

# 2010

## Renewable Energy

### DESIGN GUIDE & CATALOG

#### More New Products Than Ever!

THIS 29TH EDITION of the *Renewable Energy Design Guide & Catalog* is the biggest yet. 2009 was a banner year for new product introductions in the solar industry – especially in, though by no means limited to, the inverter market – and the trend continues into 2010. We've added dozens of brand new products, plus hundreds more upgrades and new models of existing product lines.

Brand new products are not yet extensively tested in the real world, of course. However, of the countless contending products vying to break into the solar marketplace that we evaluate each year, we believe these we have selected for the catalog have the best potential to become significant additions to the renewable energy industry in the months and years ahead.

#### Proven Products and Trustworthy Advice

In addition to all the new products, this catalog contains hundreds of products that have been field-tested and proven by our own experience over three decades in the solar industry; products you can depend on to work as described. And all with updated descriptions, specs and suggested retail prices.

The product descriptions in this catalog offer not just manufacturer-provided text, but also the seasoned advice of people who have been in the renewable energy business for decades. You'll find useful tips and guidance on system design and installation, product usage, maintenance, equipment and parts compatibility – detailed, hands-on information from people who have direct experience in the topics they are writing about. There is no other catalog like this in the industry.

#### You Can 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 guarantee that every price, specification and information detail herein is correct; so that's our standard legal disclaimer. And of course products and specifications can change without notice. Prices vary and change constantly, so these retail prices are best seen as guidelines. Check with us for the latest prices.

You can help us keep this data accurate by informing us of any mistakes, changes or updates you are aware of. Please send any and all feedback about this catalog to:

**2010@recatalog.net** (Please, use this email only to submit feedback about this publication.)

#### Contact Us for All Your Renewable Energy Needs

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

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

ADVERTISEMENT

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# We can help you generate your own electricity by putting a solar 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](http://www.dsireusa.org) for the latest rebate and tax credit information for your area.

## Feed power back to the utility

In most states, you can send your home-generated power back to the utility and get credit for the power you feed into the utility grid. This practice is called “net metering.”

## 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 parts, substantially decreasing maintenance requirements and increasing reliability and long equipment life.



The website for comprehensive information on federal, state, local and utility incentives:

[www.dsireusa.org](http://www.dsireusa.org)



# 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 renewable energy-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 Battery 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 tables 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 home and business owners to take a 30% tax credit for renewable energy equipment (solar electric, solar thermal and wind powered systems). In 2008, Congress extended this credit through the end of 2016.

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](http://www.dsireusa.org) for the latest comprehensive information about incentives in your area.

## 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.asdf

- **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 1 MW ... Disconnects up to 1200 amps ... Everything you need up for your commercial project.

- **System design assistance**

Choosing the right hardware ... Matching system layout to blueprints ... System drawings for confirmed projects.

- **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 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.

## 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 Modules, page 18, 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.

### Grid-Tie PV Array Design Worksheet – Determine 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 maps on page 13, and/or the insolation map on page 208 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. (Multiply kWh by 1000 to get AC watts.)

#### 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 table below (and on the next 2 pages) to determine array size/inverter combinations

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

14°F, the maximum number of modules per string may be lower.

In the table 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.

Inverter		CEC Efficiency	Module > CEC / Ratio >	REC Solar AE-US		SCHOTT	SolarWorld	Evergreen
				REC215	REC225	POLY 220	SW230	ES-A-200
MFG	Model			187.2/0.871	196.2/0.872	193.9 / 0.881	204.4 / 0.889	180.7 / 0.904
<b>Recommended Number of Modules per String</b>								
Schneider / Xantrex	GT 2.8	94.0%	one string	9 to 14	9 to 14	9 to 14	9 to 14	14 to 16
	GT 3.3	94.5%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 19
	GT 3.8	95.0%	one string	9 to 14	9 to 14	9 to 14	9 to 14	14 to 22
			two strings	9 to 10	9 to 10	9 to 10	9	
	GT 4.0	95.5%	one string	11 to 14	11 to 14	11 to 14	11 to 14	17 to 23
			two strings	11				
	GT 5.0	95.5%	one string	11 to 14	11 to 14	11 to 14	11 to 14	17 to 23
			two strings	11 to 13	11 to 13	11 to 13	11 to 13	

Inverter		CEC Efficiency	Module > CEC / Ratio >	REC Solar AE-US Series		SCHOTT	SolarWorld	Evergreen
				REC215	REC225	POLY 220	SW230	ES-A-200
MFG	Model			187.2/0.871	196.2/0.872	193.9 / 0.881	204.4 / 0.889	180.7 / 0.904
<b>Recommended Number of Modules per String</b>								
SMA	SB700U	91.5%	one string					-
	SB2000HFUS	95.0%	one string	8 to 11	8 to 11	8 to 11	8 to 10	-
	SB2500HFUS	95.0%	one string	10 to 14	10 to 13	10 to 14	10 to 13	15
	SB3000HFUS	95.0%	one string	10 to 14	10 to 14	10 to 14	10 to 14	16 to 18
	SB3000US	95.5%	one string	10 to 12	9 to 12	9 to 12	9 to 12	14 to 18
	SB4000US	96.0%	one string	12 to 14	11 to 14	11 to 14	11 to 14	18 to 23
			two strings		11	11		
	SB5000US	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	18 to 23
			two strings	12 to 14	11 to 13	11 to 13	11 to 13	
	SB6000US	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	18 to 23
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	18
			three strings		11	11		
	SB7000US	96.0%	one string	12 to 14	11 to 14	11 to 14	11 to 14	18 to 23
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	18 to 21
three strings			12 to 13	11 to 12	11 to 13	11 to 12		
SB8000US	96.0%	one string	14	14	13 to 14	12 to 13	21 to 23	
		two strings	14	14	13 to 14	12 to 13	21 to 23	
		three strings	14	14	13 to 14	12 to 13		
PV Powered	PVP1100EVR	92.0%	one string	6	6	5 to 6	5 to 6	-
	PVP2000EVR	92.5%	one string	6 to 11	6 to 11	5 to 11	5 to 10	8 to 12
			two strings			5		
	PVP 2500	93.5%	one string	7 to 12	7 to 12	6 to 12	6 to 12	10 to 15
			two strings	7				
	PVP3000SVR	93.0%	one string	8 to 12	8 to 12	8 to 12	8 to 12	12 to 18
			two strings	8	8	8	8	
	PVP 3500	94.0%	one string	10 to 12	9 to 12	9 to 12	9 to 12	14 to 19
two strings			10	9	9	9		
PVP 4800	94.0%	one string	10 to 12	9 to 12	9 to 12	9 to 12	14 to 19	
		two strings	10 to 12	9 to 12	9 to 12	9 to 12	14 to 15	
PVP 5200	94.5%	one string	11 to 12	11 to 12	11 to 12	11 to 12	17 to 19	
		two strings	11 to 12	11 to 12	11 to 12	11 to 12		
Solectria	PVI1800	92.5%	one string	6 to 9	6 to 9	6 to 9	6 to 9	9 to 11
	PVI2500	93%	one string	6 to 9	6 to 9	6 to 9	6 to 9	9 to 15
			two strings	6 to 7	6	6		
	PVI3000	96.0%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 18
	PVI4000	96%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 23
			two strings	10 to 11	9 to 10	9 to 10	9 to 10	
	PVI5000	96%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 23
			two strings	10 to 14	9 to 13	9 to 13	9 to 13	14 to 15
PVI5300	96%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 23	
		two strings	10 to 14	9 to 14	9 to 14	9 to 14	14 to 16	
			three strings	10	9	9	9	



Inverter		CEC Efficiency	Module >	REC Solar AE-US Series		SCHOTT	SolarWorld	Evergreen
MFG	Model		CEC / Ratio >	REC215	REC225	POLY 220	SW230	ES-A-200
				187.2/0.871	196.2/0.872	193.9 / 0.881	204.4 / 0.889	180.7 / 0.904
Recommended Number of Modules per String								
Fronius	IG2000	93.5%	one string	7 to 11	7 to 11	7 to 12	7 to 11	11 to 12
	IG3000	94.0%	one string	7 to 12	7 to 12	7 to 12	7 to 12	11 to 16
			two strings	7	7	7	7	
	IG4000	94.0%	one string	7 to 12	7 to 12	7 to 12	7 to 12	11 to 19
			two strings	7 to 11	7 to 11	7 to 12	7 to 10	11 to 12
			three strings	7	7	7		
	IG5100	94.5%	one string	7 to 12	7 to 12	7 to 12	7 to 12	11 to 19
			two strings	7 to 12	7 to 12	7 to 12	7 to 12	11 to 15
			three strings	7 to 9	7 to 9	7 to 9	7 to 9	
			four strings	7	7			
	IG+3.0-1	95.5%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 17
	IG+3.8-1	95.5%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 22
	IG+5.0-1	95.5%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23
			two strings	11 to 13	11 to 12	10 to 13	10 to 12	
	IG+6.0-1	96.0%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23
			two strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 17
			three strings			10	10	
	IG+7.5-1	95.5%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23
			two strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 21
			three strings	11 to 13	11 to 12	10 to 12	10 to 12	
	IG+10.0-1	95.5%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23
			two strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23
			three strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 19
			four strings	11 to 13	11 to 12	10 to 12	10 to 12	
IG+11.4-1	96.0%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23	
IG+11.4-3	95.5%	two strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23	
		three strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 21	
		four strings	11 to 14	11 to 14	10 to 14	10 to 14	16	
		five strings	11 to 12	11	10 to 11	10 to 11		
IG+12.0-3 277v only	96%	one string	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23	
		two strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 23	
		three strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 22	
		four strings	11 to 14	11 to 14	10 to 14	10 to 14	16 to 17	
		five strings	11 to 12	11 to 12	10 to 12	10 to 12		
		six strings				10		
KACO new energy	1501xi	94%	one string			6 to 8	6 to 8	9 to 10
	1502xi	95.5%	one string	6 to 9	6 to 8	6 to 9	6 to 8	9 to 10
	2502xi	95.5%	one string	10 to 13	9 to 13	9 to 13	9 to 12	15
	3502xi	95.5%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 21
			two strings		9	9	9	
	5002xi	95.5%	one string	10 to 14	9 to 14	9 to 14	9 to 14	14 to 22
two strings			10 to 13	9 to 13	9 to 13	9 to 13	14 to 15	

## Grid-Tie with Battery Backup

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

OutBack makes G-Series inverters and switchgear, page 98, that can power loads up to 7.2 kW.

The Schneider Xantrex XW series of inverters, page 101, offers grid-tie inverters with battery backup capability in 6000-watt increments. Several can be stacked for 12kW or 18kW battery backup systems.

The SMA Sunny Island inverter, page 80, in conjunction with a Sunny Boy inverter and PV array, can be used to provide high-efficiency backup power in a grid-tied home or business. Backup systems up to 20kW can be configured using up to 4 Sunny Island inverters. SMA will soon have a way to expand this for systems up to 80kW

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 Grid-Tie PV Array Design Worksheet on page 7 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 141). 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 that you need to run all at the same time to arrive at the total amount of watts. This is your "peak wattage" inverter requirement and 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 146 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.

## Off-Grid System Sizing Information

The size of an off-grid 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, wood or solar-heated water 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 120-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. High quality fluorescent lights are available for 12- and 24-volt systems. LED lighting is improving rapidly and already meets or beats the light output and efficiency of fluorescent lighting.

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 70° 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

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

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

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.

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

## Calculate your DC loads

- List all DC loads, wattage and hours of use per week in the spaces provided. Multiply watts by hours/week to get DC watt-hours per week (WH/Wk). Add up all the watt hours per week to determine total DC watt-hours per week.. \_\_\_\_\_

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

- DC system voltage. Usually 12, 24, or 48 volts. \_\_\_\_\_
- Find total amp-hours per week used by DC loads: divide total in line 5 by line 6. \_\_\_\_\_
- Enter total DC amp-hours per week used by AC loads from line 4. \_\_\_\_\_
- Add lines 7 and 8. This is total DC amp-hours per week used by all loads. \_\_\_\_\_

## Calculate your amp-hours per day

- 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 13, and on line 1 of the Battery Sizing Worksheet on page 149. \_\_\_\_\_



# Off-Grid Solar Array Sizing Worksheet

Use this worksheet to calculate the total number of solar modules required for your system if you are using a non-MPPT charge controller. If you are using an MPPT type charge controller, do steps 1-4 on this worksheet, then move to step 5 on the next page. Information on the different types of PV charge controllers can be found in the Charge Controller section, page 122.

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 page 207 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.

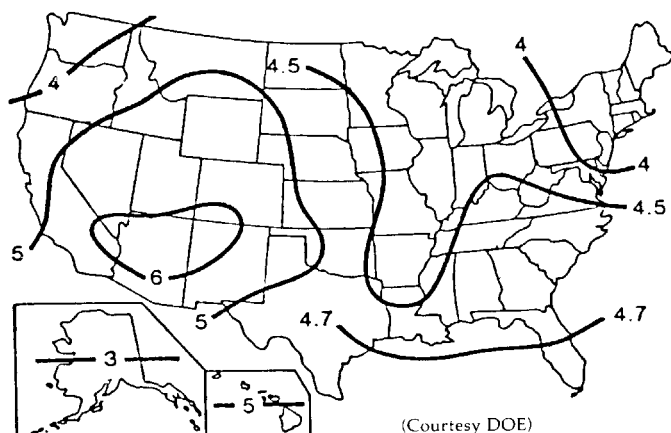
- Step 1** Total average amp-hours per day needed (line 10 of the Off-Grid Loads Worksheet, page 12) \_\_\_\_\_
- Step 2** Multiply line 1 by 1.2 to compensate for loss from battery charge/discharge \_\_\_\_\_
- Step 3** Average sun-hours per day in your area \_\_\_\_\_
- Step 4** Divide line 2 by line 3. This is the total solar array amps required \_\_\_\_\_  
 If you are using a PWM charge controller, continue to Step 5 below.  
 If you are using an MPPT charge controller, go to step 5 on page 14
- Step 5** Peak-power 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
12	1	N/A
24	2	1
48	4	2

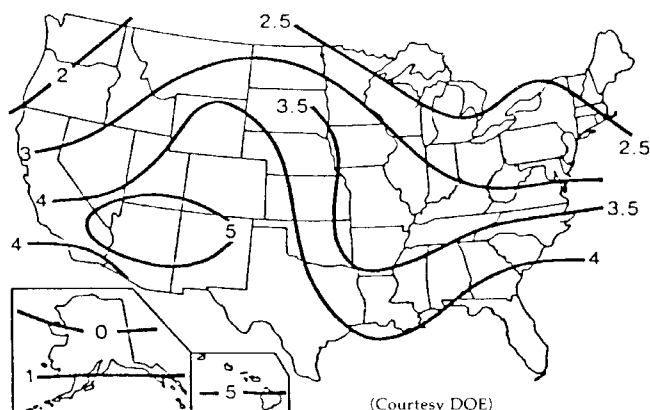
### The maps below show sun-hours per day for the U.S.

See a larger version of the USA map on page 208.

Yearly Average



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



## Solar Array Sizing Worksheet for use with MPPT Charge Controllers

Begin on page 13, steps 1 - 4 before starting on this page.

- Step 5 Total solar array amps required from Step 4 of module worksheet for standard controllers. \_\_\_\_\_
- Step 6 Enter average charging voltage: use 13.5V for 12V systems; use 27V for 24V systems; use 54V for 48V systems. \_\_\_\_\_
- Step 7 Multiply Step 5 result by Step 6 result. This is the total PV array wattage required. \_\_\_\_\_
- Step 8 Enter the peak power wattage of the chosen PV module. (Use the module's Peak Power wattage at STC.) \_\_\_\_\_
- Step 9 Divide the wattage on Step 7 by the wattage on Step 8. This is the total number of modules needed. Round up to the nearest whole number. (NOTE: this number may need to be adjusted in Step 11.) \_\_\_\_\_
- Step 10 Number of modules in each series string. See table below, and add number here. \_\_\_\_\_

Table for 150VDC maximum controllers. (For controllers with other max voltages, see controller instructions.)				
Module		Nominal battery voltage		
Type	# of cells	12V	24V	48V
REC220, SCHOTT 220, SolarWorld 230	60	1 to 3	2 or 3	3
SolarWorld 175	72	1 to 2	1 to 2	2
Mitsubishi UD185MF5, Kyocera 200	54	1 to 3*	2 to 3*	3*
Evergreen ES-A and other 12V nominal modules	36	1 to 5	3 to 5	4 to 5
12V nominal modules w/ Apollo 200V controller	36	2 to 5	3 to 5	5

\*In climates that never have freezing temperatures below 10°F, four Mitsubishi 185UD5 modules may be used in series

- Step 11 Divide the number of total modules in Step 9 by the number of modules per series string from Step 10. This is the total number of array series strings. If this is not a whole number, either increase or decrease the number of modules in Step 9 to obtain a whole number of series strings. CAUTION: decreasing the total number of modules may result in insufficient power production. \_\_\_\_\_
- Step 12 Determine wattage of each series string. Multiply module wattage from Step 8 by number of modules per string on Step 10. This is the total wattage per string. \_\_\_\_\_
- Step 13 Determine number of module strings per controller. Divide appropriate wattage figure from the chart below by the wattage per string from Step 12. Round down to a whole number. This is the total number of module strings per controller. If you have more module strings (from Step 11) than can be handled by the chosen controller, either use a larger controller, or use multiple controllers. \_\_\_\_\_
- Step 14 Divide total number of strings from Step 11 by the number of strings per controller from Step 13. Round up to a whole number. This is the total number of chosen controllers needed. \_\_\_\_\_

Maximum watts that can be used with an MPPT controller			
Controller amp rating	System nominal battery voltage		
	12V	24V	48V
15A	200W	400W	800W
30A	400W	800W	1600W
50A	650W	1300W	2600W
60A	750W	1500W	3000W
80A	1000W	2000W	4000W

# AEE Solar

## Grid-Tie PV Power 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 REC photovoltaic (PV) modules, a Fronius, SMA, PV Powered or KACO inverter, array wiring, DC and AC disconnects, SnapNrack mounting structures to secure modules on the roof, electrical drawings, data sheets, warranties and instructions.

All inverters have integrated DC disconnects. 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 2008 National Electrical Code (NEC-2008); IEEE Std 929-2000, Institute of Electrical and Electronics Engineers Recommended Practices for Utility Interface of Photovoltaic (PV) Systems; UL 1741; and the ICBO 2000 International Building Code. The arrays and inverters are matched for maximum efficiency, however, a complete site survey is required to adjust expected system output to actual site conditions.

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 5 of the table. CEC's calculation takes into account module output in normal operating conditions and inverter efficiency. However, a complete site survey is required to adjust expected system output to the specific site conditions.



Solar module	Nameplate watts	Module qty	# of strings	CEC watts	Inverter model	Item code	Price
Evergreen ES-A-200	1640	8	1	1372	PVP2000	010-07401	\$11,611
	2050	10	1	1715	PVP2000	010-07403	\$13,931
	2460	12	1	2058	PVP2000	010-07405	\$16,061
	2870	14	1	2440	IG3000	010-07407	\$18,463
	3280	16	1	2818	SB3000US	010-07409	\$20,870
	4510	22	1	3895	SB4000US	010-07411	\$28,321
	5330	26	2	4555	IG5100.0	010-07413	\$33,414
	7380	36	2	6407	SB7000US	010-07415	\$45,822
	9840	48	3	8499	IGPlus10.0	010-07417	\$61,924
12300	60	3	10679	IGPlus11.4	010-07419	\$76,504	
REC210 AE-US	1260	6	1	1047	1502xi	010-07440	\$9,400
	1680	8	1	1396	1502xi	010-07442	\$11,600
	2100	10	1	1745	SB3000US	010-07444	\$14,391
	2520	12	1	2105	SB4000US	010-07446	\$17,242
	2940	14	2	2455	PVP2500	010-07448	\$18,698
	3360	16	2	2784	IG4000	010-07450	\$21,952
	4200	20	2	3435	IG4000	010-07452	\$26,602
	5040	24	2	4187	SB5000US	010-07454	\$31,837
	7560	36	3	6314	SB7000US	010-07456	\$46,195
10080	48	4	8375	IGPlus10.0	010-07458	\$62,386	
REC220 AE-US	1320	6	1	1098	1502xi	010-07480	\$9,628
	1760	8	1	1465	1502xi	010-07482	\$11,904
	2200	10	1	1831	SB3000US	010-07484	\$14,800
	2640	12	1	2208	SB4000US	010-07486	\$17,698
	3080	14	2	2509	PVP2500	010-07488	\$19,230
	3520	16	2	2883	IG4000	010-07490	\$22,560
	4400	20	2	3604	IG4000	010-07492	\$27,362
	5280	24	2	4394	SB5000US	010-07494	\$32,749
	7920	36	3	6625	SB7000US	010-07496	\$47,563
10560	48	4	8788	IGPlus10.0	010-07498	\$64,210	

# SolarWorld

## Sunkit Grid-Tie PV Power Systems

SolarWorld Sunkits provide complete solar electric systems for any sloped roof. The Sunkit consists of high quality SolarWorld monocrystalline Sunmodules, a high quality inverter, and the mounting components. They ensure highly durable systems by using only aluminium and stainless steel components. Each Sunkit is individually assembled to meet the customer's specific requirements. Systems are available in sizes from 2,070 watts and up by increments of 230 watts.

SolarWorld Sunkits include all major PV system components, including solar modules, mounting rails and hardware, inverters, grounding lugs and PV jumper cables as well as mechanical and electrical layout drawings. They do not provide common AC electrical items, such as EMT, breakers, or common building materials such as roof flashings, cement and conduit. Pricing is based on STC DC watts (also called "nameplate watts"). This is intended to simplify the pricing of system installations. Their standard module is a 230W Sunmodule. Changes to inverter capacity, hardware or other components based on installation requirements are included in the \$/watt price.

SolarWorld makes Sunmodules entirely in the USA from American-made raw materials and components.



SolarWorld Sunkits - order watts required in multiples of 230			
System description	Wattage range	Item code	Price per watt
Small systems	2,070 to 2,990	010-08001	\$4.65
Medium systems	3,220 to 14,950	010-08002	\$4.51
Large systems	15,180 or more	010-08003	\$4.33

# ADVERTISEMENT



# AEE Solar

## Grid-Tie PV 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, and 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 bank determines the amount of backup power available during a power failure. Use the worksheet on page 10 to determine battery bank size. Battery backup systems qualify for the California Energy Commission incentives and the federal tax credit.

The OutBack SmartRE systems come with a SmartRE battery enclosure and batteries. Order a battery pack below for the Schneider/Xantrex systems. Schneider Xantrex systems are for indoor mounting only. OutBack SmartRE systems can be mounting indoor or outdoor. See Inverter section, page 69 for more information about these inverters.



Grid-Tie Systems with Battery Backup (see table at bottom for batteries)

PV watts	Module quantity	Module brand & watts	System Description	Backup watts	Output VAC	Item code	Price
1000	5	Evergreen 200 watt	OutBack SmartRE 3000 with 4 Type 31 sealed batteries	3600	120	010-06725	\$14,346
3000	15	Evergreen 200 watt	OutBack SmartRE 3000 with 4 Type 31 sealed batteries	3600	120	010-06729	\$25,548
2850	15	Evergreen 200 watt	Xantrex XW4548 with 1 XW-MPPT60 charge controller	4500	120/240	010-07016	\$23,502
4560	24	Evergreen 200 watt	Xantrex XW4548 with 2 XW-MPPT60 charge controller	4500	120/240	010-07023	\$34,183
5700	30	Evergreen 200 watt	Xantrex XW6048 with 2 XW-MPPT60 charge controller	6000	120/240	010-07028	\$40,954
660	3	REC 220 watt	OutBack SmartRE 3000 with 4 Type 31 sealed batteries	3600	120	010-07033	\$12,184
2640	12	REC 220 watt	OutBack SmartRE 3000 with 4 Type 31 sealed batteries	3600	120	010-07039	\$22,785
5280	24	REC 220 watt	OutBack FLEXware system with two GVFX3648	7200	120/240	010-07046	\$38,064
3960	18	REC 220 watt	Xantrex XW4548 with 2 XW-MPPT60 charge controllers	4500	120/240	010-07052	\$28,485
5280	24	REC 220 watt	Xantrex XW6048 with 2 XW-MPPT60 charge controllers	6000	120/240	010-07057	\$36,003

Battery Packs for Xantrex/ Schneider Systems above

Watt-hours storage to 80% discharge	Battery quantity	System amp-hours	Battery model	Battery rack	Item code	Price
3750	4	98	MK S31-SLD-G	MidNite MNBE-B	010-07085	\$2,253
7500	8	196	MK S31-SLD-G	MidNite MNBE-B	010-07088	\$3,782
11250	12	294	MK S31-SLD-G	MidNite MNBE-C	010-07092	\$5,656



# REC Solar

## AE-US Series PV modules

The REC AE-US Series modules, made in Sweden by REC, are a series of high quality solar modules designed to meet system demand for exceptional performance.

### Quality and Performance

Rigorous quality control is applied throughout the production process, from cells to modules. Sixty 156 mm square multicrystalline solar cells in each module are optimized for low light conditions and increased light absorption. The modules have an innovative design that reduces shading effects in order to achieve maximum performance. A power output tolerance of -0/+5W guarantees minimum mismatch losses.

### Installation

REC AE-US Series allows for quick and easy installation. The modules are equipped with PV Wire cables with MC4 locking connectors for problem-free inter-module connection. Cables meet 2008 NEC requirements for use with transformerless inverters.

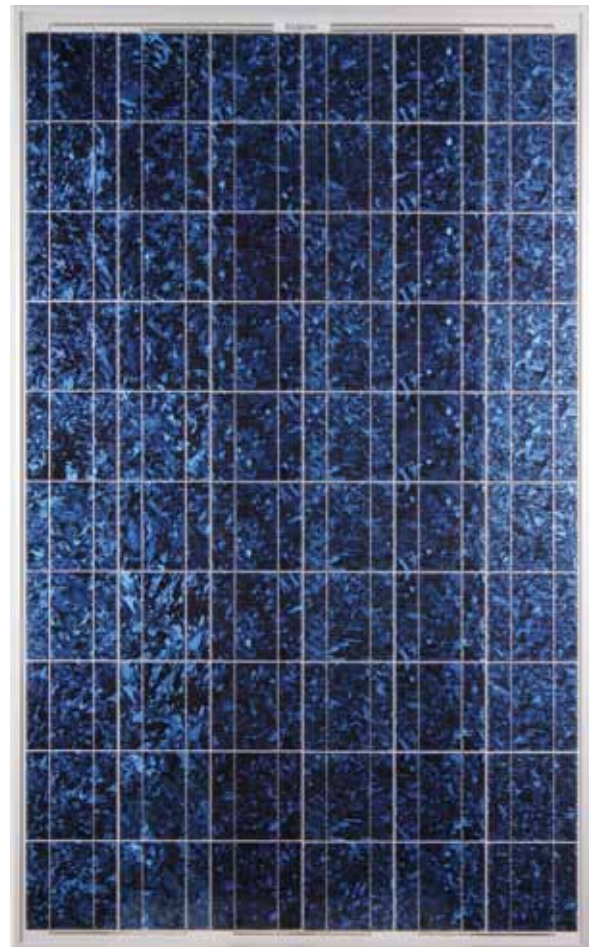
### Environmental Practices

The REC AE-US Series generates environmentally sound electricity. Cell and module production processes are designed to maximize recycling and reduce environmental impact. REC's wafers, cells and modules are produced within Scandinavia and the company's activities are therefore subject to very high standards of regulation regarding environmental standards.

### Warranty

The REC AE-US Series comes with a 63-month workmanship warranty and a guarantee of 90% of rated power output for 10 years, and 80% of rated power output for 25 years.

CSA Listed to UL 1703 for the U.S. and Canada. Please check wattage availability when ordering.



Technical data		
Cells	qty/size	60/156 mm
Power output tolerance		-0/+5W
Temperature <sub>NOCT</sub>	°C	48.6
Power temp coefficient	%/°C	-0.497
Voc temp coefficient	%/°C	-0.370
Fire rating	class	C
Connector type		MC4
Cable length	inch (m)	61 (1.55)
Load rating	lbs/ft <sup>2</sup>	112
Quantity per pallet		30
Quantity per 53-ft trailer		540

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### Warranty

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CSA Listed to UL 1703 for the U.S. and Canada. Please check wattage availability when ordering.

Module		REC205 AE-US	REC210 AE-US	REC215 AE-US	REC220 AE-US	REC225 AE-US	REC230 AE-US
Power STC (peak)	watts	205	210	215	220	225	230
Power PTC (CEC)	watts	178.2	182.7	187.2	191.7	196.2	200.7
Peak power voltage	volts	27.2	27.6	28.0	28.4	28.8	29.1
Peak power current	amps	7.6	7.6	7.7	7.8	7.8	7.9
Open circuit voltage	volts	36.0	36.1	36.3	36.4	36.6	36.8
Short circuit current	amps	8.3	8.3	8.3	8.4	8.4	8.4
Max. system voltage	volts	1000V (UL 600V)					
Series fuse rating	amps	15					
Length	inch (mm)	65.55 (1665)					
Width	inch (mm)	39.02 (991)					
Depth	inch (mm)	1.7 (43)					
Weight	lbs (kg)	48.5 (22)					
Item code w/clear anodized frame		011-02537	011-02538	011-02539	011-02540	011-02541	011-02542
Price		\$1,025	\$1,050	\$1,075	\$1,100	\$1,125	\$1,150
Item code w/black anodized frame		011-02531	011-02532	011-02533	011-02534	011-02535	011-02536
Price		\$1,035	\$1,060	\$1,085	\$1,110	\$1,135	\$1,160

# REC Solar

## NEW! PE-US Series PV modules

The REC PE-US Series modules, made by REC in Singapore, are a series of high quality solar modules designed to meet system demand for exceptional performance.

### Quality and Performance

Rigorous quality control is applied throughout the production process, from cells to modules. Sixty acid-etched, 3-busbar, 156 mm square multicrystalline solar cells laminated behind high-transparency glass with an anti-reflective surface treatment give these modules an efficiency of up to 14.2%. A power output tolerance of -0/+5W guarantees you the power you pay for and minimum mismatch losses.

The REC PE-US Series modules are made with silicon refined in the U.S. using renewable energy. Their energy payback is under one year and their cell and module production processes are designed to maximize recycling and reduce environmental impact.

### Installation

The comparatively low weight (39.6 lbs/18 kg) of the REC PE-US Series allows for quick and easy installation. The modules are equipped with an environmentally sealed junction box and PV Wire cables with MC4 locking connectors for problem-free inter-module connection. Cables meet 2008 NEC requirements for use with transformerless inverters.

### Warranty

The REC PE-US Series modules come with a 63-month workmanship warranty and a guarantee of 90% of rated power output for 10 years, and 80% of rated power output for 25 years.



Technical data		
Cells	qty/size	60/156 mm
Power output tolerance	W	-0/+5
Fire rating	class	C
Connector type		MC4
Cable length	inch (m)	+ 35 (0.9) + 47 (1.2)
Design load (UL 1703)	lbs/ft <sup>2</sup>	75
Quantity per pallet		40
Quantity per 53-ft trailer		760

Module		REC215 PE-US	REC220 PE-US	REC225 PE-US	REC230 PE-US	REC235 PE-US
Peak power	watts	215	220	225	230	235
Peak power voltage	volts	28.3	28.7	29.1	29.4	29.8
Peak power current	amps	7.6	7.7	7.7	7.8	7.9
Open circuit voltage	volts	36.3	36.6	36.8	37.1	37.4
Short circuit current	amps	8.1	8.2	8.2	8.3	8.3
Max. system voltage	volts	1000V (UL 600V)				
Series fuse rating	amps	15				
Length	inch (mm)	65.55 (1665)				
Width	inch (mm)	39.02 (991)				
Depth	inch (mm)	1.5 (38)				
Weight	lbs (kg)	39.6 (18)				
Item code	Clear anodized frame	011-02562	011-02563	011-02564	011-02565	011-02566
Price		\$1,075	\$1,100	\$1,125	\$1,150	\$1,175
Item code	Black anodized frame	011-02572	011-02573	011-02574	011-02575	011-02576
Price		\$1,085	\$1,110	\$1,135	\$1,160	\$1,185

# Evergreen Solar

## ES-A Modules

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

### Performance

- Maximum power up to 5W above rated
- Anti-reflection cover glass delivers more energy
- A rigid, double-walled, deep frame with integrated water drainage holes
- Crimped frame corners – no screws to loosen
- Sealed junction box on ES-A modules never needs field maintenance

### Environmental Credentials

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

PV modules produced by Evergreen Solar are distinctive in their appearance because they incorporate a 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.

Evergreen ES-A modules utilize three parallel strings of 38 cells in series giving an 18-volt peak power voltage which allows fewer strings in grid-tie systems and also provides optimum voltage for battery charging with conventional as well as MPPT charge controllers. They have Multi-Contact MC4 locking connectors, PV Wire, and black anodized frames. Made in USA.

Evergreen modules are ETL listed to UL 1703 for U.S. and Canada. Modules have a 10-year 90% power warranty, 25-year 80% power warranty.



Technical data		ES-A
Power output tolerance		-0/+5W
Temperature <sub>NOCT</sub>	°C	45.4
Power temp coefficient	%/°C	-0.43
Open circuit voltage	%/°C	-0.31
Fire rating	class	C
Connector type		MC4
Cable length	inch (m)	42.1 (1.07)
Load rating	lbs/ft <sup>2</sup>	60
Quantity per pallet		28
Quantity per 53-ft trailer		504

Module		ES-A-200-FA3	ES-A-205-FA3	ES-A-210-FA3
Power - STC (peak)	watts	200	205	210
Power - PTC	watts	180.7	185.4	190
Peak power voltage	volts	18.1	18.2	18.3
Peak power current	amps	11.05	11.27	11.48
Open circuit voltage	volts	22.6	22.7	22.8
Short circuit current	amps	11.8	11.93	12.11
Max. system voltage	volts	600	600	600
Series fuse rating	amps	20		
Length	inch (mm)	65.0 (1651)		
Width	inch (mm)	37.5 (953)		
Depth	inch (mm)	1.8 (46)		
Weight	lbs (kg)	42.0 (19.1)		
Item code		011-05356	011-05358	011-05360
Price		\$1,000	\$1,025	\$1,050



# Mitsubishi Solar

## PV-Series Modules

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 Manufacture

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.

The 185-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.

These modules use 156mm square poly-crystalline cells behind tempered glass with anodized aluminum frames, and Multi-Contact MC4 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 MC4 locking connector output cables and are optimized for 12-volt battery charging.

### Environmental Commitment

From their manufacturing process to their recyclable packaging, Mitsubishi has made a commitment to protect the environment. They use 100% lead-free solder in all of their modules and they are ISO 14001 certified for eco-friendly manufacturing processes, minimal cardboard packaging and recyclable steel pallets.

### Warranty

Made in Japan. UL Listed. 10-year 90% power warranty, 25-year 80% power warranty.



Technical data		PV-UE125	PV-UD	PV-UJ
Cells	qty	36	50	60
Power output tolerance		-3/+3	-3/+3	-3/+3
Temperature <sub>NOCT</sub>	°C	47.5	47.5	47.5
Power temp coefficient	%/°C	-0.452	-0.452	-0.452
Voc temp coefficient	%/°C	-0.343	-0.343	-0.343
Fire rating	class	C	C	C
Connector type		MC4	MC4	MC4
Cable length	inch	(+)31.5/(-)49.2	(+)31.5/(-)49.2	40
Load rating	lbs/ft <sup>2</sup>	75	112	112
Quantity per pallet		20	18	20
Quantity per 53-ft trailer		800	648	760

Module		PV-UE125MF5N	PV-UD185MF5	PV-UD190MF5	PV-UJ225GA6	PV-UJ230GA6
Peak power	watts	125	185	190	225	230
Peak power voltage	volts	17.3	24.4	24.7	30.0	30.2
Peak power current	amps	7.23	7.58	7.71	7.50	7.62
Open circuit voltage	volts	21.8	30.6	30.8	36.4	36.6
Short circuit current	amps	7.9	8.13	8.23	8.30	8.39
Max. system voltage	volts	600	600		600	
Series fuse rating	amps	15	15		15	
Frame color		black	black		black	
Length	inch (mm)	58.9 (1495)	65.3 (1658)		65.3 (1658)	
Width	inch (mm)	26.5 (674)	32.8 (834)		39.1 (994)	
Depth (120W incl j-box)	inch (mm)	1.8 (46)	1.8 (46)		1.8 (46)	
Weight	lbs (kg)	29.8 (13.5)	37 (17)		44 (20)	
Item code		011-08827	011-08867	011-08869	011-08874	011-08875
Price		\$690	\$953	\$978	\$1,144	\$1,170

# SolarWorld



## NEW! SW220, 225, 230, and 240 Sunmodules

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 USA since 1977. The factory, originally opened by ARCO Solar, later sold to Siemens Solar and then Shell, was purchased by SolarWorld in 2006.

Headquartered in Camarillo, CA, SolarWorld California maintains ingot and cell production in their new plant in Hillsboro, OR, and module production facilities in the Camarillo facility. SolarWorld California modules are made in the USA ensuring high quality, performance and output. SolarWorld California is the largest manufacturer of solar modules in the U.S.

### Plus-sorting

SolarWorld's plus-sorting method ensures that you receive the watts you pay for. Every module is factory flash tested (at standard test conditions) to determine the peak rated power output, then sorted in 5 watt bin increments. SolarWorld's power rating accounts for initial light-induced degradation (LID) so there are no surprises after installation.

With plus-sorting, SolarWorld only delivers modules that have equal to or greater than the nameplate rated power.

### Construction and Performance

These SolarWorld PV modules are designed for use in high-voltage grid-tie applications, using 60 six-inch semi-square single-crystalline cells in series behind tempered glass. They feature clear- or black-anodized aluminum frames and a sealed junction box with bypass diodes and Multi-Contact MC4 locking connector and PV Wire output cables.

The Sunmodule is certified to meet or exceed the safety and design requirements of UL 1703 and IEC 61215. All U.S. Sunmodules are produced in the ISO 9001:2000 certified Camarillo, California facility. SolarWorld offers end-of-life module recycling for all Sunmodules.

Sunmodules have a +/-3% power tolerance.

SolarWorld bonds the tempered glass laminate deep into the aluminum frame with a continuous bead of silicone adhesive. This method guarantees exceptional rigidity for the entire module and prevents the frame from loosening or pulling away from the glass caused by sliding of heavy snow or handling. Tests carried out in accordance with IEC 61215, which applies loads of up to 113 lb/sf (5.4 kN/m<sup>2</sup>), demonstrate that the module can withstand the high loads that accompany heavy accumulations of snow and ice.

### Warranty

Sunmodules have a 10-year 90% power warranty and 25-year 80% power warranty. UL Listed for the U.S. and Canada.



#### Technical data

Cells	qty/size	60/156 mm
Power tolerance		-3/+3%
Temperature <sub>NOCT</sub>	°C	46
Power temp coefficient	%/°C	-0.45
Open circuit voltage	%/°C	-0.33
Fire rating	class	C
Connector type		MC4
Cable length	inch (m)	37.4 (0.95)
Load rating (UL)	lbs/ft <sup>2</sup>	113
Quantity per pallet		30
Quantity per 53-ft trailer		540

Module		SW 220 mono	SW 225 mono	SW 230 mono	SW 240 mono
Peak power	watts	220	225	230	240
Peak power voltage	volts	29.4	29.7	30.0	37.6
Peak power current	amps	7.50	7.59	7.68	7.87
Open circuit voltage	volts	37.2	37.3	37.4	37.6
Short circuit current	amps	8.10	8.13	8.16	8.22
Max. system voltage	volts	600			
Series fuse rating		15A			
Length	inch (mm)	65.94 (1675)			
Width	inch (mm)	39.41 (1001)			
Depth	inch (mm)	1.34 (34)			
Weight	lbs (kg)	48.5 (22)			
Item code - clear frame		011-02286		011-02288	011-02293
Price		\$1,100		\$1,150	\$1,200
Item code - black frame		011-02290	011-02291	011-02292	
Price		\$1,120	\$1,145	\$1,170	

ADVERTISEMENT

# SCHOTT Solar



## NEW! SCHOTT POLY Solar Modules

SCHOTT Solar is a world leader in the photovoltaic industry with more than 50 years of experience in the development and production of quality components for solar applications. The company has been in business for 125 years. The polycrystalline cells within each module are sorted to narrow performance tolerances, thereby allowing series interconnections with minimal mismatch losses.

SCHOTT bulk packs modules to reduce job site waste and disposal costs. Available with black or clear anodized frames, SCHOTT modules have PV Wire type cables for use with transformerless inverters.

### Output Tolerance

SCHOTT Solar POLY modules are among the industry leaders in power output tolerances. Produced in a facility in Albuquerque, NM, these modules are available in 4 wattages, with minus 0 watts output tolerance. This provides for a stable, high-energy output.

### Warranty

2-year workmanship warranty and 10-year 90% power warranty and 25-year 80% power warranty.

CSA Listed to UL 1703 for U.S. and Canada. CEC approved.



#### Technical data

Cells	qty/size	60/156 mm
Power tolerance	%	-0/+5%
Power temp coefficient	%/°C	-0.47
Open circuit voltage	%/°C	-0.334
Fire rating	class	C
Connector type		Tyco
Cable length	inch (m)	43.3 (1.1)
Load rating	lbs/ft <sup>2</sup>	75
Quantity per pallet		30
Quantity per 53-ft trailer		540

SCHOTT POLY module		210	217	220	225
Power STC (peak)	watts	210	217	220	225
Power PTC (CEC rating)	watts	184.4	191.2	193.9	198.4
Peak power voltage	volts	29.3	29.6	29.7	29.8
Peak power current	amps	7.16	7.33	7.41	7.55
Open circuit voltage	volts	36.1	36.4	36.5	36.7
Short circuit Current	amps	7.95	8.10	8.15	8.24
Max. system voltage	volts	600			
Series fuse rating	amps	15			
Length	inch (mm)	66.34 (1685)			
Width	inch (mm)	39.09 (993)			
Depth	inch (mm)	1.97 (50)			
Weight	lbs (kg)	50.6 (23)			
<b>Item code - silver frame</b>		<b>011-04533</b>	<b>011-04534</b>	<b>011-04535</b>	<b>011-04536</b>
<b>Price</b>		<b>\$1,050</b>	<b>\$1,085</b>	<b>\$1,100</b>	<b>\$1,125</b>
<b>Item code - black frame</b>		<b>011-04537</b>	<b>011-04538</b>	<b>011-04539</b>	<b>011-04540</b>
<b>Price</b>		<b>\$1,070</b>	<b>\$1,105</b>	<b>\$1,125</b>	<b>\$1,145</b>

# Kyocera

## KD Series Modules

Kyocera KD series modules have locking MC4 cables and black anodized frames for clean looking grid-tie installations. The 135-watt module has 36 cells and can be used for grid tie or off-grid applications.

New frame technology on the KD-LPU modules allows for end mounting with 2400 Pa (50 psf) or wind speeds of 130 mph (ASTM E1830) and traditional mounting with 5400 Pa (113 psf) to support increased snow load. Because of Kyocera's high cell efficiency, they use 54 cells in their large grid-tie modules where most competitors use 60. This makes their module efficiency higher, but does not allow them to be used with Enphase inverters.

## KC-T Series Modules

Kyocera KC-T Series off-grid modules are ideal for charging storage batteries to power remote homes, recreational vehicles, telecommunications systems, and other consumer and commercial applications. Kyocera KC-T series modules have an industrial-grade junction box that allows the use of nominal half-inch conduit fittings. They are available as 85-watt, 65-watt and 50-watt modules used for 12-, 24- and 48-volt battery charging. These modules are rated class 1, division 2 for hazardous locations.

All Kyocera modules feature extremely sturdy frames, tempered low-reflection glass covers, built-in bypass diodes and a 20-year power output warranty. UL Listed. Made in Japan or Mexico.



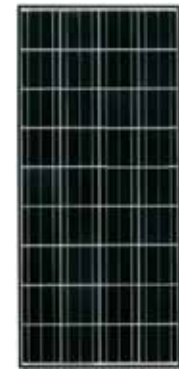
KC65T



KD205GX-LPU



KC85T



KD135GX-LPU

Technical data		KC- series	KD135GX-LPU	KD2xx-LPU	KD235-LB
Cells	qty	36	36	54	60
Power output tolerance		-5/+10	-5/+5	-0/+5	-0/+5
Temperature <sub>NOCT</sub>	°C	47	47.9	47.9	47.9
Power temp coefficient	%/°C	-0.480	-0.490	-0.490	-0.490
Voc temp coefficient	%/°C	-0.369	-0.359	-0.361	-0.361
Fire rating	class	C	C	C	C
Connector type		J-Box	MC4	MC4	MC4
Cable lengths	inch +/-	n/a	29.9(760) / 72.4(1840)		+40.6 / - 32.7
Load rating	lbs/ft <sup>2</sup>	75	113	113	113
Quantity per pallet		20	20	20	20
Quantity per 53-ft trailer		n/a	760	760	760

Kyocera module		KC50T	KC65T	KC85T	KD135GX-LPU	KD205GX-LPU	KD210GX-LPU	KD215GX-LPU	KD235GX-LB
Power STC (peak)	watts	50	65	87	135	205	210	215	235
Power PTC (CEC)	watts	n/a	n/a	n/a	119.4	180	184.6	189.1	1
Peak power voltage	volts	17.4	17.4	17.4	17.7	26.6	26.6	26.6	29.8
Peak power current	amps	3.11	3.75	5.02	7.63	7.71	7.90	8.09	7.89
Open circuit voltage	volts	21.7	21.7	21.7	22.1	33.2	33.2	33.2	36.9
Short circuit current	amps	3.31	3.99	5.34	8.37	8.36	8.58	8.78	8.55
Max. system voltage	volts	600	600	600	600	600			
Series fuse rating					15	15			
Nominal voltage	volts	12	12	12	12	n/a			
Length	inch (mm)	25.2 (639)	29.6 (751)	39.6 (1007)	59.1 (1501)	59.1 (1500)			65.4 (1662)
Width	inch (mm)	25.7 (652)	25.7 (652)	25.7 (652)	26.3 (668)	39.0 (990)			39.0 (990)
Depth (including j-box)	inch (mm)	2.125 (54)	2.125 (54)	2.125 (54)	1.8 (46)	1.8 (46)			1.8 (46)
Weight	lbs	11	13.2	18.3	28.6	39.7			35.3
Item code		011-07719	011-07722	011-07725	011-07752	011-07765	011-07766	011-07754	011-07769
Price		\$400	\$504	\$635	\$890	\$1,035	\$1,060	\$1,085	\$1,186



# SANYO

## HIT Power N Series Modules

SANYO HIT N Series solar cells are hybrids of mono crystalline silicon surrounded by ultra-thin amorphous silicon layers, and are available solely from SANYO.

### Efficiency

HIT N Series solar cells efficiency is as high as 19.3% and module efficiency is as high as 17.1%. With this high sunlight conversion efficiency, you can obtain maximum power within a fixed amount of space. Save money using fewer system attachments and racking materials, and reduce costs by spending less time installing per watt. HIT Power N Series models are ideal for grid-connected solar systems, areas with performance based incentives, and renewable energy credits.

### Performance

SANYO's power ratings for HIT Power modules guarantee customers receive 100% of the nameplate rated power (or more) at the time of purchase, enabling owners to generate more kWh per rated watt.

Unique eco-packing minimizes cardboard waste at the job site. The packing density of the modules reduces transportation, fuel, and storage costs per installed watt.

As temperatures rise, HIT Power N solar modules produce 10% or more electricity (kWh) than conventional crystalline silicon solar modules at the same temperature.

SANYO silicon wafers in HIT Power N solar modules are made in California and Oregon, and the modules are assembled in an ISO 9001 (quality), 14001 (environment), and 18001 (safety) certified factory.

### Warranty

The modules have a limited 20-year power output and 5-year product workmanship warranty. UL Listed for the U.S. and Canada



Technical data			Module		HIP-205NKHA6	HIP-210NKHA6	HIP-215NKHA6
Power output tolerance		-0/+10	Power - STC (peak)	watts	205	210	215
Temperature <sub>NOCT</sub>	°C	46	Power - PTC	watts	190.1	194.8	199.6
Power temp coefficient	%/°C	-0.336	Peak power voltage	volts	40.7	41.3	42.0
Open circuit voltage coefficient.	%/°C	-0.143	Peak power current	amps	5.05	5.09	5.13
Fire rating	class	C	Open circuit voltage	volts	50.3	50.9	51.6
Connector type		MC4	Short circuit current	amps	5.54	5.57	5.61
Cable length + / -	inch	40.55/34.6	Max. system voltage	volts	600	600	600
Load rating	lbs/ft <sup>2</sup>	60	Series fuse rating	amps	15		
Quantity per pallet		32	Length	inch (mm)	62.2 (1580)		
Quantity per 53-ft trailer		952	Width	inch (mm)	31.4 (798)		
			Depth	inch (mm)	1.8 (46)		
			Weight	lbs (kg)	35.3 (16)		
			Item code		011-00126	011-00127	011-00128
			Price		\$1,230	\$1,260	\$1,290

## AEE Solar

### Battery Charging Modules

The AE-HE Series photovoltaic modules provide cost-effective photovoltaic power for DC loads with moderate energy requirements. They charge batteries efficiently in virtually any climate. These modules are made with back-contact 18-20% efficient monocrystalline cells laminated behind tempered glass with aluminum frames, offering the smallest footprint available for this size module.

They have an industrial-grade conduit-ready junction box on the back that has knockouts for two standard half-inch conduit fittings. Typical commercial applications of these modules include remote telemetry, instrumentation systems, security sensors, signals, and land-based navigation aids. They have a 10-year power output warranty. Made in China.



Module		AE-120HE	AE-90HE	AE-80HE	AE-60HE	AE-50HE	AE-30HE
Peak power	watts	120	90	80	60	50	30
Number of cells		36	32	32	36	36	36
Peak power voltage	volts	18.90	17.60	17.60	18.90	17.4	18.90
Peak power current	amps	6.34	5.12	4.55	3.20	2.89	1.60
Open circuit voltage	volts	23.8	21.4	21.4	23.8	23.3	23.8
Short circuit current	amps	7.10	5.50	4.89	3.57	3.43	1.78
Length	inch (mm)	42.6 (1082)	40.83 (1037)	40.83 (1037)	31.10 (790)	24 (610)	21.89 (556)
Width	inch (mm)	31.3 (796)	20.75 (527)	20.75 (527)	21.10 (536)	21.10 (536)	16.38 (416)
Depth	inch (mm)	1.38 (35)	1.38 (35)	1.38 (35)	1.38 (35)	1.38 (35)	1.38 (35)
<b>Item code</b>		<b>011-08466</b>	<b>011-08463</b>	<b>011-08460</b>	<b>011-08455</b>	<b>011-08454</b>	<b>011-08443</b>
<b>Price</b>		<b>\$720</b>	<b>\$585</b>	<b>\$520</b>	<b>\$400</b>	<b>\$350</b>	<b>\$230</b>

### Small Off-Grid Modules

AEE small off-grid modules provide cost-effective photovoltaic power for DC loads with minimal energy requirements. They charge batteries efficiently in virtually any climate. These modules are made with multicrystalline cells laminated behind tempered glass. They have a small junction box on the back with screw terminals for wire connections. Typical commercial applications of these modules include remote telemetry, instrumentation systems, security sensors, signals, and land-based navigation aids. They have a 10-year power output warranty. Made in China.



Module		AEE-20	AEE-10	AEE-5
Peak power	watts	20	10	5
Peak power voltage	volts	17.3	17.3	17.3
Peak power current	amps	1.16	0.58	0.29
Open circuit voltage	volts	21.6	21.6	21.6
Short circuit current	amps	1.29	0.64	0.32
Length	inch (mm)	20.9 (530)	14.6 (370)	11.8 (300)
Width	inch (mm)	13.8 (350)	10.6 (270)	7.5 (190)
Depth	inch (mm)	1.0 (25)	0.7 (18)	0.7 (18)
Weight	lbs (kg)	5.4 (2.45)	2.54 (1.15)	1.54 (0.7)
<b>Item code</b>		<b>011-08603</b>	<b>011-08602</b>	<b>011-08601</b>
<b>Price</b>		<b>\$140</b>	<b>\$70</b>	<b>\$40</b>

# SnapNrack

## Roof Mounting System

SnapNrack was developed by a team of veteran solar engineers working with installers in the field, dedicated to overcoming the limitations of conventional racking and ensuring a quick, efficient installation. It simplifies and reduces the cost of the solar installation process.

SnapNrack is a top-down roof mounting solution, load tested and engineered for up to 150 mph wind speeds and 100 psf snow loads. See [www.snapnrack.com](http://www.snapnrack.com) for full details.

SnapNrack is compatible with modules from virtually any manufacturer. Snap-in sliding channel nuts ensure quick and easy installation and precise alignment. Mid-clamps are a half-inch wide to keep the math simple. Every bolt in the system uses the same size wrench, ensuring efficient installation and reducing man-hours on the roof during installation. And there's no need to drill any holes in the rails to connect standoffs and L-feet. The channels in the rail profiles can house running module leads, providing better aesthetics and improved conductor protection.

SnapNrack is engineered for durability and structural integrity in all environments, with excellent seismic, wind, and snow loading protection. Its compact and efficient rail design reduces material requirements and ensures a low profile installation on your roof.

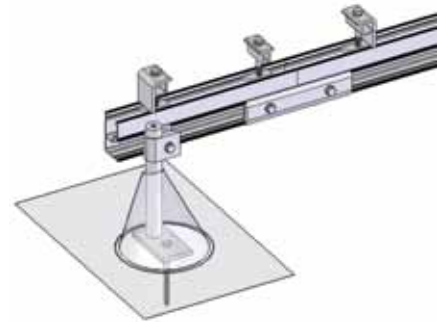
SnapNrack standoffs are height-adjustable to ensure a clean, level installation on even the most uneven roof surface. Tilt-up can be achieved with pieces of cut rail and L-feet.

Rails and components have a 10-year warranty.

You can order complete kits below, or bulk components on the following pages.



Weather-tight flashing and standoffs for tilt applications



## SnapNrack Tilt Leg Kits

Tilt angles from 0 to 15 degrees can be configured without legs by simply using SnapNrack standoffs. Use a 5-1/2 inch standoff for the lower rail and a 7-inch standoff for the upper rail. This allows adjustability for shallow tilts.

Tilt angles from 10 to 45 degrees can be configured by using standoffs for both upper and lower rails and adding an extension to the standoff supporting the upper rail using a scrap of rail cut to the appropriate length and drilled with two holes. Calculate the length of the upper rail standoff extension to provide the desired module tilt angle. Tilt leg rails can be cut and drilled in advance to save time on the job site. A simple drill guide will help with locating the holes in the tilt leg.

If the length of the cut rail exceeds 4 feet, consult a structural engineer before proceeding.

Order one tilt-leg hardware kit for each tilt leg required. It contains all the front and rear rail hardware needed for each leg, but does not include standoffs and rail needed to make the legs. Order those items separately.



Universal End Clamp allows rails to be cut flush with the end of the modules

## SnapNrack Universal Roof Mount Kits

SnapNrack universal roof mount kits include black anodized rail, Universal End Clamps (UEC), black mid clamps and black rail end caps so they are suitable for use with black and clear framed modules. The unique universal end clamp is not dependent on module frame depth like typical end clamps because they clamp the bottom of the module frame to the rail. This provides a very strong connection and give a finished look to the end of the mounting rails.

These kits will work for the number of modules listed in the table on the next page for all of the 200 to 235 watt modules listed in this catalog and any other brand of modules with a width of 39.5" or less. Cutting of aluminum rail may be required.

The roof attachment parts are sold separately and depend on the type of roof that the mounting structure is being attached to. See page 30 for SnapNrack roof attachment components.



### SnapNrack Universal Roof Mount Kits

Module Quantity	Package dimensions L" x W" x D"	Item code	Price
3	126 x 4 x 4	015-09950	\$215
4	166 x 4 x 4	015-09951	\$280
5	126 x 4 x 4	015-09952	\$369
6	126 x 4 x 8	015-09953	\$435
7	166 x 4 x 8	015-09954	\$500
8	166 x 4 x 8	015-09955	\$565
9	166 x 4 x 8	015-09956	\$655
10	166 x 4 x 8	015-09957	\$719

## SnapRack Bulk Parts

Rails, clamp sets and roof attachment parts are sold separately below, and on the next page.

### Rail Sets

Rails are sold in pairs, as rail sets, offered in two lengths to simplify ordering. The 122-inch rail set accommodates a single row of 3 modules in the 200-watt range. The 162-inch rail set will accommodate four modules in the 200 watt range. The chart below shows which rails and how many splice kits to use based on the number of modules to be installed in a single row. All of the 200 watt modules in this catalog are 39.5 inches wide or less. If you are installing 5 module rows, each row will use one 122 inch rail set and half of a 162 inch rail set. For other module widths, calculate rail length for your installation and remember to add 1/2" between modules for mid clamp spacing. These light-weight aluminum rails can be cut with a chop saw or circular saw with a carbide blade, a saber saw with a metal cutting blade, or a hack saw.



Rail sets and splice kits to order	Item code		Number of modules in a row						
	Clear	Black	3	4	5 - 6	7	8	9	10
No. of 122-inch rail sets to order	015-09814	015-09816	1	0	2	1	0	3	2
No. of 162-inch rail sets to order	015-09817	015-09818	0	1	0	1	2	0	1
Splice kits to order	015-09961	n/a	0	0	2	2	2	4	4

Standard Rail Set Prices					
Description	Fits quantity of modules	Clear aluminum		Black anodized	
		Item code	Price	Item code	Price
SnapRack standard rail set 122" - clear	3 module	015-09814	\$132	015-09816	\$163
SnapRack standard rail set 162" - clear	4 module	015-09817	\$176	015-09818	\$217
Rail cut fee includes splice kit (for UPS shipping)		015-09829	\$30	015-09829	\$30
Splice kit - single bar with hardware		015-09961	\$9	015-09963	\$13

### Standard Top-Mount Clamp sets for fastening the PV modules to the rail

For each row of modules we suggest you buy a 3-module clamp set plus two additional mid clamps for each additional module in the row. Choose your clamps based, first, on the module frame thickness and then on the quantity of modules to install. SnapRack clamps are available individually, in bulk packs, and in a 3-module clamp set. You can also buy bulk end clamps and mid clamps on the next page. See the examples below.

Example 1: Evergreen ES-A-200 modules have a 1.8-inch thick frame. Eight (8) ES-A-200 modules require a 1.8-inch 3-module set (item code 015-09929) and 10 mid clamps (item code 015-09903, or one 12-pack item code 015-09904).

Example 2: REC 210-230 AE-US modules have a 1.69-inch thick frame. Seven (7) REC215 AE-US modules require a 1.69-inch 3-module set and 8 mid clamps.

3-Module Clamp Sets w/ bolts & nuts					
Frame depth	Modules	Clear aluminum		Black anodized	
		Item code	Price	Item code	Price
1.34"	SolarWorld SW230	015-09910	\$22	015-09911	\$27
1.40"	AE-HE Series	015-09916	\$22	015-09917	\$27
1.50"	REC PE-US	015-09951	\$22	015-09952	\$27
1.60"		015-09920	\$22	015-09953	\$27
1.69"	REC AE-US	015-09925	\$22	015-09925	\$27
1.80"	Evergreen ES-A, Mitsubishi, Kyocera GX-LP & GX-LPX, SANYO N Series	015-09929	\$22	015-09931	\$27
1.97"	SCHOTT POLY	015-09934	\$22	015-09937	\$27





### SnapRack Bulk SnapRack Module Top Clamps

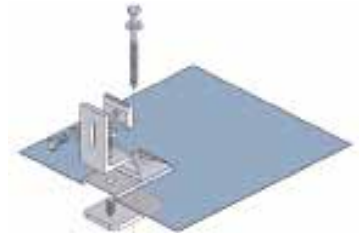
Order bulk clamps from the table below. For each row of modules, you will need 2 mid-clamps for each space between two modules in the row, and 4 end-clamps. For example, a four-module row would need 6 mid clamps. Use end clamps that match the module frame thickness or use Universal End Clamps for any module with a typical internal L-frame.



Bulk Module Clamps w/ bolts & nuts										
Description	Frame depth	Modules	Clear aluminum				Black anodized			
			Single pieces		12 pack		Single piece		12 pack	
			Item code	Price	Item code	Price	Item code	Price	Item code	Price
Mid clamp	< 2"		015-09903	\$4	015-09904	\$29	015-09906	\$6	015-09907	\$37
Mid clamp	2" +		015-09905	\$4	015-09902	\$29	015-09871	\$6	015-09872	\$37
Universal end clamp	All	All brands	015-09943	\$7	015-09944	\$75				
End clamp	1.34	SolarWorld	015-09909	\$4	015-09913	\$35	015-09912	\$7	015-09914	\$47
End clamp	1.4	AE-HE Series	015-09915	\$4	015-09873	\$35	015-09918	\$7	015-09874	\$47
End clamp	1.5	REC PE-US	015-09947	\$4	015-09948	\$35	015-09877	\$7	015-09878	\$47
End clamp	1.6		015-09921	\$4	015-09879	\$35	015-09924	\$7	015-09880	\$47
End clamp	1.69	REC AE-US	015-09923	\$4	015-09938	\$35	015-09922	\$7	015-09935	\$47
End clamp	1.8	Evergreen ES-A , Mitsubishi, Kyocera GX-LPU & GX-LB, SANYO N Series	015-09927	\$4	015-09928	\$35	015-09930	\$7	015-09940	\$47
End clamp	1.97	SCHOTT POLY	015-09933	\$4	015-09942	\$35	015-09936	\$7	015-09941	\$47
SnapRack splice kit - single bar with hardware			015-09961	\$9	015-09962	\$86	015-09963	\$13	015-09964	\$136
SnapRack rail end cap 12 piece - black rubber									015-09994	\$13
SnapRack rail cover clear - two 48" pieces			015-09995	\$17						
Tilt leg hardware kit - clear (2 L-foot with hardware)			015-09972	\$10						
SnapRack channel nut 12 pack (bolt not included)					015-09993	\$9				

### SnapRack Roof Attachment Components

We offer a variety of roof attachment components. Some may be used individually and others require a combination of components. For simple flush mount to a roof with composition shingles we recommend the Flashed L-foot. If the roof has tile or thick roofing material then you probably need a stand-off. The Standing Seam Clamp is designed to be used to attach rails to a standing seam metal roof and is to be used in conjunction with the SnapRack rail mounting system. The Corrugated Roof Block is for use with standard corrugated metal roofing. It spans across a ridge and provides a flat mounting surface for an L-foot.



Roof Attachment Parts								
Description	Clear aluminum				Black anodized			
	Single pieces		12 pack		Single pieces		12 pack	
	Item code	Price	Item code	Price	Item code	Price	Item code	Price
SnapRack L-foot - clear	015-09978	\$5	015-09977	\$45	015-09979	\$6	015-09980	\$54
SnapRack Flashed L-foot			015-09975	\$164	015-09985	\$17	015-09981	\$173
SnapRack standoff spacer 1"			015-09983	\$20				
SnapRack standoff - 5.5"	015-09973	\$17	015-09986	\$176				
SnapRack standoff - 7"	015-09974	\$19	015-09988	\$182				
Corrugated Roof Block for metal roofs			015-09989	\$83				
Oatey flashing #11830 12.5" x 8.75"	015-00162	\$10	014-00629	\$104				
Oatey flashing #11831 18" x 18" galv	015-00163	\$20						
Commercial Standing Seam Metal Roof Clamp								
Standing Seam Metal Roof Clamp	015-09945	\$9	015-09946	\$94				





# Unirac

## NEW! CLICKSYS Mounting System

Engineered for flush roof mounting applications, CLICKSYS is easily installed on most roofing types, including barrel and Spanish tiles. The unique I-beam design of CLICKSYS optimizes strength, eliminates excess material found in other systems, and offers a cost effective solution. With no drilling required and "click and secure" connections eliminating the need for nuts and bolts, CLICKSYS gets installers off the roof in less time when compared to other competitive products. 10-year warranty.

The 100-series aluminum support beams come in a mill finish, 144 inches long.

Flange connections snap on to support beams without the need of hardware or tools. The 1-flange connection is for use in conjunction with standoffs, Quick Mount PV, or when directly installing on composite shingles using a lag bolt. The 2-flange connections come with or without the integrated butyl backing and are designed to be secure beams to the roof using 3" Concealor screws. Concealor screws can be driven into the structure with a cordless drill with no need for pilot holes.

CLICKSYS Standoffs offer more elevation for greater airflow under a finished array. They are accompanied with all hardware needed including a 1 flange connection and lag bolts.

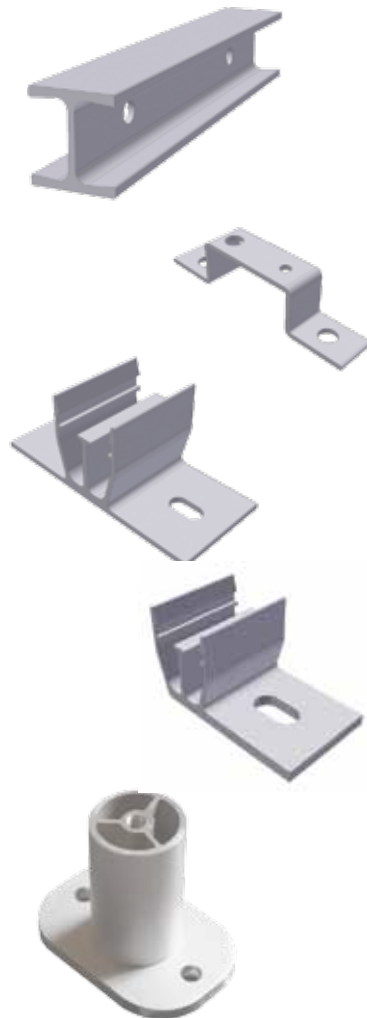
Quick Mount PV flashing is custom designed for CLICKSYS. Each flashing comes with 1 Flange Connection and lag hardware. This flashing provides a clear advantage over standard flashing techniques by increasing the height 3/4" and providing a faster installation.

### Sliders and Top Mounting Clamps

Sliders hold hex bolts in place while top mounting clamps securely grip any point of the module frame, freeing you from the constraints of module mounting holes. See page 34 for module frame sizes designated by letters A-K.

All components are sold in bulk quantities. See table below for quantities and pricing.

Unirac part #	CLICKSYS parts description	Quantity	Item code	Price
010144M-0050	Beam 100 Series 144"	50	014-04200	\$1,895
003020C-0048	Beam splice kit, clear	48	014-04230	\$97
003021C-0048	Beam splice kit, clear w/ grounding	48	014-04231	\$194
004000M-0048	Two flange connection w/ 3" screws	48	014-04210	\$419
004001M-0048	Two flange connection w/ 3" screws & butyl	48	014-04211	\$429
004010M-0048	One flange connection w/ lag bolt	48	014-04212	\$387
005003C-0024	3" standoff w/ one flange connection	24	014-04215	\$345
005004C-0024	4" standoff w/ one flange connection	24	014-04216	\$362
005006C-0024	6" standoff w/ one flange connection	24	014-04217	\$395
005007C-0024	7"standoff w/ one flange connection	24	014-04218	\$411
005020S-0018	QM flashing 9.5" x 12.5", SS, w/ one flange	18	014-04214	\$569
002001C-0048	End clamp A with slider	48	014-04240	\$133
002002C-0048	End clamp B with slider	48	014-04241	\$133
002003C-0048	End clamp C with slider	48	014-04242	\$133
002004C-0048	End clamp D with slider	48	014-04243	\$133
002005C-0048	End clamp E with slider	48	014-04244	\$133
002006C-0048	End clamp F with slider	48	014-04245	\$133
002009C-0048	End clamp J with slider	48	014-04246	\$133
002010C-0048	End clamp K with slider	48	014-04247	\$133
002026C-0048	Mid clamp A with slider	48	014-04250	\$133
002027C-0048	Mid clamp B-C with slider	48	014-04251	\$133
002028C-0048	Mid clamp D with slider	48	014-04252	\$133
002030C-0048	Mid clamp E-F-J - K with slider	48	014-04253	\$133
008000S-0050	UGC-2 grounding clip, SS, qty 50	50	014-04232	\$115



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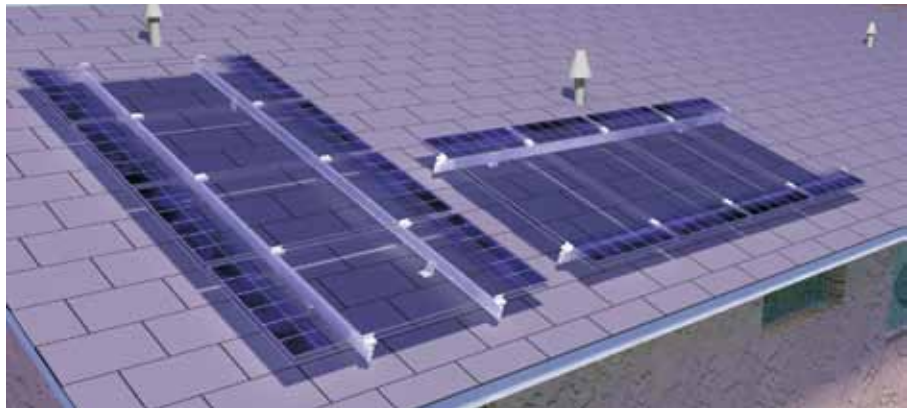
## SolarMount

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.

Once you've selected the PV modules and planned your installation layout, you're ready to choose SolarMount components. The table on the following page shows what components to use if you are bottom-mounting the modules. The table on page 34 shows what parts to use if you are top-mounting the modules. If you need tilt legs for the mounts, see the explanation on page 36. Rail and parts to complete your mounting system can be found on pages 35 to 37.

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 35 contain just the right quantities of each component for a given installation.

The 8-piece bulk rail bundles on page 35 require the addition of L-feet, and splices when necessary, along with top-mount clamps (either bulk or in pre-packaged sets) or back mount clips.



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.

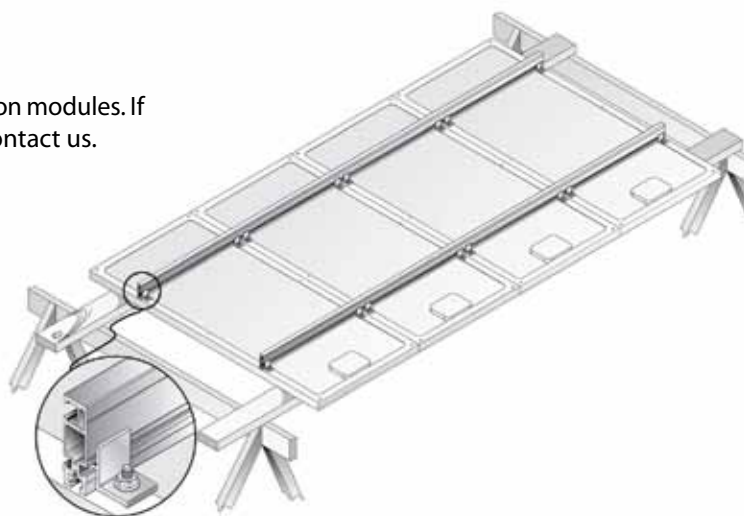
In roof mounts, when using top-mounting clamps, no extra roof bracing is needed since rails or mounting feet can be adjusted to match rafter spacing. With bottom-mounting clamps, spacing between the rails depends on spacing between the mounting holes of your particular PV module, and it is unlikely that they will match rafter spacing if rails are mounted parallel to rafters. 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.

## SolarMount Bottom-Mounting Sizing

### Rail set lengths

This table 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.

Order bulk bottom mount clips below.



Rail Length Sizing - Bottom Mount Clips												
Module brand and model		Rail length (inches) by number of modules per row										
		2	3	4	5	6	7	8	9	10	11	12
<b>AEE</b>	AE-80HE	48	72	96	120	132	156	180	192	216	240	264
<b>BP Solar</b>	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
<b>Evergreen</b>	ES-A series	84	120	156	192	216	264	312	348	384	420	
<b>Kyocera</b>	KD135GX-LP	60	84	106	132	156	180	216	240	264	288	312
	KD180GX-LP, KD205-210, 230	84	120	156	204	240	276	312	360	396	432	
<b>Mitsubishi</b>	UE125MF5N	60	84	120	144	168	204	240	252	276	300	324
	UD185MF5	72	106	132	168	204	240	264	300	336	372	408
	UJ6 series 212 to 235	84	120	168	204	240	276	324	360	396	432	
<b>REC Solar</b>	AE & PE series	84	120	168	204	240	276	324	372	408		
<b>SANYO</b>	HIT-205N, 210N, 215N	72	96	132	168	192	240	264	288	324	360	384
<b>SCHOTT</b>	POLY 217 to 232	84	120	156	192	226	264	312	348	384	420	
<b>Sharp Solar</b>	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
	ND-U216 to ND-U230	84	120	168	204	240	276	324	360	396	432	
<b>SolarWorld</b>	SW220 to 235	84	120	168	204	240	288	324	360	396		
<b>Suntech</b>	STP110 to 175	72	106	132	168	204	226	264	300	324	360	396
	STP190 to 210 & STP260 to 280	84	120	168	204	240	276	324	360	396		
<b>SunPower</b>	SPR200, 210, 215, 220	72	106	132	168	204	240	264	300	336	360	396

### 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.



### Cable Ties

Cable ties fit into 1/4-inch holes drilled along mounting rails.



Unirac part #	Description	Weight (lbs)	Item code	Price	Unirac #	Description	Quantity	Item code	Price
321002	20 ea. clips	5	014-00875	\$39	990104	100 ea. push mount cable ties	1	014-00895	\$12

# Unirac

## SolarMount Top-Mounting Sizing

### Clamp sizes & rail set lengths

Use this table 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 35 to 37 for pricing. All Unirac components have a 10-year product warranty and a 5-year finish warranty.



**Rail Length Sizing - Top Mounts**

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
AEE Solar	AE-80HE	D	48	72	96	120	144	156	180	204	226	252	264
	BP380, BP485	E	48	72	96	120	144	156	180	192	216	240	252
BP Solar	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	ES-A-200 to ES-A-210	F	84	120	156	204	240	276	312	360	396		
Kyocera	KD135GX-LP	C	60	84	120	144	168	192	216	252	276	300	324
	KD180GX-LP	C	84	132	168	204	252	288	324	372	408		
	KD180-230 GX-LPU, GX-LB	F	84	132	168	204	252	288	324	372	408		
Mitsubishi	UE125MF5N	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
	UD185MF5	F	72	106	144	180	216	240	276	312	348	384	420
	UJ6 series 212 to 235	F	84	132	168	204	252	288	324	372	408		
REC Solar	AE series	J	84	132	168	204	252	288	324	372	408		
	PE series	D	84	132	168	204	252	288	324	372	408		
SANYO	HIT-205N, 210N, 215N	F	72	106	144	168	204	240	276	312	336	360	396
SCHOTT	POLY 217 to 232	E	84	132	168	204	252	288	324	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-175UC1, NE-170U1, NE-185UC1	F	72	106	144	180	204	240	276	312	348	372	408
	ND-200U1 to ND224UC1 & NDU230C	F	84	132	168	216	252	288	336	372	408		
SolarWorld	SW220 to SW245	C	84	132	168	204	252	288	324	372	408		
SunPower	SPR200, 210, 215, 220	F	72	106	132	168	204	240	264	300	336	360	396
Suntech	STP110-24Ab, STP175-24Ab1	C	72	106	144	168	204	240	276	300	336	372	396
	STP190 to 210 & STP260 to 280	E	84	132	168	204	252	288	324	372	408		

## SolarMount Standard Rail Kits

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 table on this page for arrays with top mounting clamps, or the table on page 33 for arrays with bottom mounting clips. Rails, L-feet, and splices are clear-anodized.

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



## 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 and splices to connect them together.

Two-Rail Unirac SolarMount Kits – L-feet Included					
Rail length	Unirac part #	# of L-ft	Weight (lbs)	Item code	Price
48	300201	4	13	014-01020	\$110
60	300202	4	14	014-01024	\$127
72	300203	4	16	014-01028	\$145
84	300204	4	17	014-01032	\$162
96	300205	4	19	014-01036	\$179
106	300206	4	20	014-01040	\$196
120	300207	6	22	014-01044	\$217
132	300208	6	24	014-01048	\$234
144	300209	6	25	014-01052	\$250
156	300210	6	27	014-01056	\$267
168	300211	6	28	014-01060	\$284
180	300212	6	30	014-01064	\$307
192	300213	8	31	014-01068	\$323
204	300214	8	33	014-01072	\$340
216	300215	8	34	014-01076	\$357

## 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. Ship via truck freight only.

Four-Rail Unirac SolarMount Kit - L-feet Included						
Rail length	Segment length	Unirac part #	# of L-ft	Ship wt. (lbs)	Item code	Price
226	106/120	300224	10	40	014-01000	\$391
240	120/120	300225	10	42	014-01001	\$408
252	132/120	300226	10	44	014-01002	\$425
264	132/132	300227	10	46	014-01003	\$436
276	144/132	300228	10	47	014-01004	\$453
288	144/144	300229	10	48	014-01005	\$470
300	156/144	300230	12	50	014-01006	\$492
312	156/156	300231	12	52	014-01007	\$509
324	168/156	300232	12	53	014-01008	\$525
336	168/168	300233	12	54	014-01009	\$542
348	180/168	300234	14	56	014-01010	\$559
360	180/180	300235	14	58	014-01011	\$571
372	192/180	300236	14	59	014-01012	\$587
384	192/192	300237	14	60	014-01013	\$604
396	204/192	300238	14	62	014-01014	\$621
408	204/ 204	300239	14	64	014-01015	\$637
420	216/ 204	300240	16	65	014-01016	\$661
432	216/ 216	300241	16	66	014-01017	\$671

## Bulk Rail Bundles

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

Bulk bundles of Standard Rail consist of 8 rails and do not include L-feet or hardware. See the bottom mount sizing table and/or the top mount sizing table to determine rail length appropriate for your installation. If desired rail length exceeds 240 inches, order a splice and two segments. Spliced segments should be equal or as close to equal as possible.

Pro-Pak Standard Rail Bundles – 8 rails				
Rail Length	Unirac part #	Ship wt. (lbs)	Item code	Price
48	300101	32	014-00810	\$258
72	300103	48	014-00812	\$347
84	300104	54	014-00813	\$392
96	300105	62	014-00814	\$437
106	300106	68	014-00815	\$481
120	300107	80	014-00820	\$533
132	300108	88	014-00821	\$583
144	300109	95	014-00822	\$633
156	300110	102	014-00823	\$683
168	300111	109	014-00824	\$734
180	300112	116	014-00825	\$785
192	300113	123	014-00826	\$835
204	300114	130	014-00827	\$856
216	300115	137	014-00828	\$936
228	300116	144	014-00831	\$975
240	300117	152	014-00829	\$1,026

## Splice Bars and Plates

Splice bars are used to join together lengths of SolarMount Rail or SunFrame. Splice plates are also structural and may be used only with SolarMount Standard Rail. 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				
Unirac part #	Description	Wt. (lbs)	Item code	Price
310216	20 ea splice plates	14	014-00888	\$271
310229	20 ea splice bars	10	014-01267	\$112



# 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.



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

### Tilt angles for low-profile legs

Choose (a) the correct maximum leg extension for your desired tilt angle from the table below and (b) the number of kits required from the table at right. Item codes in table below.

### Quantity of tilt legs required

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

### Sizing Table for Unirac Low-Profile Tilt Legs

(Tilt angle range given in degrees from horizontal.)

of the mounting rails.

Low profile leg length:		12-inch	30-inch	44-inch
Unirac part #		310121	310122	310123
Item code		014-01185	014-01189	014-01193
Price		\$36	\$45	\$52
Module make and model		Tilt angle range (degrees)		
<b>AEE Solar</b>	AE80HE, AE90HE	15-19	31-49	45-60
<b>Evergreen</b>	ES-A-200	16-20	34-53	48-60
<b>Kyocera</b>	KC65, 85, KD135	12-21	24-38	35-57
	KD180	10-16	16-46	38-72
	KD210GX-LP/LPU	7-14	22-40	33-60
<b>SANYO</b>	HIT205N, 210N, 215N	12-15	25-39	36-60
<b>Sharp</b>	80	14-18	31-48	44-60
	123	13-17	28-44	40-60
	165, 175, 185	12-15	25-39	36-59
	ND200, 208	13-16	27-42	39-60
<b>SolarWorld</b>	SW230	14-18	30-47	43-60
	SW165/175	12-15	25-39	36-60
<b>REC</b>	AE-US and PE	14-18	30-47	43-60
<b>SunPower</b>	SPR200, 210, 215, 220	17-22	37-58	53-60
<b>SCHOTT</b>	POLY 217 - 230	14-18	30-47	43-60
<b>Suntech</b>	STP110-24b, STP175	9-12	19-30	28-45
<b>Mitsubishi</b>	UE125	15-19	31-50	45-60
	UD190/185	12-15	25-39	36-60
	UJ230	13-16	27-42	39-60

## 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 this top mounting arrays sizing table and/or this bottom mounting arrays sizing table. 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.



### Sizing Table for High-Profile Tilt Legs

(Tilt angle range is in degrees from horizontal.)

One 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	014-01160	014-01164	014-01168
Price	\$51	\$78	\$103
Rail Length	Tilt angle range (degrees)		
48	9 - 21	30 - 60	N/A
60	7 - 17	24 - 60	37 - 60
72	6 - 14	19 - 54	31 - 60
84	5 - 12	17 - 46	26 - 60
96	4 - 10	14 - 40	23 - 60
106	4 - 9	13 - 36	21 - 60
Two 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	014-01172	014-01176	014-01180
Price	\$96	\$161	\$217
Rail length	Tilt angle range (degrees)		
120	5 - 10	17 - 38	26 - 60
132	6 - 10	17 - 37	24 - 60
144	6 - 9	16 - 33	22 - 43
156	5 - 10	14 - 30	20 - 49
168	5 - 7	13 - 28	18 - 46
180	3 - 7	12 - 26	17 - 43

## Standoffs, Flashings and Accessories

Standoffs are sold in packs of 12 and come with stainless-steel hardware and 2 lag bolts. Use flat-top standoffs with L-feet to attach solarmount or SunFrame rails



Height (inch)	Wt. (lbs)	Unirac part #	Item code	Price
<b>Flat-top 2-piece, Clear-anodized 1-5/8" OD Aluminum Standoffs</b>				
3	9	310553	014-00789	\$153
4	10	310554	014-00791	\$165
6	12	310556	014-00793	\$189
7	13	310557	014-00795	\$202



Height (inch)	Wt. (lbs)	Unirac part #	Item code	Price
<b>Flat-top 2-piece, Bronze-anodized 1-5/8" OD Aluminum Standoffs</b>				
3	9	310653	014-00797	\$160
4	10	310654	014-00799	\$173
6	12	310656	014-00801	\$197
7	13	310657	014-00803	\$209



Height (inch)	Wt. (lbs)	Unirac part #	Item code	Price
<b>Flat-top One Piece Zinc-Plated Steel 1-5/8" O.D. Standoffs</b>				
3	16	310051	014-00661	\$214
4	18	310052	014-00662	\$224
6	22	310053	014-00664	\$233
7	24	310054	014-01233	\$255



Height (inch)	Wt. (lbs)	Unirac part #	Item code	Price
<b>Raised-Flange Zinc-Plated Steel 1-5/8" O.D. Standoffs</b>				
3	16	310047	014-01237	\$221
4	18	310048	014-01241	\$245
6	22	310049	014-01245	\$262
7	25	310050	014-01249	\$275

## 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	Item code	Price
990105	20 ea. 1/16" shims (blue)	014-00649	\$1.50
990106	20 ea. 1/8" shims (red plastic)	014-00651	\$3.00
990107	20 ea. 1/4" shims (black)	014-00653	\$4.50
990108	20 ea. tapered shims (black)	014-00655	\$11.00

## Flashings

These flashings work with the steel and aluminum standoffs above. Soft aluminum flashings can be molded to fit curved roofing material, such as Spanish tile. No-Calk flashings have a rubber seal that fits both steel and aluminum 1-5/8" standoffs.



Description	Wt. (lbs)	Unirac part #	Item code	Price
<b>No-Calk Collar Flashings for Standoffs</b>				
<b>Bulk 12-piece pack</b>				
12 ea. galvanized, 12 1/2" x 8 3/4" base (Oatey # O-11840)	11	990101	014-00621	\$91
12 ea. aluminum, 12 1/2" x 8 3/4" base (Oatey # O-12920)	11	990102	014-00623	\$132
12 ea. soft aluminum, 18" x 18" base (Oatey # O-12836)	14	990103	014-00625	\$189

## Pro-Pak Top Clamps

See this sizing table 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.

The end clamps and mid clamps come with stainless steel T-bolts and flange nuts. The H clamps, which can be used as mid and end clamps, come with hex bolts.

Unirac part #	Description	Wt. (lbs)	Item code	Price
<b>End Clamps with Stainless Steel T-Bolts and Flange Nuts</b>				
320012	20 ea. A clamps	6	014-00840	\$44
320013	20 ea. B clamps	6	014-00841	\$44
320014	20 ea. C clamps	6	014-00842	\$44
320081	20 ea. C clamps; dark bronze	6	014-00861	\$57
320015	20 ea. D clamps	6	014-00843	\$44
320185	20 ea. D clamps dark bronze	6	014-00863	\$57
320016	20 ea. E clamps	6	014-00844	\$44
320017	20 ea. F clamps	6	014-00845	\$44
320123	20 ea. F clamps dark bronze	6	014-00846	\$57
320083	20 ea. G clamps dark bronze	6	014-00847	\$57
320079	20 ea. J clamps	6	014-00849	\$44
320221	20 ea. K clamps	3	014-00860	\$44
<b>Mid Clamps with Stainless Steel T-Bolts and Flange Nuts</b>				
320020	20 ea. A-B-C-D-K mid clamps	6	014-00867	\$49
320084	20 ea. A-B-C-D-K mid clamps, bronze	6	014-00865	\$68
320021	20 ea. E-F-J mid clamps	6	014-00869	\$49
320085	20 ea. E-F-J mid clamps brnz	6	014-00878	\$68
320087	20 ea. G mid clamps, dark bronze	6	014-00871	\$68
<b>H Clamps Used as Mid &amp; End Clamps – Includes Hex Bolts</b>				
320086	20 ea. H clamps, dark bronze	6	014-00873	\$68

## L-Feet

Each L-foot includes a stainless steel bolt and flange nut to attach the foot to a Solar-Mount rail. Lag bolts are not included.



Unirac part #	Description	Weight (lbs)	Item code	Price
310067	20 ea. L-foot	5	014-00891	\$85.00
310077	1 ea. double L-foot		014-00886	\$8.50

# 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. Note: SunFrame cannot be used with REC AE-US modules.

Contact us with your module type, quantity, number of rows and foot spacing for design help, or use the online SunFrame estimator at...

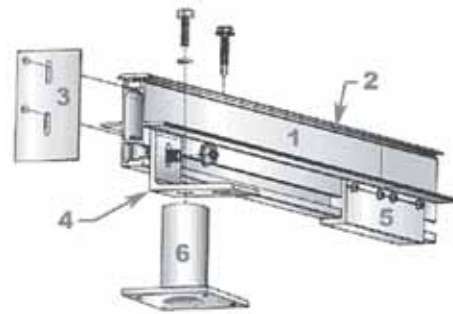
<http://www.unirac.com/estimator/part/estimator/detail/solar>

...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 37.





# CreoTecc

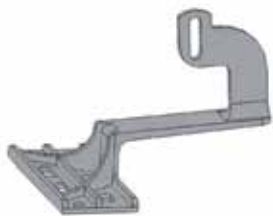
## Cast Aluminum Roof Hooks

These high quality German-made cast aluminum roof attachments make it easy to put solar on tile roofs without cutting the tiles. They can support up to 600 pounds and their wide mounting flange allows for perfect placement on tile while still screwing into a rafter.

There is a front-fit model that allow rails to run across the roof, a side-fit model that allows rails to run up and down the roof, and a bottom-fit model for use with L feet.



CreoTecc Aluminum Roof Hooks



Description	Item code	Price	Description	Item code	Price	Description	Item code	Price
Side mount roof hook	014-09811	\$30	Front mount roof hook	014-09813	\$30	Bottom mount roof hook	014-09815	\$30

## 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
321221	Star head bolt, s/s, 3/8" x 11/4"	20	014-02116	\$69
321222	Breakaway nut, aluminum, 1/4"	20	014-02106	\$24
321223	Breakaway nut, aluminum, 3/8"	20	014-02110	\$32
321209	Star Key (Tool) 1/4"	1	014-02125	\$19
321210	Star Key (Tool) 3/8"	1	014-02126	\$23

## EJOT

### NEW! Solar Fastening System

These specially designed solar fasteners are for use with L-feet to support rails on tile or metal roofing. 5/16" thread bolts for metal substructures and 5/16" lag bolts for wood substructure.

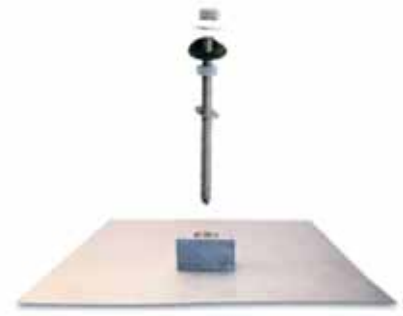


EJOT part #	Length (inches)	Item code	Price
<b>For wood substructures</b>			
3150851905	5.3	014-06451	\$13
3151351905	7.3	014-06452	\$14
3152051905	10	014-06453	\$18
<b>For metal substructures</b>			
3130851905	5.3	014-06462	\$13
3131251905	7.3	014-06464	\$14
3132051905	10	014-06466	\$15

## Quick Mount PV

### All-In-One Waterproof Flashing

The Quick Mount PV product is an all-in-one waterproof flashing and mount designed to anchor photovoltaic racking systems to a new or existing roof. The flashing includes an attached standoff block and stainless steel hardware to attach with an L-foot to racking from Unirac, DP&W, and SnapNrack. No roof cutting is required. Sold in boxes of 12 flashings.



### Composition Shingle Flashing

The composition shingle flashing mount is made of aluminum and includes stainless steel hardware. It works with all standard racks, installs seamlessly and provides low-profile mount.



The flashing includes an attached standoff block and stainless steel hardware.

### Curved Tile Flashing

The curved tile mount is comprised of all-aluminum standoff and flashing. All hardware is included. The tile is removed, the standoff is bolted into position, the tile is cut to allow for the



standoff to pass through. An additional peel-and-stick flashing is included for waterproofing at the sub-roof. The aluminum flashing is then placed and molded to the shape of the tiles.

### Flat Tile Mount

The flat tile mount is comprised of an all-aluminum mount and tile flashing cover. All stainless steel hardware is included. The aluminum tile cover replaces one existing tile. It works with most tiles that measure from 11-1/2" to 12-3/8" wide and have a pan lip on the left side and a cover lip on the right side. Call us for questions regarding further compatibility with your roof tiles.



### Shake Mount Flashing

This 18" x 18" aluminum flashing is large enough to do a good job flashing on wood shake roofs. Available in mill finish, clear anodized or bronze anodized finish.



### Roofing Bar

This 24" roofing bar removes nails.



Quick Mount model	Description	Weight (lbs)	Item code	Price
QMSC-A 12	Composition mounts - mill finish 12" x 12" - 12 pack	16	014-06315	\$413
QMSC-C 12	Composition mounts - clear anodized finish 12" x 12" - 12 pack	16	014-06317	\$562
QMSC-B 12	Composition mounts - bronze anodized finish 12" x 12" - 12 pack	16	014-06316	\$635
QMLC-A 12	Shake mounts - mill finish 18" x 18" mount - 12 pack	30	014-06319	\$498
QMLC-C 12	Shake mounts - clear anodized finish 18" x 18" - 12 pack	30	014-06320	\$793
QMLC-B 12	Shake mounts - bronze anodized finish 18" x 18" - 12 pack	30	014-06321	\$940
QMFT T 12	Flat tile flashing - 12" x 17" - 12 pack	25	014-06323	\$304
QMCT L 12	Curved tile flashing - 18" x 18" - 12 pack	65	014-06327	\$580
QMTMH A 12	Tile mount hardware - mill finish - 12 pack	13	014-06335	\$383
QMTMH C 12	Tile mount hardware - clear anodized finish - 12 pack	13	014-06337	\$458
QM RB 1	24" Roofing bar - nail removal tool	4	094-00143	\$53

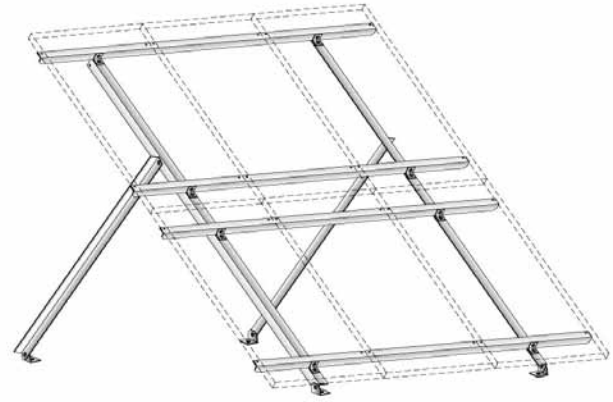


ADVERTISEMENT

# DPW Solar

## POWER-FAB Two-Tier Ground Mounts

DPW Solar'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	DPW two-tier mount part number	# of modules	Item code	Price
Evergreen ES-A-200	DP-TTRGM4-ESA200	4	013-08756	\$840
	DP-TTRGM6-ESA200	6	013-08757	\$956
	DP-TTRGM8-ESA200	8	013-08758	\$1,103
Kyocera KD180	DP-TTRGM4-KD180	4	013-08764	\$730
	DP-TTRGM6-KD180	6	013-08765	\$830
	DP-TTRGM8-KD180	8	013-08766	\$960
Kyocera KD205 KD210	DP-TTRGM4-KD205	4	013-08767	\$780
	DP-TTRGM6-KD205	6	013-08768	\$885
	DP-TTRGM8-KD205	8	013-08769	\$1,030
Kyocera KD230	DP-TTRGM4-KD230	4	013-09785	\$800
	DP-TTRGM6-KD230	6	013-09787	\$910
	DP-TTRGM8-KD230	8	013-09789	\$1,050
Mitsubishi UD185	DP-TTRGM4-MT185	4	013-08441	\$655
	DP-TTRGM6-MT185	6	013-08775	\$745
	DP-TTRGM8-MT185	8	013-08776	\$865
Mitsubishi UJ212 UJ230	DP-TTRGM10-MT185	10	013-8447	\$1,015
	DP-TTRGM4-MT230	4	013-09792	\$800
	DP-TTRGM6-MT230	6	013-09794	\$910
REC Solar AE-US PE	DP-TTRGM8-MT230	8	013-09796	\$1,050
	DP-TTRGM4-REC210	4	013-08778	\$800
	DP-TTRGM6-REC210	6	013-08779	\$910
	DP-TTRGM8-REC210	8	013-08780	\$1,050

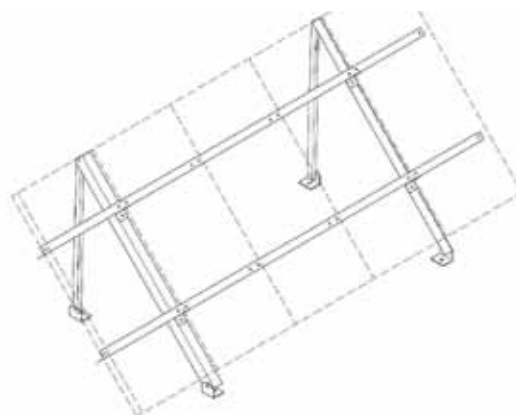
Module type	DPW two-tier mount part number	# of modules	Item code	Price
SANYO HIT215N	DP-TTRGM4-SY215	4	013-09765	\$675
	DP-TTRGM6-SY215	6	013-09767	\$765
	DP-TTRGM8-SY215	8	013-09769	\$885
Sharp 165,170, 175,185	DP-TTRGM4-SHP175	4	013-08812	\$655
	DP-TTRGM6-SHP175	6	013-08813	\$745
	DP-TTRGM8-SHP175	8	013-08814	\$865
	DP-TTRGM10-SHP175	10	013-08815	\$1,015
Sharp 208 216, 224, 230	DP-TTRGM4-SHP208	4	013-08791	\$800
	DP-TTRGM6-SHP208	6	013-08792	\$910
	DP-TTRGM8-SHP208	8	013-08793	\$1,050
SCHOTT POLY 217, 220, 225	DP-TTRGM4-SCT220	4	013-09771	\$800
	DP-TTRGM6-SCT220	6	013-09773	\$910
	DP-TTRGM8-SCT220	8	013-09775	\$1,050
SolarWorld 220, 230	DP-TTRGM4-SWD230	4	013-09778	\$800
	DP-TTRGM6-SWD230	6	013-09780	\$910
	DP-TTRGM8-SWD230	8	013-09782	\$1,050
SunPower SPR-200, 210, 220	DP-TTRGM4-SPR200	4	013-08798	\$655
	DP-TTRGM6-SPR200	6	013-08799	\$745
	DP-TTRGM8-SPR200	8	013-08800	\$865
	DP-TTRGM10-SPR200	10	013-08801	\$1,015

## POWER-FAB Low-Profile Ground Mounts

DPW Solar's low-profile ground mounts are made from 6061-T6 structural aluminum extrusions with a mill finish. The module length is vertical (each module is in portrait-mode) and modules are mounted side-by-side. Models are available to hold from 3 to 8 modules, depending on module width. Multiple low-profile ground 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. Please contact us for information and pricing on mounts for other brands and sizes of module.

Module type	DPW low-profile mount part number	# of modules	Item code	Price
AEE Solar AE-80HE AE-90HE	DP-LPRGM3-AE80HE	3	013-08851	\$370
	DP-LPRGM4-AE80HE	4	013-08852	\$415
	DP-LPRGM5-AE80HE	5	013-08853	\$465
	DP-LPRGM6-AE80HE	6	013-08854	\$510
	DP-LPRGM8-AE80HE	8	013-08855	\$575
Evergreen ES-A-200 205, 210	DP-LPRGM3-ESA200	3	013-08859	\$605
	DP-LPRGM4-ESA200	4	013-08860	\$670
	DP-LPRGM5-ESA200	5	013-08861	\$730
Kyocera KC85	DP-LPRGM3-KC85	3	013-08862	\$360
	DP-LPRGM4-KC85	4	013-08863	\$400
	DP-LPRGM5-KC85	5	013-08864	\$455
	DP-LPRGM6-KC85	6	013-08865	\$485
Kyocera KD135	DP-LPRGM3-KD135	3	013-08866	\$405
	DP-LPRGM4-KD135	4	013-08867	\$450
	DP-LPRGM5-KD135	5	013-08868	\$520
	DP-LPRGM6-KD135	6	013-08869	\$555
Kyocera KD-180	DP-LPRGM3-KD180	3	013-08870	\$565
	DP-LPRGM4-KD180	4	013-08871	\$630
	DP-LPRGM5-KD180	5	013-08872	\$690
Kyocera KD205	DP-LPRGM3-KD205	3	013-08873	\$600
	DP-LPRGM4-KD205	4	013-08874	\$660
	DP-LPRGM5-KD205	5	013-08875	\$720
Kyocera KD230	DP-LPRGM3-KD230	3	013-08951	\$605
	DP-LPRGM4-KD230	4	013-08952	\$670
	DP-LPRGM5-KD230	5	013-08953	\$730

Module type	DPW low-profile mount part number	# of modules	Item code	Price
Mitsubishi UE125	DP-LPRGM3-MIT125	3	013-08881	\$410
	DP-LPRGM4-MIT125	4	013-08882	\$460
	DP-LPRGM5-MIT125	5	013-08883	\$535
	DP-LPRGM6-MIT125	6	013-08884	\$757
Mitsubishi UD185	DP-LPRGM3-MIT185	3	013-08886	\$515
	DP-LPRGM4-MIT185	4	013-08887	\$570
	DP-LPRGM5-MIT185	5	013-08888	\$625
	DP-LPRGM6-MIT185	6	013-08889	\$680
Mitsubishi UJ230	DP-LPRGM3-MIT230	3	013-08956	\$605
	DP-LPRGM4-MIT230	4	013-08957	\$670
	DP-LPRGM5-MIT230	5	013-08958	\$730
REC Solar AE-US PE	DP-LPRGM3-REC210	3	013-08890	\$605
	DP-LPRGM4-REC210	4	013-08891	\$670
	DP-LPRGM5-REC210	5	013-08892	\$730
SANYO HIT215	DP-LPRGM3-SY215	3	013-08971	\$515
	DP-LPRGM4-SY215	4	013-08972	\$570
	DP-LPRGM5-SY215	5	013-08973	\$625
	DP-LPRGM6-SY215	6	013-08974	\$680
Sharp 165,170, 175,185	DP-LPRGM3-SHP175	3	013-08921	\$515
	DP-LPRGM4-SHP175	4	013-08922	\$570
	DP-LPRGM5-SHP175	5	013-08923	\$625
	DP-LPRGM6-SHP175	6	013-08924	\$680
Sharp 208 216, 224, 230	DP-LPRGM3-SHP208	3	013-08905	\$605
	DP-LPRGM4-SHP208	4	013-08906	\$670
	DP-LPRGM5-SHP208	5	013-08907	\$730
SCHOTT POLY 210, 217, 220	DP-LPRGM3-SCT208	3	013-08960	\$605
	DP-LPRGM4-SCT208	4	013-08961	\$670
	DP-LPRGM5-SCT208	5	013-08962	\$730
SolarWorld SW220 SW230	DP-LPRGM3-SWD230	3	013-08967	\$605
	DP-LPRGM4-SWD230	4	013-08968	\$670
	DP-LPRGM5-SWD230	5	013-08969	\$730



## Unirac

### PV PoleTops

Unirac PV PoleTops pole mounts use SolarMount Light Rails and clips. The lightweight rails are hollow aluminum extrusions that provide great strength over long spans and help keep shipping costs low. The back-mount clips slip 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, described on this page. See table on 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 5014/5034

- Mounts to 6-inch Schedule 40 or 80 steel mounting pole
- Accommodates array size up to 140 square feet
- Adjusts from 15 to 60 degrees from the horizontal

(Not pictured.)

Module	Unirac part #	No. of modules	Pole size (schd 40)	Item code	Price
AE-80J AE-80HE AE-90HE	500024	1	2.5	014-02405	\$137
	500016	2	2.5	014-02417	\$160
	500117	3	3	014-02533	\$291
	500123	4	3	014-02545	\$322
	500350	6	4	014-02681	\$551
	500337	8	4	014-02663	\$621
Evergreen ES-A-200	500131	2	3	014-02561	\$319
	500241	3	4	014-02666	\$515
	500315	4	4	014-02632	\$639
Kyocera KC85T	500025	1	2.5	014-02405	\$141
	500031	2	2.5	014-02417	\$169
	500108	3	3	014-02515	\$306
	500113	4	3	014-02525	\$345
	500326	6	4	014-02641	\$565
	500330	8	4	014-02649	\$636
Kyocera KD135GX-LP	500044	1	2.5	014-02441	\$149
	500129	2	3	014-02557	\$286
	500132	3	3	014-02563	\$275
	500229	4	4	014-02619	\$506
	500315	6	6	014-02632	\$972
	501463	8	6	014-03248	\$1,077
Mitsubishi UD185MF5	500128	1	3	014-02555	\$286
	500131	2	3	014-02561	\$319
	500227	3	4	014-02615	\$496
Mitsubishi UE125MF5N	500044	1	2.5	014-02441	\$149
	500129	2	3	014-02557	\$286
	500132	3	3	014-02563	\$322
	500229	4	4	014-02619	\$506
REC AE series PE series	500349	6	4	014-02680	\$646
	500128	1	3	014-02555	\$286
	500132	2	3	014-02563	\$275
	500243	3	4	014-02631	\$522
500349	4	4	014-02680	\$646	

Module	Unirac part #	No. of modules	Pole size (schd 40)	Item code	Price
SANYO HIT205N HIT210N HIT215N	500130	2	3	014-02559	\$302
	500227	3	4	014-02615	\$496
	501453	4	6	014-03239	\$912
	501460	6	6	014-02782	\$1,032
SCHOTT POLY 217 POLY 220	500041	1	2.5	014-02435	\$163
	500120	2	3	014-02539	\$311
	500230	3	4	014-02621	\$494
	500342	4	4	014-02673	\$633
Sharp NE-80EJEA	500034	1	2.5	014-02421	\$140
	500041	2	2.5	014-02435	\$163
	500117	3	3	014-02533	\$291
	500123	4	3	014-02545	\$322
	500350	6	4	014-02681	\$551
	500337	8	4	014-02663	\$621
Sharp ND-123W & L5EIU-125	500044	1	2.5	014-02441	\$149
	500129	2	3	014-02557	\$156
	500132	3	3	014-02563	\$322
	500229	4	4	014-02619	\$506
	500315	6	6	014-02632	\$639
	501463	8	6	014-03248	\$1,077
Sharp NE170 - 185	500027	1	2.5	014-02409	\$140
	500105	2	3	014-02509	\$263
	500237	3	4	014-02628	\$439
	500348	4	4	014-02675	\$557
	501489	6	6	014-02833	\$974
SunPower SPR-210 to 230	500038	1	2.5	014-02429	\$150
	500117	2	3	014-02533	\$291
	500340	4	4	014-02669	\$558
	501460	6	6	014-02782	\$1,032
Suntech STP175	500038	1	2.5	014-02429	\$151
	500118	2	3	014-02535	\$295
	500237	3	4	014-02628	\$469
	501453	4	6	014-03239	\$912
	501460	6	6	014-02782	\$1,032

Unirac makes many more PoleTops models to for other module brands and sizes. Call for information.

Custom ordered PoleTops may take 6 weeks from order to delivery.



## 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 table on the right 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" (63.5mm) 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" (73.0mm)

3" – OD 3.5" (88.9mm)

4" – OD 4.5" (114.3mm)

Module	Unirac part #	Pole size	No. of modules	Item code	Price
AEE 80/90HE	400204	2.5	1	014-02243	\$194
	400215	3	2	014-02277	\$335
	400244	3	3	014-02262	\$341
	400229	4	4	014-02313	\$429
Evergreen ES-A 200	400248	2.5	1	014-02269	\$233
	400224	4	2	014-02305	\$410
Mitsubishi UE125MF5	400236	2.5	1	014-02257	\$207
	400233	3	2	014-02287	\$342
	400224	4	3	014-02305	\$410
Mitsubishi UD185MF5	400248	2.5	1	014-02269	\$233
	400224	4	2	014-02305	\$410
	400246	4	3	014-02305	\$448
Mitsubishi UJ235	400248	2.5	1	014-02269	\$233
	400224	4	2	014-02305	\$410
REC AE & PE	400248	2.5	1	014-02269	\$233
	400224	4	2	014-02305	\$410
SCHOTT POLY 220	400248	2.5	1	014-02269	\$233
	400224	4	2	014-02305	\$410

Unirac makes many more PoleSides models to fit other module brands and sizes. Call for modules not listed.

## IronRidge

### Small-Module Side-of-Pole Mount

These low-cost, universal side-of-pole mounts from IronRidge 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. Mounts have a fully adjustable tilt angle mechanism which can be set for maximum solar module efficiency depending on your location and the season. Two sizes fit most small modules.

#### Module Fit Chart

Model	Fit one of the following modules
UNI-SA/13.0	AE-5D, AE-10D, AE-20D AE-10J
	AE20HE, AE-20J
UNI-SA/21.5	AE-30HE, AE-50HE, AE-60HE

Model	Maximum module width	Inside frame dimension	Item code	Price
UNI-SA/13.0	14.0"	5.26" to 11.60"	014-06011	\$57
UNI-SA/21.5	21.5"	12.66" to 20.10"	014-06013	\$65



# DPW Solar

## POWER-FAB Side Pole Mounts (SPM)

Power-FAB mounts are available in painted steel and mill-finish aluminum versions. Aluminum mounts are listed here; call for pricing on painted steel mounts. Stainless steel module mounting hardware is provided with all mounts.

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

Most SPM mounts can be shipped by UPS.

Mounts for other modules are available. Call for information.



Module type	DPW pole-side mount part number	# of modules	Item code	Price
AEE Solar AE-80HE, AE-90HE	DP-SPM1-AE80HE	1	013-09701	\$150
	DP-SPM2-AE80HE	2	013-09702	\$300
	DP-SPM3-AE80HE	3	013-09703	\$385
	DP-SPM4-AE80HE	4	013-09704	\$445
Evergreen ES-A 200 to 215w	DP-SPM1-ESA200	1	013-09708	\$330
	DP-SPM2-ESA200	2	013-09709	\$545
	DP-SPM3-ESA200	3	013-09710	\$705
Kyocera KC85	DP-SPM1-KC85	1	013-03746	\$165
	DP-SPM2-KC85	2	013-03748	\$325
	DP-SPM3-KC85	3	013-03750	\$395
	DP-SPM4-KC85	4	013-03751	\$440
Kyocera KD135	DP-SPM1-KD135	1	013-09719	\$240
	DP-SPM2-KD135	2	013-09720	\$370
	DP-SPM3-KD135	3	013-09721	\$500
	DP-SPM4-KD135	4	013-09722	\$600
Kyocera KD230	DP-SPM1-KD230	1	013-09727	\$230
	DP-SPM2-KD230	2	013-09728	\$350
	DP-SPM3-KD230	3	013-09729	\$495

Module type	DPW side pole mount part number	# of modules	Item code	Price
Mitsubishi UE125	DP-SPM1-MT125	1	013-09727	\$230
	DP-SPM2-MT125	2	013-09728	\$350
	DP-SPM3-MT125	3	013-09729	\$495
	DP-SPM4-MT125	4	013-09730	\$600
Mitsubishi UD185	DP-SPM1-MT185	1	013-09731	\$270
	DP-SPM2-MT185	2	013-09732	\$445
	DP-SPM3-MT185	3	013-09733	\$565
	DP-SPM4-MT185	4	013-09734	\$750
Mitsubishi UJ230	DP-SPM1-MT230	1	013-09921	\$300
	DP-SPM2-MT230	2	013-09922	\$495
	DP-SPM3-MT230	3	013-09923	\$640
REC Solar AE & PE 200+ series	DP-SPM1-REC210	1	013-09735	\$300
	DP-SPM2-REC210	2	013-09736	\$495
	DP-SPM3-REC210	3	013-09737	\$640
SANYO HIT215N	DP-SPM1-SY215	1	013-09738	\$260
	DP-SPM2-SY215	2	013-09739	\$430
	DP-SPM3-SY215	3	013-09740	\$550
	DP-SPM4-SY215	4	013-09741	\$730
Sharp 165 to 185	DP-SPM1-SHP175	1	013-09750	\$260
	DP-SPM2-SHP175	2	013-09751	\$430
	DP-SPM3-SHP175	3	013-09752	\$550
	DP-SPM4-SHP175	4	013-09753	\$730
Sharp 208, 216, 224, 230	DP-SPM1-SHP205	1	013-09775	\$300
	DP-SPM2-SHP205	2	013-09776	\$495
	DP-SPM3-SHP205	3	013-09777	\$640
SCHOTT POLY 217, 220, 225	DP-SPM1-SCT220	1	013-09785	\$300
	DP-SPM2-SCT220	2	013-09786	\$495
	DP-SPM3-SCT220	3	013-09787	\$640
SolarWorld 220, 230	DP-SPM1-SWD230	1	013-09795	\$300
	DP-SPM2-SWD230	2	013-09796	\$495
	DP-SPM3-SWD230	3	013-09797	\$640

# DPW Solar

## POWER-FAB Top Pole Mounts (TPM)



Power-fab 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 here that has "/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.

Module type	DPW top pole mount part #	No. of modules	Pole size schd 40	Item code	Price
Evergreen ES-A-200, 205 210	DP-TPM1-ESA200	1	2	013-06251	\$180
	DP-TPM2-ESA200	2	3	013-06252	\$395
	DP-TPM3-ESA200	3	4	013-06253	\$590
	DP-TPM4-ESA200	4	4	013-06254	\$720
	DP-TPM6-ESA200	6	6	013-06256	\$1,220
	DP-TPM8-ESA200	8	6	013-06258	\$1,600
	DP-TPM9-ESA200*	9	8	013-06259	\$1,775
	DP-TPM10-ESA200*	10	8	013-06260	\$2,275
	DP-TPM12-ESA200*	12	8/80	013-06261	\$2,485
	DP-TPM14-ESA200*	14	8/80	013-06262	\$3,265
	DP-TPM15-ESA200*	15	8/80	013-04905	\$3,480
	DP-TPM16-ESA200*	16	8/80	013-06264	\$3,695
Kyocera KC85T	DP-TPM2-KC85T	2	2	013-04523	\$190
	DP-TPM3-KC85T	3	2.5	013-04524	\$335
	DP-TPM4-KC85T	4	3	013-04525	\$365
	DP-TPM6-KC85T	6	4	013-04527	\$590
	DP-TPM8-KC85T	8	4	013-04529	\$670
	DP-TPM10-KC85T	10	6	013-04531	\$1,035
	DP-TPM12-KC85T	12	6	013-04533	\$1,215
	DP-TPM14-KC85T*	14	6	013-04534	\$1,340
	DP-TPM16-KC85T*	16	6	013-04535	\$1,555

Module type	DPW top pole mount part #	No. of modules	Pole size schd 40	Item code	Price
Kyocera KD 135	DP-TPM1-KD135	1	2	013-06171	\$155
	DP-TPM2-KD135	2	2.5	013-06172	\$310
	DP-TPM3-KD135	3	3	013-06173	\$365
	DP-TPM4-KD135	4	4	013-06174	\$525
	DP-TPM6-KD135	6	4	013-06176	\$680
	DP-TPM8-KD135	8	6	013-06178	\$955
	DP-TPM9-KD135	9	6	013-06179	\$1,170
	DP-TPM10-KD135	10	6	013-06180	\$1,215
	DP-TPM12-KD135	12	6	013-06182	\$1,335
	DP-TPM14-KD135*	14	8	013-06184	\$1,765
DP-TPM16-KD135*	16	8	013-06186	\$2,140	
Kyocera KD180	DP-TPM18-KD135*	18	8/80	013-06188	\$2,330
	DP-TPM1-KD180	1	2	013-06191	\$170
	DP-TPM2-KD180	2	3	013-06192	\$370
	DP-TPM3-KD180	3	4	013-06193	\$530
	DP-TPM4-KD180	4	4	013-06194	\$645
	DP-TPM6-KD180	6	6	013-06196	\$1,035
	DP-TPM8-KD180	8	6	013-06198	\$1,390
	DP-TPM9-KD180	9	6	013-06199	\$1,645
	DP-TPM10-KD180*	10	8	013-06200	\$1,900
	DP-TPM12-KD180*	12	8	013-06202	\$2,300
DP-TPM14-KD180*	14	8/80	013-06204	\$2,525	
DP-TPM16-KD180*	16	8/80	013-06206	\$3,025	
DP-TPM18-KD180*	18	8/80	013-06208	\$3,545	
Kyocera KD230GX-LB	DP-TPM1-KD230	1	2	013-06211	\$180
	DP-TPM2-KD230	2	3	013-06212	\$395
	DP-TPM3-KD230	3	4	013-06213	\$590
	DP-TPM4-KD230	4	4	013-06214	\$710
	DP-TPM6-KD230	6	6	013-06215	\$1,220
	DP-TPM8-KD230	8	6	013-06216	\$1,600
	DP-TPM9-KD230	9	8	013-06217	\$1,775
	DP-TPM10-KD230	10	8	013-06218	\$2,275
	DP-TPM12-KD230	12	8/80	013-06219	\$2,485
	DP-TPM14-KD230	14	8/80	013-06220	\$3,265
DP-TPM15-KD230	15	8/80	013-06221	\$3,645	



Module type	DPW top pole mount part #	No. of modules	Pole size schd 40	Item code	Price
Mit-subishi UE125MF	DP-TPM1-MT125	1	2	013-05054	\$160
	DP-TPM2-MT125	2	2.5	013-05055	\$315
	DP-TPM3-MT125	3	3	013-05056	\$390
	DP-TPM4-MT125	4	4	013-05057	\$555
	DP-TPM6-MT125	6	4	013-05058	\$710
	DP-TPM8-MT125	8	6	013-05059	\$985
	DP-TPM9-MT125	9	6	013-05060	\$1,220
	DP-TPM10-MT125	10	6	013-05061	\$1,290
	DP-TPM12-MT125	12	6	013-05062	\$1,375
	DP-TPM14-MT125 *	14	8	013-05063	\$1,810
	DP-TPM16-MT125 *	16	8	013-05064	\$2,190
DP-TPM18-MT125 *	18	8/80	013-05065	\$2,420	
Mitsubishi PVUD 180MF5 185MF5 190MF5	DP-TPM1-MT185	1	2	013-05080	\$160
	DP-TPM2-MT185	2	3	013-05081	\$345
	DP-TPM3-MT185	3	4	013-05082	\$505
	DP-TPM4-MT185	4	4	013-05083	\$610
	DP-TPM6-MT185	6	6	013-05085	\$985
	DP-TPM8-MT185	8	6	013-05086	\$1,320
	DP-TPM9-MT185	9	6	013-05086	\$1,570
	DP-TPM10-MT185*	10	8	013-05087	\$1,810
	DP-TPM12-MT185*	12	8	013-05088	\$2,180
	DP-TPM14-MT185*	14	8/80	013-05089	\$2,400
DP-TPM16-MT185*	16	8/80	013-05090	\$2,885	
DP-TPM18-MT185*	18	8/80	013-05091	\$3,280	
Mitsubishi UJ212 UJ218 UJ225 UJ230 UJ235	DP-TPM1-MT235	1	2	013-05130	\$180
	DP-TPM2-MT235	2	3	013-05131	\$395
	DP-TPM3-MT235	3	4	013-05132	\$590
	DP-TPM4-MT235	4	4	013-05133	\$710
	DP-TPM6-MT235	6	6	013-05134	\$1,220
	DP-TPM8-MT235	8	6	013-05135	\$1,600
	DP-TPM9-MT235	9	8	013-05136	\$1,775
	DP-TPM10-MT235	10	8	013-05137	\$2,275
	DP-TPM12-MT235	12	8/80	013-05138	\$2,485
DP-TPM14-MT235	14	8/80	013-05139	\$3,265	
REC Solar 205-230 AE-US PE	DP-TPM1-REC210	1	2	013-06301	\$180
	DP-TPM2-REC210	2	3	013-06302	\$395
	DP-TPM3-REC210	3	4	013-06303	\$590
	DP-TPM4-REC210	4	4	013-06304	\$710
	DP-TPM6-REC210	6	6	013-06306	\$1,220
	DP-TPM8-REC210	8	6	013-06308	\$1,600
	DP-TPM9-REC210*	9	8	013-06309	\$1,775
	DP-TPM10-REC210*	10	8	013-06310	\$2,275
	DP-TPM12-REC210*	12	8/80	013-06312	\$2,485
	DP-TPM14-REC210*	14	8/80	013-06314	\$3,265
DP-TPM15-REC210	15	8/80	013-06222	\$3645	
SANYO 205N 210N 215N	DP-TPM1-SY215	1	2	013-06429	\$160
	DP-TPM2-SY215	2	3	013-06428	\$345
	DP-TPM3-SY215	3	4	013-06427	\$505
	DP-TPM4-SY215	4	4	013-06426	\$610
	DP-TPM6-SY215	6	6	013-06425	\$985

Module type	DPW top pole mount part #	No. of modules	Pole size schd 40	Item code	Price
SANYO 205N 210N 215N	DP-TPM8-SY215	8	6	013-06424	\$1,320
	DP-TPM10-SY215*	10	8	013-06423	\$1,810
	DP-TPM12-SY215*	12	8	013-06422	\$2,180
	DP-TPM14-SY215*	14	8/80	013-06421	\$2,400
	DP-TPM16-SY215*	16	8/80	013-06420	\$2,885
	DP-TPM18-SY215*	18	8/80	013-06419	\$3,280
Sharp 175 185	DP-TPM1-SHP175	1	2	013-04867	\$160
	DP-TPM2-SHP175	2	3	013-04868	\$345
	DP-TPM4-SHP175	4	4	013-04869	\$610
	DP-TPM6-SHP175	6	6	013-04870	\$985
	DP-TPM8-SHP175	8	6	013-04871	\$1,320
	DP-TPM10-SHP175*	10	8	013-04872	\$1,810
	DP-TPM12-SHP175*	12	8	013-04873	\$2,180
	DP-TPM14-SHP175*	14	8/80	013-04874	\$2,400
	DP-TPM16-SHP175*	16	8/80	013-04875	\$2,885
	DP-TPM18-SHP175*	18	8/80	013-04876	\$3,280
Sharp 208 216 224 230	DP-TPM1-SHP224	1	2	013-04895	\$180
	DP-TPM2-SHP224	2	3	013-04896	\$395
	DP-TPM3-SHP224	3	4	013-04897	\$590
	DP-TPM4-SHP224	4	4	013-04898	\$710
	DP-TPM6-SHP224	6	6	013-04899	\$1,220
	DP-TPM8-SHP224	8	6	013-04900	\$1,600
	DP-TPM9-SHP224	9	8	013-04901	\$1,775
	DP-TPM10-SHP224*	10	8	013-04902	\$2,275
	DP-TPM12-SHP224*	12	8/80	013-04903	\$2,485
	DP-TPM14-SHP224*	14	8/80	013-04904	\$3,265
DP-TPM15-SHP224*	15	8/80	013-04905	\$3,645	
SCHOTT Solar POLY 210 to 225	DP-TPM1-SCT200	1	2	013-04760	\$180
	DP-TPM2-SCT200	2	3	013-04761	\$395
	DP-TPM3-SCT200	3	4	013-04762	\$590
	DP-TPM4-SCT200	4	4	013-04763	\$710
	DP-TPM6-SCT200	6	6	013-04764	\$1,220
	DP-TPM8-SCT200	8	6	013-04765	\$1,600
	DP-TPM9-SCT200	9	8	013-04766	\$1,775
	DP-TPM10-SCT200	10	8	013-04767	\$2,275
	DP-TPM12-SCT200	12	8/80	013-04768	\$2,485
	DP-TPM14-SCT200	14	8/80	013-04769	\$3,265
DP-TPM15-SCT200	15	8/80	013-04770	\$3,645	
Solar-World SW220 SW230	DP-TPM1-SWD230	1	2	013-04695	\$180
	DP-TPM2-SWD230	2	3	013-04696	\$395
	DP-TPM3-SWD230	3	4	013-04697	\$590
	DP-TPM4-SWD230	4	4	013-04698	\$710
	DP-TPM6-SWD230	6	6	013-04699	\$1,220
	DP-TPM8-SWD230	8	6	013-04700	\$1,600
	DP-TPM9-SWD230	9	8	013-04701	\$1,775
	DP-TPM10-SWD230	10	8	013-04702	\$2,275
	DP-TPM12-SWD230	12	8/80	013-04703	\$2,485
	DP-TPM14-SWD230	14	8/80	013-04704	\$3,265
DP-TPM15-SWD230	15	8/80	013-04705	\$3,645	

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



# Wattsun

## Active Trackers



Wattsun active trackers use electronic sensors and motor or actuator drives to track the sun from east to west. 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 and roll trackers. Wattsun's azimuth trackers provide nearly 270 degrees of rotational movement and can adjust from 5 to 75 degrees of elevation tilt.

### 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.

### 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 an 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 table below.

Wattsun model	Description	Item code	Price
12-24 15W for 12V battery	Required for 12 VDC AZ-125 Trackers	014-07118	\$125
48-24 LVC	Steps down 48 VDC from battery or 36VDC from array to 24 VDC for controller on AZ-125 tracker	014-07116	\$58
PPT-48-5R24	Steps down 48 VDC from battery to 24 VDC for controller. One required per two AZ-125 or one AZ-225	014-07117	\$219
PPT-48-10R24	Steps down 48 VDC from battery to 24 VDC. Will power four AZ-125 trackers or three AZ-225 trackers	014-07119	\$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 VAC for one AZ-125 tracker	014-07112	\$145
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	014-07115	\$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	014-07018	\$525
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	014-07030	\$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	014-07032	\$150

## Wattsun Tracker Prices

Module	Module quantity	Wattsun drive	Dual axis	Steel pipe ID	Item code	Price
AE-80/90HE	12	AZ-125	optional	6"	014-08001	\$3,385
	16	AZ-125	optional	6"	014-08002	\$3,385
	24	AZ-225	included	8"	014-08004	\$6,250
	28	AZ-225	included	8"	014-08005	\$7,175
Evergreen ES-A-200 205, 210	6	AZ-125	optional	6"	014-07347	\$3,385
	9	AZ-225	included	6"	014-07349	\$6,250
	12	AZ-225	included	8"	014-07350	\$7,175
Kyocera KC85T	8	AZ-125	optional	6"	014-07431	\$3,385
	12	AZ-125	optional	6"	014-07433	\$3,385
	16	AZ-125	optional	6"	014-07435	\$3,385
Kyocera KD135	24	AZ-225	included	8"	014-07436	\$6,645
	8	AZ-125	optional	6"	014-07466	\$3,385
	10	AZ-125	optional	6"	014-07467	\$3,385
	15	AZ-225	included	8"	014-07469	\$6,250
Kyocera 180	16	AZ-225	included	8"	014-07470	\$6,645
	20	AZ-225	included	8"	014-07471	\$7,175
	6	AZ-125	optional	6"	014-07455	\$3,385
	8	AZ-125	optional	6"	014-07456	\$3,385
Kyocera KD205GX-LDU	12	AZ-225	included	8"	014-07457	\$6,645
	16	AZ-225	included	8"/80	014-07458	\$7,175
	6	AZ-125	optional	6"	014-07473	\$3,385
	8	AZ-125	optional	6"	014-07474	\$3,385
Kyocera KD235GX-LB	12	AZ-225	included	8"	014-07475	\$6,645
	16	AZ-225	included	8"/80	014-07476	\$7,175
	6	AZ-125	optional	6"	014-07478	\$3,385
	8	AZ-225	included	8"	014-07479	\$6,250
Mitsubishi UE125	9	AZ-225	included	8"	014-07480	\$6,250
	12	AZ-225	included	8"/80	014-07481	\$7,175
	8	AZ-125	optional	6"	014-08171	\$3,385
	9	AZ-125	optional	6"	014-08172	\$3,385
	10	AZ-125	optional	6"	014-08173	\$3,385
Mitsubishi UD185	15	AZ-225	included	8"	014-08176	\$6,250
	16	AZ-225	included	8"	014-08177	\$6,645
	20	AZ-225	included	8"	014-08181	\$7,175
	6	AZ-125	optional	6"	014-08087	\$3,385
Mitsubishi UJ235	8	AZ-125	optional	6"	014-08088	\$3,385
	12	AZ-225	included	8"	014-08090	\$6,645
	6	AZ-125	optional	6"	014-08185	\$3,385
Mitsubishi UJ235	9	AZ-225	included	8"	014-08186	\$6,250
	12	AZ-225	included	8"/80	014-08187	\$7,175

Module	Module quantity	Wattsun drive	Dual axis	Steel pipe ID	Item code	Price
REC AE & PE 205 to 245	6	AZ-125	optional	6"	014-08205	\$3,385
	8	AZ-225	included	8"	014-08208	\$6,250
	9	AZ-225	included	8"	014-08209	\$6,250
	12	AZ-225	included	8"/80	014-08212	\$7,175
SANYO HIT190 to 205	6	AZ-125	optional	6"	014-07546	\$3,385
	8	AZ-125	optional	6"	014-07548	\$3,385
	9	AZ-125	optional	6"	014-07549	\$3,385
	12	AZ-225	included	8"	014-07552	\$6,250
SANYO HIT 205N, 210N, 215N	16	AZ-225	included	8"/80	014-07556	\$7,175
	6	AZ-125	optional	6"	014-07557	\$3,385
	8	AZ-125	optional	6"	014-07558	\$3,385
	9	AZ-125	optional	6"	014-07559	\$3,385
SCHOTT POLY 210,217, 220, 225	12	AZ-225	included	8"	014-07560	\$6,250
	16	AZ-225	included	8"/80	014-07561	\$7,175
	6	AZ-125	optional	6"	014-07585	\$3,385
	8	AZ-225	included	8"	014-07586	\$6,250
Sharp 165, 175,185	9	AZ-225	included	8"	014-07587	\$6,250
	12	AZ-225	included	8"/80	014-07588	\$7,175
	6	AZ-125	optional	6"	014-07653	\$3,385
	8	AZ-125	optional	6"	014-07655	\$3,385
Sharp 208, 216, 224, 230	9	AZ-125	optional	6"	014-07656	\$3,385
	12	AZ-225	included	8"	014-07657	\$6,250
	16	AZ-225	included	8"/80	014-07658	\$7,175
	6	AZ-125	optional	6"	014-07692	\$3,385
SolarWorld SW220, SW230	8	AZ-225	included	8"	014-07694	\$6,250
	9	AZ-225	included	8"	014-07696	\$6,250
	12	AZ-225	included	8"/80	014-07698	\$7,175
SunPower 210	6	AZ-125	optional	6"	014-07765	\$3,385
	9	AZ-225	included	8"	014-07766	\$6,250
	12	AZ-225	included	8"/80	014-07767	\$7,175
SunPower 210	6	AZ-125	optional	6"	014-07845	\$3,385
	8	AZ-125	optional	6"	014-07846	\$3,385
	12	AZ-225	included	8"	014-07847	\$6,250
	16	AZ-225	included	8"/80	014-07848	\$7,175

Call us for pricing on other Wattsun trackers for different modules.

# 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 last row of table below. If the quantity is followed by double asterisks, order two additional rail sets. Call us about Zomeworks trackers for modules not listed.



Zomeworks model	UTR020	UTRK040	UTRF64	UTRF90	UTRF120	UTRF168-2	UTRF168-2-HD
Item code	014-09020	014-09043	014-09064	014-09090	014-09120	014-09130	014-09132
Price	\$712	\$1,450	\$1,920	\$2,170	\$2,452	\$3,636	\$4,213
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)						
<b>Evergreen</b>							
ES-A-200 to 210	1	2	3, 4	5*	6, 7*	8, 9*	10HD
<b>Kyocera</b>							
KC-80, 85T	1, 2	3, 4	5, 6, 7*, 8, 9*, 10	12	14*, 15*, 16*	18*, 20**, 21**, 22**, 24**	N/A
KD-135	1, 2	3	4, 5*, 6*	8	9*, 10	12, 14*	N/A
KD-180	1	2	3, 4	5*, 6	8	9*, 10*, 11*	N/A
KD-205GX-LP	1	2	3, 4	5*	6	8, 9*	10HD
<b>SANYO</b>							
HIT205N, 210N, 215N	1	2, 3	4	6	8	10	12HD
<b>SCHOTT Solar</b>							
POLY 217, 220, 225	1	2	3	4, 5*	6*	8, 9*	N/A
<b>SolarWorld</b>							
SW165, SW175	1	2	3, 4	5*, 6*	8*	9*, 10	12HD
SW220, SW230	1	2	3	4, 5*	6*	8, 9*	N/A
<b>Sharp</b>							
NE165, NE170, NT175	1	2	3, 4	6	8	10	12
ND208, ND216, ND224	1	2	3	4	6	8, 9*	N/A
<b>Mitsubishi</b>							
UE125MF4	1	2, 3	4, 5*, 6*	8	10	12, 13*, 14, 15*, 16*	N/A
UD185MF5	N/A	2	3, 4	5*, 6*	8*	10	N/A
<b>REC Solar</b>							
PE & AE-US-205 to 230	1	2	3	4, 5*	6*	8-9*	N/A
<b>Description</b>						<b>Item code</b>	<b>Price</b>
* Additional rail for mounts with a quantity followed by an asterisk in chart. Order two for quantities followed by two asterisks.						<b>014-09155</b>	<b>\$291</b>

## ADVERTISEMENT

### Unirac

#### RapidRac G10 Ballasted Flat Roof Mounting System

Unirac's universal ballasted flat roof solution accommodates a wide range of modules and requires very few or no penetrations, depending on location and building codes. Minimal parts, faster installation, reduced labor expenses and versatility – all customer-driven demands that helped engineer this unique flat roof solution.

The RapidRac was developed through significant computational fluid dynamics and wind tunnel engineering. The efficient design, built at a fixed 10 degree tilt angle, optimizes natural convective cooling of the modules and was designed to meet the requirements of current applicable building codes.

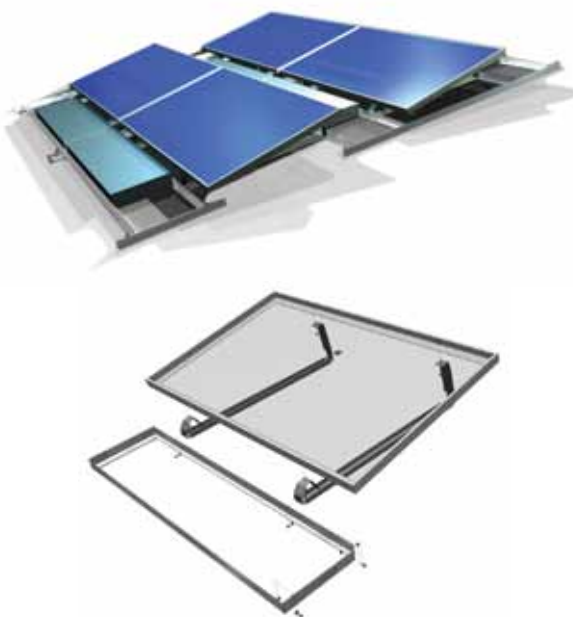
The RapidRac is custom made to the exact specifications of the module you will be racking. We must have the exact model number of the modules being installed.

Unirac offers an attachment option for the RapidRac, the RapidFoot, which can be used for seismic restraint and for ballast trade off, allowing for a reduction in roof dead load.

10-year limited product warranty, 5-year limited finish warranty.

A mounting system includes module support rails, ballast pans, Stainless-steel bolts and WEEB grounding washers. Other hardware may be required depending on roof type and penetrations required.

Order one RapidRac with Module frame for each module in the array. Order one additional RapidRac ballast tray for each module on the north end of the array.



Description	Unirac part #	Item code	Price
RapidRac Ballast Tray (only)	Call	Call	\$99
RapidRac ballast tray with module mount	Call	Call	\$198
RapidFoot assembly	310370	015-02261	\$67
Galvalume flashing #1	990120	015-02265	\$6.56
Patch for flashing	990161	015-02269	\$6.68



## Ballasted Flat Roof Mounts (beginning on the previous page)

Ballasted PV mounting systems are used when the roof is a flat or very slightly pitched surface and the installation requires minimal or no penetrations. They are usually used in commercial systems. The advantages are short installation time, minimal penetrations of the roof means less chance of leakage,

but there can be high weight loading on the roof, and the modules will have a very low tilt angle. It is critical that the proper amount of ballast is applied in a ballasted system and at the correct location. Professional design assistance and engineering support is highly recommended when using a ballasted system.

## DPW Solar

### POWER-FAB CRS PV Ballasted Flat Roof Mounting System

The POWER-FAB CRS top-clamping module mounting system is designed to install fast and provide a secure mounting structure for any framed module. The system's ballasted design minimizes the impact of dead loads on the roof and eliminates roof penetrations. The CRS system typically adds less weight per square foot than competitive products. Full-scale wind tunnel results qualify the system's performance in high wind speed areas. The POWER-FAB CRS system offers a variety of tilt angles from 5 to 25 degrees and features the flexibility to design the racking around roof obstructions and shaded areas to maximize the number of modules and total energy production.



Contact us for other tilt angle and wind load options. Full scale wind tunnel data used to calculate ballast weights along with ASCE 07-05 and building code requirements.

\*Tilt angles from 5 - 25 degrees available.

#### Standard Product Wind Loading Specifications

Wind load	Standard tilt angle*	Roof loading	Category
90 mph	10 degree	< 5 lbs/ft <sup>2</sup>	Exposure C
130 mph	5 degree	< 5 lbs/ft <sup>2</sup>	Exposure C

## ADVERTISEMENT

# AET

## Rayport Ballasted Flat Roof Mounting System

The Rayport ballasted mount for flat roof commercial installations is made from all stainless steel parts, providing best-available corrosion protection in every environmental condition. Extensive engineering and loading analysis from AET's product design group help to provide a low-cost, high-quality product that minimizes assembly time. Rayport ballasted roof mounts can be used with any module that are between 31.8" and 39.1" wide. Modules are mounted in a landscape orientation, at a 10 degree angle. Installed dimensions are module length x (number of modules per row) east to west by 58.65 inches x (the number of rows)

Rayport mounts are wind tunnel tested to 120 mph.

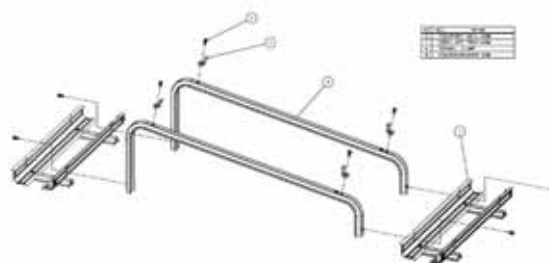
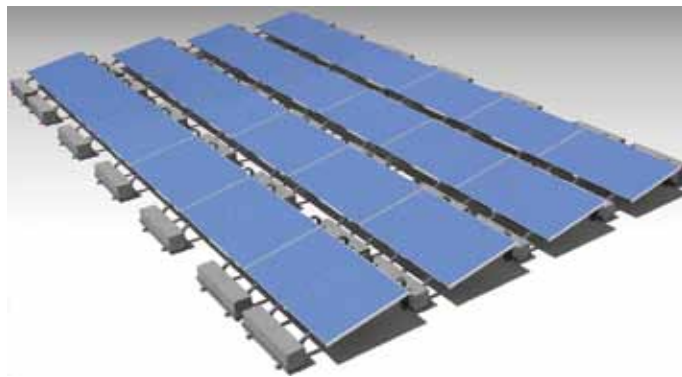
Integrated fasteners and built-in WEEB grounding between the modules and the frames allow for quick, easy installation.

### Parts required

A mounting system includes module support rails, ballast pans, module clips, bolts and ground lugs. If you consider modules running north to south as columns and modules running east to west as rows, you will need the following:

1. Number of module supports = number of modules x 2
2. Number of modules clamps = number of modules x 4
3. Number of ballast pans = (number of columns + 1) x (number of rows + 1)
4. Number of bolts = (number of ballast pans + number of modules) x 4

Contact us for help with the required ballast which will depend on building height, module type and exposure category. We can provide that informations and help with final system design.



Part #	Description	Module frame depth (inches)	Item code	Price
80001-953	Support rail, Evergreen ES-A200		015-03001	\$38
80001-991	Support rail, REC 205-235 AE or PE		015-03006	\$38
	Support rail, SloarWorld 220/230		015-03027	
80001-982	Support rail, Canadian Solar 160-240		015-03004	\$38
80001-990	Support rail, Kyocera 175-210		015-03005	\$38
80001-798	Support rail, SunPower 210-230		015-03023	\$38
80001-993	Support rail, SCHOTT POLY 210-225		015-03020	\$38
80001-992	Support rail, Suntech 190-210		015-03008	\$38
80001-994	Support rail, Sharp 176-230		015-03009	\$38
80009	Ballast tray		015-03010	\$54
80013	Bolt		015-03019	\$0.45
80022-34	Module clamp for SolarWorld SW220, 230	1.34	015-03012	\$1.30
80022-36	Module clamp for Kyocera KD175-210GX-LP	1.4	015-03013	\$1.30
80022-40	Module clamp for Canadian Solar 160-240	1.57	015-03014	\$1.30
80022-41	Module clamp for Evergreen 180-195	1.6	015-03015	\$1.30
80022-43	Module clamp for REC 205-235AE-US	1.69	015-03016	\$1.30
80022-46	Module clamp for Evergreen ES-A 200, Kyocera GX-LB, GX-LPU	1.8	015-03017	\$1.30
80022-57.5	Module clamp for Sharp 176-198	2.26	015-03018	\$1.30
80022-50	Module clamp for SCHOTT POLY225	1.96	015-03021	\$1.30
80022-38	Module clamp for REC PE series	1.5	015-03026	\$1.30

## Commercial Grade Ground Mount Racking

The following pages include large ground mount racks from several leading manufacturers. They are designed to be a cost effective solution for installing large quantities of PV modules,

from kilowatts to megawatts. Each product has its benefits. Some can be adjusted seasonally and some are a fixed tilt angle. Please contact us for system design assistance.

## Unirac

### U-LA

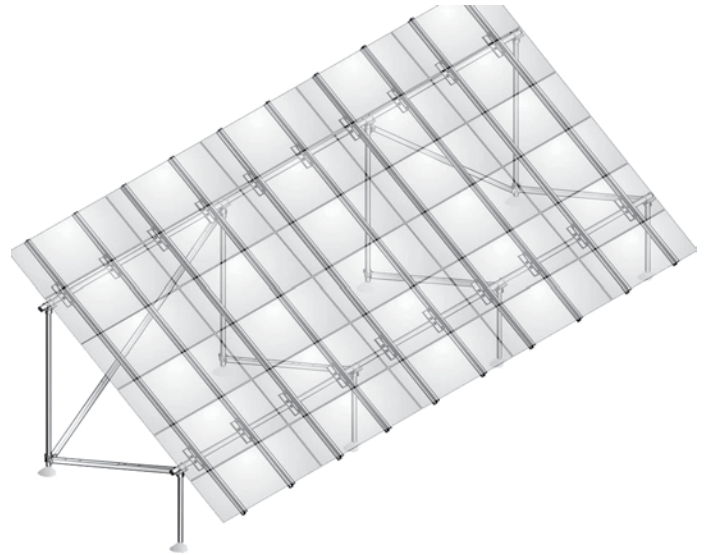
U-LA is a mounting system using large arrays of PV modules designed to generate 3 kilowatts or more. The size of the system is limited only by the available space for the array. The U-LA can be installed on the ground or on commercial flat roofs.

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 ...

<http://www.unirac.com/equestionnaire.php>

... 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.



Unirac part#	Description	Item code	Price
<b>2 inch Pipe Caps, Feet and Sliders, Zinc plated steel</b>			
330001	1 ea front cap	014-01378	\$68
330002	1 ea rear cap	014-01363	\$52
330005	1 ea slider, 1 flange	014-01365	\$40
<b>3 inch Pipe Caps, Feet and Sliders, Zinc steel</b>			
330010	1 ea front cap	014-01373	\$95
330011	1 ea rear cap	014-01374	\$79
330014	1 ea Slider, 1 Flange	014-01375	\$66
<b>2 inch Pipe Caps and Sliders, Mill finish aluminum</b>			
330019	1 ea front cap	014-01353	\$41
330020	1 ea rear cap	014-01354	\$41
330021	1 ea slider	014-01356	\$20
<b>2 inch Braces and Brackets, Mill finish aluminum</b>			
330101	1 ea 7 ft brace	014-01370	\$65
330102	1 ea 10.5 ft brace	014-01371	\$94
330103	1 ea 14 ft brace	014-01372	\$123
330104	1 ea rail mounting bracket	014-01357	\$18.08
<b>3 inch Braces and Brackets, Mill finish aluminum</b>			
330105	1 ea 7 ft brace	014-01376	\$104
330106	1 ea 10.5 ft brace	014-01377	\$150
330107	1 ea 14 ft brace	014-01379	\$198
330108	1 ea rail mounting bracket	014-01360	\$21.12

ADVERTISEMENT



## SnapNrack

### Ground Mount system



The SnapNrack ground rail and rail-to-pipe clamp simplifies installing a multi-pole, fixed tilt ground mount. The ground rail accepts all the standard module mounting clamps and the pipe clamp is designed for 1.5-inch Schedule 40 steel pipe substructures. It can be installed with tilt angles up to 45 degrees and in locations that may see wind speeds up to 105 mph. For module attachment hardware refer to the SnapNrack roof mount section of this catalog, pages 28-30.



## HatiCon Solar

These ground mount structures are optimized for easy assembly using pre-assembled components, an adaptable, malleable foundation, and compatibility with all framed modules. Height-adjustable module clamps and end clamps allow for maximum flexibility when mounting framed modules from 28 to 52 mm thick. Thin Film clamps are available for First Solar modules and other frameless laminates.

HatiCon Solar's proprietary Sigma post can be rammed into the soil or cast into concrete footings to serve as the ground interface for the system. Soil conditions determine the best option for each site. The HatiCon Solar ground mount system significantly reduces the need for intensive site surveying in the installation of framed photovoltaic modules and allows the racking design to follow the landscape harmoniously. Module inclination is adjustable from 15° to 35° and the system utilizes a proprietary bearing in conjunction with adjustable vertical posts to minimize footing inconsistencies and problems.

The HatiCon system is a custom designed turn-key product designed for large scale installations. Provide us with your project and site details and we will obtain a custom quote including all necessary hardware from foundation footings to the module mounting hardware.



Description	Item code	Price
<b>Ground Rail</b>		
SnapNrack ground rail set 162" - clear	015-09819	\$189
SnapNrack ground rail set 208" - clear	015-09820	\$244
SnapNrack ground rail custom length	015-09835	Call
<b>Ground Rail Parts</b>		
SnapNrack pipe clamp 1.5"	015-09998	\$9
SnapNrack pipe clamp 1.5" 12 pack	015-09999	\$98
TEE, Single Socket, 1.5" pipe, KEE Klamp 10-8	172-05310	\$12.50
Swivel Socket, 1.5" pipe, KEE Klamp 10-88	172-05410	\$18.50
Plug End, Plastic pipe cap 1.5", KEE Klamp 77-8	172-05510	\$2.95

# DPW Solar

## Multi-Pole Mounts

Designed to mount on 3-, 4- and 6-inch Schedule 40 galvanized steel pipe (installer supplied), it supports 2 to 4 modules high in landscape orientation. These mounts can be horizontally expanded as far as necessary by adding more vertical pipe supports. This type of mount requires fewer ground penetrations than traditional ground mounts and offer a full range of seasonal elevation adjustability.

Multi-Pole mounts are ideal for shade and carport structures because the design is capable of significant ground clearance. When seeking recommendations on foundation and pipe sizing, be ready to provide the following site-specific details: maximum design wind speed, exposure category, soil type, steepest expected tilt angle, and above-ground clearance.



Multi-pole Mount Rail Sets (includes module rails and clamp sets, rail-to-pipe brackets, and associated hardware)									
Module	Qty	DPW #	Item code	Price	Module	Qty	DPW #	Item code	Price
Evergreen ES-A-200/205/210	2	MPM2-EG200	013-02006	\$410	SCHOTT POLY 217, 220, 225	2	MPM2-SCT220	013-02050	\$415
	3	MPM3-EG200	013-02001	\$540		3	MPM3-SCT220	013-02051	\$545
	4	MPM4-EG200	013-02007	\$660		4	MPM4-SCT220	013-02052	\$665
Canadian Solar CS6P-170 to 210	2	MPM2-CS1200	013-02011	\$415	Sharp NE-165/170U1 NT-175/185U1	2	MPM2-SHP170	013-02029	\$400
	3	MPM3-CS1200	013-02012	\$545		3	MPM3-SHP170	013-02030	\$545
	4	MPM4-CS1200	013-02013	\$665		4	MPM4-SHP170	013-02031	\$665
Kyocera KD180GX-LP	2	MPM2-KD180	013-02017	\$415	Sharp ND-208/216/ 224U1F	2	MPM2-SHP224	013-02032	\$415
	3	MPM3-KD180	013-02018	\$545		3	MPM3-SHP224	013-02033	\$545
	4	MPM4-KD180	013-02019	\$665		4	MPM4-SHP224	013-02034	\$665
Kyocera KD205/210 GX-LP	2	MPM2-KD205	013-02020	\$415	SolarWorld SW220, 230	2	MPM2-SWD230	013-02038	\$415
	3	MPM3-KD205	013-02021	\$545		3	MPM3-SWD230	013-02039	\$545
	4	MPM4-KD205	013-02022	\$665		4	MPM4-SWD230	013-02040	\$665
Mitsubishi PV-UD175 to 190MF5	2	MPM2-MT180	013-02023	\$400	SunPower SPR210/215/ 220/225/230	2	MPM2-SPR220	013-02041	\$395
	3	MPM3-MT180	013-02024	\$510		3	MPM3-SPR220	013-02042	\$505
	4	MPM4-MT180	013-02025	\$605		4	MPM4-SPR220	013-02043	\$600
Mitsubishi UJ6 - 212 to 235	2	MPM2-MT225	013-02061	\$415	Suntech STP170/175/ 180S-24/Ab-1	2	MPM2-STP175	013-02044	\$395
	3	MPM3-MT225	013-02062	\$545		3	MPM3-STP175	013-02045	\$505
	4	MPM4-MT225	013-02063	\$665		4	MPM4-STP175	013-02046	\$600
REC AE-US 210 to 230 PE Series	2	MPM2-REC210	013-02014	\$415	Suntech STP190/200/ 210Ub	2	MPM2-STP200	013-02047	\$415
	3	MPM3-REC210	013-02015	\$545		3	MPM3-STP200	013-02048	\$545
	4	MPM4-REC210	013-02016	\$665		4	MPM4-STP200	013-02049	\$665

Multi-Pole Mount Pipe Caps (includes U-bolts)				
Size	Description	DPW #	Item code	Price
3" SCH40	For connecting 3" vertical to 3" horizontal steel pipe	PC-3V3H	013-02002	\$200
4" SCH40	For connecting 4" vertical to 3" horizontal steel pipe	PC-4V3H	013-02000	\$220
4" SCH40	For connecting 4" vertical to 4" horizontal steel pipe	PC-4V4H	013-02003	\$230
6" SCH40	For connecting 6" vertical to 3" horizontal steel pipe	PC-6V3H	013-02005	\$265
6" SCH40	For connecting 6" vertical to 3" horizontal steel pipe	PC-6V4H	013-02004	\$275



## “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. 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, and about 6 times the output at ground level.

### Measuring Wind Speed

If you do not have a wind gauge, you can get a rough idea of wind speed from the table below.

Wind speed	Wind effect
0-1 mph	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

## 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
Kestrel 1000 pocket wind meter	016-00253	\$85
Kestrel 1000 replacement impellor	016-00255	\$19

### Towers

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.

## APRS

### Wind Data Loggers

The Wind Data Logger is designed to provide an affordable and easy-to-use solution for wind site evaluation and wind generator performance. It records wind speed, as well as the time and date directly to a Secure Digital (SDTM) card to provide convenient data downloads. An inexpensive 128 megabyte SDTM card will store weeks of data at 30 second intervals and months of data at longer logging intervals. Microsoft Excel, OpenOffice.org, or practically any spreadsheet program can be used to view, graph, and analyze your wind data. Web-based software that makes your analysis even easier is provided. Simply upload your data and our software will automatically plot the data as well as provide basic statistics. It is in comes in a waterproof enclosure.

The solar powered models come with a 10-watt module, a side-of-pole mount for the module and a 7 amp-hour battery. The AC model operates on 90 to 264 VAC or 125 to 370 VDC and does not come with a solar module and battery. The #40R anemometer is a rugged, extra heavy duty version of the 3-cup anemometer.



Description	Item code	Price
APRS 6060 wind data logger - solar powered	016-00270	\$1,125
APRS 6063 #40R wind data logger - solar powered	016-00271	\$1,200
APRS 6061 wind data logger - AC Powered	016-00273	\$890
APRS 6064 #40R wind data logger - AC Powered	016-00274	\$976



## Skystream 3.7

The Southwest Windpower Skystream 3.7 is a residential wind generator that hooks up to your home to reduce or eliminate your monthly electrical bill. It's the first all-inclusive UL Recognized wind generator (with controls and inverter built in) designed to provide quiet, clean electricity in low winds. The Skystream is ideal for residential homes and small businesses. They are available for 120, 240 and 208 VAC operation and come with a monopole or sectional monopole tower or a kit for assembling a guyed tower with locally purchased pipe and anchors.

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 areas that averages 12 mph windspeed.

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 2.4 kW, Skystream can provide anywhere from 40 to 100 percent of the total energy needs 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. 5-year limited warranty.

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.

To order, use the Item Code Determination chart below to get the item code for the Skystream you want to order. Skystream pricing is in the table to the right. Prices include Skystream 3.7, tower, Skyview monitoring software, and Skylevel uptower kit.



Tower type	Tower height	Land price	Marine price
Monopole	33 ft.	\$7,685	\$8,330
	45 ft.	\$8,520	\$9,164
	60 ft.	\$13,353	\$13,998
Guyed tower kit	30 ft.	\$6,298	\$6,942
	42 ft.	\$6,375	\$7,020
	70 ft.	\$6,812	\$7,457

### Chose digits from each section to get part number

Item Code Determination Chart	Base part number	Land	Marine	Tower Height (feet)			Single Piece	Sectional	Voltage		
Monopole Tower	016-1	1	2	33*	45*	60*	1	2	-120	-240	-208
Guyed Tower Kit	016-1	1	2	30	42	72		3	-120	-240	-208

Example: A Marine Skystream and 45' Sectional Tower for 240 volt operation is 016-12452-240

\* 33-ft tower available as single piece only; 45-ft available as single piece or sectional; 60-ft available only as a sectional.

Model	Description	Item code	Price
SMarT Foundation kit 33' & 45'	Complete Foundation kit including Anchor bolts for 33' and 45' Monopole Towers	016-01402	\$1,280
SMarT Foundation kit 60' Tower	Complete Foundation kit including anchor bolts for 60' Monopole Tower	016-01404	\$1,280
32" Foundation bolt kit	Includes bolts and bolt template for 33-ft monopole tower on mat foundation	016-01010	\$565
42" Foundation bolt kit	Includes bolts and bolt template for 33-ft, and 45-ft tower on pier foundation	016-01009	\$658
42" Foundation bolt kit	Includes bolts and bolt template for 60-ft monopole tower on pier or pad-pier foundation	016-01020	\$658
Gin pole kit for monopole	Gin pole and hardware for 33' 6" monopole Tower Only	016-01011	\$364
Hinge plate kit for monopole	Hinge plate and hardware for 33' 6" monopole Tower Only	016-01012	\$322
Gin pole kit for 45' sectional	Gin pole and hardware for 45' 0" sectional monopole towers	016-01114	\$364
Hinge plate kit for 45' sectional	Hinge plate and hardware for 45' 0" sectional monopole towers	016-01115	\$322
Remote interface kit, 916 MHz	Includes wireless display, antenna and AC adaptor	016-01015	\$341
Skystream zoftware utilities kit	Includes remote to USB adaptor and software	016-01016	\$99
Tower adaptor kit (5")	Includes aluminum casting and hardware to attach Skystream to Whisper 500 guyed tower kits or any 5" Schedule 40 pipe	016-01017	\$139
Battery charging controller kit	Includes battery voltage sensor and antenna (required for all battery charging)	016-01018	\$255



## Southwest Windpower

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. Whisper 200 is also available with nominal 120V and 230V output.

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. Use NRG model #40 anemometer available at: <http://www.nrgsystems.com/>



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 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. Available in 24- and 48-volt DC versions.

Description	Weight	Item code	Price
Whisper 100 w/ charge controller	73 lbs	016-01154	\$2,495
Whisper 100 w/o charge controller	70 lbs	016-01155	\$2,240
Whisper 100 Marine w/ charge controller	80 lbs	016-01162	\$2,760
Whisper 200 w/ charge controller	85 lbs	016-01180	\$3,015
Whisper 200 w/o charge controller	80 lbs	016-01181	\$2,780
Whisper 200-120 volt w/o charge controller	80 lbs	016-01199	\$2,780
Whisper 200-230 volt w/o charge controller	80 lbs	016-01198	\$2,780
Whisper 200 Marine w/ charge controller	90 lbs	016-01189	\$3,195
Charge controller display for 100/200/500	1 lb	016-01211	\$105
Whisper 500 w/ charge controller 24V	310 lbs	016-01144	\$7,810
Whisper 500 w/ charge controller 48V	310 lbs	016-01145	\$7,810

High voltage (HV) generators and transformers available for long distance applications. Call for info.

### Towers

A tilt-up pole tower is economical and easier to install. Wiring and mounting of the generator are done before the tower is erected. No climbing necessary. Purchase steel tubing locally to save freight.

### 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. Uses 5" Schedule 40 pipe.

### 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. Do not use these auger sets with Whisper 500 towers.

Description	Item code	Price
Whisper 100 & 200 24' guyed tower kit	016-01083	\$364
Whisper 100 & 200 30' guyed tower kit	016-01089	\$585
Whisper 100 & 200 50' guyed tower kit	016-01095	\$812
Whisper 100 & 200 65' guyed tower kit	016-01098	\$1,072
Whisper 100 & 200 80' guyed tower kit	016-01101	\$1,268
Whisper 500 30' guyed tower kit	016-01110	\$1,164
Whisper 500 42' guyed tower kit	016-01104	\$1,268
Whisper 500 70' guyed tower kit	016-01107	\$1,788
36 Galvanized auger set of 4 - 24' 27' towers	016-01116	\$182
48 Galvanized auger set of 4 - 32'-50' towers	016-01122	\$214
60 Galvanized auger set of 4 - 65'-80' towers	016-01125	\$280
Whisper 100/200 60 amp brake switch	016-01227	\$75

## Southwest Windpower

### AIR X 400W and AIR Breeze 200W

#### Wind Generators

The AIR Breeze, introduced in 2007, is the next generation of the AIR X turbine. Both are available in land and marine versions. The quieter AIR Breeze features newly designed blades and higher power output at wind speeds below 12 MPH. Because of its increased efficiency at lower wind speeds and advanced blade design, the AIR Breeze is the best choice for small wind applications unless average wind speed it well over 12 MPH.

The Marine versions are corrosion-proofed for use in coastal and nautical applications. A white powder-coated housing and sealed electronics prevent damage from salt spray.

All units weigh 13 lbs, have a 46-inch rotor diameter and come with a 3-year warranty. The AIR Breeze is rated at 200 watts at 28 MPH wind and the Air X is rated at 400 watts at 28 MPH wind. A stop switch is included with the Marine versions; it can be ordered separately (016-01351; \$33) for the Land versions.

Volts / Use	AIR X		AIR Breeze	
	Item code	Price	Item code	Price
12V Land	016-01032	\$699	016-00985	\$699
24V Land	016-01035	\$699	016-00984	\$699
48V Land	016-01037	\$699	016-00986	\$699
12V Marine	016-01050	\$879	016-00987	\$879
24V Marine	016-01053	\$879	016-00989	\$879
48V Marine	016-01055	\$879	016-00990	\$879

#### 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 the 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 controller in "diversion load" configuration and add an air- or water-heating diversion load (see page 137). 3-year warranty.



Description	Item code	Price
AIR403 12V Industrial w/o controller	016-01056	\$905
AIR403 24V Industrial w/o controller	016-01062	\$905
AIR403 48V Industrial w/o controller	016-01074	\$905

#### 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.



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	016-01128	\$220
9' AIR Marine aluminum mast and 2 stays	016-01131	\$234
Roof kit without roof seal	016-01134	\$120
Roof kit with roof seal	016-01137	\$137
Roof seal – for roof mount kit	016-01140	\$65
27' AIR guyed tower kit (AIR only)	016-01086	\$190
45' AIR guyed tower kit (AIR only)	016-01092	\$310
29' EZ Tower kit including pipe and anchors	016-01081	\$573
36" Auger – set of 4; use with 24' & 27' towers	016-01113	\$129
36 Galvanized auger set of 4; for 24' & 27' towers	016-01116	\$182
48 Auger set of 4 32' - 50' towers	016-01119	\$140
48 Galvanized auger set of 4 32'-50' towers	016-01122	\$214
AIR Shutoff/circuit breaker	016-09003	\$172
30 amp circuit breaker kit	016-01225	\$26
50 amp circuit breaker kit	016-01226	\$26
100 amp circuit breaker kit	016-01222	\$59
Amp meter kit	016-01223	\$30
Stop Switch for Land Versions	016-01351	\$33
Diversion load for Air Industrial	016-01078	\$135

# American Zephyr

## Airdolphin Wind Generators

Zephyr combines advanced wind turbine technology with Japan's world-renowned manufacturing craftsmanship, to successfully develop the Airdolphin wind turbine — a next-generation, low-mass wind turbine which instantly adapts to changing wind conditions, from slight to stormy.

The total weight of the Airdolphin is 17.5 kg (38.5 lbs). Unlike larger turbines, the Airdolphin's low mass allows it to be mounted on existing structures like remote telecommunication towers, transmission line pylons and billboards, as well as near roads, railways and airports. Even factory and urban rooftops can become cost effective locations for producing usable electrical power.

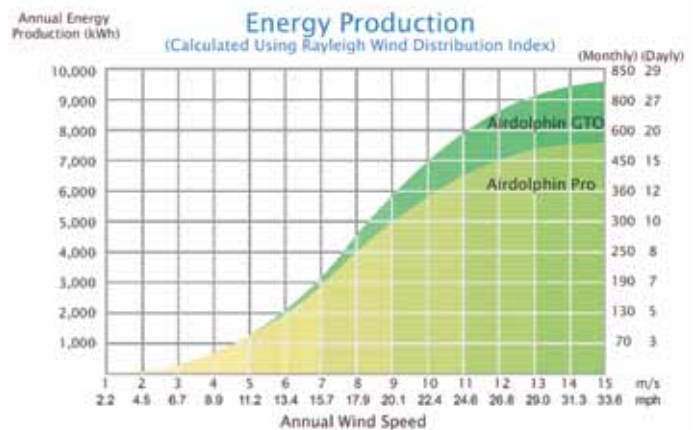
The blades of each Airdolphin are created with Zephyr's patented SD blade technology (noise reduction ridges). Their designers were inspired by the feather patterns of owl wings, which allow owls to fly in silence. This technology applies a series of thin ridges to the surface of each blade, creating micro vortices to keep the airflow attached to the airfoil longer than conventional blades, thus reducing decibel count.

### Intelligent Power Management System

By realizing constant blade rotation speed, operation of the wind turbine has been made much more silent and secure. Their original and patented technology maintains uniform rotor spinning speeds while encountering turbulent gusts found in cities or raging winds at remote locations. These attributes are crucial for small wind turbines because they are often installed in cities where turbulence is caused by tall buildings. When the wind speed increases beyond 20 m/s (44.7 mph), the Airdolphin continues delivering output power at a reduced rpm eliminating the need for cut-out entirely. The intelligent power management system inside the turbine achieves its outstanding performance by software driven microprocessors including control firmware, an internal battery charge controller monitoring voltage and charging rates in a variety of climatic conditions, a web interface, and data logging functions.

Zephyr wind turbines are built with bolt-less self-fitting body parts, inspired by Japanese traditional block puzzle craftsmanship. This technique ensures an exact fit and provides superb resistance to adverse weather conditions, greatly minimizing maintenance requirements. All units come with a 5-year warranty.

24-volt and 48-volt battery charging models have built in charge controllers. The grid-tie GTO has a 250 VDC output and requires a separate grid tie inverter. Zephyr recommends using an SMA 3000US or 4000US inverter for grid tie applications. All turbines mount on a 1.5 inch Schedule 40 pipe. Maximum pipe diameter is 1-15/16 inches.



Airdolphin model	Wind turbine description	Item code	Price
Z-1000-24	Mark-Zero 24 VDC 1000-watt charger	016-03011	\$5,995
Z-1000-48	Pro 48 VDC 1000-watt charger	016-03013	\$5,995
Z-1000-250	GTO 1000-watt 250 V for grid-tie	016-03015	\$5,995
Airdolphin model	Accessory description	Item code	Price
RM-1000(E)-24	Remote monitor for 24 volt turbine	016-03020	\$1,495
RM-1000(E)-24	Remote monitor for 48 volt turbine	016-03022	\$1,495
RM-1000(E)-24	Remote monitor for 250 volt turbine	016-03024	\$1,495
	Monopole tower - 30 foot	016-03041	Call
	Monopole tower - 45 foot	016-03043	Call
	Monopole tower - 60 foot	016-03045	Call
	Monopole tower - 100 foot	016-03049	Call



## How much power can you generate with a hydroelectric turbine?

These micro-hydro turbines require that water be piped from a higher elevation to a lower elevation where the turbine is installed. This pipeline is called a "penstock" and the elevation difference is called the "static head". The "dynamic head" is the static head adjusted for losses due to friction in the pipeline.

The amount of power produced depends on the dynamic head, the amount of water flow and the efficiency of the turbine-generator combination. To get an idea of the potential power generation in watts, multiply the dynamic head in feet, times flow in gallons per minute, times 0.18, times turbine efficiency. Turbine efficiency ranges from 35% to 70%, with higher efficiency at higher heads. To get a rough idea, use 0.40 (representing 40%) as a multiplier for efficiency.

$$\text{Dynamic Head (ft)} \times \text{Flow (gpm)} \times 0.18 \\ \times \text{Turbine Efficiency (use 0.40)} = \text{Output watts}$$

Water flows greater than a single micro hydro turbine can handle can be accommodated by using multiple turbines with a penstock manifold, or separate penstocks running to each unit.

The Harris Pelton turbines use a brushless alternator and a

Pelton wheel runner, and are well suited to higher head and water flows up to 250 gpm. Flow is limited by nozzle size. The Harris permanent magnet (PM) alternator provides up to 50% efficiency and is adjustable for tuning to the particular site conditions.

The HI-Power LV Hydroelectric Generator can deliver up to 1500 watts into 12, 24, or 48V battery banks.

The LV is also available with a 120V output for wire runs as long as 1000 feet and is a good solution where the generator must be far from the batteries. 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. An Iota battery charger (page 161) or the new MidNite Classic MPPT charge controller (page 125) is used to convert this high voltage down to the battery's voltage, at the battery's location.

The HI-Power LV 120V unit can also be used with a PV Powered inverter for grid-tie applications without batteries. Call for more information on grid-tie micro-hydro applications.

### Pipelines

A hydroelectric turbine uses the energy from the pressure at the end of a gravity-fed 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 enters the system, to 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 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 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 table on the next page shows water flow through various size nozzles at given pressures. Use this table 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 0.433). 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 table on the next page.)



## Water Flow Information for Pumping and Hydroelectric Design

### Flow Through Nozzles

The table 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 table 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 4" turbine
feet	psi	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1.0"	
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 Table

Use the table 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 dynamic head in the system.

Pipe Friction Loss Table – 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	22	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

### Low-Voltage Hydroelectric Generators

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

- Head range: 40 to 400 feet
- Flow range: 5 to 100 gpm
- Maximum power: 1500 watts
- Efficiency: 30% to 70%
- Battery voltage options: 12V, 24V, 48V, 120VDC

HI-Power low-voltage hydroelectric generators are available in four voltages for direct battery charging, including the 48V and 120V units, which allow the use of smaller gauge wire between the generator and the battery. An MPPT charge controller such as the OutBack FM-60 can be used to efficiently step the voltage down for charging and regulating 12V, 24V or 48V batteries.

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



Description	Item code	Price
LV Hydro with 1 nozzle	017-02005	\$1,450
LV Hydro with 2 nozzles	017-02007	\$1,500
LV Hydro with 3 nozzles	017-02009	\$1,550
LV Hydro with 4 nozzles	017-02011	\$1,600
Brushless alternator upgrade kit for older Harris Hydroelectric units with brush type alternators	017-02019	\$600

## Harris Hydroelectric

### 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.

Fan kit is recommended when producing over 500W.



Description	Item code	Price
Harris PM 1-Nozzle 12/24V/48V	017-01030	\$2,300
Harris PM 2-Nozzle 12/24V/48V	017-01032	\$2,387
Harris PM 4-Nozzle 12/24V/48V	017-01034	\$2,555
Fan kit (recommended when producing over 500W)	017-01092	\$70
Permanent magnet upgrade for older Harris units	017-01037	\$1,650

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## Inverters

The inverter is the heart of all but the smallest power systems. It is an electronic device that converts direct current DC power from batteries or solar modules into alternating current (AC) power to operate lights, appliances or anything else that

normally operates on electricity supplied by the utility grid. Inverters come in many varieties and sizes with different qualities and features that optimize 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 XW Series, SMA Sunny Island, Magnum MS 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 XW 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, small-system sine wave alternative.

Xantrex TR series, Magnum, 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.

Microinverters, such as the one at right, from Enphase, are bolted to the PV mounting structure beneath the solar modules. They convert the DC output of each module in a grid-tie system to AC, replacing the dangerously high DC voltages with comparatively lower AC potentials and a greatly simplified system design. The microinverter output connects directly to the breakers in the AC load center using conventional wiring. Micro-inverters provide MPPT tracking and monitoring for individual modules and allow modules to be installed in a wider variety of orientations and without the dramatic production losses caused by shading.

Module optimizers, such as those from Tigo and SolarEdge, mount behind each module like a microinverter and provide individual module MPPT tracking and monitoring, but have a DC output that is connected to a string inverter. These devices simplify system design and increase safety at a cost slightly below that of a microinverter.

Central inverters are used in larger commercial grid-tie systems, usually of 50 kilowatts to 1 megawatt or more. They are the most economical way to convert the DC output of PV systems this large to AC for connection to the utility grid.

All grid-tie PV systems use the utility company, in effect, as a 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 company through your electric meter; in such cases, your meter actually runs 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 XW series, and the OutBack GFX 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 new Xantrex XW is a grid-tie inverter 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 subpanel 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.

## Xandex

### **NEW!** SunMizer DC Power Optimizer

SunMizer is a new per-module DC-to-DC power optimizer that performs MPP tracking at the PV module substring level to increase array power harvest. SunMizer achieves maximum power flow from the module during sub-optimal module operating conditions caused by shade and soiling to recover more than half of system level power loss. Modules can now be placed on roof space that would not have been utilized in the past because modules in these areas would actually decrease system output. In addition, SunMizer optimized modules can be installed in locations to match the roofline, avoiding odd shapes and cut-outs.

#### Use one on each module that will be shaded

Selective installation gives SunMizer a unique advantage over competing DC power optimizers that require a unit on each module in a string. SunMizer can be installed selectively, only on the solar modules that experience regular shade or soiling. Selective installation provides optimized power output at a lower initial cost than a fully installed solution. SunMizer is lightweight (< 2 kg) and its compact dimensions of 6" x 4" x 1.6" (15 x 10 x 4 cm) make it easy to install directly to module racking with standard rack system 5/16 or 1/4 inch fasteners. Each unit has an integral grounding lug that also accepts a ring terminal connection. SunMizer is connected in-line with PV modules using standard series wiring schemes and does not require specialized wiring, or add-on equipment. SunMizer is compatible with solar modules that have 54-60 156mm cells. Modules with a maximum power rating of 250W (Pmax), no more than 48V (Voc), and 9A (Isc) can be used with the SunMizer. SunMizer is compatible with most 208V and 240V residential size inverters. SunMizer is made in the U.S. TUV certified to the UL 1741 safety standard. 20-year warranty includes a replacement labor provision.



## Output Voltage

Most of the inverters we stock supply standard 120VAC 60 HZ. OutBack and Magnum inverters can be stacked in pairs for 240VAC, such as is available from utility companies and internal combustion 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 2kW 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.

Xandex model	Maximum module watts	Module voltage max Voc	Module amps max Isc	String voltage maximum Voc	Item code	Price
SunMizer	250	48 V	9 A	600 VDC	030-09105	\$312

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# Tigo Energy

## NEW! Module Maximizer Solution

The Tigo Energy Maximizer Solution delivers up to 20% additional energy harvest through its dynamic module balancing technology which corrects for power mismatch caused by soiling, module aging, temperature, clouds, orientation, and shade. The Tigo Energy Module Maximizer is a DC-side solution that can be paired with any of the most popular inverters in the industry, offering a complimentary solution that enhances the performance of the system and improves overall energy production. UL and CSA Listed to UL 1741.



### TIGO Energy Module Maximizer-ES (MM-ES)

The Tigo Energy Maximizer technology corrects for performance mismatch issues, which drag down the energy output of arrays. Each Tigo Energy Module Maximizer communicates with the Tigo Energy Management Unit (MU), which sets the Maximum Power Point (MPP) of each module through a patented method of impedance matching (rather than DC to DC power conversion). In the Tigo Energy Serial Solution (MM-ES) modules are connected in series as in a normal array (1 Module Maximizer per module). The MM-ES solution provides an industry-leading 99.4% average conversion efficiency, the smallest electronics footprint of its kind, and a polycarbonate enclosure, which eliminates the need for extra grounding. The MM-ES enhances the performance of shaded and unshaded arrays and is usually the best solution for standard modules with Voc below 90 volts. UL and CSA Listed to UL 1741.

### TIGO Energy Module Maximizer-EP (MM-EP)

In the parallel solution (MM-EP) the Tigo Energy Module Maximizer distributes MPPT to the module, adds galvanic isolation, and DC conditioning. This solution outputs a fixed 375 volts to a parallel bus. For high-voltage modules, which are limited to short string lengths, this technology enables longer branches (up to 40 amps) reducing the cost of combining and fusing. The MM-EP is ideal for BIPV and branches with different types of modules. This solution also works well for distressed systems needing galvanic isolation and provides enhanced arc protection. The fixed voltage bus also allows the system to work at the optimal voltage range of the inverter, eliminating the need for DC pre-conditioning stage while increasing the inverter's AC conversion efficiency.



#### Active System Management

The Tigo Energy management software provides greater control over performance with module-level granularity, alerts, maintenance reports, and many other applications. By understanding the performance levels of each system component, maintenance can be quickly and effectively performed. On-demand maintenance reports help crews directly target problem areas which greatly reduces time in the field and O&M costs. They can arrive at the site with the correct replacement components and tools to get the job done quickly.

The Tigo Energy PV-Safe feature allows system owners to disconnect the module from the bus at the Maximizer. This application can be activated with a safety button located on the Management Unit or via a remote command console. This allows for system installation, maintenance, and emergency work to be done without endangering personnel with high DC voltage.



Tigo model	Maximizer type	Module voltage	Input amps (max)	Module connector	Module watts (max)	Item code	Price
MM-EP026V200W375V-3WL	EP (parallel)	23-36	8	MC3	200	030-09206	\$79
MM-EP026V200W375V-4WL	EP (parallel)	23-36	8	MC4	200	030-09207	\$79
MM-EP035V200W375V-4WL	EP (parallel)	31-46	5.7	MC4	200	030-09219	\$79
MM-EP045V200W375V-4WL	EP (parallel)	39-54	4.4	MC4	200	030-09231	\$79
MM-EP060V200W375V-4WL	EP (parallel)	53-78	3.3	MC4	200	030-09243	\$79
MM-ES060V300W-3WL	ES (series)	18-60	12	MC3	300	030-09254	\$56
MM-ES060V300W-4WL	ES (series)	18-60	12	MC4	300	030-09255	\$56
MM-ES060V300W-5WL	ES (series)	18-60	12	Tyco	300	030-09256	\$56
MM-ES090V300W-3WL	ES (series)	50-90	6	MC3	300	030-09266	\$56
MM-ES090V300W-4WL	ES (series)	50-90	6	MC4	300	030-09267	\$56
MU-EPW	Management Unit for parallel Maximizers come with gateway, cable, and three months of access					030-09273	\$625
MU-ESW	Management Unit for series Maximizers come with gateway, cable, and three months of access					030-09277	\$625
MP60	5-year monitoring service for systems under 10kW DC					030-09285	\$350
MP61	Annual monitoring service for systems above 10kW DC					030-09287	\$7/kW

\*Additional connector types are available, lead times may vary

ADVERTISEMENT



# SolarEdge

## NEW! Distributed Power Harvesting Systems

SolarEdge makes the first end-to-end distributed power harvesting system with DC-DC power optimizers for each module combined with a specialized DC-AC string inverter to work with power optimizers, and module-level monitoring. The SolarEdge system maximizes energy yield of a PV installation with maximum power point tracking (MPPT) on each module and fixed string DC voltage. Individual module MPPT eliminates performance and power loss problems, such as lost production from partial shading, module mismatch related to manufacturer tolerance, uneven soiling or aging variance, and delayed response to dynamic weather conditions. Fixed string voltage ensures the inverter always operates at its peak efficiency voltage and prevents under-voltage power losses even on hot days.



The system is designed to automatically maintain the optimum string DC voltage for the inverter, regardless of shading, temperature, or string length. SolarEdge architecture allows flexible string length ranging from 8 to 25 modules regardless of module operating and open circuit voltages. Also, the ability to connect different length strings, as well as modules with different orientations to the sun, to the same inverter removes traditional design constraints and makes string sizing calculations unnecessary. The installation is scalable and facilitates expansion because future modules need not match existing ones. Installing a SolarEdge system typically reduces time and cost by decreasing the number of strings, DC disconnects, wires and other balance of system elements.

### Module-Level Monitoring

Web-based software provides real-time monitoring, from the module to the entire installation, facilitating increased system uptime and lowering maintenance costs. Installation feedback and troubleshooting are immediate and accurate. Remote fault detection allows faster fault resolution via a semi-automatic troubleshooting process that pinpoints the location of underperforming modules on a PV site map. Module performance data is communicated over existing power lines; no additional wiring or labor is required.

The SolarEdge system ensures installer and firefighter safety at all times by automatically shutting off their modules' DC current and voltage if they sense heat of nearby fire. DC current is also automatically shut off when the SolarEdge inverter is turned off or disconnected from the grid. A safe module voltage eliminates electrocution risk during installation and servicing and protects firefighters.

### SolarEdge Components

SolarEdge PowerBoxes can fit almost any crystalline silicon or thin-film module. An AOB PowerBox can be connected to a single crystalline silicon module with a maximum output of 250 watts and maximum power voltage under 60VDC. A TFI PowerBox can be connected to between two and four modules with a total maximum output of 300 watts and a maximum power voltage under 95VDC, and can be used with low power thin-film modules.

SolarEdge inverters are the only inverters designed to work exclusively with power optimizers. These simple, reliable, ungrounded inverters perform only DC to AC inversion of incoming power from one or multiple strings, because MPPT and voltage management are handled by the PowerBoxes. They work with 208 and 240 VAC systems, have built-in AC and DC disconnects, weigh 52 pounds and are 97.2% efficient. ETL Listed to UL 1741 for the U.S. and Canada.

### SolarEdge Systems

SolarEdge systems are available for modules with MC3, MC4 and Tyco connectors and comes with a monitoring datalogger and communication gateway, 3 years of module-level monitoring and lifetime access to site-level web dashboard. The SolarEdge system is accompanied by 20-year warranty for the PowerBoxes and 12-year warranty for the inverters. PowerBoxes and inverters are ETL Listed to UL 1741 for the U.S. and Canada and are NEMA 3R. Order a system kit that matches the number and type of modules you plan to use, with the correct connectors. For some lower wattage modules, extra PowerBoxes may be required. Please contact us for individual component pricing.



SolarEdge system kit	Inverter AC watts	PowerBox type	PowerBox quantity	PowerBox max volts/watts	For modules w/ MC3		For modules w/ MC4		For modules w/ Tyco	
					Item code	Price	Item code	Price	Item code	Price
PHS-AOB-3.3k	3300	AOB	16	60V / 250W	030-09402	\$3,597	030-09401	\$3,597	030-09403	\$3,597
PHS-AOB-4k	4000	AOB	20	60V / 250W	030-09408	\$4,090	030-09407	\$4,090	030-09409	\$4,090
PHS-AOB-5k	5000	AOB	24	60V / 250W	030-09414	\$4,650	030-09413	\$4,650	030-09415	\$4,650
PHS-AOB-6k	6000	AOB	28	60V / 250W	030-09420	\$5,100	030-09419	\$5,100	030-09421	\$5,100
PHS-TFI-3.3k	3300	TFI	11	95V / 300W	030-09426	\$3,597				
PHS-TFI-4k	4000	TFI	14	95V / 300W	030-09432	\$4,090				
PHS-TFI-5k	5000	TFI	17	95V / 300W	030-09438	\$4,650				
PHS-TFI-6k	6000	TFI	20	95V / 300W	030-09444	\$5,100				

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# Enphase

## Grid-Tie Microinverter System

The Enphase Microinverter system is the first commercially available microinverter system for residential and commercial solar PV applications. The Enphase Microinverter is a fully-integrated device that converts the DC output from a single solar module into grid-compliant AC power. The microinverter system is designed to maximize energy harvest, increase system reliability and dramatically simplify design, installation and system management while also improving safety.

The power from each PV module is individually tracked by a microinverter, eliminating losses caused by under performing modules in the array. Microinverters help realize the full energy potential of every PV array, reducing the power-limiting effects of shading, dust, debris, module mismatch, and thermal differences. Problems are isolated to a small fraction of the PV array, while the rest of the PV system continues to function optimally. Service is simplified to routine maintenance.

Microinverters eliminate the need for string sizing exercises that require fitting equal lengths of module strings on a roof. Each PV module is connected directly to its own microinverter and mounted on the racking underneath. The microinverter's AC wire harnesses are connected to form a continuous AC branch circuit that leads ultimately to the AC utility distribution center.

### Model Selection

Enphase makes microinverters for most popular PV modules. The M190 inverters can be used with modules of up to 230 watts made with 60 to 72 cells in series. The New D380 TwinPack Microinverter is comprised of two Enphase microinverters in a single enclosure. Its innovative cabling system further reduces balance-of-system and installation costs because it's possible to install 33% more modules per circuit with the D380. The D380 has a black anodized housing, which improves aesthetics and allows for better thermal dissipation. The D380 TwinPack is optimized for commercial applications, but is applicable to many residential installations as well.

D380 Microinverter "TwinPacks" are auto-sensing and compatible with 240Vac split-phase and 208Vac WYE three-phase utility systems.

The M210 can be used with modules of up to 240 watt with peak power voltage of 31-50 volts. This version is designed for high-efficiency modules like SunPower and SANYO.

The Enphase Microinverter is qualified to a NEMA 6 environment rating and operates at full power at temperatures from -40°C (-40°F) to 65°C (149°F), allowing applications in harsh environments. CSA Listed to UL 1741 for the U.S. and Canada. 15-year



M190/ M210



D380

Enphase model	Module watts	Module inputs	AC output volts	AC output watts (max)	Max DC Voltage	DC MPPT Voltage	Module connector	CEC efficiency	Item code	Price
M190-72-240-S12	150 - 230	1	240	190	54	22-40	MC4	95.0%	030-03740	\$230
M190-72-208-S12	150 - 230	1	208	190	54	22-40	MC4	95.0%	030-03742	\$230
M190-72-240-S13	150 - 230	1	240	190	54	22-40	Tyco	95.0%	030-03734	\$230
M190-72-208-S13	150 - 230	1	208	190	54	22-40	Tyco	95.0%	030-03735	\$230
D380-72-2LL-S12	150 - 230	2	208 or 240	380	54	22-40	MC4	95.0%	030-03724	\$400
D380-72-2LL-S13	150 - 230	2	208 or 240	380	54	22-40	Tyco	95.0%	030-03725	\$400
M210-84-240-S12	150 - 240	1	240	210	62	31-50	MC4	95.5%	030-03744	\$245
M210-84-208-S12	150 - 240	1	208	210	62	31-50	MC4	95.5%	030-03745	\$245

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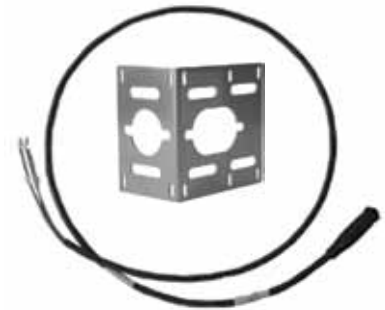


# Enphase

## Module Level Monitoring

Enphase Energy's per-module monitoring technology is integrated into the Enphase Microinverter System, meaning there's no need for a bolt-on or standalone third-party monitoring tool. Every microinverter communicates with the Enphase Enlighten website to show you a physically accurate representation of your entire system and the performance of each PV module in real time. Data is monitored 24/7 and Enlighten will immediately notify you via email of any issues it detects. For example, Enlighten will notify you if an individual module is under performing compared to its neighboring modules. One Envoy communications gateway is required for monitoring on each installation of up to 250 inverters. A Line Communication Filter is required for installations with more than 250 inverters.

The Enphase Envoy communications gateway plugs into any standard AC outlet and collects microinverter performance information over the existing power line. No additional wiring is required. By plugging the Ethernet cable of the Envoy into a broadband router, performance data is automatically transmitted to Enlighten using the site's existing internet connection, further simplifying installation. The Envoy comes with a 90-day free trial of Enlighten monitoring subscription. One-year and 5-year per-inverter subscriptions are available for continued monitoring. CSA Listed to UL 60950.



Enphase model	Enphase module-level monitoring	Item code	Price
IEMU-02	Envoy Energy Management Unit, indoor enclosure	030-03751	\$365
ENLS-01-Y1	Enlighten 1-year subscription, priced per module	030-03764	\$2
ENLS-05-Y5	Enlighten 5-year subscription, priced per module	030-03765	\$9
ELCF-120-001	Line Communication Filter	030-03750	\$850
ELPC-01	Powerline Carrier Ethernet bridge	030-03752	\$102

## M-series Inverter Installation Accessories

Order one install kit for each AC branch circuit of up to 15 modules in a 240-volt M190 system, 13 modules in a 240-volt M210 system, 21 modules for a 208-volt M190 installation and 18 modules for a 208-volt M210 system. An extension cable is required when inverters are mounted more than 6 feet apart.

Enphase model	Enphase installation kits	Item code	Price
EKIT-01-001	M-series installation kit for one AC branch circuit	030-03748	\$68
EKIT-12-001	M-series installation kit for one AC branch circuit (quantity 12)	030-03748	\$770
EEXC-01-06	M-series extension cable with connectors at both ends - 6 foot	030-03753	\$73
EEXC-01-12	M-series extension cable with connectors at both ends - 12 foot	030-03754	\$92
EEXC-01-20	M-series extension cable with connectors at both ends - 20 foot	030-03755	\$110

## D-series Inverter Installation Accessories

Each AC branch circuit may have up to 20 modules in a 240-volt system and 30 modules in a 208-volt system. The D-series cables are ordered separately from the inverter.

Enphase model	Enphase installation kits	Item code	Price
ET3R-G2-06	Enphase AC trunk cable with drops for D380, 240VAC	030-03776	\$90
ET3C-G2-06	Enphase AC trunk cable with drops for D380, 208VAC	030-03777	\$90
ECWP-G2-06	Enphase AC interconnect cable 6 ft. for D380	030-03778	\$50
ECWP-G2-12	Enphase AC interconnect cable 12 ft. for D380	030-03780	\$75
ECWP-G2-20	Enphase AC interconnect cable 20 ft. for D380	030-03781	\$105
EEXC-G2-06	Enphase extension cable, connectors/both ends, 6 ft. for D380	030-03782	\$60
EEXC-G2-12	Enphase extension cable, connectors/both ends, 12 ft. for D380	030-03783	\$90
EEXC-G2-20	Enphase extension cable, connectors/both ends, 20 ft. for D380	030-03784	\$135

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# SMA

## Sunny Boy Grid-Tie Inverters

The popular SMA Sunny Boy inverters are available in sizes from 700 watts to 8000 watts, making them ideal for a wide range of applications from small residential systems to very large 3-phase industrial applications. All SMA inverters come standard with built-in LCD digital monitors that display instantaneous power output, the current day's power production, and the total energy produced since installation. All SMA 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, with 5- and 10-year extensions available.



### Sunny Boy SB700

The SB700 has a 120VAC output and three different configurable input voltage ranges. The 120 volt output allows it to be used on 120/240 VAC systems as well as 208 VAC systems. Evergreen ES-A modules and typical 60-cell grid-tie modules cannot be used with this inverter because their voltage is too low to reach the MPPT voltage of this inverter before exceeding the maximum wattage allowed. It can be used with SANYO modules and with 36-cell and 72-cell modules. The SB700 is 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.

### NEW! Sunny Boy 2000HFUS / 2500HFUS / 3000HFUS

Featuring world-class efficiency, a slim-line enclosure and reduced weight, the Sunny Boy HF series of inverters can be mounted in between wall studs, making it a good choice for new construction and space-constrained retrofits. Installation is simplified by automatic grid voltage detection and field configuration for positive ground. An input voltage range of 175 to 600 volts allows this inverter to work with a wide variety of module types and makes string sizing easier. The modern graphic display and wireless Bluetooth communication system also makes the new Sunny Boy easy to use.

Also available for the HFUS series are an installation frame for integration in between studs in wood-framed walls and an RS-485 communication unit multi-function relay.

UL Listed for the U.S. and Canada

Model	Maximum AC power	AC output volts	DC array voltage	Peak power tracking	CEC efficiency	Max AC Output 208V/240V		Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
SB700USB	700	120VAC	150-250	123-250	91.5%	7A @ 120V		12.7 x 12.6 x 7.1	43	030-03113	\$1,664
	600		125-250	100-200		6A @ 120V					
	460		95-250	77-150		4A @ 120V					
SB2000HFUS	2000	208VAC 240VAC	175-600	175-480	95.0%	10A	8.5A	28 x 13.7 x 7.2	50	030-03074	\$2,820
SB2500HFUS	2500		175-600	215-480	95.0%	12A	10.4A	28 x 13.7 x 7.2	50	030-03075	\$2,960
SB3000HFUS	3000		175-600	220-480	95.0%	14.4A	12.5A	28 x 13.7 x 7.2	50	030-03076	\$3,100

Installation frame

CALL

### Sunny Island

The Sunny Island inverter can be used for standalone off-grid systems, and they are a great way to add battery backup to an SMA Sunny Boy inverter based grid-connected system. UL 1741 Listed.

#### Grid-Tie System Backup

Combined with a grid-tie inverter system the Sunny Island can be used to backup critical loads in the event of utility grid blackouts. Connected to a bank of batteries, the Sunny Island helps keep grid-connected systems running anytime the sun is shining. The loads are actually powered directly by the grid-tie system on sunny days and by a battery bank at night. If the grid-tie inverter has a 240 VAC output, a backup system will require two Sunny Island inverters or one inverter and an autotransformer.



Model	Watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
SI5048U	5000	48 VDC	120 VAC / 60HZ	25 watts	120	150 A	139	030-03095	\$6,540

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# SMA

## Sunny Boy 3000US and 4000US

The compact design of the Sunny Boy 3000US and 4000US inverters makes them suitable for residential and light commercial use and the integrated DC disconnect helps keep installations cost effective. They are field configurable for positive ground systems. The 3000US and 4000US are auto-sensing for use on 240 and 208 VAC applications. They come with a DC disconnect and a 4-circuit integrated fused series string combiner that can be used with fuses up to 20 amps. It is shipped with 15-amp fuses.

## Sunny Boy 5000US / 6000US / 7000US / 8000US

The 5000US, 6000US and 7000US can be used in 208, 240 and 277 VAC applications. The 8000US can be used in 240 and 277 VAC applications. These inverters also come with a DC disconnect switch that connects to the bottom of the inverter. The disconnect has a 4-circuit integrated fused series string combiner that can be used with fuses up to 20 amps. The disconnect also has an input main lug for array DC input if the system has a separate combiner box. It is shipped with 15-amp fuses.

All four models are field-configurable for positive ground systems. All inverters are compliant with UL 1741, UL 1998, IEEE-929, IEEE-1547, FCC Part 15 A & B. 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 AC current	Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
SB3000US	3000	208VAC 240VAC	200-500	175-400 200-400	95.0% 95.5%	15A 13A	17.8 x 13.8 x 9.3	88.6	030-03083	\$2,900
SB4000US	3500 4000	208VAC 240VAC	250-600	220-480 250-480	95.5% 96.0%	17A 17A	17.8 x 13.8 x 9.3	88.6	030-03084	\$3,580
SB5000US	5000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 95.5%	24A 21A	18.4 x 24.1 x 9.5	141	030-03085	\$4,680
SB6000US	6000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 96.0%	29A 22A	18.4 x 24.1 x 9.5	141	030-03086	\$5,020
SB7000US	7000	208VAC 240VAC 277VAC	250-600	250-480	95.5% 96.0%	34A 29A 25A	18.4 x 24.1 x 9.5	141	030-03087	\$5,470
SB8000US	8000	240VAC 277VAC	300-600	300-480	96.0% 96.0%	32A 29A	18.4 x 24.1 x 9.5	148	030-03100	\$6,065

## Sunny Boy Inverter Accessories

### Sunny WebBox – Sunny Portal Connection

The SMA Sunny WebBox provides a connection between the operator’s computer and the free Sunny Portal website ([www.sunnyportal.com](http://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 SensorBox

The Sunny SensorBox is compact in size and installs easily at the PV array. Its integrated sensors continuously monitor solar irradiation and module temperature. By using irradiation and module temperature, it is possible to calculate the expected output of the PV array for comparison to the actual power output of the inverters. This can help identify and troubleshoot reductions in energy yield. The Sunny SensorBox sends data to the Sunny WebBox via an RS-485 data link. From there, the data can be transferred to a PC for further processing or to the Sunny Portal for automatic performance analysis. The Sunny SensorBox can accommodate up to 3 additional sensors such as ambient temperature, wind speed and an additional irradiance sensor making the performance data even more accurate. Shading, dust and dirt, defects and gradual module degradation have adverse effects on the overall performance of the PV array.



### **NEW!** Sunny Beam Bluetooth Wireless Monitor

The new Sunny Beam features Bluetooth wireless technology for improved performance and versatility. The Sunny Beam communicates wirelessly with up to 12 Sunny Boy inverters and graphically displays all the key performance data of your solar system. It features fully automatic system monitoring, including an audible alert signal and it is powered by an integrated solar module and rechargeable battery.

The Sunny Beam simultaneously displays power output, daily energy production and the total energy production of the system. It may also be configured to display other parameters such as the overall CO<sub>2</sub> offset of your system, as well as your earnings in dollars. A hundred days of system performance data can be recorded and stored, and then simply transferred to a PC via a USB interface. Using the new and included Sunny Beam Webconnect software, the data can in turn be transferred to the Sunny Portal website for long-term storage, display, and evaluation. Setting up the Sunny Beam is fast and easy via an intuitive set of user menus. A



Bluetooth Piggyback card is required for each Sunny Boy inverter and can be easily installed by a qualified solar professional. The Sunny Beam has a standard range of up to 150 feet but that can be extended or strengthened, in case of obstruction, through the use of the optional SMA Bluetooth repeater.

All HFUS inverters are set up to communicate with the Sunny Beam. For all other SMA inverters, order a Bluetooth Piggyback card for each inverter to be monitored. Sunny Beam includes a standard 5-year warranty.

Description	Item code	Price
SMA WebBox	030-03141	\$870
Sunny SensorBox	030-03191	\$700
Sunny SensorBox Anemometer	030-03193	\$146
Sunny SensorBox Ambient Temp Sensor	030-03195	\$65
Sunny SensorBox Additional Module Temp Sensor	030-03197	\$72
SMA Sunny Beam Bluetooth	030-03120	\$380
SMA Sunny Beam Bluetooth Piggyback card	030-03121	\$220

### Sunny Boy cables and communications boards

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.	030-03122	\$175
RS-485-N	Module for remote communication between multiple Sunny Boy Inverter(s) and Sunny WebBox or 3rd party monitoring system. A 4-conductor cable required between inverters. RS-485 cable is required between one inverter and Sunny WebBox. One module is required for each inverter.	030-03123	\$140
RS-232 Cable	Cable to connect a PC to single inverter using RS-232 modules – 50 feet (15 meters).	030-03147	\$106
RS-485 Cable	Cable to connect to multiple inverters using RS-485 modules – 50 feet (15 meters).	030-03148	\$106
Service Cable	Cable to connect a USB port to change software configuration parameters	030-03154	\$210

# KACO new energy

## **NEW!** blueplanet xi Residential Grid-Tie Inverters

The KACO 02xi series currently includes the 1502xi, 2502xi, 3502xi and 5002xi grid tied inverters. The units come with an integrated connection box with a DC/AC switch satisfying the NEC requirement for disconnecting the AC and DC circuits. Installation is as simple as mounting a bracket to the wall, hanging the inverter and installing a single bolt into the wall. The 02xi inverters are lightweight and easy to lift onto the wall bracket. The connection box allows conduit to enter from left, right, bottom, or rear sides for increased installation flexibility. New neutral silver enclosure. The inverter CEC efficiency has been increased for all units to 95.5%. The overall design has been simplified and made more reliable using the latest generation of Digital Signal Processing (DSP) control technology. Field configuration of positive or negative ground is now provided as well as 208 VAC or 240 VAC grid connection with or without a neutral present. TUV Listed to UL 1741 for U.S. and Canada. Made in Germany. 10-year warranty standard.



### Optional Monitoring

#### watchDOG

The watchDOG integrated communication card allows web-enabled monitoring of your PV system, so you will know that it is operating at its optimum level. The KACO watchDOG monitors PV system performance from inside the connection box housing. There is no need to purchase additional external hardware. All that is needed is an active Ethernet internet connection. Through the KACO blueplanet web portal you will be able to remotely view your current production, historical production data and production trends and optional alarm functions can be configured to email you the moment that a problem arises. This will help maximize system uptime, overall performance and increase savings. The data can be accessed remotely by Performance Monitoring Reporting Service (PMRS) providers to report your system data for solar incentive reporting. You can even see inverter performance on a PDA or wireless picture frame.



#### proLOG M Ethernet

The proLOG provides remote monitoring for your PV system. Monitor up to 32 KACO inverters by connecting to the inverter's RS-485 interface and connect a PC for local monitoring. Get alarm notification via email. The proLOG has 1 analog input, 1 digital input, 1 digital output.



#### proLOG XL DSL

The proLOG XL DSL has all of the features of the proLOG M plus integrated LCD display and 4 analog inputs, 4 digital inputs, 1 digital output.



#### inSIGHT frames

inSIGHT frames are Wi-Fi enabled picture frames for use with the KACO inSIGHT RSS Feed. Upload your own personal photos and videos and access other RSS feeds. An 8" and 10" TFT LCD screen is available with 800 x 480 pixel resolution. Ambient operating temperature: 32° to 122° F. The RSS feed below is required for frame to operate.



#### inSIGHT RSS Feed

This service provides remote access to your PV data via KACO inSIGHT frame or your iPhone or other mobile device. It can be used to view multiple PV systems and access PV data via multiple technology portals. Use it to sync data to your website or add test system RSS feed to your online newsletters. An email alarm will notify you if there are production problems.

Model	Maximum AC power	DC array voltage	Maximum DC volts	CEC efficiency 208 / 240		Maximum AC current 208V / 240V		Weight (lbs)	Item code	Price
blueplanet 1502xi	1500 W	125-400	550	95.0%	95.5%	8 A	8 A	42	030-03514	\$2,150
blueplanet 2502xi	2500 W	200-450	550	95.0%	95.5%	12.5 A	12 A	52	030-03516	\$2,500
blueplanet 3502xi	3500 W	200-510	600	95.5%	95.5%	17 A	16 A	69	030-03519	\$2,850
blueplanet 5002xi	5000 W	200-510	600	95.0%	95.5%	24 A	24 A	70	030-03520	\$3,550
watchDOG	Internal monitor board								030-03502	\$495
proLOG M	Remote monitor for up to 32 KACO inverters								030-03501	\$975
proLOG XL	Remote monitor for up to 32 KACO inverters with LCD display								030-03500	\$1485
inSIGHT Frame 10	10-inch Wi-Fi picture frame for displaying RSS feed (above)								030-03507	\$235
inSIGHT Frame 8	8-inch Wi-Fi picture frame for displaying RSS feed								030-03506	\$195
inSIGHT RSS Feed	Data feed for iPhone, PDA or inSIGHT Frames (above) – one-time fee – no subscription required								030-03508	\$160

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# Schneider Electric (formerly Xantrex)

## Residential GT Grid-Tie Inverters

Schneider Electric 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. An NEC-compliant integrated AC/DC disconnect eliminates the need for external DC disconnect, and in some jurisdictions, AC disconnect. CSA Listed to UL 1741 for U.S. and Canada. 10-year warranty standard.

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 the communication screens. The LCD is always on standby, ready to provide information, even at night. When inverters are daisy chained using standard Cat 5 Ethernet cable, each inverter display will report the output of the entire system. The GT offers an isolated RS-232 port and two Xanbus RJ45 communication ports. No additional communication ports or cards are needed to connect a PC.



### Inverter Monitor



The monitor easily connects to Schneider Electric GT Series inverters using standard off-the-shelf Cat 5 Ethernet cable. Built-in flash memory stores PV system data and makes software upgrades simple. This connection also provides power to the monitor, removing the need for a monitor power supply. It displays total PV system performance in daily, monthly and lifetime views on a graphical 128 x 64 pixel LCD screen. The display can access detailed individual inverter performance through the device list screen and it can display individual and total system performance for up to five GT Series inverters. Wall mounting bracket and hardware included.

### The Communication Gateway



The Communication Gateway connects Schneider Electric solar inverters and the system owner's computer. It logs performance data directly from the Schneider Electric GT inverters, and transmits it to the included Yahoo Widget-based monitoring software for a simple and graphically rich view of system performance. In addition to data logging, the Gateway offers a web page with the ability to configure automated email reports and fault status to the user or installer. The Gateway includes both built-in Wi-Fi and Ethernet connectivity allowing for flexible and simple set up for wireless or wired connection to a router or direct to a PC. The Gateway logs and transmits system power production, inverter-specific power production, lifetime power production history

(daily, weekly, monthly) and inverter faults. It can monitor a network consisting of up to 20 single-phase GT inverters through a Cat 5 connection between each inverter and the Gateway. The Gateway can also be used with the XW Series inverters on page 101.

Schneider Electric model	Maximum AC output watts 208V / 240V	Maximum AC output amps 208V / 240V	Maximum AC output overcurrent protection	Maximum DC array amps 208V / 240V	MPPT DC output voltage range	Maximum DC voltage	CEC efficiency 208V / 240V	Item code	Price
GT2.8	2700W / 2800W	13.0A / 11.7A	20A	14.9A / 15.4A	195-550VDC	600	94.5% / 95%	030-01801	\$2,375
GT3.3N	3100W / 3300W	14.9A / 13.8A	25A	16.5A / 17.5A	200-550VDC	600	94.5% / 95%	030-01803	\$2,875
GT3.8	3500W / 3800W	16.8A / 15.8A	20A	19.5A / 20.0A	195-550VDC	600	94.5% / 95%	030-01809	\$3,130
GT4.0N	3800W / 4000W	18.3A / 16.7A	25A	17.0A / 18.0A	240-550VDC	600	94.5% / 95%	030-01804	\$3,130
GT5.0	4500W / 5000W	22A / 21A	30A	20.0A / 22.0A	235-550VDC	600	94.5% / 95%	030-01805	\$3,950
GT solar inverter monitor - Monitor up to 5 inverters. Use Cat 5 cable to connect								030-01838	\$300
Communications gateway - Monitor up to 20 inverters with a PC. Use Cat 5 cable to connect								030-01813	\$650

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# Fronius

## Residential and Commercial IG Inverters

Fronius IG inverters offer high efficiency, precision maximum power point tracking, and intelligent thermal management to maximize energy output from grid-tie photovoltaic systems. Their wide input voltage range permits the use of modules in any power and voltage range. Their light weight and innovative mounting hardware make them 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 (4 kW and larger) are built with multiple power stages. When these inverters see array capacity at less than half, one stage turns off, giving the inverter higher efficiency during periods of low insolation. CSA Listed to UL 1741 for the U.S. and Canada. 10-year warranty. 5-year warranty extension available.



## IG Plus Inverters

Fronius IG Plus inverters offer all the features of the IG and add a lockable code-compliant DC disconnect with a six-circuit fused string combiner in a separable connection compartment that stays on the wall if the inverter needs to be serviced. The string combiner can be fused for up to 20 amps per circuit and a busbar is available for bypassing the combiner for higher current inputs. Fuses are not included. The single phase inverters are field settable for 208, 240 or 277 volts. The IG Plus 11.4-3 Delta and 12.0-3 Wye 277 at the bottom of the table below are true three-phase output units. They can be configured for positive or negative ground. CSA Listed to UL 1741 for U.S. 10-year warranty standard with 5-year extensions available.

Model	Maximum AC power	DC array voltage	CEC efficiency			Maximum AC current			AC output volts	Weight (lbs)	Item code	Price
			208V	240V	277V	208V	240V	277V				
IG 2000	2000 W	150-450	n/a	93.5%	n/a	8.35 A	n/a	n/a	240 VAC	26	030-03402	\$2,375
IG 2500-LV	2350 W	150-450	93.0%	n/a	n/a	n/a	11.25 A	n/a	208 VAC	26	030-03410	\$2,479
IG 3000	2700 W	150-450	n/a	94.0%	n/a	11.25 A	n/a	n/a	240 VAC	26	030-03403	\$2,640
IG 4000	4000 W	150-450	n/a	94.0%	n/a	16.7 A	n/a	n/a	240 VAC	42	030-03405	\$3,848
IG 4500-LV	4500 W	150-450	93.5%	n/a	n/a	n/a	21.6 A	n/a	208 VAC	42	030-03412	\$4,010
IG 5100	5100 W	150-450	n/a	94.5%	n/a	21.3 A	n/a	n/a	240 VAC	42	030-03407	\$4,190
IG Plus 3.0	3000 W	230-500	95.0%	95.5%	95.5%	14.4 A	12.5 A	10.8 A	All models operate at: 208 VAC 240 VAC 277 VAC	55	030-03481	\$3,255
IG Plus 3.8	3800 W	230-500	95.0%	95.5%	95.5%	18.3 A	15.8 A	13.7 A		55	030-03483	\$3,850
IG Plus 5.0	5000 W	230-500	95.5%	95.5%	96.0%	24.0 A	20.8 A	18.1 A		84	030-03485	\$5,375
IG Plus 6.0	6000 W	230-500	95.5%	96.0%	96.0%	28.8 A	25.0 A	21.7 A		84	030-03487	\$5,560
IG Plus 7.5	7500 W	230-500	95.5%	95.5%	96.0%	36.1 A	31.3 A	27.1 A		84	030-03489	\$6,430
IG Plus 10.0	10,000 W	230-500	95.0%	95.5%	96.0%	48.1 A	41.7 A	36.1 A		108	030-03491	\$8,570
IG Plus 11.4	11,400 W	230-500	95.5%	96.0%	96.0%	54.8 A	47.5 A	41.2 A		108	030-03493	\$9,720
IG Plus 11.4-3	11,400 W	230-500	95.5%	96.0%	n/a	31.6 A	27.4 A	n/a	208/240V	108	030-03495	\$9,720
IG Plus 12.0-3	12,000 W	230-500	n/a	n/a	96.0%	n/a	n/a	14.4	277	108	030-03497	\$9,990
Extended warranty - 15 years total for IG 4, 4.5 and 5 kW inverters (5-year extension over standard)											030-03470	\$660
Extended warranty - 15 years total for IG 4, 4.5 and 5 kW inverters (5-year extension over standard)											030-03471	\$910
Extended warranty - 15 years total for IG+ 3.0 and 3.8 inverters (5-year extension over standard)											030-03477	\$750
Extended warranty - 15 years total for IG+ 5, 6 & 7.5 inverters (5-year extension over standard)											030-03476	\$1,250
Extended warranty - 15 years total for IG+ 10, 11.4 & 12 kW inverter											030-03475	\$1,975



## Fronius IG Wireless Personal Display

The Fronius IG Personal Display 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 data. The display offers two levels of access: easy and pro. In the easy level, homeowners can view system basics like power, energy output, CO<sub>2</sub> offset, and the number of dollars saved. The pro level offers more advanced information like voltage, current and grid frequency. The display can mount on a wall, or be placed on table. A wireless card is required for each inverter to be monitored. 2-year warranty.



## IG DatCom Accessories

### Datalogger Boxes and Cards

Add these data communications and data logging features to your inverter and turn it into a 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. Datalogging requires a COM card to be installed in each inverter in the system and a Datalogger Box or Card or a Datalogger Web.

#### Datalogger Web



Datalogger Web provides data storage and PC Interface over a network connection. It works in tandem with COM Cards within the DatCom System to provide real-time and archival data. The built in Web server enables the use of network-based monitoring

as well as Fronius free web-hosted data access. It supports up to 100 FRONIUS Solar Inverters per Datalogger Box.

#### Datalogger Box



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.

The Datalogger Easy monitors one IG inverter. The Datalogger Pro can monitor up to 100 Fronius IG inverters.

#### Datalogger Cards



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. Output is RS-232.

### 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.



#### Interface Box and Card

The Interface Box enables a user to output data into an open protocol for systems with up to 100 Fronius IG Inverters. This data is made available to third-party monitoring options. This does not replace the need for a Datalogger Box or Card. This interface offers real-time open protocol data without data storage for up to 100 inverters and 10 sensor boxes. Interface Card Easy is able to provide data for one Fronius IG inverter without storage. Fronius IG.access software is free and is supplied when the Datalogger is ordered or can be downloaded from [www.fronius.com](http://www.fronius.com). It works with Windows.



2-year warranty on all Fronius DatCom equipment.

Model	Accessory	Item code	Price
IG+ Buss Bar	Use these to bypass the internal string combiner. Two are required when a single input is over 20A	030-03464	\$17
IG Personal Display	Wireless display for IG inverters - wireless card required to monitor each inverter	030-03417	\$297
Wireless Card	Wireless card for personal display	030-03419	\$138
COM card, retrofit	Communications card for all Fronius IG inverters	030-03425	\$143
Datalogger Pro Card	Control and monitoring data storage and PC interface for up to 100 IG inverters	030-03432	\$690
Datalogger Pro Box	Control and monitoring data storage and PC interface for up to 100 IG inverters	030-03431	\$737
Datalogger Easy Card	Control and monitoring data storage and PC interface for 1 IG inverter	030-03434	\$445
Datalogger Easy Box	Control and monitoring data storage and PC interface for 1 IG inverter	030-03435	\$466
Datalogger Interface Box	Combines benefits of the Datalogger Pro and interface box	030-03436	\$837
Interface Box	Use to export real time data without data storage – for up to 100 inverters	030-03440	\$366
Interface Card	Use to export real time data without data storage – for up to 100 inverters - mounts in inverter	030-03438	\$229
Interface Card - Easy	To export data without data storage from 1 inverter – requires Datalogger or COM Card	030-03441	\$185
DatCom power supply	Used when Datalogger boxes are too far from inverters to be power over com cable	030-03439	\$96
Sensor card	Monitoring interface with 6 sensor input channels	030-03443	\$689
Sensor box	Monitoring interface with 6 sensor input channels	030-03442	\$737
Sensor, wind speed	For measuring wind speed. Sensor box (above) is required.	030-03446	\$89
Sensor, ambient temperature	For measuring outside temperature. Sensor box is required.	030-03448	\$53
Sensor, module temperature	For measuring module temperature. Sticks to back of PV module. Sensor box is required.	030-03449	\$111
Sensor, irradiance	Reference PV cells for measuring solar insolation. Sensor box is required.	030-03444	\$243
RS-232 null modem cable	For connection of Datalogger cable to PC or cable.	030-03453	\$27
Cat 5 cable 3.3 feet	Network cable for connecting inverters to each or to Sensor Box and Datalogger Box	030-03455	\$4
Datalogger Web	Data storage and PC Interface over a network connection. Built in Web server. For up to 100 IG inverters	030-03437	\$1350



# PV Powered

## Residential Grid-Tie Inverters

PV Powered inverters use significant software integration and a modular design to create a scalable platform with fewer components to increase uptime.

PV Powered delivers high reliability and technical innovations designed to lower the total cost of PV systems installation. PV Powered is the only manufacturer of a residential inverter-integrated AC/DC PV System Disconnect that is listed to the UL 98 Standard. The UL 98 Standard, called “Enclosed and Dead-Front Switches,” ensures the integrated PV Powered disconnect meets all installation and inspection requirements of a PV system disconnect. Housed within an NEC compliant wire raceway, PV Powered’s innovative disconnect consists of one enclosure with ample working room for installation. In addition to providing for a single point of connection from the utility service and PV array, the wire raceway’s optimized knockout locations also provide options for side, bottom and back entry with minimized conduit bending. The wire raceway enables flush side-by-side mounting, eliminating the need for extra equipment and resulting in a cleaner, less expensive installation. ETL Listed to UL 1741 for the U.S.

10-year warranty, with compensation for your replacement time.

### PVM1010 Data Monitoring Module

The PVM1010 provides secure, web-based access to your system’s status and performance history to maximize your system uptime. The PVM1010 along with the secure internet-based server operated by PV Powered is equivalent to a standalone data logging meter and communication interface without the cost and inconvenience of installation and maintenance of a separate metering system. With registration you get access to inverter information from anywhere you can connect to the internet. Reports of power output and energy production trends, local weather conditions and forecasts, verification that your system is working at its full potential and collection and export of data for service and maintenance planning are all included at no charge. Just install the PVM1010 in each inverter to be monitored and connect to a router with Cat 5 cable.



You can also order the PVM1010 pre-installed by adding “0-M” to the end of the item code. These options are listed in the table below.

Model	Maximum AC power	DC array voltage	Maximum DC volts	CEC efficiency	Maximum AC current	AC output volts	Weight (lbs)	Item code	Price
PVP1100-SD-120	1100 W	115-450	500	90.5%	10 A	120VAC	55	030-03819	\$2,825
PVP1100-SD-120-PVM	1100 W	115-450	500	90.5%	10 A	120VAC	55	030-03819-M	\$3,224
PVP2000-SD-240	2000 W	115-450	500	92.0%	9 A	240VAC	65	030-03821	\$2,950
PVP2000-SD-240-PVM	2000 W	115-450	500	92.0%	9 A	240VAC	65	030-03821-M	\$3,349
PVP2500-SD-240	2500 W	140-450	500	94.5%	11 A	240VAC	70	030-03822	\$3,309
PVP2500-SD-240-PVM	2500 W	140-450	500	94.5%	11 A	240VAC	70	030-03822-M	\$3,708
PVP2800-SD-208	2500 W	180-450	500	92.0%	13 A	208VAC	70	030-03823	\$3,610
PVP2800-SD-208-PVM	2500 W	180-450	500	92.0%	13 A	208VAC	70	030-03823-M	\$4,009
PVP3000-SD-240	3000 W	170-450	500	93.5%	13 A	240VAC	80	030-03824	\$3,610
PVP3000-SD-240-PVM	3000 W	170-450	500	93.5%	13 A	240VAC	80	030-03824-M	\$4,009
PVP3500-SD-240	3500 W	200-450	500	95.5%	15 A	240VAC	85	030-03825	\$3,929
PVP3500-SD-240-PVM	3500 W	200-450	500	95.5%	15 A	240VAC	85	030-03825-M	\$4,328
PVP4600-SD-208	4600 W	205-450	500	95.5%	23 A	208VAC	135	030-03814	\$4,794
PVP4600-SD-208-PVM	4600 W	205-450	500	95.5%	23 A	208VAC	135	030-03814-M	\$5,193
PVP4800-SD-240	4800 W	200-450	500	96.0%	21 A	240VAC	135	030-03816	\$4,833
PVP4800-SD-240-PVM	4800 W	200-450	500	96.0%	21 A	240VAC	135	030-03816-M	\$5,232
PVP5200-SD-240	5200 W	240-450	500	96.0%	23 A	240VAC	135	030-03818	\$5,119
PVP5200-SD-240-PVM	5200 W	240-450	500	96.0%	23 A	240VAC	135	030-03818-M	\$5,518
PVM1010	Monitor card - 1 required for each inverter to be monitored						1	030-03803	\$399



# Solectria Renewables

## PVI 1800W and PVI 2500W

The PVI 1800W and PVI 2500W weigh only 34 and 36 pounds, respectively, and have low-profile sealed NEMA 4 enclosures with an interactive menu-driven LCD display. They are available in 208VAC and 240VAC versions.

The inverters are prewired so they do not have to be disassembled for installation. They can be purchased alone or panelized with AC and DC disconnects and utility meter. Panelized inverters are available below.

The PVI 1800W and 2500W are available with a 5-year standard warranty, and 10- and 15-year warranties optional. TUV Listed to UL 1741 for the U.S. and Canada.

## PVI 3000W, 4000W, 5000W, 5300W

The larger inverters in the Solectria line have some of the highest CEC efficiencies, 96% on all models. They have an integrated DC disconnect with a fused DC string combiner in a detachable wiring box. A quick-mount wall bracket makes it a snap to mount this lightweight inverter line. Their universal auto-detect feature allows them to be used on 240 and 208 VAC systems. RS-232 and RS-485 ports allow connection for monitoring. ETL Listed to UL 1741 for the U.S. and Canada.

A 10-year warranty is standard.



Solectria Renewables model	Continuous AC power	DC array voltage	Peak power tracking	Max DC current	CEC efficiency	Weight (lbs)	Item code	Price
PVI 1800W	1800W	125-400	125-350 VDC	11A	92.5%	34	030-03852	\$2,510
PVI 2500W	2500W	125-400	125-350 VDC	15A	93.0%	36	030-03849	\$2,889
PVI 3000W	2900W	200-600	200-550VDC	16A	96.0%	47	030-03848	\$2,836
PVI 4000W	3900W	200-600	200-550VDC	20A	96.0%	48	030-03847	\$3,498
PVI 5000W	4900W	200-600	200-550VDC	25A	96.0%	58	030-03846	\$4,188
PVI 5300W	5300W	200-600	200-550VDC	25A	96.0%	60	030-03845	\$4,452

## Solectria Integrated Panel

The Solectria Renewables Integrated Panel Assemblies are options that can be added to all PVI-series inverters. They can be used with inverters set to a grid voltage of 240VAC or 208VAC. This panel makes installing a PV system even faster and easier. The complete panel with inverter weighs only 65 lb (29.5 kg) and ships via UPS. The PVI 1800/2500 version includes visible-blade AC and DC disconnects, an optional revenue-grade, factory sealed, reconditioned easy-read kWh meter and meter socket all mounted on an aluminum panel using only stainless steel hardware. The design compliments the sleek, low profile construction of the inverters providing a clean, compact installation indoors and outdoors. The PVI 3000/4000/5000/5300 versions do not have a DC disconnect because it comes with these inverters. The AC disconnect is optional. Order a Panel below and an appropriate inverter above. Price of the Integrated Panels will be added to the inverter price.



Inverter model	Integrated Panel features	Item code	Price
PVI 1800/2500	Integrated Panel with meter socket without meter	030-03855	\$735
PVI 1800/2500	Integrated Panel with meter socket with meter	030-03856	\$795
PVI 1800/2500	Integrated Panel without meter socket and meter	030-03858	\$640
PVI 3000/4000/5000/5300	Integrated Panel with meter socket and meter, with AC Disconnect	030-03915	\$590
PVI 3000/4000/5000/5300	Integrated Panel with meter socket and meter, without AC Disconnect	030-03930	\$510

# Satcon

## PowerGate Plus 3-Phase Commercial Inverters

Satcon PowerGate Plus PV inverters provide efficient and stable power, even in harsh climates. With nine power ratings, ranging from 30 kW to 1 MW (UL and CE certified) Satcon offers a wide range of solar PV inverter solutions. PowerGate Plus solutions increase efficiency by combining sophisticated system intelligence with in-depth performance monitoring, providing you with a high level of PV system command and control.

PVS-30, -50 and -75 come changeable between 208, 240 and 480 VAC. Larger models with a -2UL suffix can be changed from 208 to 240 VAC. Larger models with a -4UL suffix are for use with 480 VAC. The PVS-500 and PVS-1MW w/ external transformer are designed for use on medium voltage systems. Satcon inverters come with a 5-year warranty standard, with 10-, 15- and 20-year warranties available.



Satcon model	Continuous output (kW)	AC output voltage	Max AC amps/phase	MPPT range	Fused subarray input options	CEC efficiency	Weight (lbs)	Item code	Price
PVS-30	30	208 240 480	84 70 36	305-600	4@50A or 5@40A	95.0%	1,204	030-03242	\$35,076
PVS-50	50	208 240 480	139 121 60	305-600	4@80A or 5@63A	95.5%	1,732	030-03239	\$41,148
PVS-75	75	208 240 480	208 181 91	315-600	5@100A or 6@80A	96.0%	2,150	030-03244	\$56,880
PVS-100-2UL	100	208 240	278 241	315-600	5@110A or 6@100A	96.0%	2,350	030-03280	\$60,988
PVS-100-4UL	100	480	121	315-600	5@110A or 6@100A	96.0%	2,350	030-03240	\$60,988
PVS-135-2UL	135	208 240	375 325	310-600 320-600	5@160A or 9@100A	96.0%	2,684	030-03245	\$83,424
PVS-135-4UL	135	480	163	310-600	5@160A or 9@100A	96.0%	2,684	030-03241	\$83,424
PVS-250-2UL	250	208 240	694 601	320-600	5@160A or 9@100A	96.0% 97.0%	4,500	030-03247	\$141,410
PVS-250-4UL	250	480	301	320-600	5@160A or 9@100A	97.0%	4,500	030-03248	\$148,678
PVS-375-4UL	375	480	451	320-600	15@160A or 24@100A	95.5%	5,500	030-03246	\$192,444
PVS-500 ext. transformer	500	200*	1388	333-600	20@160A or 30@100A	97.0%	5,900	030-03250	\$229,574
PVS-500-4UL	500	480	602	320-600	20@160A or 30@100A	96.0%	9,100	030-03249	\$233,682
PVS-1MW ext. transformer	1,000	265*	1388 602	420-815	28@160A or 40@100A	96.0%	12,000	030-03251	\$461,676

\* For medium voltage utility system connection.

## Satcon PV View Plus

Monitor and control system performance to increase uptime, output, and overall profitability. Satcon PV View Plus provides a comprehensive view of an array's performance,

PV View Plus adds an advanced layer of intelligence to PowerGate Plus, giving you complete visibility into and control over the variables that affect energy conversion. Real-time data acquisition and performance monitoring make it easy to assess array output, evaluate site conditions, pinpoint problems, and identify maintenance needs rapidly before performance is compromised.

Critical performance information is delivered through a centralized dashboard. By aggregating data, PV View Plus establishes benchmarks for normal performance, predicts anomalies, and provides system health information, helping a PV plant operate at peak performance.



Satcon options	Item code	Price
Satcon PV View direct monitoring - 10 years	030-03350	\$17,270
Satcon PV View direct monitoring - 5 years	030-03352	\$8,635
Satcon Revenue Meter Assembly	030-03351	\$4,250
Satcon PV View Gateway	030-03353	\$1,970
Satcon PV View Weather Station	030-03354	\$8100

## Accessories and Warranties for Satcon Inverters

Order one sub-combiner from the table below for each Satcon inverter. Sub-combiners and monitoring for Satcon inverters are factory installed and must be ordered with the inverter.

Warranties are total number of years and include the inverter's standard 5-year warranty. Where there are 2 item codes for a warranty, the bottom one is for the 480V version.

Satcon accessories			Sub-combiners		PV zone		Warranties					
For use with model #	Number of input strings	Max amps	Item code	Price	Item code	Price	10-year		15-year		20-year	
							Item code	Price	Item code	Price	Item code	Price
PVS-30	4	50	030-03317	\$2,163	030-03362	\$762	030-03260-10	\$4,761	030-03260-15	\$7,142	030-03260-20	\$9,047
	5	40	030-03318	\$2,252	030-03363	\$728						
PVS-50	4	80	030-03319	\$1,848	030-03364	\$757	030-03261-10	\$5,148	030-03261-15	\$7,722	030-03261-20	\$9,782
	5	63	030-03320	\$1,921	030-03365	\$880						
PVS-75	5	100	030-03321	\$1,273	030-03366	\$1,020	030-03262-10	\$5,148	030-03262-15	\$7,734	030-03262-20	\$9,796
	6	80	030-03322	\$1,363	030-03367	\$1,224						
PVS-100	5	110	030-03323	\$1,273	030-03368	\$1,023	030-03263-10	\$5,268	030-03263-15	\$7,901	030-03263-20	\$10,007
	6	100	030-03324	\$1,363	030-03369	\$1,224						
PVS-135	5	160	030-03325	\$2,354	030-03370	\$1,219	030-03265-10	\$5,268	030-03265-15	\$8,905	030-03265-20	\$11,281
	9	100	030-03326	\$2,388	030-03371	\$1,501						
PVS-250	2 x 12	100	030-03327	\$6,389	030-03372	\$2,430	030-03267-10	\$7,679	030-03267-10	\$12,670	030-03267-20	\$14,590
	10	160	030-03328	\$2,983	030-03373	\$2,482						
	15	100	030-03329	\$1,908	030-03374	\$3,800						
PVS-375	15	160	030-03330	\$4,195	030-03375	\$3,440	030-03269-10	\$10,380	030-03269-15	\$17,646	030-03269-20	\$19,723
	20	110	030-03331	\$2,427	030-03376	\$4,622						
	24	100	030-03332	\$2,785	030-03377	\$5,100						
PVS-500	2 x 15	200	030-03333	\$8,827	030-03378	\$3,443	030-03271-10	\$12,935	030-03271-15	\$20,983	030-03271-20	\$23,452
	20	160	030-03334	\$6,765	030-03379	\$3,025						
	30	100	030-03335	\$8,122	030-03380	\$4,226						
PVS-1MW	4 x 15	200	030-03336	\$17,654	030-03381	\$6,883	030-03272-10	\$26,468	030-03272-15	\$44,996	030-03272-20	\$50,289

# PV Powered

## Commercial Grid-Tie Inverters

PV Powered commercial inverters combine high reliability, low lifetime cost and high efficiency into one easy-to-install system. They are designed for 20-plus years of operation, enabled by an array of new features including busbars for all power connections, a sealed electronics module and an instrumented cooling system. The highly integrated system was designed to save commercial installers time with load break rated AC and DC service disconnects, certification for installation without a neutral conductor, cable landing points sized for maximum NEC-compliant cables and a well-planned cable bending radius for top, bottom and side cable entry options. Choose the proper subarray combiner for the inverter size you are using from the chart below.

PV Powered commercial three-phase inverters offer a voltage window of 295-600VDC, a wide operating range with low standard MPPT voltage. This provides the ability to string with all PV modules currently available including new thin film modules. Serviceability is enhanced by a modular design that divides the inverter into easy-to-maintain subsystems. 10-year warranty, with extension to 20 years available at 20% of inverter price. ETL Listed to UL 1741 for the U.S.

### NEW! PVP260kW

The PVP260kW has a standard 295VDC minimum MPPT and an optional full power 265VDC minimum MPPT- the lowest MPPT voltage of any commercial inverter in the industry. This low input voltage option enables stringing with all PV module technologies including new thin film modules. The PVP260kW also simplifies performance monitoring by offering inverter-integrated solutions from Fat Spaniel, Draker and Energy Recommence. Additional options from PV Powered include integrated revenue grade meter and sub-combiner monitoring.

### IntelliString Smart Combiner Box

PV Powered string combiners have touch-safe fuse holders, solid busbar and bridge punched back panels to help this smart string combiner box install quickly and last the life of the PV system. String current monitoring is enabled by the integrated DC Solar Current Monitor from Obvius, selected for its robust and easy to use design, modbus output, and built-in user adjustable alarming functions which simplify data collection and reporting. String-level performance data is a valuable tool for PV system owners because it enables fast diagnosis of PV system underperformance due to failed modules, shading or soiling. Monitoring at the string level has been primarily used on large expensive systems due to the high cost. Now, the IntelliString line of smart string combiner boxes offers a solution that is practical and affordable enough to use on most commercial installations. NEMA 4X fiberglass lockable boxes. 20A max fuse size. ETL Listed to UL 1741.



PV Powered model	Continuous output (kW)	AC output voltage	Max AC amps	Max DC array voltage	MPPT range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
PVP30-208-LV	30	208	82	600	295-500	93.0%	47.7 x 30.4 x 25.9	760	030-03826	\$27,100
PVP30-480	30	480	36	600	295-500	93.5%	47.7 x 30.4 x 25.9	760	030-03828	\$27,100
PVP75-208	75	208	208	600	295-500	95.5%	93 x 65.5 x 35	2750	030-03830	\$54,562
PVP75-480	75	480	90	600	295-500	95.5%	93 x 65.5 x 35	2750	030-03832	\$54,562
PVP100-208	100	208	278	600	295-500	96.0%	93 x 65.5 x 35	3000	030-03833	\$63,610
PVP100-480	100	480	120	600	295-500	96.0%	93 x 65.5 x 35	3000	030-03835	\$63,610
PVP260kW	260	480	316	600	295-500	97.0%	109 x 104 x 41	4800	030-03820	\$149,940
PVP260kW-LV	260	480	316	600	265-500	96.5%	109 x 104 x 41	4800	030-03827	\$149,940
IntelliString 8	Array combiner - 8-string 160 A with Modbus over RS-485 NEMA 4x fiberglass, 24" x 20" x 8"							27	053-02750	\$2,185
IntelliString 16	Array combiner - 16-string 320 A with Modbus over RS-485 NEMA 4x fiberglass, 24" x 24" x 8"							48	053-02751	\$4,200
6-75A Sub	Array sub-combiner - six 75 A strings for 75 kW inverter								053-01207	\$1,827
6-100A Sub	Array sub-combiner - six 100 A strings for 100 kW inverter								053-01217	\$1,827
16-100A Sub	Array sub-combiner - sixteen 100 A strings for 260 kW inverter								053-01225	\$5,150



# Solectria Renewables

## 3-Phase Commercial Inverters



Solectria Renewables PVI inverters use 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 sealed 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. Optional integrated fused DC sub-combiners are available in all units.

Solectria inverters have an RS-485 communication port. Web-based monitoring options available. Also compatible with third-party monitoring systems. Contact us for information.

The Solectria Renewables SGI 266KW, SGI 300KW and SGI 500KW are rugged, DSP-controlled, efficient PV inverters for grid-connected commercial and utility 3-phase PV and storage systems. With peak inverter power electronics efficiency at 98.5% (97% including transformer and filters) and fully integrated packaging, these inverters are highly efficient, easy to install and use, reliable and cost effective. Multiple inverters can be used together in any combination for 750kW, 1MW and multi-MW PV systems.

Inverters are ETL Listed to UL 1741 for the U.S. and Canada, and IEEE Standard 1547, and certified to IEEE 6241 NY SIR surge test requirements.

Solectria inverters come with a 5-year warranty. 10-year and 15-year warranties are available. These units ship from the Solectria factory in Massachusetts. Made in USA.

### NEW! SolrenView Monitoring Hardware Included

LCD display and web-enabled SolrenView monitoring Gateway are included in all Solectria commercial inverters. Inverter direct monitoring allows you to see detailed inverter data (AC and DC) using your web-browser. Go back in time and flip through the daily, weekly, and monthly graphs up to 5 years in the past to view single events or long-term trends. The package includes email alarms with detailed descriptions of sudden system problems and a recommended course of action. Call about monitor options and prices.

Inverter model	AC power	AC output voltage	Max AC amps	Max. DC array volts	MPPT range volts DC	CEC efficiency	Weight (lbs)	Dimension H"xW"xD"	Item code	Price
PVI 13kW-208VAC	13.2 kW	208	37	475	225-380	94.0%	376	34.5x 26x13.6	030-03863	\$15,230
PVI 13kW-480VAC	13.2 kW	480	16	475	225-380	94.5%	376	34.5x 26x13.6	030-03867	\$15,430
PVI 15kW-208VAC	15 kW	208	42	475	225-380	94.0%	398	34.5x 26x13.6	030-03871	\$17,230
PVI 15kW-480VAC	15 kW	480	18	475	225-380	94.5%	398	34.5x 26x13.6	030-03875	\$17,430
PVI 60kW-208VAC	60 kW	208	166	600	330-500	94.0%	1526	76x56x29.3	030-03885	\$51,900
PVI 60kW-480VAC	60 kW	480	73	600	330-500	95.5%	1526	76x54x25.3	030-03889	\$50,800
PVI 82kW-208VAC	82 kW	208	229	600	330-500	94.5%	1615	76x56x29.3	030-03893	\$56,200
PVI 82kW-480VAC	82 kW	480	100	600	330-500	95.5%	1615	76x54x25.3	030-03897	\$54,960
PVI 95kW-208VAC	95 kW	208	261	600	330-500	94.5%	1748	76x56x29.3	030-03901	\$63,480
PVI 95kW-480VAC	95 kW	480	115	600	330-500	95.5%	1748	76x54x25.3	030-03905	\$61,900
SGI 266kW-480VAC	266 kW	480	886	625	300-500	97.0%	4170	79x108x37	030-03930	\$150,000
SGI 300kW-480VAC	300 kW	480	1,000	625	300-500	97.0%	4760	79x108x37	030-03940	\$168,000
SGI 500kW-480VAC	500 kW	480	1,667	625	300-500	97.0%	6510	79x108x37	030-03950	\$230,000
Integrated fused combiner option for 13.2 kW and 15 kW inverters. Specify 6 or 7 fuses and fuse size (10A or 15A). Add:									030-03859	\$540
Integrated fused subarray combiner option for 60kW and larger inverters. Specify 2-8 fuses and fuse size (40-250A). Add:									030-03860	\$540



## KACO new energy

### NEW! XP100U

The new KACO XP100U 100 kW central inverter utilizes a digital signal processing design to increase the inverter's reliability and overall efficiency. Through the use of this digital design the inverter's reliability and functionality can be monitored and controlled remotely. The XP100U inverter series is available for 208V and 480V three-phase systems.

The XP MPPT window of 300 to 600VDC offers flexibility to work with a wide array of solar modules. This wide operating window in conjunction with the inverter's capability to adjust its pulse width modulation encourages the system to produce more kWh over the entire day by quickly and accurately adjusting the inverter's operating state to handle the constantly changing ambient conditions.

ETL Listed to UL 1741 for the U.S. and Canada. 5-year warranty and service reimbursement standard. 10-, 15- and 20-year warranty extensions available.

The inverters can be moved by folk-lift or crane. The compact size gives the system designer and installer flexible installation options. The XP can be easily installed indoors or on rooftops. The connection terminals are located right at the access points of the inverter to minimize wiring and all parameters are factory pre-set before installation. This means that the inverter can be turned on with the touch of a button. The commissioning installer must only choose the country and language settings desired in the touch-screen color LCD menu after AC/DC connections are complete.

Integrated AC and DC disconnects are included. NEMA 3R enclosure for indoor and outdoor installation.

With password-protected access to KACO's web server and instant monitoring, the system operator can access real time data on the inverter without data download from an external server. The inverter submits the data through the internet directly to your PC for you to access automatically. Additionally, the monitoring capabilities include system diagnostic functions that help the operator to analyze DC and AC performance data. Instantaneous inverter data is sent automatically to a pre-defined email address in case of any problem. System restarts or software upgrades can be done remotely.

Also included is SD card data storage for up to 8 GB of monitoring data.



KACO model	Continuous output (kW)	AC output voltage	Max AC amps	Max DC array volts	MPPT range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
XP100U-H2	100	208	278	600	300-600	95.5%	73 x 68 x 37	2,646	030-03511	\$59,000
XP100U-H4	100	480	120	600	300-600	96.0%	73 x 68 x 37	2,425	030-03510	\$58,000

## Schneider Electric (formerly Xantrex)

### Xantrex GT Series 3-Phase Commercial Inverters

The GT Commercial Series grid-tie inverter makes industrial-commercial power production affordable and attractive. These high efficiency inverters are available in sizes from 30 kW to 250 kW.

The compact, 220-pound, 30 kW inverter is in a wall-mounted aluminum enclosure and requires a symmetrical array input (split array +/-180-500VDC). 100 kW and 250 kW 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.



Schneider Electric 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	030-02003	\$27,909
GT100-480	100	480	347	600	300-600	96%	73 x 67 x 46	030-02015	\$74,455
GT100-208	100	208	347	600	300-600	96%	89 x 67 x 46	030-02017	\$74,455
GT250-480	250	480	867	600	300-600	96%	86 x 90 x 46	030-02026	\$122,273

# SMA

## Sunny Central 250U/500U Inverters

The Sunny Central 250U and 500U have integrated isolation transformers and deliver excellent efficiency for large PV power plant inverters.

The user interface now features a large LCD screen that provides a graphical view of daily plant production and the status of the PV array, inverter, and utility grid. The new 250U and 500U now offer optional PV string monitoring that makes troubleshooting the PV array more efficient.

The Sunny Centrals offer a variety of remote monitoring options. Users can choose from RS-485, Ethernet, or wireless communications via Bluetooth or GSM with the optional WebBox. Daily performance data can be automatically uploaded to the free Sunny Portal website. The accuracy of performance data can be increased by using the optional Sunny SensorBox which provides monitoring of local irradiance, temperatures, and wind speed. UL Listed to 1741 for the U.S. and Canada. NEMA 3R enclosure.



## Sunny Central 500HEUS Inverter

The new Sunny Central 500HE-US couples to an external medium voltage transformer to accommodate long distance power feeds to distribution substations and delivers the highest efficiency available for large PV inverters. An updated user interface features a large LCD that provides a graphical view of the daily plant production as well as the status of the inverter and the utility grid. With the optional Sunny WebBox, users can now choose from either RS-485 or Ethernet based communications. Optional AC and DC disconnects and combiner boxes with string monitoring available.

SMA model	Continuous output (kW)	AC output voltage	Max DC amps	Max DC array volts	MPPT range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code	Price
SC250U	250	480	800	600	330-600	97.0%	80 x 110 x 33	4200	030-03041	\$125,000
SC500U	500	480	1600	600	330-600	97.0%	80 x 140 x 37	7165	030-03046	\$240,000
SC500HEUS	500	200	1600	600	330-600	98.0%	90 x 98 x 35	3970	030-03036	\$210,000

## Sunny Tower 36kW, 42kW and 48kW Systems

The Sunny Tower combines the advantages of central inverters with the performance and installation advantages of string inverters by offering assembled 36kW, 42kW and 48kW systems. Each Sunny Tower consists of six 8kW, 7kW or 6kW inverters mounted on a stainless steel structure. Two Sunny Towers can be combined as 96, 84 or 72kW systems. 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 is designed for use only in three-phase systems at 208 VAC, 240 VAC or 277 VAC. Total weight is 1,115 lbs. (Tower is 330 lbs, plus six inverters.) 10-year warranty standard. UL Listed for the U.S. and Canada

NOTE: A Sunny Tower can NOT be used with less than 6 inverters, and cannot be used in single-phase systems

Model	3-phase AC voltage	Max AC power	Max AC amp output			Peak power tracking	Max DC current	Item code	Price
			208V	240V	277V				
ST36	208/240/277	36 kW	3 x 58A	3 x 50A	3 x 44A	250-480	6 x 25A	030-03060	\$35,482
ST36+WebBox	208/240	36 kW	3 x 58A	3 x 50A	n/a	250-480	6 x 25A	030-03061	\$37,445
ST36+WebBox 277	277/480	36 kW	n/a	n/a	3 x 44A	250-480	6 x 25A	030-03062	\$37,445
ST42	208/240/277	42 kW	3 x 68A	3 x 58A	3 x 50A	250-480	6 x 30A	030-03070	\$38,395
ST42+WebBox	208/240	42 kW	3 x 68A	3 x 58A	n/a	250-480	6 x 30A	030-03071	\$40,355
ST42+WebBox 277	277/480	42 kW	n/a	n/a	3 x 50A	250-480	6 x 30A	030-03072	\$40,355
ST48	240/277	48 kW	n/a	3 x 64A	3 x 58A	300-480	6 x 30A	030-03057	\$41,965
ST48+WebBox	240	48 kW	n/a	3 x 64A	n/a	300-480	6 x 30A	030-03058	\$43,925
ST48+WebBox 277	277/480	48 kW	n/a	n/a	3 x 58A	300-480	6 x 30A	030-03059	\$43,925



# OutBack

## NEW! SmartRE Grid-Tie Inverter with Battery Backup

The SmartRE (Smart Renewable Energy) solution from OutBack Power is a simplified grid-tie inverter with backup power for residential and small commercial applications. Designed with an emphasis on ease of installation, a SmartRE solution installs and operates similarly to basic grid-tie solar inverters but with the additional benefit of providing UPS quality battery backup during utility outages. An integrated ultra-fast AC transfer switch guarantees that even computers and other sensitive backup loads never know when a utility outage occurs. Recommended AGM batteries are maintained and charged by an innovative OutBack multi-stage charging process. This valuable feature assists in providing reliable backup power and will help extend your battery life up to 10 years.

The SmartRE is a versatile product and can be installed indoors or outdoors. It's available in power levels up to 3kW. They can be either wall or pad mounted, making this the most versatile grid-tie with battery backup solution on the market. A standard 5-year warranty, with an option to add an additional five year warranty, provides peace of mind.

A display shows: Battery State of Charge, PV Active, Inverter Output, Grid Active, Generator Active. The SmartRE system is in an aluminum 42.75 x 19 x 20.38 inch (108.58 x 48.26 x 51.75 cm) NEMA 3R outdoor raintight enclosure. The 120 VAC versions weigh 134 lbs (60.7 kg) and the 120/240 VAC versions weigh 166 lbs (75.3 kg) The SmartRE system is ETL Listed to UL 1741, CSA C22.2 No. 107.1.

A matching battery enclosure holds four 31-series sealed batteries, including the new "tall" 31 series batteries. This enclosure weighs 44 lbs (19.9 kg) not including batteries. For more battery capacity, extra enclosures and battery paralleling kits are available, or some other battery bank housing can be used.

Maximum PV array wattage is 4000 watts for all four models. Battery capacity is 100 amp hours at 48VDC. CEC efficiency is 93%.



OutBack model	Continuous watts	AC current max (RMS)		AC output volts	Item code	Price
		120 VAC / 240 VAC				
SRE2500-120-NA	2500	50	n/a	120	030-04040	\$6,999
SRE2500-120/240-NA	2500	50	25	120/240	030-04042	\$7,499
SRE3000-120-NA	3000	50	n/a	120	030-04041	\$6,999
SRE3000-120/240-NA	3000	50	25	120/240	030-04043	\$7,499
SRE-BE1	SmartRE Outdoor Battery Enclosure - for additional battery capacity - holds 4 type 31 batteries				030-04049	\$999
SRE-BPAR	Battery Box Paralleling Kit - required to add an additional battery box.				030-04051	\$99

## GTFX and GVFX Grid-Tie Inverters and Systems

OutBack G-Series inverter/chargers are the grid-interactive versions in OutBack's FX inverter line. Available in either sealed (GTFX) or vented (GVFX) models, these inverters allow you to sell solar, wind, and/or hydro power back to the utility grid. If the utility power goes down, the inverter will automatically switch to battery power and your renewable energy source(s) to run your critical loads. The inverter can be set up so that either utility power or your renewable source can be used after an outage to recharge the battery bank. AC power is seamlessly switched between utility and battery power through the inverter's built-in 60A transfer switch. With the OutBack grid-interactive system, backup AC power is made available 24 hours a day in the event of a utility outage, providing reliable power and peace of mind. At night, the inverter's automatic power save mode ensures that energy is not wasted by needlessly charging your batteries from the utility grid. Daily energy production efficiency is within a few percentage points of batteryless grid-intertie systems (depending on the condition of the battery bank). Up to two G-Series inverters can be combined and wired or "stacked" for 120/240V output. G-Series inverters can be stacked in Classic Series only, which is limited to two G-Series inverters. They come with a standard 2-year warranty with an optional 3-year extension (5 years total). A 10-year warranty is available for California residents. ETL Listed to UL 1741 for U.S. and Canada.



OutBack model	Continuous watts	Battery voltage	AC out volts/ hertz	No load draw	Charger amps	Peak AC surge	Weight lbs	Item code	Price
GTFX2524	2500	24 VDC	120V/60Hz	18-20W	55A	70A	56	030-04025	\$2,369
GTFX3048	3000	48VDC	120v/60Hz	21-23W	35A	70A	66	030-04030	\$2,369
GVFX3524	3500	24VDC	120V/60Hz	18-20W	85A	70A	54	030-04032	\$2,569
GVFX3648	3600	48VDC	120v/60Hz	21-23W	45A	70A	54	030-04036	\$2,569

## Indoor Systems

We offer pre-assembled, pre-wired and tested, complete one-inverter or two-inverter OutBack grid-tie power systems based on OutBack FLEXware 500 power system components. Choose a 24V or 48V system, and either the sealed or vented inverter models. Use without a solar array to provide emergency backup power, or with the addition of one or two MX-60 MPPT charge controllers and a solar array, create a fully automated utility-intertie system with battery backup. OutBack's MATE controller, HUB4, AC and DC surge arrester, and RTS remote temperature sensor are included with each system. Other options, such as AC and DC circuit breakers, and the FLEXnet battery monitor, can be pre-installed if desired, or field installed later. The X-240 autotransformer cannot be installed in grid-tie systems because they can cause islanding situations. Batteries are required – the system will not function without them. Batteries, and battery-to-inverter cables, are not included.

These power systems are not recommended for off-grid use. They are pre-assembled in our ETL Listed shop. The whole assembly is ETL Listed to UL standards. See page 114 for additional options that can be pre-installed in power systems.



Model	FLEXware type	Inverter(s) qty – model	Rated power kW - AC output	DC voltage	Battery charger	Item code	Price
<b>Indoor Sealed Grid-Tie Systems</b>							
OBFW5-GTFX2524/S	500	1 – GTFX2524	2.5kW 120V	24 VDC	55 amp	033-00201	\$4,867
OBFW5-GTFX2524/D	500	2 – GTFX2524	5kW 120/240V	24 VDC	110 amp	033-00203	\$7,930
OBFW5-GTFX3048/S	500	1 – GTFX3048	3.0kW 120V	48 VDC	35 amp	033-00209	\$4,793
OBFW5-GTFX3048/D	500	2 – GTFX3048	6.0kW 120/240V	48 VDC	70 amp	033-00211	\$7,659
<b>Indoor Ventilated Grid-Tie Systems</b>							
OBFW5-GVFX3524/S	500	1 – GVFX3524	3.5kW 120V	24 VDC	85 amp	033-00205	\$5,082
OBFW5-GVFX3524/D	500	2 – GVFX3524	7kW 120/240V	24 VDC	170 amp	033-00207	\$8,188
OBFW5-GVFX3648/S	500	1 – GVFX3648	3.6kW 120V	48 VDC	45 amp	033-00213	\$4,993
OBFW5-GVFX3648/D	500	2 – GVFX3648	7.2kW 120/240V	48 VDC	90 amp	033-00215	\$8,059
OBFW-O-FM60	OutBack FM60 charge controller with breakers, installed in power system					033-01513	\$895
OBFW-O-FM60/D	Two OutBack FM60 charge controllers with breakers, installed in 2-inverter power systems					033-01515	\$1,800
OBFW-O-FM80	OutBack FM80 charge controller with breakers, installed in 2-inverter power systems					033-01521	\$1,058
OBDC-GFP	Ground fault interrupter for PV array, installed in power system; two pole					033-01221	\$171



ADVERTISEMENT

# Schneider Electric (formerly Xantrex)

## Xantrex XW Sine Wave Battery-Based Inverter System

The Schneider Electric XW Series hybrid inverter/charger offers an innovative, integrated design which minimizes external balance-of-system components allowing for quick and easy installation, both off-grid and grid-tie. The XW Series offers pure sine wave capability as well as split-phase operation for 120 VAC and/or 240 VAC solutions. Up to three units can be operated in parallel or operate in a 3-phase configuration, offering 18 kW, 120/240VAC 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. XW MPPT charge controllers are required for PV grid-tie operation.

High 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 LED indicates output power or charge current. A battery temperature sensor is included with each inverter, but only one is needed per system.

The new wall-mount design is easy to install. The Power Distribution Panel includes all AC/DC disconnects and wiring. The distribution panel and conduit box is factory wired and labeled 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. For each charge controller use a 60-amp input breaker and 80-amp output breaker listed in the table below.

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. Up to four MPPT-60 charge controllers can be wired into the Power Distribution Panel.

The XW System Control Panel plugs into Xanbus network and provides a central user interface to configure and monitor all components in the system. A battery bank is required for inverter operation. A minimum bank of 100 AH is required, but a 200 AH minimum (400 AH for the XW4024) is recommended if you need to power any loads over 1000W. The Communications Gateway on page 86 can be used to connect the XW to a PC.

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.



Schneider Electric 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	030-01166	\$3,250
XW4548-120/240-60	4500	48VDC	120/240V/60Hz	26W	85	50A	115	030-01163	\$3,600
XW6048-120/240-60	6000	48VDC	120/240V/60Hz	28W	100	70A	125	030-01160	\$4,500
XW Power Distribution Panel	XW Power Distribution Panel w/ conduit box for 1 XW inverter							030-01169	\$1,500
XW Connection Kit	XW Connection Kit is needed for each additional inverter, includes breakers and conduit box*							030-01172	\$850
XW Conduit Box	XW empty conduit box raceway							030-01175	\$250
XW-MPPT60-150	XW 60A MPPT charge controller with built-in ground fault protection							020-08040	\$650
865-1070	Input circuit breaker for charge controller 60 A 160 VDC							030-01192	\$25
865-1075	Output circuit breaker for charge controller 80 A 125 VDC							030-01189	\$25
XW Auto Generator Start	Automatic generator start module for the XW system							030-01183	\$200
XW System Control Panel	Plugs into Xanbus network and provides a central user interface							030-01181	\$300

\* Third inverter requires additional pair of 5-foot long 4/0 battery cables, which are not included.

# OutBack

## Off-Grid Inverters

The sealed, externally fan-cooled OutBack FX is designed to survive harsh environments. The higher powered ventilated VFX version is a better choice in high ambient temperature applications or where generator-powered battery charging is an important part of system battery charging.

Each inverter/charger 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 10 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 a programmable, auxiliary relay output connection (AUX) that 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. Note: The AUX relay is used to power the external cooling fan of the FX sealed inverters, so it is not available for other uses.

The 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 for the U.S. and Canada. Standard 2-year warranty with an available 5-year extended warranty.

OutBack model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Wt. (lbs)	Item code	Price
<b>OutBack Sealed/Turbo Cooled Off-Grid Inverters</b>									
FX2012T	2000	12VDC	120V/60Hz	20 W	80	56A	56	030-04147	\$2,369
FX2012MT	2000	12VDC	120V/60Hz	20 W	80	56A	56	030-04145	\$2,369
FX2524T	2500	24VDC	120V/60Hz	20 W	55	70A	56	030-04119	\$2,369
FX3048T	3000	48VDC	120v/60Hz	23 W	35	70A	56	030-04121	\$2,369
<b>Export Models – can be connected in parallel or 3-phase Y 400VAC</b>									
FX2012ET	2000	12VDC	230V/50Hz	20 W	100	70A	56	030-04140	\$2,369
FX2024ET	2000	24 VDC	230V/50Hz	20 W	55	70A	56	030-04144	\$2,369
FX2348ET	2300	48VDC	230V/50Hz	23 W	35	70A	56	030-04142	\$2,369
<b>OutBack Ventilated Fan Cooled Inverters</b>									
VFX2812	2800	12VDC	120V/60Hz	20W	125	56 A	54	030-04149	\$2,569
VFX2812M	2800	12VDC	120V/60Hz	20W	125	56 A	54	030-04146	\$2,569
VFX3524	3500	24 VDC	120V/60Hz	20W	85	70 A	54	030-04155	\$2,569
VFX3648	3600	48VDC	120v/60Hz	23W	45	70 A	54	030-04157	\$2,569
<b>Export Models – can be connected in parallel or 3-phase Y 400VAC</b>									
VFX2612E	2600	12VDC	230V/50Hz	20W	120	56 A	54	030-04134	\$2,569
VFX3024E	3000	24 VDC	230V/50Hz	20W	85	70 A	54	030-04136	\$2,569
VFX3048E	3000	48VDC	230V/50Hz	23W	42	70 A	54	030-04138	\$2,569

# 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. Multiple power panels can be used for systems up to 36 kW. Both the FLEXware 500 and 1000 systems provide ample locations for AC and DC breakers, DC-current shunts, an auto-transformer and other items required in higher kW systems. The FLEXware MP mounting plate is used with with both FLEXware 500 and FLEXware 1000 enclosures. Use two mounting plates for the FW1000. The picture here shows the FLEXware 1000 AC and DC boxers with 4 inverters and 4 MX60 charge controllers. See page 99 for a picture of the FLEXware 500.



OutBack model	FLEXware 500 and 1000	Inverters	Item code	Price
<b>FLEXware Mounting Plate</b>				
FW-MP	Mounting plate for FLEXware 500 and 1000 enclosures (2 required for FW-1000 systems).	2	030-04260	\$179
<b>FLEXware 500 Power System Box and IOB Kits</b>				
FW500-AC	FLEXware 500 enclosure with TBB-ground, DIN rail for AC breakers	2	030-04215	\$309
FW500-DC	FLEXware 500 enclosure with DC breaker bracket, TBB, BBUS, 500A shunt	2	030-04212	\$309
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	2	030-04237	\$249
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	2	030-04240	\$219
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export	2	030-04243	\$199
<b>FLEXware 1000 Power System Box and IOB Kits</b>				
FW1000-AC	FLEXware 1000 Enclosure with TBB-ground, DIN Rail for AC breakers	up to 4	030-04223	\$509
FW1000-DC	FLEXware 1000 Enclosure with DC Breaker bracket, TBB, 2 SBUS, BBUS, 500A Shunt	up to 4	030-04221	\$509
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	2	030-04237	\$249
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	2	030-04240	\$219
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and bypass slide plate, TBB, wire - EXPORT ONLY	2	030-04243	\$199
FW-IOB-T-120/208VAC	IOB kit includes nine 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	3	030-04253	\$309
FW-IOB-T-230/400VAC	IOB kit includes nine 30A 230VAC breakers and bypass slide plate, TBB, wire - EXPORT ONLY	3	030-04255	\$309
FW-IOB-Q-120VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	4	030-04249	\$409
FW-IOB-Q-120/240VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	4	030-04247	\$409
FW-IOB-Q-230/AC	IOB kit includes twelve 30A 230VAC breakers and bypass slide plate, TBB, wire EXPORT	4	030-04251	\$409

## FLEXware Components

When adding charge controllers, additional inverters or circuit breakers, these components may be necessary.

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	030-04270	\$390
TBB-GROUND	Ground/neutral terminal busbar with mounting screws (no insulators).	030-04356	\$19
OBDC-GFP	Ground Fault Protection, 2 pole, 80A	030-04323	\$129
TBB-black	Bus bar with black insulators	030-04353	\$19
TBB-BLUE	Bus bar with blue insulators (for 3-phase and export versions)	030-04359	\$19
TBB-RED	Bus bar with red insulators	030-04355	\$19
TBB-WHITE	Bus bar with white insulators	030-04354	\$19
TBB-BROWN	Bus bar with brown insulators (for export versions)	030-04352	\$19
FW-BBUS	FLEXware Breaker Bus connector two 175-250A, three 100-125A, four 1-80A DC breakers or three 500 amp DC shunts	030-04280	\$19
FW-CBUS	Combiner Bus connects up to eight DIN mount breakers or four DIN mount fuse holders – includes one 1/0 screw lug	030-04361	\$19
FW-SBUS	FLEXware shunt bus connector allows up to four high current cable connections on same side of DC shunt	030-04284	\$29
FW-CCB	FM charge controller mounting bracket for one side mounted on FW500 or FW1000 DC enclosures – with hardware	030-04263	\$55
FW-CCB2	FM charge controller mounting bracket for two side mounted on FW500 or FW1000 DC enclosures – with hardware	030-04265	\$59
FW-CCB2T	FM charge controller mounting bracket for two top mounted on FW500 or FW1000 DC enclosures – with hardware	030-04267	\$59

\*The FW-X240 Autotransformer cannot be used for stacking with a grid-interactive FX system. However, the FW-X240 can be used to step-up the AC output of a single grid-interactive FX system from 120VAC to 240VAC. These inverters are not recommended for off-grid use.



## OutBack Accessories

### Conduit Adapters

Use the FX-DCA to connect 2-inch conduit to the DC side of the inverter. Also required to connect inverters to the FW-500DC or FW-1000DC. Use the FX-ACA to connect to the AC side of the inverter. The FX-SP-ACA can be used in place of the FX-ACA and offers surge protection. Use either one to connect inverters to the FW-500DC or FW-1000DC.

OutBack model	OutBack inverter accessories	Item code	Price
DCA	2" conduit adapter – required to mount inverter to FLEXware 500 or 1000	030-04163	\$45
FW-ACA	AC wiring compartment extension – includes two 1" conduit knockouts and an AC outlet knockout – required to mount FX or VFX to FLEXware 500 or 1000	030-04169	\$45
FW-SP-ACA	AC wiring compartment with surge arrestor for AC and DC side of inverter	030-04290	\$259
FW-SP-R	Replacement surge protector board for FW-SP-ACA or FW-SP-ACA	030-04294	\$209



### MATE Remote Monitors and Hubs

The OutBack MATE is a complete system controller and display for both the OutBack inverter/charger and OutBack MPPT PV charge controller. It provides a display of the operation and 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, OutBack 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-10 communication manager. The OutBack MATE also includes an optoisolated RS-232 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.



### The FLEXnet DC System Monitor

The FLEXnet DC System Monitor integrates with an OutBack MATE communications device, providing you with the data you need concerning your system's health, performance and efficiency. Easily see your system's current condition with this at-a-glance display. This screen shows battery state-of-charge and whether you are currently charging or discharging your batteries. It monitors the amount of power your system is currently producing and consuming as well as the amount of power going IN and OUT of your battery bank. It allows the MATE to display real-time production monitoring of DC sources, such as a solar array or small wind turbine, as well as consumption by loads. It also displays the cumulative energy your system has produced and consumed as well as the total amount of energy that has gone to charging your batteries today. This screen displays each day's lowest state-of-charge and allows you to see how your overall system production compares to system consumption. Review historical energy production and consumption data for the most recent 128 days, including the minimum battery state-of-charge reached for each day. The FLEXnet DC can be used to watch power system production and consumption trends.



A HUB is required to connect more than one inverter to the same load or to connect inverters, MATEs and FM charge controllers to allow programming and monitoring of the entire system by the MATE.

The RTS remote temperature sensor is important for accurate battery charging, especially if the batteries get very warm or cold. If used with a HUB, one temperature sensor can be shared by all inverters and FM charge controllers.



OutBack model	OutBack MATE system monitor and control	Item code	Price
MATE	System control – shipped with a 50 ft Cat 5 cable	030-04180	\$295
MATE-B	Black version of MATE above	030-04180-B	\$295
MATE2	Flush-mount version	030-04181	\$295
FlexNet DC	Advanced DC System Monitor - requires a MATE	030-04187	\$379
HUB-4	Stacking kit for up to 4 inverters and/or charge controllers	030-04185	\$195
HUB-10	Stacking kit for up to 10 inverters and/or charge controllers	030-04188	\$375
RTS	Remote temperature sensor with 20' cable	030-04190	\$29

# Apollo Solar

## **NEW!** TSW TrueSineWave Inverter/Chargers

The Apollo Solar TSW3224 and TSW4048 include a true sine wave inverter, battery charger, and AC transfer switch in a compact modular housing. These inverters provide 120 and 240 volt split-phase AC power at 60Hz or 230VAC at 50Hz. The output provides 240 volts for well pumps, appliances, or shop tools while providing 120 volts for standard circuits. They handle 75% unbalanced loads as well. The input can accept the utility line or 240-volt AC generators. The output can be wired for single 230/240VAC output or for single 120VAC output at twice the current. Internal switches allow the option to select 230VAC or 240VAC and 50Hz or 60Hz.

Over 200% of the rated TSW power is available to allow for surges for short periods, such as starting a 3-HP motor, without interrupting sensitive computer loads. At the same time, the TSW inverters can be wired in parallel to provide additional output current. The high-current battery-charging circuit is power factor corrected and optimizes the efficient use of energy from generator or utility line input. The 4-stage charging algorithm — Bulk, Absorb, Float, Equalize — maximizes both battery life and storage capacity.

Monitoring of energy used, battery state-of-charge, and system performance is included in the Apollo TSW inverters. The two-line LCD shows all major parameters and adjusts to allow horizontal and vertical inverter installation. The TSW's ASNET port allows networking capability between multiple units as well as access to the T80/T80HV MPPT Turbocharger PV controllers. Remote system monitoring on a local Ethernet and/or on the internet is provided via the Apollo Solar Communications Gateway via the Apollo Solar GSM Modem even when telephone land line is unavailable.



22.5" x 9"x 7.25". The TSW is UL 1741 certified and carries a standard 5-year warranty. CSA C22.2 No.107.1-01 certified.

Apollo TSW TrueSineWave Inverter/Chargers									
Apollo model	Continuous watts	Battery voltage	AC output volts/hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
TSW3224	3200	24 VDC	120V/240V 60Hz	29 W	100	6400W	49	030-02615	\$2,499
TSW4048	3600	48 VDC	120V/240V 60Hz	35 W	70	7200W	49	030-02619	\$2,499

## **NEW!** ISM 120/240 Inverter Switchgear Module

The Apollo Solar ISM 120/240 comes factory assembled with the inverter breakers for DC input and AC input/output/bypass breakers, and slots for 18 DIN rail half-inch wide breakers. It's designed for the optional ready-to-add Apollo Solar Breaker Pacs for the T80 or T80HV MPPT Charge Controller, ground fault protection, and generator/grid selector. With the AC and DC disconnects, busbars, shunt and connectors in a single enclosure, installers need only connect the PV Input, battery cables, AC load, and optional AC line/generator input from the outside, providing a complete plug-and-play solar power switchgear package for quick, fail-safe installation. The ISM 120/240 fits all versions of the Apollo TrueSineWave, Split-Phase Inverter as well as the Apollo T80 and T80 High Voltage MPPT charge controllers.

The Apollo ISM provides 120/240VAC split phase, 120VAC single phase (or 230VAC power for the global market) with the selection of the optional Apollo Solar AC Circuit Breaker Pacs, all at the low cost of an appliance that is built, wired, and tested at the factory. With a footprint of only 11" wide, 15" tall and 7"deep, and a weight of only 11 pounds, the ISM is easily installed in tight spaces and in combination with TSW inverters and charge controllers, provides a complete power center with PV input.

The wiring box has clearly labeled connectors for the PV array input, the battery cables, and a second bypass toggle space is provided for optional generator input. The ISM 120/240 ships fully assembled, is UL 1741 Certified and NEC Compliant, and carries a standard 5-year warranty. If you are adding a charge controller to the ISM, order one of the circuit breaker kits below.

See page 122 for the Apollo T80 and T80HV charge controllers and monitoring hardware.



Apollo model	Apollo inverter accessories	Item code	Price
ISM 120/240	Inverter Switchgear Module - wiring and breaker box for off-grid installations	030-02637	\$799
ISM-T80-DC Pac	DC Circuit Breaker kit to add a T80 to the ISM	030-02640	\$279
ISM-T80HV-DC Pac	DC Circuit Breaker kit to add a T80HV to the ISM	030-02642	\$319
ISM-Generator Selector	Add Generator input to the ISM - includes dual AC circuit breakers and toggle bar	030-02644	\$89
RW-Wired	Wired remote display	020-07085	\$199

# Magnum

## Sine Wave Inverters

### MMS1012 Sine Wave Inverter/Charger

The MMS Series from Magnum Energy is a pure sine wave inverter providing a cost-effective solution for those with smaller power needs in mobile applications. Versatile, easy-to-use and lightweight, the MMS Series provides a reliable base for your energy system. The MMS Series inverter's improved design accommodates entertainment systems and small appliances in smaller RVs and boats. Based on the popular ME and MS Series inverters, the MMS is smaller, lighter and less expensive while retaining all the built-in protection and reliability of ME and MS models. The MMS charger uses a PFC (power factor corrected) charger, which is 85% efficient and the same charger topology used in all Magnum models. The MMS Series is ETL Listed to the stringent requirements of UL/cUL 458, CSA C22.2 #107.1-01 and meets the KKK-A-822E standard. Made in USA.



### MS-Series Pure Sine Wave Inverter/Chargers

The MS Series inverter/charger is a pure sine wave inverter designed specifically for the most demanding mobile and off-grid applications. The MS Series is powerful, easy to use, and cost-effective. MS-series inverter/chargers are available in 12-, 24- and 48-volt versions. The M4024-AE and MS4448-AE have 120/240VAC output, eliminating the need to stack two units or buy a transformer to run 240-volt loads. The MIS2012-20B has two 20-amp AC breakers built in.



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 RS-485 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 ME-RC50 controller is required for inverter programming.

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 inches. 3-year warranty, except MS4024-AE and MS4448-AE which has a 2-year warranty. Made in USA.

Magnum model	Continuous watts	Battery voltage	AC out volts/hertz	No-load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code	Price
MMS1012	1000	12VDC	120V/60Hz	18W	50	1750W	20	030-02320	\$1,199
MS2012	2000	12VDC	120V/60Hz	25W	100	3300W	43	030-02332	\$1,999
MS2012-20B	2000	12VDC	120V/60Hz	25W	100	3300W	44	030-02334	\$2,049
MS2812	2800	12VDC	120V/60Hz	30W	125	3900W	53	030-02336	\$2,299
MS4024	4000	24VDC	120V/60Hz	25W	105	5800W	58	030-02338	\$2,599
MS4024-AE	4000	24 VDC	120/240V/60Hz	27W	105	5800W	58	030-02339	\$2,699
MS4448-AE	4400	48VDC	120/240V/60Hz	25W	60	8500W	58	030-02340	\$2,699

#### Accessories and Options

ME-RC50	Remote control for all Magnum inverters with 50-foot cable for ME, MS, MS-AE, RD	2	030-02351	\$229
ME-ARC	Advanced Remote for all Magnum inverters with 50-foot cable		030-02352	\$299
ME-SSI	Series stacking cable for MS-AE, MS and RD only	10	030-02362	\$79
ME-AGS-N	Automatic generator start – network version for use with Magnum inverters and ME-RC50	4	020-06377	\$329
ME-AGS-S	Automatic generator start – standalone version	4	020-06375	\$329
ME-BMK	Battery monitor kit - ME-RC50 required with this item	4	020-06379	\$189
ME-CB	Conduit Box for ME, MS, ME-AE, and RD inverters	4	030-02360	\$74
ME-BMK	Remote control for MM, MM-AE, and MMS inverters	4	030-02355	\$59



## Magnum Modified-Sine Wave Inverter/Chargers

### MM-AE Series 12V Inverters

The MM-AE Series 12VDC inverter/charger is designed to accommodate entertainment systems and small appliances in smaller RVs, boats and cabins. Based on the popular ME, the MM is smaller, lighter and less expensive while retaining all the built-in protection and reliability of ME models. The MM-AE models 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 with 12VDC input and 1500-watt models with 24VDC input. The MM Series inverters are powerful, easy-to-use and cost-effective. 2-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches. ETL Listed to UL/cUL 458 for marine and mobile use.



### ME-Series 12V Inverters

The ME Series 12VDC inverter/charger is designed specifically for RV use. 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. It comes in three power levels. ME is ETL Listed to UL/cUL 458 for RV, marine and mobile use. 3-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches.

### RD-Series 12V and 24V Inverters

The RD Series 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 inverters are ETL Listed to UL 1741. 2-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches.

Magnum model	Continuous 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	1100W	14	030-02302	\$599
MM1512-AE	1500	12VDC	120V/60Hz	16W	70	2100W	20	030-02306	\$899
MM1524-AE	1500	24VDC	120V/60Hz	16W	35	2650W	20	030-02303	\$939
ME2012	2000	12VDC	120V/60Hz	12W	100	3700W	38	030-02305	\$1,399
ME2512	2500	12VDC	120V/60Hz	13W	120	5000W	42	030-02311	\$1,599
ME3112	3100	12VDC	120V/60Hz	13W	160	6000W	45	030-02315	\$1,849
RD2212	2200	12 VDC	120V/60Hz	12W	110	3200W	38	030-02326	\$1,459
RD1824	1800	24 VDC	120V/60Hz	13W	50	4000W	38	030-02322	\$1,289
RD2824	2800	24 VDC	120V/60Hz	15W	80	6000W	42	030-02324	\$1,679
RD3924	3900	24 VDC	120V/60Hz	15W	105	9000W	45	030-02328	\$1,979

## Magnum Accessories and Options

The optional ME-RC remote control is simple to use, yet allows all the set-up features of the ME, MS, MS-ME, 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. The new ME-ARC advanced remote offers even more control of the inverter setup.



The optional Auto Generator Start (AGS) module automatically starts and stops most major generator brands, including Onan, Powertech, Generac and Weterbeke. Check 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 will 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. The MS Series accessories work with the ME and RD Series as well, except where noted. The optional ME-SSI allows series connection of two MS, MS-AE, ME, or RD inverters. The ME-SSI is not for use with MM-Series inverters. Reports battery percentage SOC, amps, voltage, amp hours and min/max DC volts.

ME-BMK monitors battery state-of-charge (SOC) and then provides this information in an easy-to-understand display via the ME-RC remote. Kit includes a sense module, shunt and wiring. The MM-RC is for the MS, MS-AE, MMS inverters. It provides on/off control and a quick indication of inverter and charger operation. (Prices on opposite page.)



## NEW MMP Mini Magnum Panel

The MMP – Mini Magnum Panel is an inclusive, easy-to-install panel designed to work with one Magnum MS-AE, MS, RD or other non-Magnum inverter/charger. The MMP features a small footprint and comes prewired for fast installation. Circuit breakers and the optional remote control mount on the front of the cabinet. Dimensions are 12.5" wide x 18" tall x 8" deep. They are ETL listed to UL 1741 and CSA C22.2 107-01. Each MMP includes One DC breaker – 175A or 250A, One AC bypass breaker – 30A dual pole or 60A single pole, One AC input breaker – 30A dual pole or 60A single pole, a 500A/50mv shunt, DIN rail provided for up to eight DC mini breakers. Panels are available for inverters with 120 VAC output and 120/240 VAC output.



Magnum model	DC Main Breaker	AC Output Breaker	Use with	Item code	Price
MMP250-30D	250	30A @120/240VAC	MS4024-AE	030-02380	\$689
MMP250-60S	250	60A @ 120VAC	MS4024, MS2812, MS2012, RD3924, RD2212 and all ME models	030-02381	\$689
MMP175-30D	175	30A @120/240VAC	MS4448-AE	030-02382	\$689
MMP175-60S	175	60A @ 120VAC	RD2824, RD1824	030-02383	\$689

## NEW! MP Magnum Panel

The MP Magnum Panel is available in three sizes and each size is available with either a 30-amp two-pole 120/240 VAC output breaker or a 60-amp 120 VAC output breaker.

The MPX - Magnum Panel Extension allows additional inverters to be installed on Magnum MP panels. Each MPX includes AC/DC circuit protection and wiring.

The MPSL – Magnum Panel, Single Enclosure, Low Capacity – is designed to accommodate a maximum of 2 inverters. If used with two inverters, an MPX Extension Box is required. The MPSL includes one 2850A DC breaker, one 125A AC bypass breaker, a 500A/50mv DC shunt and inverter AC input protection and all AC/DC wiring for dual inverters (source/load wiring not included).

The MPSH – Magnum Panel, Single Enclosure, High Capacity – is designed to accommodate a maximum of three inverters. One inverter can be connected directly to the MPSH. Each additional inverter requires an MPX. The MPSH includes one 250A DC breakers one 125A AC bypass breaker, a 1000A/100mv DC shunt and inverter AC input protection and all AC/DC wiring for dual inverters (source/load wiring not included).

The MPDH – Magnum Panel, Dual Enclosure, High Capacity – is designed to accommodate as many as four inverters with two enclosures – one for AC connections and one for DC connections. Two inverters can be connected to the MPDH. The third and fourth inverter require one MPX for each. The MPDH includes two 250A DC breakers one 125A AC bypass breaker, a 1000A/100mv DC shunt and inverter AC input protection and all AC/DC wiring for dual inverters (source/load wiring not included).



Magnum model	DC main breaker quantity	Main breaker spaces	AC bypass breaker	Item code	Price
MPSL-30D	1	1	60 A	030-02384	\$899
MPSL-60S	1	2	60 A	030-02385	\$899
MPSH-30D	1	3	125 A	030-02388	\$1,569
MPDH-30D	2	4	125 A	030-02389	\$2,469
MPX-30D	Extension Box w/30A dual pole AC input breaker			030-02392	\$329
MPX-60S	Extension Box w/60A single pole AC input breaker			030-02393	\$329
BP-S	Back Plate Single (fits 1 - MMP, MPSL, MPSH, MPX)			030-02394	\$99
BP-D	Back Plate Double (fits 1 - MPDH)			030-02395	\$169
BP-MMP	Back Plate MMP (fits 1 - MMP)			030-02396	\$99
MPX-CB	Panel Extension Conduit Box (conduit box only – no AC or DC breakers, no wiring)			030-02397	\$89
MP-HOOD	Panel Hood (included in MMP, MPSL, MPSH, MPDH)			030-02398	\$29

ADVERTISEMENT

## Silent Power

### **NEW!** SP4024 Sine Wave Inverter/Charger

The Silent Power SP4024 integrated inverter/charger system with GenClean technology, is a 4000 watt, pure sine wave inverter designed for off-grid operation. It combines high frequency light-weight electronics to generate a sine wave, with patented 2.5X high-surge capability. A number of patented features lessen the requirements of the backup generator by removing the surge demand from the generator and allowing the batteries to handle momentary surge requirements. GenClean technology uses independent battery charging electronics to clean and regulate the sine wave of the backup power source, allowing the SP4024 to simultaneously charge the batteries and supply conditioned, pure sine wave power to the home. Accepts 120V or 240V generator input.

The integrated design minimizes the balance of system costs and hassles, and simplifies installation by including an advanced user interface, generator controller, DC disconnect breaker, DC current shunt, AC disconnect breaker, and a wall mount ready design that eliminates the need for a separate power distribution panel for nearly all installations

The advanced remote user interface, included with the inverter, provides a bright, easy-to-read two line display, with intuitive installation and startup process. The interface includes simple end-user operations to monitor performance, including a "battery gas gauge" which indicates battery charging level and amp hours from full. The interface includes non-volatile memory to store system parameters to eliminate the need to re-enter data after powering down.

CSA listed to UL-1741 standard for U.S. and Canada. Standard 2-year warranty with an available 5-year extended warranty. Dimensions: 17 x 25 x 10.5 inches. 56 pounds. Field serviceable without removal.

Made in the U.S.A.



Model	Battery volts	AC Output volts / hertz	Continuous watts	Charger max amps	Weight (lbs)	Item code	Price
SP4024	24	120/60	4000	125	56	030-08901	\$4,990

## 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 does not have an AC receptacle so it needs to be hardwired. 2-year warranty.

Dimensions are 8.4 x 6 x 4.1 inches. The 115V inverter is UL Listed for the U.S. and cUL Listed to CSA C22.2 No. 107.1-01 for Canada.



Morningstar model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Standby draw	Peak AC watts	Wt (lbs)	Item code	Price
SI-300-115VUL	300	12VDC	115V/60Hz	450mA	55 mA	600	10	030-08022	\$308
SI-300-220V	300	12VDC	220V/50Hz	450mA	55 mA	600	10	030-08033	\$308

# Samlex

## Sine Wave Inverters

Samlex sine wave inverters offer a low-cost, high-quality small sine wave inverter for remote homes, RVs and boats. The output is overload protected. All of these inverters have AC receptacles and low-battery alarms. 120VAC 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	030-07123	\$169
PST-30S-12A	12V	300	500	4.7 x 11.22 x 2.4	3.9	030-07126	\$195
PST-60S-12A	12V	600	1000	9.3 x 13.2 x 3.3	6.6	030-07129	\$399
PST-100S-12A	12V	1000	1500	9.3 x 15.5 x 3.3	8.8	030-07130	\$649
S-1500-112B2	12V	1500	2000	15.4 X 10.8 X 4.1	15.4	030-07131	\$899
PST-60S-24A	24V	600	1000	9.3 x 13.2 x 3.3	6.6	030-07132	\$334
PST-100S-24A	24V	1000	1500	9.3 x 15.5 x 3.3	8.8	030-07134	\$575
S1500-124B2	24V	1500	2000	15.4 X 10.8 X 4.1	15.4	030-07135	\$985
S1500-148B2	48V	1500	2000	15.4 X 10.8 X 4.1	15.4	030-07148	\$985

# 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.



XP 125



XP 250



XP 600



XP 1100

Model	Battery voltage	Continuous watts	No load watts	Dimensions (inches)	Weight (lbs)	Item code	Price
<b>XP 125 Series</b>							
XP125/12	12V	125	5	4.65 x 2 x 6.75	2.3	030-06021	\$370
XP125/24	24V	125	5	4.65 x 2 x 6.75	2.3	030-06024	\$370
XP125/48	48V	125	5	4.65 x 2 x 6.75	2.3	030-06025	\$440
XP125/120	120V	125	5	4.65 x 2 x 6.75	2.3	030-06026	\$440
<b>XP 250 Series</b>							
XP250/12 LI	12V	250	6	5.23 x 2.77 x 10.38	5	030-06027	\$672
XP250/24 LI	24V	250	6	5.23 x 2.77 x 10.38	5	030-06030	\$672
XP250/48	48V	250	8	5.23 x 2.77 x 10.38	5	030-06032	\$740
XP250/120	120V	250	8	5.23 x 2.77 x 10.38	5	030-06035	\$740
<b>XP 600 Series</b>							
XP600/12	12V	600	5	7.7 x 3.6 x 11.77	6.5	030-06041	\$938
XP600/24	24V	600	5	7.7 x 3.6 x 11.77	6.5	030-06043	\$938
XP600/48	48V	600	5	7.7 x 3.6 x 11.77	6.5	030-06045	\$1,020
XP600/120	120V	600	5	7.7 x 3.6 x 11.77	6.5	030-06048	\$1,020
<b>XP 1100 Series</b>							
XP1100/12 LI	12V	1100	10	7.7 x 3.6 x 14.77	12	030-06072	\$1,224
XP1100/24 LI	24V	1100	10	7.7 x 3.6 x 14.77	12	030-06078	\$1,224
XP1100/48	48V	1100	20	7.7 x 3.6 x 14.77	12	030-06075	\$1,464
XP1100/120	120V	1100	20	7.7 x 3.6 x 14.77	12	030-06080	\$1,464



## 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 hardwired 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	Continuous 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	030-07220	\$40
SI-400HP	12V	400	600	2.4 x 6.3 x 6.3	2.9	030-07223	\$67
SI-750HP	12V	750	1500	2.4 x 6.3 x 11.4	5.3	030-07227	\$164
PSE-12125A	12V	1250	2500	3.5 x 9.4 x 12.3	8	030-07229	\$366
PSE-12175A	12V	1750	3500	3.5 x 9.4 x 17	10	030-07232	\$470
PSE-12275A	12V	2750	4500	6.3 x 9.4 x 18.2	19	030-07235	\$806
PSE-24100A	24V	1000	2000	3.5 x 9.4 x 13.5	9	030-07238	\$448
PSE-24150A	24V	1500	3000	3.5 x 9.4 x 18.2	12.4	030-07241	\$530
PSE-24250A	24V	2500	4500	6.3 x 8.5 x 19.5	22	030-07244	\$866

## Schneider Electric (formerly Xantrex)

### Xantrex TR Trace Series Inverter/Charger

Based on the proven technology of the Trace DR Series, the Xantrex TR Trace Series Inverter/Charger is an economical power conversion solution designed to provide dependable modified sine wave electricity to essential circuits in the home or business during a power outage. It can also be used in conjunction with a generator or any renewable energy source in an off-grid application. In addition to providing new features, the TR Series improves on the key features that have made the DR Series the most robust and reliable inverter/charger line for backup power and off-grid applications.

The front panel features an ON/OFF membrane switch, status indicator LEDs and a digital display that shows kilowatts when inverting and amps when charging. Other controls are protected by a snap-on cover that prevents settings from being accidentally changed.



Schneider model	Battery volts	AC volts/ hertz	Continuous watts	Charge amps	Weight (lbs)	Item code	Price
<b>Xantrex TR Trace Series Domestic Voltage Inverters</b>							
TR1512	12	120/60	1500	70	40	030-01301	\$880
TR2412	12	120/60	2400	100	42	030-01305	\$1,145
TR1524	24	120/60	1500	35	40	030-01303	\$880
TR2424	24	120/60	2400	70	45	030-01307	\$1,145
TR3624	24	120/60	3600	70	45	030-01309	\$1,425
<b>Xantrex TR Trace Series Export Voltage Inverters</b>							
TR1512E	12	230/50	1500	70	42	030-01312	\$1,000
TR1524E	24	230/50	1500	35	42	030-01313	\$1,000
TR2424E	24	230/50	2400	70	42	030-01315	\$1,250
<b>Xantrex TR Trace Series Accessories</b>							
TR-CB	Conduit box for DR series				5	030-01318	\$250
TR-RC	Remote on/off switch w/LED indicator				2	030-01316	\$150

Power factor corrected (PFC) charging, combined with a more sophisticated multi-stage battery charging algorithm, reduces electricity draw and generator run-time during generator-powered battery charging and its outstanding thermal performance allows full inverter output power to 50°C (122°F) without de-rating. A temperature sensor is included. High surge capacity starts more difficult loads and handles overload conditions reliably. Domestic voltage inverters can be series stacked for 120/240 VAC output using the cable supplied with each inverter. The TR has a durable powder-coated, corrosion-resistant steel chassis and its circuit boards are conformally coated to protect them from corrosion for longer life and improved reliability.

Optional accessories include a remote on/off switch with an LED status indicator and a conduit box that connects to the DC side of the inverter and accepts ¾-inch, 1-inch or 2-inch conduit.

## Schneider Electric

### 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.



Schneider model	Description	Item code	Price
T240	4 kW autotransformer	030-01402	\$650

### 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. Nearly silent when operating. Use an autotransformer as a step-down to connect the 240V output of a generator to the 120V input on an inverter. This allows full output power of a 240V generator to be used for battery charging. Autotransformers can step-up voltage to operate 240V appliances and motors from the 120V output of an inverter. NEMA 3R enclosure with knockouts for conduit. 2-year warranty.



Description	Dimensions (inches)	Item code	Price
2.5 kW autotransformer	8 x 8 x 4	038-09437	\$400
4 kW autotransformer	10 x 10 x 4	038-09440	\$500
8 kW autotransformer	12 x 10 x 6	038-09445	\$825

## 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. ETL Listed.



OutBack model	Description	Item code	Price
PSX-240	4 kW autotransformer	030-04429	\$539

## Samlex

### DC Step-Down Power Converters

These DC-DC converters are designed to decrease the DC voltage fed into the unit. These switching converters have a high efficiency and provide regulated 13.8VDC output from an input of 20-30VDC. Use them to power 12-volt lights and appliances from a 24-volt system. 2-year warranty.



Samlex model	Output max amps	Item code	Price
SDC-15	12	030-08720	\$82
SDC-23	20	030-08725	\$103

## Samlex

### Isolated DC-DC Converters

These isolated, enclosed DC-DC converters are designed to increase, or decrease, the DC voltage fed 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	030-08741	\$140
IDC-100C-12	30-60	12.5	8	030-08742	\$140
IDC-100A-24	9-18	24	4	030-08744	\$140
IDC-100C-24	30-60	24	4	030-08746	\$140
IDC-200B-12	20-35	12.5	16	030-08748	\$166
IDC-200C-12	30-60	12.5	16	030-08749	\$166
IDC-200A-24	9-18	24	8	030-08751	\$166
IDC-200C-24	30-60	24	8	030-08753	\$166
IDC-360A-12	9-18	12.5	30	030-08755	\$329
IDC-360B-12	20-35	12.5	30	030-08756	\$329
IDC-360C-12	30-60	12.5	30	030-08757	\$329
IDC-360A-24	9-18	24	15	030-08758	\$329
IDC-360C-24	30-60	24	15	030-08760	\$329

### Solar Converters DC Autotransformers

These high-efficiency DC to DC converters are bi-directional so they can be used to increase or decrease voltage. They can be used to operate 12-volt loads on a 24- or 48-volt battery system or to run a 24-volt refrigerator on a 48-volt battery system. See the table for up and down voltage and current limits. 1-year warranty.



Solar converters model	Voltage	Amps @ low voltage	Amps @ high voltage	Item code	Price
EQ 12/24-20	12/24	20	10	038-08209	\$262
EQ 12/24-50	12/24	50	25	038-08751	\$560
EQ 12/48-10	12/48	10	2.5	038-08745	\$296
EQ 12/48-30	12/48	30	7.5	038-08760	\$610
EQ 24/48-10	24/48	10	5	038-08748	\$296
EQ 24/48-30	24/48	30	15	038-08754	\$610

## OutBack

### FLEXware Complete Power Systems

#### Fully Assembled and Tested

NEC-compliant pre-assembled power systems include inverter(s), AC enclosure with inverter bypass, DC enclosure, inverter disconnect breaker and shunt, all mounted to a back plate and prewired. Charge controllers, 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 on the next page. Many other options are available. Please contact us for more information. Power systems ship by truck freight. ETL Listed to UL standards.

#### Complete Kits to Assemble on Site

All our FLEXware systems are available as parts kits to assemble in place. All parts are UPS shippable.

#### FLEXware 500 System

A FLEXware 500-based system will satisfy a majority of renewable energy applications with medium power requirements such as residential, light commercial or rural electrification systems by supporting up to two FX Series inverter/chargers and up to two FM 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, IOB-D-120/240VAC and HUB4. Two-inverter systems also come with a X-240.



#### FLEXware 1000 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 FM 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. FLEXware 1000 AC and DC enclosures accommodate all 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. For added versatility a FLEXware 1000-based system can be mounted horizontally or vertically. FLEXware 1000 systems come with one RTS, IOB-Q-120/240VAC, HUB10 and X-240.

Both the FLEXware 500 and 1000 systems come with the MATE remote monitors (page 104).



Model	FLEXware type	Inverter(s) qty - model	Rated power kW - AC output	DC voltage	Battery charger	Assembled & tested		Parts only	
						Item code	Price	Item code	Price
OBFW5-FX2012T/S	500	1 – FX2012T	2.0kW 120V	12 VDC	80 amp	033-00321	\$4,689	031-01015	\$4,122
OBFW5-FX2012T/D	500	2 – FX2012T	4.0kW 120/240V	12 VDC	160 amp	033-00323	\$7,819	031-01017	\$7,095
OBFW5-VFX2812/S	500	1 – VFX2812	2.8kW 120V	12 VDC	125 amp	033-00325	\$4,889	031-01019	\$4,322
OBFW5-VFX2812/D	500	2 – VFX2812	5.6kW 120/240V	12 VDC	250 amp	033-00327	\$8,219	031-01021	\$7,495
OBFW5-FX2524T/S	500	1 – FX2524T	2.5kW 120V	24 VDC	55 amp	033-00329	\$4,671	031-01023	\$4,104
OBFW5-FX2524T/D	500	2 – FX2524T	5.0kW 120/240V	24 VDC	110 amp	033-00331	\$7,826	031-01025	\$7,102
OBFW5-VFX3524/S	500	1 – VFX3524	3.5kW 120V	24 VDC	85 amp	033-00333	\$4,889	031-01027	\$4,322
OBFW5-VFX3524/D	500	2 – VFX3524	7.0kW 120/240V	24 VDC	170 amp	033-00335	\$8,217	031-01029	\$7,493
OBFW5-FX3048T/S	500	1 – FX3048T	3.0kW 120V	48 VDC	35 amp	033-00337	\$4,602	031-01031	\$4,035
OBFW5-FX3048T/D	500	2 – FX3048T	6.0kW 120/240V	48 VDC	70 amp	033-00339	\$7,677	031-01033	\$6,953
OBFW5-VFX3648/S	500	1 – VFX3648	3.6kW 120V	48 VDC	45 amp	033-00341	\$4,798	031-01035	\$4,231
OBFW5-VFX3648/D	500	2 – VFX3648	7.2kW 120/240V	48 VDC	90 amp	033-00343	\$8,037	031-01037	\$7,313
OBFW10-FX2524T/D	1000	2 – FX2524T	5.0kW 120/240V	24 VDC	110 amp	033-00365	\$8,715	031-01039	\$7,991
OBFW10-FX2524T/Q	1000	4 – FX2524T	10.0kW 120/240V	24 VDC	220 amp	033-00367	\$14,415	031-01041	\$13,153
OBFW10-VFX3524/D	1000	2 – VFX3524	7.0kW 120/240V	24 VDC	170 amp	033-00369	\$9,113	031-01043	\$8,389
OBFW10-VFX3524/Q	1000	4 – VFX3524	14.0kW 120/240V	24 VDC	340 amp	033-00371	\$15,266	031-01045	\$14,004
OBFW10-FX3048T/D	1000	2 – FX3048T	6.0kW 120/240V	48 VDC	70 amp	033-00373	\$8,568	031-01047	\$7,844
OBFW10-FX3048T/Q	1000	4 – FX3048T	12.0kW 120/240V	48 VDC	140 amp	033-00375	\$14,121	031-01049	\$12,858
OBFW10-VFX3648/D	1000	2 – VFX3648	7.2kW 120/240V	48 VDC	90 amp	033-00377	\$8,970	031-01051	\$8,245
OBFW10-VFX3648/Q	1000	4 – VFX3648	14.4kW 120/240V	48 VDC	180 amp	033-00379	\$14,899	031-01053	\$13,636
Model	Description	Install options		Parts only					
		Item code	Price	Item code	Price				
OBFW-O-FM60	OutBack FM60 charge controller with breaker, installed in power system	033-01513	\$895	031-02407	\$840				
OBFW-O-FM60/D	Two OutBack FM60 charge controllers with breaker, installed in power system	033-01515	\$1,800	031-02409	\$1,665				
OBFW-O-FM60/D-top	Two OutBack FM60 60-amp charge controller mounted on top with breakers	033-01517	\$1,765	031-02411	\$1,665				
OBFW-O-FM80	OutBack FM80 charge controller with breaker, installed in power system	033-01521	\$1,058	031-02413	\$990				
OBFW-O-FM80/D	Two OutBack FM80 charge controllers with breaker, installed in power system	033-01522	\$2,078	031-02415	\$1,965				
TriMetric meter	Amp-hour meter – connection block installed in system	033-01215	\$273	031-02417	\$210				
OBFW-O-X240	X-240 transformer installed in single inverter systems for 240 VAC input or output	033-01254	\$431	030-04270	\$399				
OBDC-GFP2	Ground fault interrupter for PV array installed in DC system box 80A 2-pole	033-01221	\$171	031-02421	\$135				
OBDC-100	100-amp DC load breaker installed in system	033-01227	\$65	031-02423	\$63				
OBDC-80	80-amp DC load breaker installed in system	033-01228	\$42	031-02425	\$32				
OBDC-60	60-amp DC load breaker installed in system	033-01229	\$33	031-02427	\$23				
OBDC-40	40-amp DC load breaker installed in system	033-01231	\$33	031-02429	\$17				
OBDC-30	30-amp DC load breaker installed in system	033-01233	\$33	031-02431	\$17				
OBDC-15	15-amp DC load breaker installed in system	033-01235	\$33	031-02433	\$17				
OBDC-10	10-amp DC load breaker installed in system	033-01237	\$33	031-02435	\$17				
OBDC-1	1-amp DC load breaker installed in system	033-01239	\$33	031-02437	\$17				
Flexnet	Flexnet metering installed with 2 additional shunts (3 total)	033-01291	\$640	031-02451	\$490				
Aux Relay	Aux relay installed (specify inverter or MX60)	033-01287	\$106	031-02455	\$25				
SP-ACA	Surge protector ACA installed (one per inverter)	033-01285	\$270	031-02463	\$250				
LA-302DC	DC Delta lightning arrestor installed	033-01281	\$57						
LA-302R	AC Delta lightning arrestor installed	033-01283	\$55						



## MidNite Solar

### E-Panel

The MidNite Solar E-Panel is a quick and easy way to install most battery-based inverters. They come standard with the basic over-current protection and disconnects required to install your renewable energy system in compliance with NEC standards. ETL Listed to UL and CSA standards for U.S. and Canada.

### E-Panels for OutBack Inverters

OutBack inverters mount on a unique hinged door to keep the footprint of the system as small as possible. They come standard with left-hand hinge, allowing the charge controller to mount on the right. The STS version leaves room for the OutBack AC box with a surge arrestor for grid-tie applications and the AL-PLUS version has room to mount an inverter and MX60 on the door. Right hand doors are available.

Mounting brackets are included to aid in one-person installations. 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. They come with a mounting bracket for an OutBack FM controller. Cutouts for mounting up to six additional 13mm-wide DIN rail mount breakers are provided, as are cutouts for GFCI-style AC outlets and 3-panel mount DC breaker slots. Circuit breakers and DC GFP are located on page 119.



MidNite model	Description	Item code	Price
MNE125ST-L	Gray steel chassis with 125A inverter breaker – left hinge	030-05126	\$489
MNE175ST-L	Gray steel chassis with 175A inverter breaker – left hinge	030-05130	\$529
MNE250ST-L	Gray steel chassis with 250A inverter breaker – left hinge	030-05134	\$529
MNE125AL-L	White alum chassis with 125A inverter breaker – left hinge	030-05138	\$529
MNE175AL-L	White alum chassis with 175A inverter breaker – left hinge	030-05142	\$559
MNE250AL-L	White alum chassis with 250A inverter breaker – left hinge	030-05146	\$559
MNE125STS-L	Gray steel chassis with 125A inverter breaker 15" wide – left hinge	030-05127	\$559
MNE175STS-L	Gray steel chassis with 175A inverter breaker 15" wide – left hinge	030-05131	\$599
MNE250STS-L	Gray steel chassis with 250A inverter breaker 15" wide – left hinge	030-05135	\$599
MNE125AL-PLUS	White alum chassis with 125A inv breaker w/ charge controller mt	030-05147	\$599
MNE175AL-PLUS	White alum chassis with 175A inv breaker w/ charge controller mt	030-05148	\$639
MNE250AL-PLUS	White alum chassis with 250A inv breaker w/ charge controller mt	030-05149	\$639

### E-Panels for Magnum Inverters

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. They come with a main breaker, 2/0 inverters cables, a 500-amp/50mv shunt for battery monitoring systems, an AC input and bypass, PV input busbars, DIN rails, 3-panel mount breaker knockouts, ground bus, remote display mounting brackets, charge controller bracket, wall mount bracket and lots of hardware. 120/240 models are for Magnum MS-AE inverters.

MidNite model	Description	Item code	Price
MNE175STM-L	Gray steel chassis with 175-amp inverter breaker	030-05160	\$599
MNE250STM-L	Gray steel chassis with 250-amp inverter breaker	030-05164	\$599
MNE175ALM-L	White alum chassis chassis with 175-amp inverter breaker	030-05168	\$639
MNE250ALM-L	White alum chassis chassis with 250-amp inverter breaker	030-05166	\$639
MNE175STM-250	White steel chassis with 175-amp inv breaker 120/240	030-05167	\$799
MNE250STM-240	White steel chassis with 250-amp inv breaker 120/240	030-05169	\$799
MNE125STMM-L	Gray steel chassis with 125-amp inv breaker for MM-series	030-05172	\$529



## E-Panel for Schneider Electric Xantrex XW

The XW inverter is mounted directly above the E-Panel. It comes with a 250-amp inverter battery breaker, AC inputs for generator and utility, knockouts for up to 7 DIN rail mount breakers and 12 panel mount breakers and a 500-amp shunt. (Power Center Xantrex sells does not have a shunt) Tin-plated copper busbars connect to the XW's battery terminals. There are busbars for AC inputs, AC output, neutral, ground, PV + in, PV- in, Bat +, Bat-, covered by a metal dead-front behind the reversible door. Charge controllers mount to either side or both sides at once for dual controllers. The AC bypass can be configured as input and output on/off as well as AC bypass. The XW MPPT controller requires no mounting bracket. FM60, FM80 and Classic require right or left E-Panel charge controller mounting brackets. A right-hand bracket is included. The color-matched enclosure is 16" wide, 18" tall, 8" deep and weighs 42 pounds.



## E-Panels for Xantrex TR and Samlex SL Inverters

This E-panel fits the discontinued Xantrex DR, current TR inverters and the Samlex sine wave inverter/charger. It comes with all the normal E-Panel features such as inverter cables, PV+ busbar, battery+ busbar, 50-amp AC input/output bypass, 50-amp AC input disconnect, 175- or 250-amp 125VDC inverter battery breaker, AC busbars, covers for DC and AC end, wall mounting brackets and hardware. Dimensions are 3" x 9" x 25" and weight is 30 lbs.



## E-Panels for Apollo Solar TSW Inverters

Comes with all standard E-Panel features and includes a 124/240 VAC input/output bypass and mounting hardware for the Apollo charge controllers. Dimensions are 4" x 14" x 25" and weight is 42 lbs.



MidNite model	Description	Item code	Price
MNE250XW	E-panel to mount under one XW inverter	030-05181	\$950
MNE-XE-L-bracket	Left-side charge controller bracket	030-05183	\$20
MNE175DR/TR-L	Gray steel chassis with 175-amp inverter breaker	030-05186	\$559
MNE250DR/TR-L	Gray steel chassis with 250-amp inverter breaker	030-05187	\$559
MNE175 Apollo	Gray steel chassis with 175-amp inverter breaker 120/240	030-05190	\$799
MNE250 Apollo	Gray steel chassis with 250-amp inverter breaker 120/240	030-05191	\$799

## More E-Panels

The E-Panel Lites come with a left-hand door, inverter breaker, pre-wired AC input and bypass, 500-amp/50mV shunt, AC terminal blocks, DIN rails, wall mounting brackets, instructions and lots of hardware.

UltraLite comes with a 50-amp AC input disconnect, 125-, 175- or 250-amp inverter breaker, ground busbar and the normal hardware and DC covers typically associated with E-Panels. They do not include an AC Bypass switch or AC and DC busbars.

Nottagutter accepts 2 UltraLites on top and 2 on the bottom, has a bypass for up to four 120/240VAC inverters.

MidNite model	Description	Item code	Price
MNE125LT	Gray steel chassis with 125-amp inverter breaker (Lite)	030-05105	\$459
MNE175LT	Gray steel chassis with 175-amp inverter breaker (Lite)	030-05109	\$499
MNE250LT	Gray steel chassis with 250-amp inverter breaker (Lite)	030-05113	\$499
MNE125ALT	White alum chassis with 125-amp inverter breaker (Lite)	030-05101	\$499
MNE175ALT	White alum chassis with 175-amp inverter breaker (Lite)	030-05102	\$539
MNE250ALT	White alum chassis with 250-amp inverter breaker (Lite)	030-05103	\$539
MNE125ALULite-L	125 amp alum OutBack UltraLite w/o bypass	030-05116	\$479
MNE175ALULite-L	175 amp alum OutBack UltraLite w/o bypass	030-05117	\$479
MNE250ALULite-L	250 amp alum OutBack UltraLite w/o bypass	030-05118	\$479
Nottagutter	Gutter with bypass, busbars and breakers	030-05120	\$659



## MidNite Solar

### NEW! Pre-Wired Power Systems

MidNite Solar is now offering pre-assembled and tested systems using OutBack and Magnum inverters.

Magnum inverters are installed on the MNE250STM-L gray steel E-Panel with the inverter listed and a ME-RC50 remote display, ME-BMK-NS, 1 MNEPV2 breaker for BMK, an FM60 charge controller with two MNEPV63 charge control breakers, one AC lightning arrestor, one DC lightning arrestor and two battery temperature sensors. All assemblies are thoroughly tested and crating is included.

OutBack inverters are installed on the MNE250AL-Plus white alum E-Panel, or a MNE250STS-L gray steel E-Panel (see model number) and include the listed inverter/charger, a Mate-B black remote display, an FM60 charge controller, two MNEPV63 charge control breakers, one AC lightning arrestor, one DC lightning arrestor and two battery temperature sensors. All assemblies are thoroughly tested and crating is included.

Options include and FM80 charge controller in place of the FM60 and a DC-GFP to meet 2008 NEC.



Model	Midnite pre-wired E-Panel system description	Inverter	Weight	Item code	Price
MNEMS4024FM60	Magnum 120VAC Off Grid 4000 Watt 24VDC Inverter	MS4024	190	033-04301	\$4,925
MNEMS4024AEFM60	Magnum 120/240VAC Off Grid 4000 Watt 24VDC Inverter	MS4024AE	190	033-04303	\$5,299
MNEMS4448AEFM60	Magnum 120/240VAC Off Grid 4400 Watt 48VDC Inverter	MS4448AE	190	033-04305	\$5,299
MNEPLUSGVFX3524FM60	OutBack Plus 120VAC Battery backup Grid-Tie 3500 W 24V Inverter	GVFX3524	190	033-04307	\$4,999
MNEPLUSGVFX3648FM60	OutBack Plus 120VAC Battery backup Grid-Tie 3600 W 48V Inverter	GVFX3648	190	033-04309	\$4,999
MNEPLUSVFX3524FM60	OutBack Plus 120VAC Off Grid 3500 Watt 24VDC Inverter	VFX3524	190	033-04311	\$4,999
MNEPLUSVFX3648FM60	OutBack Plus 120VAC Off Grid 3600 Watt/48VDC Inverter	VFX3648	190	033-04313	\$4,999
MNESTSGVFX3524FM60	OutBack 120VAC Grid Tie 3500 Watt 24VDC Inverter	GVFX3524	190	033-04315	\$4,975
MNESTSGVFX3648FM60	OutBack 120VAC Grid Tie 3600 Watt 48VDC Inverter	GVFX3648	190	033-04316	\$4,975
MNESTSVFX3524FM60	OutBack 120VAC Off Grid 3500 Watt 24VDC Inverter	VFX3524	190	033-04317	\$4,975
MNESTSVFX3648FM60	OutBack 120VAC Off Grid 3600 Watt 48VDC Inverter	VFX3648	190	033-04319	\$4,975
FM80 Option	Change FM60 Charge controller to FM80			033-04325	\$100
DC-GFP Option	Add Ground Fault Protection to systems above			033-04329	\$69

## OutBack

### NEW! FLEXpower ONE Pre-Wired Power System

The new FLEXpower ONE System accommodates all the essential protective devices in a small space at a low installed cost for applications with modest power requirements such as cabins, chalets, homes, remote communication sites and backup power systems. Utilizing a compact design and an easy-to-install mounting bracket, the fully pre-wired and factory tested.

FLEXpower ONE includes a single inverter, AC and DC wiring boxes, a single FLEXmax 80 charge controller, MATE, HUB, FLEXnet DC and surge protector. The system is also equipped with battery and PV array breakers, a PV GFDI breaker, an input-output-bypass assembly, mounting locations for both AC GFCI Type B and EU Type F style outlets and additional AC breakers. FLEXpower ONE components carry all of the necessary ETL certifications allowing for a code compliant installation. Dimensions are 12.88 x 19.69 x 33.44 inches. Weight is 98 lbs.



Model	FLEXpower ONE - System Description	Inverter	Item code	Price
FP1-1	Prewired AC and DC boxes with 120VAC Bypass and Type B Outlet, 250ADC breaker	VFX3524	033-04100	\$4,899
FP1-2	Prewired AC and DC boxes with 120VAC Bypass and Type B Outlet, 175ADC breaker	VFX3648	033-04101	\$4,899
FP1-3	Prewired AC and DC boxes with 120VAC Bypass and Type B Outlet, 250ADC breaker	GVFX3524	033-04102	\$4,899
FP1-4	Prewired AC and DC boxes with 120VAC Bypass and Type B Outlet, 175ADC	GVFX3648	033-04103	\$4,899
FP1-5	Prewired AC and DC boxes with 230VAC Bypass and 250ADC breaker - EXPORT	VFX3024E	033-04104	\$4,999
FP1-6	Prewired AC and DC boxes with 230VAC Bypass and 175ADC breaker - EXPORT	VFX3048E	033-04105	\$4,999



## MidNite Solar

### Mini-DC Disconnect Power Center (MNDC)

Use this small DC disconnect, which includes the inverter breaker, to provide overcurrent protection for any single inverter. The MNDC comes with a DIN rail for 5 additional DC breakers for DC loads, charge controller disconnect, battery status monitor feed etc. included is a ground bus, 5/16" bonding battery minus stud. Mounting holes for a 500 amp shunt are built in. The white powder-coated aluminum chassis measures 10" X 5" X 18" and weighs 7 pounds. Three main breaker sizes are available. Left side main breaker placement is available on special order.



The MNDC Plus version of the popular MNDC adds another DIN rail allowing up to ten DIN rail mount breakers. Two DIN rail cover plates and two panel mount plates are included. The panel mount plates allow for mounting the 3/4" 125VDC breakers that range from 60 amps to 100 amps. You can also fit the MNDC-GFP80 plus four more panel mount breakers in the enclosure. Another configuration would be one MNDC-GFP, one 3/4" panel mount breaker and five DIN rail breakers as well as the large 125-250A inverter breaker. Mounting is provided for a 500 amp shunt and a MNTBB-R terminal busbar. Battery negative stud is included as well as a ground busbar.

Model	Description	Item code	Price
MNDC125	125A mini-DC disconnect	053-00091	\$205
MNDC175	175A mini-DC disconnect	053-00092	\$235
MNDC250	250A mini-DC disconnect	053-00093	\$235
MNDC125 Plus	125A mini-DC disconnect	053-00096	\$250
MNDC175 Plus	175A mini-DC disconnect	053-00097	\$280
MNDC250 Plus	250A mini-DC disconnect	053-00098	\$280
MNTBR	Red terminal busbar	053-00105	\$17
MNTBB	Black terminal busbar	053-00106	\$17
MNTBW	White terminal busbar	053-00107	\$17
MNGBB	Ground busbar	053-00100	\$12

### DC Ground Fault Protection Circuit Breakers

These breakers use a trip mechanism to connect battery negative and earth ground to open the larger breaker in case of a ground fault. The 2008 NEC requires DC ground fault protection on all solar installations. The DIN rail GFPs will mount in most combiners, where they will do the most good, but that means going on the roof if one trips.



Amps	Volts	Mount type	Width (inch)	Item code	Price
63	150	DIN rail w/ screw lugs	1	030-05249	\$69
80	125	Panel w/ 1/4" studs	1.5	030-05250	\$69
50	300	DIN rail w/ screw lugs	2	030-05248	\$119

### Baby Boxes and Wiring Accessories

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 3/4" and 1" knockouts at each end. Breakers are not included. Boxed: 3" x 3" x 7" and weighs 2 pounds.



The Big Baby overcomes the Baby Box smallness. This box is at least one inch larger in all dimensions. It also includes a ground box lug and mounting provisions for our short insulated busbar. It holds up to 4 of the 13mm wide DIN rail breakers from 1-63 amps. Box Size is 9" x 5" x 4" and weighs 3 pounds.

MNEDC Quad is the same size as the Big Baby but holds up to four MNEDC-type panel-mount DC breakers available on page 120 or the panel-mount high amperage (70-100A) breakers on page 121.

#### Accessories

These UL Recognized busbars can be used in the Mini-DC Disconnect and Baby Box above.

Busbars with colored insulators. Each MNT bar has four 1/0 and eleven #6 usable wire slots, with two sizes of 10-32 screws. 4.63" long. MNS is a shorter version, useful for PV+ input on the narrow OB E-Panel and for a separate PV- busbar for charge controllers. Four #6 and two 1/0 wire slots.

Ground busbar, 3.45" long with green screws has two 1/0 and seven #6 wire slots with mounting screws. 2.3" long bar has two 1/0 & four #6 wire slots. Both come with mounting screw and nut #10-32 x 7/8".

Big Busbar is a pair for plus and minus with 5 battery connections and six small wires.

Model	Description	Item code	Price
Baby Box	Baby box breaker center	053-00089	\$36
Big Baby Box	Baby box breaker center	053-00088	\$45
MNEDC QUAD	Holds 4 MNEDC80 breakers	053-00087	\$55
MNTBB-R	Red terminal busbar	053-00105	\$17
MNTBB-B	Black terminal busbar	053-00106	\$17
MNTBB-W	White terminal busbar	053-00107	\$17
MNGBB	Ground busbar - 3.45" long	053-00100	\$12
MNSBB-R	Red terminal short busbar	053-00108	\$15
MNSBB-B	Black terminal short busbar	053-00109	\$15
MNSBB-W	White terminal short busbar	053-00110	\$15
Big Busbar	Pair of 5 hole 280A busbars	053-00115	\$75



## DIN Mount AC Circuit Breakers

DIN mount AC breakers with set-screw compression terminals for 14 to #2AWG wire. Use these for AC in OutBack FLEXware, MidNite E-panels, and Magnum 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	030-04415	\$19
15	2	120/240	50/60HZ AC	1	OBB-15D-240VAC-DIN	n/a	030-04416	\$39
20	1	120	50/60HZ AC	0.5	OBB-20-120VAC-DIN	MNEAC20	030-04418	\$19
20	2	120/240	50/60HZ AC	1	OBB-20D-240VAC-DIN	MNEAC20-2P	030-04419	\$39
25	2	120/240	50/60HZ AC	1	OBB-25D-240VAC-DIN	n/a	030-04421	\$39
10	1	120	50/60HZ AC	0.5	OBB-10-277VAC-DIN	MNEAC10	030-04439	\$19
15	1	277	50/60HZ AC	0.5	OBB-15-277VAC-DIN	n/a	030-04440	\$19
30	1	277	50/60HZ AC	0.5	OBB-30-277VAC-DIN	MNEAC30	030-04437	\$19
30	2	277/480	50/60HZ AC	1	OBB-30D-480VAC-DIN	n/a	030-04414	\$39
30	3	277/480	50/60HZ AC	1.5	OBB-30T-480VAC-DIN	MNEAC30-3P	030-04435	\$59
50	1	277	50/60HZ AC	0.5	OBB-50-277VAC-DIN	MNEAC50	030-04422	\$19
50	2	277/480	50/60HZ AC	1	OBB-50D-480VAC-DIN	MNEAC50-2P	030-04423	\$39
50	3	277/480	50/60HZ AC	1.5	OBB-50T-480VAC-DIN	MNEAC50-3P	030-04432	\$59
60	1	277	50/60HZ AC	0.5	OBB-60-277VAC-DIN	MNEAC60	030-04431	\$29
60	2	277/480	50/60HZ AC	1	OBB-60D-480VAC-DIN	n/a	053-03036	\$41

## DIN Mount DC Circuit Breakers

DIN rail mount breakers fit MidNite and Magnum enclosures, and MNPV and OutBack PV array combiners. Breakers for arrays with maximum voltage of 150 V and arrays with voltage up to 300 V are listed below.



Amps	OutBack number	MidNite Solar #	Item code	Price	Amps	OutBack number	MidNite Solar #	Item code	Price
1	OBB-1-150VDC-DIN	MNEPV1	053-03033	\$13	40	OBB-40-150VDC-DIN	MNEPV40	053-03039	\$13
2	OBB-2-150VDC-DIN	MNEPV2	053-03034	\$13	50	OBB-50-150VDC-DIN	MNEPV50	053-03035	\$13
3	OBB-3-150VDC-DIN	MNEPV3	053-03024	\$13	60	OBB-60-150VDC-DIN	MNEPV60	053-03037	\$13
4	OBB-4-150VDC-DIN	MNEPV4	053-03020	\$13	63	OBB-63-150VDC-DIN	MNEPV63	053-03038	\$13
5	OBB-5-150VDC-DIN	MNEPV5	053-03025	\$13	<b>DIN Rail Mounted 300 VDC Circuit Breakers</b>				
6	OBB-6-150VDC-DIN	MNEPV6	053-03021	\$13	<b>Amps</b>	<b>Voltage</b>	<b>MidNite Solar #</b>	<b>Item code</b>	<b>Price</b>
8	OBB-8-150VDC-DIN	MNEPV8	053-03022	\$13	7	300 VDC	MNEPV7-300	053-03107	\$34
9	OBB-9-150VDC-DIN	MNEPV9	053-03023	\$13	10	300 VDC	MNEPV10-300	053-03110	\$34
10	OBB-10-150VDC-DIN	MNEPV10	053-03026	\$13	12	300 VDC	MNEPV12-300	053-03112	\$34
12	OBB-12-150VDC-DIN	MNEPV12	053-03027	\$13	15	300 VDC	MNEPV15-300	053-03115	\$34
15	OBB-15-150VDC-DIN	MNEPV15	053-03029	\$13	20	300 VDC	MNEPV20-300	053-03120	\$34
20	OBB-20-150VDC-DIN	MNEPV20	053-03030	\$13	30	300 VDC	MNEPV30-300	053-03125	\$34
30	OBB-30-150VDC-DIN	MNEPV30	053-03032	\$13	50	300 VDC	MNEPV50-300	053-03130	\$34

## Panel Mount AC/DC Circuit Breakers

Single pole breakers with 1/4" stud connections. Ring terminals on wire are required on these panel mount breakers with stud terminals. Use these breakers for DC protection in OutBack FLEXware enclosures, and MidNite E-panels (three spaces). Breakers are rated for 150VDC/120VAC.



Breaker amps	Voltage rating	Width (inches)	MidNite Solar #	OutBack number	Generic number	Item code	Price
1	150	0.75	MNEDC-1	OBB-1-150VDC120VAC-PNL	LELK1-1	030-04350	\$25
5	150	0.75	MNEDC-5	OBB-5-150VDC120VAC-PNL	LELK1-5	030-04349	\$25
10	150	0.75	MNEDC-10	OBB-10-150VDC120VAC-PNL	LELK1-10	030-04348	\$25
15	150	0.75	MNEDC-15	OBB-15-150VDC120VAC-PNL	LELK1-15	030-04344	\$25
20	150	0.75	MNEDC-20	OBB-20-150VDC120VAC-PNL	LELK1-20	030-04347	\$25
30	150	0.75	MNEDC-30	OBB-30-150VDC120VAC-PNL	LELK1-30	030-04341	\$25
40	150	0.75	MNEDC-40	OBB-40-150VDC120VAC-PNL	LELK1-40	030-04338	\$25
50	150	0.75	MNEDC-50	OBB-50-150VDC120VAC-PNL	LELK1-50	030-04337	\$25
60	150	0.75	MNEDC-60	OBB-60-150VDC120VAC-PNL	LELK1-60	030-04335	\$25

## Panel Mount High Amperage DC Circuit Breakers

Single pole 3/4" wide breakers with stud connections. Ring terminals on wire are required on these panel mount breakers with stud terminals. Use these breakers for DC protection in OutBack FLEXware enclosures, and MidNite E-panels when equipped with 80A controllers.



Breaker amps	Voltage rating	Stud Size	Width (inches)	OutBack/Apollo number	Apollo Solar #	Item code	Price
70	150	1/4"	3/4	OBB-70-150VDC-PNL	n/a	030-04334	\$25
80	150	1/4"	3/4	OBB-80-150VDC-PNL	n/a	030-04333	\$25
100	125	1/4"	3/4	n/a	Apollo 100	030-04310	\$39

## Panel Mount DC Circuit Breakers

Single Pole panel mount breakers with stud terminals. Ring terminals are required. Use these breakers for side knockouts of the Xantrex DC Disconnect, and in the Xantrex XW Distribution Panel.



Breaker amps	Voltage rating	Stud size	Width (inches)	OutBack number	MidNite Solar #	Part #	Item code	Price
10	125	1/4"	1			CD10-PM	053-01010	\$25
15	125	1/4"	1			CD15-PM	053-01015	\$25
20	125	1/4"	1			CD20-PM	053-01020	\$25
30	125	1/4"	1			CD30-PM	053-01025	\$25
50	125	1/4"	1			CD50-PM	053-01030	\$25
60	125	1/4"	1			CD60-PM	053-01035	\$35
75	125	1/4"	1			CD75-PM	053-01040	\$35
80	125	1/4"	1			CD80-PM	053-01045	\$29
100	125	5/16"	1	OBB-100-125VDC-PNL		CD100-PM	053-01050	\$39
125	150	5/16"	1	OBB-125-125VDC-PNL	MNEDC125		030-04331	\$59
175	150	3/8"	1.5	OBB-175-125VDC-PNL	MNEDC175		030-04329	\$129
250	150	3/8"	1.5	OBB-250-125VDC-PNL	MNEDC250		030-04326	\$129

## Surface (Back) Mount DC Circuit Breakers

Surface mount breakers with screw lug terminals. 10,000A interrupting current for direct connection to a battery. Mounting feet on 10-110 amp allow them to be bolted to the back panel in an enclosure. Use these breakers in the Xantrex XW Distribution Panel, and for custom DC control panels. 175 and 250 fit Trace DC Disconnect.



Breaker amps	Lug Max Wire AWG	Voltage rating	Width (inches)	Part #	Item code	Price
10	1	125	1	CF-10	053-01011	\$25
15	1	125	1	CF-15	053-01016	\$25
20	1	125	1	CF-20	053-01021	\$25
30	1	125	1	CF-30	053-01026	\$25
50	1	125	1	CF-50	053-01031	\$25
60	1	125	1	CF-60	053-01036	\$35
60	1	160	1	CD-60-PX	030-01192	\$25
75	1	125	1	CF-75	053-01041	\$35
80	1	125	1	CF-80	030-01189	\$25
100	1	125	1	CF-100	053-01051	\$39
110	1	125	1	CF-110	053-01051	\$39
175	4/0	125	1.5	GJ1-175-SM	053-01056	\$119
250	4/0	125	1.5	GJ1-250-SM	053-01061	\$119
Rear mount kit for GJ1 breakers above					053-01051	\$10

## Square D QOU Circuit Breakers

QOU circuit breakers are designed for surface or DIN rail mounting. 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.

Description	Part #	Item code	Price
10-amp 1 pole	QOU110	053-02006	\$25
15-amp 1 pole	QOU115	053-02009	\$25
20-amp 1 pole	QOU120	053-02015	\$25
30-amp 1 pole	QOU130	053-02024	\$25
40-amp 1 pole	QOU140	053-02030	\$25
50-amp 1 pole	QOU150	053-02036	\$25
60-amp 1 pole	QOU160	053-02042	\$25
70-amp 1 pole	QOU170	053-02048	\$38
15-amp 2 pole	QOU215	053-02012	\$50
20-amp 2 pole	QOU220	053-02018	\$50
30-amp 2 pole	QOU230	053-02027	\$50
40-amp 2 pole	QOU240	053-02033	\$50
50-amp 2 pole	QOU250	053-02039	\$50
60-amp 2 pole	QOU260	053-02045	\$50



## 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 range 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 and 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 than 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

#### T80 and T80HV PV MPPT Battery Charge Management Systems

The T80 Charge Controllers integrate maximum power point tracking, battery charge management, state-of-charge information and communications into a single device. The T80 can deliver 80 amps continuous output to 12-, 24-, 36 or 48-volt battery systems from PV arrays with open circuit voltage up to 140 VDC (150 volts absolute maximum voltage). The new T80HV allows you to wire modules in series up to 200 Voc max/160 volts nominal.

The T80 and T80HV produce full-rated power without de-rating up to 45 degrees C/113 degrees F 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.

Both controllers include a built-in energy monitor using TriMetric technology from Bogart Engineering. The monitor tracks energy production and consumption to calculate the energy remaining in the battery. State of charge (SOC) is displayed in percent of capacity, amp-hours, watt-hours, and bar-graph format. They store 90 days of energy-harvest history and feature a slot for add-in cards providing system performance, data communication, and firmware updates.

Controllers do not include shunts. Order a 500A/50mV shunt if your system doesn't have one. Both the T80 and T80HV support flooded lead acid (FLA), GEL and absorbed glass mat (AGM) batteries. 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.

An optional wired display is available. The RD-wired display can be up to 100 feet from the controller using 4-conductor telephone cable.

The optional Apollo Communications Gateway makes it easy to monitor Apollo charge controllers, inverters and other products, easily and simply, supporting up to 100 connected Apollo devices per Gateway. Data from connected devices is stored on Apollo's server, where any browser accesses their website and monitors the performance of your Apollo products. The first year's Monitoring Service is provided free with the purchase of the ACG Communications Gateway. If no broadband connection to the internet is available, Apollo offers a System Manager software program that installs on your PC for local monitoring. For industrial and telecom applications Apollo Solar offers the compatible Apollo GSM modem to communicate using GSM networks. User must supply GSM SIM card for the local cellular service. Some cell providers may charge a monthly fee for this service.



Model	Description	Item code	Price
T80	Apollo T80 charge controller	020-07080	\$849
T80HV	Apollo T80 charge controller	020-07081	\$949
RD-WIRED	Wired remote display	020-07085	\$199
ASNET	Network option card	020-07091	\$99
ACG-1	Communications Gateway	020-07093	\$299
AMS-1	Apollo Monitoring Service / year	020-07094	\$49
ACM-1	Apollo Cellular Modem	020-07092	\$899



## Schneider Electric

### Xantrex XW-MPPT60-150 Charge Controller



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

Maximum power point tracking (MPPT) allows the charge controller to deliver to the batteries the maximum energy available from the PV array. 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 heat sink 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](http://www.xantrex.com/support). Dimensions are 14 1/2"H x 5 3/4"W x 5 1/2"D and weight is 12 lbs.

5-year warranty. 10-year warranty optional.

CSA Listed to UL 1741 for the U.S. and Canada

Xantrex model	Description	Item code	Price
XW-MPPT60-150	60-amp MPPT charge controller	020-08040	\$650

## OutBack

### FM60 and FM80 MPPT Charge Controllers



The FLEXmax family of charge controllers is the latest maximum power point tracking (MPPT) charge controllers from OutBack Power Systems. The innovative FLEXmax MPPT software algorithm is both continuous and active, increasing your photovoltaic array power yield up to 30% compared to non-MPPT controllers.

With active cooling and intelligent thermal management, both FLEXmax charge controllers can operate at their full maximum current rating, 60 amps or 80 amps respectively, in ambient temperatures as high as 104°F (40°C). Both controllers can be used with battery systems from 12 to 60 VDC with PV open-circuit voltage as high as 150 VDC. The controller's set points are fully adjustable to allow use with virtually any battery type, chemistry and charging profile. The OutBack

FLEXmax controllers allow you to use a higher output voltage PV array with a lower voltage battery – such as charging a 12 or 24VDC battery with a 48VDC 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.

The FLEXmax 60 can be used with PV arrays 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.

The FLEXmax 80 can be used with PV arrays up to 1,000 watts when charging a 12-volt battery; 2,000 watts when charging at 24 volts; and 4,000 watts when charging at 48 volts.

Both controllers come standard with a display of PV system performance that is easy to use and understand. The 4-line, 80-character backlit LCD display is also used for programming and monitoring the system's operation. They can be connected to the OutBack MATE series of system controllers and displays to allow monitoring of up to eight controllers from locations up to 300 feet away. The MATE also includes an opto-isolated RS-232 port for connection to a PC for data logging and system monitoring.

FM60 dimensions: 13.5"H x 5.75"W x 4"D. FM80: 16.25"H x 5.75"W x 4"D. Weight: 12 lbs. ETL Listed to UL 1741, and CSA Listed to C22.2 No. 107.1. 5-year standard warranty. 10-year warranty available.

OutBack model	Description	Item code	Price
FM80	OutBack 80A MPPT charge controller	020-02020	\$849
FM60	OutBack 60A MPPT charge controller	020-02017	\$749
MATE	System controller – shipped with 50' cable	030-04180	\$295
MATE-B	Black version of the MATE above	030-04180-B	\$295
MATE-2	Flush mount version of the MATE	030-04181	\$295
RTS	Remote temperature sensor with 20' cable	030-04190	\$29



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## MidNite Solar

### Classic MPPT Charge Controller **Coming soon!**

Three models accommodate solar arrays with up to 250 VDC of operating voltage. Open circuit voltage (Voc) is based on operating voltage plus the battery voltage. The Classic250 model is good for 300 Voc on a 48V battery. The Classic150 is good for 175 Voc on a 24V battery bank.

They have MPPT modes for solar, wind or hydro with user adjustable power curves, and a learning mode for self optimization. No hub is required for stacking Classics to act as one large controller. They have two auxiliary outputs, a dry contact relay and a 12V output. Each unit includes snap-on covers and hole plugs for sealing openings in dusty or salt-air environments, but about 20% reduction in output will result when used in sealed mode.

The Classic has built-in Ethernet, USB and RS-232 ports for two-way communications. An internal IP address allows the Classic to be a mini web server when hooked up to broadband. It has 32 MB of memory for data storage. A wizard-driven setup covers battery bank size, string voltage, wind turbine selection, power and wire loss chart, PV breaker sizing and more.



Model	Output amps maximum	Array open circuit volts at battery volts			Item code	Price
		12V battery	24V battery	48V battery		
Classic 150	80	162	175	200	020-02405	\$749
Classic 200	65	212	225	250	020-02407	\$799
Classic 250	55	262	275	300	020-02409	\$849

## Blue Sky Energy

The Blue Sky Solar Boost features reverse-polarity protection, MPPT, 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 are 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. ETL/cETL Listed



### 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. ETL/cETL Listed

### 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. ETL/cETL Listed

Model	Description	System voltage	Charge amps	Item code	Price
SB50L	Charge controller	12 or 24	50	020-03140	\$479
SB50DL	Controller w/ digital display	12 or 24	50	020-03137	\$569
SB50PDL	Front cover w/ digital display for SB50L			020-03134	\$125
SB6024HPDL	Front cover w/ digital display for SB6024HL			020-03131	\$125
SB3048L	Charge controller	24 or 48	30	020-03128	\$539
SB3048DL	Controller w/ digital display	24 or 48	30	020-03125	\$629
SB3048PDL	Front cover w/ digital display for SB3038L			020-03131	\$125
Model	Description of optional accessories			Item code	Price
SB50RD25	Remote digital display w/ 25' cable			020-03152	\$125
930-0022-20	Battery temperature sensor			020-03149	\$32

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# Blue Sky Energy

## 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 some very popular in RV installations and an optional box allows surface mounting.

## IPN controllers

Solar Boost 3024i and 2512iX charge controllers include load control outputs. These controllers can also serve as lighting controllers with complete flexibility over post-dusk and pre-dawn ON time settings. An IPN Pro-Remote is required to enable and configure dusk-to-dawn lighting control. The IPN Pro-remote does not need to remain with the system and can be used as a setup tool only.

## Solar Boost 2512i and 2512iX

The Solar Boost 2512i provides a fully automatic 3-stage charge controller system. A partial IPN network interface is included to allow use of the IPN-Remote or IPN Pro-Remote 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 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.

## Solar Boost 3024iL

SB3024iL 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 40 amps output at 12 and 30 amps at 24 VDC. The new IPN network interface coordinates multiple controllers and shares temperature sensors and display. ETL/cETL Listed.

## 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.

## IPN-Remote

The IPN-Remote display provides basic monitoring for IPN compatible charge controllers. The unit displays battery voltage, output current and charge controller system status for up to 8 controllers on a single IPN network. An LED display is used to provide readability in any lighting. The charge status indicator displays present charge controller system status and shows relative battery state-of-charge. When the battery is being charged the display toggles between battery voltage and charge controller output current. The current display can be configured to show the total output current from all controllers on the IPN network, or the output current from a particular controller. Multiple IPN-Remote displays can be placed on a single IPN network even if an IPN Pro-Remote is already present.

## IPN Pro-Remote

The Pro-Remote combines charge controller monitoring and battery system monitoring into a single user-friendly remote display. With the IPN Pro-Remote you no longer have to guess how much battery capacity remains. A high-accuracy calculation of remaining battery capacity compensates for a variety of factors including charge/discharge current, battery size, type, temperature and how the battery was brought back to full charge. Information learned from past battery behavior is used to continuously improve metering accuracy. The IPN Pro-Remote also monitors and controls Blue Sky's IPN-based charge controllers. It can monitor both the combined total and individual status of up to eight IPN charge controllers on a single IPN network.



Model	Description	System voltage	Charge amps	Item code	Price
SB2000E	Charge controller	12	25	020-03122	\$259
	Wall mount box for SB2000			020-03119	\$32

Model	Description	System voltage	Charge amps	Item code	Price
SB2512i	Charge controller	12	25	020-03123	\$199
SB2512iX	Charge controller	12	25	020-03124	\$239
SB3024iL	Charge controller	12 or 24	40/30	020-03158	\$359
SB3024DiL	Controller w/ digital display	12 or 24	40/30	020-03159	\$419
SB3024PDi	Front cover w/ digital display for SB3024i			020-03157	\$99
IPNPRO-S	IPN Pro-Remote display w/ 500 amp shunt			020-03161	\$199
IPNPRO	IPN Pro-Remote display			020-03162	\$169
IPNREM	IPN-Remote			020-03163	\$69

Model	Description of optional accessories	Item code	Price
930-0022-20	Battery temperature sensor	020-03149	\$30
CS-100	Remote shunt 100A/100mV	028-09245	\$35
CS-500	Remote shunt 500A/50mV	028-09253	\$35



## Morningstar

### NEW! TriStar MPPT Charge Controller

Morningstar's TriStar TS-MPPT-45 and -60 MPPT solar controllers with TrakStar Technology are advanced maximum power point tracking (MPPT) battery chargers for photovoltaic (PV) systems up to 3kW. Both controllers can be used with arrays with a maximum open circuit voltage of 150VDC and charge batteries between 8 and 72 VDC. A remote temperature sensor is included.

The controller provides the industry's highest peak efficiency of 99% and significantly less power loss compared to other MPPT controllers. The TriStar MPPT features a smart tracking algorithm that maximizes the energy harvest from the PV by rapidly finding the solar array peak power point with extremely fast sweeping of the entire I-V curve. The TS-MPPT-60 is the first PV controller to include on-board Ethernet for a fully web-enabled interface and includes up to 200 days of data logging. Optional TriStar meter and remote meter provide detailed operating data, alarms and faults and three LED's display system status. The chassis on the TriStar TS-MPPT controllers is isolated from the power circuits, allowing use in both negative and positive grounded systems.

Extensive Networking and Communications Capabilities enables system monitoring, data logging and adjustability. Both models offer open standard MODBUS protocol and Morningstar's MS View software, Meterbus communications between compatible Morningstar products, and allow Serial RS-232 connection to a personal computer. The TS-MPPT-60 has RS-485 communications between multiple devices on a bus and has a fully web-enabled interface to a local network or internet; you can view data from a web browser and send email/text messages. Weight: 9.2 lbs. Dimensions are 11.4 x 5.1 x 5.6 inches. 5-year warranty. ETL Listed to UL 1741.

Morningstar's MeterHub (HUB-1) allows multiple Morningstar products to communicate over a Meterbus network to provide improved data monitoring, additional capabilities and lower system cost. It enables multiple controllers to share a single TriStar meter and display both single controller data (TriStar #1, TriStar #2...) as well as aggregated data for the entire system. HUB-1 enables multiple controllers to share a single Relay Driver and fully utilize all 4 channels of the Relay Driver for different functions (alarms, load disconnects, generator starts) from multiple products. See page 136 for Relay Driver.

The RSC-1 communications adaptor enables networking capability by converting a controller or inverter's RS-232 port to a standard RS-485 serial connector. The RSC-1 may be used with any Morningstar controller or inverter equipped with an RS-232 port.



Morningstar model	Description	Web Enabled	Maximum array watts			Item code	Price
			12 V	24 V	48 V		
TS-MPPT-45	TriStar MPPT 45 A charge controller	No	600	1200	2400	020-01109	\$531
TS-MPPT-60	TriStar MPPT 60 A charge controller	Yes	800	1600	3200	020-01110	\$669
TS-M-2	Tristar Meter-2 mounts on front of charge controller					020-01111	\$104
TS-RM-2	TriStar Remote Meter-2 display with 100-ft. cable					020-01112	\$138
HUB-1	Meter Hub					020-01260	\$115
RTS	Temperature sensor					020-01141	\$32
RSC-1	Communications adaptor – RE-232 to RS-485 adapter					020-01256	\$69

### 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 grid-tie 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". DIN rail clips on page 130. 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	020-01261	\$292
RMI	SunSaver MPPT remote meter	12	15	020-01258	\$105
RTS	Battery temperature sensor			020-01141	\$32
MSC	Meterbus adapter			020-01257	\$45

## 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 set points are easily selectable with DIP switches. An RS-232 communications enables PC connection to adjust control set points 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 RJ11 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 MPPT controllers, allowing easy mounting to available power system components.

Dimensions: 10.25" H x 5" W x 2.8" D; weight is 3.5 lbs. 5-year

Model	Description	System voltage	Charge amps	Item code	Price
TS-45	TriStar 45 charge controller	12, 24 or 48	45	020-01105	\$175
TS-60	TriStar 60 charge controller	12, 24 or 48	60	020-01108	\$226
RTS	Battery temperature sensor			020-01141	\$32
TS-M-2	Tristar Meter-2 mounts on front of charge controller			020-01111	\$104
TS-RM-2	TriStar Remote Meter-2 display with 100-ft. cable			020-01112	\$138

## ProStar Charge Controllers

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	020-01120	\$112
PS-15M	ProStar 15 w/ digital display	12 or 24	15	020-01123	\$179
PS-15M-48V	ProStar 15 48V w/ display	48	15	020-01126	\$222
PS-15M-48-PG	48V w/ display & positive ground	48	15	020-01129	\$239
PS-30	ProStar 30	12 or 24	30	020-01132	\$152
PS-30M	ProStar 30 w/ digital display	12 or 24	30	020-01135	\$219
PS-30M-PG	30 w/ digital display & positive ground	12 or 24	30	020-01138	\$236
RTS	Battery temperature sensor			020-01141	\$32

## ADVERTISEMENT

## SunSaver Duo RV Charge Controller



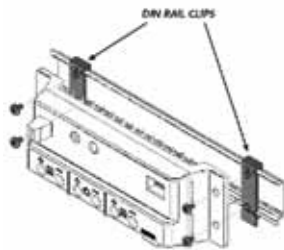
The SunSaver Duo 2-battery controller for RVs, caravans, boats and cottages is rated for 25 amps at 12 volts DC. This product will charge two separate and isolated batteries at the same time, such as a house and an engine battery, based on user selectable priorities. The SunSaver Duo employs Morningstar's 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 alpha-numeric and graphical information about the solar power system status. 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	020-01250	\$188
RTS	Battery temperature sensor			020-01141	\$32

## SunSaver DIN Rail Clips

Morningstar's Polypropylene 35mm DIN rail clips provide a simple way to install the SunSaver family of charge controllers to DIN rails in industrial enclosures. These rugged plastic clips have been custom made to match the mounting holes on the SunSaver controllers and to either snap on to the middle of the rail or to slide on from the end of the rail. The DIN rail clips are compatible with the SunSaver, SunLight, SunSaver Duo, and SunSaver MPPT.



Model	Description	Item code	Price
DIN 1	DIN rail clip - each	020-01259	\$1

## SunSaver Charge Controllers

The SunSaver is a very reliable charge controller. It 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 enhance 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".

MET Listed for the U.S. and Canada.



Model	Description	System voltage	Charge amps	LVD amps	Item code	Price
SS-6-12V	SunSaver	12	6	No	020-01245	\$50
SS-6L-12V	SunSaver w/ LVD	12	6	6	020-01248	\$61
SS-10-12V	SunSaver	12	10	No	020-01230	\$57
SS-10L-12V	SunSaver w/ LVD	12	10	10	020-01233	\$73
SS-10L-24V	SunSaver w/ LVD	24	10	10	020-01236	\$79
SS-20L-12V	SunSaver w/ LVD	12	20	20	020-01239	\$95
SS-20L-24V	SunSaver w/ LVD	24	20	20	020-01242	\$105

## SunLight Charge Controller with Lighting Control

The SunLight has all 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, 6, 8, or 10 hours. One option turns 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	020-01218	\$108
SL-10L-24V	SunLight w/ LVD	24	10	10	020-01221	\$116
SL-20L-12V	SunLight w/ LVD	12	20	20	020-01224	\$141



## 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	020-01215	\$30

## 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. ETL/cETL Listed to UL 1604. CSA 22.2 Listed.

Model	Description	System voltage	Charge amps	Item code	Price
SK-6	SunKeeper6	12	6	020-01252	\$63
SK-12	SunKeeper12	12	12	020-01253	\$89

## Specialty Concepts

### 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 table). Some have temperature compensation, low-battery voltage disconnect and adjustable set points, or a combination 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. 5-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	020-04327	\$47
ASC-12/8	Charge controller only	12	8		6 x 3.5 x 3	1	020-04331	\$54
ASC-12/8 A	Temp compensation	12	8		6 x 3.5 x 3	1	020-04332	\$64
ASC-12/8 AF	Temp compensation, adjustable set point	12	8		6 x 3.5 x 3	1	020-04355	\$59
ASC-12/12	Charge controller only	12	12		6 x 3.5 x 3	1	020-04341	\$62
ASC-12/12 A	Temp compensation	12	12		6 x 3.5 x 3	1	020-04343	\$64
ASC-12/12 AF	Temp compensation, adjustable set point	12	12		6 x 3.5 x 3	1	020-04346	\$67
ASC-12/16	Charge controller only	12	16		6 x 3.5 x 3	1	020-04352	\$66
ASC-12/16 AF	Temp compensation, adjustable set point	12	16		6 x 3.5 x 3	1	020-04356	\$78
ASC-12/16 AEF	Temp compensation, low-bat disc, adjustable	12	16	10	6 x 3.5 x 3	1	020-04357	\$94
ASC-24/8 AF	Temp compensation, adjustable set point	24	8		6 x 3.5 x 3	1	020-04437	\$61
ASC-24/16 AF	Temp compensation, adjustable set point	24	16		6 x 5 x 3	1	020-04457	\$78
ASC-24/16 AEF	Temp compensation, low-bat disc, adjustable	24	16	10	6 x 5 x 3	1	020-04458	\$94



ADVERTISEMENT

## Phocos

### CXN Charge Controllers

Phocos CXN 12V and 24V solar charge controllers have exceptional features at a very good price. They feature pulse width modulation (PWM) 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 in an LCD 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).

CXN controllers have a built-in data logger. Data can be accessed by a PC by using the CXN-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 new CXN charge controllers can be used in systems where the array, battery and load negatives are grounded. 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
CXN10	12 or 24	10	10	020-05016	\$66
CXN20	12 or 24	20	20	020-05017	\$86
CXN40	12 or 24	40	40	020-05018	\$125
CX - USB interface for data logger				020-05011	\$58

### PL60 Charge Controllers

This PWM charge controller works well as a diversion controller for wind and hydroelectric systems and a solar charge controller at the same time. It can be used on 12-, 24-, 32-, 36- and 48-volt systems. Maximum diversion load is 30 amps.

It can be programmed with the button on the front panel and the LCD display and it has built-in data monitoring.



Model	System voltage	Max PV amps	Max load amps	Item code	Price
PL60	12, 24, 32, 36, 48	60	30	020-05007	\$650

### CML Charge Control

These low-cost Phocos charge controllers can be used for 12- or 24-volt systems with sealed or flooded batteries. They offer low-voltage load disconnect and have 5 LEDs to display battery and load status.



Model	System voltage	Max PV amps	Max load amps	Item code	Price
CML15	12 or 24	15	15	020-05135	\$84
CML20	12 or 24	20	20	020-05137	\$89

### 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.



Available in 15-amp and 40-amp versions, 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	15	15	2 x 3 x 1.25	020-05425	\$95
PVLC-40	12 or 24	40	40	3.3 x 5.5 x 1.7	020-05427	\$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	15	15	2 x 3 x 1.25	020-05432	\$130
PVLC-40MD	12 or 24	40	40	3.3 x 5.5 x 1.7	020-05435	\$160

## Schneider Electric

### 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 (only the C-40 can be used in 48-volt systems). They operate in only one mode at a time, so two controllers must be used to provide both PV charge controller and low battery load disconnect. 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 set points 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	020-08004	\$119
C-40	Charge controller	12, 24 or 48	40	020-08005	\$159
C-60	Charge controller	12 or 24	60	020-08009	\$199
BTS/15	Battery temperature sensor with 15-foot cable			020-08025	\$29
BTS/35	Battery temperature sensor with 35-foot cable			020-08029	\$32
CM	Digital display mounts on front of charge controller			020-08016	\$99
CM/R50	Remote display with 50-foot cable			020-08019	\$126
CM/R100	Remote display with 100-foot cable			020-08017	\$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	020-08002	\$110

## 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 Automatic 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. Automatic Generator 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	020-06375	\$299
AGS-N	Automatic generator start – Magnum network version – use with Magnum inverters only	020-06377	\$299

## Atkinson GSCM



The GSCM (generator start controller module) 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 24 VDC 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".

### 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	Generator start controller module	020-06341	\$322
GSCM-mini	Generator start controller module	020-06343	\$165

## ADVERTISEMENT



## 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 on this page 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	020-01255	\$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 set point. The relay in the "Active-Low" is powered when voltage drops to the low set point. 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 approximately 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	020-06218	\$112
VCS-2AH	Active High	Yes	020-06215	\$180
VCS-1AL	Active Low	No	020-06221	\$112
VCS-2AL	Active Low	Yes	020-06224	\$180

### 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 closes 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 1/4" 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	053-08290	\$8
Relay socket for 40 A relay		053-08291	\$4
75 A SPST relay	300 mA	053-08293	\$30
DPDT 30A relay – 12VDC coil	170 mA	053-08281	\$48
DPDT 30A relay – 24VDC coil	53 mA	053-08287	\$48
DPDT 30A relay – 120VAC coil	83 mA	053-08278	\$48
DPDT 30A relay – 240VAC coil	42 mA	053-08284	\$4
Dual battery isolator relay		053-08272	\$28

## 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, the Phocos PL60, and the Xantrex C-35, C-40 and C-60 can be configured for this mode of charge controller. 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 C-40 or C-60, or the Morningstar TS-45 or TS-60 to turn your excess power into hot water. They fit most electric water heaters with screw-in elements. We have one model for 12- and 24-volt systems and another for higher power 24- 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 table 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-inch male pipe threads. 2-year warranty.



Regulation voltage:		14			28		56		Item code	Price
Model	Wiring	ohms	amps	watts	amps	watts	amps	watts		
12v / 24v	Series	0.96	14.6	204	29.2	817			021-09275	\$120
	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	021-09279	\$120
	Single	1.24	11.3	158	22.6	632				
	Parallel	0.62	22.6	316	45.2	1265				
Square flange element adapter									021-09285	\$25

## 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 table for diverted amps at various voltages. 2-year warranty.



Model	Resistance setting	Diversion load amps at these voltages:						Item code	Price
		14V	15V	28V	30V	56V	60V		
HL-100	0.25	56	60					021-09330	\$250
	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			021-09335	\$250
	3 ohms	4.7	5	9.3	10	19	20		

## Samlex

### Battery Watch

The battery watch is a smart piece of equipment which automatically detects battery voltages between 7V and 32V. It can be used to monitor approximate battery state-of-charge on 12- and 24-volt battery systems.



Three LEDs – green, red and yellow – light in various combinations to indicate battery voltage. An audio alarm can be set to sound at high or low voltage levels and all settings are programmable by the user with a push button on the front panel.

Description	Item code	Price
Samlex battery watch	028-02257	\$60

## 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 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 with a shunt already in place. Current draw is only 20mA. Amp meters are bi-directional, so they can be used to read loads, showing negative numbers, or to read charging sources, displaying positive numbers.

Amp meter requires 4-conductor wire; volt meter requires 2-conductor wire. Use 22 gauge or larger for up to 50 feet. Use 18 gauge for up to 150 feet. 2-year warranty.

Description	Item code	Price
Digital volt meter 11 to 65 VDC	028-09228	\$42
Digital amp meter w/o shunt	028-09257	\$42
Digital amp meter w/ 100A shunt	028-09259	\$65
Digital amp meter w/ 500A shunt	028-09261	\$65

## 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	028-07332	\$18
Analog meter 0-60A DC	028-07362	\$18
Mounting plate for 2-gang wiremold box	028-09015	\$5

## 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 and works with wire up to 20 gauge.

Description	Item code	Price
Hoyt 30A induction meter	028-08045	\$29
Hoyt 75A induction meter	028-08047	\$29
Dual Range 0-75 / 0-600 ADC	028-08049	\$35

## 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	028-08031	\$19



## 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 negative numbers. 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

**NEW!**

### LinkLITE Meter

The LinkLITE monitor can measure amps up to 999 (depending on the shunt used) and amp-hours up to 999. It selectively displays voltage, net amps, consumed amp-hours and remaining battery capacity in percentage. It is equipped with an internal programmable alarm relay, to run a generator when needed or to turn off devices when the battery voltage exceeds programmable boundaries. For use on 12- and 24-volt systems. A 500A/50mV shunt is included. 1-year warranty.



### LinkPRO Meter

The LinkPRO has all the features of the LinkLITE, but measures amps up to 9999 (depending on the shunt used) and amp-hours up to 9999. The LinkPRO also includes a time remaining display, battery temperature sensor input, additional programmable alarm relay functions, communication/expansion port, and storage of a wide range of historical event data in internal memory. The LinkPRO Communications Kit includes an isolated meter to RS-232 interface box and interface cable. The LinkPRO Battery Monitor replaces and expands the features of the XBM Battery Monitor. For use on 12- and 24-volt systems. 500A/50mV shunt is included. 1-year warranty.



### 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. It is 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! The meter includes displays for the number of days since fully charged and cumulative amp-hours, and has recharge, low-voltage and full-charge indicators. Comes with a 50' six-conductor cable with jacks, fuse, and a special 500A/50mV shunt. 2550 amp-hours is the maximum battery size it can keep track of. 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	028-01405	\$375
TM-500NS	Amp-hour meter w/o shunt	028-01403	\$325
TM48	48-volt adapter	028-01413	\$75
TC50	50' cable	028-01422-A	\$36

Description	Item code	Price
LinkLITE – meter w/ 500A/50mV shunt	028-01141	\$270
LinkPRO – meter w/ 500A/50mV shunt	028-01142	\$320
Temperature sensor – for LinkPRO only 32' (10m)	028-01123	\$75
Connection Kit -50' (15m) - for LITE/PRO	028-01122	\$115
Communication Kit – LinkPRO only	028-01120	\$225
Mounting bracket	028-09014	\$7
Bulk meter wire 8-conductor 18 AWG (price/ft.)	050-01252	\$0.40



# Bogart Engineering

## TriMetric 2025 and 2025-RV



This updated version of the 2020 amp-hour meter operates on 12, 24 or 48 volts. It 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 indicates a charging battery and flashes when it is fully charged. Another LED flashes when batteries should be recharged or equalized, and during low battery voltage. It also records minimum and maximum voltage, number of days since last charge, days since last 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. 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 XW 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 the 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.

TriMetric and accessories	Item code	Price
TriMetric 2025A amp-hour meter	028-00021	\$230
TriMetric 2025-RV amp-hour meter	028-00022	\$230
Surface mount box for 2025	028-00026	\$14
500A/50mV shunt	028-09253	\$35
100A/100mV shunt	028-09245	\$35
1000A/100mV shunt	028-09254	\$70
4-conductor 22 AWG wire	050-01243	\$0
4-conductor 18 AWG wire	050-01237	\$1

PentaMetric and accessories	Item code	Price
PentaMetric display unit PM-100D	028-00011	\$240
PentaMetric input unit PM-5000U	028-00013	\$262
Computer interface PM-100C	028-00015	\$120
Temperature sensor TS-1	028-00018	\$36
500A/50mV shunt	028-09253	\$35
100A/100mV shunt	028-09245	\$35
8-conductor 22 AWG wire / per foot*	050-01255	\$0.36

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

## 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 with LCD display and buttons up to 1000 feet from the 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.

\* 8-conductor wire is ok for measuring one battery. One additional conductor is required for two batteries. See table bottom left.

### Basic measurements:

- 2 voltage channels: 8-100 volts. (For example you can monitor volts from two-battery systems).
- 3 amperage channels  $\pm 0.1$ -200 amps (with 100A/100mV shunt).  $\pm 0.1$ -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  $\pm 83,000$  amp-hours
- Cumulative (negative) battery amp-hours (2 channels)
- Smoothed (time filtered) amps
- Volts (2 channels): 0-100 volts
- Watts (2 channels)  $\pm 0.1$ - 20,000 watts
- Watt-hours (2 channels)  $\pm 21,000$  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. In Periodically Logged Data mode you can record any or all of the following at regular intervals ranging from once per day to once per minute: amp-hours (3 channels), watt hours (2 channels), Temperature max/min (1 channel), volts (1 channel), amps (1 channel)
2. The Battery Discharge Voltage Profile logs volts and amps every time the charge level changes by 5% (or 10%) for 1 or 2 battery systems.
3. Battery Cycle Efficiency documents system efficiency for up to 2 battery systems.

## AC Kilowatt-Hour Meter



These utility-grade 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 EZ-Read cyclometer. For use on 120 or 120/240 VAC systems. Maximum current 200 amps.

The ITRON LCD meter is the standard utility grade meter you see on most homes.

The 028-03042 five terminal meter (Form 12S) is used for tracking the power fed back to the grid from an OutBack 120 VAC grid-tie system. Often used for Green Tag sales.

Description	Item code	Price
Kilowatt hour meter w/ EZ-Read cyclometer	028-03015	\$34
Kilowatt hour meter ITRON LCD Digital 240V CL200	028-03012	\$32
Kilowatt hour meter 12S LCD 120V for OutBack grid-tie	028-03042	\$200

## Kilowatt-Hour Meter Sockets



We stock two types of kilowatt hour meter bases.

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 rated for outdoor use and UL Listed.

The 5-terminal socket is rated at 200 amps, 480 VAC and is used with the 12S meter.

The low-cost cast, round base has 1-1/2" threaded holes in the top and bottom. It is not UL Listed.

Description	Item code	Price
Kilowatt hour meter socket 120/240VAC - round	028-03025	\$16
Kilowatt hour meter socket 120/240VAC NEMA 3R	028-03031	\$94
Kilowatt hour meter socket 120 V 5 term for OutBack GT	028-03047	\$80

## 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 the 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	028-02005	\$36

## Solar Energy Technologies

### EnergyTraker Solar PV200 Data Logger system



This affordable comprehensive solar electric monitoring system offers local PV system monitoring and data logging on a PC. The user-friendly analytical software allows viewing of the data and printing screen plots and data reports. The price is low enough to meet budget requirements for residential and small commercial applications and there are no monthly monitoring fees.

The package comes with the EnergyTraker Solar PV200 Series Data Logger and standard professional data logging PC software, (1) 100-amp PV220 split-core AC current transformer and (1) 100 amp DC current sensor, (1) DC array high voltage in-line attenuator module for negative ground systems, (1) AC plug-in wall transformer, serial-to-USB adapter, Serial DB9 cable, (2) 7-foot Cat5 cables.

The Solar PV200 Series Data Logger will accept use of up to (2) DC current sensors and (2) DC voltage sensors for use with (2) separate solar arrays, up to (4) AC current transformers for (2) separate single phase inverter outputs and grid power monitoring, a single irradiance sensor and a single outdoor rated temperature sensor. Additional SET sensors are not included in the system package and must be ordered separately. The EnergyTraker Solar PV200 Series can accept use of an SET wireless serial modem between the data logger and PC, and an addressable IP module for remote monitoring and operation over the internet.

Model	Description	Item code	Price
PV220	EnergyTraker PV220 Data Logging system	028-00401	\$1,749
AC-CT100	100 amp split core (.75" opening) AC current transformer	028-00420	\$129
DC-CS185	100 amp solid core (.85" core opening) DC current sensor	028-00424	\$129
TP-PV200	-10°F to 200°F temperature sensor (outdoor rated)	028-00431	\$75
IR-P100	Irradiance sensor (pyranometer) with mounting bracket	028-00438	\$299
SDS-LS110	Addressable IP serial device server for internet use	028-00442	\$259
WSM-300	Wireless serial modem pair 300-foot range	028-00447	\$459



## The Energy Detective (TED)

### TED 5000 Data Loggers



The TED 5000 Series displays up-to-the-second energy use and cost information in a sleek, easy-to-read handheld display. It shows current energy consumption in kilowatts (kW), up-to-the-moment energy costs in dollars and cents per hour (\$/hr); it will display kilowatt hours (kWh) consumed during a given day as well as their cost, and the cost and quantity of kWh consumed during any part of a billing cycle. Check projected energy use for your current billing cycle in kWh, projected energy cost for current billing cycle, peak electrical demand so far this billing cycle in kW, peak use so far in the current billing cycle measured in \$/hr, current voltage, maximum and minimum voltage, current Energy Rate (Tariff) in dollars and cents per kilowatt hour \$/kWh, and current date and time. The TED Gateway provides the TED system with added functionality and data accessibility. It receives and stores energy data internally. From there it can be relayed to the new TED 5000 Display via ZigBee wireless. The Gateway stores 60 minutes of per-second data, 2 days of per-minute data, 90 days of hourly-data, 24 months of daily-data, and 10 years of monthly-data.

Your real-time and historical data can be viewed on your computer by utilizing the Gateway's Ethernet jack, IP chip, and embedded TED Footprints software (Windows, Mac, and Linux compatible). Additionally, when you connect the Gateway to your wireless router, you can access your data from any computer or mobile device with internet access.

Model 5002-C comes with all the components necessary to monitor PV system energy output and home or business energy usage, and includes the sleek, wireless TED 5000 display. The data is logged/graphed separately, but can also be seen in aggregate as well. Works with Google PowerMeter. Model 5002-G includes no monitor for users who choose to simply access their data via computer.

Model	Description	Item code	Price
5002-C	TED 5000 monitor with Gateway and wireless display	028-00507	\$319
5002-G	TED 5000 monitor with Gateway (no display)	028-00509	\$279
5000 Display	Additional wireless display with charging stand	028-00521	\$49





## Why Use Monitoring Tools?

Residential and commercial system owners and installers can 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, individual solar energy generation and demand fluctuates. Periodic meter readings provide only a summary view of energy consumption, revealing little or nothing about PV generation efficiency or 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.

## Draker Laboratories, Inc. Sentalis Performance Monitoring

Draker Lab's Sentalis monitoring line was designed for the commercial scale solar power market. It is an end-to-end solution that includes everything needed for high performance solar monitoring: field instrumentation, remote data collection, data hosting, and a web-based user interface. The web interface includes a portfolio overview, a project overview, performance trends, advanced analytical tools, alarms, and a raw data viewer. Draker also offers a full suite of services to ensure that your solar monitoring installation goes smoothly. Their trained field technicians can provide installation and commissioning support and user training. It has a 5-year warranty.

Draker use industrial grade Campbell Scientific hardware that is built to last in harsh environments.

The simple and intuitive web interface has a portfolio overview for viewing status of multiple sites on a single screen. Login protected data feeds can be set to send different data to different user groups. It has system level performance analysis for easy comparison of actual vs. expected system output, with advanced alarms.



Draker part #	Sentalis - PV base package	Item code	Price
SPV-10	Sentalis - PV base station w/ NEMA 4X enclosure	029-05610	\$9,385
	Wireless cell modem and annual data plan service		
	Revenue grade energy meter w/ CTs		
	Plane of array irradiance pyranometer (silicon)		
	Back of module temperature sensor		
	Sentalis web-based interface / per year		
	Sentalis interface admin configuration		
<b>Environmental Sensor Add-Ons</b>			
SPV-11	Ambient temperature (with 100' cable)	029-05611	\$572
SPV-12	Wind speed (with 100' cable)	029-05612	\$863
SPV-13	Wind direction (with 100' cable)	029-05613	\$690
<b>Web Services Add-Ons</b>			
SPV-21	Project kiosk / public display (not including monitor)	029-05621	\$3,450
SPV-22	Reports (expected vs. actual output) - (billing inputs)	029-05622	\$1,139
SPV-23	Animated schematic representation	029-05623	\$863
<b>Field Support + Accessories</b>			
SPV-30	Load analysis - revenue grade Energy Meter (with CTs up to 2000 amps)	029-05630	\$2,705
SPV-31	Load analysis - Revenue grade energy meter (with CTs up to 3500 amps)	029-05631	\$3,450
SPV-32	Install support or on-site design per day	029-05632	\$1,140
SPV-33	On site commissioning services per day	029-05633	\$1,140
SPV-34	On site training per day	029-05634	\$1,140



## DECK Monitoring

### Solar Monitoring Solution

DECK Monitoring was designed with residential and commercial system owners and installers in mind. DECK Monitoring's simple, powerful, and field-proven monitoring and display services work with your residential or commercial solar electric or wind system to provide web-based visual displays.

DECK Monitoring allows system owners to see, track and share their energy production in real time on the internet via a graphics-rich public online dashboard, increasing customer satisfaction. A highly configurable alarm, and contractor notes settings, allows the installer or system owner to receive automatic alerts instantly in case of an inverter failure or an under-reporting system. Monitor energy generation, demand, irradiance, and performance data down to the string level – with user-defined real time and historical reporting capabilities.

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 any internet-connected device. Residential and commercial installers can assure customers that their renewable energy system is operating properly. DECK provides views for post-installation support, alerting you to failure issues and providing tools for remote trouble-shooting. The DECK service also generates the regular reports required for performance-based financial incentives available under programs such as California's CSI.

### Residential Monitoring Service

DECK'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, the building's energy usage, and environmental information. Energy information can be selected to show daily, weekly, monthly and yearly comparisons. A simple Flash application shows consumers "How Solar Works" as well.

DECK offers inverter-direct monitoring for many 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 are for home users only, are single phase, and measure only kWh, not volts and amps.

As with the commercial service, solar integrators who install residential monitoring for their clients also get full access to the DECK admin panel at no extra charge. This allows integrators to track performance of all of their DECK Monitored systems in one view, set custom alarms and reminders, and keep service notes online.



DECK P/#	DECK Residential Monitoring w/ 5 years monitoring included	Item code	Price
RM5YP001	Residential solar monitoring equipment and service package	029-04019	\$1,500
RM5YSWB1	Residential SMA WebBox software only	029-04022	\$750
RM5YE001	Residential solar monitoring 5-year extension	029-04030	\$600
RI5YE001	Residential inverter monitoring 5-year extension	029-04031	\$150

### Commercial Monitoring Service

With DECK's 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. Pricing is based on the actual monitoring services delivered, not on the kW size of the job.

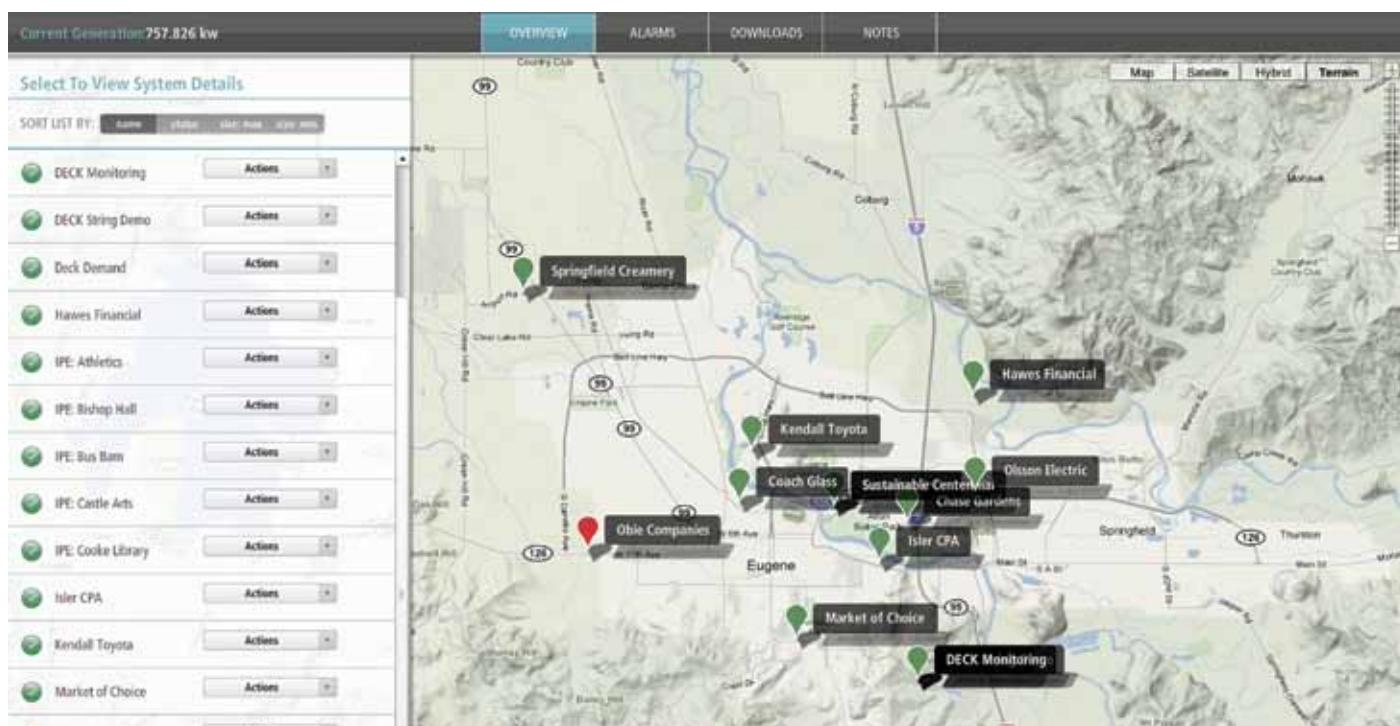
This graphically intuitive solar monitoring solution allows you to view your solar energy production in a single dashboard view. The Project Details and About tabs allows the customer to include their own pictures and text in dedicated areas to describe and promote their green investment. The DECK dashboard can be easily integrated into a customer's website, providing ready made green PR and awareness. The DECK service also generates the regular reports required for performance-based financial incentives available under programs such as California's CSI, where DECK is listed as a Private Data Provider (PDP).

For large projects, DECK also provides string monitoring on the DC side, which allows integrators, owners and PPAs to ensure that their system is operating at peak efficiency. DECK's advanced string outlier graph shows at a glance if any strings are underperforming, while giving the integrator the ability to adjust the tolerance level to prevent false alarms due to shading or other factors. String monitoring can easily pay for itself in a large system by providing alerts if a string underperforms, which otherwise would pass unnoticed.

DECK Monitoring includes ANSI standard revenue-grade meter with 2% accuracy and meets metering and reporting requirements of California EPBB and PBI programs and of all states requiring revenue-grade meters. All packages include hardware, 5 years of hosted monitoring services and 5 years of warranty coverage. Weather data and building load are options that can be added to the monitoring package. Broadband internet access is required for standard systems. Cellular modems are optional.

Indoor and outdoor kiosk and flat screen display options are also available and are a great way for a customer to promote their green investment in a public place such as a lobby or elsewhere their place of business. The DECK Administration Panel is also included at no extra cost. This password-protected Admin Panel allows you to keep track of all of your customers in one map view and to be alerted of system issues and inverter errors.

DECK P/#	DECK Commercial Monitoring w/ 5 years monitoring	Item code	Price
CM5YP001	Commercial solar monitoring equipment and service package	029-04000	\$4,195
CMAMS001	Add-on energy meter w/CTs (100A-2400A) unidirectional	029-04002	\$1,140
CMAMS002	Add-on energy meter w/CTs (100A- 1600A) bidirectional	029-04004	\$2,635
WS5YP001	Weather station standard w/5 yrs. monitoring included	029-04005	\$2,399
WS5YP002	Weather station with wind speed & direction	029-04006	\$3,959
WP2PP001	Wireless outdoor send/receive connection (1500 ft.) - 2 units	029-04009	\$1,500
WP2PP002	Wireless outdoor send or receive connection (1500 ft.) - 1 unit	029-04015	\$750
CB08S00	String monitoring and UL combiner for up to 8 strings	029-04010	\$2,100
CB16S001	String monitoring and UL combiner up to 16 strings	029-04011	\$3,960
CMG00001	Cellular modem for gateway (no internet service)	029-04012	\$720
EDI5YA001	PDP reporting	029-04013	\$420
N4REO001	NEMA 4 outdoor enclosure	029-04016	\$360
INVDIR001	System config. per commercial inverter (allows subarray monitoring)	029-04017	\$480
CS5YP001	Current Sensor 200ADC max; reading w/ 5-yr. monitoring	029-04029	\$480
Display options			
KTSIP001	Kiosk preconfigured indoor	029-04007	\$7,195
KTSOP001	Kiosk preconfigured outdoor	029-04008	\$18,000
LCD50001	50" monitoring LCD display with preconfigured PC	029-04023	\$4,800
HPTSP001	Touchscreen flat panel PC/display preconfigured	029-04024	\$3,595
STORB001	How Solar Works (story board) 4' x 3'	029-04025	\$3,600
Monitoring extension options			
CM5YE001	Commercial solar monitoring 5-year extension	029-04001	\$1,800
CI5YE001	Commercial inverter monitoring 5-year extension	029-04028	\$300
CM5YM001	Add-on meter 5-year monitoring extension	029-04003	\$300
WS5YE001	Weather station 5-year extension	029-04026	\$300
ST5YE001	String monitoring 5-year extension (per string)	029-04027	\$60



## 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 compared 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. Using one amp for 100 hours means 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 to less than 20% of capacity 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 overcharge 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 being 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 the case 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.

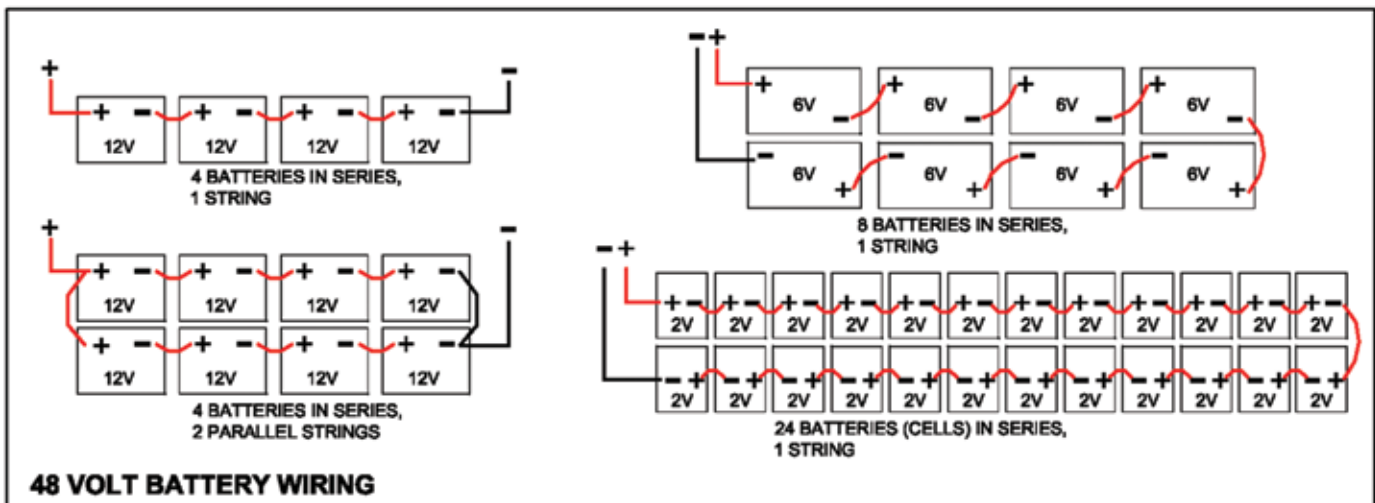
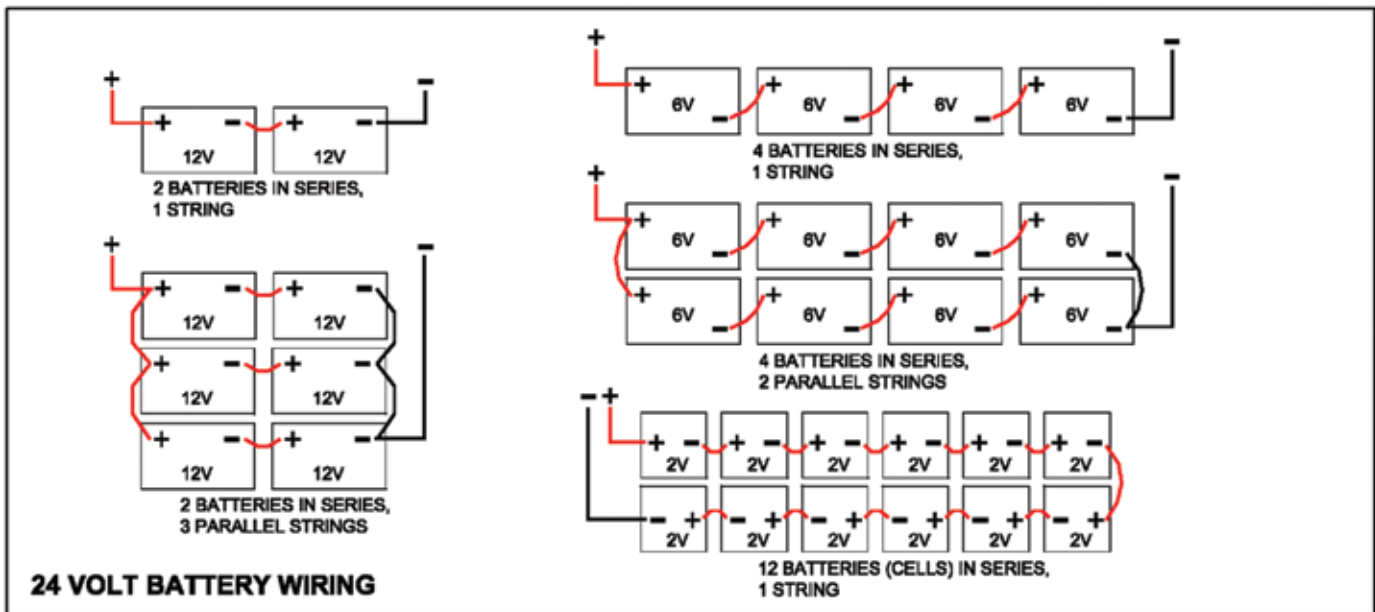
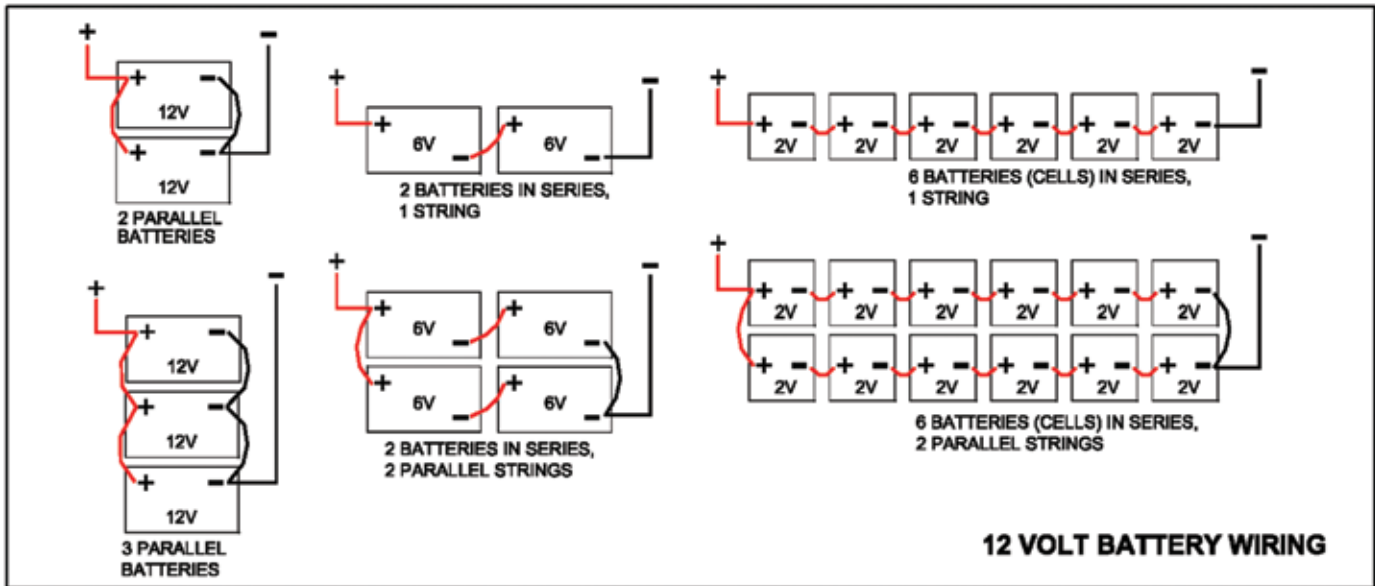
We strongly recommend the use of an amp-hour meter with all battery systems. See pages 138-139.

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 table 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 Heisey, 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 stir 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 table 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, or capacity, is measured in amp-hours. 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 (line 10 from the Off-Grid Load Worksheet on page 12): \_\_\_\_\_

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 10: \_\_\_\_\_

### Special Condition #2: High-Charge Current

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

Step 8 Multiply line 7 by 10: \_\_\_\_\_

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 table 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: \_\_\_\_\_

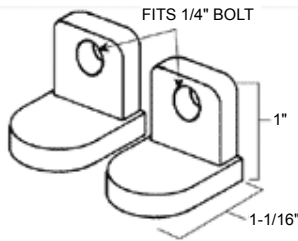
# East Penn/MK Battery

## MK Sealed PV/Solar Batteries

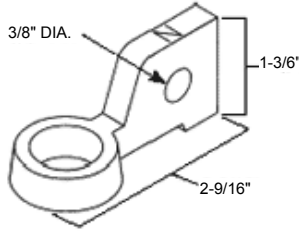
MK sealed batteries are designed for maintenance-free operation for the life of the battery. Sealed construction eliminates periodic watering, corrosive acid fumes and spills. Tank formed plates ensure voltage matching between cells. Most models are rated non-spillable by ICAO, IATA and DOT, meaning easy transportation by air requiring no special containers. Exceptions are the three AGM models marked by asterisks in the table, which cannot be shipped by air freight or UPS and must be shipped by truck freight on pallets. 1-year warranty.

## MK Sealed Gel Batteries

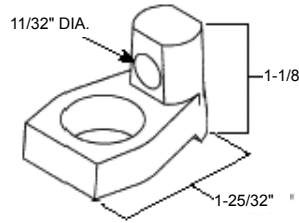
The gelled electrolyte won't stratify, so no equalization charging is required. Less than 2% per month standby loss means low discharge during transport and storage. Gel batteries are best for cycling operations and where very cold temperatures are expected. They can operate at temperatures from -76 to 140 F.



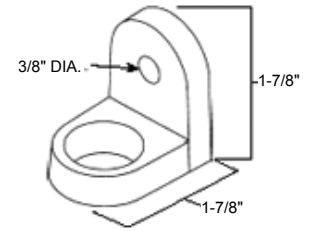
**T874**



**T876**



**T881**



**T975**

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	8GU1	12	T874	31.2	36.1	7.8 x 5.2 x 7.3	24	040-03015	\$119
	8G22NF	12	T881	50	57	9.38 x 5.5 x 9.25	38	040-03018	\$202
	8G24UT	12	T881	73.6	84	10.9 x 6.8 x 9.9	53.6	040-03022	\$270
	8G27	12	T876	86.4	99	12.75 x 6.75 x 9.75	63.2	040-03024	\$294
	8G31	12	T876	97.6	108	12.94 x 6.75 x 9.75	71.7	040-03027	\$329
	8G4DLTP	12	T975	183	210	20.8 x 8.5 x 10	130	040-03030	\$640
	8G8DLTP	12	T975	225	265	20.8 x 11 x 10	161	040-03033	\$779
	8GGC2	6	T881	180	198	10.3 x 7.2 x 10.9	69	040-03036	\$356
Sealed AGM solar batteries	8AU1H	12	T874	32.5	37	7.8 x 5.2 x 7.3	24	040-03117	\$100
	8A22NF	12	T881	55	63	9.38 x 5.5 x 9.25	38	040-03120	\$184
	8A24DT	12	T881	79	91	10.9 x 6.8 x 9.9	53.6	040-03123	\$231
	8A27	12	T876	92	106	12.75 x 6.75 x 9.75	63.2	040-03126	\$275
	8A31DT*	12	DUAL	105	116.2	12.94 x 6.75 x 9.75	71.7	040-03129	\$315
	8A4DLTP*	12	T975	200	216	20.8 x 8.5 x 10	130	040-03132	\$588
	8A8DLTP*	12	T975	245	257	20.8 x 11 x 10	161	040-03135	\$693
	8AGC2	6	T881	200	220	10.3 x 7.2 x 10.9	69	040-03137	\$315

## ADVERTISEMENT

### MK Sealed AGM Batteries

These are completely sealed, absorbed glass mat, valve-regulated batteries with efficient recombination. 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. Delivered from one of 20 MK warehouses

across the U.S. NOTE: The 3 asterisked models in the table can NOT be shipped by air or UPS, only by truck freight.

### MK 8L-16 6-Volt Deep Cycle Battery

This version of East Penn's MK L-16 battery is the best commercial deep cycle battery value we offer. They have flag terminals and a heavy duty plastic case. MK L-16 batteries are made in USA.

They seem to be able to maintain the best price on this type of battery because they own their own lead smelter which allows them to have better control of lead prices. Capacity is 370 amp-hours at a 20-hour rate and 420 amp-hours at a 100-hour rate.



Model	Volts	Dimensions (inches)	Weight (lbs)	Item code	Price
8L-16	6	11.75 x 7 x 17.3	113	040-01957	\$410



## 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 a heavy-duty cousin of the golf cart battery with much thicker lead plates and nearly twice the capacity. Trojan's Renewable Energy (RE) Series (L16RE-2V, L16RE-A, L16RE-B and T105-RE) is a line of technologically advanced lead-acid deep cycle batteries, optimized for renewable energy applications such as solar PV, small wind, and micro hydro. They have heavier duty separators and plates designed for longer life and their warranty has been extended to two years free replacement and 60 months additional pro-rated on the L16s and 36 months pro-rated on the T-105.



Model	Volts	Capacity (Ah)		Dimensions (in) L" x W" x H"	Weight lbs	Item code	Price
		20-hour rate	100-hour rate				
T-105-RE	6	225	250	10.375 x 7.125 x 11.25	67	040-01937	\$220
L16RE-A	6	325	360	11.625 x 7 x 17.7	115	040-01965	\$445
L16RE-B	6	370	410	11.625 x 7 x 17.7	118	040-01967	\$505
L16RE-2	2	1110	1235	11.625 x 7 x 17.7	119	040-01920	\$505

## Rolls/Surrette

### S-series Batteries

These commercial batteries are the same size the L16 batteries from Trojan and Deka. They are rated at 1000 cycles at 50% depth of discharge. Batteries shipped to commercial addresses qualify for free shipping to some regions of the country. East of the Mississippi, freight is free on orders of 18 batteries or more to the same commercial address. West of the Mississippi and east of the Rockies, freight is free on orders of 36 batteries or more. West of the Rockies, freight is free on orders of 54 batteries or more.



Surrette model	Battery voltage	Capacity (Ah)		Rated cycles (50% DOD)	Warranty (years)	Dimensions (in)			Weight wet / dry	Item code	Price
		20-hr rate	100-hr rate			L"	W"	H"			
S-460	6	350	460	1000	7	12.28	7.12	17	117 / 90	040-02106	\$450
S-530	6	400	530	1000	7	12.28	7.12	17	125 / 105	040-02109	\$497
S-600	6	450	600	1000	7	12.28	7.12	17	125 / 105	040-02110	\$578
S-1380	2	1050	1380	1000	7	12.28	7.12	17	125 / 105	040-02113	\$486
S-1580	2	1200	1596	1000	7	12.28	7.12	17	125 / 105	040-02114	\$533
S-1750	2	1300	1728	1000	7	12.28	7.12	17	125 / 105	040-02115	\$615

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## Rolls/Surrette

### 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 a 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. 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 case is broken the battery remains operable and spill-free. The individual cells of the CS and KS series are bolted together allowing the battery to be disassembled. 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 warranty.

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	040-02220	\$1,190
2-YS-31PS	2	2430	3435	3300	10	15.50	9	31.63	285/200	040-02221	\$1,790
4-CS-17PS	4	546	770	3200	10	14.38	8.25	18.25	128 / 98	040-02223	\$830
4-KS-21PS	4	1104	1557	3200	10	15.75	9.38	24.75	267 / 186	040-02226	\$1,548
4-KS-25PS	4	1350	1900	3200	10	15.75	10.63	24.75	315 / 220	040-02229	\$1,895
6-CS-17PS	6	546	770	3200	10	22	8.25	18.25	221 / 178	040-02232	\$1,242
6-CS-21PS	6	683	963	3200	10	22	9.75	18.25	271 / 217	040-02235	\$1,491
6-CS-25PS	6	820	1156	3200	10	22	11.25	18.25	318 / 254	040-02238	\$2,293
8-CS-17PS	8	546	770	3200	10	28.25	8.25	18.25	294 / 238	040-02247	\$1,148
8-CS-25PS	8	820	1156	3200	10	28.25	11.25	18.25	424 / 342	040-02250	\$1,605
12-CS-11PS	12	357	503	3200	10	22	11.25	18.25	272 / 220	040-02259	\$1,550

## 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% depth of discharge. 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 busbars, 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 continental 48 states.



Cell type	Capacity @ 20-hr rate	Weight lbs	Dimensions (in) L" x W" x H"	Item code	Price
SO-6-85-17	845 A-H	742	40 x 7.75 x 25	040-05269-A	\$4,148
SO-6-85-19	950 A-H	808	40 x 8.25 x 25	040-05272-A	\$4,438
SO-6-85-21	1055 A-H	880	40 x 8.75 x 25	040-05275-A	\$4,620
SO-6-85-23	1160 A-H	959	40 x 9 x 25	040-05278-A	\$5,038
SO-6-85-25	1270 A-H	1036	40 x 10.25 x 25	040-05281-A	\$5,280
SO-6-85-27	1375 A-H	1102	40 x 11.25 x 25	040-05284-A	\$5,610
SO-6-85-31	1585 A-H	1252	40 x 12.75 x 25	040-05290-A	\$6,476
SO-6-85-33	1690 A-H	1336	40 x 13.50 x 25	040-05293-A	\$6,842
SO-6-100-33	1990 A-H	1550	40 x 13.5 x 28	040-05295	\$7,960

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# GNB

## Absolyte GP 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 is 1200 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 required.

Protective steel tray housings offer maximum installation flexibility and the Absolute GP 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 GP batteries are ideal for photovoltaic and alternative energy applications including:

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



GNB part #	Volts	Capacity (Ah)		Dimensions (inches)			Weight lbs	Item code	Price
		20-hr rate	100-hr rate	L"	W"	H"			
<b>6-cell 12-volt batteries</b>									
6-50G05	12	120	140	17.19	8.53	16.22	157	040-04409	\$1,464
6-50G07	12	182	210	21.69	8.53	16.22	209	040-04412	\$1,739
6-50G09	12	240	290	26.19	8.53	16.22	252	040-04415	\$2,055
6-50G13	12	360	430	35.19	8.53	16.22	356	040-04421	\$2,625
6-90G07	12	300	360	21.69	8.53	23.56	316	040-04430	\$2,185
6-90G09	12	400	480	26.19	8.53	23.56	396	040-04433	\$2,563
6-90G11	12	500	600	30.69	8.53	23.56	477	040-04436	\$2,982
6-90G13	12	600	720	35.19	8.53	23.56	557	040-04439	\$3,518
6-90G15	12	700	840	39.69	8.59	23.56	637	040-04442	\$3,861
<b>3-cell 6-volt batteries</b>									
3-100G13	6	680	790	19.93	8.53	26.38	328	040-04313	\$1,837
3-100G15	6	800	920	22.18	8.59	26.38	374	040-04316	\$2,082
3-100G17	6	900	1,000	24.50	8.59	26.38	424	040-04319	\$2,305
3-100G19	6	1,020	1,100	26.75	8.59	26.38	470	040-04322	\$2,508
3-100G21	6	1,140	1,300	29	8.59	26.38	515	040-04325	\$2,721
3-100G27	6	1,460	1,700	35.75	8.59	26.38	653	040-04334	\$3,377
3-100G29	6	1,580	1,800	38	8.59	26.38	704	040-04337	\$3,628
3-100G31	6	1,700	1,900	40.25	8.59	26.38	750	040-04340	\$3,882
3-100G33	6	1,820	2,100	42.50	8.59	26.38	795	040-04343	\$4,129
<b>2-volt cells</b>									
1-100G39	2	2,040	2,370	19.93	8.53	26.38	328	040-04225	\$1,805
1-100G45	2	2,340	2,760	22.18	8.59	26.38	374	040-04228	\$3,612
1-100G51	2	2,700	3,000	24.50	8.59	26.38	424	040-04231	\$2,305
1-100G57	2	3,060	3,300	26.75	8.59	26.38	470	040-04234	\$2,510
1-100G63	2	3,420	3,900	29	8.59	26.38	515	040-04237	\$2,724
1-100G69	2	3,780	4,200	31.25	8.59	26.38	561	040-04240	\$2,904
1-100G75	2	4,080	4,500	33.50	8.59	26.38	608	040-04243	\$3,133
1-100G81	2	4,440	5,100	35.75	8.59	26.38	653	040-04246	\$3,377
1-100G87	2	4,800	5,400	38	8.59	26.38	704	040-04249	\$3,628
1-100G93	2	5,100	5,700	40.25	8.59	26.38	750	040-04252	\$3,884
1-100G99	2	5,460	6,300	42.50	8.59	26.38	795	040-04255	\$4,132

# East Penn

## Deka Unigy II Sealed Industrial Batteries



The Deka Unigy II line features two module designs with a wide range of capacities to fit the requirements of renewable energy applications. These batteries are ideal for float applications with an occasional deep discharge, such as battery-backup for grid-connected systems. The front safety shield design easily clips on and off without tools for quicker assembly. The modules are coated with acid resistant epoxy powder paint and each module has mounting holes for grounding option.

These batteries are available with interlocked frames for locations with tough seismic requirement and non-interlocked frames where this is not required. They are also available with flame retardant polyethylene cases. The interlocking module frames require only front access bolts for mounting, providing quick and safe installation. Their standard one-piece base enables it to be used as an anchoring template. Anchors can be drilled and installed with the base in place. They are certified to UBC 97 Zone 4 Top of Building up to 8 modules high. The non-interlock modules require front and rear access bolts for mounting, providing easy and safe installation. The standard two-piece base enables anchors to be drilled and installed with base in place. The non-interlock version is certified to UBC 97 Zone 2B Top of Building up to 8 modules high.

Item code prefix	Deka model	Amp hours		Suffix > Module volts	Non-Interlock SpaceSaver	Interlock SpaceSaver
		20 hour rate	100 hour rate		Flame retardant poly case	Flame retardant poly case
					-NL	-IL
					Price per module	
040-06011	6AVR75-5	180	210	12	\$2,134	\$2,343
040-06012	6AVR75-7	280	310	12	\$2,382	\$2,618
040-06013	6AVR75-9	380	420	12	\$2,631	\$2,888
040-06014	6AVR75-11	460	520	12	\$2,851	\$3,133
040-06015	6AVR75-13	540	630	12	\$3,109	\$3,418
040-06016	6AVR75-15	640	730	12	\$3,431	\$3,771
040-06017	3AVR75-17	720	840	6	\$2,337	\$2,565
040-06018	3AVR75-19	820	940	6	\$2,501	\$2,749
040-06019	3AVR75-21	920	1050	6	\$2,662	\$2,923
040-06022	3AVR75-23	1000	1150	6	\$2,780	\$3,055
040-06023	3AVR75-25	1100	1250	6	\$2,906	\$3,194
040-06024	3AVR75-27	1200	1360	6	\$3,063	\$3,366
040-06025	3AVR75-29	1280	1460	6	\$3,388	\$3,723
040-06026	3AVR75-31	1380	1570	6	\$3,523	\$3,868
040-06027	3AVR75-33	1460	1670	6	\$3,633	\$3,988
040-06028	6AVR95-15	790.6	941.2	12	\$3,840	\$4,221
040-06029	3AVR95-17	903.5	1075.7	6	\$2,581	\$2,836
040-06030	3AVR95-19	1016.4	1210.1	6	\$2,767	\$3,040
040-06031	3AVR95-21	1129.4	1344.6	6	\$2,942	\$3,231
040-06032	3AVR95-23	1242.3	1479	6	\$3,083	\$3,388
040-06033	3AVR95-25	1355.3	1613.5	6	\$3,232	\$3,551
040-06034	3AVR95-27	1468.2	1747.9	6	\$3,391	\$3,726
040-06035	3AVR95-29	1581.1	1882.4	6	\$3,726	\$4,094
040-06036	3AVR95-31	1694.1	2016.9	6	\$3,879	\$4,263
040-06037	3AVR95-33	1807	2151.3	6	\$4,012	\$4,409
040-06038	2AVR125-33	2367	2930	4	N/A	\$3,764

# DPW Solar

## POWER-FAB Pole-Mount Aluminum Battery Boxes

Side-of-pole mount aluminum NEMA 3R hinged door boxes from DPW Solar 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 (inches) D" x W" x H"	Item code	Price
Group 27, 30	1	9 X 16 x 20	048-04179	\$545
Group 27, 30	2	16 X 16 x 20	048-04188	\$660
Group 27, 30	4	16 X 16 x 20	048-04200	\$840
Group 27, 30	6	16 X 25 x 34	048-04201	\$1,020
Golf cart	2	14 X 18 x 22	048-04197	\$545
4D	1	12 X 24 x 22	048-04282	\$630
4D	2	12 X 24 x 36	048-04291	\$790
8D	1	15 X 24 x 22	048-04285	\$760
8D	2	15 X 24 x 36	048-04294	\$865

# MidNite Solar

## Battery Enclosures

These grey powder-coated steel battery enclosures with locking doors are ETL Listed for indoor use in the US and Canada. They are designed for use with sealed batteries. The MNBE-A ships by UPS, but all other sizes ship by truck freight. All are shipped unassembled. Choose the proper sized enclosure for the size and number of batteries that you need. Use multiple enclosures, side-by-side, for larger battery banks. The MNBE-A and MNBE-B enclosures can be stacked two high. The MNBE-D3R is an aluminum outdoor enclosure which is identical to the MNBE-D.



MidNite model	Battery size	Battery capacity	Shelves included	Dimensions (inches) D" x W" x H"	Shipping dimensions	Weight (lbs)	Item code	Price	
MNBE-A	27 or 31	6	2	14.5 X 29 x 27.25	30" X 32" x 7.5"	71	048-05501	\$425	
	8D	2							
MNBE-B	27 or 31	8	2	15.25 X 33.6 X 34.5	18" X 8" x 36" & 18" X 9" x 37"	102	048-05503	\$605	
MNBE-C	27 or 31	12	3	16 X 36.5 X 55	Ships by truck on a 42" x 42" x 60" pallet	190	048-05505	\$849	
	8D	3							
MNBE-D	27, 31, GC2	8	2	15.25 X 33.6 X 34.5	34" x 15.25" x 41"	116	048-05506	\$649	
MNBE-D3R	27, 31, GC2	8	2	15.25 X 33.6 X 34.5	34" x 15.25" x 41"	116	048-05506	\$949	
MNBE-E	27, 31, GC2, L16	8	2	15.25 X 33.6 X 34.5	2 Boxes 49" x 19" x 8"	128	048-05507	\$749	
Extra shelf	Extra Shelf for MNBE-C, MNBE-D or MNBE-D3R							048-05520	\$89

## POWER-FAB Chest-Style Battery Enclosures

Pad mount, chest style enclosures are manufactured with 0.125" 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 here, 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	048-04030	\$768	048-04033	\$1,030
	4	2x2	18x30x16	39	048-04031	\$973	048-04034	\$1,283
	4	1x4	16x34x16	37	048-04032	\$995	048-04035	\$1,314
	6	2x3	25x30x16	50	048-04140	\$1,158	048-04143	\$1,518
	8	2x4	30x33x16	60	048-04036	\$1,320	048-04043	\$1,711
	10	2x5	41x30x16	70	048-04037	\$1,469	048-04044	\$1,903
8d	2	2x1	24x26x16	44	048-04057	\$1,047	048-04065	\$1,368
	4	2x2	26x46x16	68	048-04116	\$1,433	048-04119	\$1,835
	4	1x4	24x50x16	65	048-04066	\$1,459	048-04067	\$1,871
	6	2x3	38x46x16	90	048-04128	\$1,781	048-04131	\$2,255
	8	2x4	46x50x16	111	048-04068	\$2,102	048-04069	\$2,629
	10	2x5	62x46x16	131	048-04164	\$2,400	048-04167	\$2,993
	12	2x6	46x74x16	150	048-04070	\$2,701	048-04077	\$3,431
	12	4x3	50x68x16	150	048-04071	\$2,691	048-04078	\$3,415
Golf cart	2	2x1	13x18x17	25	048-04074	\$750	048-04079	\$1,009
	4	2x2	18x25x17	37	048-04075	\$935	048-04080	\$1,236
	4	1x4	14x35x17	36	048-04076	\$980	048-04081	\$1,298
	6	2x3	25x27x17	47	048-04134	\$1,112	048-04137	\$1,462
	8	2x4	25x32x17	56	048-04152	\$1,256	048-04155	\$1,637
	10	2x5	43x25x17	65	048-04082	\$1,400	048-04089	\$1,825
	12	2x6	25x51x17	74	048-04083	\$1,547	048-04090	\$2,088
	12	4x3	34x35x17	74	048-04084	\$1,529	048-04091	\$2,056
L-16, S460, S530	2	2x1	19x22x28	43	048-04088	\$868	048-04095	\$1,157
	4	2x2	22x32x28	61	048-04122	\$1,113	048-04125	\$1,452
	4	1x4	19x39x28	63	048-04096	\$1,155	048-04097	\$1,508
	6	2x3	31x32x28	76	048-04146	\$1,333	048-04149	\$1,726
	8	2x4	32x39x28	89	048-04158	\$1,518	048-04161	\$1,945
	10	2x5	32x48x28	102	048-04098	\$1,698	048-04099	\$2,173
	12	2x6	32x56x28	115	048-04170	\$1,882	048-04173	\$2,476
	12	4x3	39x46x28	114	048-04171	\$1,860	048-04172	\$2,446
	14	2x7	32x65x28	128	048-04174	\$2,077	048-04175	\$2,694
	16	2x8	32x73x28	141	048-04176	\$2,257	048-04177	\$2,929
	16	4x4	39x59x28	137	048-04187	\$2,194	048-04181	\$2,845



## RPPS

### Pole-Mount Battery/Control Boxes



Powder-coated aluminum NEMA 3R hinged door boxes hold 2 or 4 Type 31 batteries. An optional aluminum panel that mounts in the top section can be used for charge controllers and other electronics. Box for 4 batteries is pictured above. Box for 2 batteries has 1 shelf. To mount on a pole, order pole mount brackets below.

Description	Item code	Price
Battery control enclosure - 4 battery	048-04314	\$800
Battery control enclosure - 2 battery	048-04312	\$650
Battery enclosure pole mount brackets - 1 pair	048-04319	\$56
Aluminum back panel w/ hardware	048-04315	\$20

### 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 bayonet caps.

Description	Item code	Price
Water Miser battery cap	040-09913	\$8.50

## Heavy Duty Plastic Battery Box

These battery enclosures are made from HDPE plastic, the same material used to manufacture the outside cases of batteries. A removable lid with handles allows easy access to the batteries for service. Enclosures for L-16s are made with a removable middle section that minimizes lifting when installing the batteries. The plastic is acid resistant and very strong, but easy to drill with a hole saw for adding conduit fittings or battery filling tubes. The hydrogen vent fitting on the lid should be extended to the exterior of the building.



Each of the boxes can be ordered with, or without a drain fitting. The drain allows the batteries to be washed and hosed off. The drain option includes a 3" rigid foam base with HDPE trim ring and 3/4" pipe that extends horizontally out of the trim ring. Dimensions listed are inside of the battery compartment. Shipping size is slightly larger.

Battery type	Battery quantity	With drain	Dimensions W" x L" x H"	Item code	Price
L16	4	No	33 x 14 x 22.5	048-04014	\$399
L16	4	Yes	33 x 14 x 22.5	048-04015	\$479
L16	8	No	33 x 27 x 22.5	048-04016	\$459
L16	8	Yes	33 x 27 x 22.5	048-04017	\$549
T105	4	No	32.5 x 12.5 x 17	048-04018	\$319
T105	4	Yes	32.5 x 12.5 x 17	048-04019	\$399
T105	8	No	32.5 x 23.5 x 17	048-04020	\$389
T105	8	Yes	32.5 x 23.5 x 17	048-04021	\$479

## QuickCote Anti-Corrosion Protectant

QuickCote 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	046-00195	\$20

## Schneider Electric

### Xantrex Truecharge2 12V Battery Charger

Truecharge2 is available as a 20- or 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; 3-stage includes float charge. Manual equalize charge button. Manual or automatic temperature compensation. The optional temperature sensing probe corrects charge voltage for actual battery temperature. These chargers have full 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 9.8". 1-year warranty.



Description	Item code	Price
Truecharge 2 40 amp charger	045-02896	\$400
Truecharge 2 20 amp charger	045-02895	\$300
Temperature sensor	045-02898	\$42
Remote control panel	045-02897	\$95

## 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, spikes 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 120VAC input. 75-amp and larger chargers have 120V 20-amp plugs. 2-year warranty

### IOTA IQ-4 Smart Controller

The IQ-4 makes the DLS charger into a 3-stage charger 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.



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	045-02112	\$132
DLS-30	12	30	7 x 6.5 x 3.5	5.5	045-02115	\$171
DLS-45	12	45	7 x 6.5 x 3.5	5.5	045-02118	\$183
DLS-55	12	55	7 x 6.5 x 3.5	5.5	045-02121	\$215
DLS-75	12	75	10 x 6.5 x 3.5	7.8	045-02124	\$440
DLS-90	12	90	10 x 6.5 x 3.5	7.8	045-02127	\$497
DLS-27/15	24	15	7 x 6.5 x 3.5	5.5	045-02130	\$281
DLS27/25	24	25	7 x 6.5 x 3.5	5.5	045-02133	\$335
DLS-27/40	24	40	10 x 6.5 x 3.5	7.8	045-02136	\$545
DLS-54/15	48	15	10 x 6.5 x 3.5	7.8	045-02148	\$545
IQ-4	12	Smart Controller for 12V Chargers			045-02103	\$30

## 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 multiple banks of marine, RV, industrial and automotive 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	045-03073	\$162
SEC-1230A	12	14.4	13.8	30	Yes	3	10.7 x 8.4 x 3.25	5.3	045-03076	\$266
SEC-1245A	12	14.4	13.8	45	No	2	12 x 9 x 4	11.1	045-03079	\$410
SEC-1280A	12	14.4	13.8	80	No	2	15 x 9 x 4.25	12.1	045-03080	\$580
SEC-2415A	24	28.8	27.6	15	Yes	3	10.7 x 8.4 x 3.3	5.3	045-03082	\$266
SEC-2425A	24	28.8	27.6	25	No	2	12 x 9 x 4	11.1	045-03085	\$410
SEC-2440A	24	28.8	27.6	40	No	2	15 x 9 x 4.25	12.1	045-03087	\$580

## Solar Converters

### Battery Desulfator

The 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 are adjustable. Two wires connect to positive and negative battery terminals. 1-year warranty.



Description	Item code	Price
BD-2 battery desulfator	045-07105	\$140

## Battery Power Solutions

### Battery Life Saver Desulfators

These electronic devices dissolve the lead sulfate crystals covering the battery's plates, converting them back into the original elements. They use high-frequency pulses to loosen and dissolve the sulfate. Battery Life Savers rejuvenate the sulfuric acid solution as well as the lead plates, and run constantly to keep the battery in optimum condition.



The BLS-12-A from Battery Power Solutions is for use with smaller 12V battery systems and vehicles. It comes with eye rings for attachment to the battery clamp bolts.

BLS-12/24-B is our most popular model. Ideal for 12- and 24-volt renewable energy battery banks. It's equipped with plier type battery clips.

BLS-12/24-C is the same as the BLS-12/24-B, but has 5/16" lugs for attachment to battery.

BLS-36-A is a 36-volt version for use with 36V battery systems and battery powered vehicles. Includes 3/8" lugs for attachment to the battery terminals.

BLS-48-A is for use with battery banks that operate at 48 volts. Includes 3/8" lugs for attachment to the battery terminals.

Description	Item code	Price
BLS-12-A	045-07161	\$120
BLS-12/24-B	045-07163	\$140
BLS-12/24-C	045-07165	\$140
BLS-36-A	045-07167	\$150
BLS-48-A	045-07169	\$140

## 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 XW 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). 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.



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 XW 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). 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	085-08205	\$79
Power vent 24V	085-08207	\$79
Power vent 48V	085-08209	\$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 0.20 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	046-00154	\$8
Hydrometer dial type	046-00156	\$8



## 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 controllers 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. Type 1 heavy duty surge protectors are recommended when a direct lightning strike is possible on the installation.

## Delta

### Lightning Arrestors

Delta lightning arrestors have a maximum current rating of 60,000 amps and 2,000 joules per line. Response time is 25 ns 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	053-04115	\$40
LA602DC	Arrestor for up to 600 VDC	053-04109	\$44
LA302R	Arrestor for up to 300 VAC	053-04112	\$40
LA303R	Arrestor for up to 300 VAC 3-Phase	053-04118	\$50
LA603R	Arrestor for up to 600 VAC 3-Phase	053-04120	\$72
Mounting bracket for surge arrestors		053-04138	\$3

## Citel

### Surge Protection Products

Citel PV surge protectors are DIN mount and are ideal for placement inside combiner boxes.

#### DS210DC off-grid surge arrestor

The Citel DS210DC series is designed to protect 12V, 24V, 48V and 150V DC power lines for an off-grid PV system. The surge protectors protect the charge controller and other system electronics. DS210DC automatically reset after each lightning surge or electrical transient. These surge arrestors clamp at much lower voltage than Delta surge arrestors at left so they offer much better protection for charge controllers and inverters in low-voltage DC systems.



#### DS50PV grid-tie surge arrestor

The DS50PV is designed to protect the solar array at the solar PV array combiner box for a utility-interactive PV system. The DS50PV is designed to withstand 40kA (8/20us) induced transient surges and is designed with replaceable modules. Use the DS50PV-600 for systems with inverters that have an upper limit of up to 600 volts.



#### DS60PV grid-tie surge arrestor

DS60PV are Type 1 heavy duty surge protectors, recommended when a direct lightning strike is possible on the installation. They are available in 500- and 1000-VDC operating voltages. The use of Type 1 surge protector is recommended at both ends of the DC power supply line (solar array side and inverter/converter side). The DS60PV is made with a monobloc enclosure and mounts on DIN rail.



#### DS240 AC surge arrestor

The DS240 is DIN rail compatible and is built with a plug-in module and a fixed base, which enables easy and fast maintenance. 120VAC only. Two units cannot be used to provide protection for a 240V split-phase system.

Citel model	Nominal volts	Maximum volts	Discharge current	Width (mm)	Item code	Price
DS210-12DC	12	15 VDC	1 kA	0.7 (18)	053-04201	\$52
DS210-24DC	24	30 VDC	1 kA	0.7 (18)	053-04203	\$52
DS210-48DC	48	56 VDC	1 kA	0.7 (18)	053-04205	\$52
DS210-95DC	95	100 VDC	2 kA	0.7 (18)	053-04207	\$52
DS210-130DC	130	150 VDC	2 kA	0.7 (18)	053-04209	\$52
DS50PV-600	600	690 VDC	20 kA	1.4 (36)	053-04219	\$128
DS60PV-500	500	550 VDC	40 kA	2.8 (72)	053-04224	\$168
DS60PV-1000	1000	1000 VDC	40 kA	2.8 (72)	053-04226	\$279
DS240-120	120	150 VAC	20 kA	0.7 (18)	053-04210	\$98
DS240-120R	Replacement module for above			0.7 (18)	053-04211	\$40



## 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. They meet NEC requirements for connecting a continuous ground wire to all modules. Sold in packages of 10. UL Listed.



Description	Item code	Price
Bag of 10 lay-in lugs w/ screws	051-03414	\$35

## Wiley Electronics

### WEEB Grounding Products

WEEB stands for "washer, electrical equipment bonding." WEEB products are used to bond solar modules to aluminum solar mounting rails. The mounts are then grounded, grounding the entire assembly. 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

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 (pages 42-43) and pole mount systems (pages 47-49) and on Wattsun and Zomeworks trackers (page 50-52). 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-9.5

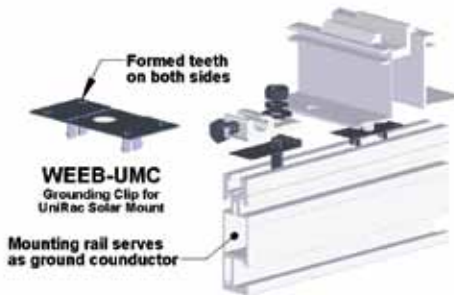


WEEB-9.5 NL

#### WEEB-UMC

WEEB-UMC grounding clips are used between modules and Unirac SolarMount Standard 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-UMC  
Grounding Clip for  
Unirac Solar Mount

Mounting rail serves  
as ground conductor

## Unirac

### Grounding Clip 1 (UGC-1)

For use with Unirac SolarMount mount rails. Slot allows the insertion of a T-bolt after the modules are in place. 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.

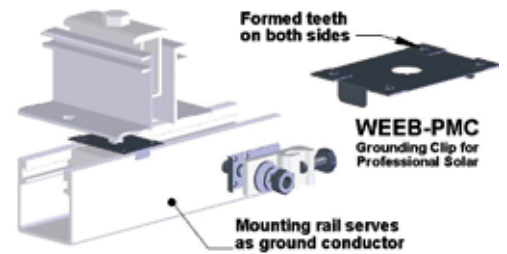


Unirac #	Item code	Price
980000	051-04055	\$1.80

#### WEEB-PMC

WEEB-PMC grounding clips are used between modules and SnapNrack or ProSolar rails when front mount clips are used to hold the module to the rails.

One clip grounds the frame of two 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.



Formed teeth  
on both sides

WEEB-PMC  
Grounding Clip for  
Professional Solar

Mounting rail serves  
as ground conductor

#### WEEB L-6.7

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.



We advise speaking to your building inspector before installing these products to see if they are acceptable in your area.

#### WEEB Bonding Jumper

WEEB Bonding Jumper is used to electrically bond mounting rails together at a splice. Use one at every splice.



Wiley part #	Description	Item code	Price
WEEB-9.5	Bonding washer for 1/4" bolted connections - price each - order in multiples of 10	051-04007	\$1.40
WEEB-9.5NL	Bonding washer for 3/8" bolted connections - price each - order in multiples of 10	051-04008	\$1.40
WEEB-UMC	Clip for use with Unirac SolarMount Standard Rail and SolarMount Light Rail - price each - order in multiples of 10	051-04003	\$1.80
WEEB-DMC	Clip for use with DPW Power Rail - price each - order in multiples of 10	051-04004	\$1.80
WEEB-PMC	Clip for use with SnapNrack and ProSolar rails - price each - order in multiples of 10	051-04001	\$1.80
WEEB-6.7	Lay-in lug with mounting hardware and WEEB washer - each	051-04015	\$6.00
Bonding Jumper	Splice kit for rails - each	051-04019	\$8.00

## ADVERTISEMENT

### MidNite Solar MNPV Combiners

These powder-coated aluminum, NEMA 3R rainproof array combiners will accept DIN-rail mounted fuse holders for 600VDC arrays, or 150VDC and 300VDC DIN-rail mounted breakers for low-voltage arrays. P

lastic cover provides a dead front for safety. Four sizes are available. ETL Listed. Negative busbar and ground bar are included. Aluminum NEMA 3R enclosure. Can be mounted at angles from 14 to 90 degrees. ETL Listed to UL 1741 for the U.S. and Canada.

Breakers and fuse holders not included. See page 166 for breakers, fuses and fuse holders.



MidNite model	PV source circuit options						Output circuits			Max output wire size	MNPV combiner dimensions (inches)	Weight (lbs)	Item code	Price	
	Max 150 VDC with breakers		Max 300 VDC with breakers		Max 600 VDC with fuses		Max output circuits	Max continuous output amps							
	# of input circuits	Max circuit amps	# of input circuits	Max circuit amps	# of input circuits	Max circuit amps		150 VDC	300 VDC						600 VDC
MNPV3	3	20	1	20	3	20	1	60	60	60	#14-1/0	10.5 x 5 x 3.5	2	053-03017	\$89
MNPV6	6	20	3	20	4	20	2	120	60	80	#14-1/0	13 x 8 x 3.5	4	053-03018	\$109
MNPV12	12	20			10	20	2	200		200	#14-2/0	14.7 x 12.4 x 3.5	6	053-03015	\$139
MNPV16					16	15	1			240	250MCM	20.7 x 16.2 x 3.5	12	053-03016	\$499

## OutBack

### FLEXware PV Combiners



The FLEXware PV8 and PV12 accommodate overcurrent protection requirements for off-grid and grid-connected applications. The DIN rail can be fitted with 150VDC circuit breakers for low-voltage PV arrays or 600VDC fuse holders for grid-tie arrays. These combiners replace the PSPV. Rated for NEMA 3R rainproof, the powder-coated aluminum chassis can be mounted on a wall, a sloped roof, or a pole. Dual output lugs allow connection for up to 2/0 AWG wire. An easily removable flame-retardant polycarbonate deadfront panel prevents accidental contact with live terminals. FWPV8 has one circuit and FWPV12 can be configured to have one or two circuits. Negative and ground terminal busbars are included.

OutBack model	# of breakers	# of fuse holders	Dimensions (inches)	Weight lbs	Item code	Price
FWPV8	8	6	15.2 x 12.7 x 3.9	4.4	053-03012	\$139
FWPV12	12	8	15.2 x 9.2 x 3.9	5.9	053-03014	\$199

### DIN Rail Mount Fuses and Fuse Holders

Fuse holder and fuses below and breakers at right fit MidNite MNPV and OutBack FlexPV and other combiners. Use the fuses and fuse holder below for 600VDC array combiners. Fuses are KLKD for 600 VDC.



Amps	Description	Item code	Price
	USM1 Fuse Holder - 600V 30A Max - DIN mount	053-03040	\$20
1	1-amp 600 VDC KLKD fuse	053-03155	\$12
2	2-amp 600 VDC KLKD fuse	053-03052	\$12
4	4-amp 600 VDC KLKD fuse	053-03051	\$12
6	6-amp 600 VDC KLKD fuse	053-03050	\$12
8	8-amp 600 VDC KLKD fuse	053-03048	\$12
10	10-amp 600 VDC KLKD fuse	053-03046	\$12
12	12-amp 600 VDC KLKD fuse	053-03044	\$12
15	15-amp 600 VDC KLKD fuse	053-03043	\$12
20	20-amp 600 VDC KLKD fuse	053-03042	\$12
30	30-amp 600 VDC KLKD fuse	053-03041	\$12

### DIN Rail Mount Combiner Breakers

These breakers fit MidNite MNPV and OutBack combiners. Use breakers for arrays with maximum voltage of 150 or less. Use 300 VDC breakers for 200 - 250 VDC charge controllers.



Amps	OutBack number	MidNite Solar #	Item code	Price
1	OBB-1-150VDC-DIN	MNEPV1	053-03033	\$13
2	OBB-2-150VDC-DIN	MNEPV2	053-03034	\$13
3	OBB-3-150VDC-DIN	MNEPV3	053-03024	\$13
4	OBB-4-150VDC-DIN	MNEPV4	053-03020	\$13
5	OBB-5-150VDC-DIN	MNEPV5	053-03025	\$13
6	OBB-6-150VDC-DIN	MNEPV6	053-03021	\$13
8	OBB-8-150VDC-DIN	MNEPV8	053-03022	\$13
9	OBB-9-150VDC-DIN	MNEPV9	053-03023	\$13
10	OBB-10-150VDC-DIN	MNEPV10	053-03026	\$13
12	OBB-12-150VDC-DIN	MNEPV12	053-03027	\$13
15	OBB-15-150VDC-DIN	MNEPV15	053-03029	\$13
20	OBB-20-150VDC-DIN	MNEPV20	053-03030	\$13
30	OBB-30-150VDC-DIN	MNEPV30	053-03032	\$13
50	OBB-50-150VDC-DIN	MNEPV50	053-03035	\$13
60	OBB-60-150VDC-DIN	MNEPV60	053-03037	\$13
63	OBB-63-150VDC-DIN	MNEPV63	053-03038	\$13

#### 1" wide DIN rail mounted 300 VDC circuit breakers

Amps	Voltage	MidNite Solar #	Item code	Price
7	300 VDC	MNEPV7-300	053-03107	\$34
10	300 VDC	MNEPV10-300	053-03110	\$34
12	300 VDC	MNEPV12-300	053-03112	\$34
15	300 VDC	MNEPV15-300	053-03115	\$34
20	300 VDC	MNEPV20-300	053-03120	\$34
30	300 VDC	MNEPV30-300	053-03125	\$34
50	300 VDC	MNEPV50-300	053-03130	\$34

## Pass-Thru Wiring Box



These ETL listed Pass-Thru Wiring Box are intended to provide a robust, secure, and code compliant method of transferring the Multi-Contact USE-2 type conductor coming from the PV array to THHN/THWN-2 type conductor. The PTWB also provides a convenient location to begin the necessary conduit run from the PV array to the power conditioning equipment. The NEMA 4 enclosure dimensions are 8" x 6" x 4". It has two cord grips for array wire entry and a hole on the opposite side for a 1/2" conduit fitting. There are two terminal blocks for positive and negative conductors and one for ground. It is designed to be mounted directly on the side of the module mounting rail.

Description	Item code	Price
Pass Thru Wiring Box	053-00271	\$172

## Wiley Electronics

### Acme Conduit Entry

This transition box to go from MC cables to conduit is made from corrosion resistant anodized aluminum. It accepts conduit from the bottom or side and has a seal for entry of USE-2 or PV wire. The optional mounting bracket makes it easy to mount on any module mounting structure. ACE-PT is for pass-through and has no terminals or DIN rail. ACE-xP have two terminal blocks for each string. The ACE-2C combines two strings into one + and - out without fuses. The ACE-3C and -4C have 3 and 4 fuse holders respectively. Fuses are not included.

Model	Description	Item code	Price
ACE-PT	Pass through - MC cables to conduit	053-00305	\$108
ACE-1P	Pass through - MC cables to conduit - 1 string	053-00308	\$151
ACE-2P	Pass through - MC cables to conduit - 2 string	053-00309	\$157
ACE-3P	Pass through - MC cables to conduit - 3 string	053-00310	\$175
ACE-4P	Pass through - MC cables to conduit - 4 string	053-00311	\$181
ACE-2C	Combiner - MC cables to conduit - 2 string	053-00312	\$151
ACE-3C	Combiner - MC cables to conduit - 3 string	053-00313	\$227
ACE-3C-1	Combiner - MC cables to conduit - 3 string w/o ground	053-00315	\$215
ACE-4C	Combiner - MC cables to conduit - 4 string	053-00314	\$245
ACE-4C-1	Combiner - MC cables to conduit - 4 string w/o ground	053-00316	\$233

## SolaDeck

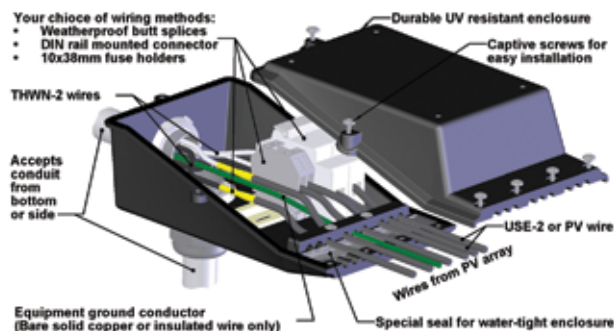
### PV Roof-Mount Enclosure/Combiner



This NEMA 3R enclosure is made from 18 gauge galvanized steel with a powder coated finish provides a professional look. It has dual ground lugs, a 6 inch universal DIN rail to mount fuse holders or terminal blocks, a wire strain relief clip and 1/2", 3/4" and 1" knockouts for running wires through the roof. It has built-in flashing to seal to roof. It is only 2.5" deep and can fit under the array. To make connections inside the Soladeck use one or two 2-String Pass-Thru Kits. It can be used with AWG 6-16 wire. This kit has 4 DIN mount terminals and hardware to hold them in place.

It is ETL listed to UL STD1741 for Photovoltaic Combiner Enclosures. Use up to four DIN mount fuse holders from previous page, a positive and negative busbar and a 2-string pass thru kit to combine up to 4 module strings. Order appropriate fuse.

Model	Description	Item code	Price
SD-786-41	SolaDeck enclosure combiner	053-00226	\$85
PASS-THRU	2-string pass-thru terminal kit	053-00231	\$8
SD-784BB	Positive busbar for 4 fuse holders	053-00227	\$14
SD-785BB	Negative busbar for 4 terminals	053-00228	\$8





## SolarBOS

### Combiners

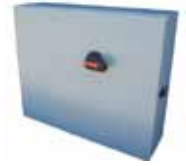
SolarBOS 600 VDC combiners are ETL listed to UL 1741 for 600-volt DC photovoltaic systems. They are designed to minimize installed costs by giving the system designer maximum flexibility. SolarBOS products are designed and manufactured with the system integrator in mind, using the highest quality components to ensure long-term field reliability. All products are assembled in their ETL certified facility in Livermore, California. SolarBOS combiners can be specified with 4 to 24 input circuits, single or dual 90C output terminals, and NEMA 3, 3R, 4 or 4X steel or fiberglass enclosures. All combiner enclosures offer complete gasketed seals for better protection from the elements as well as plenty of wiring room for ease of installation. Fuses are not included. All combiners listed below have single outputs.



	# of input circuits	# of output circuits	Dimensions (inches)	Item code	Price
NEMA 3R Steel	4	1	16 x 12 x 6	140-02004	\$355
	6	1	16 x 12 x 6	140-02006	\$375
	8	1	16 x 12 x 6	140-02008	\$395
	10	1	16 x 12 x 6	140-02010	\$415
	12	1	16 x 12 x 6	140-02012	\$435
	14	1	16 x 16 x 6	140-02014	\$560
	16	1	16 x 16 x 6	140-02016	\$580
	18	1	20 x 20 x 6	140-02018	\$600
	20	1	20 x 20 x 6	140-02020	\$695
	22	1	20 x 20 x 6	140-02022	\$715
	24	1	20 x 20 x 6	140-02024	\$735
	NEMA 4 Steel	4	1	16 x 12 x 6	140-02107
6		1	16 x 12 x 6	140-02108	\$425
8		1	16 x 12 x 6	140-02109	\$445
10		1	16 x 12 x 6	140-02110	\$465
12		1	16 x 12 x 6	140-02112	\$485
14		1	16 x 16 x 6	140-02114	\$565
16		1	16 x 16 x 6	140-02116	\$585
18		1	20 x 20 x 6	140-02118	\$605
20		1	20 x 20 x 6	140-02120	\$745
22		1	20 x 20 x 6	140-02122	\$765
NEMA 4X Fiberglass	4	1	16 x 12 x 6	140-04604	\$410
	6	1	16 x 12 x 6	140-04606	\$430
	8	1	16 x 12 x 6	140-04608	\$450
	10	1	16 x 12 x 6	140-04610	\$470
	12	1	16 x 12 x 6	140-04612	\$490
	14	1	16 x 16 x 6	140-04614	\$585
	16	1	16 x 16 x 6	140-04616	\$605
	18	1	20 x 20 x 6	140-04618	\$625
	20	1	20 x 20 x 6	140-04620	\$795
	22	1	20 x 20 x 6	140-04622	\$815
24	1	20 x 20 x 6	140-04624	\$835	

### Disconnect Combiners

SolarBOS now offers combiners with integrated load-break 600 VDC disconnects. This allows installers to further reduce system costs by merging the combiner box with the disconnect switch into one product. This is a good choice where a rooftop disconnect is required. They are available with 55, 75, 150 and 245 amp disconnects. Combiners are ETL listed to UL 1741 for 600 volt DC photovoltaic systems. These combiners have one output circuit and are NEMA 4 steel enclosures. Fuses are not included.



Input Circuits	Disconnect amps	Dimensions (in)	Item code	Price
4	55	12 x 10 x 6	140-05041	\$750
4	75	20 x 20 x 6	140-05042	\$900
6	55	12 x 10 x 6	140-05061	\$770
6	75	20 x 20 x 6	140-05062	\$920
6	150	20 x 20 x 6	140-05063	\$1,080
8	75	20 x 20 x 6	140-05082	\$940
8	150	20 x 20 x 6	140-05083	\$1,100
8	245	24 x 24 x 6	140-05084	\$1,830
10	75	20 x 20 x 6	140-05102	\$960
10	150	20 x 20 x 6	140-05103	\$1,120
10	245	24 x 24 x 6	140-05104	\$1,850
12	75	20 x 20 x 6	140-05122	\$980
12	150	20 x 20 x 6	140-05123	\$1,140
12	245	24 x 24 x 6	140-05124	\$1,870
16	75	20 x 20 x 6	140-05162	\$1,020
16	150	20 x 20 x 6	140-05163	\$1,180
16	245	24 x 24 x 6	140-05164	\$1,870
20	150	20 x 20 x 6	140-05203	\$1,350
20	245	24 x 24 x 6	140-05204	\$1,950
24	150	20 x 20 x 6	140-05243	\$1,390
24	245	24 x 24 x 6	140-05244	\$1,990

### Waterproof Strain Reliefs

Use the 1/2" NPT threaded connectors to provide a waterproof entrance or exit for wiring on PV module junction boxes and outdoor combiner boxes. Use the 3/4" NPT connector for cables up to 5/8" dia. Made of Nylon with Buna-N seals.



Resistant to salt water, weak acids, weak alkalis, alcohol, ether, esters, ketones, and mineral, animal and vegetable oils. Non-corrosive, suitable for direct burial installations. The oval-hole 1/2" strain relief works for 2-conductor TC cable used for module interconnects, PV outputs or UF cable. The 2-hole 1/2" connector is designed for use with two #10 or #12 type USE conductors. 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	054-03243	\$3.75
1/2" thread w/ 2 round holes	USE #12 & #10	054-03252	\$4.80
1/2" thread w/ 1 round hole	0.25" to 0.5" dia. wire	054-03241	\$2.60
1/2" thread w/ 1 oval hole	14/2, 12/2, 10/2 TC	054-03257	\$4.40
3/4" thread w/ 1 round hole	0.4" to 0.7" dia. cable	054-03246	\$3.90
Steel lock nut 1/2"		054-03238	\$0.18
Steel lock nut 3/4"		054-03244	\$0.20

# Square-D

## 240V and 600V NEMA 3R Safety Switch Disconnects

The National Electric Code, section 690.15, PV requires arrays to 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 3 PV arrays for 3 grid-tie inverters. Its wiring lugs are rated to accept two #14 to #10 wires each. This allows the disconnect switch to also act as a string combiner in systems that utilize 2 strings of PV modules per inverter. The 600VDC 60A and 100A 3-pole safety switches are UL Listed to handle rated current on each pole at 600VDC. All larger Square-D 600VDC disconnects are rated for disconnecting one string at full rated power using 2 poles in series.

Many utilities require an AC disconnect between a grid-tie inverter and the AC load center, close to the AC service entrance, with a visible and lockable handle. A 30A 240V disconnect is good for up to 5kW at 240 VAC and the 60A disconnect is good for up to 11kW. For connection of multiple inverters to a disconnect, 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.

Use Class R fuses of the proper voltage and amperage for fused disconnects. 600V fuses will not fit into 240V disconnects, and 250VAC/125VDC fuses will not fit into 600V disconnects. See next page for Class R fuses



Amps	AC /DC	Fused	Poles	Neutral kit	Ground kit	Dimensions (inches) H x W x D	Weight (lbs)	Square-D model	Item code	Price
<b>600-volt AC or DC 3-Pole NEMA 3R heavy duty switches</b>										
30	Yes	No	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.3	HU361RB	053-02312	\$175
30	Yes	Yes	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.8	H361RB	053-02313	\$270
60	Yes	No	3*	SN0610	GTK0610	17.50 x 9 x 6.38	16	HU362RB	053-02339	\$380
60	Yes	Yes	3*	SN0610	GTK0610	17.50 x 9 x 6.38	16	H362RB	053-02341	\$480
100	Yes	No	3*	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	HU363RB	053-02357	\$530
100	Yes	Yes	3*	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	H363RB	053-02355	\$750
200	Yes	No	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	44	HU364RB	053-02364	\$640
200	Yes	Yes	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50		H364NRB	053-02366	\$1,605
400	Yes	Yes	3**	Included	PKOGTA2	50.31 x 27.88 x 10.13		H365NR	053-02407	\$3,843
800	Yes	Yes	3**	Included	PKOGTA7	69.13 x 36.62 x 17.75		H367NR	053-02408	\$11,470
1200	Yes	Yes	3**	Included	PKOGTA8	69.13 x 36.62 x 17.75		H368NR	053-02409	\$13,995

\* Uses 2 poles in series for 600VDC, except as a PV disconnect, where all 3 poles may be used for 600VDC .

\*\* Uses 2 poles (and 2 fuses) in series for 600VDC.

<b>240-Volt AC / 125-Volt DC*** NEMA 3R heavy duty switches</b>										
30	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	H321NRB	053-02315	\$314
60	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	10	H322NRB	053-02336	\$503
100	Yes	Yes	3	included	GTK0610	21.25 x 8.50 x 6.38	19	H323NRB	053-02351	\$722
200	Yes	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.50	43	H324NRB	053-02363	\$988

\*\*\* Switches are rated for 250VDC but available fuses are only rated for 125VDC.

<b>240-Volt AC Only NEMA 3R general duty switches</b>										
30	AC only	No	2	SN03	PK3GTA1	9.63 x 7.25 x 3.75	4.4	DU221RB	053-02318	\$83
30	AC only	Yes	2	included	PK3GTA1	9.63 x 7.25 x 3.75	4.5	D221NRB	053-02326	\$90
30	AC only	No	3	SN03	PK3GTA1	9.63 x 7.25 x 3.75	4.7	DU321RB	053-02319	\$139
30	AC only	Yes	3	included	PK3GTA1	9.63 x 7.25 x 3.75	5.1	D321NRB	053-02329	\$139
60	AC only	Yes	2	included	GTK03	14.88 x 6.63 x 4.88	9.7	D222NRB	053-02334	\$141
60	AC only	No	3	SN03	PK3GTA1	9.63 x 7.25 x 3.75	5	DU322RB	053-02342	\$222
60	AC only	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	D322NRB	053-02343	\$210
100	AC only	Yes	2	included	GTK0610	17.50 x 8.50 x 6.50	16	D223NRB	053-02358	\$227
100	AC only	No	3	SN0610	GTK0610	17.50 x 8.50 x 6.50	15	DU323RB	053-02359	\$386
100	AC only	Yes	3	included	GTK0610	17.50 x 8.50 x 6.50	16	D323NRB	053-02361	\$386
200	AC only	Yes	2	included	PKOGTA2	29.25 x 17.25 x 8.25	29	D224NRB	053-02371	\$513
200	AC only	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.25	30	D324NRB	053-02372	\$853

## Square-D Disconnect Accessories

Use the hubs listed in the ordering table at the top of the 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 table below to determine which neutral and ground to use.

Neutral and ground accessories	Item code	Price
SN03 Neutral busbar	053-02389	\$52
SN0610 Neutral busbar	053-02381	\$71
SN20A Neutral busbar	053-02383	\$133
GTK03 Ground busbar	053-02387	\$8
PK3GTA1 Ground busbar	053-02395	\$8
GTK0610 Ground busbar	053-02386	\$13
PKOGTA2 Ground busbar	053-02388	\$38
PKOGTA7 Ground busbar	053-02385	call
PKOGTA8 Ground busbar	053-02384	call
Conduit hubs	Item code	Price
Top mount hub 3/4"	053-02305	\$22
Top mount hub 1"	053-02306	\$22
Top mount hub 1-1/4"	053-02307	\$22
Top mount hub 1-1/2"	053-02308	\$22
Top mount hub 2"	053-02309	\$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. UL Listed.

Amps	250VAC/125VDC	
	Item code	Price
10	053-02441	\$5
15	053-02444	\$5
20	053-02450	\$5
30	053-02456	\$5
40	053-02462	\$8
50	053-02465	\$8
60	053-02468	\$8
70	053-02469	\$18
80	053-02475	\$18
90	053-02476	\$18
100	053-02474	\$18
125	053-02478	\$48
150	053-02479	\$48
200	053-02480	\$48



Amps	600VAC/VDC	
	Item code	Price
10	053-02442	\$11
15	053-02447	\$11
20	053-02453	\$11
30	053-02459	\$11
40	053-02463	\$24
50	053-02466	\$24
60	053-02471	\$24
70	053-02470	\$46
80	053-02472	\$46
90	053-02473	\$46
100	053-02477	\$46
125	053-02481	\$80
150	053-02482	\$80
200	053-02483	\$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	053-02423	\$5
Class R fuse block 0.1-30A, 2-pole	053-02426	\$12
Class R fuse block 31-60A, 1-pole	053-02429	\$9
Class R fuse block 31-60A, 2-pole	053-02432	\$16
Class R fuse block 61-100A, 1-pole	053-02435	\$25

## 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	053-02515	\$55
TFB200C	200A fuse and holder w/screw lug	053-02532	\$55
TFB300C	300A fuse and holder w/screw lug	053-02550	\$75
TFB400C	400A fuse and holder w/screw lug	053-02562	\$75
TFB110	110A fuse and holder w/studs	053-02512	\$55
TFB200	200A fuse and holder w/studs	053-02526	\$55
TFB300	300A fuse and holder w/studs	053-02544	\$75
TFB400	400A fuse and holder w/studs	053-02559	\$75

## Class T Fuses - JJN Series

These Class T fuses are rated for 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 described above and the inline holder shown here.



Model	Description	Item code	Price
TF110	110A replacement fuse	053-02509	\$18
TF200	200A replacement fuse	053-02520	\$18
TF300	300A replacement fuse	053-02538	\$38
TF400	400A replacement fuse	053-02556	\$38



# 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 subpanels. 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.



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, and breakers, separately.

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
<b>120/240-volt AC Single-Phase Main Lug Load Centers</b>										
2	70	Yes	INCL.	# 4	PK4GTA	9.38 x 4.88 x 4	5.0	QO24L70RB	053-02141	\$60
2	70	No	INCL.	# 4	PK4GTA	9.30 x 4.81 x 3.19	3.8	QO24L70S	053-02144	\$50
6	100	Yes	INCL.	# 1	PK7GTA	12.62 x 8.88 x 4.27	9.7	QO612L100RB	053-02147	\$54
6	100	No	INCL.	# 1	PK7GTA	12.57 x 8.88 x 3.8	8.3	QO612L100DS	053-02153	\$46
12	125	Yes	INCL.	# 2/0	INCL.	19 x 14.25 x 4.5	23	QO112L125GRB	053-02163	\$190
12	125	No	Add	# 2/0	INCL.	18 x 14.25 x 3.75	15	QO112L125G	053-02162	\$85
12	200	Yes	INCL.	250 kcmil	INCL.	26.25 x 14.25 x 4.5	27	QO112L200GRB	053-02165	\$320
12	200	No	Add	250 kcmil	PK15GTA	29.86 X 14.25 X 3.75	18	QO112L200G	053-02164	\$177

Uses QO plug-in breakers

<b>120/208-volt AC Three-Phase Main Lug Load Centers</b>										
12	125	Yes	INCL.	# 2/0	INCL.	19 x 14.25 x 4.52	22	QO312L125GRB	053-02181	\$323
12	125	No	Add	# 2/0	INCL.	19 x 14.25 x 3.75	11	QO312L125G	053-02183	\$221
18	200	Yes	INCL.	250 kcmil	INCL.	30 x 14.25 x 4.52	31	QO318L200GRB	053-02185	\$412
18	200	No	Add	250 kcmil	INCL.	30 x 14.25 x 3.75	17	QO318L200G	053-02187	\$295

Uses QO plug-in breakers

<b>Square-D Load Center Covers and Ground Bus Bars for QO Load Centers</b>				
Description	Weight	Square-D model	Item code	Price
Surface cover for 12-space 125A load centers 053-02162 & 053-02183	6.0	GOC16US	053-02159	\$18.00
Flush cover for 12-space 125A load centers 053-02162 & 053-02183	7.0	GOC16UF	053-02156	\$21.50
Surface cover for all200A load centers 053-02164 & 053-02187	9.2	GOC30US	053-02169	\$58.00
Flush cover for all200A load centers 053-02164 & 053-02187	11.0	GOC30UF	053-02170	\$58.00
Ground Bus Bar for 2-Space Load Centers		PK4GTA	053-02390	\$6.00
Ground Bus Bar for 6-Space Load Centers		PK7GTA	053-02391	\$7.00
Ground Bus Bar for 12-Space Load Centers		PK9GTA	053-02392	\$10.00
Ground Bus Bar for 12-Space 200A Load Centers		PK15GTA	053-02393	\$23.00
Ground Bus Bar for 30-Space Load Centers		PK18GTA	053-02394	\$25.00

### Safety

These labels are printed in black ink, permanent, and weather-resistant. Add protective labels as recommended. For use on all equipment. All labels must be read and understood.

- DC Disconnect
- Solar Disconnect
- Warning -
- Warning -



## QO Circuit Breakers



QO circuit breakers snap into QO load centers. 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.

Description	QO Breakers		
	Part #	Item code	Price
10-amp 1 pole	QO110	053-02063	\$12
15-amp 1 pole	QO115	053-02065	\$12
20-amp 1 pole	QO120	053-02071	\$12
30-amp 1 pole	QO130	053-02075	\$12
40-amp 1 pole	QO140	053-02080	\$12
50-amp 1 pole	QO150	053-02083	\$12
60-amp 1 pole	QO160	053-02086	\$12
70-amp 1 pole	QO170	053-02090	\$28
15-amp 2 pole	QO215	053-02067	\$22
20-amp 2 pole	QO220	053-02073	\$22
25-amp 2 pole	QO225	053-02021	\$22
30-amp 2 pole	QO230	053-02077	\$22
40-amp 2 pole	QO240	053-02081	\$22
50-amp 2 pole	QO250	053-02084	\$22
60-amp 2 pole	QO260	053-02088	\$22



## 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"	051-03319	\$1.84
Single	14 to 2/0	1/4"	051-03327	\$2.69
Double	14 to 2/0	1/4"	051-03324	\$6.50
Single	6 to 4/0	3/8"	051-03334	\$8.25
Double	6 to 4/0	3/8"	051-03330	\$20

## 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	054-01142	\$14
3	4 - 14	054-01143	\$20
4	4 - 14	054-01144	\$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		Secondary		Amp rating	Item code	Price
Wire size	Taps	Wire size	Taps			
2/0 - 8	1	#14 to #6	6	175	054-01024	\$72
6/0 - 6	1	#14 to #4	6	350	054-01027	\$60
500mcm - 4	1	2/0 - 14	4	380	054-01025	\$94
350mcm - 8	1	4 - 14	12	310	054-01023	\$190

## 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	054-01030	\$20
#8 to 2/0	3	175	054-01033	\$25

## 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 (inches)	Weight (lbs)	Item code	Price
ITS-30R	120	30A	4kW	7.5 H x 8.5 H x 4 D	2	053-08041	\$80
ITS-50R	120/240	50A	12kW	7.5 H x 8.5 H x 4 D	3	053-08053	\$180
ITS-100R	120/240	100A	24kW	10 H x 12 W x 4 D	15	053-08056	\$798

## MidNite Solar

### Manual Transfer Switch

120/240VAC manual transfer switches have a neutral busbar and ground box lug terminal. Dimensions are 9 x 5 x 4 inches. Can be used with up to 6AWG wire. These can be used to connect utility power and a generator to inverters with one AC input.



Description	Weight (lbs)	Item code	Price
30 amp, 240 VAC transfer switch	4	053-07851	\$129
60 amp, 240 VAC transfer switch	4	053-07853	\$129

### 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 then 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"



Description	Weight	Item code	Price
Inverter bypass switch	7 lbs	053-07819	\$175

## Perko

### 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 E-series switch 48V	053-08268	\$63

## Why Use Larger 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 cables that are too small between batteries, and from batteries to the inverter, will limit the current available to the inverter and may prevent a large load from operating properly.

## Battery Interconnect

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 heat-shrink tubing for positive and white heat-shrink on black wire for negative.



Cable AWG	Length (ft.)	End color	End color	Item code	Price
<b>Cables with 2 Lugs</b>					
4/0	5	Red	Red	052-04005-R	\$59
	5	Black	Black	052-04005-B	\$59
	5	Black	White	052-04005-W	\$59
	10	Red	Red	052-04010-R	\$100
	10	Black	Black	052-04010-B	\$100
	10	Black	White	052-04010-W	\$100
2/0	5	Red	Red	052-02005-R	\$45
	5	Black	Black	052-02005-B	\$45
	5	Black	White	052-02005-W	\$45
	10	Red	Red	052-02010-R	\$75
	10	Black	Black	052-02010-B	\$75
	10	Black	White	052-02010-W	\$75
2	3	Red	Red	052-01003-R	\$22
	3	Black	Black	052-01003-W	\$22
	3	Black	White	052-01003-W	\$22
	5	Red	Red	052-01005-R	\$28
	5	Black	Black	052-01005-W	\$28
	5	Black	White	052-01005-W	\$28

## 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. Cables with white ends are for negative battery parallel jumpers.

When ordering, replace "-C" with "-R" for red, "-B" for black, "-W" for white or "-BR" for one end red and one end black.

Wire size (AWG)	Length of cable	Item code	Price
2	9"	052-05116-C	\$16.29
2	12"	052-05118-C	\$16.29
2	20"	052-05120-C	\$19.27
2/0	9"	052-05122-C	\$19.73
2/0	12"	052-05121-C	\$19.38
2/0	20"	052-05124-C	\$25.85
4/0	12"	052-05142-C	\$24.89
4/0	20"	052-05145-C	\$32.88

## 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	052-05106-B	\$5.60
9"	6	Red	052-05106-R	\$5.60
12"	6	Black	052-05108-B	\$6.32
12"	6	Red	052-05108-R	\$6.32
24"	4	Black	052-05112-B	\$7.50
24"	4	Red	052-05112-R	\$7.50
36"	4	Black	052-05114-B	\$10.64
36"	4	Red	052-05114-R	\$10.64

## 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	051-03240	\$0.86
Copper lug 3/8" ring #4	051-03237	\$0.92
Copper lug 3/8" ring #2	051-03234	\$1.04
Copper lug 3/8" ring #2/0	051-03231	\$1.44
Copper lug 3/8" ring #4/0	051-03228	\$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	051-03366	\$4.95
Compression lug #1 - #2	051-03363	\$5.18
Compression lug # 1/0	051-03369	\$5.29
Compression lug # 2/0	051-03372	\$6.79
Compression lug # 4/0	051-03375	\$7.48

## SB Connectors

The SB connector has been the number 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	051-07052	\$6
SB175A	175	yellow	1/0	051-07019	\$19
SB175A	175	red	1/0	051-07022	\$19
SB175A	175	blue	1/0	051-07025	\$19
SB350A-2	350	yellow	2/0	051-07031	\$27
SB350A-2	350	red	2/0	051-07034	\$27
SB350A-2	350	blue	2/0	051-07037	\$27
SB350A-4	350	yellow	4/0	051-07040	\$31
SB350A-4	350	red	4/0	051-07046	\$31
SB350A-4	350	blue	4/0	051-07049	\$31

## 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"	051-01132-B	\$0.96
Heat shrink tubing 1/2" x 6" red	3/16"	051-01132-R	\$0.96
Heat shrink tubing 3/4" x 6" black	1/4"	051-01135-B	\$2
Heat shrink tubing 3/4" x 6" red	1/4"	051-01135-R	\$2
Heat shrink tubing 1" x 6" black	3/8"	051-01137-B	\$3
Heat shrink tubing 1" x 6" red	3/8"	051-01137-R	\$3



## 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	050-01156	\$2.16
10 AWG 2-conductor TC cable	050-01162	\$1.69
12 AWG 2-conductor TC cable	050-01174	\$0.94
16 AWG 2-conductor TC cable	050-01177	\$0.46
18 AWG 2-conductor TC cable	050-01180	\$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	050-01544	\$1.69
#10-2C Duplex primary	050-01547	\$1.26
#12-2C Duplex primary	050-01550	\$0.83
#14-2C Duplex primary	050-01553	\$0.58

## 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.



Description	Item code	Price/foot
10/2 without ground	050-01637	\$1.70
12/2 with ground	050-01635	\$2.40
10/2 with ground	050-01638	\$2.80
8/2 with ground	050-01643	\$3.60
Sensor wire 22/3	050-01273	\$0.30
Splice kit	075-00130	\$12

## Direct Burial/Sunlight Resistant Cable

Type USE single-conductor copper wire for lead-in from PV arrays, wind and hydro-electric 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.



USE-2 by the foot	Item code	Price/foot
#4, AWG USE-2 single conductor	050-01024	\$1.66
#6, AWG USE-2 single conductor	050-01027	\$0.90
#8, AWG USE-2 single conductor	050-01030	\$0.64
500-foot rolls	Item code	Price/roll
#10, AWG USE-2 single conductor - black	050-01144	\$250
#10, AWG USE-2 single conductor - red	050-01145	\$250
#10, AWG USE-2 single conductor - white	050-01146	\$250

## PV Wire Sunlight Resistant Cable

This single conductor insulated with heat and moisture resistant, cross-linked polyethylene insulation, (Type USE-2), with an overall flame and sunlight resistant, Zero Halogen, Limited Smoke, Zero lead jacket meets the 2008 NEC code for use with transformerless inverters. UL Listed as Type PV Cable Conductors UL854 (#16 per UL 66) ICEA S-95-658/NEMA WC-70.



USE by the foot	Item code	Price/foot
#10, AWG USE single conductor - black	050-01138	\$1.25

## 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	050-01470	\$7.75
X-Flex battery cable 4/0 red	050-01472	\$7.75
X-Flex battery cable 2/0 black	050-01476	\$5.70
X-Flex battery cable 2/0 red	050-01478	\$5.70
X-Flex battery cable 2 AWG black	050-01487	\$3.90
X-Flex battery cable 2 AWG red	050-01488	\$3.90

## Multi-Contact

### Cables and 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.

### MC3 Solarline 1 Array Output Cables

These cables have the old style Multi-Contact soft rubber connectors on each end. Use these output cables between PV arrays with Multi-Contact cable outputs, and junction boxes or grid-tie inverters. They 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.



MC Solarline 1 Male/Female Cables		
Cable length (ft)	Item code	Price
6	052-09107	\$21
15	052-09111	\$26
30	052-09115	\$34
50	052-09116	\$45
70	052-09117	\$66
100	052-09118	\$72

### MC4 Solarline 2 Array Output Cables

These cables have the newer, snap-together Multi-Contact hard plastic connectors on each end. Use these output cables between PV arrays with Multi-Contact cable outputs, and junction boxes or grid-tie inverters. The new Solarline 2 cables 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.



MC Solarline 2 Male/Female Cables		
Cable length (ft)	Item code	Price
6	052-09407	\$25
15	052-09411	\$28
30	052-09415	\$36
50	052-09416	\$47
70	052-09417	\$68
100	052-09418	\$74

### Tyco SolarLok Array Output Cables

These cables have Tyco SolarLok connectors to match the connectors on some SCHOTT, Day4Energy, GE and CSI Solar modules. These cables have a neutral male at one end and a negative female at the other so they can be used to extend the cables on the modules or be cut in half and used to connect to a roof-top combiner. Made with black #10 AWG USE-2 sunlight-resistant cable.



Tyco SolarLok 2 Male/Female Cables		
Length (ft)	Item code	Price
6	052-09439	\$25
15	052-09442	\$28
30	052-09443	\$36
50	052-09445	\$47
100	052-09449	\$74

### MC4 Solarline 2 PV-Wire Cables

These cables have the newer, snap-together Multi-Contact hard plastic connectors on each end and are made with PV-Wire that has an extra layer of insulation for use on ungrounded arrays in conjunction with transformerless inverters. This type of wire is required to meet the 2008 NEC if you are using a transformerless inverter.



MC Solarline 2 Male/Female PV Wire Cables		
Cable length (ft)	Item code	Price
6	052-09451	\$26
15	052-09453	\$30
30	052-09455	\$39
50	052-09457	\$52
100	052-09458	\$84

## MC4-Solarline 2 to MC3-Solarline 1 Adaptors

Use these adaptors 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
MC4-Solarline 2 male to MC3-Solarline 1 female adaptor	052-09399	\$13
MC3-Solarline 1 male to MC4-Solarline 2 female adaptor	052-09398	\$13

## MC4-Solarline 2 to Tyco SolarLok Adaptors

Use these adaptors to connect solar modules with Tyco connectors to MC4 cables.



Description	Item code	Price
Tyco female negative to MC4 female adaptor	052-09471	\$13
Tyco male neutral to MC4 male adaptor	052-09473	\$13

## Tyco SolarLok Connectors

These connectors can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool and wrench set are required to assemble the connector. For 10 AWG USE-2 wire. Sold in packs of 25.



Connector description	Item code	Price
SolarLok male neutral connector - 25 pack	097-01361	\$128
SolarLok female negative connector - 25 pack	097-01366	\$128

## Cable Clip

Use this clip to keep module interconnect cables neatly secured to module frames so they do not drop below the array. Bags of 100 stainless steel clips.



Description	Item code	Price
Bag of 100 clips for 10-12 AWG USE-2 - stainless	052-09100	\$45
Bag of 100 clips for AWG 10 PV Wire - stainless	052-09102	\$47

## MC3-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	052-09103	\$18.40
Solarline 1 branch cable coupler male - 2 female	052-09104	\$19.55

## MC4-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	052-09403	\$18.40
Solarline 2 branch cable coupler male - 2 female	052-09404	\$19.55

## MC3-Solarline 1 Connectors

These connectors can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool and boot installation tool are required to assemble the connector. For 10 AWG USE-2 wire. Packs of 25.



Connector description	Item code	Price
Male Solarline 1 – fits + cables on module - 25 pack	097-01402	\$95
Female Solarline 1 – fits - cable on module - 25 pack	097-01404	\$95

## MC4-Solarline 2 Connectors

The connector can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool and wrench set are required to assemble the connector. We have connectors for 10 AWG USE-2 wire and for larger diameter 10AWG PV wire. Sold in Packs of 25 connectors.



Connector description	Item code	Price
Male Solarline 2 locking connector for USE-2 wire	097-01407	\$95
Female Solarline 2 locking connector for USE-2 wire	097-01409	\$95
Male Solarline 2 locking connector for PV wire	097-01411	\$95
Female Solarline 2 locking connector for PV wire	097-01413	\$95
MC safety locking collar PV-SSH4 – pack of 25	097-01419	\$12

## 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 it's 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 genera-

tor, 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. 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.

### Calculation of Solar Power Needs

If you are using a pump driven directly by solar modules, the 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.



## Solar Converters

### Linear Current Boosters for DC pumps

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 modules. 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	075-00124	\$140
PPT 12/24-15	12 or 24	15	075-00126	\$306
PPT 12/24-30	12 or 24	30	075-00128	\$558
PPT 48-10	48	10	075-00136	\$334

# 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 115 VAC from an inverter to 240 to run the pump. Minimum well diameter of 3 inches 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	075-01425 075-01426	\$971			7.9	7.5	7.1	6.7	6.2	5.1	4.4	3.6	2.6								
5SQ07-320	3/4	240	075-01429	\$1,195						7.9	7.3	7	6.7	6.4	5.7	5.4	4.6	3.4	1.6				
5SQ10-360	1	240	075-01431	\$1,364							7.7	7.4	7.2	6.9	6.3	6.0	5.4	4.4	3.3	1.9			
5SQ10-410	1	240	075-01437	\$1,425								7.9	7.6	7.4	6.8	6.5	6.0	5.1	4.2	3.2	1.4		
5SQ10-450	1	240	075-01434	\$1,376										7.9	7.4	7.1	6.6	5.8	5.0	4.1	2.9		
10SQ07-200	3/4	240	075-01443	\$952			14.8	14.0	13.5	12.8	11.0	10.0	9.0	7.0									
10SQ07-240	3/4	240	075-01445	\$1,025				14.6	14.0	13.5	12.4	11.5	11.0	10.0	8.0	6.5	2.5						
10SQ10-290	1	240	075-01449	\$1,165					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	075-01452	\$1,193						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	075-01458 075-01457	\$969			19.5	17.5	16.0	13.5	11.0												
15SQ07-150	3/4	240	075-01459	\$990			19.0	18.0	17.0	15.5	12.0	10.0	7.0										
15SQ07-180	3/4	240	075-01460	\$1,045				19.5	18.5	17.5	15.5	14.0	12.5	11.0	6.5								
15SQ10-220	1	240	075-01462	\$1,101						19.5	17.0	16.0	15.0	14.0	11.5	10.0	6.0						
15SQ10-250	1	240	075-01461	\$1,118						20.0	18.0	17.5	16.5	15.5	14.0	13.0	11.0	5.5					
22SQ07-160	3/4	240	075-01464	\$1,155			32.0	30.5	28.5	26.5	24.0	17.5	12.0	3.0									
22SQ10-190	1	240	075-01467	\$1,172			33.0	31.5	30.5	29.0	27.5	23.5	21.0	18.0	8.0								
30SQ05-40	1/2	115 240	075-01470 075-01471	\$971	40	30	11																

## SPDT 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.

## Single Purpose Float Switches

These SPST switches perform a single function; either on when the tank is full or off when the tank is full.

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 full. T switches.

Description of operation	Maximum amps	Item code	Price
SPDT three-wire	5	075-05270	\$52
On when full	13	075-04420	\$46
Off when full	13	075-04422	\$46
On when full	25	075-04407	\$105
Off when full	25	075-04410	\$105



# Grundfos

## SQFlex Submersible Pumps

This is the ultimate submersible pump for water lifts of up to 650 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. They can operate on a series string of PV modules with a total peak power voltage over 30 volts, but the pumps efficiency will be much higher at voltages over 100 VDC. SQFlex 3 and 6 pumps will fit into a 3" well.

Seven pump models can deliver from 2 gpm at 600 feet to 65 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.

SQFlex pumps have a 2 year warranty from the date of purchase. A 5 year extended warranty is available separately and highly recommended.

The Whisper 200-150 V wind generator can be connected directly to an SQFlex pump. Please contact us for information.



## 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.

Grundfos SQFlex pumps and accessories	Item code	Price
SQFlex 3 SQF-2 pump - 3"	075-01012	\$2,733
SQFlex 3 SQF-3 pump - 3"	075-01013	\$2,733
SQFlex 6 SQF-2 pump - 3"	075-01015	\$2,733
SQFlex 11 SQF-2 pump - 3"	075-01018	\$2,733
SQFlex 16 SQF-10 pump - 4"	075-01020	\$2,733
SQFlex 25 SQF-3 pump - 4"	075-01021	\$2,733
SQFlex 25 SQF-7 pump - 4"	075-01025	\$2,733
SQFlex 40 SQF-3 pump - 4"	075-01027	\$2,733
SQFlex 40 SQF-5 pump - 4"	075-01028	\$2,733
SQFlex 60 SQF-3 pump - 4"	075-01029	\$2,733
SQFlex Extended 5 Year Warranty	075-01001	\$249
IO100 interface box	075-01039	\$170
IO101 interface box (115V)	075-01036	\$586
CU200 interface for multiple sources	075-01033	\$490
Level switch (use with CU200 only)	075-01042	\$27
Whisper 200 wind turbine - 150V	016-01199	\$2,765
IO102 wind turbine interface box	075-01040	\$513
Tower kit 30 foot for Whisper 200	016-01089	\$585
Tower kit 50 foot for Whisper 200	016-01095	\$813
Auger/anchor (set of 4) for tower guys	016-01119	\$112
Pressure switch (use with CU200 only)	075-01044	\$125

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.

60 SQF-3	= Pump model
17,037	= Estimated daily summer volume (GPD)
12,520	= Estimated daily winter volume (GPD)
34	= 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/m<sup>2</sup> (POA) winter, and 7.5 kWh/m<sup>2</sup> (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.

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	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



# 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. Performance on a 12-volt battery will be less than half the flow on the accompanying table. 1-year warranty.

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. Water sensors hang in the well and are used to prevent dry running in very low yield wells. The 902-100 control must be mounted in a dry location and used with a 24V array.



### 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	12 - 24 VDC	6	075-05817	\$922
SHURflo 902-100 pump controller	24 VDC	6	075-05823	\$164
SHURflo 902-200 pump controller	12-24 VDC	6	075-05820	\$402

# 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-inch 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	075-08052	\$89
LVM107	2	2	11	20	1.5 x 5.67	0.5	3 ft	075-08054	\$68
LVM111	6	6	14	32	1.5 x 6.54	1.5	12 ft	075-08058	\$110

# 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	075-08157	\$150

# 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. 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. A PCA-30-M1 controller must be used with all SDS pumps. At 15 volts, flow is slightly less than half of the 30-volt flow.

SDS Pump Flows at 30 VDC																
Item code	075-03017			075-03018			075-03021			075-03023			075-03022			
Price	\$1,048			\$1,048			\$1,187			\$1,187			\$1,187			
Model	SDS-D-128			SDS-D-228			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	Flow (gpm)	Amps	Module watts	
0	1.75	1.66	62	1.40	1.37	51	3.90	1.80	68	5.10	1.94	73	4.40	1.58	59	
23	1.70	1.80	68	1.35	1.57	59	3.70	2.09	78	4.90	2.68	101	4.20	2.32	87	
46	1.65	2.05	77	1.30	1.73	65	3.50	2.70	101	4.60	3.53	132	4	3.05	114	
69	1.60	2.55	96	1.25	1.92	72	3.30	3.33	125	4.40	4.36	164	3.80	3.75	141	
92	1.55	3.08	116	1.20	2.10	79	3.09	3.90	146	4.20	5.26	197	3.60	4.50	169	
104	1.52	3.12	118	1.17	2.20	82	3	4.20	158	4.10	5.68	213	3.50	4.85	182	
116	1.50	3.16	119	1.15	2.28	86	2.90	4.50	169	4	6.12	230				
139	1.45	3.31	124	1.11	2.46	92	2.75	5.03	189							
162	1.40	3.50	131	1.07	2.64	99										
185	1.35	3.70	139	1.03	2.79	105										
208	1.30	3.92	147	1	2.96	111										
231	1.25	4.11	154	0.95	3.10	116										



## PCA/PCB 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 sensorless low-water cut-off circuit, an electronic circuit breaker, and indicator lights. SunPumps PCA 30-M1D controller uses the same controller board with all the same features as the PCA 30-M1 controller. The only difference is the box is constructed of UV stabilized Super Tuff Delrin instead of aluminum and the current rating is reduced from 8 amps to 6 amps.

Model	PCA-30M1D	PCA-30M1	PCA-60M1	PCB-90BT-M1	PCB-120BT-M1	PCB-180BT-M1	
Number of 36-cell modules in series	2	2	4	6	9	12	
Number of 54-cell modules in series	1	1	2	4	6	8	
Number of 72-cell modules in series	1	1	2	3	4	6	
Nominal volts	15, 24, 30	15, 24, 30	30, 45, 60	45, 60, 75, 90	90, 105, 120, 135	135, 150, 165, 180	
Maximum open circuit volts	45	45	90	200	250	300	
Maximum load current (amps)	6	8	8	10	10	14	
Maximum load power (watts)	250	250	500	1000	1200	2500	
Brush motor control	Item code	075-03027	075-03029	075-03029	075-03035	075-03041	075-03047
	Price	\$325	\$500	\$609	\$861	\$844	\$934

## 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.

Model	Description	Item code	Price
SPB 2.5-23C	3/4 HP Triplex Piston Booster Pump	075-03205	\$3,530
SPB 2.5-23C	1 HP Triplex Piston Booster Pump	075-03208	\$3,558
SPB 2.5-23C	1 1/2 HP Triplex Piston Booster Pump	075-03211	\$3,871
SPB 2.5-23C	2 HP Triplex Piston Booster Pump	075-03214	\$4,556
SPB 2.5-23C	3 HP Triplex Piston Booster Pump	075-03217	\$5,244
SPB 4-23C	3/4 HP Triplex Piston Booster Pump	075-03220	\$4,260
SPB 4-23C	1 HP Triplex Piston Booster Pump	075-03223	\$4,588
SPB 4-23C	1 1/2 HP Triplex Piston Booster Pump	075-03226	\$4,401
SPB 4-23C	2 HP Triplex Piston Booster Pump	075-03229	\$5,337
SPB 4-23C	3 HP Triplex Piston Booster Pump	075-03231	\$6,086
SPB 10-16C	3/4 HP Triplex Piston Booster Pump	075-03234	\$5,159
SPB 10-16C	1 HP Triplex Piston Booster Pump	075-03237	\$5,590
SPB 10-16C	1 1/2 HP Triplex Piston Booster Pump	075-03241	\$5,777
SPB 10-16C	2 HP Triplex Piston Booster Pump	075-03244	\$6,676
SPB 10-16C	3 HP Triplex Piston Booster Pump	075-03247	\$7,013



## 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 standalone 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)

Model number	Item code	Price	Nominal volts	Watts required	20	30	40	50	60	70	80	90	100	110	120	psi Head in feet
					46	69	92	116	139	162	185	208	231	254	277	
SCB 6-40P-24	075-03132	\$1,265	24	300	510	420	360	240	80							
SCB 8-40P-24	075-03134	\$1,301	24	400	590	510	470	400	310	210	70					
SCB 10-40P-24	075-03135	\$1,367	24	600	828	714	582	420	222							
SCB 20-25P-24	075-03137	\$1,330	24	900	1483	949										
SCB 12-60P-48	075-03139	\$1,489	48	900	930	870	810	770	710	660	600	520	450	360	220	
SCB 24-50P-48	075-03141	\$1,489	48	1600	2226	1996	1740	1466	1140	683						

## 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 SunPumps Control PCB-120 (075-03041). They weigh 34 pounds.

Model	HP	45 VDC			60 VDC			75 VDC			90 VDC			120 VDC			Item code	Price
		PV min watts	Max GPM	Max PSI	PV min watts	Max GPM	Max PSI	PV min watts	Max GPM	Max PSI	PV min watts	Max GPM	Max PSI	PV min watts	Max GPM	Max PSI		
SCP 48-30-07	3/4				305	60	7	540	76	11	891	90	16				075-03065	\$889
SCP 52-35-07	3/4	225	44	7	480	63	13	806	76	22							075-03067	\$931
SCP 55-50-10	1				400	65	12	750	77	20	1240	91	28				075-03069	\$931
SCP 65-40-10	1				402	70	10	780	91	19	1111	118	25				075-03075	\$963
SCP 42-47-10	1							305	58	8	400	70	12	755	93	24	075-03073	\$963

## SC 24-116 Centrifugal Surface Pump

The 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 table for basic sizing or call for a complete system quote. Use with SunPump Control PCB-120 (075-03041).



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
SJT 12-116	075-03103	\$995

## 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 250-550 watts of solar modules at 60-90 VDC. Use with SunPumps Control PCB-90 (075-03035).



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	075-03117	\$1,360



# 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 pages 186-187 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	075-05625	\$98
				30	2.31	8		
				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	075-05613	\$155
				30	2.3	8.40		
				40	2.07	9		
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	075-05615	\$160
				30	2.5	10		
				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	075-05616	\$186
				30	2.3	8.40		
				40	2.07	9		
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	075-05628	\$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	075-05619	\$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	075-05622	\$144
				30	2.08	0.76		
				40	1.85	0.94		

### 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	075-05730	\$130
170-061-20	Twist-on water strainer - 50 mesh screen 1/2" FPST inlet	075-05784	\$10
8-035	Adapter with wingnut - right angle 1/2" FSPT to 1/2" NPT for 2088 pumps	075-05735	\$2
8-155-01	Adapter with wingnut - right angle 1/2" FSPT to 5/8" barb for 2088 pumps	075-05763	\$2
8-205-00	Adapter - straight 1/2" FSPT to 1/2" NPT male for 2088 pumps	075-05760	\$2
34-006	5" heat sink for continuous-duty pump operation	075-05766	\$24

**NEW! Aquatec****550 Series Pressure Pumps**

These Aquatec booster pumps provide “town pressure” for remote home water supplies where 12-volt or 24-volt power is available. They have a longer life and greater flow rate than other diaphragm booster pumps and they use less than half the energy consumed by an AC jet pump running on an inverter. The 120-volt version can be used on remote power systems with inverters.

**ADVERTISEMENT**

Aquatec’s 550 pressure pumps delivers powerful flow rates at pressures up to 60 PSI. Their patented 5-chamber diaphragm and piston design allows these pumps to operate at very low noise levels and with minimal pulsations. These pumps are designed for intermittent duty, though most models can be run continuously for hours at a time. They are commonly used either to pressurize water from an atmospheric tank, to deliver purified water to a specific point of use, or simply to increase pressure when required.

The built-in pressure switch is set for 60 psi off and 40 psi on. The pumps come with straight threaded male half-inch fittings that snap into the quick disconnect ports. The optional strainer is highly recommended to keep debris out of the pump, insuring long diaphragm life.

All Aquatec 550 Pressure Pumps weigh 8 pounds each.

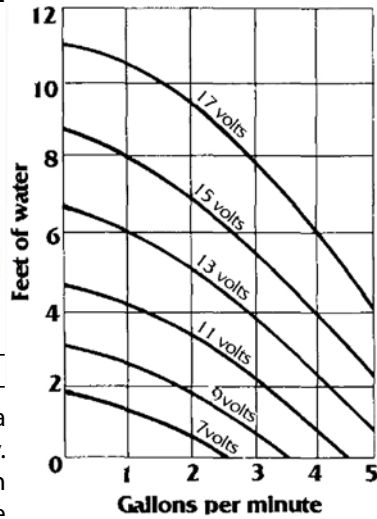
Aquatec model	Voltage	Max. gpm	Pressure (psi)	Current draw (amps)	Item code	Price
5503-AEE-B636	12 VDC	4.10	30	11.0	075-04805	\$112
		3.80	40	13.0		
		3.55	50	14.6		
5503-AEE-B736	24 VDC	4.10	30	5.5	075-04809	\$122
		3.80	40	6.5		
		3.55	50	7.3		
5503-AEE-B656	120 VAC	4.10	30	1.42	075-04813	\$144
		3.80	40	1.60		
		3.55	50	1.80		
Strainer	High flow 50 mesh in-line strainer				075-04821	\$20

## Hartell

### MD10HEH Circulator



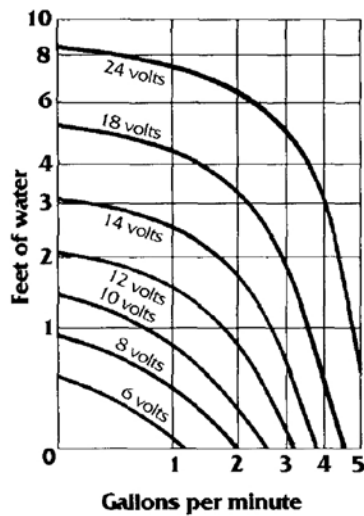
This pump has an electronically commutated, high efficiency brushless motor with a 30,000-hour life expectancy. It may be operated from an 20- to 22-watt solar module or directly from a 12-volt battery system. They work great for closed-loop solar water heating systems and radiant floor heating. The graph shows this pumps performance at various heads and flows, at different input voltages.



### 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"	075-07237	\$389
MD-3-DCL	2-24 VDC	1/2" MNPT	5.25" x 7.75"	075-07241	\$237

## 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 10PV-12 is designed to be powered by a 10- to 20-watt PV module, in open loop systems and can pump 3.3 gallons per minute at no head and 1/2 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 10B-12 is designed to be battery powered and has the same specifications at 12 volts. 10B-24 is designed to operate on a 24 volt battery system. 20B-12 used more power to provide more flow and more had. 20PV-12 requires a 40 watt of PV and is ideal for pumping glycol through 3 or more collectors. It is a good idea to face the module to the east to help this pump start in the morning. Dimensions: 4" x 4" x 5". 30,000-hour life expectancy.



El-Sid Model	Flow (gpm) Maximum	Volts (max)	Amps	Weight lbs	Item code	Price
10PV-12	3.3	20	0.9	2	075-07218	\$280
10B-12	3.3	16	0.45	2	075-07219	\$280
10B-24	3.3	32	0.25	2	075-07222	\$360
20B-12	5	16	1.5	2	075-07224	\$380
20PV-12	5	20	1.5	2	075-07226	\$410

# HighLifter

## Water Powered Water Pumps

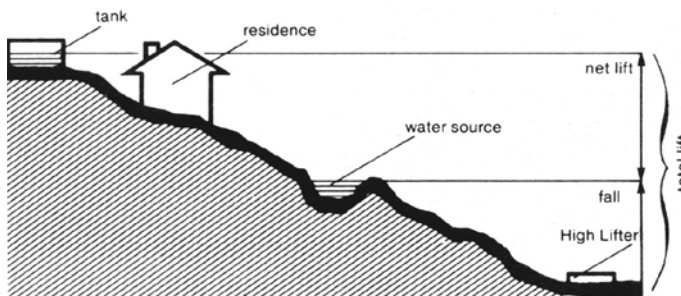
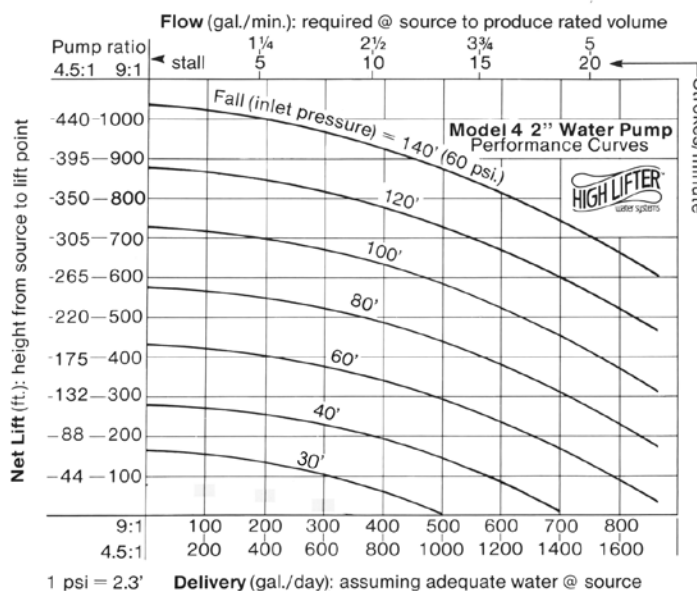
The High Lifter is a powerful water pump designed to move water uphill without using gasoline or electricity. By harnessing the energy of piped water pressure from an uphill source, the High Lifter pump can drive a portion of this water through another pipe to a tank higher than the water source. Pistons 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 graph 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 diagram 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.



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.	076-09002	\$1,095
H49	9.1:1	750 gal	1000 ft.	1140 ft.	076-09005	\$1,095



## 12V and 24V Medium-Base Bulbs

These low-cost bulbs are the least efficient of all the lamps we sell, but they are still better than 30% more efficient than 120-volt lamps. They have a standard medium base, so they fit into sockets found in most 120 VAC fixtures. AC lamp sockets rated for up to 300 watts at 120 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"	066-00025	\$2
12	50	4"	066-00029	\$2
12	75	5"	066-00033	\$4
12	100	5.5"	066-00037	\$4
24	25	4"	066-00139	\$5
24	50	4"	066-00143	\$5
24	100	5.5"	066-00147	\$9

## Low-Voltage Compact Fluorescent Lamps

CFL (compact fluorescent lamps) lighting provides very high illumination levels with an 80% savings in power consumption compared to 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 temp.	Dimensions L" x dia."	Item code	Price
12	Spiral	7.5	2700K	4½ x 1¾	066-02131	\$14
12	Spiral	11	2700K	4½ x 1¾	066-02138	\$14
12	Spiral	11	6400K	5 x 2¼	066-02139	\$14
12	Spiral	15	2700K	5 x 2¼	066-02150	\$20
12	Spiral	15	6400K	5 x 2¼	066-02152	\$20
12	3 U tube	30	6400K	8 x 3	066-02170	\$35
12	3 U tube	30	2700K	8 x 3	066-02172	\$35
24	Spiral	15	2700K	5 x 2¼	066-02261	\$20
24	Spiral	15	6400K	5 x 2¼	066-02263	\$20

## Dr. LED

### 12V LED Lamps

These 12-volt LED lamps are specially designed to replace most Edison medium screw base incandescent bulbs used in reading lights. These U.S. made high-flux LED bulbs produce a warm white light and are fabricated from the highest quality components to assure long life and trouble-free functioning. Their incredibly low power draw (1W or 3W) makes them the perfect way to reduce energy consumption. High-flux LEDs, the latest LED technology, out-perform cluster LEDs in all respects.



Description	Amps	Diameter	Length	Item code	Price
12 volt 3 watt Bulb	0.3	2.0"	2.0"	066-04232	\$40
12 volt 1 watt Bulb	0.12	2.0"	2.0"	066-04238	\$30

### Luxeon 12V LED Flood Lamp

Luxeon new technology is too bright to look directly into and provides a wide light spread angle. Has internal voltage regulator for constant full brightness with varying battery voltage. Screw in.



Description	Amps	Item code	Price
Luxeon LED flood	0.2	066-04107	\$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	066-04503	\$32

### 24V Cobra Head LED Street Light



These high-performance weatherproof lights are designed to be mounted on a 30- to 35-foot pole for street or parking lot lighting. They put out a very bright, even light covering 100 feet from side to side and 20 feet out from the pole. For street lighting, place one every 100 feet.

The aluminum die-cast housing dimensions are 25.6" long x 12.6" wide x 7.8" deep and mount on a 1.25" to 2.5" pipe. Operating temperature is from -20C to +40C. Power consumption is 2.3 amps at 24 VDC.

Model	Watts	Lumens	Item code	Price
SL-H2-CW	55	3500	066-05901	\$865

### 24V Round LED Street Light



These weatherproof lights are designed to be mounted on a 10 to 20 foot pole for street or parking lot lighting. They put out a very bright, even light covering a 30-foot circle. For area lighting, place one every 30 feet. The aluminum die-cast housing dimensions are 15.4" diameter x 7.1" deep. It mounts from the top. Operating temperature is from -20C to +40C. Power consumption is 2.3 amps at 24 VDC.

Model	Watts	Lumens	Item code	Price
SL-L1-CW	55	3500	066-05905	\$865

### 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	066-05818	\$380
LPS-135LT	35	4800	066-05821	\$380

### 12V Fluorescent Outdoor Flood Light



These weatherproof lights are designed to meet the demand for solar powered sign lighting and area lighting. They have 1/2" 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°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	066-02478	\$75

## ADVERTISEMENT

## 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, an 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 should last 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. The Solar Coach Light offers a sustainable, eco-friendly, reliable, and beautiful alternative.

Description	Item code	Price
Solar Coach Light	066-04581	\$1,240

### Solar Streetlights

These solar street lights use induction lamp technology to provide very high energy conversion efficiency. Induction lighting offers minor declining light output with age compared to other lamp types, instant-on, and significant cost savings in energy and maintenance.

Complete systems come with the solar modules, light assembly, battery box, batteries, charge controller, and all wiring and hardware. Systems are available with a 40-watt lamp that delivers 3350 lumens and a 70-watt lamp that delivers 6500 lumens.

Solar modules have a 25-year power output guarantee and all other components are have a 5-year warranty.

A grid-tie version is available without batteries. The grid-tie light sends power to the grid during the day with a microinverter, and the induction lamp uses the power at night. It is designed to be carbon and energy-use neutral. There is no battery backup for power outages. Grid-tie lighting is available with either a 100-watt or 150-watt induction light fixture.

Optional 5 x 5 inch square hot-dipped galvanized steel poles come with 30-inch long, 1-inch diameter anchor bolts and is rated for either 110 or 140 MPH wind.



#### Standalone Lighting with Batteries (poles not included)

Model number	Min sun hours/day required	Solar module watts	Solar module quantity	Lamp watts	Lamp lumens	Battery amp-hours at 24V	Item code	Price
SSL 40/170	3	170	1	40	3350	96	066-05311	\$4,900
SSL 40/340	1.5	170	2	40	3350	96	066-05315	\$5,670
SSL 70/340	3	170	2	70	6500	190	066-05319	\$6,570

#### Grid-Tie Lighting without Batteries (poles not included)

GT 170-100/240	100 watt light, 170 watt solar module and microinverter - 240 VAC						066-05322	\$3,652
GT 170-100/208	100 watt light, 170 watt solar module and microinverter - 208 VAC						066-05324	\$3,652
GT 205-150/240	150 watt light, 205 watt solar module and microinverter -240 VAC						066-05326	\$4,020
GT 205-150/208	150 watt light, 205 watt solar module and microinverter -208 VAC						066-05328	\$4,020

#### 5" x 5" Light Poles

POLE 20	20 foot 5 x 5 inch pole rated for 110 MPH wind with anchor bolts	066-05341	\$1,200
POLE 20HW	20 foot 5 x 5 inch pole rated for 140 MPH wind with anchor bolts	066-05342	\$1,350
POLE 25	25 foot 5 x 5 inch pole rated for 110 MPH wind with anchor bolts	066-05343	\$1,305
POLE 25HW	25 foot 5 x 5 inch pole rated for 140 MPH wind with anchor bolts	066-05344	\$1,440

## Thin-Lite Low-Voltage Fluorescent Lighting

Thin-Lite 12-volt and 24-volt fluorescent fixtures are 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.

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	066-02431	\$35
194	15	2	1740	12	2.1	yes	18 x 4.5 x 1.5	066-02439	\$48
181	20	1	1250	12	1.6	no	24 x 3.63 x 3.5	066-02435	\$47
957	36	1	2618	12	2.45	no	18.9 x 4.5 x 1.5	066-02441	\$62
281	20	1	1250	24	0.8	no	24 x 3.63 x 3.5	066-02464	\$55



## 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 turn a light 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. It consumes less than 3mA in standby mode. Internal DPST (double-pole-single-throw) relay switch can turn one load on at the same time 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 6-36 VDC or 120 VAC. The timer is reverse polarity protected and runs off 12 volts AC or DC. 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	054-07120	\$90

### Night Watchman 12V Photoswitch

The Flexcharge 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 0015A 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, so it can be used to control 12V fluorescent lamps. 1-year warranty.



Description	Item code	Price
Night Watchman photoswitch	054-07215	\$42

## RAB

### 12V Motion Sensor Switch

The RAB motion and heat sensing switch is 12-volt DC powered so it works full time even if your inverter is in standby or turned off. It turns lights on at approach and remains on for a user-adjustable 5 seconds to 20 minutes after motion stops. Sensitivity distance is adjustable to about 50 feet out, farther in colder weather. Connect it 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.

Description	Item code	Price
12V Motion sensor switch	054-07237	\$85

1-year warranty.





# 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	080-02330	\$3,160
R19	19 cu ft. refrigerator only	28	46	16.1	-	66 x 34.5 x 27.5	310	080-02322	\$2,909
F19	19 cu ft. freezer only	100	130	-	16.1	66 x 34.5 x 27.5	320	080-02314	\$3,190
RF16	16 cu ft. refrig / freezer	42	58	10.4	3.91	62 x 34.5 x 27.5	300	080-02328	\$3,015
RF12	12 cu ft. refrig / freezer	24	43	8.07	2.05	49 x 34.5 x 27.5	230	080-02326	\$2,254
R10	10 cu ft. refrig / freezer	15	25	9.13	-	43.5 x 34.5 x 27.5	215	080-02320	\$1,740
F10	10 cu ft. freezer only	55	70	-	9.13	43.5 x 34.5 x 27.5	215	080-02312	\$1,745
RF4	4 cu ft. refrig / freezer	13	19	3.16	0.68	31.5 x 34.5 x 27.5	160	080-02332	\$1,530
R4	4 cu ft. refrigerator only	9	13	9.91	-	31.5 x 34.5 x 27.5	160	080-02324	\$1,575
F4	4 cu ft. freezer only	28	36	-	3.91	31.5 x 34.5 x 27.5	160	080-02316	\$1,530

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	080-02427	\$3,015
R19A	19 cu ft. refrigerator only	0.35	0.58	16.1	-	66 x 34.5 x 27.5	310	080-02419	\$2,775
F19A	19 cu ft. freezer only	1.25	1.63	-	16.1	66 x 34.5 x 27.5	310	080-02413	\$3,068
RF16A	16 cu ft. refrig / freezer	0.49	0.79	10.4	3.91	62 x 34.5 x 27.5	300	080-02425	\$2,867
RF12A	12 cu ft. refrig / freezer	0.3	0.53	8.07	2.05	49 x 34.5 x 27.5	230	080-02423	\$2,129

### Options

Color finish instead of white - add:								080-02560	\$150
Wood veneer finish - add:								080-02562	\$150
Storage cabinet 24" high w/2 drawers goes under RF12 - white						24 X 34 x 27.5	110	080-02550	\$390
Storage cabinet 13" high w/2 drawers goes under RF16 - white						13 X 34 x 27.5	60	080-02544	\$427
Stand 4" high goes under RF19 - white						4 X 34 x 27.5	25	080-02556	\$99

# Sun Frost

## Vaccine Refrigerator



World Health Organization tested and 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 table 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.

Sun Frost 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	080-02503	\$1,870

# 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.



## 12V and 24V Refrigerator/Freezer Combo

This single door upright combo unit is great for situations where side by side chest style units are not practical. The powder coated galvanized steel exterior is easy to clean. The zero maintenance, brushless, thermostatically controlled DC compressor operates on 12 or 24 VDC, or 120 VAC with 12/24 VDC backup. Uses an environmentally friendly CFC-free refrigerant (R-134a), has added insulation, and a refrigeration system optimized for off-grid applications. This addition to the SunDanzer family of appliances provides the same reliable, energy efficient operation as their other units.

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				
DCR50	50L (1.8 cu ft.) refrigerator	4.6	9.4	20	26.5 x 30.5 x 23	75	080-02115	\$699
DCR165	165L (5.8 cu ft.) refrigerator	6.5	14	29	34.5 x 36.8 x 26.2	120	080-02119	\$1,149
DCR225	225L (8 cu ft.) refrigerator	7.5	17	33	34.5 x 46.9 x 26.2	140	080-02123	\$1,249
DCF50	50L (1.8 cu ft.) freezer	15	24.5	42	26.5 x 30.5 x 23	75	080-02114	\$699
DCF165	165L (5.8 cu ft.) freezer	23	37	64	34.5 x 36.8 x 26.2	120	080-02117	\$1,149
DCF225	225L (8 cu ft.) freezer	30	44	68	34.5 x 46.9 x 26.2	140	080-02121	\$1,249
DCRF134	115L (4 cu ft.) refrigerator, 19L (.7 cu ft.) freezer	38	60	88	33 x 23.5 x 26	75	080-02135	\$1099

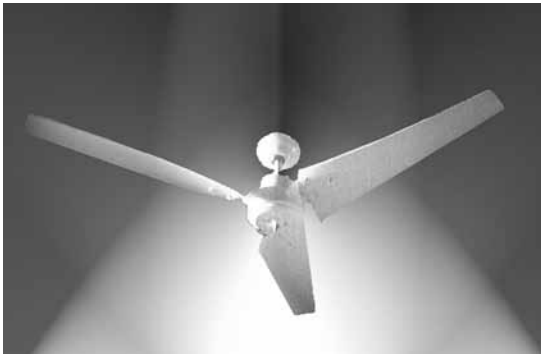
**NEW! Nextek**

**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, and 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 – 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.

**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 085-09169 control, which steps us 12 volts to 24 volts. The 24-volt input control is for use on 24-volt battery systems. Maximum 1.5 amps.

Description	Item code	Price
Nextek 42" Vari-Fan 12/24 volt ceiling fan	085-07445	\$240
Nextek 3-blade 60" Vari-Cyclone white painted	085-07453	\$322
Fan speed control 12V in / 0-24V out with reverse switch	085-09169	\$93
Fan speed control 24V in / 0-24V out with reverse switch	085-09170	\$45

**AEE Solar**

**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, draws 0.75 amp at medium speed and draws 0.5 amps 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" tan / brass w/ remote	085-07216	\$130
24-volt ceiling fan 12V 42" tan / brass w/ remote	085-07419	\$148
Ceiling fan hanging kit - 8"	085-07425	\$23

# Southwest Solar

## Solar Chill DC-Powered Evaporative Coolers

The Solar Chill solar-powered evaporative cooling system from Southwest Solar is available in five sizes and two DC voltages (12 and 24 volts). The rust-proof housings are built of 304 stainless steel and use a 6-inch thick fluted pad as the wet cooling media. The pad is the most efficient evaporative cooling medium in the world and will last five years with minimal maintenance. Solar Chill coolers use 25 to 400 watts and need only 80 watts to move 4500 cubic feet per minute (CFM).

The 42" belt-drive Solar Chill can move 9000 CFM. This 42" stainless steel Solar Chill is available for use on 12-volt or 24-volt systems and is capable of cooling spaces up to 2250 square feet. It uses only 200 to 400 watts of electricity and comes standard with an 8-inch thick Cel-Dek wet pad. Although it's possible to power this Solar Chill model directly from a 300- to 500-watt PV array, we recommend deep-cycle batteries for best performance. Whether in an industrial setting or simply a large home, if you have over 1000 square feet, this unit is perfect.

Optional rheostats may be used to slow fan speed. Optional control packages with cleanout pumps are available.

Solar Chill coolers are available by special order for 48 VDC and 120 or 240 VAC operation. Contact us for pricing.

For array-direct operation of evaporative coolers, use an array with at least the recommended watts and choose a linear current booster with the correct amp and voltage rating.



Model	Nominal voltage	Dimensions H" x L" x W"	Fan diameter	Actual watts	Recommended PV watts	Air flow (CFM)	Weight (lbs)	Item code	Price
1412XP	12	19.3 x 21.5 x 24	14"	38 - 52	60 - 80	1000	36	085-06606	\$1,300
1812HP	12	24.5 x 22 x 24	18"	53 - 73	85 - 130	1500	56	085-06609	\$1,176
2412HP	12	34 x 22.5 x 36	24"	80 - 120	120 - 200	3000	110	085-06611	\$1,880
4212XP	12	55 x 32.5 x 60	42"	200 - 400	450 - 600	8000		085-06617	\$4,800
1424XP	24	19.3 x 21.5 x 24	14"	42	60 - 80	1000	36	085-06623	\$1,300
1824HP	24	24.5 x 22 x 24	18"	60	85 - 130	1500	56	085-06626	\$1,176
2424HP	24	34 x 22.5 x 36	24"	150	120 - 200	3000	110	085-06627	\$1,880
4224XP	24	55 x 32.5 x 60	42"	200 - 400	450 - 600	8000		085-06635	\$4,800

### Solar Chill Accessories

Cooler leg kit - galvanized roof mount	085-06662	\$60
Replacement pump - 12 volt	085-06664	\$34
Replacement pump - 24 volt	085-06666	\$52
Evaporative cooler thermostat	085-06668	\$44
5-minute mechanical timer for cleanout pump	085-06670	\$37
Control box - 6" x 9" x 2.25"	085-06672	\$78
Control pkg - cleanout pump, thermostat, switches, cleanout timer in stainless steel box - 12V	085-06674	\$232
Control pkg - cleanout pump, thermostat, switches, cleanout timer in stainless steel box - 24V	085-06676	\$1,250
On/off switch for Solar Chill coolers - rated at 15 amps	085-06684	\$14
Variable speed rheostat - 2.5 amp, use with 1224HP and 1624HP	085-06691	\$98
Variable speed rheostat - 3.5 amp, use with 1212HP and 2024HP	085-06694	\$100
Variable speed rheostat - 4.7 amp, use with 2012HP	085-06695	\$116
Variable speed rheostat - 7.0 amp, use with 2412HP and 2-2024HP - by special order	085-06697	\$120
Knob for rheostat	085-06699	\$10
Diffuser grill, 14-inch	085-06705	\$98
Diffuser grill, 24-inch	085-06709	\$192



# SnapFan

## DC-Powered venturi exhaust fan

These fans have a 3-wing polypropylene fiberglass blade mounted in a square injection molded fiberglass venturi frame for easy mounting and long life. The high-efficiency DC motor has a 5000-hour life at 32 VDC and longer at lower voltage. This new design makes them quiet while moving more air with less power.

Inside finger guards are available on all fans. They are recommended for installations lower than 8 feet from the floor of an occupied building.

They can be used on existing battery systems or with other module combinations with up to 40 VDC open circuit voltage. Modules with 60 cells in the 200 to 230 watt range have an open circuit voltage just below 40 VDC and can be used to power one 20- or 24-inch fan, or two 16-inch fans directly at 30 volts. 1-year warranty.



Blade diameter	Frame dimensions	@ 12 VDC		@ 24 VDC		@30 VDC		Weight lbs	Fan w/o Guard		Fan w/ inside guard	
		Amps	CFM	Amps	CFM	Amps	CFM		Item code	Price	Item code	Price
12"	17.5" x 17.5"	0.58	580	1.59	1030	2.75	1250	14	085-09081	\$338	085-09082	\$361
16"	21.5" x 21.5"	0.98	980	2.6	1720	3.44	2030	16	085-09083	\$375	085-09084	\$406
20"	21.5" x 21.5"	1.47	1600	4.13	2800	5.51	3300	22	085-09085	\$497	085-09086	\$543
24"	25.5" x 25.5"	1.82	1900	5.07	3500	8.21	4200	26	085-09087	\$678	085-09088	\$725
28"	29.5" x 29.5"	4.90	2670	12.8	4830	17.4	5720	30	085-09089	\$875	085-09090	\$969

## 12V Freedom Fans

The two-speed Freedom Fan is quiet and efficient. Made in the USA, these rugged fans provide a refreshing breeze anywhere you have 12 volt power. Place it on the floor, on a table and tilt to any angle, or mount it on the wall.

Model 124 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. C version has battery clips and P version has a cigarette lighter plug.

Model 302 has a PWM speed control and draws 4 amps at the highest setting. It has a 20" fan blade and a cigarette lighter plug and comes with an adapter for direct connection to battery terminals.



Description	Item code	Price
12-volt 12" Freedom Fan 124-C	085-08232	\$172
12-volt 12" Freedom Fan 124-P	085-08234	\$172
12-volt 20" Freedom Fan 302	085-08236	\$290

## 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 90°F to 130°F. When the thermostat reaches the turn-on temperature, it must fall by 15°F 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. It's range is 50°F to 90°F with a differential of 2°F.

Description	Range	Item code	Price
Attic fan thermostat	90°F to 130°F	085-08036	\$35
Heating and cooling thermostat	50°F to 90°F	085-08032	\$30

## Solar-Powered Fans

Fans are nearly ideal solar powered loads. They can run directly off DC (as do 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

These solar attic fans from Natural Light are a simple and environmentally sensible solution that can save you money. Powered completely by free solar energy, these sleek and efficient vents are both compact, quiet, and fully operational right from the box. They install easily, with no electrical wiring and no expensive electrician. Place one wherever you need improved circulation: attics, lofts, workshops, storage sheds, garages, even barns. These attic fans have a tiltable mount solar module, aircraft grade aluminum dome and flashing and stainless steel screen. 5-year warranty.



Model	Solar watts	Output CFM	Venting capacity	Flashing diameter	Item code	Price
SAF-10	10	850	1500 SQ. FT.	27.25"	085-07077	\$470
SAF-20	20	1200	1800 SQ. FT.	27.25"	085-07079	\$565

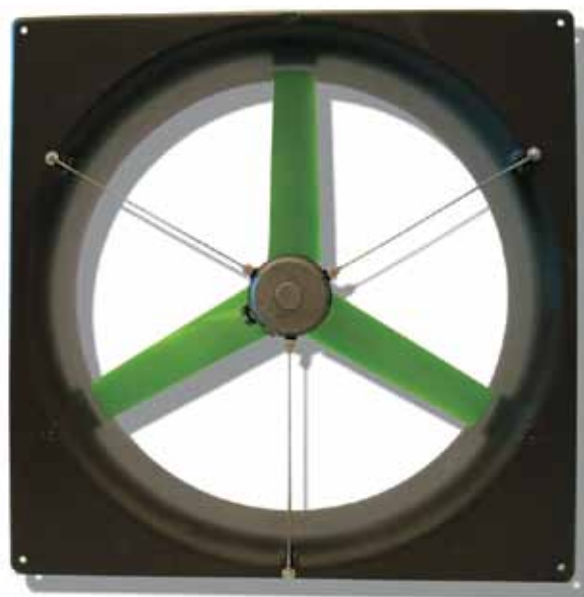
## AEE Solar

### Exhaust Fan Kit

These solar fan kits include AEE's venturi exhaust fan, a solar module with mounting hardware and a 20-foot cord. These fans have a 3-wing polypropylene fiberglass blade mounted in a square, injection-molded fiberglass venturi frame for easy maintenance and long life. The high-efficiency DC motor has a 5000-hour life at 32 VDC, longer at lower voltage. This new design makes the fan quiet while moving more air with less power.

The 12-inch fan comes with a 20-watt module and the 16-inch fan comes with a 30-watt module.

1-year warranty on the fan and 10-year power output warranty on the module.



Description	Item code	Price
Solar fan kit w/12" fan and 20-watt module	085-09062	\$475
Solar fan kit w/16" fan and 30-watt module	085-09064	\$580

### PV Cable Assembly Tools

We have tools from Multi-Contact and Tyco for crimping the pins on their connectors. There is a tool for each type of connector. We also have a high quality tool from Rennsteig that has a set of dies and positioners for MC Solarline 1 and 2; and for Tyco connectors, 10, 12 and 14 AWG wire.

MC Solarline 1 also requires a second tool to put the rubber boot on the pin after it has been crimped to the wire.

### MC Solarline 1 Assembly Tools

Crimper and boot assembly tool for Solarline 1 connectors. These tools are supplied by Multi-Contact.



Description	Item code	Price
MC Solarline 1 crimper PV-CZL	094-00116	\$952
MC Solarline 1 boot assembly tool, bench mount	094-00108	\$570

### MC Solarline 2 Crimping Tool

Crimping tool to assemble MC Solarline 2 locking connectors. Crimping tool is for 10 or 12 AWG stranded wire.



Description	Item code	Price
MC Solarline 2 pin crimper for 10/12 AWG wire	094-00104	\$712

### Tyco SolarLok Crimping Tool

Crimping tool to assemble SolarLok locking connectors. Crimping tool is for 10 or 12 AWG stranded wire.



Description	Item code	Price
Tyco crimper for 10/12 AWG wire	094-00114	\$410

### MC4 Solarline 2 Open-End Spanner Set

This set of 2 plastic wrenches is used to tighten the sealing nut in the connectors and to unlock the male and female connector. Sold in pack of 2 wrenches.



Description	Item code	Price
MC Solarline 2 open-end spanner set	094-00112	\$2

### Rennsteig Crimping Tool for Tyco and MC

This crimping tool comes with 3 die-sets and 3 pin positioners for crimping MC Solarline 1 and Solarline 2 pins and Tyco Solarlok pins on 14, 12 and 10 AWG stranded wire. Comes with a molded plastic carrying case.



Description	Item code	Price
Rennsteig crimper set for 14, 12 and 10 AWG	094-00123	\$1,105
Rennsteig stripper for 14, 12 and 10 AWG	094-00128	call
Rennsteig cutter for 14, 12 and 10 AWG	094-00129	call

### 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-inch tool gives you plenty of leverage for quality crimping. Made in USA. UL Listed.



### Cable Cutter

Cut cable up to 6/0 AWG with this 22-inch 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	094-00003	\$90
Cable cutter with 22-inch handles	094-00004	\$90
Cable crimper with 26-inch handles	094-00011	\$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	094-00013	\$36



# Solmetric

## NEW! SunEye 210 Site Analysis Tool

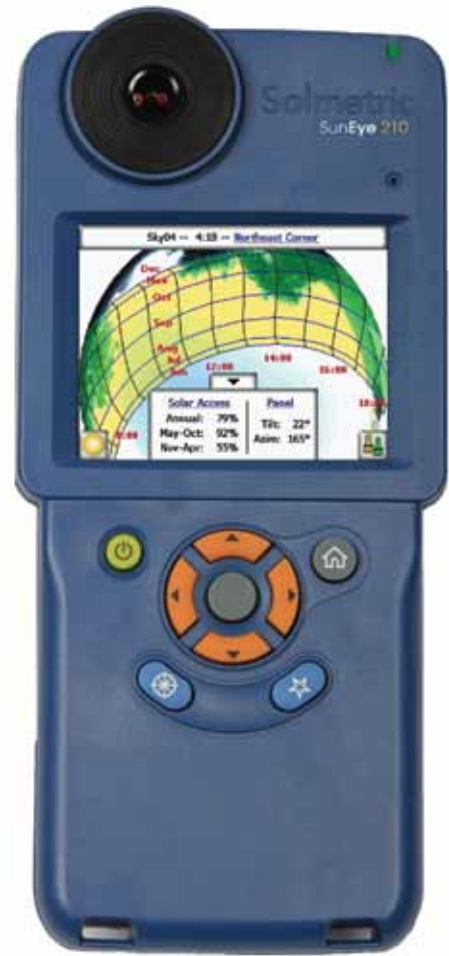
The Solmetric SunEye 210 is a hand held electronic device that allows users to assess total potential solar energy given the shading of a particular site. Identifying the shading pattern early in the process reduces the expense of system and home design and improves the efficiency of the final system or house.

The Solmetric SunEye 210 is an important tool for the professional solar installer, saving time and money and helping to design high performance systems. It's equally useful for PV, passive hot water, roof mount or ground mount systems. Optimize new systems for maximum production. Analyze existing installations to solve problems of under production. Identify specific shade-causing obstructions such as trees or structures and know instantly how much additional energy would be produced if the obstruction were removed.

The SunEye 210 comes with a fish-eye lens digital camera and sophisticated measurement software that simulates removal or addition of shading objects or structures, and measures roof tilt and azimuth. It works in the northern and southern hemispheres and provides easy measurements and instant feedback allowing you to make quick estimates and accurate system designs and stores data for later review. The SunEye interfaces to the USB port of your PC, and data is transferred from the device to the SunEye Desktop software. A Solar Access and Shading Report summarizes the data from each session. The SunEye also outputs various data files for use in simulation and design programs.

The GPS version permits automatic readings of latitude and longitude for sun path calculations and displays. Each Skyline reading can be automatically tagged with the latitude and longitude coordinates. Recommended for large sites where many skylines will be recorded, or when exact latitude/longitude coordinates are desired. Accuracy is +/-3 meters. When data is taken using the GPS option, all Skylines are geo-tagged, and the locations and data can be output to Google Earth.

It works on PCs with Windows Vista (all editions), Windows XP SP2 (Professional, Home, or Media Center), or Windows 2000 SP4. Currently, the SunEye software does not run natively on Mac OS. It is possible, however, to run the SunEye software on a Mac using a Windows emulator, such as Parallels Desktop for Mac.



Description	Item code	Price
Solmetric SunEye 210 Tool w/ worldwide operation	094-00200	\$1,995
Solmetric SunEye 210 Tool w/ worldwide operation and GPS	094-00201	\$2,195

# Daystar

## NEW! Digital Solar Meter

Daystar's DS-05A solar meter brings "point and read" simplicity to the measurement of solar irradiance. Just turn the meter on, point the sensor at the sun, and obtain a reading in watts/square meter.

Each meter is hand calibrated so you can rely on the accuracy.

Description	Item code	Price
Daystar Solar Meter	094-00271	\$155





## 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
	2000	265	400	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	100	110	110	2/0
	3600	120	200	125	2/0
	4000	135	200	175	2/0
	4500	155	200	175	2/0
	5000	167	200	175	2/0
	6000	200	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.

AMPS	#14	#12	#10	#8	#6	#4	#2	1/0	2/0	4/0
<b>12-volt system – 2% voltage drop</b>										
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
<b>24-volt system – 2% voltage drop</b>										
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 accept-

able. 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.

AMPS	#14	#12	#10	#8	#6	#4	#2	1/0	2/0	4/0
<b>48-volt System – 2% Voltage Drop</b>										
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
<b>120-volt System – 2% Voltage Drop</b>										
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

## Solar Insolation

This table 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, check local weather data, look at the map on the next page, or find a city in the table below that has similar weather to your location. If you want year-round autonomy, use the low figure. If you want only 100% autonomy in summer, use the high number. If you want a utility grid-tie system, and you have net metering available in your state, use the average figures. For off-grid systems, see U.S. insolation map on the next page.

State	City	High	Low	Avg	State	City	High	Low	Avg	State	City	High	Low	Avg
AK	Fairbanks	5.87	2.12	3.99	KS	Manhattan	5.08	3.62	4.57	NY	Schenectady	3.92	2.53	3.55
AK	Matanuska	5.24	1.74	3.55	KS	Dodge City	6.50	4.20	5.60	NY	Rochester	4.22	1.58	3.31
AL	Montgomery	4.69	3.37	4.23	KY	Lexington	5.97	3.60	4.94	NY	New York City	4.97	3.03	4.08
AR	Bethel	6.29	2.37	3.81	LA	Lake Charles	5.73	4.29	4.93	OH	Columbus	5.26	2.66	4.15
AR	Little Rock	5.29	3.88	4.69	LA	New Orleans	5.71	3.63	4.92	OH	Cleveland	4.79	2.69	3.94
AZ	Tucson	7.42	6.01	6.57	LA	Shreveport	4.99	3.87	4.63	OK	Stillwater	5.52	4.22	4.99
AZ	Page	7.30	5.65	6.36	MA	E. Wareham	4.48	3.06	3.99	OK	Oklahoma City	6.26	4.98	5.59
AZ	Phoenix	7.13	5.78	6.58	MA	Boston	4.27	2.99	3.84	OR	Astoria	4.76	1.99	3.72
CA	Santa Maria	6.52	5.42	5.94	MA	Blue Hill	4.38	3.33	4.05	OR	Corvallis	5.71	1.90	4.03
CA	Riverside	6.35	5.35	5.87	MA	Natick	4.62	3.09	4.10	OR	Medford	5.84	2.02	4.51
CA	Davis	6.09	3.31	5.10	MA	Lynn	4.60	2.33	3.79	PA	Pittsburgh	4.19	1.45	3.28
CA	Fresno	6.19	3.42	5.38	MD	Silver Hill	4.71	3.84	4.47	PA	State College	4.44	2.79	3.91
CA	Los Angeles	6.14	5.03	5.62	ME	Caribou	5.62	2.57	4.19	RI	Newport	4.69	3.58	4.23
CA	Soda Springs	6.47	4.40	5.60	ME	Portland	5.23	3.56	4.51	SC	Charleston	5.72	4.23	5.06
CA	La Jolla	5.24	4.29	4.77	MI	Sault Ste. Marie	4.83	2.33	4.20	SD	Rapid City	5.91	4.56	5.23
CA	Inyokern	8.70	6.87	7.66	MI	E. Lansing	4.71	2.70	4	TN	Nashville	5.20	3.14	4.45
CO	Grandby	7.47	5.15	5.69	MN	St. Cloud	5.43	3.53	4.53	TN	Oak Ridge	5.06	3.22	4.37
CO	Grand Lake	5.86	3.56	5.08	MO	Columbia	5.50	3.97	4.73	TX	San Antonio	5.88	4.65	5.30
CO	Grand Junction	6.34	5.23	5.85	MO	St. Louis	4.87	3.24	4.38	TX	Brownsville	5.49	4.42	4.92
CO	Boulder	5.72	4.44	4.87	MS	Meridian	4.86	3.64	4.43	TX	El Paso	7.42	5.87	6.72
DC	Washington	4.69	3.37	4.23	MT	Glasgow	5.97	4.09	5.15	TX	Midland	6.33	5.23	5.83
FL	Apalachicola	5.98	4.92	5.49	MT	Great Falls	5.70	3.66	4.93	TX	Fort Worth	6	4.80	5.43
FL	Belie Is.	5.31	4.58	4.99	MT	Summit	5.17	2.36	3.99	UT	Salt Lake City	6.09	3.78	5.26
FL	Miami	6.26	5.05	5.62	NM	Albuquerque	7.16	6.21	6.77	UT	Flaming Gorge	6.63	5.48	5.83
FL	Gainsville	5.81	4.71	5.27	NB	Lincoln	5.40	4.38	4.79	VA	Richmond	4.50	3.37	4.13
FL	Tampa	6.16	5.26	5.67	NB	N. Omaha	5.28	4.26	4.90	WA	Seattle	4.83	1.60	3.57
GA	Atlanta	5.16	4.09	4.74	NC	Cape Hatteras	5.81	4.69	5.31	WA	Richland	6.13	2.01	4.44
GA	Griffin	5.41	4.26	4.99	NC	Greensboro	5.05	4	4.71	WA	Pullman	6.07	2.90	4.73
HI	Honolulu	6.71	5.59	6.02	ND	Bismarck	5.48	3.97	5.01	WA	Spokane	5.53	1.16	4.48
IA	Ames	4.80	3.73	4.40	NJ	Sea Brook	4.76	3.20	4.21	WA	Prosser	6.21	3.06	5.03
ID	Boise	5.83	3.33	4.92	NV	Las Vegas	7.13	5.84	6.41	WI	Madison	4.85	3.28	4.29
ID	Twin Falls	5.42	3.42	4.70	NV	Ely	6.48	5.49	5.98	WV	Charleston	4.12	2.47	3.65
IL	Chicago	4.08	1.47	3.14	NY	Binghamton	3.93	1.62	3.16	WY	Lander	6.81	5.50	6.06
IN	Indianapolis	5.02	2.55	4.21	NY	Ithaca	4.57	2.29	3.79					



This map 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 off-grid 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 Off-Grid Solar Array Sizing Worksheet on page 13.)



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