Welcome to the 2007-2008

Renewable Energy
DESIGN GUIDE & CATALOG

A Whole New Look

This year's edition of the ***Renewable Energy Design Guide & Catalog*** presents a major change in format. Probably most apparent, for the first time in the 25 years we've been publishing this catalog we are full color, cover to cover.

The layout is redesigned, we've got hundreds of new color product photos, and most important, we've thoroughly updated all the information, added lots of new products, eliminated discontinued items, and updated specifications, prices and much more.

This year's catalog also features a number of enhancements to make it easier to find what you're looking for, such as:

- **A comprehensive Table of Contents**
- **Color-coded sections**
- **A more detailed index**

Help Us Keep This Vital Resource Current

Keeping this information accurate and up-to-date is an ongoing project. We do our very best, but of course we cannot absolutely guarantee that every price, specification and information detail herein is correct; so that's our standard legal disclaimer.

You can help us keep this data accurate by informing us of any mistakes, changes or updates you are aware of, especially if you are a manufacturer of a listed product.
Send any and all such feedback about the catalog to:

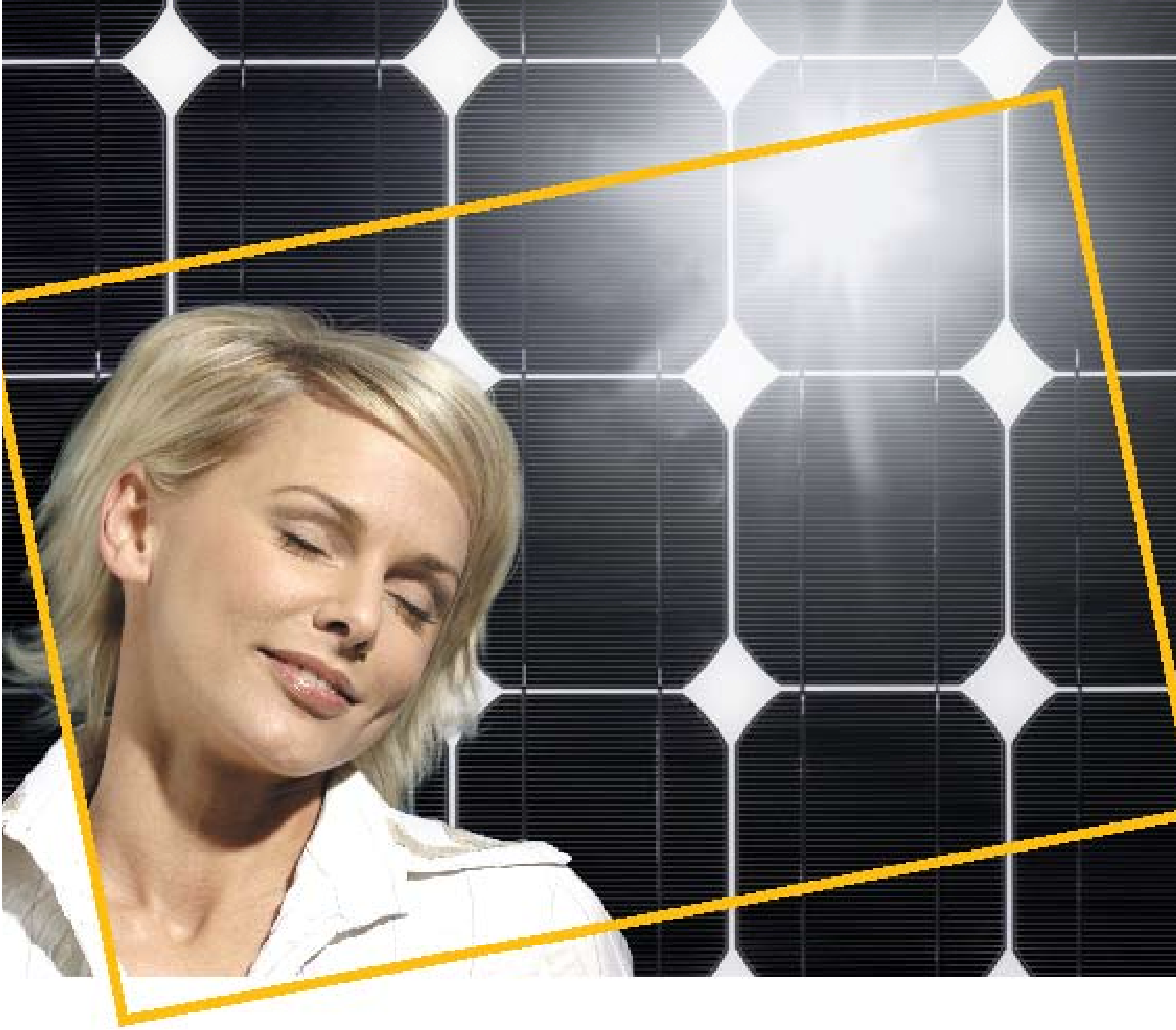
feedback@recatalog.net

Please use this email *only* to submit feedback about this publication.

Thank you for helping make the ***Renewable Energy Design Guide & Catalog*** the industry's leading product catalog and design resource.

Contact Us for All Your Renewable Energy Needs!

We stand ready to answer all your inquiries about the systems, equipment and components in this catalog. Please use our contact information on the cover if you would like to talk to us about renewable energy systems.



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Now is the time to become your own power producer.

Residential, commercial or industrial – we can help with all your power system needs.

By harnessing the power of the sun, wind or water, people all over the world produce their own pollution-free reliable electricity. Technological advances, government assistance, the need for reliable power, and the growing urgency to reduce the use of fossil fuels make renewable energy systems increasingly attractive to people around the world.

Solar technology makes it possible for home and business owners to have dependable power from renewable sources. Mass production has significantly reduced the price of renewable energy systems and their components. Solar systems with battery-based backup power can ensure reliable power even when the utility grid is down.

The use of renewable sources such as wind, water and sun increases our energy self-sufficiency and fosters economic and national security. As more families, individuals and businesses generate their own renewable electricity we will reduce pollution, provide more electricity for all to use, reduce the use of fossil fuels, and make the electricity on the grid "greener".

Deregulation has created an atmosphere of change in the United States. We are experiencing higher electricity rates and electricity shortages. Laws usually referred to as *net metering* allow solar-energy-system owners to feed their excess generated electricity back to the utility. The system owner receives a credit or payment for solar-generated electricity fed into the grid. In other words, you pay only for the net electricity you consume – the amount of electricity you take from the utility minus the amount you generate and feed back from your solar system. With a solar electric system, you can provide yourself with protection from the rising prices of fuel, because your system's fuel is the sun. Additionally, state, local and federal tax incentives and rebates make obtaining a system more economical.

Types of Power Systems

Power systems vary in design depending on what energy sources are used and what purpose they must fulfill. The next few pages have information to help you design the three basic types of renewable energy systems:

1. Grid-Tie Systems

Also called grid-interactive, grid-intertie, utility-interconnected and other such descriptive terms, grid-tie solar systems built onto your building and property that connect directly into the electric utility feed. This is possible in areas that allow net metering, whereby a solar or wind powered system turns your electric meter backwards when it is producing more power than you are using. This type of system provides no backup power when utility power fails.

2. Grid-Tie Systems with Backup

A grid-tie system with battery backup feeds excess solar electricity to the grid and provides backup power when the utility grid is down. With this type of system you sacrifice some power generation efficiency in exchange for having power when there is a utility power failure. The amount of backup power you have depends on the size of the battery and electrical loads that draw on them.

3. Off-Grid Systems

This type of power system is independent of the utility grid. It can use solar modules, a wind generator, a micro-hydroelectric generator, or a combination of any or all of them to produce your electric power. Owners of this type of system often use a gas or diesel generator for backup when the power system does not meet all of the needs.

Determine What System Meets Your Needs

Use the charts and worksheets on the following pages to become familiar with the design of these systems and consult with us to pick out the exact components.

Tax Incentives

Federal

A federal "energy credit" allows businesses to take a 30% tax credit for renewable energy equipment (solar electric, solar thermal and wind powered systems). The same incentive is available for residential customers, but a cap of $2,000 applies. It is possible that the federal government will enact new incentives in 2007 or 2008.

In addition, there is an accelerated 5-year depreciation schedule that allows businesses to write 100% of a system's cost off their taxable income over the first five years.

State and Local

The states of California, New Jersey, Pennsylvania, Washington and others, as well as municipalities like Austin, Texas and Bend, Oregon, offer a rebate or similar payment based on the generating capacity of the system installed. California offers performance-based payments as an alternative to a rebate.

Other states offer various rebates and incentives to homeowners to lower the installed cost of a utility-connected power system. Go to www.dsireusa.org for the latest comprehensive information about incentives in your area.

We can help you generate your own electricity by putting a solar electric power system on your home, business or public building.

For decades, off-grid standalone power systems – not connected to utility electric transmission lines – have generated power using solar energy for remote homes, communications facilities, telemetry, traffic control, public transportation, remote mining and drilling and scores of other applications. Now, people who live on the utility grid can economically install and obtain the benefits of solar and renewable energy systems.

Lock in your cost of electricity

The higher the percent of your total electricity needs generated by your solar system, the less affected you will be by constantly rising costs of conventionally generated electric power.

Obtain tax credits and rebates

Tax credits and rebates are available in many states to people and businesses who install solar powered products. See www.dsireusa.org for the latest rebate and tax credit information for your area.

Feed power back to the utility

In many states, you can send your home-generated power back to the utility and get credit for the power you feed into the utility grid.

Generate green power

Generate electricity with energy from the sun, wind or water, producing virtually no pollution or emissions.

Gain power independence

With the use of batteries and possibly a generator as needed, you can rely on your own generating capacity, and not on the vagaries of public utilities.

Ensure uninterrupted power

With a battery backup system, you can keep your appliances running during utility power outages.

No moving parts!

Solar electricity is the *only* form of energy generation that does not involve any moving part, substantially decreasing maintenance requirements and increasing reliability and long equipment life.

Commercial Grid-Tie Projects

Cost-effective grid-connected solar systems on commercial buildings can offset high peak electric cost and make an excellent investment for many businesses.

- **Pricing and availability**
  We offer competitive pricing for commercial projects, and our steady supply of modules and balance-of-system components will keep your project going when others are waiting for product!
- **Commercial-grade system components**
  Inverters to 500KW … Disconnects up to 800 amps … Everything you need for your commercial project.
- **System design assistance**
  Choosing the right hardware … Matching system layout to blueprints … System drawings for confirmed projects.
- **Project financing**
  We offer ***AEE Solar Financing*** with options for purchase or low-cost leasing. Ask us for details of this exciting new program.
- **System monitoring**
  Independent third-party monitoring, to provide critical data needed for Power Purchase Agreements, RECs and government incentive programs.

Remote Industrial Solar Products

We sell products and integrated solutions for a wide range of industrial applications. From large multi-kilowatt power plants to small trickle chargers, our custom-engineered solar systems are backed by an experienced technical staff you can count on.

- **Oil & Gas**
  PV power is the perfect solution for the remote energy needs of the oil & gas industry. These systems are deployed worldwide, delivering reliable electric power for telemetry and SCADA, offshore platforms, monitoring and cathodic protection.
- **Telecommunications**
  Microwave repeaters, wireless internet systems, mobile telecom are examples of effective uses for distributed solar electric power systems.
- **Traffic Control**
  Solar powered traffic signals can be located anywhere it is not practical or cost effective to install a utility connection. It can be equally useful in an urban setting or on remote stretches of highway. It is the best solution for mobile warning signals and speed monitoring.
- **Outdoor Lighting**
  PV lighting systems are often used in parking lots and bus shelters, and to illuminate highway signs.
- **Vaccine Refrigeration**
  Vaccine refrigeration systems approved by the World Health Organization (WHO) play a key role in the storage and distribution of vital vaccines and blood in remote areas of developing countries throughout the world.

The pages ahead feature thousands of products that cover virtually every renewable energy need. Please contact us to help you get the advice and resources you need for residential, commercial, industrial, government, institutional or any other kind of renewable energy system. ***Our contact information is on the cover of the catalog.***

AEE Solar Packaged Solutions

Engineered Grid-Tie PV Systems

AEE Solar grid-tie PV power systems are designed for use on residential and small commercial buildings. They consist of high quality Evergreen or SolarWorld photovoltaic (PV) modules, a Fronius, SMA or Xantrex inverter, array wiring, DC and AC disconnects, UniRac mounting structures to secure modules on the roof, electrical drawings, data sheets, warranties and instructions.

Some Xantrex and SMA inverters have integrated DC disconnects. Systems that list "ST7000" as the inverter use the new SMA Sunny Tower 42 kW tower that consists of 6 SMA SB7000US inverters, pre-assembled on a stainless steel structure.

Packaged systems with Evergreen 190-watt modules (PTC = 168.8)

PV watts	Module quantity	Series x parallel	System CEC watts	Inverter model	Inverter watts	Output VAC	Item code	Price
1900	10	10 x 1	1544	SB1800	1800	120	10.6202	$14,167
4560	24	12 x 2	3889	SB4000US	4000	240	10.6208	$32,167
5700	30	15 x 2	4836	SB5000US	5000	240	10.6211	$40,684
6840	36	12 x 3	5803	SB6000US	6000	240	10.6214	$47,829
7980	42	14 x 3	6806	SB7000US	7000	240	10.6217	$55,059
47880	252	14 x 18	40836	ST7000	42000	240	10.622	$329,990
2280	12	12 x 1	1893	IG2000	2000	240	10.6223	$16,708
3040	16	8 x 2	2539	IG3000	2700	240	10.6226	$21,630
4560	24	12 x 2	3808	IG4000	4000	240	10.6229	$32,373
5250	30	10 x 3	4785	IG5100	5100	240	10.6232	$42,214
3040	16	16 x 1	2552	GT2800	2800	240	10.6235	$21,219
3800	20	10 x 2	3173	GT3300	3300	240	10.6238	$26,514
4560	24	12 x 2	3849	GT4000	4000	240	10.6241	$31,548
5700	30	15 x 2	4836	GT5000	5000	240	10.6244	$39,496

Packaged systems with SolarWorld 175-watt modules (PTC = 156.6)

PV watts	Module quantity	Series x parallel	System PTC watts	Inverter model	Inverter watts	Output VAC	Item code	Price
700	4	4 x 1	570.	SB700	700	120	10.6247	$6,427
2100	12	6 x 2	1719	SB1800	1800	120	10.6251	$16,247
3500	20	10 x 2	2991	SB3000US	3000	240	10.6255	$25,951
4200	24	8 x 3	3608	SB4000US	4000	240	10.6259	$30,743
5250	30	10 x 3	4487	SB5000US	5000	240	10.6263	$39,149
7000	40	10 x 4	5982	SB6000US	6000	240	10.6267	$50,256
7875	45	9 x 5	6765	SB7000US	7000	240	10.6271	$56,656
47250	270	9 x 30	40590	ST7000	42000	240	10.6275	$338,995
2100	12	6 x 2	1757	IG2000	2000	240	10.6279	$16,175
3150	18	9 x 2	2649	IG3000	3000	240	10.6283	$23,192
4200	24	8 x 3	3532	IG4000	4000	240	10.6287	$31,190
5600	32	8 x 4	4735	IG5100	5100	240	10.6291	$40,607
3150	18	9 x 2	2663	GT2800	2800	240	10.6295	$22,818
3500	20	10 x 2	2944	GT3300	3300	240	10.6299	$25,394
4200	24	8 x 3	3570	GT4000	4000	240	10.6303	$30,311
5250	30	10 x 3	4487	GT5000	5000	240	10.6307	$38,148

Wiring from the array to the DC disconnect, array ground wiring, and wiring from the AC disconnect to the main panel and all conduit must be supplied by professional installers (your specific installation or utility may require additional AC disconnects). Contact us to obtain these essential resources and expert advice on your system installation.

All components comply with the 2005 National Electrical Code (NEC-2005); IEEE Std 929-2000, Institute of Electrical and Electronics Engineers Recommended Practices for Utility Interface of Photovoltaic (PV) Systems; UL 1741-Underwriters Laboratories Standard for Safety; and the ICBO 2000 International Building Code. The arrays and inverters are matched for maximum efficiency.

These modular systems can be combined to form larger systems to meet your requirements. It is economical to put these systems together for use in 30 kilowatt or smaller systems. For larger systems, please ask us for a quote.

Select a pre-packaged system that meets your needs from the accompanying table. California Energy Commission bases rebates on the system CEC rating in column 4 of the table. CEC's calculation takes into account module output in normal operating conditions and inverter efficiency.

Utility Grid-Tie System Design

Budget, roof dimensions and other site-specific factors often call for custom system design. If you are planning to mount your array on a roof, decide which module best fits into the available roof space, taking into consideration obstructions such as chimneys, plumbing vents and skylights. See Solar Power section, page 16, for dimensions of modules. A grid-connected PV system consists of PV modules, output cables, module mounting structures, AC and DC disconnect switches, inverter(s), grounding equipment and a metering system. This worksheet will help you decide what size PV array would be required to eliminate your electric bill. This will be the largest system that would be cost-effective to install. A smaller system can reduce part of your bill, or eliminate higher cost electricity in locations that have progressively increasing rates as consumption increases. Use this information and the amount of available space to get a rough idea of your PV array size.

PV Array Design Worksheet – Determine the array size for your grid-connected system.

Step 1 **Find your monthly average electricity usage from your electric bill.** _____

This will be in kilowatt-hours (kWh). Due to air conditioning, heating and other seasonal usage, it is a good idea to look at several bills. You can add the typical summer, fall, winter and spring bills and divide by four to find the average monthly usage.

Step 2 **Find your daily average electricity use.** _____

Divide the monthly average number of kWh use by 30 (days)

Step 3 **Find your location's average peak sun hours per day.** _____

See the chart and listings on pages 14 and 15, and/or the insolation maps beginning page 183. For example, the average for California is 5 peak sun hours

Step 4 **Calculate the system size (AC watts) to provide 100% of your electricity.** _____

Divide your daily average electricity use by average sun hours per day. For example, if the daily average electricity use is 30 kWh, and the site is in California, system size would be: 30 kWh / 5 h = 6 kW AC

Step 5 **Calculate the number of pv modules required for this system**. _____

Divide the system AC watts in Step 4 by the CEC watt rating of the modules to be used, then divide by the inverter efficiency, usually 0.94, and you get the total number of modules required. (Round this number up)

Use chart below (continued next page) to determine array size/inverter combinations

This chart shows inverter and module combinations for common modules used in grid connected systems. For a given inverter and module combination, the chart displays the acceptable number of series strings of modules and the number of modules per string for temperatures between 14ºF and 104ºF. Where the inverter will support more than one string of modules, the chart shows the number of modules that can be used with multiple strings. Sizing is accurate in locations where the maximum temperature is lower than 104ºF or the minimum temperature is higher than 14ºF. In locations where the minimum temperature is lower than 14ºF, the maximum number of modules per string may be lower.

In the chart on the next page, the line labeled CEC watts is the expected output of the modules at normal operating temperature, in full sun. The approximate power output of a system in full sun will be the number of modules times the CEC rating of the modules times the inverter efficiency from second column on the table. Other factors, such as high or low temperature, shading, array orientation, roof pitch and dirt on the modules, will affect the system's actual output.

Recommended number of modules per string						
Inverter		*Module* >	SW165 mono	SW175 mono	ES-180-RL/SL	ES-190-RL/SL
Brand and Model	CEC Efficiency	CEC	147.3	156.6	159.7	168.8
		Ratio	0.893	0.895	0.887	0.888
SB700U	91.5%	one string	3 to 5	3 to 5		
SWR1800U	91.5%	one string	6 to 8	5 to 8	8 to 10	8 to 10
		two strings	6	5 to 6		
SB3000US	95.5%	one string	8 to 10	8 to 10	10 to 13	10 to 13
		two strings	8 to 10	8 to 10	10 to 11	10
		three strings	8			

Recommended number of modules per string						
Inverter		*Module* >	SW165 mono	SW175 mono	ES-180-RL/SL	ES-190-RL/SL
Brand and model	CEC Efficiency	CEC	147.3	156.6	159.7	168.8
		Ratio	0.893	0.895	0.887	0.888
SB4000US	96.0%	one string	9 to 12	9 to 12	11 to 16	11 to 16
		two strings	9 to 12	9 to 12	11 to 14	11 to 13
		three strings	9 to 10	9		
SB5000US	95.5%	one string	10 to 12	10 to 12	12 to 16	12 to 16
		two strings	10 to 12	10 to 12	12 to 16	12 to 16
		three strings	10 to 12	10 to 12		
SB6000US	95.5%	one string	10 to 12	10 to 12	12 to 16	12 to 16
		two strings	10 to 12	10 to 12	12 to 16	12 to 16
		three strings	10 to 12	10 to 12	12 to 14	12 to 13
		four strings	10 to 11	10		
SB7000US	96.0%	one string	10 to 12	10 to 12	12 to 16	12 to 16
		two strings	10 to 12	10 to 12	12 to 16	12 to 16
		three strings	10 to 12	10 to 12	12 to 16	12 to 15
		four strings	10 to 12	10 to 12	12	
		five strings	10	10		
GT 2.8	94.0% (est.)	one string	8 to 12	7 to 12	10 to 16	10 to 16
		two strings	8 to 10	7 to 9		
GT 3.3	94.5%	one string	8 to 12	7 to 12	10 to 16	10 to 16
		two strings	8 to 12	7 to 11	10 to 11	10 to 11
		three strings	8	7		
GT 4.0	95% (est.)	one string	8 to 12	7 to 12	10 to 16	10 to 16
		two strings	8 to 12	7 to 12	10 to 13	10 to 12
		three strings	8 to 9	7 to 8		
GT 5.0	95.5%	one string	9 to 12	9 to 12	12 to 16	12 to 16
		two strings	9 to 12	9 to 12	12 to 16	12 to 16
		three strings	9 to 11	9 to 10		
IG2000	93.5%	one string	5 to 8	5 to 8	8 to 13	8 to 13
		two strings	5 to 7	5 to 7		
		three strings	5			
IG3000	94.0%	one string			8 to 13	8 to 13
		two strings	5 to 8	5 to 8	8 to 9	8
		three strings	5 to 6	5 to 6		
		four strings	5			
IG4000	94.0%	one string			8 to 12	8 to 12
		two strings			8 to 12	8 to 12
		three strings	5 to 9	5 to 8	8	8
		four strings	5 to 6	5 to 6		
		five strings	5	5		
IG5100	94.5%	one string	5 to 9	5 to 9	8 to 13	8 to 13
		two strings	5 to 9	5 to 9	8 to 13	8 to 13
		three strings	5 to 9	5 to 9	8 to 11	8 to 10
		four strings	5 to 9	5 to 8	8	8
		five strings	5 to 9	5 to 6		
		six strings	5 to 6	5		

AEE Solar Engineered Grid-Tie Systems with Battery Backup

These full-service renewable energy systems give you all the benefits of utility interconnection and net metering *plus* energy independence. With these grid-tie systems, backup AC power is made available in the event of a utility outage, providing reliable power and peace of mind. An average conversion efficiency of 89% to 91% using the California Energy Commission (CEC) test protocol provides greater savings and a shorter time period for system payback than previous designs.

Battery-backup grid-tie systems come with modules, array wiring, combiner boxes, roof mounting structures, inverters/control systems with all required over-current protection and disconnects. (Your specific installation or utility may require additional AC disconnects, which we can supply as needed). They require a 48-volt battery bank to operate. The size of the battery determines the amount of backup power available during power failure. Use the worksheet on the next page to determine battery bank size. Battery backup systems qualify for the California Energy Commission incentives and the federal tax credit.

Grid-tie systems with inverters installed indoors (see table at bottom for batteries)								
PV watts	Module Quantity	Module Brand & watts	System CEC watts	Inverter Model	Backup watts	Output VAC	Item code	Price
570	3	Evergreen 190	460	OutBack FLEXware system with one GVFX3648	3600	120	10.6724	$8,833
2850	15	Evergreen 190	2304	OutBack FLEXware system with one GVFX3648	3600	120	10.6728	$22,392
5700	30	Evergreen 190	4608	OutBack FLEXware system with two GVFX3648	7200	120/240	10.6732	$42,959
Grid-tie systems with NEMA 3R inverters for outdoor installation (see table below for batteries)								
PV watts	Module Quantity	Module Brand & watts	System CEC watts	Inverter Model	Backup watts	Output VAC	Item code	Price
570	3	Evergreen 190	460	OutBack PS1 system with one GVFX3648	3000	120	10.6746	$8,946
2280	12	Evergreen 190	1843	OutBack PS1 system with one GVFX3648	3000	120	10.6750	$19,501
2850	15	Evergreen 190	2304	OutBack PS1 system with one GVFX3648	3000	120	10.6754	$23,116

Battery packs for systems above							
watt-hours storage to 80% discharge	Battery quantity	System amp-hours	Battery model	Battery rack	NEMA 3R outdoor	Item code	Price
3750	4	98	MK S31-SLD-G	OutBack PS1 battery enclosure (w/ PS1 only)	Yes	10.6781	$1,586
7500	8	196	MK S31-SLD-G	OutBack PSR battery rack	No	10.6783	$2,889
7500	8	196	MK S31-SLD-G	OutBack PSR battery rack w/ 3RK cover	Yes	10.6785	$3,038
11250	12	294	MK S31-SLD-G	OutBack PSR battery rack	No	10.6787	$4,017
11250	12	294	MK S31-SLD-G	OutBack PSR battery rack w/ 3RK cover	Yes	10.6789	$4,166

Grid-tie systems with battery backup are configured differently and are much more complex than standard grid-tie systems without batteries. They need to be custom designed. If you need a backup system, consult with us to determine all the system components that you will need. .

Inverters for Grid-Tie with Battery Backup

The OutBack PS1-3048 is a 3000-watt complete system for grid-tie with battery backup. These inverters are ready to use with the addition of a PV array and a 48-volt battery bank.

OutBack also makes inverters and switchgear that can be assembled into larger grid-tie w/ battery backup systems.

The new Xantrex XW series of inverters offers grid-tie inverters with battery backup capability in 6000-watt increments. Several can be stacked for 12kW or 18kW battery backup systems.

You can use the following steps to determine the dual-function inverter size and the battery capacity that your system will require. Follow steps 1-5 on the PV Array Design Worksheet on page 8 to determine the size of the array required to provide the desired percentage of total power. Then calculate the inverter size and battery capacity needed using the worksheet below.

Worksheet: Inverter and Batteries for Grid-Tie w/ Backup System

Step 1 Find the power requirements (watts) for the appliances you need to power during a black-out. _____

Make a list of the loads and appliances that you absolutely need to power during an outage. Only list the essential items since the system size (and cost) will vary widely with power needed. The wattage of individual appliances can usually be found on the back of the appliance or in the owners manual. You can use a Kill-a-Watt meter for better measurements (page 107). If an appliance is rated in amps, multiply amps by the operating voltage (120 or 240) to find watts. Add up the wattage of all the items on your list to arrive at the total amount of watts that you need to run all at the same time. This will determine the size of the dual-function inverter that you will need.

Step 2 Decide the blackout duration you want to be prepared for. _____

Power outages last from a portion of an hour to a day (or more). Again, this decision will greatly affect the system size and cost, so it is more cost effective to stay on the conservative side.

Step 3 Find the amount of stored power required. _____

Multiply the power requirements (in step 1) by duration in hours (in step 2). The result will be in watt-hours. For instance, if you need to power 1000 watts of appliances for 2 hours, you would need to have 2000 watt-hours (or 2 kWh) of stored power.

Step 4 Calculate the power storage needed. _____

Multiply the figure arrived at in step 3 by 1.7. In the example, 2 kWh X 1.7 = 3.4 kWh of stored power needed.

Step 5 Calculate battery capacity needed. _____

Divide the power storage requirement needed from step 4 by the DC voltage of the system (usually 48V, but sometimes 24V) to get battery amp-hour (Ah) capacity. See the battery section on page 112 for more information on batteries. Most backup systems use sealed batteries due to their greatly reduced maintenance requirements, and because they can be more easily placed in enclosed battery compartments.

System Sizing Information

The size of a solar electric system depends on the amount of power that is required (watts), the amount of time it is used (hours) and the amount of energy available from the sun in a particular area (sun-hours per day). The user has control of the first two variables, while the third depends on the location.

Conservation

Conservation plays an important role in keeping down the cost of a photovoltaic system. The use of energy-efficient appliances and lighting, as well as non-electric alternatives wherever possible, can make solar electricity a cost-competitive alternative to gasoline generators and, in some cases, utility power.

Cooking, Heating and Cooling

Conventional electric cooking, space heating and water heating equipment use a prohibitive amount of electricity. Electric ranges use 1500 watts or more per burner, so bottled propane or natural gas is a popular alternative to electricity for cooking. A microwave oven has about the same power draw, but since food cooks more quickly, the amount of kilowatt hours used may not be large. Propane and wood are generally better alternatives for space heating. Good passive solar design and proper insulation can reduce the need for winter heating. Evaporative cooling is a more reasonable load than air conditioning and in locations with low humidity, the results are almost as good. One big plus for solar cooling: the largest amount of solar energy is available when the need for cooling is the greatest.

Lighting

Lighting requires the most study since many options exist in type, size, voltage and placement. The type of lighting that is best for one system may not be right for another. The first decision is whether your lights will be run on low voltage direct current (DC) or conventional 110 volt alternating current (AC). In a small home, an RV, or a boat, low voltage DC lighting is often the best choice. DC wiring runs can be kept short, allowing the use of fairly small gauge wire. Since an inverter is not required, the system cost is lower. When an inverter is part of the system, and the lights are powered directly by the battery, a home will not be dark if the inverter fails. In addition to conventional-size medium-base low voltage bulbs, the user can choose from a large selection of DC fluorescent lights, which have 3 to 4 times the light output per watt of power used compared with incandescent types. Halogen bulbs are 30% more efficient and actually seem almost twice as bright as similar wattage incandescents given the spectrum of light they produce. High quality fluorescent lights are available for 12 and 24 volt systems.

In a large installation or one with many lights, the use of an inverter to supply AC power for conventional lighting is cost effective. AC compact fluorescent lights will save a tremendous amount of energy. It is a good idea to have a DC-powered light in the room where the inverter and batteries are in case there is a problem. AC light dimmers will only function properly on AC power from inverters that have pure sine wave output.

Refrigeration

Gas powered absorption refrigerators are a good choice in small systems if bottled gas is available. Modern absorption refrigerators consume 5-10 gallons of LP gas/month. If an electric refrigerator will be used in a standalone system, it should be a high-efficiency type. Some high-efficiency conventional AC refrigerators use as little as 1200 watt-hours of electricity/day at a 70º average air temperature. A comparably sized Sun Frost refrigerator/freezer uses half that amount of energy and a SunDanzer refrigerator (without a freezer) uses less than 100 watt-hours per day. The higher cost of good quality DC refrigerators is offset by savings in the number of solar modules and batteries required.

Major Appliances

Standard AC electric motors in washing machines, larger shop machinery and tools, swamp coolers, pumps, etc. (usually 1/4 to 3/4 horsepower) require a large inverter. Often, a 2000 watt or larger inverter will be required. These electric motors are sometimes hard to start on inverter power, they consume relatively large amounts of electricity, and they are very wasteful compared to high-efficiency motors, which use 50% to 75% less electricity. A standard washing machine uses between 300 and 500 watt-hours per load, but new front-loading models use less than 1/2 as much power. If the appliance is used more than a few hours per week, it is often cheaper to pay more for a high-efficiency appliance rather than make your electrical system larger to support a low-efficiency load. Vacuum cleaners usually consume 600 to 1,000 watts, depending on how powerful they are, about twice what a washer uses, but most vacuum cleaners will operate on inverters larger than 1,000 watts since they have low-surge motors.

Small Appliances

Many small appliances such as irons, toasters and hair dryers consume a very large amount of power when they are used but by their nature require very short or infrequent use periods. If the system inverter and batteries are large enough, they will be usable. Electronic equipment, such as stereos, televisions, VCRs and computers have a fairly small power draw. Many of these are available in low voltage DC as well as conventional AC versions. In general, DC models use less power than their AC counterparts.

Off-Grid Load Worksheet

Determine the total energy in amp-hours per day used by all the AC and DC loads in your system.

Calculate your AC loads

If there are no AC loads, skip to Step 5

1. List all AC loads, wattage and hours of use per week in the spaces provided. Multiply watts by hours/week to get watt-hours per week (WH/Wk). Add up all the watt hours per week to determine AC watt-hours per week. Use a separate sheet of paper if you need to list more loads than the space below allows

NOTE: Wattage of appliances can usually be determined from tags on the back of the appliance or from the owner's manual. If an appliance is rated in amps, multiply amps by operating voltage (120 or 240) to find watts.

Description of AC loads run by inverter	watts	x	hours/week	=	watt-hours/week
	Total watt-hours/week				

2. Convert to DC watt-hours per week. Multiply line 1 by 1.15 to correct for inverter loss. _____
3. Inverter DC input voltage; usually 12-, 24- or 48-volts. This is DC system voltage. _____
4. Divide line 2 by line 3. This is total DC amp-hours per week used by AC loads. _____

Calculate your DC loads

5. List all DC loads in the table below. If you have no DC loads, enter "0" in line 7 and proceed to line 8.
6. DC system voltage. Usually 12, 24, or 48 volts. _____
7. Find total amp-hours per week used by DC loads: divide line 5 by line 6. _____
8. Total amp-hours per week used by AC loads from line 4. _____
9. Add lines 7 and 8. This is total amp-hours per week used by all loads. _____
10. Divide line 9 by 7 days. This is total average amp-hours per day that needs to be supplied by the battery. _____

Enter this number on line 1 on the Number-of-Modules Worksheet on page 14, and on line 1 of the Battery Sizing Worksheet on page 115.

Description of DC loads	watts	x	hours/week	=	watt-hours/week
	Total watt-hours / week				

Number of Modules Worksheet

Use this worksheet to calculate the total number of solar modules required for your system.

To find average sun-hours per day in your area (line 3), check local weather data, look at the map below or find a city on the next page that has similar weather to your location. If you want year- round autonomy, use the lower of the two figures. If you want 100% autonomy only in summer, use the higher figure. If you have a utility grid-tie system with net metering, use the yearly average figure. The peak amperage of the module you will be using can be found in the module specifications. You can also get close enough if you divide the module's rated wattage by the peak power point voltage, usually 17 to 17.5 for a 12-volt module or 34 to 35 volts for a 24-volt module.

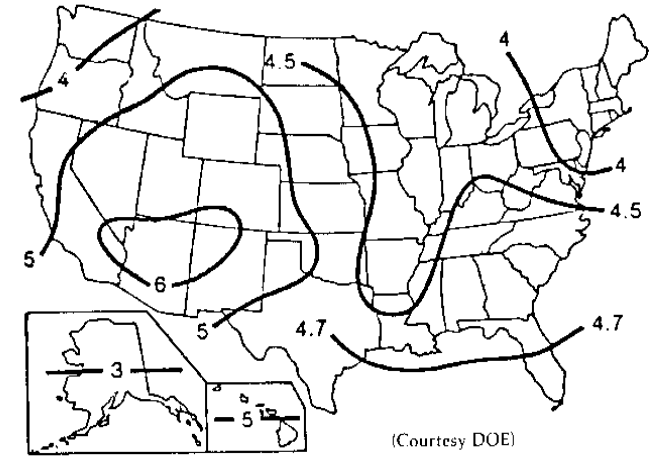
Step 1	Total average amp-hours per day needed from the System Loads Worksheet, line 10	_____
Step 2	Multiply line 1 by 1.2 to compensate for loss from battery charge / discharge	_____
Step 3	Average sun-hours per day in your area	_____
Step 4	Divide line 2 by line 3. This is the total solar array amps required	_____
Step 5	Optimum or peak amps of solar module used. See module specifications	_____
Step 6	Total number of solar modules in parallel required. Divide line 4 by 5	_____
Step 7	Round off to the next highest whole number	_____
Step 8	Number of modules in each series string to provide DC battery voltage – see table below	_____
Step 9	Multiply line 7 by line 8 to get the total number of solar modules required.	_____

Nominal system voltage	Number of series connected modules per string	
volts	12V module	24V module
12	1	N/A
24	2	1
48	4	2

The charts below show sun-hours per day for the U.S.

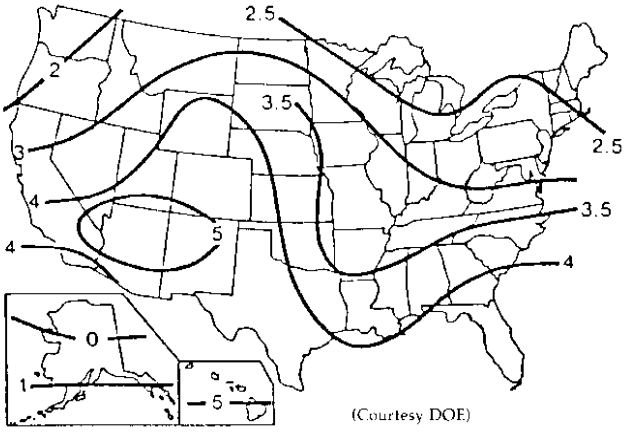
See world insolation maps (and a larger version of the USA map) beginning page 183.

Yearly Average



(Courtesy DOE)

Four-Week Average, 12/7-1/4



(Courtesy DOE)

Solar Insolation

This chart shows solar insolation in kilowatt-hours per square meter per day in many U.S. locations. For simplicity, we call this figure "sun-hours per day." To find average sun-hours per day in your area (line 3 on page 11), check local weather data, look at the map on the previous page or find a city in the table below that has similar weather to your location. If you want year-round autonomy, use the lowest of the two figures. If you want only 100% autonomy in summer, use the higher figure. If you want a utility grid-tie system, and you have net metering available in your state, use the average figures. World insolation maps are in the Reference section, beginning page 183

State	City	High	Low	Avg
AK	Fairbanks	5.87	2.12	3.99
AK	Matanuska	5.24	1.74	3.55
AL	Montgomery	4.69	3.37	4.23
AR	Bethel	6.29	2.37	3.81
AR	Little Rock	5.29	3.88	4.69
AZ	Tucson	7.42	6.01	6.57
AZ	Page	7.30	5.65	6.36
AZ	Phoenix	7.13	5.78	6.58
CA	Santa Maria	6.52	5.42	5.94
CA	Riverside	6.35	5.35	5.87
CA	Davis	6.09	3.31	5.10
CA	Fresno	6.19	3.42	5.38
CA	Los Angeles	6.14	5.03	5.62
CA	Soda Springs	6.47	4.40	5.60
CA	La Jolla	5.24	4.29	4.77
CA	Inyokern	8.70	6.87	7.66
CO	Grandby	7.47	5.15	5.69
CO	Grand Lake	5.86	3.56	5.08
CO	Grand Junction	6.34	5.23	5.85
CO	Boulder	5.72	4.44	4.87
DC	Washington	4.69	3.37	4.23
FL	Apalachicola	5.98	4.92	5.49
FL	Belie Is.	5.31	4.58	4.99
FL	Miami	6.26	5.05	5.62
FL	Gainsville	5.81	4.71	5.27
FL	Tampa	6.16	5.26	5.67
GA	Atlanta	5.16	4.09	4.74
GA	Griffin	5.41	4.26	4.99
HI	Honolulu	6.71	5.59	6.02
IA	Ames	4.80	3.73	4.40
ID	Boise	5.83	3.33	4.92
ID	Twin Falls	5.42	3.42	4.70
IL	Chicago	4.08	1.47	3.14
IN	Indianapolis	5.02	2.55	4.21
KS	Manhattan	5.08	3.62	4.57
KS	Dodge City	6.50	4.20	5.60
KY	Lexington	5.97	3.60	4.94
LA	Lake Charles	5.73	4.29	4.93
LA	New Orleans	5.71	3.63	4.92
LA	Shreveport	4.99	3.87	4.63
MA	E. Wareham	4.48	3.06	3.99
MA	Boston	4.27	2.99	3.84
MA	Blue Hill	4.38	3.33	4.05
MA	Natick	4.62	3.09	4.10
MA	Lynn	4.60	2.33	3.79
MD	Silver Hill	4.71	3.84	4.47
ME	Caribou	5.62	2.57	4.19
ME	Portland	5.23	3.56	4.51
MI	Sault Ste. Marie	4.83	2.33	4.20
MI	E. Lansing	4.71	2.70	4.00
MN	St. Cloud	5.43	3.53	4.53
MO	Columbia	5.50	3.97	4.73
MO	St. Louis	4.87	3.24	4.38
MS	Meridian	4.86	3.64	4.43
MT	Glasgow	5.97	4.09	5.15
MT	Great Falls	5.70	3.66	4.93
MT	Summit	5.17	2.36	3.99
NM	Albuquerque	7.16	6.21	6.77
NB	Lincoln	5.40	4.38	4.79
NB	N. Omaha	5.28	4.26	4.90
NC	Cape Hatteras	5.81	4.69	5.31
NC	Greensboro	5.05	4.00	4.71
ND	Bismarck	5.48	3.97	5.01
NJ	Sea Brook	4.76	3.20	4.21
NV	Las Vegas	7.13	5.84	6.41
NV	Ely	6.48	5.49	5.98
NY	Binghampton	3.93	1.62	3.16
NY	Ithaca	4.57	2.29	3.79
NY	Schenectady	3.92	2.53	3.55
NY	Rochester	4.22	1.58	3.31
NY	New York City	4.97	3.03	4.08
OH	Columbus	5.26	2.66	4.15
OH	Cleveland	4.79	2.69	3.94
OK	Stillwater	5.52.	4.22	4.99
OK	Oklahoma City	6.26	4.98	5.59
OR	Astoria	4.76	1.99	3.72
OR	Corvallis	5.71	1.90	4.03
OR	Medford	5.84	2.02	4.51
PA	Pittsburgh	4.19	1.45	3.28
PA	State College	4.44	2.79	3.91
RI	Newport	4.69	3.58	4.23
SC	Charleston	5.72	4.23	5.06
SD	Rapid City	5.91	4.56	5.23
TN	Nashville	5.20	3.14	4.45
TN	Oak Ridge	5.06	3.22	4.37
TX	San Antonio	5.88	4.65	5.30
TX	Brownsville	5.49	4.42	4.92
TX	El Paso	7.42	5.87	6.72
TX	Midland	6.33	5.23	5.83
TX	Fort Worth	6.00	4.80	5.43
UT	Salt Lake City	6.09	3.78	5.26
UT	Flaming Gorge	6.63	5.48	5.83
VA	Richmond	4.50	3.37	4.13
WA	Seattle	4.83	1.60	3.57
WA	Richland	6.13	2.01	4.44
WA	Pullman	6.07	2.90	4.73
WA	Spokane	5.53	1.16	4.48
WA	Prosser	6.21	3.06	5.03
WI	Madison	4.85	3.28	4.29
WV	Charleston	4.12	2.47	3.65
WY	Lander	6.81	5.50	6.06

Evergreen Solar

Spruce 170W, 180W and 190W Modules

Evergreen Spruce modules are designed to deliver the best performance and dependability from Evergreen Solar's patented String Ribbon technology. These modules have one of the tightest power tolerances in the industry.

Superior Performance

- Maximum power up to 4% above rated, minimum only 2% below rated
- Anti-reflection cover glass delivers more energy
- Backed by a 25-year limited power warranty; 2-year workmanship warranty
- A rigid, double-walled, deep frame with integrated water drainage holes
- Crimped frame corners – no screws to loosen
- Sealed junction box never needs field maintenance
- UL, cUL and CEC listed

Leading Environmental Credentials

- Energy payback time up to 40% faster than leading crystalline technologies
- Low carbon dioxide emissions in the manufacturing process – up to to 33% less than other leading crystalline technologies
- Low lead – use of lead-free solder for all solar cell interconnections

PV modules produced by Evergreen Solar are distinctive in their appearance because they incorporate proprietary crystalline silicon technology known as String Ribbon. In the String Ribbon technique, two high-temperature strings are pulled vertically through a shallow silicon melt, and the molten silicon spans and freezes between the strings. The process is continuous: long strings are unwound from spools; the melt is replenished; and the silicon ribbon is cut to length for further processing, without interrupting growth.

This new higher power series of modules from Evergreen is optimized for grid-tie systems. Evergreen modules utilize two parallel strings of 54 cells in series. They can be used for battery charging with an MPPT charge controller such as the OutBack MX-60, Apollo T-80 or the BlueSky series of charge controllers. Use up to 3 modules in series with the MX-60 or T-80 charge controller. They have Multi-Contact cables. Evergreen modules are UL, cUL and CEC listed and have a 25-year power output warranty. Modules are made in either USA or Germany.

Module		ES-170	ES-180	ES-190
Peak power	watts	170	180	190
Peak power voltage	volts	25.3	25.9	26.7
Peak power current	amps	6.72	6.95	7.12
Open circuit voltage	volts	32.4	32.6	32.8
Short circuit current	amps	7.55	7.78	8.05
Max. system voltage	volts	600	600	600
Series fuse rating		15 amps		
Length	inch (mm)	61.8 (1570)		
Width	inch (mm)	37.5 (951)		
Depth (including j-box)	inch (mm)	1.6 (41)		
Weight	lbs	40.1		
Item code		**11.5346**	**11.5349**	**11.5350**
Price		**$1,140**	**$1,205**	**$1,275**

SolarWorld

Sunmodule PV Modules

SolarWorld California was founded in March 2005 and expanded in July 2006 with the acquisition of Shell Solar Industries' solar manufacturing facilities that had been operating in the U.S. since 1977. The factory, originally open by ARCO Solar, later sold to Siemens Solar and then Shell, was purchased by SolarWorld in 2006.

Headquartered in Camarillo, California, SolarWorld California maintains ingot production facilities in Vancouver, WA and wafer, cell and module production facilities in the Camarillo facility. In addition, the southern California facility also houses product development, engineering, sales & marketing, and the direct projects systems group.

SolarWorld California modules are made in the USA ensuring unsurpassed quality, performance and output. SolarWorld California is the largest manufacturer of solar modules in the U.S. Modules are supported by a 25-year power warranty.

SW 165/175 Mono Modules

These SolarWorld PV modules are designed for use in high-voltage grid-tie applications as well as in large industrial and off-grid applications for 24- or 48-volt battery charging. These modules use 72 five-inch semi-square single-crystalline cells in series behind tempered glass. They feature clear-anodized aluminum frames and a sealed junction box with bypass diodes and Multi-Contact locking connector output cables. 25-year warranty. UL Listed.

Module		SW165-mono	SW175-mono
Peak power	watts	165	175
Peak power voltage	volts	34.4	35.7
Peak power current	amps	4.8	4.9
Open circuit voltage	volts	43.3	44.4
Short circuit current	amps	5.3	5.3
Max. system voltage	volts	600	
Nominal voltage	volts	24	
Series fuse rating		15A	
Length		63.4" (1610mm)	
Width		31.9" (810mm)	
Depth (including j-box)		1.33" (34mm)	
Weight		33 lbs	
Item code		**11.2282**	**11.2284**
Price		**$1,095**	**$1,165**

Mitsubishi Solar

As a general manufacturer of electrical machinery and appliances, Mitsubishi Electric Corporation offers a legacy of innovation and achievement that goes all the way back to its founding in 1921.

Since 1976, when Japan launched its first commercial satellite, Mitsubishi has participated in approximately 250 related projects around the world. One such project led to the development of a number of photovoltaic power generation systems that have proven to be extremely reliable, even in the harsh conditions of outer space.

Lead-Free Modules

Mitsubishi has applied leading-edge technologies from its space-related applications to terrestrial systems to create high-performance photovoltaic power-generation systems for an astonishing range of applications. Mitsubishi Electric successfully produced the first cells in Japan that do not require solder coatings. This was a milestone in the development of environmentally friendly composite materials and manufacturing processes for the silver electrodes used on the surfaces of crystalline silicon photovoltaic cells. Their PV modules are now made using lead-free solder, completely eliminating lead from the manufacturing process.

PV-MF Modules

The 170-watt and larger modules are designed for use in high-voltage grid-tie applications, but can be used in large industrial and off-grid applications for battery charging if the system includes an appropriate MPPT charge controller such as the OutBack MX-60, Apollo T80 or BlueSky Solar Boost. These modules use 50 square poly-crystalline 156mm cells in series behind tempered glass with anodized aluminum frames, and Multi-Contact locking connector output cables. Positive and negative cables come from junction boxes at opposite ends of the module. The 125-watt modules have Multi-Contact locking connector output cables and are optimized for 12-volt battery charging with 36 cells in series.

Made in Japan. UL Listed. 25-year power output warranty.

Module		PV-MF125UE4N	PV-MF170UD4	PV-MF175UD4	PV-MF180UD4	PV-MF185UD4
Peak power	watts	125	170	175	180	185
Peak power voltage	volts	17.3	23.7	23.9	24.2	24.4
Peak power current	amps	7.23	7.19	7.32	7.45	7.58
Open circuit voltage	volts	21.8	29.9	30.2	30.4	30.6
Short circuit current	amps	7.9	7.83	7.93	8.03	8.13
Max. system voltage	volts	600	600			
Series fuse rating	amps	15	15			
Length		58.9" (1495mm)	65.3" (1658mm)			
Width		26.5" (674mm)	32.6" (834mm)			
Depth (including j-box)		1.8" (46mm)	1.8" (46mm)			
Weight		28.9 lbs (13.5 kg)	43 lbs (19.5 kg)			
Item code		**11.8825**	**11.8859**	**11.8861**	**11.8863**	**11.8865**
Price		**$925**	**$1,140**	**$1,172**	**$1,206**	**$1,240**

Kyocera

Kyocera off-grid modules are ideal for charging storage batteries to power remote homes, recreational vehicles, telecommunications systems, and other consumer and commercial applications.

Kyocera T-series modules have an industrial-grade junction box that allows the use of nominal 1/2" conduit fittings. They are available as 130-watt, 85-watt, 65-watt and 50-watt modules used for 12-volt battery charging.

All Kyocera modules feature extremely sturdy frames, tempered low-reflection glass covers, built-in bypass diodes and a 25-year power output warranty. UL Listed. Made in Japan or Mexico.

Kyocera Module		KC50T	KC65T	KC85T	KC130TM
Number of cells		36	36	36	36
Peak power	watts	50	65	85	130
Peak power voltage	volts	17.4	17.4	17.4	17.6
Peak power current	amps	3.11	3.75	5.02	7.39
Open circuit voltage	volts	21.7	21.7	21.7	21.9
Short circuit current	amps	3.31	3.99	5.34	8.02
Max. system voltage	volts	600	600	600	600
Nominal voltage	volts	12	12	12	12
Length		25.2" (639mm)	29.6" (751mm)	39.6" (1007mm)	56.1" (1425mm)
Width		25.7" (652mm)	25.7" (652mm)	25.7" (652mm)	25.7" (652mm)
Depth (including j-box)		2.125" (54mm)	2.125" (54mm)	2.125" (54mm)	2.125" (54mm)
Weight (lbs)		11	13.2	18.3	26.8
Item code		**11.7719**	**11.7722**	**11.7725**	**11.7733**
Price		**$360**	**$420**	**$540**	**$790**

NEW! Global Solar – CIGS Framed Glass Modules

Global Solar has developed a proprietary process for manufacturing thin-film Copper Indium Gallium diSelenide (CIGS) photovoltaic (PV) modules. CIGS PV cells create more electricity from the same amount of sunlight than other thin-film PV technologies. Thus they deliver higher conversion efficiency. CIGS conversion efficiency is also very stable over time, meaning it has no light-induced degradation. CIGS technology is superior under low light level conditions. The operating voltage of these modules is designed for charging 12- and 24-volt lead-acid batteries. Junction box has wires with Multi-Contact cables. The 6- and 12-watt modules (GSE 6 and GSE 12) have 1-year warranties. The larger modules have 25-year warranties.

Module		GSE120	GSE60	GSE 30	GSE 12	GSE 6
Peak power	watts	115	60	30	12	6
Peak power voltage	volts	34.8	17.5	17.32	17.3	17.3
Peak power current	amps	3.3	3.5	2.87	1.2	0.58
Open circuit voltage	volts	52	25	21.53	21.5	21.5
Short circuit current	amps	4.3	4.5	3.22	1.34	0.66
Length	inches	49.5	46.5	24.5	17.88	17.88
Width	inches	44.7	25	25	16.38	9
Depth	inches	1.65	1.36	1.36	0.83	0.83
Weight	lbs	37.5	19.8	11	6.5	3.5
Item code		**11.2949**	**11.2951**	**11.2953**	**11.2958**	**11.2963**
Price		**$850**	**$460**	**$260**	**$130**	**$75**

AEE Solar

Off-Grid Solar Modules

These PV modules are made exclusively for AEE Solar by one of the leading solar module manufacturers in China. AEE Solar modules deliver excellent performance for all off-grid photovoltaic applications, including rural lighting and electrification, remote water pumping, telemetry, communications, and traffic control. AEE Solar PV modules can be used in single module and multiple module installations. Each module provides maximum charging power, even in hot climates. The tempered glass surface is impact-resistant and allows maximum light transmission. A conduit-ready, weather-resistant junction box on the 30-watt and larger modules accommodates all wiring methods including moisture-tight strain-relief connectors and electrical conduit. Anodized aluminum frames add strength and durability to the modules. 25-year, 80% power output guarantee on all modules 30 watts and larger.

Module		AE-110ET	AE-85ET	AE-50ET	AE-30ET	AE-10ET
Cell type		poly	mono	poly	poly	mono
Peak power	watts	110	85	50	30	10
Peak power voltage	volts	17.0	18.29	17.1	17.2	17.8
Peak power current	amps	6.47	4.65	3.28	1.74	0.57
Open circuit voltage	volts	21.0	21.96	21.78	21.6	21.96
Short circuit current	amps	7.48	5.11	2.96	1.93	0.63
Length	inches	58.35 (1482mm)	47.9 (1217mm)	28.3 (719mm)	26.8 (680mm)	14.4 (365mm)
Width	inches	26.6 (676mm)	21.85 (555mm)	21.85 (555mm)	16.8 (426mm)	11.5 (292mm)
Depth	inches	1.4 (36mm)	1.4 (36mm)	1.34 (34mm)	1.34 (34mm)	0.99 (25mm)
Item code		**11.8345**	**11.8336**	**11.8325**	**11.8318**	**11.8309**
Price		**$770**	**$600**	**$400**	**$240**	**$120**

AEE Solar

Lightweight Laminated Modules

Custom made for AEE Solar, these modules are excellent for powering fans and pumps, and are also perfect for trickle-charging batteries. These modules are made by laminating 36 solar cells between layers of EVA plastic with a Tedlar cover and a fiberglass-reinforced plastic back. They have a six-foot cable attached to the front of the module on one end. Made in China. Not UL Listed. 2-year warranty.

16.75" x 10.6" x .03"

Module		AE-10AC
Peak power	watts	10
Peak power voltage	volts	16.4
Peak power current	amps	0.61
Nominal voltage	volts	12
Item code		**11.8212**
Price		**$120**

AEE Solar

Thin-Film Module

This low-cost, 10-watt glass module is great for keeping a battery charged on any vehicle or boat that is not started for long periods of time. The 10-watt module has an output of approximately 600 mA in full sun. 10 feet of wire is included. Completely weather-proof. Perfect for science projects. Dimensions are 36.25" x 12.25" x 0.75". 3-year warranty.

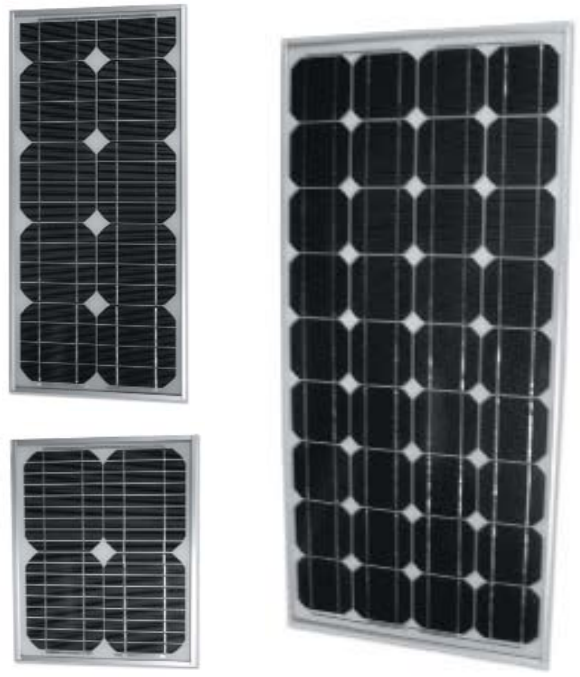
Accessories	Item code	Price
Thin film glass 10-watt solar panel	**11.9310**	**$79**

Prices subject to change without notice.

AEE Solar Battery Charging Modules

The AE series-J photovoltaic modules provide cost-effective photovoltaic power for DC loads with moderate energy requirements. With 36 cells in series, they charge batteries efficiently in virtually any climate. These modules are made with monocrystalline cells laminated behind tempered glass with aluminum frames.

The 50-watt and larger modules have an industrial-grade conduit-ready junction box on the back that has knockouts for two standard 1/2" conduit fittings. Typical commercial applications of these modules include remote telemetry, instrumentation systems, security sensors, signals, and land-based navigation aids. The 5- to 20-watt modules have a 10-year power output warranty. The 50-watt and larger modules have a 25-year power output warranty. Made in China.



Module		AE-100J	AE-80J	AE-50J	AE-20J	AE-10J	AE-5J	AE-5/6J
Peak power	watts	100	80	50	20	10	5	5
Peak power voltage	volts	17.82	18.36	17.32	17.3	17.3	17	8.5
Peak power current	amps	5.53	4.36	2.87	1.2	0.58	0.29	0.58
Open circuit voltage	volts	22	22	21.53	21.5	21.5	21.5	10.8
Short circuit Current	amps	5.89	5.17	3.22	1.34	0.66	0.33	0.66
Length	inches	46.65 (1185)	47.3 (1202mm)	28.3(719)	24.5 (621mm)	13.8 (350mm)	8.2 (209mm)	8.2 (209mm)
Width	inches	26.3 (668)	21.1 (536mm)	21.85 (555mm)	11.1 (282mm)	11.1 (282mm)	11.1 (282mm)	11.1 (282mm)
Depth	inches	1.3 (33mm)	1.3 (33mm)	1.3 (33mm)	1.3 (33mm)	1.3 (33mm)	0.63 (16mm)	0.63 (16mm)
Item code		**11.8243**	**11.8235**	**11.8231**	**11.8220**	**11.8210**	**11.8205**	**11.8206**
Price		**$700**	**$600**	**$400**	**$200**	**$120**	**$62**	**$62**

Uni-Solar

Framed Photovoltaic Modules

Each Uni-Solar framed solar module achieves high performance using Uni-Solar's proprietary Triple Junction spectrum-splitting thin-film amorphous silicon cell design. These rugged modules do not have any glass to break. They are made on stainless steel foil, encapsulated in UV-stabilized polymers and framed with anodized aluminum. A Galvalume steel backing provides stiffness to the module. US-64 are equipped with weather-resistant junction boxes to accept half-inch conduit. The US-64 has a clear anodized frame and the ES-62T has a black anodized frame. Maximum system voltage rating is 600VDC. 20-year warranty. UL Listed.

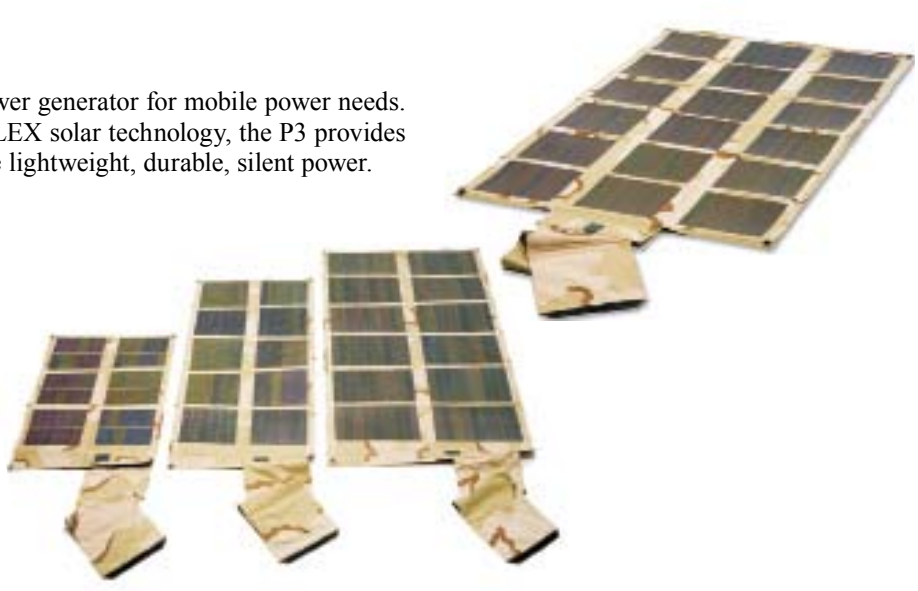
Module		ES-62T	US-64
Peak power	watts	62	64
Peak power voltage	volts	15	16.5
Peak power current	amps	4.1	3.88
Open circuit voltage	volts	21	23.8
Short circuit current	amps	5.1	4.8
Nominal voltage	volts	12	12
Series fuse rating		8	8
Weight	pounds	24	20.2
Length	inches	49.5	53.78
Width	inches	31.25	29.18
Item code		**11.3105**	**11.3110**
Price		**$494**	**$508**

Global Solar

P3 Folding Solar Modules

The Global Solar P3 is a solar-energized power generator for mobile power needs. Incorporating solid-state, thin-film, PowerFLEX solar technology, the P3 provides an excellent choice for situations that require lightweight, durable, silent power.

- Portable and lightweight
- Available from 15 to 48 watts
- Tough rip-stop nylon backing
- 12- and 24-VDC-rated products
- Weatherproof and UV-resistant
- Anti-reflection coating
- Velcro pouch for accessories
- SAE 2-prong water-resistant plug
- Some power under overcast skies
- Available in black, desert or woodland camo



Use the P3 to recharge batteries, power communication equipment and mobile electronics, or increase battery run time. It provides silent energy independence to the user.

The P3 Portable Power Pack is used worldwide to provide users an alternate power generator for charging lead-acid, nickel cadmium (NiCd), nickel-metal-hydride (NiMH) and lithium ion rechargeable batteries. The P3 will enable extended missions, provide energy security, restore power silently and can provide power for remote, portable surveillance equipment.

Twice the power-to-weight ratio of alternative solar generators, the P3 is ideal for situations requiring power renewal to batteries and mobile electronics. The P3 Portable Power Pack folds for easy transport and storage.

P3 Power Packs are available with black, desert or woodland camouflage coloring. Cables and accessories are available on the next page.

1-year warranty.

Module		P3-15 watt	P3-30 watt	P3-48 watt	P3-48 watt	P3-55 watt
Peak power	watts	15	30	48	48	55
Nominal voltage	volts	12	12	12	24	16
Peak power voltage	volts	18.8	18.8	18.8	37.8	20
Peak power current	amps	0.78	1.5	2.5	1.2	2.8
Open circuit voltage	volts	36	36	28	55	30
Short circuit current	amps	1.0	2.2	3.9	1.8	3.7
Dimensions (opened)	inches	28 x 21 x 0.1	44 x 21 x 0.1	52 x 29 x 0.1		55 x 32 x 0.1
Dimensions (folded)	inches	10.5 x 8.5 x .75	10.5 x 8.5 x 1.2	14.5 x 8.5 x 1.4		11 x 9 x 1.3
Weight	lbs	1.6	2.4	3.9		3.7
Item code – desert color		**11.2917**	**11.2911**	**11.2907**	**11.2909**	**11.2903**
Item code – woodland color		**11.2919**	**11.2913**	**11.2908**	**11.2910**	**11.2904**
Item code – black		**11.2916**	**11.2912**	**11.2906**	**11.2920**	**11.2902**
Price		**$319**	**$539**	**$859**	**$859**	**$959**

SUNLINQ Folding Solar Modules

Global Solar's SUNLINQ with PowerFLEX technology is a flexible, foldable and durable solar product that produces enough power to charge just about anything that is capable of being charged through a standard cigarette lighter adapter and has a power draw of less than the Sunlinq module being used. SUNLINQ is available in 6.5-watt, 12-watt and 25-watt foldable solar panels. These modules are great for hand-held devices like iPods, cell phones, PDAs and flashlights, but they are not suitable for charging notebook computers which require 50 to 150 watts.

The panels are made with PowerFLEX technology. Lightweight, flexible, weatherproof and durable CIGS (copper indium gallium diselenide) solar cells provide higher efficiency than other flexible solar cell technologies, including amorphous silicon. Each SUNLINQ comes with the five-piece accessory kit to make it easy to charge batteries and portable power packs, or run DC electronic devices. SP6.5 and SP12 have built-in charge controllers limiting output to 14.8 volts. Use the 7-amp charge controller below when using the SP25 to charge sealed lead acid batteries or to connect it directly to devices designed to run on 12-volt batteries. The SP25 can be connected directly to a Xantrex Powerpack without a charge controller. 1-year warranty.

Module		SP25	SP12	SP6.5
Peak Power	Watts	25	12	6.5
Nominal Voltage	Volts	12	12	12
Maximum Voltage	Volts	30	15.6	15.6
Peak Power Current	Amps	1.5	0.80	0.43
Typical Power	Watts	25	11	5.5
Dimensions (opened)	Inches	41.25 x 21.50 x 0.03	29.5 x 18 x 0.03	29.5 x 9 x 0.03
Dimensions (folded)	Inches	11 x 8.25 x 0.7	9 x 5 x 0.7	9 x 5 x 0.7
Weight	Lbs.	1.8	0.9	0.45
Item Code		**11.2930**	**11.2932**	**11.2936**
Price		**$399.00**	**$199.00**	**$99.00**

Accessories for Folding Modules

Both P3 and SUNLINQ folding modules have output power cables with SAE 2-conductor trailer plugs. This 5-piece accessory cable set contains adaptors for male and female cigarette lighter plugs, battery clips, an 8-foot extension cable and 2.5mm coaxial barrel plug. These accessories facilitate auto battery charging, using modules to power cigarette lighter adapters (CLA) for cell phones, iPods, radios and CD players.

SUNLINQ modules have a regulated output and can be directly connected to CLA from portable devices designed to plug into auto cigarette lighter outlets. P3 modules are unregulated and require a charge controller to safely operate without a battery. The charge controller below can be used between the P3 modules and power supplies designed to run on 12-volt battery power, even if a battery is not connected. 1-year warranty.

The 2.5mm barrel plug allows these modules to plug into Xantrex Powerpacks for charging. See page 176 for Xantrex Powerpacks.

The PowerBank battery pack can be used to charge small electronics with a variety of voltages. The large assortment of connector plugs and cables available with the PowerBank makes it an easy way to charge your small electronics while on the go. It has an internal lithium-ion battery. This battery pack was intended to work with the 6.5W and 12W SUNLINQ only.

Accessories	Item code	Price
5-piece cable set	**11.2921**	**$20**
7-amp charge controller	**11.2923**	**$40**
2.5mm barrell plug adapter	**11.2925**	**$6**
Powerbank battery pack	**11.2933**	**$60**
i-Pod accessory cable	**11.2922**	**$16**

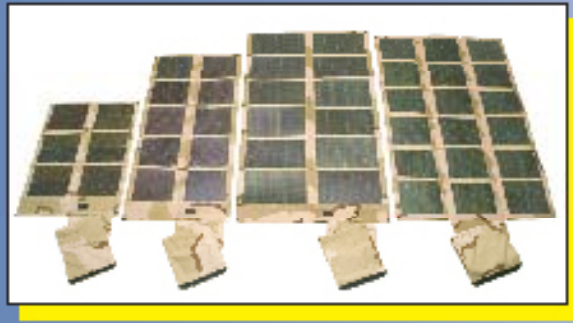
We have the technology . . . you need the products.

Global Solar Energy's next generation, thin-film, PowerFLEX™ solar technology uses CIGS solar cells on a flexible backing enabling lightweight, foldable, portable solar products as well as traditional glass modules.

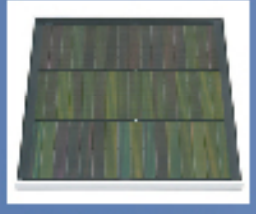
Folded Units

- Lightweight, foldable, portable
- Come in 6.5W, 12W, 25W all 12V
- For charging cell phones, sat phones, iPods, PDAs, laptops
- Trickle charge car, boat and RV batteries
- Blocking diodes
- Voltage cap in 6.5W and 12W units

Folded Units



- High power, foldable, portable
- Come in 15W, 30W, 48W, 55W
- For 12 - 24 volt charging
- Rugged, durable, military spec
- Available in green camo & black also
- Blocking diodes
- Great for larger remote power needs



Glass Modules

- Reliable CIGS solar panels
- Come in 6W, 12W, 30W, 60W, 120W
- Optimal charging for lead acid batteries
- Mount to industry standard racks
- Industry standard warranty
- Blocking or bypass diodes
- Great for off-grid power needs
- IEC compliant

GLOBAL SOLAR

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- **-Solar Water Pumping**
- **-Solar Hot Water**
- **-Biodiesel**
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PowerFilm

Roll-Up Modules

These new PowerFilm super-lightweight rollable marine-grade modules are flexible enough to roll around a 3" diameter tube for storage. Wraparound straps keep the modules rolled up, and a 15-foot cord makes it easy to connect to any of the accessories. Great for backpacking, camping and trekking.

PowerFilm model		R15-1200	R15-600	R15-300
Peak power	watts	18	9	4.5
Peak power voltage	volts	15.4	15.4	15.4
Peak power Current	amps	1.2	0.6	0.3
Nominal voltage	volts	12	12	12
Length	inches	73	38	21
Width	inches	12	11.5	11.5
Weight	lbs	1.9	1	0.5
Item code		**11.5105**	**11.5103**	**11.5101**
Price		**$375**	**$198**	**$102**

Roll-Up Module Accessories

The items listed below connect to the output cord of the Roll-up Modules. The RA-6 daisy chain accessory allows parallel connection of a second module.

PowerFilm accessories	Item code	Price
RA-1 Male cigarette lighter adapter	**11.5121**	**$8.50**
RA-2 Female cigarette lighter adapter	**11.5122**	**$8.50**
RA-4 Standard charger pack	**11.5124**	**$45.00**
RA-5 Deluxe universal charger pack	**11.5125**	**$120.00**
RA-6 Daisy chain adapter	**11.5126**	**$8.50**
RA-7 15 Foot extension cord	**11.5127**	**$10.50**
RA-8 Extension cord w/ battery clips	**11.5128**	**$14.50**
RA-9 PowerFilm charge controller	**11.5129**	**$32.00**

Ultra Flexible Plastic Solar Modules

PowerFilm products are paper thin, offer unsurpassed flexibility, are durable, and have a significant weight advantage over heavier metal-based and glass-based solar modules.

Technology

PowerFilm uses paper-thin plastic film to generate power again and again. PowerFilm integrated solar modules have a durable polymer substrate just 2 mils (0.05mm) or less thick and are monolithically integrated. The semiconductor absorber layer is made of environmentally friendly amorphous silicon PowerFilm is developed and manufactured by ITF Electronics.

Wireless Electronics Series

Modules in the PowerFilm Wireless Electronics Series offer a new opportunity to solve the old problem of limited power for wireless electronics for portable and remote applications. PowerFilm Wireless Electronics modules are lightweight, extremely thin, and durable. Their ultra-thin profile enables them to be easily integrated with devices for solar recharging or direct powering. Modules have been specifically developed to recharge AA, AAA, and 6- and 12-volt batteries. These modules do not have a UV-stabilized surface. For connection, just solder or crimp to the copper tape.

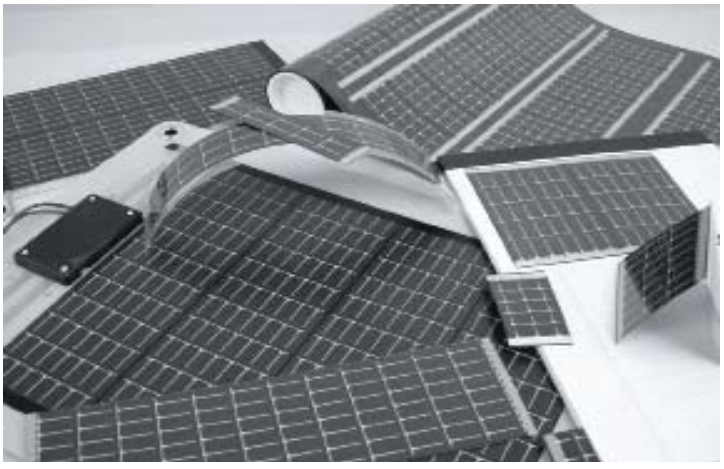
RC Aircraft Series

The PowerFilm RC Aircraft Series modules are designed to be easily integrated with remote control aircraft. These PowerFilm modules have very lightweight wires that can be soldered on the back of the module via the extended copper tape. They have an extra edge seal for protection from fuel contamination and weather. Modules are available with a strong pressure sensitive adhesive for simple bonding. These modules do not have a UV-stabilized surface. For connection, solder to the copper tape.

WeatherPro Series

The PowerFilm WeatherPro Series is a good choice for permanent outdoor applications that are directly exposed to the elements. The especially rugged construction of these PowerFilm modules includes a UV-stabilized surface, extra edge seal for weather protection, and tin-coated copper leads that extend from the module. Coating the leads with an RTV silicon compound can provide a tightly sealed package.

PowerFilm Small, Ultra-Flexible Modules



The PowerFilm product line offers a wide range of products to fit the diverse applications and environments for wireless electronics, RC aircraft, and permanent outdoor applications. The line ranges from small 3-volt modules for wireless electronics to modules 20 watts and larger. PowerFilm can be easily integrated with devices. Its thin profile and flexibility makes PowerFilm a top choice of product designers and engineers.

Specifications and Prices

PowerFilm product	Operating voltage	Operating current	Open circuit voltage	Short circuit current	Total size (inches)	Total thickness	Weight	Item code	Price
PowerFilm Wireless Electronics Series									
SP3-37	3 V	22 mA	4.1 V	30 mA	2.5 x 1.5	0.2mm (8 mil)	0.7g (0.03 oz)	**11.5011**	**$3.95**
TX3-25	3 V	25 mA	4.1 V	40 mA	4.5 x 1.0	0.2mm (8 mil)	0.8g (0.03 oz)	**11.5013**	**$2.95**
MP3-37	3 V	50 mA	4 .1 V	60 mA	4.5 x 1.5	0.2mm (8 mil)	1.2g (0.04 oz)	**11.5015**	**$5.95**
MPT3.6-75	3.6 V	50 mA	4.8 V	65 mA	2.9 x 3.0	0.2mm (8 mil)	1.6g (0.06 oz)	**11.5017**	**$8.95**
MPT3.6-150	3.6 V	100 mA	4.8 V	130 mA	2.9 x 5.9	0.2mm (8 mil)	3.1g (0.1 oz)	**11.5019**	**$17.95**
SP4.2-37	4.2 V	22 mA	5.9 V	30 mA	3.3 x 1.5	0.2mm (8 mil)	0.8g (0.03 oz)	**11.5021**	**$5.95**
MPT4.8-75	4.8 V	50 mA	6.4 V	65 mA	3.7 x 3.0	0.2mm (8 mil)	1.9g (0.07 oz)	**11.5023**	**$11.95**
MPT4.8-150	4.8 V	100 mA	6.4 V	130 mA	3.7 x 5.9	0.2mm (8 mil)	3.9g (0.1 oz)	**11.5025**	**$22.95**
MPT6-75	6 V	50 mA	8.0 V	65 mA	4.5 x 3.0	0.2mm (8 mil)	2.3g (0.08 oz)	**11.5027**	**$13.95**
MPT6-150	6 V	100 mA	8.0 V	130 mA	4.5 x 5.9	0.2mm (8 mil)	4.6g (0.1 oz)	**11.5029**	**$27.95**
MP7.2-75	7.2 V	100 mA	10.5 V	125 mA	10.0 x 3.0	0.6mm (24 mil)	12.9g (0.5 oz)	**11.5031**	**$24.95**
MP7.2-150	7.2 V	200 mA	10.5 V	150 mA	10.0 x 5.9	0.6mm (24 mil)	25.9g (0.9 oz)	**11.5033**	**$39.95**
MPT15-75	15.4 V	50 mA	19 V	60 mA	10.0 x 3.0	0.6mm (24 mil)	13.0g (0.5 oz)	**11.5035**	**$26.95**
MPT15-150	15.4 V	100 mA	19 V	120 mA	10.0 x 5.9	0.6mm (24 mil)	26.0g (0.9 oz)	**11.5037**	**$44.95**
PowerFilm RC Aircraft Series									
RC7.2-37	7.2 V	50 mA	10.5 V	60 mA	10.6 x 2.2	0.2mm (8 mil)	3.5g (0.1 oz)	**11.5051**	**$16.95**
RC7.2-37 PSA	7.2 V	50 mA	10.5 V	60 mA	10.6 x 2.2	0.2mm (8 mil)	4.4g (0.2 oz)	**11.5053**	**$19.50**
RC7.2-75	7.2 V	100 mA	10.5 V	125 mA	10.6 x 3.5	0.2mm (8 mil)	5.9g (0.2 oz)	**11.5055**	**$29.95**
RC7.2-75 PSA	7.2 V	100 mA	10.5 V	125 mA	10.6 x 3.5	0.2mm (8 mil)	7.6g (0.3 oz)	**11.5057**	**$32.95**
PowerFilm WeatherPro Series									
P7.2-75	7.2 V	100 mA	10.5 V	125 mA	10.6 x 3.9	1.1mm (44 mil)	31.3g (1.1 oz)	**11.5071**	**$39.95**
P7.2-150	7.2 V	200 mA	10.5 V	250 mA	10.6 x 6.9	1.1mm (44 mil)	54.9g (1.9 oz)	**11.5073**	**$59.95**
PT15-75	15.4 V	50 mA	19 V	60 mA	10.6 x 3.9	1.1mm (44 mil)	31.8g (1.1 oz)	**11.5075**	**$39.95**
PT15-150	15.4 V	100 mA	19 V	120 mA	10.6 x 6.9	1.1mm (44 mil)	56.4g (2.0 oz)	**11.5077**	**$59.95**
PT15-300	15.4 V	200 mA	19 V	250 mA	10.6 x 12.8	1.1mm (44 mil)	94.5g (3.3 oz)	**11.5079**	**$99.95**

Please call with any questions! Our contact information is on the cover.

UniRac

SolarMount

UniRac's SolarMount is a fast, easy, safe way to install a PV array in virtually any roof or ground installation. Bottom mounting clips and tilt legs supplement traditional top mounting clamps. As a result, the system accommodates the widest variety of installations and assembly preferences – on the roof and on the ground. Any framed module sold in North America can be mounted using SolarMount.

Lower-cost SolarMount Light Rail employs 38 percent less aluminum than SolarMount Standard Rail, yet it's more than strong enough for flush applications. Use the same top mounting clamps and footing components that make SolarMount Standard Rail so easy to install.

S-5! **Light Rail** **Standard Rail**

Once you've selected the PV modules and planned your installation layout, you're ready to choose SolarMount components. The chart on the following page shows what components to use if you are bottom-mounting the modules. The chart on page 30 shows what parts to use if you are top-mounting the modules. If you need tilt legs for the mounts, see the explanation on pages 36-37. Rail and parts to complete your mounting system can be found on pages 31 to 34.

When sizing is complete, rails, splices, and L-feet may be ordered in two ways: In kits or in bulk. 2- and 4-rail kits on page 31 contain just the right quantities of each component for a given installation.

The 8-piece bulk rail bundles on page 32 require 4 bottom-mounting clips (page 33) for every module to be mounted, and the addition of L-feet and splices when necessary.

UniRac SolarMount rails can be mounted vertically or horizontally.

Choose a Top-Mounting or Bottom-Mounting System

On pitched roofs, mount rails either parallel or perpendicular to the rafters Assembly sequence is a common determining factor. Select top-mounting clamps if you prefer to install modules last – after you've attached rails to installed footings. This sequence is especially convenient with modules that have Multi-Connect cables. Select bottom mounting clips if you plan to attach modules to rails prior to final installation. This sequence is well suited for modules that must be pre-wired. Bottom-mounting clips use space more efficiently because they do not require the 1" space between modules needed by top clamps.

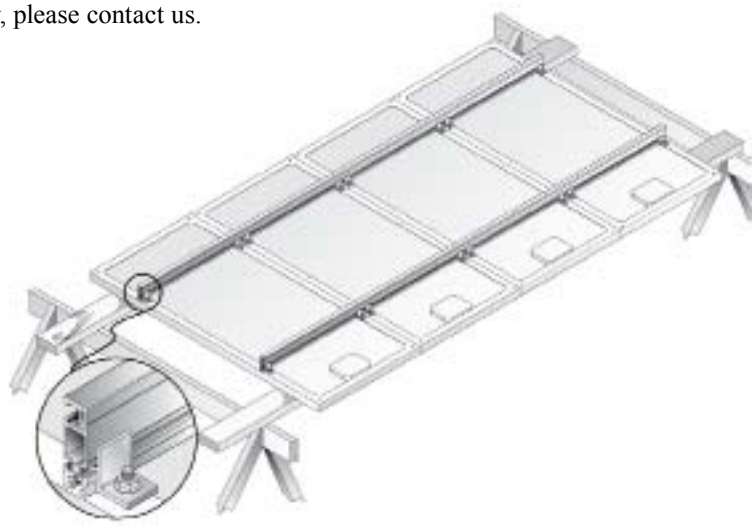
The use of top-mounting clamps is generally easier when flush-mounting to a roof. Always use top-mounting clamps when flush mounting to standoffs. If using bottom-mounting clamps with L-feet, follow the installation manual carefully to make sure footing slots are accessible during final installation.

In roof mounts, when using top-mounting clamps, no extra roof bracing is needed since rails or mounting feet can be adjusted to match rafter spacing. With bottom-mounting clamps, spacing between the rails depends on spacing between the mounting holes of your particular PV module, and it is unlikely that they will match rafter spacing. In that case, place a stringer over the roof or mounting blocks beneath it. Never attach footings to the sheathing alone – such an arrangement will not meet code and will leave the installation and roof vulnerable to severe damage from wind.

UniRac Bottom Mounting Sizing – *Rail set lengths*

This chart lists the length of the rails required for many common modules.
If you need rail sizing for a module not listed below, please contact us.

Bottom mounting clip



Module Brand and Model		Rail length (inches) by number of modules per row										
		2	3	4	5	6	7	8	9	10	11	12
AEE Solar	AE-50J	48	72	96	106	132	156	180	192	216	240	264
	AE-80J, AE-85J , AE-85ET	48	72	96	106	132	156	180	192	216	240	252
	AE-100J , AE100ET	60	84	106	132	156	192	216	240	264	288	312
BP Solar	BP380, BP485	48	72	96	106	132	156	180	192	216	240	264
	BP3125	60	84	106	144	168	192	216	240	276	300	324
	BP3160, BP4160, BP4170	72	96	132	156	192	226	252	288	312	348	384
Evergreen	EC110, EC115, EC120	60	84	106	132	156	180	216	240	264	288	312
	ES170, ES180, ES190, ES200	84	120	156	204	226	276	312	360	384	420	
GE Energy	GE65, GE70	48	72	84	106	132	156	168	192	216	240	252
	GE50, GE100, GE110	60	84	106	132	156	192	216	240	264	288	312
	GE165	84	120	156	192	240	276	312	348	384	432	
Kyocera	KC80, KC130	60	84	106	132	156	180	216	240	264	288	312
	KC175GT, KC187GT	84	120	156	204	240	276	312	360	396	432	
	KC200GT	84	120	156	204	240	276	324	360	396		
Mitsubishi	MF120UE4N, 125UE4N, 130UE4N	60	84	120	144	168	204	240	252	276	300	324
	MF165EB4, 175EB4	72	96	132	168	192	226	252	288	324	348	384
	MF175UD4, 180UD4, 185UD4	72	106	144	168	216	240	276	300	336	384	408
Sharp Solar	NE-80U1	48	72	84	106	132	156	168	192	216	240	252
	ND-L3EJE (123 watt)	60	84	106	132	168	192	216	240	264	288	324
	ND-167U1, ND-167U3	84	120	168	204	240	288	324	360	396		
	NE-165U1, NE-170U1	72	106	132	168	204	240	264	300	336	360	396
SolarWorld	SW80, 85 (Shell SQ80, 85)	48	72	84	106	132	156	168	192	216	240	252
	SW 165/175 mono	72	106	132	168	204	226	264	300	324	360	396
Suntech	STP085S	48	72	96	120	132	156	180	204	216	240	264
	STP110-12Tb,, 115, 120, 130	60	96	120	144	168	192	216	252	276	300	324
	STP110-24Ab, STP175-24Ab1	72	96	132	168	192	226	264	288	324	360	384

UniRac Top Mounting Sizing – *Clamp sizes & rail set lengths*

Use this chart to determine the size of top mounting clamps for your modules and the length of the rails required for your array. When sizing is complete, rails, clamps, splices, and L-feet may be ordered in kits that contain just the right quantities for a given installation or in bulk packaging (Pro-Paks). See pages 31 to 34 for pricing. All UniRac components have a 10-year product warranty and a 5-year finish warranty.

Module brand and model		Clamp size	Rail length in inches, by number of modules per row										
			2	3	4	5	6	7	8	9	10	11	12
BP Solar	BP380, BP485	E	48	72	96	120	144	156	180	192	216	240	252
	BP3125	E	60	96	120	144	168	204	226	252	288	312	336
	BP3150, 3160, 4160, 4170, 4175,	E	72	106	132	168	204	240	264	300	324	360	396
Evergreen	EC110, EC115, EC120	C	60	84	120	144	168	192	216	252	276	300	324
	ES170, ES180, ES190, ES200	K	84	120	156	204	240	276	312	360	396		
GE Energy	GE65, GE72 , GE85	C	48	72	96	120	144	156	180	204	226	252	264
	GE50, GE100, GE110	C	60	84	120	144	168	192	226	252	276	300	336
	GE165	C	84	132	168	204	240	288	324	360	396		
Kyocera	KC50, KC65, KC85, KC130	C	60	84	120	144	168	192	216	252	276	300	324
	KC167G, KC187G, KC200	C	84	132	168	204	252	288	324	372	408		
Mitsubishi	MF120EC3	F	60	84	120	144	168	192	216	240	276	300	324
	MF165EB4, 170EB4	F	72	106	132	168	204	240	264	300	336	360	396
	MF175UD4, 180UD4, 185UD4	F	72	106	144	180	216	240	276	312	348	384	420
Sanyo	HIT-190, 200, 205, 210	H	84	120	156	192	226	264	300	336	372	408	
Sharp Solar	NE-80U1	C	48	72	96	120	144	156	180	204	226	252	276
	ND-L3EJE (123 watt)	F	60	84	120	144	168	192	226	252	276	300	336
	ND-167U1	G	84	132	168	216	252	288	336	372	408		
	NE-175U1, NE-170U1	F	72	106	144	180	204	240	276	312	348	372	408
	ND-200U1, ND-208U1, ND208U1F	F	84	132	168	216	252	288	336	372	408		
SolarWorld	SQ80, SQ85	C	48	72	96	120	144	156	180	204	226	252	264
	SW165, SW175 mono/P	D	72	106	144	168	204	240	276	300	336	372	408
	SW165/175 mono	C	72	106	144	168	204	240	276	300	336	372	408
SunPower	SPR90, 95	F	48	72	96	120	144	156	180	204	226	252	264
	SPR200, 210. 215. 220	F	72	106	132	168	204	240	264	300	336	360	396
Suntech	STP085S	B	48	72	96	120	144	168	192	204	226	252	276
	STP110-12Tb,, 115, 120, 130	C	60	96	120	144	168	204	226	252	288	312	336
	STP110-24Ab, STP175-24Ab1	E	72	106	144	168	204	240	276	300	336	372	396

UniRac SolarMount Standard Rail and Light Rail Kits (tables on next page)

Each kit mounts a single row of modules and consists of rails plus L-feet and hardware to attach feet to rails. Splice bars are also included in four-rail kits. To determine row lengths required for your installation, see the sizing chart on this page for arrays with top mounting clamps, or above on page 29 for arrays with bottom mounting clips. Rails, L-feet, and splices are clear-anodized.

Easy handling Light Rail saves aluminum and expense without compromising structural integrity. Install an array flush to a roof or other mounting surface with footings up to 48 inches apart. Mount rails parallel or perpendicular to rafters.

Where foot spacing must exceed 48 inches, Standard Rail provides the extra strength needed. Install an array flush to a roof or other mounting surface in high profile (rails parallel to rafters) or low profile.

With both Light and Standard Rail, there are accessories to handle special circumstances, such as Spanish tile or an uneven roof.

Two-rail UniRac SolarMount kits – L-feet included

Rail Length	Standard Rail					Light Rail				
	UniRac part #	# of L-ft	Ship wt. (lbs)	Item code	Price	UniRac part #	# of L-ft	Ship wt. (lbs)	Item code	Price
48	300201	4	13	**14.1020**	**$105**	303201	4	9	**14.3101**	**$83**
60	300202	4	14	**14.1024**	**$121**	303202	4	10	**14.3103**	**$94**
72	300203	4	16	**14.1028**	**$138**	303203	4	11	**14.3105**	**$105**
84	300204	4	17	**14.1032**	**$154**	303204	4	12	**14.3107**	**$116**
96	300205	4	19	**14.1036**	**$170**	303205	6	13	**14.3109**	**$127**
106	300206	4	20	**14.1040**	**$186**	303206	6	14	**14.3111**	**$138**
120	300207	6	22	**14.1044**	**$207**	303207	6	15	**14.3113**	**$149**
132	300208	6	24	**14.1048**	**$223**	303208	8	16	**14.3115**	**$160**
144	300209	6	25	**14.1052**	**$239**	303209	8	17	**14.3117**	**$171**
156	300210	6	27	**14.1056**	**$255**	303210	8	18	**14.3119**	**$182**
168	300211	6	28	**14.1060**	**$271**	303211	8	19	**14.3121**	**$193**
180	300212	6	30	**14.1064**	**$293**	303212	10	20	**14.3123**	**$204**
192	300213	8	31	**14.1068**	**$309**	303213	10	21	**14.3225**	**$215**
204	300214	8	33	**14.1072**	**$325**	303214	10	22	**14.3127**	**$226**
216	300215	8	34	**14.1076**	**$341**	303215	10	23	**14.3129**	**$237**

2-rail kits in lengths up to 216 inches

Each kit contains two rail segments equal to the row length, L-feet, and hardware to join L-feet to rails.

Rail kits 106 inches and shorter ship by UPS. Longer rail sets ship by truck freight. To make up long rail kits that are UPS shippable, use two rail kits of 106 inches or less plus a splice on page 34.

See tables on pages 29 and 30 to determine the rail length required for modules being mounted.

Four-rail UniRac SolarMount kits – L-feet included

Rail Length	Segment length	Standard Rail					Light Rail				
		UniRac part #	# of L-ft	Ship wt (lbs)	Item code	Price	UniRac part #	# of L-ft	Ship wt (lbs)	Item code	Price
226	106/120	300224	10	40	**14.1000**	**$373**	303216	12	28	**14.3131**	**$273**
240	120/120	300225	10	42	**14.1001**	**$389**	303217	12	29	**14.3133**	**$284**
252	132/120	300226	10	44	**14.1002**	**$405**	303218	12	31	**14.3135**	**$295**
264	132/132	300227	10	46	**14.1003**	**$416**	303219	14	32	**14.3137**	**$306**
276	144/132	300228	10	47	**14.1004**	**$432**	303220	14	33	**14.3139**	**$317**
288	144/144	300229	10	48	**14.1005**	**$448**	303221	14	34	**14.3141**	**$328**
300	156/144	300230	12	50	**14.1006**	**$469**	303222	16	35	**14.3143**	**$339**
312	156/156	300231	12	52	**14.1007**	**$485**	303223	16	36	**14.3145**	**$350**
324	168/156	300232	12	53	**14.1008**	**$501**	303224	16	37	**14.3147**	**$361**
336	168/168	300233	12	54	**14.1009**	**$517**	303225	16	38	**14.3149**	**$372**
348	180/168	300234	14	56	**14.1010**	**$533**	303226	18	39	**14.3151**	**$383**
360	180/180	300235	14	58	**14.1011**	**$544**	303227	18	41	**14.3153**	**$394**
372	192/180	300236	14	59	**14.1012**	**$560**	303228	18	41	**14.3155**	**$405**
384	192/192	300237	14	60	**14.1013**	**$576**	303229	20	42	**14.3157**	**$416**
396	204/192	300238	14	62	**14.1014**	**$592**	303230	20	43	**14.3159**	**$427**
408	204/ 204	300239	14	64	**14.1015**	**$608**	303231	20	45	**14.3161**	**$438**
420	216/ 204	300240	16	65	**14.1016**	**$630**	303232	20	46	**14.3163**	**$449**
432	216/ 216	300241	16	66	**14.1017**	**$640**	303233	20	46	**14.3165**	**$460**

4-rail kits for long rows

Each kit contains four rail segments, two splices, L-feet, and hardware to join L-feet to rails. Rail segments and splices assemble into two spliced rails equal to the row length. These kits ship via truck freight only.

UniRac Bulk Rail Bundles

Use UniRac Pro-Pak components for large installations or when regularly using SolarMount Standard Rail or SolarMount Light Rail on multiple installations.

Bulk bundles of Standard Rail consist of 8 rails and do not include L-feet or hardware. Bulk bundles of Light Rail consist of 10 rails. They do not include L-feet or hardware. See the sizing charts (pages 29-30) to determine rail length appropriate for your installation. If desired rail length exceeds 240 inches (216 inches for Light Rail), order a splice (page 34) and two segments. Spliced segments should be equal or as close to equal as possible.

PRO-PAK rail bundles								
	Standard Rail – 8 rails				Light Rail – 10 rails			
Rail Length	UniRac part #	Ship wt lbs	Item code	Price	UniRac part #	Ship wt lbs	Item code	Price
48	300101	32	**14.0810**	**$246**	303101	25	**14.3167**	**$199**
60	300102	40	**14.0811**	**$288**	303102	30	**14.3169**	**$239**
72	300103	48	**14.0812**	**$331**	303103	36	**14.3171**	**$279**
84	300104	54	**14.0813**	**$374**	303104	41	**14.3173**	**$319**
96	300105	62	**14.0814**	**$417**	303105	45	**14.3175**	**$359**
106	300106	68	**14.0815**	**$460**	303106	50	**14.3177**	**$399**
120	300107	80	**14.0820**	**$508**	303107	55	**14.3179**	**$439**
132	300108	88	**14.0821**	**$556**	303108	59	**14.3181**	**$479**
144	300109	95	**14.0822**	**$604**	303109	64	**14.3183**	**$519**
156	300110	102	**14.0823**	**$652**	303110	75	**14.3185**	**$559**
168	300111	109	**14.0824**	**$700**	303111	82	**14.3187**	**$599**
180	300112	116	**14.0825**	**$749**	303112	88	**14.3189**	**$639**
192	300113	123	**14.0826**	**$797**	303113	93	**14.3191**	**$679**
204	300114	130	**14.0827**	**$845**	303114	98	**14.3193**	**$719**
216	300115	137	**14.0828**	**$893**	303115	104	**14.3195**	**$759**
228	300116	144	**14.0831**	**$930**				
240	300117	152	**14.0829**	**$979**				

UniRac L-feet

PRO-PAK: Each L-foot includes a stainless steel bolt and flange nut to attach the foot to a SolarMount rail. Lag bolts are not included. The rail set pricing chart (page 31) shows the appropriate number of L-feet needed per pair of rails.

UniRac part #	Description	Wt. (lbs)	Item code	Price
310067	20 ea. L-feet	5	**14.0891**	**$81.00**
310068	1 ea. L-foot	0.5	**14.0884**	**$4.70**

UniRac Splice Bars and Plates

Splice *bars* are used to join together lengths of SolarMount Standard Rail, SolarMount Light Rail, or SunFrame. Splice *plates* are also structural and may be used only with SolarMount Standard Rail.

Neither type creates a joint that is as strong as the rail itself. A rail should always be supported by more than one footing on both sides of the splice.

Expansion joints allow for thermal expansion and may be necessary when rails exceed 30 feet. Only splice *bars* may be used for thermal expansion joint. To create an expansion joint, slide the splice bar into the footing slots of both rail lengths. Leave a half inch between the segments. Secure the splice bar with two screws on one side only. Footings (such as L-feet or standoffs) should be secured normally on both sides of the splice. No PV module should straddle the expansion joint.

Splices for Standard Rail with hardware										Splices for Light Rail with Hardware				
														
310216	20 ea splice plates	14	**14.0888**	**$181**	**310204**	20 ea splice bars	10	**14.0889**	**$107**	**310232**	20 ea splice bars	1	**14.3203**	**$77**
310214	1 ea splice plates	1	**14.1261**	**$10**	**310202**	1 ea splice bars	1	**14.1262**	**$6**	**310231**	1 ea splice bars	5	**14.3201**	**$4**

Prices subject to change without notice.

UniRac Top Mounting Clamp Sets

See sizing chart on page 30 to determine clamp size letter. Call for modules not found on chart. Includes all clamps and hardware to attach the indicated number of PV modules to one pair of rails. Replace the "x" in the item code with a letter (A-K) to order the correct clamp set.

Top mounting clamp sets, sizes A - F, J & K					
# of modules	ship wt. (lbs)	Clear Anodized		Dark Bronze	
		Item code	Price	Item code	Price
2	1	14.1080-x	$20.25	14.1081-x	$26.75
3	2	14.1084-x	$24.00	14.1082-x	$31.75
4	2	14.1088-x	$27.75	14.1083-x	$36.75
5	2	14.1092-x	$31.50	14.1085-x	$42.00
6	2	14.1096-x	$35.25	14.1086-x	$47.00
7	2	14.1100-x	$39.00	14.1087-x	$52.00
8	3	14.1104-x	$42.75	14.1089-x	$57.25
9	3	14.1105-x	$46.50	14.1090-x	$62.25
10	3	14.1106-x	$50.25	14.1091-x	$67.25
11	3	14.1101-x	$54.00	14.1093-x	$72.50
12	3	14.1102-x	$57.75	14.1094-x	$77.50

Top mounting clamp sets for lipped frame modules					
# of modules	Ship wt. (lbs)	Dark Bronze - G (Sharp)		Dark Bronze - H (Sanyo)	
		Item code	Price	Item code	Price
2	1	14.1135	$26.75	14.1146	$19.75
3	2	14.1136	$31.00	14.1147	$22.25
4	2	14.1137	$35.25	14.1148	$25.00
5	2	14.1138	$39.50	14.1149	$27.75
6	2	14.1139	$43.75	14.1150	$30.50
7	2	14.1140	$48.00	14.1151	$33.00
8	3	14.1141	$52.25	14.1152	$35.75
9	3	14.1142	$56.50	14.1153	$38.50
10	3	14.1143	$61.00	14.1154	$41.00
11	3	14.1144	$65.25	14.1155	$43.75
12	3	14.1145	$69.50	14.1156	$46.50

UniRac Bottom Mount Clips

Order 4 clips for each module in your array. Clips are packed with stainless steel bolts and flange nuts. For use with all modules with mounting holes on the backs of their frames.

UniRac part #	Bottom mount clips w/ stainless steel T-bolts & flange nuts	Wt. (lbs)	Item code	Price
321002	20 ea. clips	5	14.0875	$25.50
321218	4 ea. clips	1	14.0879	$7.00
321001	1 ea. clip	1	14.0877	$1.50

UniRac Pro-Pak Top Clamps

See sizing chart page 30 to determine clamp size letter. End clamps: Order 4 for each row of modules you plan to mount. Mid clamps: For each row, take one less than the number of modules in the row and multiply that figure by 2 to determine the number of clamps needed.

UniRac part #	End clamps with stainless steel t-bolts and flange nuts	Wt. lbs	Item code	Price
320012	20 ea. A clamps	6	14.0840	$41.75
320001	1 ea. A clamp	1	14.0850	$2.50
320013	20 ea. B clamps	6	14.0841	$41.75
320002	1 ea. B clamp	1	14.0851	$2.50
320014	20 ea. C clamps	6	14.0842	$41.75
320003	1 ea. C clamp	1	14.0852	$2.50
320081	20 ea. C clamps; dark bronze	6	14.0861	$57.75
320117	1 ea. C clamp, dark bronze	1	14.0862	$3.25
320015	20 ea. D clamps	6	14.0843	$41.75
320004	1 ea. D clamp	1	14.0853	$2.50
320185	20 ea. D clamps dark bronze	6	14.0863	$57.75
320173	1 ea. D clamp dark bronze	1	14.0864	$3.25
320016	20 ea. E clamps	6	14.0844	$41.75
320005	1 ea. E clamp	1	14.0854	$2.50
320082	20 ea. E clamps; dark bronze	6	14.0848	$57.75
320118	1 ea. E clamp, dark bronze	1	14.0858	$3.25
320017	20 ea. F clamps	6	14.0845	$41.75
320006	1 ea. F clamp	1	14.0855	$2.50
320123	20 ea. F clamps dark bronze	6	14.0846	$57.75
320124	1 ea. F clamp dark bronze	1	14.0856	$3.25
320083	20 ea. G clamps dark bronze	6	14.0847	$57.75
320007	1 ea. G clamps dark bronze	1	14.0857	$3.25
320221	20 ea. K clamps	3	14.0860	$41.75
320220	1 ea. K clamp	1	14.0839	$2.50
Mid clamps with stainless steel T-bolts and flange nuts				
320020	20 ea. A-B-C mid clamps	6	14.0867	$41.75
320008	1 ea. A-B-C mid clamp	1	14.0866	$2.50
320084	20 ea. A-B-C mid clamps, bronze	6	14.0865	$57.75
320119	1 ea. A-B-C mid clamp, dk bronze	1	14.0876	$3.25
320021	20 ea. D-E-F-J-K mid clamps	6	14.0869	$41.75
320009	1 ea. D-E-F-J-K mid clamp	1	14.0868	$2.50
320085	20 ea. D-E-F-J-K mid clamps brnz	6	14.0878	$57.75
320120	1 ea. D-E-F-J-K mid clamp dk brnz	1	14.0870	$3.25
320087	20 ea. G mid clamps, dark bronze	6	14.0871	$47.00
320122	1 ea. G clamp, dark bronze	1	14.0872	$3.25
H clamps used as mid & end clamps – includes hex bolts				
320086	20 ea. H clamps, dark bronze	6	14.0873	$38.50
320121	1 ea. H clamp, dark bronze	1	14.0874	$2.25

UniRac Splices, Standoffs, L-feet, Flashings and Accessories

Bulk components are ideal for large installations and for contractors installing many roof mount systems. Standoffs, L-feet and splices in bulk save money. Flashings, shims, hanger bolts and cable ties help create a clean, professional-looking installation. Bulk packs will be drop-shipped from the manufacturer. Please allow 3 to 4 weeks for delivery.

Description	Wt. lbs	Single piece: UniRac part #	Item code	Price	Bulk pack: UniRac part #	Item code	Price
Flat-top two piece aluminum standoffs (1-1/8" O.D. shaft, s/s hardware, 2 lag bolts					**Bulk 12-piece pack**		
1 ea. 3 in. aluminum 2-piece standoffs	1	310027	**14.1251**	**$11.75**	310055	**14.0896**	**$122.00**
1 ea. 4 in. aluminum 2-piece standoffs	1	310028	**14.1252**	**$12.50**	310056	**14.0897**	**$131.00**
1 ea. 6 in. aluminum 2-piece standoffs	1	310029	**14.1253**	**$15.00**	310057	**14.0898**	**$150.00**
1 ea. 7 in. aluminum 2-piece standoffs	1	310030	**14.1254**	**$16.00**	310058	**14.0899**	**$160.00**
Flat-top one piece steel standoffs (1-5/8"O.D. shaft, zinc plated, with s/s hardware, 2 lag bolts)					**Bulk 12-piece pack**		
1 ea. 3 in. flat-top steel standoffs	1.5	310009	**14.1220**	**$18.00**	310051	**14.0661**	**$192.00**
1 ea. 4 in. flat-top steel standoffs	1.5	310010	**14.1224**	**$18.75**	310052	**14.0662**	**$199.00**
1 ea. 6 in. flat-top steel standoffs	2	310011	**14.1228**	**$19.25**	310053	**14.0664**	**$205.00**
1 ea. 7 in. flat-top steel standoffs	2	310012	**14.1232**	**$19.75**	310054	**14.1233**	**$211.00**
Raised-flange steel standoffs (1-5/8" O.D. shaft, zinc plated, with 2 lag bolts)					**Bulk 12-piece pack**		
1 ea. 3 in. raised-flange steel standoffs	1.5	310017	**14.1236**	**$19.25**	310047	**14.1237**	**$205.00**
1 ea. 4 in raised-flange steel standoffs	1.5	310018	**14.1240**	**$19.75**	310048	**14.1241**	**$211.00**
1 ea. 6 in raised-flange steel standoffs	2	310019	**14.1244**	**$20.25**	310049	**14.1245**	**$218.00**
1 ea. 7 in raised-flange steel standoffs	2	310020	**14.1248**	**$20.75**	310050	**14.1249**	**$224.00**
Hanger bolts – Use w/L-feet to support rails on tile or metal roofing					**Bulk 20-piece pack**		
1 ea. 8" long x 3/8" diameter hanger bolt w. s/s nut and washers	0.5	310025	**14.1256**	**$12.00**	310046	**14.1257**	**$192.00**
1 ea. 3/8" hanger bolt driver – for easy installation of hanger bolts	0.5	310026	**14.1258**	**$15.00**			
No-Calk™ collar flashings for steel standoff					**Bulk 12-piece pack**		
12 ea. galvanized, 121/2″ x 83/4″ base (Oatey # O-11840)	11				990101	**14.0621**	**$86.50**
12 ea. aluminum, 121/2″ x 83/4″ base (Oatey # O-12920)	11				990102	**14.0623**	**$126.00**
12 ea. soft aluminum, 18″ x 18″ base (Oatey # O-12836)	14				990103	**14.0625**	**$180.00**
Flashings for aluminum standoffs					**Bulk 12-piece pack**		
12 ea. galv., 121/2″ x 83/4″ base, no-calk (Oatey # O-11830)	11				990109	**14.0629**	**$99.00**
12 ea. aluminum, 12″ x 9″ base – all metal	12				310044	**14.0633**	**$176.00**
12 ea. soft aluminum, 18″ x 18″ base – 12" x 9" all metal	14				310045	**14.0635**	**$272.00**

QuickMount PV

NEW! All-In-One Waterproof Flashing

QuickMount PV is an all-in-one waterproof flashing and mount to anchor photovoltaic racking systems to a new or existing roof. It is made in the USA of aluminum and includes stainless steel hardware. It works with all standard racks, installs seamlessly and provides low-profile mount.

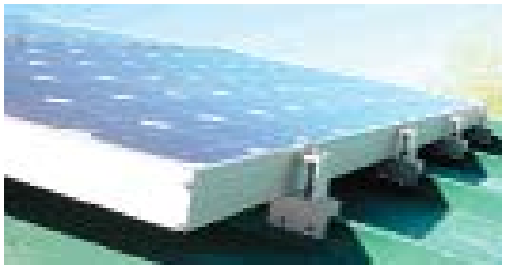
No roof cutting is required. The flashing includes an attached standoff block and stainless steel hardware to attach to ProSolar rails, UniRac and Direct Power L-Feet or Unistrut.

QuickMount model	Description	Wt (lbs)	Item code	Price
QMSC-A 12	Standard 12" x 12" Mount – 12 Pack	19	**14.6315**	**$336**
QMSC-A 12	Standard 18" x 18" Mount – 12 Pack	30	**14.6319**	**$456**

Prices subject to change without notice.

UniRac SolarMount S-5!

PV Clamp Sets for Standing Seam Roofing



S-5! PV clamps provide non-penetrating attachment points to standing seam metal roofs. Select SolarMount end clamps and mid clamps and attach modules directly to the S-5! clamp without mounting rails. Use end clamps on the edge of the array and mid clamps between rows within the array. End clamps and mid clamps are anodized. S-5! clamps are mill finish.

Use the application chart below to find the size – C, D, E or F – that fits the modules being used. Order end clamps for outside rows of modules and mid clamp for internal rows.

Roof design, tilt angle, snow loading, seam spacing, building dimension and wind loading all affect S-5! system design. Please fill out the Unirac questionnaire at: www.unirac.com/sm_s5/S5equest/S5quest.htm and you will receive a complete bill of materials with price and lead time.

S-5! Application Chart		
Size	**Frame thickness**	**Fits these modules**
C	34 - 36mm	GE Energy, Kyocera, Sharp NE-80U1, SolarWorld SW80/SW85, SolarWorld SW165/175 mono
D	38 - 40mm	Isofoton, Kaneka, Photowatt PW1250, PW1650
E	50 - 52mm	BP Solar, Schott ASE300. Suntech STP175-24, SunPower 175
F	45 - 47mm	Mitsubishi, Schott SAPC165, Sharp ND-L3EJE, ND-167U3, NE-165U1, NT-185U1, SunPower
G		Sharp Lipped Modules ND-N2ECU (140W)
H		Sanyo Lipped Modules
K	39-41mm	Evergreen ES-Series

Description	Quantity per pack	Ship wt. (lbs)	Clear anodized			Dark bronze anodized		
			UniRac part #	Item code	Price	UniRac part #	Item code	Price
S-5! + Mid clamp set C, D & K	1	0.5	321224	**14.1281**	**$21.00**	321226	**14.1301**	**$21.50**
	20	10	321236	**14.1282**	**$385.00**	321238	**14.1302**	**$395.00**
S-5! + End clamp set C	1	0.5	321228	**14.1283**	**$21.00**	321232	**14.1303**	**$21.50**
	20	10	321240	**14.1284**	**$385.00**	321244	**14.1304**	**$395.00**
S-5! + End clamp set D	1	0.5	321229	**14.1285**	**$21.00**	321233	**14.1305**	**$21.50**
	20	10	321241	**14.1286**	**$385.00**	321245	**14.1306**	**$395.00**
S-5! + Mid clamp set E & F	1	0.5	321225	**14.1287**	**$21.00**	321227	**14.1307**	**$21.50**
	20	10	321237	**14.1288**	**$385.00**	321239	**14.1308**	**$395.00**
S-5! + End clamp set E	1	0.5	321230	**14.1289**	**$21.00**	321234	**14.1309**	**$21.50**
	20	10	321242	**14.1290**	**$385.00**	321246	**14.1310**	**$395.00**
S-5! + End clamp set F	1	0.5	321231	**14.1291**	**$21.00**	321235	**14.1311**	**$21.50**
	20	10	321243	**14.1292**	**$385.00**	321247	**14.1312**	**$395.00**
S-5! + End clamp set K	1	0.5	321268	**14.1293**	**$21.00**	321270	**14.1295**	**$21.50**
	20	10	321269	**14.1294**	**$385.00**	321271	**14.1296**	**$395.00**
S-5! + Mid clamp set G	1	1	Available in Dark Bronze only			321251	**14.1297**	**$21.50**
	20	10				321250	**14.1298**	**$395.00**
S-5! + End clamp set G	1	1				321253	**14.1299**	**$21.50**
	20	10				321252	**14.1300**	**$390.00**
S-5! + Mid & End clamp set H (Mid and End are identical for H)	1	1				321248	**14.1313**	**$21.00**
	20	10				321249	**14.1314**	**$375.00**
S-5! + L- foot & 3/8" hardware (For mounting modules with rails)	1	1	321255	**14.1315**	**$26.75**	321257	**14.1279**	**$27.00**
	20	10	321256	**14.1278**	**$485.00**	321258	**14.1280**	**$490.00**

UniRac Cable Ties

Cable ties fit into ¼ -inch holes drilled along SolarMount rails.

Shims

Horseshoe shaped shims level or raise standoffs and L-feet to precisely align rails. Shims come in three color-coded thicknesses in packs of 20.

UniRac part #	Description	Quantity	Item code	Price
990104	100 ea. push mount cable ties	1	**14.0895**	**$12.00**
990105	20 ea. 1/16″ shims (blue)	0.5	**14.0649**	**$1.50**
990106	20 ea. 1/8″ shims (red plastic)	0.5	**14.0651**	**$3.00**
990107	20 ea. 1/4″ shims (black)	1	**14.0653**	**$4.50**
990108	20 ea. tapered shims (black)	1	**14.0655**	**$11.00**

UniRac Security Hardware

Security hardware dramatically increases the difficulty and time required for a thief to dismantle a PV array and steal its components. Breakaway nuts work well in conjunction with top mounting clamps and footing bolts. Note that star head bolt heads do not fit into SolarMount rail slots (where standard bolt heads are inaccessible). Use them with bottom mounting module clips and other locations where heads are exposed.

UniRac part #	Description	Quantity	Item code	Price
321205	Star head bolt, s/s, 1/4" x 3/4"	1	**14.2113**	**$1.40**
321220	Star head bolt, s/s, 1/4" x 3/4"	20	**14.2114**	**$23.50**
321206	Star head bolt, s/s, 3/8" x 11/4"	1	**14.2115**	**$3.70**
321221	Star head bolt, s/s, 3/8" x 11/4"	20	**14.2116**	**$64.00**
321207	Breakaway nut, aluminum, 1/4"	1	**14.2105**	**$1.35**
321222	Breakaway nut, aluminum, 1/4"	20	**14.2106**	**$22.50**
321208	Breakaway nut, aluminum, 3/8"	1	**14.2109**	**$1.75**
321223	Breakaway nut, aluminum, 3/8"	20	**14.2110**	**$29.75**
321209	Star Key (Tool) 1/4"	1	**14.2125**	**$17.50**
321210	Star Key (Tool) 3/8"	1	**14.2126**	**$21.25**

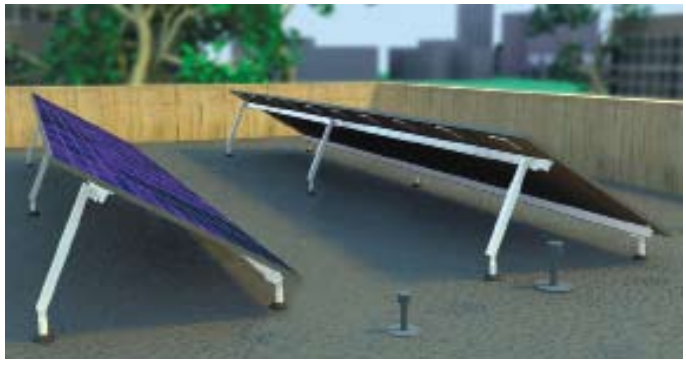
Star key

Starhead bolt

Breakaway nut before and after installation

UniRac Low-Profile Tilt Legs

Low-profile orientation minimizes the vertical height of your array to hide an array behind a parapet or minimize wind loading. You can also optimize tilt angle on a pitched roof to maximize system performance. In low profile arrays, tilt angle depends on leg length and the location of the module mounting



holes. Each low-profile tilt leg kit contains one square tube and one strut.

Tilt angles for low-profile legs

Choose (a) the correct maximum leg extension for your tilt angle and (b) the number of kits required from the charts on the next page. Then choose the correct kit model from the Sizing Chart for Low-Profile Tilt Legs, also on the next page.

Quantity of tilt legs required

The number of tilt legs in a low-profile array depends on the length of the mounting rails.

Quantity of legs required	
Rail length (inches)	**No. of legs required**
48 to 106	2
120 to 180	3
192 to 216	4
226 to 288	5
300 to 336	6
348 to 408	7
420 to 432	8

Sizing Chart for UniRac Low-Profile Tilt Legs

(Tilt angle range given in degrees from horizontal.)

Low profile leg length:		12-inch	30-inch	44-inch
	UniRac part #	310121	310122	310123
	Item code	**14.1185**	**14.1189**	**14.1193**
	Price	**$32**	**$40**	**$46**
Module make and model		**Tilt angle range (degrees)**		
AEE	AE80J, AE85J	15-19	31-49	45-60
BP Solar	BP 365	16-20	34-53	49-60
	BP380, 485	15-20	32-51	47-60
	BP3125	11-14	24-37	34-56
	BP3150, 3160, 4175	11-14	22-35	32-53
	BPSX160B, 170B	11-13	22-35	32-53
GE Energy	GE72	15-19	31-49	45-60
	GE110	21-27	45-60	50-60
	GE165, 173	21-27	45-60	50-60
Evergreen	ES170, 180, 190, 200	16-20	34-53	48-60
Kyocera	KC65, 85, KC130	11-15	24-38	35-57
	KC187G	16-21	35-55	50-60
	KC200	14-18	30-47	43-60
Sanyo	HIP190, 200, 220	14-18	30-47	42-60
Sharp	80	14-18	31-48	44-60
	123	13-17	28-44	40-60
	165, 175, 185	15-19	31-50	45-60
	ND200, 208	13-16	27-42	39-60
SolarWorld	Ultra 80, 85	9-20	21-54	31-60
	SW165 mono, 175mono	7-15	16-39	23-60
SunPower	SPR90, 95	17-21	35-55	50-60
	SPR200, 210, 215, 220	17-22	37-58	53-60
Suntech	STP110-12, 120, 130	10-13	21-33	30-49
	STP110-24b, STP175	9-12	19-30	28-45
Mitsubishi	MF170EB3	12-15	26-40	37-60
	MF175, 180, 185	12-15	25-39	36-60
UniSolar	ES62T	15-19	31-49	44-60
	US64	17-21	35-56	52-60

Sizing Chart for High-Profile Tilt Legs >

(Tilt angle range is in degrees from horizontal.)

UniRac High-Profile Adjustable Tilt Legs

In high-profile arrays, tilt angle depends on the length of the legs and the rails. To determine the length of your rails, consult the sizing charts on page 30 (for top mounting arrays) or page 29 (for bottom mounting arrays). Quantity of tilt legs required: Order one high profile tilt leg kit for each rail kit.

Rails 120 inches and longer require leg kits with 4 legs per kit – one long leg and one short leg per rail.

If ordering bulk rail packs, order one high-profile tilt leg kit for each pair of rails required in your installation. Do not use high-profile legs with rails longer than 180 inches. Never use spliced rails with this configuration.

1 Leg per rail (2 legs per kit) – for rails 48" to 106"			
Maximum leg length	**12 "**	**44 "**	**72 "**
UniRac part #	310107	310108	310109
Item code	**14.1160**	**14.1164**	**14.1168**
Price	**$46**	**$70**	**$92**
Rail Length	**Tilt angle range (degrees)**		
48	10 - 23	33 - 60	N/A
60	8 - 18	26 - 60	48 - 60
72	7 - 16	22 - 60	36 - 60
84	5 - 12	17 - 47	28 - 60
96	5 - 11	16 - 43	26 - 60
106	4 - 10	15 - 39	24 - 60
2 Legs per rail (4 legs per kit) – for rails 120" to 180"			
Maximum leg length	**18 inch**	**64 inch**	**104 inch**
UniRac part #	310111	310112	310110
Item code	**14.1172**	**14.1176**	**14.1180**
Price	**$84**	**$141**	**$188**
Rail length	**Tilt angle range (degrees)**		
120	5 - 10	17 - 38	27 - 60
132	6 - 10	17 - 37	26 - 60
144	6 - 9	16 - 33	19 - 43
156	5 - 10	14 - 30	22 - 49
168	5 - 7	13 - 28	20 - 46
180	3 - 7	12 - 26	19 - 43

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Solve any PV mounting challenge quickly with proven engineered solutions.

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- Fasten to structure or secure with ballast.
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- Create custom architectural applications.
- Document code compliance.
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UniRac SunFrame

When an installation has to look great, SunFrame offers finish choices and low, clean lines that become as natural a part of a home as a skylight. The rails are available in clear and dark bronze finish to match the module frames. The SunFrame rails run horizontally across the roof between the modules making the array look like one large skylight. Installation is slightly more difficult than using SolarMount with top clamps because rail alignment must be perfect. Since the modules will sit closer to the roof, the array may operate at a higher temperature and there may be a small loss of performance.

Contact us with your module type, quantity, number of rows and foot spacing for design help, or download the SunFrame estimator at www.unirac.com/sunframe/sf_config.htm to get a list of components needed. With this list, we can give you price and delivery time.

Components

1. Inter-module rails provide support shelves for the modules. Depending on module thickness, its upper surface can be as little as 2.125 inches above the roof. Rails come in bulk packs of eight 192" pieces in clear-anodized or dark-bronze finish.
2. 192" module-specific cap strips secure modules and finish the array topside, forming a gap-free frame. Self-drilling screws at 16" intervals provide holding power. Order cap strips for the module brand and model to be installed. Cap strips are available in clear or dark bronze anodized finishes.
3. End caps finish rail ends to complete the frame.
4. L-feet attach directly through asphalt shingle roofs and support the rails one-half to three-quarters of an inch above the roof surface to provide convective air flow for ventilation.
5. Splices safely extend rails.
6. Standoffs (optional), designed for standard flashing, support L-feet above tile or shake roofs. See page 34.

UniRac U-LA

U-LA is a mounting system using for large arrays of PV modules designed to generate 3 kilowatts or more. The size of the system is limited only by the available space for the array. Place U-LAs on the ground or on commercial flat roofs.

All U-LAs are custom systems designed by UniRac to accommodate site conditions and applicable codes. To specify a system, please use the on-line questionnaire at ...

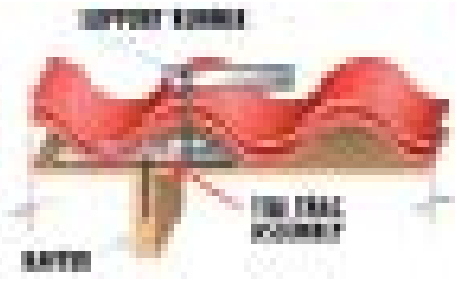
www.unirac.com/ula/ulaequest/ulaquest.htm

... to generate a bill of materials.

With all required U-LA components and specifications for installer-supplied materials such as pipe and concrete provided by UniRac's online questionnaire, we can give you a price quote and delivery lead time.

ProSolar

Professional Solar Products Roof Trac Mounting System



The Roof Trac photovoltaic (PV) solar panel mounting system is a patented top-down roof mounting solution designed and manufactured with the installer in mind. This innovative design incorporates anodized light-weight aluminum components to allow for maximum transportation and installation efficiency. The lightweight nature of the aluminum rail utilizes the basic laws of physics to create structural competence rather than just bulking up the rail in height adding unnecessary and costly aluminum. With this design the Roof Trac system holds the lowest engineered profile to the roof in the industry.

Roof Trac Support Rail

The Roof Trac mounting system has been load-tested and engineered to 125mph wind load (50 lbs/square foot of pressure load) for most module types. Roof Trac secures the solar panels and prevents damage caused from high winds and seismic forces. The Roof Trac support rail was designed to conceal all attachment hardware. All connections are made inside the support rail hidden from view. All exposed aluminum is fully anodized to module manufacturer specifications. The Roof Trac rail must be drilled on site for connection to Tile Trac or Fast Jack.

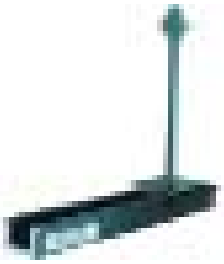
Integrated Clamping System

The clamping system consists of end clamps and mid clamps to attach the module frame to the Roof Trac support rail. This fully integrated clamping system actually changes the structural properties of the aluminum channel making it significantly stronger. This design allows solar modules to be installed at a lower profile to the roof providing a more aesthetically pleasing installation. Module clamps are specifically designed, extruded and engineered for each specific module frame. Our innovative clamping system provides inward tension on the module frame securing the laminate in the frame. Channel nuts slide easily into position to hold the end clamps and mid clamps.

Fast Jack

The Fast Jack attachment provides a quick and strong installation solution. The patented design places the bolt directly under the stanchion post where it provides the most support. This feature allows standard roof flashings to lay flat on the roof deck. The removable post allows flashings to be slipped over the base without damaging surrounding composition shingles.

Tile Track



The Tile Trac attachment system is the perfect base for surface mounting on composition roofs. It has over 10 square inches of base to prevent damaging delicate composition shingles and it allows easy positioning of the bolt or all-thread that secures the support rail.

Rail Splices

The splice kit allows multiple lengths of support rail to be secured at time of installation. Handling excessively long pieces of rail can be daunting to the installer and logistically difficult to transport to the job site. The splice kit allows both the freight company and the installation company to transport the rail more easily and economically. The splice kit can be installed to allow for the expansion and contraction of the aluminum channel when installed in longer lengths.

Model	ProSolar support rails and accessories	Weight	Item code	Price
R-136	136" x 1.5" clear-anodized support rail	6	**15.0105**	**$45.00**
R-136D	136" x 2.5" clear-anodized support rail	7	**15.0109**	**$50.00**
A-SPLICE	Rail splice kit with hardware	0.4	**15.0115**	**$5.60**
P-CN-10	Channel nuts – bag of 10; One nut required for each mid clamp and end clamp	0.2	**15.0116**	**$5.60**
A-UAS-24	U-bolt assy for Ground Trac system; stainless steel 1-1/2"x5/16" U-bolt w/ alum. U-bolt lock rail insert	0.3	**15.0171**	**$15.50**
A-TEE	Hollander tee fitting for 1-1/2" schedule 40 pipe	0.5	**15.0175**	**$18.80**
	Module end clamps			
C1810EC-B	Sharp/Mitsubishi/SunPower Module end clamps-black	0.02	**15.0118**	**$3.20**
C1810EC	Sharp/Mitsubishi/SunPower Module end clamps-clear	0.02	**15.0120**	**$3.00**
C1332EC	SolarWorld SW175 mono module end clamps	0.02	**15.0122**	**$3.00**
C1396EC-B	Kyocera module end clamps-black	0.02	**15.0124**	**$3.20**
C1396EC	Kyocera module end clamps-clear	0.02	**15.0126**	**$3.00**
C1348EC-B	GE Energy/Evergreen module end clamps-black	0.02	**15.0128**	**$3.20**
C1358EC	GE Energy/Evergreen module end clamps	0.02	**15.0130**	**$3.00**
C1232EC	UniSolar end clamps	0.02	**15.0132**	**$3.00**
	Module mid clamps			
C1810MC-B	Sharp/Mitsubishi/SunPower module mid-clamps-black	0.02	**15.0136**	**$3.20**
C1810MC	Sharp/Mitsubishi/SunPower module mid-clamps-clear	0.02	**15.0138**	**$3.00**
C1332MC	SolarWorld SW175 mono module mid-clamps	0.02	**15.0140**	**$3.00**
C1396MC-B	Kyocera module mid-clamps-black	0.02	**15.0142**	**$3.20**
C1396MC	Kyocera module mid-clamps-clear	0.02	**15.0144**	**$3.00**
C1348MC-B	GE Energy/Evergreen module mid-clamps-black	0.02	**15.0146**	**$3.20**
C1358MC	GE Energy/Evergreen module mid-clamps	0.02	**15.0148**	**$3.00**
C1232MC	UniSolar mid-clamps	0.02	**15.0150**	**$3.00**
	Fast Jacks			
FJ-300	3" Fast Jack w/ 5/16" x 3-1/2" ss lag bolt; 3/8" x 3/4" ss hex bolt, 3/8" ss washer	0.5	**15.0154**	**$10.50**
FJ-450	4.5" Fast Jack w/ 5/16" x 3-1/2" ss lag bolt; 3/8" x 3/4" ss hex bolt, 3/8" ss washer	0.7	**15.0156**	**$11.50**
FJ-600	6" Fast Jack w/ 5/16" x 3-1/2" ss lag bolt; 3/8" x 3/4" ss hex bolt, 3/8" ss washer	1.1	**15.0158**	**$12.50**
FJ-750	7.5" Fast Jack w/ 5/16" x 3-1/2" SS lag bolt; 3/8" x 3/4" ss hex bolt, 3/8" ss washer	1.2	**15.0160**	**$13.50**
	Tile Tracs			
TT-S	Tile Trac w/short stud – comes with 3/8" x 1-1/2" hex socket stud	0.8	**15.0164**	**$10.00**
TT-T	Tile Trac w/long stud – comes with 3/8" x 6" all thread	1	**15.0166**	**$10.50**

UniRac PV PoleTops

UniRac PV PoleTops pole mounts use SolarMount Light Rails and clips (page 31). The lightweight rails are hollow aluminum extrusions that provide great strength over long spans and help keep shipping costs low. The clips lip into rail slots and quickly align with module mounting holes for fast and easy assembly.

UniRac mounts use a 6-digit part number. The first 4 digits are determined by the series. See description below for each series. See the next page for mounts for specific modules.

Series 5000

- Mounts to 2½-inch schedule 40 or 80 steel mounting pole
- Accommodates arrays up to 16 square feet
- Adjusts from 15 to 60 degrees from horizontal

Series 5001

- Mounts to 3-inch schedule 40 or 80 steel mounting pole
- Accommodates arrays up to 33 square feet
- Adjusts from 0 to 90 degrees from the horizontal

Series 5002

- Mounts to 4-inch schedule 40 or 80 steel mounting pole
- Accommodates array size up to 45 square feet
- Adjusts from 0 to 90 degrees from horizontal

Series 5003

- Mounts to 4-inch schedule 40 or 80 steel mounting pole
- Accommodates array size up to 65 square feet
- Adjusts from 0 to 90 degrees from horizontal

Series 5004

- Mounts to 6-inch schedule 40 or 80 steel mounting pole
- Accommodates array size up to 120 square feet
- Adjusts from 15 to 60 degrees from the horizontal

UniRac Top-of-Pole Mount Sizing

Module	UniRac part #	No. of modules	Pole size (schd 40)	Item code	Price
Evergreen ES170 ES180 ES190	500039	1	2.5	14.2431	$149
	500120	2	3	14.2539	$291
	500230	3	3	14.2621	$463
	500341	4	4	14.2671	$587
AE-50J AE-50ET	500024	1	2.5	14.2405	$132
	500016	2	2.5	14.2417	$158
	500105	3	3	14.2513	$263
	500110	4	3	14.2525	$323
	500351	6	4	14.2682	$493
	500330	8	4	14.2649	$596
AE-80J AE-85ET	500024	1	2.5	14.2405	$132
	500016	2	2.5	14.2417	$158
	500117	3	3	14.2533	$273
	500123	4	3	14.2545	$302
	500350	6	4	14.2681	$516
AE-100J AE-110ET	500037	1	2.5	14.2427	$139
	500117	2	3	14.2533	$273
	500122	3	3	14.2543	$299
	500350	4	4	14.2681	$516
	500349	6	4	14.2680	$605
SolarWorld SW165 mono SW175 mono	500027	1	2.5	14.2409	$140
	500105	2	3	14.2509	$263
	500237	3	4	14.2628	$439
	500348	4	4	14.2675	$557
	501489	6	6	14.2833	$974
Kyocera KC85T	500025	1	2.5	14.2405	$132
	500031	2	2.5	14.2417	$158
	500107	3	3	14.2513	$284
	500113	4	3	14.2525	$323
	500325	6	4	14.2639	$523
	500330	8	4	14.2649	$596
Kyocera KC130T KC130G	500043	1	2.5	14.2439	$137
	500128	2	3	14.2555	$265
	500131	3	3	14.2561	$299
	500228	4	4	14.2617	$468
	501456	6	6	14.3241	$904
	501462	8	6	14.3247	$995
Mitsubishi MF165EB3 MF170EB3 MF175UD4 MF180UD4	500014	1	2.5	14.2389	$151
	500131	2	3	14.2561	$299
	500227	3	4	14.2615	$465
	500341	4	4	14.2671	$587
	500461	6	6	14.2783	$988

UniRac PV PoleSides

UniRac PV PoleSides side mounts uses a 6-digit part number. The first 4 digits are determined by the series. See description below for each series. See the chart below for applications. Mounts for other modules are available. Call for information.

Series 4000

For 2" schedule 40 or 80 steel pole, outside diameter 2.375" (60.3mm)

Series 4001

Includes SolarMount Standard Rails for 2.5" (65mm) schedule 40 or 80 steel pole, outside diameter 2.875" (73.0mm)

Series 4002

Includes SolarMount Standard Rails in three sizes of schedule 40 or 80 steel poles:

2.5" – OD 2.875" (63.5mm)
3" – OD 3.5" (889mm)
4" – OD 4.5" (114.3mm)

Module	UniRac part #	Pole size	No. of modules	Item code	Price
Evergreen ES190	400209	2.5	1	14.2249	$212
	400242	4	2	14.2263	$338
AE10J	400005	2	1	14.2202	$74
	400032	2	2	14.2215	$83
AE-20J	400021	2	1	14.2211	$88
	400107	2.5	2	14.2237	$128
AE-50J AE-50ET	400026	2	1	14.2213	$90
	400211	2.5	2	14.2253	$208
	400218	3	3	14.2281	$308
	400227	4	4	14.2311	$372
	400229	4	5	14.2313	$402
AE-80J AE-85ET	400111	2.5	1	14.2241	$122
	400211	2.5	2	14.2253	$208
	400250	3	3	14.2321	$311
	400227	4	4	14.2311	$372
AE-100J AE-110ET	400204	2.5	1	14.2243	$182
	400215	3	2	14.2277	$314
	400222	4	3	14.2301	$372

Direct Power & Water

PowerFab Side Pole Mounts (SPM)

Direct Power's PowerFab mounts are available in painted steel and mill-finish aluminum versions. Stainless steel module mounting hardware is provided with all mounts. For harsh environments, anodized aluminum mounts are available. Add 30% to the price of the aluminum mounts in the chart below.

Stainless steel band clamps are provided with each mount for attachment to poles. Most models can be attached to flat vertical surfaces using installer-supplied lag bolts or through-bolts.

Most SPM mounts can be shipped by UPS. Mounts with asterisks after their DP&W part number ship by truck freight.

Mounts for other modules are available. Call for information.

Module type	DP&W Pole-Side Mount part number	# of modules	Item code	Price
Evergreen ES180, ES190, ES200	DP-SPM1-ES190-ALUM	1	13.3692	$272
	DP-SPM2-ES190-ALUM	2	13.3693	$450
	DP-SPM3-ES190-ALUM	3	13.3694	$583
Kyocera KC-85	DP-SPM1-KC85-ALUM	1	13.3746	$152
	DP-SPM2-KC85-ALUM	2	13.3748	$294
	DP-SPM3-KC85-STEEL	3	13.3750	$294
Kyocera KC-130	DP-SPM1-KC130-ALUM	1	13.3729	$210
	DP-SPM2-KC130-ALUM	2	13.3731	$320
	DP-SPM3-KC130-STEEL	3	13.3733	$357
Solar-World SW165 SW175	DP-SPM1-SP150-ALUM	1	13.3899	$237
	DP-SPM1-SP150-STEEL	1	13.3900	$237
	DP-SPM2-SP150-ALUM	2	13.3901	$390
	DP-SPM2-SP150-STEEL	2	13.3902	$359
	DP-SPM3-SP150-ALUM	3	13.3903	$499

PowerFab Top Pole Mounts (TPM)

PowerFab TPM standard mounts have heavy steel mounting sleeves, elevation pivots and strongbacks that are painted with durable outdoor paint. The module rails are 6061-T6 mill-finish structural aluminum angle. Stainless steel module mounting hardware is provided. Standard top-of-pole mounts are adjustable from 15 degrees to 65 degrees in 10-degree increments and fit on schedule-40 steel pipe. (A pole size in the table on the following page that shows an "(80)" after its size requires schedule-80 pipe.)

For harsh environments, these mounts are available with hot-dip-galvanized steel and anodized aluminum. Multiply price by 1.8 for this addition. Call for additional pricing for powder-coated mounts and stainless steel hardware.

Mounts for other modules are available. Call for information.

Module Type	DP&W Top Pole Mount part #	No. of modules	Pole size schd 40	Item code	Price
AE50J	DP-TPM1-AE50	1	2	13.4045	$139
	DP-TPM2-AE50	2	2	13.4046	$149
	DP-TPM4-AE50	4	3	13.4048	$310
	DP-TPM6-AE50	6	4	13.4050	$500
	DP-TPM8-AE50	8	4	13.4052	$594
	DP-TPM10-AE50	10	6	13.4054	$915
AE85J	DP-TPM1-AE85	1	2	13.4060	$139
	DP-TPM2-AE85	2	2	13.4061	$149
	DP-TPM4-AE85	4	3	13.4063	$310
	DP-TPM6-AE85	6	4	13.4065	$500
	DP-TPM8-AE85	8	4	13.4066	$594
	DP-TPM10-AE85	10	6	13.4068	$915
AE100J	DP-TPM1-AE100	1	2	13.4076	$150
	DP-TPM2-AE100	2	3	13.4077	$310
	DP-TPM4-AE100	4	4	13.4079	$540
	DP-TPM6-AE100	6	6	13.4081	$845
	DP-TPM8-AE100	8	6	13.4083	$935
	DP-TPM10-AE100	10	6	13.4085	$1157
Evergreen ES170 ES180 ES190 ES200	DP-TPM1-ES180	1	2	13.4428	$160
	DP-TPM2-ES180	2	3	13.4429	$368
	DP-TPM3-ES180	3	4	13.4430	$551
	DP-TPM4-ES180	4	4	13.4431	$663
	DP-TPM6-ES180	6	6	13.4432	$1,090
	DP-TPM8-ES180	8	6	13.4433	$1,430
	DP-TPM9-ES180*	9	8	13.4434	$1,585
	DP-TPM10-ES180*	10	8	13.4435	$2,030
	DP-TPM12-ES180*	12	8(80)	13.4436	$2,220
	DP-TPM14-ES180*	14	8(80)	13.4437	$2,915
Mitsubishi MF175UD4 MF180UD4 MF185UD4	DP-TPM1-MT175	1	2	13.5080	$144
	DP-TPM2-MT175	2	2	13.5081	$310
	DP-TPM3-MT175	3	2.5	13.5082	$473
	DP-TPM4-MT175	4	3	13.5083	$570
	DP-TPM6-MT175	6	4	13.5085	$920
	DP-TPM8-MT175	8	4	13.5086	$1,180
	DP-TPM10-MT175	10	6	13.5087	$1,510
	DP-TPM12-MT175	12	6	13.5088	$1,945
	DP-TPM14-MT175*	14	6	13.5089	$2,145
	DP-TPM16-MT170*	16	6	13.5090	$2,575
Solar-World 165mono 175mono	DP-TPM1-SWD175	1	2	13.4678	$144
	DP-TPM2-SWD175	2	3	13.4679	$310
	DP-TPM4-SWD175	4	4	13.4680	$570
	DP-TPM6-SWD175	6	6	13.4681	$920
	DP-TPM8-SWD175	8	6	13.4682	$1,180
	DP-TPM10-SWD175*	10	8	13.4683	$1,515

Module Type	DP&W Top Pole Mount part #	No. of modules	Pole size schd 40	Item code	Price
Solar-World 165mono 175mono	DP-TPM12-SWD175 *	12	8	13.4684	$1,945
	DP-TPM14-SWD175 *	14	8 (80)	13.4685	$2,145
	DP-TPM16-SWD175 *	16	8 (80)	13.4686	$2,575
	DP-TPM18-SWD175 *	18	8 (80)	13.4687	$2,930
Kyocera KC50T KC65T	DP-TPM1-KC50/60	1	2	13.4509	$139
	DP-TPM2-KC50/60	2	2	13.4511	$155
	DP-TPM4-KC50/60	4	3	13.4513	$318
	DP-TPM6-KC50/60	6	3	13.4515	$430
	DP-TPM8-KC50/60	8	4	13.4517	$597
	DP-TPM10-KC50/60	10	4	13.4519	$868
	DP-TPM12-KC50/60	12	6	13.4520	$960
Kyocera KC/85T	DP-TPM1-KC70/80	1	2	13.4521	$145
	DP-TPM2-KC70/80	2	2	13.4523	$170
	DP-TPM3-KC70/80	3	2.5	13.4524	$300
	DP-TPM4-KC70/80	4	3	13.4525	$328
	DP-TPM6-KC70/80	6	4	13.4527	$550
	DP-TPM8-KC70/80	8	4	13.4529	$628
	DP-TPM10-KC70/80	10	6	13.4531	$966
	DP-TPM12-KC70/80	12	6	13.4533	$1,083
	DP-TPM14-KC70/80*	14	6	13.4534	$1,195
	DP-TPM16-KC70/80*	16	6	13.4535	$1,390
Kyocera KC130TM KC130GT	DP-TPM1-KC120	1	2	13.4481	$139
	DP-TPM2-KC120	2	2.5	13.4483	$265
	DP-TPM3-KC120	3	3	13.4484	$326
	DP-TPM4-KC120	4	4	13.4485	$492
	DP-TPM6-KC120	6	4	13.4487	$637
	DP-TPM8-KC120	8	6	13.4489	$893
	DP-TPM10-KC120	10	6	13.4491	$1,085
	DP-TPM12-KC120	12	6	13.4493	$1,190
	DP-TPM14-KC120 *	14	8	13.4494	$1,470
	DP-TPM16-KC120 *	16	8	13.4490	$1,910
	DP-TPM18-KC120 *	18	8 (80)	13.4488	$2,080
Kyocera KC167GT KC175GT	DP-TPM1-KC167	1	2	13.4539	$150
	DP-TPM2-KC167	2	3	13.4540	$330
	DP-TPM3-KC167	3	4	13.4541	$497
	DP-TPM4-KC167	4	4	13.4542	$603
	DP-TPM6-KC167	6	6	13.4543	$965
	DP-TPM8-KC167	8	6	13.4544	$1,243
	DP-TPM10-KC167	10	6	13.4545	$1,585
	DP-TPM12-KC167	12	8	13.4546	$2,055
	DP-TPM14-KC167 *	14	8 (80)	13.4547	$2,255
	DP-TPM16-KC167 *	16	8 (80)	13.4548	$2,700
	DP-TPM18-KC167 *	18	8 (80)	13.4549	$3,075

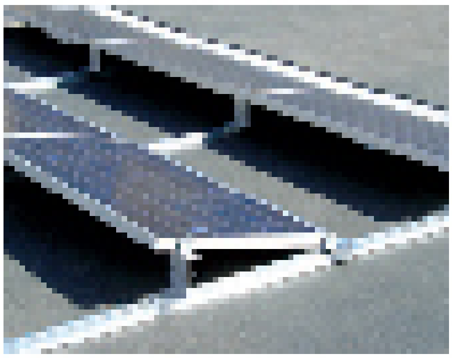
* Must be shipped by truck freight. All other mounts ship by UPS.

DIRECT POWER & WATER CORPORATION

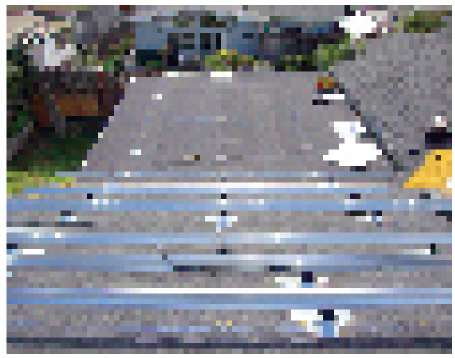
a division of PLP SOLAR

Ballasted Roof Mounts

Power Tube CS™



Power Rail™



Direct Power & Water Corp. has been manufacturing module mounting structures since 1992. We have many options available to meet your application requirements.

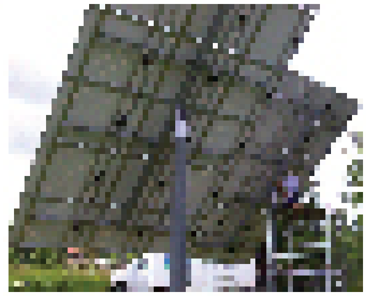
Roof/Ground Mounts

www.power-fab.com

(800) 260-3792

POWER-FAB

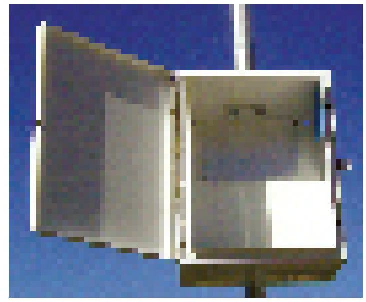
Albuquerque, NM

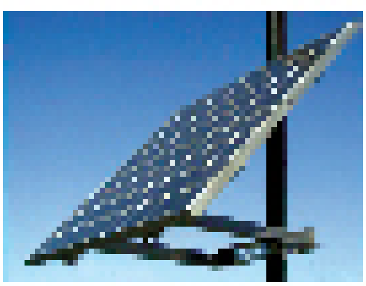


Top-of-Pole Mounts

POWER-FAB ™ products have been designed with the installer in mind. Our products are attractive, rugged, and easy to assemble.

- Ballasted Roof Mounts (BRM): No penetrations, tilt angles up to 45°, EPDM rubber on bottom surfaces to protect roof.
- Power Tube CRS™: Ballasted system for large flat roofs. 5° or 10° tilt angle, no penetrations, less than 5 lbs/sqft.
- Roof/Ground Mounts (RGM): Include Three-styles Standard, Low-Profile, Two-Tier. All styles are strong 6061-T6 aluminum construction and available with telescoping or one-piece legs.
- Power Rail™ System (PRS): are a strong, easy-to-use, top-clamping racking system for portrait-or-roof mounts. 6061-T6 aluminum extrusion, rail and module clamps, spans up to 84".
- Power Box™ enclosures include battery boxes, battery cabinets and combination battery/equipment enclosures for indoor and outdoor applications.
- Side-of-Pole Mounts (SPM): Several styles available for attaching to the side of a pole or frame. Models for one to six modules.
- Top-of-Pole Mounts (TPM): Sizes available up to 18 modules (2kW-3kW), strong and easy to assemble, heavy-duty steel mounting sleeve with fully welded caps, easy seasonal adjustment.





Side-of-Pole Mounts

Power Box ™

PowerFab Two-Tier Ground Mounts

Direct Power's Two-Tier Ground Mounts are made from 6061-T6 structural aluminum extrusions with a mill finish. Modules are racked in two rows with module length vertical. Models are available to hold from 4 to 10 modules (depending on module width). The two-tier mount is a cost-effective way to create large ground mounted arrays. Multiple two-tier mounts may be installed next to each other in an east-west direction. These mounts may also be used as roof mounts. The mounts listed have adjustable back legs. Mounts for other brands and sizes of modules and mounts with fixed back legs are available. Please contact us for information and pricing on mounts for other brands and sizes of module.

Module Type	DP&W Adjustable Legs Two-Tier Mount	No. of modules	Item code	Price
Evergreen EC180 EC190	DP-TTRGM4-ES180	4	13.8384	$725
	DP-TTRGM6-ES180	6	13.8386	$826
	DP-TTRGM8-ES180 *	8	13.8388	$956
AE-80J	DP-TTRGM6-AE85	6	13.8732	$453
	DP-TTRGM8-AE85	8	13.8734	$485
	DP-TTRGM10-AE85	10	13.8736	$521
AE-100J	DP-TTRGM6-AE100	6	13.8743	$516
	DP-TTRGM8-AE100	8	13.8745	$600
Solar-World 165 mono 175 mono	DP-TTRGM6-SWD175 *	6	13.8639	$675
	DP-TTRGM8-SWD175 *	8	13.8641	$786
	DP-TTRGM10-SWD175*	10	13.8643	$924
Mitsubishi MT175 MT180	DP-TTRGM4-MT180 *	4	13.8441	$557
	DP-TTRGM6-MT180 *	6	13.8443	$625
	DP-TTRGM8-MT180 *	8	13.8445	$728
	DP-TTRGM10-MT180 *	10	13.8447	$840
Kyocera KC85	DP-TTRGM6-KC85	6	13.8425	$423
	DP-TTRGM8-KC85	8	13.8427	$449
	DP-TTRGM10-KC85	10	13.8428	$482
Kyocera KC130	DP-TTRGM6-KC130	6	13.8417	$482
	DP-TTRGM8-KC130	8	13.8419	$556

** Ships by truck freight. Others ship via UPS.*

Two Seas

Small Module Side-of-Pole Mount

These low-cost, universal side-of-pole mounts are available in two sizes to hold a single small module 10.75" to 21.5" in width. Their unique module clamp-and-slot combination eliminates the need for bolt holes in the module by clamping to the inside of the module frame. Two sizes fit most small modules.

Module Fit Chart	
Model	**Fit one of the following modules**
UNI-SA/13.0	AE-10G, AE-5G, AE-5G/6, AE-10ET
	AE-20J, AE-10J, AE-5J, GSE 6
UNI-SA/21.5	AE-37G, AE-20G, GSE 12, AE-30ET

Model	Maximum module width	Inside frame dimension	Item code	Price
UNI-SA/13.0	13.0	5.26" to 11.60"	**14.6011**	**$57**
UNI-SA/21.5	21.5	12.66" to 20.10"	**14.6013**	**$65**

Zomeworks Universal Track Rack

Passive Solar Tracker for PV Modules

The Zomeworks passive Track Rack uses no motors, no gears and no controls that can fail. The sun's heat moves liquid from side to side, allowing gravity to turn the Track Rack and follow the sun.

The Zomeworks Universal Track Rack System allows for almost limitless adjustment in both the east-west and north-south directions. Available in five standard sizes for holding 2 to 32 modules, Universal Track Racks are designed to fit all common photovoltaic modules. This flexibility translates to faster delivery, better quality and overall economy. The F-Series Track Racks ship partially assembled for easy installation. The new UTRF168HD comes with heavy duty rails. Both UTRF168 trackers come with a high wind kit. All of these mounts come with stainless steel and zinc-plated hardware and have a 10-year standard warranty.

Please specify how many of which brand of module are to be placed on the tracker. The tracker will be customized with the correct amount of hardware, and in some cases the rail length will be adjusted for better fit. Module quantities followed by an asterisk (*) require one additional rail set at an extra charge, specified in the bottom row of table below. If the quantity is followed by double asterisks (**), order two additional rail sets.

Zomeworks model	UTR020	UTRK040	UTRF64	UTRF90	UTRF120	UTRF168	UTRF168HD
Item code	14.9020	14.9043	14.9064	14.9090	14.9120	14.9128	14.9129
Price	$606	$1177	$1,632	$1,846	$2,085	$3,091	$3,583
Pole size schd 40 steel	2.5"	3"	6"	6"	6"	8"	8"
Min. pole height	76"	84"	96"	108"	120"	144"	144"
Min. pole depth	38"	42"	48"	54"	60"	72"	72"
Shipping weight	101 lbs	170 lbs	400 lbs	490 lbs	525 lbs	650 lbs	680 lbs
Module type	**Number of modules that fit each Zomeworks model (top row)**						
Evergreen							
EC180, 190, 200	1	2 - 3	3 - 4	5	6	8 - 9	10
Kyocera							
KC-80, 85T	1 - 2	3 - 4	6 - 8	10 - 12	14* - 16*	18* - 20** - 22** - 24**	18* - 20** - 22** - 24**
KC-120, 125, 130	1-2	3 - 4	6*	8	10 -12	14* -16*	14* -16*
KC-167G, 170, 175	1	2	4	6	8	N/A	10* - 12*
SolarWorld							
SW80, SW85	1 - 2	3 - 4 - 5	6 - 8	10 - 12	14 - 16	18* - 20* -22* - 24*	18* - 20* -22* - 24*
SW165 mono, SW175 mono	1	2	3 - 4	6*	8*	10	10 - 12
Sharp							
NE165, NE170, NT175	1	2	3 -4	6	8	10	10 - 12
ND200, ND208	1	2	3	4	6*	8	8
Mitsubishi							
MF110EC3, MF120EC3	1 - 2	3 - 4	6*	8	10 - 12	14 - 16*	14 - 16*
MF175UD4. MF180UD4	1	2 - 3	4	6	8	10	10 -12
AEE Solar							
AE-85J	1 - 2	3 - 4 - 5	6 - 8	10 - 12	14 - 16	18* - 20* -22* - 24*	18* - 20* -22* - 24*
AE-100J	1 - 2	3 - 4	N/A	6 - 8	10	12 - 14 - 16*	12 - 14 - 16*

Description	Item code	Price
** Additional rail for mounts with a quantity followed by an asterisk in chart (order two for quantities followed by two asterisks):*	14.9155	$248

Wattsun Active Trackers

Wattsun Active Trackers track the sun from east to west using electronic sensors and motor or actuator drives. During partly cloudy conditions, the tracker fixes on the brightest area of the sky, capturing the maximum amount of sunlight available. At night it returns to the morning sunrise position, ready to start tracking when the sun rises again. Tracking can increase a PV array's power production from 10 to 50 percent depending on the season and location. They are particularly effective when greater power is required in the summer months, such as when a large amount of water pumping is needed. Wattsun trackers deliver a significant increase in the amount of water pumped and provide a more constant water flow during the day. The gallons-per-day increase is greatest in the summer when water is needed the most. They may also be cost effective for net-metered utility grid-tie systems that can produce large amounts of electricity in the summer, to be used as credit toward a high winter power bill.

Azimuth trackers automatically track the sun's path by rotating the PV array around the pipe, providing greater stability for larger arrays. The corners do not protrude down towards the ground or stick up in the air to catch the wind. The bottom edge of the array always remains parallel to the ground and requires less ground clearance than tilt & roll tracker'. Wattsun's azimuth trackers provide nearly 270 degrees of rotational movement and can adjust from 5 to 75 degrees of elevation tilt.

Wattsun AZ-125 Trackers

The AZ-125 gear-drive, azimuth tracker comes standard as a single-axis tracker with manual seasonal tilt adjustment. It is powered by a 24 VDC drive motor running a high quality worm and gear drive. With the addition of the dual-axis option (order separately), the AZ-125 can capture virtually all the available power the sun delivers.

Wattsun AZ-225 Trackers

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

If your system voltage is not 24 VDC, you will need a Wattsun voltage converter. See option chart below.

Wattsun model	Description	Item code	Price
12-24 15W for 12V battery	Required for 12 VDC AZ-125 Trackers.	14.7118	$125
48-24 LVC	Steps down 48V from battery or 36V from array to 24 VDC for controller on AZ-125 Tracker.	14.7116	$58
PPT-48-5r24	Steps down 48V from battery to 24V for controller. One required per two AZ-125 or one AZ-225.	14.7117	$219
PPT-48-10R24	Steps down 48V from battery to 24V. Will power four AZ-125 Trackers or three AZ-225 Trackers	14.7119	$295
DR-4524 for pumping	Accepts 120-370 VDC input to power tracker controller from a high voltage water pumping array. Needs to be mounted in a raintight box if located outside. Also accepts 115 or 230 volt AC for one AZ-125 Tracker.	14.7110	$165
IDEC PS5R-SF24	Accepts 115 or 230 VAC input to power tracker controller from the AC Grid when no backup battery bank is present. One required per two AZ-125 trackers or one AZ-225 Tracker. Needs to be mounted in a raintight box if located outside.	14.7115	$165
Dual-axis option	Add automatic elevation tracking to the AZ-125 Tracker. The DA Option is included in the Price of the AZ-225 Trackers	14.7018	$395
Manual controls	Exterior switches on the controller cover plate. Allows for the owner to turn off automatic tracking and then rotate the tracker east or west and/or up and down. Useful for dumping snow or to lay the tracker flat in extremely high winds.	14.7030	$125
Manual control kit	Field upgrade kit for Version 3 controllers. V3 controllers are "two piece" style and the sensor is independent of the main control box. Should be installed by an electrician or other certified personnel.	14.7032	$150

Module	Module quantity	Wattsun drive	Dual axis	Steel pipe ID	Item code	Price
AE-85J	12	AZ-125	optional	6"	14.8139	$2,295
	16	AZ-125	optional	6"	14.8140	$2,495
	18	AZ-125	optional	6"	14.8141	$2,895
	24	AZ-225	included	8"	14.8143	$4,695
	28	AZ-225	included	8"	14.8144	$5,495
AE-100J	6	AZ-125	optional	6"	14.8147	$2,295
	8	AZ-125	optional	6"	14.8149	$2,295
	10	AZ-125	optional	6"	14.8151	$2,495
	20	AZ-225	included	Call	14.8155	$5,495
ES 180	6	AZ-125	optional	6"	14.7356	$2,495
	9	AZ-225	included	6"	14.7357	$4,695
	12	AZ-225	included	8"	14.7358	$5,495
GE Energy 110	6	AZ-125	optional	6"	14.7147	$2,295
	8	AZ-125	optional	6"	14.7149	$2,295
	10	AZ-125	optional	6"	14.7151	$2,495
	20	AZ-225	included	Call	14.7155	$5,495
Mitsubishi 180	6	AZ-125	optional	6"	14.8087	$2,295
	8	AZ-125	optional	6"	14.8088	$2,495
	9	AZ-125	optional	6"	14.8089	$2,895
	12	AZ-225	included	Call	14.8090	$4,695
	16	AZ-225	included	Call	14.8091	$5,495
Kyocera 175	6	AZ-125	optional	6"	14.7403	$2,295
	9	AZ-225	optional	6"	14.7406	$2,895
	12	AZ-225	included	8"	14.7407	$4,695
	16	AZ-225	included	8	14.7408	$5,495

Module	Module quantity	Wattsun drive	Dual axis	Steel pipe ID	Item code	Price
Kyocera KC85T	8	AZ-125	optional	6"	14.7431	$2,295
	12	AZ-125	optional	6"	14.7433	$2,295
	16	AZ-125	optional	6"	14.7435	$2,895
	24	AZ-225	included	8"	14.7436	$4,695
Kyocera KC130	6	AZ-125	optional	6"	14.7391	$2,295
	8	AZ-125	optional	6"	14.7393	$2,295
	10	AZ-125	optional	6"	14.7395	$2,495
	12	AZ-125	optional	6"	14.7397	$2,895
	15	AZ-225	included	8"	14.7394	$4,695
	16	AZ-225	included	8"	14.7396	$4,695
	20	AZ-225	included	8"	14.7398	$5,495
Sharp 185	6	AZ-125	optional	6"	14.7653	$2,295
	8	AZ-125	optional	6"	14.7655	$2,895
	9	AZ-125	optional	6"	14.7656	$2,895
	12	AZ-225	included	8"	14.7657	$4,695
	16	AZ-225	included	Call	14.7658	$5,495
SolarWorld SW175 mono	6	AZ-125	optional	6"	14.7754	$2,295
	8	AZ-125	optional	6"	14.7756	$2,495
	12	AZ-225	included	8"	14.7758	$4,695
	16	AZ-225	included	10" *	14.7760	$5,495
SunPower 210	6	AZ-125	optional	6"	14.7845	$2,295
	8	AZ-125	optional	6"	14.7846	$2,495
	12	AZ-225	included	8"	14.7847	$4,695
	16	AZ-225	included	10" *	14.7848	$5,495

NEW! SunTracer Tracking Module Mount and Charge Controller

The SunTracer can track 1 or 2 modules and is ideal for small power systems, RVs and water pumping systems. It uses timer-activated gear motors to position the modules toward the sun on a pole mount. It features a 30-amp charge controller for 12- or 24-volt systems, built-in backup battery for the timer, adjustable charge voltage, and 100 degree motor rotation. The mounting clamp can be bolted to any pole up to 1-1/2" schedule 40 pipe.

Installation is simple with universal module mounting clamps that only require a screw driver and a u-bolt mounted to a pole that only requires one wrench. To set the tracking direction, you just point the array at the sun and push 2 buttons. SunTracer is available in four models for use with up to 2 square meters of modules. Maximum module size is determined by rail length. A 31.5" rail can hold a single module up to 130 watts. The 43" rail can hold two typical 75- to 85-watt modules or a single module up to 175 watts.

Water pumping version has an internal rechargeable battery to return tracker to morning position at the end of each day. This is the perfect tracker for a SHURflo or SunPump running on 1 or 2 modules. See rail width in chart below to see if it will fit the module width you are planing to use.

Model	Description	Mounting rail width	Warranty	Weight (lbs)	Item code	Price
SunTracer	Tracker with 30A charge controller for one module	31.5"	10 Years	13.2	14.8500	$340
SunTracer+	Tracker with 30A charge controller for up to 2 modules	43"	10 Years	18	14.8501	$380
SunTracer – Camper	Same as SunTracer, but mount folds flat for travel	31.5"	2 Years	14	14.8502	$260
SunTracer – Pumping	Same as SunTracer+, but for use in batteryless systems.	43"	10 Years	19	14.8505	$390

Please call with any questions! Our contact information is on the cover.


Now appearing in backyards everywhere.
Small wind has never been so easy. Announcing the Skystream 3.7™ residential power appliance. It's the first compact, utility-connected, all-inclusive wind generator designed to provide inexpensive, quiet, clean electricity to reduce or eliminate your home's monthly energy bill. Learn if Skystream can work for you at www.skystreamenergy.com.
SKYSTREAM 3.7™
THE POWER TO CHOOSE.
www.skystreamenergy.com

"Do I have a good site for wind power?"

Wind-powered battery-charging systems can be cost-effective if the average wind speed is nine miles per hour or more at the location of the wind generator. If you are using wind in combination with photovoltaic power, it may be cost-effective if good wind is available only during part of the year. When the wind speed doubles, the power delivered is eight times as great. Most wind generators are designed to deliver maximum power at a wind speed of 30 mph. At 15 mph, they will deliver about 1/8 their rated power. A wind generator should be mounted at least 20 feet higher than any obstruction within 300 feet to avoid turbulence. The power output of a wind generator will decrease roughly 3% for every 1000 feet of elevation.

Measuring Wind Speed

You can use the Kestrel wind speed indicator to the right to determine wind speed. It works like a speedometer, displaying current wind speed, but does not record available wind power over time.

If you measure wind speed at ground level, you can expect about 1.5 times the wind speed 30 feet up, which equates to about three times the power. At 120 feet above the ground, wind speed will be twice what is measured at ground level and power output will be more than twice the output at 30 feet. If you do not have a wind gauge, you can get a rough idea of wind speed from the table below.

Wind speed (mph)	Wind effect
0-1	Smoke rises vertically
2-3	Direction of wind shown by smoke drift but not by wind vanes.
4-7	Wind felt on face; leaves rustle; ordinary wind vane moves
8-12	Leaves and twigs in constant motion; wind extends a light flag
13-18	Raises dust, loose paper; small branches are moved
19-24	Trees in leaf begin to sway; crested wavelets form on water
25-31	Large branches in motion; whistling heard in power lines

Towers

We do not recommend mounting wind generators on roofs. Though it is possible with a wind generator of 500 watts or less output, it will be noisy. Freestanding towers, guyed towers or guyed poles may be used with wind generators.

Wind generators can be mounted on freestanding towers designed for antennas. They require a large, engineered concrete base for support, but since they do not require guy wires, they can be installed in a smaller space. Guyed steel truss towers, also designed for antenna mounting, are less costly and require a large area for guy wire placement.

A tilt-up pole tower is the most economical and the easiest to install. Wiring and mounting of the wind generator are done before the tower is erected. No climbing is necessary. Steel tubing can be purchased locally to save freight.

Kestrel 1000 Pocket Wind Meter

The Kestrel 1000 measures instantaneous, maximum and average wind speeds. Measurement unit options are knots, meters per second, kilometers per hour, miles per hour, feet per minute and Beaufort. Just hold it up to measure wind speed. Large, easy-to-read liquid crystal display with +/-3% accuracy. Measure down to 0.3 m/s.

Impeller and protective housing pop out for easy and inexpensive replacement. Includes slip-on hard case that protects the impeller, buttons and display from damage in your pocket or toolbox. It is waterproof and it floats. The replaceable battery provides 400 hours of use. One-year warranty.

Description	Item code	Price
Kestral 1000 Pocket Wind Meter	16.0253	**$85**
Kestral 1000 replacement impellor	16.0255	**$19**

Southwest Windpower

AIR-X Land Wind Generators

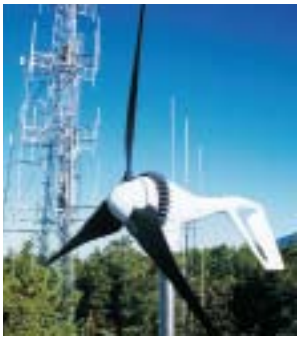
The AIR-X has a peak output of 400 watts at 28 mph (12.5 m/s) wind speed and is suitable for locations where wind speeds reach up to 100 mph. Carbon reinforced blades and a microprocessor-based speed control result in quieter operation and improved battery charging. The housing is unpainted aluminum and the weight is 17 pounds. 3-year warranty.

AIR-X Marine Wind Generators

The AIR-X Marine is a corrosion-proofed version of the AIR-X Land designed for coastal and nautical applications. A white powder-coated housing and sealed electronics prevent damage from salt spray. Weight is 17 pounds. 3-year warranty.

Description	Item code	Price
AIR-X 12V Land	16.1032	$725
AIR-X 24V Land	16.1035	$725
AIR-X 48V Land	16.1037	$725
AIR-X 12V Marine	16.1050	$915
AIR-X 24V Marine	16.1053	$915
AIR-X 48V Marine	16.1055	$915
Stop switch	16.1351	$29

AIR-Industrial Wind Generators



The Air-Industrial is capable of resisting the harsh environments that generally accompany mountaintop telecommunication sites, environmental monitoring sites and off-shore oil platforms. It has specially formulated blade material that can stand up to sub-zero temperatures, and its blades are spaced farther from the tower so that it can operate at sustained winds up to 130 miles per hour. Maintenance-free performance, easy installation and high power output make AIR-Industrial ideal for any remote battery charging application. The AIR-Industrial does not have an internal controller, so an external controller must be installed on the battery bank. The recommended external controllers are Morningstar TriStar TS-45 or TS-60, or a Xantrex C40. Set inverter in "diversion load" configuration and add an air- or water-heating diversion load (see page 73). 3-year warranty.

Description	Item code	Price
AIR403 12V Industrial w/o controller	16.1056	$935
AIR403 24V Industrial w/o controller	16.1062	$935
AIR403 48V Industrial w/o controller	16.1074	$935

AIR Tower Kits

AIR tower kits are available in roof mount, 27' (8.1m) and 45' (13.5m) heights. These kits are Professional Engineer Certified (PE Certified). Each tower kit comes with all hardware necessary to install a tower, except guy supports, pipe and cement. All parts bolt or clamp together and no welding is required. Purchase 1-7/8" steel tubing from chain link fence supplier. Roof mounts include vibration isolators, wall brace clamps and a safety leash, but do not include pole or lag screws.

Earth Auger Sets

Screw-in "auger" type guy anchors can be used in loamy and gravelly soils. Other soil types may require concrete footings or expansion bolts. Consult an engineer or geologist if you have questions about guy supports.

AIR Shutoff/Circuit Breaker

This interlocked pair of 60-amp circuit breakers protects wind-generator-to-battery wiring and allows you to disconnect and stop the wind generator for service. UL Listed breakers and NEMA 1 enclosure. For indoor mounting only. Can be used with all AIR-X wind generators.

Description	Item code	Price
AIR Marine tower hardware kit	16.1128	$180
9' AIR Marine aluminum mast and 2 stays	16.1131	$192
Roof kit without roof seal	16.1134	$91
Roof kit with roof seal	16.1137	$106
Roof seal – for roof mount kit	16.1140	$52
27' AIR guyed tower kit (AIR only)	16.1086	$149
45' AIR guyed tower kit (AIR only)	16.1092	$269
36" Auger – set of 4; use with 24' & 27' towers	16.1113	$103
36 Galvanized auger set of 4; for 24' & 27' towers	16.1116	$146
48 Auger set of 4 32' - 50' towers	16.1119	$112
48 Galvanized auger set of 4 32'-50' towers	16.1122	$172
AIR Shutoff/circuit breaker	16.9003	$120
30 amp circuit breaker	16.1225	$25
Amp meter	16.1223	$30

The Whisper 100 and 200 from Southwest Windpower are shipped in a 24-volt configuration, but can easily be changed to 12, 36, or 48 volts by the installer. The included controller is adjustable for use with 12-, 24-, 36- and 48-volt battery systems and the voltage can be adjusted for any battery type. The control can be set to stop the blade from spinning when the battery is fully charged, avoiding wear when power is not needed. The control has a "selectable silent mode" setting that allows the user to select any specific period to automatically turn the wind turbine on or off.

An optional digital display may be added to the control to display total kilowatt hours, peak amps, and peak and average wind speed. To measure wind speed, the optional wind speed sensor must be ordered.

All Whisper generators have a 5-year warranty.

Whisper 100 Wind Generator

The Whisper 100 is designed to operate in a site with wind speed averages of 12 mph and greater. It delivers 900 watts peak power at 28 mph (12.5 m/s). It can provide 100+ kWh per month, 3.4 kWh per day, in a 12 mph average wind speed location. The 100, with its 7 ft. (2.1 m) rotor diameter and 40 sq. ft. swept area, is rugged enough for extreme environments. The 3-blade design lasts longer and is more stable in turbulent wind. The Marine version is sealed and powder-coated for use in coastal and nautical environments.

Whisper 200 Wind Generator

The Whisper 200 is designed for the user who lives in low to moderate wind speed averages (less than 12 mph). The bigger brother to the 100, the 200 features a 10 ft (3.1 m) 3-blade rotor diameter and an 80 sq. ft. swept area that provides the user with greater output at low wind speed averages. The 200 has twice the swept blade area, providing double the potential energy, compared to the 100. It delivers 1000 watts peak power at 28 mph (12.5 m/s), but has a higher output than the 100 at lower wind speeds.

Whisper 500 Wind Generator

The Whisper 500 is a 3000-watt rated turbine that will deliver in excess of 500 kWh per month in a 12 mph wind. This machine has a 14-foot, 2 blade rotor providing 500 sq. ft. of swept area. It features a handmade fiberglass and foam core blade for smooth, high efficiency operation and low wind start-up. It also incorporates the patented "angle governor" design for quiet operation in high winds. The 500 is an excellent machine for village power projects, farms, ranches, backup power and remote homes with large energy demands. The Whisper 500 comes in two boxes and is shipped truck freight.

The Whisper 500 is available in 24-volt and 48-volt versions.

Description	Weight	Item code	Price
Whisper 100 w/ charge controller	73 lbs	**16.1154**	**$2,475**
Whisper 100 Marine w/ charge controller	80 lbs	**16.1162**	**$2,725**
Whisper 200 w/charge controller	85 lbs	**16.1180**	**$2,995**
Whisper 200 Marine w/ charge controller	90 lbs	**16.1189**	**$3,275**
Charge controller display for 100/200	1 lb	**16.1211**	**$109**
Whisper 500 w/ charge controller 24V	310 lbs	**16.1144**	**$7,675**
Whisper 500 w/ charge controller 48V	310 lbs	**16.1145**	**$7,675**

Whisper 100/200 Tower Kits

Whisper 100/200 tower kits come in 24' (7.2m), 30' (9m), 50' (15m), 65' (19.5m), and 80' (24m) heights. Each tower kit comes with all hardware necessary to install a tower, except guy supports, pipe and cement. All parts bolt or clamp together and no welding is required. These tower kits use 2-1/2" (63.5mm) CQ40 fence pipe or schedule 40 water pipe. Actual O.D. is 2.875" (73mm)

Whisper 500 Tower Kits

Whisper 500 Tower Kits are available in 30' (9.1m), 42' (12.8m) and 70' (21.3m) heights.

Earth Auger Sets

Screw-in auger-type guy anchors can be used in loamy and gravelly soils. Other soil types may require concrete footings or expansion bolts. Use 36" and 48" augers with Whisper 100/200 installations and 48" and 60" augers on Whisper 500 installations. Consult an engineer or geologist if you have questions about guy supports.

Description	Item code	Price
Whisper 100 & 200 24' guyed tower kit	**16.1083**	**$280**
Whisper 100 & 200 30' guyed tower kit	**16.1089**	**$450**
Whisper 100 & 200 50' guyed tower kit	**16.1095**	**$625**
Whisper 100 & 200 65' guyed tower kit	**16.1098**	**$825**
Whisper 100 & 200 80' guyed tower kit	**16.1101**	**$975**
Whisper 500 30' guyed tower kit	**16.1110**	**$895**
Whisper 500 42' guyed tower kit	**16.1104**	**$975**
Whisper 500 70' guyed tower kit	**16.1107**	**$1,375**
36 Galvanized auger set of 4 - 24' 27' towers	**16.1116**	**$146**
48 Galvanized auger set of 4 - 32'-50' towers	**16.1122**	**$172**
60 Galvanized auger set of 4 - 65'-80' towers	**16.1125**	**$215**
Whisper 100/200 60 amp brake switch	**16.1202**	**$75**

NEW! Skystream 3.7

The Skystream 3.7 is a new generation residential wind generator that hooks up to your home to reduce or eliminate your monthly electrical bill. It's the first all-inclusive UL Listed wind generator (with controls and inverter built in) designed to provide quiet, clean electricity in very low winds. The Skystream is ideal for residential homes and small businesses.

Skystream connects directly to your home. When the wind is blowing, your home is powered (in part) by Skystream; when it's not, your home is seamlessly powered by your utility, as usual. During periods of strong winds, Skystream can actually produce excess electricity. Depending on your utility, your meter will spin backwards – giving you credit for a later date. Estimated energy production is 400 kWh per month in a 12 mph wind.

If your site fits the following criteria, Southwest Windpower's Skystream 3.7 may work for you:

- At least 10 mph average wind speed (best results at 12 mph or more)
- Your property is at least a half acre and has unobstructed views
- The local zoning allows a structure that is at least 42' tall
- Your utility has an existing interconnection agreement for homeowners

With a rated capacity of 1.8 kW, Skystream can provide anywhere from 40 to 100 percent of the total energy needs a of a household or small business. Its sleek, distinctive 12-foot diameter swept-wing blades and elegant form make Skystream an attractive addition to any home. With a guyless tower, Skystream blends in like a neighborhood street lamp. And because it operates at a low rpm, Skystream is as quiet as the trees blowing in the wind.

Skystream can be used in off-grid battery charging applications that include a bi-directional inverter such as a Xantrex SW or SW Plus or OutBack FX or VFX inverter. The Skystream is connected to a breaker in the load center powered by the inverter. For this type of installation, the wireless remote battery sensor must be installed to stop the Skystream when the batteries are fully charged.

An optional two-way remote display unit lets you control your Skystream from up to 1000 feet (300 meters) away. You can also monitor performance and download energy performance data to your personal computer via USB converter.

5-year limited warranty.

Model	Description	Item code	Price
Skystream 3.7 120V Land	Skystream 1.8 kW generator for 120V 60 Hz	**16.1003-120**	**$5,400**
Skystream 3.7 208V Land	Skystream 1.8 kW generator for 208V 60 Hz	**16.1003-208**	**$5,400**
Skystream 3.7 240V Land	Skystream 1.8 kW generator for 240V 60 Hz	**16.1003-240**	**$5,400**
Skystream 3.7 120V Marine	Skystream 1.8 kW marine generator for 120V 60 Hz	**16.1005-120**	**$6,100**
Skystream 3.7 208V Marine	Skystream 1.8 kW marine generator for 208V 60 Hz	**16.1005-208**	**$6,100**
Skystream 3.7 240V Marine	Skystream 1.8 kW marine generator for 240V 60 Hz	**16.1005-240**	**$6,100**
Skystream 60 FT monopole tower	60-foot 2-piece free-standing tower (no guy wires); price includes shipping*	**16.1006**	**$8,320**
Skystream 45 FT monopole tower	45 foot tower free-standing tower (no guy wires); price includes shipping*	**16.1007**	**$3,848**
Skystream 33.5 FT monopole tower	33.5 foot tower free-standing tower (no guy wires); price includes shipping*	**16.1008**	**$2,644**
Foundation bolt kit 32"	Includes bolts and bolt template for 33-ft monopole tower on mat foundation	**16.1010**	**$358**
Foundation bolt kit 42"	Includes bolts and bolt template for 33-ft, 45-ft and 60-ft tower on pier foundation	**16.1009**	**$441**
Gin pole kit	Includes gin pole, shackles and wire	**16.1011**	**$364**
Hinge plate kit	Includes hinge plate and hardware	**16.1012**	**$322**
Wireless remote display kit 916 MHz	Includes wireless display, antenna and AC adaptor	**16.1015**	**$280**
USB converter kit	Includes remote to USB adaptor and software	**16.1016**	**$84**
Tower adaptor kit (5")	Includes aluminum casting and hardware to attach Skystream to Whisper 500 guyed tower kits or any 5" schedule 40 pipe	**16.1017**	**$118**
Wireless remote batt. sensor 916 MHz	Includes battery voltage sensor and antenna (required for all battery charging)	**16.1018**	**$210**

*Tower price includes freight and delivery charges in USA, except Alaska and Hawaii. Customer responsible for unloading the tower from the truck.

Prices subject to change without notice.

How much power can you generate with a hydroelectric turbine?

The amount of power available depends on the dynamic head, the amount of water flow and the efficiency of the turbine generator combination. To get an idea about available power in watts, multiply the head in feet, times flow in gallons per minute, times 0.18, times turbine efficiency. Turbine efficiency ranges from 25% to 50%, with higher efficiency at higher heads. To get a rough idea, use 0.30 (representing 30%) as a multiplier for efficiency. The Harris Pelton turbines are well suited to higher head and lower flow situations. Flow is limited by nozzle size (a maximum 1/2"). With the Harris, adjustment to variable flows is as easy as switching a valve and dialing in the alternator. Harris turbines are now available with permanent magnet (PM) alternators. This option provides up to 50% efficiency. Higher flows are accommodated by the ESD Turgo Turbines. They can have nozzles of up to 1" diameter, and provide better efficiency at low heads. The HI-Power Hydros are ideal for sites where water is available at long distances from power needs. They generate 100+ volts AC that is stepped down and rectified at the batteries. This allows the use of relatively small wire for a distance of up to 10,000 feet. Transmitting the power from the generator to the battery at twice the battery voltage allows you to use 1/4 of the wire size for the same power loss. At 4 times the battery voltage, you can use 1/16 of the wire size required to transmit power at the battery voltage. The HI-Power hydroelectric generator can also deliver up to 3600 watts where higher power is needed. The LV Hydroelectric Generator and the ES&D Water Baby are a good solution for very low flow situations where the head is high enough to make some power.

Pipelines

A hydroelectric turbine operates from the pressure at the bottom end of a pipeline. This pressure, usually measured in pounds per square inch (psi), is directly related to the *head*, the vertical drop from the top of the pipeline where the water goes into the turbine located at the bottom of the pipeline. The pressure at the lowest point of a pipeline is equal to 0.433 times the head, (the vertical distance in feet).

Pressure is important because it is a determining factor in how much power is available and what type of pipe is required. Polyethylene pipe can be used for pressures up to 100 psi, PVC pipe is available with pressure ratings from 160 to 350 psi and steel pipe can withstand 1000 psi or more. Check with your local plumbing supplier for pipe ratings. Pipe diameter is very important. All pipelines will cause the water flowing in them to lose some energy to friction. The pipe must be large enough for the maximum quantity of water it will carry.

The pressure at the bottom of a pipeline when water is not flowing is called static pressure. When water is flowing through the outlet or nozzle of the hydroelectric turbine, the pressure at the outlet is the dynamic pressure or running head. If you install a gate valve on the pipeline just above the turbine and a pressure gauge on a “T” fitting just above the gate valve, you will read the static pressure on the gauge when the valve is closed and the dynamic pressure when the valve is opened. The maximum power that can be delivered by a pipeline will occur when the dynamic pressure is approximately 2/3 of the static pressure.

The actual flow rate of the water in a hydroelectric system is determined by the diameter of the nozzle. We will supply a turbine with the proper size nozzle for your site, depending on the head, flow, length and diameter of the pipe. We carry hydroelectric generators made by Energy Systems and Design, HI-Power Hydroelectric, and Harris Hydroelectric. Use the descriptions on the following pages to help determine which turbine will work best for your site and power requirements.

We can help you design your system

If you think you have a suitable site, contact us and we will help you choose the best unit for your situation. Please provide the following information about your site:

1. **Head** – The total vertical elevation from the place where the water enters the pipe to the point where the turbine will be located.
2. **Flow** – The number of gallons per minute that are available.
3. **Distance** – The length of pipe that will be necessary to carry the water from the pickup to the turbine. If the pipe is already installed, what is the type and diameter?
4. **Location** – Distance from turbine to batteries.

Nozzle selection

Power output of a hydroelectric generator is determined by the pressure of the water at the nozzle and the amount of water flowing out of the nozzle. The larger the nozzle, the greater the flow will be. The nozzle must also be sized small enough to keep your pipeline full and keep the speed of the water in the pipe below 5 feet per second. The nozzle selection chart on the next page shows water flow through various size nozzles at given pressures. Use this chart to determine what size nozzle and how many nozzles you need to accommodate the flow of water you have and to deliver the amount of power you need. A pressure gauge in the pipe feeding your turbine, installed before the shutoff valve, can help you check proper operation and diagnose problems. When the valve is shut off, the gauge will read the static pressure in pounds per square inch psi (head in feet x .433). When the valve is turned on the gauge will read a lower (dynamic) pressure.

The difference between these two pressures represents your loss to friction in the pipe. The greater the flow, the greater your loss will be. (See PVC pipe loss chart on the next page.)

Water Flow Information for Pumping and Hydroelectric Design

Flow Through Nozzles

The chart below shows the flow in gallons per minute (gpm) through various diameter nozzles at a range of heads from 5 feet to 400 feet. Use chart to choose what nozzle size to use and how many nozzles a turbine must have to give the required flow to use all of the water available in the system.

Head		Flow in gpm through these nozzle diameters:											rpm for
feet	psi	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1.0"	4" turbine
5	2.2	-	-	-	-	6.18	8.4	11	17.1	24.7	33.6	43.9	460
10	4.3	-	-	3.88	6.05	8.75	11.6	15.6	24.2	35	47.6	62.1	650
15	6.5	-	2.68	4.76	7.4	10.7	14.6	19	29.7	42.8	58.2	76	800
20	8.7	1.37	3.09	5.49	8.56	12.4	16.8	22	34.3	49.4	67.3	87.8	925
30	13	1.68	3.78	6.72	10.5	15.1	20.6	26.9	42	60.5	82.4	107	1140
40	17.3	1.94	4.37	7.76	12.1	17.5	23.8	31.1	48.5	69.9	95.1	124	1310
50	21.7	2.17	4.88	8.68	13.6	19.5	26.6	34.7	54.3	78.1	106	139	1470
60	26	2.38	5.35	9.51	14.8	21.4	29.1	38	59.4	85.6	117	152	1600
80	34.6	2.75	6.18	11	17.1	24.7	33.6	43.9	68.6	98.8	135	176	1850
100	43.3	3.07	6.91	12.3	19.2	27.6	36.6	49.1	76.7	111	150	196	2070
120	52	3.36	7.56	13.4	21	30.3	41.2	53.8	84.1	121	165	215	2270
150	65	3.76	8.95	15	23.5	33.8	46	60.1	93.9	135	184	241	2540
200	86.6	4.34	9.77	17.4	27.1	39.1	53.2	69.4	109	156	213	278	2930
250	108	4.86	10.9	19.9	30.3	43.6	59.4	77.6	121	175	238	311	3270
300	130	5.32	12	21.3	33.2	47.8	65.1	85.1	133	191	261	340	3590
400	173	6.14	13.8	24.5	38.3	55.2	75.2	98.2	154	221	301	393	4140

PVC Pipe Loss Chart

Use the chart below to determine what pipe size is required to efficiently allow necessary flow for your power need. Once you know the required flow for your system (gpm), find the head loss for various pipe sizes. Multiply the head loss number by the length of the pipe divided by 100 and you will get the loss of head for that pipe size. The actual head minus the head loss will give you the effective head in the system.

Pipe Friction Loss Chart – Head loss in feet per 100 feet of schedule 40 PVC pipe																								
		Flow (gallons per minute)																						
		1	2	3	4	5	7	10	15	20	25	30	40	50	60	70	80	100	150	200	250	300	400	500
Pipe diameter (inches)	1/2	2.08	4.16	8.7	14.8	23.5	43																	
	3/4	0.51	1.02	2.2	3.7	5.73	10.5	20.1	42.5															
	1	0.1	0.55	0.68	1.15	1.72	3.17	6.02	12.8	21.8	32.9	46.1												
	1-1/4	0.03	0.14	0.19	0.31	0.44	0.81	1.55	3.28	5.59	8.45	11.9	20.2	30.5	45.6									
	1-1/2		0.07	0.08	0.13	0.22	0.38	0.72	1.53	2.61	3.95	5.53	9.43	14.3	20	28.6	36.7							
	2			0.03	0.05	0.07	0.11	0.21	0.45	0.76	1.15	1.62	2.75	4.16	5.84	7.76	9.94	15.1	34.8	59.3				
	2-1/2				0.03	0.04	0.05	0.09	0.19	0.32	0.49	0.68	1.16	1.75	2.46	3.27	4.19	6.33	13.4	25.0	37.8	46.1		
	3						0.02	0.03	0.07	0.11	0.17	0.23	0.4	0.6	0.85	1.13	1.44	2.18	4.63	7.88	11.9	18.4	40.1	
	4										0.04	0.06	0.11	0.16	0.22	0.3	0.38	0.58	1.22	2.08	3.15	4.41	7.52	
	5											0.03	0.04	0.05	0.07	0.1	0.13	0.19	0.4	0.69	1.05	1.46	2.49	3.76
	6													0.02	0.03	0.04	0.05	0.08	0.16	0.28	0.43	0.6	1.01	1.53

Hi-Power

NEW!

LV Hydroelectric Generators

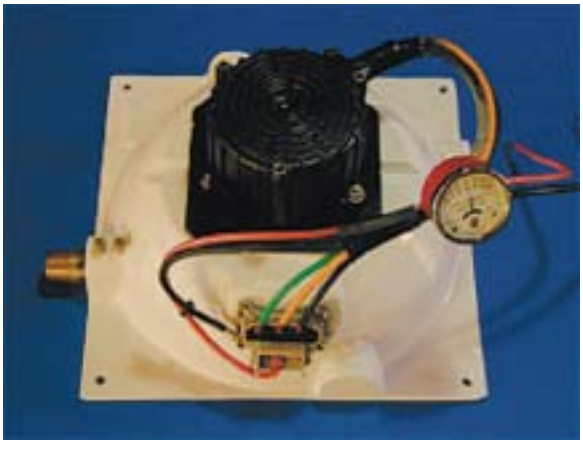
Hi-Power is now offering a low voltage brushless PM generator. This user-friendly unit requires no adjustments and is more efficient than car alternator types over a wider range of head and flow.

- Head range: 40 to 400 feet
- Flow range: 5 to 400 gpm
- Maximum power: 1200 watts
- Efficiency: 30% to 70%
- Battery voltage options: 12V, 24V, 48V, 96V

Available in the four voltages above for direct battery charging. The 48- and 96-volt units allow the use of smaller gauge wire between the generator and the battery. An MPPT charge control, like the Outback MX-60, can be used to efficiently step the voltage down for charging and regulating 12-, 24- or 48-volt batteries.

The sealed permanent magnet alternator is mounted on a Harris housing with the bronze Harris Pelton wheel. The external rectifier is water-cooled and all fasteners are stainless steel. It comes with an induction meter and 3 feet of 1" flexible hose per nozzle.

Order multiple nozzles for convenient adjustment to varying flows. Alternator has 2 sealed 6203 bearings which should be changed every 5-10 years, depending on use. When ordering, specify battery voltage, transmission line length and size, flow, pressure, pipe size and length.



Hydroelectric Generators

Hi Power Hydroelectric generators are ideal for sites where water is far from power needs (up to 10,000 feet), or when greater power is required. High transmission voltage can be sent over a mile before being 'stepped down' to battery voltage. It comes complete with step-down transformer, rectifier, fuses and amp meter. Use a diversion-type regulator with these units.

- Head range: 60 to 500 feet
- Flow range: 10 to 400 gpm
- Maximum power: 3600 watts
- Efficiency: 30% to 60%
- Transmission voltage: 110V to 440V
- Battery voltage: 12V, 24V, 48V

These hydroelectric generators use brushless alternators for reliability and versatility. They produce 110V, 220V, or 440V "wild" (unregulated) AC, which is then stepped down with the supplied transformer and rectifier.

The heavy-duty brushless alternator is housed on the Harris housing and uses the Harris Bronze Pelton Wheel for flows up to 200 gpm and the ESD Turgo Wheel and housing for flows of 200 to 400 gpm. Available in 4 sizes ranging from 600 to 3600 watts. The HV600 is available with 2 or 4 nozzles. The larger units come with 4 nozzles.

2-year warranty. Specify battery voltage when ordering.

Description	Item code	Price
LV Hydro with 1 nozzle	**17.2005**	**$1,350**
LV Hydro with 2 nozzles	**17.2007**	**$1,400**
LV Hydro with 3 nozzles	**17.2009**	**$1,450**
LV Hydro with 4 nozzles	**17.2011**	**$1,500**
Car alternator upgrade kit	**17.2019**	**$500**

Description	Item code	Price
HV 600 – 600 watt 2 nozzle	**17.2025**	**$2,500**
HV 600 – 600 watt 4 nozzle	**17.2028**	**$2,600**
HV 1200 – 1200 watt 4 nozzle	**17.2030**	**$3,000**
HV 1800 – 1800 watt 4 nozzle	**17.2031**	**$3,500**
HV 3600 – 3600 watt 4 nozzle	**17.2034**	**$5,000**
Hi-Power turgo nozzle	**17.2037**	**$600**

Harris

Pelton Turbines

This hydroelectric battery charger uses a cast bronze Pelton wheel and a brushless permanent magnet alternator on a white powder-coated aluminum housing.

- Head range: 20 to 600 feet
- Flow range: 4 to 250 gpm
- Maximum 12-volt power: 700 watts
- Maximum 24-volt power: 1400 watts
- Maximum 48-volt power: 2500 watts

They are available with one, two or four nozzles, depending on water flow and power requirements. (PVC manifold with one shut-off valve on two-nozzle machines and 3 shut-off valves on 4-nozzle machines is available). These turbines can be fitted with nozzles up to 1/2" in diameter. Each hydroelectric system is custom-built to match your site specifications. Please tell us your head, flow, pipe size and length, electrical transmission line length and battery voltage when ordering. The new permanent magnet (PM) brushless alternator pictured here is 15-30% more efficient than the automotive alternator used in the past; and they last longer. Allow 5 to 6 weeks for delivery. 1-year warranty.

Description	Item code	Price
Harris PM 1-Nozzle 12/24V/48V	17.1030	$2,300
Harris PM 2-Nozzle 12/24V/48V	17.1032	$2,387
Harris PM 4-Nozzle 12/24V/48V	17.1034	$2,555
Fan kit (recommended when producing over 500 watts)	17.1092	$70.00.

ES&D

ES&D's micro hydro systems employ high-efficiency, precision-cast parts and non-corrosive alloys for long life and durability. A digital multimeter accompanies each turbine for measuring output amperage. These units can be used in off-grid/standalone or grid-tie systems.

ES&D Stream Engine Turbines

ES&D hydroelectric battery chargers use a cast bronze turgo runner to drive a long-life, brushless permanent magnet alternator.

- Head Range: 5 to 200 feet
- Flow range: 10 to 400 gpm
- Maximum Power: 1000 watts
- voltage from 12 to 48 VDC

A simple change of wiring in the junction box allows this turbine to charge 12, 24, or 48-volt battery systems. These turbines come with cut-to-size nozzles that can be user-set for up to 1", allowing a very large flow in low head situations. They can operate on heads as low as five feet with a flow of 40 gpm.

Description	Item code	Price
ES&D 2-Nozzle Stream Engine	17.3241	$2,125
ES&D 4-Nozzle Stream Engine	17.3244	$2,375

ES&D Water Baby

- Head Range: 50 to 500 feet
- Flow range: 3 to 30 gpm
- Max Power: 350 watts
- Voltage from 12 to 48 VDC

This new tiny turbine, a miniature version of the Stream Engine above, is ideal for sites with good head but with very little flow.

Two models are available; one for 12- to 48-volt charging and one for high voltage transmission. At 3 gpm and 100 feet of head, the Water Baby will charge at 25 watts. Comes with a selection of nozzles.

Description	Item code	Price
ES&D 1-Nozzle Water Baby – 12 - 24V	17.3245	$1,645
ES&D 2-Nozzle Water Baby – 12 - 24V	17.3247	$1,770
ES&D 4-Nozzle Water Baby – 12 - 24V	17.3249	$2,645
ES&D 1-Nozzle Water Baby – 48V	17.3252	$1,770
ES&D 2-Nozzle Water Baby – 48V	17.3254	$1,895
ES&D 4-Nozzle Water Baby – 48V	17.3256	$2,645

Prices subject to change without notice.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Charge Controllers – PWM and MPPT

A charge controller is an electronic voltage regulator, used in off-grid systems and grid-tie systems with battery backup, that controls the flow of power from the charging source to the battery. The charge controller automatically tapers, stops, or diverts the charge when batteries become fully charged. Some charge controllers have metering and datalogging capability to show system operation parameters and battery charge status. Some have low battery load disconnect to prevent over-discharge and some have built-in light controls to turn on lights at night.

Charge controller capacities ranges from 4 amps to 80 amps and multiple charge controllers can be used in parallel for larger systems. The simplest charge controllers turn off the charge when the battery reaches a voltage near full charge, and turn it on when the voltage drops about one volt. Pulse width modulated (PWM) charge controllers turn on an off very rapidly, holding the batteries at full charge, making better use of available power.

Maximum power point tracking (MPPT) charge controllers take power from the charging source at a voltage where it can put out the most power (its maximum power point) and convert that to the correct voltage to charge the battery. This technique significantly increases the power from a solar array, especially when batteries are discharged, battery voltage is low, and the temperature is low causing the maximum power point voltage of the solar modules to be high. Most MPPT charge controllers can take an array voltage much higher that what is required by the batteries, allowing the use of modules with higher peak power voltage, designed for grid-tie use. A higher voltage solar array also allows smaller wire to be used between the array and the charge controller, which can save wire and installation cost in large systems. Maximum power point tracking allows a PV array to deliver up to 30% more power to a battery than it would if it were connected directly to the battery.

Apollo Solar

NEW! T80 Turbo Charger

The T80 TurboCharger integrates maximum power point tracking, battery charge management, state-of-charge information and communications into a single device. It can deliver 80 amps continuous output to 12-, 24- or 48-volt battery systems from PV arrays with open circuit voltage up to 140 VDC (150 V absolute maximum voltage). Wire modules in series to use smaller wire between the array and charge controller. The T80 captures up to 35% more power from the PV array. Their MPPT algorithm starts early and locks onto the peak power during rapidly changing insolation and temperature. The controller supports flooded lead acid (FLA), GEL and absorbed glass mat (AGM) batteries. Four-stage charging with adjustable set points for all parameters.

The T80 TurboCharger produces full rated power without de-rating up to 40°C ambient temperature. Above that, the output current is reduced gradually to protect the life of the T80 and then automatically ramped up as the temperature decreases. High efficiency power circuits and robust thermal design minimize heat generation. The internal temperature-controlled variable speed fan runs just fast enough to maintain optimum reliability. UL Listed. Dimensions are 15.2" x 8.5" x 4.4" and weight is 22 lbs.

The T80 includes a built-in energy monitor using TriMetric technology from Bogart Engineering. It tracks power production and consumption to calculate the energy remaining in the battery. State of charge (SOC) is displayed in percent full, amp-hours, watt-hours and bar graph format on a 4-line 20-character LCD with back light. In addition, 90 days of energy harvest history is stored in the T80. The on-board RS-232 and slot for optional add-in cards provide data communication to remote readouts, PCs and the internet. System performance can be monitored remotely and the T80 accepts software upgrades from a PC.

Two independently programmable SPST relays can be used to control external devices based on battery voltage, charge or discharge current or battery state of charge. Contact rating is ½ amp at up to 50 VDC.

Optional wired and wireless displays are available. The RD wired display can be up to 100 feet from the controller using 4-conductor telephone cable. The RD100 wireless display can be 100 feet away from controller in buildings and 300 feet line-of-sight. Its built-in rechargeable batteries last up to 3 months and can be recharged from 12, or 24 VDC or 115 VAC.

Optional network card allows you to stack up to 16 T80 controllers on one battery bank. Add a network card to each controller and connect with CAT-5 cables. One controller acts as a master and the others as slaves.

Model	Description	Item code	Price
T80	Apollo T80 charge controller	20.7080	$849
RD-WIRED	Wired remote display	20.7085	$199
RD100	Wireless remote display	20.7087	$399
RCL100	Wireless computer link	20.7089	$199
ASNET	Network option card	20.7091	$99

Xantrex

NEW! XW-MPPT60-150 Charge Controller

The XW-MPPT60-150 can used with PV arrays with a voltage equal to anything from battery voltage to 150 VDC and can support an output of up to 60 amps into the battery for battery voltage of 12 to 60 VDC. The PV open circuit voltage must not exceed 150 VDC.

Maximum power point tracking allows the charge controller to harvest the maximum energy available from the PV array and deliver it to the batteries. The MPPT algorithm continuously adjusts the operating points in an attempt to find the maximum power point of the array. The algorithm can then determine if it is harvesting more or less power than the previous operating points.

The charge controller has a configurable auxiliary output (producing 5 to 13 volts at 200 mA) to drive a relay for load control or to turn on devices such as vent fans or indicator alarms. The auxiliary output can be configured to perform only one function at a time.

Its large aluminum heatsink allows it to operate at full power with only convection cooling, without the need for a fan. Built-in PV ground fault protection allows code-compliant installation without the need for additional ground fault protection. The XW-MPPT60-150 can be mounted on the side or top of the XW power distribution panel, or used by itself in other PV systems. The front panel features a 2-line 16-character display and four buttons for configuration and system monitoring. A battery temperature sensor is included with the controller.

The XW-MPPT60-150 is able to communicate its settings and activity to other Xanbus-enabled devices, such as the XW Series inverter/charger, the system control panel II (SCP), XW automatic generator start (XW-AGS), and other Xantrex XW-MPPT-60-150 solar charge controllers through the Xanbus network.

Array size can be up to 750 watts when charging a 12-volt battery, 1,500 watts when charging at 24 volts and 3,000 watts when charging at 48 volts. See the Xantrex array sizing tool at www.xantrex.com/support. Dimensions are 14 ½"H x 5 ¾"W x 5 ½"D and weight is 12 lbs. 5-year warranty.

Xantrex model	Description	Item code	Price
XW-MPPT60-150	60-amp MPPT charge controller	**20.8040**	**$650**

OutBack

MX60 MPPT Charge Controller

Rated for up to 60 amps of DC output current, the OutBack MX60 can be used with battery systems from 12 to 60 VDC with PV open-circuit voltage as high as 140 VDC. The MX60's setpoints are fully adjustable to allow use with virtually any battery type, chemistry and charging profile. The OutBack MX60 allows you to use a higher output voltage PV array with a lower voltage battery – such as charging a 12- or 24-VDC battery with a 48-VDC PV array. This reduces wire size and power loss from the PV array to the battery/inverter location and can maximize the performance of your PV system. Array size can be up to 707 watts when charging a 12-volt battery, 1,500 watts when charging at 24 volts and 3,000 watts when charging at 48 volts.

The OutBack MX60 comes standard with an easy-to-use and understand display of the PV system's performance. The 4-line, 80-character backlit LCD display is also used for programming and monitoring of the system's operation. The OutBack MX60 can also be connected to the OutBack MATE system controller and display to allow monitoring of up to eight MX60 controllers from a distant location – up to 300 feet away. The MATE also includes an optoisolated RS232 port for connection to a PC computer for data logging and system monitoring. ETL Listed. Dimensions 14.5"H x 5.75"W x 5.75"D. Weight: 12 lbs. 2-year warranty.

OutBack model	Description	Item code	Price
MX60	OutBack 60A MPPT charge controller	**20.2015**	**$649**
RTS	Remote temperature sensor with 20' cable	**30.4190**	**$29**
MATE	System controller – shipped with a 50' cable	**30.4180**	**$295**
MATE-B	Black version of the MATE above	**30.4180-B**	**$295**
MATE-B	Flush mount version of the MATE	**30.4181**	**$295**

Blue Sky Energy – Solar Boost MPPT Charge Controllers

The Blue Sky Solar Boost features reverse-polarity protection, MPP tracking and selectable-charge voltage for flooded and gel lead-acid batteries. An equalize function periodically conditions liquid electrolyte lead-acid batteries. An optional user-friendly digital display is available to monitor PV charge performance. The display shows battery voltage, solar current, charge current and charge mode, either in the controller, as a remote panel installed up to 300 feet away, or both. Optional temperature compensation of charge voltage is also available to further improve charge controller and battery performance. Solar Boost controllers available with or without digital display and optional remote display. 3-year limited warranty.

Solar Boost 50L

This charge controller can be used on 12- and 24-volt systems. It can also be used to charge a 12-volt battery from a 24 volt array. Maximum open-circuit PV array voltage is 57 VDC.

Solar Boost 6024H

The 6024H is designed for charging 12- or 24-volt batteries from 36-, 48- or 60-volt PV arrays (maximum open circuit voltage is 140). This allows for a much smaller wire size between the array and battery in large systems. Maximum charge current is 60 amps at 12 or 24 volts.

Solar Boost 3048

SB3048 is designed to charge 24- and 48-volt battery systems from a 48- to 60-volt array (maximum open-circuit voltage is 140). Maximum charge current is 30 amps output at 24 or 48 VDC.

Solar Boost 2000E

This 25-amp solar charge controller is for 12-volt systems. It mounts in a 5-11/16" x 3-15/16" cut-out and is wired from the rear. This controls very popular in RV installations. Optional box allows surface mounting.

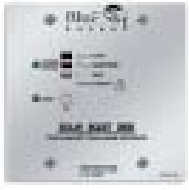
Solar Boost 3024i

SB3024i is designed to charge 12- and 24-volt battery systems from a 24-volt array (maximum open circuit voltage is 57). Maximum charge current is 30 amps output at 12 or 24 VDC. The new IPN network interface coordinates multiple controllers and shares temperature sensors and display.

Optional Equipment

A remote temp probe and a remote digital display can be mounted up to 300 feet away and used with all of the Solar Boost controllers. Optional shunts allow it to monitor other charging sources and loads.

Solar Boost 2512i



The low-cost Solar Boost 2512i provides a fully automatic 3-stage charge controller system. A partial IPN network interface is also included to allow use of the IPN-Remote or IPN-ProRemote displays. Additional features provided in the Solar Boost 2512iX include automatic or manual equalization, battery temperature sensor input, full IPN network compatibility, and an auxiliary output. The user-configurable auxiliary output can serve as either a 25-amp load controller, or as a 2-amp auxiliary battery charger. The auxiliary battery charge feature is ideal for charging a separate battery such as the engine battery in an RV.

Model	Description	System voltage	Charge amps	Item code	Price
SB50L	Charge controller	12 or 24	50	20.3140	$432
SB50DL	Controller w/ digital display	12 or 24	50	20.3137	$514
SB50PDL	Front cover w/ digital display for SB50L			20.3134	$119
SB6024HL	Charge controller	12 or 24	60	20.3143	$518
SB6024HDL	Controller w/ digital display	12 or 24	60	20.3146	$599
SB6024H-PDL	Front cover w/ digital display for SB6024HL			20.3131	$119
SB3048L	Charge controller	24 or 48	30	20.3128	$493
SB3048DL	Controller w/ digital display	24 or 48	30	20.3125	$575
SB3048PDL	Front cover w/ digital display for SB3038L			20.3131	$119
SB2000E	Charge controller	12	25	20.3122	$236
Wall mount box for SB2000				20.3119	$30
SB2512i	Charge controller	12	25	20.3123	$179
SB2512iX	Charge controller	12	25	20.3124	$219
SB3024i	Charge controller	12 or 24	30	20.3155	$299
SB3024Di	Controller w/ digital display	12 or 24	30	20.3156	$359
SB3024PDi	Front cover w/ digital display for SB3024i			20.3157	$99
IPNPRO-S	IPN ProRemote display w/ 500 amp shunt			20.3161	$199
IPNPRO	IPN ProRemote display			20.3162	$169
IPNREM	IPN basic remote			20.3163	$69

Model	Description of optional accessories	Item code	Price
SB50RD25	Remote digital display w/ 25' cable	20.3152	$112
930-0022-20	Battery temperature sensor	20.3149	$30
CS-100	Remote shunt 100A/100mV	28.9245	$35
CS-500	Remote shunt 500A/50mV	28.9253	$35

Prices subject to change without notice.

Morningstar

NEW! SunSaver MPPT Charge Controller

The SunSaver MPPT charge controller is designed for 12V and 24V battery charging from PV modules with a maximum open circuit voltage of 75V. Use up to three 36-cell modules in series.

It can be used with 200 watts of PV when charging a 12-volt battery and up to 400 watts when charging a 24-volt battery.

Provides an estimated 5-25% boost of amps from the PV array into the battery. Actual boost depends on PV cell temperature and battery state of charge. Enables the use of high voltage PV modules (designed for on-grid applications) for off-grid 12V or 24V battery charging. Provides a means to use a 24V PV array to charge a 12V battery, reducing power losses in systems with a long cable run between the PV array and the battery. The controller has electronic protection from short circuit, overcurrent, reverse polarity, high temp, high voltage, lightning and transient surges. An adjustable low battery voltage load disconnect protects the battery from over-discharge. LED indicators indicate charging, low battery and faults. Dimensions are 6.6" x 2.75" x 2.2". Weight is 1.65 lbs. 5-year warranty.

Model	Description	System voltage	Charge amps	Item code	Price
SS-15MPPT	SunSaver MPPT charge controller	12 or 24	15	**20.1261**	**$ 278**

NEW! SunSaver Duo RV Charge Controller

The SunSaver Duo two battery controller for RVs, caravans, boats and cottages is rated for 25 amps at 12 volts DC. This product will charge two separate and isolated batteries at the same time, such as a house and an engine battery, based on user selectable priorities. The SunSaver Duo employs Morningstar's legendary SunSaver controller technology, whose long-term track record for high reliability and improved battery charging is well-recognized in the solar industry.

This controller includes a backlit remote meter which may be mounted in or on a wall, and displays digital and pictorial status information about the solar power system. The SunSaver Duo is epoxy encapsulated for environmental protection, is user adjustable via DIP switch or connection to a personal computer and has an optional remote temperature sensor. 5-year warranty.

Model	Description	System voltage	Charge amps	Item code	Price
SK-6	SunSaver Duo	12	25	**20.1250**	**$188**

SunKeeper Charge Controller

The SunKeeper is available in 6-amp or 12-amp versions at 12 volts DC. To withstand the high temperatures at the solar module, the controller has been designed using extremely efficient power electronics and is rated to 70C. The SunKeeper is also certified for use in Class 1, Division 2 hazardous locations, making it an ideal controller for solar powered oil/gas applications. Mounts in 1/2" knockout. 5-year warranty.

Model	Description	System voltage	Charge amps	Item code	Price
SK-6	SunkKeeper6	12	6	**20.1252**	**$63**
SK-12	SunKeeper12	12	12	**20.1253**	**$89**

Morningstar TriStar Charge Controllers

The TriStar pulse width modulated (PWM) controller can operate as a solar charge controller, a load controller, or a diversion regulator in 12-, 24- or 48-volt systems. It can operate in only one of these modes at a time, but two or more controllers can be used to provide multiple functions. PWM operation may be changed to on/off operation to prevent telecom noise. Two models are available with UL current ratings of 45 and 60 amps. A choice of 7 different setpoints are easily selectable with DIP switches. An RS-232 communications enables PC connection to adjust control setpoints and data logging. An optional digital display may be mounted on the front of the controller or up to 100 feet away using 4-conductor phone cable with RJ-11 jacks. Battery temperature compensation may be added with the optional temperature sensor. Knock-outs on the bottom of the charge controller match knock-out spacing on the Xantrex DC-175/250 disconnect and the OutBack FLEXware power system components, allowing easy mounting on either. Dimensions: 10.25" H x 5" W x 2.8" D; weight is 3.5 lbs. 5-year warranty. UL Listed.

Model	Description	System voltage	Charge amps	Item code	Price
TS-45	TriStar 45 charge controller	12, 24 or 48	45	**20.1105**	**$169**
TS-60	TriStar 60 charge controller	12, 24 or 48	60	**20.1108**	**$218**
RTS	Battery temperature sensor			**20.1141**	**$32**
TS-M	Digital display mounts on front of charge controller			**20.1113**	**$99**
RM	Remote display with 100 ft. cable			**20.1115**	**$136**

ProStar Charge Controllers

Recently revised, this sophisticated line of PV charge controllers incorporates constant voltage PWM to make maximum use of valuable PV power. They have automatic equalization, temperature compensation and very high efficiency. They can be used on 12-, 24- and 48-volt systems with sealed, gel and wet-cell lead-acid batteries. Front panel LEDs indicate when the batteries are being charged and relative battery state of charge. Reverse polarity protection on input and output. In the event of a load short circuit, the load is automatically disconnected. “M” models include LCD meter of battery voltage, PV charging current, and load current. Low voltage LVD is current-compensated to prevent false disconnect when the battery is heavily loaded. Units are conformal coated to guard against corrosion.

Dimensions: 6.01" x 4.14" x 2.2". 5-year warranty.

Model	Description	System voltage	Charge amps	Item code	Price
PS-15	ProStar 15	12 or 24	15	**20.1120**	**$112**
PS-15M	ProStar 15 w/ digital display	12 or 24	15	**20.1123**	**$179**
PS-15M-48V	ProStar 15 48 volt w/ display	48	15	**20.1126**	**$222**
PS-15M-48-PG	48 volt w/ display & positive ground	48	15	**20.1129**	**$239**
PS-30	ProStar 30	12 or 24	30	**20.1132**	**$152**
PS-30M	ProStar 30 w/ digital display	12 or 24	30	**20.1135**	**$219**
PS-30M-PG	30 w/ digital display & positive ground	12 or 24	30	**20.1138**	**$236**
RTS	Battery temperature sensor			**20.1141**	**$32**

Morningstar SunSaver Charge Controllers

The SunSaver is a very reliable charge controller and uses the same battery charging algorithm as the ProStar and offers many of the advantages of the ProStar for smaller systems, at a reduced cost. Constant voltage pulse width modulation (PWM) charging is a proven advance compared to the common on/off PV regulators. SunSavers are field-selectable for sealed or flooded batteries. A rugged anodized aluminum case and epoxy encapsulated electronics ensure durability and longevity. A temperature compensation sensor in the charge controller varies full charge voltage with temperature. They have LED charging and load control indicators in LVD models. 5-year warranty. Dimensions: 6" x 2.2" x 1.3".

Model	Description	System voltage	Charge amps	LVD amps	Item code	Price
SS-6-12V	SunSaver 6	12	6	No	**20.1245**	**$48**
SS-6L-12V	SunSaver 6 w/ LVD	12	6	6	**20.1248**	**$59**
SS-10-12V	SunSaver 10	12	10	No	**20.1230**	**$55**
SS-10L-12V	SunSaver 10 w/ LVD	12	10	10	**20.1233**	**$70**
SS-10L-24V	SunSaver 10 w/ LVD	24	10	10	**20.1236**	**$76**
SS-20L-12V	SunSaver 20 w/ LVD	12	20	20	**20.1239**	**$95**
SS-20L-24V	SunSaver 20 w/ LVD	24	20	20	**20.1242**	**$101**

SunLight Charge Controller with Lighting Control

The SunLight has all of the features of the SunSaver controller. It also has a rotary switch that allows it to turn on the loads after dusk for 2, 4, 5, 8, or 10 hours. It also has the option to turn loads on at dusk, off and on again before dawn. In this configuration, you can choose the following settings (in hours): 3/off/1, 4/off/2, or 6/off/2. “On” from dusk to dawn is also possible. A test button turns light on for five minutes. 5-year warranty. Dimensions: 6.6" x 2.2" x 1.3".

Model	Description	System voltage	Charge amps	LVD amps	Item code	Price
SL-10L-12V	SunLight w/ LVD	12	10	10	**20.1218**	**$108**
SL-10L-24V	SunLight w/ LVD	24	10	10	**20.1221**	**$116**
SL-20L-12V	SunLight w/ LVD	12	20	20	**20.1224**	**$141**
SL-20L-24V	SunLight w/ LVD	24	20	20	**20.1227**	**$148**

SunGuard Charge Controller

The SunGuard uses the same charging circuit as the SunSaver. It is ideal where a 12-volt low-power controller is needed. It can control up to 75 watts of PV module(s). Since it is epoxy encapsulated, it can be used outdoors in a harsh environment. Dimensions are 2.5" x 2" x 1.6" with wire leads for connecting module and battery. 5-year warranty.

Model	Description	System voltage	Charge amps	LVD amps	Item code	Price
SG-4	SunGuard	12	4.5	No	**20.1215**	**$30**

Xantrex C-35, C-40 and C-60 PWM Controllers

The Xantrex C-35, C-40, and C-60 PWM (pulse width modulator) controllers can be used as PV charge controllers, DC load controllers or DC diversion regulators in 12-, 24- and 48-volt systems (except only the C40 can be used in 48-volt systems). They operate in only one mode at a time, so to provide both PV charge controller and low battery load disconnect, two controllers must be used. As DC load controllers they disconnect the load at a user-settable low voltage and reconnect at a higher voltage reconnect point. As diversion controllers they send excess power to a "dummy load"

(such as a water or space heater) to regulate hydroelectric or wind generators. When used in diversion mode, derate the amperage by 25%. All Xantrex controllers, when used as a charge controller, have field-adjustable bulk and float setpoints and perform automatic equalization every 30 days or whenever LVD is reached. Equalization can be manually initiated with automatic shut-off. Order the optional temperature sensor for a more accurate battery charge controller. The optional LCD digital display shows battery voltage, array amps and watts, cumulative amp-hours and a separately resettable "trip" amp-hour measurement. The digital display is available for mounting on the front of the charge controller, or with a 50- or 100-foot cable for remote mounting in a double-gang electrical box. UL Listed. 2-year warranty.

Model	Description	System voltage	Max PV amps	Item code	Price
C-35	Charge controller	12 or 24	35	**20.8004**	**$119**
C-40	Charge controller	12, 24 or 48	40	**20.8005**	**$159**
C-60	Charge controller	12 or 24	60	**20.8009**	**$199**
BTS/15	Battery temperature sensor with 15 foot cable			**20.8025**	**$29**
BTS/35	Battery temperature sensor with 35 foot cable			**20.8029**	**$32**
CM	Digital display mounts on front of charge controller			**20.8016**	**$99**
CM/R50	Remote display with 50 foot cable			**20.8019**	**$126**
CM/R100	Remote display with 100 foot cable			**20.8017**	**$146**

Xantrex C-12 Charge / Lighting Controller

The Trace C-12 controller is PWM microprocessor-based and ideal for small village power systems, vacation homes, outdoor area lighting, sign lighting, and bus shelters. It has a 12-amp low-voltage disconnect and an automatic lighting control. The lighting control turns the light on at dusk, then has an adjustable duration timer for 2 to 8 hours of run time, or can be set to run all night. If the battery gets low, lights are turned off. User-adjustable LVD set points. For use in 12-volt systems only. Can be mounted outdoors. Dimensions: 6.5" x 4.3" x 1.5". UL Listed. 2-year warranty.

Model	Description	System voltage	Max PV / load amps	Item code	Price
C-12	Charge controller / lighting controller	**12**	**12 / 12**	**20.8002**	**$110**

Specialty Concepts Inc.

SCI RV Charge Controllers

These charge controllers are designed by Specialty Concepts Inc. for the RV market. They are designed to flush-mount in a rectangular cut-out. They have a digital amp- and volt-meter for accurate information and an LED bar graph display for at-a-glance battery status. Charging is set to stop at 14.4 volts and resume at 13.0, but the full charge level can be adjusted by turning a small screw on the back of the circuit board. Terminal strip on back of unit accepts up to 10 AWG stranded wire. The Mark 15 and 22 controllers have array and battery fuses on the back of the panel and a switch to set the display to volts, amps, or off. The optional black anodized aluminum box can be used to surface-mount this controller on a wall. Knock-outs are provided for wiring. Dimensions: 7.5" W x 4.25" H x 1.5" D. 5-year warranty.

Model	System voltage	Charge amps	Item code	Price
Mark 15/12	12	15	**20.4215**	**$119**
Mark 22/12	12	22	**20.4217**	**$129**
Surface mount box			**20.4211**	**$25**

ASC Charge Controllers

The ASC is a compact, encapsulated, battery charge regulator for use in small photovoltaic systems. It is available in 12-volt and 24-volt units up to 16 amps. The ASC is a switching shunt regulator, housed in an anodized aluminum chassis and encapsulated in a hard epoxy resin. The terminal block accepts up to 12-gauge wire or a spade connector, providing simple installation.

We stock a variety of 12- and 24-volt controllers. See the chart below. Some have temperature compensation, low-battery voltage disconnect and adjustable set points or a combination of some of these. All ASC controllers are FM approved, Class 1, Division 2 explosion-proof devices so they are an excellent choice for oil, gas and industrial installations.

Shipping weight 1 pound. Five-year warranty.

Model	Optional features	Battery voltage	PV amps	Load amps	Dimensions L x W x D	Weight (lbs)	Item code	Price
ASC-12/4	Charge controller only	12	4		6" x 3.5" x 3"	1	**20.4327**	**$47**
ASC-12/8	Charge controller only	12	8		6" x 3.5" x 3"	1	**20.4331**	**$54**
ASC-12/8 A	Temp compensation	12	8		6" x 3.5" x 3"	1	**20.4332**	**$64**
ASC-12/8 AF	Temp compensation, adjustable set point	12	8		6" x 3.5" x 3"	1	**20.4355**	**$59**
ASC-12/12	Charge controller only	12	12		6" x 3.5" x 3"	1	**20.4341**	**$62**
ASC-12/12 A	Temp compensation	12	12		6" x 3.5" x 3"	1	**20.4343**	**$64**
ASC-12/12 AF	Temp compensation, adjustable set point	12	12		6" x 3.5" x 3"	1	**20.4346**	**$67**
ASC-12/16	Charge controller only	12	16		6" x 3.5" x 3"	1	**20.4352**	**$66**
ASC-12/16 AF	Temp compensation, adjustable set point	12	16		6" x 3.5" x 3"	1	**20.4356**	**$78**
ASC-12/16 AEF	Temp compensation, low-bat disc, adjustable	12	16	10	6" x 3.5" x 3"	1	**20.4357**	**$94**
ASC-24/8 AF	Temp compensation, adjustable set point	24	8		6" x 3.5" x 3"	1	**20.4437**	**$61**
ASC-24/16 AF	Temp compensation, adjustable set point	24	16		6" x 5" x 3"	1	**20.4457**	**$78**
ASC-24/16 AEF	Temp compensation, low-bat disc, adjustable	24	16	10	6" x 5" x 3"	1	**20.4458**	**$94**

Prices subject to change without notice.

Phocos CX Charge Controllers

Phocos CX 12/24-volt solar charge controllers have exceptional features at a very good price. They feature PWM (pulse width modulator) regulation, with integrated temperature compensation, low-battery load disconnect and a comprehensive display. Battery state of charge, charge and discharge current and faults are clearly displayed on an LCD in a bar graph.

These only consume 4 mA at night. The deep discharge protection function can be set up to three different modes: voltage controlled, SOC controlled or adaptive (fuzzy logic).

CX controllers have a built-in data logger. Data can be accessed by a PC by using the CX-USB interface converter. Data includes maximum and minimum battery voltage, state of charge at beginning and end of day, amp-hours produced by PV array and more. Daily data is available for the past 7 days.

Other features include audible warnings and a programmable night light function.

Phocos charge controllers cannot be used in systems where the array, battery and load negatives are grounded, hence they are not for use in systems that meet the NEC. Dimensions are 3.5" x 3.5" x 1.5". Not UL Listed. 3-year warranty.

Model	System voltage	Max PV amps	Max load amps	Item code	Price
CX10	12 or 24	10	10	**20.5004**	**$58**
CX20	12 or 24	20	20	**20.5005**	**$78**
CX40	12 or 24	40	40	**20.5009**	**$116**
CX – USB interface for data logger				**20.5011**	**$58**

Atkinson Lighting Controllers

This fully waterproof PV charge and lighting controller for area lighting, roadside signs, and warning signs can be used with 12- or 24-volt systems. 15-amp and 40-amp versions are available. Controllers have low-voltage load disconnect and temperature compensation and can be used with sealed or flooded batteries. Pulse action reduces sulfation.

Model	System voltage	PV amps	Load amps	Dimensions L" x W" x D"	Item code	Price
PVLC-15	12 or 24	10	10	2 X 3 X 1.25	**20.5425**	**$95**
PVLC-40	12 or 24	20	20	3.3 X 5.5 X 1.7	**20.5427**	**$140**

Lighting Controllers with Motion Sensor

This fully waterproof PV charge and lighting controller for area lighting, roadside signs, and warning signs can be used with 12- or 24-volt systems. 15-amp and 40-amp versions are available. Controllers have a motion sensor to activate the light or load when motion is sensed. They have temperature compensation and can be used with sealed or flooded batteries. Pulse action reduces sulfation.

Model	System voltage	PV amps	Load amps	Dimensions L" x W" x D"	Item code	Price
PVLC-15MD	12 or 24	10	10	2 X 3 X 1.25	**20.5432**	**$130**
PVLC 40MD	12 or 24	20	20	3.3 X 5.5 X 1.7	**20.5435**	**$160**

GSCM – Generator Start Controller Module

The GSCM is a microprocessor-based generator-starting controller that receives start commands from the 12-volt output from an OutBack FX inverter auxiliary relay, a user-supplied switch, an auxiliary relay in an inverter, a voltage controlled relay, a timer or any user-supplied contact closure. It automatically controls a gas/propane or diesel powered generator or pump, and is totally sealed for harsh environment operation.

The GSCM provides contact signal relays to start the engine and disconnect the starter when a minimum generator frequency output is measured. It monitors the generator operation, shutting it down if one of several fault conditions is detected. LEDs are flashed to indicate the cause of the shutdown. Manually resetting the GSCM removes the lockout and allows the generator to restart if called. The GSCM is powered by 12 to 24VDC from a battery bank and will start generators for 12 to 48V systems. For 48V systems the GSCM must be powered by a 24V-or-less tap on the 48V battery bank. The GSCM provides a 30-day exercise function which can be synchronized with a photovoltaic input to only start each 30-day period at the beginning of the solar charge day. 2-year limited warranty. Dimensions are 5.5" x 3.3" x 1.5".

Model	Description	Item code	Price
GSCM	Generator start controller module	20.6341	$248

GSCM-mini

This 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.

Model	Description	Item code	Price
GSCM-mini	Generator start controller module	20.6343	$165

Magnum AGS – RV Auto Generator Start

The Magnum AGS is compatible with most major generators, including Onan, Powertech, Generac, and Weterbeke. Please check with us for specific model compatibility. The Magnum Auto Generator Start (AGS) is designed to automatically start your coach generator based on low battery condition or the inside temperature of the coach.

You can set the battery start voltage from 10-12 VDC or 20-22 VDC, the start temperature from 65°-85°F, the run time from one to five hours, and the quiet time with an easy-to-set clock. Auto Gen Start settings do not interfere with the manual start / stop operation of the generator. Just use any existing start / stop switch in your coach.

Two models are available. The standalone version of the AGS works well for installation and operation without an inverter. The network version of the AGS allows operation of the AGS via the ME Series remote panel.

Model	Description	Item code	Price
AGS-S	Automatic generator start standalone	20.6375	$299
AGS	Automatic generator start – Magnum network version – Use with Magnum inverters only	20.6377	$299

Diversion Load Information

In most hydroelectric and wind-powered battery charging systems, the charging source cannot be disconnected from the batteries while running without the possibility of damaging them from over-voltage.

The typical way to regulate battery charging voltage with this type of generating system is to use a "load diversion" type charge controller. The Morningstar TS45 and TS60 and the Xantrex C-35, C-40 and C-60 can be configured for this mode of charge control. A diversion-type charge controller also may be used in a PV system. If the array is much larger than necessary to charge the battery, excess power can be used to heat water by using a water heating diversion load.

In operation, when battery voltage reaches the full charge setting in the charge controller, it begins to divert power to the diversion load. The controller uses pulse width modulation to turn the load on just enough to keep the battery voltage from rising further. To determine wattage of these diversion loads at other voltages, use Ohm's Law: voltage = amps x ohms.

The critical requirements are that the diversion load can dissipate more watts than the charging source can deliver, and that the maximum amperage that the load can draw is smaller than the maximum diversion rating of the charge controller. Order one or more loads with a total current (amps) draw greater than your charging system's maximum output, but no more than the maximum power rating of the charge controller in the diversion mode. We recommend that you do not use a load that draws more than 75 percent of the maximum rating of the charge controller. For example, if the charging source can deliver 20 amps at 24 volts, use a 30-amp diversion load with a 40-amp or larger charge controller.

Low-Voltage Water Heating Element

These low-voltage water-heating elements are for use as diversion loads for wind or hydroelectric systems. Use one or more of these heating elements with a charge controller designed for load diversion, such as the Xantrex C40 or C60, Morningstar TS-45 or TS-60 or the OutBack MX-60 to turn your excess power into hot water. They fit most standard electric water heaters with screw-in elements. We have one model for 12-volt and 24-volt systems and another for higher power 24-volt systems and 48-volt systems. Each unit has two elements that can be wired in series or parallel or used individually, depending on voltage and desired amp draw. See the chart to determine what each element will draw at various charging voltages.

If your water heater tank is designed for square flange elements, use one square flange adapter for each element. 1" male pipe threads. 2-year warranty.

	Regulation voltage:		14.00		28.00		56.00			
Model	Wiring	ohms	amps	watts	amps	watts	amps	watts	Item code	Price
12v / 24v	Series	0.96	14.6	204	29.2	817			21.9275	$137
	Single	0.48	29.2	408						
	Parallel	0.24	58.3	817						
24v / 48v (12v also)	Series	2.48	5.6	79	11.3	316	22.6	1265	21.9279	$95
	Single	1.24	11.3	158	22.6	632				
	Parallel	0.62	22.6	316	45.2	1265				
Square flange element adapter									21.9285	$12

Air Heating Diversion Loads

These resistive loads enclosed in vented aluminum boxes can be used in 12-, 24 and 48-volt diversion regulation systems. The aluminum box may get very hot in operation. It should be mounted on a nonflammable surface and should be at least 12" from any flammable material.

HL-100 is shipped as a 4-ohm resistor and can be reconfigured as a 1-, 0.5- or 0.25-ohm resistor by easily changing connections in the terminal block.

HL-75 is shipped as a 3-ohm resistor and can be reconfigured as a 0.75-ohm resistor by changing connections in the terminal block. See chart below for diverted amps at various voltages. 2-year warranty.

Model	Resistance setting	Diversion load amps at voltage below						Item code	Price
		14V	15V	28V	30V	56V	60V		
HL-100	0.25	56	60					21.9330	$235
	0.50	28	30						
	1 ohm	14	15	28	30				
	4 ohms	3.5	3.8	7	7.5	14	15		
HL-75	0.75 ohms	19	20	38	40			21.9335	$235
	3 ohms	4.7	5	9.3	10	19	20		

NEW! Morningstar Relay Driver

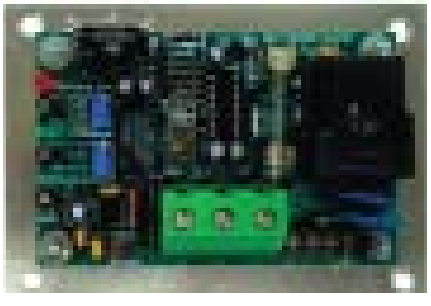
The Relay Driver is a logic module which provides control functions such as high/low voltage alarms, load control and generator start for 12-, 24- or 48-volt battery systems. It controls four independent relay driver outputs by reading digital data inputs from Morningstar's TriStar controller or by reading battery voltage. Outputs can be used to operate any of the relays in the next column or any other mechanical or solid state relay with a coil voltage that is the same as the battery voltage used to power the relay driver. Maximum current for each output channel is 750 mA.

The Relay Driver may be mounted to a DIN rail and is fully programmable with the included PC software via serial RS-232 port connection. Dimensions are 6.4" x 3.2" x 1.3" and weight is 0.4 lb. Terminals can accept 16- to 24-AWG wire. Self consumption is less than 20 mA and the unit will operate from 8 to 68 volts DC. 3-year warranty

Description	Item code	Price
Morningstar Relay Driver RD-1	20.1255	$169

Voltage-Controlled Switches

These are user-adjustable voltage-activated relays with SPDT (single pole, double throw) contacts rated for 30 amps. The relay coil in the "Active-High" version is powered when the voltage rises to the high setpoint. The relay in the "Active-Low" is powered when voltage drops to the low setpoint. The SPDT relay allows the voltage controlled switch to either connect or disconnect a circuit when it operates or to turn one thing on while turning another thing off.



Voltage settings are user-adjustable and can be read with a voltmeter. An active high relay can be used as a DC pump controller, a diversion load controller, or to operate a large relay for a high-powered charge controller. An active low can be used as a 2-wire generator start controller or as a low battery voltage load disconnect. These devices consume 17mA when off. Maximum switched current is 30A at 12/24 VDC, 3A at 48 VDC. VCS-1 measures approx. 3" x 5.3" x 1.75".

VCS-2 comes in a 5" x 7" x 2" enclosure. 1-year warranty.

Model	Mode of operation	Enclosure	Item code	Price
VCS-1AH	Active High	No	20.6218	$102
VCS-2AH	Active High	Yes	20.6215	$124
VCS-1AL	Active Low	No	20.6221	$102
VCS-2AL	Active Low	Yes	20.6224	$124

SPDT 12V 40A Relay

These single pole, double throw 40-amp enclosed relays are widely used in the automotive industry. Wires may be attached with 1/4" quick-connect terminals or the relay socket below may be used. Nominal operating current is 140mA. Relay socket has 2 feet of wire.

SPST N.O. 12V 75A Relay

This enclosed single-pole, single-throw relay has one set of contacts that close when power is applied to the coil terminals. It can be used to turn on 12-volt loads of up to 75 amps. Power terminals are 10-32 screws and coil terminals are ¼" quick disconnects. 300mA is nominal operating current.

DPDT 30A Relays

These double-pole, double-throw relays can be used for up to 30 amps at 12 or 24 volts DC or 120/240 volts AC. All contact surfaces are silver alloy with gold flashing. Contact terminals are #8-32 screws and coil terminals are #6-32 screws. Relays with 120 VAC or 240 VAC coils can be used to build simple transfer switches. Relays with DC coils can be used for remote operation of pumps and fans. By connecting a relay with a DC coil to a voltage controlled switch, AC or DC loads may be turned on or off based on battery voltage levels.

Battery Isolator Relay

This relay is designed to isolate a second battery in a vehicle. The contact terminals are connected between the positive terminal of the starting battery and the positive terminal of the second battery. The negative terminals of both batteries are connected to the vehicle chassis. One of the coil terminals is connected to chassis ground and the other coil terminal is connected to the ignition switch or fuse box. When the vehicle is running, both batteries are connected together in parallel and being charged by the alternator. When the ignition switch is off, the contacts are open, disconnecting the second battery from the vehicle electrical system. 80-amp maximum continuous current. 12-volt coil.

Description	Coil current	Item code	Price
40 A SPDT 12V relay	140 mA	53.8290	$8
Relay socket for 40 A relay		53.8291	$4
75 A SPST relay	300 mA	53.8293	$30
DPDT 30A relay – 12VDC coil	170 mA	53.8281	$40
DPDT 30A relay – 24VDC coil	53 mA	53.8287	$40
DPDT 30A relay – 120VAC coil	83 mA	53.8278	$41
DPDT 30A relay – 240VAC coil	42 mA	53.8284	$40
Dual battery isolator relay		53.8272	$25

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Customers rely on the long-term performance of our solar inverters. That's why over 500,000 of them are in service around the world. Our innovative engineers have developed a complete range of inverters, all designed, manufactured, and tested in Germany.

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Rock Solid Solar SMA

Inverters

The inverter is the heart of all but the smallest power systems. It is an electronic device the converts direct current DC power from batteries or solar modules into alternating current AC power to operate lights, appliances or anything that normally operates on power supplied by the utility grid. Inverters come in many varieties, sizes and qualities and offer various features that specialize them for particular applications.

Off-Grid Inverters

Off-grid, or standalone, inverters convert DC power stored in batteries to AC power that can be used as needed. Select an inverter for your power system based on the maximum load you will be powering, the maximum surge required, AC output voltage required, input battery voltage and optional features needed. High quality standalone inverters are available in sizes from 100 watts, for powering notebook computers and fax machines from your car, to 60 kilowatts, for powering a commercial operation. The size of an inverter is measured by its maximum continuous output in watts. This rating must be larger than the total wattage of all of the AC loads you plan to run at one time. Wattage of most AC loads can be determined from a tag or label on the appliance, usually located near where the power cord enters, or from the owner's manual. If the inverter is expected to run induction motors, like the ones found in top loading washers, dryers, dishwashers and large power tools, it must be designed to surge, or deliver power many times its rating for short periods of time while these motors start. Standalone inverters are available with two basic power output waveforms: *sine wave*, and *modified sine wave* (the proper term is actually modified *square* wave, but since *modified sine wave* is much more commonly used, we use that term in this catalog).

Grid-tie inverters, dual-function inverters and utility companies deliver a sine wave. Exeltech, Xantrex SW Series, SMA Sunny Island and OutBack FX inverters are sine wave off-grid inverters. Sine wave inverters have a higher cost, but they can operate almost anything that can be operated on utility power. Exeltech sine wave inverters are an excellent choice for power systems running audio or telecommunications equipment and other electronics that are waveform-sensitive. The OutBack and Xantrex SW series inverters can be ganged together for up to 36 kW of output and can operate off-grid or grid-tie. We now carry Samlex sine wave PST inverters for a lower cost, a small-system sine wave alternative.

Xantrex DR series and Samlex PSE inverters have modified sine wave output with harmonic distortion of around 40%. They are an economical choice in power systems where waveform is not critical. Their high surge capacity allows them to start large motors while their high efficiency makes them economical with power when running small loads like a stereo or a small light. They can power most lighting, televisions, appliances and computers very well. Unfortunately, this type of inverter may destroy some rechargeable tools and flashlights, and laser printers and copiers. They may not allow many laser printers, copiers, light dimmers and some variable speed tools to operate. Equipment with silicon controlled rectifiers (SCRs) will not operate. Some audio equipment will have a background buzz that may be annoying to music connoisseurs.

Grid-Tie Inverters

Grid-tie, or utility intertie, inverters convert DC power from PV modules into AC power to be fed into the utility grid. There are two major types of grid-tie inverters; string inverters and low voltage input inverters.

The SMA Sunny Boy, Fronius and Xantrex GT-3 inverters are string inverters. The name "string" comes from the way the PV modules are wired together, in series to achieve a higher voltage. These inverters are designed to run at voltages up to 600 VDC. String wiring is faster to install, more efficient and allows the use of smaller gauge wire. DC voltage this high can be very dangerous and life-threatening, so string inverters should be installed and serviced by qualified electricians.

A grid-tie PV system uses the utility company, in effect, as its storage battery. When the sun is shining, your electricity comes from the PV array, via the inverter. If the PV array is generating more power than you are using, the excess is sold to the power utility company through your electric meter, by making the meter run backward. When you need more power than the PV array can supply, the utility makes up the difference. This type of system makes the most sense in most cases where you have utility power, because there are no batteries to maintain or replace. Unfortunately, if the utility power goes down, this type of inverter will go off, too, regardless of whether or not the sun is shining.

Dual-Function Inverters

Using a dual-function inverter allows you to sell excess power to the utility, and also maintain a battery bank for standby power in the event of a utility power failure. The Xantrex

SW series inverters are primarily standalone inverters that can function as an intertie inverter at the same time, but with a lower efficiency than an inverter designed for grid-tie only. The OutBack PS1 and the new Xantrex XW are grid-tie inverters that are designed to provide battery backup when the utility

fails. The SMA Sunny Island inverter is designed to work with a Sunny Boy inverter to provide utility intertie (grid-tie) with battery backup.

In a typical installation, the inverter is connected to a battery bank, a sub panel for critical loads that will be powered during a power outage, and the house load center. If the utility is available, the inverter will supply the house loads from the utility. If the utility fails, the inverter will supply power to the loads from the battery. When the utility is available again, the inverter will switch the loads back to the utility, and recharge the batteries. If the batteries become fully charged by another power source, such as photovoltaic modules or a wind or hydroelectric generator, excess power may be sold back to the utility in locations where net metering is allowed.

Output voltage

Most of the inverters we stock supply standard 120VAC 60 HZ. Outback, Xantrex SW and Magnum inverters can be stacked in pairs for 240VAC, such as one gets from utility companies and fuel-powered generators. The Xantrex XW and the Magnum MS4448-AE deliver 120/240VAC power from one inverter. Most of them can be special ordered with other output voltages and frequencies for use anywhere in the world. See our export models and contact us with any special requirements that you have.

Interference

The electronic circuitry in inverters may cause problems with radio and television reception, noise on telephones and buzz in audio equipment. Sine wave inverters cause the least amount of interference. Interference can be minimized by locating the inverter very close to the batteries, twisting together the cables that connect the inverter to the battery, running AC lines separate from other wiring (such as telephone wires) and locating the inverter away from appliances that are susceptible to interference. All inverters cause interference on AM radio!

Wiring Considerations

Standalone inverters require very high current from a battery to operate large loads. A 2000 watt inverter running at full power in a 12 volt system will be drawing nearly 200 amps from the battery. Large cables and good connections are required for proper operation.

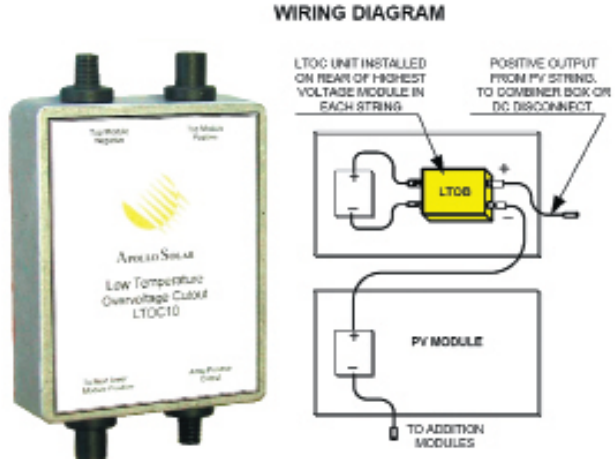
Use caution when plugging a small inverter into a lighter outlet located far from a battery. Typical DC house wiring may have insufficient wire sizes and too much voltage drop to supply the current required by these inverters. All battery-based inverters require proper fusing between the battery and the inverter.

NEW PRODUCT!

Low Temperature Overvoltage Bypass

Protect MPPT charge controllers and grid-tie inverters from high PV open circuit voltage at low temperatures with the new Low Temperature Overvoltage Bypass (LTOB) from Apollo Solar. Solar module voltage rises with drop in temperature. Sometimes when the temperature gets very low, the voltage of a string of several modules in series gets too high and causes damage to a charge controller or inverter. This problem can be solved by putting less modules in series, but sometimes this causes a sacrifice when temperatures are high.

Now you can size the PV array for optimum performance without regard to high open circuit voltages at low temperatures. The Apollo Solar LTOB automatically switches modules out of the circuit if the temperature falls below 10 degrees F. One unit is required for each string of modules. Switch up to 8 amps per string. Installation is simple. Just plug in M-C connectors and stick the LTOB to back of the module. Zero power consumption.



Description	Item code	Price
Low temperature overvoltage bypass	20.7013	$185

SMA America

Sunny Boy Grid-Tie Inverters

SMA Sunny Boy inverters are the most widely used grid-tie PV inverters in the world. SMA inverters are available in sizes from 700 watts to 7000 watts, making them ideal for a wide range of applications from small residential systems to very large 3-phase industrial systems.

All SMA inverters come standard with built-in LCD digital monitors that display instantaneous power output, energy delivered during the current day and the total energy produced since installation.

The SB700 and 1800 have 120 VAC output. The SB3000 and SB4000 are auto-sensing for use on 240 VAC and 208 VAC applications. The SB 5000, 6000 and 7000 can be used in 208, 240 and 277 VAC applications. SMA offers a wide range of accessories for communications and monitoring of the system. The SB 3000 and 4000 come with a DC disconnect switch and the SB 5000, 6000, and 7000 come with an AC/DC disconnect switch, each with an integrated fused series string combiner that connects to the bottom of the inverter. The disconnect switches are housed in a NEMA 3R enclosure. All electronic components are in a sealed compartment.

The SB 700 and SB 1800 are housed in a completely sealed stainless steel enclosure. Outdoor installation is recommended for the sealed inverters so natural air-flow can cool the heat-sink. The chart on page 9 shows a typical module string size for many PV module brands that can be used with each inverter. This number can vary depending on maximum and minimum temperatures in the location where the system is installed. For more details, consult us or visit www.sma-america.com to use SMA's string-sizing software.

All inverters are compliant with UL 1741, UL 1998, IEEE-929, IEEE-1547, FCC Part 15 A & B. The new SMA inverters now have a standard 10-year warranty.

Model	Maximum AC power	AC output volts	DC array voltage	Peak power tracking	CEC efficiency	Max DC current	Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
SB700U SBD	700 600 460	120VAC	150-250 125-250 95-250	123-250 100-200 77-150	91.5%	7A	12.7 x 12.6 x 7.1	43	**30.3113**	**$1540**
SB1800U SBD	1800	120VAC	156-400	156-350	91.5%	12A	17.1 x 11.6 x 8.4	60	**30.3105**	**$2,400**
SB3000US	3000	208VAC 240VAC	200-500	180-400 200-400	95.0% 95.5%	17A	17.8 x 13.8 x 9.3	88.6	**30.3083**	**$3,432**
SB4000US	3500 4000	208VAC 240VAC	250-600	220-480 250-480	95.5% 96.0%	18A	17.8 x 13.8 x 9.3	88.6	**30.3084**	**$3,750**
SB5000US	5000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 95.5% 95.5%	21A	18.4 x 24.1 x 9.5	143	**30.3085**	**$5,138**
SB6000US	6000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 95.5% 96.0%	25A	18.4 x 24.1 x 9.5	143	**30.3086**	**$5,277**
SB7000US	7000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 96.0% 96.0%	30A	18.4 x 24.1 x 9.5	143	**30.3087**	**$5,733**

Prices subject to change without notice.

NEW! Sunny Tower 36kW and 42 kW Systems

The Sunny Tower combines the advantages of central inverters with the performance and installation advantages of string inverters by offering assembled 36-kW or 42-kW systems. Each Sunny Tower consists of six 7-kW or 6-kW inverters mounted on a stainless steel structure. Two Sunny Towers can be combined as an 84 kW system. The Sunny WebBox comes standard making the Sunny Tower internet-ready. This type of system offers the advantage of multiple array MPP tracking, optimum operation under partial load, 96% CEC efficiency and quick delivery. Sunny Towers can be assembled on-site, eliminating the need for specialized heavy equipment. The system is NEMA 3R outdoor rated and can be used in single-phase or three-phase systems at 208 VAC, 240 VAC or 277 VAC and its total weight is 1115 lbs. (Tower is 330 lbs, plus six inverters.)

Model	Max AC power	Max AC output	DC Array voltage	Peak power tracking	Max DC current	Item code	Price
ST6000U	36 kW	3 x 58A	250-600	250-480	6 x 25A	**30.3060**	**$36,422**
ST6000U+WebBox	36 kW	3 x 58A	250-600	250-480	6 x 25A	**30.3061**	**$42,404**
ST7000U	42 kW	3 x 68A	250-600	250-480	6 x 30A	**30.3070**	**$39,160**
ST7000+WebBox	42 kW	3 x 68A	250-600	250-480	6 x 30A	**30.3071**	**$45,142**

SMA Sunny WebBox – Sunny Portal Connection

Description	Item code	Price
SMA WebBox	**30.3141**	**$938**

The SMA Sunny WebBox provides a connection between the operator's computer and/or the free Sunny Portal web site (www.sunnyportal.com). The WebBox can be connected to a Sunny Boy, Sunny Tower, Sunny Island, or Sunny Central inverter (up to 50 units). Connection is made with 4-conductor twisted pair cable between the inverter's RS-485 output and the Sunny WebBox terminals. The Sunny WebBox connects to a local area network (LAN) with an Ethernet cable or to a phone line with the optional modem. The Sunny WebBox stores system performance data in its internal 8 MB memory or on a standard SD memory card and can be set to upload the data to the Sunny Portal website at user-selectable intervals. Password protected. 5-year warranty

Sunny Beam Wireless System Monitor

Description	Item code	Price
Sunny Beam wireless system monitor	**30.3143**	**$563**
Additional antenna module for Sunny Beam	**30.3144**	**$198**

With the new Sunny Beam wireless system monitor from SMA you can remotely monitor the performance of your PV system without wires. It also stores a month's worth of production data for review at any time. The Sunny Beam can monitor up to four inverters and simultaneous display output power, daily energy, and energy total. The Sunny Beam automatically logs each day's energy production and displays it in graph format for the past thirty days. Based on the energy production of the PV system, the Sunny Beam will also calculate the amount of CO2 and money saved. The built-in solar cell keeps the internal batteries fully charged. The internal batteries may also be recharged via the built-in USB port. The Sunny Beam comes with an antenna module for one inverter. Monitor up to 3 additional inverters by purchasing additional antenna modules. 5-year warranty.

Model	SMA Sunny Boy Communications Cards	Item Code	Price
RS-232-N	Module for remote communication between Sunny Boy without display and a Windows based PC. Requires cable and Sunny Data software from web. Maximum distance from PC is 50 feet. Display must be removed from SB1800, 2100 and 2500.	**30.3122**	**$183**
RS-485-N	Module for remote communication between multiple Sunny Boy Inverter(s) and Sunny WebBox or Fat Spaniel monitoring system.. A 4 conductor cable required between inverters. RS485 Cable is required between one inverter and Sunny WebBox. One module is required for each inverter.	**30.3123**	**$175**
RS232 Cable	Cable to connect a PC to single inverter using RS232 modules – 50 feet (15 meter).	**30.3147**	**$114**
RS485 Cable	Cable to connect to multiple inverters using RS485 modules – 50 feet (15 meter).	**30.3148**	**$114**

Fronius

IG Inverters

Fronius IG inverters offer high efficiency, precision maximum power point tracking, and intelligent thermal management, all of which result in superior energy output from grid-tie photovoltaic systems. Their wide input voltage range (150-450 volts) permit the use of modules in any power and voltage range. Their light weight and innovative mounting hardware make them very easy to install.

Fronius IG inverters come standard with an integrated LCD that displays and records over 20 parameters pertaining to inverter and system operation. Fronius inverters have 3 expansion slots that allow you to add features like external sensors and remote displays. You can use a personal computer to update the inverter with the latest software upgrades.

The larger inverters (over 3 kW) are built with the same power stages as the smaller ones, but use 2 of them. When these inverters see array capacity at less than half, one stage turns off, giving the inverter higher efficiency during periods of low insolation. UL Listed. 10-year warranty.

Model	Maximum AC power	DC Array voltage	LCD Display	CEC Efficiency	Maximum DC current	AC output volts	Weight (lbs)	Item code	Price
IG 5100	5100 W	150-450	Yes	94.5%	33.9A	240VAC	42	**30.3407**	**$4,190**
IG 4500-LV	4500 W	150-450	Yes	93.5%	29.3A	208VAC	42	**30.3412**	**$4,110**
IG 4000	4000 W	150-450	Yes	94.0%	26.1A	240VAC	42	**30.3405**	**$3,848**
IG 3000	2700 W	150-450	Yes	94.0%	18A	240VAC	26	**30.3403**	**$2,588**
IG 2500-LV	2350 W	150-450	Yes	93.0%	16.9A	208VAC	26	**30.3410**	**$2,430**
IG 2000	2000 W	150-450	Yes	93.5%	13.6A	240VAC	26	**30.3402**	**$2,328**

Fronius IG Wireless Personal Display

The Fronius IG Personal Display is easy to install and easy to use. The readout and interface are based on the same display that comes standard on all Fronius IG Series inverters. Although tested to 150 feet indoors and 500 feet outdoors, there are many reports from the field of the units transmitting from much farther distances.

The Personal Display can aggregate data for up to 15 Fronius IG inverters or show data for each individual inverter in a system – i.e., data from a system that is over 75 kW AC can be viewed together or as sub-systems. It shows instantaneous data such as power, voltage and current, and it will store the daily and cumulative. The display offers two levels of access: easy and pro. In the easy level, homeowners can view system basics like power, energy output, CO_2 offset, and the number of dollars saved; meanwhile, the pro level offers more advanced users information like voltage, current and grid frequency. The unit was designed with a backlit display and a stylish silver case to attract the attention of solar enthusiasts and their visitors alike. The display can mount on a wall near a thermostat or clock, or be placed on the coffee table or night stand. A wireless card is required for each inverter to be monitored.

Fronius IG Public Display

The Fronius Public Display is constructed on the plug & play principle. Just insert the plug-in card or box and any cables supplied, select the display values and away you go. Alphanumeric large-format display. The data from up to 100 inverters, can be selected for the rotating display. One value in the group is picked as the favorite and is then displayed every second time the value changes. The following values can be displayed: AC-power – total energy; energy/day – energy/year – CO_2 total – CO_2/year – CO_2/day – total earning; earnings/day – earnings/year – date & time. A Com Card (30.3425 on next page) must be installed in each inverter to be monitored.

Description	Item code	Price
Fronius IG Personal Display	**30.3417**	**$284**
Wireless card for Personal Display	**30.3419**	**$131**
Public Display	**30.3463**	**$2,329**

Fronius IG DatCom Accessories

Remote data communications and data logging features can easily be added to transform the inverter into a sophisticated data acquisition system and weather monitoring station. DatCom components and accessories connect to the inverter and each other with standard Cat-5 network cables and RS-232 cables.

Datalogger Boxes and Cards

Datalogging requires a COM card to be installed in each inverter in the system and a Datalogger Box. The Datalogger Box stores the data collected from the inverters and any of the optional weather sensors, and connects to a PC or an external modem to allow you to monitor your PV system from anywhere in the world. Two versions of the Datalogger Box are available. The Datalogger Easy monitors one IG inverter. The Datalogger Pro can monitor up to 100 Fronius IG inverters.

Datalogger cards perform the same function as the Boxes. The Easy card works for one inverter; the Pro card works for up to 100 inverters. Both cards work with a COM card and DatCom systems.

Sensor Box, Sensor Card and Sensors

A Sensor Box or Sensor Card is required to add weather sensors to your data acquisition system. The Sensor Box and Card each have 6 inputs – two for measuring temperature, one for measuring irradiance, two digital inputs for a wind speed sensor and/or kilowatt hour meter and one 20 mA current interface for a humidity sensor.

Model	Accessory	Item code	Price
COM card, retrofit	Communications card for all Fronius IG inverters	30.3425	$137
Datalogger Pro Card	Control and Monitoring data storage and PC interface for up to 100 IG inverters	30.3432	$660
Datalogger Pro Box	Control and Monitoring data storage and PC interface for up to 100 IG inverters	30.3431	$705
Datalogger Easy Card	Control and Monitoring data storage and PC interface for 1 IG inverter	30.3434	$426
Datalogger Easy Box	Control and Monitoring data storage and PC interface for 1 IG inverter	30.3435	$446
Datalogger Interface Box	Combines benefits of the Datalogger Pro and interface box	30.3436	$798
Interface Box	Use to export real time data without data storage – for up to 100 inverters	30.3440	$350
Interface Card Easy	Use to export real time data without data storage from 1 inverter – requires Datalogger or ComCard	30.3441	$177
TIXI modem	Allows DatCom system to dial out on standard phone line to email or fax energy output information	30.3452	$558
Sensor card	Monitoring interface with 6 sensor input channels	30.3443	$659
Sensor box	Monitoring interface with 6 sensor input channels	30.3442	$705
Sensor, wind speed	For measuring wind speed. Sensor box (above) is required.	30.3446	$85
Sensor, ambient temperature	For measuring outside temperature. Sensor box (above) is required.	30.3448	$51
Sensor, module temperature	For measuring module temperature. Sticks to back of PV module. Sensor box (above) is required.	30.3449	$106
Sensor, irradiance	Reference PV cells for measuring solar insolation. Sensor box (above) is required.	30.3444	$243
RS232 null modem cable	For connection of Datalogger cable to PC or cable.	30.3453	$25
Cat-5 cable 3 foot	Network cable for connecting inverters to each other or between Sensor Box and Datalogger Box	30.3455	$4
Cat-5 cable 65 foot	Network cable for connecting inverter to Datalogger.	30.3457	$33
Cat-5 cable 196 foot	Network cable for connecting inverter to Datalogger.	30.3459	$129

Until someone figures out how to bottle the energy of a toddler, Pronius will be here to harness the energy of the sun.

With over 250,000 Pronius solar inverters installed worldwide, you can be confident that our products are designed and manufactured for the long term, using the best components available. And we stand behind this with a **standard ten-year warranty on all our inverters sold in North America.**

Best of all? Our customer support is paperwork free.

Standard ten-year warranty on Fronius inverters sold in North America.

Paperwork-free customer support.

800 reimbursements for warranty-related service repairs.

Warranties are tied to the inverter serial number, not the owner.

Take a look at what 60 years of experience can do for you.

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Fronius

POWERING YOUR FUTURE

Xantrex

GT Grid-Tie Inverters

Xantrex GT Series grid-tie solar inverters have an integrated, lockable 600-volt PV/Utility disconnect switch which may eliminate the need for external disconnects in some jurisdictions. A split-chassis design keeps the wiring box separate from the inverter, allowing for easy access and spacing to the AC and DC string terminals and eliminating exposed wiring during inverter installation and removal. The wiring box includes eight 3/4-inch knockouts and easy access DC and AC terminal blocks that accept wire sizes from #14 to #6 AWG.

The GT enclosure is a NEMA 3R, allowing for both for outdoor and indoor installation. The inverter includes a slotted, hook-style back plate for easy installation. For large systems, multiple inverters can be mounted side by side centered on standard 16" stud spacing to reduce visible conduit and make installations look more attractive.

GT inverters come standard with a backlit 16-character two-line liquid crystal display (LCD). The display provides inverter power, daily and lifetime energy production, PV array voltage and current, utility voltage and frequency, time online "selling" today, fault messages, and two installer-customizable screens. Tapping a finger close to the LCD activates the backlight display. With each tap, the display cycles through all the communication screens. The LCD is always on standby, ready to provide information even at night. When inverters are daisy chained using standard CAT5 Ethernet cable, each inverter display will report the output of the entire system. The GT offers an isolated RS232 port and two Xanbus RJ45 communication ports. No additional communication ports or cards are needed to connect a PC. An optional wall mount inverter monitor and communication gateway can be connected to the inverter(s) with Cat-5 cable. The communications gateway connects to a computer to monitor inverter performance. UL Listed. 5-year warranty is standard, a 5-year extension is available.

Xantrex model	Maximum DC array amps	Maximum DC array volts	MPPT input voltage range	CEC Efficiency 208/240	Item code	Price
GT2.8 2800-watt 208/240V	14.9/15.4	600	195 - 600	94.5%/95%	**30.1801**	**$2,375**
GT3.3 3300-watt 208/240V	17.0/18.0	600	195 - 600	94.5%/95%	**30.1803**	**$2,875**
GT4.0 4000-watt 208/240V	20.0/22.0	600	240 - 600	94.5%/95%	**30.1804**	**$3,130**
GT5.0 5000-watt 208/240V	21.0/22.0	600	240 - 600	94.5%/95%	**30.1805**	**$3,950**
GT solar inverter monitor	Monitor up to 5 inverters. Use Cat-5 cable to connect				**30.1838**	**$300**
Communications gateway	Monitor up to 7 inverters with a PC. Use Cat-5 cable to connect				**30.1813**	**$650**

NEW! GT 3-Phase Commercial Inverters

The GT Commercial Series grid-tie inverter makes industrial-commercial power production affordable and attractive. These inverters have the highest efficiency of any large commercial inverters on the market. Xantrex GT inverters are available in sizes from 30 kW to 250 kW.

The compact, 220-pound, 30kW inverter is in a wall-mounted aluminum enclosure and requires a symmetrical array input (split array +/-180-500VDC).

100kW and 250kW inverters have pad-mounted epoxy-coated steel enclosures with integrated transformers and disconnects. These inverters can be configured as positive ground for use with SunPower modules. They require zero clearance on back and sides and can fit through standard doors. UL Listed. 5-year warranty; 5-year extension available.

Xantrex model	Continuous output (kW)	AC output voltage	Max DC amps	Max DC array voltage	MPPT range	CEC efficiency	Dimensions H" x W" x D"	Item code	Price
GT30-208	28.8	208	100	600	180-500	96%	44 x 22 x 13	**30.2003**	**$27,909**
GT100-480	100	480	347	600	300-600	96%	69 x 67 x 42	**30.2015**	**$74.455**
GT100-208	100	208	347	600	300-600	96%	69 x 67 x 42	**30.2017**	**$74.455**
GT250-480	250	480	867	600	300-600	96%	84 x 91 x 42	**30.2026**	**$122,273**

Prices subject to change without notice.

Solectria

3-Phase Commercial Inverters

Solectria Renewables PVI inverters use rugged DSP-controlled IGBT circuitry to achieve high efficiency, reliability and low installed cost. The NEMA 3R enclosure with forced ventilation allows these inverters to be mounted in full sun, on roof tops or indoors. Inverter electronics are in a NEMA 4X enclosure within the housing. Their fully integrated design includes transformer, filters and AC and DC disconnects. Disconnects face to the side. If you are using multiple inverters and need to have the disconnects facing forward to minimize distance required between inverters, contact us for pricing.

All Solectria inverters have an RS232 and RS485 communications ports; Fat Spaniel inverter direct monitoring ports are optional. Contact us for information. Inverters are listed to UL1741 and IEEE Std 1547 and are certified to IEEE 6241 NY SIR surge test requirements.

Solectria inverters come with a 5-year warranty. Call for pricing on 10-year warranty. They will be shipped from the Solectria factory in Massachusetts.

Inverter model	AC power	AC output voltage	Max DC amps	Max. DC array volts	MPPT Range volts DC	CEC efficiency	Weight (lbs)	Dimension H"xW"xD"	Item code	Price
PVI 95KW-480VAC	95 kW	480	287	600	330-500	95.50%	1610	76x54x25.3	**30.3905**	**$61,900**
PVI 95KW-208VAC	95 kW	208	287	600	330-500	94.50%	1610	76x56x29.3	**30.3901**	**$63,480**
PVI 82KW-480VAC	82 kW	480	248	600	330-500	95.50%	1591	76x54x25.3	**30.3897**	**$54,960**
PVI 82KW-208VAC	82 kW	208	248	600	330-500	94.50%	1591	76x56x29.3	**30.3893**	**$56,200**
PVI 60KW-480VAC	60 kW	480	190	600	330-500	95.50%	1526	76x54x25.3	**30.3889**	**$50,800**
PVI 60KW-208VAC	60 kW	208	190	600	330-500	94.00%	1526	76x56x29.3	**30.3885**	**$51,900**
PVI 15KW-480VAC	15 kW	480	68	475	225-380	94.00%	398	34.5x 26x13.6	**30.3875**	**$17,430**
PVI 15KW-208VAC	15 kW	208	68	475	225-380	94.50%	398	34.5x 26x13.6	**30.3871**	**$17,230**
PVI 13KW-480VAC	13.2 kW	480	60	475	225-380	94.00%	376	34.5x 26x13.6	**30.3867**	**$15430**
PVI 13KW-208VAC	13.2 kW	208	60	475	225-380	94.00%	376	34.5x 26x13.6	**30.3863**	**$15,230**
Fused combiner for 13KW/15KW inverter. Specify 6 or 7 fuses and fuse size (10A or 15A) – integrated into inverter – add									**30.3859**	**$540**

SatCon

Powergate 3-Phase Commercial Inverters

PowerGate inverters offer market-leading reliability, efficiency and ease-of-use for large-scale grid-connected photovoltaic systems. A single-enclosure solution, the utility-grade PowerGate incorporates a high-efficiency transformer and both AC and DC switchgear that disconnect the inverter at night, minimizing tare losses. A highly efficient MPPT tracking algorithm and intelligent wake-up routine further maximize net energy harvest.

The PowerGate is certified to UL-1741 and is available with a variety of local and remote data monitoring options. A 4-line alphanumeric LCD display provides local monitoring.

A single enclosure with integrated high-efficiency transformer and internal AC and DC switchgear simplifies installation.

Options include integrated sub-array combiner, PV View web-enabled data monitoring, PV Zone sub-array performance monitoring and RS485 Modbus.

Wide input voltage range. 10-year warranty.

Combiner for use with inverter size	No. of strings	amps per string	Item code	Price
30-50 kW	3	100	**30.3311**	**$560**
75-100 kW	6	100	**30.3313**	**$1,050**
135 kW	9	100	**30.3315**	**$1,300**
225 kW	12	100	**30.3317**	**$3,950**
500 kW	30	100	**30.3319**	**$7,160**

Model	Continuous output (kW)	AC output voltage	Max DC amps	Max DC array volts	MPPT range	CEC efficiency	Weight (lbs)	Item code	Price
AE30-60-PV-D	30	208	96	600	295-600	92.5%	1300	**30.3210**	**$33,780**
AE30-60-PV-A		480				93.0%		**30.3209**	**$33,000**
AE50-60-PV-D	50	208	160	600	295-600	94.5%	1778	**30.3218**	**$38,780**
AE50-60-PV-A		480				93.0%		**30.3216**	**$37,800**
AE75-60-PV-D	75	208	240	600	295-600	95.0%	2600	**30.3222**	**$58,420**
AE75-60-PV-A		480				95.5%		**30.3220**	**$57,240**
AE100-60-PV-D	1`00	208	319	600	295-600	94.5%	3250	**30.3226**	**$72,600**
AE100-60-PV-A		480				94.5%		**30.3224**	**$71,280**
AE135-60-PV-D	135	208	431	600	295-600	95.0%	3500	**30.3233**	**$87,980**
AE135-60-PV-A		480				95.5%		**30.3231**	**$86,400**
AE225-60-PV-A	225	480	718	600	295-600	94.5%	4800	**30.3235**	**$113,400**
AE500-60-PV-A	500	480	1595	600	295-600	95.0%	5400	**30.3237**	**$216,680**

OutBack

GTFX and GVFX Grid-Tie Inverters and Systems

The OutBack GTFX and GVFX series are grid-tie versions of the FX inverters. Available as either turbo-cooled and sealed, the GTFX; or internally ventilated, the GVFX. With these inverters you can sell solar, wind and hydro power back to the utility grid. When the utility power goes out, the inverter will automatically switch to battery power and your renewable sources to run your standby loads. The inverter can be set so that either utility power or your renewable sources will recharge the battery after an outage. To prevent AC power draw at night, an automatic "silent" sell mode is built in. Stacked inverters optimize conversion efficiency by matching the number of inverters to the amount of power being sold or used. Daily energy production is within a few percentage points of a batteryless grid-tie system (depending on battery bank). Two inverters can be stacked for 120/240v output. Not recommended for off-grid use. 2-year warranty standard, with optional 5- and 10-year warranties.

OutBack model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Weight lbs	Item code	Price
OutBack sealed grid-tie inverters									
GTFX2524	2500	24 VDC	120V/60Hz	18-20W	55A	70A	56	**30.4025**	**$1,995**
GTFX3048	3000	48VDC	120v/60Hz	21-23W	35A	70A	66	**30.4030**	**$1,995**
OutBack vented grid-tie inverters									
GVFX3524	3500	24 VDC	120V/60Hz	18-20W	85A	70A	54	**30.4032**	**$2,345**
GVFX3648	3600	48VDC	120v/60Hz	21-23W	45A	70A	54	**30.4036**	**$2,345**

OutBack Outdoor Systems

The PS1 systems below are turnkey, pre-programmed and fully ETL Listed as complete grid-tie battery backup solutions. Even the battery interconnecting cables and conduit are included to eliminate all guess work and difficult to find parts. The PS1 includes a type 3R rainproof enclosure which provides flexibility in where you choose to install the system, allowing for installation in limited space or outdoors. The PS1 is ETL Listed and has a 5-year warranty.

OutBack model	System type	Inverter(s) qty - model	Rated power kW - AC output	DC voltage	Battery charger	Item code	Price
OBPS1-GTFX3048	PS1	1 – GTFX3048	2.5 kW 120V	48 VDC	35 AMP	**30.4611**	**$4,795.00**
OBPS1-GVFX3648	PS1	1 – GVFX3648	3.0 kW 120V	48 VDC	45 AMP	**30.4615**	**$4,795.00**
PS1-BE	Battery box – holds four group-31 sealed batteries					**30.4631**	**$599.00**

OutBack Indoor Systems

OutBack also offers pre-wired and tested one- and two-inverter grid-tie systems for indoor installation. Choose a 24- or 48-volt system and sealed or ventilated inverters. Charge controller is not included in price below. Add optional MX60 charge controllers (33.1201) to use this panel as a PV grid-tie system. Batteries are required.

Model	FLEXware type	Inverter(s) qty - model	Rated power kW - AC output	DC voltage	Battery charger	Item code	Price
Indoor sealed grid-tie systems							
OBFW5-GTFX2524/S	500	1 – GTFX2524	2.5kW 120V	24 VDC	55 AMP	**33.0201**	**$3,980**
OBFW5-GTFX2524/D	500	2 – GTFX2524	5kW 120/240V	24 VDC	110 AMP	**33.0203**	**$6,309**
OBFW5-GTFX3048/S	500	1 – GTFX3048	3.0kW 120V	48 VDC	35 AMP	**33.0209**	**$3,920**
OBFW5-GTFX3048/D	500	2 – GTFX3048	6.0kW 120/240V	48 VDC	70 AMP	**33.0211**	**$6,189**
Indoor ventilated grid-tie systems							
OBFW5-GVFX3524/S	500	1 – GVFX3524	3.5kW 120V	24 VDC	85 AMP	**33.0205**	**$4,337**
OBFW5-GVFX3524/D	500	2 – GVFX3524	7kW 120/240V	24 VDC	170 AMP	**33.0207**	**$7,024**
OBFW5-GVFX3648/S	500	1 – GVFX3648	3.6kW 120V	48 VDC	45 AMP	**33.0213**	**$4,270**
OBFW5-GVFX3648/D	500	2 – GVFX3648	7.2kW 120/240V	48 VDC	90 AMP	**33.0215**	**$6,889**
OBFW-O-MX60	OutBack MX60 charge controller with breaker, installed in power system					**33.1513**	**$763**

Xantrex

NEW! XW Sine-Wave Battery-Based Inverter System – Off-Grid and Grid-Tie

The Xantrex XW Series hybrid inverter/charger offers an innovative, integrated design which minimizes external balance-of-system components allowing for much quicker and easier installation. The XW Series offers pure sine-wave capability as well as split-phase operation right out of the box for 120 VAC and/or 240 VAC solutions. Up to three units can be operated in parallel, offering 18 kW, 120/240 VAC power.

Certified to UL-1741 and CSA for grid-tie applications, the XW can be used as a grid-tie battery-backup inverter or an off-grid inverter. One or two XW MPPT charge controllers are required for PV grid-tie operation.

Unsurpassed surge capacity is achieved by using digital control to regulate the output voltage from dropping during surge. A full 200% rated output power is delivered to load under surge conditions. Efficient, power-factor-corrected, high-current multi-stage battery charging minimizes recharge time and electricity/fuel costs, and prolongs battery life.

The inverter display panel give status-at-a-glance. LEDs indicate AC-in status, faults/warnings, equalize mode, and battery state of charge. Three-character LCD indicates output power or charge current.

The new wall-mount design is easier to install than the SW power panel. The power distribution panel includes all AC/DC disconnects and wiring so there is no need to individually purchase separate components. The distribution panel and conduit box is factory wired and labelled to support one inverter in a code-compliant manner, and it has wiring space and conduit and breaker knockouts to add up to three inverters and/or four charge controllers. Field-reversible door with magnetic catch makes access to wiring easy. Options include an XW connection kit for a second inverter, an XW conduit box for systems with more than two inverters or to retrofit XW inverters into existing systems which already have AC/DC disconnects. Conduit box/raceway has barriers to ensure separation between low-voltage communication cables and AC and DC wires.

XW-MPPT60-150 60A Solar Charge Controller with integrated PV ground fault protection accepts arrays with open-circuit voltage up to 150 VAC and employs dynamic maximum power point tracking.

The XW system control panel plugs into Xanbus network and provides a central user interface to configure and monitor all components in the system.

5-year warranty. Dimensions of the inverter are 16" x 23" x 9". The inverter is field-serviceable without needing to remove it from the wall.

Xantrex model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
XW4024-120/240-60	4000	24 VDC	120/240V/60Hz	24W	85	50A	115	**30.1166**	**$3.250**
XW4548-120/240-60	4500	48VDC	120/240V/60Hz	26W	85	50A	115	**30.1163**	**$3,600**
XW6048-120/240-60	6000	48VDC	120/240V/60Hz	28W	100	70A	125	**30.1160**	**$4,500**
XW power distribution panel	XW Power distribution panel w/ conduit box for 1 XW inverter							**30.1169**	**$1500**
XW-connection kit	XW connection kit for second inverter, includes breakers and raceway							**30.1172**	**$750**
XW-conduit box	XW empty conduit raceway							**30.1175**	**$175**
XW-MPPT60-150	XW 60A MPPT charge controller							**20.8040**	**$650**
XW-auto generator start	Automatic generator start module for the XW system							**30.1183**	**$200**

Prices subject to change without notice.

THE NEXT GENERATION

XW SYSTEM

Xantrex introduces the new standard in battery-based systems, for renewable energy and backup power applications – the Xantrex XW system.

The complete XW System includes our sophisticated XW Hybrid Inverter/Charger, XW Power Distribution Panel – incorporating both AC and DC breakers – and the XW Solar Charge Controller – which offers a dynamic, maximum power point tracking algorithm to optimize energy harvest.

When looking for a battery-based solution that offers performance, value and peace of mind, look for the next generation – XW from Xantrex, the smart choice for power.

For more information about the XW System and other Xantrex products, please contact your AGE Solar representative.

xantrex

We enable GREEN energy™

Xantrex

SW Series Inverters

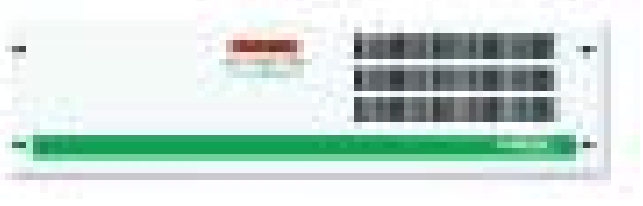
The Xantrex SW inverter provides sine-wave output with high surge, low idle current, and high efficiency. It can be used for off-grid or grid-tie systems with battery backup. It is over 90% efficient through most of its load range, peaking at 95-96% efficiency.

SW inverters can be programmed to perform automatic generator start and stop, automatic load sensing and generator support, and includes protective circuitry which guards against downtime. Three user-adjustable voltage-controlled relays are provided to control charging sources and loads. LED status indicators report the status of eight system conditions. Selecting modes, enabling features and adjusting parameters are all easily accomplished by moving through a menu tree that is displayed on the control panel's LCD read-out. Doubling as a meter, the LCD readout displays inverter AC amps, input AC amps, load AC amps, battery volts, and output voltage and frequency. Adjustable "search mode" can reduce idle power draw to 1 watt when not operating any AC loads.

All Xantrex SW inverters include a built-in, programmable, three-stage battery charger, with manual equalize mode, designed for maximum charging efficiency with minimum generator run time. A remote battery temperature sensor is included.

Two SW inverters can be connected in series in a 120V/240V split-phase configuration (with twice the wattage), with the addition of the SWI stacking interface cable. Or, two inverters can be connected in parallel for twice the output wattage at 120V with the SWI/PAR stacking interface cable. The SW2512MC is designed for mobile use. SW Series dimensions: 15" x 22.5" x 9". UL Listed. 2-year warranty.

Xantrex GTI



A Grid-tie interface (GTI) is required when connecting SW inverters in grid-tie applications. Software/hardware revision 4.2 or higher SW inverter is required to connect the SW4024, SW4048, or SW5548 to the GTI.

SW Series domestic voltage Inverters							
Xantrex model	**Battery volts**	**AC volts / Hz**	**Continuous watts**	**Charge amps**	**Weight (lbs)**	**Item code**	**Price**
SW2512MC	12	120/60	2500	150	90	**30.1022**	**$2,795**
SW4024	24	120/60	4000	120	111	**30.1015**	**$2,750**
SW4048	48	120/60	4000	60	111	**30.1018**	**$2,750**
SW5548	48	120/60	5500	75	143	**30.1021**	**$3,450**
SW Series export voltage Inverters							
Xantrex model	**Battery volts**	**AC volts / Hz**	**Continuous watts**	**Charge amps**	**Weight (lbs)**	**Item code**	**Price**
SW3024E	24	230/50	3300	100	111	**30.1033**	**$3,095**
SW3048E	48	230/50	3300	50	111	**30.1036**	**$3,095**
SW4548E	48	230/50	4500	60	143	**30.1039**	**$3,695**
voltages for Japan and Korea are also available – please call							
SW Series accessories							
Xantrex model	**Description**				**Weight (lbs)**	**Item code**	**Price**
SWRC/25	Remote control for SW with 25" cable				2	**30.1069**	**$295**
SWRC/50	Remote control for SW with 50" cable				2	**30.1072**	**$329**
SWCB	Conduit box for SW series – for DC side of inverter				8	**30.1051**	**$135**
SWI	Stacking cable for SW				2	**30.1057**	**$45**
SWI/PAR	Sine wave parallel stacking interface				44	**30.1060**	**$445**
SWI/PAR/E	Parallel stacking interface for export "E" and "W" models				44	**30.1066**	**$445**
SWCA	SW communications adapter – connects SW to a computer				1	**30.1048**	**$225**
GTI	Grid-tie interface				44	**30.1075**	**$750**

OutBack Off-Grid Inverters

The OutBack FX and VFX inverters are modular "building block" sine-wave inverter/charger that can be used for both residential and commercial off-grid applications with battery storage. Inverters are available in two versions, a sealed, fan-cooled FX version and a higher powered ventilated VFX version. Each inverter/charger module is a complete power conversion system – DC to AC inverter, battery charger and AC transfer switch. Additional inverter/chargers can be added at any time either in parallel (120VAC), series (120/240VAC), or even three-phase (120Y208 VAC) configurations, allowing the system to be tailored to the specific needs of the application, both at the time of installation and into the future. With the addition of an X-240 autotransformer, multiple inverter systems can be set up to provide 120/240 VAC split-phase output with the ability to provide full power on either 120VAC leg of the system. Up to ten inverters can be connected together to provide up to 36 kW of continuous power capacity with the use of the HUB and the MATE controller. The inverter's powerful battery charger operates in five stages: BULK (constant current output), ABSORB (constant voltage output), FLOAT (reduced voltage output), SILENT (no charger output) and EQUALIZE (constant voltage regulation overcharging). Charge time in each stage is adjustable to provide control and to maximize the performance of the charger and battery system.

Each OutBack inverter has one programmable, auxiliary relay output connection (AUX). The AUX terminal provides 12VDC output to run 12V cooling or ventilation fans or operate an external relay to perform other functions, such as remote generator starting (two-wire), to disconnect external charging sources (such as PV), or to turn on a diversion load for voltage regulation.

The built-in transfer switch is rated for 60 amps. When an external source of AC power (either a generator or the utility grid) is detected at the "AC in" terminal on the inverter, the switch operates to transfer the loads to the external power source, and then activates the battery charger to re-charge the battery bank.

Inverters with an M-suffix are an RV/marine version. They have a transfer switch that switches hot and neutral. Dimensions: 16.25" L x 8.25" W x 11.5" H. ETL Listed to UL 1741. Standard 2-year warranty with an available 5-year extended warranty.

OutBack FX Sealed Inverters with Turbo Fan

The OutBack FX-series is designed to survive harsh environments anywhere in the world. Their unique sealed, gasketed die-cast aluminum chassis protects and keeps the power conversion components cool without requiring outside air to be blown through the sensitive electronics.

OutBack VFX Ventilated Inverters

The OutBack VFX series is a ventilated version of the original sealed FX series modular inverter/charger that can be used for both small and large power systems. The VFX can be used in high ambient applications up to 60°C (with reduced output ratings). Ventilated inverters are a better choice when generator-powered battery charging is an important part of system battery charging. The fan cooling allows higher continuous battery charging current which results in shorter generator run time.

OutBack model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Wt. (lbs)	Item code	Price
OutBack sealed/turbo cooled off-grid inverters									
FX2012T	2000	12VDC	120V/60Hz	20 W	80	56A	56	**30.4147**	**$1,995**
FX2012MT	2000	12VDC	120V/60Hz	20 W	80	56A	56	**30.4145**	**$1,995**
FX2524T	2500	24 VDC	120V/60Hz	20 W	55	70A	56	**30.4119**	**$1,995**
FX3048T	3000	48VDC	120v/60Hz	23 W	35	70A	56	**30.4121**	**$1,995**
Export models – can be connected in parallel or 3-phase Y 400VAC									
FX2012ET	2000	12VDC	230V/50Hz	20 W	100	70A	56	**30.4140**	**$1,995**
FX2024ET	2000	24 VDC	230V/50Hz	20 W	55	70A	56	**30.4144**	**$1,995**
FX2348ET	2300	48VDC	230V/50Hz	23 W	35	70A	56	**30.4142**	**$1,995**
OutBack ventilated fan cooled inverters									
VFX2812	2800	12VDC	120V/60Hz	20W	125	56 A	54	**30.4149**	**$2,345**
VFX2812M	2800	12VDC	120V/60Hz	20W	125	56 A	54	**30.4146**	**$2,345**
VFX3524	3500	24 VDC	120V/60Hz	20W	85	70 A	54	**30.4155**	**$2,345**
VFX3648	3600	48VDC	120v/60Hz	23W	45	70 A	54	**30.4157**	**$2,345**
Export Models – can be connected in parallel or 3-phase Y 400VAC									
VFX2612E	2600	12VDC	230V/50Hz	20W	120	56 A	54	**30.4134**	**$2,345**
VFX3024E	3000	24 VDC	230V/50Hz	20W	85	70 A	54	**30.4136**	**$2,345**
VFX3048E	3000	48VDC	230V/50Hz	23W	42	70 A	54	**30.4138**	**$2,345**

OutBack MATE Remote Monitor and Control

The OutBack MATE is a complete system controller and display for both the OutBack inverter/charger and MX60 MPPT PV charge controller. It provides a display of the operation as well as allows control and adjustment of the setpoints. The OutBack MATE also coordinates the operation of the entire system to maximize performance and to prevent multiple products from conflicting. A single OutBack MATE is able to connect to multiple inverter/chargers, MX60 MPPT PV charge controllers and any other OutBack power conversion and control products offered in the future. A maximum of ten OutBack products will be able to be connected to a single MATE via CAT 5 Ethernet type cabling with 8 wire RJ45 modular connectors and the OutBack HUB communication manager. The OutBack MATE also includes an optoisolated RS232 port with a DB9 jack for connection to the serial port of a PC computer. The MATE2 has a flush-mount black face for panel or in-wall mounting. 2-year warranty.

OutBack model	OutBack MATE system monitor and control	Item code	Price
MATE	System control – shipped with a 50 ft CAT 5 cable	30.4180	$295
MATE2	Flush-mount version	30.4181	$295

OutBack FX Inverter Accessories

Use these accessories to integrate power electronics into an OutBack FLEXware Power System, to connect it to conduit or to stack multiple inverters. FX-DCA allows connection of 2" conduit to the DC side of the inverter and mates with FLEXware 500 DC and FLEXware 1000 DC boxes. FX-ACA allows conduit connection to the AC side of the inverter and mates with FLEXware 500 AC and FLEXware 1000 AC boxes. A Hub is required to connect more than one inverter to the same load or to connect inverters, MATEs and MX charge controllers to allow programming and monitoring of the entire system by the MATE. The remote temperature sensor is important for accurate battery charging, especially if the batteries get very warm or cold. If used with a HUB, one temp. sensor can be shared by all inverters. and MX charge controllers.

OutBack model	OutBack inverter accessories	Item code	Price
FX-DCA	Aluminum 2" conduit adapter – required to mount FX or VFX to FLEXware 500 or 1000	30.4163	$45
FX-ACA	AC wiring compartment extension and 2" conduit adapter – includes two 1" conduit knockouts and an AC outlet knockout – required to mount FX or VFX to FLEXware 500 or 1000	30.4166	$35
HUB-4	Stacking kit for up to 4 inverters and charge controllers – includes cables	30.4185	$195
HUB-10	Stacking kit for up to 10 inverters and charge controllers – includes cables	30.4188	$375
RTS	Remote temperature sensor with 20' cable	30.4190	$29

FLEXware 250

The FLEXware 250 offers the lowest cost solution for single inverter/charger installations where space and budget are of primary concern. The picture at right shows a FLEXware 250 on both ends of an inverter. See page 139 for circuit breakers to fit FW250.

OutBack model	FLEXware 250 power system box and IOB kits	Weight	Item code	Price
FW250	FLEXware 250 enclosure with TBB (ground or neutral block) knockouts for breakers	5 lbs	30.4205	$99
FW-IOB-S-120VAC	IOB kit includes 3 50A 120VAC breakers and AC breaker bypass slide plate	2 lbs	30.4230	$99
FW-IOB-S-230VAC	IOB kit includes 3 30A 230VAC breakers and AC breaker bypass slide plate – export model	2 lbs	30.4233	$99

Prices subject to change without notice.

OutBack FLEXware 500 and 1000

The FLEXware 500 supports up to two inverter/chargers and two charge controllers in an attractive, versatile and code-compliant package for installations where more power is needed. The FLEXware 1000 accommodates up to four inverter/chargers and four charge controllers. For usage in large systems with multiple power panels for up to 36 kW. Both the FLEXware 500 and 1000 systems provide ample locations for additional breakers, DC-current shunts, an autotransformer and other items required in higher kW systems. The new FLEXware MP mounting plate shows the versatility of the FLEXware line with and is compatible with both FLEXware 500 and FLEXware 1000 enclosures. The picture here shows the FLEXware 1000 AC and DC boxers with 4 inverters and 4 MX60 charge controllers. See the following page for a picture of the FLEXware 500.

OutBack model	FLEXware mounting plate	Inverters	Item code	Price
FW-MP	Mounting plate for FLEXware 500 and 1000 enclosures (2 required for FW-1000 systems).	14	30.4260	$159
OutBack model	**FLEXware 500 power system box and IOB kits**			
FW500-AC	FLEXware 500 enclosure with TBB-ground, DIN rail for AC breakers	2	30.4215	$289
FW500-DC	FLEXware 500 enclosure with DC breaker bracket, TBB, BBUS, 500A shunt	2	30.4212	$289
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	2	30.4237	$169
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	2	30.4240	$169
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export	2	30.4243	$169
OutBack model	**FLEXware 1000 power system box and IOB kits**			
FW1000-AC	FLEXware 1000 Enclosure with TBB-ground, DIN Rail for AC breakers	up to 4	30.4223	$489
FW1000-DC	FLEXware 1000 Enclosure with DC Breaker bracket, TBB, 2 SBUS, BBUS, 500A Shunt	up to 4	30.4221	$489
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	2	30.4237	$169
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	2	30.4240	$169
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export	2	30.4243	$169
FW-IOB-T-120/208VAC	IOB kit includes nine 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	3	30.4253	$299
FW-IOB-T-230/400VAC	IOB kit includes nine 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export	3	30.4255	$299
FW-IOB-Q-120VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	4	30.4249	$339
FW-IOB-Q-120/240VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, bus bars, wire	4	30.4247	$339
FW-IOB-Q-230/AC	IOB kit includes twelve 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export	4	30.4251	$339

FLEXware Components

When assembling FLEXware power systems, the following components may be necessary when adding charge controllers, additional inverters or circuit breakers for additional loads or inputs.

Model	FLEXware options	Item code	Price
FW-X240	4kVA 120/240VAC autotransformer -w/ 25A 2-pole breaker for mounting inside FLEXware 500 and 1000 AC enclosures	30.4270	$390
TBB-GROUND	Ground/neutral terminal bus bar with mounting screws (no insulators).	30.4356	$19
TBB-black	Bus bar with black insulators	30.4353	$19
TBB-BLUE	Bus bar with blue insulators	30.4359	$19
TBB-RED	Bus bar with red insulators	30.4355	$19
TBB-WHITE	Bus bar with white insulators	30.4354	$19
TBB-BROWN	Bus bar with brown insulators	30.4352	$19
FW-BBUS	Breaker Bus for connection of two 175-250A, three 100-125A, four 1-80A DC breakers or three 500 amp DC shunts	30.4358	$19
FW-CBUS	Combiner Bus connects up to eight DIN mount breakers or four DIN mount fuse holders – includes one 1/0 screw lug	30.4361	$19
FW-SBUS	Shunt bus allows up to four high current cable connections on same side of DC shunt – includes hardware	30.4360	$29
FW-CCB	MX charge controller mounting bracket for one side mounted on FW500 or FW1000 DC enclosures – with hardware	30.4263	$55
FW-CCB2	MX charge controller mounting bracket for two side mounted on FW500 or FW1000 DC enclosures – with hardware	30.4265	$59
FW-CCB2T	MX charge controller mounting bracket for two top mounted on FW500 or FW1000 DC enclosures – with hardware	30.4267	$59

OutBack FLEXware Complete Power Systems

Fully Assembled and Tested

NEC-compliant pre-assembled power systems include inverter(s), AC enclosure inverter bypass, DC enclosure, inverter disconnect breaker and shunt, all mounted to a back plate and wired. Charge controllers and battery cables and displays are not included. Charge controllers, additional AC and DC input and load breakers can be added at the time of pre-assembly or in the field. Some options are listed below. Many other options are available. Please contact us for more information. Power systems ship by truck freight. ETL Listed to UL standards.

FLEXware 500 Power System

A FLEXware 500-based system will satisfy a majority of renewable energy applications with large power requirements such as residential, light commercial or rural electrification systems by supporting up to two FX Series inverter/chargers and up to two MX charge controllers. FLEXware 500 AC and DC enclosures accommodate all the essential protective devices while still providing lots of room for additional breakers and large cable connections. In addition to the ability to be mounted horizontally, a FLEXware 500 based system can also be mounted vertically for added versatility. FLEXware 500 systems come with one RTS, and IOB-D-120/240VAC and HUB4. Two-inverter systems also come with a X-240.

FLEXware 1000 Power System

A FLEXware 1000-based system is best utilized in applications with greater power requirements like large residential, commercial or mini-grid projects. FLEXware 1000 system architecture is capable of supporting up to four FX Series inverter/chargers, four MX charge controllers, and all the required AC and DC components and wiring. FLEXware 1000 is easily expandable for systems as large and complex as your imagination allows. Of course, FLEXware 1000 AC and DC enclosures accommodate all of the essential protective devices while still providing lots of room for additional breakers and large cable connections. With mounting provisions for three DC shunts, there is now space for enough to max out the inputs of multi-channel amp-hour meters. In addition to the ability to be mounted horizontally, for added versatility a FLEXware 1000-based system can also be mounted vertically. FLEXware 1000 systems come with one RTS, and IOB-Q-120/240VAC, HUB10 and X-240.

Model	FLEXware type	Inverter(s) qty - model	Rated power kW - AC output	DC voltage	Battery charger	Item code	Price
OBFW5-FX2012T/S	500	1 – FX2012T	2.0kW 120V	24 VDC	80 AMP	**33.0321**	**$4,100**
OBFW5-FX2012T/D	500	2 – FX2012T	4.0kW 120/240V	24 VDC	160 AMP	**33.0323**	**$6,875**
OBFW5-VFX2812/S	500	1 – VFX2812	2.8kW 120V	48 VDC	125 AMP	**33.0325**	**$4,460**
OBFW5-VFX2812/D	500	2 – VFX2812	5.6kW 120/240V	48 VDC	250 AMP	**33.0327**	**$7,575**
OBFW5-FX2524T/S	500	1 – FX2524T	2.5kW 120V	24 VDC	55 AMP	**33.0329**	**$4,100**
OBFW5-FX2524T/D	500	2 – FX2524T	5.0kW 120/240V	24 VDC	110 AMP	**33.0331**	**$6,875**
OBFW5-VFX3524/S	500	1 – VFX3524	3.5kW 120V	24 VDC	85 AMP	**33.0333**	**$4,337**
OBFW5-VFX3524/D	500	2 – VFX3524	7.0kW 120/240V	24 VDC	160 AMP	**33.0335**	**$7,575**
OBFW5-FX3048T/S	500	1 – FX3048T	3.0kW 120V	48 VDC	35 AMP	**33.0337**	**$4,100**
OBFW5-FX3048T/D	500	2 – FX3048T	6.0kW 120/240V	48 VDC	70 AMP	**33.0339**	**$6,875**
OBFW5-VFX3648/S	500	1 – VFX3648	3.6kW 120V	48 VDC	45 AMP	**33.0341**	**$4,337**
OBFW5-VFX3648/D	500	2 – VFX3648	7.2kW 120/240V	48 VDC	90 AMP	**33.0343**	**$7,575**
OBFW10-FX2524T/D	1000	2 – FX2524T	5.0kW 120/240V	24 VDC	55 AMP	**33.0365**	**$7,810**
OBFW10-FX2524T/Q	1000	4 – FX2524T	10.0kW 120/240V	24 VDC	110 AMP	**33.0367**	**$12,300**
OBFW10-VFX3524/D	1000	2 – VFX3524	7.0kW 120/240V	24 VDC	85 AMP	**33.0369**	**$8,525**
OBFW10-VFX3524/Q	1000	4 – VFX3524	14.0kW 120/240V	24 VDC	170 AMP	**33.0371**	**$13,730**
OBFW10-FX3048T/D	1000	2 – FX3048T	6.0kW 120/240V	48 VDC	70 AMP	**33.0373**	**$7,688**
OBFW10-FX3048T/Q	1000	4 – FX3048T	12.0kW 120/240V	48 VDC	140 AMP	**33.0375**	**$12,062**
OBFW10-VFX3648/D	1000	2 – VFX3648	7.2kW 120/240V	48 VDC	90 AMP	**33.0377**	**$8,388**
OBFW10-VFX3648/Q	1000	4 – VFX3648	14.4kW 120/240V	48 VDC	180 AMP	**33.0379**	**$13,462**
FLEXware 500 and 1000 power systems installed options							
OutBack MX60	One OutBack MX60 60-amp charge controller mounted on FLEXware side with breaker					**33.1513**	**$763**
2 x OutBack MX60	Two OutBack MX60 60-amp charge controller mounted on FLEXware side with breakers					**33.1515**	**$1458**
2 x OutBack MX60	Two OutBack MX60 60-amp charge controller mounted on FLEXware top with breakers					**33.1517**	**$1458**
Trimetric meter	Amp-hour meter – installed in PSDC 24 volt system					**33.1215**	**$211**
Trimetric meter	Amp-hour meter – installed in PSDC 48 volt system					**33.1216**	**$285**
OBDC-GFP2	Ground fault interrupter for PV array installed in DC system box					**33.1221**	**$134**
OBDC-100	100-amp DC load breaker installed in system					**33.1227**	**$39**
OBDC-80	80-amp DC load breaker installed in system					**33.1228**	**$39**
OBDC-60	60-amp DC load breaker installed in system					**33.1229**	**$29**
OBDC-40	40-amp DC load breaker installed in system					**33.1231**	**$29**
OBDC-30	30-amp DC load breaker installed in system					**33.1233**	**$25**
OBDC-15	15-amp DC load breaker installed in system					**33.1235**	**$25**
OBDC-10	10-amp DC load breaker installed in system					**33.1237**	**$25**
OBDC-1	1-amp DC load breaker installed in system					**33.1239**	**$25**
X240	Autotransformer 120/240 4kVA (included in multiple inverter systems)					**33.1253**	**$425**

Magnum MS-Series

Pure Sine Wave Inverter/Chargers

The MS Series inverter/ charger is a new pure sine wave inverter designed specifically for the most demanding mobile and off-grid applications. The MS Series is powerful, easy-to-use and cost effective.

MS-series inverter/chargers are available in 12-, 24- and 48-volt versions. The 48-volt MS4448-AE has 120/240VAC output, eliminating the need to stack two units or buy a transformer to run 240-volt loads.

Install the MS Series in four easy steps: simply connect the inverter's output to your distribution circuits or electrical panel, connect AC power from the utility or generator to the inverter's easy-to-reach terminal block, connect the batteries, and switch on the power. Mount the MS Series on a shelf, bulkhead, or even upside down.

The lightweight aluminum base and cover provide noise reduction and corrosion resistance. The MS Series has an RS485 communication port for network expansion, and a remote control port. The extra large AC-access cover with terminal screw block and 360° DC connection terminals with covers make the inverter wiring accessible when it needs to be. The MS Series front panel has an on/off switch with an easy-to-read LED indicator. All models have a 50-amp transfer relay. MS inverters can be series stacked, using the ME-SSI, for 120/240 VAC operations.

The MS Series is ETL Listed to UL/cUL 458 for mobile use and UL 1741 for off-grid installations.

Dimensions: 13.75" x 12.65" x 8". 3-year warranty, except MS4448-AE which has a 2-year warranty.

Accessories and Options

The optional ME-RC remote control is simple to use, yet allows full set-up features of the ME, MM, MS and RD Series inverters. The ME-RC also has the option of controlling the ME-AGS automatic generator start using a network connection to the inverter. This remote has convenient finger-tip operation, including the new one-knob programming.

Magnum model	Continuous watts	Battery voltage	AC out volts/ hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
MS2012	2000	12VDC	120V/60Hz	24W	100	50A	43	**30.2332**	**$1,799**
MS2012-20B	2000	12VDC	120V/60Hz	24W	100	50A	44	**30.2334**	**$1,849**
MS2812	2800	12VDC	120V/60Hz	24W	125	70A	53	**30.2336**	**$2,099**
MS4024	4000	24VDC	120V/60Hz	15W	105	120A	58	**30.2338**	**$2,399**
MS4448-AE	4400	48VDC	120/240V/60Hz	24W	60	70A	58	**30.2340**	**$2,599**
Accessories and Options									
ME-RC50	Remote for all Magnum inverters with 50 foot cable						2	**30.2351**	**$229**
ME-SSI	Series stacking cable for ME, MS and RD only						10	**30.2362**	**$79**
ME-AGS	Automatic generator start – network version for use with Magnum inverters						4	**20.6377**	**$299**
ME-AGS-S	Automatic generator start – standalone version for use with Magnum inverters						4	**20.6375**	**$299**

The optional Auto Generator Start (AGS) module automatically starts and stops most major generator brands, including Onan, Powertech, Generac, and Weterbeke. Please check with us for specific model compatibility based on temperature or battery voltage. The generator can automatically start based on low battery voltage or the inside temperature of a cabin or RV. The temperature start feature is designed to start a generator to run an air conditioner when the inside temperature of an RV or cabin rises to a user settable level. The network version of the AGS comes with a cable that plugs into the network port of the inverter.

The optional ME-SSI allows series connection of two inverters.

NEW! MM-AE Series 12V Inverters

The MM-AE Series 12VDC inverter/charger is a new generation inverter designed to accommodate entertainment systems and small appliances in smaller RVs, boats and cabins in an all-new design. Based on the popular ME and MS Series inverters, the MM is smaller, lighter and less expensive while retaining all the built-in protection and reliability of MS models. The MM models with chargers use a PFC (power factor corrected) charger, which is 85% efficient and uses the same charger topology for all Magnum models. Available in 600- and 1200-watt models, the MM Series inverters are powerful, easy-to-use and cost-effective. 2-year warranty. Dimensions: 16.6" x 8.4" x 4.7"

ME- Series 12V Inverters

The ME Series 12VDC inverter/charger is designed specifically for RV use. The sine wave charger efficiently charges your batteries even at low AC voltage from low-cost generators, while the modified sine wave inverter keeps the cost down. Additionally, the battery temperature sensor works with the charger for optimum battery charging. It comes in three power levels. ME is ETL Listed to UL458 for RV, marine and mobile use. 3-year warranty. Dimensions: 16.6" x 8.4" x 4.7"

RD-Series 24V Inverters

The RD Series 24VDC inverter/charger is designed specifically for off-grid use. It is built in the same chassis as the MS sine wave inverters. The power factor corrected battery charger efficiently charges your batteries even at low AC voltage from low-cost generators, while the modified sine wave inverter keeps the cost down. Additionally, the battery temperature sensor works with the charger for optimum battery charging. The RD Series comes in three power models. The RD inverters are ETL Listed to UL1741 for solar and off-grid applications. 2-year warranty. Dimensions: 16.6" x 8.4" x 4.7"

Magnum model	Continu-ous watts	Battery voltage	AC out volts/ hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
MM612-AE	600	12VDC	120V/60Hz	10W	30	10A	14	**30.2302**	**$549**
MM1212-AE	1200	12VDC	120V/60Hz	16W	70	20A	20	**30.2304**	**$849**
ME20122	2000	12VDC	120V/60Hz	11W	100	37A	38	**30.2305**	**$1,448**
ME2512	2500	12VDC	120V/60Hz	12W	130	45A	42	**30.2311**	**$1,679**
ME3112	3100	12VDC	120V/60Hz	12W	150	50A	45	**30.2315**	**$1,847**
RD1824	1800	24 VDC	120V/60Hz	6W	50	33A	38	**30.2322.**	**$1,179**
RD2824	2800	24 VDC	120V/60Hz	6W	80	50A	42	**30.2324**	**$1,529**
RD3924	3900	24 VDC	120/V/60Hz	6W	105	75 A	45	**30.2328**	**$1,799**

Accessories and Options – See table on previous page

The MS Series accessories described on the previous page work with the ME and RD Series as well, except where noted. The optional ME-SSI allows series connection of two MS. ME or RD inverters. The ME-SSI is not for use with MM-Series inverters.

We've got you covered.

No matter what your power needs, we have an inverter for you.

From our entry-level 600 watt MM and MM-AE Series to the robust 4400 watt MS-AE Series, with 12, 24, and 48-volt options, and sine wave or modified sine wave models there is a Magnum inverter/charger designed to meet your needs.

And to expand our available offerings, Magnum has teamed with MidNite Solar to create a MidNite Solar E-Panel, designed to work specifically with the MS and RD Series, combines necessary components into one easily installed panel.

- 600 to 4400 watt models
- 12 to 48 volt models
- Sine wave and modified sine wave models
- Smaller and lighter weight than comparable models
- Easy installation and operation
- Durable design
- Economical

MAGNUM ENERGY

Phone: 425-353-8833 www.magnumenergy.com The Powerful Difference

Our product line now includes the Magnum MS4448AE 120/240 split phase inverter/charger, providing 120/240 volt output with only one unit.

MidNite Solar

NEW! E-Panel

The MidNite Solar E-Panel is a quick and easy way to install an OutBack, Magnum or Xantrex SW or DR inverter. It comes standard with the basic over-current protection and disconnects required to install your renewable energy system. It can also expand to grow as your needs arise. The picture at right shows an OutBack inverter mounted on an E-Panel.

OutBack and Magnum inverters mount on a unique hinged door to keep the footprint of the system as small as possible. Mounting brackets are included to aid in one person installations. The E-Panel Lite for Xantrex inverters mounts next to the inverter.

Main breaker, inverters cables, a 500-amp/50mv shunt for battery monitoring systems, 175-amp AC-power distribution block, 50-amp AC-input disconnect for generator or utility, 50-amp AC bypass switch are included and pre-wired. It comes with a mounting bracket for an OutBack MX60. Cut outs for mounting up to six additional 13mm wide DIN rail mount breakers are provided as well as a cut out for a GFCI style AC outlet.

NEW! Apollo T80 Kit includes left side bracket for E-Panels, two 80A breakers and mounting hardware. (Cannot be used on MNE175STM-240.)

ETL Listed to UL and CSA standards.

MidNite model	E-Panels for OutBack inverters	Item code	Price
MNE125ST	Gray steel chassis with 125-amp inverter breaker	30.5125	$439
MNE125ST-L	Gray steel chassis with 125-amp inverter breaker – left hinge	30.5126	$439
MNE175ST	Gray steel chassis with 175-amp inverter breaker	30.5129	$479
MNE175ST-L	Gray steel chassis with 175-amp inverter breaker – left hinge	30.5130	$479
MNE250ST	Gray steel chassis with 250-amp inverter breaker	30.5133	$479
MNE250ST-L	Gray steel chassis with 250-amp inverter breaker – left hinge	30.5134	$479
MNE175STS	Gray steel chassis with 175-amp inverter breaker 18" wide	30.5131	$549
MNE250STS	Gray steel chassis with 250-amp inverter breaker 18" wide	30.5135	$549
MNE125AL	White alum chassis with 125-amp inverter breaker	30.5137	$479
MNE125AL-L	White alum chassis with 125-amp inverter breaker – left hinge	30.5138	$479
MNE175AL	White alum chassis with 175-amp inverter breaker	30.5141	$519
MNE175AL-L	White alum chassis with 175-amp inverter breaker – left hinge	30.5142	$519
MNE250AL	White alum chassis with 250-amp inverter breaker	30.5145	$519
MNE250AL-L	White alum chassis with 250-amp inverter breaker – left hinge	30.5146	$519
MNEleftdoorsST	Gray steel left hand hinge door with alum right hand CCB	30.5237	$59
MNEleftdoorsAL	White alum left hand hinge door with alum right hand CCB	30.5241	$65
MNEPV63	63-amp 125VDC DIN rail mount breaker (13mm wide)	30.5245	$13
MNDC-GFP	63-amp DC ground fault protector	30.5249	$69
MN-APOLLO	Kit to mount Apollo T80 on E-Panels	30.5280	$69
	E-Panels for Magnum inverters	**Item code**	**Price**
MNE175STM	Gray steel chassis with 175-amp inverter breaker	30.5161	$549
MNE250STM	Gray steel chassis with 250-amp inverter breaker	30.5163	$549
MNE175STM-40	White steel chassis with 175-amp inverter breaker – 120/240	30.5167	$799
MNEleft-doorsSTM	Gray Steel left hand hinge door with right hand CCB	30.5165	$59
MidNite model	**E-Panel Lite for Xantrex SW and DR inverters**	**Item code**	**Price**
MNE125ST	Gray steel chassis with 125-amp inverter breaker	30.5105	$419
MNE175ST	Gray steel chassis with 175-amp inverter breaker	30.5109	$459
MNE250ST	Gray steel chassis with 250-amp inverter breaker	30.5113	$459

Xantrex

SW Plus Inverter

The new SW Plus inverter/charger, like the SW, is designed to provide homes with a completely independent power supply. It can be programmed to operate as a standalone inverter or as a generator hybrid, or it can be used for backup power. Surge power has been improved. The SW Plus cannot be used as a grid-tie inverter. All program settings are stored in flash memory so they are maintained even if the inverter is disconnected from the battery. Two SW Plus inverters can be stacked to provide up to 11 kW of 120/240 VAC power. The inverter communications adapter interfaces with a personal computer.

The SW Plus can be programmed to start and stop generators with the addition of a GSM. The ALM can be added to control loads for power diversion regulations or to control a battery vent fan. ETL Listed. 2-year warranty. Dimensions: 15" x 22.5" x 9"

The SW Plus Long DC Conduit Box (DCCB-L) connects to the DC side of one or two inverters and provides a centralized location for the DC circuit breakers and PV ground fault protection (GFP) breakers. It is also designed to incorporate up to two charge controllers, and cabling for a battery meter (there is a space on the front cover to mount a Xantrex TM500A meter). The DCCB-L includes a 175- or 250-amp circuit breaker, a DC-negative bus bar and 500A/50mV shunt, battery cables (1 set) and a ground wire connected to the ground bar. For expandability, the Long DC Conduit Box is designed so that a second DCCBL can be added on for additional breaker spaces, wiring space and controller mounting spaces. Knockouts are provided for 1/2", 3/4" and 2" sizes. Certified to meet UL 1741-2001.

The SW Plus Long AC Conduit Box (ACCB-L) connects to the AC side of one or two SW Plus inverters. It is designed to protect the wiring connections to the inverter and provides room for up to nine additional AC disconnect breakers (Square D, Type QOU, DIN rail mounted) to protect user-specified loads. The ACCB-L includes an AC bypass switch (for a single AC input source) and input/output wiring attached to the AC input/output terminals, a neutral bar with neutral wire installed, and an isolated HOT bar.

1 or 2 inverters and AC and DC conduit boxes can be bolted to the 2-piece back plate to build a power panel. Other options at right can be added to the system.

SW Plus inverters

Model	Battery volts	AC volts / hertz	Continuous watts	Charge amps	Weight (lbs)	Item code	Price
SW-Plus2524	24	120/60	2500	70	105	30.1009	$2,500
SW-Plus4024	24	120/60	4000	110	113	30.1010	$2,800
SW-Plus2548	48	120/60	2500	40	105	30.1012	$2,500
SW-Plus4048	48	120/60	4000	60	113	30.1013	$2,800
SW-Plus5548	48	120/60	5500	75	136	30.1014	$3,500

SW Plus Series accessories

Model	Description	Item code	Price
GSM	Generator start module – 2 or 3 wire gen start	30.1085	$225
ALM	Auxiliary load module – user adjustable relays	30.1087	$250
ICA	Communications adapter for connection to a PC	30.1088	$175
ICM/25	Full function remote control with 25 foot cord	30.1089	$275
ICM/50	Full function remote control with 50 foot cord	30.1090	$295
ISC-S	Stacking cable for 2 SW Plus 120/240V output	30.1093	$65
DCCB-L-175	DC conduit box for 1 or 2 inverters w/175A main	30.1097	$700
DCCB-L-250	DC conduit box for 1 or 2 inverters w/250a main	30.1098	$700
GJ175F-PCK	Additional 175A breaker & wire for 2nd inverter	30.1114	$200
GJ250F-PCK	Additional 250A breaker & wire for 2nd inverter	30.1115	$200
ACCB-L-L1	AC side conduit box w/AC bypass-disconnect	30.1101	$550
ACCB-L2-PCK	Additional bypass breaker assembly for 2nd inverter	30.1102	$150
CC-CPK	Wiring kit for c40 or c60 charge controller	30.1126	$35
XBP	Back plate – 2 piece for 1 or 2 SW Plus inverters	30.1107	$450
XBP-DC	Back plate extension for 2nd DC conduit box	30.1108	$185
PVGFP-CF-1	PV ground fault protection – 1 pole	30.1141	$250
PVGFP-CF-2	PV ground fault protection – 2 pole	30.1142	$275
PVGFP-CF-3	PV ground fault protection – 3 pole	30.1143	$300
TX4K	Autotransformer 4 kW	30.1151	$750
TX6K	Autotransformer 6 kW	30.1153	$800

Xantrex SW Plus Assembled Power Panels

The Xantrex SW Plus can be ordered as a complete NEC-compliant pre-assembled power system, factory built to UL standards. Systems include inverter(s), ACCB-L, AC inverter bypass, DCCB-L with inverter disconnect breaker and shunt mounted on a metal back plate.

Charge controllers and battery cables are not included. Charge controllers, additional AC and DC input and load breakers can be added at the time of pre-assembly or in the field. Some options are listed below. Many other options are available. Please contact us for more information. ETL Listed. Ships by truck freight.

Power systems with SW Plus sine wave inverters

Xantrex model	Qty of inverters	Inverter model	Continuous power	Input voltage	Output	Battery charger	Item code	Price
PP-SW Plus2524/S	1	SWPlus2524	2.5 kW	24 VDC	120 VAC	70 amp	**33.3101**	**$4,054**
PP-SW Plus2524/D	2	SWPlus2524	5 kW	24 VDC	120/240 VAC	140 amp	**33.3104**	**$6,778**
PP-SW Plus2548/S	1	SWPlus2548	2.5 kW	48 VDC	120 VAC	40 amp	**33.3107**	**$4,054**
PP-SW Plus2548/D	2	SWPlus2548	5 kW	48 VDC	120/240 VAC	80 amp	**33.3111**	**$6,778**
PP-SW Plus4024/S	1	SWPlus4024	4 kW	24 VDC	120 VAC	120 amp	**33.3114**	**$4,555**
PP-SW Plus4024/D	2	SWPlus4024	8 kW	24 VDC	120/240 VAC	240 amp	**33.3117**	**$7,780**
PP-SW Plus4048/S	1	SWPlus4048	4 kW	48 VDC	120 VAC	60 amp	**33.3121**	**$4,555**
PP-SW Plus4048/D	2	SWPlus4048	8 kW	48 VDC	120/240 VAC	120 amp	**33.3124**	**$7,780**
PP-SW Plus5548/S	1	SWPlus5548	5.5 kW	48 VDC	120 VAC	70 amp	**33.3127**	**$5,255**
PP-SW Plus5548/D	2	SWPlus5548	11 kW	48 VDC	120/240 VAC	140 amp	**33.3131**	**$9,180**

Xantrex SW Plus power system optional equipment

Installed option	Installed option description	Item code	Price
OutBack MX60	MX60 charge controller installed with 60 amp breaker	**33.3201**	**$728**
Xantrex C-40	C40 charge or load controller installed, includes 60 amp DC breaker 12, 24, or 48 VDC	**33.3205**	**$240**
Xantrex C-60	C60 charge or load or diversion controller installed with 60 amp breaker 12, or 24 VDC 48A(Max)	**33.3203**	**$284**
Xantrex CM	LCD digital display for C series installed	**33.3208**	**$99**
Xantrex BTS	Battery temperature sensor for C series controller	**33.3209**	**$29**
Morningstar TS-60	TS-60 charge or load or diversion controller installed with 60 amp breaker 12, 24 or 48 VDC	**33.3211**	**$302**
Morningstar TSM	LCD digital display for TriStar installed	**33.3212**	**$99**
Morningstar RTS	Battery temperature sensor for TriStar	**33.3213**	**$29**
TM500A-24V	Xantrex TM500A meter installed in 24V power panel	**33.3217**	**$195**
TM500A-48V	Xantrex TM500A meter installed in 48V power panel	**33.3218**	**$235**
Trimetric-24V	Trimetric meter installed in 24V power system	**33.3221**	**$211**
Trimetric-48V	Trimetric meter installed in 48V power system	**33.3223**	**$285**
DCCB-L ADD	Additional DCCB-L and backplate	**33.3251**	**$600**
PDB-6	PDB-6 power block installed	**33.3255**	**$120**
PDB-12	PDB-12 power block installed	**33.3257**	**$120**
PVGFP-CF-1	PV ground fault protection – 1 pole – installed in DCCB	**33.3261**	**$270**
PVGFP-CF-2	PV ground fault protection – 2 pole – installed in DCCB	**33.3262**	**$295**
PVGFP-CF-3	PV ground fault protection – 3 pole – installed in DCCB	**33.3263**	**$320**
PVGFP-CF-4	PV ground fault protection – 4 pole – installed in DCCB	**33.3264**	**$345**
TX4K	Autotransformer 4 kW installed in ACCB	**33.3241**	**$780**
TX6K	Autotransformer 6 kW installed in ACCB	**33.3243**	**$830**

NEW! Morningstar SureSine 300W Inverters

The Morningstar SureSine pure sine wave inverter is designed to meet the needs of rural PV electrification requiring AC power for solar home systems, schools, community centers and health clinics. This inverter is also a good choice for small PV systems for telecom, remote cabins and weekend homes, and RV/caravans and boats. It has outstanding surge capability for a small inverter. The SureSine handles a 200% surge during load start-up, to a maximum of 600 watts.

The SureSine uses epoxy encapsulation, conformal coating, stainless steel hardware, and an anodized aluminum enclosure to protect against harsh tropical and marine environments. AC output connection is a hard wire terminal. It does not have an AC receptacle. 2-year warranty. Dimensions are 8.4" x 6" x 4.1"

Morningstar model	Continuous watts	Battery voltage	AC out volts/ hertz	No load draw	Standby draw	Peak AC watts	Wt lbs	Item code	Price
SI-300-115V	300	12VDC	115/V/60Hz	450mA	55 mA	600	10	**30.8021**	**$299**
SI-300-220V	300	12VDC	220V/50Hz	450mA	55 mA	600	10	**30.8033**	**$299**

Exeltech XP Series Sine Wave Inverters

Exeltech XP inverters are the most affordable, high-performance true sine wave inverters on the market. They feature sophisticated protection circuitry, making them immune from damage by overloads, short circuits, overtemperature and input polarity reversal. XP series are excellent for telecommunications, audio recording equipment, or any loads that require an excellent waveform. Efficiency = 87-89% (distortion <2%). Exeltech XP inverters can run on the high charging voltages needed to charge alkaline batteries. 120 VAC output. 1-year warranty.

Model	Battery voltage	Continuous watts	No load watts	Dimensions (inches)	Weight (lbs)	Item code	Price
XP 125 Series							
XP125/12	12V	125	5	4.65 x 2 x 6.75	2.3	**30.6021**	**$250**
XP125/24	24V	125	5	4.65 x 2 x 6.75	2.3	**30.6024**	**$315**
XP125/48	48V	125	5	4.65 x 2 x 6.75	2.3	**30.6025**	**$335**
XP 1100 Series							
XP1100/12 LI	12V	1100	10	7.7 x 3.6 x 14.77	12	**30.6072**	**$759**
XP1100/24 LI	24V	1100	10	7.7 x 3.6 x 14.77	12	**30.6078**	**$759**
XP1100/48	48V	1100	15	7.7 x 3.6 x 14.77	12	**30.6075**	**$1,175**

Samlex Sine Wave Inverters

Samlex sine wave inverters offer the first low-cost, high-quality small sine-wave inverters for remote homes, RVs and boats. The output is overload protected. All of these inverters have AC receptacles and low-battery alarms. 120 VAC output. If you plan to use these inverters with reactive load, such as motors and compact fluorescent lights or other ballasted light, size the inverter for 4 times the continuous watts required. 1-year warranty.

Samlex model	Battery voltage	Continuous watts	Surge watts	Dimensions (inches)	Weight (lbs)	Item code	Price
PST-15S-12A	12V	150	250	2.4 x 4.7 x 7.4	2.6	**30.7123**	**$169**
PST-30S-12A	12V	300	500	4.7 x 11.22 x 2.4	3.9	**30.7126**	**$195**
PST-60S-12A	12V	600	1000	9.3 x 13.2 x 3.3	6.6	**30.7129**	**$399**
PST-100S-12A	12V	1000	1500	9.3 x 15.5 x 3.3	8.8	**30.7130**	**$649**
S-1500-112B2	12V	1500	2000	15.4 X 10.8 X 4.1	15.4	**30.7131**	**$899**
PST-60S-24A	24V	600	1000	9.3 x 13.2 x 3.3	6.6	**30.7132**	**$334**
PST-100S-24A	24V	1000	1500	9.3 x 15.5 x 3.3	8.8	**30.7134**	**$575**
S1500-124B2	24V	1500	2000	15.4 X 10.8 X 4.1	15.4	**30.7135**	**$985**
S1500-148B2	**48V**	**1500**	**2000**	**15.4 X 10.8 X 4.1**	**15.4**	**30.7148**	**$985**

Prices subject to change without notice.

Xantrex DR Series Inverters

Xantrex DR Series inverters have plenty of power to run microwave ovens, refrigerators, vacuum cleaners and power tools. They were originally designed as a standby

power system to keep lights and refrigerators going in Caribbean countries that are plagued with numerous power failures. Their powerful battery charger quickly charges batteries and holds them in float condition. When the power goes off, the inverter goes on, keeping everything running.

The DR inverters are available for 12-volt systems in 1500 and 2400 watt versions. The 24-volt versions are available in 1500, 2400 and 3600 watt versions. The output is 120-volt AC, but with the optional stacking cable, two units of the same input voltage can be connected for up to 7200 watts of 120/240-VAC power, allowing the pair to operate large 240-volt appliances like pumps, as well as typical 120-volt appliances.

Export models are available in 230-volt/50 HZ, 105-volt/50 HZ, 105-volt/60 HZ and 220-volt/60 HZ outputs. Call for those not listed. Export models cannot be stacked.

DR inverter dimensions are 20" x 8.5" x 8". ETL Listed to UL standards. 2-year warranty.

DR Series domestic voltage Inverters

Xantrex model	Battery volts	AC volts / hertz	Continuous watts	Charge amps	Weight (lbs)	Item code	Price
DR1512	12	120/60	1500	70	40	**30.1243**	**$850**
DR2412	12	120/60	2400	120	52	**30.1249**	**$1,100**
DR1524	24	120/60	1500	35	39	**30.1246**	**$850**
DR2424	24	120/60	2400	70	47	**30.1252**	**$1,100**
DR3624	24	120/60	3600	70	47	**30.1255**	**$1,350**

DR Series export voltage Inverters

Xantrex model	Battery volts	AC volts / hertz	Continuous watts	Charge amps	Weight (lbs)	Item code	Price
DR1512E	12	230/50	1500	70	39	**30.1258**	**$850**
DR1524E	24	230/50	1500	35	39	**30.1261**	**$850**
DR2424E	24	230/50	2400	70	47	**30.1267**	**$1,100**

DR Series accessories

Xantrex model	Description	Weight (lbs)	Item code	Price
DRCB	Conduit Box for DR series	1	**30.1270**	**$150**
DRI	Stacking Cable for DR	2.5	**30.1273**	**$85**
RC8/50	Remote On/Off Switch w/50 ft Cable	2	**30.1279**	**$110**
BTS/15	Temperature Sensor 15'	2	**20.8025**	**$29**
BTS/35	Temperature Sensor 35'	1	**20.8029**	**$32**

Samlex Modified Sine Wave Inverters

Samlex modified sine wave inverters are a value-priced solution to mobile power requirements. They provide modified sine wave output with over voltage, under voltage, overload and thermal protection, and low-voltage alarm. Samlex 1000-, 1500- and 2500-watt inverters have dual LED bar graph meters indicating battery current and voltage. Cigarette plug included only on 140 and 300. Larger units need to be hard-wired to battery. If you plan to use these inverters with reactive loads, such as motors and compact fluorescent lights or other ballasted lights, size the inverter for 4 times the continuous watts required. 1-year warranty.

Model	Battery voltage	Continu-ous watts	Surge watts	Dimensions (inches)	Weight (lbs)	Item code	Price
SI-175HP	12V	175	300	1.6 x 4.7 x 5.4	1.8	**30.7220**	**$40**
SI-400HP	12V	400	600	2.4 x 6.3 x 6.3	2.9	**30.7223**	**$67**
SI-750HP	12V	750	1500	2.4 x 6.3 x 11.4	5.3	**30.7227**	**$164**
PSE-12125A	12V	1250	2500	3.5 x 9.4 x 12.3	8	**30.7229**	**$366**
PSE-12175A	12V	1750	3500	3.5 x 9.4 x 17	10	**30.7232**	**$470**
PSE-12275A	12V	2750	4500	6.3 x 9.4 x 18.2	19	**30.7235**	**$806**
PSE-24100A	24V	1000	2000	3.5 x 9.4 x 13.5	9	**30.7238**	**$448**
PSE-24150A	24V	1500	3000	3.5 x 9.4 x 18.2	12.4	**30.7241**	**$530**
PSE-24250A	24V	2500	4500	6.3 x 8.5 x 19.5	22	**30.7244**	**$866**

Samlex Isolated DC-DC Converters

These isolated, enclosed DC-DC converters are designed to increase, or decrease, the DC voltage that is inputted to the unit. We have 100W, 200W, and 360W versions.

Samlex model	Input voltage	Output voltage	Output amps	Item code	Price
IDC-100B-12	20-35	12.5	8	30.8741	$140
IDC-100C-12	30-60	12.5	8	30.8742	$140
IDC-100A-24	9-18	24	4	30.8744	$140
IDC-100C-24	30-60	24	4	30.8746	$140
IDC-200B-12	20-35	12.5	16	30.8748	$166
IDC-200C-12	30-60	12.5	16	30.8749	$166
IDC-200A-24	9-18	24	8	30.8751	$166
IDC-200B-24	20-35	24	8	30.8752	$166
IDC-200C-24	30-60	24	8	30.8753	$166
IDC-360A-12	9-18	12.5	30	30.8755	$329
IDC-360B-12	20-35	12.5	30	30.8756	$329
IDC-360C-12	30-60	12.5	30	30.8757	$329
IDC-360A-24	9-18	24	15	30.8758	$329
IDC-360C-24	30-60	24	15	30.8760	$329

Samlex DC Step-Down Power Converters

These DC-DC converters are designed to decrease the DC voltage that is inputted into the unit. These switching converters have a high efficiency and provide regulated 13.8 VDC output from and input of 20 -30 VDC. Use them to power 12-volt lights and appliances from a 24-volt system.

Samlex model	Output max amps	Item code	Price
SDC-15	12	30.8720	$82
SDC-23	20	30.8725	$103

Xantrex T-240 Autotransformer

Use this to power 240-volt appliances on 120-volt inverters. Indoor enclosure, steel powder-coated white. Maximum load is 4.5 kilowatts. (For smaller or larger loads, see the toroid autotransformers below. Consumes 12 watts at idle. Includes 2-pole 25-amp QOU circuit breaker/disconnect and has room for 3 other QOU AC breakers. #14 to #2 hookup wire size. Dimensions: 6.3" x 21" x 7". UL Listed. 2-year warranty.

Xantrex model	Description	Item code	Price
T240	4 kW Autotransformer	30.1402	$550

Toroid Autotransformers

These AC step-up and step-down transformers are greater than 98% efficient and cause less than 0.2% idle loss at no load. They are nearly silent when operating. Use an autotransformer as a step-down to connect the 240-volt output of a generator to the 120-volt input on an inverter. This allows full output power of a 240-volt generator to be used for battery charging. Autotransformers can step-up voltage to operate 240-volt appliances and motors from the 120-volt output of an inverter. NEMA3R enclosures with knockouts for conduit. 2-year warranty.

Description	Size (inches)	Item code	Price
2.5 kW Autotransformer	8 x 8 x 4	38.9437	$325
4 kW Autotransformer	10 x 10 x 4	38.9440	$450
8 kW Autotransformer	12 x 10 x 6	38.9445	$675

Outback PSX-240 Autotransformer

The OutBack PSX-240 autotransformer can be used for step-up, step-down, generator and split phase output balancing or as a series stacked inverter to load balancing auto-former. Incorporating a transformer with 120-volt/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 to install in your custom application. Use for 120- or 240-VAC 60-Hz systems only. Powering 240-volt items like deep well pumps with a single 120-volt inverter is possible thanks to the PSX-240's step-up capability. Its step-down feature allows you to charge your batteries with a 240-volt generator through a single 120-volt inverter. The PS'-240+s ability to balance the output of series-stacked inverter/chargers makes it a critical item when using the OutBack stacking 120/240VAC configuration.

OutBack model	Description	Item code	Price
PSX-240	4 kW Autotransformer	30.4429	$520

Prices subject to change without notice.

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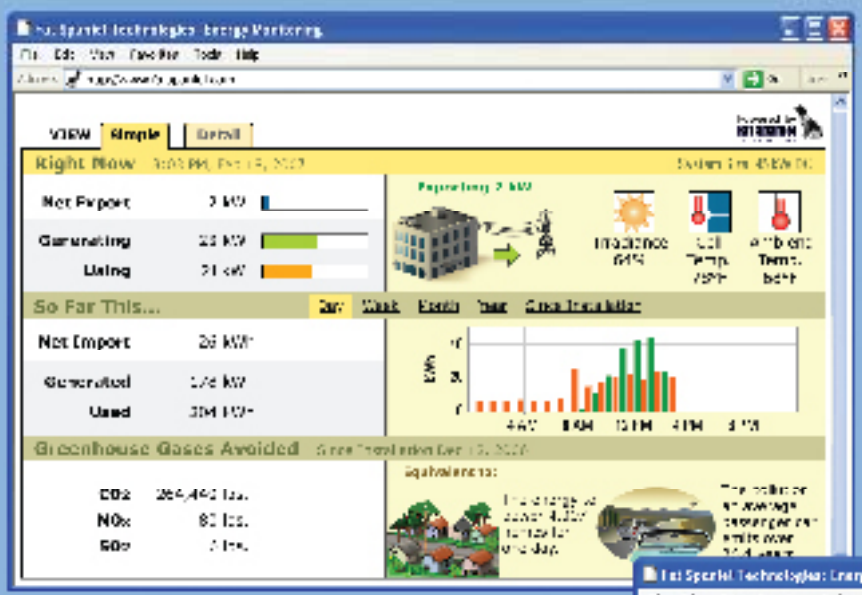

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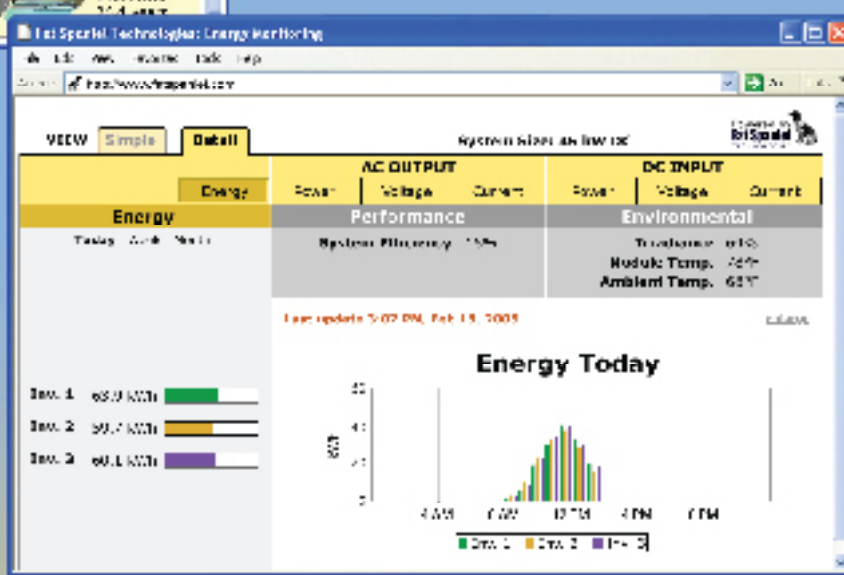

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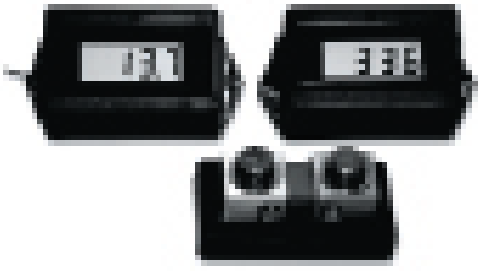
Mastech Digital Multimeter

Test diodes and measure DC volts, AC volts, up to 10 amps AC or DC current, ohms and continuity with this 9-volt powered digital multimeter (battery included). This inexpensive troubleshooting tool is made in China. Dimensions are 2.75" x 5" x 1".

Description	Item code	Price
Digital multimeter	**28.8031**	**$19**

AEE Solar Digital DC Volt & Amp Meters



Measure amps and volts in 12-, 24- or 48-volt systems with these high-quality, low-cost LCD digital meters. The surface mount, 3" x 2" x 1" plastic enclosure can be easily attached to wood or metal surfaces with two screws. Terminal strip on the back of the meter accepts 14 to 22 AWG wire.

Amp meters are available with a 100A/100mV shunt for measuring up to 100 amps with 0.1 amp resolution, a 500A/50mV shunt to measure up to 500 amps with 1 amp resolution or without a shunt for installations that already have a shunt. Current draw is only 20mA. Amp meter requires 4-conductor wire; volt meter requires 2-conductor wire. Use 22 gauge or larger for up to 50 feet. Use 18 AWG for up to 150 feet. 2-year warranty.

Description	Item code	Price
Digital volt meter 11 to 65 VDC	**28.9228**	**$42**
Digital amp meter w/o shunt	**28.9257**	**$42**
Digital amp meter w/ 100A shunt	**28.9259**	**$65**
Digital amp meter w/ 500A shunt	**28.9261**	**$65**

NEW! **Atkinson** PV and Wind Digital Monitor

This digital monitor and shunt combination can measure amps and amp-hours from two charging sources of up to 40 amps each on a 12-, 24- or 48-volt battery system. The monitor and shunt module are connected with a cat-5 network cable. The monitor stays in the battery voltage mode until the select button is pushed. The button can turn on the backlight, advance through display settings, reset amp-hours, lock the display in any mode or activate a scroll setting. Backlight comes on for 15 seconds every time the button is pushed and stays on in scroll mode.

Display module requires a shunt module to operate. Order both items. Cat-5 cable required to connect display to shunt.

Description	Item code	Price
Atkinson PVWDM digital monitor	**28.2205**	**$42**
Atkinson PVWSM shunt module	**28.2207**	**$42**
Cat-5 cable – 50'	**30.4199**	**$25**
Cat-5 cable – 6'	**30.4197**	**$8**

Hoyt Induction Amp Meters

These meters read DC amps from a wire that is placed in the slot frame on the rear of the meter case. No electrical connection is needed. The 30-amp meter will work with wires up to 8 gauge. The dual range meter has a 75-amp scale and a 600-amp scale. This amp meter will work with wire up up to 20 gauge.

Description	Item code	Price
Hoyt 30A induction meter	28.8045	$25
Hoyt 75A induction meter	28.8047	$25
Dual Range 0-75 / 0-600 ADC	28.8049	$25

Analog Amp Meters

These high quality amp meters mount in a 72mm square hole. The meter movement is very smooth and accurate. The shunt is built into the 30-amp meter so it can be in series with the load to be measured on the negative or positive wire. The 60-amp meter comes with a separate shunt. The mounting plate in the table below holds 1 meter and mounts in a 2-gang wiremold deep switch box.

Description	Item code	Price
Analog meter 0-30A DC	28.7332	$12
Analog meter 0-60A DC	28.7362	$18
Mounting plate for 2-gang wiremold box	28.9015	$5

Kill-a-Watt AC Meter

This kilowatt-hour meter is easy to set up and use. It gives the user power usage information for individual appliances, displaying true power consumed (including power factor information), and keeps track of cumulative kilowatt-hours, cumulative time the meter has been plugged in, and amount of money the electricity consumed costs. A 15-amp circuit breaker protects against overloads. UL Listed.

Description	Item code	Price
Kill-A-watt portable kilowatt hour meter	28.2005	$50

AC Kilowatt-Hour Meter

These EZ-Read cyclometer GE utility grade meters have been removed from service and reconditioned and certified. If you are selling power back to the utility grid, you can keep track of how much power your system is generating. Order one of the raintight meter bases to mount and connect wires to the meter. For use on 120 or 120/240 VAC systems. Maximum current 200 amps. GE Model I-70S, CEC approved. Please contact us for pricing on kilowatt-hour meters for higher power and for 3-phase systems.

Kilowatt-Hour Meter Sockets

We stock two types of kilowatt hour meter bases. The cast, low-cost round base has 1-1/2" threaded holes in the top and bottom. The Milbank brand sheet metal base is 8" W x 11.5" H (shown with meter mounted). Both are for single phase 2- or 3-wire 100-amp service and both come with sealing ring. Raintight, NEMA 3R for outdoor use.

Description	Item code	Price
GE kilowatt hour meter w/ EZ-Read cyclometer	28.3015	$30
GE kilowatt hour meter w/ conventional dial	28.3018	$32
Kilowatt hour meter socket 120/240VAC - round	28.3025	$16
Kilowatt hour meter base 120/240VAC NEMA-3R	28.3031	$48

Tech Tip: Amp-Hour Meters

With the use of an amp-hour meter, you can tell the condition of your batteries at a glance. An amp-hour meter is the best indicator of your system's condition. As you use power, the meter counts how many amp-hours are used. As the battery is charged, the meter goes backwards, toward zero. When the battery is full, the meter reads zero. This type of meter is a must for nickel-cadmium and nickel-iron batteries, where it is hard to tell state of charge from voltage, or specific gravity. The main destroyer of lead acid batteries is sulfation caused by undercharging. These sophisticated meters help you keep track of your batteries state of charge so you can keep them charged. Get maximum life out of your batteries and save money and system down time. Note: Amp-hour meters lose accuracy if batteries are always run in a very discharged state.

Xantrex Link 10 Meters

Link 10 meters provide complete battery status information for a battery bank. Simple and easy-to-use digital display shows volts, amps, amp-hours consumed, and operating time remaining. It also has an easy-to-read multi-color LED bar graph. The Link 10 allows you to select automatic, sleep and scanning modes and automatically calculates and displays charging efficiency. By adding an optional prescaler, Link 10 can monitor battery banks up to 500 volts. The splash-proof panel allows for outdoor mounting and hands-free operation. It displays key historical battery information such as charge efficiency, deepest discharge, and average discharge and they are compatible with 12- and 24-volt DC systems. The shunt is included. Accessories include prescalers (0-100 or 0-500 volts) to extend voltage range covered by your meter. 1-year warranty.

Description	Item code	Price
Link-10 Standard – Meter w/ 500A/50mV shunt	28.1128	$250
Pre-scaler 0-100V – Use w/ battery higher than 24V	28.1131	$75
Pre-scaler 0-500V – For use w/ battery up to 500V	28.1134	$80
Temperature sensor – Increases meter accuracy	28.1137	$57
Mounting bracket	28.9014	$7
Meter wire 8-conductor 18 AWG (price/ft)	50.1252	$1

Xantrex Battery Monitor XBM

The Xantrex battery monitor uses sophisticated microprocessor technology to provide complete battery status information for your battery. A simple display shows volts, amps, amp-hours consumed, and operating time remaining. An optional communications kit is available that contains hardware and software to enable battery monitoring from a Windows-based laptop. The splash-proof panels allow for outdoor mounting and hands free operation. XBM is compatible with 12- and 24-volt DC systems and comes with a 500A/50mV shunt. Front panel measures 2.56" square and the back fits in a 2.05" hole. 1-year warranty.

Description	Item code	Price
XBM meter w/ 500A/50mV shunt	28.1119	$275
XBM communication kit with software for Windows	28.1120	$150
XBM connection kit – 32 feet	28.1121	$50
XBM connection kit – 50 feet	28.1122	$62
XBM temperature sensor kit – 32 feet	28.1123	$40
XBM temperature sensor kit – 64 feet	28.1124	$60

Xantrex TM-500A

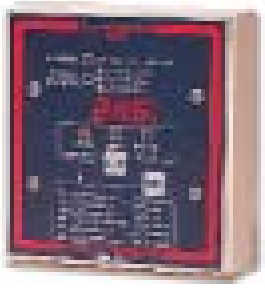
The TM-500A is similar to the Trimetric meter in a special package with fuse and fuse holder. An improved display shows volts, amps, amp-hours and percent without changing mode. Very easy to install and use. Installation is simplified with a special shunt that includes a phone-type jack. Install the shunt, plug the special six-conductor cable into the shunt and meter and all the connections are made! Meter shows days since fully charged, cumulative amp-hours, recharge indicator, low-voltage indicator, and full-charge indicator. Comes with a 50' six-conductor cable with jacks, fuse, and a special 500A/50mV shunt. Also is capable of turning DR, PS, and UX inverters on and off. 2550 amp-hour max battery size. Longer length cables are available for long runs. Use the 48-volt adapter for 48-volt systems.

Dimensions: 4.55" x 4.55" x 1.725". 2-year warranty.

Xantrex model	Description	Item code	Price
TM-500A	Amp-hour meter w/shunt	28.1405	$345
TM-500NS	Amp-hour meter w/o shunt	28.1403	$295
TM48	48-volt adapter	28.1413	$65
TC25	25-foot cable	28.1421	$22
TC50	50-foot cable	28.1422	$36

Trimetric 2020

This amp-hour meter for 12- or 24-volt battery systems (and 48-volt with adapter) reads volts, amps and amp-hours on an LED display. Amp-hours can be displayed in actual amp-hour numbers or as "% full". An LED lights when the battery is charging and flashes when the battery has been fully charged. Another LED flashes when batteries should be recharged, equalized, and during low battery voltage. It also records min and max voltage, days since batteries were last charged, days since equalized, and total lifetime amp-hours withdrawn from the batteries. The Trimetric can be located hundreds of feet away from batteries using inexpensive 4-conductor twisted-pair meter wire. For 48V systems or additional lightning protection on 12/24 V systems, use a 48V adapter with the meter. A shunt is required for operation. Use the 500-amp shunt if you have a 12V inverter larger than 800 watts or a 24V inverter larger than 1600 watts. Use a 1000-amp 100mV shunt for systems with stacked SW inverters or where continuous current is over 300 amps. The 1000A/100mV shunt has the same resistance as the 500A/50mV shunt and may be used interchangeably. Order shunt separately. Allows for a maximum battery bank size of 2500 amp-hours. The positive lead to the Trimetric should be fused with a 1-amp fuse. Flush mount or use wiremold box to mount. Made in USA. Dimensions: 4.5" x 4.75". 2-year warranty.



Description	Item code	Price
Trimetric 2020 amp-hour meter	28.0020	$175.00
48-volt adapter	28.0023	$28.00
Surface mount box	28.0026	$11.00
500A/50mV shunt	28.9253	$35.00
100A/100mV shunt	28.9245	$35.00
1000A/100mV shunt	28.9254	$47.00
4-conductor 22 AWG wire	50.1243	$0.30
4-conductor 18 AWG wire	50.1237	$0.78

Pentametric Battery Monitor

The Pentametric monitor measures 1 or 2 battery systems with a common negative. With one battery system, battery current plus two charging sources/loads can be measured.

The new PentaMetric battery monitor system offers a lot more capability than the TriMetric monitor. The complete system consists of 3 parts: input unit (near batteries), display unit (shown here) and computer interface unit. It can monitor up to 3 shunts: For example; measure total solar input and wind input independently in addition to monitoring battery "state of charge". You can access the data with display unit (shown above) with LCD display and buttons up to 1000 feet from batteries. An optional computer interface with Windows software allows you to control and read out all data from the computer. It has a relay output to control a generator or external alarm and it has audible and visual alarms for high and low battery conditions. 2-year warranty.

Basic measurements include:

- 2 voltage channels: 8-100 volts. (For example you can monitor volts from two-battery systems).
- 3 amperage channels ±.01-200 amps (with 100A/100mV shunt). ± 0.1-1000 amps (with 500A/50mV or 1000A/10mV shunt). Each of these requires a separate shunt.
- Temperature -20 to +65 degrees C.

Secondary measurements

- Amp-hour (3 channels): to ±83,000 amp-hours
- Cumulative (negative) battery amp-hours (2 channels)
- Smoothed (time filtered) amps
- Volts (2 channels): 0-100 volts
- Watts (2 channels) ±.01- 20,000 watts
- Watt-hours (2 channels) ±21,000 kilowatt hours
- Battery % full (2 channels) 0-100%
- Days since batteries charged (2 channels) .01-250 days
- Days since batteries equalized (2 channels) .01-250 days

Data logging functions.

There are 3 types of data logging functions. With the computer interface all 3 types can be output to spreadsheet file.

1. "Periodically logged data" can record any or all of the following at regular intervals: once per day to up to once per minute, amp-hours (3 channels), watt hours (2 channels), Temperature max/min (1 channel), volts (1 channel), amps (1 channel)
2. "Battery discharge voltage profile" data logs volts and amps every time charge level changes by 5% (or 10%) for 1 or 2 battery systems.
3. "Battery cycle efficiency data" documents system efficiency for up to 2 battery systems.

*

Description	Item code	Price
Pentametric display unit PM-100D	28.0011	$199.00
Pentametric input unit PM-5000U	28.0013	$220.00
Computer interface PM-100C	28.0015	$100.00
Temperature Sensor TS-1	28.0018	$29.00
500A/50mV shunt	28.9253	$35.00
100A/100mV shunt	28.9245	$35.00
8-conductor 22 AWG wire / per foot*	50.1255	$0.20

8-conductor wire is ok for measuring one battery. One additional conductor will be required for two batteries.

Why Use Monitoring Tools?

Residential and commercial system owners and installers can now benefit from remote monitoring services for renewable energy systems. These services provide knowledge and control over energy system generation and demand and are remotely accessible via the internet. Monitoring systems typically consist of a local device that connects to the energy system, collects data, and communicates with the monitoring service provider's central data center. Using such a service, residential and commercial system owners can remotely monitor their solar electric installations and see the impact of changes in consumption as well as problems such as tree shading or equipment degradation over time. Installers can check system performance, diagnose problems, and take corrective actions quickly and cost-effectively – often without ever leaving their office. Over time your solar energy generation and demand fluctuates. Periodic meter readings provide only a summary view of energy consumption, while telling you little or nothing about PV generation or about short-term performance issues. Good monitoring and display tools can help reveal trends, transient issues, cost-saving opportunities and emerging issues. They feature real-time and historical system performance graphs and downloadable data. Additionally, they provide the independent third-party, revenue-grade monitoring and reporting required to collect performance-based financial incentives.

Fat Spaniel Technologies

Monitoring and Visualization Services

Finally, a monitoring product with residential and commercial system owners and installers in mind! Fat Spaniel Technologies' simple, powerful, and field proven monitoring and visualization services work with your residential or commercial solar electric or wind system to provide visually engaging, web-based displays. This remote monitoring solution allows you to manage and view your solar energy system or whole-building energy usage in a single view. You can view your system anytime, anywhere using a web browser or mobile phone. Residential and commercial installers can assure customers that their renewable energy system is operating properly. Fat Spaniel provides views for post-installation support, alerting you to failure issues and providing tools for remote troubleshooting. The Fat Spaniel service also generates the regular reports required for performance-based financial incentives available under programs such as California's CSI.

Residential Monitoring Service

Fat Spaniel's Residential Monitoring Service gives the residential system owner the monitoring and visualization tools to understand their solar energy system. The Residential Solution allows you to improve your net-metering results and reduce your electricity bill by managing your energy use.

The image at right is a typical Simple View showing real-time and historical data about energy generation, building energy usage, and environmental information. Energy information can be selected to show daily, weekly, monthly and yearly comparisons.

Fat Spaniel offers inverter-direct monitoring for most grid-tie inverters as well as revenue grade, inverter-independent monitoring that can be used for power purchase agreements, performance incentives and renewable energy credit trading. Residential monitoring systems can be used for systems under 20 kW.

Inverter direct monitoring meets Calif. PUC < 10kW EPBB metering requirement, and is not designed to meet Calif. PUC PBI metering requirement. SMA and Fronius inverters require optional equipment from the inverter manufacturer. See information on the table on the next page. Xantrex inverters do not require extra equipment. Inverter direct monitoring comes with a simple web based view. Detail view and alerts are an extra cost option.

Inverter independent monitoring includes ANSI standard revenue grade meter with 2% accuracy and meets metering & reporting requirements of California EPBB & PBI programs and of all states requiring revenue-grade meters. These systems come with simple and detail web-based views, and alerts for inverter off condition and communications failures

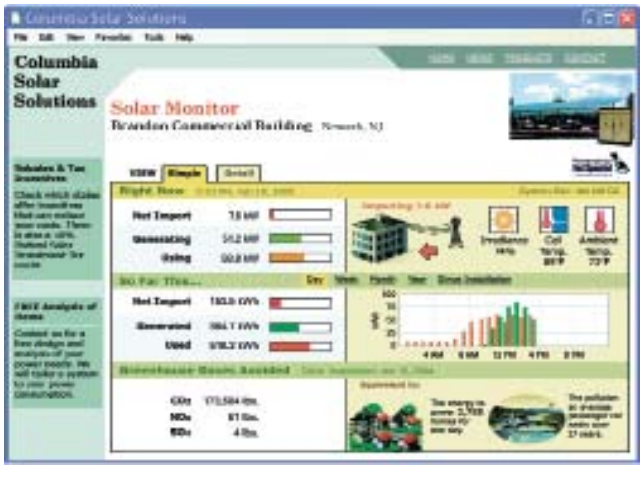
Weather data and building load are options that can be added to the monitoring package. All packages include hardware, 5 years of hosted monitoring services and 5 years of warranty coverage. Broadband internet access is required for standard systems. Cellular and dialup modems are optional.

Model	Description of products	Item code	Price
Residential inverter-direct monitoring products			
2151	Basic inverter-direct PV monitoring for one SMA SB-series inverter. Simple View only. Includes enclosure-requires SMA RS485 com card	29.1121	$999
2151-W	SMA SB monitor above w/ weather and environmental monitoring; includes irradiance, module temperature and ambient temperature.	29.1124	$2,999
3151	Basic inverter-direct PV monitoring for a single Xantrex GT-series inverter. Simple View only. Includes enclosure.	29.1131	$999
3151-W	Xantrex monitor above w/weather and environmental monitoring; includes irradiance, module temperature and ambient temperature	29.1134	$2,999
4551	Basic inverter-direct PV monitoring for a single Fronius IG-series inverter. Simple View. Includes enclosure. (requires Fronius ComCard, Datalogger and Interface Box. Fronius IG inverter with S/N higher than 1715 may use EZ Card instead of Datalogger and Interface Box.)	29.1135	$999
4551-W	Fronius monitor above w/weather and environmental monitoring; includes irradiance, module temperature and ambient temperature	29.1137	$2,999
7700	Detail View option offers historical information and alerts to systems above	29.1143	$332
7800	Add monitoring to an additional inverter (except Xantrex, which requires an additional 3151 gateway for each inverter)	29.1142	$332
Residential inverter-independent monitoring products – meets metering & reporting requirements of California EPBB & PBI programs			
1272-15-240	Revenue-grade inverter-independent PV monitoring: 15A/240V, 2-wire single phase inverters with simple and detail web views	29.1137	$2,599
1272-60-240	Revenue-grade inverter-independent PV monitoring: 60A/240V, 2-wire single phase inverters with simple and detail web views	29.1138	$2,599
1272-AA-VVV	Revenue-grade inverter-independent PV monitoring: for other than 15A or 60A/240V, specify amps and volts in the model # to the left	29.1139	$2,599
8205	Basic Weather station with temperature and sunlight monitoring for 1272 above	29.1190	$1,999
8295	Full Weather Station with temperature, sunlight and wind monitoring for 1272 above	29.1191	$3,299
1235	Revenue-grade inverter-independent PV monitoring for 2-wire single-phase inverters w/ 3-wire bldg demand w/detail web views	29.1154	$2,999
1235-W	Premium pkg w/ bldg demand (same as above w/ addition of a complete weather station for temperature, sunlight and wind monitoring)	29.1155	$6,199
Off-grid monitoring products			
4701-12	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 12 volt system – no enclosure	29.1105	$998
4701-24	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 24 volt system – no enclosure	29.1106	$998
4701-48	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 48 volt system – no enclosure	29.1108	$998
Options			
9041	Cellular modem add-on – requires purchase of cellular service from a communications service provider	29.1145	$998
7750	Add 5 more years of monitoring service	29.1181	$499
7752	Add 5 more years of monitoring service on a TriStar off grid system	29..1182	$298
7760	Add 5 additional years of Fat Spaniel Gateway warranty (parts only)	29.1183	$100
1760	System Installer Portal – web-based aggregated view of data from all of an installer's end-user systems with access to views for each individual installed system, system status info and to data downloads	29.1299	$7,500

Commercial Monitoring Service

With Fat Spaniel Technologies Commercial Monitoring Service, you get an accurate and real-time view of your savings and production, whenever and wherever you need it. It allows you to view your whole-building energy picture by monitoring one or many building systems in a single view.

The image at right is a typical commercial simple view showing real-time and historical data. Custom commercial views are available to view selected aspects of your whole-building energy picture. Monitor one or many building systems in a single view. Call for more information.



Features:

- View one or many building systems, from a single inverter to multi-inverter installations
- Reduce your energy bill through tighter management of energy production and usage.
- Improve net-metering results by maximizing export and load-shifting
- View real-time and historical energy production and usage
- Access your system information anytime, anywhere
- Show off the environmental benefits of your installation
- Automated alerts reduce service calls
- CEC approved as an eligible system performance meter

Battery Information and Sizing

All standalone and battery-backup PV systems require battery storage. Photovoltaic modules charge the batteries during daylight hours and the batteries supply the power when it is needed, often at night and during cloudy weather. Utility grid-tie systems supply power directly to the utility grid; no battery storage is needed.

The two most common types of rechargeable batteries in use today are lead-acid and alkaline. Lead acid batteries have plates made of lead, mixed with other materials, submerged in a sulfuric acid solution. We do not list nickel-cadmium batteries in this catalog because of their high cost and environmental problems related to disposal. Nickel metal hydride and lithium ion batteries look promising for the future, but at this time their price is much too high for the size needed for all but the smallest of remote lighting systems.

Battery Size

The size of the battery bank required depends on the storage capacity required, the maximum discharge rate, the maximum charge rate, and the minimum temperature at which the batteries will be used. When designing a power system, all these factors are looked at and the one requiring the largest capacity will dictate battery size. Temperature has a significant effect on lead-acid batteries. At 40°F they will have 75% of rated capacity, and at 0°F their capacity drops to 50%. The storage capacity of a battery, the amount of electrical energy it can hold, is usually expressed in amp-hours. If one amp is used for 100 hours, then 100 amp-hours have been used. A battery in a PV power system should have sufficient amp-hour capacity to supply needed power during the longest expected period of cloudy weather. A lead-acid battery should be sized at least 20% larger than this amount. If there is a source of backup power, such as a standby generator with a battery charger, the battery bank does not have to be sized for worst-case weather conditions.

Lead-Acid Batteries

Lead-acid batteries are the most common in PV systems because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is whether they are deep cycle batteries or shallow-cycle batteries. Shallow-cycle batteries, like the starting batteries in automobiles, are designed to supply a large amount of current for a short time and to stand mild overcharge without losing electrolyte. However, they cannot tolerate being deeply discharged. If they are repeatedly discharged more than 20% their life will be very short. These batteries are not a good choice for a PV system. Deep cycle batteries are designed to be repeatedly discharged by as much as 80% of their capacity so they are a good choice for PV systems. Even though they are designed to withstand deep cycling, these batteries will have a longer life if the cycles are shallower. All lead-acid batteries fail prematurely when they are not recharged completely after each cycle. Letting a lead-acid battery stay in a discharged condition for days at a time will cause a permanent loss of capacity. Sealed deep cycle lead-acid batteries (gel cells and absorbed glass mat) are maintenance-free. They never need watering or an equalization charge. Sealed batteries require very accurate regulation to prevent over-charge and over-discharge. Either of these conditions will drastically shorten their lives. We recommend sealed batteries for remote, unattended power systems.

Caring for Lead-Acid Batteries

Always use extreme caution when handling batteries and electrolyte . Wear gloves, goggles and old clothes. “Battery acid” will burn skin and eyes and destroy cotton and wool clothing.

The quickest way to ruin lead-acid batteries is to discharge them deeply and let them stand “dead” for an extended time. The positive plates change from lead oxide when charged to lead sulfate when discharged. If they remain in the lead sulfate state for a few days, part of the plate does not return to lead oxide when the battery is recharged. The parts of the plates that become “sulfated” no longer store energy.

Batteries that are deeply discharged and then charged partially on a regular basis can fail in less than one year. Check your batteries on a regular basis to be sure they are getting charged. Use a hydrometer to check the specific gravity of your lead-acid batteries. If batteries are cycled very deeply and then recharged slowly, the specific gravity reading will be lower because of incomplete mixing of electrolyte. Check the electrolyte level in wet-cell batteries at least four times a year and top-off each cell with distilled water. Do not add water to discharged batteries. Electrolyte is absorbed when batteries are discharged. If you add water at this time and then recharge the battery, electrolyte will overflow and make a mess. Keep the tops of your batteries clean and check that cables are tight. Do not tighten or remove cables while charging or discharging. Any spark around batteries can cause a hydrogen explosion inside, and ruin one of the cells, and you. It is a good idea to do an equalizing charge when some cells show a variation of 0.05 specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel-type batteries.

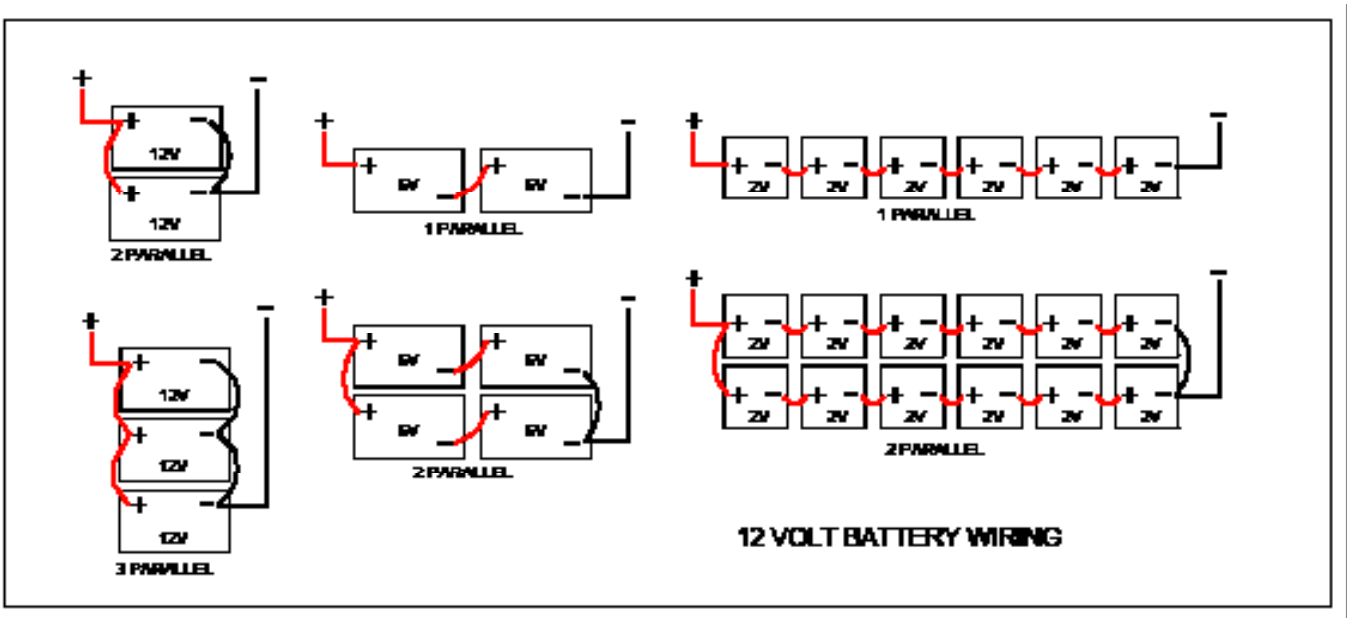
With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. With poor treatment lead-acid battery life will be very short.

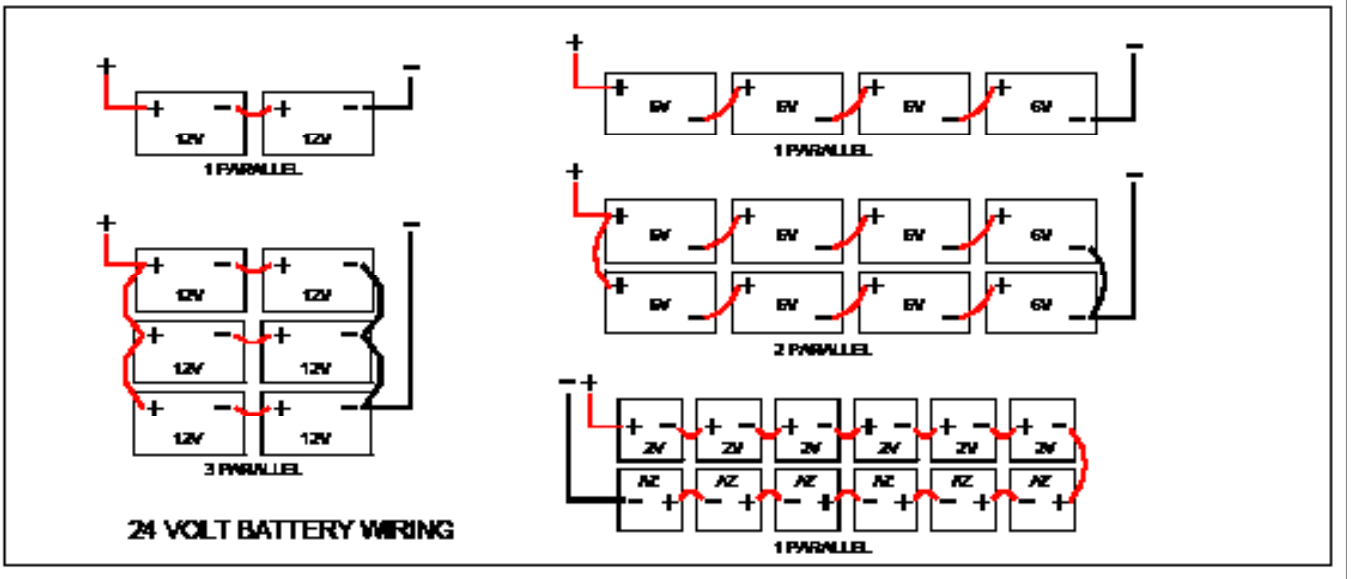
We strongly recommend the use of an amp-hour meter with all battery systems. See pages 108-109.

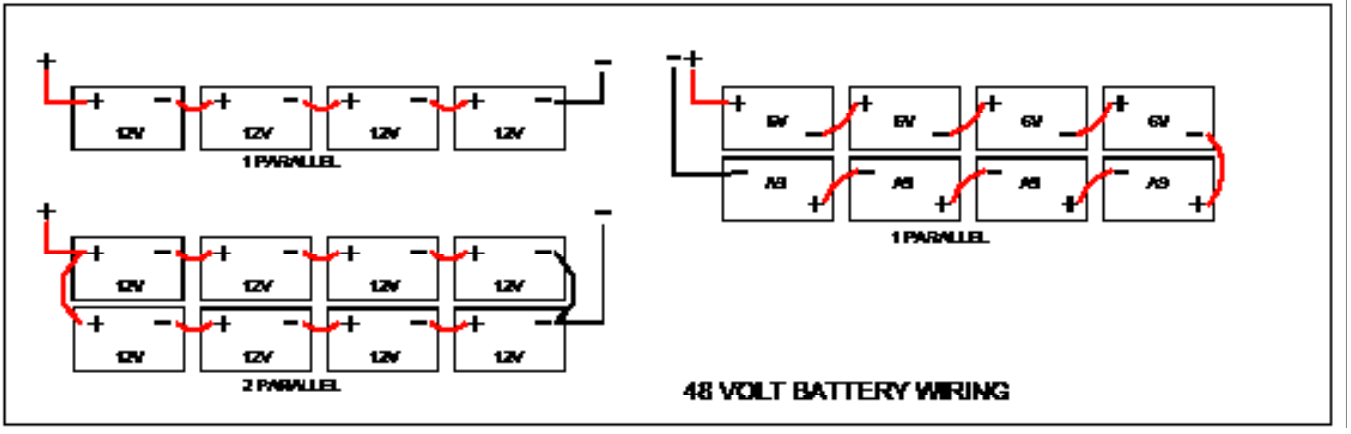
Battery warranties do not cover damage due to poor maintenance or loss of capacity from sulfation.

Battery Wiring Diagrams

The diagrams below show typical 12-, 24- and 48-volt battery wiring configurations. Batteries can deliver extremely high current. Always install fuse protection on any positive wiring connected to batteries.







Battery State-of-Charge

Battery state-of-charge (SOC) can be measured by an amp-hour meter, voltage or by specific gravity. Some care and knowledge is required to interpret state-of-charge from voltage or specific gravity readings. We recommend amp-hour meters for all systems with batteries.

Amp-Hour Meters

An amp-hour meter is like having a "gas gauge" for batteries. It gives users all the information they need to keep their batteries charged. At a glance the user can see system voltage, current, and battery condition. (See the meter section for more information on amp-hour meters.)

Measuring Battery State-of-Charge

Battery voltage will vary for the same state-of-charge depending on whether the battery is being charged or discharged, and what the current flow is in relation to the size of the battery. The chart below will give you an idea of state-of-charge for various battery conditions in flooded cell lead-acid batteries. Voltage varies with temperature. While charging, a lower temperature will increase battery voltage. Full-charge voltage on a 12-volt battery is 0.9 volts higher at 32°F than at 70°F. While discharging, a higher temperature will increase battery voltage. There is little temperature effect while a battery is standing.

(Thanks to Ralph Heisy, Bogart Engineering, for this information.)

Battery condition @ 77°F	Nominal battery voltage		
	12V	24V	48V
Battery during equalization charge	Over 15	Over 30	Over 60
Battery near full charge while charging	14.4 to 15.0	28.8 to 30.0	57.6 to 60.0
Battery near full discharge while charging	12.3 to 13.2	24.6 to 26.4	49.2 to 52.8
Battery fully charged with light load	12.4 to 12.7	24.8 to 25.4	49.6 to 50.8
Battery fully charged with heavy load	11.5 to 12.5	23.0 to 25.0	46.0 to 50
No charge or discharge for 6 hours - 100% charged	12.7	25.4	50.8
No charge or discharge for 6 hours - 80% charged	12.5	25	50
No charge or discharge for 6 hours - 60% charged	12.2	24.4	48.8
No charge or discharge for 6 hours - 40% charged	11.9	23.8	47.6
No charge or discharge for 6 hours - 20% charged	11.6	23.2	46.4
No charge or discharge for 6 hours - fully discharged	11.4	22.8	45.6
Battery near full discharge while discharging	10.2 to 11.2	20.4 to 22.4	40.8 to 44.8

Hydrometers

A hydrometer is very accurate at measuring battery state-of-charge if you measure the electrolyte near the plates. Unfortunately, you can only measure the electrolyte at the top of the battery. When a battery is being charged or discharged, a chemical reaction takes place at the border between the lead plates and the electrolyte. During charging, the electrolyte changes from water to sulfuric acid. The acid becomes stronger and the specific gravity rises as the battery charges. Near the end of the charging cycle gas bubbles rising through the acid stirs the fluid to mix it. It takes several hours for the electrolyte to mix so that you get an accurate reading at the top of the battery. Always try to take readings after a period of no charge or discharge.

Hydrometer Readings

The chart below shows battery state-of-charge at various specific gravities. These readings are correct at 75 degrees F.

State of charge	Specific gravity
100% charged	1.265
75% charged	1.239
50% charged	1.2
25% charged	1.17
Fully discharged	1.11

Battery Sizing Worksheet

Use this worksheet to determine what size battery is required for your system. Battery size is measured in amp-hours. This is a measure of battery capacity. Battery voltage is determined by the number of "cells" in series. All lead-acid battery cells have a nominal output of 2 volts. Actual cell voltage varies from about 1.7 volts at full discharge to 2.4 volts at full charge. 12-volt lead-acid batteries are made of 6 separate cells in one case. 6-volt batteries are made of 3 cells in one case. Putting battery cells in parallel increases amp-hour capacity, but does not change voltage.

Battery temperature	Multiplier
80°F/26.7°C	1
70°F/21.2°C	1.04
60°F/15.6°C	1.11
50°F/10.0°C	1.19
40°F/4.4°C	1.3
30°F/-1.1°C	1.4
20°F/-6.7°C	1.59

Step 1 Total average amp-hours per day required, from line 9 on the Off-Grid Load Worksheet on p. 13: _____

Step 2 Maximum number of continuous cloudy days expected in your area : _____

Step 3 Multiply line 1 by line 2: _____

Step 4 Divide line 3 by 0.8 to maintain a 20% reserve after deep discharge period. (Dividing line 3 by a more conservative 0.5 will maintain a 50% reserve and increase battery life): _____

If no special conditions below apply, skip to line 9:

Special Condition #1: Heavy Electrical Load

Step 5 Maximum amperage that will be drawn by the loads for 10 minutes or more : _____

Step 6 Multiply line 5 by line 5.0: _____

Special Condition #2: High-Charge Current

Step 7 Maximum output amperage of PV array or other battery charger : _____

Step 8 Multiply line 7 by 5.0: _____

Step 9 Amp-hours from line 4, 6 or 8, whichever is largest : _____

Step 10 If you are using a lead acid battery, select the multiplier from the Battery Temperature Chart above which corresponds to the battery's wintertime average ambient temperature: _____

Step 11 Multiply line 9 by line 10. This is your optimum battery size in amp-hours: _____

Step 12 Amp-hours of battery chosen. (Industrial Cell, T105=220, L16=350, etc.): _____

Step 13 Divide line 11 by line 12. This is the total number of batteries in parallel required: _____

Step 14 Round off to the next highest whole number. This is the number of parallel strings required: _____

Step 15 To determine the number of batteries required in series, divide the system voltage (12, 24, or 48) by the voltage of the chosen battery (2V, 6V or 12V): _____

Step 16 Multiply line 14 by line 15. This is the total number of system batteries needed for the chosen battery: _____

MK Battery

Sealed PV/Solar Batteries

MK sealed batteries are designed for maintenance-free operation for the life of the battery. Sealed construction eliminates periodic watering, corrosive acid fumes and spills. Tank formed plates ensure voltage matching between cells. They are all rated non-spillable by ICAO, IATA, and DOT, which means easy transportation by air and no special containers are needed. 1-year warranty.

MK Sealed Gel Batteries

The gelled electrolyte won't stratify, so no equalization charging is required. Less than 2% per month standby loss means low discharge during transport and storage.

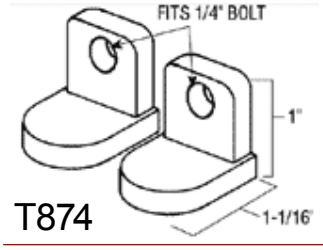
Gel batteries are best for cycling operations and where very cold temperatures are expected. They can operate at temperatures from -76 to 140 F.

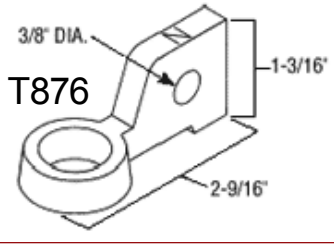
MK Sealed AGM Batteries

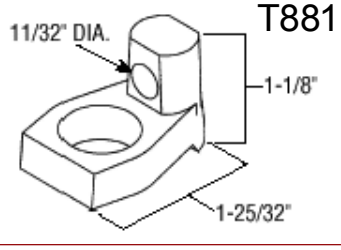
These are completely sealed, absorbed glass mat, valve-regulated batteries with efficient recombination. They are UL Recognized components to UL MH17218. AGM batteries are recommended for battery backup standby power systems where batteries are in float service with occasional deep discharges. They can operate at temperatures from -40 to 140 F.

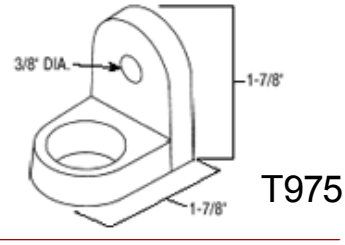
Delivery is easy from one of 20 MK warehouses all across the US.

Battery type	Model number	Volts	Terminals	Capacity (Ah)		Dimensions (in) L x W x H	Weight lbs	Item code	Price
				20-hr rate	100-hr rate				
Sealed gel solar batteries	SU1-SLD-G	12	T874	31.2	36.1	7.8 x 5.2 x 7.3	24	**40.3015**	**$95**
	S222NF-SLD-G	12	T881	50	57	9.38 x 5.5 x 9.25	38	**40.3018**	**$156**
	S24-SLD-G	12	T881	73.6	84	10.9 x 6.8 x 9.9	53.6	**40.3022**	**$189**
	S27-SLD-G	12	T876	86.4	99	12.75 x 6.75 x 9.75	63.2	**40.3024**	**$214**
	S31-SLD-G	12	T876	97.6	108	12.94 x 6.75 x 9.75	71.7	**40.3027**	**$262**
	S4D-SLD-G	12	T975	183	210	20.8 x 8.5 x 10	130	**40.3030**	**$490**
	S8D-SLD-G	12	T975	225	265	20.8 x 11 x 10	161	**40.3033**	**$590**
	SV6GC-SLD-G	6	T881	180	198	10.3 x 7.2 x 10.9	69	**40.3036**	**$270**
Sealed AGM solar batteries	8AU1	12	T874	32.5	37	7.8 x 5.2 x 7.3	24	**40.3117**	**$99**
	8A22NF	12	T881	55	63	9.38 x 5.5 x 9.25	38	**40.3120**	**$154**
	8A24	12	T881	79	91	10.9 x 6.8 x 9.9	53.6	**40.3123**	**$195**
	8A27	12	T876	92	106	12.75 x 6.75 x 9.75	63.2	**40.3126**	**$230**
	8A31	12	T876	105	116.2	12.94 x 6.75 x 9.75	71.7	**40.3129**	**$269**
	8A4D	12	T975	200	216	20.8 x 8.5 x 10	130	**40.3132**	**$504**
	8A8D	12	T975	245	257	20.8 x 11 x 10	161	**40.3135**	**$590**
	8AGC2	6	T881	200	220	10.3 x 7.2 x 10.9	69	**40.3137**	**$270**









Prices subject to change without notice.

Trojan

Commercial Deep Cycle Lead Acid Batteries

These batteries have been used in off-grid power systems in remote cabins for the past 25 years with great success. Because of their low initial cost, they are the most affordable true, deep cycle batteries. The T105 golf cart battery is designed to be used in small electric vehicles where they are cycled heavily and last about 2 years. In a remote home system where they are cycled down 20% every day they can last 3 to 6 years. The L-16 battery is designed for electric floor scrubbing machines. They are a heavy-duty cousin of the golf cart battery with much thicker lead plates and nearly twice the capacity. The L-16 is available in a standard and a high-capacity version. The standard version holds more electrolyte and has a slightly longer life.

The SCS-series 12-volt marine batteries are Trojan's top of the line 12-volt deep cycle batteries. They are designed for marine and RV use and work well in small cabin systems where 110 to 130 amp-hours is enough storage.

Model	Volts	Capacity (Ah) 20-hour rate	Dimensions (in)	Weight lbs	Item code	Price
T-105	6	225	10.375 x 7.125 x 11.25	6 2	40.1939	$123
L-16PO	6	390	11.625 x 7 x 16.75	113	40.1963	$320
L-16HC	6	420	11.625 x 7 x 16.75	121	40.1964	$364
SCS150	12	110	11.25 X 6.75 X 9.75	50	40.1921	$147
SCS225	12	130	13.25 X 6.75 X 9.75	66	40.1927	$179

Automatic battery watering systems are available for all flooded batteries.
Contact us for information and pricing.

Rolls/Surrette Battery – Deep Cycle Industrial Flooded Batteries

These are the new generation, dual container, deep cycle Rolls batteries from Surrette. (S-460 and S-530 are not dual container). They are high-capacity batteries with heavy duty plate grid to resist positive plate breakdown. The plates are double insulated with glass mat and a polyethylene envelope, eliminating the possibility of separator misalignment, cracked separators, treeing or shorting at the bottoms or sides. Rolls batteries are rated at 3200 cycles at 50% depth of discharge except for S-460 and S-530 which are rated at 1000 cycles. Each 2-volt cell is built into its own lightweight container made of durable polypropylene with the cover heat bonded to the container, thus acid leakage is eliminated. The cells are then assembled into a tough, lightweight polyethylene outer container with a removable lid. Even if the outer container were to break, the battery would still be operable without acid spills. The individual cells are bolted together (CS and KS series) allowing the battery to be disassembled and the cells can be independently removed. This facilitates easy on-site installation, disassembly, assembly, or replacements of individual cells without special skills or tools. All Surrette CS & KS deep cycle solar batteries come with a 10-year warranty, 3-year full warranty, and 7-year prorated.

Batteries shipped to commercial addresses qualify for free shipping to different regions of the country as follows:

- ***East of the Mississippi:***
  S-460s and S-530s – 18 batteries or more
  All other batteries – greater than 2000 pounds
- ***West of the Mississippi, east of the Rockies:***
  S-460s and S-530s – 36 batteries or more
  All other batteries – greater than 4000 pounds
- ***West of the Rockies:***
  S-460s and S-530s – 54 batteries or more
  All other batteries – greater than 6000 pounds

Surrette model	Battery voltage	Capacity (Ah)		Rated cycles (50% DOD)	Warranty (years)	Dimensions (inches)			Weight wet / dry	Item code	Price
		20-hr rate	100-hr rate			L	W	H			
2-KS-33PS	2	1766	2491	3300	10	15.44	8.31	24.81	208/145	**40.2220**	**$913**
2-YS-31PS	2	2430	3435	3300	10	15.50	9.00	31.63	285/200	**40.2221**	**$1432**
4-CS-17P	4	546	770	3200	10	14.38	8.25	18.25	128 / 98	**40.2223**	**$525**
4-KS-21P	4	1104	1557	3200	10	15.75	9.38	24.75	267 / 186	**40.2226**	**$790**
4-KS-25P	4	1350	1900	3200	10	15.75	10.63	24.75	315 / 220	**40.2229**	**$1236**
S-460	6	350	460	1000	7	12.28	7.12	16.75	117 / 90	**40.2106**	**$333**
S-530	6	400	530	1000	7	12.28	7.12	16.75	125 / 105	**40.2109**	**$366**
6-CS-17PS	6	546	770	3200	10	22	8.25	18.25	221 / 178	**40.2232**	**$824**
6-CS-21PS	6	683	963	3200	10	22	9.75	18.25	271 / 217	**40.2235**	**$957**
6-CS-25PS	6	820	1156	3200	10	22	11.25	18.25	318 / 254	**40.2238**	**$1130**
8-CS-17PS	8	546	770	3200	10	28.25	8.25	18.25	294 / 238	**40.2247**	**$1050**
8-CS-25PS	8	820	1156	3200	10	28.25	11.25	18.25	424 / 342	**40.2250**	**$1535**
12-CS-11PS	12	357	503	3200	10	22	11.25	18.25	272 / 220	**40.2259**	**$1001**

Prices subject to change without notice.

OUR STANDARD LABEL

Rolls has been producing premium batteries specifically designed for the renewable energy market since 1964. That's why those who can't afford to go without power know they can't afford to trust anyone else.

Rolls
BATTERY ENGINEERING

Superior Cycling | Dual-Container Construction | Widest Range of Sizes
Largest Liquid Reserves | Easiest to Install | Longest Life Span | Premium Warranties

T. 1.800.681.9914 E. sales@rollsbattery.com www.rollsbattery.com

HuP Solar-One – 2100 Cycle Industrial Batteries

The Solar-One battery with HuP Technology is optimized for renewable energy systems. It has a slightly enlarged epoxy-coated steel case that allows cell removal and easier installation without a forklift or crane. Solar-One batteries are designed with 0.310" thick positive plates and a patented technology that allows them to be warranted for 2100 cycles to 80% DOD. The 10 year-warranty, 7-year free replacement and 3 years prorated is the best in the RE industry. Each Solar-One is made up of six 2-volt cells and comes with stainless steel hardware, lead-plated copper buss bars, a cell lifting strap and an operator/installation manual. Order two for 24-volt systems or four for 48-volt systems. Many sizes are in stock and available for immediate shipment. Other sizes are made to order; please allow up to 8 weeks for delivery. Free shipping to a commercial location in the lower 48 states.

Cell type	Capacity @ 20-hr rate	Weight lbs	Dimensions L" x w" x 25" h	Item code	Price
SO-6-85-17	845 A-H	742	40" x 7.75"	**40.5269-A**	**$1,959**
SO-6-85-19	950 A-H	808	40" x 8.25"	**40.5272**	**$2,099**
SO-6-85-21	1055 A-H	880	40" x 8.75"	**40.5275**	**$2,169**
SO-6-85-23	1160 A-H	959	40" x 9.0"	**40.5278**	**$2,315**
SO-6-85-25	1270 A-H	1036	40" x 10.25"	**40.5281**	**$2,425**
SO-6-85-27	1375 A-H	1102	40" x 11.25"	**40.5284**	**$2,500**
SO-6-85-31	1585 A-H	1252	40" x 12.75"	**40.5290**	**$2,899**
SO-6-85-33	1690 A-H	1336	40" x 13.5"	**40.5293**	**$2,999**

IBE

POWR-Plus Solar Batteries

POWR-Plus batteries are designed to give more energy and maximum battery life. All batteries are custom built when an order is received. All batteries have high capacity industrial type deep cycle cells with flag type terminals on the positive and negative posts. Heat-sealed cell covers eliminate the major source of electrolyte leakage, reducing corrosion build-up. Tough steel cases are powder coated for acid resistance and have lifting handles.

Cycle life of these batteries is 5,000 cycles at 20% depth of discharge or 1500 cycles at 80% depth of discharge.

We list 12-volt packs that can be combined for 24- or 48-volt systems. IBE can also supply 2-volt cells with the same high quality cells, for use when the batteries must be moved by hand.

IBE batteries have an 8-year warranty. The first 5 years are full replacement. The last 3 years are prorated.

Cell type	Capacity @ 20-hr rate	Capacity @ 100-hr rate	Weight lbs	Dimensions L" x W" x 24" H	Item code	Price
12V POWR-plus solar batteries						
Pp-6-85-9	418 A-h	510 A-h	490	21.5 X 6.62	**40.7209**	**$1,229**
Pp-6-85-11	523 A-h	638 A-h	630	26.5 X 6.62	**40.7211**	**$1,382**
Pp-6-85-13	627 A-h	765 A-h	670	30.75 X 6.62	**40.7213**	**$1,493**
Pp-6-85-15	732 A-h	893 A-h	710	18 X 13	**40.7215**	**$1,698**
Pp-6-85-17	836 A-h	1020 A-h	790	20.25 X 13	**40.7217**	**$1,848**
Pp-6-85-19	941 A-h	1148 A-h	905	22.38 X 13	**40.7219**	**$2,034**
Pp-6-85-21	1046 A-h	1275 A-h	1006	24.75 X 13	**40.7221**	**$2,171**
Pp-6-85-23	1160 A-h	1403 A-h	1080	27 X 13	**40.7223**	**$2,304**
Pp-6-85-25	1255 A-h	1530 A-h	1160	29.25 X 13	**40.7225**	**$2,516**
Pp-6-85-27	1359 A-h	1658 A-h	1240	31.5 X 13	**40.7227**	**$2,663**
Pp-6-85-29	1464 A-h	1785 A-h	1325	33.75 X 13	**40.7229**	**$2,913**
Pp-6-85-31	1568 A-h	1913 A-h	1389	36 X 13	**40.7231**	**$3,177**
Pp-6-85-33	1673 A-h	2040 A-h	1480	38.25 X 13	**40.7233**	**$3,497**
2V POWR-plus solar batteries						
PP-1-85-17	836 A-H	1020 A-H	138	6.62 x 6.88	**40.7155**	**$399**
PP-1-85-19	941 A-H	1148 A-H	146	6.62 x 7.62	**40.7157**	**$429**
PP-1-85-21	1046 A-H	1275 A-H	168	6.62 x 8.38	**40.7159**	**$451**
PP-1-85-23	1160 A-H	1403 A-H	180	6.62 x 9.12	**40.7161**	**$473**
PP-1-85-25	1255 A-H	1530 A-H	194	6.62 x 9.88	**40.7163**	**$510**
PP-1-85-27	1359 A-H	1658 A-H	208	6.62 x 10.62	**40.7165**	**$533**
PP-1-85-29	1464 A-H	1785 A-H	224	6.62 x 11.38	**40.7167**	**$575**
PP-1-85-31	1568 A-H	1913 A-H	238	6.62 x 12.12	**40.7169**	**$619**
PP-1-85-33	1673 A-H	2040 A-H	252	6.62 x 12.88	**40.7171**	**$672**

Prices subject to change without notice.

GNB

Absolyte IIP Industrial Sealed Batteries

The Absolyte battery was developed by GNB, in conjunction with Sandia National Laboratories, as the first VRLA, large capacity, deep cycle battery for photovoltaic applications. This design provides for extended partial state-of-charge operation and allows for deep discharge recovery. Their wide band of temperature operation, from -40°C (-40°F) to +50°C (122°F), retains more capacity in cold temperatures than traditional flooded batteries. Life expectancy in float conditions is 20 years @ 25°C (77°F) with proper charging. Life expectancy in cycling conditions is1200 cycles to 80% DOD with proper charging. Sealed cells with absorbed glass mat (AGM) separators eliminate the need for periodic water additions as found in flooded cells. Periodic visual inspections, voltage readings, and connection retorquing are all that is required.

Protective steel tray housings offer maximum installation flexibility and the Absolute IIP is qualified to stack horizontally up to eight high for use in 1997 UBC/2001 CBC Seismic Zone IV (at or below grade). This provides for high capacity in a small footprint and frees up floor space for other equipment; and because they are sealed, they do not require a separate battery room.

They are IEC 896, BS 6290, UL Recognized, ISO 9001:2000, designed to meet Telcordia SR4228 and GR-63-CORE (NEBS).

Applications

Absolyte IIP batteries are ideal for photovoltaic and alternative energy applications including:

- Village electrification
- Telecommunications
- Residential power
- Railroad signal
- Navigational aids

GNB part #	Volts	Capacity (Ah)		Length (in.)	Width (in.)	Height (depth) (in.)	Weight lbs	Item code	Price
		20-hr rate	100-hr rate						
6-cell 12-volt batteries									
6-50a05	12	120	145	17.19	8.53	16.22	157	40.4409	$1,322
6-50a07	12	182	220	21.69	8.53	16.22	209	40.4412	$1,561
6-50a09	12	240	290	26.19	8.53	16.22	252	40.4415	$1,850
6-50a13	12	360	440	35.19	8.53	16.22	356	40.4421	$2,359
6-90a07	12	300	365	21.69	8.53	23.56	316	40.4430	$1,968
6-90a09	12	400	490	26.19	8.53	23.56	396	40.4433	$2,303
6-90a11	12	500	610	30.69	8.53	23.56	477	40.4436	$2,710
6-90a13	12	600	730	35.19	8.53	23.56	557	40.4439	$3,163
6-90a15	12	700	855	39.69	8.59	23.56	637	40.4442	$3,473
3-cell 6-volt batteries									
3-100a19	6	1,020	1,200	26.75	8.59	26.38	470	40.4322	$2,255
3-100a21	6	1,140	1,330	29.00	8.59	26.38	515	40.4325	$2,446
3-100a27	6	1,460	1,730	35.75	8.59	26.38	653	40.4334	$3,088
3-100a29	6	1,580	1,860	38.00	8.59	26.38	704	40.4337	$3,262
3-100a31	6	1,700	1,995	40.25	8.59	26.38	750	40.4340	$3,493
3-100a33	6	1,820	2,130	42.50	8.59	26.38	795	40.4343	$3,717
2-volt cells									
1-100a39	2	2,040	2,400	19.93	8.53	26.38	328	40.4225	$1,623
1-100a45	2	2,340	2,795	22.18	8.59	26.38	374	40.4228	$1,860
1-100a51	2	2,700	3,190	24.50	8.59	26.38	424	40.4231	$2,073
1-100a57	2	3,060	3,590	26.75	8.59	26.38	470	40.4234	$2,258
1-100a63	2	3,420	3,990	29.00	8.59	26.38	515	40.4237	$2,450
1-100a69	2	3,780	4,390	31.25	8.59	26.38	561	40.4240	$2,632
1-100a75	2	4,080	4,790	33.50	8.59	26.38	608	40.4243	$2,817
1-100a81	2	4,440	5,185	35.75	8.59	26.38	653	40.4246	$3,037
1-100a87	2	4,800	5,585	38.00	8.59	26.38	704	40.4249	$3,263
1-100a93	2	5,100	5,985	40.25	8.59	26.38	750	40.4252	$3,492
1-100a99	2	5,460	6,385	42.50	8.59	26.38	795	40.4255	$3,716

OutBack

Power System Rack (PSR)

This is a combined battery cabinet and system component rack for batteries, disconnects, over-current protection devices and even the inverter/charger in a single enclosure. The PSR is a powder-coated steel enclosure with internal support frame, shelves and removable side and top panels for indoor use. The PSR is also available in a frame-only version (PSR-FO).

It holds up to eight Group 27/31, eight T105, four L16, or two 8D type batteries in its standard configuration. With one extra shelf, it will hold 12 Group 27/31 batteries and with 2 extra shelves it can hold four 8D batteries. Dimensions: 43"H x 34"W x 17"D.

It is packaged disassembled for easy shipping and must be assembled at the site with a screwdriver.

- All sides and top can be removed with conduit attached on the PSR
- Includes DC breaker bracket which holds up to five small breakers and one large breaker
- Easily connected to various power inverters or the OutBack PSDC via 2" conduit
- Circuit breakers are easily added in the field
- PSRs can be directly mated end-to-end for large storage battery systems

Optional Components

- PSR-SK - Additional shelf kit for use with more batteries or components
- One 100-, 175- or 250-amp panel mount DC breaker for disconnecting the inverter/battery system
- 5- to 70-amp panel mount breakers for DC loads and inputs
- PSR-SZ4 - Seismic Zone 4 Kit to meet UBC earthquake safety requirements
- PSR-HDT - Heavy duty top for mounting an inverter directly on top of a PSR cabinet – indoor use only
- PSR-BCK – Lockable breaker cover kit for PSR only
- PSR-MP - Mounting plate for mounting inverters or PV charge controllers inside PSR

For more panel mount breakers, see page 139.

Spill Containment Tray

This tray holds four Group 31, T105 or L16 batteries. The tray has enough capacity to hold one ruptured battery cell's spilled electrolyte. Fits on one PSR shelf. Molded acid resistant polyethylene plastic.

OutBack model	Description	Item code	Price
PSR	Battery and power system rack	30.4519	$649
PSR-FO	Battery rack - frame only	30.4528	$399
	Optional components		
PSR-3RK	Outdoor kit includes an insulated rain-proof cover, gasketing and a plastic breaker cover	30.4525	$149
PSR-SK	Additional shelf kit	30.4531	$89
PSR-SZ4	Seismic Zone 4 kit	30.4537	$89
PSR-HDT	Heavy duty top	30.4522	$79
PSR-SCT	Spill containment tray - fits one shelf	30.4534	$29
PSR-MP	Mounting plate attached to the inside back of the psr for mounting inverters or electrical components	30.4470	$39
PSR-BCK	Breaker cover kit with mounting screws and padlock hasp	30.4540	$19
PSR-MMA	Allows side mounting of Beacon M-5 inverter	30.4545	$39

Direct Power – Pole-Mount Aluminum Battery Boxes

Side-of-pole mount aluminum NEMA 3R hinged door boxes from Direct Power & Water are available for several battery sizes and battery/equipment configurations. They are made to order from 0.125" 5052- H32 aluminum with white powder coating, and can be built to meet specific application requirements. The doors have padlock hasps and stainless steel continuous hinges. Each box has a removable control mounting plate, screened vents and two 7/8" wire entrance holes.

Battery size	Batteries spaces	Dimensions D" x W" x H"	Item code	Price
Group 27, 30	1	9 X 16 x 20	**48.4179**	**$495**
Group 27, 30	2	16 X 16 x 20	**48.4188**	**$660**
Group 27, 30	4	16 X 16 x 20	**48.4200**	**$840**
Group 27, 30	6	16 X 25 x 34	**48.4201**	**$1,020**
Golf cart	2	14 X 18 x 22	**48.4197**	**$545**
Golf cart	4	14 X 18 x 36	**48.4203**	**$680**
4d	1	12 X 24 x 22	**48.4282**	**$630**
4d	2	12 X 24 x 36	**48.4291**	**$790**
8d	1	15 X 24 x 22	**48.4285**	**$690**
8d	2	15 X 24 x 36	**48.4294**	**$865**

MidNite Solar – Battery Enclosures

These grey powder-coated steel battery enclosures with locking doors are ETL Listed for the US and Canada for indoor use. They are for use with sealed AGM or gel batteries. MNBE-A ships by UPS, unassembled. MNBE-B ships by UPS unassembled in 2 boxes. MNBE-C ships by truck freight, unassembled .

MidNite model	Battery size	Batteries spaces	Dimensions (in) D x w x h	Shipping dimensions	Weight (Lbs)	Item code	Price
MNBE-A	27 or 31	6	14.5" X 29" x 27.25"	30" X 32" x 7.5"	71	**48.5501**	**$375**
	8d	2					
MNBE-B	27 or 31	8	15.25" X 33.6" X 34.5"	18" X 8" x 36" & 18" X 9" x 37"	102	**48.5503**	**$575**
MNBE-C	27 or 31	12	16" X 36.5" X 55"	Ships by truck on a 42" x 42" x 60" pallet	190	**48.5505**	**$849**
	8d	3					

Direct Power – Chest Style Battery Enclosures

Pad mount, chest style enclosures are manufactured with .125" 5052-h32 aluminum. All die marks and welds are sanded smooth and the boxes are finished with a reflective bright white polyester powder coat to minimize internal heat gain. All enclosures are provided with integrated louvers located to promote convective air flow through the enclosure to reduce internal temperatures and remove gasses. Filters are located over the louvers to keep out dust and insects. The filters are removable for cleaning or replacement. All standard enclosures are built to meet NEMA 3R specifications.

Other sizes are available. For sizes not listed below, contact us for price.

Battery size	Batteries spaces	Layout	Dimensions (inches)	Weight lbs	Non-insulated		Insulated	
					Item code	Price	Item code	Price
27/30	2	2x1	16x16x16	26	48.4030	$768	48.4033	$1,030
	4	2x2	18x30x16	39	48.4031	$973	48.4034	$1,283
	4	1x4	16x34x16	37	48.4032	$995	48.4035	$1,314
	6	2x3	25x30x16	50	48.4140	$1,158	48.4143	$1,518
	8	2x4	30x33x16	60	48.4036	$1,320	48.4043	$1,711
	10	2x5	41x30x16	70	48.4037	$1,469	48.4044	$1,903
8d	2	2x1	24x26x16	44	48.4057	$1,047	48.4065	$1,368
	4	2x2	26x46x16	68	48.4116	$1,433	48.4119	$1,835
	4	1x4	24x50x16	65	48.4066	$1,459	48.4067	$1,871
	6	2x3	38x46x16	90	48.4128	$1,781	48.4131	$2,255
	8	2x4	46x50x16	111	48.4068	$2,102	48.4069	$2,629
	10	2x5	62x46x16	131	48.4164	$2,400	48.4167	$2,993
	12	2x6	46x74x16	150	48.4070	$2,701	48.4077	$3,431
	12	4x3	50x68x16	150	48.4071	$2,691	48.4078	$3,415
Golf cart	2	2x1	13x18x17	25	48.4074	$750	48.4079	$1,009
	4	2x2	18x25x17	37	48.4075	$935	48.4080	$1,236
	4	1x4	14x35x17	36	48.4076	$980	48.4081	$1,298
	6	2x3	25x27x17	47	48.4134	$1,112	48.4137	$1,462
	8	2x4	25x32x17	56	48.4152	$1,256	48.4155	$1,637
	10	2x5	43x25x17	65	48.4082	$1,400	48.4089	$1,825
	12	2x6	25x51x17	74	48.4083	$1,547	48.4090	$2,088
	12	4x3	34x35x17	74	48.4084	$1,529	48.4091	$2,056
L-16, s460, s-530	2	2x1	19x22x28	43	48.4088	$868	48.4095	$1,157
	4	2x2	22x32x28	61	48.4122	$1,113	48.4125	$1,452
	4	1x4	19x39x28	63	48.4096	$1,155	48.4097	$1,508
	6	2x3	31x32x28	76	48.4146	$1,333	48.4149	$1,726
	8	2x4	32x39x28	89	48.4158	$1,518	58.4161	$1,945
	10	2x5	32x48x28	102	48.4098	$1,698	48.4099	$2,173
	12	2x6	32x56x28	115	48.4170	$1,882	48.4173	$2,476
	12	4x3	39x46x28	114	48.4171	$1,860	48.4172	$2,446
	14	2x7	32x65x28	128	48.4174	$2,077	48.4175	$2,694
	16	2x8	32x73x28	141	48.4176	$2,257	48.4177	$2,929
	16	4x4	39x59x28	137	48.418	$2,194	48.4181	$2,845

Heavy Duty Plastic Battery Box

This battery box designed to hold eight L-16 batteries is made from high density polyethylene (HDPE) sheet.

The box has an insulated base with removable middle section that minimizes lifting, easing battery installation. The plastic is easy to drill with hole saw to attach conduit fitting for inverter cables. A hydrogen vent tube in the top should be extended to exterior of building. A drain in the bottom section makes it possible to wash batteries.

Description	Dimensions H x W x D	Weight lbs	Item code	Price
HDPE battery box	18" X 30" x 26"	60	**48.4017**	**$499**

Plywood Battery Storage Containers

These durable wooden storage units are constructed with 5/8" plywood for the bottom to provide a solid support platform. The sides, back and front are ¾" plywood. The lid is 5/8" plywood with an overhang on the both the front and sides and is fastened using galvanized hinges to provide durability in all weather conditions. Handles are added to the lid to make it easy to open. Each box is vented on both sides and the front to provide a constant air flow. A drain plug is included in the floor for easy washing of your battery bank. Every box is finished with quality exterior paint available in black, brown or white. It can also be shipped unfinished so you can match to your home's exterior.

Top and front are removable to allow easy battery installation. Battery boxes are shipped unassembled. Assembly is easy and can be done in just a few hours with 2 people. Step by step instructions, all hardware, screws, and finishing supplies are included in every box.

Model	Battery size	Number of batteries	Dimensions W" x D" x H"	Item code	Price
A8	T105, SCS150, SCS225	8	40 x 33 x 22	**48.3905**	**$839**
B8	L16PO, L16HC; S460, S530	8	40 x 31 x 27	**48.3911**	**$839**
D8	Type 24, 27, 31	8	37 x 33 x 20	**48.3915**	**$839**
A16	T105, SCS150, SCS225	16	80 x 33 x 22	**48.3919**	**$1,299**
B16	L16PO, L16HC; S460, S530	16	80 x 31 x 27	**48.3923**	**$1,299**

Water Miser Battery Caps

Water Misers are molded plastic "flip-top" vent caps designed to reduce and ease maintenance on flooded lead-acid batteries. There is no need to remove the caps when charging, filling or equalizing the batteries. When charging, the plastic pellets capture up to 90% of the moisture and acid droplets. This reduces acid fumes, corrosion, and keeps the battery tops much cleaner and dryer. Excess water is dropped back into the battery cell. Water loss is reduced, which extends time between watering.

These caps fit all batteries with standard caps

Description	Item code	Price
Water Miser battery cap	**40.9913**	**$8.50**

IBE Generator-Powered Chargers

All IBE GPU models are designed with simple and time-proven controlled-reactance transformer and saturable reactor circuits, which requires the least amount of AC power, little or no maintenance and provides a true, constantly tapering charge. The IBE charger is regulated by the "ON CHARGE" battery voltage to control the output DC current. The charger is protected against overloads, short circuits, line voltage surges and reversed battery connections.

Design features include full magnetic control that automatically allows for full taper charge from high rate to maximum safe finish rate. The charging rate is easily re-adjusted to accommodate aging batteries or batteries with faulty cells.

10-year limited warranty.

IBE model	Volts	AC kW required	Max DC current		Weight lbs	Item code	Price
			Start	Continuous			
6GPU60	12	0.84	60	42	48	45.4105	$650
6GPU70	12	1.1	70	49	68	45.4107	$780
6GPU90	12	1.4	90	63	76	45.4109	$870
6GPU100	12	1.6	100	70	83	45.4111	$940
6GPU125	12	1.9	125	88	102	45.4117	$1,070
6GPU150	12	2.3	150	105	115	45.4119	$1,180
6GPU170	12	2.6	170	119	120	45.4121	$1,280
6GPU200	12	3.1	200	140	130	45.4123	$1,445
6GPU240	12	3.7	240	168	150	45.4125	$1,790
6GPU270	12	4.2	270	189	180	45.4127	$2,040
12GPU60	24	1.9	60	42	75	45.4145	$810
12GPU70	24	2.2	70	49	82	45.4147	$930
12GPU90	24	2.9	90	63	103	45.4149	$1,075
12GPU100	24	3.1	100	70	114	45.4151	$1,155
12GPU115	24	3.6	115	81	132	45.4153	$1,275
12GPU125	24	4.1	125	88	138	45.4155	$1,370
12GPU150	24	4.7	150	105	154	45.4157	$1,470
12GPU170	24	5	170	119	160	45.4159	$1,565
12GPU200	24	6	200	140	178	45.4161	$1,755
12GPU240	24	7	240	168	204	45.4163	$1,990
12GPU270	24	8	270	189	220	45.4165	$2,290
24GPU60	48	3.8	60	42	112	45.4207	$1,290
24GPU70	48	4.4	70	49	143	45.4209	$1,440
24GPU90	48	5.8	90	63	154	45.4211	$1,580
24GPU100	48	6	100	70	165	45.4213	$1,720
24GPU115	48	6.8	115	81	182	45.4215	$1,880
24GPU125	48	7.7	125	88	188	45.4217	$1,990
24GPU150	48	9.3	150	105	196	45.4219	$2,120
24GPU170	48	10.5	170	119	204	45.4221	$2,310
24GPU200	48	12.5	200	140	227	45.4223	$2,570

Xantrex Truecharge 40+ Charger

Truecharge 40+ is a high reliability 40-amp electronic battery charger for deep cycle batteries. Switch settings give correct charge for wet, gel cell, or absorbed glass mat (AGM) batteries. Selectable 2- or 3-stage charging where 3-stage includes float charge. Manual equalize charge button. Manual or automatic temperature compensation. Optional temperature sensing probe to correct charge voltage for actual battery temperature. This charger has full 40-amp output even with low-cost generators, which is important when using the charger with a 1000- to 3000-watt generator. Dimensions: 2.75" x 6.7" x 15.1". 1-year warranty.

Description	Item code	Price
Truecharge 40+ charger	45.2885	$450
Temperature sensor	45.2889	$30
Remote control panel	45.2888	$40

IOTA DLS Converter/Chargers

The DLS series converter/power supply output is so clean and ripple-free, it can be used with or without a battery. The DLS series converter/charger quickly and efficiently charges batteries from the full rated output of the DLS. The DLS then maintains the batteries, only putting into the battery what is required by load or self discharge, cutting back to milliamps as the battery requires. Low and transient AC line voltage can be a major cause of converter/power supply failure. The DLS series converter/power supply is protected against low line voltage, as well as spikes coming from the AC power source or from improperly adjusted generators. When used as a power supply, the DLS model will only supply what is required by the load. When not in use it is essentially off, reducing electricity usage. External fuses can be quickly and easily replaced.

Chargers have 120 VAC input. 75-amp and larger chargers have 120V 20-amp plugs. 2-year warranty

IOTA model	Battery volts	Charge amps	Dimensions (inches)	Weight lbs	Item code	Price
DLS-15	12	15	7 x 6.5 x 3.5	4	**45.2112**	**$132**
DLS-30	12	30	7 x 6.5 x 3.5	5.5	**45.2115**	**$171**
DLS-45	12	45	7 x 6.5 x 3.5	5.5	**45.2118**	**$183**
DLS-55	12	55	7 x 6.5 x 3.5	5.5	**45.2121**	**$215**
DLS-75	12	75	10 x 6.5 x 3.5	7.8	**45.2124**	**$440**
DLS-90	12	90	10 x 6.5 x 3.5	7.8	**45.2127**	**$497**
DLS-27/15	24	15	7 x 6.5 x 3.5	5.5	**45.2130**	**$281**
DLS27/25	24	25	7 x 6.5 x 3.5	5.5	**45.2133**	**$335**
DLS-27/40	24	40	10 x 6.5 x 3.5	7.8	**45.2136**	**$545**
DLS-54/15	48	15	10 x 6.5 x 3.5	7.8	**45.2148**	**$545**
IQ-4	12	Smart Controller for 12V Chargers			**45.2103**	**$30**

IOTA IQ-4 Smart Controller

The IQ-4 makes the DLS charger into 3-stage charge with bulk, absorption and float charging. If the battery remains in float stage for 7 days, it delivers a bulk charge. The IQ-4 is not recommended for generator-powered battery charging if generator is only run for short periods of time.

Samlex Battery Chargers

These compact, lightweight, multi-stage battery chargers are designed to charge and maintain lead-acid and gel-cell batteries, without supervision. Safely charge and condition marine, recreational vehicle, industrial and automotive batteries. They can charge multiple banks of batteries.

Charges have 120VAC input. 1-year warranty.

Samlex model	Battery volts	Bulk voltage	Float voltage	Max DC current	Amp meter	Isolated banks	Dimensions (inches)	Weight lbs	Item code	Price
SEC-1215A	12	14.4	13.8	15	Yes	3	8.4 x 8.4 x 3.25	5.0	**45.3073**	**$162**
SEC-1230A	12	14.4	13.8	30	Yes	3	10.7 x 8.4 x 3.25	5.3	**45.3076**	**$266**
SEC-1245A	12	14.4	13.8	45	No	2	12 x 9 x 4	11.1	**45.3079**	**$410**
SEC-2415A	24	28.8	27.6	15	Yes	3	10.7 x 8.4 x 3.3	5.3	**45.3082**	**$266**
SEC-2425A	24	28.8	27.6	25	No	2	12 x 9 x 4	11.1	**45.3085**	**$410**

QuickCote Anti-Corrosion Protectant

Quick-Cote offers a complete acid neutralizing coating, formulated especially for battery terminals and exposed electrical connections. The 8-ounce can has a brush-on applicator that will give years of use and cannot clog like aerosol coatings.

Description	Item code	Price
QuickCote	**46.0195**	**$20**

BD-2 Battery Desulfator

The BD-2 battery desulfator from Solar Converters rejuvenates weak and dead batteries. It uses sharp spikes of current forced into the battery to "jar" sulfate crystals and cause mechanical and electrical resonance to grind them down, removing sulfation from battery plates. It can be used for 12-, 24- and 48-volt batteries. Voltage and pulse strength is adjustable. Two wires connect to positive and negative battery terminals. 1-year warranty.

Description	Item code	Price
BD-2 battery desulfator	45.7105	$125

Battery Power Solutions Desulfators

The BLS-12-A from Battery Power Solutions is for use on vehicles that are used frequently and have one or two batteries. Also for use with a battery bank that operates at 12 volts. Runs constantly to keep the battery in optimum condition. Can also be used for battery storage in conjunction with a float charger. Comes with eye rings for attachment to the battery clamp bolts.

BLS-12/24-B is a higher powered version of BLS-12-A. For use with a battery charger to rejuvenate unusable batteries. Works faster than BLS-12/24-A. Comes with plier type battery clips.

BLS-12/24-C is for use on heavy trucks and other vehicles and systems with multiple batteries. Runs constantly to keep batteries in optimum condition. Comes with 5/16" lugs for attachment to the battery clamp bolts.

BLS-36-A is a 36-volt version for use with battery powered vehicles. Can be mounted on the vehicle to constantly keep the batteries in optimum condition or can be used in conjunction with a battery charger. Comes with 3/8" lugs for attachment to the battery terminals.

BLS-48-A is a 48-volt version for use with battery powered vehicles and for battery banks that operate at 48 volts. Can be mounted on the vehicle to constantly keep the batteries in optimum condition or can be used in conjunction with a battery charger. Comes with 3/8" lugs for attachment to the battery terminals.

Description	Item code	Price
BLS-12-A	45.7161	$60
BLS-12/24-B	45.7163	$96
BLS-12/24-C	45.7165	$96
BLS-36-A	45.7167	$96
BLS-48-A	45.7169	$96

Zephyr Power Vent Battery Box Vent

Lead-acid batteries produce hydrogen gas when charging. But if the battery box is left open to vent gas in cold climates, the batteries get too cold and battery capacity is significantly reduced. A vent that solves this problem is especially important when battery boxes are placed in basements, garages and sheds. When heat rises in the structure, a low pressure area forms around the box, cool air flows into the box and gases vent into the structure. The Power Vent controls battery box venting, removing hydrogen gas while reducing cold air infiltration into the box. The Power Vent contains a gravity-operated damper that normally stays closed. When connected to a voltage-controlled relay, the fan operates only when the batteries are being charged and blows gas vapors out. Designed for battery banks under 2200 Ah and charge rates under 125 amps. Fan can be operated from the auxiliary relay on a Xantrex SW inverter, from the auxiliary relay of an OutBack FX inverter (use 12 volt-fan for all OutBack inverter voltages) or by a voltage controlled switch (sold separately on page 74.) The 12/24-volt unit uses 3 watts and pushes air at 6 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 7.25" with a 2" PVC pipe socket on the inlet and outlet. The 48-volt unit uses 6 watts and pushes 8 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 10" long, with a 3" PVC pipe socket on the inlet and outlet.

Description	Item code	Price
Power vent 12V	85.8205	$79
Power vent 24V	85.8207	$79
Power vent 48V	85.8209	$104

Hydrometers

Reads actual specific gravity for an accurate measurement of battery state of charge. Float type has built-in thermometer for temperature correction. Variation of .20 or greater specific gravity between battery cells indicates a need for battery equalization charging or a weak cell.

Description	Item code	Price
Hydrometer float type	46.0154	$8
Hydrometer dial type	46.0156	$8

Why Use Such Large Cable?

Low-voltage power systems with inverters can have very high current flows in the cables that connect the inverter to the batteries. Large AC loads like microwave ovens, toasters, irons and washers can cause an inverter operating on a 12-volt battery to draw over 100 amps. Large motors may draw 300 to 500 amps at startup. Using the proper size wire between batteries, and from batteries to the inverter, will enable proper operation of the appliance. Cables that are too small will limit the current available to the inverter and may prevent a large load from operating.

Battery to Main Load Center Cables

Use these cables between a battery bank and an inverter, fuse or power center. They have flexible stranded UL Listed copper wire and 3/8" diameter lugs. Lug barrels are covered with glue-filled heat-shrink tubing. Cables are marked in red and black heat-shrink at each end.

Use cables with 1 lug to connect a Xantrex DC Disconnect to a battery or anywhere the wire will be attached to a compression connection.

Cables with 2 lugs				
Cable AWG	Length (ft.)	Color	Item code	Price
4/0	5	Red	52.4005-R	$50
	5	Black	52.4005-B	$50
	10	Red	52.4010-R	$89
	10	Black	52.4010-B	$89
2/0	5	Red	52.2005-R	$39
	5	Black	52.2005-B	$39
	10	Red	52.2010-R	$67
	10	Black	52.2010-B	$67
2	3	Red	52.1003-R	$18
	3	Black	52.1003-B	$18
	5	Red	52.1005-R	$23
	5	Black	52.1005-B	$23
Cables with 1 lug				
Cable AWG	Length (ft.)	Color	Item code	Price
4/0	5	Red	52.4105-R	$48
	5	Black	52.4105-B	$48
	10	Red	52.4110-R	$87
	10	Black	52.4110-B	$87

Heavy Duty Battery Interconnects

Use these cables between individual battery cells or between battery banks. Circuits protected by 250-amp breakers or 400-amp fuses should use 4/0 cables. Use 2/0 cables for 175-amp breakers and 200-amp fuses. Use #2 cables for 110-amp or smaller fuses or breakers. Cables with 1 red end and 1 black end are used for series battery interconnects.

When ordering, replace "-C" with "-R" for red, "-B" for black or "BR" for one end red and one end black.

Wire size (AWG)	Length of cable	Item code	Price
2	9"	52.5116-C	$11.75
2	12"	52.5118-C	$12.50
2	20"	52.5120-C	$14.27
2/0	9"	52.5122-C	$14.29
2/0	12"	52.5121-C	$15.72
2/0	20"	52.5124-C	$19.54
4/0	12"	52.5142-C	$19.62
4/0	20"	52.5145-C	$24.81

Light Duty Battery Interconnects

Use these cables between batteries where charge and discharge current will not exceed 50 amps. These cables are often used in golf cart and automotive applications.

Length of cable	Wire size (AWG)	Wire color	Item code	Price
9"	6	Black	52.5106-B	$2.30
9"	6	Red	52.5106-R	$2.30
12"	6	Black	52.5108-B	$3.00
12"	6	Red	52.5108-R	$3.00
24"	4	Black	52.5112-B	$4.10
24"	4	Red	52.5112-R	$4.10
36"	4	Black	52.5114-B	$4.60
36"	4	Red	52.5114-R	$4.60

Plated Copper Lugs

These UL- listed lugs are made from tin-plated copper tubing with 3/8" holes. Solder or crimp to stranded cable.

Description	Item code	Price
Copper lug 3/8" ring #6	51.3240	$0.86
Copper lug 3/8" ring #4	51.3237	$0.92
Copper lug 3/8" ring #2	51.3234	$1.04
Copper lug 3/8" ring #2/0	51.3231	$1.44
Copper lug 3/8" ring #4/0	51.3228	$1.96

Compression Terminals

These solid brass terminals allow good connections to large gauge wire without the need of special tools or soldering. You just remove insulation from the end of the cable, insert in the terminal and tighten the nut with a wrench.

Description	Item code	Price
Compression lug #4	51.3366	$4.95
Compression lug #1 - #2	51.3363	$5.18
Compression lug # 1/0	51.3369	$5.29
Compression lug # 2/0	51.3372	$6.79
Compression lug # 4/0	51.3375	$7.48

SB Connectors

The SB connector has been the #1 quick disconnect for over 20 years for battery powered vehicles and fork lifts. Use them to make quick disconnects on battery or inverter cables. Two connectors of the same size and color will mate. The 50 amp version is ideal for PV arrays and motors. The 175 and 350 amp units are used on battery and inverter cables. 175 amp connectors fit 1/0 wire. Contacts must be crimped or soldered. We stock the following colors in the larger versions: yellow (Y) for 12V, red (R) for 24V, blue (B) for 48V. The 50 amp connectors come with terminals for up to #6 wire and are available in gray only. Order two of the same size and color to mate.

Model	Max amps	Color	Wire size	Item code	Price
SB50A	50	grey	up to 6	51.7052	$6.00
SB175A	175	yellow	1/0	51.7019	$18.98
SB175A	175	red	1/0	51.7022	$18.98
SB175A	175	blue	1/0	51.7025	$18.98
SB350A-2	350	yellow	2/0	51.7031	$27.00
SB350A-2	350	red	2/0	51.7034	$27.00
SB350A-2	350	blue	2/0	51.7037	$27.00
SB350A-4	350	yellow	4/0	51.7040	$31.00
SB350A-4	350	red	4/0	51.7046	$31.00
SB350A-4	350	blue	4/0	51.7049	$31.00

Cable Crimper

Use crimper to crimp battery terminals, copper lugs and splices on wire from 8 gauge to 4/0. Adjustable crimp dies are clearly marked and easy to rotate into position. This 26" tool gives you plenty of leverage for quality crimping. Made in U.S.A. UL Listed for use with lugs at left.

Cable Cutter

Cut cable up to 6/0 AWG with this 22" long handheld or bench-mount cutter with removable carbon steel blades. Use this tool for cutting large cable to make inverter cables and battery interconnects. Made in U.S.A.

Description	Item code	Price
Cable cutter 22 inch bench mount	94.0003	$90
Cable cutter with 22 inch handles	94.0004	$90
Cable crimper with 26 inch handles	94.0011	$220

Hammer Crimp Tool

This simple, inexpensive crimping tool can be used to crimp connectors on 8 through 4/0 AWG wire. Spring-loaded pin locks in “up” position for loading connector and cable. When released, the pin holds the connector securely during crimping. Use with a hammer or vice.

Description	Item code	Price
Hammer crimp tool	94.0013	$36

Heat Shrink Tubing

Use this tubing to insulate copper lugs and compression terminals. Tubing shrinks and glue inside melts when heated with a heat gun or torch, sealing wires against corrosion and moisture. Maximum shrinkage is listed below. Sold in 6" lengths.

Description	Shrinks to	Item code	Price
Heat shrink tubing 1/2" x 6" black	3/16"	51.1132-B	$0.96
Heat shrink tubing 1/2" x 6" red	3/16"	51.1132-R	$0.96
Heat shrink tubing 3/4" x 6" black	1/4"	51.1135-B	$2.00
Heat shrink tubing 3/4" x 6" red	1/4"	51.1135-R	$2.00
Heat shrink tubing 1" x 6" black	3/8"	51.1137-B	$3.00
Heat shrink tubing 1" x 6" red	3/8"	51.1137-R	$3.00

Tray Cable (TC)

This 2-conductor flexible wire is excellent for outdoor applications like PV array lead-in and subarray wiring. It may be buried directly in the ground or exposed to direct sunlight. 10- and 12-gauge are good for array interconnects. UL Listed, stranded type THHN / THWN conductors. Conductor insulation is red and black.

Description	Item code	Price / foot
8 AWG 2-conductor TC cable	**50.1156**	**$2.16**
10 AWG 2-conductor TC cable	**50.1162**	**$1.69**
12 AWG 2-conductor TC cable	**50.1174**	**$0.94**
16 AWG 2-conductor TC cable	**50.1177**	**$0.46**
18 AWG 2-conductor TC cable	**50.1180**	**$0.35**

Duplex Primary Cable

This cable has two flexible stranded conductors covered with a vinyl jacket. It is commonly used for low voltage house wiring. Since it is stranded, it can be used in boats and RVs where vibration is encountered. Conductor insulation is black and white.

Description	Item code	Price / foot
#8-2C Duplex primary	**50.1544**	**$1.69**
#10-2C Duplex primary	**50.1547**	**$1.26**
#12-2C Duplex primary	**50.1550**	**$0.83**
#14-2C Duplex primary	**50.1553**	**$0.58**

Meter and control wire - see pages 108 and 109

Submersible pump wire - see page 151

Direct Burial/Sunlight Resistant Cable

Type USE single-conductor copper wire for lead-in from PV arrays, wind and hydroelectric systems. It may be used for AC or DC wiring up to 600 volts. Insulation is black crosslinked polyethylene. UL Listed, USE-2 RHH / RHW-2.

Description	Item code	Price / foot
#4, AWG USE single conductor	**50.1024**	**$1.66**
#6, AWG USE single conductor	**50.1027**	**$0.90**
#8, AWG USE single conductor	**50.1030**	**$0.64**
#10, AWG USE single conductor - black	**50.1033**	**$0.40**
#10, AWG USE single conductor - red	**50.1129**	**$0.40**
#10, AWG USE single conductor - white	**50.1130**	**$0.40**
#12, AWG USE single conductor - black	**50.1036**	**$0.28**
#12, AWG USE single conductor - red	**50.1131**	**$0.28**
#12, AWG USE single conductor - white	**50.1132**	**$0.28**

UL Listed Battery Cable

This fine-stranded, very flexible cable is UL Listed for use as battery cable. It is rated MTW or THW or AWM, 600-volt, sunlight resistant, direct burial, 105 degrees C. Available with red or black insulation.

Description	Item code	Price / foot
X-Flex battery cable 4/0 black	**50.1470**	**$7.75**
X-Flex battery cable 4/0 red	**50.1472**	**$7.75**
X-Flex battery cable 2/0 black	**50.1476**	**$5.70**
X-Flex battery cable 2/0 red	**50.1478**	**$5.70**
X-Flex battery cable 2 AWG black	**50.1487**	**$3.90**
X-Flex battery cable 2 AWG red	**50.1488**	**$3.90**

Why Have Surge Protection?

Photovoltaic, wind and hydroelectric systems usually have long runs of exposed wire that can pick up surges from lightning, even if the lightning strike is not nearby. These power surges can damage sensitive electronic components in meters, charge controls and inverters. Surges can also damage telephone, audio and video equipment connected to the power system. It is a good idea to install surge protection on all incoming wires in the system, including incoming PV, wind or hydroelectric power lines, AC generator lines, telephone and antenna leads. Proper grounding is absolutely necessary for lightning protection to be effective. In the event of a direct strike, damage may occur, even with surge protectors installed.

Delta Lightning Arrestors

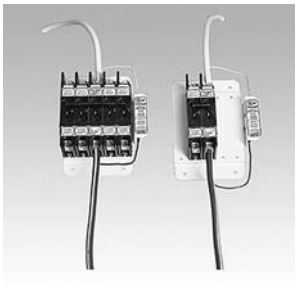
Delta lightning arrestors have a maximum current rating of 60,000 amps and 2,000 joules per line. Response time is 25ns to clamp 50,000 amps. Mounts easily in a 1/2" knockout.

Install the DC version for surge protection on wires coming from a PV array, DC wind generator or DC hydroelectric turbine. Use the 600VDC unit for high-voltage grid-tie PV arrays. Lightning protection can be installed in a combiner box, DC load center or grid-tie inverter.

The AC versions can be mounted in your AC load center to protect 120/240 VAC equipment and on AC wiring running outside of the building, to generators, pumps or outbuildings. All units are waterproof.

Delta model	Description	Item code	Price
LA302DC	Arrestor for up to 300 VDC	**53.4115**	**$40**
LA602DC	Arrestor for up to 600 VDC	**53.4109**	**$42**
LA302R	Arrestor for up to 300 VAC	**53.4112**	**$40**
LA303R	Arrestor for up to 300 VAC 3-Phase	**53.4118**	**$50**
Mounting bracket for surge arrestors		**53.4138**	**$3**

Xantrex DC Ground Fault Protection



These specially designed Xantrex circuit breakers meet the NEC requirement for ground fault protection of PV arrays mounted on roofs of dwellings. Each pole can carry up to 100 amps for arrays up to 100VDC open circuit. UL Listed.

Lay-in Lugs for Module Grounding

These tin-plated copper lugs have stainless steel set screws and come with stainless steel thread-forming screws and lock washers, to meet NEC requirements for connecting a continuous ground wire to all modules in an array and having the ability to remove a module without breaking grounding continuity for the rest of the array. Sold in packages of 10. UL Listed.

Description	Item code	Price
Bag of 10 lay-in lugs w/ screws	**51.3414**	**$35**

UniRac Grounding Clip 1 (UGC-1)

For use with UniRac SolarMount or Light Rail mounts. Order one grounding clip for every two top mounting clamps (end clamps and mid clamps) in your installation. Only one of the two rails in each row requires grounding clip. ETL listed..

UniRac Grounding lugs

Pro-Pak: Order two grounding lugs for each rail splice and one additional lug for each rail.

UniRac grounding clips				
Quantity	**UniRac #**	**Wt. lbs**	**Item code**	**Price**
1	980000	1	**51.4055-001**	**$1.20**
20	980001	1	**51.4055-020**	**$19.00**
100	980002	1	**51.4055-100**	**$92.00**
250	980003	2	**51.4055-250**	**$187.00**
500	980004	4	**51.4055-500**	**$360.00**
UniRac grounding lugs				
Quantity	**UniRac #**	**Wt. lbs**	**Item code**	**Price**
1	980010	1	**51.4050-001**	**$12.50**
10	980011	2	**51.4050-010**	**$112.00**
100	980012	8	**51.4050-100**	**$995.00**

DC Ground Fault Protection Enclosure

The GFP enclosure is specially designed to house the Xantrex ground fault protectors (to the left) and is white powder-coated.

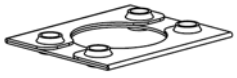
Model	Description	Item code	Price
PVGFP-1	Ground fault protection 1 Pole	**30.1423**	**$275**
PVGFP-2	Ground fault protection 2 Pole	**30.1426**	**$325**
Enclosure for GFP breakers		**53.0090**	**$107**

Wiley Electronics – WEEB Grounding Products

WEEB stands for "washer, electrical equipment bonding". The WEEB family of products are used to bond solar modules to aluminum solar mounting rails. The mounts are then grounded so the entire assembly is grounded. This eliminates the need to use a lay-in lug and thread-forming screw on each module and it eliminates the need to run a continuous wire to each module.

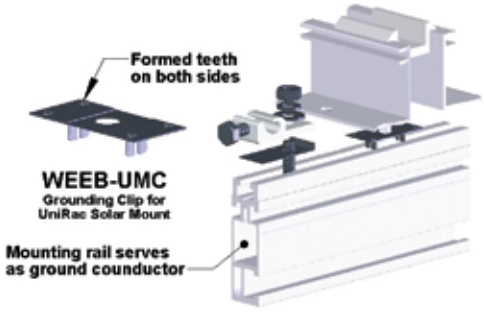
This saves time and money and it meets the requirements of UL 467. Wire is only needed to connect a lay-in lug on each module rail to an equipment grounding terminal in the inverter or disconnect. ETL listed to UL standards

WEEB-9.5

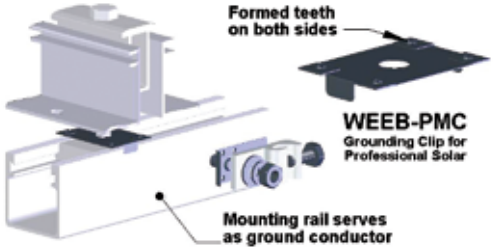


WEEB-9.5 NL

The **WEEB-9.5** is used for bonding modules to mounting structures when the modules are directly bolted to the rails using 1/4" bolts through the mounting holes on the rear of the module frames. This type of mounting is typical on DP&W ground and pole mount systems (pages 42-48) and on Wattsun and Zomeworks trackers (49-51). The WEEB-9.5NL is used for bonding strong-back structure and legs to the rail where 3/8" bolts are used. Sold in packs of 10.



WEEB-UMC grounding clips are used between modules and UniRac SolarMount Standard Rails or SolarMount Light Rails when front mount clips are used to hold the module to the rails. One clip grounds the frame of 2 adjoining modules to one of the mounting rails. Two clips are required for each pair of modules so that the modules will be bonded to both rails. Sold in packs of 10.



WEEB-PMC grounding clips are used between modules and ProSolar rails when front mount clips are used to hold the module to the rails. One clip grounds the frame of 2 adjoining modules to one of the mounting rails. Two clips are required for each pair of modules so that the modules will be bonded to both rails. Sold in packs of 10.

The **WEEB L-6.7** provides a connection to the mounting system and has lay-in provision for an equipment ground conductor. The WEEB-6.7 kit includes the lay-in lug, matching WEEB washer, bolt, nut flat washer and lock washer. Two WEEB lugs and a short piece of bare wire can be used to connect across a rail splice, or a WEEB splice kit can be used.

WEEB splice kit is used to bond two rails together at a splice.

Wiley part #	Description	Item code	Price
WEEB-9.5	Bonding washer for 1/4" bolted connections - pack of 100	**51.4007**	**$140**
WEEB-9.5NL	Bonding washer for 3/8" bolted connections - pack of 100	**51.4008**	**$140**
WEEB-UMC	Clip for use with UniRac SolarMount Standard Rail and SolarMount Light Rail - pack of 100	**51.4003**	**$180**
WEEB-PMC	Clip for use with ProSolar rails - Pack of 100	**51.4001**	**$180**
WEEB-6.7	Lay-in lug with mounting hardware and WEEB washer - each	**51.4015**	**$6**
WEEB-Splice Kit	Splice kit for UniRac SolarMount Standard Rail and SolarMount Light Rail - each	**51.4018**	**$9**

Multi-Contact Cables & Connectors

The Multi-Contact Solarline family of connectors delivers a flexible system solution for time-saving, dependable series-cabling of solar modules. All module manufacturers supply their grid-tie modules with pre-assembled output cables, tested and ready for connection. This saves considerable time during an installation and greatly increases reliability over wire junction boxes. These cable couplers are fully touch-protected and designed for up to 1000 volts and 30 amps. They are also waterproof. For parallel connection of modules in 12- to 48-volt systems, Multi-Contact makes branch connectors for use with currents up to 30 amps.

For the past few years, modules have come with Multi-Contact Solarline 1 connectors which have a soft rubber insulator. In 2007, PV manufacturers began switching to Multi-Contact Solarline 2 locking connectors to meet future electrical code requirements.

The Multi-Contact plug-and-play connector system allows for the PV arrays to be pre-assembled and pre-wired in the shop or on site. We stock both styles of connectors for use with 10 AWG or 12 AWG USE-2 stranded wire. Proper crimping to the wire and insulator assembly requires special tools. We stock standard lengths of assembled cables and adapters to go between Solarline 1 and Solarline 2 connectors and the tools required for on-site assembly of cables.

Solarline 1 & 2 Array Output Cables

Use these output cables between PV arrays with Multi-Contact cable outputs, and junction boxes or grid-tie inverters. Both the original Solarline 1 and the new Solarline 2 have a male connector on one end and a female connector on the other end. Use them to extend module output cables or cut anywhere along the wire to obtain the needed length of male and female cable to run from the ends of a module string to a combiner box or to an inverter. For example, if you need a 30' male and a 20' female, order a 50' cable. Made with black #10 AWG USE-2 sunlight-resistant cable.

We stock cables with Solarline 1 standard connectors and the newer Solarline 2 locking connectors.

MC Solarline 1 & 2 male/female cables			
Cable length (ft)	Solarline 1 item code	Solarline 2 item code	Price
6	52.9107	**52.9407**	**$18**
15	52.9111	**52.9411**	**$22**
30	52.9115	**52.9415**	**$26**
50	52.9116	**52.9416**	**$29**
100	52.9118	**52.9418**	**$52**

MC Solarline 1 & 2 Color-Coded Cables

Use these output cables between PV arrays with Multi-Contact cable outputs, and junction boxes or grid-tie inverters. White cables have an MC connector that fits the module negative output cable. Red and black cables have an MC connector that fits the module positive output cable. Made from #10 AWG USE-2 sunlight-resistant cable.

Solarline 1 connector cable description	Item code	Price
#10 AWG white negative 100 ft.	**52.9083**	**$48**
#10 AWG black positive 100 ft.	**52.9082**	**$48**
#10 AWG red positive 100 ft.	**52.9081**	**$48**

Solarline 2 locking connector cable description	Item code	Price
#10 AWG white negative 100 ft.	**52.9383**	**$48**
#10 AWG black positive 100 ft.	**52.9382**	**$48**
#10 AWG red positive 100 ft.	**52.9381**	**$48**

MC Solarline 1 & 2 Connectors

The connector can be assembled quickly on site by a contractor allowing custom cables to be made at the job site. A special crimping tool and wrench set are required to assemble the connector. For 10 and 12 AWG USE-2 wire.

Connector description	Item code	Price
Male Solarline 1 – fits + cables on module	**99.1403**	**$3.20**
Female Solarline 1 – fits - cable on module	**99.1401**	**$3.20**
Male Solarline 2 locking – fits + cables on module	**99.1406**	**$2.80**
Female Solarline 2 locking – fits - cable on module	**99.1408**	**$3.20**
UL label	**99.1405**	**$0.10**

MC Solarline Assembly Tools

Crimper and boot assembly tool for Solarline 1 connectors.

Crimping tool and wrenches required to assemble MC Solarline2 locking connectors. Crimping tool is for 10 or 12 AWG stranded wire.

Description	Item code	Price
MC Solarline 1 crimper by Astrodyne	**94.0103**	**$410**
MC Solarline 1 boot assembly tool, bench mount	**94.0108**	**$540**
MC Solarline 2 pin crimper for 10/12 AWG wire	**94.0104**	**$712**
MC Solarline 2 connector assembly tool	**94.0112**	**$2**

MC Solarline 1 Branch Connectors

These waterproof Y-connectors make it possible to parallel wire PV modules with Multi-Contact output cables. Maximum current allowed through connectors is 30 amps.

Description	Item code	Price
Solarline 1 branch cable coupler female - 2 male	**52.9103**	**$18.40**
Solarline 1 branch cable coupler male - 2 female	**52.9104**	**$19.55**

MC Solarline 2 Branch Connectors

These waterproof Y-connectors make it possible to parallel wire PV modules with Multi-Contact output cables. Maximum current allowed through connectors is 30 amps.

Description	Item code	Price
Solarline 2 branch cable coupler female - 2 male	**52.9403**	**$18.40**
Solarline 2 branch cable coupler male - 2 female	**52.9404**	**$19.55**

MC Solarline 2 to Solarline 1 Connectors

Use these adapters to connect new style modules to old style Solarline 1 cables or anywhere a transition is needed between Solarline 1 and Solarline 2 cables.

Description	Item code	Price
Solarline 2 male to Solarline 1 female adapter	**52.9099**	**$13**
Solarline 1 male to Solarline 2 female adapter	**52.9098**	**$13**

Waterproof Strain Reliefs

Use the 1/2" threaded connectors to provide a waterproof entrance or exit for wiring on PV module junction boxes, outdoor combiner boxes, and junction boxes. Use the 3/4" connector for larger cables up to 5/8" diameter. They are made of Nylon with Buna-N seals and are resistant to salt water, weak acids, weak alkalis, alcohol, ether, esters, ketones, and mineral, animal and vegetable oils. The threads are 1/2" or 3/4" NPT. Non-corrosive and suitable for direct burial installations. The oval-hole 1/2" strain relief works great for two-conductor TC cable used for module interconnects and for PV outputs or for UF cable. The two-hole 1/2" connector is designed for use with two #10 or #12 type USE conductors like the ones used for Multi-Contact PV output cables. UL Listed. Suitable for use in NEMA 4, 6 and 12 applications.

Strain relief description	Fits cable size	Item code	Price
1/2" Thread w/ 1 round hole	USE #12 & #10	54.3243	$3.75
1/2" Thread w/ 2 round holes	USE #12 & #10	54.3252	$4.80
1/2" Thread w/ 1 round hole	0.25" to 0.5" dia. wire	54.3241	$2.60
1/2" Thread w/ 1 oval hole	14/2,12/2,10/2 TC	54.3257	$4.40
3/4" Thread w/ 1 round hole	0.4" to 0.7" dia. cable	54.3246	$3.90
Steel lock nut 1/2"		54.3238	$0.18
Steel lock nut 3/4"		54.3244	$0.20

Cable Clip

Use this clip to keep module interconnect cables neatly connected to module frames so they do not drop below the array. Bags of 100 clips with anti-corrosion coating.

Description	Item code	Price
Bag of 100 clips	**52.9101**	**$35**

PCB10 Combiner Box

The PV array combiner box from Pulse Energy is designed to combine the output of multiple solar electric (PV) source circuits. The PCB10 has 10 fused circuits in a NEMA 3R lockable enclosure. Each circuit can accept up to 15 amps of PV input current up to a total maximum of 64 amps. The PCB10 may be used with 12-, 24- and 48-VDC PV systems and can handle a maximum 125 VDC input and includes built-in lightning protection. UL Listed. Use type ABC fuses. Comes with ten 15-amp fuses. Dimensions: 8"W x 10"H x 4"D.

Model	Description	Weight lbs	Item code	Price
PCB10	Combiner box - 10 circuit	8	**53.2709**	**$150**

Type ABC Fuses for Combiner Boxes

These fuses can be used with the combiner box above. Use a fuse equal to or less than the series fuse rating of the modules being protected.

Fuse part #	ABC fuse sizes	Weight lbs	Item code	Price
ABC-5	5-amp fuse for combiner	1	**53.2721**	**$1.20**
ABC-6	6-amp fuse for combiner	1	**53.2724**	**$1.20**
ABC-8	8-amp fuse for combiner	1	**53.2727**	**$1.20**
ABC-10	10-amp fuse for combiner	1	**53.2730**	**$1.20**
ABC-15	15-amp fuse for combiner	1	**53.2733**	**$1.20**

MidNite Solar MNPV Combiners

These powder-coated aluminum, NEMA-3R rainproof array combiners will accept 150VDC DIN-rail mounted fuse holders for 600VDC arrays or 150VDC DIN-rail mounted breakers for low voltage arrays. Dead front. Two sizes. ETL Listed. Negative busbar and ground bar are included. Breakers and fuse holders are not included. Breakers, fuse table at right.

OutBack model	# of breakers	# of fuse holders	MNPV combiner dimensions	Weight lbs	Item code	Price
MNPV3	3	N/A	11" x 5" x 4"	2	**53.3017**	**$89**
MNPV6	6	4	14" x 9" x 4"	4	**53.3018**	**$109**

DIN Rail Mount Fuse Holders and Breakers

Fuse holder and fuses below and breakers at right fit MidNite MNPV and OutBack PSPV combiners. Use breakers for arrays with maximum voltage of 150 or less. Use the fuses and fuse holder below for 600VDC array combiners.

Amps	Description	Item code	Price
USM1 Fuse Holder - 600V 30A Max - DIN mount		**53.3040**	**$20**
4	4 -amp 600 VDC KLKD fuse	**53.3051**	**$12**
6	6 -amp 600 VDC KLKD fuse	**53.3050**	**$12**
8	8 -amp 600 VDC KLKD fuse	**53.3048**	**$12**
10	10 -amp 600 VDC KLKD fuse	**53.3046**	**$12**
12	12 -amp 600 VDC KLKD fuse	**53.3044**	**$12**
15	15 -amp 600 VDC KLKD fuse	**53.3043**	**$12**
20	20 -amp 600 VDC KLKD fuse	**53.3042**	**$18**
30	30 -amp 600 VDC KLKD fuse	**53.3041**	**$18**

Amps	OutBack number	MidNite Solar #	Item code	Price
1	OBB-1-125VDC-DIN	MNEPV1	**30.4350**	**$13**
2	OBB-2-125VDC-DIN	MNEPV2	**53.3034**	**$13**
3	OBB-3-125VDC-DIN	MNEPV3	**53.3024**	**$13**
4	OBB-4-125VDC-DIN	MNEPV4	**53.3020**	**$13**
5	OBB-5-125VDC-DIN	MNEPV5	**53.3025**	**$13**
6	OBB-6-125VDC-DIN	MNEPV6	**53.3021**	**$13**
8	OBB-8-125VDC-DIN	MNEPV8	**53.3022**	**$13**
9	OBB-9-125VDC-DIN	MNEPV9	**53.3023**	**$13**
10	OBB-10-125VDC-DIN	MNEPV10	**53.3026**	**$13**
12	OBB-12-125VDC-DIN	MNEPV12	**53.3027**	**$13**
15	OBB-15-125VDC-DIN	MNEPV15	**53.3029**	**$13**
20	OBB-20-125VDC-DIN	MNEPV20	**53.3030**	**$13**
30	OBB-30-125VDC-DIN	MNEPV30	**53.3032**	**$13**
50	OBB-50-125VDC-DIN	–	**53.3035**	**$13**
60	OBB-60-125VDC-DIN	–	**53.3037**	**$13**
63	–	MNEPV63	**53.3038**	**$13**

Prices subject to change without notice.

OutBack PSPV Array Combiner Box

The PSPV outdoor, rainproof powder-coated aluminum array combiner can be used with a wide variety of PV system designs and module configurations. It can be installed on vertical or sloped surfaces (14-90 degrees from horizontal) or pole-mounted and configured with DC breakers for low-voltage systems (under 140 VDC) or touch safe type fuse holders for high voltage systems (up to 600 VDC). The PSPV is designed to provide NEC code compliant overcurrent protection and interconnection of multiple PV panels or subarrays into one or more PV arrays for connection to charge controllers or inverter systems. The PSPV is easily field configured to match your system design and ampacity requirements. It is shipped without the breakers or fuse holders installed. Order the quantity, type and amperage needed from the previous page.

Snap-in DIN rail mounting system has spaces for up to twelve DC-rated PV breakers for 12-, 24-, 48- and 60-VDC PV arrays with open circuit voltages up to 140 VDC, or up to seven touch safe type midget fuse holders for high-voltage PV arrays up to 600 VDC.

Dual positive breaker combiner busbars with #1/0 AWG set-screw compression-type box lug terminals for output wiring provide one or two PV output circuits. There is one PV negative terminal busbar with mounting holes for an additional busbar.

Wire access is through four ¾- and 1-inch conduit knock-outs, one on the bottom, back and each side. Ample space provided on bottom and back to allow up to a 2-inch conduit punch for large cabling. Eight half-inch knockouts on bottom for PV module or sub-array input conduits or strain reliefs. A #1/0 AWG ground lug can be mounted either on the inside or outside surface. ETL Listed. NEMA 3R.

Dimensions:13.1"H x 9.2"W x 3.5"D

OutBack Part #	Description	Weight lbs	Item code	Price
PSPV	Array combiner box	6	53.3019	$139
	Busbars			
TBB	Terminal busbar - black insulator	1	30.4353	$19
TBB-W	Terminal busbar - white insulator	1	30.4354	$19
TBB-R	Terminal busbar - red insulator	1	30.4355	$19
GBB	Ground busbar	1	30.4356	$15

SMA Combi-Switch

This 600VDC-rated disconnect has a built-in 4-input fused array combiner. Four 10-amp 600VDC fuses are included. Bring up to 8 module strings together, two into each fuse holder. Maximum fuse size: 10 amps. NEMA 3R outdoor enclosure. 5-year warranty. ETL Listed.

Description	Item code	Price
SMA DC disconnect & combiner	30.3181	$580

SMA Combiner Boxes

These 600VDC-rated array combiners are in NEMA 3R enclosures and feature DIN Rail mounted touch-safe fuse holders for use with KLKD fuses. Input terminals take wire from 10 AWG to 6 AWG. Output terminals take wire from 6 AWG to 300 MCM. SBCB6 has one output circuit. Larger combiners have two output circuits.

SMA model	Input circuits	Max input fuse	Max output current	Dimensions (In)	Weight (lb.)	Item code	Price
SBCB 6	6	15 Amp	72 Amps	10 x 8 x 6	11	53.3003	$467
SCCB 28	28	15 Amp	336 Amps	20 x 20 x 8	56	53.3005	$1,649
SCCB 52	52	8 Amp	333 Amps	42 x 30 x 8	70	53.3009	$3,361

Xantrex DC Disconnect

The Xantrex DC Disconnect is a white, powder-coated indoor enclosure with conduit knockouts for connection to inverters, batteries, DC charging sources, charge controllers and DC load centers. It comes with one 175A or 250A circuit breaker for an inverter (with space for a second breaker for a second inverter; order separately) that meets the National Electric Code requirements for disconnection and overcurrent protection of battery-based power systems. There are knockouts on the sides for four 15- to 100-amp DC breakers used for charging sources and DC loads. Use the DC Bonding Block (DCBB; order separately below) for connecting the negative cables and for single-point DC system grounding. There are pre-drilled places inside for two metering shunts. Knock-outs on the top are provided for mounting two Xantrex C-Series or OutBack MX-60 PV charge controllers, or one BlueSky PV charge controller. Knockouts on the sides are designed for mounting two Xantrex SW, SW Plus, or DR inverter/chargers with their optional conduit boxes and 2" offset nipples.

Order 175A or 250A DC surface mount circuit breakers listed at right for adding second inverter breaker. Order 15A to 100A DC panel-mount circuit breakers on the next page to use in the DC Disconnect side spaces. Use the DC175 for the Xantrex SW4048, SW Plus 2524 & 2548, DR1512, DR1524, and DR2424 inverters. Use the DC250 for the Xantrex SW4024, SW5548, DR2412, and DR2436 inverters. ETL Listed to UL508. Dimensions: 21"H x 10.5"W x 5"D. Weight: 14 lbs.

Xantrex model	Description	Item code	Price
DC250	Xantrex 250A DC disconnect	**30.1414**	**$329**
DC175	Xantrex 175A DC disconnect	**30.1411**	**$329**
DCBB	DC bonding block	**30.1417**	**$75**
GJ1-175-SM	175 A add-on breaker	**53.1056**	**$119**
GJ1-250-SM	250 A add-on breaker	**53.1061**	**$119**
GJ1 Rear mounting kit for second breaker		**53.1066**	**$10**

MidNite Solar Mini–DC Disconnect Power Center

Use this small DC disconnect, which includes the inverter breaker, to provide overcurrent protection for any single inverter. It has a DIN rail for additional rail mounted breakers for DC inputs or loads and it is pre-drilled for a shunt and optional busbars listed below. The white powder-coated aluminum chassis measures 10" X 5" X 18" and weighs 7 pounds. Three main breakers sizes are available.

MidNite Solar Baby Box

The Baby Box encloses up to four MNEPV or MNEAC DIN rail breakers. It is a general-use enclosure for retrofits, a small inverter disconnect, a PV disconnect or a small AC or DC distribution center. It has concentric ¾" and 1" knockouts at each end. Breakers are not included. Order DIN rail breakers on the next page. Boxed: 3" x 3" x 7". 2 pounds.

MidNite Solar Accessories

These UL Recognized components can be use in the Mini-DC Disconnect and Baby Box above.

Busbars with colored insulators. Each has four 1/0 and eleven #6 usable wire slots, with two sizes of 10-32 screws. 4.63" long.

Ground busbar, 3.45" long with green screws. Two 1/0 and seven #6 wir with mounting screws.

Model	Description	Item code	Price
MNDC125	125A mini-DC disconnect	**53.0091**	**$205**
MNDC175	175A mini-DC disconnect	**53.0092**	**$235**
MNDC250	250A mini-DC disconnect	**53.0093**	**$235**
Bay Box	Baby box breaker center	**53.0089**	**$36**
MNTBR	Red terminal busbar	**53.0105**	**$17**
MNTBB	Black terminal busbar	**53.0106**	**$17**
MNTBW	White terminal busbar	**53.0107**	**$17**
MNGBB	Ground busbar	**53.0100**	**$12**

DIN mount AC breakers with set-screw compression terminals for 14 to #2AWG wire. Use these breakers for AC protection in OutBack FLEXware and MidNite E-panels.

Breaker amps	Poles	Voltage rating	Frequency rating	Width (inches)	OutBack number	MidNite Solar #		Item code	Price
15	1	120	50/60HZ AC	0.5	OBB-15-120VAC-DIN	MNEAC15		30.4415	$19
15	2	120/240	50/60HZ AC	1	OBB-15D-240VAC-DIN			30.4416	$39
20	1	120/240	50/60HZ AC	1	OBB-20-120VAC-DIN	MNEAC20		30.4418	$19
20	2	120/240	50/60HZ AC	1	OBB-20D-240VAC-DIN			30.4419	$39
25	2	120/240	50/60HZ AC	1	OBB-25D-240VAC-DIN			30.4421	$39
10	1	277	50/60HZ AC	0.5	OBB-10-277VAC-DIN	MNEAC10		30.4439	$19
15	1	277	50/60HZ AC	0.5	OBB-15-277VAC-DIN			30.4440	$19
30	1	277	50/60HZ AC	0.5	OBB-30-277VAC-DIN	MNEAC30		30.4437	$19
30	2	277/480	50/60HZ AC	1	OBB-30D-480VAC-DIN			30.4414	$39
30	3	277/480	50/60HZ AC	1.5	OBB-30T-480VAC-DIN	MNEAC30-3P		30.4435	$59
50	1	277	50/60HZ AC	0.5	OBB-50-277VAC-DIN	MNEAC50		30.4422	$19
50	2	277/480	50/60HZ AC	1	OBB-50D-480VAC-DIN			30.4423	$39
50	3	277/480	50/60HZ AC	1.5	OBB-50T-480VAC-DIN	MNEAC50-3P		30.4432	$59
60	1	277	50/60HZ AC	0.5	OBB-60-277VAC-DIN	MNEAC60		30.4431	$29

Panel mount breakers with stud terminals. Ring terminals on wire are required. Use these breakers for DC protection in OutBack FLEXware and MidNite E-panels. Stud size is 1/4" on 80A and smaller, 5/16" on 100A and 125A and 3/8" on 175A and 250A.

Breaker amps	Poles	Voltage rating	Frequency rating	Width (inches)	OutBack number	MidNite Solar #	Generic number	Item code	Price
1	1	125	AC/DC	0.5	OBB-1-125VDC120VAC-PNL		LELK1-1	30.4350	$25
5	1	125	AC/DC	0.5	OBB-5-125VDC120VAC-PNL		LELK1-5	30.4349	$25
10	1	125	AC/DC	0.5	OBB-10-125VDC120VAC-PNL		LELK1-10	30.4348	$25
15	1	125	AC/DC	0.5	OBB-15-125VDC120VAC-PNL		LELK1-15	30.4344	$25
20	1	125	AC/DC	0.5	OBB-20-125VDC120VAC-PNL		LELK1-20	30.4347	$25
30	1	125	AC/DC	0.5	OBB-30-125VDC120VAC-PNL		LELK1-30	30.4331	$25
40	1	125	AC/DC	0.5	OBB-40-125VDC120VAC-PNL		LELK1-40	30.4338	$25
50	1	125	AC/DC	0.5	OBB-50-125VDC120VAC-PNL		LELK1-50	30.4337	$25
60	1	125	AC/DC	0.5	OBB-60-125VDC120VAC-PNL		LELK1-60	30.4335	$25
80	1	125	DC	1	OBB-80-125VDC-PNL	MNEDC80		30.4333	$25
100	1	125	DC	1	OBB-100-125VDC-PNL			30.4332	$59
125	1	125	DC	1	OBB-125-125VDC-PNL	MNEDC125		30.4331	$59
175	1	125	DC	1.5	OBB-175-125VDC-PNL	MNEDC175		30.4329	$129
250	1	125	DC	1.5	OBB-250-125VDC-PNL	MNEDC250		30.4326	$129

Panel mount breakers with 1/4" stud terminals. Ring terminals on wire are required. Use these breakers for DC protection in the Xantrex DC Disconnect. 10A to 75A fit in the four side knockouts of the DC disconnect. The 175A and 250A panel mount breakers for the Xantrex DC Disconnect are listed on the previous page with the DC disconnect.

Breaker amps	Poles	Voltage rating	Frequency rating	Width (inches)		Xantrex #	Generic number	Item code	Price
10	1	125	DC	0.75			CD10-PM	53.1010	$25
15	1	125	DC	0.75		CD15	CD15-PM	53.1015	$25
20	1	125	DC	0.75		CD20	CD20-PM	53.1020	$25
30	1	125	DC	0.75			CD30-PM	53.1025	$25
50	1	125	DC	0.75			CD50-PM	53.1030	$25
60	1	125	DC	0.75		CD60DC	CD60-PM	53.1035	$35
75	1	125	DC	0.75			CD75-PM	53.1040	$35

Square-D 240V and 600V NEMA 3R Safety Switch Disconnects

According to the National Electric Code, section 690.15, PV arrays must have a disconnecting means to isolate the inverter from the PV power source. Utility grid-tie inverters that utilize PV arrays with voltages above 250VDC require a disconnect rated for 600VDC to perform this function. The Square-D 600VDC 30-amp 3-pole safety switches are UL Listed to handle 13A at 600VDC per pole. They can be used for disconnecting up to three PV arrays for three grid-tie inverters. It has wiring lugs that are rated to accept two #14 to #10 wires in each lug.

This allows the disconnect switch to also act as a string combiner in systems that utilize two strings of PV modules per inverter. The 600VDC 60-amp 3-pole safety switches are UL Listed to handle 38A at 600VDC per pole. All other Square-D 600VDC disconnects are rated for disconnecting one string at full rated power.

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 30-amp 240-volt disconnect is good for up to 5kW at 240 VAC and the 60-amp disconnect is good for up to 11kW. For connection of multiple inverters to one of these disconnects, use an AC load center, with a circuit breaker for each inverter installed, as an AC combiner box between the inverters and the disconnect switch. The breakers can be back-fed with the inverter outputs and the load center main lugs will handle the combined outputs to be connected to the AC disconnect.

Amps	AC / DC	Fused	Poles	Neutral kit	Ground kit	Dimensions (in.) H x W x D	Weight lbs	Square-D model	Item code	Price
600-volt AC or DC 3-pole NEMA 3R heavy duty switches										
30	Yes	No	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.3	HU361RB	**53.2312**	**$165**
30	Yes	Yes	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.8	H361RB	**53.2313**	**$260**
* Uses 2 poles in series for 600VDC, except for PV where all 3 poles may be used for 600VDC at 13 amps per pole										
60	Yes	No	3**	SN0610	GTK0610	17.50 x 9.00 x 6.38	16	HU362RB	**53.2339**	**$380**
60	Yes	Yes	3**	SN0610	GTK0610	17.50 x 9.00 x 6.38	16	H362RB	**53.2341**	**$480**
100	Yes	No	3**	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	HU363RB	**53.2357**	**$530**
100	Yes	Yes	3**	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	H363RB	**53.2355**	**$750**
200	Yes	No	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	44	HU364RB	**53.2364**	**$640**
00	Yes	Yes	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	44	H364RB	**53.2374**	**$884**
** Uses 2 poles (and 2 fuses) in series for 600VDC										
240-volt AC / 125-volt DC* NEMA 3R heavy duty switches**										
30	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	H321NRB	**53.2315**	**$314**
60	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	10	H322NRB	**53.2336**	**$503**
100	Yes	Yes	3	included	GTK0610	21.25 x 8.50 x 6.38	19	H323NRB	**53.2351**	**$722**
200	Yes	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.50	43	H324NRB	**53.2363**	**$988**
*** Switches are rated for 250VDC but available fuses are only rated for 125VDC										
240-volt AC only NEMA 3R general duty switches										
30	AC only	No	2	N/A	PK3GTA1	9.63 x 7.25 x 3.75	4.4	DU221RB	**53.2318**	**$83**
30	AC only	Yes	2	included	PK3GTA1	9.63 x 7.25 x 3.75	4.5	D221NRB	**53.2326**	**$90**
30	AC only	No	3	N/A	PK3GTA1	9.63 x 7.25 x 3.75	4.7	DU321RB	**53.2319**	**$139**
30	AC only	Yes	3	included	PK3GTA1	9.63 x 7.25 x 3.75	5.1	D321NRB	**53.2329**	**$139**
60	AC only	Yes	2	included	GTK03	14.88 x 6.63 x 4.88	9.7	D222NRB	**53.2334**	**$141**
60	AC only	No	3	N/A	PK3GTA1	9.63 x 7.25 x 3.75	5	DU322RB	**53.2342**	**$222**
60	AC only	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	D322NRB	**53.2343**	**$210**
100	AC only	Yes	2	included	GTK0610	17.50 x 8.50 x 6.50	16	D223NRB	**53.2358**	**$227**
100	AC only	No	3	N/A	GTK0610	17.50 x 8.50 x 6.50	15	DU323RB	**53.2359**	**$386**
100	AC only	Yes	3	included	GTK0610	17.50 x 8.50 x 6.50	16	D323NRB	**53.2361**	**$386**
200	AC only	Yes	2	included	PKOGTA2	29.25 x 17.25 x 8.25	29	D224NRB	**53.2371**	**$513**
200	AC only	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.25	30	D324NRB	**53.2372**	**$853**

Use Class R fuses of the proper amperage for fused disconnects. Use the hubs on the next page to connect conduit or a kWh meter socket to the top of the disconnect. Disconnects are raintight (NEMA 3R) for outdoor use. Order a neutral busbar and ground busbar if you need to land these conductors in the disconnect switch box. See next page for accessories.

Prices subject to change without notice.

Square-D Disconnect Accessories

Field-installable service ground and neutral busbars and hubs for the safety disconnect switches on the previous page. See table to determine which neutral and ground to use.

Neutral and ground accessories	Item code	Price
SN03 Neutral busbar	53.2389	$52
SN0610 Neutral busbar	53.2381	$71
SN20ANeutral busbar	53.2383	$133
GTK03 Ground busbar	53.2387	$8
PK3GTA1 Ground busbar	53.2395	$8
GTK0610 Ground busbar	53.2386	$13
PKOGTA2 Ground busbar	53.2388	$38
Conduit hubs	**Item code**	**Price**
Top mount hub 3/4"	53.2305	$22
Top mount hub 1"	53.2306	$22
Top mount hub 1-1/4"	53.2307	$22
Top mount hub 1-1/2"	53.2308	$22
Top mount hub 2"	53.2309	$40

Class R Fuses

These Class R fuses can be used in AC circuits up to 250V or DC circuits up to 125V. They have the high amp interrupting capacity (AIC) required for fusing circuits powered by batteries and for protecting Square-D brand circuit breakers. They can be used to protect wiring to small inverters (100-700 watts) and wiring from charging sources. Use these fuses in fused safety disconnect switches on the previous page and in the fuse blocks at right. UL Listed

Amps	250VAC/125VDC		600VAC/VDC	
	Item code	Price	Item code	Price
10	53.2441	$5	53.2442	$11
15	53.2444	$5	53.2447	$11
20	53.2450	$5	53.2453	$11
30	53.2456	$5	53.2459	$11
40	53.2462	$8	53.2463	$24
50	53.2465	$8	53.2466	$24
60	53.2468	$8	53.2471	$24
70	53.2469	$18	53.2470	$46
80	53.2475	$18	53.2472	$46
90	53.2476	$18	53.2473	$46
100	53.2474	$18	53.2477	$46
125	53.2478	$48	53.2481	$80
150	53.2479	$48	53.2482	$80
200	53.2480	$48	53.2483	$80

Class R Fuse Blocks

Use these fuse blocks with the Class R 250-volt fuses. Bare wire ends fit into the screw terminals on each end of the fuse block. The small fuse block holds 10-30A fuses and accepts up to #2 wire. The medium size block holds 40-60A fuses and accepts up to #2 wire also. The large size block holds a 100A fuse and accepts up to #1/0 wire. Small and medium size blocks are available in one-pole and two-pole versions.

Description	Item code	Price
Class R fuse block 0.1-30A, 1-pole	53.2423	$5
Class R fuse block 0.1-30A, 2-pole	53.2426	$12
Class R fuse block 31-60A, 1-pole	53.2429	$9
Class R fuse block 31-60A, 2-pole	53.2432	$16
Class R fuse block 61-100A, 1-pole	53.2435	$25

Inline ATC Fuse Holder

The waterproof cover makes this an excellent choice to fuse a single circuit, indoors or out. Cut wire loop and splice into the line to be protected. We recommend these with 1-amp fuses below in the positive power line for Trimetric, Link and Trace TM500A meters. Low-voltage DC use only.

Description	Item code	Price
ATC Inline holder 18 awg	53.2663	$3
ATC Inline holder 10 awg	53.2669	$3

ATC Fuses

ATC blade-type fuses were designed for low-voltage DC circuits for the automotive industry. They are very popular in autos and RVs. They are not approved by the National Electric Code (NEC) for use in homes, but they are often used to provide circuit protection in remote cabin power systems. They are sold in boxes of 10 fuses.

Description	Item code	Price
ATC Fuse 1A	53.2629	$0.40
ATC Fuse 3A	53.2631	$0.40
ATC Fuse 5A	53.2633	$0.40
ATC Fuse 10A	53.2635	$0.40
ATC Fuse 15A	53.2637	$0.40
ATC Fuse 20A	53.2639	$0.40
ATC Fuse 30A	53.2641	$0.40

Square-D QO Load Centers

Square-D brand load centers can be used for multiple purposes, for wiring that meets the National Electric Code (NEC). All of these can be used as AC load centers or sub-panels. Panels using QO plug in breakers are rated up to 50 VDC for use as 12V or 24V DC load centers. They can also be used to combine the AC output from multiple inverters feeding the grid. When used as DC load centers they should be protected by a high interrupt capacity fuse or circuit breaker between the load center and the battery. Use one of the Class T or Class R fuses, or the DC breakers used in the OutBack and Xantrex DC power centers.

Spaces (single)	Bus amp rating	Outdoor	Cover	Max wire in main lug	Ground kit for this unit	Dimensions (inches) H x W x D	Weight lbs	Square-D model	Item code	Price
120/240-volt AC single-phase main lug load centers										
2	70	Yes	INCL.	# 4	PK4GTA	9.38 x 4.88 x 4	5.0	QO24L70RB	**53.2141**	**$60**
2	70	No	INCL.	# 4	PK4GTA	9.30 x 4.81 x 3.19	3.8	QO24L70S	**53.2144**	**$50**
6	100	Yes	INCL.	# 1	PK7GTA	12.62 x 8.88 x 4.27	9.7	QO612L100RB	**53.2147**	**$54**
6	100	No	INCL.	# 1	PK7GTA	12.57 x 8.88 x 3.8	8.3	QO612L100DS	**53.2153**	**$46**
12	125	Yes	INCL.	# 2/0	INCL.	19 x 14.25 x 4.5	23	QO112L125GRB	**53.2163**	**$190**
12	125	No	Add	# 2/0	INCL.	18 x 14.25 x 3.75	15	QO112L125G	**53.2162**	**$85**
12	200	Yes	INCL.	250 kcmil	INCL.	26.25 x 14.25 x 4.5	27	QO112L200GRB	**53.2165**	**$320**
12	200	No	Add	250 kcmil	PK15GTA	29.86 X 14.25 X 3.75	18	QO112L200G	**53.2164**	**$177**
Uses QO plug in breakers										
120/208-volt AC three-phase main lug load centers										
12	125	Yes	INCL.	# 2/0	INCL.	19.00 x 14.25 x 4.52	22	QO312L125GRB	**53.2181**	**$323**
12	125	No	Add	# 2/0	INCL.	19.00 x 14.25 x 3.75	11	QO312L125G	**53.2183**	**$221**
18	200	Yes	INCL.	250 kcmil	INCL.	30.00 x 14.25 x 4.52	31	QO318L200GRB	**53.2185**	**$412**
18	200	No	Add	250 kcmil	INCL.	30.00 x 14.25 x 3.75	17	QO318L200G	**53.2187**	**$295**
Uses QO plug in breakers										
277/480-volt AC three-phase main lug load centers										
12	125	Yes	INCL.	250 kcmil	PK9GTA	26.00 x 20.00 x 6.50	36	NF412L1 (MH26WP)	**53.2191**	**$2,319**
12	125	No	INCL.	250 kcmil	PK9GTA	26.00 x 20.00 x 5.75	22	NF412L1 (MH26,NC26S)	**53.2193**	**$1,264**
30	250	Yes	INCL.	350 kcmil	PK18GTA	38.00 x 20.00 x 6.50	42	NF430L2 (MH38WP)	**53.2195**	**$2,556**
30	250	No	INCL.	350 kcmil	PK18GTA	38.00 x 20.00 x 5.75	27	NF430L2 (MH38,NC38S)	**53.2197**	**$1,603**
Circuit breaker, single pole, 277-volt, 30-amp continuous duty rated							1	EDB14030	53.2111	$85

When used to combine the AC output of multiple grid-tie inverters, and meet the requirements of NEC 690.64(B)(2) the bus amp rating for the load center must be larger than the sum of all of the overcurrent devices feeding it, from both the utility and all inverters.

The 277/480V load centers can be used to combine the output from multiple inverters to feed a 277Y/480VAC grid interconnection. One 30A continuous duty breaker is used for each inverter that is set up for 277V hot to neutral.

Load centers are not supplied with any breakers – order conduit hubs for outdoor load centers, page 141, and breakers on next page, separately

Square-D load center covers and ground busbars for load centers on page 142				
Description	**Weight lbs**	**Square-D model**	**Item code**	**Price**
Surface cover for 12-space 125A load centers, 53.2162 & 53.2183	6.0	QOC16US	**53.2159**	**$18.00**
Flush cover for 12-space 125A load centers, 53.2162 & 53.2183	7.0	QOC16UF	**53.2156**	**$21.50**
Surface cover for all 200A indoor load centers, 53.2164 & 53.2187	9.2	QOC30US	**53.2169**	**$58.00**
Flush cover for all 200A indoor load centers, 53.2164 & 53.2187	11	QOC30UF	**53.2170**	**$58.00**
Ground busbar for 2-space load centers		PK4GTA	**53.2390**	**$6.00**
Ground busbar for 6-space load centers		PK7GTA	**53.2391**	**$7.00**
Ground busbar for 12-space load centers		PK9GTA	**53.2392**	**$10.00**
Ground busbar for 12-space 200A load center		PK15GTA	**53.2393**	**$23.00**
Ground busbar for 30-space load centers		PK18GTA	**53.2394**	**$25.00**

Square-D QO Circuit Breakers

QO circuit breakers snap into QO load centers on the previous page. They are UL Listed for DC branch circuits up to 48VDC (not for use in 48V systems). They can also be used for 120VAC (1-pole) or 120/240VAC (2-pole) circuits.
Circuit breakers in 10A to 30A sizes can handle one or two #14 to #10 wires or one #8 wire. Circuit breakers 40A to 70A will handle #8 to #2 wire sizes.

QOU circuit breakers are designed for surface or DIN rail mounting and are used in the Xantrex T-240 and in SW Plus AC conduit boxes.

	QO Breakers			QOU Breakers		
Description	**Part #**	**Item code**	**Price**	**Part #**	**Item code**	**Price**
10-amp 1 pole	QO110	**53.2063**	**$12**	QOU110	**53.2006**	**$25**
15-amp 1 pole	QO115	**53.2065**	**$12**	QOU115	**53.2009**	**$25**
20-amp 1 pole	QO120	**53.2071**	**$12**	QOU120	**53.2015**	**$25**
30-amp 1 pole	QO130	**53.2075**	**$12**	QOU130	**53.2024**	**$25**
40-amp 1 pole	QO140	**53.2080**	**$12**	QOU140	**53.2030**	**$25**
50-amp 1 pole	QO150	**53.2083**	**$12**	QOU150	**53.2036**	**$25**
60-amp 1 pole	QO160	**53.2086**	**$12**	QOU160	**53.2042**	**$25**
70-amp 1 pole	QO170	**53.2090**	**$28**	QOU170	**53.2048**	**$38**
15-amp 2 pole	QO215	**53.2067**	**$22**	QOU215	**53.2012**	**$50**
20-amp 2 pole	QO220	**53.2073**	**$22**	QOU220	**53.2018**	**$50**
30-amp 2 pole	QO230	**53.2077**	**$22**	QOU230	**53.2027**	**$50**
40-amp 2 pole	QO240	**53.2081**	**$22**	QOU240	**53.2033**	**$50**
50-amp 2 pole	QO250	**53.2084**	**$22**	QOU250	**53.2039**	**$50**
60-amp 2 pole	QO260	**53.2088**	**$22**	QOU260	**53.2045**	**$50**

Class T Fuse Blocks with Fuses

Use these single-pole fuse blocks to fuse inverters or other large loads. Holders with set screw lugs accept up to 2/0 wire in the 110A and 200A sizes and up to 4/0 wire in the 300A and 400A sizes.

On stud mount holders, a 5/16" bolt at each end of the fuse allows connection of a cable with a ring lug terminal end. To connect an inverter, order two cables with lugs on both ends: one to go from the battery to the fuse and one to go from the fuse to the inverter.

Class T fuses exceed the 10,000-amp interrupting capacity (AIC) required to protect Square-D brand circuit breakers in DC load centers. They are UL Listed for up to 160VDC and NEC approved for inverter use. A fuse comes installed in the block. Order spare fuses separately.

Xantrex Model	Description	Item code	Price
TFB110C	110A fuse and holder w/screw lug	**53.2515**	**$53**
TFB200C	200A fuse and holder w/screw lug	**53.2532**	**$53**
TFB300C	300A fuse and holder w/screw lug	**53.2550**	**$75**
TFB400C	400A fuse and holder w/screw lug	**53.2562**	**$75**
TFB110	110A fuse and holder w/studs	**53.2512**	**$53**
TFB200	200A fuse and holder w/studs	**53.2526**	**$53**
TFB300	300A fuse and holder w/studs	**53.2544**	**$75**
TFB400	400A fuse and holder w/studs	**53.2559**	**$75**

Class T Fuses - JJN Series

These Class T fuses are rated for 160 VDC and 300 VAC as protection for circuit breakers, load centers and inverters where high available short circuit currents are possible. These fuses fit the fuse blocks above and the inline holder at right.

Model	Description	Item code	Price
TF110	110A replacement fuse	**53.2509**	**$18**
TF200	200A replacement fuse	**53.2520**	**$18**
TF300	300A replacement fuse	**53.2538**	**$38**
TF400	400A replacement fuse	**53.2556**	**$38**

Inline Class T Fuse Receptacle

This is a great way to retrofit an inverter cable with an NEC approved fuse. To install the fuse holder and fuse, just cut the positive cable, remove an inch of insulation from each side of the cut, insert the wire in the terminal blocks, tighten the set screws and tighten the strain relief at each end of the holder. The fuse is not included. It holds 110- to 400-amp fuses. Order fuse below on left. Dimensions are 11" x 2.5" x 3".

Description	Item code	Price
Class T inline fuse holder	**53.2563**	**$38**

Battery Selector Switch

This high current switch is designed for battery switching in boats but can be used in land-based units. It permits selection between one of two batteries or the connection of both batteries in parallel. The “off” position also acts as a battery disconnect. Many people are using these to choose between two banks of batteries or between a main battery and a backup battery. The switch surface mounts with a slot for wires to enter from the bottom. Wires connect to 5/16" brass bolts. Capacity is 250 amps continuous and 360 amps intermittent. For use on 6-, 12-, 24- or 32-volt systems. UL Listed for marine use.

Description	Item code	Price
Battery selector switch	**53.8267**	**$32**

Inverter Bypass Switch

Wired between any 120VAC inverter/charger, generator and load center, this unit allows you to bypass the inverter in the event of an inverter failure. After the bypass switch is thrown, the generator is connected directly to the load center. The inverter can than be removed for repair. This is designed for inverters with built-in transfer switches. Maximum current is 60 amps. Dimensions: 13.5" x 6.25" x 3.5"

All components are UL Listed.

Description	Weight	Item code	Price
Inverter bypass switch	7 lbs	**53.7819**	**$110**

IOTA Automatic Transfer Switches

Safely connect an inverter and an AC generator to the same house wiring. These automatic transfer switches can be used with inverters that don't have built-in transfer switch capability. If the generator is not running, then the inverter is connected to the house wiring. When the generator is started, the house wiring is automatically disconnected from the inverter and connected to the generator. A time delay feature allows the generator to warm up before the transfer takes place.

These transfer switches are particularly useful in RV and marine installations where both the hot and neutral terminals must be switched. They can be used between an inverter and a generator, between an inverter and shore power, or a generator and shore power. Two transfer switches can be used if switching between all three power sources is desired.

Indoor-rated housings have conduit knockouts on all four sides. 30A and 50A units have a plastic housing and 100A units have a metal housing. ETL Listed to UL1008.

Model	AC volts	Max amps	Generator max kW	Dimensions	Weight	Item code	Price
ITS-30R	120	30A	4kW	7.5"H x 8.5"H x 4"D	2 lbs	**53.8041**	**$80**
ITS-50R	120/240	50A	12kW	7.5"H x 8.5"H x 4"D	3 lbs	**53.8053**	**$180**
ITS-100R	120/240	100A	24kW	10"H x 12"W x 4"D	15 lbs	**53.8056**	**$798**

Flexcharge Timer

The Flexcharge digital timer is a 7-day, 8-event digital clock based programmable load controller. Eight ON and eight OFF events can be programmed independently, each with its own unique timing pattern. For example: use one ON event to have a light come on at 7 pm every day then use seven OFF events to

turn the light off at a different time each day. The replaceable internal battery maintains the clock and programmed memory in the event of a system power failure (for up to 3 months). Consumes less then 3mA in standby mode. Internal DPST (double-pole-single-throw) relay switch can turn one load on at the same time that it turns another load off. Timer switch can handle up to 8 amps of inductive load or up to 16 amps of resistive load, at 6 to 36VDC or 120VAC. Timer requires 12V DC or AC to operate. Reverse polarity protected. Manual override allows the user to turn the load ON or OFF as desired. Easy to use terminal block for wiring. Dry contacts.

1-year warranty. Dimensions: 3.9"W x 3.8"H x 2"D

Description	Item code	Price
Flexcharge timer	**54.7120**	**$90**

RAB 12V Motion Sensor Switch

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 20 minutes after motion stops. Sensitivity distance is adjustable, up to about 50 feet out, farther in colder weather. 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 - amp DC, uses only 7 milliamps at idle, 40 milliamps when activating. Switch uses only 7 milliamps at idle. 1-year warranty.

Description	Item code	Price
12V Motion sensor switch	**54.7237**	**$85**

Flexcharge Night Watchman 12V Photoswitch

The Night Watchman Dusk To Dawn Controller is designed to be mounted outside in a marine salt air environment. It is completely waterproof, and very small (1" x 1" x 1") for mounting in an inconspicuous location.

Because power consumption is always a concern on battery powered systems (sail boats, PV systems, etc.) the Night Watchman is designed to use an extremely small amount of power in standby mode (only 0.00015A or 0.15mA), yet it is capable of supplying up to 10A of load current.

The Night Watchman will turn 12V incandescent or fluorescent lights ON in the evening within a half hour of sunset, and OFF in the morning within a half hour of sun rise.

The Night Watchman's circuitry is designed to prevent flickering therefore it can be used to control 12V fluorescent lamps. 1-year warranty

Description	Item code	Price
Night Watchman photoswitch	**54.7215**	**$42**

Insulated Cable Connector Blocks

This insulated connector is molded for precise fit and supplied with removable access plugs over the hex screws. Available with 2- to 4-wire entry ports on one side for 4 to 14 AWG wire. This can be used to transition from Multi-Contact cables to conduit wiring on roof to PV arrays or for any parallel wiring connection. UL Listed for 600 volts.

Number of poles	Wire range AWG	Item code	Price
2	4 -14	**54.1142**	**$14**
3	4 - 14	**54.1143**	**$20**
4	4 - 14	**54.1144**	**$26**

Power Distribution Blocks

Use these blocks to split primary power into secondary circuits, or join cables from a solar array to a power lead-in cable. Install cables and tighten set screws. Terminal blocks are made of zinc-plated aluminum for use with aluminum or copper conductors. 2 poles. Primary side accepts one large cable; secondary side accepts 6 smaller cables. UL Recognized for up to 600 volts.

Primary wire size (AWG)	Secondary wire size (Qty)	Amp rating	Item code	Price
#8 to 2/0	#14 to #6 (6)	175	**54.1024**	**$54**
#6 to 6/0	#14 to #4 (6)	350	**54.1027**	**$60**

Splicer Blocks

Use these blocks to splice wires of up to #2/0 gauge. They are UL Recognized and CSA certified for up to 600 volts. The terminal blocks are made of zinc-plated aluminum, for use with aluminum or copper conductors. 2 pole and 3-pole blocks. One connection on each side.

Wire size (AWG)	Poles	Amp rating	Item code	Price
#8 to 2/0	2	175	**54.1030**	**$20**
#8 to 2/0	3	175	**54.1033**	**$25**

Wall Outlets and Plugs for 12VDC and 24VDC

In our search for an economical, NEC-approved outlet to use for low voltage systems, we have decided upon something that is readily available: a 240-volt, 15-amp receptacle. Our choice of this configuration is based on the assumption that PV-powered remote homes will not normally have appliances that use 240 volts at 15 amps. If you have a large power tool it will usually have a 240-volt 20-amp plug on it. These receptacles are duplex (two outlets) and they fit standard wiring boxes and standard duplex receptacle covers.

Description	Item code	Price
DC outlet - brown	**55.1060**	**$6.00**
DC outlet - ivory	**55.1063**	**$6.00**
Plug - black rubber	**55.1057**	**$5.00**

Barrel Connectors

These UL Listed connectors are tin-plated high strength aluminum alloy. They can be used with copper or aluminum wire. Set screw holds wire in terminal. Single-and double-barrel connectors.

Type	Wire size (AWG)	Hole size	Item code	Price
Single	14 to 2	1/4"	**51.3319**	**$1.84**
Single	14 to 2/0	1/4"	**51.3327**	**$2.69**
Double	14 to 2/0	1/4"	**51.3324**	**$6.50**
Single	6 to 4/0	3/8"	**51.3334**	**$8.25**
Double	6 to 4/0	3/8"	**51.3330**	**$20.00**

Wall Plate Lighter Receptacle

This receptacle comes with a chrome plated cover that fits a standard single gang outlet box. This heavy duty outlet is made of brass and steel so it can handle up to 20 amps. The positive connection is a 10-32 threaded stud with nuts. The negative connection is a short piece of 18 gauge wire. If you plan to use more than 10 amps, replace negative wire with 12 AWG. The negative connection of the outlet is connected to the steel cover, so it is a good idea to use a steel junction box with the negative wire connected to the box as well as the negative lead on the outlet.

Description	Item code	Price
Wall plate receptacle	**55.1038**	**$5**

Extension Cord with Battery Clips

10-foot extension cord with lighter receptacle at one end and color coded battery clips at the other. 16 gauge wire.

Description	Item code	Price
Extension cord with clips	**55.1035**	**$11**

Double Receptacle

Plug two devices into the same outlet with this heavy duty "Y" connector. Leads are 6 inches long 16 gauge wire.

Description	Item code	Price
Inline double receptacle	**55.1030**	**$7**

Inline Lighter Receptacle

Lighter receptacle with a 12-inch 16 AWG wire. Maximum current is 10 amps.

Description	Item code	Price
Inline receptacle with 1/2" wire	**55.1033**	**$5**

Lighter Plug

This heavy-duty plug is made from high heat thermoset plastic to prevent distortion at high temperatures. It comes with an easy to replace 3-amp glass fuse, but any AGC type fuse up to 15 amps may be used. Wire connections should be soldered. Screw together assembly requires no tools.

Description	Item code	Price
Lighter plug	**55.1027**	**$3**

Lighter Plug Extension Cord

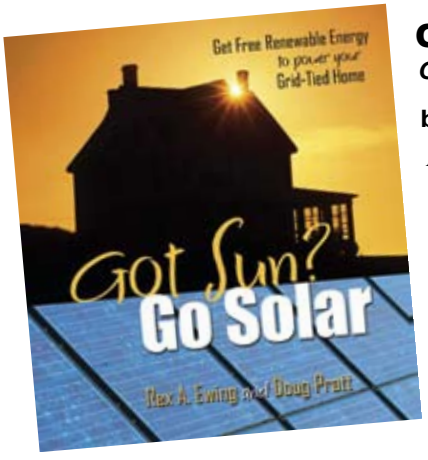
15-foot extension cord with lighter plug at one end and lighter receptacle at the other. 16 gauge wire.

Description	Item code	Price
Lighter extension cord	**55.1036**	**$9**

RV Roof Connector

The roof outlets are typically installed on RV roofs to allow for later installation of PV modules without adding a new roof penetration. They are a great waterproof method to bring wires through an RV roof. Cords below mate to roof outlet. They are typically used to connect PV modules to the roof outlet. Cable 55.1110 and 55.1113 have unjacketed wire with one red conductor and one black conductor. Cable 55.1111 has 20 feet of jacketed type TC cable with red and black conductors.

Description	Item code	Price
RV roof outlet	**55.1109**	**$4**
Connector with 5', #12 AWG cable	**55.1110**	**$5**
Connector with 20', #10 AWG cable	**55.1111**	**$20**
Connector with 10-inch cable	**55.1113**	**$3**



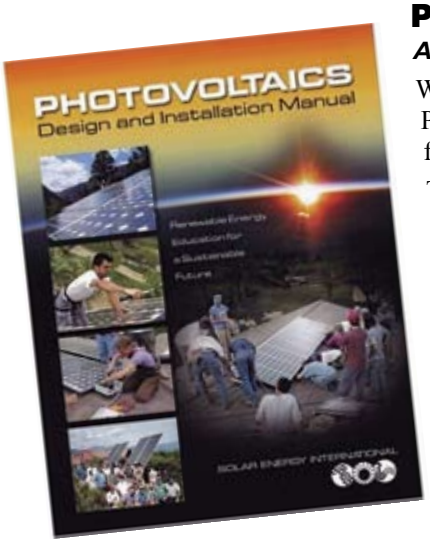
Got Sun? Go Solar

Get Free Renewable Energy to Power Your Grid-Tied Home

by Rex A. Ewing and Doug Pratt

Are you connected to the grid, but want to reduce or even eliminate your electric bills with free energy from the sun and wind? From the sun-soaked Southwest to windy North Dakota to the hurricane-prone Southeast, homeowners are discovering renewable energy. Now with rebates and incentives from most states, installing a solar or wind system is an economically attractive and environmentally responsible option. Do it for your checkbook, or for independence from blackouts. Or do it just because you want to help the environment. You'll be glad you did.

Description	Item code	Price
Got Sun? Go Solar	**91.1005**	**$18.95**



Photovoltaics: Design and Installation Manual

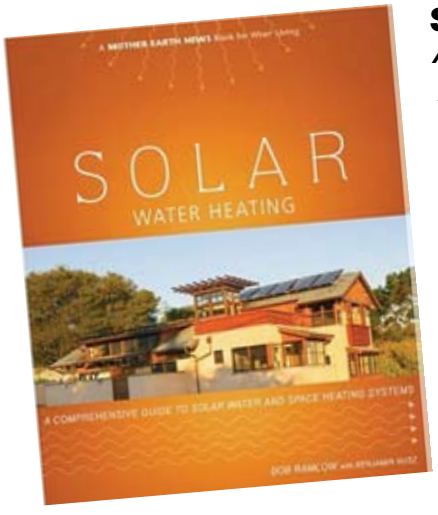
A PV design manual by Solar Energy International

Written by SEI, a world-class solar energy training and education provider since 1991, Photovoltaics: Design and Installation Manual provides the critical information to successfully design, install and maintain PV systems.

The book contains an overview of photovoltaic electricity and detailed descriptions of PV system components. It includes chapters on sizing photovoltaic systems, analyzing sites and installing PV systems, as well as detailed appendices on PV system maintenance, troubleshooting, and worldwide solar insolation data. This textbook is meant as a user-friendly, how-to-guide for anyone interested in installing PV on their home or as a business. This book is a must-have textbook, that should be to be required in any renewable energy course.

Solar Energy International is a non-profit organization whose mission is to help people incorporate renewable energy into their lives. Based in Carbondale, Colorado, and active around the world, SEI provides information, education and hands-on training to people who want to shape a sustainable future. "SEI offers the most comprehensive, intensive and practical PV training available in the country," comments Richard Perez, publisher of *Home Power* magazine.

Description	Item code	Price
Photovoltaics: Design and Installation Manual	**91.1008**	**$60**



Solar Water Heating

A Comprehensive Guide to Solar Water and Space Heating Systems

After giving a history of solar water heating in the US, the book describes various systems that use the sun to heat and store water. Climate, freeze conditions, water quality and amount of sunlight available are some of the factors considered in choosing a system, and the book describes them all. Individual components are detailed in a logical, straightforward way. It's obvious the authors have extensive practical knowledge. The writing style is informal and easy to read. Besides all the solar water heating information, this book also has a good section on radiant floor heating, detailing the use of PEX tubing to heat a concrete slab.

For anyone planning a residential sized solar water heating system, this is the best book available. It's an excellent guide, whether you decide to choose the individual components yourself, buy a package, or hire a contractor to install a turnkey system.

Description	Item code	Price
Solar Water Heating	**91.1012**	**$25**

Solar Water Pumping

The sun is the natural source of energy for an independent water supply. Solar pumps operate anywhere that the sun shines, and the longer it shines, the more water they pump. When its cloudy, they pump less water, but often you need less water when it is cloudy.

Photovoltaic modules, the power source for solar pumping, have no moving parts, require no maintenance and last for decades. A properly designed solar pumping system will be efficient, simple and reliable.

Solar water pumping systems operate on direct current. The output of the solar power system varies throughout the day and with changes in weather conditions. The nature of variable electricity in the form of direct current (DC) is quite different from conventional, steady alternating (AC) current from the utility grid or a generator.

To use solar energy economically, the pumping system must utilize the long solar day, drawing a minimum of power. This means pumping more slowly than conventional pumps. Pumping at rates of less than 6 gpm requires different mechanisms from the conventional (centrifugal) pumps. Small solar pumps are unique, both electrically and mechanically.

The most efficient pumps are "positive displacement" pumps. They pump a certain amount of water with each rotation. If it is cloudy or early morning, the pump will receive less energy and run more slowly. A positive displacement pump will pump approximately half as much water with half as much energy.

Conventional AC pumps are usually centrifugal pumps that spin at a high speed to pump as many gallons per minute as possible. They also consume a large amount of power. If you run a centrifugal pump at half speed, it pumps one quarter the pressure. Their efficiency is very low at low speeds and when pumping against high pressure.

If your water sources are remote from power lines, add up your long-term costs of fuel and repairs on generators, or the cost of utility line extensions. Now consider the savings with a solar pump that needs attention only once every 2 to 20 years depending on the model.

Solar powered pumps can provide an equal volume of water per day without the high and inefficient energy demands of a large capacity AC pump. Instead of pumping a large volume of water in a short time and turning off, the solar pump works slowly and efficiently all day. Often a solar pump will work fine in a well with a recovery rate too slow for a conventional AC pump.

Submersible Pumps

If you are pumping from a well, we have solar pumps that can deliver from 1 gallon per minute to over 75 gpm. The smallest pumps, the low-power diaphragm pumps from SHURflo and SunPumps, operate from two 50- to 100-watt solar modules, depending on the head (vertical distance) they are pumping. They can pump 500 to 1000 gallons per day and lift water 200 feet. These pumps require service every 2 to 4 years.

If you have a higher lift, need more water or want a pump that does not require service for 10 to 20 years, the Grundfos SQFlex pump is a good choice. The SQFlex can lift water over 600 feet and can pump over 20,000 gallons per day at lower lifts. The SQFlex pump can be powered by solar modules, a wind generator, a fuel powered generator, and inverter or the utility grid or a combination of several of these.

For greater water needs or deeper wells, the Grundfos SQ-series AC submersible pump can easily be powered by an inverter or generator. Larger, custom-designed solar powered pumping systems can be supplied by SunPumps. Contact us if your needs fall outside of the flow or lift specifications found in the following pages.

Surface Pumps

Surface pumps are less expensive than DC submersibles, where applicable. A surface pump is not submersible. It can draw water from a dug well, spring, pond, river or tank, and push it far uphill and through a long pipeline to fill a storage tank or to pressurize it for home use or for irrigation, livestock, etc. The pump may be placed at ground level, or suspended in a well in some cases.

All pumps are better at pushing than pulling. Surface pumps must be placed no higher than 10 or 20 feet above the surface of the water source at sea level (subtract one foot per 1000 feet elevation).

Suction piping must be oversized a bit and not allow air entrapment (much like a drain line) and should be as short as possible. Pumps can push very long distances. The vertical lift and flow rates are the primary factors that determine power requirements.

Pressurization

Many conventional AC powered water systems pump from a well or other water source, into a pressure tank that stores water and stabilizes the pressure for household use. When you turn on water in the house, an air-filled bladder in the tank forces the water into the pipes. When the pressure drops, a pressure switch turns on the pump, refilling and repressurizing the tank. This works fine because of the ability of the AC pump to deliver a volume of water larger than what is required for household use.

An AC pressure pump can work in systems with an inverter large enough to run a standard AC pump. However, this will not work with pumps operating directly from PV modules because the sun may not be shining when you need pressure and thus the pump may not keep up with household use.

There are two ways to solve this problem. A non-pressurized water tank can be located high enough above the house for gravity to supply the water pressure. This can be on a hill or a tower. Water pressure in psi = head (in feet) times 0.433. For reasonable pressure the tank needs to be at least 40 feet above the house. If this is not possible, a battery operated pressure booster pump can fill a pressure tank as needed from a storage tank that is filled by a solar pump during the day. The Flowlight booster pump, the SHURflo 2088 pumps and the SunPumps DC centrifugal pumps can be used for this purpose.

You must use a pump that can deliver the maximum gpm required by the house, or have a pressure tank that is large enough to make up the difference between what the pressure pump can deliver and what is required, for the amount of time it is required. This is called the "drawdown volume" of the tank. Ask us about obtaining air-filled pressure tanks.

Calculation of Solar Power Needs

With all solar powered pumps, the necessary solar array can be determined by looking at the watts required for the head and flow in your situation. Solar array watts should be at least 20% higher than the power required by the pump in your situation. If you use a larger array or a tracking array, the pump will operate at its maximum output for more hours of the day, delivering more gallons per day.

If the pump runs on 24 volts, you can use pairs of 12V solar modules wired in series or 24V modules. Two solar modules with total wattage equivalent to or exceeding the wattage required by the pump must be used. If the pump uses 48 volts, you can use groups of four 12V solar modules wired in series or a group of two 24V modules whose total wattage exceeds the pump's power requirement.

Linear Current Boosters

Linear current boosters from Solar Converters are used in solar direct pumping applications. They can achieve a 30-90 percent increase in water pumped over connecting the pump directly to the solar panels. We can special order 90V units that can operate 12-, 24-, 36- and 48-volt pumps from several modules in series. This will be useful where the panels must be a long distance from the motor, allowing wiring with a smaller wire size as the current is reduced. The wire savings alone can easily pay for the controller. Call for details.

Solar Converters model	Array volts nominal	Current max amps	Item code	Price
PPT 12/24-7	12 or 24	7	**75.0124**	**$112**
PPT 12/24-15	12 or 24	15	**75.0126**	**$247**
PPT 12/24-30	12 or 24	30	**75.0128**	**$449**
PPT 48-10	48	10	**75.0136**	**$263**

Submersible Pump Cable

10/2 without ground pump cable is for the SHURflo 9300 submersible pump. 2-conductor with ground pump cable is required for Grundfos SQFlex and SQ AC pumps.

Sensor Wire

This 3-conductor, 22-gauge direct-burial wire can be used between water level sensors and pump controls in pumping applications where you must sense the water level in a remote tank or in a well.

Splice Kit

This kit contains crimp splices and heat string tubing for splicing AWG 10 or 12 submersible pump wire for use under water.

Description	Item code	Price / ft.
10/2 without ground	**50.1637**	**$1.70**
12/2 with ground	**50.1635**	**$2.40**
10/2 with ground	**50.1638**	**$2.80**
8/2 with ground	**50.1643**	**$3.60**
Sensor wire 22/3	**50.1273**	**$0.30**
Splice kit	**75.0130**	**$12.00**

Float Switch

The SPDT float switch can be used to control a pump in tank-filling or tank-emptying operation. Contacts located in the float will switch at 12 degrees above and below horizontal. Use a pipe clamp or cable tie to secure the cable to a pipe or weight in tank. The length of cable from clamp to float determines the difference between turn-on level and turn-off level. For larger pumps, use float switch to turn a relay on and off and let relay contacts control pump. Safe for domestic water systems. 2-year warranty.

ON WHEN FULL is used to turn on a pump when a tank is full and pump it down. OFF WHEN FULL turns the pump off when a tank is filled. These are SPST switches.

Description of operation	Maximum amps	Item code	Price
SPDT three-wire	5	**75.5270**	**$52**
On when full	13	**75.4420**	**$46**
Off when full	13	**75.4422**	**$46**
On when full	25	**75.4407**	**$105**
Off when full	25	**75.4410**	**$105**

Grundfos – SQFlex Submersible Pumps

This is the ultimate submersible pump for water lifts of up to 525 feet. They can be directly powered by solar or wind power or can be run on an inverter, a generator, a battery or the utility grid, or any combination of these sources. Virtually any source of power, 30-300 VDC and 90-240 VAC, can be used to run the pump. And with Grundfos, you know it is built to last and is maintenance-free. Some SQFlex pumps will fit into a 3" well.

Seven pump models can deliver from 4 gpm at 525 feet to 50 gpm at 20 feet of head with a 1 kilowatt solar array or less. Helical rotor pumps (models 3, 6 and 11) for high head applications and centrifugal pumps for low head applications assure a pump that is efficient for any use. The SQFlex has built-in protection from dry-running, overload and overheating.

The SQFlex pump can run on a solar arrays starting at 129 watts. The array must have an operating voltage over 30 volts. The array can be made of any combination of 3 or more 12-volt nominal modules in series or 2 or more 24-volt nominal module.

Grundfos SQFlex pumps and accessories	Item code	Price
SQFlex 3 SQF-2 pump - 3"	75.1012	$2,602
SQFlex 3 SQF-3 pump - 3"	75.1013	$2,602
SQFlex 6 SQF-2 pump - 3"	75.1015	$2,602
SQFlex 11 SQF-2 pump - 3"	75.1018	$2,602
SQFlex 16 SQF-10 pump - 4"	75.1020	$2,602
SQFlex 25 SQF-3 pump - 4"	75.1021	$2,602
SQFlex 25 SQF-6 pump - 4"	75.1024	$2,602
SQFlex 40 SQF-3 pump - 4"	75.1027	$2,602
SQFlex 40 SQF-5 pump - 4"	75.1028	$2,602
SQFlex 60 SQF-3 pump - 4"	75.1029	$2,602
IO100 interface box	75.1039	$170
IO101 interface box (115V)	75.1036	$440
CU200 interface for multiple sources	75.1033	$490
Level switch (use with CU200 only)	75.1042	$27
Whisper 200 wind turbine - 150V	16.1199	$2765
IO102 wind turbine breaker box	75.1040	$488
Tower kit 30 foot for Whisper 200	16.1089	$450
Tower kit 50 foot for Whisper 200	16.1095	$625
Auger/anchor (set of 4) for towers	16.1119	$112
Pressure switch (use with CU200 only)	75.1044	$67

Grundfos also has a specially designed Whisper 200, 1kW wind generator with 150VDC output for applications using wind power. Please contact us for information.

Poly pipe in rolls is acceptable instead of rigid pvc or galvanized, because the slow-start feature of the motor reduces startup torque and twisting of the pipe.

Optional Controls

The CU200 interface box communicates with the pump and monitors operating conditions. Built-in diagnostics indicate faults and dry-running, display operating status, power consumption and water level switch input. The water level switch interfaces with the CU200 control to turn off the pump when a tank is full.

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 on a solar pump. An 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 to let the sun continue pumping.

The IO102 interface unit is used for systems powered exclusively by a wind turbine or by a combination of wind and PV. You can use several controls if you need more features than one control can provide.

The SQFlex pumps will not function with a GFCI in the supply circuit, and should not be used where a GFCI is required.

Use the table on next page to choose a pump. Left column shows total head in feet and meters. The top row shows array wattage/number and suggested type of modules. Boxes show seasonal pump performance and maximum flow as shown here:

Select the row with the head (total lift) that most closely matches your application. Move across the row to the column that contains the desired daily volume or peak flow rate. Note the pump model in that block and wattage of the PV array in that column.

75 SQF-3	= Pump model
22,040	= Estimated daily summer volume (GPD)
14,630	= Estimated daily winter volume (GPD)
52	= Peak flow rate (gpm)

NOTE: Daily volume and flow calculations are based on 38° north latitude location, fixed array tilt of 38° and 4.5 kWH/m2 (POA) winter, and 7.5 kWH/m2 (POA) summer solar insolation. The pump model is optimized for summer operation. Up to 40% more water can be pumped in the summer if the array is on a tracking mount. The output can vary with different locations and years, and is not guaranteed.

Prices subject to change without notice.

Estimated Water Production from SQFlex Pumps

Summer and winter volumes and peak flow rates based on solar array wattage.

Head	(Module watts)	85	85	85	85	175	175	175	175
feet	X (# of modules)	3	4	5	6	4	5	8	10
(m)	= (Array watts)	255	340	425	510	700	880	1400	1750
6 (2)	Model	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3
	7.5 kWh/m2	17,037	21,485	24,918	27,917	31,023	36,797	39,138	45,690
	4.5 kWh/m2	12,520	15,986	18,732	21,256	25,518	29,229	33,549	39,613
	Max flow	34	41	47	52	55	65	66	76
25 (8)	Model	40 SQF-5	40 SQF-5	40 SQF-5	40 SQF-5	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3
	7.5 kWh/m2	6,834	9,853	12,466	15,113	18,582	25,358	29,804	36,941
	4.5 kWh/m2	3,944	6,219	8,305	10,319	12,489	17,744	23,459	29,319
	Max flow	16	22	27	32	41	52	54	65
50 (15)	Model	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	25 SQF-6	40 SQF-5	40 SQF-5	40 SQF-5
	7.5 kWh/m2	3,284	4,406	5,020	5,499	9,120	14,171	17,910	23,566
	4.5 kWh/m2	2,195	3,061	3,803	4,375	6,170	9,060	13,517	18,316
	Max flow	7	9	10	10	20	31	33	44
75 (23)	Model	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	25 SQF-6	25 SQF-6	40 SQF-5
	7.5 kWh/m2	2,524	3,557	4,381	4,910	5,352	8,805	10,871	15,732
	4.5 kWh/m2	1,588	2,343	3,035	3,684	4,314	5,703	8,387	11,880
	Max flow	6	8	9	10	10	19	21	31
100 (30)	Model	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	16 SQF-10	16 SQF-10
	7.5 kWh/m2	1,824	2,708	3,552	4,202	4,794	5,503	7,768	10,016
	4.5 kWh/m2	1,015	1,648	2,277	2,868	3,667	4,445	6,036	7,875
	Max flow	4	6	8	9	9	10	15	18
125 (38)	Model	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	16 SQF-10	16 SQF-10
	7.5 kWh/m2	1,495	1,977	2,825	3,534	4,268	5,071	6,445	8,792
	4.5 kWh/m2	891	1,370	1,704	2,248	3,012	3,988	4,930	6,823
	Max flow	3	4	6	8	9	10	13	16
150 (46)	Model	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	16 SQF-10
	7.5 kWh/m2	1,319	1,847	2,127	2,380	3,770	4,651	5,121	7,530
	4.5 kWh/m2	758	1,179	1,591	1,888	2,506	3,551	4,180	5,771
	Max flow	3.1	4.2	4.5	4.6	8.3	9.3	9.3	14.4
175 (53)	Model	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2
	7.5 kWh/m2	1,133	1,684	2,008	2,250	3,265	4,233	4,787	5,393
	4.5 kWh/m2	624	1,009	1,407	1,741	2,029	3,058	3,874	4,450
	Max flow	2.7	3.8	4.4	4.5	7.4	8.9	8.9	9.1
200 (61)	Model	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2
	7.5 kWh/m2	952	1,514	1,888	2,114	2,352	3,807	4,435	5,064
	4.5 kWh/m2	493	867	1,207	1,583	1,903	2,552	3,536	4,153
	Max flow	2.3	3.5	4.3	4.5	4.5	8.5	8.4	8.8
250 (76)	Model	3 SQF-2	3 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2
	7.5 kWh/m2	698	905	1,578	1,875	2,125	2,483	3,733	4,344
	4.5 kWh/m2	422	644	890	1,183	1,639	2,017	2,816	3,493
	Max flow	1.6	1.9	3.7	4.3	4.3	4.5	7.4	8.1
300 (91)	Model	3 SQF-2	3 SQF-3	3 SQF-3	3 SQF-3	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2
	7.5 kWh/m2	609	865	1,015	1,132	1,884	2,253	2,482	3,453
	4.5 kWh/m2	355	555	750	890	1,282	1,785	2,050	2,700
	Max flow	1.4	2.0	2.1	2.2	4.2	4.4	4.3	6.9
360 (110)	Model	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	6 SQF-2	6 SQF-2	6 SQF-2	6 SQF-2
	7.5 kWh/m2	535	801	953	1,072	1,583	2,010	2,260	2,541
	4.5 kWh/m2	294	484	669	827	918	1,458	1,839	2,108
	Max flow	1.3	1.8	2.1	2.2	3.8	4.3	4.2	4.3
420 (128)	Model	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3
	7.5 kWh/m2	467	724	900	1,013	1,122	1,284	1,314	1,439
	4.5 kWh/m2	247	423	599	762	910	1,062	1,109	1,239
	Max flow	1.1	1.7	2.0	2.1	2.1	2.2	2.2	2.3
500 (152)	Model	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3
	7.5 kWh/m2	367	606	809	931	1,053	1,211	1,257	1,379
	4.5 kWh/m2	180	337	489	651	828	990	1,052	1,186
	Max flow	1.0	1.4	1.9	2.1	2.1	2.2	2.2	2.2
600 (183)	Model		3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3
	7.5 kWh/m2		406	612	779	898	1,066	1,146	1,260
	4.5 kWh/m2		190	321	454	664	855	952	1,063
	Max flow		1.0	1.5	1.9	1.9	2.0	2.0	2.0

Please call with any questions! Our contact information is on the cover.

Grundfos SQ AC Submersible Pumps

The SQ series pump features a permanent magnet motor controlled by an electronic frequency converter developed by Grundfos. It starts slowly, without surge, so it can be run on a much smaller inverter or generator than any conventional AC submersible pump. It is a high-efficiency pump and motor with built-in dry-run protection.

This is the ideal pump to use if you are pumping from a well and into a pressure tank, especially for solar-powered homes. They work on modified sine wave or sine wave inverters. Highest volume pumps run on 240VAC. They can be powered by inverter systems with 240VAC output, or by using an autotransformer to step 115VAC from an inverter to 240 to run the pump. Minimum well diameter of 3" is required. Use 2-conductor with ground pump cable.

Warranty is 18 months from date of installation or 24 months from date of purchase, whichever comes first.

Grundfos SQ-series AC pumps					Depth to pumping water level (lift) In feet																
Pump model	HP	AC volts	Item code	Price ($)	20	40	60	80	100	120	140	180	200	220	240	280	300	340	400	460	520	600
5SQ05-180	1/2	115 240	75.1425 75.1426	$971			7.9	7.5	7.1	6.7	6.2	5.1	4.4	3.6	2.6							
5SQ05-230	1/2	240	75.1427	$1031				8	7.7	7.3	6.9	6.1	5.6	5.1	4.6	3.4	2.8	0.8				
5SQ07-320	3/4	240	75.1429	$1195							7.9	7.3	7	6.7	6.4	5.7	5.4	4.6	3.4	1.6		
5SQ10-360	1	240	75.1431	$1364								7.7	7.4	7.2	6.9	6.3	6.0	5.4	4.4	3.3	1.9	
5SQ10-410	1	240	75.1437	$1425									7.9	7.6	7.4	6.8	6.5	6.0	5.1	4.2	3.2	1.4
5SQ10-450	1	240	75.1434	$1376											7.9	7.4	7.1	6.6	5.8	5.0	4.1	2.9
10SQ07-200	3/4	240	75.1443	$952				14.8	14.0	13.5	12.8	11.0	10.0	9.0	7.0							
10SQ07-240	3/4	240	75.1445	$1025					14.6	14.0	13.5	12.4	11.5	11.0	10.0	8.0	6.5	2.5				
10SQ10-290	1	240	75.1449	$1165						14.7	14.3	13.3	12.8	12.3	11.8	10.5	9.5	7.7	3.0			
10SQ15-330	1.5	240	75.1452	$1193							14.7	14.0	13.5	13.0	12.7	11.6	11.0	9.8	7.2	3.0		
15SQ05-110	1/2	115 240	75.1458 75.1457	$969			19.5	17.5	16.0	13.5	11.0											
15SQ07-150	3/4	240	75.1459	$990				19.0	18.0	17.0	15.5	12.0	10.0	7.0								
15SQ07-180	3/4	240	75.1460	$1045					19.5	18.5	17.5	15.5	14.0	12.5	11.0	6.5						
15SQ10-220	1	240	75.1462	$1101							19.5	17.0	16.0	15.0	14.0	11.5	10.0	6.0				
15SQ10-250	1	240	75.1461	$1118							20.0	18.0	17.5	16.5	15.5	14.0	13.0	11.0	5.5			
22SQ07-160	3/4	240	75.1464	$1155			32.0	30.5	28.5	26.5	24.0	17.5	12.0	3.0								
22SQ10-190	1	240	75.1467	$1172			33.0	31.5	30.5	29.0	27.5	23.5	21.0	18.0	8.0							
30SQ05-40	1/2	115 240	75.1470 75.1471	$971	40	30	11															

Solar Stream Pulsing Solar Fountain Kit

The Solar Stream LJ-01 solar fountain pump provides a unique feature for any pond, garden pool, or business display. Powered by a 5-watt photovoltaic module, the fountain sends a stream of water 6 feet into the air two times a second in full sun. The pump is a stainless steel cylinder, 6 inches high and 3 inches in diameter. It fits into a 5-inch foam collar that allows the pump to float at the water's surface. An 8-foot cord allows connection to the commercial grade 5-watt photovoltaic module supplied with the kit.

These pumps have only one moving part – a free piston. Electricity from sunlight (from the PV module) charges a capacitor. When the capacitor voltage reaches a fixed level (about 16 volts), an electronic switch feeds the capacitor energy into the pump coil which drives the piston, creating a pulse of water.
The more sunlight, the more pulses of water are delivered.

1-year warranty.

Model number	Description	Item code	Price
LJ-01	Solar fountain pump kit	**75.8157**	**$150**

SHURflo 9300 Submersible Pump

Use this lightweight submersible pump for livestock, irrigation or remote home application with low water requirements. The 9300 is a positive displacement diaphragm type pump with very high efficiency, but a much shorter life than centrifugal or helical rotor pumps. Diaphragm should be replaced every two to four years, depending on pumping volume.

The SHURflo 9300 can be operated on a 12- or 24-volt battery, or, with the use of one of the SHURflo Pump Controls, directly on a PV array. The pump can lift 1.3 gpm to 230 feet and can pump nearly 2 gpm from very shallow wells. It measures only 3.75" diameter x 12" long.

The 902-200 controller comes in an outdoor enclosure with water level sensors and sensor wire. It can be operated from a 12V or 24V array. The 902-100 control must be mounted in a dry location and used with a 24V array. Performance on a 12-volt battery will be less than half the flow on the accompanying chart. 1-year warranty.

Array direct performance (24V array)			
Vertical lift	Minimum solar array size	Flow rate (gpm)	Amps @ 30V
20	2 x 32 watts	1.95	1.5
40	2 x 32 watts	1.90	1.7
60	2 x 50 watts	1.81	2.1
80	2 x 50 watts	1.76	2.4
100	2 x 50 watts	1.71	2.6
120	2 x 50 watts	1.68	2.8
140	2 x 80 watts	1.65	3.1
160	2 x 80 watts	1.63	3.3
180	2 x 80 watts	1.55	3.6
200	2 x 80 watts	1.52	3.8
230	2 x 80 watts	1.36	4.1

Description	Voltage / wattage	Wt. lbs	Item code	Price
SHURflo 9300 submersible pump	24 VDC	6	**75.5817**	**$689**
SHURflo 902-100 pump controller	24 VDC, 150 W max	6	**75.5823**	**$122**
SHURflo 902-200 pump controller	12-24 VDC, 150 W max	6	**75.5820**	**$273**

LVM Submersible Pumps

LVM pumps are constructed of polyacetal plastic, enabling them to pump almost any liquids. They are small enough to enter the opening in a five gallon container or a 2" well casing. The outlet is a half-inch hose barb. The intake has a removable strainer with another hose barb for inline use. These pumps can be used for most general intermittent pumping applications, like hosing down cars, vans, boats, pumping into and from containers, emptying bilges, etc. LVM 105 comes with battery clips. These pumps are designed for 12-volt operation and will be damaged by array-direct operation if voltage goes above 15 volts. Made in England.

Model number	Current (amps)	Flow rate (gpm) at 0 psi	Pressure (max psi) at 0 flow	Maximum head (feet)	Dimensions (inches)	Weight (lb)	Cable length	Item code	Price
LVM105	4.5	4	14	32	1.5 x 6.54	1.1	12 ft	**75.8052**	**$89**
LVM107	2	2	11	20	1.5 x 5.67	0.5	3 ft	**75.8054**	**$68**
LVM111	6	6	14	32	1.5 x 6.54	1.5	12 ft	**75.8058**	**$110**

SunPumps – SDS DC Submersible Pumps

SunPumps SDS series submersible pumps are efficient, low voltage, DC powered, diaphragm type positive displacement pumps designed specifically for water delivery in remote locations. They operate at 12 to 30 volts DC which may be supplied from a variety of independent DC power sources. There are two models of SDS pump. The D-series has a dual diaphragm and fits in a 4-inch well. The Q-series is a higher flow pump that fits in 5-inch or larger wells. A PCA-30-M1 controller must be used with all SDS pumps.

SDS pump flows at 30 VDC												
Item code	**75.3017**			**75.3021**			**75.3023**			**75.3022**		
Price	**$675**			**$720**			**$720**			**$720**		
Model	SDS-D-128			SDS-Q-128			SDS-Q-135			SDS-Q-130		
Head (ft)	Flow (gpm)	Amps	Module watts	Flow (gpm)	Amps	Module watts	Flow (gpm)	Amps	Module watts	Flow (gpm)	Amps	Module watts
0	1.75	1.66	62	3.90	1.80	68	5.10	1.94	73	4.40	1.58	59
23	1.70	1.80	68	3.70	2.09	78	4.90	2.68	101	4.20	2.32	87
46	1.65	2.05	77	3.50	2.70	101	4.60	3.53	132	4.00	3.05	114
69	1.60	2.55	96	3.30	3.33	125	4.40	4.36	164	3.80	3.75	141
92	1.55	3.08	116	3.09	3.90	146	4.20	5.26	197	3.60	4.50	169
104	1.52	3.12	118	3.00	4.20	158	4.10	5.68	213	3.50	4.85	182
116	1.50	3.16	119	2.90	4.50	169	4.00	6.12	230			
139	1.45	3.31	124	2.75	5.03	189						
162	1.40	3.50	131									
185	1.35	3.70	139									
208	1.30	3.92	147									
231	1.25	4.11	154									

They can be used to fill an open tank or in pressurized water delivery systems. Simplicity is the key feature of the SDS series pumps. They are easy to install, require very little maintenance and are repairable.

Use the table to choose the pump that best meets your flow need at a given head. At 15 volts, flow is slightly less than half of the 30-volt flow.

SunPumps Controllers

SunPumps PCA and PCB series pump controllers are microprocessor-controlled DC power converters designed as the interface between a DC powered pump and the power source. The DC source may be solar modules, batteries or systems using wind generators. The primary function of the PC series controller is to boost the current of solar modules in low sunlight conditions while holding the voltage of the solar modules at the maximum power point. This allows a pump to start earlier in the morning and stay running longer in the evening. SunPumps PC series pump controllers have many unique features designed specifically for water pumping. All PC series controllers include a pump speed control circuit, a remote switch circuit, a sensor-less low water cut-off circuit, an electronic circuit breaker and indicator lights.

Model		PCA-30M1	PCA-60	PCB-90	PCB-120	PCB-180
Number of 36-cell modules in series		2	4	6	9	12
Number of 54-cell modules in series		1	2	4	6	8
Number of 72-cell modules in series		1	2	3	4	6
Nominal volts		15,24,30	30,45,60	45,60,75,90	90105120135	135150165180
Maximum open circuit volts		45	90	200	250	300
Maximum load current (amps)		8	8	10	10	14
Maximum load power (watts)		250	500	1000	1200	2500
Brush motor control	**Item code**	**75.3027**	**75.3029**	**75.3035**	**75.3041**	**75.3047**
	Price	**$350**	**$390**	**$575**	**$585**	**$665**

Prices subject to change without notice.

SunPumps centrifugal surface pumps cover a wide range of applications from high volumes and low heads to high heads and low volumes. Applications include home pressure systems, pool filtration, shallow-well jet systems, deep-well jet systems, pond water circulation as well as many other uses. SunPumps SC series centrifugal pumps are equipped with heavy duty permanent magnet, DC motors with long-life brushes. The motors are close-coupled to the pump end thus eliminating the need for base plates, belts and pulleys. These pumps are designed to be used array direct. Allow 1 to 2 weeks for delivery.

SunPumps SCP Pool Pump

These centrifugal pumps are designed specifically for pool water circulation. The SCP series pumps are equipped with heavy duty permanent magnet, DC motors. The pump ends are constructed from high performance thermoplastic and are extremely resistant to chemicals as well as mineral and algae deposits. For added protection, a basket strainer is incorporated into the suction side of the pump. They can also be used to fill open tanks, aerate ponds, circulate water for aqua culture or irrigate small farms. Inlet and discharge ports are 2" NPT and they operate at 45 to 90 VDC. SCP 42-47-10 operates up to 120 VDC and can pump 93 gpm at 0 psi. Use with SunPump Control PCB-120 (75.3041).

Model	HP	60 VDC			75 VDC			90 VDC			Item code	Price
		Current (amps)	Flow rate at 0 psi	Pressure max psi	Current (amps)	Flow at 0 psi	Pressure max psi	Current (amps)	Flow at 0 psi	Pressure max psi		
SCP 48-30-07	3/4	4.1	60 gpm	8	5.8	76 gpm	12	7.9	90 gpm	16	**75.3065**	**$899**
SCP 52-35-07	3/4	6.4	63 gpm	13	8.6	76 gpm	22				**75.3067**	**$910**
SCP 55-50-10	1				8.0	77 gpm	20	11	91 gpm	28	**75.3069**	**$931**
SCP 65-30-10	1	6.7	70	10	10.4	91 gpm	18				**75.3071**	**$980**
SCP 42-47-10	1.5				3.2	58 gpm	8	4.4	70 gpm	12	**75.3073**	**$963**

SunPumps SC 24-116 Centrifugal Surface Pump

SunPumps SC 24-116 centrifugal surface pump is the centrifugal section of a convertible jet pump. It will produce 24 gpm at 116 feet of head, operating at 120 VDC. This pump can also be used as either a shallow well or deep-well jet pump with the addition of a jet adapter. This SC centrifugal pump is used as a panel-direct centrifugal booster pump. See the chart for basic sizing or call for a complete system quote. Use with SunPump Control PCB-120 (75.3041).

PSI	Head (feet)	Amps	GPM	Motor watts	PV watts
5	12	5.83	42.4	700	875
10	23	11.3	40.7	1360	1700
20	46	11.2	37.1	1310	1686
50	116	9.9	23.9	1195	1494
65	150	8.3	9.2	998	1248

Model	Item code	Price
SC 24-116	**75.3103**	**$995**

SunPumps Solar Jet Pump

The SunPumps SJT series pump was designed for use in shallow water wells. It has excellent suction lift capabilities and is primarily used to fill open storage tanks. It operates directly on 200-500 watts of solar modules at 60-90 VDC. Use with SunPump Control PCB-90 (75.3035)

60 VDC			75 VDC			90 VDC		
Module watts	Flow rate (gpm)	Pressure (psi)	Module watts	Flow rate (gpm)	Pressure (psi)	Module watts	Flow rate (gpm)	Pressure (psi)
195	15.6	0	356	19.4	0	546	23	0
179	11.1	5	338	16.3	5	513	18	10
155	4.3	10	315	12	10	486	14	15
139	0	12	281	6.5	15	450	9	20
			244	0	19	394	0	27

Model	Item code	Price
SJT 12-40	**75.3117**	**$980**

Please call with any questions! Our contact information is on the cover.

SunPumps SPB Piston Pump

SunPumps SPB series triplex piston booster pumps are high quality, positive displacement piston pumps designed for medium to high heads where flow rates are low to medium but reliability is a must. They are surface-mounted pumps designed to pump from cisterns, lakes, rivers or above-ground tanks. They have good suction lift capability, up to 15 feet at sea level. Sunpumps SPB series triplex pump systems come as a complete

package including the pump, motor, mounting base, pulleys, geared belt and belt guard. These pumps are custom built and tested for your specific application. SunPumps have pumps in operation boosting water as high as 2300 feet vertically. Call for design help.

SunPumps SJ Jack Pumps

SunPumps SJ series jack pumps are either Jensen or JC brand pumping units retrofitted for solar power. They can efficiently pump from wells with a depth of up to 1000 feet. These pumps are custom built and tested for your specific application. Call for more information.

SCB Pressure Booster Pumps

SunPumps SCB series pressure pumps are multi-stage centrifugals designed primarily for boosting pressure from surface water as long as the water supply is above or no more than 3' below the level of the pump. They are ideal pumps for home pressure systems, sprinkler systems or inline booster pumps. SunPumps SCB series pressure pumps are very high quality, maintenance-free, DC pumps specifically designed for stand-alone water delivery in remote locations to be powered from batteries. Allow 2 weeks for delivery.

Capacities in U.S. gallons per hour at discharge pressure or feet of lift (head)																
					20	30	40	50	60	70	80	90	100	110	120	psi
Model number	Item code	Price	Nominal volts	Watts required	46	69	92	116	139	162	185	208	231	254	277	Head in feet
SCB 6-40P-12	75.3130	$988	12	300	510	420	360	240	80							Gallons per hour
SCB 6-40P-24	75.3132	$978	24	300	510	420	360	240	80							
SCB 8-40P-24	75.3134	$988	24	400	590	510	470	400	310	210	70					
SCB 10-40P-24	75.3135	$998	24	600	828	714	582	420	222							
SCB 20-25P-24	75.3137	$978	24	900	1483	949										
SCB 12-60P-48	75.3139	$1145	48	900	930	870	810	770	710	660	600	520	450	360	220	
SCB 22-40P-48	75.3140	$1145	48	900	1860	1560	1300	960	360							
SCB 24-50P-48	75.3141	$1145	48	1600	2226	1996	1740	1466	1140	683						

Flowlight Booster Pump

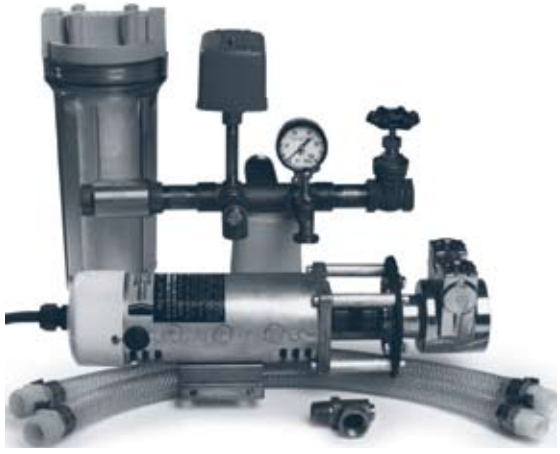
The Flowlight booster pumps provide "town pressure" for home water supplies where 12-, 24- or 48-volt power is available. They have a longer life and greater flow rate than Flojet and SHURflo booster pumps and they use less than half the energy consumed by an AC jet pump running on an inverter.

The Flowlight booster pump will be damaged if it runs dry or is used for pumping rusty or dirty water, so order a filter and dry run switch. To make installation and service easy, flexible hose connectors with ¾" threaded adapters are included. A minimum 40 gallon pressure tank is required for all Flowlight booster pump installations (available locally from a pump supplier).

The standard Flowlight model has the highest flow. Use only where suction lift is less than 10 feet. The low flow model has a higher pressure capacity and should be used where suction lift is greater than 10 feet or where suction pipe is less than 1" inside diameter. Maximum suction lift is 20 feet at sea level for low flow model; subtract 1 foot per 1000 feet in elevation. Use the 120 VAC pump where DC wiring is not feasible, like long wire runs. It has similar high efficiency and low starting surge. It can run on less than a 500 watt inverter. Dimensions: 16.5" in length.

NOTE: Pumps listed 12 or 24 volts may be used with batteries or array-direct. The 36PV/48B pumps can be run PV-direct with a 36V array or from a 48V battery bank. For 120VAC operation order the desired pump and the slowpump AC option.

1-year warranty.



Description	Voltage	Max. gpm	Pressure (psi)	DC amps	Weight (lb.)	Item code	Price
Standard 12V	12 VDC	4.5	30	13.0	15	75.4125	$567
			40	15.0			
			50	16.0			
Standard 24V	24 VDC	4.5	30	6.5	15	75.4127	$567
			40	7.5			
			50	8.0			
Standard 48V	48 VDC	4.5	30	3.5	15	75.4129	$835
			40	4.0			
			50	4.5			
Standard 120VAC	120 VAC	4.5	30	1.5	15	75.4131	$662
			40	1.6			
			50	1.7			
Low flow 12V	12 VDC	3.4	30	10.0	15	75.4121	$546
			40	11.0			
			50	12.0			
Low flow 24V	24 VDC	3.4	30	5.0	15	75.4123	$546
			40	7.5			
			50	8.0			

Accessories for slowpump and booster pump	Weight lbs	Item code	Price
EZ installation kit for booster pump - includes accessory t-fitting, adjustable pressure switch, pressure gauge, check valve, drain valve, shut-off valves and pipe nipples	5	75.4205	$98
Inline filter housing for slowpump and booster (has 3/4" female pipe fittings)	3	78.1125	$35
Filter cartridge for housing above - 5 micron	4	78.1130	$4
Pressure switch - off at 40 psi and on at 20 psi	1	71.4135	$25
Dry run switch for slowpump 1300/1400	1	75.4213	$75
Dry run switch for slowpump 2500/2600 and booster	1	75.4215	$75
30-inch filter foot valve assembly for shallow wells	3	75.4207	$70
Filter cartridge 30-inch for filter assembly above (3-pack)	2	75.4209	$44

Solar Slowpump

The Solar Slowpump can push water as high as 450 vertical feet. It runs on very little power, with or without batteries, to supply between 200 and 2600 gallons of water per day. The positive displacement vane pump mechanism is housed in forged brass, and lasts for years of all-day running. 5-micron filtration is required to protect the pump. For PV-direct (no batteries in system) array, watts must exceed pump watts by 20% or more, and a linear current booster controller is required (page 151). The sizing chart shows the gallon per minute (gpm) output from the pump and power (watts) consumed by the pump for various vertical lifts. (This is the lift from the water level to the top of the tank that the water is pumped to). The performance in the chart is measured at array-direct voltage. The peak power voltage of typical solar modules is 17 volts. A battery powered system will have 15% lower flow and wattage. To estimate gallons per day delivery, multiply gpm figure by 60 and then by the peak sun hours per day in your location. Using a tracker with your solar modules will give you approximately 40%-50% more water in the summer. Slowpumps are available with 1/2 HP motors for greater lift.

NOTE: Pumps listed 12 or 24 volts may be used with batteries or array-direct. The 36PV/48B pumps can be run PV-direct with a 36V array or from a 48V battery bank. Call for price and availability on 120VAC slow pumps.. 1-year warranty.

Description	Item code	Price
Slowpump 1304-12	**75.4155**	**$499**
Slowpump 1304-24	**75.4157**	**$499**
Slowpump 1308-12	**75.4159**	**$499**
Slowpump 1308-24	**75.4161**	**$499**
Slowpump 1310-12	**75.4163**	**$499**
Slowpump 1310-24	**75.4165**	**$499**
Slowpump 1322-12	**75.4167**	**$499**
Slowpump 1322-24	**75.4169**	**$499**
Slowpump 1303-12	**75.4171**	**$499**
Slowpump 1303-24	**75.4173**	**$499**
Slowpump 2505-12	**75.4175**	**$499**
Slowpump 2505-24	**75.4177**	**$499**
Slowpump 2507-12	**75.4179**	**$499**
Slowpump 2507-24	**75.4181**	**$499**
Slowpump 1408-24B	**75.4185**	**$730**
Slowpump 1408-36PV/48B	**75.4187**	**$730**
Slowpump 1404-24B	**75.4189**	**$730**
Slowpump 1404-36PV/48B	**75.4191**	**$730**
Slowpump 1403-24B	**75.4193**	**$730**
Slowpump 1403-36PV/48B	**75.4195**	**$730**
Slowpump 2605-24B	**75.4197**	**$730**
Slowpump 2605-36PV/48B	**75.4199**	**$730**
Slowpump 2607-24B	**75.4201**	**$730**
Slowpump 2607-36PV/48B	**75.4203**	**$730**

Vert. lift	1322		1310		1308		1304		1303		2503		2505		2507	
	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W
20	0.51	27	0.92	29	1.25	30	1.75	37	2.5	48	2.5	48	3.25	52	4	57
40	0.51	32	0.92	41	1.25	48	0	53	2.5	60	2.5	60	3.23	69	3.05	78
60	0.51	36	0.89	46	1.2	54	1.68	64	2.4	78	2.4	78	3.15	90	3.9	102
80	0.49	40	0.88	51	1.2	60	1.64	73	2.3	93	2.3	93	3.1	106	3.9	120
100	0.49	45	0.88	57	1.2	66	0	82	2.3	105	2.3	105	3.08	124	3.85	144
120	0.48	50	0.88	61	1.2	66	1.62	90	2.25	121	2.25	121	3.02	142	3.8	165
140	0.48	56	0.88	66	1.2	75	1.6	100	2.2	138	2.2	138	2.92	166	3.65	195
160	0.47	62	0.87	74	1.2	84	0	112	2.2	153	2.2	153	2.85	187		
180	0.47	68	0.86	82	1.18	93	1.57	122	2.15	165	2.15	165	2.75	205		
200	0.47	74	0.85	89	1.16	99	1.56	133	2.15	180	2.15	180				
240	0.45	90	0.83	105	1.14	117	1.54	152	2.15	204	2.15	204				
280	0.44	102	0.81	120	1.1	135	1.51	175								
320	0.41	120	0.79	138	1.1	153	1.48	196								
360	0.41	134	0.76	154	1.05	171										
400	0.4	150	0.73	176	1	198										
440	0.39	168	0.7	202	1.1	269										

1403		2605		2607	
gpm	W	gpm	W	gpm	W
				4.30	283
		3.35	280	4.25	305
		3.33	296	4.20	338

1408		1404							
gpm	W	gpm	W						
		1.66	255	2.50	338	3.20	410		
		1.62	280	2.50	374	3.16	450		
		1.64	312	2.50	406				
1.1	269	1.66	342	2.50	451				
				2.55	266	3.30	331	4.05	396
				2.50	302	3.25	373	4.00	444

SHURflo 2088 Pressure Pumps

These positive displacement diaphragm pumps make excellent household pressure pumps if you need less flow than the booster pumps on the page 151 deliver. The SHURflo 2088 pumps up to 3.6 gallons per minute, is designed for continuous-duty operation with addition of optional heat sink, and can be run dry without harm. It has a built-in pressure switch and half-inch male pipe-thread ports for easy connection to common plumbing fittings. Home pressurization installation requires a precharged water tank. For general water pumping, this pump can self prime to 10 feet and lift water up 100 feet. The 120-volt AC version can run on a 200-watt inverter and can be 1000 feet from the inverter using 12 gauge wire. Dimensions: 4.45" x 12.4" x 5".

SHURflo part #	Description	Voltage	Max gpm	Pressure (psi)	Flow (gpm)	Current (amps)	Item code	Price
2088-443-144	Standard pump - 3.5 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	12VDC	3.5	10	2.83	5.80	75.5625	$98
				30	2.31	8.00		
				40	2.02	9.10		
2088-514-145	Premium pump with fan cooled motor 3.6 gpm open flow, 45 psi demand switch, 1/2" MSPT ports, splash-proof motor	12VDC	3.5	10	2.9	5.60	75.5613	$155
				30	2.3	8.40		
				40	2.07	9.00		
2088-514-144	High flow pump - 3.8 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	12VDC	3.8	10	3.3	7.90	75.5615	$160
				30	2.5	10.00		
				40	2.2	10.50		
2088-414-534	Premium pump with splash-proof motor 3.6 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	12VDC	3.6	10	2.9	5.60	75.5616	$186
				30	2.3	8.40		
				40	2.07	9.00		
2088-474-144	Standard pump - 3.0 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	24VDC	3	10	2.8	2.41	75.5628	$102
				30	1.75	2.73		
				40	1.25	2.91		
2088-573-534	Premium pump with splash-proof motor 3.6 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	24VDC	3.6	10	3.17	3.10	75.5619	$186
				30	2.63	4.10		
				40	2.34	4.50		
2088-594-154	Standard pump - 3.3 gpm open flow, 45 psi demand switch, 1/2" MSPT ports	120VAC	3.3	10	2.6	0.58	75.5622	$144
				30	2.08	0.76		
				40	1.85	0.94		

SHURflo Pump Accessories

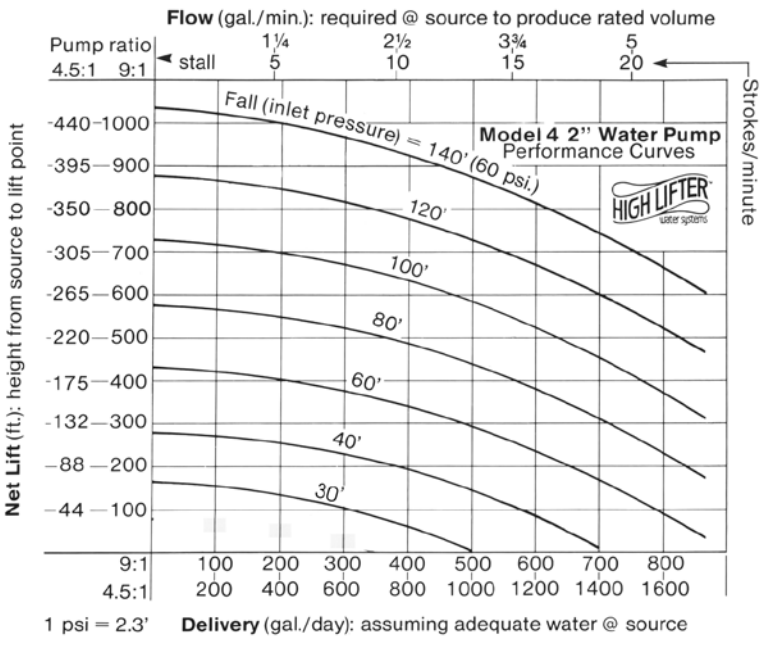
Use the 2-gallon pre-charged pressure tank to extend the life of your SHURflo pump. The tank helps provide a smooth flow in your pumped water system and reduces motor heating and pressure switch wear by decreasing the number of on/off cycles. Internal bladder is precharged to 20 psi.

Adapters fit the straight pipe thread on the 2088 pumps and allow connection of tapered pipe thread fitting. Right angle fittings have wingnut fitting that can be tightened by hand. Straight fitting has a hex nut cast into it.

SHURflo part #	Description	Item code	Price
3400-002	Vertical 2-gallon pre-charged pressure tank - stainless steel with 3/4" male NPT port	75.5730	$130
170-061-20	Twist-on water strainer - 50 mesh screen 1/2" FPST inlet	75.5784	$10
8-035	Adapter with wingnut - right angle 1/2" FSPT to 1/2" NPT for 2088 pumps	75.5735	$2
8-155-01	Adapter with wingnut - right angle 1/2" FSPT to 5/8" barb for 2088 pumps	75.5763	$2
8-205-00	Adapter - straight 1/2" FSPT to 1/2" NPT male for 2088 pumps	75.5760	$2
34-006	5" heat sink for continuous-duty pump operation	75.5766	$24

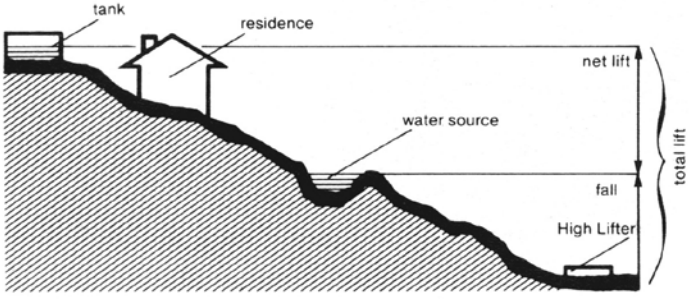
High Lifter Water Powered Water Pumps

The High Lifter is a powerful water pump designed to move water uphill without using gasoline or electricity. By harnessing the energy of piped water pressure from an uphill source, the High Lifter pump can drive a portion of this water through another pipe to a tank higher than the water source. Pistons provide the pumping action and water is the only lubricant used. With adequate water and pressure it can pump up to 1500 gallons of water per day as high as 300 feet, or it can pump 200 gallons per day as high as 1000 feet! It can also pump smaller amounts on as little as one quart per minute of source water, and can pump to lower elevations with as little as a 30-foot drop from the water source. It is self-starting and requires no lubrication, priming, or tuning, and is quiet compared to gas engine pumps. Due to its light weight, ease of installation, and lack of fuel requirements, it is ideally suited for hilly or remote terrain. Simply run a pipe downhill to your High Lifter from a pond, stream, or spring, lay out a pipe to your high tank, and start pumping! Designed to be installed and maintained by the user with basic hand tools, the High Lifter requires little attention other than filter cleaning for years of hardworking service. Depending on how clean the water source is, a High Lifter can operate continuously for 1-3 years between piston replacement service, or even longer if the inlet water is processed through a settling tank to remove grit. The High Lifter is an efficient, economical, and reliable way to handle many water pumping requirements. It can be effectively used for domestic water pumping, garden water supply, irrigation, range cattle, etc. All High Lifter parts are made of stainless steel, Teflon, and acrylic, so they are safe for drinking water. Pump is 26" long. 1-year warranty on materials and workmanship.



As illustrated in the graph, the High Lifter responds to both inlet and output pressure. Because the High Lifter utilizes inlet water pressure to pump water, locating the pump farther down from the water source will yield greater delivery or higher pumping elevations. The higher the upper tank is located, the slower the pump will work. If the upper tank is placed too high, the pump will stall (with no damage to the pump) and no water will be pumped.

To determine how much water will be pumped, find the net lift for either the 4.5:1 or 9:1 pump on the left side of the graph. Move across the graph horizontally to the right until you cross the curve for the fall (inlet pressure). From the point where lift and fall cross, move vertically down to the bottom of the graph and read the "Delivery (gal/day)" for the type of pump being used. To get this delivery amount, the input flow to the pump must be equal to or greater than the "Flow (gal/min)" at the top of the chart in line with the point where the lift and fall lines cross. If the input flow is less than this number, the output will be correspondingly lower.



The picture above shows a typical installation using the High Lifter to fill a tank. Note that "net lift is the vertical distance from the water source to the tank.

Model	Pump ratio	Max output/day	Max net lift	Max total lift	Item code	Price
H44	4.5:1	1500 gal	440 ft.	580 ft.	**76.9002**	**$995**
H49	9.1:1	750 gal	1000 ft.	1140 ft.	**76.9005**	**$995**

EL-SID Brushless Water Circulators

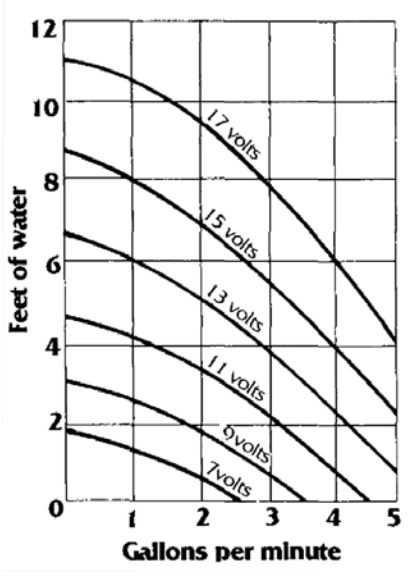
These tiny brushless, magnetic-drive circulators can be driven by PV modules or 12-volt batteries for closed-loop circulation in solar water heating systems, individual space heat zones and individual loop radiant floor loops. Use of several small pumps in a radiant floor system allows each loop to be controlled by a different thermostat. Model SID10 is designed to be powered by a 10-watt PV module, in open loop systems and can pump 3.3 gallons per minute at no head and ½ gpm at 2.5 feet of head at 17 volts input. A 20-watt module should be used for glycol systems. It can circulate water in a well designed solar water heating system with two 4 x 10 collectors. Model SID10B is designed to be battery powered and has the same specifications at 12 volts. Dimensions: 4" x 4" x 5".

30,000-hour life expectancy

Model	Flow (gpm) at no head	Volts (max)	Amps	Weight lbs	Item code	Price
EL-SID 10PV-12	3.3	20	0.9	2	75.7218	$255
EL-SID 10B-12	3.3	16	0.45	2	75.7219	$255

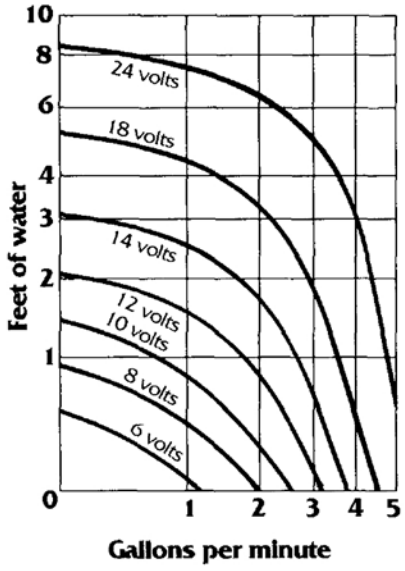
Hartell MD10HEH Circulator

This pump has an electronically commutated, high efficiency brushless motor with a 30,000-hour life expectancy. It may be operated from an 20- to 22-watt solar module or directly from a 12-volt battery system. They work great for closed-loop solar water heating systems and radiant floor heating. The graph shows this pumps performance at various heads and flows, at different input voltages.



Hartell MD3DCL Circulator

This pump has an economical brush-type motor that may be used with a 12- or 24-volt battery system, or directly from an 20-watt 12-volt PV module. It has a 7,000-hour life expectancy. It works well as a circulating pump between a tank and solar collector in a domestic hot water system. It also functions well as a circulating pump in a radiant floor heating system that requires less than 5 gpm of circulation. Brushes last for 3-5 years and are easily replaced without removing pump from plumbing.



Model	Operating voltage	Pipe connections	Dimensions (inches)	Item code	Price
MD-10-HEH	6-16 VDC	1/2" MNPT	5.25 x 9	75.7237	$387
MD-3-DCL	2-24 VDC	1/2" MNPT	5.25 x 7.75	75.7241	$215

Tankless Water Heaters

Since a tankless water heater has neither a storage tank to keep heated all day nor a pilot light, it burns gas only when you need hot water. This eliminates standby heat loss, which can be as high as 3-4% every hour for storage tank water heaters. This higher efficiency can allow you to save up to 50% off your water heating costs. Since there is no tank to fill, there is no end to your supply of hot water. Depending on the model, tankless water heaters deliver between 150 and 500 gallons of hot water every hour on demand. Tankless systems guarantee that an endless supply of water is available to residences, commercial spaces or anywhere a constant source of hot water is needed.

Infinion Tankless Water Heaters

With the Infinion tankless water heater, you'll enjoy constant comfort, conservation and peace of mind with tankless water heating, at a cost you can easily afford. The Infinion is a very simple tankless water heater that does not require electricity so it is ideal for remote cabins, park bathrooms or any locations where power is not available. There are two models which are the same except that one has a standing pilot light and one has a D-cell powered battery spark ignition. The spark ignition model comes with easily replaceable D-cell batteries that last 2 years or more. You get a range of safe, comfortable water heating with dual temperature and capacity controls. The Infinion is carefully engineered, using quality materials but without unnecessary bells and whistles. You get 90 years of tankless water heater experience in the Infinion design. Take advantage of excellent performance in a simple package. Both units have a burner-BTU adjustment knob and a 5-year parts warranty and a 10-year heat exchanger warranty.

Model		C13	C13E
	Ignition type:	Pilot	Spark
Power input	BTU max	105,000	
Flue size	inches	5	
Gas pipe size	inches	1/2	
Water pipe size	inches	1/2	
Min. water flow	gpm	0.66	
120 VAC required		No	
Height	inches	28.13	
Width	inches	14.94	
Depth	inches	10.81	
Weight	lbs	37	
Flow rates			
60°F temp. rise	gpm	2.64	
70°F temp. rise	gpm	1.90	
90°F temp. rise	gpm	0.66	
Item code	**LP gas**	**83.0991**	**83.0995**
Item code	**Natural gas**	**83.0992**	**83.0996**
Price		**$720**	**$895**

Prices subject to change without notice.

Takagi Tankless Water Heaters

These are state-of-the art high-output units featuring pilotless electronic ignition, computerized control, power ventilation, and freeze protection for outdoor or indoor operation down to 10°F. They are very efficient but all of them require AC power for operation. They will consume AC power from the system 24 hours per day.

T-K3 is the most popular Takagi water heater. Takagi's smallest, most versatile and most powerful residential model. Connect up to four units to meet the demands of even the largest homes! The compact T-K3 measures under 14 inches wide to save space. But the T-K3 is also powerful. With Takagi's new easy link technology, the T-K3 will meet the hot-water needs of most high volume residential applications. The T-K3OS is a lower cost, outdoor-only version

T-M1 is the largest Takagi water heater. A unique feature of the T-M1 is its flexibility in large-use applications such as big homes, hotels and motels, apartments and other commercial structures. Up to 20 units can be linked using a single main control system. When installed in this manner, it can replace the space-consuming, inefficient boilers used in most large buildings.

T-K Jr. is the most compact unit in the Takagi line. Designed to produce endless hot water and radiant heating for smaller homes, The T-K Jr. uses the same innovative technology as the original Takagi units – only on an even smaller scale. Takagi water heaters have a 2-year parts only and a 7-year heat exchanger warranty.

	Model:	T-M1	T-K3	T-K3OS	T-KJR
Power input	BTU x1000	235	199	199	140
Flue size	Inches	4	4	4	4
Gas pipe size	Inches	3/4	3/4	3/4	3/4
Water pipe size	Inches	3/4	3/4	3/4	3/4
Min. water flow	gpm	0.75	0.5	0.5	0.75
Max. water flow	gpm	9.6	7.0	7.0	5.8
120 VAC required		Yes	Yes	Yes	Yes
Height	inches	24	20.5	20.5	20
Width	inches	18	13.8	13.8	14
Depth	inches	9	8.5	8.5	6
Weight	lbs	70	40	40	30
Flow rate at a 77°F temperature rise	Flow rates				
	gpm	5	4	4	3
Item code	**LP gas**	**83.1071**	**83.1065**	**83.1068**	**83.1077**
Item code	**Natural gas**	**83.1072**	**83.1066**	**83.1069**	**83.1078**
Price		**$2,590**	**$1895**	**Call**	**$1104**

Model	Description	Fits	Item code	Price
TK-TV01	Wall ventilation terminator	T-KJr, T-K3, T-M1	**83.1092**	**$108**
TK-TV03	Backflow prevention kit	T-KJr, T-K3, T-M1	**83.1093**	**$93**
TK-TV04	Outside install venting cap	T-KJr	**83.1094**	**$60**
TK-TV05	Wall ventilation terminator	T-K3	**83.1095**	**$130**
TK-TV06	Outside install venting cap	T-M1	**83.1096**	**$237**
TK-TV09	Direct vent conversion	T-KJR	**83.1103**	**$102**
TK-TV10	Direct vent conversion	T-K3	**83.1104**	**$102**
TM-RE10	Temperature remote control	T-K3, T-M1	**83.1099**	**$289**
TK-RE02	Temperature remote control	T-KJr	**83.1101**	**$170**

Tankless Water Heater Vents

The Takagi Tankless water heater must be vented in accordance with the section on venting of equipment in the latest edition of the National Fuel Gas Code. This is a Category III appliance, and must be vented accordingly. The following are UL Listed or CSA certified manufacturers: ProTech Systems FasNSeal; Z-Flex Inc Z-Vent II; Heat-Fab Inc Saf-T Vent and Flex-L. They require 4" vent pipe. Connect the vent pipe to the unit so that it is sealed airtight. Follow the vent pipe manufacturer's instructions when installing the vent pipe. Do not common vent this appliance with any other vented appliance.

SunDanzer 12V and 24V Refrigerators and Freezers

Save on system costs with SunDanzer battery-powered solar refrigerators and freezers. These highly efficient units with exceptionally low energy consumption require a smaller photovoltaic (PV) system for your refrigeration needs. SunDanzer units feature 4.33" (110 mm) of polyurethane insulation and coated steel cabinets. The brushless DC motor compressor operates on 12 or 24 VDC. A patented low-frost system reduces frost build-up for low maintenance. SunDanzer chest-style refrigerators and freezers are easy to clean using the drain hole at the bottom of the unit. With thick insulation and a refrigeration system optimized for solar, SunDanzer refrigerators and freezers provide outstanding, economical and reliable operation. SunDanzer cabinets are commercially produced by one of the world's leading appliance manufacturers. 1-year limited warranty.

Model	12/24 VDC models	Ah/day @ 12V			Outside dimensions H" x W" x D"	Weight lbs	Item code	Price
		at 70 F	at 90 F	110 F				
DCR165	165L (5.8 cu ft.) refrigerator	6.5	14	29	34.5 x 36.8 x 26.2	120	**80.2119**	**$949**
DCR225	225L (8 cu ft.) refrigerator	7.5	17	33	34.5 x 46.9 x 26.2	140	**80.2123**	**$1,049**
DCF165	165L (5.8 cu ft.) freezer	23	37	64	34.5 x 36.8 x 26.2	120	**80.2117**	**$949**
DCF225	225L (8 cu ft.) freezer	30	44	68	34.5 x 46.9 x 26.2	140	**80.2121**	**$1,049**

Sun Frost Vaccine Refrigerator

World Health Organization tested & approved. For the past 12 years Sun Frost refrigerators/freezers have been used in more than 50 countries and have an excellent track record. Sun Frost units are very ruggedly constructed and will provide many years of reliable operation, even in the harshest environments. The Sun Frost RFVB provides a means of storing vaccines and medical supplies without the use of fossil fuels. Not only is the need for a fuel supply eliminated, but the unit operates more reliably than kerosene powered refrigerators. The RFVB can freeze 2.2 kg of ice per day, but will use approximately 50% more power than the figures in the chart below. The evaporator in the RFVB is protected by a fiberglass liner and cannot be punctured while defrosting, a common problem in many manual defrost refrigerators. Also contributing to the longevity of the cooling system is the compressor's low percentage of run time, only 19% in a 32° C (90° F) room. The RFVB is the most efficient vaccine refrigerator available. The cost of a solar power system is typically more than the cost of the refrigerator, so efficiency is of prime importance in reducing system costs. 2-year limited warranty. Call for system design help.

Sunfrost model	12/24 VDC models	Ah/day @ 12V		Inside volume cu ft.		Dimensions H" x W" x D"	Weight lbs	Item code	Price
		at 70 F	at 90 F	Refrigerator	Freezer				
RFVB	4 cu ft. vaccine refrig/freezer	13	18	1.8	1.2	31.5 x 34.5 x 27.5	160	**80.2503**	**$1,870**

Servel Americana 400 LP Gas Refrigerator-Freezer

This time proven, 2-door 8 cubic foot refrigerator freezer combination can maintain 6 degree F in the freezer and 39 degrees F in the refrigerator when the outside temperature is 110 degrees F. The refrigerator section is 6.4 cubic feet, and the top freezer section is 1.6 cubic feet. Overall dimensions are 63.5" high, 23" wide, 26.5 " deep. The door openings are reversible. The average gas usage is 1/4 gallon of propane in 24 hours. Piezo lighter and temperature adjustment are accessible on the front without opening door. This refrigerator is *not* AGA approved. Servel offers a 1-year warranty.

Model	Description	Weight	Item code	Price
400W	Servel Americana LP gas refrigerator - white	195	**80.1105**	**$1,410**
400A	Servel Americana LP gas refrigerator - almond	195	**80.1107**	**$1,410**

Prices subject to change without notice.

Sun Frost Refrigerators and Freezers

Sun Frost refrigerators are the most energy-efficient upright refrigerators available. They keep food fresher longer by maintaining high humidity, which prevents freezer burn and wilting caused by water loss in food. Defrosting is seldom needed: frost buildup is extremely slow because water vapor in the refrigerator section from moist room air or food is not transformed into ice. When defrosting is needed, usually once or twice a year, just transfer frozen food to the refrigerator section and turn it off for 30 minutes. Ice quickly falls off the smooth flat surfaces in large pieces.

The Sun Frost refrigerator comes finished on the outside with white laminate, but it can be ordered in natural wood or any of over 100 colors or shades of Formica or Nevamar to match kitchen decor. The spacious, well-lit interior, made from sturdy fiberglass reinforced plastic, is easy to clean. There are no exposed ducts, tubing or hard to reach corners. All of the shelves are adjustable.

The Sun Frost refrigerator should provide well over 15 years of trouble-free operation. The only moving part is a hermetically sealed compressor. The brushless motor used in the DC models eliminates periodic servicing.

Low-voltage DC models: Energy use listed in the table below is for 12 VDC. On 24 VDC systems the same amount of energy is used (half as many amp-hours per day).

When ordering, please specify whether you want the hinge on the left or right. If a color is not specified, the Sun Frost comes in white Formica. (For a different color or a natural wood veneer, add $150.) Sun Frost refrigerators are also available without a finish, with unfinished birch plywood, ready for custom covering by your cabinetmaker. Prices include crating charge. Sun Frost refrigerators are shipped by truck freight. All Sun Frost refrigerators are custom made so delivery times will vary. Call for exact lead time. 2-year warranty.

Model	12/24 VDC models	Ah/day @ 12V		Inside volume cu ft.		Dimensions H" x W" x D"	Weight lbs	Item code	Price
		at 70 F	at 90 F	Refrig	Freezer				
RF19	19 cu ft. 1/2 refrig - 1/2 freezer	62	82	8.07	8.07	66 x 34.5 x 27.5	320	**80.2330**	**$3,160**
R19	19 cu ft. refrigerator only	28	46	16.1	-	66 x 34.5 x 27.5	310	**80.2322**	**$2,719**
F19	19 cu ft. freezer only	100	130	-	16.1	66 x 34.5 x 27.5	320	**80.2314**	**$3,040**
RF16	16 cu ft. refrig / freezer	42	58	10.4	3.91	62 x 34.5 x 27.5	300	**80.2328**	**$2,915**
RF12	12 cu ft. refrig / freezer	24	43	8.07	2.05	49 x 34.5 x 27.5	230	**80.2326**	**$2,129**
R10	10 cu ft. refrig / freezer	15	25	9.13	-	43.5 x 34.5 x 27.5	215	**80.2320**	**$1,640**
F10	10 cu ft. freezer only	55	70	-	9.13	43.5 x 34.5 x 27.5	215	**80.2312**	**$1,745**
RF4	4 cu ft. refrig / freezer	13	19	3.16	0.68	31.5 x 34.5 x 27.5	160	**80.2332**	**$1,530**
R4	4 cu ft. refrigerator only	9	13	9.91	-	31.5 x 34.5 x 27.5	160	**80.2324**	**$1,430**
F4	4 cu ft. freezer only	28	36	-	3.91	31.5 x 34.5 x 27.5	160	**80.2316**	**$1,430**
Model	**120 VAC models**	**kilowatt hours per day @ 120 VAC**		**Refrig**	**Freezer**	**Dimensions H" x W" x D"**	**Weight lbs**	**Item code**	**Price**
RF19A	19 cu ft. 1/2 refrig, 1/2 freezer	0.77	1.0	8.07	8.07	66 x 34.5 x 27.5	310	**80.2427**	**$3,015**
R19A	19 cu ft. refrigerator only	0.35	0.58	16.1	-	66 x 34.5 x 27.5	310	**80.2419**	**$2,775**
F19A	19 cu ft. freezer only	1.25	1.63	-	16.1	66 x 34.5 x 27.5	310	**80.2413**	**$3,068**
RF16A	16 cu ft. refrig / freezer	0.49	0.79	10.4	3.91	62 x 34.5 x 27.5	300	**80.2425**	**$2,867**
RF12A	12 cu ft. refrig / freezer	0.3	0.53	8.07	2.05	49 x 34.5 x 27.5	230	**80.2423**	**$2,129**
Options									
Color finish instead of white - add:								**80.2560**	**$150**
Wood veneer finish - add:								**80.2562**	**$150**
Storage cabinet 24" high w/2 drawers goes under RF12 - white						24 X 34 x 27.5	110	**80.2550**	**$390**
Storage cabinet 13" high w/2 drawers goes under RF16 - white						13 X 34 x 27.5	60	**80.2544**	**$427**
Stand 4" high goes under RF19 - white						4 X 34 x 27.5	25	**80.2556**	**$99**

12V and 24V Remote-Control Ceiling Fans

This is a 42" four-blade ceiling fan with tan or white painted wood blades and a bright brass housing. The 3-speed reversible motor is controlled by infrared remote control and draws 1.2 amps (on 12V models) at high speed, .75 amp at medium speed and .5 amp at low speed. This fan is designed for surface mounting on a flat ceiling. An 8" swivel pendant mount for pitched ceilings is available as an option. They are available for 12- or 24-volt DC operation. CSA/UL approved.

Description	Item code	Price
12-volt ceiling fan 12V 42" white / brass w/ remote	**85.7214**	**$120**
12-volt ceiling fan 12V 42" tan / brass w/ remote	**85.7216**	**$120**
24-volt ceiling fan 12V 42" tan / brass w/ remote	**85.7419**	**$120**
24-volt ceiling fan 12V 42" white / brass w/ remote	**85.7418**	**$120**
Ceiling fan hanging kit - 8"	**85.7425**	**$20**

12V Freedom Fan 124-C

The two-speed Freedom Fan is quiet and efficient. Built in the USA by the Amish, this rugged fan uses only 1.25 amps at low speed and 3 amps at high speed. It has a 12" fan blade protected by a durable plastic housing. Place it on a table and tilt to any angle, or mount it on the wall. Comes with battery clips.

Description	Item code	Price
12-volt 12" Freedom Fan 124-C	**85.8232**	**$156**

RCH Fanworks 42" Vari-Fan

The Vari-Fan can be operated at 12 or 24 VDC. At 24 volts, it moves more air. The Vari-Fan comes with a matte black finish, but it can be easily painted. The main body parts (the black parts) of the Vari-Fan are made from injection molded ABS plastic insuring a lightweight, very durable fan that will stand up to a variety of environments from extreme heat and cold and high humidity to very dry. The Vari-Fan will not corrode, dent, or show minor scratches. The Vari-Fan is a dual mount ceiling fan – close mount or down rod, 4 or 5 blade fan – it's your choice. Everything you need comes in the box with the fan; how you mount it is your decision. Blades are light oak on one side and dark oak on the other side.

RCH Fanworks Vari-Cyclone

The Vari-Cyclone is a high efficiency version of the already very efficient Vari-Fan line of DC powered ceiling fans. The Vari-Cyclone's 60" fan blades, designed by the Florida Solar Energy Center in cooperation with a major fan manufacturer, utilize Gossamer Wind Technology, previously found only in AC powered ceiling fans. In tests conducted by the Florida Solar Energy Center, the 3-blade Vari-Cyclone showed a 22.8% increase in cubic feet per minute (CFM) over the 5-blade, 42" Vari-Fan. 12- or 24-volt operation.

Fan Speed Controls

If you are using a Fanworks fan on 12 volts, you can increase air movement and power consumption with the 85.9169 control, which takes 12 volts and steps it up to 24 volts. The 24-volt input control is for use on 24-volt battery systems. Maximum 1.5 amps.

Description	Item code	Price
RCH Fanworks 42" Vari-Fan 12/24 volt ceiling fan	**85.7445**	**$140**
RCH Fanworks 3-blade 60" Vari-Cyclone white painted	**85.7453**	**$225**
RCH Fanworks 3-blade 60" Vari-Cyclone unpainted	**85.7456**	**$210**
Fan speed control 12V in / 0-24V out with reverse switch	**85.9169**	**$93**
Fan speed control 24V in / 0-24V out with reverse switch	**85.9170**	**$45**

Solar Fan Info

Fans are nearly ideal solar powered loads. They can run directly off DC (as with all of the following products). Solar powered fans run when they are most needed, when the sun is shining. During summer months, your attic temperatures can reach 150°F. High temperatures cause an increase in temperature in the living space and an increase in energy consumption by air conditioning equipment. Forced ventilation will circulate cooler air through the attic space and lower the temperature. Fan and solar module combinations allow daytime ventilation and air circulation anywhere the sun shines. They are great for greenhouses, kennels, barns and attics where AC power is not available. The solar module runs the fan at full power in full sun and at a slower speed in overcast weather. Operation is automatic. When the sun shines on the solar module, the fan begins to operate. The 12" and 16" solar fan kits include fan, solar module and 20 feet of two-conductor wire.

Natural Light Solar Attic Fan

The solar attic fan from Natural Light is a simple and environmentally sensible solution that can save you money. Powered completely by free solar energy, this sleek and efficient vent is both compact and quiet. Fully operational right from the box, it installs easily, with no electrical wiring, no expensive electrician and no city permits. And let's not forget powerful! Operating at a whopping 850 CFM, a single unit can fully vent up to 1200 square feet. Place it wherever you need improved circulation; attics, lofts, workshops, storage sheds, garages, even barns. These attic fans are available with a flush mount solar modules or with a tiltable mount solar module. 5-year warranty.

Description	Item code	Price
Solar attic fan with adjustable module	**85.7077**	**$459**

DC Powered Venturi Fans

These fans have a 3-wing blade mounted in a square steel ring frame style venturi for easy mounting. They can be used on existing battery systems or with other module combinations with up to 30 VDC. The 12" fan fits between 16" on-center studs and delivers approximately 500 CFM at 12 volts and 1200 CFM at 24 volts. The 16" fan fits between 24" on-center studs and delivers 750 CFM at 12 volts and 1800 CFM at 24 volts. 1-year warranty.

Blade diameter	Frame dimensions	Amps (12VDC)	Amps (24VDC)	Weight lbs	Item code	Price
12"	15" x 15"	0.7	2	14	**85.9112**	**$155**
16"	20" x 20"	0.9	2.4	16	**85.9116**	**$170**

Solar Fan Kit

These solar fans include our venturi fan below, a 20-watt solar module with a 20' cord and mounting hardware. The 12" fan will deliver up to 800 CFM, and the 16" fan will deliver up to 1300 CFM when the module is in full sun. The reversible, ball bearing PM motor allows the fan to be used for intake or exhaust by reversing the wire at the motor. 2-year warranty.

Description	Item code	Price
Solar fan kit w/12" fan and 20-watt module	**85.9113**	**$275**
Solar fan kit w/16" fan and 20-watt module	**85.9117**	**$290**

Solar Chill DC Powered Evaporative Coolers

The Solar Chill solar powered evaporative cooling system is available in five sizes and 2 DC voltages (12, and 24 volts DC). The rust-proof housings are built of 304 stainless steel, and use a 6" thick fluted pad as the wet cooling media. This pad is the most efficient evaporative cooling media in the world, and it will last five years with minimal maintenance. SOLAR CHILLs use only 25 to 130 watts! Only 80 Watts for 4500 cubic feet per minute (CFM). Use the 24" or 2-20" if the cooler will be connected to duct work. Optional rheostats may be used to slow fan speed. Optional Control Packages with cleanout pumps are available.

For array direct operation evaporative coolers, use an array with at least the recmended watts and choose a Linear Current Booster on page 151 with the correct amp and voltage rating.

Model	Nominal voltage	Dimensions H" x L" x W"	Fan diameter	Current amps	Recommended PV watts	Air flow (CFM)	Weight lbs	Item code	Price
1412HP	12	18.5 x 19 x 17	14"	3	45 - 65	900	36	**85.6606**	**$695**
1812HP	12	26 X 21.5 X 24	20"	4.4	85 - 130	2400	56	**85.6609**	**$789**
2412HP	12	35.5 X 22 X 36	24"	6.7	110 - 180	4500	110	**85.6611**	**$1,047**
1424HP	24	18.5 x 19 x 17	14"	1.5	45 - 65	1100	36	**85.6623**	**$759**
1824HP	24	26 X 21.5 X 24	20"	2.9	85 - 130	2500	56	**85.6626**	**$829**

Solar Chill Accessories		
Cooler leg kit - galvanized roof mount	**85.6662**	**$30**
Replacement pump - 12 volt	**85.6664**	**$24**
Replacement pump - 24 volt	**85.6666**	**$33**
Evaporative cooler thermostat	**85.6668**	**$28**
5 Minute mechanical timer for cleanout pump	**85.6670**	**$25**
Control box - 6" x 9" x 2.25"	**85.6672**	**$45**
Control pkg - cleanout pump, thermostat, switches, cleanout timer in stainless steel box - 12V	**85.6674**	**$129**
Control pkg - cleanout pump, thermostat, switches, cleanout timer in stainless steel box - 24V	**85.6676**	**$139**
On/off switch for Solar Chill coolers - rated at 15 amps	**85.6684**	**$10**
Variable speed rheostat - 2.5 amp, use with 1224HP and 1624HP	**85.6691**	**$55**
Variable speed rheostat - 3.5 amp, use with 1212HP and 2024HP	**85.6694**	**$60**
Variable speed rheostat - 4.7 amp, use with 2012HP	**85.6695**	**$69**
Variable speed rheostat - 7.0 amp, use with 2412HP and 2-2024HP	**85.6697**	**$75**
Knob for rheostat	**85.6699**	**$5**
Diffuser grill 14 inch	**85.6705**	**$55**
Diffuser grill 24 inch	**85.6709**	**$80**

Thermostats

These thermostats can switch up to 22 amps at 120 VAC and they work fine for up to 10 amps at 12 or 24 VDC. Use them with DC fans to turn the fans on or off as temperature changes. They mount in a standard 2" x 4" electrical box. The attic fan thermostat has single pole contacts that close (turn fan on) as temperature rises. Its adjustment range is 90ºF to 130ºF. When the thermostat reaches the turn-on temperature, it must fall by 15ºF before it will turn off. The heat/cool thermostat has double throw contacts, so it can be used to turn a fan on as the temperature rises or as it falls, depending on how it is wired. Its range is 50ºF to 90ºF and its differential is 2ºF.

Description	Range	Item code	Price
Attic fan thermostat	90°F to 130°F	**85.8036**	**$35**
Heating and cooling thermostat	50°F to 90°F	**85.8032**	**$30**

Prices subject to change without notice.

12V & 24V Medium-Base Bulbs

These low-cost bulbs are the least efficient of all lamps that we sell, but they are still more than 30% more efficient than 120-volt lamps. They have a standard medium base, so they fit into standard sockets found in most 110 VAC fixtures. AC lamp sockets rated for up to 300 watts at 110 VAC can usually handle up to 50 watts at 12 VDC. Use 600-watt rated sockets for 100-watt 12-volt bulbs. 300-watt rated sockets are good for 100 watts at 24 volts.

Volts	Watts	Length	Item code	Price
12	25	4"	**66.0025**	**$2**
12	50	4"	**66.0029**	**$2**
12	75	5"	**66.0033**	**$4**
12	100	5.5	**66.0037**	**$4**
24	25	4"	**66.0139**	**$5**
24	50	4"	**66.0143**	**$5**
24	100	5.5	**66.0147**	**$9**

12V Candelabra Base Lamps

The 6-watt miniature screw or "candelabra" base bulbs look

like regular nightlight bulbs The 15-, 25- and 40-watt bulbs have a decorative candle flame shape.

Volts	Watts	Length	Item code	Price
12	6	1.75"	**66.0061**	**$1.85**
12	15	3.5"	**66.0065**	**$2.50**
12	25	3.5"	**66.0069**	**$2.50**
12	40	3.5"	**66.0073**	**$2.50**

12V MR-16 Flood Lamps

Tungsten-halogen bulb with a multifaceted dichroic reflector provides sharp, clean light and excellent color rendition. These bulbs have a GX5.3 2 pin base and will fit a medium base socket when used with the MR-16 adapter. These lamps have a glass cover over the halogen lamp to prevent damage from splashed water or human contact.

Volts	Watts	Item code	Price
12	20	**66.1332**	**$4**
12	35	**66.1334**	**$4**
12	50	**66.1336**	**$8**

Halogen Bi Pin Lamps

These tiny halogen lamps are very bright. They are recommended for locations where they will not get wet or be looked at directly.

Volts	Watts	Item code	Price
12	20	**66.1310**	**$4**
12	50	**66.1314**	**$4**
24	20	**66.1311**	**$4**
24	50	**66.1315**	**$5**

GX5.3 to Medium Base Adapter

This adapter allows 12-volt MR-16 reflector lamps and halogen bi-pin lamps to be used in any standard medium-base socket powered by 12 volts. Lamps plug into holes in adapter. A tight friction fit allows adapter to be used safely with lamp pointing downward.

Description	Item code	Price
Medium-base adapter	**66.1340**	**$9**

Dr. LED Mars Dome

The Mars Dome is a general purpose, surface-mount, two-level white-LED light fixture. These lights produce a warm white light and are fabricated from the highest quality components to assure long life and trouble-free function. Their patented internal circuitry provides consistent brightness and makes them immune to life-shortening voltage fluctuations. Their incredibly low power draw makes them the perfect way to reduce energy consumption in your RV, boat or solar off-grid cabin. The three-position switch lets you choose off, 0.09A on low and 0.18A on high. Internal circuitry provides for constant current consumption, regardless of voltage fluctuations from 11 to 15 VDC. 5.5" diameter chrome flush mount fixture.

Description	Item code	Price
Mars dome 2-level 5.5" LED fixture	**66.4270**	**$80**

Luxeon 12V LED Flood Lamp

Screw-in. Notice wide light spread angle. Luxeon new technology is too bright to look directly into. Has internal voltage regulator for constant full brightness with varying battery voltage.

Description	Amps	Item code	Price
Luxeon LED flood	0.2	**66.4107**	**$55**

12V LED Cabin Light

This high-efficiency, wall-mount 12-volt light has an adjustable swivel that puts the light where you want it. It has a push button on/off switch and three ultra-bright white LEDs. All parts are plastic. Power consumption is only 30mA, less than 1/2 watt!

Description	Watts	Item code	Price
LED cabin light	0.5	**66.4503**	**$32**

Dr. LED Lamps

Unique, cutting-edge internal circuitry and the highest quality components make Dr. LED lamps the longest lasting, most energy efficient LED products on the market. These high quality, general purpose bulbs produce a warm, white light, and are the perfect way to reduce energy consumption in your boat, or even your home. They have a long service life, are shock proof, and UV-, lead- and mercury-free. They produce a spot-type beam and are best used in directional light fixtures.

The eBulb

This high quality Par-20 36 LED bulb produces a warm, slightly golden white light, and is the perfect way to reduce energy consumption in an off-grid home. It has an extra long service life, is shock proof, and UV-, lead- and mercury-free. This bulb best used in directional light fixtures such as desk lamps.

PAR16-24

This medium screw-base lamp has 24 LEDs per bulb (equivalent to 48 ultra-bright LEDs). Its soothing warm white (~3200K) spot seems like a 30W lamp within the main beam and is good enough to read a book.

MR16 LED Bulb

This high quality bulb produces a cold, bluish white light. It is designed to replace MR16 halogen lamps in track lighting and similar fixtures that use a twin-pin connector bulb working at 12 volts.

All Dr LED products feature a one-year warranty.

Description	Amps	Diameter	Length	Item code	Price
Par20 36 LED eBulb	0.3	2.0"	4.13"	**66.4232**	**$40**
Par16 24 LED lamp	0.12	2.0"	2.0"	**66.4238**	**$30**
MR-16 24 LED lamp	0.12	2.0"	2.0"	**66.4251**	**$30**

EverLite Solar LED Spotlite

This is a high-tech solar spotlight with eight ultra-bright, 50,000 mcd white LEDs and a built-in nickel-metal hydride battery pack. The lightweight 2 pound EverLite is ideal for camping, backpacking or other outdoor activities. It operates 24 hours or more from its fully-charged battery and provides 12 hours of light output from about 3 hours of charging in full sun or 10 hours of gray overcast sky. The solar panel sits on the ground or can be mounted to almost any surface. It connects to the light with a 15-foot detachable cord that can be disconnected to make the light portable. EverLite's waterproof design makes it suitable for outdoor use. The lamp turns off when you fold it down into the closed position. When unfolded, it automatically turns on at dusk and turns off at dawn.

The compact Everlite has the same bright light with half the battery and charging capacity. It runs for 12 hours on a full charge and provides 6 hours of light output from about 3 hours of charging in full sun.

Optional chargers include a 12VDC charger with a cigarette lighter plug, a 12-volt hard-wire kit for permanent connection to a 12-volt battery system, and a 120VAC charger. All of the optional chargers plug into the same jack as the solar module.

Other optional accessories allow the EverLite battery pack to charge cell phones and other portable devices. The 12-volt converter has a cigarette lighter receptacle to plug in a standard cell phone car charger. The 5-volt converter can recharge or operate your personal CD player, electronic game, iPod or PDA, and comes with 6 different DC plug styles that will fit most handheld electronic devices.

EverLite has a 2-year replacement warranty for any defects in parts or workmanship.

EverLite part #	Description	Item code	Price
EL-6D	EverLite solar spotlight	**66.7144**	**$78**
EL-6C	EverLite compact solar spotlight	**66.7146**	**$60**
EA-3	AC charger	**66.7149**	**$11**
EA-4	12-volt charger	**66.7147**	**$11**
EA-5	12-volt hard-wire charger	**66.7151**	**$11**
EA-1	12-volt converter	**66.7152**	**$19**
EA-2	5-volt converter	**66.7153**	**$19**
AF-1	Nylon travel case	**66.7155**	**$19**

12V LED Rope Light

This long-life high-intensity LED rope light uses 0.96 watts per foot and has an LED every inch. It can be cut to length. A maximum of 80 feet can be used before dimming is noticeable. Dimensions are 10.5mm x 12.5mm (0.41 inch x 0.4 inch) and we can supply up to 150 feet in one length. Order the number of feet required and a power cord, connector and end cap.

Description	Item code	Price
12-volt white LED rope light - per foot	**66.4062**	**$20**
Rope light end cap	**66.4067**	**$3**
Rope light power connector	**66.4069**	**$3**
Rope light 6-foot power cord	**66.4068**	**$4**

Osram Co-Pilot Halogen Lights

These 12-volt, 5-watt lights have a flat black finish with a flexible arm and focused reflector. The lights use very little power but focus a large amount of quality light in a small area. They are great for reading and hand tasks. The base is designed to be permanently mounted to the work surface with two screws or plugged into a cigarette lighter plug in the case of the 7" model.

Description	Item code	Price
Copilot 20" 5W 12V	**66.1285**	**$30**
Copilot 12" 5W 12V	**66.1288**	**$30**
Copilot 7" 5W 12V w/ lighter plug	**66.1291**	**$28**
5W replacement bulb	**66.1328**	**$7**

Low-Voltage Compact Fluorescent Lamps

CFL (Compact Fluorescent Lamps) lighting provides very high illumination levels with an 80% savings in power consumption over incandescent lamps. These high quality DC lamps are designed to be used in 12-volt and 24-volt battery systems. Cool-white 6400°K lamps provide a bright blue-white glow. Warm-white 2700°K lamps provide a light similar to incandescent lamps. The life span of the lamp is more than 6,000 hours. A special electronic circuit guarantees more than 50,000 switching cycles. The lamps have a standard E27/Edison socket. 2-year warranty.

Nominal voltage	Lamp type	Watts	Color temperature	Dimensions L" x dia."	Item code	Price
12	Spiral	7.5	2700K	4½ x 1¾	**66.2131**	**$14**
12	Spiral	11	2700K	4½ x 1¾	**66.2138**	**$14**
12	Spiral	11	6400K	5 x 2¼	**66.2139**	**$14**
12	Spiral	15	2700K	5 x 2¼	**66.2150**	**$20**
12	Spiral	15	6400K	5 x 2¼	**66.2152**	**$20**
12	3 U tube	30	2700K	8 x 3	**66.2172**	**$35**
12	3 U tube	30	6400K	8 x 3	**66.2170**	**$35**
24	Spiral	15	2700K	5 x 2¼	**66.2261**	**$20**
24	Spiral	15	6400K	5 x 2¼	**66.2263**	**$20**

Thin-Lite Low Voltage Fluorescent Lighting

Thin-Lite 12- and 24-volt fluorescent fixtures are both efficient and attractive. Anodized aluminum housing and clear acrylic diffuser lenses provide high light output on three sides. They are designed for commercial and industrial vehicles, and for use in remote area housing, schools and medical facilities in conjunction with alternative sources of energy. Comes with tube and ballast. Some models come with a switch on the side. These fixtures use the same standard fluorescent tubes as AC fluorescent fixtures. Replacements can be purchased locally. 1-year warranty.

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957

Thin-Lite model	Fluorescent tube watts	# of tubes	Lumens	Volts	Amps	Switch	Dimensions L" x W" x D"	Item code	Price
193	15	1	870	12	1.3	yes	18 x 2.25 x 2.44	**66.2431**	**$35**
194	15	2	1740	12	2.1	yes	18 x 4.5 x 1.5	**66.2439**	**$48**
181	20	1	1250	12	1.6	no	24 x 3.63 x 3.5	**66.2435**	**$47**
957	36	1	2618	12	2.45	no	18.9 x 4.5 x 1.5	**66.2441**	**$62**
281	20	1	1250	24	0.8	no	24 x 3.63 x 3.5	**66.2464**	**$55**

12V Fluorescent Outdoor Flood Light

These weatherproof lights are designed to meet the demand for solar powered sign lighting and area lighting. They have ½" male pipe thread mounts and can be used for up lighting or down lighting. They use an electronic ballast that will operate down to -20 º F. Replacement fluorescent tube is S/E 13-watt tube. This light uses 1 amp at 12VDC.

Description	Watts	Item code	Price
12V fluorescent flood	13	**66.2478**	**$75**

12V Low-Pressure Sodium Outdoor Light

These are 12 volt versions of common LPS street lights. Low pressure sodium give the most lumens per watt of power consumed, but the light is an orange-pink color.

Cast aluminum housing has a vandal resistant polycarbonate diffuser. A wall or wood pole mount bracket is included. Warm-up time is 7 to 10 minutes. Also has a photocell and a 1 to 15 hour adjustable timer may be used or by-passed. Weight is 6.30 lbs (2.857 kg)

Model	Watts	Lumens	Item code	Price
LPS-118LT	18	1800	**66.5818**	**$380**
LPS-135LT	35	4800	**66.5821**	**$380**

American Solar Electric Solar Coach Light

The Solar Coach Light is a commercial solid metal light fixture with integrated solar modules, designed to light streets and yards. It has 42 powerful extra-bright LEDs, 18 watts of charging solar modules, a automatic on/off light sensor and a 12-volt, 12 amp-hour sealed battery. This is no garden light ! The Solar Coach Light will stay on over 30 hours (that's 2-4 nights depending on time of year) without sunlight charge. The solar modules are guaranteed for 10 years and are made of tempered glass, Monocrystalline and Tedlar lamination (just like large commercial-grade modules). The battery should last 1 - 3 years depending on temperature and the LEDs 30,000 hours. It was originally designed for Las Vegas and the southwestern states to replace the resource-wasting gas lights that are sold by the gas company and remain on 24 hours per day. When gas was cheap, the idea of burning the lamps day and night seemed acceptable, but now with higher natural gas prices, it has become very costly.

Description	Item code	Price
Solar Coach Light	**66.4581**	**$1,240**

Xantrex PowerHub 1800

The Xantrex PowerHub is designed with the do-it-yourselfer in mind. The PowerHub is an inverter/battery charger combination with an attached battery box for two 100 amp-hour 12-volt batteries. One or two battery boxes can be attached to the PowerHub.

The PowerHub with two fully charged 100 Ah batteries can deliver up 950 watt-hours of electricity to run small appliances in a weekend cabin or during a power failure. The PowerHub allows batteries to be recharged with a small wind generator and/or PV systems, with a gas generator or with utility power. It does not have a built-in charge controller for PV modules but it has two DC charging inputs, one at 32 amps maximum, labeled PV and one at 80 amps labeled wind. Both could be used for PV with the addition of a charge controller. The 80-amp input is suitable for an AirX wind turbine (page 54) which has a built-in regulator.

When AC power is available from a generator or utility grid, the PowerHub will function as an automatic backup power unit. It will sit in bypass mode and will pass the power through to support the loads and/or the battery charger. When AC power is connected to the unit, input from wind or solar will not be used for powering the loads. When the AC input fails, the PowerHub's automatic transfer relay de-energizes and will switch the unit to inverter mode within 40 milliseconds.

Once AC input is restored, after a 20-second delay the relay energizes and qualifies the AC input and the load is automatically reconnected to the primary AC source.

When no AC power is available from a generator or utility grid, the inverter draws power from the battery bank and delivers a modified-sine wave AC output voltage. This output voltage can be accessed by using the four outlets on the front of the unit or by hard wiring the unit to the AC distribution panel which provides AC power to AC outlets at the site.

The inverter control panel provides a user interface for monitoring power levels, battery levels, and controlling the inverter functions and displays. Four 120VAC outlets on the front panel provide up to 1440W (continuous) output power. One 15 A supplemental protector provides over-load protection to the four AC outlets on the front panel. 1 year warranty.

Xantrex model	Description	Item code	Price
PH1800-GFP	Xantrex PowerHub 1800	**30.0018**	**$899**
PH1800-UL	Xantrex PowerHub 1800 with ground fault protection	**30.0020**	**$899**
PH1800-BBX	Xantrex PowerHub battery box	**30.0023**	**$150**

Xantrex XPower 1500 Powerpack

The XPower Powerpack 1500 is a portable power system that can supply up to 1500 watts of household electricity. It consists of a battery pack that stores electrical energy, an inverter that converts 12 volts from the battery pack to household power, two standard AC outlets, and a DC power outlet that is used to run 12-volt products. These components are packaged into a rugged cart with a removable waist handle that allows XPower Powerpack 1500 to be wheeled from room-to-room or outdoors over rough terrain. Recharge XPower from a standard wall outlet with the included AC charger or recharge from your car, truck or RV with the included DC charging cable. Battery capacity is 60 Ah. 1-year warranty.

Xantrex XPower Powerpack 300Plus

Powered by a rechargeable battery, the XPower Powerpack 300Plus provides up to 300 watts of AC power and can jump-start a car, truck, boat or small RV. It can also operate a wide range of 12-volt automotive and marine products. Ideal for power emergencies, XPower Powerpack 300Plus comes with a built-in fluorescent emergency light and jump-start cables. The 20 amp-hour battery will power a cordless telephone for up to 40 hours, a laptop computer for six hours, and a portable stereo for 17 hours. The fluorescent light that comes with it will run for up to 25 hours on a fully charged battery. Recharge XPower from a standard wall outlet with the included AC charger. 1-year warranty.

Description	Item code	Price
XPower Powerpack 1500	**30.1518**	**$370**
XPower Powerpack 300 plus	**30.1513**	**$130**

Xantrex XPower Mobile-Plugs

The XPower Mobile Plug 75 is the smallest inverter on the market today. It incorporates high-frequency technology to convert power from a vehicle's battery (12-volt DC) into standard utility power (120-volt AC, 60 Hz) through a single, three-prong outlet. By plugging the XPower Mobile Plug 75 into a vehicle's lighter socket, users can recharge and run electronic devices such as cell phones, camcorders, and most laptop computers and PDAs - without the need for multiple adapters. It will run 75 watts for 5 minutes and 60 watts continuously. The XPower Mobile Plug 175 is a higher power version with a 175-watt output. 1-year warranty on both units.

Xantrex Pocket Inverter 100

The XPower Pocket Inverter 100 utilizes advanced electronics to convert 12-volt DC battery power from a vehicle or airplane into 115-volt household AC electricity. So if your laptop battery runs down, you can just plug straight into the AC outlet on the inverter and keep working away, just like you're at home. In addition to the AC power outlet, this inverter includes a USB charge port which can power or charge iPod, Blackberry, iPaq, Palm and a wide range of other 'can't live without' electronic devices. The thinnest inverter on the market today, and only 0.5 pounds, makes it easy to fit inside even the most overburdened carry-on or laptop bag. With the integrated vehicle and airline connector you can keep your iPod music flowing, your cell phone charged and your laptop running nearly anywhere you're on the go. 1-year warranty.

XPower Pocket Powerpack 100

The XPower Pocket Powerpack combines a 100W inverter with a high capacity, high output battery pack to create a truly mobile power solution. If your laptop battery runs down, or you need five more minutes with your portable DVD player, you can just plug straight into the AC outlet on the inverter and keep working or watching, just like you're at home. In addition to the AC power outlet, this inverter includes a USB charge port which can power or charge iPod, Blackberry, iPaq, Palm and a wide range of other electronic devices. The XPower Pocket Powerpack comes with a DC cable with vehicle and airplane connector and a 3.3 Ah NiMh battery pack. 1-year warranty.

NEW! XPower Digital Micro 400

120 VAC/60 Hz portable power for mobile offices

Designed to power electronics while on the go, these new compact digital inverters combine innovative industrial design with an advanced interactive LED display. This provides the user with instant feedback on input current and output voltage and valuable troubleshooting guidance through Fault Codes. With a power rating up to 400 watts, this new digital inverter provides a convenient and powerful way to access AC power. 1-year warranty.

Description	Item code	Price
XPower Mobile Plug 75	**30.0075**	**$30**
XPower Mobile Plug 175	**30.0081**	**$45**
XPower Pocket Inverter 100	**30.0069**	**$50**
XPower Pocket Powerpack 100	**30.0071**	**$119**
XPower Digital Micro 400	**30.0096**	**$30**

Nickel Metal Hydride Batteries

NiMH batteries have up to twice the power of nickel-cadmium rechargeable batteries, can be recharged or topped off anytime, and don't have the memory effect. Their only drawback is all NiMH self discharge about half their energy in two months without use. They are best used in devices that use up batteries quickly, like digital cameras, portable entertainment devices and flashlights in constant use. They can be recharged about 500 times and last for years. Unlike nickel-cadmium batteries, nickel metal hydride batteries do not contain toxic substances.

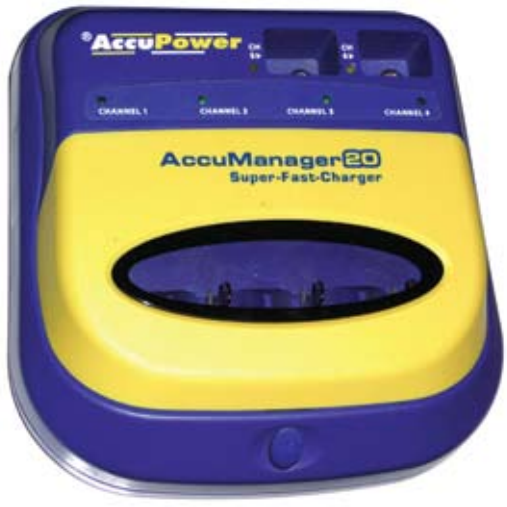
Description	Item code	Price
Nickel metal hydride AAA cell 750 mAh	**87.2019**	**$1.60**
Nickel metal hydride AA cell 2200 mAh	**87.2021**	**$2.20**
Nickel metal hydride C cell 4500 mAh	**87.2022**	**$8.00**
Nickel metal hydride D cell 9000 mAh	**87.2024**	**$11.00**

QuickCharger

The QuickCharger sets a new standard in battery chargers for today's ultra-high capacity NiMH and NiCad batteries. Ordinary chargers are not able to charge NiMH and NiCads to their full capacity, and often generate heat while charging that shortens the life of the battery. The QuickCharger's sophisticated internal computer charges your batteries quickly without overheating. NiCad batteries can be automatically discharged prior to charging to improve capacity and life. The computer also uses a trickle charge on fully charged batteries so the batteries can sit in the charger until you need them. It can recharge up to four D, C, AA, AAA batteries, analyze batteries for their charge and capacity, and it rejects damaged batteries. Negative pulse charging and Intelligent Discharge System (IDS) prevents memory effect and overcharging. Soft start function prevents overheating of battery, helping extend battery life. The QuickCharger can fully charge 2 AA nickel metal hydride batteries in about 2-1/2 hours. This charger is powered by 120 VAC through a wall transformer (included) with a 12VDC output and can easily be adapted to operate from 12VDC.

Description	Item code	Price
Quick charger Ni Cad/NiMH	**87.2219**	**$50**

AccuManager 20 Fast Charger



This new super-fast charger from AccuPower can be powered by AC power or 12 VDC from a car cigarette lighter outlet and will charge nickel-cadmium, nickel-metal-hydride and rechargeable-alkaline batteries at the same time. One to four AAA, AA, C, D and two 9V batteries can be charged in any combination of sizes and battery chemistry at the same time.

The AccuManager20 automatically recognizes each battery type and charges them separately.

Description	Item code	Price
AccuManager20 charger	**87.2216**	**$65**

Soltronix Headphone Radio

The Soltronix headphone radio is a solar recharging AM/FM headphone radio with superb sound. The solar module allows it to operate on just solar power in as little as thirty percent of full sunlight. Additional power generated goes to charging the battery while the headphones are still operating! When the headphones are off, all power generated by the module goes to charging the included NiMH battery. One hour of charging in bright sunlight in a windowsill gives 1-2 hours of play time, and a fully charged battery provides over 18 hours of play time. The user benefits both from the savings and convenience of not having to change batteries.

Description	Item code	Price
Soltronix headphone radio	**87.0136**	**$40**

Voltaic Solar Bags

Voltaic solar bags are mobile power generators, designed to charge your devices without tying you to a power outlet, which makes them ideal for traveling. Just plug a standard car charger into the bag and recharge most small electronic devices including: cell phones, cameras, two-way radios, PDAs, and MP3s. Note: Voltaic solar bags are not designed to charge laptops.

If you don't have a car charger, the bags come with a set of 11 standard adapters for common cell phones and other devices. We also offer a full range of optional adapters.

Embedded in the outside of all bags are three lightweight, tough, waterproof solar panels which generate up to 4 watts of power. included with each bag is a Li Ion battery pack which stores any surplus power generated, so it is available when you need it – not just when the sun is up. The battery pack can also be charged using an AC travel charger or car charger (both included). This makes the Voltaic bags just as useful on the grid as off.

Voltaic Backpack

The Voltaic Backpack is built tough for use as a weekend hike bag or as a large daypack. There are pockets and wire channels for multiple electronic devices and 1,850 cubic inches of storage space. It features high density padding in the shoulder straps and back panel for comfort, nylon mesh backing material for better air flow, an adjustable phone / MP3 pouch on the shoulder and a second lined MP3 / sunglasses pouch inside. The solar panels provide protection for fragile items inside the front pocket and wire channels throughout the bag take power to the shoulder strap and for headphones etc. It weighs 3.5 lbs (1,590 grams) including battery and solar panels and its dimensions are 20" high x 10-15" wide x 7-10" deep (51cm high x 25-38cm wide x 18-25cm deep).

Voltaic Daypack

The Voltaic Daypack has the same solar panels, battery and electronics pockets and wire channels for multiple electronic devices as the Backpack. With 1,500 cubic inches of storage space, it is slightly smaller. It is constructed of 840D nylon, weighs 3.5 lbs (1,590 grams) and measures 18" high x 10-13" wide x 6-9" deep (46cm high x 25-33cm wide x 15-23cm deep).

Voltaic Messenger

The Voltaic Messenger is reinforced and padded to carry and protect a laptop. It has large zipped pockets for documents, and multiple small pockets for electronic devices. Ideal for use in town or as a travel bag. It features an adjustable padded laptop sleeve, for laptops with up to a 15" screen (14" x 10" x 2"), oversized nylon zips for extra strength and a padded adjustable shoulder strap. The solar panels provide protection for fragile items inside the front pocket. It weighs 3.25 lbs (1,500 grams) including battery and solar panels. Dimensions are 14.5"x11.5"x 4-5.5" (37x29x10-14cm).

Voltaic Converter

The Voltaic Converter is designed to attach to a larger rucksack to provide power for extended outdoor use. I also stands alone for use as a small daypack and laptop bag. It features a lined MP3/ sunglasses pouch inside, loops with removable fastek buckles to attach to another bag and serve as an anchor point and MOLLE-compatible PALS for attachment to military-style rucksacks. It can be worn as a backpack or sling bag. Its shoulder straps can be stashed in back sleeve when not in use. It is big enough to carry a laptop with a 15" screen (14" x 10" x 2" or 35cm x 25cm x 5cm). Wire channels throughout the bag for headphones, bladder tubes or hands free phone kit make this bag very useful. It weighs 2.9 lbs (1,300 grams) including battery and solar panels. Its dimensions are 17" high x 10-12" wide x 3-4" deep (43cm high x 25-30cm wide x 7-10cm deep). Volume is 600 cubic inches (10 liters).

Model #	Description	Item code	Price
1001	Backpack	**87.2501-x**	**$249**
1002	Daypack	**87.2502-x**	**$239**
1003	Converter	**87.2503-x**	**$199**
1004	Messenger	**87.2504-x**	**$229**

Replace the x with solar module trim color.
-S for silver, -O for orange, -G for green, -C for charcoal

Maximum Ampacities for Wire

The table to the right shows allowable ampacities of conductors (wires) in conduit, raceway, cable or directly buried, based on ambient temperature of 30°C (86°F). National Electrical Code (NEC) allows rounding up cable ampacity to next size standard fuse or breaker.

For ambient temperatures above 30°C (86°F), multiply the allowable ampacities shown at right by the correction factor listed under the insulation temperature rating below.

Temperature Range		75°F insulation	90°F insulation
31-35°C	87-95F	0.94	0.96
36-40°C	96-104F	0.88	0.91
41-45°C	105-113F	0.82	0.87
46-50°C	114-122F	0.75	0.82
51-55°C	123-131F	0.67	0.76
56-60°C	132-140F	0.58	0.71

Wire Size	Copper conductor temp. rating		Aluminum cond. temp. rating	
	75°C (167°F)	90°C (194°F)	75°C (167°F)	90°C (194°F)
*14	20	25		
*12	25	30	20	25
*10	35	40	30	35
8	50	55	40	45
6	65	75	50	60
4	85	95	65	75
2	115	130	90	100
1	130	150	100	115
1/0	150	170	120	135
2/0	175	195	135	150
3/0	200	225	155	175
4/0	230	260	180	205

NEC specifies that the overcurrent protection device not exceed 30A for 10 AWG wire, 20A for 12 AWG wire and 15A for 14 AWG wire.

Recommended Inverter Cable and Overcurrent Protection

Use this table to decide cable size and fuse or breaker size for common inverter models. Smaller cable sizes can be used if fuse or breaker size is reduced but this can cause problems if the inverter is run near its maximum output wattage. Larger cables may be necessary if the distance from the inverter to the battery is greater than 10 feet.

We stock battery-to-inverter cables in #2, 2/0 and 4/0 AWG.

Inverter voltage	Continuous watts	Maximum inverter input amps	Fuse size (amps)	Circuit breaker (amps)	Wire size AWG
12-volt	600	80	80	80	2
	800	107	110	110	2
	1000	134	200	175	2/0
	1500	200	300	250	4/0
	2400	320	400	250	4/0
	2500	334	400	250	4/0
	2800	382	400	250	4/0
	3000	400	400	250	4/0
24-volt	600	40	50	50	8
	800	54	75	75	4
	1000	67	80	100	2
	1500	100	110	110	2/0
	2400	160	200	175	2/0
	2500	167	200	175	2/0
	3000	200	300	250	4/0
	3500	230	300	250	4/0
	4000	265	300	250	4/0
48-volt	3000	76	110	110	2/0
	3600	90	110	110	2/0
	4000	148	200	175	2/0
	5500	185	400	250	4/0

Wire Loss Tables - 12V and 24V

Use these tables to determine the maximum distance one-way in feet of various gauges of two-conductor copper wire from power source to load for 2% voltage drop in 12-volt and 24-volt system wiring. You can go twice the distance where a 4% loss is acceptable. Do not exceed the 2% drop for wire between PV modules and batteries. A 4% to 5% loss is acceptable between batteries and lighting circuits in most cases. Note that if you change an array from 12 volts to 24 volts and the wattage remains the same, then the current is cut in half. This allows you to go 4 times as far with the same wire gauge with the 24-volt array as you could with the 12-volt array.

12-volt system – 2% voltage drop										
AMPS	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#2**	**1/0**	**2/0**	**4/0**
1	45	70	115	180	290	456	720			
2	22.5	35	57.5	90	145	228	360	580	720	1060
4	10	17.5	27.5	45	72.5	114	180	290	360	580
6	7.5	12	17.5	30	47.5	75	120	193	243	380
8	5.5	8.5	15	22.5	35.5	57	90	145	180	290
10	4.5	7	12	18	28.5	45.5	72.5	115	145	230
15	3	4.5	7	12	19	30	48	76.5	96	150
20	2	3.5	5.5	9	14.5	22.5	36	57.5	72.5	116
25	1.8	2.8	4.5	7	11.5	18	29	46	58	92
30	1.5	2.4	3.5	6	9.5	15	24	38.5	48.5	77
40			2.8	4.5	7	11.5	18	29	36	56
50			2.3	3.6	5.5	9	14.5	23	29	46
100					2.9	4.6	7.2	11.5	14.5	23
150							4.8	7.7	9.7	15
200							3.6	5.8	7.3	11

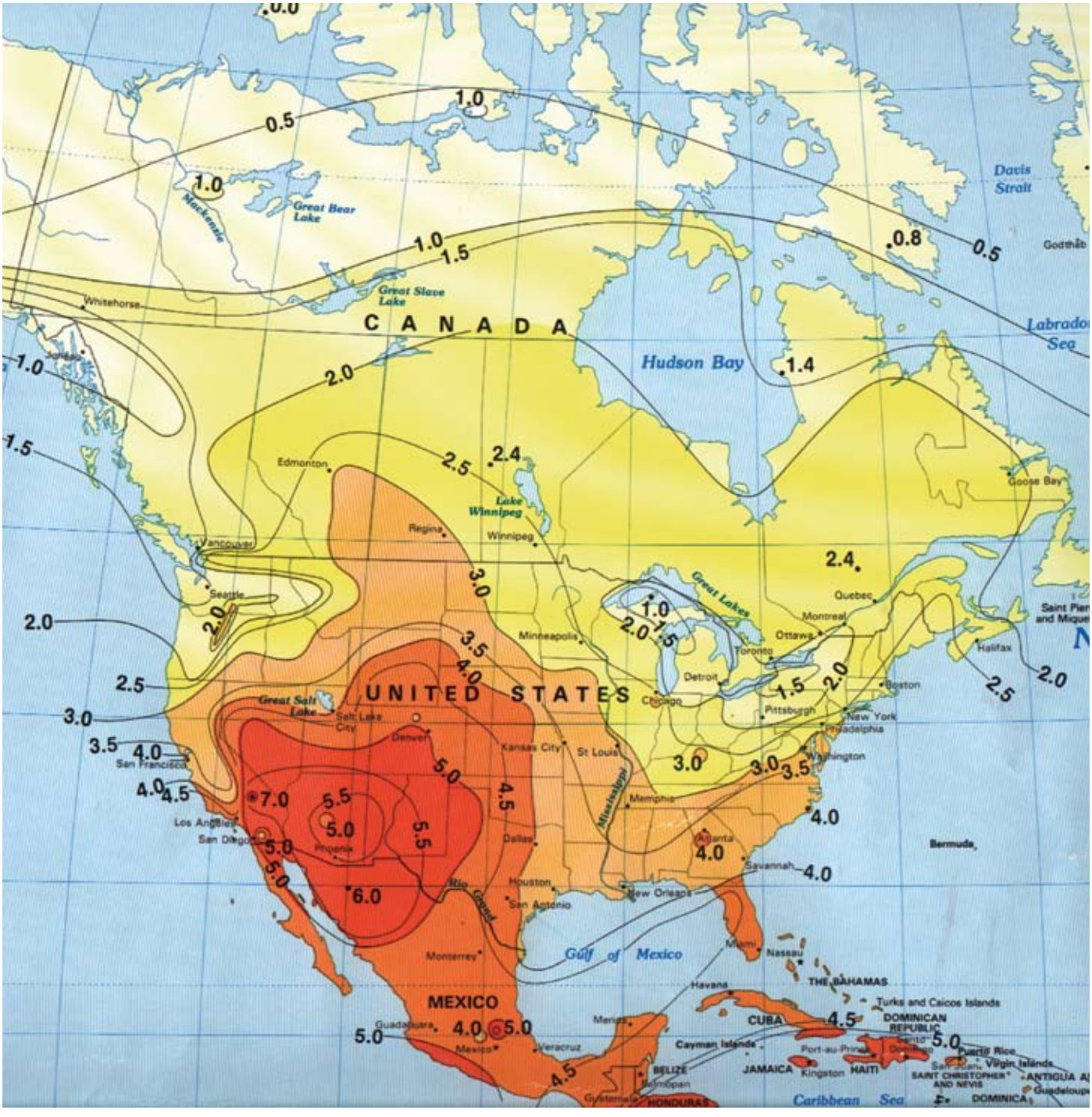
24-volt system – 2% voltage drop										
AMPS	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#2**	**1/0**	**2/0**	**4/0**
1	90	140	230	360	580	912	1440			
2	45	70	115	180	290	456	720	1160	1440	2120
4	20	35	55	90	145	228	360	580	720	1160
6	15	24	35	60	95	150	240	386	486	760
8	11	17	30	45	71	114	180	290	360	580
10	9	14	24	36	57	91	145	230	290	460
15	6	9	14	24	38	60	96	153	192	300
20	4	7	11	18	29	45	72	115	145	232
25	3.6	5.6	9	14	23	36	58	92	116	184
30	3	4.8	7	12	19	30	48	77	97	154
40			5.6	9	14	23	36	58	72	112
50			4.6	7.2	11	18	29	46	58	92
100					5.8	9.2	14.4	23	29	46
150							9.6	15.4	19.4	30
200							7.2	11.6	14.6	22

Wire Loss Tables - 48V and 120V

Use these tables to determine the maximum distance one-way in feet of various gauge two-conductor copper wire from power source to load for 2% voltage drop in 48-volt and 120-volt system wiring. You can go twice the distance where a 4% loss is acceptable. Do not exceed the 2% drop for wire between PV modules and batteries. A 4 to 5% loss is acceptable between batteries and lighting circuits in most cases.

48-volt system – 2% voltage drop										
AMPS	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#2**	**1/0**	**2/0**	**4/0**
1	180	280	460	720	1160	1824	2880			
2	90	140	230	360	580	912	1440	2320	2880	4240
4	40	70	110	180	290	456	720	1160	1440	2320
6	30	48	70	120	190	300	480	772	972	1520
8	22	34	60	90	142	228	360	580	720	1160
10	18	28	48	72	114	182	290	460	580	920
15	12	18	28	48	76	120	192	306	384	600
20	8	14	22	36	58	90	144	230	290	464
25	7.2	11.2	18	28	46	72	116	184	232	368
30	6	9.6	14	24	38	60	96	154	194	308
40			11.2	18	28	46	72	116	144	224
50			9.2	14.4	22	36	58	92	116	184
100					11.6	18.4	28.8	46	58	92
150							19.2	30.8	38.8	60
200							14.4	23.2	29.2	44
120-volt system – 2% voltage drop										
AMPS	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#2**	**1/0**	**2/0**	**4/0**
1	450	700	1150	1800	2900	4560	7200	0	0	0
2	225	350	575	900	1450	2280	3600	5800	7200	10600
4	100	175	275	450	725	1140	1800	2900	3600	5800
6	75	120	175	300	475	750	1200	1930	2430	3800
8	55	85	150	225	355	570	900	1450	1800	2900
10	45	70	120	180	285	455	725	1150	1450	2300
15	30	45	70	120	190	300	480	765	960	1500
20	20	35	55	90	145	225	360	575	725	1160
25	18	28	45	70	115	180	290	460	580	920
30	15	24	35	60	95	150	240	385	485	770
40			28	45	70	115	180	290	360	560
50			23	36	55	90	145	230	290	460
100				18	29	46	72	115	145	230
150							48	77	97	150
200							36	58	73	110

These maps shows the average value of total solar energy received in peak sun hours per day on an optimally tilted surface during the month with the lowest solar radiation. This is the best number to use in system design where the electrical demand is continuous or is not expected to vary seasonally and the system must be designed to operate year around. (Use this number for line 3 in the Number-of-Modules Worksheet on page 14.)

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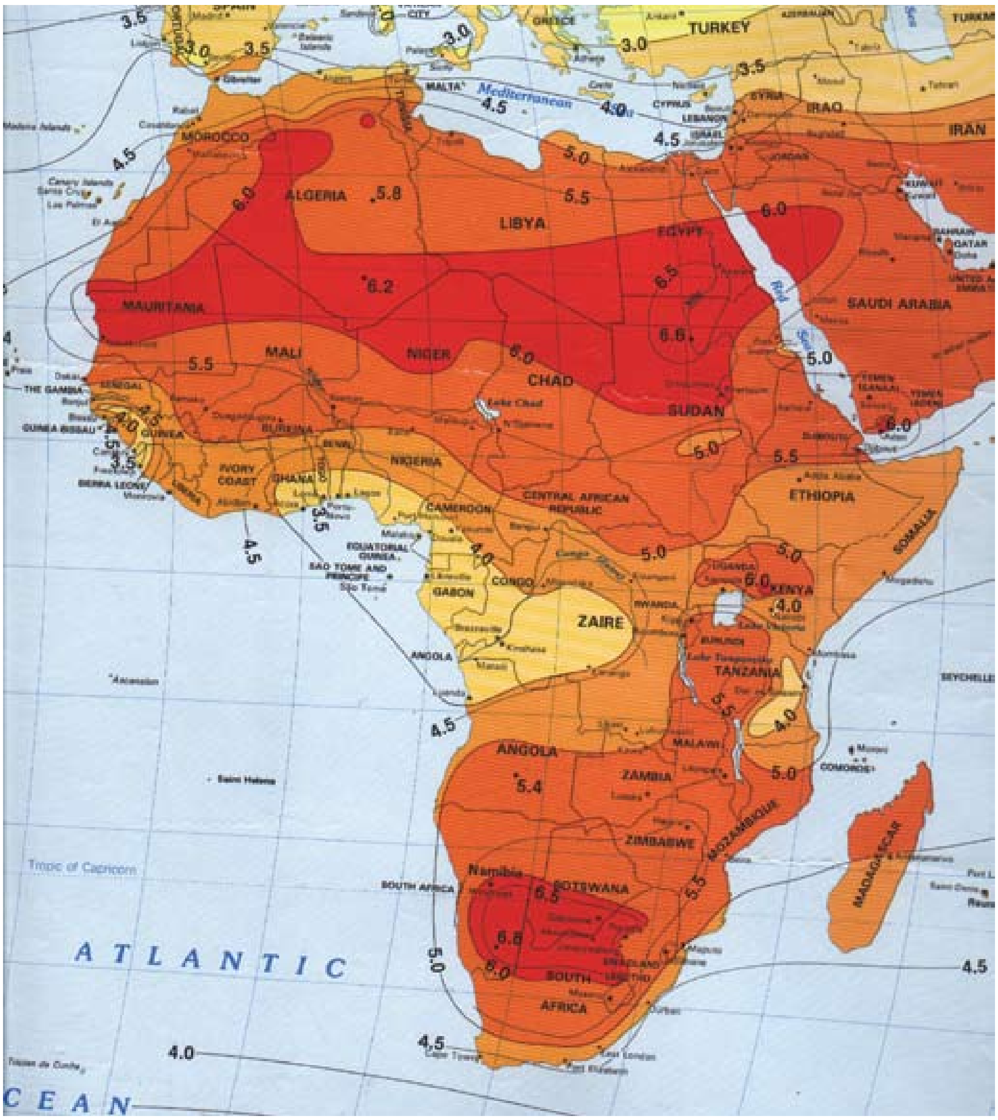
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SEYCHELLES
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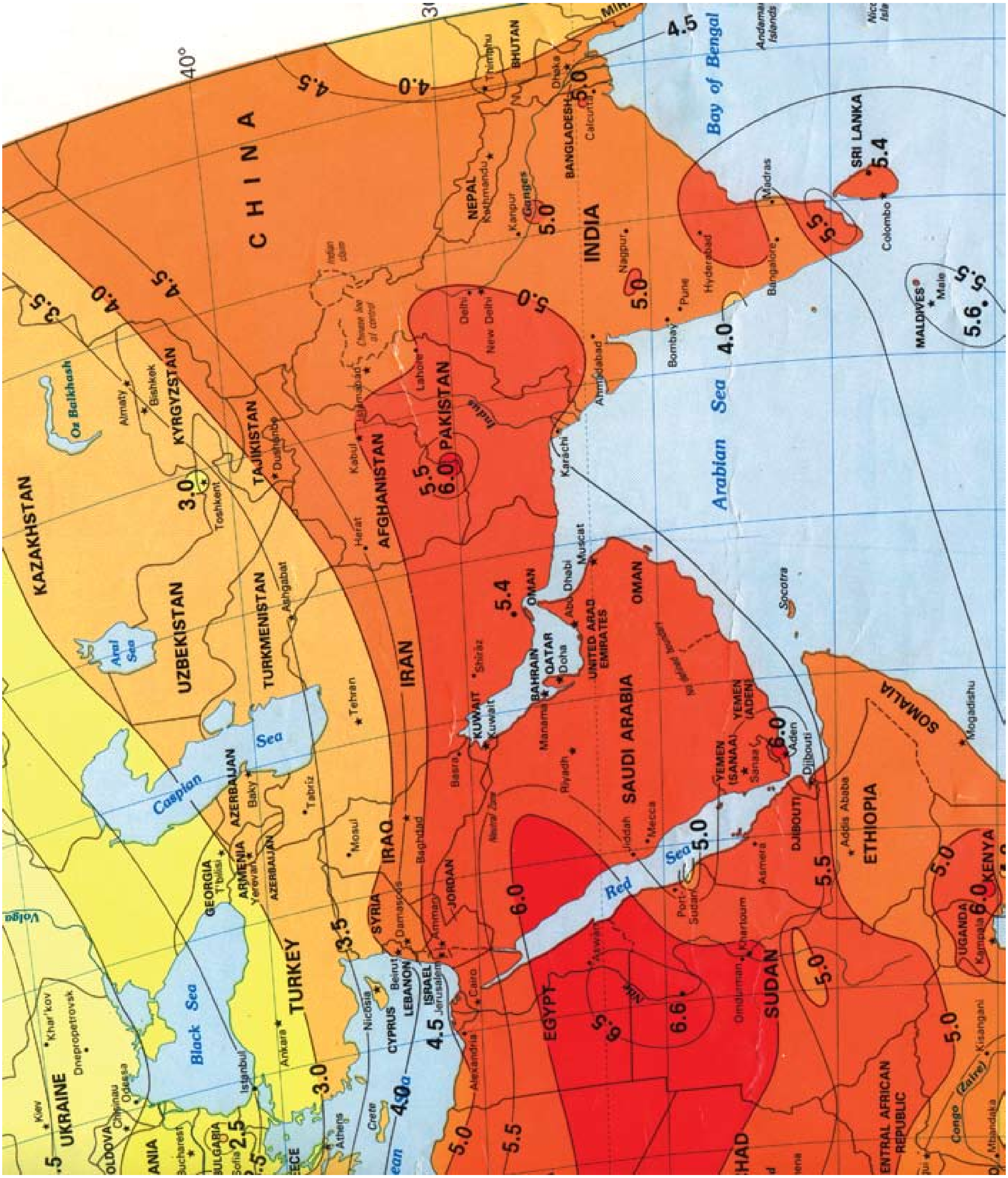

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QATAR
UNITED ARAB EMIRATES
GEORGIA
ARMENIA
AZERBAIJAN
CENTRAL AFRICAN REPUBLIC
Caspian Sea
Black Sea
Aral Sea
Oz Balkhash
Red Sea
Arabian Sea
Bay of Bengal
Andaman Islands
Socotra
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Wuhan
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Ryukyu Islands
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Oreor (Koror)
Trust Territory of the Pacific Islands
FEDERATED STATES OF
BRUNEI
Bandar Seri Begawan
MALAYSIA
Kuala Lumpur
SINGAPORE
Ujung Pandang
Jakarta
INDONESIA
Surabaya
PAPUA NEW GUINEA
Port Moresby
Arafura Sea
30°
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3.8
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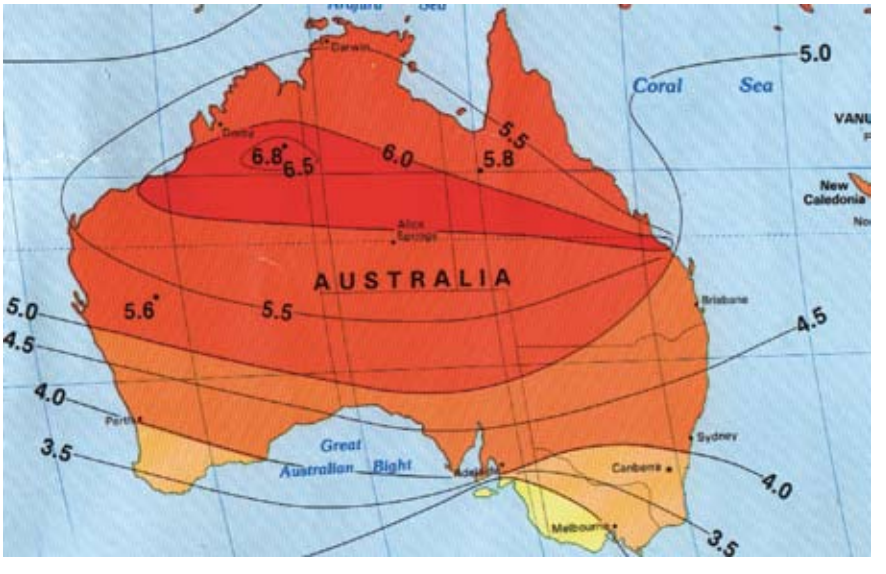
Darwin
Coral Sea
New Caledonia
AUSTRALIA
Brisbane
Great Australian Bight
Sydney
Canberra
Melbourne
5.0
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6.5
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5.8
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4.5
4.0
3.5


Auckland
NEW ZEALAND
Wellington
Christchurch
Dunedin
3.5
3.0
4.0
2.5

Renewable Energy Glossary

absorbed glass mat (AGM): A fibrous silica glass mat to suspend the electrolyte in batteries. This mat provides pockets that assist in the recombination gasses generated during charging back into water.

alternating current (AC): Electric current in which the direction of flow is reversed at frequent intervals, usually 100 or 120 times per second (50 or 60 cycles per second or 50//60 Hz).

amorphous silicon: A non-crystalline semiconductor material that has no long-range order, often used in thin-film photovoltaic modules.

ampere (A) or amp: The unit for the electric current; the flow of electrons. One amp is 1coulomb passing in one second. One amp is produced by an electric force of 1 volt acting across a resistance of 1 ohm. Sometimes this is abbreviated as I for intensity.

ampere-hour (Ah): Quantity of electrical energy equal to the flow of one ampere of current for one hour. Typically used to quantify battery bank capacity.

array: Any number of photovoltaic modules connected together to provide a single electrical output at a specified voltage. Arrays are often designed to produce significant amounts of electricity.

autonomous system: A standalone PV system that has no backup generating source. May or may not include storage batteries.

avoided cost: The minimum amount an electric utility is required to pay an independent power producer, under the PURPA regulations of 1978, equal to the costs the utility calculates it avoids in not having to produce that power (usually substantially less than the retail price charged by the utility for power it sells to customers)

balance of system (BOS): All system components and costs other than the PV modules, including inverters, mounting structures, disconnects, wire and conduit.

battery: Two or more "cells" electrically connected for storing electrical energy. Common usage permits this designation to be applied also to a single cell used independently, as in a flashlight battery.

battery capacity: The total number of ampere-hours that can be withdrawn from a fully charged cell or battery.

battery cycle life: The number of cycles, to a specified depth of discharge, that a cell or battery can undergo before failing to meet its specified capacity or efficiency performance criteria.

battery self-discharge: The rate at which a battery, without a load, will lose its charge.

battery state of charge: Percentage of full charge, or100 percent minus the depth of discharge.

bypass diode: A diode connected across one or more solar cells in a photovoltaic module such that the diode will conduct if the cell(s) become reverse biased. Alternatively, a diode connected anti-parallel across a part of the solar cells of a PV module. It protects these solar cells from thermal destruction in case of total or partial shading of individual solar cells while other cells are exposed to full light.

cell: The basic unit of a photovoltaic module. This word is also commonly used to describe the basic unit of batteries (i.e., a 6-volt battery has three 2-volt cells).

charge controller: A device that controls the charging rate and/or state of charge for batteries.

charge rate: The current applied to a cell or battery to restore its available capacity.

compact fluorescent lights (CFL): Lights that use a lot less energy than regular light bulbs We can use compact fluorescent lights for reading lights and ceiling lights.

crystalline silicon: A type of PV cell made from a single crystal or polycrystalline slice of silicon.

current: The flow of electric charge in a conductor between two points having a difference in potential (voltage).

current at maximum power (Imp): The current at which maximum power is available from a module. [UL 1703]

cycle life: Number of discharge-charge cycles that a battery can tolerate under specified conditions before it fails to meet specified criteria as to performance (e.g., capacity decreases to 80-percent of the nominal capacity).

days of autonomy: The number of consecutive days a standalone system battery bank will meet a defined load without solar energy input.

DC to DC converter: Electronic circuit to convert DC voltages (e.g., PV module voltage) into other levels (e.g., load voltage). Can be part of a maximum power point tracker (MPPT).

deep cycle battery: Type of battery that can be discharged to a large fraction of capacity many times without damaging the battery.

depth of discharge (DOD): The amount of ampere hours removed from a fully charged cell or battery, expressed as a percentage of rated capacity.

diode: Electronic component that allows current flow in one direction only.

direct current (DC): Electric current in which electrons flow in one direction only. Opposite of alternating current.

discharge rate: The rate, usually expressed in amperes over time, at which electrical current is taken from the battery.

disconnect: Switch gear used to connect or disconnect components of a PV system for safety or service.

duty cycle: The ratio of active time to total time. Used to describe the operating regime of appliances or loads.

edge-defined film-fed growth (EFG): A method for making sheets of polycrystalline silicon in which molten silicon is drawn upward by capillary action through a mold.

efficiency: The ratio of output power to input power. Expressed as a percent.

electric circuit: Path followed by electrons from a power source (generator or battery) through an external line (including devices that use the electricity) and returning through another line to the source.

electric current: A flow of electrons; electricity.

electrical grid: An integrated system of electricity distribution, usually covering a large area; most typically in the USA, owned and operated by a public utility.

electrolyte: A liquid conductor of electricity in which flow of current takes place by migration of ions. The electrolyte for a lead-acid storage cell is an aqueous solution of sulfuric acid.

energy: The ability to do work. Stored energy becomes working energy when we use it.

energy density: The ratio of energy available from a battery to its volume (Wh/1) or mass (Wh/kg).

equalization: The process of mixing the electrolyte in batteries by periodically overcharging the batteries for a short period to "refresh" cell capacity.

float charge: Float charge is the voltage required to counteract the self-discharge of the battery at a certain temperature.

float life: Number of years that a battery can keep its stated capacity when it is kept at float charge.

gassing current: Portion of charge current that goes into electrolytical production of hydrogen and oxygen from the electrolytic liquid in the battery. This current increases with increasing voltage and temperature.

gel-type battery: Lead-acid battery in which the electrolyte is composed of a silica gel matrix.

gigawatt (gW): One billion watts. One million kilowatts. One thousand megawatts.

grid-tie: A PV, wind or hydroelectric systems that supplies power directly to the utility grid. Also called **grid-connected**, **grid-interactive**, **utility-intertie** and other similarly descriptive terms.

hybrid system: A PV system that includes other sources of electricity generation, such as wind or fossil fuel generators.

insolation: Sunlight, direct or diffuse; from 'incident solar radiation.' Usually expressed in watts per square meter. Not to be confused with 'insulation.'

interconnect: A conductor within a module or other means to provide an electrical connection between the solar cells.

inverter: Device that converts DC electricity into AC electricity (single or multiphase), either for off-grid standalone systems or for grid-tie systems.

junction box: An electrical box designed to be a safe enclosure in which to make proper electrical connections. On PV modules this is where PV strings are electrically connected.

kilowatt (kW): 1000 watts.

kilowatt-hour (kWh): One thousand watt-hours. The kWh is a unit of energy. 1 kWh=3600 kJ.

life cycle cost: An estimate of the cost of owning and operating a system for the period of its useful life; usually expressed in terms of the present value of all lifetime costs.

load: Anything in an electrical circuit that, when the circuit is turned on, draws power from that circuit.

maximum power point tracker (MPPT): Means of a power conditioning unit that automatically operates the PV generator at its MPP under all conditions.

megawatt (MW): One million watts; 1000 kilowatts.

module: See 'photovoltaic module.'

multicrystalline: Material that is solidified at such as rate that many small crystals (crystallites) form. The atoms within a single crystallite are symmetrically arranged, whereas crystallites are jumbled together. These numerous grain boundaries reduce the device efficiency. A material composed of variously oriented, small individual crystals. (Sometimes referred to as polycrystalline or semicrystalline).

NEC: An abbreviation for the National Electrical Code which contains safety guidelines and required practices for all types of electrical installations. Article 690 pertains to solar photovoltaic systems.

nominal operating cell temperature (NOCT): The reference cell (module) operating temperature presented on manufacturer's literature. Generally the NOCT is referenced at 25°C, 77°F.

nominal voltage: A reference voltage used to describe batteries, modules, or systems (i.e., a 12-, 24-, or 48-volt battery, module or system).

ohm: The unit of resistance to the flow of an electric current.

one-axis tracking: A system capable of rotating about one axis, also referred to as single axis. These tracking systems usually follow the sun from east to west throughout the day.

open-circuit voltage (Voc): The maximum possible voltage across a photovoltaic cell or module; the voltage across the cell in sunlight when no current is flowing.

orientation: Placement according to the compass directions, north, south, east, west.

parallel connection: A way of joining two or more electricity-producing devices such as PV cells or modules, or batteries by connecting positive leads together and negative leads together. Such a configuration increases the current but the voltage is constant.

peak load; peak demand: The maximum load, or usage, of electrical power occurring in a given period of time, typically a day.

peak sun hours: The equivalent number of hours per day when solar irradiance averages 1000 w/m2 (full sun).

photovoltaic (PV): Pertaining to the direct conversion of photons of sunlight into electricity.

photovoltaic array: An interconnected system of PV modules that function as a single electricity producing unit. The modules are assembled as a discrete structure, with common support or mounting. In smaller systems, an array can consist of a single module.

photovoltaic cell: The smallest semiconductor element within a PV module to perform the immediate conversion of light into electrical energy (DC voltage and current).

photovoltaic module: The smallest environmentally protected, essentially planar assembly of solar cells – including ancillary parts such as interconnections, terminals and protective devices such as diodes – intended to generate DC power under unconcentrated sunlight. The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate).

photovoltaic peak watt: Maximum "rated" output of a cell, module, or system. Typical rating conditions are 0.645 watts per square inch (1000 watts per square meter) of sunlight, 68 degrees F (20 degrees C) ambient air temperature and 6.2 x 10-3 mi/s (1m/s) wind speed.

photovoltaic system: A complete set of components for converting sunlight into electricity by the photovoltaic process, including the array and balance of system components.

polycrystalline: See 'multicrystalline.'

power factor: The ratio of the average power and the apparent volt-amperes.

pulse-width-modulated wave inverter (PWM): Pulse-width-modulated wave inverters are the most expensive, but produce a high quality of output signal at minimum current harmonics. The output voltage is very close to sinusoidal.

PV: Abbreviation for photovoltaic.

remote site: Site which is not located near the utility grid.

remote systems: Systems located away from the utility grid.

resistance (R): The property of a conductor which opposes the flow of an electric current resulting in the generation of heat in the conducting material. The unit of resistance is ohms.

satellite power system (SPS): Concept for providing large amounts of electricity for use on the Earth from one or more satellites in geosynchronous Earth orbit. A very large array of solar cells on each satellite would provide electricity, which would be converted to microwave energy and beamed to a receiving antenna on the ground. There, it would be reconverted into electricity and distributed the same as any other centrally generated power, through a grid.

series connection: A way of joining electrical equipment by connecting positive leads to negative leads; such a configuration increases the voltage while current remains the same.

series regulator: Type of battery charge regulator where the charging current is controlled by a switch connected in series with the PV module or array.

shelf life of batteries: The length of time, under specified conditions, that a battery can be stored so that it keeps its guaranteed capacity.

short-circuit current (Isc): The current flowing freely from a photovoltaic cell through an external circuit that has no load or resistance; the maximum current possible.

shunt regulator: Type of a battery charge regulator where the charging current is controlled by a switch connected in parallel with the PV generator. Overcharging of the battery is prevented by shorting the PV generator.

silicon (Si): A chemical element, atomic number 14, semi-metallic in nature, dark gray, an excellent semiconductor material. A common constituent of sand and quartz (as the oxide). Crystallizes in face centered cubic lattice – like a diamond. The most common semiconductor material used in making photovoltaic devices.

sine wave inverter: An inverter that produces utility quality, sine wave power forms.

single-crystal material: A material that is composed of a single crystal or a few large crystals.

solar cell: See 'photovoltaic cell.'

solar constant: The strength of sunlight; 1353 watts per square meter in space and about 1000 watts per square meter at sea level at the equator at solar noon.

solar energy: Energy from the sun. For example, the heat that builds up in your car when the windows are closed is solar energy.

solar-grade silicon: Intermediate-grade silicon used in the manufacture of solar cells. Less expensive than electronic-grade silicon used to make semiconductors.

square wave inverter: The inverter consists of a DC source, four switches, and the load. The switches are power semiconductors that can carry a large current and withstand a high voltage rating. The switches are turned on and off at a correct sequence, at a certain frequency. The square wave inverter is the simplest and the least expensive to purchase, but it produces the lowest quality of power.

Staebler-Wronski effect: The tendency of amorphous silicon photovoltaic devices to lose efficiency upon initial exposure to light; named for Dr. David Staebler and Dr. Christopher Wronski; work performed at RCA.

standalone: An autonomous or hybrid photovoltaic system not connected to a grid. Some standalone systems require batteries or some other form of storage. "Standalone" is virtually synonymous with "off-grid" when applied to energy systems.

stand-off mounting: Technique for mounting a PV array on a sloped roof, which involves mounting the modules a short distance above the pitched roof and tilting them to the optimum angle. This promotes air flow to cool the modules.

standard test conditions (STC): Conditions under which a module is typically tested in a laboratory: (1) Irradiance intensity of 1000 W/square meter (0.645 watts per square inch), (2) AM1.5 solar reference spectrum, and (3) a cell (module) temperature of 25°C, plus or minus 2 °C (77 °F, plus or minus 3.6 °F).

state of charge (SOC): The available capacity remaining in a cell or battery, expressed as a percentage of the rated capacity. For example, if 25 amp-hours have been removed from a fully charged 100 amp-hour cell, the state of charge is 75 percent.

sulfation: A condition that afflicts unused and discharged batteries; large crystals of lead sulfate grow on the plate, instead of the usual tiny crystals, making the battery extremely difficult to recharge.

superstrate: The covering on the sun side of a PV module, providing protection for the PV materials from impact and environmental degradation while allowing maximum transmission of the appropriate wavelengths of the solar spectrum.

surge: The momentary start-up condition of a motor requiring a large amount of current.

surge capacity: The ability of an inverter or generator to deliver high currents momentarily required when starting a motor.

temperature compensation: An allowance made in charge controller set points for changing battery temperatures.

thin film: A layer of semiconductor material, such as copper indium diselenide, cadmium telluride, gallium arsenide, or amorphous silicon, a few microns or less in thickness, used to make photovoltaic cells.

tilt angle: Angle of inclination of a module as measured in degrees from the horizontal. For maximum performance solar collectors/modules should be set as close as possible to perpendicular to the sun.

total harmonic distortion (thd): The measure of closeness in shape between a waveform and its fundamental component.

tracking PV array: PV array that follows the path of the sun to maximize the solar radiation incident on the PV surface. The two most common orientations are (1) one axis where the array tracks the sun east to west and (2) two-axis tracking where the array points directly at the sun at all times. Tracking arrays use both the direct and diffuse sunlight. Two-axis tracking arrays capture the maximum possible daily energy.

transformer: An electromagnetic device used to convert AC electricity, either to increase or decrease the voltage.

trickle charge: A charge at a low rate, balancing through self-discharge losses, to maintain a cell or battery in a fully charged condition.

two-axis tracking: A system capable of rotating independently about two axes and following the sun's orientation and height in the sky (e.g., vertical and horizontal).

utility-interactive inverter: An inverter that can function only when tied to the utility grid, and uses the prevailing line-voltage frequency on the utility line as a control parameter to ensure that the PV system's output is fully synchronized with the utility power.

VAC: Volts AC.

VDC: Volts DC.

Voc: Open-circuit voltage (seen entry).

volt (V): A unit of measure of the force, or 'push', given the electrons in an electric circuit. One volt produces one amp of current when acting against a resistance of one ohm.

voltage at maximum power (VMP): The voltage at which maximum power is available from a module.

wafer: A thin sheet of semiconductor material made by mechanically sawing it from a single-crystal or multicrystal ingot or casting.

watt (W): The unit of electric power, or amount of work. One ampere of current flowing at a potential of one volt produces one watt of power.

watt-hour (Wh): A quantity of electrical energy when one watt is used for one hour.

waveform: The shape of the curve graphically representing the change in the AC signal voltage and current amplitude, with respect to time.

This glossary was compiled with assistance and permission from Solar Energy International (SEI) and their book "Photovoltaics: Design and Installation Manual." See page 149 to purchase this book. See page 25 for information on SEI classes.

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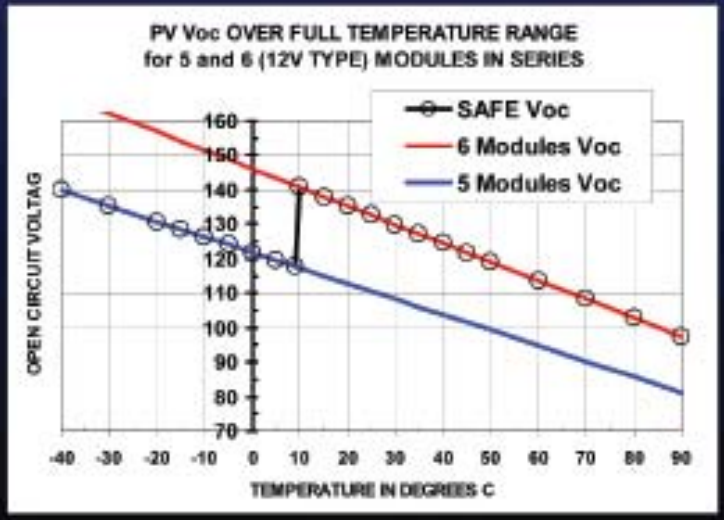

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