC adapter. Backwoods Solar adds 12 volt DC power cord too. One-Year warranty. Size: 6" x 8" x 2-1/2".

V500 ma draw; 1-20 hour recharge time
Will recharge new high capacity batteries

ITEM	Description	Additional Shipping	Price
A-NICCHRGR	Nicad Battery Charger	\$10	\$45

POND BUBBLER

Aerator For Large Fish Tank Or Garden Pond

POWER BUBBLES is a 12 volt DC air pump kit with two 10 foot air hoses, check valves, and emitter stones to oxygenate the water. Run full-time with NO INVERTER. Reduces algae growth and improves water for frogs and fish. Only 1/4 ampere on 12 volt. In smaller aquariums, a resistor or voltage converter can be used to further reduce power for less vigorous bubbles. Electronic vibrator pump is durable. Will aerate up to 10 gallons. One year warranty.

**JUST 3 WATTS,
12 VOLT DC**



ITEM	Description	Price
A-BUBBLES	Pond/Aquarium Bubbler Kit	\$50

Minimum shipping \$10 per whole order covers all items with no shipping listed

Your choice of 12 VOLT DC Powered Wireless PHONES and ANSWERING MACHINES now possible!!

Operation on 12 volts DC means round the clock phone power without running the inverter. You save significant energy by avoiding the conversion to AC via the inverter and then back to 12 volts DC in the phone. However most phones pass your grounded battery power through to the phone line, which in turn grounds the phone line. Phone lines must never be directly grounded or a loud hum will render the phone unusable. One year warranty.



Our DC-ISOLATOR externally isolates or removes the ground so you can connect any 9-12 volt DC machine to your 12v battery. When shopping for your phone be sure that

ITEM	Description	Price
A-DCISOLATOR	Rated 670 mA; tested to 850 mA	\$40

its 120v AC wall cube transformer states that the output to the base station is 9-12v DC. The DC-Isolator does not include the phone nor

answering machine. You will purchase one locally. Lightning will ruin this DC Isolator. Our A-Spike (below) should protect it.



LIGHTNING entering via your phone line, seeking ground, often damages phones, message machines, and our DC Isolator when connected to grounded battery power. This spike suppressor plugs in between phone and wall jack, and connects directly to your ground rod to reduce lightning surges. Manufacturer offers a Lifetime warranty!

ITEM	Description	Price
A-SPIKE	Lightning Protector	\$32

12 Volt BED WARMERS



Goes on the mattress to warm you from underneath. Turn it on one half hour before bed time to preheat, then turn it off after entering bed. Heating pads are 50/50 cotton/poly and include large pins to attach the bed warmer to your mattress. Wire length 4' warmer to Control and 6' to plug.

Thermostat control responds to room temperature, cycling on and off as required to maintain the bed temperature. Conventional electric blankets use 200 watts but these DC bed warmers use less than 60 watts and they avoid questionable AC magnetic field exposure. It can overheat if folded. Comes with 1 or 2 cig lighter plug. Cut them off and replace with any good 12 volt plug. One year warranty. UL and CSA listed.

ITEM	Description	Shipping	Price
A-BED-T36	Twin Size Bed Warmers	\$10	\$75

EVAPORATIVE COOLERS



Solar Chill DC Motors
Use Less Energy



Stainless Steel Construction



These coolers use high efficiency 12 or 24 volt DC motors that draw 50 to 200 watts from your battery bank. These motors use much less energy than AC induction motors.

A cooler uses 1 to 7 gallons of water per hour and delivers 8000 cooling BTUs per gallon water used. 3 CFM per square foot recommended. Offers as much as 30 degrees of cooling in dry climate. A DC water pump keeps water flowing through the pad, and a separate motor runs the fan. Propeller fan uses less energy than squirrel cage fans. Installation with minimal or no duct work required. Warranty is 5 years on stainless, 1 year on mechanics.

STATE IF 12 OR 24 VOLTS (48 V AVAILABLE BY SPECIAL ORDER)

ITEM	Size Outside H x D x W	Fan Size	Watts Used @ 12V/24V	CFM	Additional Shipping (UPS)	Price
A-COOL14	19.3 x 21.5 x 24	14	52/42	1000	\$75	\$980
A-COOL18	24.5 x 22 x 24	18	73/60	1500	\$75	\$1,090
A-COOL24	34 x 22.5 x 36	24	120/150	3000	FREIGHT	\$1,495

A-COOL CONTROL powder coated metal enclosure with thermostat, on-off switches wind-up timer, and clean-out pump which provides fresh water before each start-up. This control panel is optional but **HIGHLY RECOMMENDED**

ITEM	Description	Shipping	Price
A-COOLCONT12	12V Solar Chill Control Package	\$16	\$119
A-COOLCONT24	24V Solar Chill Control Package	\$16	\$129

REPLACEMENT PUMPS for Solar Chill are available by special order, call for pricing.

Minimum shipping \$10 per whole order covers all items with no shipping listed

NEW! LARGE DC FANS



16 INCH BLADE
ONE YEAR WARRANTY

DC powered fans operate from battery or solar direct. Moves large volumes of air quietly to vent home, greenhouse, or run a food dryer. Powered from a small solar module, it starts and stops with the sun for greenhouse vents. Use a 20 watt panel for 16" fan. The frame is galvanized metal, with HTI motors and high density plastic blades. Our Linear Current Booster in the Pump Accessories section will improve operating hours when direct solar powered.

ITEM	Size Outside	Amps 12V	CFM 12V	Amps 24V	CFM 24V	Additional Shipping	Price
A-F16	20 x 20	1.4	750	3.0	1800	\$16	\$200
A-FANMOTOR	<i>Replacement motors for 12" & 16" fans only 3.5" L x 3.0" D, with a 3/8" shaft</i>						\$75
A-FANTHERM	<i>Thermostat turns fan on at a selected temperature. Range 90 - 130 degrees F. When temperature falls 15 degrees, fan turns off. Max 10A 12/24V DC</i>						\$45

PORTABLE 12 VOLT DC FREEDOM FANS



Manufactured in the USA by the Amish Folks of Arthur, IL to their demanding standards, these rugged, plastic housed fan are quiet, powerful, and efficient. One year warranty. Model 124 pictured at right.

Model 124 has a 12" blade, two speeds, draws 1 amp at 12v on low and 3 amps on high. It has a metal adjustable tilting base that can also be wall mounted. Our version ships with a 6' cord that has battery clamps. We would recommend removing these clamps and hard-wiring to your 12v system with a fuse in the (+) leg. 500-1500 cfm.



Model 302 has a 20" blade and continuously variable speed adjustment. This fan draws 4 amps at maximum speed. The fan's cord has a cigarette lighter plug and an adapter with battery clips.

ITEM	Description	Additional Shipping	Price
A-FREEFAN	Model 124: 12V, 12 in blade	\$10	\$149
A-FREEFAN-302	Model 302: 12V, 20 in blade	\$22	\$280

FANTASTIC VENT

Endless Breeze 12V Fan

NEW!



Endless Breeze is a powerful, high volume, portable 12 volt fan using an automotive type motor and twelve inch blade that operates at three speeds. Air movement of up to 900 CFM (cubic feet per minute) equivalent of a constant 10 mph wind. Standing only fourteen inches tall on retractable legs and less than four inches deep it travels and stores easily and weighs under five pounds.

The fan can be powered by any 12 volt power source such as automotive lighter outlets, connecting jumpers to any 12 volt battery or you can plug in your Endless Breeze in a *110 volt AC, 5 AMP converter. Maximum current draw is three amps. Fan is equipped with an attached 12 volt plug and cord. Fan-Tastic Vent provides a one-year limited warranty against defects in materials and workmanship when installed and operated according to instructions. Dimensions: 14 1/4" H X 13 1/2" W X 3 5/8" D. UL certified

ITEM	Description	Additional Shipping	Price
A-FANTASTIC	Endless Breeze 12V Fan	\$10	\$72

12 & 24 VOLT MUFFIN FANS

SUPER LOW POWER



Square 4-5/8 inch, larger than usual computer fans. Quiet brushless motors use little power. Great on a desk for personal cooling or near a wood stove to move heat. Rated 60 to 110 cfm. Power draw varies with model & voltage, 0.2 to 0.5 amps. Fan guard protects fingers, but spreads airflow. Removable guard is included on most 12 volt fans this year.



ITEM	Description	Price
A-MUFFAN12	12V Muffin Fan	\$15
A-MUFFAN24	24V Muffin Fan	\$15
A-MUFFAN48	48V Muffin Fan	\$15
A-FANGUARD	Wire Fan Guard	\$3

Minimum shipping \$10 per whole order covers all items with no shipping listed

CAFRAMO ECOFAN AIRPLUS

REQUIRES NO ELECTRICITY



The Caframo Ecofan is a heat powered fan designed to circulate the warm air created by a wood stove. This fan does NOT use any batteries nor wall cords.

These fans have a thermoelectric module which acts as a small generator to power the fan's motor. When this module experiences a heat differential between its top and bottom surfaces, it pumps out electricity and rotates the 9" prop.

The 11" tall Ecofan Airplus is designed to be used on freestanding wood stoves with normal surface temperatures of 400-650 degrees F for optimum performance. Higher temps will damage the fan! Moves as much as 150 cfm. 1 year warranty.

ITEM	Description	Additional Shipping	Price
A-ECOFAN	Caframo Ecofan	\$12	\$126



SOLAR DIRECT ATTIC VENT FAN



This quiet solar-powered attic fan utilizes an 11, 15, or 20 watt, totally weather-proof, PV module to move 850-1250 cfm in full sun. The cover and base are paintable, molded, UV-stabilized, ABS plastic. The 5 bladed, 12" aluminum fan is pitched for maximum air flow and a stainless steel screen keeps critters out. **Arrives fully assembled!**

Each fan has a **factory equipped thermal on-off switch**. When attic temps exceed 80°, the fan turns on. When temps drop below 65°, it shuts off. If temps do not fall below 65° overnight, the fan will start with the AM sun. The flat base measures 24.5" x 24.5" and the overall fan height is 7". Typically installs in under an hour and cools as much as 1200 sq. ft. 5 year warranty on motor and 10 years on PV module and other parts.

ITEM	Description	Additional Shipping	Price
A-ATTIC850	850 CFM, for 1200 sq. ft.	\$30	\$485
A-ATTIC1050	1050 CFM, for 1600 sq. ft.	\$35	\$585
A-ATTIC1250	1250 CFM, for 2000 sq. ft.	\$35	\$685

12/24 VOLT DC CEILING FAN



ALL NEW REMOTE CONTROLLED 4 Bladed Fan

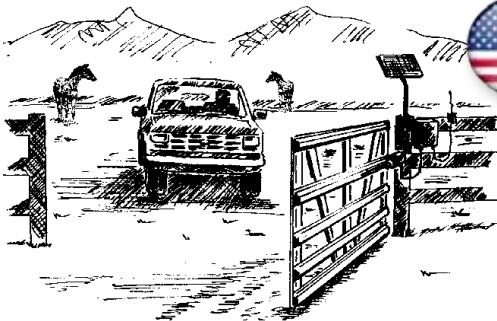
Fans are available with brass housing and oak laminate blades or white housing and white blades. The three speed reversible motor is controlled by infrared remote control and draws 1.2 amps at high speed, 0.75 amps at medium speed, and 0.5 amps at low speed(12 or 24v). It is designed for surface mounting on a flat ceiling. A swivel mount for pitched ceilings is available as an option. It includes a white 6" downrod extension. This 1/2" rod can easily be replaced with conduit and length of your choice purchased locally. 12mA phantom load. One year warranty.

ITEM	Description	Additional Shipping	Price
A-CEILFAN12	40 in, 12V Ceiling Fan (specify color)	\$12	\$108
A-CEILFAN24	40 in, 24V Ceiling Fan (specify color)	\$12	\$135
A-SWIVELKIT	Required w/ any downrod installation (white downrod)		\$20
A-REMOTE	Additional Replacement Remote (specify voltage)		\$32



Photo Courtesy of Marcia Pimentel: Off-grid enthusiast
 Newsletter contributor and kindred spirit

Minimum shipping \$10 per whole order covers all items with no shipping listed



AMERICA'S #1 DIY GATE OPENER

Solar Powered Radio Controlled

MIGHTY MULE FM 500 GATE OPENER activates with the pocket transmitter, or an optional keypad digital lock. Soft start draws a maximum of 5 amps. The gate can be set to remain open until a second signal from the operator is sent, or it can be set to automatically close after adjustable time from 1-120 seconds, so you don't need to worry if you closed the gate. And it can be released for manual operation in emergencies. If the gate hits an object while opening it stops, or while closing, it stops and backs off.

Gate can be from 3-1/2 to 18 feet in length, wrought iron, chain link, pipe etc, weighing up to 850 pounds. The gate swings a maximum 110 degrees. Because of wind load, large solid surface gates are not advised.

Max draw: 5 amps from a 12 volt 7 amp hour gel cell, charged from either an AC outlet, or an optional 5 watt solar module on site. Use 2 solar modules for model 502 or in low sunshine areas. Up to 100 cycles per day with AC charger; 4 to 25 cycles a day with solar charge depending on the season. 40+ cycles with a 30 watt module. 40 ma idle draw. LOCK is an electrically operated pin that secures gate against forcing. DIGITAL KEYPAD mounts near gate, activating when number combination is entered.

Gate openers now qualify for Federal Tax Rebate incentives, check our website for full details.

ITEM	Description	Additional Shipping	Price
A-MULE500	Opens and closes single pull-to-open gate (inward)	\$30	\$580
Includes 1 transmitter (50- 100'), receiver/control box, opener mechanism & battery			
A-MULE502	as above, but has two actuators for dual swing gates	\$55	\$890
A-MULESOLAR	Mule Solar panel kit with mounting & wire		\$160
Extra accessories to enhance security and convenience			
A-MULETRAN	Extra pocket transmitter (one comes with kit)		\$32
A-MULEKEY	Key chain mini-transmitter (50' - 100')		\$32
A-MULELOCK	Electric bolt lock secures against forcing		\$185
A-MULEDIG	Digital keypad with changable 3-18 digit codes		\$56

Minimum shipping \$10 per whole order covers all items with no shipping listed

SUNMAR COMPOSTING TOILET



The success of the Excel design meant that a three chamber unit could be specifically designed for those with NO continuous 110 volt supply. First launched in 1981, the Excel NE has long been the standard toilet for those living off the grid. A 1998 redesign gave the unit a rounded look, and recessed the drum handle. Please give us a call to discuss the fine art of composting toilets.

The Excel NE has no fan or heater. Odorless operation is achieved by a 4" vent mounted at the top rear of the unit which acts like a chimney on a wood stove. For good air movement the vent should be installed vertically and to 2-3 feet above the peak of the roof. **Backwoods includes a free 12v fan kit** which should be installed if you need to install the toilet with any bends in the vent. No more than 2 45° bends are encouraged, even with the fan. Backwoods recommends

using the fan in every installation.

This fan draws 1.4 watts and can be powered by a solar panel and 12 volt marine battery.

Evaporating capacity on the Excel NE is variable, so the 1" drain at the rear should be connected to an approved drain pit, container, or other facility.

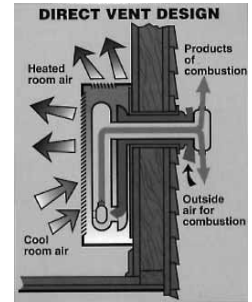
ITEM	Description	Additional Shipping	Price
A-EXCEL NE	SunMar Composting Toilet	FREIGHT	\$1,500

"COZY" DIRECT VENT HEATERS

Derate 4% per 1000' elevation



CDV 25/33 unit in back
CDV 15 is in front



NO ELECTRICITY NEEDED. Cozy Wall Furnaces vent through an outside wall behind the heater. Sealed combustion unit draws air from outside and exhausts back to outside. It draws no air from the room and puts no exhaust into the room. Burner is stainless steel, with 10 year warranty on burner and sealed combustion unit. One year warranty on other parts; not labor. Finish is white. Push button spark pilot lighting. Listed models have wall mounted thermostat for even room temperature, but you can add the much superior digital/timer control below. NOT for RV use.

18.5 watt AC fan kit is available for CDV25 and CDV33, but you can add two of our DC MUFFAN fans for much lower power use. The 9" diameter vent pipe fits walls 5" to 9" thick, optional extension kit goes to 15" thick. Overall efficiency is about 66%. Please specify propane or natural gas. 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS APPLIANCE.

ITEM	BTU/Hour & Room Size	W x H x D	Weight	Price
A-CDV156	15,000 450 sq. ft.	18" x 28.25" x 9.75"	65 lbs	\$735
A-CDV256	25,000 750 sq. ft.	34.5" x 31.5" x 9.75"	99 lbs	\$895
A-CDV336	33,000 1000 sq. ft.	34.5" x 31.5" x 9.75"	99 lbs	\$950

SHIPPED TRUCK FREIGHT. CALL FOR COST

BACKWOODS SOLAR RECOMMENDS THIS SUPERIOR DIGITAL THERMOSTAT

ITEM	Description	Price
O-THERM9610	Programmable 7 day clock and temperature settings	\$60

CHOFU HOT TUB HEATER

No circulating pumps needed!

Stainless Steel

Wood Fired

Includes Connecting

Fittings For Tanks with 3/8" thick walls or less.

1 year warranty



Stove is double wall 22 gauge stainless steel construction with cast iron grates and door. Takes 17" wood. Stove pipe takes smoke away from tub area. 8' of pipe required (10' of pipe and possibly guy wires if cap is used) to create enough draw for proper firebox heating. Use indoors or outside. Water jacket is over 1" deep around the firebox, so it heats water without heating the house. 1.5" water connections for thermo-siphon to a hot tub;

Use a low cost 24" deep, 6 foot round galvanized stock tank as the tub or a more elegant tub of your choice. Each Chofu includes an ash rake, connection ports, clamps, etc. 23" long x 16" round. Ask for brochures. Not for pressurized water, 10 psi maximum water jacket. 63 lbs.

ITEM	Description	Additional Shipping	Price
A-CHOFU	Wood Fired Water Heater	\$50	\$895
A-CHOFUPIPE	Each two foot piece of 4" stainless steel pipe		\$19
A-CHOFUCAP	Stainless steel cap; requires 10' SS pipe/guy wires		\$44
A-CHOFUSHANK	Extra long shanks for tubs thicker than 3/8" up to 1 5/8"		\$55
SHIPPING: on one to five sections of stainless steel pipe and/or one stainless steel pipe cap			\$18

SHOWER HEAD



For low pressure gravity fed water. Gives a good shower on 7 lbs. pressure, better with 10 pounds. 2.0-2.5 gpm; psi dependent. 3/4" female thread. Solid brass, chrome plated.

ITEM	Price
A-SHOWERHEAD	\$9

Minimum shipping \$10 per whole order covers all items with no shipping listed

BOSCH TANKLESS WATER HEATERS

BOSCH INSTANT GAS WATER HEATERS have copper heat exchangers, and the burner is stainless steel. These use a combustion vent pipe out through the roof just like a gas tank type heater.

The 520PN and 520HN models are rated at 117,000 BTUs and are a good choice for 1 user at a time. Each heater is activated by a flow rate of 0.5 gallons per minute at full BTUs. Maximum flow rate is 4.7 gpm at 45 degree increase and 2.7 gpm at 75 degree increase in water temperature.

The 520HN model uses a water pressure generated spark ignition, no pilot light. Very reliable. Derate 4% per 1000' elevation.



520 HN Internal

The 330PN is 31,000-75,000 BTUs.

Produces from 2.6 gpm flow with a 45 degree water temperature rise to 1.3 gpm flow with a 90 degree rise. Aquastar recommends minimum of 30 PSI for this units.

2 year warranty with 12-15 year warranty on heat exchanger.



520 HN External

ITEM	Description	Additional Shipping	Price
A-GWH520PN	with pilot light and external thermostat	\$26	\$755
A-GWH520HN	water pressure generates spark; no pilot light	\$26	\$799
A-GWH330PN	with pilot light	\$26	\$459
A-8GWHVENT	30 ES- Horizontal Vent Kit	\$15	\$248

SPECIFY WHETHER UNIT IS FOR PROPANE OR NATURAL GAS WHEN ORDERING

NEW! GLOBAL SUNOVEN



Since 1986, SUN OVENS have been being used around the globe to provide true solar cooking to countries around the globe. Even though it is called an oven, food can be boiled, steamed, roasted or baked at cooking temperatures of 360° F / 182° C, making it ideal for cooking a wide variety of dishes. This ruggedly built solar appliance weighs only 21 pounds, and can fold up like a suitcase to be carried with the integrated handle.

The GLOBAL SUN OVEN® can be set up for use or taken down for storage in a matter of seconds. The reflectors literally fall into place at an angle that allows you to maximize the power of the sun. The reflectors are made of highly polished, mirror-like anodized aluminum that can be cleaned quickly and easily with glass cleaner, and they will never oxidize or rust.

There is never any need to worry about your food spilling in a GLOBAL SUN OVEN®. While cooking, your food rests on a shelf that self adjusts to always stay level as you refocus., and a self-contained leveling leg can be readily adjusted to choose from 9 different angled positions to allow for correct alignment to the sun throughout the day.

A thick batt of non-toxic insulation retains heat. Food cooked in the sun and left in the oven will remain hot for hours. Cold air is held out allowing the GLOBAL SUN OVEN® to be used on sunny days year around regardless of the ambient temperature. A built in thermometer allows you to see the temperature at a glance.



ITEM	Description	Additional Shipping	Price
A-SUNOVEN	Global Sun Oven	Freight	\$269

Minimum shipping \$10 per whole order covers all items with no shipping listed

EFFICIENT REFRIGERATORS

Refrigerators for solar electricity should be the most efficient, lowest energy consumption available. Super efficient electric refrigerators and freezers designed with 3 to 5 inches insulation use only one third the energy of most standard units. This catalog shows the best of those solar designed refrigerators. They are the very best choice for smaller power systems.

Check website www.energystar.gov/products/refrigerators/. Standard freezers and refrigerators use up to 3000 watt hours each day. A few better models like Maytag MTBI956 can be found that use 1500 watt hours a day, costing around \$900. You need to add about 450 watts of solar modules in the best year round sunny locations to power them; more modules in less sunny areas. Approximate cost for the sunniest locations: \$900 for the refrigerator plus \$2400 for the solar modules equals \$3300 to use the best, Energy Star rated, conventional units.

Refrigerators that are specially designed for solar require fewer solar modules and less generator time. All our refrigerators are energy rated in watt-hours used per day. Watt-hours compare equally whether 12, 24, 48, or 120 volt units. Divide watt-hours per day by your battery voltage, 12, 24, or 48 to get amp-hours per day consumed.

GAS versus ELECTRIC: A refrigerator's need for power typically matches solar electric production: more energy in summer and less in winter. Added solar modules for electric refrigeration raise the up-front cost, whereas you pay for propane gas for 15+ years. Long term comparison is close either way (if gas prices don't rise). **WARNING: COMBINATION GAS-ELECTRIC** refrigerators are usable only as gas powered, not as electric. These combination models use an electric heater that runs nearly full time to replace the gas flame. They use more power than any electric compressor, so they are not practical as electric units.

SUNFROST products have 4 to 6 inches of insulation, and the compressor is on top where it can't put heat back into the box. The RF16 model can use 750 watt hours a day, about 225 - 400 watts of solar modules, depending on the climate.

NOVAKOOL products are smaller DC powered refrigerators made for RV & marine markets. With the same Danfoss compressor as the Sunfrost, these models have smaller refrigerators but use about the same power as larger Sunfrosts. Adding 2 extra inches foam insulation to all surfaces except the door cuts that power use in half. A very practical choice for a small refrigerator IF you add the insulation.

SUNDANZER DC powered chest freezers are as well insulated and efficient as any available, 200 to 800 watt hours/day, at better prices.

DOMETIC

Propane Gas

Door is reversible so two units can be placed side by side to make a larger refrigerator

**Clearances:
1" sides and back
4" top**

No venting needed.



DOMETIC RGE 400 GAS REFRIGERATOR-FREEZER

Time proven 2 door refrigerator freezer combination, 8 cubic foot total. Refrigerator section is 6.4 cubic feet, and top freezer section is 1.6 cubic feet. Door openings are reversible. Interior light uses 4 "D" batteries. Piezo lighter and temperature adjustment on front without opening door. Manufactured in Sweden, only the name has changed, same great product.

Better insulation in this model gives average gas usage of 1/4 gallon propane in 24 hours, much less than older gas units. Can maintain 6 degree freezer and 39 degree refrigerator with 110 degree F outside. Overall dimensions are 63-1/2" high, 23" wide, 26-1/2 " deep.

1 year warranty. An extended warranty which provides 5 years of coverage can be purchased direct from the factory for \$90. Propane model is AGA approved.

ITEM	Description	Price
R-DOMETIC400-W	White RGE 400- Propane	\$1,445
R-DOMETIC400-B	Bisque RGE 400- Propane	\$1,445

ALL DOMETICS SHIP TRUCK FREIGHT, PLEASE CALL FOR FREIGHT QUOTE. DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

CRYSTAL COLD

Gas Refrigerators



CC18

Engineered to meet the demands of their cubic footage, these Crystal Cold gas refrigerators and freezer are the only units of their size that we have found which can adequately cool even in the desert Southwest. Available in textured white or bisque, the CC15 and CC18, have 2 adjustable glass shelves in the fridge and one in the freezer as well as reversible doors. Clear double crispers and cover. Front push button igniter. Heavy duty moving casters and thermostat controlled temperature. Both models have a built-in interior light that requires 4 D batteries (not included). Clearances: 2" sides and back; 8" top for CC15/18. No venting needed. High altitude orifice needed above 9500'. Warranty: 1 year parts and labor and 3 years on cooling unit.

ITEM	Description	Price
15 CUBIC FOOT GAS REFRIGERATOR-FREEZER 63.5" H x 28.5" W x 34.5" D Freezer: 4.2 cuft, refrigerator 10 cuft. Uses 0.29 gallons gas per 24 hours. 298 lb ship weight.		
R-CCOLD-15	for propane (add \$50 for natural gas)	\$1,995
18 CUBIC FOOT GAS REFRIGERATOR-FREEZER 65" H x 28.5" W x 34.5" D Freezer: 4.2 cuft, refrigerator 13 cuft. Uses 0.35 gallons gas per 24 hours. 298 lb ship weight		
R-CCOLD18	for propane (add \$50 for natural gas)	\$2,125
THE R-CCOLD18 IS AVAILABLE IN BLACK W/ A STAINLESS STEEL DOOR- ADD \$140		

ALL CRYSTAL COLD S SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNDANZER

DC POWERED CHEST FRIDGE AND FREEZERS

12 or 24 volt DC Operation
One year warranty



4.3" Insulation and maximum 10-12 amp draw at 12v
 Instantaneous surge: 2x max draw; Baskets measure: 15 x
 10 x 7 deep Interior dimensions: 8 cu. ft.: 38L x 25H x 16D
 (interior); 5.8 cu. ft.: 28L x 25H x 16D (interior).

Thick insulation, top opening, and a refrigeration system optimized for solar makes SunDanzer refrigerators and freezers the ultimate low energy user. SunDanzer cabinets are commercially produced by Electrolux of Sweden, one of the world's leading refrigeration unit manufacturers. SunDanzer chest-style refrigerators and freezers are easy to clean using the drain hole at the bottom. Interior light in all models. 6' 2 wire 12awg wire lead. Can be hardwired to battery bank using a 15A inline fuse, or a DC plug can be added and will be code compliant as long as no 240V wiring exists within the home. See page 138 for DC plugs and outlets.

Exceptional low energy consumption direct from the house battery. Danfoss brushless DC compressor operates on 12 or 24 VDC. Power used is at +38 and +10 degrees. 3" clearance all on sides required. Call for freight quote.

R-THERMOST: Thermostat replacement: Turns fridge into freezer OR freezer into fridge, must be specified before ordering: \$30

If an AC/DC model is ordered, the unit will have 120V AC cord and plug wired into it and it will have the same DC cord without plug wired into it. Both AC and DC cords can be plugged in at the same time and the AC power is primary and it will automatically switch to DC if the AC power is taken away. Once AC power returns, it will return to powering the unit.

Model	Description	Exterior Size Inches Shipping weight	Energy Used 70-90 degrees	Price
R-R165	5.8 Cu. Ft. Fridge with 3 baskets	37W x26D x 35H 125 lbs	100-240 watt-hours/day	\$1,035
R-F165	5.8 Cu. Ft. Freezer with 3 baskets	37W x 26D x 35H 125 lbs	340-600 watt- hours/day	\$1,035
R-R225	8 Cu. Ft. Fridge with 4 baskets	47W x 26D x 35H 145 lbs	140-300 watt hours/day	\$1,195
R-F225	8 Cu. Ft. Freezer with 4 baskets	47W x 26D x 35H 145 lbs	500-800 watt hours/day	\$1,195
R-SUNDNZR- ACDC	AC/DC model option			\$135

NO 30 DAY RETURN PRIVILEGE ON THESE APPLIANCES
 SHIPS VIA FREIGHT; PLEASE CALL FOR QUOTE

SUNDANZER

Refrigerator and Freezer



This single door upright unit is perfect for situations where a chest style is just not practical. Even with its small footprint, it still has food storage capacity of 4.7 cubic feet. The built-in freezer compartment is perfect for making ice and storing small frozen items.

High quality construction provides excellent reliability and a long life. The powder coated galvanized steel exterior is easy to clean. The zero maintenance, brushless, thermostatically controlled Danfoss DC compressor operates on 12 or 24 VDC.

With the added insulation and a refrigeration system optimized for off-grid applications, this newest addition to the SunDanzer family of Energy Efficient refrigeration appliances will provide the same outstanding economical and reliable operation

as our popular Chest Style units. Low energy consumption allows SunDanzer refrigerators and freezers to be the most cost effective for use with power from solar, wind, fuel cells or batteries. This technology allows refrigeration in remote locations where it was previously unavailable or prohibitively expensive. 6' 2 wire 12awg wire lead. Can be hardwired to battery bank using a 15A inline fuse, or our DC plug can be added and will be code compliant as long as no 240V wiring exists within the home. See page 138 for DC plugs and outlets. AC/DC option available, \$135.

FEATURES:

- Reversible door and handle
- Dairy compartment and vegetable crisper, two adjustable safety glass shelves
- Adjustable legs for leveling
- Rugged scratch resistant top doubles as a work surface
- Internal control thermostat and temperature gauge

SPECIFICATIONS:

- Voltage: 10-31VDC
- Average Energy Use: 70°F - 460 Whrs/day, 38 AH/day; 90°F - 720 Whrs/day, 60 AH/day; 110°F - 1050 Whrs/day, 88 AH/day
- Gross Capacity: 134 L / 4.7 cubic feet; Refrigerator: 115 L / 4 cubic feet; Freezer: 19 L / .7 cubic feet
- Exterior Dimensions (WxDxH): 23.5x26x33in
- Weight: 75 lbs including packaging

ITEM	Description	Additional Shipping	Price
R-RF134	4.7 cubic foot DC Fridge and Freezer	FREIGHT	\$972

BACKWOODS IS AN AUTHORIZED RESELLER OF REPAIR AND REPLACEMENT PARTS FOR SUNDANZER APPLIANCES. LET US KNOW IF WE CAN HELP YOU WITH YOUR EXISTING UNIT

NOVAKOOL

26 DC MODELS AVAILABLE



Interchangeable 12 or 24 volt DC power

**Warranty
one year parts and labor
two years on parts**

Very Reliable

Best buy in a small refrigerator for solar power, favored in our catalog for over 20 years. NOVAKOOL offers 26 DC models and another 24 AC/DC models. Made to build into RV or marine cabinets. Exterior is galvanized sheet metal. The door comes with a white (black by special request) ABS panel but you can slide in paneling or Formica, or use a square of carpet on the door for durability and insulation. Interior is well finished with 2 shelves, vegetable crisper, and a top freezer box, 2 ice cube trays included. Call for Color Brochure!

Running power on all models has been reduced with new dual voltage Danfoss compressors and new refrigerant. Single door models consume 35 watts when compressor runs: under 3 amps 12 volt, or 1.5 amps 24 volt. Two door models will consume up to 60 watts. Running time varies with temperature but is about 30% duty cycle on a 70 degree day. Owner can glue foam board insulation to the entire outside of box and carpet on the door to cut daily run time in half. As supplied the R4500 uses 480 watt hours/day, but with added insulation, just 240 watt hours on a 70 degree day. The new Danfoss compressors use R134A (CF3-CH2F) refrigerant gas for atmospheric protection. Interchangeable use on 12 or 24 volt DC.

ITEM	Description	Price
R-4500	4.3 cu. ft. refrigerator with freezer box	\$920
R-5810	5.7 cu. ft. refrigerator with freezer box	\$1,125
R-FU-9000	9.1 cu. ft. two door upright fridge/freezer	\$1,530
R-FS7501	7.5 cu. ft two door side by side fridge/freezer	\$1,232

TYPICAL SHIPPING IS \$125 FOR SINGLE DOOR, \$175 - \$255 TO A RESIDENCE, FOR TWO DOOR MODELS TO LOWER 48 STATES.

DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNFROST



Sunfrost runs on 35-70 watts instead of the usual 250 watts. Super insulated with 3 to 4 inches of foam everywhere, and 1 or 2 top mounted Danfoss compressors, no heat goes back into the box. With no radiator on the back, it goes flat to the wall, no clearance behind is necessary. 4" Door hinge clearance is necessary in front. 6" clearance on top for cooling. Height varies with the model but all are 34.5" wide, 28" deep. Ask for a color brochure and a diagram of dimensions. 2 year warranty.

All models are available in choice of 12 or 24 volt DC, or 120 volt AC. Roughly 20% more energy efficient than similarly sized, conventional Energy Star rated models.

Since the cooling mechanism is on top, the lowest shelf is near the floor. Owners usually buy or build a raised base, as pictured here with the RF16 model, for easy access to lower shelves. Sun Frost offers a matching 2 drawer, 13" high cabinet for \$347 in white; \$492 in color. A 24 inch base is \$396 in white; \$550 in color. ADD \$120.00 to the white price for stainless steel. Wood finish is extra cost.

The cabinet is well finished in a wide choice of Formica counter top material. 2year warranty.

ORDERING SUNFROST

ADD \$60 CRATING for each fridge unless picked up at factory. **ADD \$30 CRATING** for each cabinet. Call for freight quote to your zip code area. **SALES TAX** is charged for all CALIFORNIA destinations.

SPECIFY DOOR HINGE which side for hinge as you look at the door.

SPECIFY COLOR. WHITE FORMICA is standard. Other Formica or Nevamar colors are typically \$250 extra. Genuine wood veneer is available for \$250 extra. Some colors and woods may be more costly. Stainless steel front on any model, please call.

SPECIFY VOLTAGE: 12v DC, 24v DC, or 120v AC. There is an AC/DC version also available, it's \$250 per compressor when installed by Sunfrost. To field modify a DC model to AC/DC it is \$350 per compressor.

Each unit is made to order. Allow 6-8 weeks for your order to ship.

A full line Sunfrost brochure is available on request.

DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNFROST RF12, R10, & F10



RF-12 with 24" CABINET BASE PICTURED

All daily watt-hour ratings are based on room temperatures of 70° to 90° and depend on the temperature setting of the Sunfrost. For more details, ask for Sunfrost Brochure and dimension plan sheet.

Model	Description	Price
R-SUNRF12	Two door Refrigerator-Freezer 2 cuft freezer and 8 cuft refrigerator. Single compressor. Height: 49.5". Uses 360-590 Watt-Hours per day.	12/24V DC: \$2,410
		120V AC: \$2,330
R-SUNR10	Single door Refrigerator only 9.1 cuft refrigerator. Single compressor. Height: 43.5". Uses 200-325 Watt-Hours per day.	12/24V DC: \$1,935
		120V AC: \$1,855
R-SUNF10	Single door Freezer only 9.1 cuft freezer. Single compressor. Height: 43.5" high. Uses 715-910 Watt-Hours per day.	12/24V DC: \$2,040
		120V AC: \$1,960

DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM
SHIPS VIA FREIGHT; PLEASE CALL FOR QUOTE

SUNFROST RF16, R19, RF19, & F19



RF-16 with 13" CABINET BASE PICTURED

Model	Description	Price
R-SUNRF16	Two door Refrigerator-Freezer 3.9 cuft freezer and 10 cuft refrigerator. Two compressors and two thermostats, one for each section. Height 62.5". Uses 585-845 Watt-Hours per day.	12/24V DC: \$3,250
		120V AC: \$3,095
R-SUNR19	Two door Refrigerator only Two 8 cuft refrigerator sections; NO freezer section. Single compressor. Height: 65". Uses 390-650 Watt-Hours per day.	12/24V DC: \$3,030
		120V AC: \$2,950
R-SUNRF19	Two door Refrigerator-Freezer 8 cuft refrigerator and 8 cuft freezer. Two compressors and two thermostats, one for each section. Height: 65". 800-1066 Watt-Hrs/day.	12/24V DC: \$3,400
		120V AC: \$3,245
R-SUNF19	Two door Freezer only Two 8 cuft freezer sections; No refrigerator section. Two compressors and two thermostats. Height: 65". Uses 1300-1700 Watt-Hours per day.	12/24V DC: \$3,430
		120V AC: \$3,295

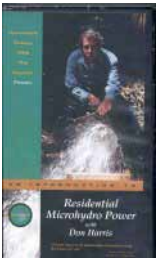
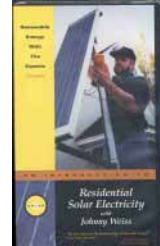
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM
 SHIPS VIA FREIGHT; PLEASE CALL FOR QUOTE

Renewable Energy With The Experts

EDUCATIONAL DVDs

Residential SOLAR ELECTRICITY with Johnny Weiss

For over 20 years, Johnny Weiss of Solar Energy International has been designing, installing and teaching classes on photovoltaic systems. Johnny demonstrates practical answers to questions often asked by homeowners as they consider the purchase and installation of their solar system. Some installation but not step by step instructions.

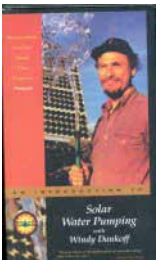
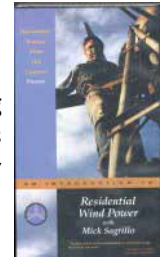


Residential MICRO-HYDROPOWER with Don Harris

Don Harris has manufactured and designed micro-hydro electric systems for over 25 years from his shop in northern California. He discusses water powered electric generation for the individual home; how to judge the site; and how to plan the pipeline and electrical equipment. Perhaps the best information available for the homeowner who may have hydropower capability.

Residential WIND POWER with Mick Sagrillo

For 30 years, Mick has been installing, repairing, and re-manufacturing over thousands of wind turbines at his wind powered shop. Mick gives and demonstrates practical answers to the questions frequently asked by homeowners considering their own wind systems.



Solar WATER PUMPING with Windy Dankoff

From watering livestock in India, to irrigating crops in Mexico, to domestic use here in the United States, Windy has been involved in over 3500 solar powered water systems. He reviews the process of assessing water needs; selecting the appropriate pump for the application; selecting components; and setting a submersible pump.

ITEM	Description	Price
EV-SOLAR-DVD	Solar Electricity DVD	\$35
EV-HYDRO-DVD	Micro-Hydro Power DVD	\$35
EV-WIND-DVD	Wind Power DVD	\$35
EV-PUMP-DVD	Water Pumping DVD	\$35

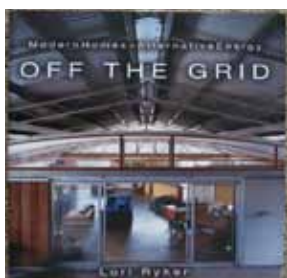
Minimum shipping \$10 per whole order covers all items with no shipping listed

Less Technical Home-Design Books

A HANDMADE LIFE: In Search of Simplicity

by William Coperthwaite

For some, "off-grid" encompasses more than electricity. In this book, Coperthwaite explores the possibilities of true simplicity from his homestead on the coast of Maine. His work will challenge you to examine your "grid-tied" daily life and encourage you to create a more sustainable way of life. 144 pages.



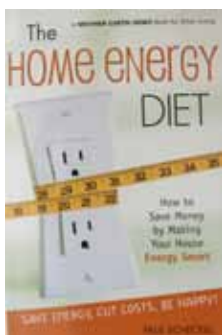
OFF THE GRID

by Lori Ryker **HARDCOVER!** 160 pages

Technologies that can be used to live "off the grid" are presented in this beautifully illustrated book. Lori shows that "off the grid" is not just a concept for rural living. Homes from NY, CA, MT, MN, Canada, Germany, and Australia are specifically discussed in relation to their off-grid components.

LEHMANS NON-ELECTRIC HARDWARE CATALOG

170 page catalog of tools, oil lamps, and lots of kitchen equipment of old fashioned high quality. Wood stoves, cook stoves, books, and more.



THE HOME ENERGY DIET

by Paul Scheckel

Easy to read and directed to the person that wants to take control of their personal energy use in order to save money on their electric bill, live more comfortably, and help the environment. For grid connected folks, this book is a **MUST** read! Once energy conservation is mastered, then creating a grid-tied PV system can be considered. 304 pages, published 2005.

ITEM	Description	Price
E-HANDMADE	A Handmade Life	\$20
E-OFFGRID	Off the Grid: Modern Homes and Alt Energy	\$25
E-LEHMANS	Lehmans Non-Electric Hardware	\$5
E-HOMEENERGY	The Home Energy Diet	\$18

Home Design and Technical Books



NEW GREEN HOME SOLUTIONS

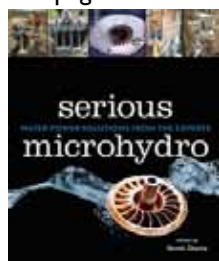
by Dave Bonta & Stephen Snyder

This book is a top pick for any library catering to either homeowners or architect/builders. It packs in 'green' ideas and solutions for both existing and new structures, with color photos supplementing ideas for solar space heating, wind power, passive heating and cooling systems, and more. A bright, appealing 'must' for any library serious about renewable resources. 144 pages.

THE NEW SOLAR HOME

by Dave Bonta & Stephen Snyder

The New Solar Home reveals just how greatly solar homes have evolved since the 1980s. Filled with stunning, full-color photography of the interiors and exteriors of solar homes in large cities, suburbs or rural locations. The New Solar Home is both a resource filled with inspirational ideas and a practical guide to different types of solar-powered systems one can incorporate into one's dwelling. A handy resource for anyone seeking to build a new home or remodel their existing one. 160 pages.



SERIOUS MICROHYDRO

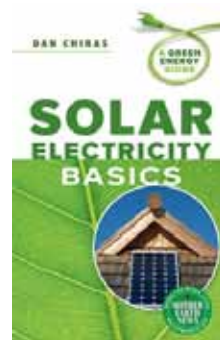
by Scott Davis

Serious Microhydro brings you dozens of firsthand stories of energy independence covering a complete range of systems, from household pressure sites to higher pressure installations capable of powering a farm, business or small neighborhood. 336 Pages

SOLAR ELECTRICITY BASICS

by Dan Chiras

Solar Electricity Basics provides a clear understanding of the sun, solar energy, and solar electric systems. It discusses the theoretical, practical and economic aspects of residential solar installations. Whether your goal is to lower your energy bill through a grid-connected system or to achieve complete energy independence, Solar Electricity Basics is the introduction you need-no PhD required! 192 Pages



ITEM	Description	Price
E-NEWGREENHOME	New Green Home Solutions	\$24
E-NEWSOLARHOME	The New Solar Home	\$24
E-SRSHYDRO	Serious MicroHydro	\$29
E-SOLARBASICS	Solar Electricity Basics	\$12

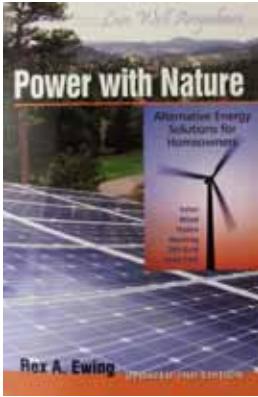
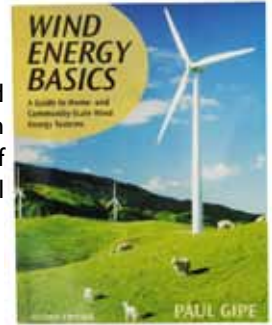
Minimum shipping \$10 per whole order covers all items with no shipping listed

HANDS-ON DESIGN & TECHNICAL

WIND ENERGY BASICS

by Paul Gipe

In 1999, Wind Energy Basics introduced micro and mini wind turbines and explained how to install and use them. This version introduces the concept of “community wind” where groups of people invest in large wind turbines that produce commercial quantities of electricity for sale to the grid. 224 pages.



POWER WITH NATURE: Solar & Wind Energy Demystified

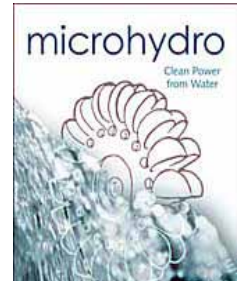
by Rex A Ewing

A comprehensive book by an off-grid homesteader explaining independent power in plain language. Covers solar, wind, and hydro power planning, also hot water, home heating, and water systems. Revised in 2006 with latest equipment explained. Our **best selection** for overall system review. Lots of diagrams and pics. 288 pages.

MICROHYDRO CLEAN POWER FROM WATER

by Scott Davis **ESSENTIAL READING!**

Highly illustrated and practical, this book covers both AC and DC systems, principles, design, site considerations, equipment options and more. 157 pages.



ITEM	Description	Price
E-WINDBASIC	Wind Energy Basics	\$29
E-POWER	Power with Nature, Solar & Wind Demystified	\$24
E-HYDROBK	MicroHydro Clean Power from Water	\$20

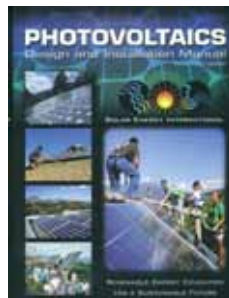
HANDS-ON DESIGN & TECHNICAL

PV DESIGN and INSTALL MANUAL

by Solar Energy International

This is a must have book!!

A new textbook manual on how to design, install and maintain a photovoltaic (PV) system. This manual offers an overview of photovoltaic electricity, and a detailed description of PV system components, including PV modules, batteries, controllers and inverters. Electrical loads are also addressed, including lighting systems, refrigeration, water pumping, tools and appliances. The manual includes chapters on sizing photovoltaic systems, analyzing sites and installing PV systems. 317 Pages.



PV-GENERATOR HYBRID SYSTEM FOR YOUR HOME



by New England Solar.
A good 24 page introduction to the whole PV system, charge control, inverter, generator and battery care. Shows clearly how they all connect together and to the house wiring. Similar to the introduction to this catalog, with more detail and drawings.

BATTERY BOOK FOR YOUR PV HOME

by New England Solar.

This 22 page booklet covers lead acid batteries, care and testing, and how to make them last longest. Hydrometer testing, voltage readings, and battery equalizing explained. We give this book free with each battery sale.



ENGINE - ALTERNATOR BOOKLET

by Backwoods Solar. Build a battery charger from a small engine and a car alternator. Explanation, parts list, plans and wiring diagram for building a home made version of the Backwoods Battery Booster listed with generators in this catalog, using a gas engine and car alternator.

ITEM	Description	Price
E-SEI-PV	PV Design and Install Manual	\$59
E-HYBRID	PV/Generator Hybrid Home System	\$10
E-BATTERY	Battery Book for Your PV Home	\$10
E-ENGALT	Engine Alternator Booklet	\$10

Minimum shipping \$10 per whole order covers all items with no shipping listed

FUN STUFF



Show your love for Backwoods. 100% pre-shrunk cotton in S, M, L, XL unisex sizes.

SOLAR BUMPER STICKER



ITEM	Description	Price
E-TSHIRT	Backwoods T-Shirt (Specify Size)	\$20
E-BUMP	Solar Bumper Sticker- 15" x 3.7"	\$1

SHIPPING

COST TO DESTINATIONS IN THE LOWER 48 STATES ARE SHOWN WITH EACH CATALOG PRICE

\$10 MINIMUM SHIPPING PER ORDER IF NONE OF YOUR ITEMS SHOW A SHIPPING CHARGE

UPS or US POSTAL SERVICE?

Backwoods Solar will ship via UPS or the US Postal Service at our discretion unless you specify a preferred method. Orders ship Monday through Friday. We can ship via Fed Ex if you have a Fed Ex account.

FASTER DELIVERY WITHIN 48 STATES

UPS 3 DAY SELECT minimum \$20 per order; or actual amount if more

UPS 2ND DAY AIR minimum \$30 per order; or actual amount if more

ALASKA, HAWAII, and PUERTO RICO

Orders ship via UPS Ground or US Postal Service Priority; the actual freight amount to be determined. Some items cannot ship via USPS.

CANADA shipments both Post & UPS charge 3 times listed rate or the actual freight amount if it is higher.

ALL ORDERS: Solar Modules must go UPS or truck freight.

Your shipment is fully insured against damage but damage must be IMMEDIATELY reported to the carrier or the insurance is lost.

TO FIND US

Directions to find Backwoods Solar are available over the phone or by mail/email from us.

NEED HELP?

Visit us between 1pm and 4pm PST M-F or Call between 8am and 5pm M-F or Write or Email anytime

INSTALLATION

We help diagnose problems, but **we do not do installations**. Installation can take from 4 to 20+ hours. We can sometimes refer you to a local installer that you can contract with independently. Several installers are licensed electricians, living in their own solar powered homes. We have a list of available helpers in most states.

Phone (208) 263-4290 * 8-5 Pacific Time * Weekdays * FAX (208) 265-4788
Email: info@backwoodssolar.com * Website: www.backwoodssolar.com

BACKWOODS SOLAR ORDER BLANK 2012

CUSTOMER NUMBER FROM CATALOG LABEL _____
 PHONE # (_____) _____ - _____ DATE _____
 NAME _____
 MAIL ADDRESS _____
 CITY _____ STATE _____ ZIP _____
 SHIPPING ADDRESS _____
 CITY _____ STATE _____ ZIP _____

FOR POST OFFICE PARCEL POST SHIPPING ONLY
 CHECK THIS BOX IF UPS WILL NOT DELIVER TO YOUR
 LOCATION, OR IF YOU ONLY HAVE A POST OFFICE BOX

BANK CARD # _____	EXPIRES MONTH YEAR _____/____
We accept Visa/Master Card/Discover/Amex Last 3 digits on back of card: _____	

Item #	How Many?	Description	Price Each	Total	Ship Cost

TOTAL COST OF ITEMS ORDERED \$ _____

ONLY in Idaho add 6% sales
tax to total before shipping fee: _____

Shipping must be at
least \$10
minimum
cost

PLUS TOTAL OF SHIPPING CHARGES \$ _____

TOTAL AMOUNT OF ORDER \$ _____

**Your shipment is fully insured against damage but damage must be
IMMEDIATELY reported to the carrier or the insurance is lost.**

TO PLACE AN ORDER

BACKWOODS SOLAR ELECTRIC SYSTEMS
1589 RAPID LIGHTNING RD, SANDPOINT, IDAHO 83864

PHONE CALLS: (208) 263-4290

or **FAX: (208) 265-4788**

E-MAIL info@backwoodssolar.com

**Check the newsletter section of our website
for current sales, new products, and used items.**

www.backwoodssolar.com

PHONE ORDERS with a bank card or COD for immediate processing.

COME UP IN PERSON, Write, Email, or Fax questions and orders

USE OUR WEBSITE'S ONLINE CATALOG

MAIL ORDERS using the order blank page (tear out),
photocopy, or just write your own order letter.

ORDERS MUST BE PREPAID by cash, money order, good check, or
Visa, MasterCard, American Express, or Discover card. We also ship COD.
The fee is \$10 extra per COD package. Call first, some items cannot ship COD.
No COD *outside the USA*

OFFICE HOURS WEEK DAYS 8 AM to 5 PM PACIFIC COAST TIME.

Nights, weekends, and when phones are busy, some calls may go to our message machine.
Leave a message. **We will call you back!!**

**PRICES may change between printings. We try to stay with the best
prices, and match or better most sale prices that you find. If you see a
lower currently advertised price, call us before you order and ask.**

RETURNS, EXCHANGES, WARRANTY

Manufacturers warranty and return address are included with each product. PLEASE contact
them first. If they don't help you, please let us know.

Additionally, you can return or exchange unsatisfactory items to Backwoods Solar within 30
days of purchase, **if in original unaltered new condition** with box and instructions. (This
does **not** apply to heavy large appliances where so stated in catalog). Be sure to enclose a
note telling us the trouble and what you would like done: exchange, repair, or refund. Include
your name & address. If you call first we may resolve it better by phone.

SPECIAL REQUESTED ITEMS not in this catalog are not returnable.

BACKWOODS SOLAR ORDER BLANK 2012

CUSTOMER NUMBER FROM CATALOG LABEL _____
 PHONE # (____) _____ - _____ DATE _____
 NAME _____
 MAIL ADDRESS _____
 CITY _____ STATE _____ ZIP _____
 SHIPPING ADDRESS _____
 CITY _____ STATE _____ ZIP _____

FOR POST OFFICE PARCEL POST SHIPPING ONLY
 CHECK THIS BOX IF UPS WILL NOT DELIVER TO YOUR
 LOCATION, OR IF YOU ONLY HAVE A POST OFFICE BOX

BANK CARD # _____	EXPIRES MONTH YEAR ____ / ____
We accept Visa/Master Card/Discover/Amex Last 3 digits on back of card: _____	

Item #	How Many?	Description	Price Each	Total	Ship Cost

TOTAL COST OF ITEMS ORDERED \$ _____

ONLY in Idaho add 6% sales
 tax to total before shipping fee: _____

Shipping must be at least \$10 minimum cost

PLUS TOTAL OF SHIPPING CHARGES \$ _____

TOTAL AMOUNT OF ORDER \$ _____

Your shipment is fully insured against damage but damage must be
IMMEDIATELY reported to the carrier or the insurance is lost.

WIRING SIZING USING VDI CALCULATION

Using a Voltage Drop Index calculation will allow you to figure the correct size wire for the percentage of voltage drop you would like to stay within on your systems wiring.

$$\text{VDI} = \frac{\text{Amp x Feet}}{\% \text{ Voltage Drop (2 - 3\%) x Voltage}}$$

where:

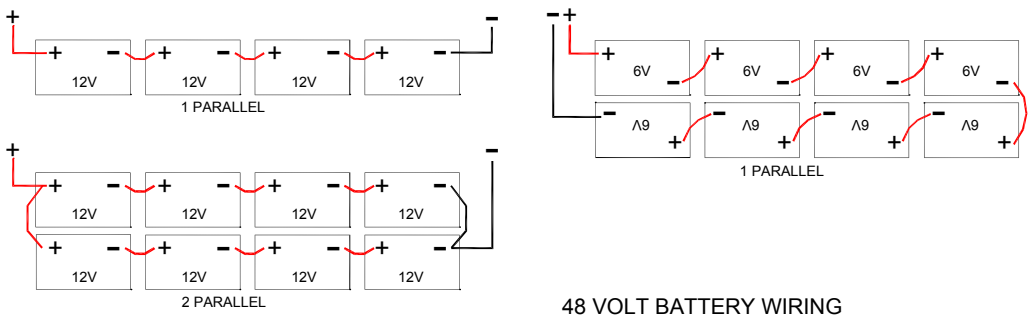
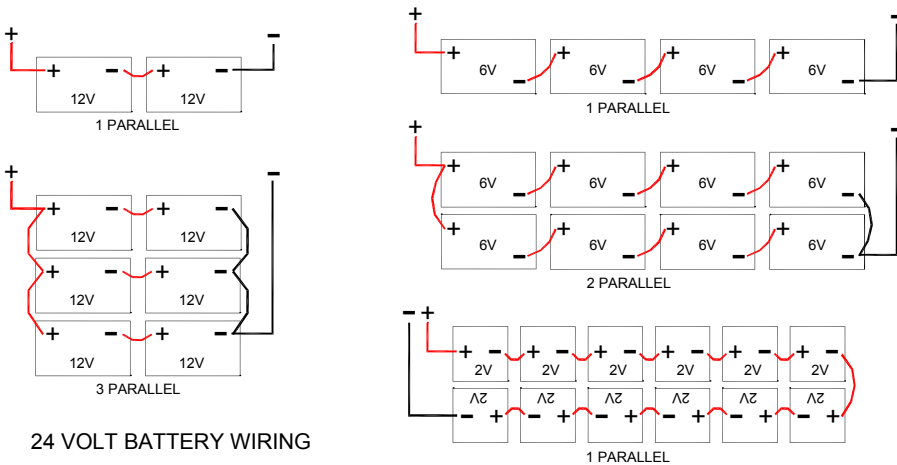
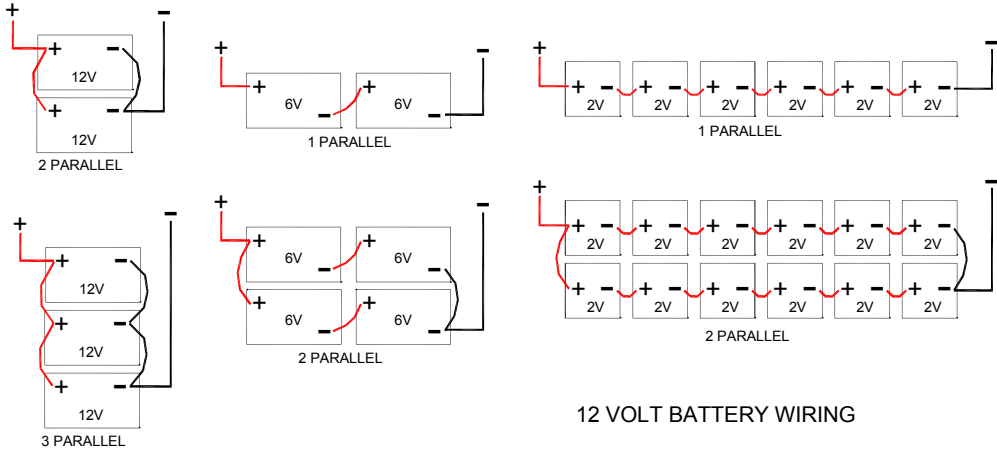
- amps = maximum number of amps through circuit
- feet = one way wire distance
- % voltage drop = percentage of voltage drop desired, use 2 for 2%
- voltage = voltage running through the wire

Voltage Drop Index Chart

Wire Size (AWG)	Copper Wire		Aluminum Wire	
	VDI	Ampacity	VDI	Ampacity
4/0	99	230	62	180
3/0	78	200	49	155
2/0	62	175	39	135
1/0	49	150	31	120
2	31	115	20	94
4	20	85	12	65
6	12	65		
8	8	50		
10	5	30		
12	3	20		
14	2	15		

BATTERY WIRING DIAGRAMS

All wiring diagrams are in series parallel to get to the proper voltage based on the voltage of each battery.



NOTES

NOTES