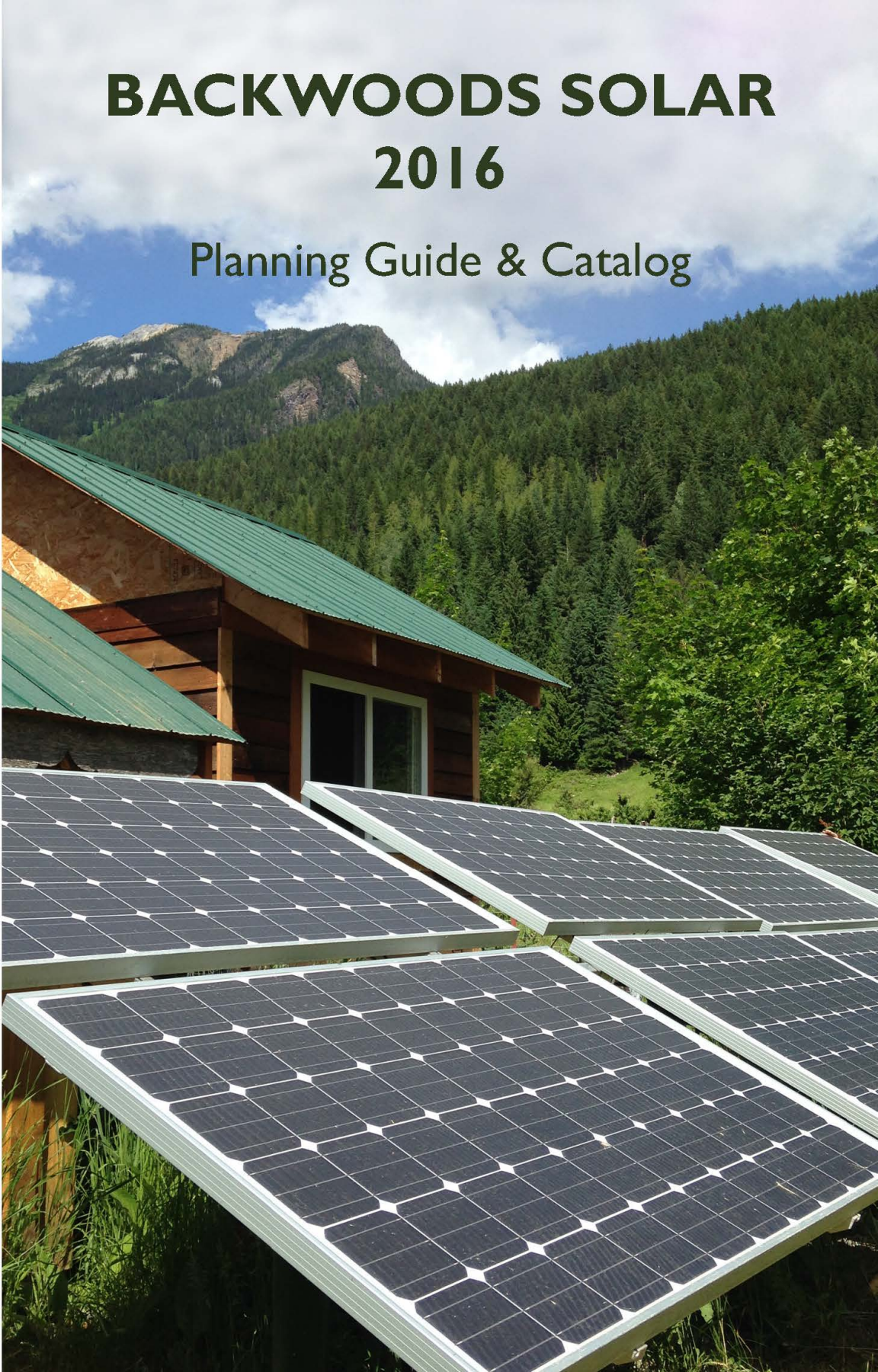
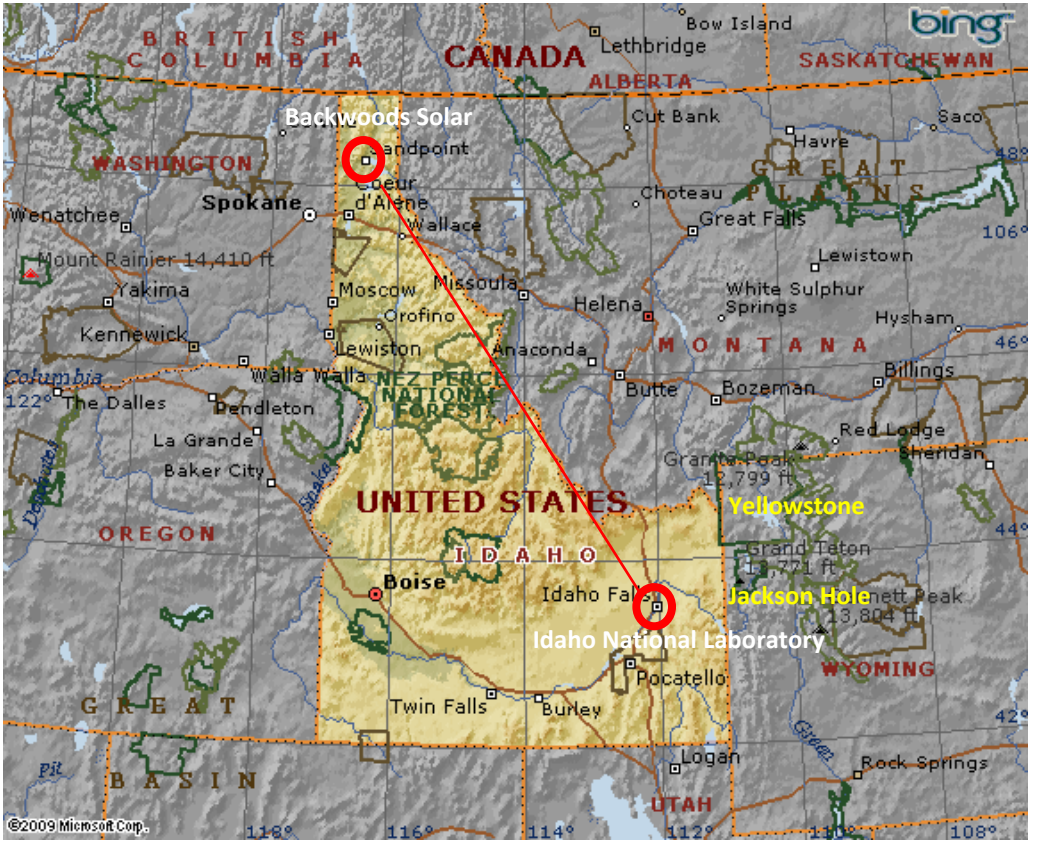
BACKWOODS SOLAR 2016

Planning Guide & Catalog

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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, AGM or GEL 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 120/240 volt AC current, the same as utility power for standard household lights, outlets, and appliances. Most solar homes use primarily 120/240 volt AC produced by the inverter. A few DC circuits can be 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 120/240 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 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 string by sunlight tolerant solar interconnect wiring. Several strings 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 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 300 to 8000 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 on next page

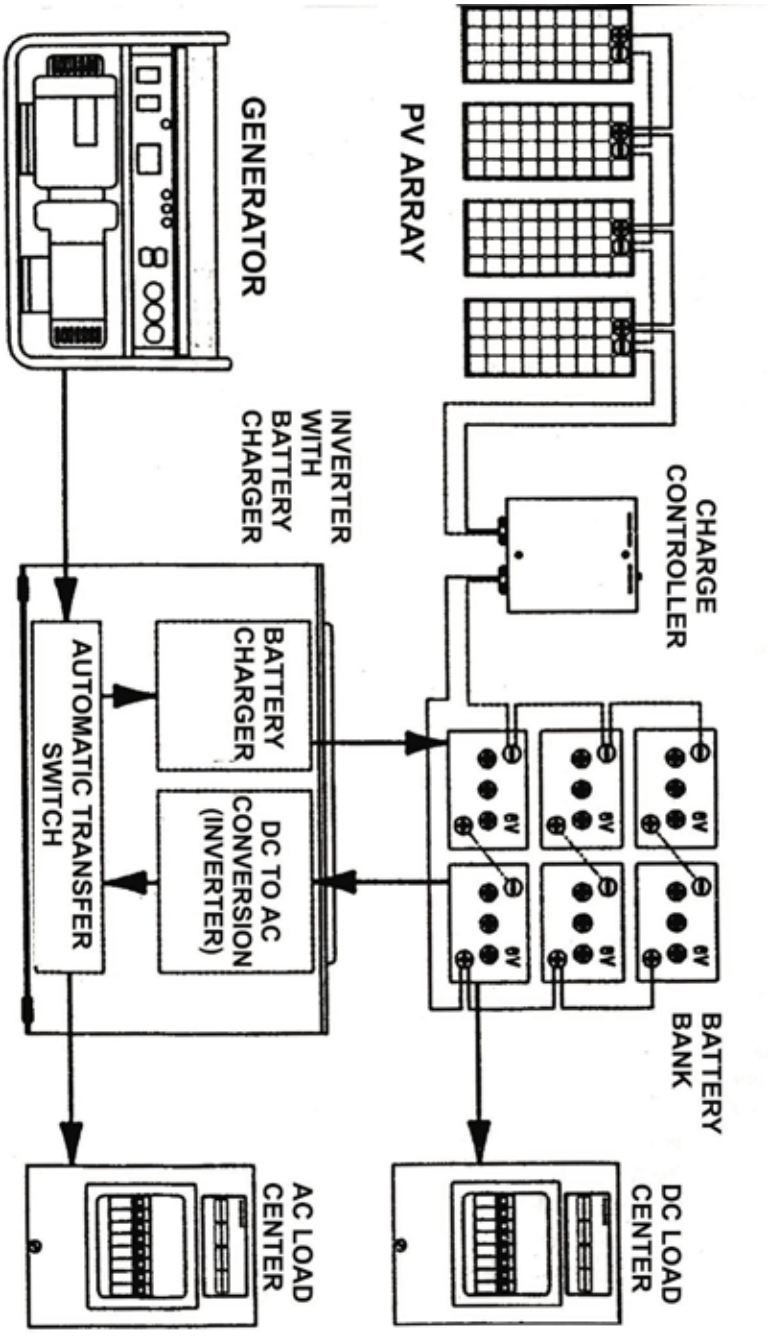
FUSES or CIRCUIT BREAKERS are necessary in all DC wiring between the batteries and other power system components described, but not shown in the drawing. This prevents fires and equipment damage in event of a malfunction. Breakers may be separate components in their own box, or might be built into a 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 it would be to select, buy, and install all those parts separately. The power room is simplified, with just a few main components: power center with charge control attached, a standby inverter-charger, and a battery box on the floor. Some power centers 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 37 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 31 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 educational books followed by order blanks and technical charts for wire sizing, battery sizing and light levels.

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. For small 12V systems, we sometimes 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.

Our office currently uses an XW system with sealed batteries as an Uninterrupted Power Source (UPS). This serves as back-up during power failures.

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 120/240 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 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 with the exception of more efficient energy star models using less than 450 kWh/year:

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.

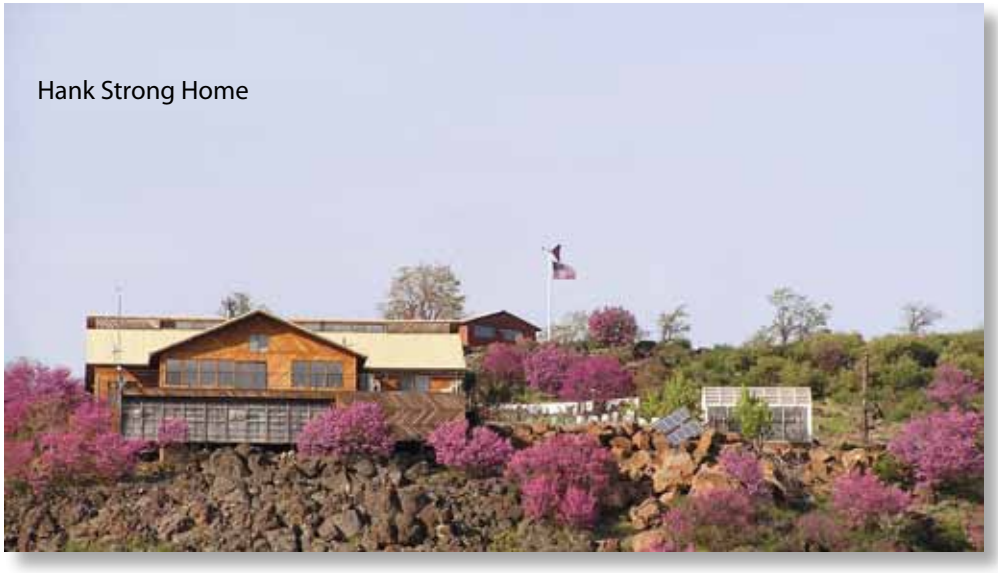
STILL — Independent electrical power is not quite a 'turnkey' appliance like a central heating system with sales and service people knocking at your door. Many independent homes are in remote places, where the owner is the prime decision maker, meter reader, and service person. A practical solar electric 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 never get discharged below 50 percent. This is done by watching the meters and if needed, running the generator to supplement shortfalls due to extended no-sun weather. Flooded batteries require regular maintenance. Every month or two, all battery cells 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. Sealed batteries, such as AGM, Gel and Silicon-Salt do not require the same maintenance as flooded batteries and should never be equalized. Routine and strict monitoring of equipment that measures state-of-charge and battery health should be done continually. 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?



Because life-styles and power usage vary so widely between individuals, a rural off-grid solar electric home can be set up anywhere from $1,200 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.

Wind 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 can be 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 $4,000 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 $3,500 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 other side of a wall from the 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 80 degrees F, if possible. 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. We highly recommend a generator 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 off-grid solar electric homes. This is a little different than you might expect for utility connected homes, and the difference is essential. If you live in a utility connected home, some of these coices may not be relevant, such as...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, or 2 - 4 watt LED spotlights 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 or LED lights using significantly less power of regular bulbs while giving the same brightness and color. For compact fluorescents 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

Most computers run on any inverter and we believe that they do not require a "true sine wave" inverter. However, we recommend a true sine-wave inverter anytime a component has an internal circuit board.

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. 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 & DRYER

Modern horizontal axis, Energy Star washing machines are reasonably efficient with water and electricity but do require a good quality true sine wave inverter to run. These are the best style to use for full time off-grid living.

Top loading washing machines also work but use more water and electricity than a horizontal axis so they are not ideal for an efficient off-grid household. The benefit to a top loader is that they are less expensive and usually work fine with a modified sine inverter, 1500 watts or larger.

Gas heated clothes dryers work fine for off-grid use. They use a little electricity to spin the drum and ignite the gas. 240 volt AC electric dryers are not usually used for off-grid since they use massive amounts of power.

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. Ideally avoid a gas range with a glow-bar in the oven, however this is getting harder to find. 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 or LED 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, DVD, 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/DVD 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, DVD/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. LCD and LED televisions are most efficient but do require a sine wave inverter.

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.

INTERNET

Many companies offer high speed satellite internet services, no phone line required. An excellent choice in most remote areas for off-grid homes. Many cellphone companies also offer an internet card that can be connected to your computer.

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 AN OFF-GRID HOUSE FOR ENERGY EFFICIENCY

AC BREAKER BOX: An inverter produces 120/240 volt AC. Many inverters that we sell now can accommodate both 120/240V circuits. We can assist you with the proper breaker sizing for your box. 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.

METERING WIRES in your home should be kept away from AC wires because all inverters can create some level of interference. Make sure to use shielded, twisted pair for your telephone and meter wiring to minimize the effect of cross talk and noise.

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: You might consider and discuss with us a few DC circuits in the house for those items that can save energy by using DC power directly from your battery. 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 VOLTAGE CONVERTER products found in 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. (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 Magnum, Outback, Schneider Electric, 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 EXAMPLES	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
Coffee Maker	300	1	300
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

Cliff Kalfaian's Home

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

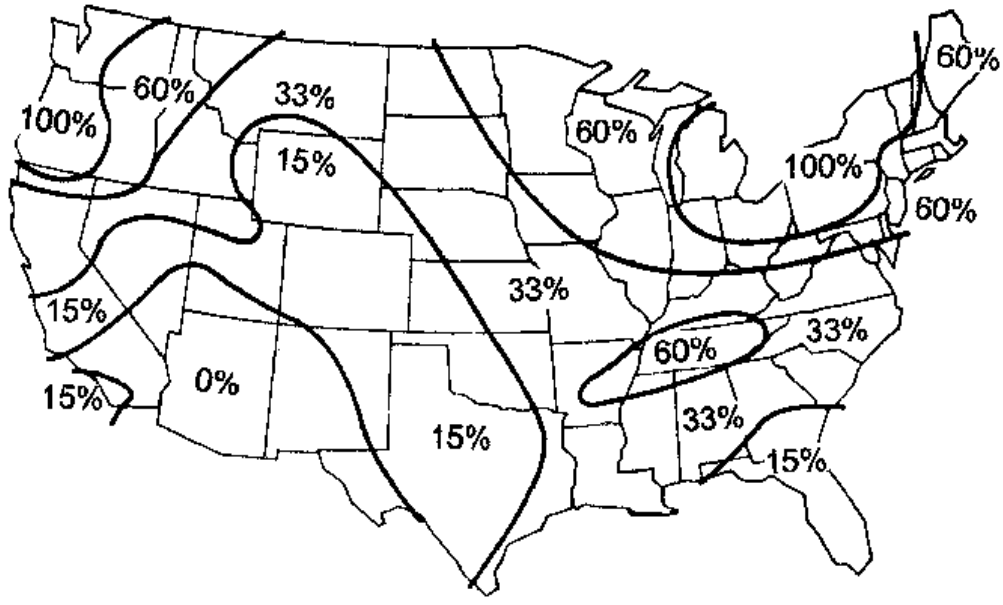
HOW MANY WATTS OF SOLAR MODULES ARE NEEDED?

On a fully sunny day, each solar module produces the equivalent of 4-5 hours of its maximum charging ability. Divide your total watt-hours needed each day by four or five. 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 26.



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.

We have updated many of the system examples to utilize the larger 60 cell solar modules with an MPPT charge controller. This has increased the array wattage significantly without increasing cost as these larger "grid-tie" type modules are much less expensive and more readily available.

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. Smaller systems may start with a less expensive battery bank that will last for four to five years; and then upgrade to a more expensive high-capacity battery bank for a long term 10 – 15 year storage application. 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 .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 60 - 125 watts of solar to power a few 12V lights and stereo. Closer to 250 watts of solar allows a lot more light, a 12V TV, 12V water pressure system and a small modified wave inverter for some power tools and non-sensitive electronics. Northern winters will require backup charging with a generator. One or two pairs of 6V deep cycle golf cart batteries make a 12V set.

SOLAR: 60-280 Watts: Smaller 60W or 90W modules to two 145W modules
CHARGE CONTROL: 12-35 Amp PWM Controller
METERS: Trimetric Battery Meter, optional but recommended
HARDWARE: QO DC Breaker box or Midnite Inverter disconnect, solar and inverter fuses and connecting wires, as needed
BATTERIES: 2 - 4 Trojan T-105s and cables
INVERTER/CHARGER: None or a mid-range inverter like the Magnum 1512, 1500W 12V Modified Wave Inverter with RC50 Digital Display Remote

Recommended Generator: Honda EU3000

#2 CONSERVING COTTAGE

$4,000 - $9,000

Produces about 1.5 - 3.0 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 TV, DVD or satellite receiver, stereo, and limited use of vacuum, 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 can be 12V but should be 24V if expansion is intended. If you have high end electronics that are sensitive to modified wave inverters make sure to choose a sinewave option.

SOLAR: 375 - 750 Watts: Three 250W solar modules with post mount (roof mount would be the lower end)
CHARGE CONTROL: 30A or 60A MPPT Controller w/ Temp Sensor
METERS: Trimetric Battery Meter, optional but recommended
HARDWARE: Midnite inverter disconnect, solar and inverter fuses and connecting wires as needed, Midnite lightning protection
BATTERIES: 12V or 24V battery bank consisting of (6) T105s or up to (8) L-16RE-Bs, cables and venting
INVERTER/CHARGER: Magnum 2212, 2200W 12V Modified Wave Inverter (for non sensitive equipment) with RC50 Digital Display Remote or a Magnum 2812, (2800W, 12V) or MS4024 Sinewave Inverter (for homes with sensitive electronics)

Recommended Generator: Honda EU3000 or larger

EXAMPLES

#3 CONSERVING FAMILY HOME

$8,500 - $15,000

Produces about 4-6 usable kilowatt-hours on a sunny day

Year round home for 1 to 3 people. Provides 120V AC power for lighting, vacuum, washer, kitchen appliances & microwaves, DC or 120V AC well pump, color TV, DVD, 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 using high load appliances, such as a washing machine. We would recommend that this system should be set up with a 24V or 48V battery bank and an automatic generator start for battery charging should be considered.

SOLAR: 1000 - 1500 Watts: Six 250W or larger solar modules with mounts
POWERCENTER: Magnum Mini-Panel system (240V) with 4000W, 24V sinewave inverter, 60-80 Amp MPPT charge controller, RC50 Remote (or ARC50, if you want auto-gen start), string combiner, lightning protection and all cabling.
METERS: Trimetric Battery Meter
BATTERIES: Eight to sixteen L-16s and cables

Recommended Generator: Honda EU7000is or larger

#4 ACTIVE FAMILY SOLAR HOME

$13,000 - $25,000

Produces about 6-10 usable kilowatt-hours on a sunny day

More power for a family of 3 to 4, or a home office. Includes the loads in Example #3 plus power for a high efficiency refrigerator or energy efficient chest freezer as well as extensive computer use. Washing machine and 120V well pump run from inverter AC, but uses generator back-up if weather remains overcast. 48V battery is recommended, especially if future expansion is planned. Systems of this size typically utilize industrial class batteries.

SOLAR: 2000 - 3000 Watts: Six to Twelve 250W or larger solar modules, with mounts.
POWERCENTER: Magnum Mini-Panel system w/ 4400W, 48V sinewave inverter, 60-80 Amp MPPT charge controller, RC50 Remote (or ARC50, if you want auto-gen start), string combiner, lightning protection and all cabling.
METERS: Trimetric Battery Meter
BATTERIES: Eight to sixteen L-16s or Rolls/Surrettes or HuP Solar One and cables

Recommended Generator: Honda EU7000is or larger

EXAMPLES

#5 LARGE HOME / SMALL BUSINESS

$28,000 - $40,000

produces about 12 - 18 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. 48V is recommended for battery voltage. Includes automatic generator start as batteries or loads require. A 48 volt system requires 6-volt batteries in multiples of 8. This example is simplified by factory assembled equipment.

SOLAR: 3000-4000 WATTS: Twelve to Eighteen 250W or larger 60 cell modules, mounts and wiring
MAGNUM PANEL or an integrated power system with 1 or 2 inverters and MPPT charge controllers, lightning protection, meters, etc.
BATTERIES: Surrette 4KS21PS or Solar One (HuP)

Recommended Generator: Honda EU7000is or larger

#6 HIGHER POWER SYSTEM

$45,000 -$53,000

produces about 16-24 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 4000-6000 WATTS: 250W or any of the larger 60 cell modules
MAGNUM PANEL or an integrated power system with 1 or 2 inverters and MPPT charge controllers, lightning protection, meters, etc.
BATTERIES: Surrette 4KS25PS or Solar One (HuP)

Recommended Generator: Honda EU7000is or larger

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 be 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.

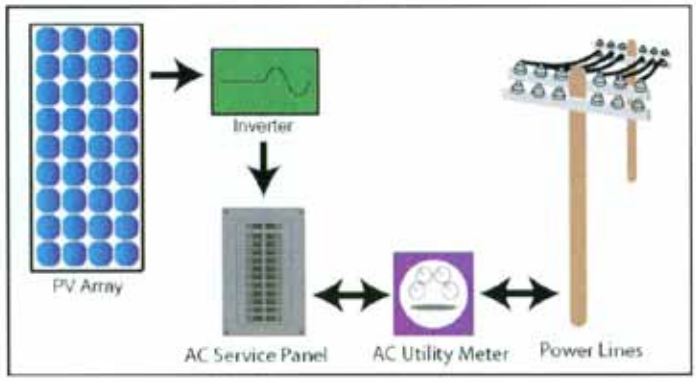
BACKUP FOR UTILITY POWER OUTAGE

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 Schnedier Electric 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!

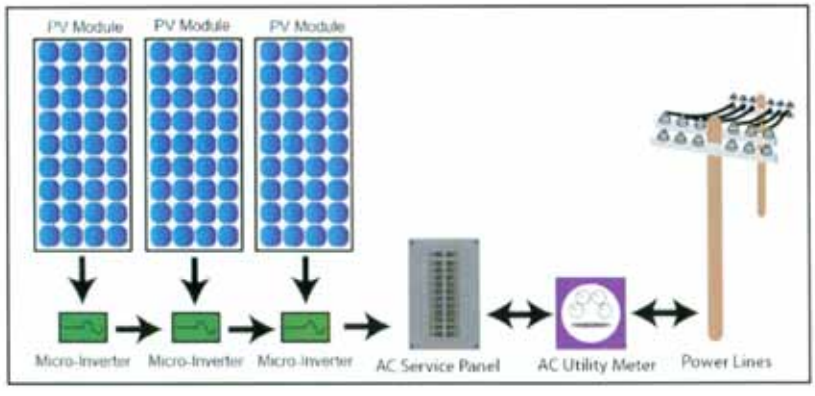
This standby inverter and battery system can automatically support a few selected emergency needs during short utility outages. When the utility fails, the system can instantly deliver power to a computer, cash register, pellet stove, or lights for frequent but short utility outages. Batteries are kept 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



GRID-CONNECTED SYSTEMS

AC COUPLING FOR BACK-UP POWER

Most grid connected solar systems do not include a method for storing the power that the system is producing and will shut down during a utility power outage. When the grid goes out, so does your solar system. By adding batteries, you can store the energy that the solar array is producing and use it during an electrical outage. What makes Backwoods Solar and other off-grid focused companies uniquely qualified to design and sell AC Coupled systems is that we truly understand battery storage systems. Many grid-tie solar installers haven't worked with batteries before, and many choose to continue to not work with batteries. That doesn't mean that it has to be daunting for the homeowner.

Backwoods has made this easy by designing several kits with Magnum PAE inverters and maintenance-free sealed AGM batteries. Each system is based on the length of time and size of the loads that you want to back-up during an outage. Most of the components come prewired, so with the addition of a critical loads sub-panel, you can start storing energy for use when you REALLY need it, when the lights go out everywhere else.

The systems continue to work during daylight hours, charging the batteries and providing power to the back-up loads throughout the black-out period. So day or night, you will have power for use in your home.

HOW AC COUPLING WORKS

AC Coupling is the process of tying in an additional battery based, off-grid inverter/charger. The inverter/charger works alongside your existing grid-tie string or micro-inverters, keeping the system running during a power outage.

A critical loads sub panel is necessary for this application. The "critical loads" sub panel is an additional breaker panel that is separate from a building's main breaker panel, designated only for appliances backed up during power outages. When we design and size the back-up portion of an AC Coupled system, we look at it similarly to a stand-alone off-grid system or micro-grid system. The system becomes "islanded" during an outage, functioning very similarly to a traditional off-grid system without grid input. There are a couple of unique differences with an AC Coupled system in terms of sizing to match the existing grid-tie array and the lack of charge controllers. We go into more detail about this further along in the article.

When the grid is active, power is flowing through the Magnum inverter/charger to the batteries to maintain their charge. Your grid connected inverter will function normally, selling power back to the grid and off-setting the loads in both the main panel and sub panel.

When a black-out occurs, the Magnum inverter/charger seamlessly begins to invert power from the battery bank to power only the loads in the critical loads sub panel. The grid connected inverter cannot sense the disconnect of the main power supply due to the Magnum being online and continues to feed power to the system.

Adding a Grid-Tie Retrofit Kit to your existing grid-tie system doesn't require any change to the existing solar wiring. The most complicated wiring will be the moving of the loads you want to power during a utility outage to breakers to the new back-up "critical loads" sub panel. The AC output of the existing grid-tie system will also be moved to critical loads sub-panel.

Backup batteries must be protected from overcharging during grid outage periods. Magnum Energy PAE inverters can be programmed to change their output frequency slightly by setting the battery type for "Custom Settings". When in this mode, the Magnum inverter will shift its frequency to 60.6 Hz when the battery voltage gets to 4 volts higher than the absorb-voltage in a 48 volt system. This will cause the grid-tie inverter to turn off for 5 minutes, stopping the battery from charging and allowing the loads to be powered from the batteries. After 5 minutes the grid-tie inverter turns on again and begins charging the batteries. This process repeats as

long as the grid-tie system is making more power than the house loads are using.

As a secondary safety mechanism, Backwoods Solar provides a relay that communicates with the Magnum router to disconnect the grid-tied inverter and the solar array when the grid is inactive, the sun is shining and more power is being produced than consumed through the critical loads sub panel. As in the method above, when the battery voltage climbs to a pre-set voltage the relay will trip, disconnecting the grid-tie inverter. When the loads pull the voltage of the batteries down again to a lower pre-set voltage the grid-tied inverter and solar array will come back online (there is a 5-minute timeout that is preset in all grid-connected inverters that will need to progress before coming back online).

HOW DO I SET-UP A CRITICAL LOADS SUB PANEL

First, determine what things you can't live without during a power outage. Most of the time it would be a refrigerator, some light and power circuits, and perhaps a well-pump, etc. The minimum amount of loads that you transfer results in a reduction in the amount of batteries that are required to power the loads.

Once you have determined the loads that you want to back-up and the amount of time you want to be prepared to back them up, we can help you determine the size of the battery required. This type of work should be done by a qualified electrician or electrical contractor and permitting may be required in some jurisdictions.

SIZING THE BATTERY BANK

First think about the length of time that your power is typically out, a couple hours to multiple days. This is going to determine, along with the critical loads size, the total capacity needed within the battery bank. In an effort to simplify the process, all of our systems battery banks are shown in watt-hours (Wh).

The total amount of watts your critical loads consume times the length of time that you want to back-up those loads (duration of outage) will determine the size of the battery bank for your system. Plan for the worst case scenario in terms of the weather. Although the sun may be shining during the daylight hours of an outage, most of the time we experience outages during severe weather storms that have low-light conditions. This means that you may not experience the full output of power from your solar array.

SIZING THE AC COUPLED, RETRO-FIT OVERALL SYSTEM SIZE

Which AC Coupled system is for you? The Magnum inverter needs to have a 10% higher wattage than the production wattage of your solar array after derating for system inefficiencies. If you have multiple grid-tied string inverters wired in parallel within your system, it is possible to only utilize one of the inverters and a portion of the array for back-up purposes. For systems with micro-inverters, if you have multiple strings of micro-inverters wired into your main panel, it is possible to only utilize the same methodology and only use a portion of the array and inverters for back-up purposes.

EMERGENCY PREPAREDNESS

Many residents of Florida and other hurricane alley states have called Backwoods Solar for information about back-up systems for their homes. Whether the cause of a power outage is a hurricane in Florida, an ice storm in the Midwest, a snowstorm in the inland Northwest (home to Backwoods), California style rolling outages during high use times of year, or just a good old-fashioned brown-out or the large storms that affected a large portion of the Eastern US in 2012, people are always calling us looking for a way to keep critical (and some not-so-critical) loads operating.

There are several different ways that you can prepare for a power outage that lasts from hours to days. A battery-based inverter system, a solar powered battery/inverter system, or back-up

generator systems are all possible solutions. As you look toward this winter, or next hurricane season, these options can help maintain your lights, refrigeration, security system and even the television. Like a UPS (un-interruptible power supply) for your computer, these systems for your home will keep the lights on, when everyone else's are off.

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 Schneider Conext XW+, Outback Radian or VFXR/FXR systems and a battery bank is a complete package for back up power. When solar modules are added to your design it also offers you the opportunity to sell power to the grid!

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.

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.

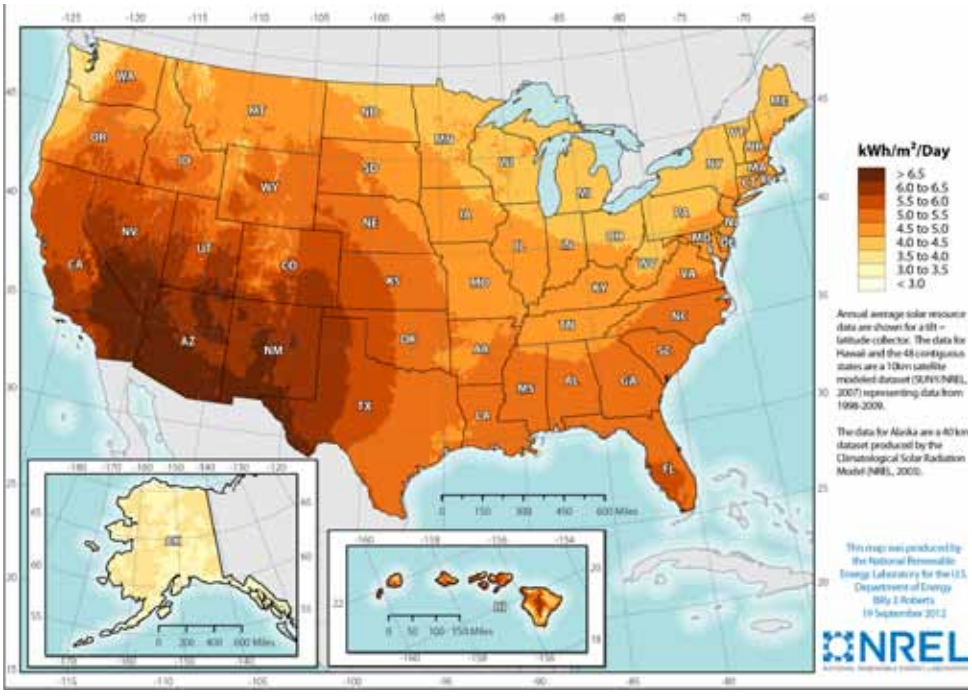
GET HELP AS NEEDED. Some electricians may not be familiar with low voltage equipment, but they can certainly help you with installation of conduit, underground cable, and wiring the home safely. Books on design and safety are at the end of this catalog.

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.

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. 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. 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. The Backwoods Solar website also has a very easy to use sizing calculator for grid-tie systems. It shows the size of the system you need based on your zip code and you usage. It also illustrates payback time using your utility rate. Links for rebates and incentives for your area are also shown.

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. _____

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. 36, 60 or 72 cells are built into a 4 to 23 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.

Module availability and pricing can change quickly. We've listed our most reliable module options with current pricing (at time of printing). For more brands/models and current pricing see our website or give us a call.

24V MODULES

S-QCELL-315W

QCELL POLY
315 Watt, 24V

This 72-cell, German-engineered, QCell module is one of the strongest in the market with one of the best warranties in the industry. It's a large module with a surface area of 21.5 square feet. This module is optimized for high energy density per square foot which reduces the balance of system costs.

VIKRAM MONO
190 Watt, 24V

The true 24V modules is getting harder to find these days but the Vikram monocrystalline solar module fits the bill as a true 24V option for off-grid and grid-tie use.

S-VK-190

ITEM#	S-VK-190	S-QCELL-315W
WATTS	190	315
CELLS	72	
VOLTS (Vmp)	37.41	37.3V
AMPS (Imp)	5.08	8.45A
OPEN CIRCUIT VOLTAGE (Voc)	44.4	45.3V
SHORT CIRCUIT-CURRENT (Isc)	5.58	9.02A
SIZE	52.1" x 38.7" x 1.42"	77.6" x 39" x 1.57"
WEIGHT	30.42	51.8 lbs
WARRANTY	12/25 years	12/25 years
COUNTRY	India	South Korea
CELL TYPE	Poly	
FRAME	Anodized Aluminum	
CABLE TYPE	MC4	H4 Connectors
UPM SIZE*	"B"	"D"
PRICE	**$180**	**$309**

* See pages 39-42 for our racking & post mount size charts.

THESE SHIP BY TRUCK FREIGHT ONLY. Call for freight quote.

QCELL POLY & MONO

260 - 275 Watt

Q-Cell polycrystalline panels received Photon Magazine's award for Best Polycrystalline Solar Module in 2013 in a ranking of 151 panels from around the world. A de-rating spec of only 0.6% per year places them in the top tier of long term durability and performance. Standard industry size and electrical specs for a 60 cell module make them highly compatible with similar, existing panels or ideal for a brand new array.

All Q-Cell panels carry UL and CE certification making them viable for installations just about anywhere.

Minimum Requirements for battery charging:
MPPT Charge Controller plus:
1 module for 12V systems
2 modules for 24V systems
3 modules for 48V systems

QCELL-275W-BB

QCELL-260W-BLK

ITEM#	S-QCELL-260W-BK	S-QCELL-275W-BB
WATTS	260	275
CELLS	60	60
VOLTS (Vmp)	30.46V	31.73V
AMPS (Imp)	8.53A	8.74A
OPEN CIRCUIT VOLTAGE (Voc)	37.77V	38.8V
SHORT CIRCUIT-CURRENT (Isc)	9.15A	9.21A
SIZE	65.7" x 39.4" x 1.26"	65.7" x 39.4" x 1.38"
WEIGHT	41.45 lbs	41.88 lbs
WARRANTY	25 years	
COUNTRY	South Korea	
CELL TYPE	Poly	Mono
FRAME	Anodized Aluminum (Black)	
BACKSHEET	White	Black
CABLE TYPE	PV4 Connectors	
UPM SIZE*	"C"	
PRICE	**$244**	**$313**

* See pages 39-42 for our racking & post mount size charts.

Discounts available for pallet and truckload quantities. Just ask!
THESE SHIP BY TRUCK FREIGHT ONLY. Call for freight quote.

ET SOLAR POLY
255 Watt

ET Solar produces a wide variety of PV modules ideally suited for all types of installations: residential, commercial, industrial and utility. These modules work well for larger off-grid installations using an MPPT charge controller, or grid-tied systems.

Minimum Requirements for battery charging:
MPPT Charge Controller plus
1 module for 12V systems
2 modules for 24V systems
3 modules for 48V systems

	S-ETSOLAR255
WATTS	255
CELLS	60
VOLTS (Vmp)	30.91
AMPS (Imp)	8.25A
OPEN CIRCUIT VOLTAGE (Voc)	37.54V
SHORT CIRCUIT CURRENT (Isc)	8.82A
SIZE	64.57" x 39.06" x 1.57"
WEIGHT	41.45 lbs.
WARRANTY	25 years
COUNTRY	China
CELL TYPE	Poly
FRAME	Anodized Aluminum (Black)
CABLE TYPE	MC4 Connectors
UPM SIZE*	"C"
PRICE	**$235**

* See pages 39-42 for our racking & post mount size charts.

SHIP BY TRUCK FREIGHT ONLY. Call for freight quote.

12V MODULES
VIKRAM
100 and 150 Watt

Vikram Solar offers a very reliable high quality 12V module at a very good price. The modules are manufactured with tempered glass and twin-wallled anodized aluminum frames. A power rating tolerance of +5WP ensures that you get a high return on your investment.

vikramsolar

ITEM#	S-VK-100	S-VK-150
WATTS	100	150
VOLTS (Vmp)	17.99	17.85
AMPS (Imp)	5.57	8.41
OPEN CIRCUIT VOLTAGE (Voc)	21.84	22.58
SHORT CIRCUIT CURRENT (Isc)	6.11	8.7
SIZE	45.3" x 26.2" x 1.34"	39.8" x 38.7" x 1.4"
WEIGHT	17.6 lbs	23.4 lbs
WARRANTY	5/25 years	5/25 years
COUNTRY	India	
CELL TYPE	Poly	
FRAME	Anodized Aluminum	
CABLE TYPE	Junction Box	MC4 Connectors
UPM SIZE*	"A"	"A"
PRICE	**$100**	**$150**

S-VK-100W

S-VK-150W

* See pages 39-42 for our racking & post mount size charts.

These modules can ship via UPS in SMALL quantities. Larger quantities will ship via TRUCK FREIGHT. Call for freight quote.

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

SMALL PV MODULES
DASOL
10, 30, 60 Watt, 12V

S-SOLAR10

S-SOLAR30

S-SOLAR60

The 10, 30 and 60 watt Dasol modules are tempered glass laminated and crystalline silicon based with a sturdy aluminum frame. Ideal for directly powering small DC fans, fountain pumps, and fence chargers. The 10 and 30 watt modules have a junction box with attachment points. The 60 watt modules have MC4 connections. Warranty: 10 year limited. Made in China.

ITEM#	S-SOLAR10	S-SOLAR30	S-SOLAR60
WATTS	10	30	60
CELLS	18	18	18
VOLTS (Vmp)	18V	18V	18V
AMPS (Imp)	.55A	1.67A	3.33A
OPEN CIRCUIT VOLTAGE (Voc)	22.3V	22.3V	22.3V
SHORT CIRCUIT-CURRENT (Isc)	.61A	1.82A	3.64A
SIZE	14.6" x 9.8" x .7"	25.6" x 13.8" x 1"	25.6" x 26.2" x 1.38"
WEIGHT	2.42 lbs	5.95 lbs	11.68 lbs
WARRANTY	10 year limited		
COUNTRY	China		
CELL TYPE	Crystalline Silicon		
FRAME	Anodoized Aluminum		
CABLE TYPE	Junction Box	Junction Box	MC4 Connectors
PRICE	**$38**	**$70**	**$121**

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 country, 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 risen. 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. Some of the roof mounts we sell come with their own flashing and sealants. 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: Ground mount system.

SOLAR MODULE LOCATION

TYPES OF SOLAR MOUNTS

POLE or POST 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 can help 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 good 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.

GENERAL SPECIALTIES
UNIVERSAL POST MOUNT

UPM 8X

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.

See chart on the next page for pricing and sizes.

UPM SIZE CHART

To use chart, find the "UPM Size" on the module you're interested in on pages 33-37 to determine the proper column on this chart. Follow the column down to find the number of modules you will be mounting on each post mount.

ITEM CODE & POST SIZE INFO	SIZE "A" Smaller 12V panels 26.5" x 59.5" (10.94 sqft MAX)	SIZE "B" Midsize 12V & 24V 32.5" x 62.5" (14.10 sqft MAX)	SIZE "C" Larger 60cell 39.5" x 65.5" (17.96 sqft MAX)	Size "D" Larger 72cell 39" x 77" (20.84 sqft MAX)
UPM3X For 4" post Sched 40/80	**$340** 3 modules	**$340** 2 modules	**$340** 2 modules	**$340** 1 module
UPM4X For 4" post Sched 40/80	**$480** 4 modules	**$480** 3 modules	N/A	**$615** 2 modules
UPM6X For 5" post Sched 40/80	**$695** 6 modules	**$695** 4 modules	**$695** 4 modules	N/A
UPM6X-CUSTOM For 5" post Sched 40/80	N/A	N/A	**$695** 3 modules	**$810** 3 modules
UPM8X For 6" post Sched 40/80	**$880** 8 modules	**$880** 6 modules	N/A	N/A
UPM10X For 6" post Sched 40/80	**$1110** 8 modules	**$1110** 8 modules	**$1110** 6 modules	**$1220** 4 modules
UPM10X-HD For 6" post Sched 40/80*	**$1425** 12 modules	**$1425** 10 modules	**$1425** 8 modules	**$1540** 6 modules
UPM12X-HD 9 modules use 8" post Sched 40/80, 10 modules use 8" post Sched 80 only. **	SPECIAL ORDER	SPECIAL ORDER	**$2840** 9-10 modules	N/A
UPM12X-HD-D For 8" post Sched 80 only**	SPECIAL ORDER	SPECIAL ORDER	N/A	**$3135** 8 modules
UPM 15X For 8" post Sched 80 only**	SPECIAL ORDER	SPECIAL ORDER	**$3199** 12 modules	**$3345** 10 modules
UPM 18X For 8" post Sched 80 only**	SPECIAL ORDER	SPECIAL ORDER	**$4255** 15 modules	**$4395** 12 modules

* Add $200 to upgrade tee socket from 6" to 8" (at time of ordering UPM)
** Add $275 to upgrade tee socket from 6" or 8" to 10" (at time of ordering UPM)

UPM10X and higher must ship via FREIGHT TRUCK. Please call for a quote.

SIDE OF POLE MOUNTS

ITEM #	Module Compatibility*	Pipe Size	# of Modules	Price
S-SOP-K	"A" or "B"	3", Sch 40	1	**$216**
S-SOP-S	"A"	3", Sch 40	2	**$265**
S-SOP-X	"C"	3", Sch 40	1	**$240**
S-SOP-X-D	"D"	3", Sch 40	1	**$290**
S-SOP-Y	"B" or "C"	4" Sch 40	2	**$325**
S-SOP-Y-D	"D"	4" Sch 40	2	**$375**
Mount can accommodate a 4", Sch 40 pipe for taller installations add:				**$84**

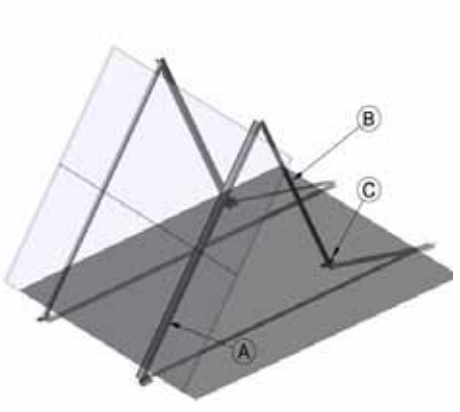
* See Solar Module section and page 40 for specific panel recommendations.

ROOF & WALL MOUNTS

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

Sturdy, 2" x 1-1/2" x 1/8" extruded Aluminum Rails (A) securely attach to your choice of solar module(s). The Back Legs (B) adjust to multiple tilt angles (most folks adjust just twice a year, for summer and winter sun). L-Feet (C) anchor the assembly to your mounting surface - a south facing roof or wall, deck or railing, or even an RV roof where tilt-up legs aren't normally desired.

Mounts include all stainless steel nuts & bolts required to mount modules to the slotted rails and to attach support legs and L-feet to rails. Customer provides appropriate anchor bolts/ screws to attach the feet to your structure. With illustrated instructions.



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	Rail length	Price
S-RAILS	"A" or "B"	2	68.5"	**$82**
S-RAILS-SINGLE	"A" or "B"	1	36"	**$75**
S-RAILS-LRG	"C"	2	83.5"	**$110**
S-RAILS-LRG-72	"D"	2	83.5"	**$110**
S-RAILS-SNG-LRG	"C" or "D"	1	44"	**$90**
S-RVRAILS	"A" or "B"	2	68.5"	**$56**
S-RVRAILS-LRG	"C" or "D"	2	83.5"	**$75**

* See Solar Module section and page 40 for specific module recommendations.

SIMPLE RV 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 has back mounted holes drilled in the frame.

ITEM #	Description	Price
S-RV1	Single module RV roof mount	**$28**

ROOFTECH
RAIL-LESS MOUNTS

Roof Tech mounts are uniquely scalable for rooftop solar installations. Instead of placing solar panels on top of long rails, you simply fasten RT-[E] Mount brackets to rafters or anywhere else on the roof decking. Once panels are secured to the brackets, the system array is electrically bonded. Each mount comes with butyl rubber flashing, renowned for its watertight performance and durability. The result is a visually seamless module installation.

The RT-[E] Mount AIR offers all the benefits of RT-[E] Mount while providing three inches of clearance from the roof surface to improve cooling in warmer climates. Ideal for PV installations that use a microinverter.

Both mounts are available for module frame thickness 31, 33, 35, 40, 46 and 50mm. 10 year warranty.

RT-[E] Mount (shown with End Clamp)

RT-[E] Air Mount

ITEM #	Description	Price
S-RT-MOUNT	Rooftech RT-[E] Mount	$14
S-RT-AIRMOUNT	Rooftech RT-[E] AIR Mount	$16
S-RT-END	End Clamp (specify 31, 33, 35, 40, 46 or 50mm)	$4.50
S-RT-MID	Mid Clamp (specify 31, 33, 35, 40, 46 or 50mm)	$5
S-RT-MICRO	Micro-Inverter Bracket	$5
S-RT-CABLEHLDR	Cable Holder	$1
S-RT-CABLEBRKT	Cable Bracket	$3

SNAPNRACK

Roof Mounting System

SnapNrack is a top-down roof mounting solution, load-tested and engineered for up to 150 mph wind loads. The rail is a lightweight anodized aluminum extrusion that is easy to transport, handle, and install. It is compatible with modules from virtually any manufacturer. Snap-in sliding channel nuts ensure quick and easy installation and precise alignment of module clamps. Every bolt in the system uses the same size wrench, making installation simple and minimizes the amount of tools needed. Standoffs and L-feet connect to the rails using the same snap-in channel nuts as the module clamps—no drilling required. Channels in the rail can be used for clean, simplified wire management. SnapNrack is engineered for excellent seismic, wind, and snow loading protection on all components. Its compact and efficient rail design ensures a low profile installation on any roof. Tilt-up can be achieved with pieces of cut rail and the tilt leg kit.

There are many components and configurations available to suit almost any situation. We suggest giving us a call to discuss your specific needs and let us design a SnapNrack system for you. Covered by a 10-year warranty.

SnapNrack Rail Sets - SnapNrack Rail Sets include black or clear anodized aluminum rail in either 122" or 162" lengths. They're available in packs of 2 or 6.

ITEM #	# of rails	Rail Length	Clear Frame	Black Frame
S-SNR-122-2-(COLOR)	2	122"	$130	$160
S-SNR-122-6-(COLOR)	6	122"	$332	$425
S-SNR-162-2-(COLOR)	2	162"	$168	$199
S-SNR-162-6-(COLOR)	6	162"	$440	$540
S-SNR-SPLICE-(COLOR)	Rail Splice Assembly, UL		$10	$10.50

SnapNrack Module Attachment Clamps - Mid Clamps & End Clamps are used to attach modules to rails. No drilling necessary! All clamps listed below are UL.

ITEM #	Description	Clear	Black
S-SNR-MC-SM-(COLOR)	Mid Clamp Kit (for panels1.20-1.48" thick), UL	$3.50	$3.75
S-SNR-MC-MED-(COLOR)	Mid Clamp Kit (for panels 1.31-1.77" thick), UL	$3.50	$3.75
S-SNR-MC-LRG-(COLOR)	Mid Clamp Kit (for panels 1.50-2.00" thick), UL	$3.50	$3.75
S-SNR-END-CU	Universal End Clamp Kit, UL	$5.75	NA

Please specify frame color (C for clear anodized aluminum or B for black) as well as the thickness of the module frame when ordering.

ALL ROOF MOUNT RAILS SHIP TRUCK FREIGHT. CALL FOR A QUOTE.

SNAPNRACK

SnapNrack Roof Attachment Components

SnapNrack offers a variety of roof attachment methods. Some require a combination of components. The Flashed L-foot is recommended for simple flush mounts to a roof with composition shingles. Roofs with tile or thick roofing material will likely require Standoffs. The Corrugated Roof Straddle Block allows attachment of an L-foot directly to structural members covered with corrugated metal without collapsing or crushing the ridge in the roof material. Configuring tilt angles from 0° to 10° simply require SnapNrack standoffs. A 5 ½" standoff on the lower rail and a 7" standoff for the upper rail allow adjustability for shallow tilts.

Flashed L-Foot

L-Foot

Corrugated Straddle Block

Seam Clamp w/ L-Foot

ITEM #	Description	Clear (-C)	Black (-B)
S-SNR-FLSHL-U	Flashed L-Foot, UL	$12	$12
S-SNR-LFT	Simple L-Foot Attachment	$3.5	$4
S-SNR-CORRBLOCK	Corrugated Metal Roof Straddle Block	$3.50	NA
S-SNR-MRB	Metal Roof Base with L-Foot	$9.75	NA
S-SNR-SEAMS-U	Metal Roof Seam Clamp with L-Foot,UL	$12	NA

Please specify color (C for Clear or B for Black) where applicable.

Please note: In addition to the wide variety of roof attachment options, SnapNrack manufactures many more accessories that we don't have room for that can be special ordered. Some of these include: Stand-off attachment options, Array Edge Screens to eliminate debris and critters from getting under the modules, Wind Screens for tilt up arrays, Micro-Inverter Attachment Kits, and Rail Covers for wire enclosure.

SnapNrack Residential Ground Mount System

The SnapNrack Series 200 PV module installation system is low profile and visually appealing. Their ground mount systems include everything necessary to install modules on a steel pipe frame with vertical posts up to 8 feet from grade. The SnapNrack ground rail and rail-to-pipe clamp is a multi-pole, fixed-tilt ground mount. It can be installed with tilt angles up to 45° and in locations that may see wind speeds up to 120 mph. Pricing and components will be specific to each system. Give us a call and let us design a racking system for you.

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's DuraTrack DA 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 DURATRACK DA TRACKER- This is a dual-axis tracker made for large arrays enabling it to capture the maximum amount of solar energy. It can hold 3-4kW of solar modules and accomodates up to 12 standard 60-cell modules. Powered by a sturdy 24VDC motor running a heavy duty azimuth gear drive. Mounts on a 8" ID schedule 80 steel pole. 10" poles will require an 8" section to be welded to the top.

Ten year limited warranty.

ITEM	Cell Size	Cells per Module	Generic Dims	# of Modules (Landscape)	Layout	Price
S-WS-DA-660-09	**6"**	60	39" x 66"	9	3 x 3	**$6330**
S-WS-DA-660-12				12	4 x 3	**$6330**
S-WS-DA-672-09	**6"**	72	39" x 77"	9	3 x 3	**$6495**
S-WS-DA-672-10				10	3-4-3	**$6495**

Custom configurations that aren't shown above are available to order.
Please give us a call to discuss.

These ship via TRUCK FREIGHT. Please call for a quote.

ZOMEWORKS SUN TRACKERS

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.

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. To ensure the correct mount is ordered give us a call to discuss your specific installation.

ITEM #	Pipe Size	ET SOLAR	QCELL		VIKRAM		PRICE
		255	260-275	315	150	190	
S-UTR020	2.5”	**1**	**1**	**-**	**1**	**1**	**$819**
S-UTRK40	3”	**2**	**2**	**1**	**2**	**2**	**$1668**
S-UTRF72	6”	**3-4**	**3-4**	**2-3**	**3, 4, 6**	**3-4**	**$2330**
S-UTRF90	6”	**5***	**5**	**4**	**5*, 7***	**5*-6**	**$2496**
S-UTRF120	6”	**6***	**6***	**5*-6***	**8, 9*, 10***	**7*-8**	**$2820**
S-UTRF168	8”	**7*-8-9***	**7*-8-9***	**7*-8***	**11*,12*,13* 14, 15**	**9*-10-11*-12***	**$4182**

* requires 1 extra rail set. ADD: $335 more than shown.

In order to receive the proper hardware for your installation, please state which module will be used when ordering.

These ship via TRUCK FREIGHT. Please call for a quote.

WIRING SOLAR MODULES

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 eves 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.

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, see page 190 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
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	184

Copper Wire Size and Length Table, 2% loss for 120 Volt Wiring

AMPS	WATTS	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	4/0
8	960	85	150	225	355	570	900	1450	1800	2900
15	1800	45	70	120	190	300	480	765	960	1500
25	3000	28	45	70	115	180	290	460	580	920
50	6000	---	23	36	55	90	145	230	290	460
100	12000	---	---	18	29	46	72	115	145	230

WIRING SOLAR MODULES



READY-TO-USE SOLAR MODULE INTERCONNECTS O-SOLARCBLE 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 modules with a junction box. The MC4, H4, & PV4 cables are a single 10 gauge conductor which get cut in half.

ITEM #	Purpose/Description	Length	Price
O-SOLARCBLE	Join two modules together	36 inches	$18
O-MC4-CABLE	One male & one female MC4 end	30 feet	$30
O-H4-CABLE	One male & one female Amphenol H4 end	30 feet	$30
O-PV4-CABLE	One male & one female Solarlok PV4 end	30 feet	$30
"Y" Connectors			
O-MC4-Y-MALE	2 Male, 1 Female for parallel connections	ea	$20
O-MC4-Y-FEMALE	2 Female, 1 Male or parallel connections	ea	$20

TWO CONDUCTOR JACKETED

10 gauge pair of stranded copper, one red, one black, in a sunlight resistant jacket. Use weatherproof fittings on next page. Allow about 30 inches per module, plus length to combiner box. For modules with junction boxes, order 30 feet per module.

ITEM #	Length	Price
O-SOLAR-2	1 foot	$1.80

CABLE CLIPS

These stainless steel clips keep cables neatly secured to the frame of module so that they do not hang below the array. O-CLIP holds 10-12 awg size wire. O-WILEY-CLIP holds one or two USE-2 cable(s) or one PV cable to module.


O-CLIP


O-WILEY-CLIP

SINGLE CONDUCTOR WIRE

Single 10 gauge or 12 gauge stranded copper wire type XLP-USE, tough sunlight resistant insulation. Simplified connection between modules wired in series to make higher voltage strings. Red insulating sheath for positive and Black sheath for negative. 12 gauge is available in black only. Order by the foot.

ITEM #	Length	Price
O-SOLAR10-RED	1 foot	$.50
O-SOLAR10-BLK	1 foot	$.50
O-SOLAR12-BLK	1 foot	$.50

ITEM #	Quantity	Price
O-CLIP	Bag of 10	$5
O-WILEY-CLIP	Each	$.75

WIRING SOLAR MODULES

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

STRAIN RELIEF - Thread size - 1/2" NPT, Cable Outer Diameter .394" to .551"

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

FLEXIBLE PLASTIC CONDUIT & WEATHER FITTINGS

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

OUTBACK FLEXWARE

PV Combiners

Two sizes for 8 or 12 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. 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 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. Breakers and fuseholders are not included but are the same as the ones used by the Midnite combiners, see next page.

ITEM #	Description	Size	Weight	Price
S-OBFWPV8	8 Circuit Combiner Box	15.2" x 9.2" x 3.9"	4.4lbs	$116
S-OBFWPV12	12 Circuit Combiner Box	15.2" x 12.7" x 3.9"	5.9lbs	$169

SOLAR COMBINER BOXES

MidNite Combiners

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. The MidNite Combiner and Disconnect is for use with 150 & 300VDC breakers. The 250 versions are for use with 200 - 250VDC charge controllers.

COMBINER BOXES

ITEM #	Price
S-MNPV3	$89
S-MNPV6	$108
S-MNPV6-250	$116
S-MNPV12	$170

ITEM #	Price
S-MNPV12-250	$170
S-MNPV16	$359
S-MNPV16-24	$359
S-MNPV16-250	$359

DISCONNECTING COMBINER

The MidNite Combiner and Disconnect is for use with 150 & 300VDC breakers. The 250 versions are for use with 200 - 250VDC charge controllers.

ITEM #	Price
S-MNPV6-DISCO	$185

BREAKERS & FUSES

ITEM #	Description	Price
S-MNEPV-XX	Breaker for 6, 9, 10, 15, 20, 30, 40, 50, 60, 63 Amps	$16
S-MNEPV-XX	80A and 100A dual slot breakers	$60
S-MNEPV-GFP63	63A GFP Breaker	$69
S-MN-FH	Fuse holder for KLKD fuse	$6.50
S-MN-FUSEXX	1A, 15A or 20A KLKD 600VDC fuse	$4
S-MNEPV-HV	15, 20, 30 or 50A High Voltage Breaker, 300V	$38
S-MNEPV-H6V	16A or 20A High Voltage Breaker, 600V	$130

FULL LINE OF MIDNITE PRODUCTS ARE AVAILABLE.

SOLAR COMBINER BOXES

MidNite Combiners & Disconnects

PRE-WIRED COMBINER BOXES

Some installations may benefit from a plug and play combiner. These combiners have fusing and bulkhead mount connectors already installed and wired. Low voltage versions use breakers. In an Aluminum rainproof 3R enclosure. Smaller versions are available. Cable connections for MC4 connectors. Versions for other connections are available.

LOW VOLTAGE VERSIONS

ITEM #	Price
S-MNPV4-MC4-LV*	$240

* Breaker included. Specify amperage - 1-20A

FUSED VERSIONS

ITEM #	Price
S-MNPV4-MC4	$188
S-MNPV8-MC4	$323

SolaDeck Combiners

Combine flashed roof penetration protection with the ability to transition, pass through, or combine solar PV strings with one weather tight enclosure. Combiners make installation faster and easier with a simple design and clear instructions.

Pass thru enclosures for simple residential pass thru from exterior wiring to interior attic space. Din rails and grounding blocks for wire transition. Combiners/pass thru boxes are used when you want to combine multiple stings and pass them through to interior wiring. 3" and 6" din rails to accommodate fuse holders. Negative and Positive bus bars available.

ITEM #	Description	Price
S-SD-PASSTHRU	Passthrough, AC/DC	$95
S-SD-COMBINER	Combiner Enclosure, AC/DC	$128
S-SD-2STRING	2 String PassThru Term Kit	$30
S-SD-FUSEHLDR	Fuseholder KLKD DIN Mount	$10

PRIMUS TURBINES

primuswindpower

- **Maximize Power in Winter**
- **Night Time Power Production**
- **Ideal for Hybrid combinations with Solar PV.**

The AIR Wind Turbine product line, acquired by Primus Windpower in 2013, is recognized across the industry as the standard for small, residential scale, off-grid wind power. Primus advocates a practical appoach to the application of wind power and how the AIR line is ideally suited to compliment solar PV systems during the least sunny, winter months of the year.

For Backwoods customers this can mean a significant reduction in generator runtime IF you live in an area of moderate or greater winter season winds. The smaller turbines, on a reasonably sized tower offer a cost effective approach to complimenting the shorter collection window that a solar array sees during the winter time.

The Air30 and Air X Marine models are intended for industrial applications of higher wind speeds where turbine noise is not an issue. A narrower blade design allows for peak production in higher wind speeds of 25-30 mph. More wind and power does mean more noise as well. More info about the Air40 and AirBreeze is available on our website.

Power is rectified to DC in the turbine. The DC voltage setpoint is field adjustable on the side of the turbine. Normal operating mode uses built-in electromagnetic regulation feedback to internally brake the turbine when voltage set-point is achieved. A simple control switch down the line sets the turbine to operate in normal charging mode, or in a slow-braking mode when extreme winds and storms are expected. Switch can be changed at a moments notice from one mode to the other.

Rotor diameter: 46”
Energy: Approx. 30kWh/mo at 12 mph
Startup windspeed: 8 mph
Factory specified voltage: 12, 24 or 48 volts
Permanent magnet brushless alternator
Turbine weight: 13 lbs
5 year limited warranty

PRIMUS TURBINES

TURBINES

ITEM #	Description	Price
W-PR-AIR30	Primus Air 30 Turbine	$849
W-PR-AIR40	Primus Air 40 Turbine	$849
W-PR-AIRBREZ	Primus Air Breeze Turbine	$1139
W-PR-AIRX-M	Primus Air X Marine Turbine	$1139
All turbines are available in 12V, 24V or 48V. Please specify when ordering.		

TOWERS

Continuing with their affordable and practical approach, Primus offers several tower options for their turbines.

The 27' and 45' tower kits use a simple cross-piece as a base and guy wires for structure. The steel pipe needs to be purchased locally as it is NOT included with the kit.

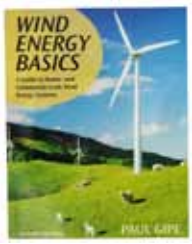
The 29' EZ Tower is a guy-wire supported tower which uses lightweight tubing (included) while providing plenty of strength. Two people can easily erect this tower in about an hour. Because the wind turbine and EZ Tower are lightweight, no winches or vehicles are needed to erect the tower. Depending on your soil conditions, a cement pad may or may not be necessary for proper anchoring. It's best to understand your soil conditions before you begin construction.

ITEM #	Description	Price
W-PR-TWR-27	Primus 27' Guyed Tower Kit (pipe not included)	$230
W-PR-TWR-45	Primus 45' Guyed Tower Kit (pipe not included)	$405
W-PR-TWR-29EZ	Primus 29' EZ Tower Kit (includes pipe)	$775

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 these 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.



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

ITEM #	Description	Price
E-WINDBASIC	Wind Energy Basics Book, 224 pages	$24

To Measure Your Wind

The hand held KESTREL 1000 POCKET METER offers reliable and accurate wind measurements at an economical price. Features a 1" impeller (user-replaceable, if damaged) with a large easy-to-read display. Includes the meter, a slip-on protective cover, neck lanyard, and CR2032 coin cell battery (avg life 300 hours). Weight: 3.6 oz. Dimensions: 4.8" x 1.9" x 1.1" / Five year warranty

The JARVIS 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 by recording wind speed, gust, and direction, as well as the time and date, temperature (with optional temp sensor), battery voltage, and other important wind parameters. Capable of recording wind speed from up to three anemometers.

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.

ITEM #	Description	Price
W-KE-METER	Kestrel 1000 Pocket Meter	$98
W-JARVISDLX	Jarvis Wind Data Logger	$415

HYDROPOWER

WATER TURBINES steadily charge 12, 24, or 48 volt batteries, working 24 hours a day every day. Compare this with solar modules that are in sunshine only 6 full-power hours a day, and that's just on sunny days. A hydro generator producing 10 amperes around 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 INDUCTION POWER

Low-Voltage Hydroelectric Generators

Hydro Induction Power is introducing a new unit, now the LV1500 (LV750 for low head, below 60'), with a larger motor. Along with renaming their previous unit as the LV800. The LV800 is ideal for sites with 2" pipe, and the new LV1500 for sites with 3" or 4" pipe. The new ratings for the LV800 are for direct battery hookup. At higher pressures (>150'), they can produce more when connected to an MPPT controller or a high-frequency transformer box, which is available upon request.

All models are available in DC for direct battery hookup and grid- intertie. They are also available in 3-phase AC for use with their transformer box.

LV800 (LV400 is available for sites with low head below 60'): for Pipes 2" diameter
Head range: 70 to 600 feet
Flow range: 5 to 100gpm
Maximum power: 800W
Efficiency: 30% to 70%
Battery voltage options: 12-, 24-, 48-, 120VDC or AC

LV1500 (LV750 is available for sites with low head below 60'): for Pipes > 2" diameter
Head range: 70 to 600 feet
Flow range: 5 to 100gpm
Maximum power: 1500W
Efficiency: 30% to 70%
Battery voltage options: 12-, 24-, 48-, 120VDC or AC

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 ¾-inch brass nozzle holders. 1½-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 style housing and wheel with PM alternator.

THESE ARE CUSTOM BUILT - OUR 30 DAY RETURN PRIVILEGE
DOES NOT APPLY TO THIS ITEM

HYDRO INDUCTION POWER

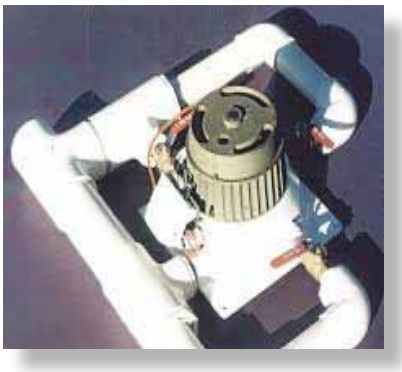
ITEM #	Description	Price
W-LV800-1	Low Voltage 800 Hydro with one nozzle	**$1350**
W-LV800-2	Low Voltage 800 Hydro with two nozzles	**$1400**
W-LV800-3	Low Voltage 800 Hydro with three nozzles	**$1450**
W-LV800-4	Low Voltage 800 Hydro with four nozzles	**$1500**
W-LV1500-1	Low Voltage 1500 Hydro with one nozzle	**$1850**
W-LV-1500-2	Low Voltage 1500 Hydro with two nozzles	**$1900**
W-LV-1500-3	Low Voltage 1500 Hydro with three nozzles	**$1950**
W-LV-1500-4	Low Voltage 1500 Hydro with four nozzles	**$2000**
W-LVHYDRO-NOZZ	Replacement Nozzles	**$15**

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 $8.

THESE ARE CUSTOM BUILT - OUR 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

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	Price
W-H1	One nozzle Harris HPM Hydro Turbine	$1850
W-H2	Two nozzle Harris HPM Hydro Turbine	$1950
W-H4	Four nozzle Harris HPM Hydro Turbine	$2200
W-FANKIT	Fan Kit, required for 500 watts or greater output	$80
W-HYDROBASE	Plastic drain basin catches water discharged by the Harris and ES&D turbines. Harris Turbine rests on top.	$59
W-ESD-ADPTR	ES&D Adapter, this aluminum adapter bolts ONLY to the ES&D turbine & inserts in hydro base.	$78
W-BB-KIT	Brushes and bearings for Motorcraft alternator	$12

HYDRO PLANNING TOOLS

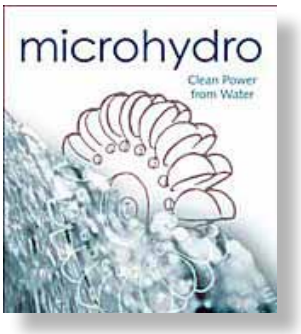
ELEVATION SITE LEVEL is a low cost device to measure the feet of head on your stream by walking it just once. Starting at the bottom, looking uphill along the trail or stream, this site shows you a spot ahead on the trail that is the height of your eye - 5 feet higher than where you are standing. Go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

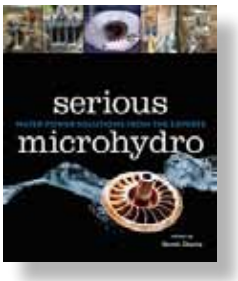
MICROHYDRO CLEAN POWER FROM WATER

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	$19



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	$24

POWER ROOM EQUIPMENT

THE HEART OF THE SYSTEM LIES IN THE POWER ROOM, electricity flows from solar and/or wind through a charge controller and into the battery (hydro goes through a fuse or breaker directly to the battery and is regulated independently). From the battery, power goes out to any DC house circuits, and the inverter/charger producing 120/240 volts AC. The hub of the system is often a DC rated circuit panel (or a set of fuses) housing charge controller, inverter, and AC circuit breakers. Meters show power produced, power used, and battery condition. This equipment mounts on the wall near the battery bank. The installer wires everything together into a functioning power system one of three ways:

INDIVIDUAL 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 PANEL: A single box contains all DC (and often AC as well) circuit breakers, 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 panel forming a single integrated unit. This approach eliminates the need to find, buy, and assemble all the hardware separately. Some manufacturer power panels can come mostly pre-assembled, with as many pieces as possible already in place and the connection points for the rest of the system ready to go. It's a simplified standard design which saves labor and installation time. The result is a safe, clean looking battery room. Power panel components typically meet National Electric Code and pass electrical inspection.

INTEGRATED POWER SYSTEM: The closest option to plug and play that is available. Standardized configurations that vendors/manufacturers make available, can often fit many applications. Call and speak with us to find out what is available to best suit your needs. These systems ship in one piece, assembled on a single mounting plate, ready to hang on the wall of your power room. You finish the installation by connecting the battery bank, solar panel wiring, generator, and the household AC breaker panel. Options for minor configuration tweaks are available in some cases. Call Backwoods to see what we can offer.

MIDNITE E-PANELS

The Midnite Solar E-Panel is a quick and easy way to install most battery-based inverters. They are pre-wired to save time, money and complexity. All field wiring connections are clearly labeled. ETL listed to UL and CSA standards for US and Canada. These do not include inverter, charge controller, Tri-Metric battery monitor (page 116) or surge protection (page 130). Full pre-wired systems (including the inverter) are also available to order. Call for details.

E-PANELS FOR OUTBACK & MAGNUM

The AL-PLUS model is made from powder coated aluminum for the **Outback VFXR, FXR, & GVFXR** inverters. The door is hinged on the left and it has room to mount the inverter and an FM60 or FM-80 on the door. Mounting brackets included. Main breakers, inverter cables, a 500A shunt, busbars, anAC power distribution block, a 50A AC-input disconnect for generator or utility, and a 50A AC bypass switch are all included and pre-wired. Cutouts for mounting up to 6 additional 13mm-wide DIN rail breakers are provided, as are cut-outs for a GFCI-style AC outlet, and 3 panel mount DC breaker slots. The STM model is made from white steel for **Magnum PAE** inverters.

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.

ITEM #	Description	Price
C-MNE175STM-240	Magnum PAE 175A E-panel, White Steel	$719
C-MNE250STM-240	Magnum PAE 250A E-Panel, White Steel	$719
C-MNE175AL-PLUS	Outback 175A E-Panel, Wide White Aluminum Chassis	$612
C-MNE250AL-PLUS	Outback 250A E-Panel, Wide White Aluminum Chassis	$612
C-MNE250XW	Schneider XW E-Panel (gray - matches XW4024) Limited Quantities Available	$999
C-MNE250XW SINGLE	Schneider XW+ E-Panel (white - matches XW+ inverters)	$999
C-MNE250XW MASTER	*NEW!* Master E-Panel for dual XW+ Systems (Requires Slave E-panel as well)	$1170
C-MNE250XW SLAVE	*NEW!* Slave E-Panel for dual XW+ Systems (Requires Master E-panel as well)	$899

Other models are available for Magnum, Schneider Electric and Outback inverters.

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 THE NEXT PAGE FOR LARGER PANEL SYSTEMS. PAE units come with a 5-year warranty.

Includes:

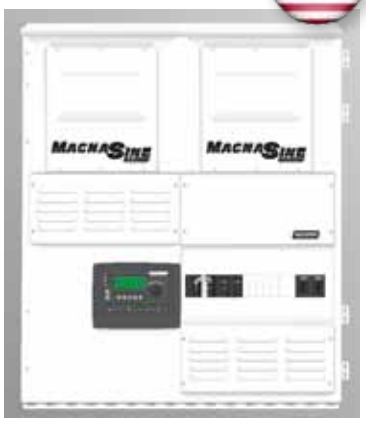
- One DC 175A or 250A breaker,
- One AC bypass breaker 30A dual pole or 60A single pole,
- One AC input breaker 30A dual pole or 60A single pole,
- One 500A/50mv DC shunt,
- DC buss bars for battery positive and negative and
- A din rail for optional DC mini breakers (will hold up to eight breakers).

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	Price
I-ME-MMP250-30D	Magnum Mini Panel 250A DC, 30A AC Dual Pole	**$584**
I-ME-MMP250-60S	Magnum Mini Panel 250A DC, 60A AC Single Pole	**$584**
I-ME-MMP175-30D	Magnum Mini Panel 175A DC, 30A AC Dual Pole	**$584**
I-ME-MMP175-60S	Magnum Mini Panel 175A DC, 60A AC Single Pole	**$584**
I-ME-MMP-BP	Back Plate for wall mount	**$79**
S-MNEPVXX	6, 9, 10, 15, 20, 30, 40, 50, 60 or 63 amp PV Breakers	**$16**
S-MNEPV80 or 100	80 or 100A PV Breaker	**$60**
S-MNEPV-GFP63	63A, Single Pole Ground Fault DC Breaker	**$69**
I-ME-ARC50	Advanced Remote Display with Cable	**$239**

MAGNUM PANEL SYSTEMS

For Larger Magnum Systems



The Magnum Panel (MP) enclosures, for multiple inverter applications, have been 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 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	Price
I-ME-MPSL250-30D	Single Enclosure, Low Power w/250A DC breaker, 30A dual pole AC breaker, **24V inverters**	$720
I-ME-MPSL175-30D	Single Enclosure, Low Power w/175A DC breaker, 30A dual pole AC breaker, **48V inverters**	$720
I-ME-MPSL250-60S	Single Enclosure, Low Capacity, 250A DC breaker, 60A single pole AC input breaker, **24V inverters**	$720
I-ME-MPSH175-30D	Single Enclosure, High Power w/175A DC breaker, 30A dual pole AC input breaker, **48V inverters**	$1256
I-ME-MPSH250-30D	Single Enclosure, High Power w/250A DC breaker, 30A dual pole AC input breaker, **24V inverters**	$1256
I-ME-MPDH250-30D	Dual Enclosure, High Power w/250A DC breaker, 30A dual pole AC breaker, **24V inverters**	$1975
I-ME-MPDH175-30D	Dual Enclosure, High Power w/250A DC breaker, 30A dual pole AC breaker, **48V inverters**	$1975
I-ME-MP-BPD	Back Plate Double for Dual Inverters	$135
I-ME-MPXS-30D	Extension Box for MPSL & MPSH enclosures (specify Left or Right & 175A or 250A breaker)	$263
I-ME-MPXD-30D	Extension Box for MPDH enclosures (specify Left or Right & 175A or 250A breaker)	$263
I-ME-RTR	Router	$320

HOW A CHARGE CONTROLLER WORKS

SERIES CHARGE CONTROLLERS are 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 CONTROLS are connected between a battery & dump load. They 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.

MPPT CHARGE CONTROLLERS employ DC to DC conversion, which allows the solar array voltage to be higher that 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 lead 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.

HOW A CHARGE CONTROLLER WORKS

MPPT CHARGE CONTROLLERS cont'd:

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 to 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.

SELECTING 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.

VOLT & 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 TO LOOK FOR - 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.

TRADING UP**:** If you outgrow the capacity of a smaller charge control that you bought from us, you can trade it in for a larger control, within a reasonable amount of time. Call us for a trade-in value.

CHARGE CONTROLLER SELECTION

MPPT Charge Controllers					
MODEL	**Amps**	**Digital Display**	**Web Enabled**	**Page**	**PRICE**
Magnum PT-100	100	Yes	Yes	70	$799
Outback FM80	80	Yes	Yes	75	$630
Midnite Classic 150 SL	76-96	Yes	Yes	71	$639
MidNite Classic 150	76-96	Yes	Yes	71	$698
Schneider XWMPPT80	80	Yes	Yes	74	$1599
Midnite Classic 200 SL	63-79	Yes	Yes	71	$656
Midnite Classic 200	63-79	Yes	Yes	71	$698
Midnite Classic 250 SL	53-62	Yes	Yes	71	$820
Midnite Classic 250	53-62	Yes	Yes	71	$870
Outback FM60	60	Yes	Yes	75	$550
Schneider XWMPPT60	60	Yes	Yes	74	$685
Morningstar MPPT60	60	Optional	Yes	72	$640
Morningstar MPPT60-600V	60	Optional	Yes	73	$1464
Morningstar MPPT45	45	Yes	Yes	72	$514
PWM Charge Controllers					
MODEL	**Amps**	**Digital Display**	**Voltages**	**Page**	**PRICE**
Morningstar Tristar 60	60	Optional	12, 24, 48	76	$238
Schneider Electric C60	60	Yes	12, 24	77	$199
Morningstar Tristar 45	45	Optional	12, 24, 48	76	$180
Schneider Electric C40	40	Yes	12, 24, 48	77	$159
Schneider Electric C35	35	Yes	12, 24	77	$119
Morningstar SunSaver 20	20	No	12	78	$95
Morningstar SunSaver 20	20	No	24	78	$99
Morningstar SunLight 20	20	No	12	78	$124
Morningstar SunLight 20	20	No	24	78	$129
Morningstar SunSaver 10	10	No	12	78	$69
Morningstar SunSaver 10	10	No	24	78	$74
Morningstar SunLight 10	10	No	12	78	$96
Morningstar SunLight 10	10	No	24	78	$102
Morningstar SunGuard	4.5	No	12	79	$33

NEW! MAGNUM PT100

The PT-100 MPPT Controller is Magnum Energy's first offering to the solar charge controller market. Added to their proven inverter and power panel product lines; Magnum now offers a complete solution to the core of off-grid solar electric system design.

The PT-100 is an MPPT controller rated for an impressive 100 amp output to the battery bank. This means flexibility of panel selection, array configuration, and transmission distance, as well as the ability to accommodate some of the largest array sizes with the use of a single controller.

The input voltage rating of up to 187 volts allows the panel configuration to be designed using fewer, high voltage strings of panels; offering savings in cabling, circuit breakers, combiner box selection, and transmission wire sizing over modest distance of 50 feet and up. Small incremental savings like this can quickly add up to hundreds of dollars or more and are a practical consideration of any medium or larger system design. The 100 amp output rating means the PT-100 has a impressive maximum array size of 6,600 watts.

Features include: Front panel display for array and battery bank status, charge state and fault indicators, and operational Select and Reset buttons; traditional 3-stage charging with manual equalization; on-board configuration DIP switch for "stand-alone" applications; integrated PV Ground Fault and Arc Fault detection/interruption; over temperature protection and de-rating in hot temperatures (room temperatures of 104 F and greater); output over current protection; 255 days of PV harvest and battery amp-hour data logging; programmable dry contact auxiliary relay; easy set-up and integration with Magnum inverters and Advanced Remote Control (ME-ARC rev 4.0 or greater) products; supports on-site software upgrades. The PT-100 is NOT protected against reverse polarity wiring on the PV or battery side. A voltmeter must be used to ensure proper wiring polarity during installation.

Magnum's reputation for simplicity, quality, and customer satisfaction; along with competitive pricing, make the PT-100 an easy consideration for any larger off-grid system design.

ITEM #	Description	Price
C-ME-PT100	Magnum PT-100 Charge Controller	$799

MIDNITE CLASSIC

The MidNite Classic charge controller with arc fault detection maximizes the flexibility and features available in a charge controller. 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%.

The NEW "SOLAR ONLY" versions are a simplified version of the CLASSIC with streamlined menus. It has a graphics panel and ground fault but no arc fault or Ethernet capabilities. The temperature sensor (BTS) is sold separately.

LITE versions have a LED light display versus the LCD display,in addition the user friendly dip switches can be used to select the appropriate voltage for your battery banks and equalization voltage. These are available by special order. Call for details or see our website for more information.

MidNite Solar offers an industry first; an extended warranty for all the Classic MPPT charge controllers. Six months prior to the end of the warranty period customers can ship their Classic back to MidNite Solar with a check for $147 dollars plus shipping and they will replace any wearable parts and do a general tune-up. This will extend the warranty by 2 additional years, another good reason to purchase a Classic. **Note**: Max 4awg wire for battery +/- and PV +/-.

Dimensions: 14.9" x 6" x 4" / Weight: 12 lbs / Five year warranty / ETL Listed

ITEM #	Description	Price
C-MID-MPPT150	150V Midnite MPPT Charge Controller	$698
C-MID-MPPT200	200V Midnite MPPT Charge Controller	$698
C-MID-MPPT250	250V Midnite MPPT Charge Controller	$870
C-MID-MPPT150SL	150V Midnite MPPT Charge Controller - SOLAR ONLY	$639
C-MID-MPPT200SL	200V Midnite MPPT Charge Controller - SOLAR ONLY	$656
C-MID-MPPT250SL	250V Midnite MPPT Charge Controller - SOLAR ONLY	$820
C-MID-BTS	Midnite Battery Temperature Sensor	$27

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 digital display and remote display 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.

Dimensions: 11.4" x 5.1" x 5.6" / Weight: 9.2 lbs / Five year warranty / ETL Listed to UL 1741

ITEM #	Description	Price
C-MS-TSMPPT45	TriStar 45 Amp MPPT Charge Control	$514
C-MS-TSMPPT60	TriStar 60 Amp MPPT Charge Control- Web Enabled	$640
C-MS-TRISTARDD	TriStar Digital Display-Front Plate for unit	$108
C-MS-TRISTARRD	TriStar Remote Display-98' cable	$134
C-MS-TSHUB1	MeterHub: Communications Network Hub	$106

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!

NEW! MORNINGSTAR HIGH VOLTAGE MPPT

The Morningstar TriStar MPPT 600V Charge Controller with Transfer Switch introduces to the market a new approach to adding battery bank functionality to existing grid-tie solar systems.

Rated for the high voltage of a traditional grid-tie array, the TriStar MPPT 60A 600V w/ Transfer Switch is intended to be inserted between the solar array and the input to a grid-tie inverter. The built-in manual transfer switch is used to direct power to the inverter for normal net-metering operation; and is switched by the operator to direct power to the 600 volt charge controller during utility blackouts.

When switched to the battery bank, the charge controller delivers array power to the battery bank in a traditional 3-stage, off-grid fashion. The battery bank can be sized to support critical loads in the household; such as refrigerator, lighting, well pump, tv/ satellite/computer, or even the whole house, if feasible. A separate battery-based inverter is used to generate the 120/240 VAC in this mode, and also provide float charging to the batteries when utility power is available.

Backwoods is featuring two models from the line-up. Along with the charge controller itself, both include a simple disconnect breaker and transfer switch. The second model; see separatley the C-MS-TS600-DTRG, also includes a high voltage Ground Fault Protection circuit/box. Choose the model with the Ground Fault Protection if your existing system has no GFP already at the array.

The maximum amount of power the charge controller can utilize for charging the batteries is 3200 watts. The input power from the array can exceed this amount, but the controller will limit and provide its continuous maximum output current into the batteries. This means the DC coupling insertion can be on arrays as big as 6000 watts, but the battery charging will only utilitize about 3200 watts of the available power.

Dimensions (as pictured): 21.4” x 8.7” x 5.9” / Weight: 28 lbs / Five year warranty

ITEM #	Description	Price
C-MS-TS600	TriStar 60A 600V MPPT Charge Control	$1464
C-MS-TS600-D	TriStar 60A 600V MPPT CC with DC Disconnect Box (pictured above with Digital Meter, sold separately)	$1720
C-MS-TS600-DTR	TriStar 60A 600V MPPT CC with DC Disconnect & Transfer Switch	$1892
C-MS-TS600-DTRG	TriStar 60A 600V MPPT CC with DC Disconnect, Transfer Switch & GFPD	$2296
C-MS-TS600-MTR	Tristar 600V Digital Meter	$121

SCHNEIDER ELECTRIC 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 which may require an RS-232 to USB connector, available at most electronic stores such as Radio Shack.

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.

XW MPPT80

It 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. The XWMPPT80 requires the XW System Control Panel (SCP) to operate. See page 101-103.

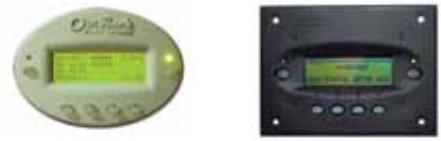
Standby and night-time power draws less than one watt.

XWMPPT60 - Dimensions: 14.5" x 5.75" x 5.5" / Weight: 10.75 lbs
XWMPPT80 - Dimensions: 30" x 8.6" x 8.6" / Weight: 29.80 lbs

Five year warranty / ETL Listed to UL 1741

ITEM #	Description	Price
C-XWMPPT60	60A, 150VDC MPPT PV Charge Controller	**$685**
C-XWMPPT80	80A, 600VDC MPPT PV Charge Controller HIGH VOLTAGE	**$1599**

OUTBACK FLEXMAX 60 AND 80



Outback MATE & MATE 2
Optional Accessory

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 FM80 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.

OUTBACK FM60 - Dimensions: 13.75" x 5.75" x 4.5" / Weight: 11.65 lbs
OUTBACK FM80 - Dimensions: 16.25" x 5.75" x 4.5" / Weight: 12.20 lbs

Five year warranty / ETL Listed

ITEM #	Description	Price
C-OB-FM60	FLEXmax FM60 Outback Charge Controller	$550
C-OB-FM80	FLEXmax FM80 Outback Charge Controller	$630
I-OBMATE	Outback Mate System Controller Specify light gray (oval) or black (rectangular)	$265
C-OB-TEMP	15" sensor compensates charge voltage to battery temp	$28

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 (C-TRISTARDD below) 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.

Dimensions: 10.3" x 5.0" x 2.8" / Weight: 3.5 lbs / Five year warranty / UL Listed

ITEM #	Description	Price
C-MS-TRISTAR45	TriStar 45 Charge Control	$180
C-MS-TRISTAR60	TriStar 60 Charge Control	$238
C-MS-TRISTARDD	Digital Display (for either controller)	$108
C-MS-TRISTARRD	Remote Digital Display with 98' cable	$134
C-MS-TRISTARRT	30' plug-in Battery Temperature Sensor	$32

SCHNEIDER CHARGE 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.

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.

C35 - Dimensions: 8" x 5" x 2.5" / Weight: 2.7 lbs
C40 & C60 - Dimensions: 10" x 5" x 2.5" / Weight: 3.1 lbs
Two year warranty / UL Listed

ITEM #	Description	Price
C-35-ONLY	35 Amp Charge Control	$119
C-40-ONLY	40 Amp Charge Control	$159
C-60-ONLY	60 Amp Charge Control	$199
I-TEMP	Optional 15' plug in Battery Temperature Sensor	$32
C-CM-R50	Remote Digital Display with 50' cable	$126

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. Must be connected to batteries to see output.

Dimensions: 6" x 2.2" x 1.3" / Weight: 8 oz / Five year warranty / ETL Listed

ITEM #	Description	Price
C-MS-SS-10L-12	12 Volt, 10 Amp charging and LVD	$69
C-MS-SS-10L-24	24 Volt, 10 Amp charging and LVD	$74
C-MS-SS-20L-12	12 Volt, 20 Amp charging and LVD	$95
C-MS-SS-20L-24	24 Volt, 20 Amp charging and LVD	$99

MPPT VERSIONS ARE AVAILABLE FOR SPECIAL ORDER

MORNINGSTAR SUNLIGHT

- **10 adjustable lighting control options**
- **Special on/off/on lighting functions**
- **Low Voltage Disconnect protection**
- **Detects day and night using the PV array**

Morningstar's Sunlight solar lighting controller combines the SunSaver design with an advanced controller for automatic lighting control functions. Four Versions Available. 12V or 24V and 10A or 20A.

Dimensions: 6" x 2.2" x 1.3" / Weight: 9 oz / Five year warranty / ETL Listed

ITEM #	Description	Price
C-MS-SL-10L-12	12 Volt, 10 Amp charging and LVD	$96
C-MS-SL-10L-24	24 Volt, 10 Amp charging and LVD	$102
C-MS-SL-20L-12	12 Volt, 20 Amp charging and LVD	$124
C-MS-SL-20L-24	24 Volt, 20 Amp charging and LVD	$129

MORNINGSTAR PROSTAR

The Morningstar ProStar controller is a very reliable mid-range PWM controller. It has an estimated 15-year life. With a 3 position battery select: gel, sealed or flooded. The ProStar Controller has 4 stages of charging to provide increased battery capacity & life. It can be paralleled up to 300 amps and has built in temperature compensation. LED's indicate battery status and faults. Capable of 25% overloads. Many electronic protections are built-in such as reverse polarity, short-circuit, overload, reverse current at night, high temperature and voltage disconnection, lightning and transient surge protection, voltage spike protection and auto recovery.

Dimensions: 6" x 4.1" x 2.3" / Weight: 12 oz / Five year warranty / CE Certified

ITEM #	Description	Price
C-MS-PS-15	12 or 24 Volt, 15 Amp charging with LVD	$99
C-MS-PS-15M	12 or 24 Volt, 15 Amp charging with LVD & Digital Meter	$156
C-MS-PS-15M-48V	48 Volt, 15 Amp charging with LVD & Digital Meter	$196
C-MS-PS-30	12 or 24 Volt, 30 Amp charging with LVD	$132
C-MS-PS-30M	12 or 24 Volt, 30 Amp charging with LVD & Digital Meter	$192

MORNINGSTAR SUNGUARD

4.5 amp, 12V 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.

Dimensions: 2.5" x 2" x 1.5" / Weight: 3 oz / Five year warranty

ITEM #	Description	Price
C-MS-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

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 Schneider Electric C series & Morningstar Tristar.

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	Price
AIR HEATER DIVERSION LOAD box as pictured with connection terminals		
C-HL-12V	Diversion Heat Load - 45A - 12V - 675W 8” x 12” x 4”	**$148**
C-HL-24V	Diversion Heat Load - 35A - 24V - 1000W 8” x 12” x 4”	**$160**
C-HL-48V	Diversion Heat Load - 36A - 48V - 2160W 12” x 16” x 4”	**$235**
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		
C-RESISTOR	Ceramic Resistor	**$40**
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	**$130**
C-WTRLOAD2448	30 volt/24 or 48 amp, or 60 volt/24 amp	**$195**
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. Keep in mind that mixing new and old batteries is not recommended. No two batteries should be more than a year apart in age in the same battery bank. A smaller scale, "starter" battery bank can be implemented for a lower cost that can be operated for 4-5 years. Then a larger capacity set of batteries with a lifespan of 10-15 years and higher cost would be suitable for long term planning.

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 batteries are some of the most common, along with the industrial batteries from HuP, Surrette and Deka's Maintenance Saver.

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 battery book included with all new flooded battery orders. Many batteries can be picked up or delivered free of charge depending on your location. Distant customers: give us a call. We may be able to provide a local pick-up location near you for little or no shipping/delivery charges or sales 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

T-105RE
2 year full warranty +
3 more years prorated

L16RE-B & L16 2V
2 year full warranty +
3 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 1200 cycles to 50% DoD.

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 L16RE-B.

MODEL	VOLTS	AMP-HRS (20 hr)	L	W	H	LBs	PRICE
B-T105	6	225	10	7	11	65	**$155**
B-T105-RE	6	225	10.375	7.25	11.75	65	**$180**
B-L16RE-B	6	370	12	7	18	118	**$350**

Trojan's "Industrial" batteries are also available to order. They're 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.

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 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 (in the KS/CS/YS product line) 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!!

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-S1450 & B-S550, 2 year free replacement warranty; 5 years pro-rated.

MODEL	VOLTS	AMP-HRS (20 hr)	L	W	H	LBs	PRICE
B-S1450	2	1124	12 1/2"	7 1/8"	17"	120	**$362**
B-S550	6	428	12 1/2"	7 1/8"	16 3/4"	123	**$358**
B-2-KS-33PS	2	1766	15 7/16"	8 5/16"	24 13/16"	208	**$876**
B-2-YS-31PS	2	2430	15 1/2"	9"	31 5/8"	285	**$1220**
B-4-KS-21PS	4	1104	15 3/4"	9 3/8"	24 3/4"	267	**$1095**
B-4-KS-25PS	4	1350	15 3/4"	10 5/8"	24 3/4"	315	**$1372**
B-6-CS-21PS	6	683	22"	9 3/4"	18 1/4"	271	**$1068**
B-6-CS-25PS	6	820	22"	11 1/4"	18 1/4"	318	**$1285**
B-8-CS-17PS	8	546	28 1/4"	8 1/4"	18 1/4"	294	**$1235**
B-8-CS-25PS	8	820	28 1/4"	11 1/4"	18 1/4"	424	**$1700**

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!!

DEKA FLOODED BATTERIES

DEKA MAINTENANCE SAVERS

Higher voltage systems naturally have greater power requirements. The Deka Solar Maintenance Saver System is designed to offer reliable low maintenance power for renewable energy applications where frequent deep cycles are required and minimum maintenance is desirable. 3 year full warranty with 7 additional pro-rated years. These batteries feature:

- High capacity flat plate cells
- Long life: 12 - 14 years of shallow cycle service
- Extended watering interval - up to 6 months due to a large reservoir for electrolyte
- Thermally sealed cover to container

ITEM #	Volts	Amp Hrs	L	W	H	LBs	Price
B-DK-6-M100-07	12	356	16.81	6.5	30.56	450	$1927
B-DK-6-M100-11	12	593	26.06	6.5	30.56	624	$2072
B-DK-6-M100-15	12	830	35.06	6.69	30.56	816	$2758

DEKA L16 FLOODED BATTERY

Deka Solar Flooded Monobloc L16 battery is a 3 cell (6 volt) photovoltaic battery that offers reliable, low-maintenance power for renewable energy applications where frequent deep cycles are required.

2 year full replacement on monobloc flooded batteries with 5 additional pro-rated years.

ITEM #	Volts	Amp Hrs	L	W	H	LBs	Price
B-DK-L16LTP	6	370	11.75”	7”	17.3”	113	$299

Shipping: Call for freight quote or batteries may be available for pick-up in limited locations. Free/reduced shipping on large orders to a commercial address w/ dock.

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.

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.

Industrial UNIGY & UNIGY II lines are also available by special order.

ITEM #	Type	Volts	Amp Hrs	L	W	H	LBs	Price
B-DK-8G30H	GEL	12	97.6	12.94”	6.75”	9.75”	70	**$275**
B-DK-8G4DLTP	GEL	12	183	20.75”	8.5”	10”	127	**$560**
B-DK-8G8DLTP	GEL	12	225	20.75”	11”	10”	157	**$679**
B-DK-8GGC2	GEL	6	180	10.25”	7.13”	10.88”	69	**$296**
B-DK-8A27	AGM	12	92	12.75”	6.75”	9.88”	63	**$228**
B-DK-8A4DLTP	AGM	12	198	20.75”	8.5”	10”	129	**$515**
B-DK-8A8DLTP	AGM	12	245	20.75”	11”	10”	161	**$605**
B-DK-8AGC2	AGM	6	190	10.25”	7.13”	10.88”	68	**$262**

Shipping: Call for freight quote or batteries may be available for pick-up in limited locations. Free/reduced shipping on large orders to a commercial address w/ dock.

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.

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 #	Volts	Amp Hr	L	W	H	LBs	Ship Via	Price
B-2580L	12	258	20.76”	10.8”	9.73”	165	Freight	**$712**
B-2120L	12	212	20.76”	8.7”	9.76”	138	Freight	**$596**
B-1080	12	108	12.9”	6.75”	8.96”	70	UPS*	**$325**
B-890	12	89	12.9”	6.75”	8.96”	62	UPS*	**$295**
B-2240	6	224	10.28”	7.06”	9.99”	67	UPS*	**$332**
B-3050T	6	305	10.28”	7.06”	12.94	91	Freight	**$375**
B-4050HT	6	405	11.64”	6.95”	15.73”	120	Freight	**$636**
B-9150	2	915	10.28”	7.06”	13”	94	Freight	**$444**

* Large quantities ship via FREIGHT TRUCK. Call us for a quote.

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**

SOLAR-ONE BATTERIES WITH HuP TECHNOLOGY

In Progress Install

With Cells Removed

The Solar-One® battery with HuP® technology has been powering off grid homes for over 13 years while being charged from clean energy produced by solar modules that turn sunlight in to electricity, wind turbines that tap a valuable resource or microhydro generators that convert falling water into usable energy.

Along with outstanding support you also receive an installation and maintenance manual written for renewable energy users by renewable energy users as well as the manufacturers written warranty. No other battery in the renewable energy industry offers the technology, quality, warranty, support, and value of the Solar-One®.

The Solar-One® warranty is a full ten year manufacturers warranty and is very simple. If the battery fails to deliver 80% of it's capacity in the first year, any defective cells will be replaced by EnerSys including the shipping costs. For the next 6 years any defective cells will be replaced by EnerSys, but the consumer will pay the shipping costs. The last 3 years of the warranty you will be offered a substantial discount on the purchase of a new Solar-One® battery of equal or greater value.

ITEM #	Volts	Amp Hr	L*	W*	H*	LBs	Price
B-HP6-85-17-12	12	845	40"	7.75"	25"	742	**$2995**
B-HP6-85-21-12	12	1055	40"	8.75"	25"	880	**$3490**
B-HP6-85-33-12	12	1690	40"	13.5"	25"	1336	**$5245**
B-HP6-85-17-24	24	845	40"	7.75"	25"	1484	**$5990**
B-HP6-85-21-24	24	1055	40"	8.75"	25"	1760	**$6980**
B-HP6-85-33-24	24	1690	40"	13.5"	25"	2672	**$10490**
B-HP6-85-17-48	48	845	40"	7.75"	25"	2968	**$11980**
B-HP6-85-21-48	48	1055	40"	8.75"	25"	3520	**$13960**
B-HP6-85-33-48	48	1690	40"	13.5"	25"	5244	**$20980**

* Measurements are PER 12V unit.

These batteries ship TRUCK FREIGHT but can ship for FREE to a commercial dock that has a forklift. Please call us for details.

SILICON SALT BATTERIES

We've added a new battery technology to our battery offerings. They are most appropriate for sub-zero temperature conditions. Proper system design is paramount in off grid living. Choosing a battery technology that makes sense for the location, environmental concerns, access to the site and experience of the end user all play a role. One of the biggest challenges many of our customers face is temperature. How to mitigate capacity loss in colder climates is a question we hear quite often. This new battery technology is being referred to as Silicon Salt.

These batteries feature an electrolyte of an ultra-micro composite silicon salt forming solution giving them a smaller resistance ratio of 2 mili-ohm, twelve to thirteen times smaller than that of the lead-acid battery (lead-acid batteries are 25 mili-ohm and greater). Because this resistance is so low they are able to be heavily charged and discharged in an astounding temperature range of -40 degrees F up to 158 degrees F.

We have been testing them in various configurations in Canada. Our testing is covering small two battery 12V banks for telecom towers to large 48V grid-connected back-up systems. They are located outside at fully exposed projects and inside various non-insulated power sheds as well as in insulated garages.

This new maintenance free Silicon Salt storage technology is being widely used by the Military, Telecommunications (UPS), GPS, Computer backup, Electric Vehicles (EV), Hospitals backup power, Airports, and many other applications in many countries. They are being readily used in these industries due to their low maintenance cost and excellent safety.

At this point we have found the claims regarding temperature to be valid. We are not seeing freezing or issues with capacity loss as expected with lead acid batteries. We have also found that after being fully charged and stored for 2 years they have retained 80% of their charge. The only claim we haven't been able to substantiate quite yet is the longevity claim of 17-20 years. Our Canadian and U.S. testing time period has covered just two years now.

Due to the non-toxicity of the materials, they do not require an MSDS for shipment and are considered non-hazardous. Also, they work well with other components currently on the market. There is no need for a sophisticated battery management system and most charge controllers, set at a sealed battery charging perimeter, work seamlessly with these batteries.

If you are working in sub-zero temperatures these may be a good fit for you. Give us a call for a free custom design of a system with this new and exciting Silicon Salt storage technology.

9.5"	Volts	Amp Hr	L	W	H	LBs	Ship Via	**Price**
B-SI-2V-550	2	550	9.5"	6.75"	13.9"	66	Freight	**$370**
B-SI-2V-800	2	800	16.1"	6.89"	13.5"	121	Freight	**$515**
B-SI-6V-220	6	220	12.6"	6.93"	8.86"	65	Freight	**$269**
B-SI-12V-100	12	100	13"	6.85"	8.70"	68	Freight	**$314**

SHIPPING via truck freight. Call for freight quote.

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. Custom lengths are also available.

ITEM #	Description	Price
O-BIC-2G-UL	2 gauge copper, **15**", 5/16" bolt holes, UL	**$14**
O-BIC-2/0-UL	Heavier 2/0 gauge copper, **15**", 3/8 bolt holes, UL	**$18**
O-BIC-4/0-UL	Heavier 4/0 gauge copper, **15**", 3/8 bolt holes, UL	**$24**
O-SHUNT2/0-24UL	2/0 Copper, **24"**, 3/8 bolt holes, UL	**$19**
O-SHUNT4/0-24UL	4/0 Copper, **24"**, 3/8 bolt holes, UL	**$27**
O-SHUNT4/0-36UL	4/0 Copper, **36"**, 3/8 bolt holes, UL	**$35**

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

O-AU4/0

ITEM #	Description	Price
O-AU2/0	Dual	**$4.75**
O-AU4/0	Single	**$5.75**

O-AU2/0

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

4.5 x 2.25 x2.0 11.4 oz

Battery Life Saver De-Sulfator

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!** We have seen some good results when used on depleted batteries that are past their warranty period.

ITEM #	Description	Price
Simply clips to main battery +/- terminals		
B-BLS12-24	Draws 250 ma; 50% duty cycle	**$98**
B-BLS-48	Draws 500 ma; 50% duty cycle	**$98**

HYDROMETERS

HYDROMETERs are the most accurate, direct and reliable indicators of battery state of charge.

O-HYDRO-VOLT

O-HYDRO-VOLT: Durable, accurate, and easy to read; this German made hydrometer is the best offering we have ever had. A heavy duty plastic body resists breaking more than glass body units. The softer rubber ball stays flexible at a greater range of temperatures, and the built-in temperature compensation makes the reading more accurate and speeds up the testing exercise.

O-HYDROMETER-2: This glass hydrometer is also temperature compensated for an even better indicator of a battery's state of charge. Flared barrel makes it easier to take readings quickly without the float sticking to the barrel.

O-HYDROMETER-2

ITEM #	Description	Price
O-HYDRO-VOLT	Plastic, German-made	**$28***
O-HYDROMETER-2	Glass, American-made	**$56****

*The O-HYDRO-VOLT is just $10 when purchased w/ any of our flooded batteries!
**The O-HYDROMETER-2 is $30 when purchased w/ any of our flooded batteries!

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	$85
O-PVENT-24	24 Volt, draws 3 Watts	$85
O-PVENT-48	48 Volt, draws 6 Watts	$116

When you have a charge controller with auxillary output, such as the Outback FlexMax, you would use our O-MINIRELAY rather than the O-VENTCONTROL.

ITEM #	Description	Price
O-MINIRELAY	12V Relay for Aux Output Terminal	$20

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 FAN
(BRUSHLESS)

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-MUFFAN-12	12 Volt	$15
A-MUFFAN-24	24 Volt	$18
A-MUFFAN-48	48 Volt	$20
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 without a full charge or deeper discharges due to heavy loads or battery temperature.

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.

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 most generators. *Honda generators 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.

BATTERY CHARGERS

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

Works better with generator power than most chargers

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. These set points are user selectable via a simple plug-in jack.

40-60 amp external fusing required for each model.

Dimensions: 7” x 6.5” x 3.5”

Two year warranty

ITEM #	Description	Price
BC-IOTA5512	Iota 5512 Battery Charger, 740 Watt, 12V	**$190**
BC-IOTA2524	Iota 2524 Battery Charger, 675 Watt, 24V	**$266**
BC-IOTA4024	Iota 4024 Battery Charger, 1100 Watt/40A, 24V	**$328**

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.

At this point in time, Backwoods does not sell generators but can recommend the Honda EU7000iS as a great model to use IF LP fuel use is not required and auto start is not important. If those are important requirements for your application a Honda can be modified to be LP fueled and auto start but it will void the warranty of a new unit.

Backwoods employees use a variety of generators for backup when needed but we all try not to use them as a primary energy source, only for backup when energy use exceeds what is available from the renewable sources. Tom uses an older Kohler 10KW unit with a Honda EU5000iS as a backup and as a mobile power source around the homestead. Shawn and Tracey both use Honda EU6500iS's. Brian has a hydro system, rarely has to run a backup generator so he can get by with smaller lower quality Porter Cable portable generator. John uses a Honda EM5000. Feel free to contact any one of us to discuss our experiences and recommendations!

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 RELAYS

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.

Both models measures 8.625" w x 8" h x 3.875" d

ITEM #	Description	Price
O-TS30	120V, 30Amp Transfer Relay	$70
O-TS50	120/240V, 50Amp Transfer Relay	$140

GENERATOR START CONTROLS

The Atkinson GSCM (generator start controller module) is a microprocessor-based generator-starting controller that receives start commands from the 12V output from an Outback FX inverter aux relay, or any user-supplied contact closure. It automatically controls a gas/propane or diesel powered generator and is totally sealed for harsh environments.

The GSM-MINI generator start controller is optimized for use with OutBack inverters. It supports three types of 3-wire gas-generator control: momentary, maintained or ignition. It has a fixed crank time and over and under frequency shutdown.

2-year limited warranty

ITEM #	Description	Price
G-GSCM	Atkinson Generator Start Control	$295
G-GSCM-MINI	Atkinson Generator Start Control - Mini	$182

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 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 the Backwoods Bargains page of 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. Schneider Electric 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, some of the newer refrigerators 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.

SIZE of inverters range from under 100 to over 8000 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					
Schneider Conext XW+ 6848	6800	yes	48	101	$4564
Schneider Conext XW+ 5548	5500	yes	48	101	$3875
Magnum MS-PAE (parallel stackable)	4000/4400	yes	24/48	99	$2160
Schneider XW4024	4000	yes	24	101	$3877
Magnum MS4024	4000	yes	24	99	$2080
Outback VFXR	3600	yes	48	104	$2315
Outback VFXR	3500	yes	24	104	$2315
Outback VFXR	2800	yes	12	104	$2315
Outback FXR	3000	yes	48	104	$2145
Outback FXR	2000/2500	yes	12/24	104	$2145
Magnum MS2012	2000	yes	12	99	$1720
Magnum MMS1012	1000	yes	12	99	$960
Magnum MMS1012G	1000	yes	12	99	$1040
Samlex 1500	1500	no	12/24	106	$565
Samlex 1000	1000	no	12/24	106	$425
Samlex 600	600	no	12	107	$348
Morningstar Sure Sine 300	300	no	12	107	$275
Modified Wave Inverters					
Magnum RD3924	3900	yes	24	108	$1584
Magnum RD2824	2800	yes	24	108	$1344
Magnum RD2212	2200	yes	12	108	$1168
Magnum MM1512AE	1500	yes	12	108	$720
Grid Tied Inverters					
Fronius	1.5-6kW	No	Page 110		Various
Enphase Micro	250W	No	Page 111		Various
SMA	2 - 7kW	No	Page 112		Various

Backwoods can special order almost any brand of inverter, however our in-house tech support is limited to those featured in our catalog and on our website at www.backwoodssolar.com.

MAGNUM ENERGY

The **MMS Series** is a pure sinewave inverter providing a cost effective solution for those with smaller power needs in mobile applications. Versatile, easy-to-use, and lightweight.

This inverter is designed to accommodate entertainment systems and small appliances in smaller RVs in an all new design. Mobile models can be special ordered for use on RVs and boats, where shore-power is needed. Based on the popular ME and MS Series inverters, the MMS is smaller, lighter and less expensive while retaining all the built in protection and reliability of ME and MS models. The MMS charger uses a PFC (Power Factor Corrected) charger, which is 85% efficient and the same charger topology used in all Magnum models. MMS1012G model comes with a flexible cord on the AC input and a GFCI outlet on the output.

The **MS Series Inverter/Charger** (not pictured) is a pure sine wave inverter designed specifically for the most demanding mobile and off grid applications. The MS Series is powerful, easy-to-use, and best of all, cost effective. Install the MS Series in four easy steps: simply connect the inverter's output to your distribution circuits or electrical panel, connect your shore power cable (AC) to the inverter's 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. MS4024 inverters (without PAE) can be series stacked, using the ME-SSI (special order $63).

The **MS-PAE Series Inverter/Charger** is a pure sinewave inverter designed specifically for the most demanding renewable energy applications. The unique design of the MS-PAE Series provides two 120VAC output lines that are 180° out-of-phase with each other, so that the combination of the L1 and L2 lines total 240VAC and the voltage between either L1 or L2 and neutral is 120VAC, eliminating the need to purchase two units and stack them together to get 240 volts.

When the power requirements of the system are beyond the capacity of a single MS-PAE Series inverter or the system is expanded as more loads are added, up to four MS-PAE Series inverters can be connected together in a parallel configuration. When connecting inverters in parallel, the overall inverter power and surge capacity is increased to power a large single load or more smaller loads. Battery temperature sensor included.

MAGNUM ENERGY

Note: If you are planning on connecting the MS-PAE Series inverter in parallel with another MS-PAE Series inverter, ensure they all have Firmware revision 5.1 or higher.

Inverter Dimensions: 13.75" x 12.65" x 8" / Weight: 43 - 58 lbs / Three year warranty (five years when installed on MMP or MP system). / ETL Listed

The full line of Magnum products (including Export and Mobile models) are available to order. Give us a call to discuss.

ITEM #	Input Voltage	Continuous Power	AC Surge Amps (1 msec)	Battery Charging Maximum	Price
I-ME-MMS1012	12	1000W	38	50	**$960**
I-ME-MMS1012G	12	1000W	38	50	**$1040**
I-ME-MS2012	12	2000W	50	100	**$1720**
I-ME-MS2812	12	2800W	70	125	**$1984**
I-ME-MS4024	24	4000W	120	105	**$2080**
I-ME-MS4024PAE	24	4000W	120	105	**$2160**
I-ME-MS4448PAE	48	4400W	120	60	**$2160**

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	**$176**
I-ME-BMK-NS	Above without shunt (for use in panel systems)	**$168**

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

SCHNEIDER CONEXT XW+ SERIES

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

An upgrade of the long-standing XW product line, the new XW+ series from Schneider Electric features a power upgrade to the inverters, a robust solution to stacked systems, a new suite of products for large systems and internet connectivity. The XW+ and legacy XW series will sell excess solar energy to the grid like a typical grid-tie solar system but with the added benefit of being able to provide uninterrupted backup power during utility outages. If you are considering adding a grid-tie solar power system to your home or business, incorporating a back-up power system as well is a sensible decision.

The XW+ and XW grid-interactive features are highly configurable; allowing for full net-metering based functionality, with the battery bank held in reserve for utility outages, or run your battery based solar electric system as if you were off the grid, using utility power as the world's biggest back-up generator, or any combination of functionality in between. The secondary AC input allows for use of a generator as well, resulting in one of the most robust system designs possible. All in one package!

Inverter output ranges from 4000 to 6800 watts that features two 240 volt AC inputs for grid and generator, with 120/240 split phase AC output. 75% of the inverter's rated output can continuously support a 120v AC leg. Built-in transfer relay is rated for 60 amps. Peak efficiency is 95%; power draw in search mode is 8 watts and averages 28 watts when on without a load (<8W and 24W for 24V version). Up to three inverters can be stacked together for increased continuous wattage capacity of your system.

Surge Wattage and Battery Charging Capability:
XW+6848 = 12,000W for 1 minute, 140A Charger
XW+5548 = 7,000W for 1 minute, 110A Charger
XW4024 = 5,400W for 1 minute, 150A Charger

While the XW+6848 and XW+5548 are the new flagship inverters for the product line; at this time Scheider is still producing the XW4024 for smaller systems that want the full functionality the series has to offer. Many of the accessory products such at the SCP and AGS are compatible with any of the inverters. The older XW line still has several unique products available as well, including software configuration tools, as well as PDPs with a matching color scheme. Contact Backwoods for recommendations if you plan to utilize the XW4024.

SCHNEIDER CONEXT XW+ SERIES

System Control Panel (SCP): The SCP is the control interface for the XW+ and XW product lines, enabling communication on the proprietary XANBUS to all XW+ inverters, charge controllers, and Automated Generated Start modules installed on the system. Features a graphical, backlit LCD screen that displays system configuration and diagnostic information for all devices connected to the network. When installed as an XW Plus system accessory, the Conext SCP eliminates the need for separate control panels for each device and gives a single point of control to set up and monitor an entire XW+ System. Note: some ethernet cabling may be purchased locally for a complete XW system installation.

XW+ Power Distribution Panel (PDP): The XW series wall mounted design is easy to install. Its PDP includes double pole 60 amp AC input/output/bypass breaker assembly, inverter disconnect breaker, internal wiring components, one ground and one AC neutral bus bar, and DC positive and DC negative bus bars. Shunt for battery monitor is NOT included. Breaker space for up to two additional inverters is available. Conduit cover and shunt cables included for first inverter. Knockout space for installation of charge controller breakers is also available (8 spaces total available).

Use the **XW+ Connection Kit (I-XWPL-CONN-KIT)** for each additional inverter. It includes a conduit box, dual pole 60 amp AC input/output/bypass breaker assembly, wire harness, power distribution bars, 250 amp inverter breaker, positive bus bar, 4/0 battery shunt cables, and XANBUS and AC Synch cables.

Automatic Generator Start (AGS): The Conext AGS is a Xanbus™-enabled device that can automatically activate a generator to provide an XW Series Inverter/Charger with power to recharge depleted batteries or assist with heavy loads. Compatible with popular generators, the Conext AGS adds intelligence to power management and eliminates time spent monitoring batteries and inverter loads. The AGS can be configured to start the generator in response to low battery voltage, thermostat operation, or load size on the inverter battery. A quiet-time setting prevents the generator from starting at inconvenient times. The LED display shows the status of the XW AGS, while all user-defined settings are programmed through the Conext System Control Panel(ordered separately).

XW Charge Controllers: 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 74 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. The XW-MPPT 60 & 80 will work with PV systems that don't use the XW series equipment but the XW-MPPT80 requires the XW System Control Panel (SCP) to operate.

SCHNEIDER CONEXT XW+ SERIES

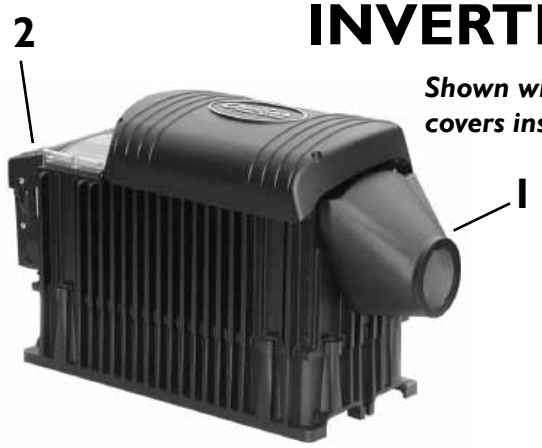
The XW inverter is what Shawn at Backwoods uses to power his full time off grid residence. The XW is also what Alan at Backwoods uses to provide a battery backup to the grid power we use to power daily operations at our office. Feel free to call Alan or Shawn to discuss their experiences with the XW inverters.

Inverter - Dimensions: 23" x 16" x 9" / Weight: 115-122 lbs
Power Distribution Panel - Dimensions: 30" x 16" x 8.25" / Weight: 67 lbs
Conduit Box - Dimensions: 15.75" x 8.25" x 8.25" / Weight: 9 lbs
System Control Panel Dimensions: 6.5" x 4.5" x 2", 2 lbs
Automatic Generator Start Dimensions: 5.5" x 3.5" x 1.5", .5 lbs
Five year warranty / CSA & UL Listed

ITEM #	Description	Price
I-XW4024	4000 Watt, 24VDC, 120/240V AC Inverter	**$3877**
I-XWPL-5548	5500 Watt, 48VDC, 120/240V AC Inverter	**$3875**
I-XWPL-6848	6800 Watt, 48VDC, 120/240V AC Inverter	**$4564**
I-XWPL-SCP	System Control Panel	**$300**
I-XWPL-PDP	Power Distribution Panel	**$1250**
I-XWPL-CONN-KIT	Connection Kit for 2nd Inverter with cables & breakers (Requires I-XWPL-BRKRKIT-1 (120/240VAC, $185) or I-XWPL-BRKRKIT-2 (3 Phase, $265))	**$890**
I-XWPL-AGS	Automatic Generator Start Control	**$200**
C-XWMPPT60	60A, 150VDC MPPT PV Charge Controller	**$685**
C-XWMPPT80	80A, 600VDC High Voltage MPPT PV Charge Controller	**$1599**
I-XWPL-BMK	Battery Monitor Kit	**$480**
I-XWPL-COMBOX	Communications and monitoring device. Integrated web server, graphical display, and data monitoring.	**$535**

OUTBACK VFXR AND FXR INVERTERS

NEW!



Shown with 2 optional covers installed

MATE 2 Black Only

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

The latest, most advanced features have been incorporated into the new line of off-grid or grid-hybrid inverters from Outback using the well-known and trusted VFX and FX platform. This allows for an immense amount of system flexibility for nearly any power conversion scenario all in one model. These inverters are true sine wave, and includes a battery charger and 60 amp automatic AC transfer relay plus automatic start and stop of your remote start back-up generator. 5 sec surges of 4500 – 5400 watts depending on model.

They can used stand alone or be stacked for up to nine inverters for three-phase with the 12V, 24V and 48V models and ten inverters in grid-tied 24V and 48V applications for higher power. Units are programmable for seven different modes, including GridZero and Support Mode with generator assist with built in networked communications. Advanced Battery Charging with expanded charging voltages and time parameters, accommodating charging profiles and algorithms for new and emerging battery technologies such as Lithium Ion, Silicon Salt, and Flow Chemistry have been added.

The FXR inverter/charges can be paired with a MATE3 to add OPTICS RE to monitor and control system performance remotely from any location.

No-load power used is 3 watts when in automatic sleep-mode with no home power usage, or 34 watts if programmed to keep AC on full time. Peak efficiency is 90-93% depending on model. Operating temperature range: -40 to + 60 degrees C. All have field upgradable software. Includes an 8.4 watt auxiliary output relay.

VFXR vented models are higher power inverter-chargers, using fan cooling with screened insect proof vents in die-cast aluminum enclosure. **FXR models** are quieter and completely sealed against dust and moisture. 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.

MATE3 is required to initially program inverter, charger, and generator-auto-start features.

FXR inverters - Dimensions: 13” x 8.25” x 16.25” / Weight: 62 lbs
VFXR inverters - Dimensions: 12” x 8.25” x 16.25” / Weight: 61 lbs

Standard 5 year warranty / Optional 10 year / ETL Listed to UL 1741

OUTBACK INVERTERS

OUTBACK MATE3

Outback MATE3 is a programming input device as well as meter display for power room or remote mounting. It plugs into any VFXR/FXR inverter to program any of the adjustable settings for battery charging or start-up sensitivity, automatic start for an engine-generator etc. It features an easy-to-read, backlit LCD display, tactile buttons and user programmable "favorite" keys for quick access to the most wanted features. A built-in clock and calendar function enables timer-base programming of inverter and charger operation. This setting allows the you to limit a generator's runtime to a specific time period of the day or week. **Each inverter requires battery cables with lug ends.**

MATE3

MATE

ITEM #	Description	Price
VENTED COOLED MODELS		
I-OB-VFXR2812	2800 Watt, 12 Volt, 125 Amp Charger	**$2315**
I-OB-VFXR3524	3500 Watt, 24 Volt, 82 Amp Charger	**$2315**
I-OB-VFXR3648	3600 Watt, 48 Volt, 45 Amp Charger	**$2315**
SEALED TURBO MODELS FOR HARSH CLIMATES		
I-OB-FXR2012T	2000 Watt, 12 Volt, 100 Amp Charger	**$2145**
I-OB-FXR2524T	2500 Watt, 24 Volt, 55 Amp Charger	**$2145**
I-OB-FXR3048T	3000 Watt, 48 Volt, 35 Amp Charger	**$2145**
I-OBMATE	MATE - Meter Display & Programming Device	**$265**
I-OBMATE2	MATE2 - Meter Display & Programming Device	**$265**
I-OBMATE3	Remote Monitor & System Controller	**$535**
I-OB-HUB4	Connects MATE to up to 4 inverters and/or FM60/ FM80 solar controls at the same time without switching any cables	**$175**
I-OB-FXDCA	DC Conduit adapter- pictured prev page #1	**$44**
I-OB-FXACA	Cover for AC Terminals, pictured prev page #2	**$44**
I-X240	120/240 output or generator balancing	**$470**

SAMLEX SMALL INVERTERS

1000K

1500

True sinewave 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' RJ11 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 - Dimensions: 15.1" x 7.2" x 3.5" / Weight: 8.8 lbs
1500 inverters - Dimensions: 15.4" x 10.8" x 4.1" / Weight: 15.5 lbs
Two year warranty / UL Listed

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

SMALLER TRUE SINE WAVE INVERTERS

SAMLEX

SA-600R-112

MORNINGSTAR

SURESINE 300

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.

Samlex600 - Dimensions: 12" x 7" x 3" / Weight: 5.4 lbs
Morningstar SureSine300 - Dimensions: 8.4" x 6" x 4" / Weight: 10 lbs
Two year warranty / UL Listed

ITEM #	Description	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	**$348**
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	**$275**

MAGNUM ENERGY

RD SERIES

RC50 - REMOTE DISPLAY

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 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. Dimensions: 16.6" x 8.4" x 4.7" / Weight: 20 lbs / Two year warranty

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.

Dimensions: 13.75" x 12.65" x 8" / Weight: 38-45 lbs / Two year warranty

ITEM #	Input Voltage	Continuous Power	AC Surge Amps (1 msec)	Battery Charging Maximum	Price
I-ME-MM1512AE	12	1500 Watts	42A	70A	**$720**
I-ME-RD2212	12	2200 Watts	60A	110A	**$1168**
I-ME-RD2824	24	2800 Watts	100A	80A	**$1344**
I-ME-RD3924	24	3900 Watts	150A	105A	**$1584**

OPTIONAL EXTRAS

ITEM #	Description	Price
I-ME-AGS-N	Magnum Auto Gen Start. Allows operation with either the RC50 or ARC50 remote	**$264**
I-ME-RC50	Allows access & programming of critical settings on inverter	**$184**
I-ME-ARC50	Magnum Advanced Remote recommended for use w/ AGS	**$239**
I-ME-BMK	Magnum Battery Monitoring Kit	**$176**
I-ME-BMK-NS	Above without shunt (for use in panel systems)	**$168**

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 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	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-UL	Copper, 2 gauge 10' pair, lugs on all ends	**$79**
I-BC2-SINGLE	Single cable: cut it in half for inverter with clamps	**$40**
FOR INVERTERS THAT ARE 12V 1000-1500 WATTS; 24V 2000-3000 WATTS; 48V 3600-4000 WATTS		
I-BC10-2/0-UL	Copper, 2/0 gauge, 10' pair, lugs on all ends	**$130**
I-BC2/0-SINGLE	Single cable: cut it in half for inverter with clamps	**$65**
FOR INVERTERS THAT ARE 12V OVER 1500 WATTS; 24V OVER 3000 WATTS; 48V OVER 4000 WATTS		
I-BC10-4/0-UL	Copper, 4/0 gauge, 10' pair, lugs on all ends	**$198**
I-BC4/0-SINGLE	Single cable: cut in half for inverter with clamps	**$99**

FRONIUS GALVO & PRIMO
Grid-Connected Inverters

Fronius Galvo high frequency inverters are available in sizes ranging from 1.5 kW to 3.1 kW and offer several unique features to streamline installation and maintenance. The Fronius SnapINverter hinge mounting system allows for tool-free attachment and removal of the inverter from the wall mounting plate and it's integrated disconnect; making it practical for a single person to hang the device.

The Galvo inverters also come with integrated Wi-Fi communications and complementary monitoring via Fronius's Solar. web monitoring portal. Note that an on-site Internet connection and Wi-Fi local network are required to use the monitoring.

The wide input voltage and MPPT operating range allows for extra flexibility in string sizing and the Galvo 1.5-1 can be deployed with as few as 5 modules. An internal Arc Fault Circuit Interrupter (AFCI) is included.

10-year warranty, which is extendable to 15 or 20 years.

ITEM #	Description	Price
I-FR-GALVO1.5-1	1500W Single Phase Fronius Galvo Inverter	$1698
I-FR-GALVO2.0-1	2000W Single Phase Fronius Galvo Inverter	$1835
I-FR-GALVO2.5-1	2500W Single Phase Fronius Galvo Inverter	$1872
I-FR-GALVO3.1-1	3100W Single Phase Fronius Galvo Inverter	$1997

The **Fronius Primo** line features mid-range residential grid-tie inverters incorporating dual MPPT DC connections. The flexibility of the Primo line is a great choice when plans call for starting small with the intent to grow the array over time. A minimum input voltage rating starting at 80 volts allows for starting string sizes as small as three 60 cell(nominal 30 volt) panels in series. The result is the option for a lower cost, entry level system with plenty of room to grow the array over time.

10-year warranty, which is extendable to 15 or 20 years.

ITEM #	Description	Price
I-FR-PRIMO3.8-1	3800W Single Phase Fronius Primo Inverter	$1750
I-FR-PRIMO5.0-1	5000W Single Phase Fronius Primo Inverter	$2234
I-FR-PRIMO6.0-1	6000W Single Phase Fronius Primo Inverter	$2484
I-FR-PRIMO7.6-1	7600W Single Phase Fronius Primo Inverter	$2935
I-FR-PRIMO8.2-1	8200W Single Phase Fronius Primo Inverter	$3109

FRONIUS IG PLUS
Grid-Connected Inverters

The **Fronius IG Plus Advanced Inverters** are highly efficient, light weight and easy to install. They also have an internal Arc Fault Circuit Interrupter (AFCI) for added safety. This is a now a required feature in most NEC 2011 jurisdictions. These inverters come with a lockable code-compliant DC disconnect with a built-in 6-circuit fused string combiner that can remain on the wall when the inverter is removed for servicing.

10-year warranty, which is extendable to 15 or 20 years.

ITEM #	Description	Price
I-FR-PLUSA10-1	10,000W Single Phase Fronius IG Plus A Inverter	$3883
I-FR-PLUSA11-1	11,000W Single Phase Fronius IG Plus A Inverter	$4206

The Fronius SYMO line of 3-phase inverters is also available to order. Give us a call!

ENPHASE ENERGY
Micro Inverters

Most grid-connected solar energy installations use a single centralized inverter to convert the DC output from the solar array into AC power. The Enphase Energy micro-inverter system mounts behind each solar panel and converts the DC output into AC power. The Envoy Gateway collects performance data for each solar module in a user's system and transmits data to a website, where users can view their system's performance.

We are happy to help you choose the right components for your installation. Just give us a call!

ITEM #	Description	Price
I-ENPHASE-250	250W Enphase Micro-Inverter	$222
I-ENVOY-ETHRNT	Envoy Communications Gateway with Ethernet Bridge	$695
I-ENVOY-WIFI	Envoy Communications Gateway with WIFI Adapter	$695
I-ENGAGE-PORT	Micro-Inverter Portrait Style Trunk Cable	$29 each
I-ENGAGE-LAND	Micro-Inverter Landscape Style Trunk Cable	$37 each

SMA-SUNNY BOY

SMA String inverters are available in sizes from 3kW to 24kW and can be used in a wide range of applications from small residential systems at 240VAC to very large 480VAC three-phase industrial installations. We can special order any of the configurations that you find on their website and are not listed in our catalog. The SMA "TL" version inverters feature a transformer-less design, which are much lighter and easier to install.

3000TLUS-22 - 7700TLUS-22

SMA's Transformerless inverters feature high efficiency and reduced weight, and include ground and arc fault detection as required by the 2011 NEC code. They have a input voltage range of 175VDC – 600VDC and dual MPPT inputs, making string sizing much more flexible. This watt range also includes an onboard Emergency Power Supply that enables them to supply up to 12A at 20 VAC for charging portable devices or a small UPS system when the grid isn't active and without adding batteries. Integrated DC disconnect is included.

3000US-12 - 8000US-12

The SunnyBoy "US" have been updated with SMA's most advanced technology. All models feature an integrated DC disconnect and fused 4-circuit combiner that can be used with fuses up to 20A and are shipped with 15A fuses. They are field configurable for positive-ground systems and have built in ground- fault and arc-fault detection and interruption.

The 3000 and 4000US-12 are autosensing for use on 240 and 208VAC applications. The 3800US-12 is for 240VAC only and is specifically sized for buildings with a 100A service entrance panel. The 5000 – 7000US-12 can be used in 208, 240 and 277VAC applications and the 8000US-12 can only be used in 240 and 277VAC.

10 year warranty

SMA-SUNNY BOY

ITEM #	Description	Price
I-SB3000TLUS-22	Sunny Boy 3000W Transformerless 208/240V Inverter	$2354
I-SB4000TLUS-22	Sunny Boy 4000W Transformerless 208/240V Inverter	$2448
I-SB5000TLUS-22	Sunny Boy 5000W Transformerless 208/240V Inverter	$2978
I-SB6000TLUS-22	Sunny Boy 6000W Transformerless 208/240V Inverter	$3458
I-SB7000TLUS-22	Sunny Boy 7000W Transformerless 208/240V Inverter	$3768
I-SB7700TLUS-22	Sunny Boy 7700W Transformerless 208/240V Inverter	$3989
I-SB3000US-12	Sunny Boy 3000US Inverter	$2045
I-SB3800US-12	Sunny Boy 3800US Inverter	$2450
I-SB4000US-12	Sunny Boy 4000US Inverter	$2495
I-SB5000US-12	Sunny Boy 5000US Inverter	$3075
I-SB6000US-12	Sunny Boy 6000US Inverter	$3425
I-SB7000US-12	Sunny Boy 7000US Inverter	$3730
I-SB8000US-12	Sunny Boy 8000US Inverter	$4045

Adding wireless communication to any of these inverters is available. Please check with us when ordering so that we can pair the correct options with your order.

Sunny Island

The Sunny Island is a bi-directional battery-based inverter/charger that can be used completely off-grid, or for battery backup in grid-tie systems with Sunny Boy grid-tie inverters. These are available by special order. Please give us a call to discuss your specific needs.

VOLTAGE TRANSFORMERS

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	Price
I-OBPSX240	Outback PSX240 6kva Transformer	$630

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.

ANALOG 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. Dimensions: 3.2" W x 2.5" H 1.75" D. Faceplate is .5" thick

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-AVOLT	8-16V Analog Voltmeter	$25
M-60AMP	60 Amp DC Meter	$12

TRIMETRIC BATTERY METER

Model 2030 for 12, 24 or 48 Volt Systems

IF YOU HAVE JUST ONE METER, MAKE THIS THE ONE

The Trimetric meter 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. 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. One year warranty.

NEW! Bogart Engineering has a *NEW* solar charger ($132) that works with this meter called the SC-2030. We haven't tried it out ourselves yet but we've heard good things about it and it has some nice features! Give us a call or check it out on our web-site, backwoodssolar.com.

ITEM #	Description	Price
M-TRIMETRICKT30	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 -22awg Cable, 25 feet (or specify length) with 3 amp fuse connects meter to shunt & power	**$230**
M-TRIONLY-2030A	Trimetric 2030 Meter head alone, no shunt or parts kit, 5" x 4.5"	**$172**
M-SHUNT-100	100A Shunt	**$29**
M-SHUNT-500	500A Shunt	**$29**
M-TRI-WIRE-18	18awg thermostat wire for longer runs	**.39/ft**

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. LCD not backlit.

6 month warranty / ETL approved

ITEM #	Description	Price
M-KILLAWATT	AC Watt Hour Meter	$32

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.

Timer dimensions: 3" x 3" x 2" / One year warranty

ITEM #	Description	Price
A-DIGTIME12	12 Volt Digital Programmable Timer	$79
A-DIGTIME24	24 Volt Digital Programmable Timer	$79
O-12VRELAY	12V, 30A DPDT Screw Term Relay (210ma coil)	$45
O-24VRELAY	24V, 30A DPDT Screw Term Relay (210ma coil)	$53
O-48VRELAY	48V, 30A DPDT Screw Term Relay (210ma coil)	$70
O-INLINE	Inline 3 Amp Fuse & Holder	$4

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 (call for pricing). 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-TIMEERDI-12	12V Adjustable Off Timer	**$50**

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-TIMEHRDB-12	12V Delayed Off Timer	**$55**
A-TIMEHRDB-24	24V Delayed Off Timer	**$55**

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.

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.

One year warranty

ITEM #	Description	Price
EQ12/24-20	Balances 24V battery use to 12V power tap Covers 40 Amp average 12V load	**$220**
EQ12/48-10	Balances 48V battery to use 12V power tap Covers 20 Amp average 12V load	**$248**
EQ24/48-10	Balances 48V battery to use 24V power tap Covers 20 Amp average 24V load	**$248**
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. One 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	$211
CV12/48-3	Converts 12V input to 48V output, 3 Amps max output	$211
CV24/48-6	Converts 24V input to 48V output, 6 Amps max output	$211

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	$212
PPT12/48-10	Converts 48V input to 12V output, 10 Amps max output	$256
PPT24/48-10	Converts 48V input to 24V output, 10 Amps max output	$256

MIDNITE SOLAR 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. Box measures 17" x 9" x 4". ETL listed for US and Canada.

Consider making your own power panel. See kits using Midnite E-Panels & Magnum Mini Panels in the Power Panel section.

ITEM #	Description	Price
O-MNDC125	125A DC Disconnect	$198
O-MNDC175	175A DC Disconnect	$225
O-MNDC250	250A DC Disconnect	$225
Breakers: Use S-MNEPV and O-MNEDC breakers. See pages 124-125		

AC GRID-TIE 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 & amperage for fused disconnects.

ITEM #	Description	Price
O-AC30FUSED-2	30A, 2-Pole Disconnect	$85
O-AC30FUSED-3	30A, 3-Pole Disconnect	$138
O-AC60FUSED-2	60A, 2-Pole Disconnect	$154
O-FUSE-XX	15A, 30A or 60A Class R Fuse	$9

BREAKER BOXES

MIDNITE BABY BOXES

Midnite Solar's "Baby Box" is a general use powder coated aluminum enclosure for retrofits, small inverter disconnect, PV disconnect or AC or DC distribution. 3/4" & 1" knockouts on each end. The Baby Box accepts up to four Din mount breakers from 1A to 63A or two larger 80/100A dual slot breakers.

The"Big Baby Box" is about twice as wide as the Baby Box allowing more room for wiring. It also includes a ground box lug and mounting provisions for a short insulated bus bar as well as a ground bus bar. Holds up to four13mm wide din rail breakers from 1A to 63A or two larger 80/100A dual slot breakers.

ITEM #	Description	Size	Weight	Price
O-MNE-BABY	Baby Breaker Box	7" x 3" x 2.5"	2lbs	$33
O-MNE-BIGBABY	Big Baby Breaker Box	8" x 5" x 3"	3lbs	$41

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 an 80A or larger charge controller is used. This allows for a 100A panel mount breaker to be wired into the system.

Size: 8"(L) x 5" (W) x 4" (D)

ITEM #	Description	Price
O-MNEDCQUAD	Midnite DC Quad Box	$52

Midnite Solar offers many enclosure options, some with din rails and breakers included. We are happy to special order what you need.

SQUARE-D BREAKER BOX

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 QO612L100S, 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. Box measures 13" x 9" x 4".

ITEM #	Description	Price
O-QO612KIT	Load center with two 20A breakers	$58
O-QOBRKR	10, 15, 20 or 30A (Specify when ordering)	$15
O-QOBRKR60	60A Breaker	$18
O-QOU-BRKR260	60A, 2-Pole, QOU Breaker	$102

BREAKERS

DC BREAKERS - MidNite's breakers are rated to break the full rated load at the rated voltage repeatedly, with NO DAMAGE. Always use a properly sized breaker for disconnecting. Comes with mounting screws.

We use these breakers in the Midnite Disconnect Boxes on page 122.

ITEM #	Description	Price
O-MNEDC100	100A DC Breaker	$39
O-MNEDC175	175A DC Breaker	$122
O-MNEDC250	250A DC Breaker	$122
O-MNEDC(Amp)	5, 10, 20, 30, 40, 50, 60 or 80A DC Breakers	$22
O-OBDC-GFP2	Outback Double Pole Breaker 80A/Pole GFP	$98

BREAKERS

PV Breaker

Dual Slot

GFP63

PV BREAKERS - 150VDC din rail mount breaker (13mm wide). MNEPV breakers are the same as CBI QY breakers available elsewhere except MidNite Solar breakers are 150VDC. Typically used in combiner boxes; and for charge controller input and output breakers.

ITEM #	Description	Price
S-MNEPVXX	6, 9, 10, 15, 20, 30, 40, 50, 60 or 63 amp PV Breakers	$16
S-MNEPV80 or 100	80 or 100A PV Dual Slot Breaker	$60
S-MNEPV-GFP63	63A, Single Pole Ground Fault DC Breaker	$69

AC Breaker

AC BREAKERS - Midnite din rail mount AC breakers are branch circuit rated 489A for continuous duty. They hold 100% rated current independent of ambient temperature.

Dual Slot

ITEM #	Description	Price
O-MNEAC(Amp)	15, 20, 30, 50, 60 AC Single Pole Breakers	$19
O-MNEAC(Amp)-D	15, 20, 25, 30, 50 AC DOUBLE Pole Breakers	$38

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	$30

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	$56
O-FUSE100	100A Class R Fuse only	$21

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	$32
O-FB40	40-60A Holder & Two 40A Class R Fuses	$32
O-FB30	30A Holder & Two 30A Class R Fuses	$20
O-FB15	15A Holder & Two 15A Class R Fuses	$20
O-FUSE:15,30,40,60	R15, R30, R40 or R60 Fuse Only	$9

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.

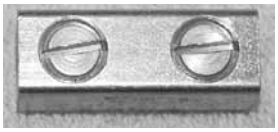
ITEM #	Description	Price
O-SIXFUSE	Includes 6 fuses and 4 spares	$22
O-INLINE	Inline 3A Fuse & Holder	$5

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	$4.75
O-AU4/0	$5.75
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	$18

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. Includes allen wrench.

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	$28
O-16220-2	Double Terminal Block	$42
O-16220-3	Triple Terminal Block	$50
O-16325-1	Larger Single Block	$59
O-BLOCK	Terminal Block	$9

PLUGS, OUTLETS & SWITCHES

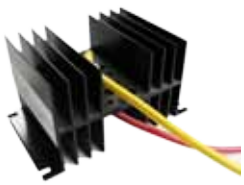
DC OUTLET & PLUG Handles 20 amps, fits standard outlet box & cover. Takes 10 or 12 gauge wire on the screw terminals. These are actually heavy duty 240 volt outlets which pass building codes for DC wiring if there is no 240 volt in the house.

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	$15
O-DCPLUG	Plug for DC or 240V AC, 20A, Three Prong	$9
O-TOGGLE	50A DC Toggle Switch	$9

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-DIODE80	Rated 80A, up to 100V	$48

MIDNITE SOLAR SURGE PROTECTOR

Fast becoming the industry standard!

The MidNite Solar Surge Protector Device (MNSPD) is a Type 1 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. Other 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! However, 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 MidNite SPD 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	Price
LA-MID-SPD115	115V Surge Protector Device	$102
LA-MID-SPD300	300V Surge Protector Device	$102
LA-MID-SPD300AC	300V AC Surge Protector Device	$102
LA-MID-SPD600	600V Surge Protector Device	$102

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) make less heat and more light making them more efficient, using one fourth the power of ordinary bulbs. A 15 watt CF has the brightness of a 60 watt incandescent bulb. 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. The price and light color of LED bulbs 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.

Tip: DC socket wiring for Edison base bulbs: Pos (+) = center pole; Neg (-) = side

See the LIGHTING CHART on page 192 of this catalog for more information about LUMENS.

PICO LED LIGHT AND PORTABLE CHARGING STATION

The Pico Lamp is a multifunctional stationary or mobile lighting device that is specially designed to meet the needs of rural households and recreational activities. It is equipped with a high-efficiency power LED and excellent charging technology. Its flare housing conceals multiple functions as a ceiling-mounted lamp, a portable, hand-held lamp, and a USB charger (for cell phones, MP3 players, and others) – in a single device. Charging is highly flexible as well: Pico can be powered by solar modules, batteries, or AC adapters. The integrated Phocos MPPT charge controller extends battery lifespan and provides light for up to 55 hours. The robust housing is sealed against water and dust. It also is shock resistant – this protects the electronic components inside from soil, moisture, insects, and malfunctions.

An added advantage: The Phocos Pico Lamp is the only lamp on the market, which has no moving parts thanks to capacitive switches, thus eliminating conventional switch failures, one of the most common reasons for the breakdown of small solar systems.

The Phocos Pico Lamp can be expanded individually to a Pico Solar System to meet customer specifications. Design your own Pico System! Just add as many Pico Lamps and accessories as needed via its simple plug & play functionality.

- Charging is possible from three sources: via 7 V to 25 V solar module, 12 V car battery, or AC adapter
- High environmental protection (IP65) against dust, soil and other climate influences
- USB output to charge USB devices e.g. mobile phones, MP3 players, etc.
- Three adjustable light levels for best comfort
- Automatic reduction of the lighting level when batteries are running down

Two year warranty

INCLUDED ACCESSORY PACKAGE

ITEM #	Description	Price
L-PICO-REC	Rechargeable Pico Light	$79

"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	Super Bright 9V Glow-In-The-Dark LED Pak-Lite	$30
L-PAKLITEKIT	Accessory Kit for 9V Pak-Lite	$15

12V WHITE MR16 LED

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.

ITEM #	Description	Price
L-LED-MR16	20 Bright LED's with 2 pin base	$15

ULTIMATE DC LED BULBS

We have recently found a promising new 12V LED. This is the brightest most omnidirectional bulb that we have found on the market for 12V use. It even outperforms many AC LED bulbs made by major manufacturers. This A19 size lamp is the perfect replacement for 12 volt incandescent and compact fluorescent bulbs in table lamps and ceiling fixtures. Light is evenly distributed in all directions and the light is warm and even. Power consumption is only 6 watts (500 mA) and light output is 480 lumens. Color temperature is 3000 Kelvin, which is a warm soft white like most incandescent bulbs. Voltage range is 9 to 16 volts. Standard medium Edison base. Light output from this lamp is constant, even in low battery conditions. Unlike an incandescent lamp, it remains bright when battery voltage drops to 10 volts. Base is actually white, not blue like picture illustrates. 3 year warranty.

ITEM #	Description	Price
L-LED-ULTIMAT12	6W Ultimate LED Bulb, 12V, 480 lumens, 4-3/4" long	$22
L-LED-ULTIMAT24	6W Ultimate LED Bulb, 24V, 480 lumens, 4-3/4" long	$22

PHOCOS 12/24V DC LED BULBS

The solar SL LED bulbs from Phocos features bright illumination levels combined with low power consumption. The 8W bulb is 12V only but the 3W DC bulbs can be used directly from a 12V or 24V battery. Both offer an extended lifespan of up to 50,000 hours (with minimal light degradation). They have a standard E27 edison socket.

L-PH-LED3W

These bulbs are great for ceiling fixtures and task lighting where 170 degree angle of light is sufficient.

Color temperature on the 8W bulb is 3,950 K - 4,300 K, which gives off a more neutral/cool white color. The color temp on the 3W bulb is 5,600K which is a more typical cool white color.

L-PH-LED8W

ITEM #	Description	Price
L-PH-LED-3W	3W Phocos LED Bulb, 12/24V, 210 lumens, 3-3/4" long	$17
L-PH-LED-8W	8W Phocos LED Bulb, 12V, 500 lumens, 5-1/2" long	$45

12 VOLT DC LED THIN LITE

The **LED ST130WP** features a 48 LED bulb, powder coated aluminum housing and acryllic diffuser lens. Delivers even, non-glare, lighting to ensure a stress free work environment. No hot-spots or eye strain. One Touch switch with 2 dimming levels. LED life of 100,000 hours and voltage input of 8-30 VDC. Uses 2.88W on low and 9.6W on high. Amp draw at 12VDC is .24A/.8A. Lumen rating of 480 on low and 1600 on high. Dimensions: 12" x 5.375" x 1.75" / Three year warranty

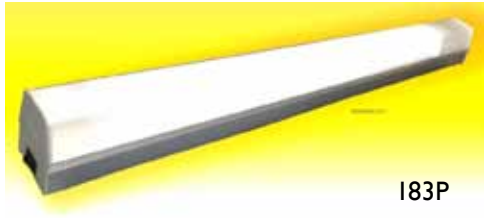
ITEM #	Description	Price
L-LED-130WP	LED ST130WP Light Fixture	$70

The **LED 116P** mimics the original dual surface mount/low profile fixtures from Thin-Lite. Non-yellowing diffuser and white powder coated aluminum housing. Features 72 super bright LEDs with One Touch switch and 2 dimming levels. LED life of 100,000 hours and voltage input of 8-30 VDC. Uses 4.32W (.4A @ 12V) on low and 14.4W (1.25A @ 12V) on high. Lumen rating of 720 on low and 2400 on high. Dimensions: 18" x 5.625" x 1.375" / Three year warranty

ITEM #	Description	Price
L-LED-116P	LED 116P Light Fixture	$89

12 VOLT DC LED THIN LITE


186P


183P

Thin-Lite's LED 180 Industrial and Commercial surface mount fixtures provide efficiency for use in commercial, industrial, and residential applications. Very easy to install. Clear acrylic diffuser lens with One Touch switch and two dimming levels. LED life of 100,000 hours and voltage input of 8 -30 VDC.

The **LED 186P** has 72 super bright LEDS and draws 4.32W(.24A) on low and 14.4W(.8A) on high. Equivalent lumens are 480 and 1600 respectively. Dimensions: 18.125" x 3.625" x 3.5" / Weight: 2 lbs / Three year warranty.

The **LED183P** has 96 super bright LEDS and draws 5.76W(.48A) on low and 19.2W(1.6A) on high. Equivalent lumens are 960 and 3200 respectively. Dimensions: 48.125" x 3.625" x 3.5" / Weight: 3.3 lbs / Three year warranty

ITEM #	Description	Price
L-LED-186P	LED 186P Light Fixture	$99
L-LED-183P	LED 183P Light Fixure	$128

12V DC LED CIRCULAR FIXTURE

Thin-Lite's Circuline series offers years of reliable, virtually maintenance free service. Minimum draw, utilizing 48 super bright high efficiency LEDs. Opaque white diffuser lens, white powder coated aluminum housing, and wood grain accent. One Touch switch with 2 dimming levels, LED life of 100,000 hrs, voltage input of 8 - 30 VDC. Uses 2.88W on low and 9.6W on high, draws .24A/.8A on 12VDC. Lumen output is 480 on low and 1600 on high setting.

Dimensions: 9.5" diameter x 1.75" / Three year warranty

ITEM #	Description	Price
L-LED-CIRCLE	LED Circular Light Fixture	$71

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 for surface mounting in an inconspicuous location. Made in USA. Dimensions: 1" x 1" x 1" / Two year warranty

ITEM #	Description	Price
L-NITEWATCHMAN	12V DC Photoswitch	$42

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

COMPACT FLUORESCENT

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.

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. 15 watt uses 1.2 amps. The 30 watt uses 2.4 amps.

Choice of light color: available in a warm yellow(2700K) or cool white (6400K) in all sizes. Minimum wire size: 10 gauge copper. One year warranty.

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	**$12**
L-CF15 (C or W)	15 Watt (Spiral), total length is 6", 925 lumens, 12V	**$15**
L-CF15 (C or W)-24	15 Watt (Spiral), total length is 6", 925 lumens, 24V	**$24**
L-CF30 (C or W)	30 Watt, total length is 8", 1500 lumens, 12v	**$30**

12 VOLT DC FIXTURES

Compact Fluorescent Reflector Lamp

A Bright light for serious work Indoor/Outdoor

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 (Cool) 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. Red wire is (+); Blue wire is (-). Minimum wire size: 10 gauge copper. One fixture per switch.

A customer reports that five of these fixtures adequately illuminate a 10' by 40' sign in the Nevada desert. 24V available by special order.

Dimensions: 9" x 4" x approx. 6" from wall, depending on aim adjustment. One year warranty.

ITEM #	Description	Price
L-ELF	Specify WHITE, BLACK or GREEN	$66

12 VOLT DC 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 fluorescent bulb and electronic ballast included. On-off switch built in.

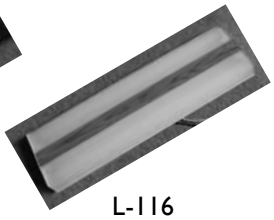
Dimensions: 9" x 4.5" x 1.5" / Two year warranty.

ITEM #	Description	Price
L-949	13 Watt Compact Fluorescent Wall Fixture	$52

DC FLUORESCENT FIXTURES

Covered Straight Tube Fixtures With Switches

L-139



L-116

L-193

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.

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.

Two year warranty on fixtures, not tubes. TUBES ARE INCLUDED.

ITEM #	Description	Price
L-139	32W with one 48” F32TB/CW tube: 2850 lumens	**$68**
L-116	30W with two 18” F15T8/CW tubes: 1740 lumens	**$52**
L-193	15W with one 18” F15T8/CW tube: 870 lumens	**$28**

22 WATT CIRCULAR SCREW-IN

22 Watts, 1.6 amps. 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 amps.

Two year warranty.

ITEM #	Description	Price
L-108	Screw ballast & circular bulb	**$48**
L-108/9BULB	Replacement 22W circular bulb only	**$5**

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.

Ten year warranty!

ITEM #	Description	Price
L-RAB	12V DC Motion Sensing Light	$112

SMALL GOOSENECK LAMP

For 12 Volt DC power

LITTLITE 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.

Two year warranty.

ITEM #	Description	Price
L-LITTLITE	12V Gooseneck lamp with 5W halogen bulb, 18”	$40
L-LITTLED	12V Gooseneck lamp with 5 LED bulbs, 18”	$62
L-LITTLEBASE	Weighted portable metal base	$14.50
L-GOOSE-5	Replacement 5W halogen bulb (not for LED version)	$7
L-1815BULB	1/4 Amp plain bulb for traditional Little Lite	$.50

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	$5
L-50W	12V, 50 Watts, 4 Amp plain screw in bulb	$5

12V 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	$7
L-Q35	12V, 35 Watts, 3 Amps	$8

Backwoods Solar welcomes all new product ideas. Many of the products you find in our catalog are 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. 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:

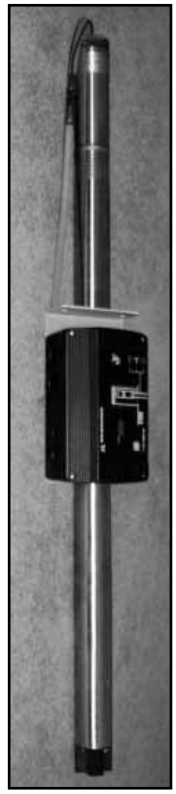
1) How deep is your well or alternative water source
2) What is the static water level in the well (the static level is that height in the well to which the water rises under it's own pressure)
3) How many gallons per minute does your well produce
4) How many gallons per day do you need
5) Will you pump 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 ponder 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. 48-300v 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. Two year 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	Price
P-SQFLEX	Grundfos SQ Flex Pump & Kit	$2199
P-IO50	SQFlex/PV On-Off Control Box	$94
P-IO101	SQFlex AC/PV Interface Box	$565
P-CU200	SQFlex Multi Purpose Interface	$488

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.

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. Max temperature is 104 degrees Farenheit.

Two year warranty.

ITEM #	HP & Amp Draw	GPM at Feet of Lift	Price
P-5SQ05A180	1/2, 9.8A	5 at 180’	**$899**
MAX CAPABILITY OF ABOVE		1.1 at 260’	
P-10SQ05A160	1/2, 9.8A	10 at 160’	**$815**
MAX CAPABILITY OF ABOVE		5 at 200’	
P-15SQ05A110	1/2, 9.8A	15 at 110’	**$810**
MAX CAPABILITY OF ABOVE		7.5 at 160’	

240V models are also available.

DC SUBMERSIBLE PUMP AQUATEC 4000

The Aquatec SWP-4000 is a submersible pump ideal for many off-grid applications. The DC motor can be driven by 12 or 24 volts from a battery bank or solar panel direct (considered 15 and 30 volt applications). As a lower volume pump it is ideally suited for filling livestock troughs or holding tanks.

It's rugged design includes a stainless steel casing, a double O-ring seal against leaks into the motor, a factory installed electrical wiring harness (with 36" leads), and a stainless steel water intake. The pump is field servicable a with a typical service cycle of two to seven years depending on use.

Solar direct applications should use a nominal panel size of ~110 watts at 24 volts for standard applications, but larger 60 cell panels can be used for peak performance and a wider window of operation. Always use a P-LCB-7 linear current booster in solar direct applications, ordered separately. Aquatec recommends a maximum submersion depth of 75', meaning the pump should not be positioned any deeper than 75' below the static water level. Maximum total lift of 230'

0.43 gallon per minute flow rate at 230' of lift (3.5 amp draw), 0.62 gpm at 20' of lift (1.1 amp draw), for 12 volt configurations.

1.25 gallon per minute flow rate at 230' of lift (3.7 amp draw), 1.70 gpm at 20' of lift (1.4 amp draw), for 30 volt configurations.

Dual-Size Stainless Steel Outlet Nipple Fits 0.5" Hose Barb Tubing (0.50 Inch ID) or 0.5" Poly Pipe (0.62 Inch ID).

Made in the U.S.A. Warranty of 12 months from date of purchase or 18 months from date of manufacture.

ITEM	Description	Price
P-AQUA-4000	Aquatec SWP-4000 Pump - 12.5" long x 3.75" diameter	**$795**
Accessories & Replacement Parts		
P-SFWIRE	Flat jacketed,10awg 2-conductor wire. Order enough to get to an above water level splice, or to wellhead.	**$1.50/ft**
P-HOSE-250	250' 1/2" drinking quality hose (also available by the foot for $1 per foot)	**$218**
P-AQUA-4000-EBK	End Bell Kit	**$40**
P-AQUA-4000-LHA	Lower Housing Assembly	**$77**
P-AQUA-4000-MTR	Replacement Motor Kit	**$125**
P-AQUA-4000-VHA	Valve Housing Kit	**$36**

NEW! The **Aquatec 6000** is available for lower lift/higher volume needs. See website for more details. **P-AQUA-6000 - $975.00**

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.

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

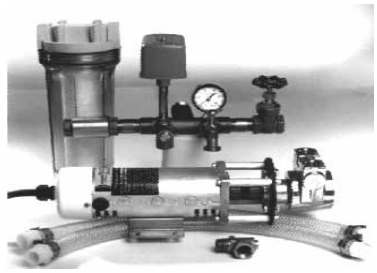
Dimensions: 5.7 x 15.5" / Weight: 16 lbs / One year warranty against defects in materials and workmanship.

ITEM #	Lift (ft)	GPM	PV Watts	Max Lift (ft)	GPM	PV Watts	Price
P-1322	20	.51	27	440	.39	168	**$675**
P-1308	20	1.25	30	400	1.0	198	**$675**
P-1303	20	2.5	48	240	2.15	204	**$675**
P-2507	20	4.0	57	140	3.65	195	**$699**
ACCESSORIES							
P-FLOWFLTRKIT			10" Inline Filter with Cartridge				**$107**
P-10FILTERS			Quantity 2, 10" Filters				**$14**
P-DRSWITCH			Works with 2500 series				**$140**
P-DRSWITCH-1300			For 1300 & 1400 series				**$140**

Pumps have a nominal operating voltage of 12V or 24V. Please specify when ordering.

FLOWLIGHT BOOSTER PUMP

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).



Shown with EZ Flow Kit & Filter

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.

Dimensions: 16” x 5” / Weight: 15 lbs / One Year Warranty

ITEM	Description	Price
P-2910	Specify 12, 24, or 48V DC	**$705**
P-2920	Specify 12, 24, or 48V DC	**$762**
P-2920-AC	120V AC	**$1050**
P-2930-48V	48V DC	**$1399**
P-EZFLOWKIT	EZ Flow Kit	**$157**
P-FLOWFLTRKIT	10” Inline Filter with Cartridge	**$107**
P-10FILTERS	Quantity 2, 10” Filters	**$14**
P-DRSWITCH	Dry Run Switch	**$140**

AQUATEC 550 PRESSURE PUMP

The AQUATEC 550 pump is commonly used either to pressurize water from an atmospheric tank, to deliver purified water to a specific point of use, or simply to increase pressure when required.

Backwoods features a model that includes a standard 5 chamber diaphragm pump head, a permanent magnet motor, quick disconnect inlet/outlet ports, and a built-in pressure switch (cut-in at ~45 psi, shut-off at 60 psi). We include 1/2" barbed intake and outlet port fittings, which are ideal for connection to flexible hose to act as a shock absorber for pump vibrations. Order our P-EZ kit (page 156), if desired. The built-in pressure switch is NOT adjustable. Backwoods has an external Square D pressure switch that can be used instead, to operate the pump at lower, adjustable pressure settings for lower power consumption.

The 550 is a higher volume booster pump, capable of 5.3 gallons per minute at no head/pressure; and a maximum pressure capability of 70 psi (the equivalent of 161' of lift) with a delivery of 3 gallons per minute. At half power, the pumps can run for extended periods of at least a couple of hours with no heat concerns; BUT running at higher pressures than ~25 psi should be limited to runs of 25 minutes at a time to avoid overheating. This is a possible issue to consider with very large pressure tanks that take a long time to fill, but easily avoided with a small to medium pressure tank that can be charged to full in 10 minutes or less. This pump is capable of being run dry.

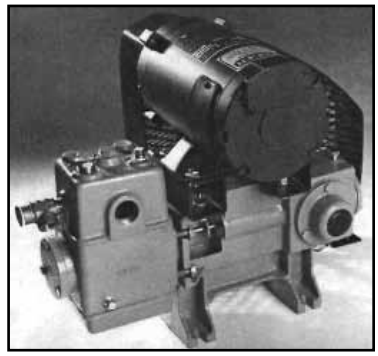
Power draw at no head is 5.5 amps, up to 18 amps at 70 psi.

Warranty of 12 months from date of purchase or 18 months from date of manufacture.

Dimensions: 10" x 4.5" x 5" / Weight: 7 lbs

ITEM	Description	Price
P-AQUA-550-12	Aquatec 550 Series 12V Pump & Fittings	**$98**
P-AQUA-550-24	Aquatec 550 Series 24V Pump & Fittings	**$108**
P-AQUA-550-AC	Aquatec 120V AC Pump & Fittings	**$124**
EASY SET-UP KIT of hose, clamps, and water system diagrams; as well as **Pressure Tanks and Pressure Switch** are available in ACCESSORIES on page 156		
REPLACEMENT PARTS FOR AQUATEC 550 SERIES		
P-AQUA-550-LHA	Aquatec 550 Lower Housing Assembly	**$31**
P-AQUA-550-VHA	Aquatec 550 Valve Housing Assembly	**$22**
P-AQUA-QBS554	Aquatec Straight 1/2" Male Barbed Fitting	**$2**

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: 23" x 13" x 16" / Two year warranty

ITEM	Description	Price
P-3010-B	Solar Force: 5 GPM, 60 PSI, 1/4 HP - Battery	$1759
P-3020-B	Solar Force: 5 GPM, 100 PSI, 1/2 HP - Battery	12V - $2370
		24V - $2321
		48V - $2302
P-3020-PV	Solar Force: 5 GPM, 100 PSI, 1/2 HP - PV Direct	12V - $2737
		24V - $2691
		48V - $2429
P-3020-AC	Solar Force: 5 GPM, 100 PSI, 1/2 HP - 115VAC	$2380
P-3040-B	Solar Force: 9 GPM, 60 PSI, 1/2 HP - Battery	12V - $2489
		24V - $2441
		48V - $2420
P-3040-PV	Solar Force: 9 GPM, 60 PSI, 1/2 HP - PV Direct	12V - $2918
		24V - $2869
		48V - $2849
P-3040-AC	Solar Force: 9 GPM, 60 PSI, 1/2 HP - 115VAC	$2456
P-HDPRSWITCH	Heavy Duty Pressure Switch for 3020 & 3040	$125
LINEAR CURRENT BOOSTER IS REQUIRED FOR SOLAR ARRAY DIRECT MODELS		
P-LCB-15	12/24V/15A, Linear Current Booster	$248
P-LCB-30	12/24V/30A, Linear Current Booster	$440
P-LCB-48	48/10A, Linear Current Booster	$270
P-FOOTVALVE	1.25” valve, required for suction lift	$56

SPECIFY MOTOR VOLTAGE: 3010 available in 12, 24 or 48V DC, battery operation only. 3020 & 3040 available in 12, 24, 48V DC, or 120 AC, or Solar Direct (PV).

REPLACEMENT PARTS ARE AVAILABLE ON ALL MODELS

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.

One year warranty on both brands.

MODEL	Volt	Amp	Gal/Min flow at no head	Max unbalanced head	Price
P-MAR809-12	12	1.5	4.25	7'	**$230**
P-MAR809-24	24	0.8	5.0	7'	**$230**
P-M809HS-12	12	4	6.5	15'	**$250**
P-M809HS-24	24	1.8	6.25	15'	**$250**
P-IVAN10-PV	12	0.9	3	3.5'	**$220**
P-IVAN10-12B	12	0.45	3	3.5'	**$220**
P-IVAN10-24B	24	0.25	3	3.5'	**$260**
P-IVAN20-PV	12	1.5	5	7'	**$290**
P-IVAN20-12B	12	1.5	5	7'	**$290**

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. Cable length is 13 feet.

Dimensions: 6.5" x 1.5" diameter / One year warranty

ITEM	Description	Price
P-AMAZON	Submersible Pump, 4 gpm, 12V, with 1/2" hose barb	$49
P-CONGO	Submersible Pump, 8 gpm, 12V, with 3/4" hose barb	$73

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.

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. 2' two-wire cord attached.

Dimensions: 3.5" tall x 3" wide (including barb) with a 3/4" diameter hose barb / Weight: 11.4 oz / Six-month warranty only when battery powered. Warranty does not cover pumps that are solar direct powered.

ITEM	Description	Price
P-RULE	Low Lift, 12V Fountain Pump	$23

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.

Backwoods recommends running the Piranha with one S-SOLAR60 panel. 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.

Dimensions: 4.5" x 3", footprint 2 3/8" round, 1-1/8" opening / Three year warranty from battery, six-month warranty, if PV direct.

MODEL	Description	Volt	Max Amp	Gal/Min flow at no head	Price
P-PIRANHA-1000	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	Price
P-TANK-1	Shurflo Accumulator Tank, 24 oz capacity 9" long x 4" diameter with 4.5" mounting bracket	$54
P-TANK-2	2 Gallon Pressure Tank 12.5" tall x 7.75" diameter	$75

EASY SET UP KIT Recommended for Aquatec 550 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 Aquatec 550	$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	Price
P-HOSE-250	250 Foot Roll (also available by the foot for $1 per foot)	$218

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

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, 12/24V	$110
P-LCB-15	Linear Current Booster - 15 Amp input, 12/24V	$248
P-LCB-30	Linear Current Booster - 30 Amp input, 12/24V	$440
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	$52

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 - 12V or 24V	$132

PEERLESS PREMIER RANGES

P30B3102P

- ***Battery spark models use eight AA batteries***
- ***Sealed burners available***
- ***Natural gas or propane***
- ***No Electric Glow bar in oven***

Beware of 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 offers "battery spark" kitchen stoves made specifically for the off grid customer. **Battery spark models** ("B" in the model number) use 8 "AA" batteries (located under the broiler drawer on the kick plate) to create the spark ignition for both cooktop and oven burners. Batteries will last approx. 4 years. A match can light any model. Sixteen 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. Solid or glass oven door with window & light. Completely insulated oven saves gas. 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. Made in the U.S.A.

Battery Spark models:

BAK100OP/TP/BP	BFK5S9WP/TP/BP	P30B3102P
BHK5X0OP/BP	BLK100WP/TP/BP	P30B3202P
BCK100OP/TP/BP	BLK5S9WP/TP/BP	P36B3182P
BJK5X0OP/BP	P20B3102P	P36B3282P
BFK100OP/TP/BP	P24B3102P	
BMK5X0OP/BP	P24B3202P	

See www.premierrange.com for more info about these models or give us a call and we'll mail an information packet to you.

ITEM	Description	Price
PEERLESS	Porcelain Versions	**$480 - $820**
PEERLESS-SS	Pro-Series Stainless Steel Models	**$1100 - $1875**
PEERLESS-FRT	Freight on shipping each model	**$225 Res / $175 Biz**

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.

SUNJACK SOLAR CHARGER

SunJack® helps mobile users stay charged on the go anywhere the sun shines. The SunJack® is able to fully charge its internal battery pack in about five hours of direct sunlight, or directly power any USB device. When the sun isn't shining, users can still energize their devices from the powerful SunJack® battery, which holds enough charge to power up to four smartphones. Portable power is valued by campers, boaters, travelers, survivalists, hunters, rock climbers, and working professionals. The SunJack is a critical item in any emergency or disaster preparedness kit. There is growing demand to be untethered from a wall socket and to become energy independent. SunJack® is compatible with most mobile phones, iPad/tablets, USB lights, digital cameras, MP3 players, and portable gaming devices. 14 watt mono-crystalline. Two 5V/2A USB Ports. One year limited warranty.

We tested these out over the summer and they easily lived up to its claims. Comes in a rugged case that conveys quality.

Dimensions: Folded - 6.75" x 9.25" x 1.75"; Unfolded: 30.75" x 9.25" x 1.75" / Weighs 2lbs

ITEM	Description	Price
S-SJ-14W	Sunjack 14W Portable Solar Charger	$135
S-SJ-CAMPLITE	Sunjack USB Camp Light	$10

POND BUBBLER

Aerator For 10 Gallon Fish Tank or Tiny 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.

ITEM	Description	Price
A-BUBBLES	Pond/Aquarium Bubbler Kit	$47

BED WARMER - 12V

Goes on top of 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 is 4' from 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 then 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	Price
A-BED-T36	Twin Size Bed Warmers	$95

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

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.

Five year warranty on stainless. One year warranty 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	Shipping	Price
A-COOL14	19.3 x 21.5 x 24	14	52/42	1000	$83 (UPS)	**$980**
A-COOL18	24.5 x 22 x 24	18	73/60	1500	$83 (UPS)	**$1090**
A-COOL24	34 x 22.5 x 36	24	120/150	3000	FREIGHT	**$1495**

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	Price
A-COOLCONT12	12V Solar Chill Control Package	**$119**
A-COOLCONT24	24V Solar Chill Control Package	**$129**

REPLACEMENT PUMPS for Solar Chill are available by special order.
Call for more information & pricing.

LARGE DC FANS

Our fans are designed to meet your needs every season in the greenhouse or attic install. Intended for use with 12 volt or 24 volt solar panels as low as 30 watts; up to 250 watts and can be used in conjunction with 24 volt battery banks. It will also perform with 300 watt and 72 cell modules with open circuit voltages of 44 volts. They are protected from moderate over-voltage and thermal fluctuations.

A 30 watt 12V module will provide an airflow of about 9 mph (estimated 1000 cuft/min). A 60 watt 12V module will produce up to 17 mph (estimated 1900 cuft/min). A 135 watt 12V panel will hit 18 mph and faster.

The best thing about our new DC Super Fan is the brushless motor. Motor brushes wear out quickly especially if they were run at high RPM's. With no brushes the F16-PLUS will outperform other fans. Solve your circulation issue with this solar direct solution!

Note: These fans are not intended for use with 12 volt battery banks or AC power of any kind. 2 Year Warranty from purchase date. All parts are replaceable and can be ordered individually, as needed.

The 16" fan with "Version 1" motor works in conjuction with an included thermostat that delays connection of PV power until there is fuller sunlight at slightly warmer morning temperatures. A simple manual switch can also reset power to the fan.

The 16" fan with "Version 2" motor and the 20" fan has a built-in 5 minute start delay to prevent stress on the motor during low light conditions. If there's not enough light the motor will wait 5 minutes before trying again. If disconnected and re-connected to power, there will be a delay before the blades start spinning again.

16" Fans - Dimensions: 20.125" X 20.125" X 5.5". Weight: 16 lbs.
20" Fans - Dimensions: 24.125" X 24.125" X 5.5" - Weight 20 lbs.

ITEM	Description	Price
A-F16-PLUS-V.1	Large DC Super Fan - 16 inch - Version 1	**$270**
A-F16-PLUS-V.2	Large DC Super Fan - 16 inch - Version 2	**$320**
A-F20-PLUS	***NEW!*** Large DC Super Fan - 20 inch	**$420**
A-F16/20-MOTOR	Replacement motor for F16 or F20	**$115**
A-F16P-BLADE	16" Blade set with hub	**$52**
A-F20P-BLADE	20" Blade Set with Hub	**$55**
A-F16/20-BRACKET	Replacement Bracket for F16 or F20	**$20**

FANTASTIC VENT

Endless Breeze 12V Fan

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. UL certified.

Dimensions: 14.25" H X 13.5" W X 3.625" D / One year warranty against defects in materials and workmanship when installed and operated according to instructions.

ITEM	Description	Price
A-FANTASTIC	Endless Breeze 12V Fan	$72

PORTABLE 12V DC 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. Model 124 pictured at right.

FREEDOM FAN Model 124 has a 12" blade, 2 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.

FREEDOM FAN 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. Both models have a one year warranty.

ITEM	Description	Price
A-FREEFAN	Model 124: 12V, 12 inch blade diameter	$169
A-FREEFAN-302	Model 302: 12V, 20 inch blade diameter	$320

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.

One year warranty.

ITEM	Description	Price
A-ECOFAN-812	Caframo Ecofan	$142

12, 24 & 48 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-MUFFAN-12	12V Muffin Fan	$15
A-MUFFAN-24	24V Muffin Fan	$18
A-MUFFAN-48	48V Muffin Fan	$20
A-FANGUARD	Wire Fan Guard	$3

SOLAR DIRECT ATTIC VENT FAN

The Solar Royal Attic Fan was developed, designed and engineered in the USA to address all the missing features and limitations within the current offerings. Whether you're trying to ventilate your attic, shed, boat dock, garage, barn or commercial spaces you have found the smartest solution for your solar powered ventilation needs. 25W recessed MONO-crystalline adjustable solar panel, with low profile design. Additional panels can easily be added. Removeable flashed base with multi-layer noise dampening. Qualifies for the 30% Federal Rebate program (unit and installation). Thermostat is included.

Please visit our website or call for a diagram on how many units are needed per the pitch and square footage of your roof for proper ventilation.

Fifteen year warranty on components; upgradable to a Limited Lifetime warranty.

ITEM	Description	Price
A-ATTIC-ROYAL	Attic Royal Attic Fan	**$359**

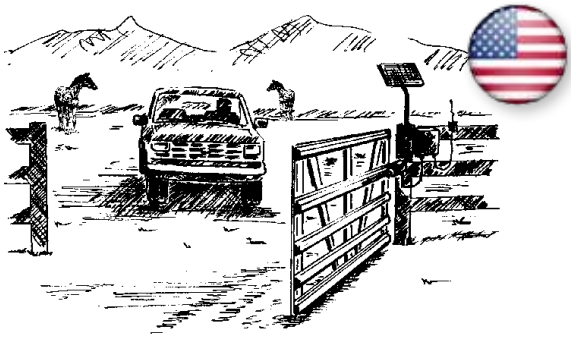
12/24 VOLT DC CEILING FAN

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. The 12V draws 1.2 amps at high speed, 0.75 amps at medium speed, and 0.5 amps at low speed. 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	Price
A-CEILFAN12	40" 12V Ceiling Fan (specify Oak/Brass or White)	**$119**
A-CEILFAN24	40" 24V Ceiling Fan (specify Oak/Brass or White)	**$142**
A-SWIVELKIT	Required w/ any downrod installation (6" white downrod included)	**$20**
A-CEIL-REMOTE	Additional Replacement Remote (specify voltage)	**$35**
A-CFMOTOR	Repacement motor for these fans (specify voltage)	**12V: $46**
		24V: $60



MIGHTY MULE
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	Price
A-MULE500	Opens and closes single (pull-to-open/inward) gate. Includes: 1 transmitter (50- 100'), receiver/control box, opener mechanism & battery	**$595**
A-MULE502	As above, but has two actuators for dual swing gates	**$895**
A-MULESOLAR	Mule Solar panel kit with mounting & wire	**$169**
Extra accessories to enhance security and convenience		
A-MULETRAN	Extra pocket transmitter (one comes with kit)	**$22**
A-MULEKEY	Key chain mini-transmitter (50' - 100')	**$24**
A-MULELOCK	Electric bolt lock secures against forcing	**$110**
A-MULEBATT	Replacement Battery for FM500, FM502	**$37**
A-MULEDIG	Digital keypad with changable 3-18 digit codes	**$74**

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 (Non-Electric) 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.

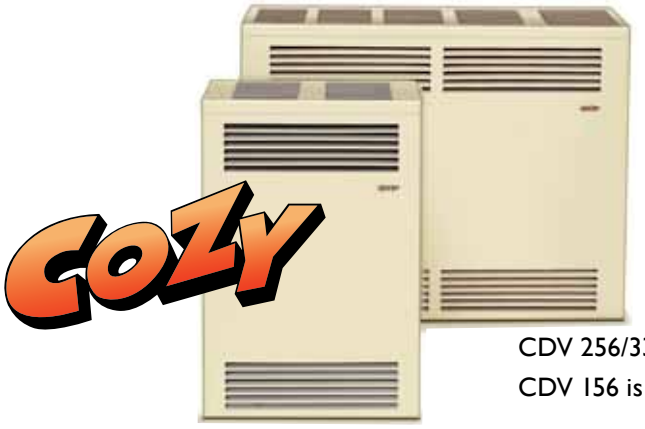
ITEM	Description	Price
A-EXCEL NE	SunMar Composting Toilet & 12v fan	**$1575**

Ships via FREIGHT TRUCK. Please give us a call for a quote.

Full line of Sunmar Composting Toilets and Accessories is available! Call us for information and a listing.

30 DAY RETURN PRIVELEGE DOES NOT APPLY TO THIS APPLIANCE.

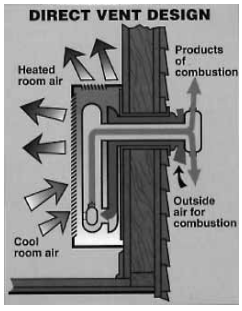
"COZY" DIRECT VENT HEATERS



Derate 4% per 1000' elevation

CDV 256/336 unit in back
CDV 156 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. 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.

Ten year warranty on burner and sealed combustion unit. One year warranty on other parts; not labor.

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	**$933**
A-CDV256	25,000 750 sq. ft.	34.5" x 31.5" x 9.75"	99 lbs	**$1118**
A-CDV336	33,000 1000 sq. ft.	34.5" x 31.5" x 9.75"	99 lbs	**$1200**

THESE HEATERS SHIP VIA TRUCK FREIGHT. CALL FOR A QUOTE.
30 DAY RETURN PRIVELEGE DOES NOT APPLY TO THIS APPLIANCE.

BACKWOODS SOLAR RECOMMENDS THIS SUPERIOR DIGITAL THERMOSTAT

ITEM	Description	Price
O-THERM6110	Programmable 7 day clock and temperature settings	**$68**

CHOFU HOT TUB HEATER

No circulating pumps needed!

Stainless Steel

Wood-Fired

Includes connecting fittings for tanks with 3/8" thick walls or less.

Ask for a brochure!

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.

Not for pressurized water, 10 psi maximum water jacket.

Dimensions: 16” diameter x 23” long / Weight: 63 lbs / One year warranty

ITEM	Description	Price
A-CHOFU	Wood Fired Water Heater	$895
A-CHOFUPIPE	Two foot section of 4” stainless steel pipe	$20
A-CHOFUBRACE	Brace Kit - Necessary if using 5 sections of pipe	$12
A-CHOFUCAP	Stainless steel cap; requires 10’ SS pipe/guy wires	$48
A-CHOFUSHANK	Extra long shanks for tubs thicker than 3/8” up to 1 5/8”	$78

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

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.

520 HN External

The 520PN and 520HN models are rated at 117,000 BTUs and are a good choice for one 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.

520 HN Internal

The 520HN model uses a water pressure generated spark ignition, no pilot light. Very reliable. Derate 4% per 1000' elevation.

The 330PN is rated at 31,000-75,000 BTUs. Maximum flow rate is 2.6 gpm at a 45 degree temperature increase and 1.3 gpm at a 90 degree increase. Bosch recommends minimum of 30 PSI for this unit.

These use "B-Vent" (purchased locally). 5" on 520 models. 4" on 330 model.

Two year warranty with 12-15 year warranty on heat exchanger. Requires service every 2-3 years. Service kits are available.

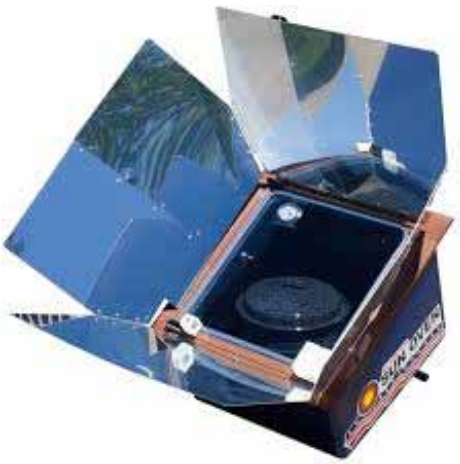
ITEM	Description	Price
A-GWH520PN	With pilot light and external thermostat	**$875**
A-GWH520HN	Water pressure generates spark; no pilot light	**$935**
A-GWH330PN	With pilot light	**$530**
A-GWH-AQ4	Vent Kit for 520PN and 520HN	**$425**
Specify whether unit is for PROPANE or NATURAL GAS when ordering.		

ALL AMERICAN SUN OVEN

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 is lightweight and can fold up like a suitcase to be carried with the integrated handle.

The ALL AMERICAN 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 an ALL AMERICAN 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 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.

Dimensions (inside): 14" x 14" x 12" / Weight: 21 lbs

ITEM	Description	Price
A-SUNOVEN	All American Sun Oven	$295

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 of 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. But many of the 19-24cf Energy Star refrigerators use 1.3 to 1.5 kWh per day and retail around $1000. You would need to add two larger 260-280W modules in the best year round sunny locations to power them; more modules in less sunny areas. Approximate cost for the sunniest locations: $1000 for the refrigerator plus $500 for the solar modules equals $1500 or so 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.

EXTERNAL THERMOSTAT

Plug your freezer into the thermostat and the thermostat into the wall. Has a built-in temperature probe that is placed into the freezer/refrigerator compartment and a dial for fine-tuning the temperature. Backwoods has been using one with a Sundanzer F-165(AC/DC model), running it as a refrigerator but maintaining a temperature of 36 F with a daily power consumption of 167 watt hours per day. Note: The unit functions by disconnecting power to the freezer when the compressor is not running, therefore any compartment lights will NOT come on when the compressor is not running. Attached 8 foot cord included.

ITEM	Description	Price
R-4E047	120VAC External Thermostat	$110

DOMETIC

Propane Refrigerator-Freezer

Door is reversible so <u>two</u> 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. 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 makees average gas usage much less than older units. Can maintain 6 degree freezer and 39 degree refrigerator with 110 degree F outside. Propane model is AGA approved.

Interior capacity: Refrigerator - 6.4 cubic feet; Freezer: 1.6 cubic feet

One year warranty; Extended warranty (to five years) may be purchased directly from the factory for $90.

ITEM	Description	Exterior Size (HxWxD) Shipping weight	Propane Usage (24-hour period)	Price
R-DOMETIC (WHITE)	8 Cu. Ft. Fridge Freezer Combo	63.5” x 23.3” x 26.5” 205 lbs	0.25 gallon	**$1499**
R-DOMETIC (BISQUE)				

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 Refrigerator-Freezers

CC18

Engineered to meet the demands of their cubic footage, these Crystal Cold gas refrigerators and freezers 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'.

Interior capacity: CC15 - Refrigerator: 10 cubic feet; Freezer: 4.2 cubic feet
CC18 - Refrigerator: 13 cubic feet; Freezer: 4.2 cubic feet

Three year warranty on cooling unit. One year warranty on other parts and labor.

Model	Description	Exterior Size (HxWxD) Shipping weight	Propane Usage 24-hour period)	Price*
R-CCOLD-15	15 Cu. Ft. Fridge Freezer Combo	63.5” x 28.5” x 34.5” 290 lbs	0.29 gallon	**$1895**
R-CCOLD-18	18 Cu. Ft. Fridge Freezer Combo	65” x 28.5” x 34.5” 290 lbs	0.39 gallon	**$2025**
THE CCOLD-18 IS AVAILABLE IN BLACK W/ A STAINLESS STEEL DOOR- ADD $140				

* Propane setup is standard. Add $50 for Natural Gas and please specify when ordering.

ALL CRYSTAL COLDS SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNDANZER
DC CHEST FRIDGES AND FREEZERS

12 or 24 volt DC Operation

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 129 for DC plugs and outlets. 4.3 inches of insulation. Maximum 10-12 amp draw at 12V. Instantaneous surge: 2x max draw.

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.

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.

Interior capacity: R165 - 5.8 cubic feet (28"L x 25"H x 16"D)
R225 - 8 cubic feet (38"L x 25"H x 16"D)

One year warranty

Item	Description	Exterior Size (WxDxH) Weight	Energy Used 90 Degrees	Price
R-R165	5.8 Cu. Ft. Fridge with 3 baskets	36.8" x26.2" x 34.5" 130 lbs	168 watt hours/day	**$1020**
R-F165	5.8 Cu. Ft. Freezer with 3 baskets	36.8" x26.2" x 34.5" 130 lbs	441 watt hours/day	**$1020**
R-R225	8 Cu. Ft. Fridge with 4 baskets	46.9" x 26.2" x 34.5" 150 lbs	198 watt hours/day	**$1190**
R-F225	8 Cu. Ft. Freezer with 4 baskets	46.9" x 26.2" x 34.5" 150 lbs	532 watt hours/day	**$1190**
R-SUNDNZR-ACDC	AC/DC Option - Allows unit to be operated AC or DC (must be ordered at same time as unit above)			**$135**
R-THERMOST-F2R	Turns an existing freezer unit into a refrigerator			**$30**
R-THERMOST-R2F	Turns an existing refrigerator unit into a freezer			**$30**

ALL SUNDANZERS SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNDANZER
DC FREEZER

Save on costs with the new SunDanzer 390 DC freezer. This new larger capacity freezer has exceptionally low energy consumption requiring smaller, less expensive power systems and low operating expense.

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 their smaller 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 for 12V operation (7.5A fuse for 24V operation), or our DC plug can be added and will be code compliant as long as no 240V wiring exists within the home. See page 129 for DC plugs and outlets. Voltage: 10-31VDC

FEATURES:

- Low Frost System
- Environmentally friendly CFC-free refrigerant (R-134a)
- Easy to clean aluminum interior
- Rugged scratch resistant galvanized steel exterior
- Automatic control with adjustable thermostat

Interior Capacity: 14.7 cubic feet
One year warranty

Item	Description	Exterior Size (WxDxH) Weight	Energy Used 90 Degrees	Price
R-F390	14.7 Cu.Ft. DC Freezer	63.4" x 28.7" x 34.3" 175 lbs	800 watt-hours/day	**$1475**
R-SUNDNZR-ACDC	This model is not available with the AC/DC option			**NA**

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

ALL SUNDANZERS SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

NOVAKOOL

26 DC MODELS AVAILABLE

Interchangeable 12 or 24 volt DC power

Very Reliable

R5810

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.

One year warranty on parts and labor; Two years on parts.

ITEM	Description	Price
R-4500	4.3 cu. ft. refrigerator with freezer box	**$999**
R-5810	5.7 cu. ft. refrigerator with freezer box	**$1135**
R-FU-9000	9.1 cu. ft. two door upright fridge/freezer	**$1665**
R-RFS7501	7.5 cu. ft two door side by side fridge/freezer	**$1360**

THESE REFRIGERATORS TYPICALLY SHIP VIA FREIGHT TRUCK. CALL FOR A QUOTE.
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.

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 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.

2 year 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.

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	Exterior (HxWxD) Shipping Weight	Energy Used 70-90 Degrees	Price
R-SUNRF12	Two door Fridge/Freezer 8 cu. ft Fridge and 2 cu.ft. Freezer. Single compressor	49.5”x34.5”x27.75” 230 lbs	360-590 watt hrs/day	12/24VDC **$2495** 120VAC **$2425**
R-SUNR10	Single door Fridge Only 9.1 cu. ft Single compressor	43.5”x34.5”x27.75” 215 lbs	200-325 watt hrs/day	12/24VDC **$2050** 120VAC **$1995**
R-SUNF10	Single door Freezer Only 9.1 cu. ft Single compressor	43.5”x34.5”x27.75” 215 lbs	715-910 watt hrs/day	12/24VDC **$2170** 120VAC **$2085**

ALL SUNFROST UNITS SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

SUNFROST RF16, R19, RF19, & F19

RF-16 with 13" CABINET BASE PICTURED

Model	Description	Exterior (HxWxD) Shipping Weight	Energy Used 70-90 Degrees	Price
R-SUNRF16	Two door Fridge/Freezer 10 cu.ft. Fridge and 3.9 cu.ft. Freezer. Two compressors and two thermostats, one for each section.	62.5”x34.5”x27.75” 300 lbs	585-845 watt hrs/day	12/24VDC **$3325** 120VAC **$3150**
R-SUNR19	Two Door Refrigerator only. Two 8 cu.ft. refrigerator sections; NO freezer section. Single compressor.	66”x34.5”x27.75” 310 lbs	390-650 watt hrs/day	12/24VDC **$3090** 120VAC **$2995**
R-SUNRF19	Two door Fridge/Freezer 8 cu.ft. Fridge and 8 cu.ft. Freezer. Two compressors and two thermostats, one for each section.	66”x34.5”x27.75” 320 lbs	800-1066 watt hrs/day	12/24VDC **$3525** 120VAC **$3350**
R-SUNF19	Two Door Freezer only. Two 8 cu.ft. freezer sections; NO refrigerator section. Two compressors and two thermostats, one for each section.	66”x34.5”x27.75” 320 lbs	1300-1700 watt hrs/day	12/24VDC **$3525** 120VAC **$3390**

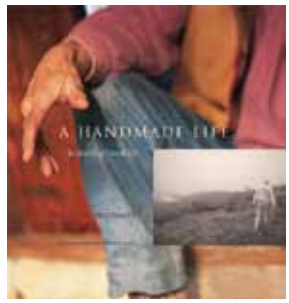
ALL SUNFROST UNITS SHIP TRUCK FREIGHT; CALL FOR FREIGHT QUOTE
DUE TO SIZE, 30 DAY RETURN PRIVILEGE DOES NOT APPLY TO THIS ITEM

Less Technical Home-Design Books

A HANDMADE LIFE: In Search of Simplicity

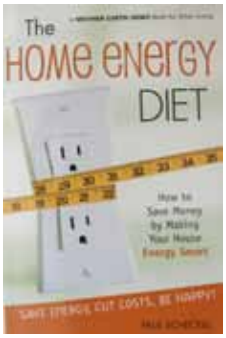
by William Coperthwaite

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.



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.

ITEM	Description	Price
E-HANDMADE	A Handmade Life	**$20**
E-LEHMANS	Lehmans Non-Electric Hardware	**$5**
E-HOMEENERGY	The Home Energy Diet	**$16**

HOME DESIGN & TECHNICAL BOOKS

NEW GREEN HOME SOLUTIONS

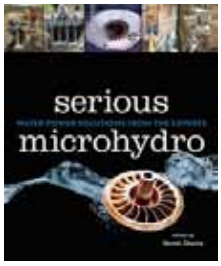
by Dave Bonta & Stephen Snyder

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.

CRAFTING LOG HOMES, SOLAR STYLE

by Rex A. Ewing and LaVonne Ewing

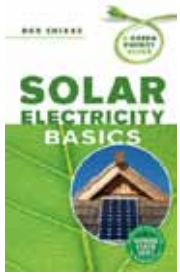
A down-to-earth guide to building solar-powered log homes, complete with how-to illustrations and photos, plus enlightening stories from log home owners across the country. Follow the authors' journey of handcrafting an off-the-grid log home in the Colorado Rockies and discover how renewable energy is a perfect match for modern log home living, from small weekend cabins to expansive year-round homes. (The completey revised edition of Logs, Wind and Sun). 255 pages.

ITEM	Description	Price
E-NEWGREENHOME	New Green Home Solutions	$18
E-NEWSOLARHOME	The New Solar Home	$18
E-SRSHYDRO	Serious MicroHydro	$24
E-LOGHOMES	Crafting Log Homes, Solar Style	$18

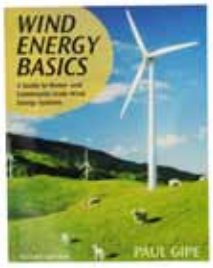
HANDS–ON DESIGN & TECHNICAL

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.



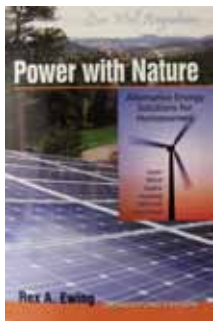
WIND ENERGY BASICS

by Paul Gipe

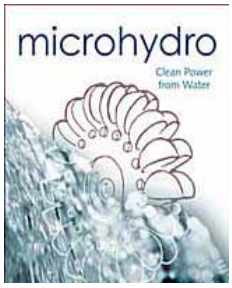
In 1999, Wind Energy Basics introduced micro and mini wind turbines and explained how to install and use them. This version introduces the concept of "community wind" where groups of people invest in large wind turbines that produce commercial quantities of electricity for sale to the grid. 224 pages.

POWER WITH NATURE: Solar & Wind Energy Demystified

3rd Edition 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 2012 with latest equipment explained. Our **best selection** for overall system review. Lots of diagrams and pics. 240 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-SOLARBASICS	Solar Electricity Basics	$10
E-WINDBASIC	Wind Energy Basics	$24
E-POWER	Power with Nature, Solar & Wind Demystified	$19
E-HYDROBK	MicroHydro Clean Power from Water	$19

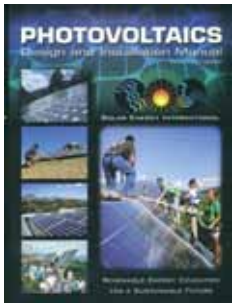
HANDS–ON DESIGN & TECHNICAL

PV DESIGN and INSTALL MANUAL

This is a must-have book!!

by Solar Energy International

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 flooded lead acid 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

ORDERING INFORMATION

BACKWOODS SOLAR ELECTRIC SYSTEMS
1589 RAPID LIGHTNING ROAD
SANDPOINT, IDAHO 83864
Phone: (208) 263-4290 / Fax: (208) 265-4788
Email: info@backwoodssolar.com

OFFICE HOURS are Monday thru Friday, 8 AM to 5 PM, PACIFIC.
Nights, weekends, and when phones are busy, some calls may go to our message machine. Leave a message. **We will call you back!!**

PLACING ORDERS: The quickest way to order is to give us a call. **Phone** orders with a credit card are processed immediately. You may also **fax** or **email** your orders. Please include a phone number so that, should the need arise, we can call you. Orders may also be placed thru our **website** at www.backwoodssolar.com.

And finally, we can also accept orders by **mail** using the order blank forms on pages 188 &189. This is the method with the slowest processing time. It's best to give us a call ahead of time, if possible, so that we may give you a shipping total for your items.

ALL ORDERS MUST BE PREPAID by cash, money order, good check or credit card. We accept Visa, MasterCard, American Express or Discover card. We can also accept checks by phone or Paypal.

Check out our website for the most current news, products, and bargains.
www.backwoodssolar.com

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, custom built items, special order items or where ever 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.

SHIPPING & ORDERING INFO

Actual shipping charges will apply based on the weight of the shipment. $12 MINIMUM SHIPPING PER ORDER.

UPS or US POSTAL SERVICE?

Backwoods Solar will ship small orders via UPS or the US Postal Service at our discretion unless you specify a preferred method. Large/bulky orders will ship via LTL freight. 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 Orders ship via US Postal Service Priority whenever possible. The actual freight service and amount to be determined. In some cases, a customs broker (provided by you) is required to get your shipment through customs.

ALL ORDERS: Solar Modules must go UPS or truck freight.

Your shipment is fully insured against damage but damage must be <u>IMMEDIATELY</u> reported to the carrier or the insurance is lost.

TO FIND US

Directions to 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 (PST)
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 on our website at: www.backwoodssolar.com/renewable-energy-helpers/

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 2016

CUSTOMER NUMBER FROM CATALOG LABEL_____
PHONE # (_____) _____–_____ DATE_____
NAME_____
BILLING 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

CREDIT CARD # **EXPIRES (MM/YY)**

_____ _____/_____

Last 3 digits on back of card:_____

We accept Visa / Master Card / Discover / American Express

Item #	Qty	Description	Price Each	Total

Shipping: We charge actual charges (MIN. $12) based on the weight of the items being shipped. Please give us a call for a quote.

TOTAL COST OF ITEMS ORDERED $ _____

in Idaho add 6% sales tax to total before shipping fee: _____

In California add 7.5% sales tax to total before shipping fee: _____

PLUS TOTAL SHIPPING (Minimum $12) $ _____

TOTAL AMOUNT OF ORDER $ _____

Your shipment is fully insured against damage but damage must be <u>IMMEDIATELY</u> reported to the carrier or the insurance is lost.

BACKWOODS SOLAR ORDER BLANK 2016

CUSTOMER NUMBER FROM CATALOG LABEL_____
PHONE # (_____) _____–_____ DATE_____
NAME_____
BILLING 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

CREDIT CARD # **EXPIRES (MM/YY)**

_____ _____/_____

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We accept Visa / Master Card / Discover / American Express

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TOTAL AMOUNT OF ORDER $_____

Your shipment is fully insured against damage but damage must be <u>IMMEDIATELY</u> 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.

$$VDI = \frac{\text{Amp x Feet}}{\text{\% Voltage Drop (2 - 3\%) x Voltage}}$$

where:

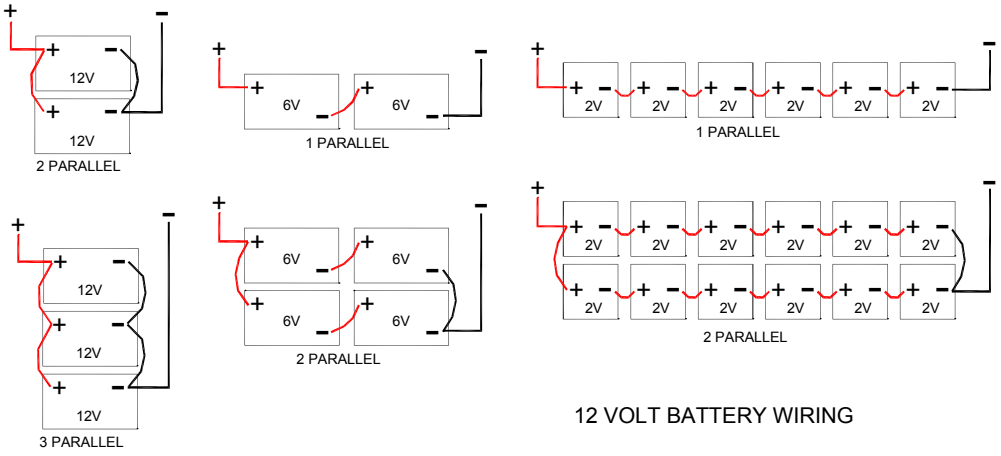
- amps = maximum number of amps through circuit
- feet = one way wire distance
- % voltage drop = percentage of voltage drop desired, use 2 for 2%
- voltage = voltage running through the wire

Voltage Drop Index Chart

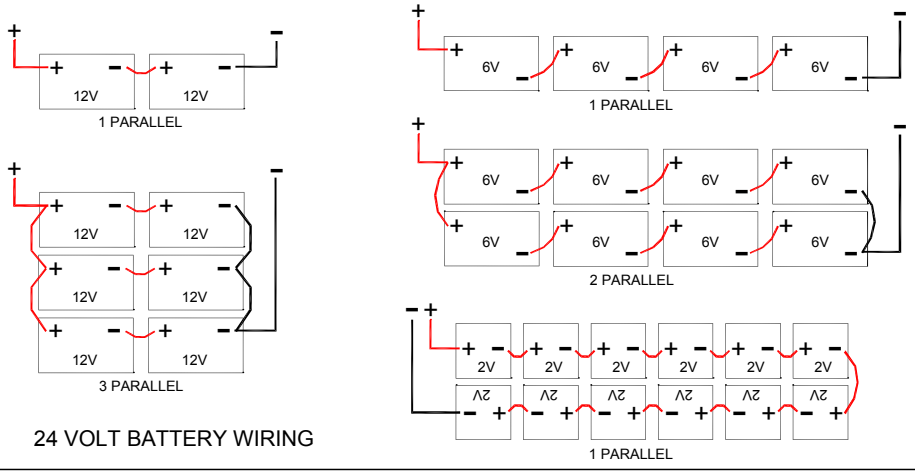
Wire Size (AWG)	Copper Wire		Aluminum Wire	
	VDI	Ampacity	**VDI**	Ampacity
4/0	99	230	62	180
3/0	78	200	49	155
2/0	62	175	39	135
1/0	49	150	31	120
2	31	115	20	94
4	20	85	12	65
6	12	65		
8	8	50		
10	5	30		
12	3	20		
14	2	15		

BATTERY WIRING DIAGRAMS

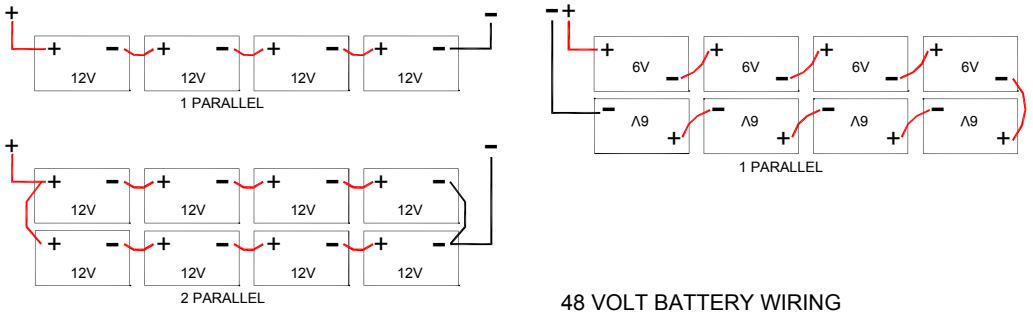
All wiring diagrams are in series parallel to get to the proper voltage based on the voltage of each battery.



12 VOLT BATTERY WIRING



24 VOLT BATTERY WIRING



48 VOLT BATTERY WIRING

LIGHT LEVELS & LUMENS

Lumens represent the amount of light emitted by a light source, such as a light bulb. Following are typical lumens levels for various light (CFL) bulbs. Realize that recommended light levels will vary based on the person and the task. When purchasing light bulbs don't assume that more watts means more light, more lumens means more light.

Light Output	LED Bulb	CFL Bulb	Incandescent Bulb
Lumens	Watts	Watts	Watts
122-125	.5-1.5	3	15
210 (ambient)	2-3	4-8	25
450-500 (general room lighting)	4-5	9-13	40
800-900	6-8	13-15	60
1100-1400 (suitable for reading)	9-13	18-25	75
1600-2600	16-20	23-30	100
2600-2780	25-28	30-55	150

Light on a surface (such as a tabletop) is referred to as illuminance, which is typically represented by footcandles (lumens per square foot, equal to 10.76 lux) or lux (lumens per square meter, equal to 0.092903 footcandles)