THE NEW VALUE FRONTIER

KYOCERA

KYOCERA Solar, Inc.

11th Edition

Solar Electric Products Catalog

Kyocera is a group of companies that create new value for society by continually pursuing excellence while adhering to universal principles.

SOLUTIONS FOR TODAY

Kyocera Corporation was established in 1959 as a producer of engineered ceramics. In four decades, Kyocera has pioneered many new developments in electronics, telecommunications, automotive components, optics, medical products and solar energy. We are a dynamic, customer-oriented enterprise that consistently creates innovative new products for critical market needs worldwide.

Kyocera's solar energy products, pollution-reducing ceramic engine parts, cartridge-free laser printers and filmless digital cameras reflect our commitment to the environment and the well being of future generations.

Quality of Life

Information & Communication

Environmental Preservation

Introduction

Kyocera Solar, Inc. is a world-leading supplier of environmental solar electric energy solutions. With headquarters in Scottsdale, Arizona, and regional sales affiliates in Brazil and Australia, Kyocera Solar, Inc. services thousands of customers worldwide.

Kyocera Solar's integrated solar energy systems are used for variety of applications. These applications include telecommunications, the oil and gas industry, railway safety and traffic management systems, village electrification, remote home power generation, marine and RV applications, residential and agricultural water pumping, and utility grid support systems for homes and commercial facilities.

Kyocera began research into photovoltaics in 1975, and has installed thousands of systems worldwide since 1978. Since that time, the company has expanded substantially both through acquisitions and through the rapid growth of our dealer sales network.

The New Value Frontier

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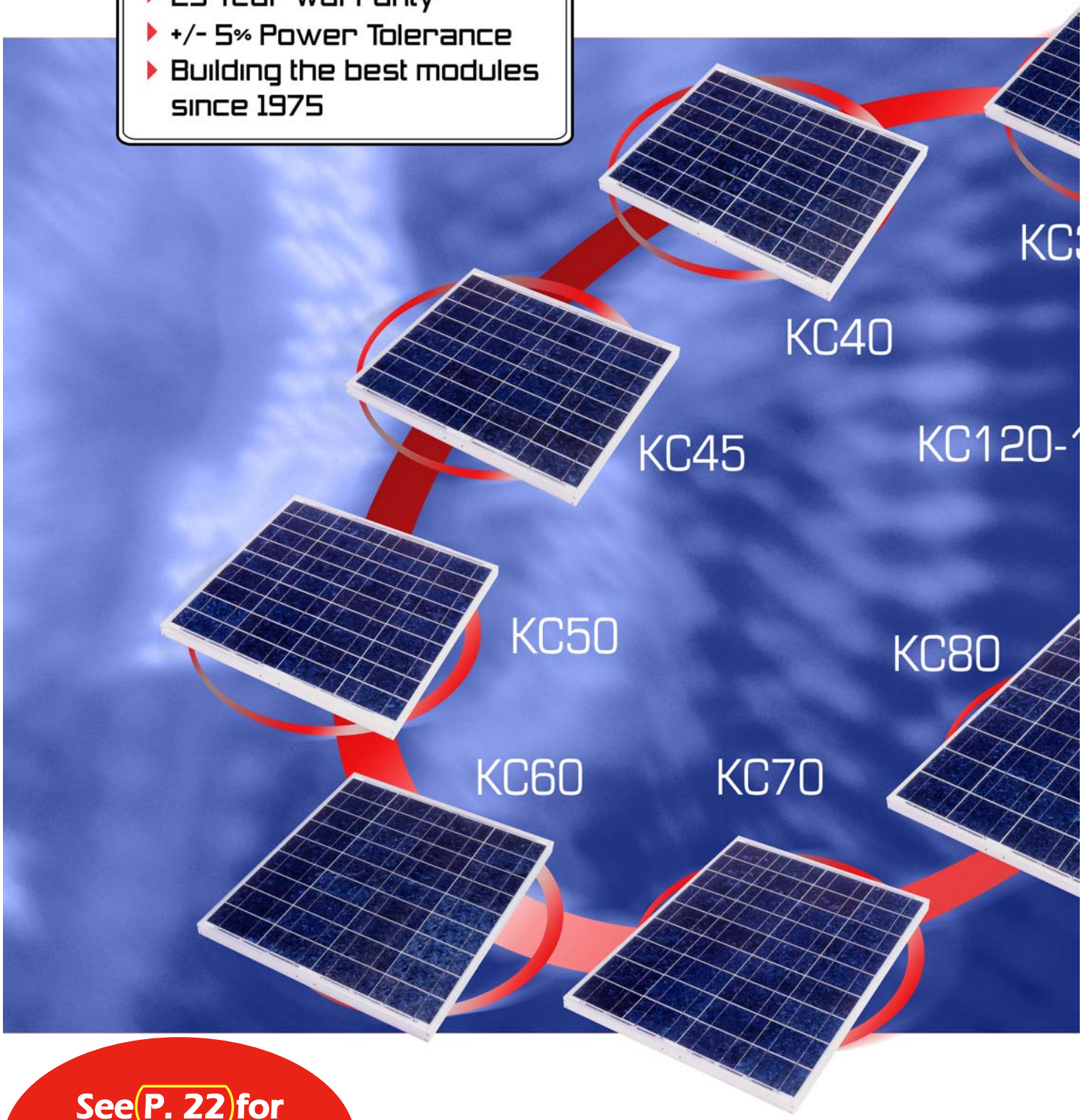
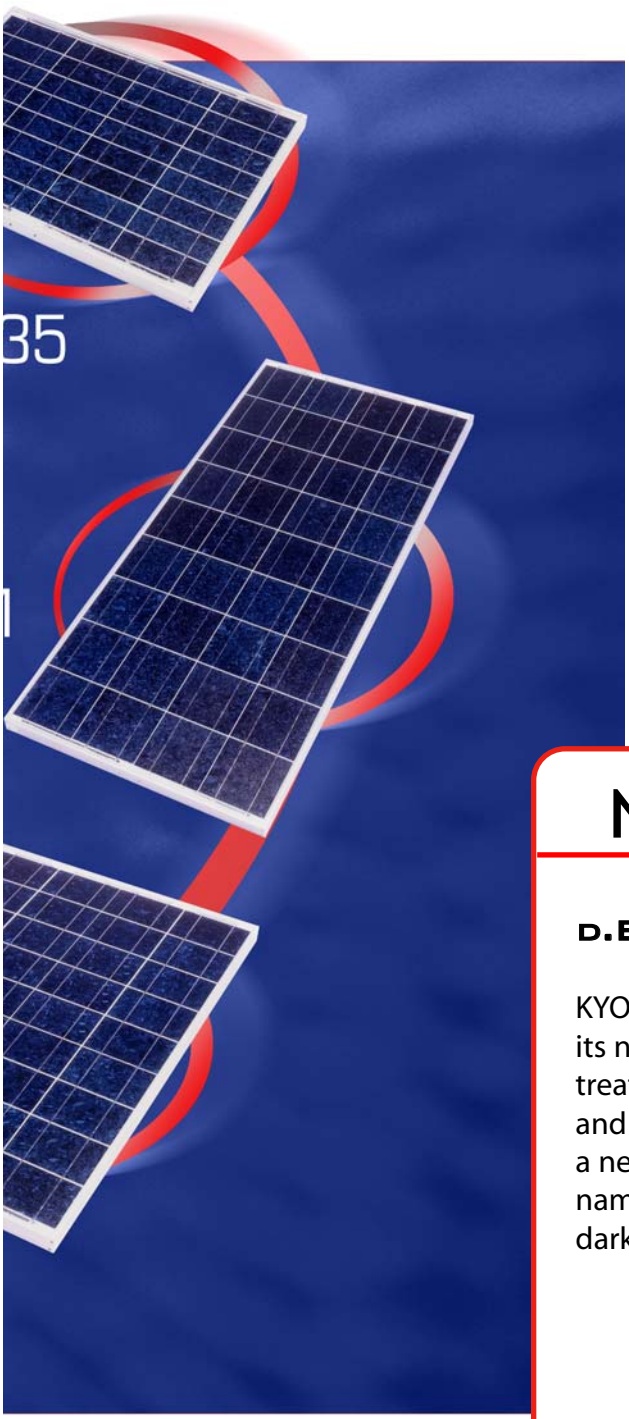
Table of Contents

- 25 Year Warranty
- +/- 5% Power Tolerance
- Building the best modules since 1975



See P. 22 for Complete Details!

Multi-crystal Photovoltaic Modules



- Kyocera's advanced cell processing technology and automated production facilities produce a highly efficient multicrystal photovoltaic module.
- The conversion efficiency of the Kyocera solar cell is over 14%
- These cells are encapsulated between a tempered glass cover and an EVA pottant with PVF back sheet to provide maximum protection from the most severe environmental conditions.
- The entire laminate is installed in an anodized aluminum frame to provide structural strength and ease of installation.

Now Available

d.Blue Module

KYOCERA has perfected its new surface treatment technology and is introducing it on a new line of modules named d.Blue, for its dark blue color.

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Strong > Stainless steel and marine bronze housing

Efficient > More water per Watt than competing pumps

Reliable > Means less down time and service calls

Easy > Simple and fast installation, the controller programs itself

Versatile > Water delivery up to 43 gpm, Pumping range 0-550 feet

Complete Support > The ONLY company that manufactures both solar modules and pumps

See P. 103 for Complete Details!

Submersible Water Pumps and Controllers

Centrifugal Pumps:

- Brushless, permanent magnet motor with multi-stage centrifugal pump end
- Corrosion-resistant, permantly lubricated and maintenance free

Diaphragm Pumps:

- Highest quality submersible Pump line in its class
- Field serviceable with simple hand tools

Controllers:

- Maximum Power Point Tracking
- Self Programming Operation
- Self Diagnostic
- Current Boosting
- Simplified Control and Troubleshooting

New Model

More Water at Greater Depth!

SD 6-60

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MyGen™ Utility Interactive System

MyGen™
MyGeneration

A growing number of Homeowners worldwide are expressing a desire for "clean electricity" which ensures independence from imported oil and gas. As restructuring of the U.S. electric utility industry accelerates and electric service monopolies are opened up to competition, many new markets for value added and environmentally sustainable, solar electric systems and services will emerge.

KYOCERA Solar has designed and built a Solar Electric Power System that has everything you need to generate your own electricity. Kyocera's utility interactive systems are installed on the roofs of thousands of grid connected buildings worldwide. These rooftop systems not only produce electricity for households, but also allow surplus energy to be sold back to the utility.

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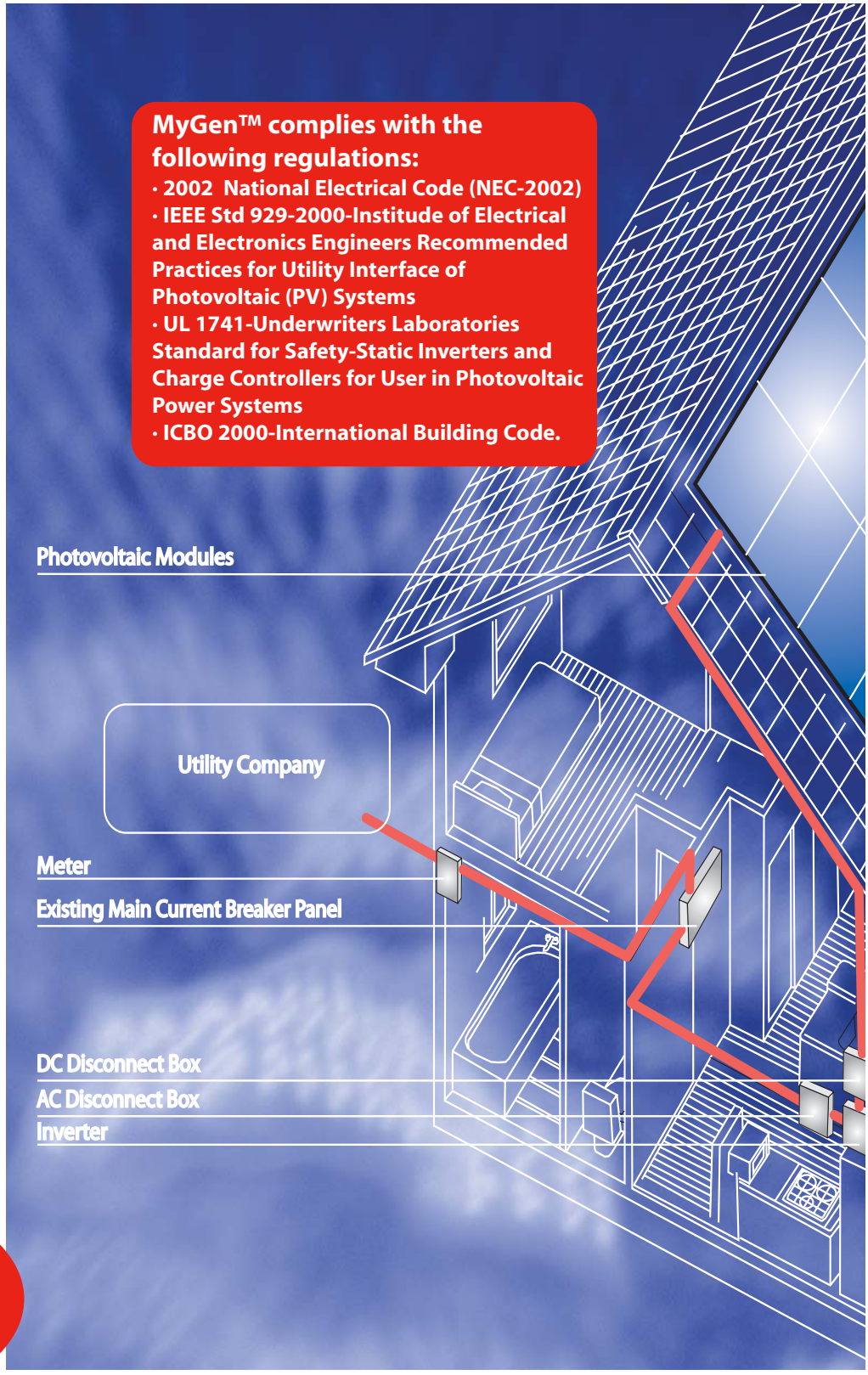


See P. 17 for Complete Details!

Increase the Value of Your Home

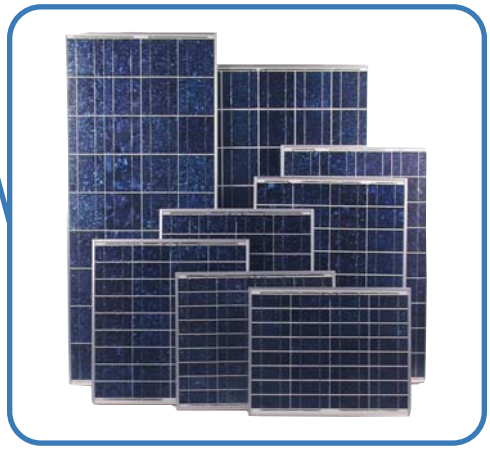
Your MyGen™ Residential System will provide value to your home by quietly and reliably producing electricity every day of its long life. Beyond simply avoiding purchase of commodity power from the utility, the system adds financial value to your home. A PV system is a capital improvement to the building and will increase its resale value as it will continue to produce electricity for the new owners. Your house will be more valuable with a PV Solar System on it, and because the added value of your home is tax-exempt, you'll have all the resale value without an increased tax burden.

Do Your Part to Help the Environment

By avoiding the use of electricity created from fossil or nuclear fuels, you'll contribute to the health of the planet. Utilizing solar energy allows you to keep harmful by-products out of our air and water. When you install a MyGen™ Residential System on your home, you'll be supporting cleaner energy, and you'll play a major role in preserving precious natural resources. A years use of the MyGen-20 in Arizona will prevent 5,109 lbs of carbon dioxide from being released into the air - the equivalent of that produced by burning 250 gallons of gasoline!

Longest Photovoltaic Module Warranty in the Business

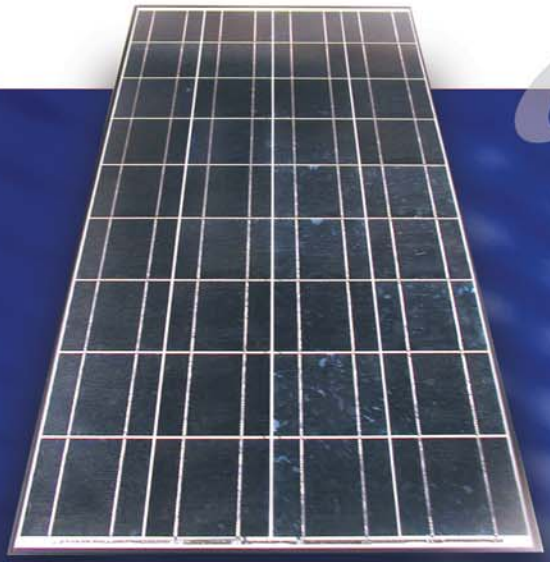
Kyocera's multi-crystalline silicon modules carry 25-year warranties, with an expected life span of more than 30 years. In addition, they require very little maintenance. This guaranteed durability enhances the cost effectiveness of the system particularly in applications where maintenance is a prime consideration.



Pre-Engineered System

The MyGen™ is a truly complete solar solution for your home. With quality components, and everything needed for installation, the MyGen™ delivers additional value of easy installation for customers and PV installers. The system comes with all the components needed for installation and includes a detailed manual explaining installation, operation, and maintenance of the system. All the systems are modular and fully expandable, allowing for future upgrades of the system.

New Innovation
Kyocera d.Blue Module



KYOCERA has perfected its new surface treatment technology and is introducing it on a new line of modules named d.Blue, for its dark blue color.

The newly developed treatment method processes multi-crystalline silicon cells in order to produce a surface texture that minimizes surface reflectance and maximizes output. The result is higher wattage without increasing module size.

d.Blue is ideal for installation on all types of buildings, from residential to large scale commercial systems. The stylish dark blue cells, combined with black module frames, allow the modules to blend in with the buildings architecture while producing energy at exceptional efficiencies.

See P. 22 for Complete Details!

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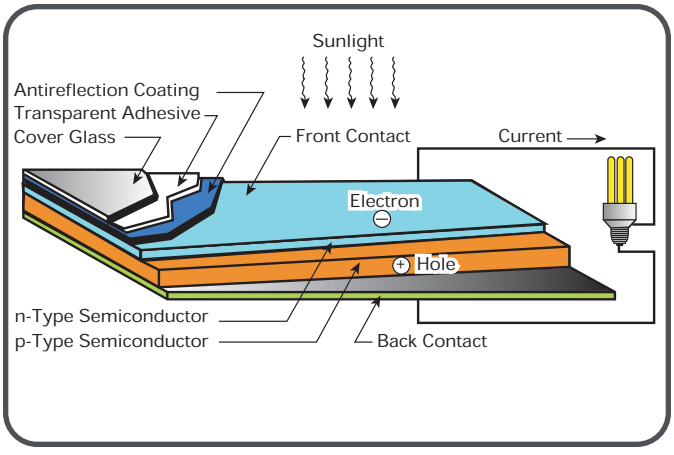
FREQUENTLY ASKED QUESTIONS

Renewable Energy (RE) may seem puzzling to some people that are not familiar with it. To help those of you that are being exposed to solar power for the first time, we have compiled and answered a dozen of the most frequently asked questions that we commonly hear at Kyocera Solar. We hope this FAQ file is helpful to you.

Q1... How do solar cells generate electricity?

A1...

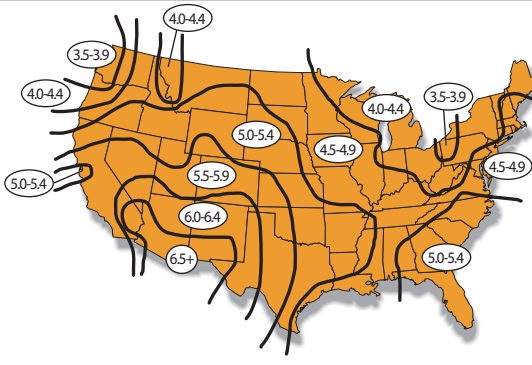
Photovoltaics or PV for short can be thought of as a direct current (DC) generator powered by the sun. When light photons of sufficient energy strike a solar cell, they knock electrons free in the silicon crystal structure forcing them through an external circuit (battery, inverter or direct DC load), and then returning them to the other side of the solar cell to start the process all over again. The voltage output from a single crystalline solar cell is about 0.5V with an amperage output that is directly proportional to the cell's surface area (approximately 7A for a 6 inch square multi-crystalline solar cell). Typically 30-36 cells are wired in series (+ to -) in each solar module. This produces a solar module with a 12V nominal output (~17V at peak power) that can then be wired in series and/or parallel with other solar modules to form a complete solar array.



Q2... Will solar work in my location?

A2...

Solar is universal and will work virtually anywhere, however some locations are better than others. Irradiance is a measure of the sun's power available at the surface of the earth and it peaks at about 1000 watts per square meter. With typical crystalline solar cell efficiencies around 14-16%, that means we can expect to generate about 140-160W per square meter of solar cells placed in full sun. Insolation is a measure of the available energy from the sun and is expressed in terms of "full sun hours" (i.e. 4 full sun hours = 4 hours of sunlight at an irradiance level of 1000 watts per square meter). Obviously different parts of the world receive more sunlight than others, so they will have more "full sun hours" per day. The solar insolation zone map will give you a general idea of the full sun hours per day during the summer for your location.



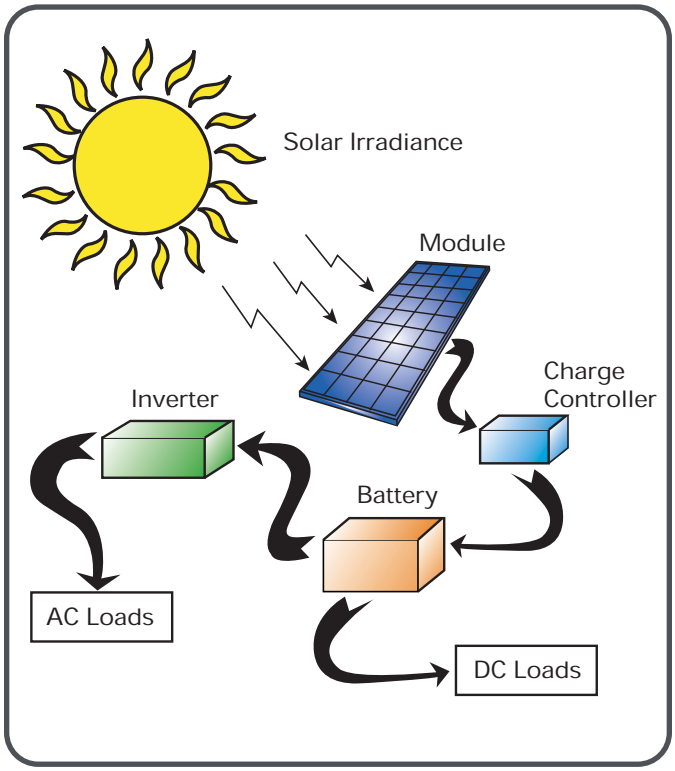
Solar Insolation Zone Map

Q3... How much will solar cost for a 2000 square foot home?

A3...

Unfortunately there is no per square foot "average" since the cost of a system actually depends on your daily energy usage and how many full sun hours you receive per day; and if you have other sources of electricity. To accurately size a system to meet your needs, you need to know how much energy you use per day. If your home is connected to the utility grid, simply look at your monthly electric bill. If not, you can fill out the "load evaluation form" on page 15. Using this information, your authorized Kyocera Solar Dealer can design a system to meet your needs.

Q4...
What components do I need for an off-grid system?



A4...

There are many components that make up a complete solar system, but the 4 main items on a stand-alone system are: solar modules, charge controller(s), battery(s) and inverter(s). The solar modules are physically mounted on a mount structure (see question 7) and the DC power they produce is wired through a charge controller before it goes on to the battery bank where it is stored. For more detailed information on solar modules, turn to page 20. The two main functions of a charge controller are to prevent the battery from being overcharged and eliminate any reverse current flow from the batteries back to the solar modules at night. Turn to page 41 for more detailed information on charge controller functions and features. The battery bank stores the energy produced by the solar array during the day for use at anytime of the day or night. Batteries come in many sizes and grades, which you can see starting on page 52. The inverter takes the DC energy stored in the battery bank and inverts it to 120 or 240 VAC to run your AC appliances. For more detailed information on different inverter models and features, turn to page 71.

Q5...
What components do I need for a grid-tie system?

A5...

Grid-tie systems are inherently simpler than either grid-tie with battery back-up or stand-alone solar systems. In fact, other than safety disconnects, mounting structure and wiring, a grid-tie system is just solar modules and a grid-tie inverter! Today's sophisticated grid-tie inverters incorporate most of the components needed to convert the direct current from the modules to alternating current, track the maximum power point of the modules to operate the system at peak efficiencies and terminate the grid connection if grid power is interrupted from the utility.

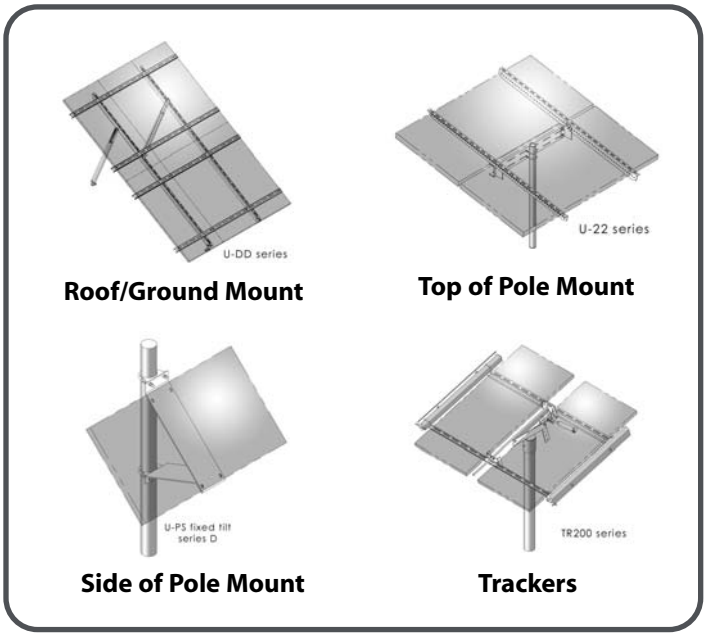
Q6...
Can I use all of my normal 120/240 VAC appliances?

A6...

Maybe. Many older homes were not designed or built with energy efficiency in mind. When you purchase and install a renewable energy system for your home, you become your own power company, so every kWh of energy you use means more equipment (and hence more money) is required to meet your energy needs. Any appliance that operates at 240 VAC (such as electric water heaters, cookstoves, furnaces and air conditioners) are expensive loads to run on solar. You should consider using alternatives such as LP or natural gas for water/space heating or cooking, evaporative cooling instead of compressor based AC units and passive solar design in your new home construction if possible. Refrigeration and lighting are typically the largest 120 VAC energy consumers in a home (after electric heating loads) and these two areas should be looked at very carefully in terms of getting the most energy efficient units available. Great strides have been made in the past 5 years towards improving the efficiency of electric refrigerators/freezers. Compact fluorescent lights use a quarter to a third of the power of an incandescent light for the same lumen output and they last ten times longer. These fluorescent lights are now readily available at your local hardware or discount store. The rule of thumb in the renewable energy industry is that for every dollar you spend replacing your inefficient appliances, you will save three dollars in the cost of a renewable energy system to run them. So you can see that energy conservation is crucial and can really pay off when considering a renewable energy system.

Q7...
What type of solar module mounting structure should I use?

A7...



Roof/Ground Mount **Top of Pole Mount**

Side of Pole Mount **Trackers**

There are four basic types of mount structures: roof/ground, top-of-pole, side-of-pole and tracking mounts, each having their own pros and cons. For example roof mount structures typically keep the wire run distances between the solar array and battery bank or grid-tie inverter to a minimum, which is good. But they may also require roof penetrations in multiple locations, and they require an expensive ground fault protection device to satisfy article 690-5 of the National Electrical Code-NEC. On the other hand, ground mounted solar arrays require fairly precise foundation setup, are more susceptible to theft/vandalism and excessive snow accumulation at the bottom of the array. Next are top-of-pole mounts which are relatively easy to install (you sink a 2-6 inch diameter SCH40 steel pole up to 4-6 feet in the ground with concrete). Make sure that the pole is plumb and mount the solar modules and rack on top of the pole. Top-of-pole mounts reduce the risk of theft/vandalism (as compared to a ground mount). They are also a better choice for cold climates because snow slides off easily. Side of pole mounts are easy to install, but are typically used for small numbers of solar modules (1-4) for remote lighting systems where there already is an existing pole to attach them to. Last but not least are the trackers, which increase the daily number of full sun hours and are usually used for solar water pumping applications. Trackers are extremely effective in the summer time when water is needed the most. In the northern U.S., typical home energy usage peaks in the winter when a tracker mount makes very little difference as compared to any type of fixed mount (roof, ground or top-of-pole). In this situation, having more modules on a less expensive fixed mount will serve you better in the winter than fewer modules on a tracker. However, if you are in the southern U.S. and your energy usage peaks in the summer, then a tracker may be beneficial to match the time of your highest energy consumption with a tracking solar array's maximum energy output.

Q8...
Should I wire my home for AC or DC loads?

A8...

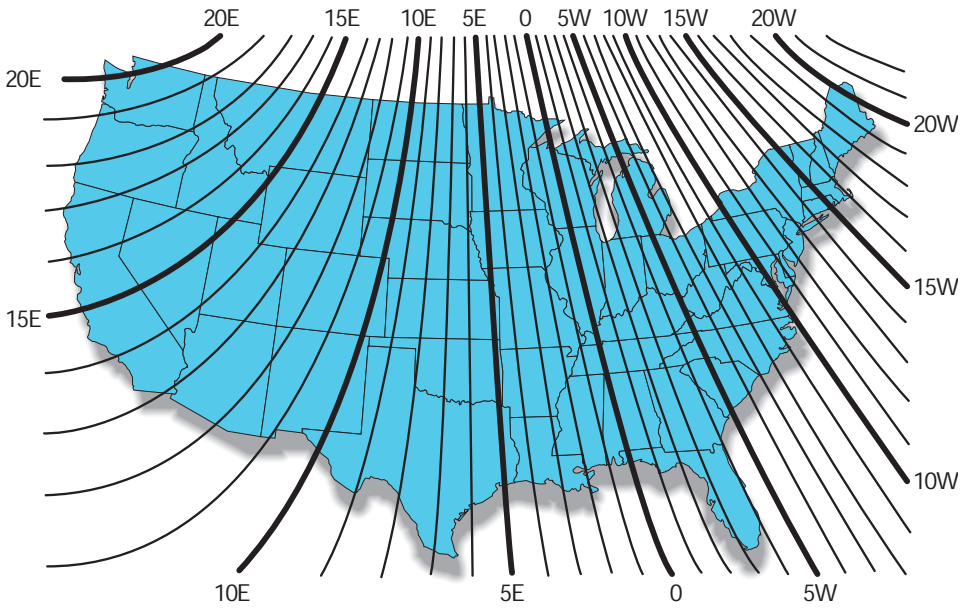
It depends on the size of the system and what type of loads you want to run. DC appliances are usually more efficient than AC since you don't have to worry about the loss through the inverter, but DC loads are typically more expensive and harder to find than their AC counterparts. Small cabin and RV systems are typically wired DC while most home systems are wired exclusively for AC loads. With improvements in inverter efficiency and reliability in the last 5 years, AC is the way to go for a home system. Another advantage AC has over DC is that the voltage drop for a 120VAC circuit is much less than a 12VDC circuit carrying the same power, which allows you to use smaller gauge wire.

Q9...
Can I use PV to heat water or for space heating?

A9...

No. Photovoltaics converts the sun's energy into DC electricity at a relatively low efficiency level (14-16%), so trying to operate a high power electric heating element from PV would be very inefficient and expensive. Solar thermal (or passive solar) is the direct heating of air or water from the heat of the sun and is much more efficient for heating applications than photovoltaics.

Q10...
Where should I mount the solar modules and what direction should I face them?



Magnetic Declination Map

A10...

If your site is in the northern hemisphere you need to aim your solar modules to true south (the reverse is true for locations in the southern hemisphere) to maximize your daily energy output. For many locations there is quite a difference between magnetic south and true south, so please consult the declination map before you setup your mount structure. The solar modules should be tilted up from horizontal to get a better angle at the sun and help keep the modules clean by shedding rain or snow. For best year round power output with the least amount of maintenance, you should set the solar array facing true south at a tilt angle equal to your latitude with respect to the horizontal position. If you plan to adjust your solar array tilt angle seasonally, a good rule of thumb is:

- latitude minus 15° in the summer
- latitude in the spring/fall
- latitude plus 15° in the winter

Most mount structures are available with a seasonal adjustment of the tilt angle from horizontal to 65°. To determine if your proposed array site will be shaded at any time of the day or year you should consider using the Solar Pathfinder in the tool section on page 121.

Q11...
Should I set my system's battery bank up at 12, 24, or 48 VDC?

A11...

The PV industry really began with the 12V radio communications market. These systems were typically small (1-2 solar modules) and had all 12 VDC loads. As the solar industry matured and entered the home market, systems became much larger (16+ solar modules) and no longer used DC loads exclusively. Most home systems today are 24 or 48 VDC since the higher system voltage gives you a lot more flexibility as to how far away you can place your solar modules from the battery bank as compared to a 12V system. For a given power output, a higher system voltage reduces your amperage flow (but not your power) which allows you to use a smaller and less expensive gauge wire for your solar to battery and battery to inverter wire runs. Of course, if you already have a lot of 12VDC loads, that may be your deciding factor as to what voltage you set your system up at. Most grid-tie systems operate at 48 volts or higher.

The Basics of Electricity

Before purchasing a photovoltaic system, it is a good idea to have a basic understanding of electricity. Simple familiarity with basic electrical terms and concepts will enable you to better understand your renewable energy system and use it with confidence.

The building blocks of an electrical vocabulary are voltage, amperage, resistance, watts and watt-hours. Electricity can simply be thought of as the flow of electrons (amperage) through a copper wire under electrical pressure (voltage) and is analogous to the flow of water through a pipe. If we think of copper wire in an electrical circuit as the pipe, then voltage is equivalent to pressure (psi) and amperage is equivalent to flow rate (gpm).

To continue with our electricity to water analogy, a battery stores energy much as a water tower stores water. Since a column of water 2.31 feet tall produces 1 psi at the base, the taller the water tower the higher the pressure you get at the base. As you can see from the picture to the right, the mushroom shape design of a water tower allows it to provide a large volume of water to end users at between 40-60 psi. Once drained below 40 psi which occurs near the neck of the tower, continued water usage will rapidly deplete the water supply at an ever decreasing pressure. Although a 12 volt battery is not physically shaped like a water tower, it has most of its stored electricity available between 12 volts to 12.7 volts. When drained below 12 volts, little amperage remains and the battery voltage will decrease rapidly.

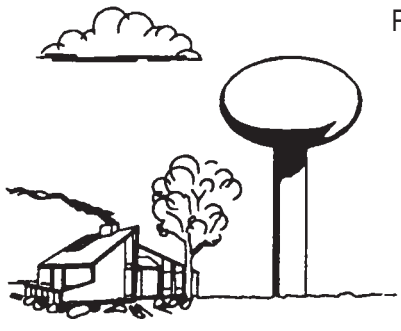
In a simple system, a power source like a solar module provides the voltage which pushes the amperage through a conductor (wire) and on through a load that offers resistance to the current flow which in turn consumes power (watts). Power is measured in watts and is the product of voltage multiplied by amperage. Energy is power (watts) used over a given time frame (hours) and is measured in watt-hours or kilowatt-hours (1 kilowatt-hour equals 1000 watt-hours). For example, a 100 watt light left on for 10 hours each night will consume 1000 watt-hours or 1 kilowatt-hour of energy. A kilowatt-hour is the unit of energy measurement that the utility company bills you for each month. Electrical appliances are rated in terms of how many watts (or amps) they draw when turned on. To determine how much energy a particular appliance uses each day, you need to multiply the wattage by the number of hours used each day. See the load evaluation sheet on page 15 for more information on electrical load calculations.

When wiring solar modules or batteries together in an renewable energy system, remember that connecting two of them in series (+ to -) doubles their voltage output, but keeps their amperage (or amp-hour capacity) the same. Connecting two of them in parallel (+ to +, - to -) doubles their amperage output (or amp-hour capacity), but keeps their voltage output the same. For example, most solar modules have a 12V nominal output so you would need to wire four of them in series (+ to -) to charge a 48V battery bank. The amperage output from these four solar modules in series is the same as that of a single solar module. Similarly, you would need to wire four 6V 350 amp-hour (AH) L-16 size batteries in series (+ to -) to configure them for 24V operation and then connect two strings of four batteries in parallel (+ to +, - to -) to obtain a 700 amp-hour capacity battery. See Appendix F for more information on battery wiring.

The discussion above of voltage and amperage leads to the subject of wire size. The amount of current that you can send through any electrical circuit depends on three things; the size or gauge (AWG) of the wire being used, the voltage of the system and the one way wire run distance. All wire (Cu and Al) has a listed resistance per 1000 feet with a larger gauge wire having a lower resistance value than a smaller one. The longer the distance and lower the voltage, the larger gauge wire you will need to use to minimize the voltage drop.

As a "rule of thumb", if your solar array consists of 4 or more, 60 watt or larger solar modules and is 50 feet or more away from the battery bank you should consider setting your system up at 24 or 48V instead of 12V. See the voltage drop tables in Appendix B at the back of the catalog for more information on wire sizing for 12, 24 or 48 VDC.

Many water towers are physically shaped like a mushroom. Electrically speaking, batteries are mushroom shaped as well. A tower designed to produce 50 p.s.i. for household pressure might be built like this.



PSI	FEET	VOLTAGE
60	139	12.70
50	115	12.57
40	92	12.43
30	69	12.30
20	46	12.17
10	23	12.03
0	0	11.90

POWER CONSUMPTION TABLE

These figures are approximate representations. The actual power consumption of your appliances may vary substantially from these figures. Check the power tags, or better yet, measure the amperage draw with a clamp-on ammeter.

Multiply the hours used on the average day by the wattage listed below. This will give you the watt hours consumed per day, which you can then plug into the load evaluation form on the next page.

Remember that some items, such as garage door openers, are used only for a fraction of an hour or minute per day. A 300 watt item used for 5 minutes per day will only consume 25 watt hours per day.

Where a range of numbers are given, the lower figure often denotes a technologically newer and more efficient model. The letters "NA" denote appliances which would normally be powered by non-electric sources in a PV powered home.

We strongly suggest that you invest in a true RMS digital multimeter if you are considering making your own power. Also helpful are clamp-on type ammeters. It actually makes sense to know where your power is being used, even if you are not producing it, and if you are, these meters are essential diagnostic tools.

appliance	watts	appliance	watts	appliance	watts
Coffee Pot	200	Garage door opener	350	Compact fluorescent	
Coffee Maker	800	Ceiling fan	10-50	Incandescent equivalents	
Toaster	800-1500	Table fan	10-25	40 watt equivalent	11
Popcorn Popper	250	Electric blanket	200	60 watt equivalent	16
Blender	300	Blow dryer	1000	75 watt equivalent	20
Microwave	600-1500	Shaver	15	100 watt equivalent	30
Waffle Iron	1200	Waterpik	100		
Hot Plate	1200	Well Pump (1/3-1 HP)	480-1200	Electric mower	1500
Frying Pan	1200			Hedge trimmer	450
		Computer		Weed eater	500
Dishwasher	1200-1500	Laptop	20-50	1/4" drill	250
Sink waste disposal	450	PC	80-150	1/2" drill	750
		Printer	100	1" drill	1000
Washing machine		Typewriter	80-200	9" disc sander	1200
Automatic	500	Television		3" belt sander	1000
Manual	300	25" color	150	12" chain saw	1100
Vacuum cleaner		19" color	70	14" band saw	1100
Upright	200-700	12" black and white	20	7-1/4" circular saw	900
Hand	100	VCR	40	8-1/4" circular saw	1400
Sewing machine	100	CD player	35		
Iron	1000	Stereo	10-30	Refrigerator/Freezer	
		Clock radio	1	20 cu. ft. (AC)	1411 watt-hours/day*
Clothes dryer		AM/FM auto cassette player	8	16 cu. ft. (AC)	1200 watt-hours/day*
Electric NA	4000	Satellite dish	30		
Gas heated	300-400	CB radio	5	Freezer	
		Electric clock	3	15 cu. ft. (Upright)	1240 watt-hours/day*
Heater				15 cu. ft. (Chest)	1080 watt-hours/day*
Engine block NA	150-1000	Radiotelephone			
Portable NA	1500	Receive	5	Note: TV's, VCR's and other devices left plugged in, but not turned on, still draw power.	
Waterbed NA	400	Transmit	40-150		
Stock tank NA	100				
Furnace blower	300-1000	Lights:			
Air conditioner NA		100 watt incandescent	100		
Room	1000	25 watt compact fluor.	28		
Central	2000-5000	50 watt DC incandescent	50		
		40 watt DC halogen	40		
		20 watt DC compact fluor.	22		

* The daily energy values listed here are for the most efficient units in their class and the information was obtained from *Consumer Guide to Home Energy Savings* by Alex Wilson and John Morrill.

LOAD EVALUATION FORM

Please copy if more than one sheet is required.

If your home is connected to the utility grid, your energy usage has already been calculated for you in kilowatt-hours per month on your electric bill. If you are building a new home and would like to size a renewable energy system to power it, fill out the following form as completely as you can. Just break down your electrical appliances by room (kitchen, living room, bathroom, etc.), check if they are AC or DC, list how many you have, their wattage and then estimate how many hours per day and days per week you use each particular appliance. If you can do that for each and every electrical appliance in your home, then your Kyocera Dealer can calculate your daily corrected watt-hours and design your system.

Name:

Appliance	AC	DC	Qty.		Wattage		Hrs. Per Day		Days Per Week	÷		Avg. Watt Hrs. / day
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
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				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	
				X		X		X		/7	=	

Highest AC loads in watts:	Total AC connected wattage at one time:			Total watt-hr per day:
Total watt-hr per day:	X	Load correction factor*	=	Corrected watt-hr per day:
	X	1.25	=	

*The load correction factor is required as batteries are not 100% efficient and other losses occur in a system. We increase the load value by 25% to compensate for these losses.

Solar Array Sizing

Worksheet

Use the worksheet on the right to determine your solar requirements. We have included an example column and a column for your system.

1. Locate your site on the average yearly insolation map on page 9 and list the nearest figures.

2. Take the daily corrected total loads in watt hours from your load evaluation sheet.

3. Divide line 2 by line 1. This is the number of watts we need to generate per hour of full sun.

4. Find actual power produced by your selected module and enter. (rated amperage x battery voltage during charging). Example: Using KC120's, one module produces 7.1 amps. 13 volts is a common charging voltage for 12 volt systems. Actual power = amperage x charging voltage.

5. Divide line 3 by line 4. The result is the number of modules required for your system. When rounding this number, remember that sets of 2 modules are needed for a 24 volt system, sets of 4 for 48, etc.

	Example	Actual Figures
Step	yearly average	yearly average
1	5.0 sun hours per day	
2	1000 watt-hours per day	
3	200 watts	
4	(7.1x13) =92.3	
5	2.17	

Battery Sizing Worksheet

Use this worksheet to determine your battery requirements. We have included an example column and a column for your system.

1. Determine total watt-hours per day required from your load calculation.

2. Determine days of storage required. This approximates the greatest number of cloudy days in a row expected (3 to 7 is common for residences, 7 to 14 for remote communications and monitoring sites).

Battery Temp. (F°)	Multiplier	Battery Temp. (F°)	Multiplier
80	1.00	40	1.30
70	1.04	30	1.40
60	1.11 (example)	20	1.59
50	1.19		

3. Multiply line 2 by line 1.

4. Determine planned depth of discharge. 80% is the maximum for lead acid deep cycle batteries, 50% is a common amount for optimum longevity. Divide line 3 by .80 or .50, respectively.

5. Derate your battery for low temperatures by multiplying the answer in line 4 by the factors in the table below using the lowest expected weekly average temperature.

6. Find the watt hour capacity of your selected battery. This is voltage times ampere hour capacity. Example; Surrette S-460 deep cycle, 6 volts x 350 amp-hours = 2100 watt-hours

7. Divide line 5 by line 6. The result is the number of batteries required.

8. Round number of batteries to fit system voltage. Example; A 24 volt system requires sets of 2 when using 12 volt batteries; sets of 4 when using 6 volt batteries and sets of 12 when using 2 volt cells.

Rule of thumb: We recommend that your battery bank's watt-hour capacity (at the 20 hr rate) be at least 10 times more than your daily corrected watt-hour figure from the load evaluation form on page 15.

Step	Example	Actual Figures
1	1000 watt-hour	
2	7 storage days	
3	7000 watt-hours	
4	7000 /0.50 = 14,000	
5	14,000 x 1.11 = 15,540	
6	2100 watt-hours	
7	7.4	
8	**8**	

Rule of Thumb: Most battery manufacturers recommend no more than 4 parallel strings in a battery bank.

Pre-Packaged Systems

Kyocera Solar, Inc. specializes in pre-packaged, integrated solar electric systems for all power applications. The applications include residential power for stand-alone and utility interactive buildings, RV/Marine, water pumping and industrial remote power systems (telecommunication, oil & gas, traffic signals, and medical). The most popular system configurations for residential applications are represented in this catalog; however, systems requiring larger power requirements and other system components can be provided. Call your Kyocera Authorized Dealer for more information and design assistance.

MyGen™ Grid-Tie PV Power Systems

The MyGen™ Grid-Tie Photovoltaic (PV) Power System consists of photovoltaic modules, a direct current to alternating current (DC-to-AC) power conversion device, DC wiring, DC and AC protection, lightning protection, component mounting and mechanical support.

The MyGen System is designed for use on residential and small commercial buildings of typical construction. Photovoltaic mounting is rafter-secured for structural compliance with most local building codes. MyGen complies with the 2002 National Electrical Code (NEC-2002), IEEE Std 929-2000-Institute of Electrical and Electronics Engineers Recommended Practices for Utility Interface of Photovoltaic (PV) Systems, UL 1741-Underwriters Laboratories Standard for Safety-Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems and the ICBO 2000-International Building Code.

The modular, packaged systems listed below can be combined to form larger systems, depending upon user need, availability of unshadowed roof space and existing or planned electrical utility configuration.

	MyGen 20	MyGen 24
Part Number	**98520**	**98524**
Price	**$22000.00**	**$26000.00**
STC-Lab Rated Power (1)	2400 W	2880 W
Estimated Monthly Energy Production DC(2)	See next page for list of US cities	
DC Voltage	207-550 VDC	
AC Output Voltage	240 VAC nominal	
AC Output Frequency	60 Hz	
Operational Temperature	-25ºC to 60ºC	
Roof Angles	Flat to 45º	
PV to Roof Clearance	3" - 3/4"	
Wind Loading	Up to 125 mph	
Outdoor Rating	All components	
Utility Protection	Visible blade disconnect, inverter anti-islanding protection	
Inverter User Interface	Status display of AC RMS volts, AC Amps, Watt-hours produced daily	
PV Panel Dimensions	Each PV panel (4 grouped modules): 8'-8" L x 4'-8" W x 4" to 5" D	
PV Panel Area	200 ft²	240 ft²
PV Panel+Mount Weight	675 lb	810 lb
Inverter Dimensions	Inverter : 11.61" H x 17.83" W x 8.42" D	
Inverter Weight	70.0 lbs	
System Warranty	5 year full system	

(1) Standard Test Conditions (STC) of 1000 Watts per square meter irradiance, air mass of 1.5, 25ºC cell temperature used in lab testing and rating of photovoltaic modules. These conditions are only experienced in a laboratory setting.
(2) The actual energy output in kilowatt-hours your system will produce each month is a function of many site specific and instantaneous variable s including the operating temperature of the PV modules, the amount of solar radiation reaching the modules, the roof angle, the array orientation relative to south ("azimuth"), shading effects, soiling and installation quality.

Estimated Monthly KiloWatt-hours (kWh) Produced by MyGen™ Grid-Tie System at Roof Tilt

MyGen 24

City	Atlanta	Chicago	Denver	Houston	Las Vegas	Los Angeles	Miami	N.Y. City	Phoenix	San Francisco
Latitude	*33.6*	*41.8*	*40*	*30*	*36.8*	*33.9*	*25.8*	*40.8*	*33.4*	*37.6*
Tilt	*20*	*30*	*30*	*20*	*20*	*20*	*20*	*30*	*20*	*30*
JAN	170 - 275	150 - 245	200 - 330	160 - 265	205 - 340	180 - 290	200 - 330	150 - 245	210 - 340	160 - 260
FEB	185 - 305	170 - 280	315 - 355	170 - 280	225 - 370	195 - 315	205 - 335	175 - 285	235 - 380	175 - 290
MAR	240 - 395	210 - 340	235 - 435	215 - 350	300 - 490	260 - 425	260 - 420	225 - 370	290 - 475	240 - 390
APR	270 - 440	230 - 380	280 - 460	225 - 370	330 - 540	295 - 485	265 - 440	245 - 400	325 - 535	280 - 460
MAY	280 - 460	265 - 435	290 - 470	245 - 405	350 - 575	300 - 495	260 - 425	265 - 430	350 - 570	310 - 510
JUN	270 - 445	270 - 440	290 - 475	245 - 500	340 - 560	290 - 475	230 - 375	260 - 425	335 - 545	310 - 505
JUL	270 - 440	270 - 440	290 - 470	250 - 410	330 - 535	320 - 530	245 - 400	260 - 430	310 - 510	325 - 535
AUG	260 - 425	255 - 415	275 - 455	245 - 400	315 - 515	305 - 500	245 - 400	250 - 410	310 - 505	310 - 505
SEP	225 - 370	215 - 350	255 - 420	225 - 365	295 - 480	260 - 420	200 - 360	215 - 355	280 - 460	275 - 450
OCT	225 - 370	185 - 300	235 - 390	220 - 365	265 - 430	230 - 380	220 - 360	195 - 320	265 - 430	235 - 380
NOV	170 - 280	120 - 200	190 - 310	170 - 280	315 - 350	190 - 310	200 - 325	135 - 220	215 - 350	165 - 270
DEC	155 - 255	120 - 200	180 - 290	150 - 245	200 - 325	170 - 275	195 - 315	125 - 205	200 - 330	150 - 240
Average	227 - 372	205 - 335	247 - 405	210 - 344	281 - 459	250 - 408	229 - 374	208 - 341	277 - 453	245 - 400
Yearly Sum	2720 - 4460	2460 - 4025	2695 - 4850	2520 - 4125	3370 - 5510	3995 - 4900	2745 - 4485	2500 - 4095	3325 - 5430	2935 - 4795

MyGen 20

City	Atlanta	Chicago	Denver	Houston	Las Vegas	Los Angeles	Miami	N.Y. City	Phoenix	San Francisco
Latitude	*33.6*	*41.8*	*40*	*30*	*36.8*	*33.9*	*25.8*	*40.8*	*33.4*	*37.6*
Tilt	*20*	*30*	*30*	*20*	*20*	*20*	*20*	*30*	*20*	*30*
JAN	140 - 225	125 - 200	165 - 270	135 - 220	170 - 280	150 - 240	145 - 235	125 - 205	175 - 285	130 - 215
FEB	155 - 250	145 - 235	180 - 295	140 - 230	190 - 305	160 - 260	165 - 270	145 - 235	195 - 315	145 - 240
MAR	200 - 325	175 - 285	220 - 360	175 - 290	245 - 405	215 - 350	205 - 335	185 - 305	240 - 395	200 - 325
APR	226 - 365	190 - 315	235 - 380	190 - 310	275 - 445	245 - 400	200 - 330	200 - 300	270 - 445	230 - 380
MAY	235 - 385	220 - 360	240 - 390	205 - 335	290 - 480	250 - 410	225 - 370	220 - 360	290 - 475	260 - 420
JUN	225 - 365	225 - 365	240 - 395	205 - 335	285 - 465	240 - 395	230 - 375	215 - 350	275 - 455	255 - 420
JUL	225 - 365	225 - 365	240 - 390	210 - 340	270 - 445	265 - 440	235 - 380	220 - 355	260 - 425	270 - 445
AUG	215 - 350	210 - 345	230 - 375	205 - 335	260 - 430	255 - 415	215 - 350	205 - 340	255 - 420	255 - 420
SEP	190 - 310	175 - 290	210 - 345	185 - 300	245 - 400	215 - 350	180 - 290	180 - 290	230 - 380	230 - 370
OCT	185 - 305	150 - 245	195 - 320	180 - 295	220 - 355	190 - 315	150 - 245	160 - 265	220 - 355	195 - 315
NOV	140 - 230	100 - 165	160 - 260	140 - 230	175 - 290	155 - 255	105 - 170	110 - 180	180 - 290	135 - 225
DEC	130 - 210	100 - 165	150 - 240	125 - 200	165 - 270	140 - 230	110 - 175	105 - 170	165 - 270	125 - 200
Average	189 - 307	170 - 278	205 - 335	175 - 285	233 - 381	208 - 338	180 - 294	173 - 282	230 - 376	203 - 331
Yearly Sum	2265 - 3685	2040 - 3335	2465 - 4020	2095 - 3420	2970 - 4570	1480 - 4060	2165 - 3530	2070 - 3385	2755 - 4510	2430 - 3975

Notes:

(1) Table provided for reference only, not a guarantee of power output.

(2) Arrays in southern half of US tilted 20º, northern half tilted 30º from horizontal. All facing within 15 degrees of true south (may not be magnetic south).

(3) Mounting the modules at latitude tilt will yield a higher annual energy output.

(4) Estimated MyGen output dependent upon proper installation, commissioning and operation. Overcast weather conditions, shading, heavy dirt, bird droppings or other obstructions on a solar module face will reduce the system's power output until the obstruction is cleared.

Kyocera Integrated PV Power Systems

Kyocera Solar, Inc. serves the widely varying needs of customers for distributed solar power through two major market channels. Industrial customers, such as original equipment manufacturers, government organizations, utilities, corporate clients, and institutions, are serviced directly with fully integrated systems packages. Kyocera Solar, Inc. also services a global network of more than 1,500 authorized distributors and dealers with components, packaged systems, engineering, technical support, project management, sales aids, and training.

At Kyocera Solar, Inc. Corporate Headquarters, teams of solar engineers and technicians assemble and integrate thousands of complete solar electric systems for immediate on-site deployment by the customer. These systems range from specialty industrial modules to container mounted communication systems for shipment overseas. Modules are integrated by Kyocera for use in these systems.

From large multi-kilowatt power plants to small trickle chargers, Kyocera solar products are backed by experience and technology you can rely on for all of your photovoltaic applications.

Kyocera Solar System Applications

Telecommunications

Kyocera has worldwide experience in providing reliable and economical solar electric systems for remote power solutions. Typical applications powered by solar electricity include microwave repeaters, base stations, VSATs, and WLL telecommunication systems.

Traffic Signaling

Solar powered traffic systems are located primarily in urban settings. Because the cost associated with installing a transformer and underground cable is substantial, solar electric power offers a reliable, cost-effective solution.

RV & Marine

Solar electric power systems are important for people on the go. Whether the system is installed on a camper, 5th wheel, self-contained RV, motor coach or marine pleasure craft, solar energy can provide the necessary electricity. These systems easily integrate into on-board battery systems and complement existing means of power production.

Oil & Gas

Wireless solar electric power is a logical solution for the remote energy needs of the oil & gas industry . Thousands of integrated systems now operate worldwide, delivering reliable, cost-effective electricity for pipeline monitoring, telemetry, offshore drilling rigs, and cathodic protection.

Railroad Signaling

Remote signaling for railroad applications is a Kyocera specialty. Systems ranging from small two-volt track circuits to larger intermediate signaling systems are custom-engineered to meet the demanding requirements of the railroad industry.

Water Pumping

Kyocera manufactures solar-electric water pumps and offers complete packaged systems. These systems replace generator or hand-powered pumps, and are able to affordably deliver a usable quantity of water with no fuel cost and little maintenance. KSI water delivery systems are used for both community and livestock applications

Commercial Grid-Tie Systems

Solar "grid-tie" systems on commercial buildings can be a cost-effective alternative to the replacement of old, underground electricity distribution feeder systems. PV systems can be incorporated into rural or urban settings with equal ease.

Lighting

Kyocera's solar lighting systems are used in a variety of applications, including street/parking lots, billboard/highway signage, and bus/transit shelters.

Remote Homes

Solar electric systems are ideal for those who choose to live beyond the reach of conventional electric power. Kyocera has provided thousands of residential solar electric systems across the globe. These systems can be delivered fully integrated for ground mounting or installed on a rooftop or stand-alone structure.

Rural Development Vaccine Refrigeration

Kyocera has supplied thousands of systems worldwide to serve remote locations and improve the quality of life. Individuals and professional organizations are increasingly turning to solar electricity for lighting homes, pumping clean drinking water, refrigerating vaccines, and powering schools.

SOLAR ELECTRIC MODULES

The balance of this catalog lists and describes all of the equipment that you might need for a renewable energy system. We start with solar modules since they are your power producers and we progress through your system concluding with the loads your system will operate.

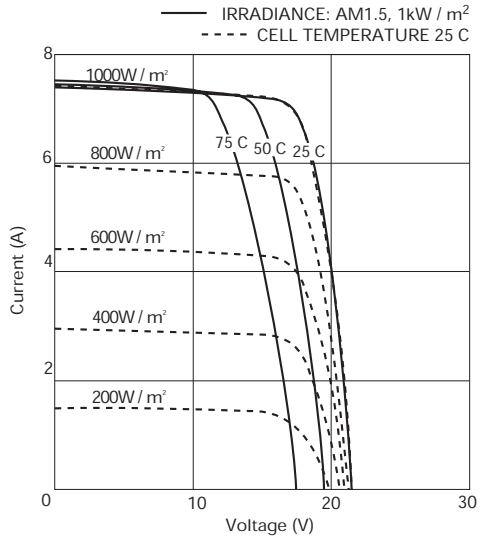
Solar Module Power Characteristics

The current and power output of photovoltaic modules are approximately proportional to sunlight intensity. At a given intensity, a module's output current and operating voltage are determined by the characteristics of the load. If that load is a battery, the battery's internal resistance will dictate the module's operating voltage.

A module which is rated at 17 volts will put out less than its rated power when used in a battery system. This is because the working voltage will be between 12 and 15 volts. As wattage (power) is the product of volts times amps, the module output will be reduced. For example: a 50 watt module working at 13.0 volts will produce 39.0 watts (13.0 volts x 3.0 amps = 39.0 watts). This is important to remember when sizing a PV system.

An I-V curve as illustrated to the right is simply all of a module's possible operating points, (voltage/current combinations) at a given cell temperature and light intensity. Increases in cell temperature increase current slightly, but drastically decrease voltage.

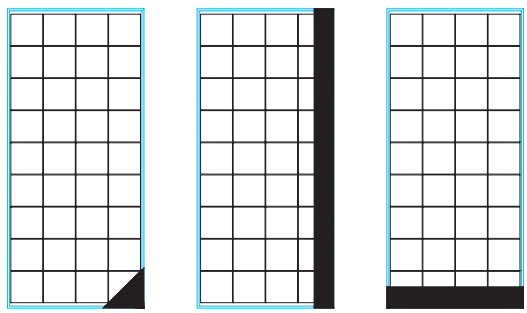
Maximum power is derived at the knee of the curve. Check the amperage generated by the solar array at your battery's present operating voltage to better calculate the actual power developed at your voltages and temperatures.



Shading

PV modules are very sensitive to shading. Unlike a solar thermal panel which can tolerate some shading, many brands of PV modules cannot even be shaded by the branch of a leafless tree.

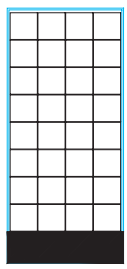
Shading obstructions can be defined as soft or hard sources. If a tree branch, roof vent, chimney or other item is shading from a distance, the shadow is diffuse or dispersed. These soft sources significantly reduce the amount of light reaching the cell(s) of a module. Hard sources are defined as those that stop light from reaching the cell(s), such as a blanket, tree branch, bird dropping, or the like, sitting directly on top of the glass. If even one full cell is hard shaded the voltage of that module will drop to half of its unshaded value in order to protect itself. If enough cells are hard shaded, the module will not convert any energy and will, in fact, become a tiny drain of energy on the entire system.



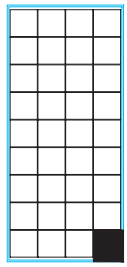
Examples of partial-cell shading that reduce PV module power by ½

Partial-shading even one cell of a 36-cell module, such as the KC120, will reduce its power output. Because all cells are connected in a series string, the weakest cell will bring the others down to its reduced power level. Therefore, whether ½ of one cell is shaded, or ½ a row of cells is shaded as shown above, the power decrease will be the same and proportional to the percentage of area shaded, in this case 50%.

When a full cell is shaded, it can act as a consumer of energy produced by the remainder of the cells, and trigger the module to protect itself. The module will route the power around that series string. If even one full cell in a series string is shaded, as seen on the right, it will likely cause the module to reduce its power level to ½ of its full available value. If a row of cells at the bottom of a module is fully shaded, as seen in Figure 7, the power output may drop to zero. The best way to avoid a drop in output power is to avoid shading whenever possible.



Example of full-cell shading that can reduce PV module power to zero



Example of full-cell shading that can reduce PV module power by ½

Tilt Angle

To capture the maximum amount of solar radiation over a year, the solar array should be tilted at an angle approximately equal to a site's latitude, and facing within 15° of due south. To optimize winter performance, the solar array can be tilted 15° more than the latitude angle, and to optimize summer performance, 15° less than the latitude angle. At any given instant, the array will output maximum available power when pointed directly at the sun.

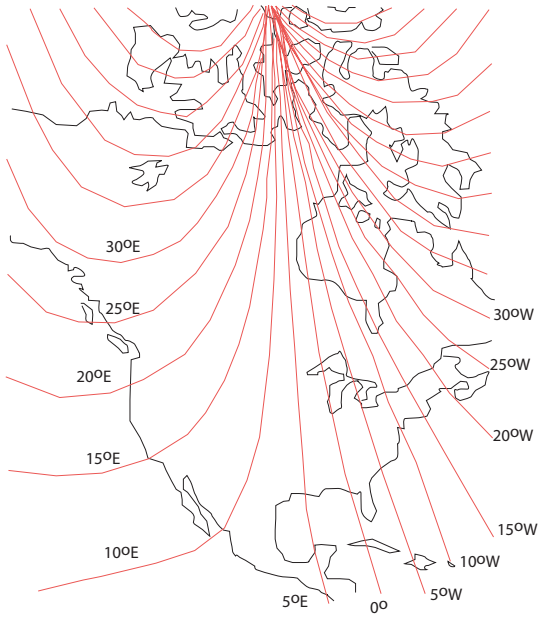
To compare the energy output of your array to the optimum value, you will need to know the site's latitude, and the actual tilt angle of your array-which may be the slope of your roof if your array is flush-mounted. If your solar array tilt is within 15° of the latitude angle, you can expect a reduction of 5% or less in your system's annual energy production. If your solar array tilt is greater than 15° off the latitude angle, the reduction in your system's annual energy production may fall by as much as 15% from its peak available value. During winter months at higher latitudes, the reduction will be greater.

Azimuth Angle and Magnetic Declination

If a south-facing roof is unavailable, or the total solar array is larger than the area of a south-facing roof section, an east or west-facing surface is the next best option. Be aware that solar power output decreases proportionally with a horizontal angle, or "azimuth," greater than 15° from due south. The decrease in annual power output from a latitude-tilted east or west-facing array may be as much as 15% or more in the lower latitudes or as much as 25% or more in the higher latitudes of the United States. Avoid directing your tilted solar panels northwest, north or northeast, as you'll get little power output.

Magnetic declination, the angle difference between magnetic south and true solar south, must also be taken into account when determining proper solar array orientation. If a magnetic compass alone is used to determine where to point the array, you may not capture the maximum amount of solar radiation. For a general view of the magnetic declination field lines in North America, see the map on the right.

If you have access to the Internet, and wish to calculate the exact magnetic declination of your site, visit the following website:
http://www.gwolab.nrcan.gc.ca/geomag/e_cgrf.html.



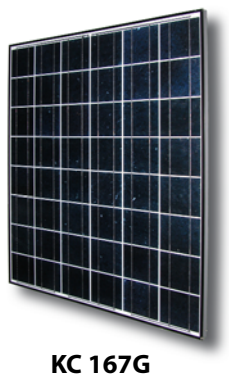
Magnetic declination map of North America for the year 1995

If you wish to gain in-depth information about magnetic declination, visit the following website:
http://www.ngdc.noaa.gov/seg/potfld/faqgeom.html.

KYOCERA Solar, Inc.

Kyocera Solar Modules (KC)

Kyocera's advanced cell processing technology and automated production facilities have produced a multi-crystal solar cell with an efficiency of over 14%. All modules are constructed using a tempered glass front, EVA pottant and a PVF backing to provide maximum protection from the most severe environmental conditions. The entire laminate is framed in a heavy duty anodized aluminum frame to provide structural strength and ease of installation. Because Kyocera modules are so efficient less space is required than other solar modules of equal output. This translates to both more wattage per square foot and lower mounting structure cost.



KC 167G

KC Module Family

Features

- High efficiency multicrystal modules
- Consistent, reliable time proven products
- Cell efficiency over 14%
- UL listed
- 6 inch cell modules
- Low iron, tempered glass, EVA encapsulant and anodized aluminum frame construction
- 25 year output warranty on KC Series modules
- 10 year output warranty on KS Series modules
- Weather resistant junction box or multi-contact connectors (KC 158G)

Quality Assurance

Kyocera multi-crystal photovoltaic modules exceed government specifications for the following tests:

- Thermal cycling test
- Thermal shock test
- Thermal/Freezing and high humidity cycling test
- Electrical insolation test
- Hail impact test
- Mechanical, wind and twist loading test
- Salt mist test
- Light and water exposure test
- Field exposure test

Product Name and Description	KC 167G	KC 158G	KC 125G	KC 120-1	KC 80	KC 70	KC 60	KC 50	KC 45	KC 40	KC 35
Part Number	**15467**	**15477**	**15425**	**15484**	**15483**	**15474**	**15482**	**15473**	**15472**	**15481**	**15486**
Price (1-20 modules)	**$890.00**	**$830.00**	**$670.00**	**$640.00**	**$450.00**	**$410.00**	**$350.00**	**$290.00**	**$265.00**	**$260.00**	**$225.00**
Rated Power (Watts)	167.0	158.0	125.0	120.0	80.0	70.0	60.0	50.0	45.0	40.0	35.0
Current at Max. Power (Amps)	7.2	6.82	7.2	7.1	4.73	4.14	3.55	3.00	3.00	2.34	2.33
Voltage at Max. Power (Volts)	23.2	23.2	17.4	16.9	16.9	16.9	16.9	16.7	15.0*	16.9	15.0*
Short Circuit Current (Amps)	8.0	7.58	8.0	7.45	4.97	4.35	3.73	3.1	3.1	2.48	2.5
Open Circuit Voltage (Volts)	28.9	28.9	21.7	21.5	21.5	21.5	21.5	21.5	19.2	21.5	18.8
Length (Inches)	50.8	50.8	56.0	56.0	38.4	34.1	29.6	25.2	22.6	20.7	18.5
Width (Inches)	39.0	39.0	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7
Depth (Inches)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Shipping Weight (lbs.)	38.0	38.0	33.0	33.0	23.0	19.0	18.0	16.0	15.0	13.0	12.0

All specification at 25°C. cell temperature, 1.5 AM and 1000W/m^2. Wattage rating are + or – 5%. *The 35 and 45 watt modules are self-regulating, designed to produce a lower voltage than standard 12 volt nominal modules. We don't recommend using self regulating modules in hot climates.

See Appendix A for module dimensions and shipping information.

Solartec KS Modules

Using highly efficient KYOCERA multi-crystal PV cells, these modules are manufactured in small sizes for more flexibility and versatility in applications that require small spaces and minimal amounts of electricity.

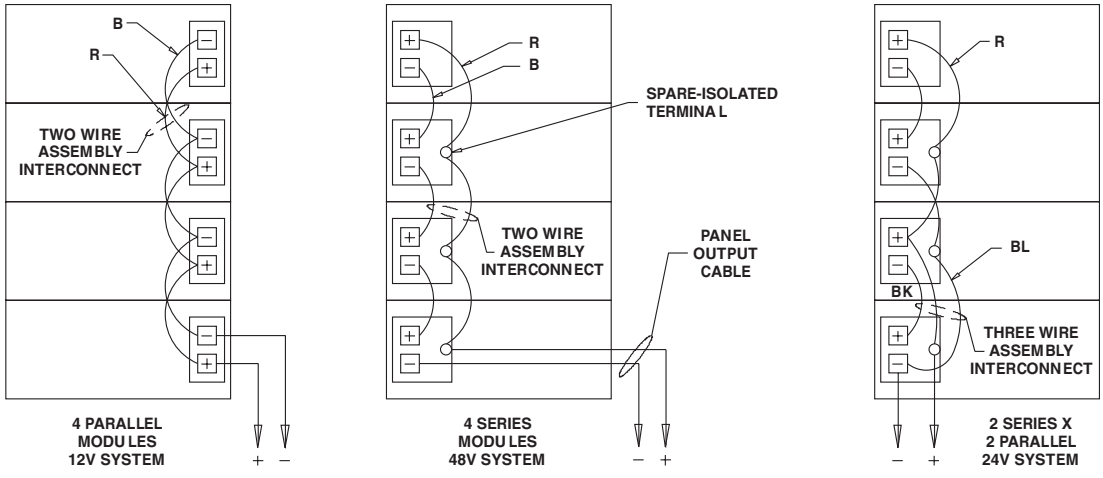
Applications

- Village electrification
- Electrification of remote homes and schools
- Power for medical facilities, security posts and community centers
- Water pumping systems and desalination systems
- Warning lights, traffic systems and railroad signals
- Telecommunications, radios, sensing and signaling equipment
- Battery charging for boats and RV's
- Pipeline monitoring and cathodic protection systems

Small Wattage Modules

Product Name and Description	KS 20	KS 10	KS 5
Part Number	**12556**	**12552**	**12550**
Price	**$181.00**	**$125.00**	**$89.00**
Rated Power (Watts)	20.0	10.0	5.0
Current at Max. Power (Amps)	1.23	0.61	0.31
Voltage at Max. Power (Volts)	16.30	16.30	16.30
Short Circuit Current (Amps)	1.33	0.66	0.34
Open Circuit Voltage	20.70	20.70	20.70
Length (Inches)	25	20.47	16.26
Width (Inches)	13.86	13.86	13.86
Depth (Inches)	0.87	0.87	0.87
Shipping Weight (lbs.)	7.04	4.62	4.62

Module Interconnect Wiring



UNI-SOLAR

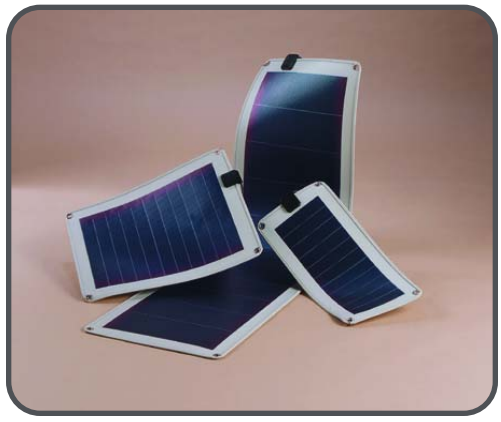
UNI-SOLAR Solar Modules

UNI-SOLAR Framed Modules

Each *UNI-SOLAR* solar electric module utilizes Triple-Junction silicon solar cells. The cells are made using a roll-to-roll deposition process on a continuous roll of stainless steel sheet metal. The result is a unique, flexible, light-weight cell. The modules are exceptionally durable. They are encapsulated in UV stabilized polymers and framed with anodized aluminum. A coated Galvalume steel backing plate provides stiffness. The polymer encapsulation includes EVA and fluoropolymer ETFE. Bypass diodes are connected across each cell, allowing the modules to produce power even when partially shaded. Each module (US-32, 42, 64) has a weather resistant junction box designed to accept 1/2" conduit. These modules, are appropriate for all applications from simple single module requirements to high voltage grid-connected installations. Lead length 8 feet (US-3.5.11.21). US-116 has M/C type connectors individually packed.

Features

- Glass Free
- Durable
- Unbreakable
- Lightweight
- Shadow Tolerant
- Easily Installed
- US-116, 64, 42, 32 carry a twenty year warranty
- US-5, 11, 21 have ten year warranty
- US-3 has a 3 year warranty



FLX Flexible Modules

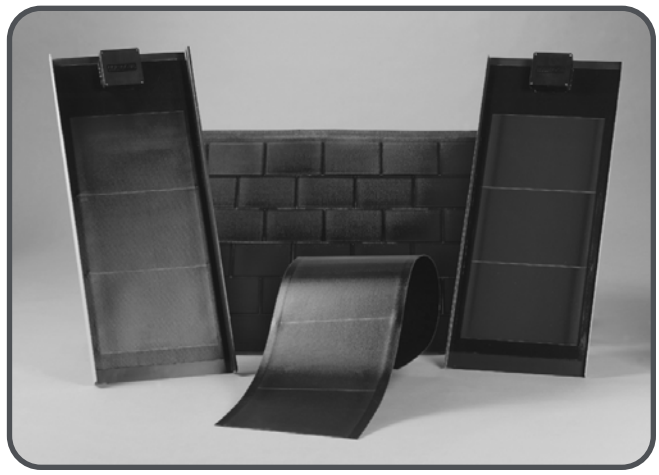
These modules are constructed with "soft" backing and advanced polymer encapsulants, protecting the cells from the oxygen and moisture of the environment. They can easily be mounted to a curved surface or rolled up into a 16 inch or greater cylinder and stored for use when needed. These modules are popular on RV's, boats or anywhere truly portable power is needed. A five year warranty and eight feet of output cable are standard. Individually packed.

Product Name and Description	US-116	US-64	US-42	US-32	US-21	US-11	US-5	US-3	FLX-32	FLX-11	FLX-5
Part Number	**15667**	**15664**	**15642**	**15632**	**15621**	**15610**	**15605**	**15603**	**15674**	**15672**	**15670**
Price	**$714.00**	**$395.00**	**$294.00**	**$228.00**	**$173.00**	**$129.00**	**$62.00**	**$50.00**	**$318.00**	**$157.00**	**$89.00**
Rated Power (Watts)	116.0	64.0	42.0	32.0	21.0	11.0	5.0	2.7	32.0	11.0	5.0
Current at Max. Power (Amps)	3.88	3.88	2.54	1.94	1.20	0.62	0.30	0.33	1.94	0.62	0.30
Short Circuit Current (Amps)	4.80	4.80	3.17	2.40	1.59	0.78	0.37	0.40	2.4	0.78	0.37
Voltage at Max. Power (Volts)	30.0	16.5	16.5	16.5	16.5	16.5	16.5	8.1	16.5	16.5	16.5
Open Circuit Voltage (Volts)	43.2	23.8	23.8	23.8	23.8	23.8	23.8	12.0	23.8	23.8	23.8
Length (Inches)	96.0	53.8	36.5	53.8	36.5	19.3	19.3	11.3	56.27	21.8	21.8
Width (Inches)	30.2	29.0	29.0	15.0	15.0	15.0	8.0	8.1	16.67	16.7	9.71
Shipping Weight (lbs.)	44.0	24.0	21.0	13.0	12.0	5.0	5.0	3.0	6.0	2.5	2.0

FLX Series Solar Module Accessories

Product Name and Description	Description	Part Number	Price
StayPut Hard Mount - 4 piece	FLX-5 and 11	15532	$8.00
StayPut Canvas Kit - 4 piece	FLX-5 and 11	15534	$13.00
StayPut Canvas Kit - 6 piece	FLX-32	15533	$15.00
StayPut Hard Mount - 6 piece	FLX-32	15531	$11.00
Extension Cord - 10 foot (3.05m)	SAE to SAE Connector	15527	$16.00
Fused Battery Cable	2 foot (.61m) replacement	15529	$13.00

Solar Electric Roofing Systems



The leader in thin-film amorphous-silicon photovoltaic (PV) modules offers a new and revolutionary line of solar electric roofing panels with *UNI-SOLAR*'s advanced Triple Junction cell technology. *UNI-SOLAR*'s roofing panels are unbreakable, lightweight, architecturally attractive and emulate conventional roofing materials in design, construction, function and installation. These panels are glass free. Manufacturer's 20 year performance warranty guarantees no less than 80% of rated power.

UNI-SOLAR's modules are available as a frameless laminate that can be factory bonded or field applied to conventional roofing materials. These are Structural Standing Seam (SSR) metal panels, Field Applied Laminate (PVL), and PV Shingles (SHR). Solar electric roofing products are configured in series on the roof deck to form a sub-array. Sub-array groups are then combined together to form an array. Array wiring configuration comes available with a standard junction box or factory wired with quick connect wiring, dependent upon specific system needs.

Structural Standing Seam (SSR) Panels

Designed for ease of installation, this solar module is integrated into the roof of conventional structural standing seam panels. Typical applications include: PV covered parking shelters, EV charging stations, commercial buildings and covered park shelters. Solar laminates are bonded to a 16 inch (40.64 cm) wide painted Galvalume® steel panel with a weather resistant clear polymer cover. Adjacent metal pans interlock together by an integral snap seam. Mounting clips are supplied by installer for attachment to purlin, beam or decking. Standard laminate length: 55 inches up to 216 inches. Maximum metal pan length for factory bonding is 21 ft.

Field Applied Laminate (PVL)

Solar Field Applied Laminates are aesthetically pleasing and integrated into roof. Solar cells with peel and stick adhesive are field bonded to a 16 inch (40.64 cm) wide Galvalume steel pans. Adjacent panels attach to roof with standard clips and fasteners supplied by installer. Solar laminate wiring is covered by ridge trim at the peak of the roof. A variety of lengths are available to achieve complete ridge to eave coverage. Bonding on any other surface voids the warranty. Installer must complete factory training prior to ordering PVL Laminates.

PV Shingles (SHR)

Combining solar innovation with award winning design, the flexible SHR assumes the pattern of traditional asphalt shingles. The new PV shingle enables roofs of residential or commercial buildings to become sources of electricity as well as protection from the elements. The PV shingle face is textured to blend and complement the granular surface of conventional surrounding shingles. Each shingle is 12 inches (30.48 cm) wide by 86.5 inches (219.71 cm) long and nailed in place on roof decking over fire resistant underlayment. Electrical lead wires, #18 AWG, extend 12 inches (30.48 cm) from underside of each shingle and pass through the roof deck allowing interior roof space connections. The sun's warmth aids in bonding shingles together, further providing a weather resistant seal. Cell exposure 5.0 inches (12.7 cm) x 86.4 inches (219.46 cm). Array size depends on power demands.

Product Name and Description	SSR128	SSR64	PVL128	PVL116	PVL87	PVL64	PVL58	PVL29	SHR17
Part Number	**15682**	**15681**	**15687**	**15690**	**15691**	**15686**	**15692**	**15693**	**15685**
Price	**$1054.00**	**$526.00**	**$690.00**	**$638.00**	**$481.00**	**$345.00**	**$325.00**	**$169.00**	**$116.00**
Rated Power (Watts)	128.0	64.0	128.0	116.0	87.0	64.0	58.0	29.0	17.0
Current at Max. Power (Amps)	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	2.0
Voltage at Max. Power (Volts)	33.0	16.5	33.0	30.0	22.5	16.5	15.0	7.5	8.6
Length (Inches)	219.0	115.13	216.0	198.25	150.25	112.13	102.75	55.5	86.5
Width (Inches)	16.0	16.0	15.5	15.5	15.5	15.5	15.5	15.5	12.0
Shipping Weight (lbs.)	48.5	25.5	17.0	16.5	12.3	9.0	8.2	4.1	10.0

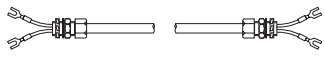
Module Interconnects and Panel Output Cables

Proper connection of your solar modules to each other and to other components is crucial to the overall performance of your photovoltaic system. Without proper wiring, power from your solar array may be lost right at the source before it ever gets to your battery bank or inverter. The module interconnects and panel output cables listed below make it very easy to make clean, code-compliant, water-tight connections.

Cable Assemblies

All of these interconnects are pre-assembled, featuring tin-plated copper fork terminals crimped and soldered to #10 AWG stranded copper wire with adhesive "melt wall" shrink tubing heat sealed over the crimp connection. All cables are UL type TC, 600V, 90°C with black PVC sunlight resistant jacket and include corrosion resistant, non-metallic, liquid-tight cable strain relief connectors for half inch knockouts.

Product Name and Description	Part Number	Price
Kyocera KC60/80/120 10-2 x 30"	43605	$5.50
Kyocera KC60/80/120 10-3 x 30"	43606	$6.50



Two Wire Cable

Three Wire Cable

Conduit Assemblies

Conduit interconnects provide supplemental protection for wiring and in some cases are required to satisfy the NEC. All interconnects are pre-assembled in half inch flexible liquid-tight, non-metallic conduit which is UL listed for outdoor use (80°C) for added protection and ease of installation. Fork terminals are crimped and soldered to #10 AWG THHN wire and heat shrink sealed for ultimate protection in all environments.

Product Name and Description	Part Number	Price
Kyocera KC60/80/120 10-2 x 30"	43495	$7.50
Kyocera KC60/80/120 10-3 x 30"	43496	$9.50

Two Wire Conduit Assemblies

Three Wire Conduit Assemblies

Multi-Contact Assemblies

These wire harnesses are terminated on one or both ends with UL-listed Multi-Contact (MC) connectors. Use P/N 98500 and 98504 to convert standard junction boxes to those with MC pigtails, and P/N 98501, 98502 and 98503 to extend cable from existing MC connectors. Cable assemblies are made with UL-listed, 600 Volt, multi-stranded, #10 AWG RHH/RHW/USE-2, outdoor-rated, sunlight-resistant cable."

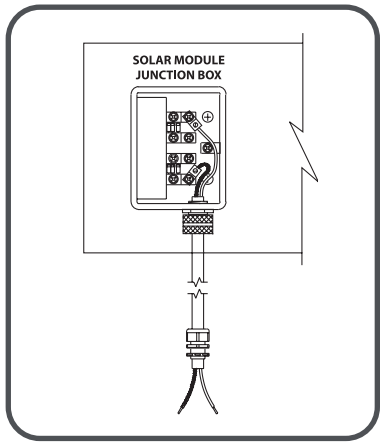
Product Name and Description	Part Number	Price
20 inch MC pigtail set for KC J-box	98500 P	$17.50
Double-ended 10 foot MC extension set (M/F ends)	98503 S	$13.60
30 inch MC pigtail set for KC J-box	98504 P	$16.00
Single-ended 30 foot MC extension set (cut wire one end)	98501 P	$29.00
Double-ended 30 foot MC extension set (M/F ends)	98502 S	$14.50

P/N 98504

Custom lengths are available. Call for information.

Panel Output Cable Assemblies

These panel output cable assemblies are intended for interconnecting the output of pre-wired solar panel assemblies to charge controllers, disconnect switches or sub-array combiner boxes. All panel output cable assemblies are pre-assembled, featuring UL type TC, 600V, 90ºC wire with #10 AWG, stranded copper wire with adhesive "melt wall" shrink tubing heat sealed over crimp connection on one end, cut wire on other end. Includes 2 corrosion resistant, non-metallic, liquid-tight strain relief connectors for 1/2" knockouts. Available in #10 AWG in 10, 20 or 30 foot lengths.



Product Name and Description	Part Number	Price
PC #10-2 x 10'	43780	$15.00
PC #10-2 x 20'	43781	$22.00
PC #10-2 x 30'	43782	$28.00

Larger sizes are available. Call for more information

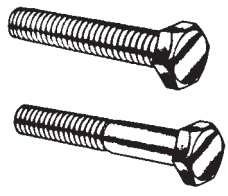
ELECTRICAL / MECHANICAL ACCESSORIES

Mechanical Accessories

Hardware

The following hardware kits are pre-packaged fasteners used primarily for attachment of solar modules to mounting structures and for structural component connections. All fasteners are type 316 stainless steel. All bolts include: (1) hex head screw, (2) flat washers, (1) hex nut, and (1) lockwasher. Foundation pack includes 4-6" stainless steel 'J' bolts with nuts and washers.

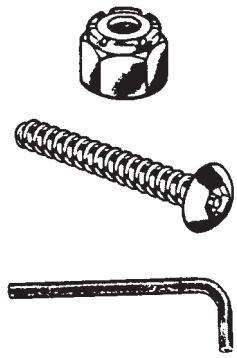
Product Name and Description	Part Number	Price
Module Hardware Kit 1/4" x 3/4" (4 bolts)	43652	$2.50
Structure Hardware Kit 3/8" x 1 1/4" (6 bolts)	43663	$7.57
Structure Hardware Kit 1/2" x 1 1/4" (6 bolts)	43668	$8.61
Foundation Hardware Pack 3/8" (4 bolts)	43647	$18.00
SL-13 Strain Relief	43231	$1.80



Security Hardware

Stainless steel hardware features vandal resistant truss head, pin-in-hex drive screws requiring a special key. Screw head cannot be turned with conventional tools. Hex nut has nylon locking collar-preventing fastener removal without special key. All fasteners are type 316 stainless steel. All bolts include: (1) hex head screw, (2) flat washers, (1) hex nut, and (1) lockwasher.

Product Name and Description	Part Number	Price
Module Hardware Kit 1/4" x 3/4" (4 bolts)	43658	$3.59
Structure Hardware Kit 3/8" x 1 1/4" (6 bolts)	43661	$13.84
Security Hex Key 1/4"	43659	$3.13
Security Hex Key 3/8"	43662	$4.61



Solar Module Mounting Structures

There are many different ways to mount solar modules, each with its own pros and cons. Below is a list of the most common types of mount structures available. If you don't see a particular type of mount structure that you are looking for, talk to your KSI dealer and he can find it for you.

See Appendix C (Page 125) for sizing information

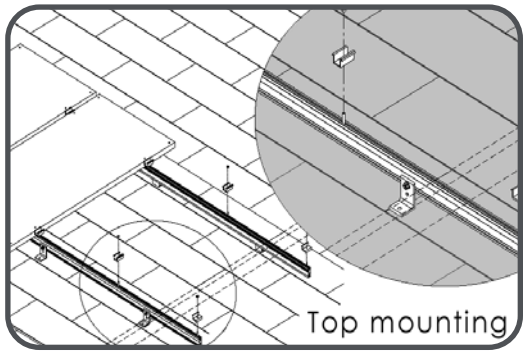
Roof / Ground Mounts

SolarMount™ UniRac® The New Standard in PV Module Racks™

SolarMount Rail Sets can be used with either Top Mounting Clamps or Bottom Mounting Clips. You use Top Mounting Clamps if you plan to install the SolarMount first and then clamp the modules on top. You use Bottom Mounting Clips if you plan to pre-assemble the modules to the SolarMount prior to installation and then attach the completed assembly at the job site. Your choice will also depend on the make and model of module, installation location requirements and other factors. Each mill finish aluminum Rail Set contains 2 rails, L-feet, module mounting hardware type 304 and other fasteners. Lag bolts not included. Clamp Sets and Clip Sets (page 29) contain all hardware required for fastening the modules to the SolarMount rails.

Rail Sets

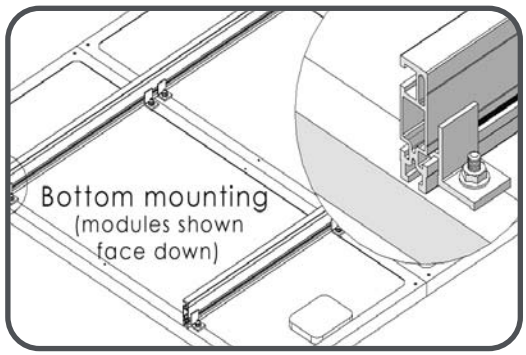
Product Name and Description	Part Number	Number of L-Feet	Price	Shipping Weight (lbs.)
SMR48	24844	4	$83.00	13.0
SMR60	24845	4	$99.00	14.0
SMR72	24846	4	$115.00	16.0
SMR84	24847	4	$131.00	17.0
SMR96	24848	4	$145.00	19.0
SMR106	24849	4	$157.00	20.0



Rail sets below are not UPS shippable. For a special UPS shippable version (except SMR216), which includes split rails and splices, add $20.00 (UPS-20, P/N 24882).

Rail Sets

Product Name and Description	Part Number	Number of L-Feet	Price	Shipping Weight (lbs.)
SMR120	24850	6	$178.00	22.0
SMR132	24851	6	$190.00	24.0
SMR144	24852	6	$202.00	25.0
SMR156	24853	6	$214.00	27.0
SMR168	24854	6	$226.00	28.0
SMR180	24855	6	$238.00	30.0
SMR192	24856	8	$259.00	31.0
SMR204	24857	8	$271.00	33.0
SMR216	24858	8	$283.00	34.0



Top Mounting Clamps			
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
CT2B	24802	$16.00	1.0
CT3B	24803	$20.00	2.0
CT4B	24804	$24.00	2.0
CT5B	24805	$28.00	2.0
CT6B	24806	$32.00	2.0
CT7B	24807	$36.00	2.0
CT8B	24808	$40.00	3.0
CT2C	24859	$16.00	1.0
CT3C	24860	$20.00	2.0
CT4C	24861	$24.00	2.0
CT5C	24862	$28.00	2.0
CT6C	24863	$32.00	2.0
CT7C	24864	$36.00	2.0
CT8C	24865	$40.00	3.0

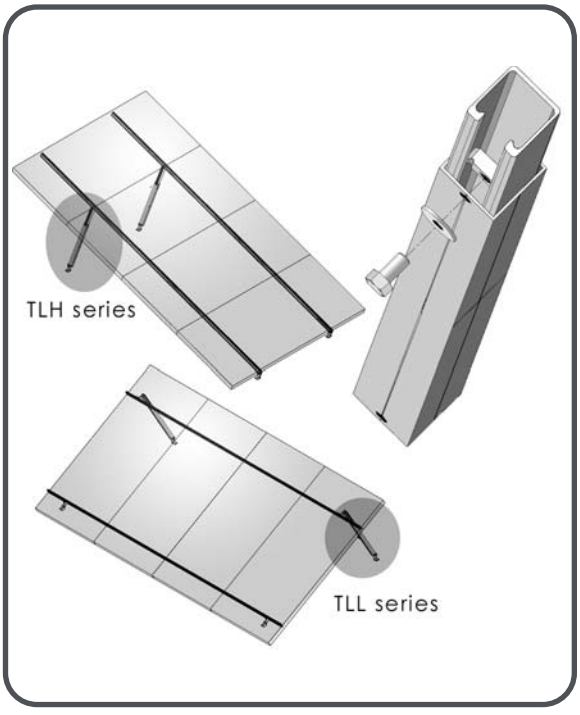
Bottom Mounting Clips			
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
CB2	24866	$14.00	2.0
CB3	24867	$18.00	2.0
CB4	24868	$22.00	3.0
CB5	24870	$26.00	3.0
CB6	24871	$30.00	4.0
CB7	24872	$34.00	4.0
CB8	24873	$38.00	5.0

SolarMount™ Tilt Leg Kits

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Tilt Leg Kits (optional) can be used to set the array to a more optimum angle in order to enhance overall system performance. SolarMount kits feature a quick locking adjustment that makes even seasonal adjustments fast and easy. There are two tilt up modes, 1) high profile (TLH), and 2) low profile (TLL), as illustrated in the adjacent drawings. Use the appropriate chart in Appendix C to select the required SolarMount Tilt Leg Kits.

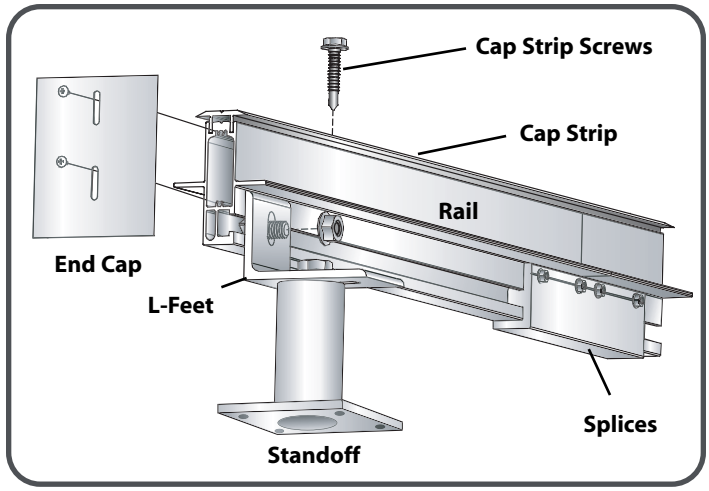
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
High Profile			
TLH2-12	24816	$37.00	3.0
TLH2-44	24817	$54.00	7.0
TLH2-72	24818	$68.00	10.0
TLH4-18	24819	$65.00	7.0
TLH4-64	24820	$99.00	16.0
TLH4-104	24821	$129.00	20.0
Low Profile			
TLL2-12	24822	$49.00	3.0
TLL3-12	24823	$68.00	4.0
TLL2-30	24824	$59.00	5.0
TLL3-30	24825	$83.00	7.0
TLL2-44	24826	$67.00	7.0
TLL3-44	24827	$94.00	10.0



SUNFRAME™ UNIRAC® THE NEW STANDARD IN PV MODULE RACKS™

Add aesthetics to the benefits of PV power. With your array in full view, the sunshine rule applies: it has to look good. SunFrame delivers the visual appeal you and your neighbors expect. To be sure, the mounting system provides structural integrity for your array. Properly installed, SunFrame complies with the Uniform and California Building Codes. It also meets UniRac's own high standard of installation friendliness, both initially and whenever modules need replacement.

But it is aesthetics that truly sets SunFrame apart. It's the only PV module mounting system designed from the outset to enhance the appearance of the home. A completed installation blends handsomely into the roof, becoming as much as part of the house as a skylight.



SunFrame is designed to comply with the Uniform Building Code, 1997, Chapter 16, and the California building Code, 2001, when installed according to the SunFrame installation manual.

The SunFrame is designed to fit KC 125G, 158G and 167G. No sizing is necessary.

Product Name and Description	Anodize Color	Part Number	Price	Shipping Weight (lbs.)
Rails: Includes 8ea. 192 in. rails				
SFRB192-8	Dark Bronze	24970	$1215.00	135.0
SFRC192-8	Clear	24971	$1065.00	135.0
Cap Strips: Includes 8 ea. 192 in. pre-punched cap strips				
SFCSB192-8C	Dark Bronze	24972	$435.00	50.0
SFCSC192-8C	Clear	24973	$385.00	50.0
Cap Strip Screws: Includes 8 ea. 192 in. pre-punched cap strips				
SF10B100	Black	24974	$26.10	2.0
SF10C100	Clear	24973	$21.15	2.0
End Caps: Includes 40 end caps and 2 screws per end cap				
SF11B40	Black	24974	$42.30	2.0
SF11C40	Clear	24975	$42.30	2.0
L-Feet: Includes L-feet and rail mounting hardware				
FTB20	Dark Bronze	24976	$48.60	5.0
FTC20	Clear	24979	$45.90	5.0
Splices: Includes splices and self-tapping screws				
SBB20	Dark Bronze	24980	$48.60	10.0
SBC20	Clear	24981	$45.90	10.0

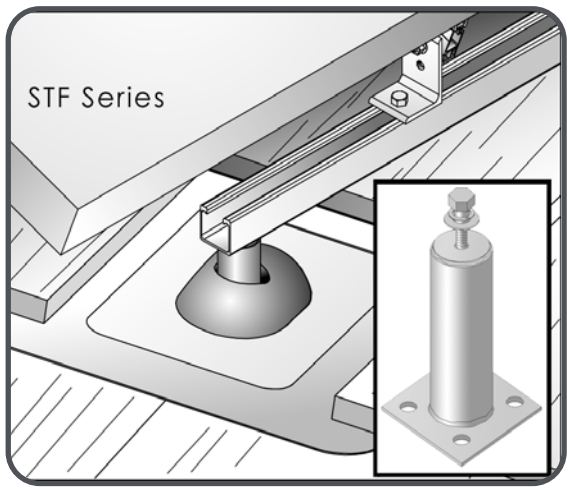
Components:

- **Inter-Module Rails** provide support shelves for the modules.
- **Full Length Cap Strips** secure modules and finish the array topside forming a gap-free frame. Self-drilling screws at 16-in intervals provide the holding power.
- **End Caps** finish the rail ends to complete the frame.
- **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.
- **Splices** safely extend rails.
- **Standoffs** (optional), designed for standard flashing, support L-feet above tile or shake roofs. A range of heights ensure a low profile.

Standoffs

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Standoffs are used for flashed, roof-mounted installations. STR type has vertical flanges with mounting holes for direct connection to the SolarMount rail and are used to substitute for standard L-feet on tile or shake roofs. See the SolarMount Price List (page 28) for quantity of L-feet packed with each SolarMount. STF type have a flat top with a 3/8" threaded insert nut, bolt and flat washer. They are used to support strut to which L-feet and/or tilt legs are attached. Two 3 1/2" x 5/16" stainless steel lag bolts included with all standoffs. Marine-grade zinc-plated welded steel construction.

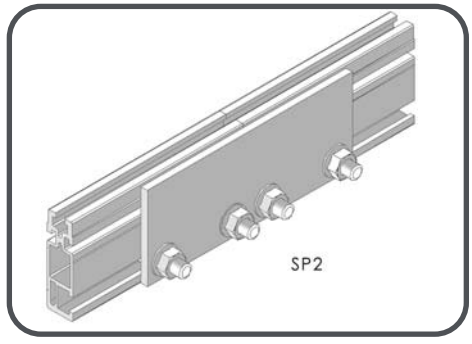


Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
STF3 (3" flat top)	24874	$17.00	2.0
STF4 (4" flat top)	24875	$17.50	2.0
STF6 (6" flat top)	24876	$18.00	2.0
STR3 (3" vertical flange)	24878	$18.00	2.0
STR4 (4" vertical flange)	24879	$18.50	2.0
STR6 (6" vertical flange)	24880	$19.00	2.0

Splice Kits

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Splice kits are required if SolarMounts are installed end to end to mount a large number of modules in a single row. Each splice kit contains two splices and fasteners.



Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
SP2	24917	$16.00	2

Universal Ground Mounts

ZOMEWORKS CORPORATION

These light-weight racks are most commonly installed on roofs. The telescoping back legs make them easy to adjust to face the sun on any slope, either roof or ground. See Appendix C for sizing information.

More Features:

- Telescoping rear legs
- All aluminum construction
- Stainless steel hardware
- Non-corrosive materials
- Sturdy, lightweight design
- Seasonally adjustable from 0° to 60°
- Vertical and low profile configurations
- Slotted, custom-formed aluminum channel accommodates any size module

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
UGM 24	20010	$100.00	8.0
UGM 30	20011	$110.00	9.0
UGM 36	20012	$120.00	10.0
UGM 48	20014	$145.00	13.0
UGM 54	20015	$153.00	15.0
UGM 60	20016	$169.00	16.0
UGM 66	20017	$184.00	17.0
UGM 72+	20018	$200.00	18.0

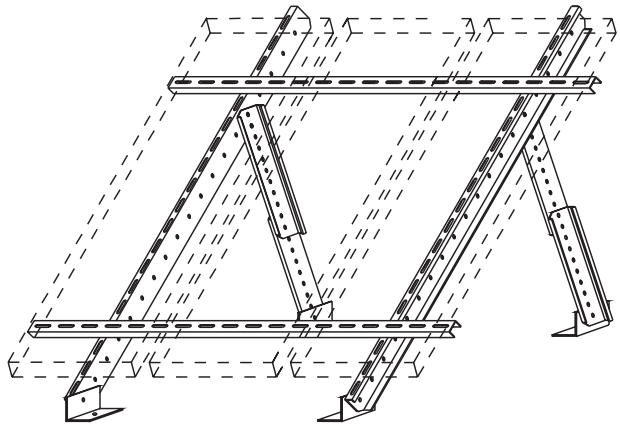
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
UGM 84+	20020	$233.00	22.0
UGM 90+	20021	$263.00	29.0
UGM 96+	20022	$273.00	31.0
UGM 102+	20023	$299.00	33.0
UGM 108+	20024	$328.00	35.0
UGM 114+	20025	$340.00	38.0
UGM 120+	20026	$354.00	40.0

+ Indicates oversize. UPS charges a minimum as for a package weighting 70 lbs.

Universal Roof/Ground Low Profile Mounts

See Appendix C for sizing information.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
UGMLP 72	21068	$200.00	20.0
UGMLP 84+	21069	$208.00	22.0
UGMLP 96+	21070	$218.00	24.0
UGMLP 108	21071	$226.00	26.0
UGMLP 120	21072	$234.00	36.0
UGMLP 132	21073	$314.00	38.0
UGMLP 144	21074	$322.00	40.0
UGMLP 156+	21075	$330.00	48.0
UGMLP 168+	21076	$340.00	50.0
UGMLP 180+	21077	$340.00	53.0
UGMLP 192+	21078	$416.00	55.0
UGMLP 204+	21079	$424.00	62.0
UGMLP 216+	21080	$432.00	65.0



UGMLP Mounts

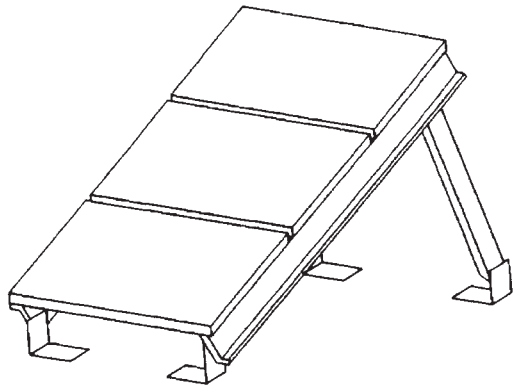
+ Indicates oversize. UPS charges a minimum as for a package weighing 70 lbs.

KYOCERA Solar, Inc.

KSI Adjustable Ground Mounts

Industrial quality aluminum support structures are designed for maximum durability and corrosion resistance in all environments. Constructed of 6061-T6 structural aluminum. Features 3 inch deep support channels, 2 inch square adjustable rear telescoping legs, clear anodized finish and engineered to survive 100 mph winds. Module support channels are pre-drilled to mount 3 or 5 KC 40, 50, 60, 70, 80 or 120 modules. Includes (4) 1/4 inch thick aluminum angle mounting feet and all necessary stainless steel fasteners-type 316. Adjustable tilt angle structures are stocked in two tilt ranges: from 20 to 40 degrees, or 45 to 65 degrees from horizontal. Flat surface (roof) support structures are also offered without adjustable legs (0 degrees). Custom sizes available

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
KCS-3-0	17000	$149.00	21.0
KCS-3-20/40	17072	$214.00	29.0
KCS-3-45/65	17073	$229.00	34.0
KCS-5-0	17010	$199.00	31.0
KCS-5-20/40	17075	$292.00	42.0
KCS-5-45/65	17076	$317.00	51.0

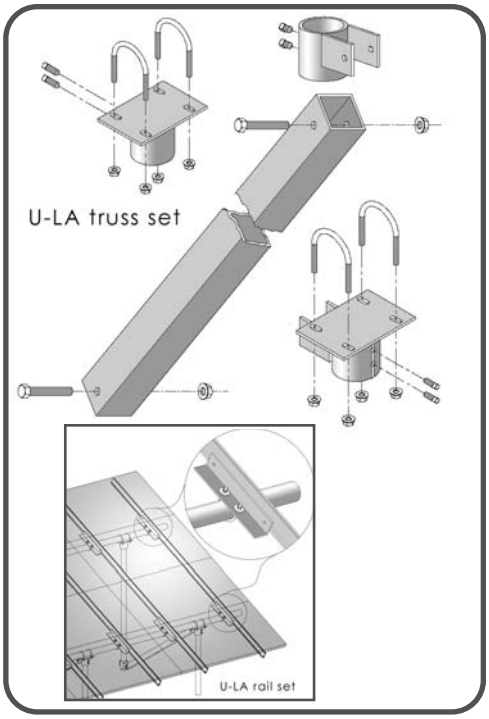


3 Module Adjustable Support Structure

UNIRAC The New Standard in PV Module Racks™ — See Appendix C for sizing information — Large Array Ground Mounts

U-LA Series large array mounting system is ideal for large ground-based arrays. The system is composed of 1) rail sets, 2) truss sets and other components, and 3) 2 1/2" Schedule 40 pipe (not supplied). Consult your Kyocera representative for assistance in configuring your U-LA system for any ground based array of 12 or more modules. Mill finish aluminum.

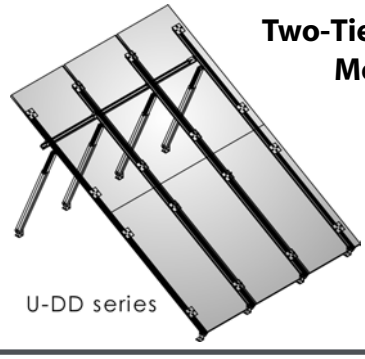
Rail Sets			
Product Name and Description	**Part Number**	**Price**	**Shipping Weight (lbs.)**
U-LA/84	24216	$160.00	14
U-LA/96	24883	$175.00	16
U-LA/106	24884	$190.00	18
U-LA/120	24885	$210.00	20
U-LA/132	24886	$230.00	22
U-LA/156	24887	$260.00	26
Truss Sets			
Product Name and Description	**Part Number**	**Price**	**Shipping Weight (lbs.)**
U-LA/TRK7 - Incl 7 ft. cross brace	24888	$160.00	14
U-LA/TRK10 - Incl 10 ft. cross brace	24889	$175.00	16
U-LA/TRK14 - Incl 14ft. cross brace	24890	$190.00	18



UNIRAC The New Standard in PV Module Racks™ — See Appendix C for sizing information — Two-Tier Tilt Up Mounts

Two-tier mounts are configured in two rows with the module length running vertically. The mounting rails are attached to the mounting holes on the back of the module. Telescoping back legs adjust tilt up to 60 degrees maximum. Lag bolts not included. Mill finish aluminum, stainless steel hardware.

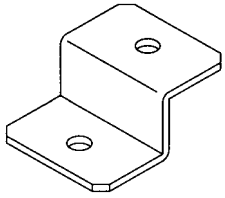
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
U-DD/60	24214	$335.00	42
U-DD/72	24828	$350.00	44
U-DD/84	24220	$450.00	49
U-DD/96	23245	$460.00	53
U-DD/104	23250	$465.00	55



Universal Flush Mount Brackets

These brackets are especially useful for solar modules that have only intermediate frame mounting holes. They can be attached to any solar module frame and are perfect for applications that have curved or irregular surfaces.

Product Name and Description	Part Number	Price
UFB-01	23450	$8.00



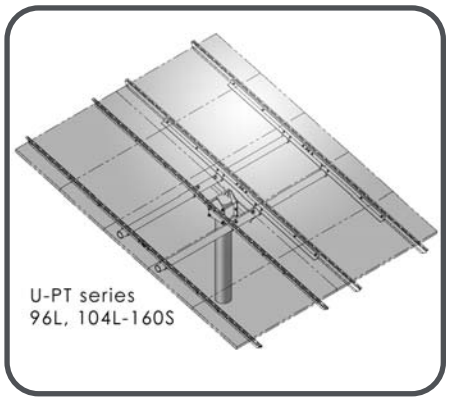
See Appendix C for sizing information

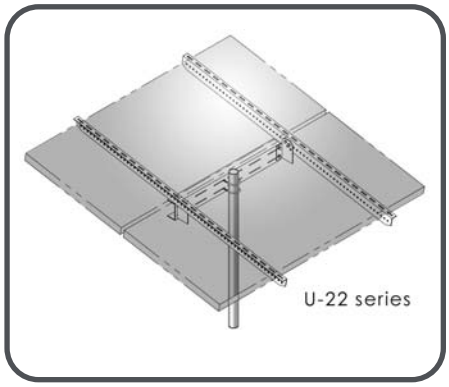
Pole Top Mounts

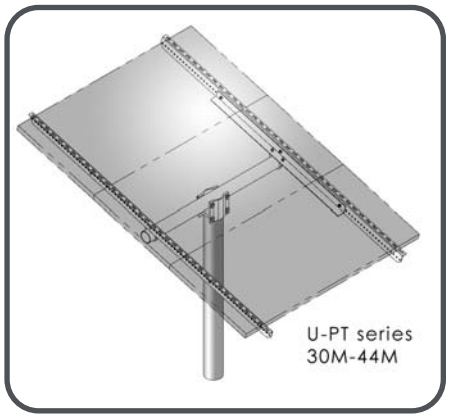
UNIRAC THE STANDARD IN PV MODULE RACKS™

Pole top mounts are mill finish aluminum, except for grade 5 zinc plated steel pole plates for 6 in. models. Stainless steel hardware, including module mounting hardware, included. Requires Schedule 40 steel pole, not included. Tilt angle adjustment is from 15 to 60 degrees.

Product Name and Description	Part Number	Nom. Size Pole I.D. (O.D.) (in.)	Price	Shipping Weight (lbs.)
U-22/28M	23299	2.5 (2.875)	$109.00	10
U-22/28XL	24281	2.5 (2.875)	$123.00	11
U-22/32L	23298	2.5 (2.875)	$119.00	11
U-22/52M	23297	3.0 (3.50)	$139.00	12
U-22/52XL	23301	3.0 (3.50)	$153.00	12
U-PT/30M	24350	4.0 (4.50)	$210.00	23
U-PT/40S	24346	4.0 (4.50)	$225.00	30
U-PT/40M	24298	4.0 (4.50)	$235.00	30
U-PT/40L	23340	4.0 (4.50)	$245.00	30
U-PT/44M	23324	4.0 (4.50)	$245.00	31
U-PT/52S	23352	4.0 (4.50)	$285.00	31
U-PT/52L	24400	4.0 (4.50)	$320.00	39
U-PT/60L	23343	4.0 (4.50)	$345.00	40
U-PT/80S	23356	4.0 (4.50)	$385.00	40
U-PT/80M	24299	4.0 (4.50)	$395.00	44
U-PT/80L	23347	4.0 (4.50)	$420.00	48
U-PT/96L	23349	6.0 (6.625)	$575.00	74
U-PT/104S	23359	4.0 (4.50)	$475.00	48
U-PT/104L	23333	6.0 (6.625)	$620.00	78
U-PT/120L	23339	6.0 (6.625)	$685.00	79
U-PT/136S	24297	6.0 (6.625)	$705.00	81
U-PT/136L	24296	6.0 (6.625)	$755.00	87
U-PT/152L	24830	6.0 (6.625)	$815.00	95
U-PT/160S	24831	6.0 (6.625)	$795.00	88







ZOMEWORKS CORPORATION

See Appendix C for sizing information.

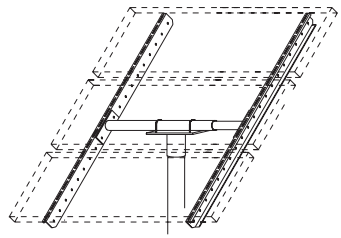
These sturdy racks are set on poles above ground, out of the way of grazing animals or other activity on the ground. Excellent for remote sites. Stainless steel hardware.

Product Name and Description	Part Number	Nom. Size Pole I.D. (O.D.) (in.)	Price	Shipping Weight (lbs.)
FX3 - 24	20082	3.0 (3.50)	$168.00	27.0
FX3 - 28	20090	3.0 (3.50)	$168.00	28.0
FX3 - 52	20253	3.0 (3.50)	$168.00	30.0
FX3 - 32	20091	3.0 (3.50)	$168.00	28.0
FX3 - 48	20094	3.0 (3.50)	$186.00	30.0
FX3 - 52	20255	3.0 (3.50)	$186.00	30.0
FX3 - 60	20096	3.0 (3.50)	$194.00	31.0
FX3 - 64	20097	3.0 (3.50)	$194.00	32.0
FX3 - 80	20101	3.0 (3.50)	$216.00	33.0
FX3 - 92+	20104	3.0 (3.50)	$246.00	35.0
FX3 - 96+	20105	3.0 (3.50)	$246.00	35.0
FX4 - 452	20111	4.0 (4.50)	$320.00	53.0
FX4 - 552	20112	4.0 (4.50)	$320.00	55.0
FX4 - 852	20115	4.0 (4.50)	$330.00	61.0
FX4 - 560	20256	4.0 (4.50)	$340.00	57.0
FX4 - 860	20125	4.0 (4.50)	$340.00	61.0
FX4 - 864	20128	4.0 (4.50)	$345.00	64.0
FX4 - 480	20139	4.0 (4.50)	$365.00	59.0
FX4 - 580	20140	4.0 (4.50)	$365.00	61.0
FX4 - 880	20395	4.0 (4.50)	$380.00	67.0
FX4 - 592+	20147	4.0 (4.50)	$400.00	64.0
FX4 - 892+	20149	4.0 (4.50)	$400.00	70.0
FX 6-4 - 352+	20220	6.0 (6.625)	$475.00	85.0
FX 6-4 - 416+	20221	6.0 (6.625)	$495.00	85.0
FX 6-4 - 448	20222	6.0 (6.625)	$515.00	85.0
FX 6-5 - 416+	20224	6.0 (6.625)	$555.00	85.0
FX 6-5 - 480	20226	6.0 (6.625)	$620.00	90.0
FX 6-6 - 528*	20232	6.0 (6.625)	$650.00	105.0
FX 6-6 - 624*	20233	6.0 (6.625)	$675.00	105.0
FX 6-8 - 320+	20241	6.0 (6.625)	$455.00	95.0
FX 6-8 - 368+	20242	6.0 (6.625)	$475.00	95.0
FX 6-8 - 384+	20243	6.0 (6.625)	$495.00	95.0
FX 6-8 - 416+	20396	6.0 (6.625)	$575.00	95.0
FX 6-8 - 608+	20245	6.0 (6.625)	$650.00	105.0
FX 6-9 - 528*	20258	6.0 (6.625)	$590.00	105.0
FX 6-9 - 624*	20249	6.0 (6.625)	$650.00	125.0
FX 6-9 - 704+**	20250	6.0 (6.625)	$675.00	125.0
FX 6-9 - 800**	20251	6.0 (6.625)	$725.00	125.0
FX 6-9 - 896**	20252	6.0 (6.625)	$775.00	125.0
FX 90+	20270	6.0 (6.625)	$790.00	275.0
FX120+	20271	6.0 (6.625)	$850.00	300.0

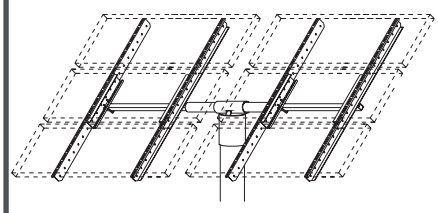
For FX3 and FX4 Series: + Indicates oversize, UPS charges a minimum as for a package weighing 70 lbs.
For FX6 Series: + Indicates the series that can be shipped by UPS, * Indicates 3 rows of modules. ** Indicates 4 rows of modules.
For FX Series: + Indicates that FX Series must ship by common carrier

More Features:

- Sturdy, wind-resistant construction
- Designed for 90 MPH wind loads
- Stout, welded steel gimbal and cross- bar assembly
- Heavy-duty welded steel with urethane enamel coating
- Mounts on Schedule 40 steel pipe
- Slotted, custom-formed aluminum channel accommodates any size PV module
- Easy, unlimited, seasonal adjustment



FX 3



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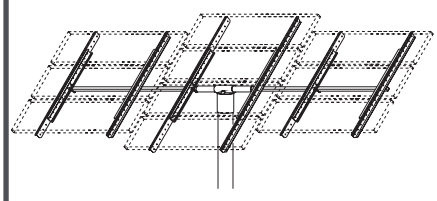
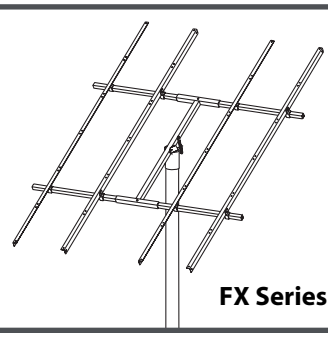


FX 6



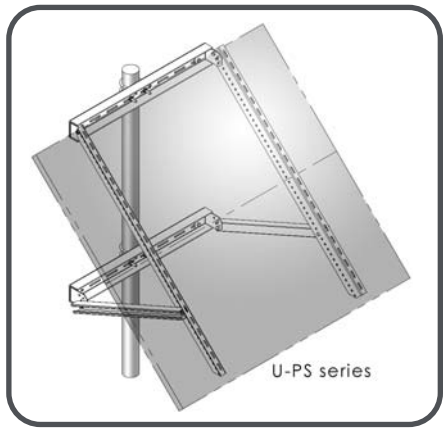
FX Series

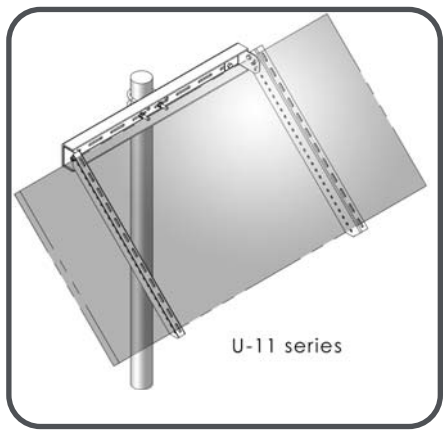
UNIRAC The New Standard in PV Module Racks™

See Appendix C for sizing information

Side of Pole Mounts

Side of pole mounts feature mill finish aluminum components throughout. Stainless steel hardware, including module mounting hardware included. Requires schedule 40 pole, not included.



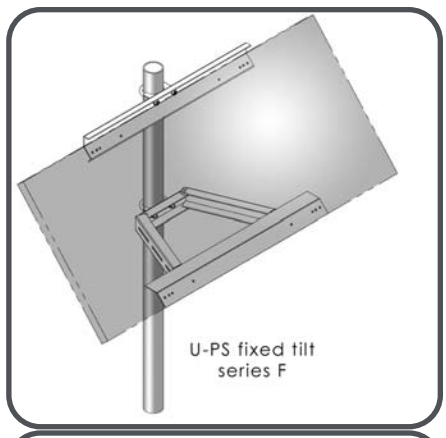


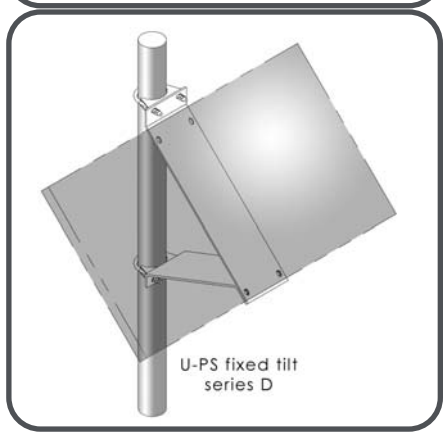
Adjustable Tilt

Product Name and Description	Part Number	Price	Nom. Size Pole I.D. (O.D.) (in.)	Shipping Weight (lbs.)
U-11/28M	23295	$109.00	2.5 (2.875)	9.0
U-PS/26XXL	24104	$146.00	2.5 (2.875)	12.0
U-PS/30XL	24107	$153.00	2.5 (2.875)	14.0
U-PS/40XL	24282	$184.00	2.5 (2.875)	20.0
U-PS/52M	23304	$225.00	3.0 (3.50)	20.0
U-PS/52XL	24109	$245.00	3.0 (3.50)	22.0
U-PS/60L	23302	$245.00	3.0 (3.50)	24.0
U-PS/80M	23306	$270.00	4.0 (4.50)	25.0
U-PS/80XL	24111	$290.00	4.0 (4.50)	26.0
U-PS/88L	24117	$300.00	4.0 (4.50)	26.0
U-PS/104M	24114	$330.00	4.0 (4.50)	30.0

Fixed Tilt

Product Name and Description	Fixed Tilt Angle (deg.)	Part Number	Price	Nom. Size Pole I.D. (O.D.) (in.)	Shipping Weight (lbs.)
U-PS/14D	45	24125	$29.00	1.5 (1.9)	3.0
U-PS/20D	45	24126	$39.00	1.5 (1.9)	3.0
U-PS/12F	45	24832	$69.00	2.0 (2.375)	5.0
	60	24833	$69.00	2.0 (2.375)	5.0
U-PS/26F	45	24834	$89.00	2.0 (2.375)	6.0
	60	24835	$89.00	2.0 (2.375)	6.0
U-PS/26FL	45	24836	$97.00	2.0 (2.375)	6.0
	60	24837	$97.00	2.0 (2.375)	6.0
U-PS/29FL	45	24838	$105.00	2.0 (2.375)	7.0
	60	24839	$105.00	2.0 (2.375)	7.0





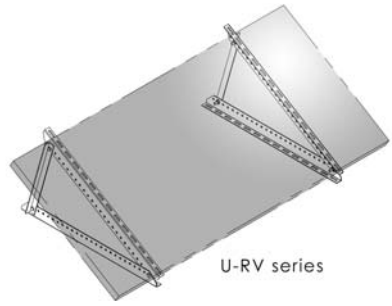
UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

RV Mounts

Adjustable Tilt

RV mounts are designed to tilt up from either side. Wing bolts ease the raising and lowering of the module. Legs adjust tilt up to 60 degrees maximum. Stainless steel module mounting hardware provided. Bolts or screws to attach the rack to the RV not included.

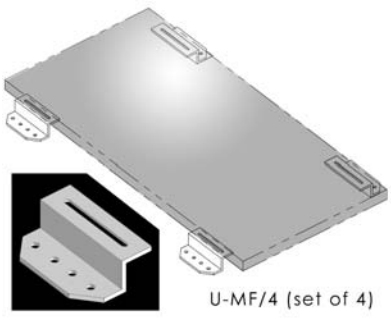
Product Name and Description	Part Number	Modules	Price	Shipping Weight (lbs.)
U-RV/26/KC	23368	1 - KC 120, 80, 60, 40	$70.00	6
U-RV/32	23372	1 - US64, 42	$75.00	7
U-RV/52	24841	2 - KC 120's	$100.00	12.0



Mounting Feet

Mounting feet have great flexibility because of a long slot to attach to the mounting holes on the modules rail, and multiple mounting holes for attachment to the RV roof. Large foot area also allows for adequate adhesive, if used. Bolts or screws to attach to RV not included.

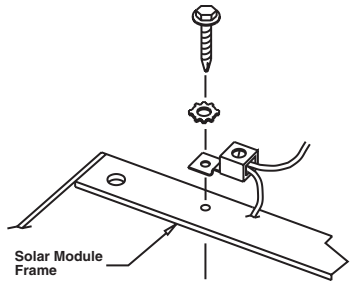
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
U-MF/4	24840	$18.00	1



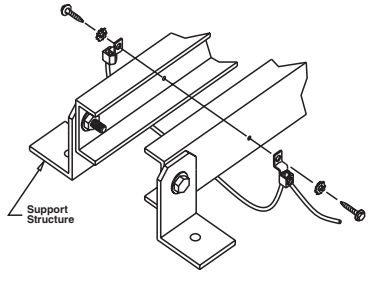
System Grounding Accessories

The following items and kits will help you properly ground your system to minimize the shock potential and the possibility of lightning damage.

Product Name and Description	Part Number	Price
Ground Rod Kit - Comes complete with 5/8" by 8' copper clad steel rod, 10' of #6 AWG wire, copper ground rod clamp and copper ground lug with stainless steel hardware.	42800	$35.00
Module Ground Kit (Fits KC Series) - Copper lug, #6 AWG x 30" wire and hardware for grounding module frame(s).	42804	$9.00
Panel Ground Kit - Copper lug, #6 AWG x 96" wire and hardware for grounding module frame(s).	42805	$12.00
Ground Rod Clamp - 5/8"	42795	$2.00
Ground Lug (Copper) - Set screw type, 70A, #2 to #8 AWG, 1/4" hole.	42797	$2.00
Ground Wire - Bare #6 AWG	42796	$0.30/ft.
Two-Piece Ground Rod Kit - Not UL listed. Easy to ship international. Contains all material as PN 42800 except different ground rod.	7102-0097	$31.00



Module Ground Kit



Panel Ground Kit

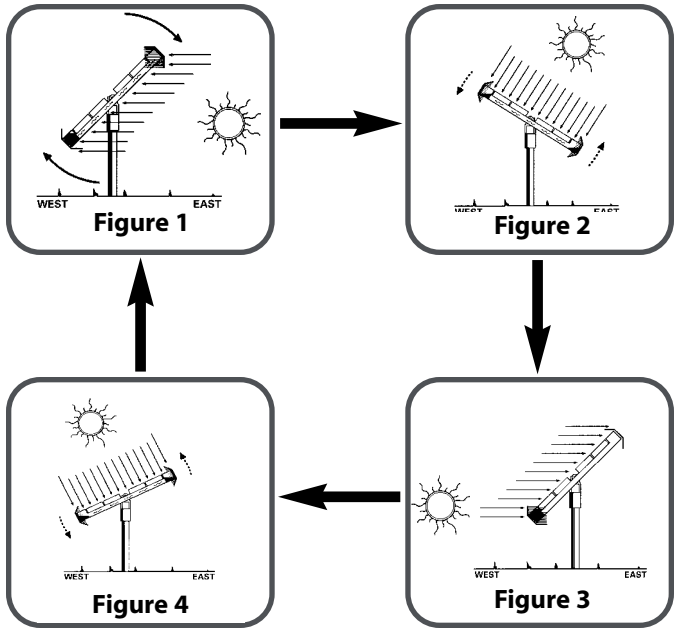
See Appendix C for sizing information

Passive Trackers

A tracker mount follows the path of the sun from east to west, keeping the solar modules facing directly toward the sun from dawn to dusk. This can result in a 25% increase in your daily energy production during the summer as compared to the same solar array on a fixed mount. The trackers operate passively (see how they work below) without any motors, gears or pistons to wear out making them almost as dependable as gravity and the heat of the sun. These units are ideal for water pumping systems since power is produced in a gradual dawn to dusk flow rather than around a noon peak. The north-south tilt axis can be adjusted seasonally for peak performance throughout the year. The use of a tracker increases the amount of water pumped per day and makes the most of your solar modules and pump.

How the Tracker Follows the Sun

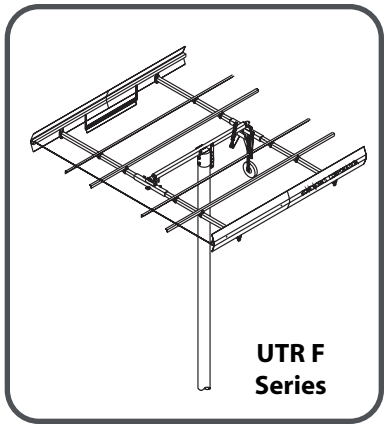
The Tracker begins the day facing west (see figure 1). As the sun rises in the east it heats the unshaded west side canister from behind the solar array forcing liquid through an interconnecting copper tube and into the shaded east side canister. As this happens, the east side canister becomes heavier causing the tracker to rotate to the east. The movement of the liquid is controlled by the aluminum shadow plates mounted on the outside of each canister. When one canister is exposed to the sun more than the other, its vapor pressure increases which forces liquid freon to the cooler shaded side. As the sun moves across the sky from east to west (see figures 2 and 3) the Track Rack follows it at approximately 15° per hour continually seeking equilibrium as liquid freon moves from one side of the tracker to the other. The tracker ends the day facing west (see figure 4)where it sits waiting for the sun to rise in the east the next morning to start the cycle all over again.



Universal Track Rack

ZOMEWORKS CORPORATION

The Zomeworks universal passive Track Rack can increase solar array daily power output by 25% or more. The adjustable single-axis passive solar tracker follows the sun by heated liquid flowing between east and west sealed canisters. Tracker rails adjust along the East-West canister to allow for varied module lengths. The UTR is designed to withstand 90 MPH winds. Five universal models "each size fits all modules"design, supports various quantities of Kyocera (KC), Uni-Solar (US), and other manufacturers' modules. Ten year limited warranty. The High Wind Upgrade Kit (HWU) is recommended for stabilizing the tracker in areas where there are frequent high winds. This kit can be ordered with your tracker or purchased later as an add-on. The High Wind Upgrade Kit consists of an additional set of shock absorbers, a shock mounting bracket, a bumper bolt to protect the shock absorbers from the tracker rails, and a heavy duty seasonal adjustment bar. The High Wind Upgrade Kit is not available for the UTR 020 tracker.



Product Name and Description	Part Number	Price	Shipping Weight (lbs.)	Pole Size (SCH 40 Steel Pipe) (in.)	Minimum Pole Height (in.)	Minimum Pole Depth (in.)
UTR 020	20370	$490.00	108.0	2.5	75	38
UTR 040	20371	$860.00	232.0	3.0	84	42
UTR F 64	20382	$1320.00	400.0	6.0	96	48
UTR F 90	20391	$1493.00	490.0	6.0	108	54
UTR F 120	20392	$1686.00	525.0	6.0	120	60
UTR-040-HWU*	20900	$130.00	40.0	-	-	-

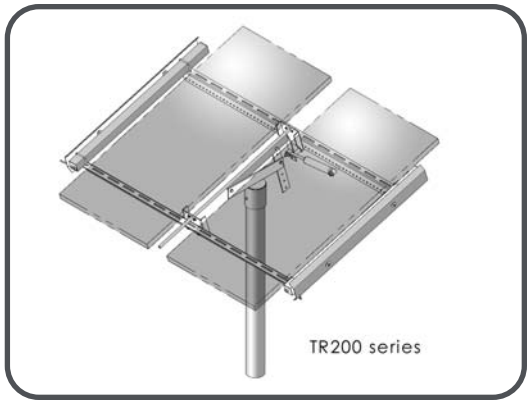
*Requires Track Rack modification if purchased as an add-on.

Tracker 200

UniRac THE NEW STANDARD IN PV MODULE RACKS™

Tracker 200 is a pole-mounted, passive tracking rack for 2 PV modules. Tracker 200 equipped modules produce more power for your equipment earlier, longer and later each day. In the case of a water pumping system, a Tracker 200 can increase your daily water production by up to 50%. when compared to fixed racks. Ten year warranty. Fits 2 1/2" SCH 40 pole.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
T200/68 - All Kyocera Models	24500	$520.00	75.0
T200/80 - US-64's	24501	$535.00	75.0



WATSUN SOLAR TRACKERS

See Appendix C for sizing information

Active Trackers

WATTSUN Trackers

Wattsun Solar Trackers are available in five models. Your selection of a specific Wattsun tracker depends on your application and PV array size.

Wattsun Single-Axis Tilt & Roll Trackers automatically track the sun from East to West. The TR-Series Trackers employ a Linear Actuator Drive for precise tracking accuracy. The frames are fabricated from sturdy structural aluminum finish and engineered for rigidity. The TR-15 Drive is perfect for small, two-panel water pumping applications. The larger TR-75 Drive marries well to larger pumping systems. Trackers offer a significant increase in the amount of water pumped and provide a smooth flow of water from dawn to dusk. The solid state tracker controller electronics and positive drive mechanisms of all the trackers are unaffected by wind or cold, an important concern for remote water pumping applications. PV racking capacity ranges from 120 to 720 Watts per tracker.

Wattsun Azimuth Gear Drive Trackers automatically track the sun by rotating the PV array about the pipe mast. The Dual-Axis Option automatically elevates the array and enables it to capture virtually all the power the sun delivers. Compared to passive, tilt and roll trackers, The AZ-125 and AZ-225 azimuth trackers provide greater stability for large arrays. The corners do not protrude down toward the ground or stick up in the air to catch the wind. The bottom edge of the array always remains parallel to the ground and requires less ground clearance than tilt & roll designs. The standard Azimuth Trackers provide nearly 270 degrees of rotational movement tilt to 75 degrees. PV racking capacity ranges from 900 to over 2000 Watts per tracker. Larger fixed-tilt, AZ-225 azimuth trackers with a capacity of 3000 watts are available. Please specify your system requirements when ordering.

If your PV system voltage is not 24 volts, you will need a Wattsun voltage converter.

Wattsun Solar Trackers for KC60's

Product Name and Description	Part Number	Price
2 modules	20410	$495.00
4 modules	20411	$1195.00
6 modules	20412	$1245.00
8 modules	20413	$1295.00
12 modules	20414	$1795.00
16 modules	20415	$1995.00
20 modules	20416	$2195.00

Wattsun Solar Trackers for KC60's

Product Name and Description	Part Number	Price
2 modules	20417	$495.00
4 modules	20418	$1195.00
6 modules	20419	$1295.00
8 modules	20420	$1345.00
10 modules	20421	$1395.00
12 modules	20422	$1795.00
16 modules	20423	$2195.00
24 modules	20424	$3750.00

The prices above are only for mounting KC 120-1 modules. Other models are available. Specify number and model of the modules you are using when ordering.

Wattsun Solar Trackers for KC120's		
Product Name and Description	**Part Number**	**Price**
4 modules	20456	$1195.00
6 modules	20457	$1245.00
8 modules	20458	$1895.00
10 modules	20549	$1995.00
12 modules	20466	$2295.00
18 modules	20467	$3950.00

Wattsun Solar Trackers for KC158's		
Product Name and Description	**Part Number**	**Price**
4 modules	20425	$1295.00
6 modules	20426	$1795.00
8 modules	20427	$1995.00
12 modules	20428	$3750.00
16 modules	20429	$4495.00

Wattsun Solar Trackers for US64's		
Product Name and Description	**Part Number**	**Price**
2 modules	20430	$1195.00
4 modules	20431	$1245.00
6 modules	20432	$1295.00
8 modules	20433	$1795.00
10 modules	20434	$1995.00

Wattsun Tracker Accessories

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
W12-24 15W For 12V TR-75 Systems	20406	$125.00	1.0
W48-24 LVC For 48V AZ-125 Azimuth Tracker Systems	20407	$78.00	1.0
W48-24 HD For 48V AZ-225 Azimuth Tracker Systems	20408	$130.00	1.0
WSP100-24 For "Battery-less" Grid-Tie Systems and High Voltage Water Pumping Systems	20409	$165.00	2.0
W D/A Dual-Axis option for AZ-125 Trackers	20490	$395.00	20.0
W-MANCON Manual Control Switch, Factory Installed	20502	$125.00	1.0

Charger Controller / Regulators

Why you need a Controller

The main function of a controller or regulator is to fully charge a battery without permitting overcharge while preventing reverse current flow at night. If a non-self-regulating solar array is connected to lead acid batteries with no overcharge protection, battery life will be compromised. Simple controllers contain a transistor that shunt the PV charging circuit, terminating the charge at a pre-set high voltage and, once a pre-set reconnect is reached, opens the shunt, allowing charging to resume. More sophisticated controllers utilize pulse width modulation (PWM) or maximum power point tracking (MPPT) to assure the battery is being fully charged. The first 70% to 80% of battery capacity is easily replaced, but the last 20% to 30% requires more attention and therefore more complexity.

How controllers work and available options

The circuitry in a controller reads the voltage of the batteries to determine the state of charge. Designs and circuits vary, but most controllers read voltage to control the amount of current flowing into the battery as the battery nears full charge. Features of a controller to consider include:

- Reverse current leakage protection – by disconnecting the array or using a blocking diode to prevent current loss into the solar modules at night.
- Low-voltage load disconnect (LVD) – to reduce damage to batteries by avoiding deep discharge.
- System monitoring - analog or digital meters, indicator lights and/or warning alarms.
- Overcurrent protection – with fuses and/or circuit breakers
- Mounting options – flush mounting, wall mounting, indoor or outdoor enclosures.
- System control – control of other components in the system; standby generator or auxiliary charging system, diverting array power once batteries are charged, transfer to secondary batteries.
- Load control – automatic control of secondary loads, or control of lights, water pumps or other loads with timers or switches

- Temperature compensation – utilized whenever batteries are placed in a non-climate controlled space. The charging voltage is adjusted to the temperature.
- Pulse Width Modulation (PWM) – an efficient charging method that maintains a battery at its maximum state of charge and minimizes sulfation build-up by pulsing the battery voltage at a high frequency.
- Maximum Power Point Tracking (MPPT) – a new charging method designed to extract the most power possible out of a solar module by altering its operating voltage to maximize the power output.

Sizing a Controller

Some systems require most of these functions, others require only one or a certain combination. Your KSI dealer can help you select a unit to meet your specific needs.

Charge controllers are rated and sized by the array current and system voltage. Most common are 12, 24, and 48-volt controllers. Amperage ratings run from 1 amp to 60 amps, voltages from 6-60 volts.

For example, if one module in your 12-volt system produces 7.45 amps and two modules are utilized, your system will produce 14.9 amps of current at 12 volts. Because of light reflection and the edge of cloud effect, sporadically increased current levels are not uncommon. For this reason we increase the controller amperage by a minimum of 25% bringing our minimum controller amperage to 18.6. Looking through the products we find a 20-amp controller, as close a match as possible. There is no problem going with a 30-amp or larger controller, other than the additional cost. If you think the system may increase in size, additional amperage capacity at this time should be considered.

xantrex

C Series Controllers

C-Series: Multifunction DC Controller

The C40 has long been the mainstay of our charge controller lineup, its versatility and reliability have made it an industry standard. Now the C40 is joined by two companion controllers, the C35 and C60. All three of these are full solid state, PWM microprocessor-driven controllers and are UL and cUL listed. C Series controllers may be configured for PV battery charging, or DC load control or DC diversion operation. Whatever the charging source, a C Series controller is sure to meet your DC controller needs. Two year warranty.

Product Name and Description	Part Number	Voltage	Max Amperage	Shipping Weight (lbs.)	Price
C-35	33701	12V or 24V	35	3.0	$119.00
C-40	33710	12V, 24V, 48V	40	3.5	$159.00
C-60	33706	12V or 24V	60	3.5	$199.00

Xantrex C-40

C-Series Options

The optional LCD display shows volts, amps, and cumulative amp-hours for a solar array or DC loads. The unit can be mounted on the controller (CM) itself or located 50 or 100 feet (CUR) away in a double gang switchbox. Two year warranty.

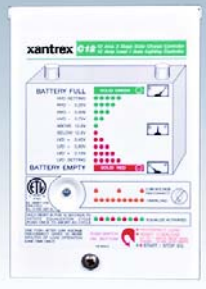
Product Name and Description	Part Number	Voltage	Shipping Weight (lbs.)	Price
CM	33702	C Series Monitor Option	2.0	$99.00
CUR/50	33703	Remote Monitor - 50 ft. cable	2.0	$126.00
CUR/100	33704	Remote Monitor - 100 ft. cable	3.0	$146.00
BTS/15	53037	Battery Temp. Sensor - 15 ft. cable	1.0	$29.00
BTS/35	53063	Battery Temp. Sensor - 35 ft. cable	2.0	$32.00

CUR/50, 100

Model C-12 Charge/Load Controller

Sophisticated, compact, 12 volt, 12-amp controller/ timer that utilizes 100% solid state, adjustable low voltage disconnect and reconnect (with reset buttons) and Pulse Width Modulated (PWM) charging. Standard features include a tri-color LED battery monitor, status indicator for over-temperature, overload and low voltage disconnect. ETL approved. The C-12 is perfect for use in automatic lighting systems and controlling small photovoltaic systems. Two year warranty.

Product Name and Description	Part Number	Voltage	Max Amperage	Shipping Weight (lbs.)	Price
C-12	33722	12V	12	2.0	$110.00



Xantrex C-12

Morningstar Controllers

ProStar Charge Controllers

Morningstar has just upgraded their very popular ProStar line of pulse width modulated (PWM) charge controllers to include several new features. The new design is still dual voltage at 12 or 24 volts with an optional LCD display, but it is now available only in 15 or 30 amp capacities. Morningstar has added a 15 amp 48 volt model to the ProStar lineup that comes standard with the LCD display. A 15A/48V positive ground model (PN 34939) is available. The ProStar's LCD display still shows battery voltage, array amperage and load amperage (if applicable), but now it also shows system information when a self diagnostics test is performed as well as error codes to let you know what is going on if it detects a fault. Internal temperature compensation is still standard. These additional features make the new ProStar controllers one of the most advanced on the market. Five year warranty.

Morningstar ProStar Controller

Product Name and Description	Part Number	Array/ Load Amperage	Meter	Price
PS-15	34971	15	No	$112.00
PS-15M	34976	15	Yes	$179.00
PS15M/48V	34991	15	Yes	$230.00
PS-30	34958	30	No	$152.00
PS-30M	34952	30	Yes	$219.00
PS-15M/48V-PG	34939	15	Yes	$239.00

SunSaver and SunGuard Charge Controllers

The SunSaver line of controllers offers most of the same features of the ProStar line, but without the battery status LED's, automatic equalization circuit or the optional LCD display. The SunSaver is a PWM controller and is available in 12 or 24 volt models from 6 to 20 amps. Morningstar makes a variation of the SunSaver called the SunLight controller that is designed specifically for 12 or 24V lighting systems. Turn to page 118 for details and pricing on the SunLight controllers. Five year warranty.

Morningstar SunSaver Controller

The SunGuard is the little brother of the SunSaver and it is only available in a 12V version with a 4 amp capacity. It is also a PWM controller with temperature compensation and simple 4 wire hookup. The SunGuard has a slightly lower output voltage (14.1 V) than the SunSaver and ProStar and may not be the best choice for flooded batteries that require a higher voltage. Five year warranty.

Product Name and Description	Part Number	Array Amperage	Load Amperage	Voltage	LVD	Price
SunSaver 6	34962	6.5	N/A	12	No	$48.00
SunSaver 6L	34963	6.5	6	12	Yes	$59.00
SunSaver10	34965	10	N/A	12	No	$55.00
SunSaver 10L	34966	10	10	12	Yes	$70.00
SunSaver 20L	34935	20	20	12	Yes	$95.00
SunSaver 10L-24	34942	10	10	24	Yes	$76.00
SunSaver 20L-24	34936	20	20	24	Yes	$101.00
SunGuard 4	34931	4.5	N/A	12	No	$30.00

Morningstar SunGuard

TriStar™ Controllers

Morningstar's TriStar Controller is a three-function controller that provides reliable solar battery charging, load control or diversion regulation. This controller operates in only one of these modes at a time but two or more controllers may be used to provide multiple functions. The TriStar uses advanced technology and automated production to provide exciting new features at a competitive cost. The controller is UL listed and is designed for both solar home systems and industrial applications. Five year warranty.

TriStar Controller

- Rated for 45A or 60A, both at 12V or 24V or 48V
- Includes RS-232 communication port for customizing controller set points or data logging
- Optional on-board digital meter and remote meter
- Designed for mechanical fit on a Xantrex power panel or OutBack PSDC
- Provides extra bending room for large wires
- 100% solid state microprocessor controller

Product Name and Description	Part Number	Voltage	Load Amperage	Price	Shipping Weight (lbs.)
TriStar-45	34995	12V, 24V, 48V	45	$169.00	4.5
TriStar-60	34996	12V, 24V, 48V	60	$218.00	4.5
TriStar Digital Meter	34997	-	-	$99.00	0.5
TriStar Remote Digital Meter	34998	-	-	$136.00	0.5
Remote Temperature Sensor	34999	-	-	$32.00	1.0

Specialty Concepts

Automatic Sequencing Charger (ASC)

Specialty Concepts, Inc.

The ASC is a very compact, efficient, 100% solid-state battery charge regulator for use in photovoltaic systems. It is available in 12-volt and 24-volt units up to 16 amps. The ASC is a negative-ground 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. Shipping weight 2 lbs. Five year warranty.

- Solid state, encapsulated for high reliability.
- Low frequency, pulse charge method – no RF noise.
- UL listed, CSA, FM approved for hazardous locations.
- Optional low voltage disconnect or alarm contacts.
- 5 year warranty.
- Optional temperature compensation is on a remote sensor for accurate temperature monitoring.

Product Name and Description	Part Number	Volts	Amp Capacity	Price
ASC 12/8	32300	12.0	8.0	$46.00
ASC 12/8A - with Temp. Comp.	32310	12.0	8.0	$56.00
ASC 12/8AE - with Temp. Comp. Low Voltage Disconnect	32380	12.0	8.0	$70.00
ASC 12/16	32440	12.0	16.0	$63.00
ASC 12/16A - with Temp. Comp.	32450	12.0	16.0	$73.00
ASC 12/16AE with Temp. Comp. Low Voltage Disconnect	32472	12.0	16.0	$91.00
ASC 24/16	32540	24.0	16.0	$63.00

ASC Controller

RV / Cabin Controllers

Specialty Concepts, Inc. MARK Series controllers are cost effective, flush mount, battery charge controllers with digital system monitoring. Both MARK/15 and 22 provide efficient charging while protecting the batteries from damage due to overcharging. These controllers are designed for use in mobile or stationary PV systems, and offer complete system monitoring of battery voltage, solar charging current, and charge set-point calibration. Five year warranty.

Product Name and Description	Part Number	Amp Capacity	Price
MARK/15-12	32841	15	$129.00
MARK/22-12	32842	22	$139.00
MARK Series Mounting Box	32961	-	$25.00

MARK/15-12

Heliotrope

The DC3000 is a 30 amp, 12 volt DC, Series type pulse width modulated charge controller. It utilizes power MOS FET technology to eliminate relays and subsequent failures associated with them. The DC 3000 maintains the exact state-of charge (SOC) voltage by frequent on and off switching of the photovoltaic source and is actually two charge controllers in one. The DC 3000 has one circuit for the engine starting battery that is limited to 3 Amps with the SOC fixed at 13.4 volts. The house battery charging circuit can deliver up to 30 Amps with a selectable SOC from 13.2 VDC to 14.6 VDC. The Liquid Crystal Display allows you to monitor the engine battery voltage, the house battery voltage, and the solar charging amperage. Ten year limited warranty.

Product Name and Description	Part Number	Amp Capacity	Price
DC 3000	34850	30/3	$225.00

Digital Commander DC-3000

Connect Energy

PC60 Charge or Load Controller

PC60 is field selectable for 12, 24, or 48 VDC battery systems and can operate either as a battery charge controller, or load controller, or load diversion controller rated at 60A maximum. UL listed for PV charging to 60A. Adjustable switch selections for three battery types; flooded, sealed, gell, AGM, or defeated allows user adjustable trim-pots for bulk and float mode, with manual or automatic battery equalize setting (flooded). Adjustable load-disconnect and reconnect settings, low battery LED (as load controller). Features; illuminated LCD display, for battery capacity or charge current, includes 60A DC battery or PV circuit breaker, conduit-ready enclosure, wire screw terminal lugs for #1/0 AWG. Five year warranty.

The PC60 comes standard with an integrated digital meter. With the touch of a button the PC60 displays the system's operational status on an illuminated LCD screen.

Metering Features

- Charging stage (Bulk, Float, Equalization)
- Charge set-points (Bulk, Float)
- Input voltage, battery voltage
- Input amps, input amps (max), input watts
- Input amp-hours today, total input amp-hours accumulated
- Equalization start / stop (for flooded batteries only)

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
PC60	33804	6.6	$329.00

PC60

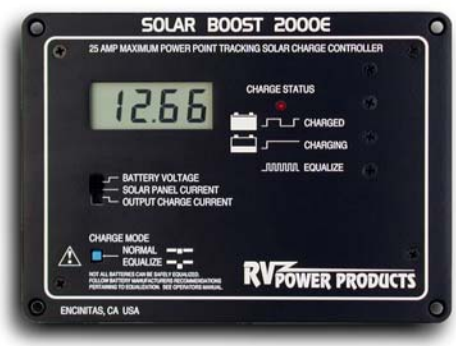
RV Power Products Solar Boost™

The Solar Boost™ PV charge controllers utilize a patented Maximum Power Point Tracking (MPPT) charging algorithm that allows the controller to get up to 30% more power out of your solar modules under certain conditions (low battery voltage and cool temperatures). The Solar Boost 50, 3048 and 6024H have an automatic 3-stage battery control system. This controller also has a pulse width modulated (PWM) control configuration. As an option the controller has a digital display that shows battery voltage, solar current, output charge current, charge mode and state of charge. The remote panel can be mounted on the front of the controller or up to 300 feet away. The SB50 can be set up to charge a 12 volt battery from a 24 volt array, while the SB3048 can be set up to charge a 24 volt battery from a 48 volt array. The SB6024H must use a 36 volt or 48 volt array to charge a 12 volt or 24 volt battery. This can reduce your PV-to-battery wire size. SB50, 3048 and 6024H are listed to UL1741, CSA standards, and are CE labeled for sales in the European Union. 36 month warranty.

	Solar Boost 50	Solar Boost 3048	Solar Boost 2000E	Solar Boost 6024H
Output Current Rating (Amps)	50.0	30.0	25.0	60.0
System Voltage (Volts)	12/24	24/48	12	12/24
Standby Current (Milliamps)	30.0	30.0	17.0	30.0
Charge On Current (Milliamps)	12/24 - 150.0/90.0	24/48 - 100.0/70.0	70.0	12/24 - 150.0/90.0
Power Conversion Efficiency	97%@40A	97%@25A	95%@15A	96%@50A
PV Maximum Open Circuit Voltage (Volts)	57	140	30	140
Acceptance Voltage Adjust Range (Volts)	13-16/26-32	26-32/52-64	13-16	13-16/26-32
Cabinet Dimensions (H x W x D) (in)	10.0 x 8.75 x 3.5	10.0 x 8.75 x 3.5	4.63 x 6.38 x 1.88	10.0 x 8.75 x 3.5
Remote Display Dimensions (H x W x D) (in)	4.5 x 4.5 x 1.75	4.5 x 4.5 x 1.75	N/A	4.5 x 4.5 x 1.75

Product Name and Description	Part Number	Price
SB50L - 12/24V Controller	33743	$419.00
SB50DL - Controller with display	33755	$499.00
SB50PDL - Front panel display	33738	$115.00
SB2000E - 12V Controller	33745	$229.00
SB2000E Wall Mount Box	33744	$28.00
SB3048L - 24/48V Controller	33742	$479.00
SB3048DL - Controller with display	33749	$559.00
SB3048PDL - Front panel display	33737	$115.00
SB6024HL - 12/24V Controller	33739	$509.00
SB6024HDL - Controller wth display	33756	$589.00
SB6024PDL - Front panel display	33758	$115.00
SB50RD25 - Remote display, 25' cable, for SB50, 3048 and 6024H	33747	$109.00
20' Battery Temperature Sensor	33741	$28.00

SB50DL



SB2000E

OutBack MPPT Charge Controller

MPPT Charge Controller

The OutBack MX60 Maximum Power Point Tracking (MPPT) charge controller enables your PV system to achieve its highest possible performance. Rated for up to 60 amps of DC output current, the MX60 can be used with battery systems from 12 to 60 VDC with PV open circuit voltage as high as 125 VDC. The MX60's set points are fully adjustable to allow use with virtually any battery type, chemistry and charging profile. The MX60 allows you to use a higher output voltage PV array with a lower voltage battery. 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 MX60 comes standard with an easy to use and understand display of the PV system's performance. The four line, 80 character, back-lit LCD display is also used for programming and monitoring of the system's operation.

The MX60 can also be connected to the OutBack MATE system controller and display to allow monitoring of up to eight MX60 controllers from a location up to 1000 feet away. The MATE also includes an opto-isolated RS232 port for connection to a PC for data logging and system monitoring. See page 91 for more information on the MATE.

MX60

Model Number	MX60
Part Number	**55295**
Price	**$649.00**
Output Current Rating	60.0 Amps DC Maximum at 12, 24, or 48 VDC
Nominal Battery Voltage	12, 24, 32, 36, 48, 54, or 60 VDC
PV Maximum Open Circuit Voltage	125 VDC
Standby Power Consumption	Less than 1 Watt typical
Charging Regulation Methods	Five Stage: Bulk, Absorption, Float, Silent, Equalization
Charging Regulation Set Points	13 - 80 VDC
Equalization Voltage	Adjustable 1.0 to 5.0 VDC above Bulk Setpoint
Temperature compensation	Programmable slope -2.0mV/oC/Cell to -5.0mV/oC/Cell
Voltage Step-Down Capability	Can change a 12 or 24 VDC battery from a 48V nominal PV array
Power Conversion Efficiency	99.1%@40A, 97.3%@60A
Digital Display	4 line 80 character backlit LCD Display
Remote Interface	RJ45 Modular Connector CAT 5 Cable 8 wire
Operating Temperature Range	-40 to 60 °C Power derated above 25 °C
Environmental Rating	Indoor Type 1
Conduit Knockouts	Two 3/4 - 1" on the back; One 1" - 1 1/2" on each side; Two 1" 1/2" on the bottom
Warranty	Two years parts and labor / optional extended warranty
Dimensions (HxWxD) (in)	Enclosure: 14.5 x 5.75 x 5.75 / Shipping Box: 17.75 x 10 x 7
Shipping Weight (lbs.)	15.0

OutBack Charge Controller Accessory

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
RTS - Outback Remote Temperature Sensor w/ 20' cable	55300	1.0	$29.00

Solarix Controllers

Solar Charge Controller

Solarix solar charge controllers set new standards in solar technology. For the first time a solar charge controller is offered, equipped with an integrated circuit (ASIC) specially designed for solar charging. This integrated circuit, called Atonic, provides a charge controller with new functions. Atonic is more than a protective device for your battery, and contains the most recent and innovative technology. It contains a self-learning algorithm which gives detailed information on the battery's state of charge (SOC) and adjusts itself to the battery's age and capacity. The SOC provides a basis for all control and regulatory functions. This new type of hybrid regulator is much more efficient than conventional series and shunt regulators. The display gives information about the SOC, and faults. A combination of electronic and electro-mechanical protection increase the safety of the charge controller. Two year warranty.

Solarix Delta

More Features

- Temperature-adjusted SOC
- Optimized fast, medium and trickle charging
- 6 character LCD display
- External temperature sensor
- The SOC provides load disconnect
- Two LEDs, fixed / flashing, different colors, provide SOC and operation status
- Polarity protection
- Extremely low electromagnetic emission
- 12/24V automatic setting

Product Name and Description	Solarix Alpha	Solarix Zeta (w/ LCD)	Solarix Gamma	Solarix Jota (w/ LCD)	Solarix Sigma	Solarix Delta (w/ LCD)	Solarix Omega	Solarix Theta (w/ LCD)
Part Number	**62629**	**49406**	**49403**	**49407**	**62630**	**62631**	**62632**	**62633**
Price	**$49.00**	**$80.00**	**$58.00**	**$90.00**	**$74.00**	**$106.00**	**$94.00**	**$126.00**
Max charge current at 50°C	8A		12A		20A		30A	
Max load current at 50°C	8A		12A		20A		30A	
Max self consumption	7mA		7mA		7mA		7mA	
Admissible ambient temperature	-25 to 50°C		-25 to 50°C		-25 to 50°C		-25 to 50°C	
Connection terminal (fine/single wire)	#6/4 AWG		#6/4 AWG		#6/4 AWG		#6/4 AWG	
Weight (lbs.)	1.0		1.0		1.0		1.0	
Dimensions (in.)	7.4 x 4.2 x 1.9		7.4 x 4.2 x 1.9		7.4 x 4.2 x 1.9		7.4 x 4.2 x 1.9	
Enclosure	IP 22 / NEMA1		IP 22 / NEMA1		IP 22 / NEMA1		IP 22 / NEMA1	
System voltage	12/24V		12/24V		12/24V		12/24V	

SolSum™

Wear-resistant MOSFET transistors are used for the over-discharge protection in this charge controller, whereby a maintenance-free operation with an extremely long product life is ensured. Absolutely new in this price class is cycle charging, boost charging and temperature compensation which are integrated in these charge controllers. LED color display gives information about voltage of the battery bank. Two year warranty.

Solsum 6.6 & 8.8

More Features

- Overvoltage protection
- PWM shunt regulator
- Built-in fuse
- Automatic voltage adaptation 12/24V
- Electronically circuit protected
- CE Certified
- Temperature Compensation
- Schottky diode

Product Name and Description	Solsum 5.0* (with LVD)	Solsum 6.6* (with LVD)	Solsum 8.0* (with LVD)	Solsum 8.8* (with LVD)
Part Number	**49423**	**62624**	**62625**	**62626**
Price	**$21.00**	**$29.00**	**$29.00**	**$39.00**
Max charge current at 50°C	5A	6A	8A	8A
Load current at 50°C	-	6A	-	8A
Connection terminal (fine/single wire)	#14/12 AWG	#14/12 AWG	#14/12 AWG	#14/12 AWG
Weight (lbs.)	0.24	0.24	0.24	0.25
Dimensions (in.)	3.3 x 3.8 x 1.3	3.3 x 3.8 x 1.3	3.3 x 3.8 x 1.3	3.3 x 3.8 x 1.3
Enclosure	IP22 / NEMA1	IP22 / NEMA1	IP22 / NEMA1	IP22 / NEMA1
Ambient temperature	-25 to 50°C	-25 to 50°C	-25 to 50°C	-25 to 50°C
System voltage	12/24V	12/24V	12/24V	12/24V

*No load disconnect, fused only with 6. 3 and 10 amp.

PR 0303 and PR 0505

The photovoltaic regulator PR 0303 and PR 0505 are well suited for small solar home systems with up to 5 amp solar and load current. The load such as lights, radios or small TVs can be manually switched off on the controller without additional wall mounted switches. Several safety features guarantee a maintenance free operation. High quality production standards according to ISO9001 and semiconductor components assure a long life time for the controller, especially in extreme climatic conditions. The regulator is optimized for use with amorphous as well as with crystalline Modules or other technologies. Two year warranty.

Product Name and Description	Part Number	Max. Load Current	Max. PV Current	System Voltage	Price
PR 0303	62627	3.0A	3.0A	12V	$26.00
PR 0505	62628	5.0A	5.0A	12V	$29.80

PR 0303

Solarix Tarom

Solarix Tarom combines two new power technologies and aims to be the best quality PV controller. First, it traces down the charging status of the battery with unprecedented accuracy, this way you can manage the system yourself with the precise status indicator. Second, all the data can be transmitted into the DC-net. With this function, there is no need for additional data nets to send battery information to other installed devices. With the help of installed receivers, the deep discharge protection is decentralized by setting up different priorities. A connected monitor can be used to call back all the recorded actual system parameters. Solarix Tarom certainly offers the best quality of functions as a solar system controller.

The double-line display keeps you informed on important system parameters via status indicators. The first line permanently indicates the status of charge, battery voltage, charging and final charging current (with rough decomposition). The second line informs on the system parameters and current status with changing detailed values and descriptions by changing the display every three seconds. Two year warranty.

Solarix Tarom

More Features

- By putting an additional shunt into the battery cable, the controller can register the charging status and display up to 100 amps.
- External temperature sensor optional
- Data receiver
- Will operate as a lighting controller with optional PA15

PA15 Remote Control

Product Name and Description	Part Number	Max. Load/ Operating Current	Max. Current	System Voltage	Enclosure	Connection	Dimensions HxWxD (in.)	Price	Shipping Weight (lbs.)
Solarix Tarom 235	62634	35A	45A	12/24V	IP22/NEMA1	#6/4 AWG	7.4x5.0x1.9	$196.00	1.0
Solarix Tarom 245	62635	45A	60A	12/24V	IP22/NEMA1	#6/4 AWG	7.4x5.0x1.9	$226.00	1.0
Solarix Tarom 430	62636	30A	40A	48V	IP22/NEMA1	#6/4 AWG	7.4x5.0x1.9	$260.00	1.0
External Temperature Sensor	49409	-	-	-	-	-	-	$30.50	-
Data Logger - Tarom 01- Equipped with RS232 and two analog entrances	62637	-	-	-	-	-	-	$580.00	-
PA15 - Remote Control	62638	15A	-	-	-	-	-	$350.00	-
PA 200 Shunt Module	62639	-	-	-	-	-	-	$350.00	-

System Meters

We highly recommend installing a system meter of some kind in your renewable energy system. If you don't, it is like driving your car without a fuel gauge. There are many different types of meters available with different features so please read the information below to determine which type will best suit your needs. The bare minimum you should have in any renewable energy system is a voltage meter to approximate the state of charge on your battery bank.

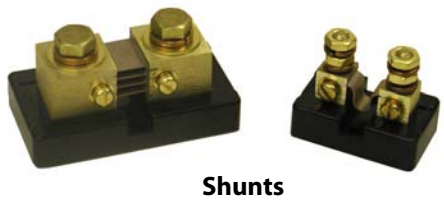
Instantaneous vs. Cumulative

All of the meters that we sell provide instantaneous values of battery voltage or charging/load amperage which is better than nothing, but it still doesn't tell you the whole picture. More advanced cumulative amp-hour meters like the TM500A, Tri-Metric 2020 and Xantrex Link 10 (see following pages) provide much more detailed information regarding your system's actual state of charge. Think of these three cumulative amp-hour meters as a fuel gauge for your system since they all tell you how much energy you have put into your battery bank versus what you have taken out. We highly recommend one of these meters for every battery based home system.

Shunts

A shunt is a very precise resistor that will produce a low voltage drop (millivolts) proportional to the amount of current flowing through it. There are several different size shunts available depending on the maximum amperage of the circuit it will be installed in and the amperage to millivolt drop ratio required by the particular meter you plan to use. For example, a 10:1 shunt will produce a 1 millivolt drop for every 10 amps of current that is flowing through it. Most meters that use an external shunt can be placed 50-100 feet away from the shunt. If any of the meters we sell require an external shunt, we say so and let you know which one to use.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
100 Amp - 100 Millivolt	32980	$25.00	1.0
500 Amp - 50 Millivolt	32990	$30.00	2.0



Shunts

Meters

Digital Meters

An accurate meter for monitoring battery voltage in the control room or remotely. Accuracy to a tenth of a volt, amp draw - 8 milliamps. Meter is a compact digital monitor for 12 or 24 VDC battery banks with a 40 VDC maximum. Two year warranty.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Digital Volt Meter	37401	$53.00	1.0

Digital Volt Meter

Battery Capacity Meter (BCM)

The BCM is an economical solid-state meter for monitoring battery SOC. Assists user as to when to employ load conservation. Available in 12, 24, or 48 VDC models. One in a series of multicolored LEDs will light up corresponding to voltage and battery percent state of charge in 10% increments and in low battery, float and equalize conditions. Waterproof design is reverse polarity and surge protected with super low battery consumption. Supplied with mounting fastener and a 5 foot cable; can remote mount up to 50 feet. Five year warranty.

Product Name and Description	Part Number	Price
BCM-12	32070	$56.00
BCM-24	32068	$66.00
BCM-48	32071	$84.00

Battery Capacity Meter

Link-10 xantrex

The Link-10 meter (previously known as the E-meter) displays the voltage, system current and amp-hours but doesn't stop there. This unit reports time remaining until the batteries are discharged, deepest discharge, and number of cycles on the battery bank. Above the numeric LED display is a row of four lights indicating state of charge at a glance. This meter and its level of information go a long way to unraveling the mysteries associated with living with a battery bank. The Link-10 can be used on 12 or 24 volt systems and with an optional pre-scaler, up to 100 volts can be measured. It comes with a 500A/50mV shunt. It can also be ordered with an RS-232 port so you can download the information to your computer. One year warranty.

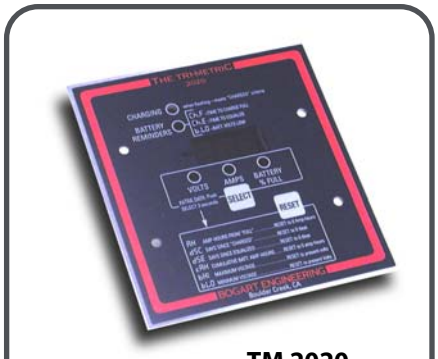
Product Name and Description	Part Number	Price
Link-10 with shunt	51519	$250.00
Link-10 with RS232 Port	51520	$375.00
Meter Prescaler 0-100V	37374	$99.95
#16-8 Meter Cable 4 Twisted Pairs	43385	$2.00 / ft.

Link-10

Tri-Metric 2020 Amp Hour Meter

The Tri-Metric 2020 meter displays amp-hours, net current flow and battery percent state of charge. Two additional LEDs indicate charging status and a battery reminder LED. When your system reaches your pre-set programmable full charge setpoints, the LED flashes to indicate the system has achieved a complete charge. Previous to this type of meter, one was left to guess if a full charge had been reached. The manufacturer of this meter has actively pursued feedback from system integrators and owners. The result – increased features giving more information in an easy to read, understandable format. A 100A, 100mV or 500A, 50mV shunt is required. See page 50. One year warranty.

Product Name and Description	Part Number	Price
12 or 24 Volt Unit	37398	$180.00
48 Volt Adapter	37399	$29.00
Enclosure	37395	$12.00



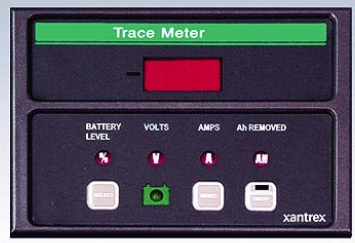
TM 2020

48 Volt Adapter

Xantrex TM500A xantrex

This meter is best described as an energy storage computer for your renewable energy system. The connection between the TM500A and its shunt is made via an easy phone-cord-like connection. The TM500A will measure battery voltage, net battery current, battery charge level, cumulative amp-hours removed, days since full, battery highest and lowest voltage. With one of the optional remote control cables listed below the TM500A can also serve as a remote on/off switch for your DR or UX series inverter. The TM500A uses a 500A/50mV shunt and it can be purchased with or without the shunt (if you already have a shunt installed in your system). Comes with a 50' cord. The TM500A can be mounted up to 100' from the shunt. Two year warranty.

Product Name and Description	Part Number	Price
TM 500 - with shunt	53040	$245.00
TM 500NS - without shunt	53066	$195.00
TM 48 - voltage adapt.	53067	$40.00
TC 25 - remote cable	49128	$22.00
TC 50 - remote cable	49129	$36.00
TC 100 - remote cable	49130	$43.00



TM500A

Batteries

Batteries are a key component in a grid-tie with back-up or a stand-alone renewable energy system that all of the other components rely on for operation. Without proper maintenance, batteries can fail prematurely and shut the whole system down. However, toiling over your battery bank with a voltmeter, hydrometer and a gallon of distilled water every day is not necessary. With simple monthly and quarterly maintenance procedures, your batteries should last for a long time. On the other hand, neglecting your batteries can drastically shorten their life span. The following statement sums it up best, "few batteries die a natural death, most are murdered". The following information is designed to tell you how to get the longest life and best performance possible from your battery bank. Most of this information is for flooded cell lead-acid batteries; alkaline (Ni-FE & Ni-Cad) and sealed gel-cell battery charging characteristics are completely different.

Battery Types Used in Solar Systems

There are three types of batteries that are most popularly used in solar electric systems. Each type has its pluses and minuses, so we will also include the systems the individual types are best suited for.

Flooded Lead Acid

Flooded lead acid batteries have the longest track record in solar electric use and are still used in the majority of stand-alone solar systems. They have the longest life and the least cost per amp-hour of any of the choices. However the other side of the coin is, in order to enjoy these advantages, they require regular maintenance in the form of watering, equalizing charges and keeping the top and terminals clean. Some examples of flooded lead-acid batteries used in solar electric systems are 6 volt golf-cart batteries, 6 volt L-16's and 2 volt industrial cells for large systems.

Absorbed Glass Mat Sealed Lead Acid (AGM)

AGM batteries are seeing more and more use in solar electric systems as their price comes down and as more systems are getting installed that need to be maintenance free. This makes them ideally suited for use in grid-tied solar systems with battery back-up. Because they are completely sealed they can't be spilled, do not need periodic watering, and emit no corrosive fumes, the electrolyte will not stratify and no equalization charging is required. AGM's are also well suited to systems that get infrequent use as they typically have less than a 2% self discharge rate during transport and storage. They can also be transported easily and safely by air. Last, but not least, they can be mounted on their side or end and are extremely vibration resistant. AGM's come in most popular battery sizes and are even available in large 2 volt cells for the ultimate in low maintenance large system storage.

When first introduced, because of their high cost, AGM's were mostly used in commercial installations where maintenance was impossible or more expensive than the price of the batteries. Now that the cost is coming down they are seeing use in all types of solar systems as some of today's owners think the advantages outweigh the price difference and maintenance requirements of flooded lead acid batteries.

Gelled Electrolyte Sealed Lead Acid

Gelled lead acid batteries actually predated the AGM type but are losing market share to the AGM's. They have many of the same advantages over flooded lead acid batteries including ease of transportation, as the AGM type, except the gelled electrolyte in these batteries is highly viscous and recombination of the gases generated while charging, occurs at a much slower rate. This means that they typically have to be charged slower than either flooded lead acid or AGM batteries. In a solar electric system you have a fixed amount of sun hours every day and need to store every solar watt you can before the sun goes down. If charged at too high a rate, gas pockets form on the plates and force the gelled electrolyte away from the plates, decreasing the capacity until the gas finds its way to the top of the battery and is recombined with the electrolyte. For use in a grid-tie with back up system or any system where discharge rates are less than severe, gel batteries could be a good choice.

Think of your batteries like a bucket of energy...

Batteries are simply a storage vessel for the direct current (DC) power produced from your charging sources (solar modules, wind generator, micro-hydro or generator/battery charger). If you aren't familiar with the water to electricity analogy, please read the Basics of Electricity section on page 13. If you don't have time to read that whole section, then just remember that pressure = voltage and flow rate = amperage. The size of the bucket determines how much water it will hold which is analogous to the amp-hour storage capacity of a battery (bigger, heavier batteries hold more energy like a larger bucket holds more water). If you connected a pressure gauge to the bottom of a bucket and started filling it with water you would see the pressure increase until the water reaches the top. The same holds true for a battery as you put amperage or current into it, the voltage level rises.

Deep Cycle vs. Shallow Cycle

In battery lingo, a cycle on your battery bank occurs when you discharge your battery and then charge it back up to the same level. A lead acid battery is designed to absorb and give up electricity by a reversible electrochemical reaction.

How deep a battery is discharged is termed **depth of discharge (DOD)** while the **state of charge (SOC)** is 100% minus the DOD. This means that a 25% DOD equals a 75% SOC. A shallow cycle occurs when the top 20% or less of the battery's energy is discharged and then recharged.

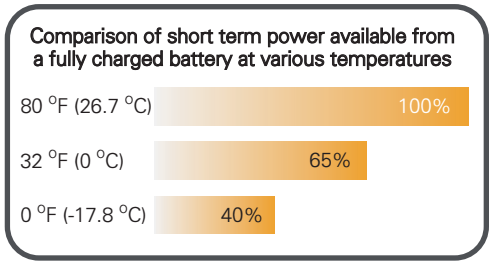
Automotive starting, lighting and ignition batteries (SLI) are of the **shallow cycle** type and are not recommended for use in a photovoltaic system. The lead plates inside an SLI battery are thin with a large overall surface area. This design can produce a high amount of current in a very short time (which is ideal for starting engines), but cannot be discharged very deeply without damaging them and/or shortening their life span considerably.

Deep cycle batteries on the other hand can be repeatedly discharged to 80% DOD and recharged without damaging them (although repeated deep cycling will shorten the battery's life as compared to the same number of shallow cycles). Deep cycle batteries have thicker lead plates which have less overall surface area as compared to an SLI battery. Because of the lessened availability of surface area for chemical reaction, deep cycle batteries produce less current than a shallow cycle battery but can produce that amount of current for a much longer period of time.

The depth of cycling has a good deal to do with determining a battery's useful life. Even batteries designed for deep cycling are "used up" faster as the depth of discharge is increased. It is common practice for a system to be designed with deep cycle batteries even though the daily or average discharging amounts to a relatively shallow depth of discharge. To get the longest life out of your battery bank, **purchase deep cycle batteries and shallow cycle them.**

Warm in the winter, Cool in the summer

The speed of the charging and discharging chemical reactions occurring inside a lead-acid battery is governed by temperature and charge/discharge current. The colder the temperature the slower the reactions and conversely the warmer the temperature the faster the reactions. Hence a cold battery will deliver less amperage in any given time frame as compared to a warm battery. Most of us have experienced this effect when trying to start our cars on a cold morning; the engine just doesn't turn over as quickly if at all. Warm that same battery up and you will see a major improvement. (See the bar graph of temperature effects below). The optimum temperature for a lead-acid battery is around 77°F, but 60-80°F is acceptable. For this reason we like to see batteries placed indoors or in a heated and ventilated space to maintain them between 60° to 80°F. If you do install them in an unheated space, battery capacity must be increased to compensate for this derating. On the other extreme, high temperatures (110°F+) can drastically shorten the life of the battery and should be avoided as well.



Batteries aren't 100% efficient

Energy is never consumed or produced, it merely changes form. The efficiency of conversion is never 100% and in the case of new batteries averages around 90%. This means that if you want to discharge 100 watt-hours of energy from a battery you must charge it with approximately 110 watt-hours of energy.

Due to impurities in the chemicals used for battery construction, batteries will lose power to local action, an internal reaction which occurs whether you are using the battery or not. This slow discharging is termed self-discharge and it's rates vary greatly among battery types and increases along with temperature. The rate also increases with the age of a battery, so much so that an old battery may require significant amount of charging just to stay even. Even new batteries may lose 1 to 2% of charge per day. Lead calcium grid batteries have the lowest self-discharge rates, but are not designed for deep cycling applications.

Determining battery state of charge

Battery state of charge is determined by reading the static (i.e. not charging or discharging) battery voltage or the specific gravity of the electrolyte. The density or specific gravity of the sulfuric acid (H2SO4) electrolyte of a lead-acid battery varies with the state of charge and temperature. The density is lower when the battery is discharged and higher as the cells are charged, (see the table below). This is because the electrolyte is part of the chemical reaction, it changes as the chemical reaction takes place. Specific gravity is read with a hydrometer which will tell the exact state of charge. A hydrometer cannot be used with sealed or gel-cell batteries.

Voltage meters are used to approximate battery state of charge. They are relatively inexpensive and easy to use. The main problem with relying on voltage reading alone is the high degree of battery voltage variation through the working day. Battery voltage reacts highly to charging and discharging. In a PV system we are usually charging or discharging and many times are doing both at the same time. As a battery is charged the indicated voltage increases and as discharging occurs, the indicated voltage decreases.

These variations may seem hard to track, but in reality they are not. A good accurate digital meter with a tenth of a volt accuracy can be used with success. The pushing and pulling of voltage, once accounted for by experience, can also help indicate the amount of charging or discharging that is taking place.

By comparing voltage readings to hydrometer readings, shutting off various charging sources or loads and watching the resulting voltage changes, the system owner can learn to use indicated voltage readings with good results.

Percentage of Charge	12 Volt Battery Voltage	24 Volt Battery Voltage	Specific Gravity
100	12.70	25.40	1.265
95	12.64	25.25	1.257
90	12.58	25.16	1.249
85	12.52	25.04	1.241
80	12.46	24.92	1.233
75	12.40	24.80	1.225
70	12.36	24.72	1.218
65	12.32	24.64	1.211
60	12.28	24.56	1.204
55	12.24	24.48	1.197
50	12.20	24.40	1.190
45	12.16	24.32	1.183
40	12.12	24.24	1.176
35	12.08	24.16	1.169
30	12.04	24.08	1.162
25	12.00	24.00	1.155
20	11.98	23.96	1.148
15	11.96	23.92	1.141
10	11.94	23.88	1.134
5	11.92	23.84	1.127
Discharged	11.90	23.80	1.120

Specific gravity values can vary + or -.015 points of the specified values. This table is for the Trojan L-16 battery in a static condition, no charging or discharging occuring, at 77 degrees F. **Discharging or charging will vary these voltages substantially.**

Source - Trojan Battery Company

Monitoring & Maintenance

Monitoring battery state of charge is the single largest responsibility of the system owner. The battery voltage should be kept at or above a 50% state of charge at all times for maximum battery life (see the battery voltage table). Be sure to keep the battery's electrolyte level at the marked full level and never let the plates become exposed to the air. When refilling the batteries, use only distilled water - not tap water. Water is the only element used by your battery, you should never have to add additional acid to your battery. Do not over-fill the batteries or fill when the batteries are discharged. Over-watering dilutes the acid excessively and electrolyte will be expelled when charging.

Battery Gassing

As batteries are charged they create bubbles of gas, produced when the chemical reaction cannot keep up with the energy input. Some gassing is necessary in flooded cell batteries. The amount and duration of gassing varies from one battery to another. Gassing mixes the electrolyte and compensates for the tendency of the electrolyte to stratify with the more dense acid on the bottom. Gassing is the product of splitting water molecules into hydrogen and oxygen. This consumes water and creates the need for its periodic replacement.

Corrosion

A slight acid mist is formed as the electrolyte bubbles upon charging. This mist is highly corrosive, especially to the metallic connectors on the tops of the batteries. Inspect for corrosion and carefully clean these periodically as needed with baking soda and water. Be sure not to get any baking soda into the battery electrolyte as it will have a neutralizing effect. Corrosion buildup can create a good deal of electrical resistance, which can contribute to shortened battery life and the waste of power. It's always a good idea to wear goggles and protective gear (goggles, rubber gloves and apron) when working on your batteries as the sulfuric acid can seriously damage your eyes and eat holes in your clothes.

Equalization (EQ)

Equalization is a controlled overcharging of a fully charged battery. This overcharge mixes the electrolyte, evens the charge among varying battery cells and reduces permanent sulfation of the battery plates. It is energy invested in lengthening the life of the battery. Though the PV system battery bank receives a good deal of cycling and gassing through normal activity, equalization is a complement to this activity and as a rule of thumb should be done every 60 to 90 days. The equalization process consumes water and produces much gassing, so your batteries should be well ventilated during this charging. Equalization charging voltages vary widely, as do duration times, so the batteries should be monitored closely during this process. Check periodically during the EQ process. You don't have to check every cell each time, but watch any that show a high variation from the rest of the cells. Keep checking the specific gravity of the electrolyte until you receive three readings of 30 minutes apart which indicate no further increase of specific gravity values. Keep a record of individual cell voltages and specific gravity before and after equalizing. Equalization will take your voltage to 15 volts or higher (30 volts on a 24 volt system) so make sure any DC loads are disconnected before you begin.

Battery Connections

The connections from battery to battery and on to the charging and load circuits are critical. Before connecting your batteries together, be sure that the interconnects and battery terminals are clean. When making your series and parallel battery connections, be careful not to torque the connecting hardware too tight as the battery's lead posts can break easily. After all battery connections are made, go back to each battery terminal and apply anti-corrosion coating or grease to minimize corrosion build up. Torquing all bolts equally avoids variations in resistance. This variation in resistance is the main reason we prefer to minimize the number of parallel strings in the bank. Higher resistance values on one string of batteries result in less charge to that string and consequently shorter life. We also place the main negative and positive on opposing corners of the battery bank. The goal is to keep the variation of resistance from one parallel string to another to a minimum.

Used Batteries

Like most things, you get what you pay for. Used lead acid batteries, especially large two volt telephone type cells can be found for sale at some very attractive prices. While used solar modules and inverters are usually an acceptable risk, used batteries are not. Should you consider them? In our experience it is difficult to know just how an older battery has been used and cared for. Our recommendation on used batteries is to inspect them carefully in person, get as much information as you can on them (manufacturer, age, amp-hour capacity and type of system they were used in) and have them load tested. Without load testing used batteries you are really guessing as to their remaining life. If you are considering telephone cells, realize that they are normally shallow cycle lead calcium grid construction, and should not be used in a system designed for deep cycling.

DON'T SKIMP ON BATTERIES!

A correctly sized battery bank is vital to the proper functioning of your system. Compromising on the battery bank can lead to poor performance and dissatisfaction with the entire system. Do not skimp here.

Rolls

Deep cycle, flooded lead-antimony batteries feature a high cycle life, thick plates, a large liquid reserve, and a ten year warranty. Dry charged models for export are available. Rolls Battery Engineering has been manufacturing the highest quality deep cycle lead-acid batteries for more than 60 years. Their series 5000 system of batteries has been manufactured specifically for renewable energy applications and are designed to offer up to a 20 year lifetime.

- Non-Breakable dual container construction which prevents acid leakage
- Thick lead plates with the highest density active material which provides unsurpassed cycling service
- Increased liquid reserve which means less maintenance
- 3000+ cycles to 50% depth of discharge, 2000+ cycles to 80% depth of discharge
- Ten year (first 36 months full; next 84 months pro-rated) warranty

Rolls 6CS-21PS

Product Name and Description	Part Number	Voltage	Amp Hour (20 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
4KS-21PS	40468	4	1104	15.75 x 9.75 x 24.75	$730.00	230.0
4KS-25PS	40232	4	1350	15.75 x 10.625 x 24.75	$910.00	315.0
6CS-17PS	40446	6	546	22.0 x 8.25 x 18.25	$541.00	221.0
6CS-21PS	40466	6	683	22.0 x 9.75 x 18.25	$680.00	271.0
6CS-25PS	40465	6	820	22.0 x 11.25 x 18.25	$812.00	318.0

L-16 Solar Batteries

Series 4000 battery is recommended for many medium sized PV systems. It is rated 350 to 400 amp-hours at 6 volts. Their lead plates are heavier than those in 6 volt golf cart batteries. This heavier construction increases the useful life of the battery while keeping initial costs low, making this a good battery to choose for a medium size system. Multiples of two required on 12 volt systems. Multiples of four required on 24 volt systems. Seven year (first 24 months full; next 60 months pro-rated) warranty.

Rolls S460

Product Name and Description	Part Number	Amp Hour (20 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
Surrette S-460	40433	350	12.3 x 7.125 x 16.75	$300.00	117.0
Surrette S-530	40403	400	12.3 x 7.125 x 16.75	$350.00	127.0

MK Solar Batteries

MK Gel Cell Batteries

The Deka Solar Series of valve-regulated, gelled-electrolyte batteries are designed to offer reliable power for renewable energy applications where frequent deep cycles are required and minimum maintenance is desired. These batteries are sealed, but will vent at a pressure of 2 psi while being charged. Therefore, they require a ventilated enclosure to prevent gas build up. Maximum charging voltage should be at least 13.8 volts, but no more than 14.1 volts at 68°F. Two year warranty (One full and one pro-rated).

We recommend these batteries for small to medium sized PV systems, from recreational vehicles to remote telecommunication sites.

MK Gel

Features:

- Valve-regulated
- Gelled-electrolyte
- Compucast, power path grids are computer controlled oxide
- Low standing loss
- Tank formed plates
- Rated non-spillable by ICAO, IATA and DOT
- Made in the USA
- Lead Calcium Construction

Benefits:

- Sealed construction eliminates periodic watering, corrosive acid fumes and spills.
- Electrolyte will not stratify, no equalization charging required.
- Increases durability and deep-cycle ability for heavy demand applications.
- Less than 2% per month stand loss means little deterioration during transport and storage.
- Insures voltage matching between cells.
- Transports easily and safely by air. No special containers needed.
- Insures reliable service, support and quality.
- Excellent cycling performance.

Product Name and Description	Part Number	Amp Hour (20 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
MK 12V100	40274	86.0	12.75 x 6.75 x 9.875	$158.00	69.0
MK 8GU1 Gel	40261	31.2	7.75 x 5.13 x 7.25	$57.00	24.0
MK 8G22NF Gel	40266	50.0	9.38 x 5.50 x 9.25	$99.00	38.0
MK 8G24 Gel	40262	73.6	10.25 x 6.75 x 9.88	$109.00	53.6
MK 8G27	40274	86.4	12.75 x 6.75 x 9.88	$151.00	63.2
MK 8A27 AGM	40305	92.0	12.75 x 6.88 x 9.88	$175.00	63.0
MK 8A31 AGM	40306	105.0	12.94 x 6.75 x 9.75		69.0
MK 8G4D Gel	40264	183.0	20.75 x 8.50 x 11.0	$320.00	129.8
MK 8A4D AGM	40301	200.0	20.75 x 8.5 x 10.0	$375.00	129.0
MK 8G8D Gel	40265	225.0	20.75 x 11.0 x 11.0	$360.00	160.8
MK 8GGC2 Gel	40276	180.0	10.25 x 7.13 x 10.88	$375.00	68.4

Concorde

Sun-Xtender VRLA Sealed AGM Batteries

Concorde's proprietary, maintenance-free, valve-regulated lead acid batteries, employ non-spillable absorbed glass mat (AGM) technology. Immobilized electrolyte and thick lead calcium plates are compressed within a microfibrous silica glass mat envelope which provides excellent electrolyte absorption and retention with greater contact surface to plates compared to gelled batteries, resulting in higher capacity ratings and cyclic performance. Lower self discharge rate - five times better than flooded batteries. Expected life cycles are 5000 cycles to 10% DOD, 1000 cycles to 50% DOD. UL listed as a recognized system component. Meet DOT transportation requirements and are not restricted for shipment because they are exempted from hazardous materials category. All have copper alloy terminals and silicon bronze bolts. One year warranty.

Product Name and Description	Part Number	Voltage	Amp Hour (20 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
PVX-340T	42180	12	32	7.71 x 5.18 x 6.89	$65.97	25.0
PVX-420T	42181	12	40	7.71 x 5.18 x 8.05	$81.81	30.0
PVX-490T	42192	12	48	8.99 x 5.45 x 8.82	$108.00	36.0
PVX-560T	42182	12	55	8.99 x 5.45 x 8.82	$97.20	40.0
PVX-690T	42204	12	65	10.22 x 6.60 x 8.93	$126.54	51.0
PVX-840T	42197	12	80	10.22 x 6.60 x 8.93	$140.88	57.0
PVX-890T	42193	12	85	12.90 x 6.75 x 8.96	$181.00	70.0
PVX-1040T	42194	12	100	12.03 x 6.77 x 8.93	$158.54	66.0
PVX-1080T	42189	12	105	12.90 x 6.75 x 8.96	$204.00	62.0
PVX-2120L	42199	12	210	20.75 x 8.71 x 10.42	$323.62	138.0
PVX-2580L	42198	12	255	20.76 x 10.89 x 8.92	$448.00	165.0
PVX-1380T	42183	6	130	10.22 x 6.77 x 8.92	$127.82	51.0
PVX-1680T	42184	6	165	10.22 x 6.77 x 8.92	$146.59	57.0
PVX-1780T	42187	6	170	12.90 x 6.75 x 8.96	$155.92	62.0
PVX-2080T	42188	6	200	12.03 x 6.77 x 8.93	$166.46	66.0
PVX-2160T	42205	6	210	12.90 x 6.75 x 8.96	$173.26	70.0
PVX-2240L	42206	6	220	10.27 x 7.12 x 10.24	$131.90	67.0
PVX-4140T	42207	2	408	10.22 x 6.77 x 8.93	$138.69	51.0
PVX-5040T	42208	2	495	10.22 x 6.77 x 8.93	$157.57	57.0
PVX-5340T	42209	2	530	12.90 x 6.75 x 8.96	$165.42	62.0
PVX-6240T	42210	2	615	12.03 x 6.77 x 8.93	$175.82	66.0
PVX-6480T	42211	2	640	12.90 x 6.75 x 8.96	$185.25	70.0

Battery Enclosures and Accessories

Battery Enclosures

Outdoor Battery Enclosures

Battery boxes serve many purposes. Protection from tampering, weather and physical damage to name a few. Should a battery rupture a good battery box will contain the acid and minimize the damage.

6B Battery Enclosure

Product Name and Description	Part Number	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
2 TB - (2 Group 27) Outdoor, Black HDPE	27420	34.5 x 13.5 x 12.75	$96.00	8.0
4 TB - (4 Group 27) Outdoor, Aluminum with clear powder coat	28170	32.0 x 14.0 x 15.0	$208.00	32.0
6B - HDPE Battery Enclosure Constructed of heavy-duty polyethylene; hold up to four (4) L-16, six (6) T105 or group 27 batteries.	27391	37.0 x 21.0 x 20.1	$125.00	24.0

Industrial Grade, Galvanized Battery Enclosures

Rugged, welded 12 gauge steel, NEMA 3R construction, hot dipped galvanized, fully insulated with 1 inch eps foam insulation, with self venting lid. Includes mounting feet. 4B enclosure models include side lifting handles and bottom mounting channels and padlock style lid closure. 1BE and 2BE models have quarter turn latches.

Galvanized Battery Enclosure

Product Name and Description	Part Number	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
1BE	26091	9.80 x 15.30 x 13.00	$333.00	55.0
2BE	26092	16.50 x 15.30 x 13.00	$350.00	78.0
4B	26022	34.00 x 16.50 x 21.50	$699.00	125.0

OutBack Power System Rack (PSR)

OutBack Power Systems (PSR) introduces a new idea - a combined battery cabinet and system component rack that is changing how energy systems are installed. The PSR saves time, money and space by combining the batteries, disconnects, overcurrent protection devices and even the inverter / charger into a single enclosure. The PSR is packaged knocked down for ease of shipment, storage and installation. Also available frame only. (PSR-FO)

The PSR battery rack / enclosure is available either as an open rack or with removable side panels for indoor use. It can also be used for outdoor installations with an optional PSR-3RK Outdoor Rainproof Kit installed. The PSR can be used to hold inverters, controls, battery chargers and other system components together with sealed batteries. Includes a mounting area for 5 small (0.75" wide) and 1 medium or large (1.0" or 1.5" wide) DC breakers.

Power System Rack

Includes removable top & side panels, two shelves and conduit / breaker knockout plates. PSR front bracket will hold one DC-GFP/2, two PV array disconnect breakers and one large inverter / charger breaker. Holds eight non-sealed T105 or four non-sealed L-16s with space to check and add water without removing the top. Holds twelve sealed Group 31 / T105 using one additional self kit or four sealed 8D batteries with two additional shelf kits. Optional spill containment trays, PSR-SCT, are available for use with unsealed batteries. For indoor use only - ETL listed under UL1741 as a Photovoltaic accessory. Shipped unassembled in three boxes.

Product Name and Description	Part Number	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
PSR	55279	37 x 17 x 43	$649.00	110.0
PSR-FO	55281	34 x 17 x 43	$399.00	74.0

PSR

Power System Rack - Accessories

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PSR-3RK - Type 3R / Outdoor Rainproof Kit A field installable kit to allow the mounting of the PSR in an outdoor location. Includes an insulted powder-coated aluminum top rain shield, gasketing, and a lockable, transparent flip-up circuit breaker cover. Shipped as a kit in one additional box. ETL listed.	55280	$149.00	10.0
PSR-SK - Additional Shelf Kit Additional shelf for the PSR for more batteries or inverter/chargers when using sealed batteries. Maximum of four shelves inside a PSR or five total shelves on a PSR-FO version.	55283	$89.00	12.5
PSR-BCK - Breaker Cover Kit Transparent flip-up cover with mounting screws and padlock hasp. Fits on PSR only.	55285	$19.00	1.0
PSR-HDT - Heavy Duty Top Allows mounting of a SW series II inverter / charger with conduit box on top of the PSR cabinet.	55282	$79.00	16.5
PSR-SCT - Spill Containment Tray Holds four Group 31, T105 or L16 batteries. The tray has enough capacity to hold one ruptured battery cell's spilled electrolyte. Fits on one PSR shelf. Molded acid resistant polyethylene plastic.	55286	$29.00	5.0
PSR-MP - Mounting Plate for PSR Attaches to the back of a PSR to allow mounting of electrical components. Predrilled for TBB and GBB options and various other control / inverter components. Fits inside of enclosure panel.	55287	$39.00	10.6
PSR-SZ4 - Seismic zone 4 Kit To meet UBC earthquake safety requirements	55284	$89.00	9.2

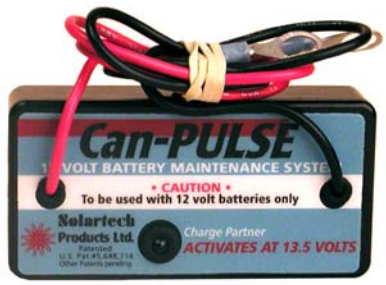
PSR-3RK

PSR-BCK

Can-PULSE Solar Charge / Motive Partner

The Solar Charge/Motive Partner (SCP/SMP) is an electronic battery conditioning device that enhances battery performance by preventing/reducing sulfation buildup on the battery's lead plates. Sulfation is present in every battery to some degree and is part of the natural aging process of a lead acid battery. The Can-PULSE Solar Charge/Motive Partner combats this sulfation buildup by emitting a short duration high voltage pulse that stimulates and dissolves the sulfation molecules returning them back to the electrolyte where they belong. Activates at 13.5 volts (12V), 27 volts (24V), or 54 volts (48V).

SCP units are for batteries with capacities less than 600 amp-hours while SMP units are for batteries over 600 amp-hours capacities. All units come with a 1 year warranty.



Can-PULSE SMP-12

Product Name and Description	Part Number	Voltage	Operating Current	Activation Voltage	Price	Shipping Weight (lbs.)
SCP-12	43910	12	<100mA	13.5	$159.00	1.0
SCP-24	43911	24	<50mA	26.0	$160.00	1.0
SMP-12	43920	12	<150mA	16.2	$495.00	1.0
SMP-24	43921	24	<75mA	26.0	$495.00	1.0
SMP-48	43922	48	<25mA	50.0	$495.00	1.0

Battery Vent Caps - Water Miser

Flip-top vent cap design allows watering without cap removal. A pellet condensing medium captures and returns electrolyte-laden droplets during the charging cycle, assuring cell electrolyte gravities are better maintained. Reduces fumes in the environment and extends watering intervals.

Product Name and Description	Part Number	Price
Water Miser Safety Vent Cap Bayonet quarter-turn design fits most wet batteries	42025	$7.00

Water Miser Cap

Power Vent - Battery Box Ventilator

This ventilation unit mounts in the 2 inch SCH40 PVC pipe commonly used to vent battery boxes (48 volt units require 2 inch inlet and 3 inch outlet PVC piping). The PVC housing of the power vent encloses a small 12, 24 or 48 volt fan and flap valve to stop back draft. Now your basement battery box will vent to the outside whenever charging voltages are present and at night no air will enter the house. Many passive ventilation systems do a better job at ventilating the batteries into the house than outside, because of the lower pressure associated with many basements. A voltage sensitive switch is required to operate this unit. Auxiliary relays inside a Trace SW series inverter will accommodate this nicely. Power consumption is 2.2 watts; 2.0 inch pipe provides 6 cfm.

Product Name and Description	Part Number	Voltage	Price	Shipping Weight (lbs.)
Power Vent 12V	84550	12	$79.00	3.0
Power Vent 24V	84552	24	$79.00	3.0
Power Vent 48V	84554	48	$125.00	4.0

Power Vent

Battery Interconnect Cables

High quality, flexible cable with copper ring lugs for 3/8 inch bolt. Lugs are professionally double crimped and sealed to cable with adhesive melt-wall tubing to prevent corrosive fumes from damaging conductors.

Non-Domestic Use

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
#4 x 12 in. Red	43000	$6.00	0.19
#4 x 12 in. Black	43010	$6.00	0.19
#4 x 18 in. Red	42910	$7.00	0.31
#4 x 18 in. Black	42900	$6.00	0.31
#2 x 16 in. Red	44362	$9.00	1.00
#2 x 16 in. Black	44363	$9.00	1.00
#2/0 x 7.5 in. Red	43055	$10.00	0.38
#2/0 x 7.5 in. Black	43057	$10.00	0.38
#2/0 x 12 in. Red	43040	$12.00	0.50
#2/0 x 12 in. Black	43050	$12.00	0.50

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
#2/0 x 18 in. Red	43110	$14.00	0.75
#2/0 x 18 in. Black	43120	$14.00	0.75
#2/0 x 24 in. Red	43060	$16.00	1.00
#2/0 x 24 in. Black	43070	$16.00	1.00
#4/0 x 13 in. Red	43126	$18.00	1.00
#4/0 x 13 in. Black	43125	$18.00	1.00
#4/0 x 18 in. Red	43121	$20.00	1.50
#4/0 x 18 in. Black	43122	$20.00	1.50
#4/0 x 24 in. Red	43123	$22.00	2.00
#4/0 x 24 in. Black	43124	$22.00	2.00

Domestic Use (UL Listed)

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
BC1.5B 2/0 Red (18")	49137	$20.00	2.0
BC1.5B 2/0 Black (18")	49136	$20.00	2.0
BC1.5B 4/0 Red (18")	49139	$20.00	3.0
BC1.5B 4/0 Black (18")	49140	$20.00	3.0

Battery Maintenance Items

Battery systems should be properly installed and maintained on a regular basis. The following items are recommended for typical installations and periodic maintenance.

Product Name and Description	Part Number	Price
Hydrometer - Temperature compensating Measures electrolyte specific gravity.	44030	$7.00
Water Filling Jug - With auto shut-off 72 oz.	44036	$29.00
Anti-Corrosion Paste - Brush-on 2 lbs. jar. Prevents battery terminal corrosion	44115	$17.00
Chemical Goggles Recommended eye protection	44045	$5.00
Rubber Globes - Solvex Large pair. Protects skin from chemical contact.	44046	$3.00

Safety and Disconnect Equipment

To have a safe code compliant photovoltaic system you need to install the appropriate disconnects, fuses and/or breakers throughout your system. The National Electrical Code (NEC) states that a disconnect is required for every piece of equipment (charge controllers, inverters, etc.) to isolate them from all sources of power (solar modules, batteries and generators). This might sound complicated, but it is really pretty easy. On the following pages you will find several disconnect and overcurrent protection options for your system. If you aren't sure which disconnects you should use and where, just give your KSI dealer a call and he can point you in the right direction.

Connect Energy PV Combiner Box

The NEC requires that each series string of solar modules in an array must be paralleled together in a fused combiner box. Connect Energy offers their PCB10 combiner box to do just that. It will accept up to ten pairs (one + and one -) of #10 AWG wire and combines them together into a pair of dual #1/0 AWG lugs. The PCB10 is UL listed, housed inside an 8" x 10" x 4" NEMA-3R enclosure and includes a ground bar and MOV surge suppressors. Fuses must be ordered separately and vary in size depending on the amperage of the solar modules in your array. PCB10 shipping weight is 7 lbs.

Product Name and Description	Part Number	Price
PCB10 Combiner box	53072	$229.00
ABC-6 (pack of 10-6A fuses)	36727	$12.00
ABC-8 (pack of 10-8A fuses)	36728	$12.00
ABC-10 (pack of 10-10A fuses)	36729	$12.00
ABC-15 (pack of 10-15A fuses)	36730	$12.00

PCB10 Combiner Box

OutBack Power Systems PV Combiner (PSPV)

PSPV

OutBack offers a PV array combiner which can be used with a wide variety of PV system designs and module configurations. It can be configured with DC breakers for low voltage systems (under 125 VDC) or touch safe type fuse holders for high voltage systems (up to 600 VDC). PSPV is designed to provide NEC code compliant overcurrent protection and interconnection of multiple PV panels or sub-arrays into one or more PV arrays for connection to charge controllers or inverter systems. The PSPV is easily field configured to match your PV system design and ampacity requirements.

The PSPV Power system PV Combiner provides series over-current protection of PV module circuits allowing NEC compliant installation. Includes space for up to twelve 125 VDC rated breakers or eight 600 VDC rated fuse holders. Includes two positive output bus bars with two #1/0 terminals for single or dual output circuits. The type 3R outdoor rainproof enclosure can be mounted vertically, or inclined to 14 degrees (3 in 12 pitch). Enclosure only without breakers or fuse holders. Order breakers or fuses/fuse holders from selection on the next page.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PSPV	55252	$139.00	5.0

PSPV Combiner

PV Array Breakers

DIN rail snap-in mount with #2 AWG setscrew type compression terminals. UL listed for up to 125 VDC. Maximum of twelve breakers. Fits in the PSPV only.

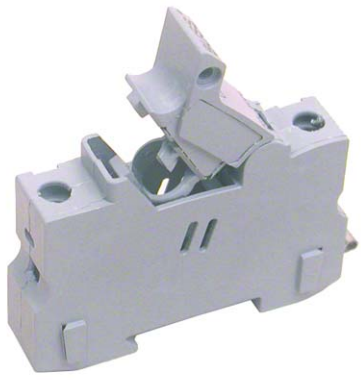
Product Name and Description	Part Number	Price
OBPV-6	55240	$12.00
OBPV-9	55241	$12.00
OBPV-10	55242	$12.00
OBPV-15	55243	$12.00
OBPV-30	55244	$12.00

OBPV-6

High Voltage PV Array Fuseholder

DIN rail snap-in mount with #8 AWG setscrew type compression terminals. Touch-safe design. Not rated for load make or load break usage. UL listed for up to 600 VDC. Maximum of seven fuseholders in one PSPV enclosure.

Product Name and Description	Part Number	Price
OBFH	55230	$18.00
OBF-15	55231	$18.00



OBFH

OutBack Power Systems — OutBack Power System PV Segmenting Breaker

PSSB

OutBack PV array disconnect is designed specifically to work with the SMA Sunny Boy line-tie inverter systems. It can also be used with other high voltage utility interactive PV inverters or other applications such as large inverter power systems or water pumping systems. It can also be used as a standard 600 VDC disconnect for a single high voltage PV array.

The PSSB is designed to provide NEC code compliant overcurrent protection and disconnect means of up to six separate low voltage PV sub-arrays into a single high voltage PV array for connection to a high voltage PV inverter. An optional AC breaker disconnect can also be installed inside the same enclosure to provide a local means of disconnect at the location of the inverter.

PSSB

Additional space for an OBAC-15D (PN 55322) AC breaker disconnect - 2 pole 15 amp 208 and 240 VDC load break rated - 10K AIC or for an additional six pole segmenting breaker (OBSB-15) allowing connection of up to twelve low voltage PV sub-arrays.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PSSB	55289	$249.00	7.0

Segmenting Breaker

Segmenting breaker only - 6 pole 15 amp 100 VDC per pole / 600 VDC total. Two can be installed in a single PSSB enclosure allowing connection of up to twelve low voltage PV sub-arrays.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
OBSB-15	55233	$110.00	2.0

PSSB Sunny Boy Mounting Plate

Mounting plate for one PSSB and a Sunny Boy Inverter, or without an inverter, up to three PSSBs - 16 & 24 inch mounting holes. Grey powder-coated aluminum. Includes mounting hardware.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PSSB-MP	55232	$99.00	8.6

OBSB-15 Segmenting Breaker

PV Ground Fault Protection

PVGFP xantrex

The NEC requires that you install a ground fault protection (GFP) device in your system if your solar array is mounted on the roof of a dwelling. To accomplish this, Xantrex has designed four different "PVGFP" units to handle 100-400 amps at 125 VDC max. Voc. This is actually a fire protection device designed to interrupt a fault current in excess of 1 amp by disconnecting the PV array from the rest of the system. Units from Xantrex are supplied without an enclosure, but it can be housed in a box with internal dimensions not less than 10.5"W x 12"H x 3.75"D.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PVGFP-1	54011	$275.00	2.0
PVGFP-2	54013	$325.00	3.0
PVGFP-3	54014	$375.00	4.0
PVGFP-4	54015	$425.00	5.0

PVGFP-1

OutBack DC Ground Fault Protection System

The OutBack Power systems GFP/2 is required for PV arrays mounted on dwelling roofs. A GFP/2 protects wiring and system components for one or two PV arrays: Dual 60 amp PV circuits 125 VDC max Voc. Requires three small breaker spaces. The GFP/2 has 1/4" stud terminals. The OBDC-GFP/2 system includes the GFP unit, a ground bus bar, neutral and ground connection wiring and mounting hardware. The PSR includes mounting for only one OBDC-GFP/2 along with two PV disconnects and one large battery breaker. For use in OutBack PSR and PSDC's.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
OBDC-GFP/2	55270	$129.00	2.0

OBDC

General Electric Fused Safety Switches

Indoor NEMA 1 Enclosure

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
TG3221 - 2 pole 30A	36600	$60.00	6.0
TG4321 - 3 pole 30A	36641	$89.00	6.0
TG3222 - 2 pole 60A	36621	$99.00	11.0
TG4322 - 3 pole 60A	36643	$145.00	16.0
TG3223 - 2 pole 100A	36630	$195.00	17.0

Outdoor NEMA 3R Enclosure

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
TG3221R - 2 pole 30A	36620	$91.00	6.0
TG4321R - 3 pole 30A	36642	$135.00	6.0
TG3222R - 2 pole 60A	36625	$159.00	11.0
TG4322R - 3 pole 60A	36644	$196.00	16.0
TG3223R - 2 pole 100A	36631	$219.00	17.0

General Electric 2 and 3-pole fused safety switches are typically used for single and 3-phase AC circuits, but can be used for 12-125 VDC circuits as well. Class-R fuses are required with these switches, but are not included. See the Class-R fuse and block section.

Indoor Enclosure

Class R Fuses and Fuse Blocks

Class R Fuses

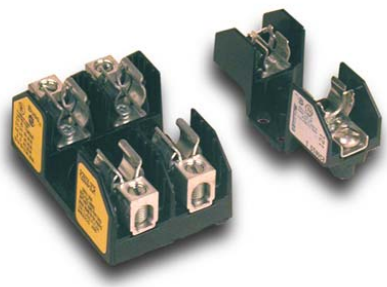
Class-R fuses are current limiting fuses with a high amp interrupting capacity (AIC) that can be used in DC or AC circuits. These fuses can be used in the GE safety switches or the single or double pole fuse blocks.

Product Name and Description	Part Number	Price
FRN-R15 - 15A	36699	$4.00
FRN-R20 - 20A	36702	$4.00
FRN-R30 - 30A	36700	$4.00
FRN-R40 - 40A	36704	$8.00
FRN-R50 - 50A	36720	$8.00
FRN-R60 - 60A	36706	$8.00
FRN-R80 - 80A	36707	$18.00
FRN-R100 - 100A	36710	$20.00

Class R Fuses

Class R Fuse Blocks

Use these fuse holders for a low-cost means of protecting small to medium sized inverters or other DC circuits. These blocks should be mounted inside an enclosure for safety.



Class R Fuse Blocks

Product Name and Description	Part Number	Max. Wire Size	Number of poles	Price
FB-30-1	36961	2AWG	1	$7.00
FB-30-2	36962	2AWG	2	$15.00
FB-60-1	36963	2AWG	1	$12.00
FB-60-2	36964	2AWG	2	$29.00
FB-100-1	36966	1/0	1	$26.00
FB-100-2	36967	1/0	2	$36.00

Class T Fuses and Fuse Blocks

Class T Fuse Blocks

Class-T fuses are also current limiting like the Class-R, but have an even higher AIC and are available in amperages from 110 to 400 Amps. These fuse blocks are typically used in between the battery bank and inverter. Consult the inverter overcurrent protection chart in Appendix D to determine which fuse block is right for your particular inverter. The PFB fuse blocks come with set-screw lugs for cut cables. Shipping weight, 2 lbs.

Class T Fuse Blocks

Product Name and Description	Part Number	Max. Wire Size	Amperage	Price
PFB110T	36735	3/0	110A	$53.00
PFB175T	36745	3/0	175A	$69.00
PFB200T	36740	250MCM	200A	$62.00
PFB250T	36747	250MCM	250A	$79.00
PFB300T	36750	250MCM	300A	$79.00
PFB400T	36741	250MCM	400A	$79.00

Class T Fuses

Product Name and Description	Part Number	Price
JJN-110	36767	$20.00
JJN-175	36746	$20.00
JJN-200	36739	$20.00
JJN-250	36748	$39.00
JJN-300	36751	$39.00
JJN-400	36742	$39.00

Class T Fuse

xantrex Xantrex Disconnect

The Xantrex DC175 / DC250 disconnect offers the ultimate in terms of overcurrent protection and a disconnect means for your inverter all in one enclosure. It also interfaces very nicely with the Xantrex SW, PS & DR series inverters. These disconnects can also serve as a central wiring point for your system by housing a DC bonding block and/or shunt. Each disconnect comes with one main 175A or 250A breaker with space for adding a second breaker. Four smaller knockouts on the side can each house a 15-60A DC breaker for solar input or DC load output. Size 21" x 10.5" x 4.8".

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
DC250 - 250 Amp breaker and enclosure (for #4/0 cables).	53039	$329.00	16.0
DC175 - 175 Amp breaker and enclosure (for #2/0 cables).	53043	$329.00	16.0
GJ250 - Additional 250 Amp breaker	53044	$195.00	3.0
GJ175 - Additional 175 Amp breaker	53045	$195.00	3.0
CD60DC - 60 Amp circuit breaker	53047	$39.00	1.0
CD15 - 15 Amp circuit breaker	53041	$29.00	1.0
CD20 - 20 Amp circuit breaker	53053	$29.00	1.0
DCBB - Negative / ground block handles up to four #4/0 cables	53046	$50.00	1.0

DC250
Breaker / Enclosure

CD15 Circuit Breaker

Inverter AC Disconnect - Bypass Breaker Enclosure

For 120 VAC inverters, UL listed, provides overcurrent protection and disconnection means for inverter AC output and back-up generator or utility AC input to inverter. Can be connected in a bypass mode for pass-through generated power directly to AC loads, bypassing the inverter in the event of down time. 60A models supplied with one and two pole QO circuit breakers, mechanical interlock, lockable enclosure and #6 AWG wire. For 240 VAC applications, use two assemblies. Shipping weight, 11 lbs.

Product Name and Description	Part Number	Price
BPE-60, Bypass Enclosure 60A-indoor	55126	$112.00
BPE-60R, Bypass Enclosure 60A-outdoor 3R	55125	$279.00

BPE-60

OutBack DC / AC Fuses

DC Overcurrent Protection

These 125 VDC rated breakers are for DC inputs / loads and power inverters. The Amps Interrupt Capacity, AIC, rating is in accordance with UL489.

Product Name and Description	Part Number	Amperage	Stud Terminal Size	Price	Shipping Weight (lbs.)
OBDC-250	55261	250	3/8”	$119.00	3.0
OBDC-175	55262	175	3/8”	$119.00	3.0
OBDC-100	55263	100	5/16”	$59.00	1.0
OBDC-60	55264	60	1/4”	$29.00	1.0
OBDC-50	55307	50	1/4”	$29.00	1.0
OBDC-40	55265	40	1/4”	$29.00	1.0
OBDC-30	55266	30	1/4”	$25.00	1.0
OBDC-20	55310	20	1/4”	$25.00	1.0
OBDC-15	55267	15	1/4”	$25.00	1.0
OBDC-10	55268	10	1/4”	$25.00	1.0
OBDC-1	55269	1	1/4”	$25.00	1.0

DC Overcurrent Protection

AC Overcurrent Protection

All AC breakers are DIN rail snap-in mount and can be used for AC input or load circuits. All breakers accept #2 to 14 AWG wire. OutBack AC breakers are hydraulic magnetic type which are not sensitive to ambient temperature like other breakers in the market.

Product Name and Description	Part Number	Amperage	Panel Space Width	Price
AC-60	55208	60	3/4”	$25.00
AC-60D	55209	60	1 1/2”	$25.00
AC-30	55210	30	3/4”	$25.00
AC-30D	55211	30	1 1/2”	$25.00
OBAC-25D	55214	25	1”	$25.00
OBAC-20	55213	20	1/2”	$15.00
OBAC-15	55212	15	1/2”	$15.00

AC Overcurrent Protection

Battery Chargers

xantrex™ Xantrex TRUECharge®

Xantrex's advanced power conversion technology puts high-end multi-step battery charging within your reach. Advanced microcomputer control improves charger performance and ensures the fastest possible charge while actually making the charger easier to use. The TRUECharge units are true "connect-and-forget" chargers since they will drop their voltage output to a safe "float" voltage level to maintain the battery's charge once it has completed its charging cycle. After that it will check the battery's condition every 21 days and automatically top them off if they have self discharged. While these features set the Xantrex TrueCharge units apart from the rest, their most noticeable feature is their silence. There is none of the buzz commonly found in older technology battery chargers. Status LED's on all of the units indicate the charging status and charging amperage (except the TC10TB). All of the TrueCharge units are for 12V nominal systems and are available in ampacities ranging from 10 to 40 amps. Their features vary slightly so please consult the chart below to see which one will work best for you.

TC20 Remote Panel

TRUECharge TC20+

Product Name and Description	Part Number	Amperage	DC Connection	Temperature Compensation	Equalization Mode	Price
TC10TB	35912	10	Hardwire	N/A	N/A	$199.95
TC10	35915	10	Alligator clips	Manual Switch	N/A	$269.95
TC20+	35920	20	Hardwire - 3 outputs	w/ optional sensor	Yes, Manual	$429.95
TC40+	35925	40	Hardwire - 3 outputs	Manual Switch w/ optional sensor	Yes, Manual	$579.95
TC10i	35916	10	Alligator clips	Manual Switch	N/A	$300.00
TC20i	35921	20	Hardwire - 3 outputs	w/ optional sensor	Yes, Manual	$469.00
TC40i	35926	40	Hardwire - 3 outputs	Manual Switch w/ optional sensor	Yes, Manual	$625.00
Remote temperature sensor (25')	35932	-	-	-	-	$29.95
Remote panel for TC20+ (Displays charging amperage and battery voltage)	35930	-	-	-	-	$39.95
Remote panel for TC40+ (Displays charging amperage and battery voltage)	35931	-	-	-	-	$39.95

Iota Engineering Company DLS Power Supplies

Iota Engineering uses advanced switch mode technology to bring to market highly sophisticated electronic converter/power supplies at an affordable price. Their DLS line of battery chargers offer an exceptionally clean DC output that quickly and efficiently charges your battery bank. It then maintains the battery state of charge by only putting into the battery what is required by the load or self discharge, cutting back to milliamps as the battery requires. The DLS line of battery chargers is fully protected against low AC line voltage as well as spikes coming in from the AC power source. The DLS chargers operate at much cooler temperatures as compared to other brands of chargers which equates to a substantially longer life and safer operation. The DLS chargers can also be used as a power supply without a battery to supply your DC load with just the right amount of power that it requires. A Dual Voltage Jack on all of the units allows the user to manually change the charging voltage from 13.6 to 14.2 volts. These chargers/power supplies meet FCC criteria for minimal radio and television interference especially on the lower frequency bands.

IOTA DLS-75

All DLS converters are compatible with IQ Smart Control Technology. The IQ Smart Charger allows a DLS charger to operate as an automatic 3-stage (Bulk, Absorption, and Float) smart charger with a weekly equalization function. The IQ Smart Charger installs simply by plugging into the DLS Dual Voltage Jack. The Smart Charge circuitry is automatically engaged.

Product Name and Description	Part Number	Voltage	Amperage	Size (in.) (L x W x D)	Shipping Weight (lbs.)	Price
DLS-15	36271	13.6	15	7.0 x 6.5 x 3.5	5.0	$142.00
DLS-30	36266	13.6	30	7.0 x 6.5 x 3.5	5.5	$182.00
DLS-45	36277	13.6	45	7.0 x 6.5 x 3.5	5.5	$194.00
DLS-55	36278	13.6	55	7.0 x 6.5 x 3.5	5.5	$212.00
DLS-75	36281	13.6	75	10.0 x 6.5 x 3.5	7.8	$386.00
DLS-75/IQ4	36282	13.6	75	10.0 x 6.5 x 3.5	7.8	$416.00
DLS-90	36283	13.6	90	10.0 x 6.5 x 3.5	7.8	$488.00
DLS 27-15	36267	27	15	7.0 x 6.5 x 3.5	5.5	$299.00
DLS 27-25	36268	27	25	7.0 x 6.5 x 3.5	5.5	$353.50
DLS 27-40	36269	27	40	10.0 x 6.5 x 3.5	7.8	$554.00
DLS 36-20	36272	36	20	7.0 x 6.5 x 3.5	5.5	$396.00
DLS 42-18	36273	42	18	7.0 x 6.5 x 3.5	5.5	$396.00
DLS 48-15	36274	48	15	7.0 x 6.5 x 3.5	5.5	$378.00
DLS 48-20	36275	48	20	10.0 x 6.5 x 3.5	7.8	$581.00
IQ Smart Charger	36279	-	-	-	-	$35.00

INVERTERS

The inverter is a basic component of PV systems and it converts DC power from the batteries or in the case of grid-tie, directly from the PV array into high voltage AC power as needed. Inverters of the past were inefficient and unreliable while today's generation of inverters are very efficient (85 to 94%) and reliable.

Today, the majority, if not all of the loads in a typical remote home operate at 120 VAC from the inverter. Most stand-alone inverters produce only 120 VAC, not 120/240 VAC as in the typical utility-connected home. The reason being, once electrical heating appliances are replaced with gas appliances, there is little need for 240 VAC power. Exceptions include good-sized submersible pumps and shop tools which can either be powered by a generator, step-up transformer, or possibly justify the cost of adding a second inverter. Several utility line-tie inverters do produce 240 VAC.

Two types of stand-alone inverters predominate the market – modified sine and sine wave inverters. Modified sine wave units are less expensive per watt of power and do a good job of operating all but the most delicate appliances. Sine wave units produce power which is almost identical to the utility grid, will operate any appliance within their power range, and cost more per watt of output.

Utility-tie systems / sine wave inverters for utility interactive photovoltaic applications, provide direct conversion of solar electric energy to utility power with or without a battery storage system. These systems are designed to meet or exceed utility power company requirements and can be paralleled for any power level requirement. They are listed to UL 1741 for photovoltaic power systems.

Inverter Component Checklist

While an inverter can account for a good portion of the cost of a PV system, it is really a sub-system that requires a number of additional components. To make a safe, reliable, code compliant installation one should provide the following:

Inverter to battery cabling

Because of the high current required on low voltage circuits, this cable is large, commonly #2 to 4/0 in size. Smaller conductors than required are unsafe and will not allow the inverter to perform to its full rating.

DC input disconnect and overcurrent protection

It is important to have safe installation with a properly sized DC rated, UL listed disconnect. Typically the disconnect works in conjunction with an overcurrent protection device such as a fuse or circuit breaker. These components are usually installed in an enclosure which can also house shunts and additional equipment or circuit breakers.

Shunts

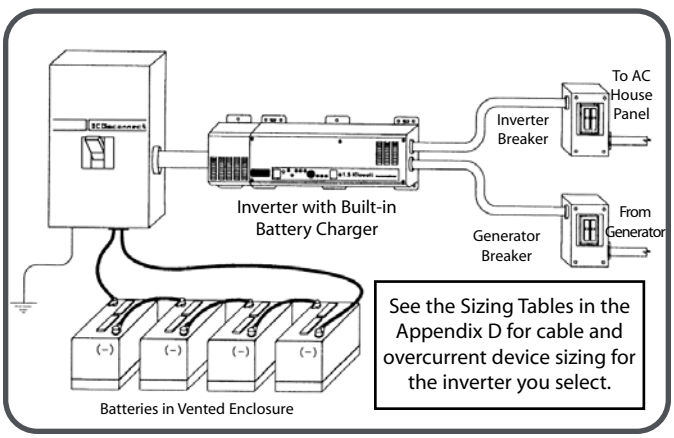
Used to read the amperage flowing between the battery and inverter, this device is installed in the negative conductor. It can easily be housed in the disconnect or its own enclosure.

AC output disconnect and overcurrent protection

If the breaker panel, which is fed from the inverter, is adjacent to the inverter, then the main breaker will serve as the inverter output disconnect and overcurrent protection. If, however, this panel is not grouped with the inverter, then a separate unit should be installed. This also holds true for AC circuits coming into the inverter from a generator or utility source. A second breaker may be needed if these breakers are not grouped.

Inverter Sub-System Checklist

_____ Inverter to battery cabling
_____ DC disconnect and overcurrent device
_____ Inverter conduit boxes
_____ Inverter output breaker box
_____ Generator input breaker box
_____ Shunt(s) if required for monitoring



Built-In Battery Chargers

Most larger inverters can operate as battery chargers as well. This is easily and economically accomplished because of the design of most inverters. Inverters step up low voltage DC power and change it to 120VAC power. Battery chargers do the reverse of this.

Transfer switches are also incorporated into these Inverter / Chargers so that the AC loads can be powered directly from the generator when the battery charger is operating.

From a reliability, performance, and economical standpoint, built-in battery chargers are the way to go.

Multi-Stage Battery Charging

A typical 12-volt lead-acid battery must be taken to approximately 14.2-14.6 VDC before it is fully charged. (For 24 volt systems double these figures for 48 volt, multiply by four.) If taken to a lesser voltage level, some of the sulfate deposits that form during discharge will remain on the battery's lead plates. Over time, these deposits will cause a 200 amp-hour battery to act more like a 100 amp-hour battery, and battery life will be shortened considerably. Once fully charged, batteries should be held at a lower float voltage to maintain their charge – typically 13.2 to 13.4 volts. Higher voltage levels will "gas" the battery and boil off electrolyte, requiring more frequent maintenance.

Most automotive battery charger designs cannot deal with the conflicting voltage requirements of the initial "bulk charge" and subsequent "float" or maintenance stage. These designs can accommodate only one charge voltage, and therefore must use a compromise setting – typically 13.8 volts. The result is a slow incomplete charge, sulfate deposit build-up, excessive gassing and reduced battery life.

The charger available in our inverters automatically cycles batteries through a proper three stage sequence (bulk, absorption and float) to assure a rapid and complete charge without excessive gassing.

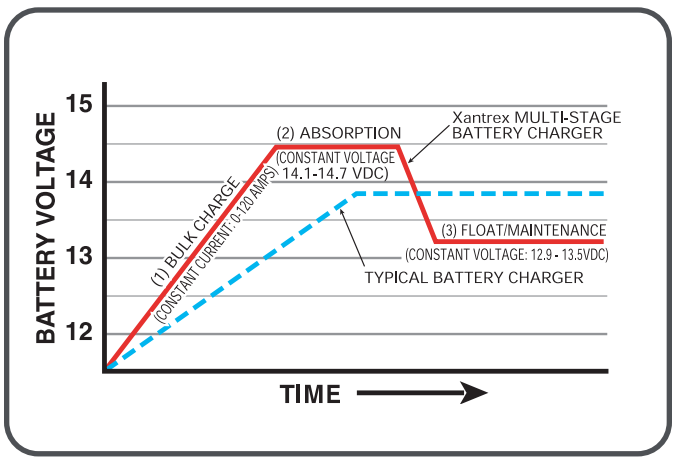
Factory battery charger settings on most inverter-charger combinations are optimal for a lead acid (liquid electrolyte) battery bank of 250-300 amp hours in a 70°F environment. If your installation varies from these conditions, you will obtain better performance from your batteries if you adjust the control settings.

The Maximum Charge Rate in amps should be set to 20-25% of the total amp-hour rating of a liquid electrolyte battery bank. For example, a 400 amp-hour bank should be charged at no more than an 80 -100 amp rate. Excessive charge rates can damage batteries and create a safety hazard.

Comparing Inverters

Inverters are compared by three factors:

- Continuous wattage rating. Hour after hour, what amount of power in watts can the inverter deliver.
- Surge Power. How much power and for how long can an inverter deliver the power needed to start motors and other loads.
- Efficiency. How efficient is the inverter at low, medium and high power draws. How much power is used at idle.



The Bulk Charge Voltage of typical liquid electrolyte lead acid batteries should be about 14.6 VDC. There is no one correct voltage for all types of batteries. Incorrect voltages will limit battery performance and useful life. Check the battery manufacturer's recommendations.

The Float Voltage setting should hold the batteries at a level high enough to maintain a full charge, but not so high as to cause excessive "gassing" which will "boil off" electrolyte. For a 12-volt liquid electrolyte battery at rest, a float voltage of 13.2-13.4 is normally appropriate; gel cells are typically maintained between 13.5 and 13.8. If the batteries are being used while in the float stage, slightly higher settings may be required.

Charge voltage guidelines used here are based on ambient temperatures of 70°F. If your batteries are not in a 70°F environment, the guidelines are not valid. Temperature Compensation automatically adjusts the voltage settings to compensate for the differences between ambient temperature and the 70°F baseline. Temperature compensation is important for all battery types, but particularly gel cell, valve-regulated types which are more sensitive to temperature.

xantrex STXR 2500 Utility Interactive Inverter

The STXR 2500 is designed, built and priced to make the benefits of site generated power easy and affordable. Now anyone can install a solar array on their home or business to reduce or eliminate their monthly electric bill while doing their part to reduce air pollution. To take full advantage of this type of a system, net metering from your utility company would be a big plus as it allows you to turn your existing kilowatt-hour meter backwards when your PV system is producing more power than you are using.

The STXR 2500 incorporates all of the NEC and IEEE required AC and DC input/output connections, disconnects and circuit breakers. A six input combiner and a ground fault protection device are included for installer convenience. With the optional rain shield (STRS) an STXR inverter can even be mounted on an outside wall near your utility service entrance.

Product Name	STXR2500
Part Number	**52931**
Price	**$2759.00**
AC Voltage - Nominal	240 VAC
DC Input Voltage - Nominal	48 VDC
Minimum Operational DC Input	44 VDC
Minimum Wake-up DC Input Voltage	70 VDC
AC Voltage - Min/Max	211-264 VAC (North American models)
Maximum Power Point Tracking	52-85 VDC (For full rated AC output power)
Absolute Max PV Open Circuit Voltage	120VDC
AC Output Characteristics	Current source
Frequency - Nominal	60Hz +0.5 – 0.7 per IEEE 929 and UL 1741
Continuous AC Output @ 40°C	2.5kVA
Efficiency @75% load - Peak	90% (91%)
AC Output Waveform	Sine wave, high frequency PWM controlled
Total Harmonic Distortion	Less than 5% at rated power per IEEE 929 and UL 1741
AC Disconnect	Double pole 15 Amp 240 VAC rated circuit breaker
DC Disconnect	Single pole 100 Amp DC rated circuit breaker
Specified Temperature Range	-38°F - 113°F (-39°C - +45°C)
User Display	Backlit alphanumeric dynamic LCD display - AC watts, kWh today, array voltage, and lifetime status messages.
Enclosure Type	Powder coated aluminum enclosure, fully screened
Combiner Board Included	Yes
Dimensions - Inverter Only (W x H x D)	13.25 x 33.25 x 5.3 (33.8 cm x 83.1 cm x 13.25 cm)
Weight - Inverter Only (lbs.)	35.0 (16 kg)
Shipping Weight (lbs.)	40.0 (18.14 kg)

Sun Tie (STXR) Inverter Accessories

Product Name and Description	Part Number	Price
SunTie Remote Monitor (STRM) with 50' of cable	52929	$179.00
SunTie Rain Shield (STRS)	52927	$125.00

STXR 2500

The STXR's proprietary Sunsweep™ Maximum Power Point Tracking (MPPT) technology maximizes power extraction from a PV array of any type (single crystal, poly-crystalline or amorphous) by matching the inverter's performance to current solar conditions. The STXR 2500 comes with a built-in backlit LCD display that shows system status and cumulative energy production. The optional remote meter (STRM) allows you to monitor the inverter's status and performance from 50 feet away.

The STXR 2500 requires a 48V nominal DC input from your solar array which is typically 4 solar modules wired in series. Multiple STXR inverters can be used in parallel for a solar array that is larger than 2500 watts. The STXR 2500 is listed to UL 1741, and cUL listed to CSA C22.2 No. 107.1-95. Its durable construction ensures a long life under any environmental conditions. Two year warranty.

xantrex Sine wave (SW) Inverters

This inverter/charger can be configured as a simple stand-alone unit, work in conjunction with your generator to handle loads too large for the generator alone, or function as a utility interactive inverter, with the use of the GTI option, sending excess power back into the power grid.

More Features

- Adjustable search mode can reduce idle power to 1 watt
- Current compensated, adjustable low battery cut-out volt ages and high battery cut-out protection.
- Protection circuitry guards against over-current, short circuit, over temp, low battery and high battery conditions.
- Battery charger design allows the use of smaller back up generators at high efficiencies.
- Three stage, temp. compensated, adjustable, battery charger, with remote temperature probe to maximize battery life.

SW4024 Inverter

The Grid Tie Interface (GTI) is an integrated assembly used with the Xantrex SW Series II Inverter / Charger with Revision 4.2 software. This new device provides active anti-islanding detection along with side benefits such as reducing voltage and current total harmonic distortion (THD) below the test requirements. Anti-islanding and THD testing is described in the IEEE-929-2000 and UL-1741-2000.

The SW units are certified to meet UL spec. 1741, and includes a powerful battery charger, a 60 amp AC transfer switch, automatic generator start function and three built-in programmable auxiliary relays for operating loads and/or charging sources. Two year warranty.

Model	SW4024	SW4048	SW5548	SW3024E	SW4548E
Part Number	**50187**	**50188**	**50189**	**50901**	**50932**
Price	**$3495.00**	**$3495.00**	**$3995.00**	**$3495.00**	**$3995.00**
Input Voltage	24VDC	48VDC	48VDC	24VDC	48VDC
Output Power (Watts)	4000	4000	5500	3300	4500
Continuous (Amps)	33	33	46	14	20
Surge Power (Amps)	78	78	78	34	34
Efficiency - Peak	94%	95%	96%	94%	96%
Output Voltage / Regulation	120 VAC/ +/- 2%			230 VAC/ +/- 2%	
Frequency / Regulation	60Hz/ +/- 0.04%			50Hz/ +/- 0.04%	
Input Requirements					
- Min. Search Power	1 watt				
- On Mode (No Load-Idle) (Amps)	16.0	16.0	20.0	16.0	20.0
- Input Voltage (VDC)	20.0 to 34.0	40.0 to 60.0	40.0 to 68.0	22.0 to 33.0	44.0 to 66.0
Distortion	3 to 5%				
Power Factor Allowed	-1 to 1				
Max. Charge Rate (Amps)	120.0	60.0	75.0	100.0	60.0
Automatic Transfer Relay (Amps)	60.0				
Specified Temperature Range	32°F - 113°F (0°C - 45°C)				
Series Operation with 2nd Unit	Yes, 240VAC				
Automatic Low Battery Protection	Adjustable				
Forced Air Cooling (4 speed fan)	Thermally Activated				
Temp. Comp. Probe	Yes				
Weight - Inverter Only (lbs.)	35.0 (16 kg)				
Shipping Weight (lbs.)	118.0	118.0	148.0	118.30	143.0

Inverter/Generator Backup Mode

The SW Series II includes a powerful battery charger and a 60 amp AC transfer switch. When utilizing the charging circuitry, we typically program the unit to activate the battery charger, and switch all AC loads to generator power via a pre-programmed low voltage set-point.

Extensive automatic generator start features are standard and user programmable. Gen start can be triggered by battery voltage, load size in amps or time of day. "Quiet time" can be set during which the generator is not allowed to start unless a "must start" override voltage is reached. "Warm-up seconds," max cranking seconds," and "max charge amps and/or gen amps AC" are some of the user adjustable parameters.

Grid Tie Interface (GTI)

Model	GTI
Part Number	**50345**
Price	**$449.00**
Utility Interactive Protection	Over/under AC voltage and frequency detection plus active islanding detection
AC Voltage (Nominal)	120 VAC
Frequency - Utility Interactive Mode	59.3 - 60.5Hz
Frequency - Bypass Mode	53.0 - 67.0Hz
AC Current (@25ºC) - Utility Interactive Mode	40A Continuous
AC Current (@25ºC) - Bypass Mode	60A Continuous
Total Output Harmonic Distortion (Typical)	2.5% at full power
Enclosure Type	Indoor, ventilated, steel chassis with white, powder coat finish
Dimensions (in.) (D x W x H)	6.3 x 21.0 x 7.0
Shipping Weight (lbs.)	26.0

xantrex Sine wave (SW) Plus Inverter Charger

The 2.5 kW Xantrex Sinewave Plus Inverter Charger with Smart Power Management (SW Plus) takes electrical independence to a new level. It can be programmed to operate in stand-alone, generator-hybrid, utility management, or backup power modes. The SW Plus has storable program settings (flash memory), simple three-level menus and plug-and-play expandability, which makes it easier than ever before to install and configure an independent power system. 2 year warranty.

SW Plus

More Features

- Powerful Surge (inrush current) up to 4 times continuous rating
- Non-volatile memory-user stored settings
- Includes standard built-in programming and operational status interface
- Excellent high temperature capabilities - full power at 40ºC
- Powerful, automatic 4-stage battery charger
- Programmable to take advantage of time of day utility rates

Options

- Expandable - Two SW Plus Inverters may be stacked for increased output in 120/240A configuration (5kW total)
- Matching AC and DC conduit boxes for code compliant installation
- Generator Start Module used to control two and three wire generators
- Auxiliary Load Module used to automatically start and stop auxiliary loads such as fans based on programmable voltage parameters.
- Inverter Communications Adapter allows for remote connection to Sine wave Plus via PC
- An Additional Inverter Control Module may be installed for remote operation and monitoring of an inverter

Model	SW Plus 2524	SW Plus 2548	SW Plus 4024	SW Plus 4048	SW Plus5545
Part Number	**50935**	**50936**	**50960**	**50961**	**50962**
Price	**$2299.00***	**$2299.00***	**$2800.00**	**$2800.00**	**$3500.00**
AC Output Voltage	120 VAC				
Output Power - Continuous (Watts)	2500	2500	4000	4000	5000
Efficiency - Peak	95%	95%	95%	95 %	96%
Voltage Regulation	+/- 3%				
Frequency / Regulation	60 Hz / +/- 0.04 %				
Automatic Transfer Relay	60 A				
DC Input Voltage Range	22 to 32 VDC	44 to 64 VDC	22 to 32 VDC	44 to 64 VDC	44 to 64 VDC
DC Current @ Rated Power	120 A	60 A	190 A	95 A	135 A
Continuous Charge Rate	70 A	40 A	120 A	60 A	70 A
Dimensions (in.) (D x W x H)	15 x 21 x 9				
Shipping Weight (lbs.)	111.0				

SW Series Inverter Options

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
SWRC - Remote control monitor Duplicate of built-in unit on SW, 25' of cable	53036	3.0	$295.00
SWRC/50 Duplicate of built-in unit on SW, 50' of cable	53042	5.0	$329.00
SWI Series stacking interface cable between two identical SW or SW+ units for 120/240VAC operation. (not for use on export models).	50930	1.0	$45.00
SWI/PAR - Sine wave parallel kit Paralleling kit, connects two identical SW inverters together for twice the power output at the same voltage	50933	43.0	$345.00
SWI/PAR/E - Sine wave parallel kit for export models	50934	43.0	$345.00
SW-D - Display inverter (non-operational)	50480	28.0	$175.00
GSM Generator Start Module for SW+ inverters. Allows auto gen start (standard in SW Series)	53061	3.0	$159.00
ALM Auxiliary Load Module for SW+ inverters. Provides voltage controlled relays (standard in SW Series).	53062	3.0	$159.00
SWCA Sine wave Communications Adapter for SW. Allows PC connection and monitoring of up to 8 inverters , includes adapter, DOS based software 50' of cable and DB9 connector.	50943	9.0	$175.00

SWI

SWCA

SWRC

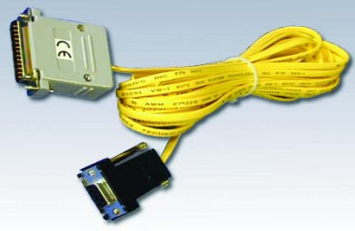
Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
SWCB Sinewave Conduit Box. Fits on the DC or AC end of SW inverters.	50940	9.0	$94.00
RC8/100 Remote control panel. Designed for use with SW+, DR and UX inverter/chargers. Can be mounted up to 100' (30 meters) away for convenient status monitoring and on/off inverter activation.	50584	2.0	$94.00
RC8/50 Remote control panel. Designed for use with SW+, DR and UX inverter/chargers. Can be mounted up to 50' (15 meters) away for convenient status monitoring and on/off inverter activation.	50583	2.0	$69.00
ACCB - AC Conduit Box	50951	15.0	$369.00
DCCB - DC Conduit Box	50952	11.0	$94.00
ICM/25 - ICM Inverter Control Module with 25' cable	50965	10.0	$275.00
ICM/50 - ICM Inverter Control Module with 50' cable	50966	10.0	$295.00
ICA - ICA Inverter Communications Adapter	TBA	TBA	TBA
ISC-S Iverter Stacking Cable. Allows two idential SW+ inverters to provide 120/240V split phase	TBA	TBA	TBA
ISC-P Iverter Stacking Cable. Allows two idential SW+ inverters to provide 120/240V split phase	TBA	TBA	TBA

SWCB

RC8

ACCB

ICM

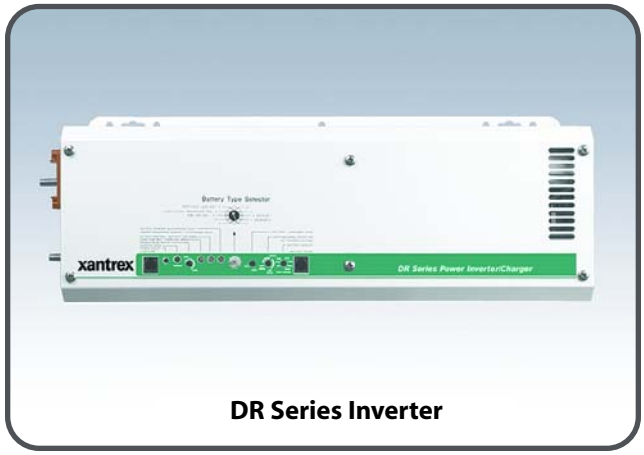


ICA

xantrex DR Series Modified Sine wave Inverters

The DR Series of inverter/chargers are extremely versatile. They are designed for remote home power, utility back-up systems, and industrial applications. An automatic battery charger and transfer switch are standard, as are the easy to understand status and control function LEDs.

Both the 12 and 24 volt input DR Series inverters utilize the same enclosure, only the input voltage, output wattage and weight vary.



DR Series Inverter

More Features

- 1500 to 3600 watts of continuous power.
- Powder-coated, wall mounting chassis.
- Standard, built-in programmable battery charger.
- Series stackable for 240 VAC output.
- ETL certified to UL standards for residential use.
- Low power search mode.
- Automatic, fast transfer switching for standby.
- Overload and temperature protection power systems (SPS).
- Quiet, high-efficiency operation.
- Generator compatible.
- Two year warranty.

Product Name	DR1512	DR2412	DR1524	DR2424	DR3624	DR1512E	DR1524E	DR2424E
Part Number	**51005**	**51012**	**51015**	**51017**	**51018**	**51006**	**51016**	**51008**
Price	**$850.00**	**$1100.00**	**$850.00**	**$1100.00**	**$1350.00**	**$850.00**	**$850.00**	**$1100.00**
Nominal Input Voltage (Volts)	12VDC	12VDC	24VDC	24VDC	24VDC	12.6VDC	25.2VDC	25.2VDC
Continuous Power (Watts)	1500	2400	1500	2400	3600	1500	1500	2400
Surge Power (Amps)	28.0	52.0	40.0	72.0	100.0	20.0	20.0	40.0
Efficiency - Peak	94%	94%	94%	95%	95%	94%	94%	95%
Input Current								
- Search Mode	.045A	.045A	.03A	.03A	.03A	.045A	0.03A	0.03A
- Full Output (Amps)	0.7A	0.9A	0.35A	0.45A	0.5A	0.7A	0.35A	0.45A
- Rated Power (Amps)	165.0A	280.0A	80.0A	140.0A	210.0A	150.0A	37.0A	120.0A
Input Voltage Range DC	10.8 - 15.5		21.6 - 31.0			10.8 - 15.5	21.6 - 31.0	
Output Voltage / Regulation	120VAC / +/- 5%					230VAC / +/- 0.04%		
Waveform	Modified sine wave							
Power Factor Allowed	-1 to +1							
Frequency	60Hz +/- 0.04%					50Hz / +/- 0.04%		
Adjustable Load Sensing	5 to 100W							
Series Stackable - 240VAC	Yes							
Low Battery Protection Cut-out	11VDC		22VDC			11VDC	22VDC	
Forced Air Cooling	3 Speed Fan							
Automatic Transfer Relay	30A							
Maximum Charger Rate (Adjustable)	0-70A	0-120A	0-35A	0-70A	0-70A	0-70A	0-35A	0-70A
Three Stage Charging	Yes							
Temp. Comp. Probe	Optional							
Operating Ambient Temp	0 to 50°C							
Dimensions (in.) (H x W x D)	8.5 x 7.25 x 21.0							
Shipping Weight (lbs.)	39.0	50.0	39.0	45.0	49.0	42.0	42.0	48.0

DR Series Inverter Options

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
DRI Stacking interface cable	51019	1.0	$85.00
BTS/15 Remote battery temp. sensor with 15 ft. cable	53037	1.0	$29.00
BTS/35 Same as above with 35 ft. cable	53063	2.0	$32.00
RC8/50 50' cable for DR, TS, UX inverters. Remote status monitor and on/off switch - specify voltage	50583	2.0	$69.00
RC8/100 100' cable. Remote status monitor and on/off switch	50584	3.0	$94.00
DRCB Conduit box - Can be used on the AC or DC side of inverter	53038	5.0	$69.00
DR-D Display DR Series inverter (Non-operational)	50482	16.0	$95.00

xantrex PV Series Inverters

PV Series Inverters are high voltage, commercial scale utility interactive, three-phase inverters, with models ranging from 5kW to 300kW. It is designed for cost-effectiveness, high performance, easy installation and reliability. Advanced MPPT technology for maximized PV array output (not for use with batteries). Revolutionary switching technology utilizing insulated gate bi-polar transistors (IGBT), greatly reducing power losses during the conversion process. The inverter meets all applicable UL, IEEE, and NEC codes. Automatic operation includes start-up, shut-down, self-diagnosis, and fault detection. Inverter models PV10, 15, and 20 include 5 year warranties as standard. Other units have a one year warranty with optional extension to five years.

PV Series Inverter

More Features

- Efficient design, with over 95% peak efficiency for the inverter, and overall efficiency, including transformer losses, in excess of 93%
- Digital Signal Processor (DSP) based controls with self-diagnostics and LDC for display of operating status.
- Inverter shut off and reset toggle switch.
- Over- and under-voltage and frequency protection, shutting down the inverter in compliance with UL1741.
- Anti-islanding protection - prevents back-feeding inverter-generated power to the grid in the event of a utility outage.
- User definable power tracking matches the inverter to the array, as well as adjustable delay periods to customize system shut-down sequences.

Model	PV10	PV15	PV20	PV30	PV45	PV100	PV225
Part Number	**52501**	**52502**	**52508**	**52509**	**52510**	**52507**	**52512**
Price	**$8473.00**	**$12200.00**	**$15452.00**	**$20989.00**	**$29647.00**	**$69241.00**	**$114697.00**
Nominal Output Voltage (Volts)	208VAC						
Continuous Power (Watts)	10000	15000	20000	30000	45000	10000	225000
Max. AC Line Current (Amps)	30.8	46.3	61.7	94	143	316	325
Line Power Factor	> 0.99 above 20% rated power						
Efficiency - Peak	95%	95%	95%	95%	95%	95%	95%
Max. DC Input Current (Amps)	30.8	47.8	63.8	100	150	319	710
Max. Open Circuit Voltage	600 VDC						
Power Tracking Window Range	330 to 480 VDC (360 Nominal)						
Frequency	60Hz (+0.5Hz / -0.7Hz)						
Ambient Temperature	-20 to 50°C						
Storage Temperature	-40 to 50°C						
Cooling Method	Forced Convection Cooling						
Shipping Weight (lbs.)	115.0	191.0	205.0	288.0	400.0	1000.0	2150.0

PV Series Inverter Options

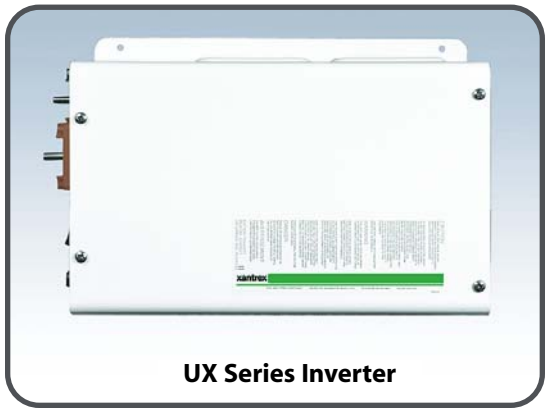
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
PV10208 208VAC Complete Kit	52505	$12257.80	362.0
PV10208 480VAC Complete Kit	52516	$12082.75	362.0
PV15208 208VAC Complete Kit	52517	$17396.18	562.0
PV15208 480VAC Complete Kit	52518	$17221.13	555.0
PV20208 208VAC Complete Kit	52519	$21138.25	660.0
PV20208 480VAC Complete Kit	52506	$20860.58	665.0
PV30208 208VAC Complete Kit	52511	$27775.22	675.0
PV30208 480VAC Complete Kit	52530	$27155.15	680.0
Combiner Box 10 Circuit, fuses not included, NEMA 3R	52543	$581.00	14.0
Combiner Box 12 Circuit, fuses not included, NEMA 3R, touch safe	52544	$756.00	20.0
Combiner Box 10 Circuit, 5 ADC, with diodes, fuses not included, NEMA 3R	52545	$723.00	20.0
Fuse, Midget, 600 VDC, 10A	52549	$15.70	1.0
Fuse, Midget, 600 VDC, 15A	52547	$15.70	1.0
Fuse, Midget, 600 VDC, 20A	52550	$15.70	1.0

Combiner Box 12

Complete kit includes: Inverter, Isolation Transformer, AC Disconnect Switch, DC Disconnect Switch, Combiner Box, 10 pole, 15 ADC 600 VDC Fuse

xantrex UX Series Inverters

The UX Series is a powerful, compact inverter for use with renewable energy systems in vacation cabins or small remote homes, and as a back-up power unit in homes and businesses. This modified sine wave unit is available in three standard sizes: 600 watts, 1100 watts, and 1400 watts. Each size is also offered with a three stage battery charger option (SB). Available in export voltages (E) models.



UX Series Inverter

More Features

- 500 to 1400 watts continuous output
- Surges 2500-3400 watts
- ETL certified to UL specifications
- Available in export voltages and frequencies (230VAC, 50Hz)
- Available with or without the (SB) battery charger and transfer switch

Model	UX512E	UX612	UX1112	UX1112E	UX1412
Part Number	**50564**	**50560**	**50570**	**50574**	**50580**
Price	**$595.00**	**$595.00**	**$795.00**	**$729.00**	**$885.00**
Continuous Power (Watts)	500	600	1100	1100	1400
Surge Power (Watts)	2500	2500	3000	3000	3400
Efficiency - Peak	92%	92%	90%	90%	92%
Input Current					
- Search Mode (Amps)	0.022A	.022A	.045A	.045A	.06A
- On Mode (No Load-Idle) (Amps)	0.4A	0.4A	0.45A	0.45A	0.6A
Nominal Input Voltage	12VDC				
Input Voltage Range	10.8 - 15.5VDC				
Nominal Output Range	230 VAC	120 VAC		230 VAC	120 VAC
Voltage Regulation	5% Max +/- 2.5% Typical				
Frequency	50Hz +/-0.04%	60Hz +/-0.04%		50Hz +/-0.04%	60Hz +/-0.04%
Waveform	Modified sine wave				
Power Factor Allowed	Power factor of load can very from -1 to +1				
Dimensions (in.) (H x W x D)	10.5 x 15.5 x 6.0				
Shipping Weight (lbs.)	30.0	30.0	30.0	40.0	41.0

Model	UX512ESB	UX612SB	UX1112SB	UX112ESB	UX1412SB
Part Number	**50566**	**50562**	**50572**	**50576**	**50582**
Price	**$695.00**	**$695.00**	**$895.00**	**$829.00**	**$985.00**
Automatic Transfer Relay	30 Amps AC				
Maximum Charge Rate	25 Amps DC	25Amps DC	50 Amps DC	50 Amps DC	50 Amps DC
Three Stage Charging	Yes				
Shipping Weight (lbs.)	30.0	30.0	36.0	36.0	41.0

UX Series Inverter Options

Product Name and Description	Part Number	Price
RC8-50 Remote Control Option	50583	$69.00
RC8/100 Remote Control Option	50584	$94.00
BTS/15 - Battery Temp. Sensor	53037	$29.00
BTS/35 - Battery Temp. Sensor	53063	$32.00
UX-D Display	50577	$70.00

xantrex™ **RV/Marine Inverters**

SW Heavy Duty True Sine Wave Inverter/Chargers

Widely used in RV, marine, truck, and other mobile applications, the SW2512MC and SW4024MC2 instantly supplies true sine wave , utility grade, AC output power. Ideal for heavier loads, the SW2512MC and SW4024MC2 offer high capacity battery charging, high surge current ability (inrush current), and easy installation.

More Features

- Three-stage battery charging (bulk, absorption, and float) with remote temperature sensor for increased charge accuracy.
- Dual AC source inputs - shorepower and generator.
- Programmable control modules with LCD and LED indicators.
- Low idle current (less than 16 watts) conserves energy when no loads are present.
- Soft start capability for starting heavy loads.
- Series stacking capability for 120/240 VAC.
- Parallel stacking capability for greater output at the same volt age.
- Remote panel and status indicator (optional).
- Two year warranty.

SW2512MC

Model	SW2512MC	SW4024MC2
Part Number	**50945**	**50944**
Price	**$2585.00**	**$3345.00**
AC Input Voltage Range	50-149 VAC	
AC Input Current (AC pass thru)	60 A	
Continuous Power	2500 VA	4000 VA
Efficiency - Peak	90%	94%
AC Output Voltage (RMS) / Regulator	120 VAC / +/-5%	
Frequency	60 Hz	
Total Harmonic Distortion	< 5%	
Continuous Ouput	21 A	33 A
Surge Capacity (5 sec rating)	4000 Watts	8000 Watts
Automatic Transfer Relay	60 A	60 A
DC Input Voltage (Nominal)	12 VDC	24 VDC
DC Current at Rated Power	275 A	200 A
Idle Consumption	< 16 Watts	
Maximum Charge Rate (Adjustable)	150A @12VDC nominal	150A @24VDC nominal
Dimensions (in.) (H x W x D)	15 x 27 x 21	
Shipping Weight (lbs.)	96.0	111.0

Freedom 458 Series

With filtered modified sine wave output, Freedom 458 inverter/chargers run virtually anything, from office equipment to household appliances and electronics. Temperature controlled multi-stage charging ensures that your batteries are recharged quickly, and automatic shutdown and other safety features protect your expensive deep-cycle batteries from excessive depletion.

Freedom 458 10-12

More Features:

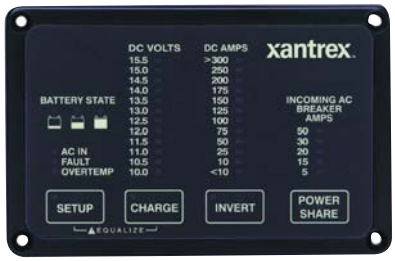
- 1000 to 3000 watt continuous output
- 50 to 140 amp automatic chargers
- Programmable front panel and LED indicators
- Three-stage battery charger recharges batteries quickly and accurately
- Temperature sensitive charging provides optimal care of all types of deep cycle batteries
- Built-in 30 amp transfer switch automatically transfers between inverter power and incoming AC power
- Power sharing prevents source AC input circuit breaker from tripping
- Customized settings can be programmed with the Freedom Basic Remote or Link 1000 panel
- Includes battery temperature sensor
- UL and cUL listed to 458 Standard
- 30 month warranty

Model	FDM 458 10-12	FDM 458 15-12	FDM 458 20-12	FDM 458 30-12	FDM 458 25-12 D/D*	FDM 458 30-12 D/D*
Part Number	**51690**	**51691**	**51692**	**51694**	**51695**	**51698**
Price	**$975.00**	**$1125.00**	**$1225.00**	**$1625.00**	**$1425.00**	**$1625.00**
Continuous Output Power	1000 W	1500 W	2000 W	3000 W	2500 W	3000 W
Surge Power (Amps)	25 A	37.5A	50 A	75 A	62.5 A	75 A
Output Frequency	60 Hz					
Output Voltage / Regulation	120 V +/-5%					
Efficiency - Peak	93%	92%	92 %	93%	92%	93%
Charge Rate	50 A	75 A	100 A	140 A	130A	140A
Battery Voltage (Nominal)	12 VDC					
AC Input (Max. Charge Mode)	20 A	17 A	21 A	28 A	26 A	28A
Dimensions (in.) (H x W x D)	7.9 x 11.5 x 13.2					
Shipping Weight (lbs.)	45.0	45.0	45.0	50.0	50.0	50.0

*D/D: dual input, dual output

FDM Series Options

Product Name and Description	Part Number	Price
Remote Control Panel FDM12-25	51548	$150.00
Remote Panel 12V Head Only	51550	$150.00
Cable Assembly Kit 50'	51551	$15.00



Remote Control Panel

xantrex Prosine Inverters

The 2.0, 2.5 and 3 kW inverters include the "smart" battery charging circuitry that is available in the True Charge battery chargers, as well as an automatic 30 amp transfer switch. The high frequency switching technology of these inverters eliminates the need for large, heavy transformers. This reduces the size and weight when compared to other units. The display panel and on/off switch can be mounted remotely so this inverter/ charger can be mounted anywhere, even inside a large, well-ventilated enclosure.

Xantrex is known for their high level of quality and excellent customer support. We believe this line of sinewave inverters will have a dramatic effect on the solar electric industry as they are the first to have this quality in a sinewave at these prices. One year warranty on 2.5 and 3kW, and two year warranty on 1.0, 1.8, and 2.0 kW. 30 foot cable included.

PROSine 1000 Inverter

Product Name	1000/12 GFCI	1000/12 AC Hardwire	1000/12 AC Hardwire & Transfer Switch	1000/24 GFCI	1000/24 AC Hardwire	1800/12 GFCI	1800/12 AC Hardwire & Transfer Switch
Part Number	**49986**	**49987**	**49988**	**49989**	**49994**	**49983**	**49985**
Price	**$890.00**	**$890.00**	**$940.00**	**$980.00**	**$980.00**	**$1300.00**	**$1350.00**
Continuous Output Power	1000 W					1800 W	
Surge Rating (5 seconds)	1500 W					2900 W	
Inverter Efficiency - Peak	89%					90%	
Search Mode Power Draw	<1.5W						
Wave Shape	Sine wave <3% THD						
Input Voltage Range	10-14 V			20-32 V		10-14 V	
Dimensions (in.) (L x W x H)	15.4 x 11.0 x 4.5						
Shipping Weight (lbs.)	17.0	17.0	17.0	17.0	17.0	18.0	18.0

Product Name	1800/24 GFCI	1800/24 AC Hardwire & Transfer Switch	2000/12 H/W & Transfer Switch	2000/12 GFCI, H/W & Transfer Switch	2500/12	2500/24	3000/12	3000/24
Part Number	**50003**	**49999**	**49996**	**49995**	**49982**	**49992**	**49981**	**49993**
Price	**$1430.00**	**$1480.00**	**$2000.00**	**$2000.00**	**$2600.00**	**$2860.00**	**$3000.00**	**$3300.00**
Continuous Output Power	1800 W		2000 W		2500 W	2500 W	3000 W	3000 W
Surge Rating (5 seconds)	2900 W		4500 W		4000 W	4000 W	4000 W	4000 W
Inverter Efficiency - Peak	90%		89%		88%	88%	88%	88%
Search Mode Power Draw	<2W							
Wave Shape	Sine wave <5% THD							
Input Voltage Range	20-32 V		10-16 V		10-16 V	20-32 V	10-16 V	20-32 V
Dimensions (in.) (L x W x H)	15.4 x 11.0 x 4.5				20.0 x 15.5 x 5.5			
Shipping Weight (lbs.)	18.0	18.0	24.0	24.0	32.0	32.0	32.0	32.0

PROSine Series Inverter Options

Product Name and Description	Part Number	Price
ACS - Advanced Control System Remote Panel for PROsine 2500 only.	49991	$250.00
Remote Panel Interface Kit for 1000/1800	49998	$50.00
Temperature Sensor	35932	$30.00
DC Conduit Box for PROsine 2000	50937	$89.00

xantrex Portawattz® Modified Sinewave Inverters

Imagine being able to run business and household items miles away from the nearest utility line. With the Portawattz line of inverters from Xantrex, a world of possibilities is open to you at an affordable price.

There are several Portawattz units available ranging from 150 to 2500 watt continuous output. The 150 and 300 watt units have a cigarette lighter style plug for the DC input and they are designed to power small loads like a television, VCR, stereo, lights and a desktop or laptop computer. These units are perfect for bringing along in the car, boat or RV since you can simply plug it into your cigarette lighter for quick and easy 120 VAC power.

Their larger units (600 to 3000 watt) are designed to be hard wired to the battery bank with appropriately sized conductors and fusing (Appendix D). These units are able to power larger loads like microwave ovens, refrigerators, vacuum cleaners and power tools. The 1000, 1750 and 3000 watt units have LED bar graphs indicating the battery voltage and load amperage which provides a measure of system status monitoring.

All of the Portawattz units will shut down if the battery voltage gets too low, if overheated or overloaded and will reset themselves automatically once the problem is corrected. All units specified here are 12 VDC nominal input with a 115 VAC 60 Hz output.

Portawattz 600

Inverter cables can be found on page 100 & 101.

More Features

- 90% efficient over power range
- High frequency switching design dramatically reduces transformer size and weight
- Front panel LED's report voltage and inverter current draw (1000, 1750 & 3000W units only)
- DC Input voltage range from 10 to 15 volts
- 1 year warranty

Portawattz 1000

Portawattz 3000

Model	Portawattz 150	Portawattz 300	Portawattz 400
Part Number	**49910**	**49912**	**49915**
Price	**$40.00**	**$50.00**	**$69.95**
Continuous Output Power	150 W	300 W	400 W
5 Minute Surge Power	200 W	500 W	800 W
No Load Current Draw	0.06 A	0.18 A	0.18 A
Output Voltage & Waveform	115 VAC RMS +/-5% Modified Sine wave		
Output Frequency	60Hz quartz crystal controlled		
Dimensions (in.) (L x W x H)	4.7 x 4.7 x 1.6	6.0 x 4.7 x 1.8	6.3 x 4.7 x 1.9
Shipping Weight (lbs.)	1.0	2.0	1.8

Model	Portawattz 600	Portawattz 700	Portawattz 1000	Portawattz 1750	Portawattz 3000
Part Number	**49913**	**49918**	**49914**	**49916**	**49917**
Price	**$110.00**	**$119.15**	**$270.00**	**$380.00**	**$600.00**
Continuous Output Power	600W	700W	800W	1500W	2500W
5 Minute Surge Power	1200W	1300W	2000W	3000W	5000W
No Load Current Draw	0.3A	0.3A	0.3A	0.6A	0.65A
Output Voltage & Waveform	115VAC RMS +/-5% Modified Sinewave				
Output Frequency	60Hz quartz crystal controlled				
Dimensions (in.) (L x W x H)	11.0 x 6.25 x 2.5	11.0 x 6.25 x 2.5	10.25 x 9.5 x 3.25	16.25 x 9.5 x 3.25	20.0 x 8.5 x 6.5
Shipping Weight (lbs.)	5.0	4.5	7.0	10.0	24.0

xantrex PROwatt® Inverters

Highest quality inverters are perfect for remote AC power needs, modified sine wave output for operating power tools, computers and small appliances from a 12V battery. These lightweight models are 100% solid state. Transformer-less design is rated 90% peak efficiency and features exceptionally low idle current power loss. Wattage ratings shown are continuous duty at 115VAC / 60Hz.

Product Name	Notepower 50	Notepower 75
Part Number	**49975**	**49977**
Price	**$39.00**	**$74.00**
Continuous Output Power	50 W	70 W
Surge Capacity	75 W	150 W
No Load Current Draw	< .07 A	< 0.15 A
Output Voltage / Waveform	115 VAC / Modified Sine wave	
Output Frequency	60Hz +/- 3Hz	
Dimensions (in.) (L x W x H)	3.5x2.5x1.25	4.8x3.2x1.6
Shipping Weight (lbs.)	1.5	2.0

PROwatt 3000

Product Name	PROwatt 150	PROwatt 300	PROwatt 600	PROwatt 1000	PROwatt 1750	PROwatt 3000
Part Number	**50030**	**50021**	**49911**	**49920**	**49921**	**50036**
Price	**$75.00**	**$60.00**	**$130.00**	**$488.00**	**$689.00**	**$800.00**
Continuous Output Power	150	300	600	1000	1750	2500
Surge Capacity	400 W	500 W	1200 W	2000 W	3000 W	5000 W
No Load Current Draw	0. 1A	0.18 A	0.3 A	< 0.45 A	< 0.5 A	< 0.6 A
Output Voltage / Waveform	115 VAC RMS / Modified Sine wave					
Output Frequency	60 +/- 4Hz			60 +/- 0.01 Hz		
Dimensions (in.) (L x W x H)	4.7 x 4.7 x 1.6	6.3 x 4.7 x 1.9	2.5 x 6.25 x 11	10.25 x 9.5 x 3.25	16.25 x 9.5 x 3.25	20.0 x 8.5 x 6.5
Shipping Weight (lbs.)	1.3	1.8	4.5	5.2	8.25	20

PROwatt Series Inverter Options

Product Name and Description	Part Number	Price
Remote Switch - for retrofit on PROwatt 1000, 1750 and 3000	50035	$25.00

Samlex Pure Sine Wave Inverters

Pure Sine Wave Inverter

With a passively cooled heat sink, no fans to break down, minimal derating with an ambient temperature of up to 70 degrees Celsius and simple hook up, this unit will not let you down. The Samlex 150 Watt, Pure Sine Wave Inverter is an excellent performer providing high caliber, pure sine wave output simply and reliably. An excellent choice for powering small loads in consumer and industrial applications.

Now you have two more choices in pure sine wave inverters, at the price of some modified sine wave units. The PST-60S-12 is rated at 600 watts continuous. It can supply a surge to 1000 watts for a few seconds to start motor loads. The PST-100S-12 is rated at 1000 watts continuous. It can supply a surge to 1300 watts for 2 seconds to start motor loads. Both supply pure sine wave output that does not sag under full load.

These units are ideaL for both consumer and industrial loads. They will run the items that modified sine wave inverters will not, such as: Laser printers, Photocopiers, Power tools employing "solid state" power or speed control, some battery chargers for cordless tools, X-10 home automation systems and more.

All Feature

- Switching mode design
- High efficiency
- Pure sine wave output voltage
- 12 VDC input and 115 VAC output
- Overload protection
- High output current surge
- Low battery alarm / shut down
- Low idle power draw
- Compact and light weight
- Two output receptacles
- Input via terminals
- 1 year warranty

PST-15S-12

PST-60S-12

PST-100S-12

Model	PST-15S-12	PST-60S-12	PST-100S-12
Part Number	**55105**	**55106**	**55107**
Price	**$149.00**	**$339.00**	**$699.00**
Continuous Output Power	150 W	600 W	1000 W
Input Voltage	10-15 VDC		
Output Voltage	115 V RMS		
Waveform	Pure Sine Wave		
Peak Efficiency	> 90%		
Idle Power Draw	0.85 Amps	0.85 Amps	1.80 Amps
Dimensions (in.) (L x W x H)	7.5 x 4.7 x 2.4	9.3 x 13.2 x 3.3	9.3 x 15.5 x 3.3
Shipping Weight (lbs.)	2.3	6.6	8.8

OutBack Inverter - Chargers

FX Series

The OutBack FX Inverter is a modular "building" block sine wave inverter / charger which can be used for both small and large power systems. Each OutBack FX inverter / charger module is a complete power conversion system - DC to AC inverter, battery charger and AC transfer switch. Additional inverter / chargers can be connected at anytime in either parallel (120 VAC), series (120/240 VAC), or even three-phase (120Y208 VAC) configurations, allowing the system to be tailored to the specific power conversion requirements of the application, both at the time of the installation and in the future. The FX2000 is also available in export versions. Up to eight FX inverter / charger can be connected together to provide up to 20 kW of continuous power conversion capacity. The OutBack FX inverter / charger system is designed for both residential and commercial stand-alone and utility-interactive applications with battery energy storage.

FX Series
Shown with optional parts

More Features

- Powdercoated all aluminum die-cast chassis
- Internal electronic components are cooled by heat transfer
- Gaskets on all openings to provide water-resistance
- Sealed design protects internal electronics from salt, dirt or contaminated air, bugs, critters, mold etc.
- Conformal coated circuit boards to resist corrosion
- Designed to allow easy field servicing and repair

Applications

- Hot and humid climates where a protected area is not available for installation of the inverter/charger system
- Salt air environments such as Hawaii where you can't get away from the salt air and where there is little difference between indoors and outdoors
- Dirty environments where dust or drifting organic matter such as cottonwood could clog an air openings in an unattended system
- Boats and RV's where water might splash on the inverter
- Greater control of unwanted radio frequency interference

Product Name	FX2024	FX2548	FX2024E	FX2348E
Part Number	**55290**	**55291**	**55338**	**55339**
Price	**$1795.00**	**$2245.00**	**$1995.00**	**$2245.00**
Continuous Output Power	2000 VA	2500 VA	2000 VA	2300 VA
Continuous Output Current at 25º	17 amps AC RMS	21 amps AC RMS	8.7 amps AC RMS	10 amps AC RMS
Idle Power (120 VAC Output No Load)	18 - 20 W DC	21 - 23 W DC	18 - 20 W DC	21 - 23 W DC
Output Voltage	120 VAC / 60Hz		230 VAC / 50Hz	
DC Input Voltage (Nominal)	24 VDC	48 VDC	24 VDC	48 VDC
Efficiency - Peak	92%	93%	92%	93%
Output Voltage Regulation	+/- 2% typical			
Continuous DC Charge Rate	55 Amps DC	35 Amps DC C	55 Amps DC	35 Amps DC
Frequency Range	50-70Hz		40-60 Hz	
DC Input Voltage Range	20-33 VDC	40-66 VDC	20-33 VDC	40-66 VDC
Dimensions (in.) (L x W x H)	21.6 x 12.75 x 15.5			
Shipping Weight (lbs.)	60.0			

VFX Series

Although OutBack has become known for offering the first and only sealed sinewave inverter/charger, there are some real reasons to consider offering a vented version of the popular FX series as well. Now you can choose from sealed or vented OutBack inverter/chargers depending on the environment of your installation. Up to eight VFX inverters can be connected together to provide up to 28,800 watts of continuous power conversion capacity.

VFX Series

More Features

- Powdercoated all aluminum die-cast chassis
- Internal electronic components are cooled by outside air
- Stainless steel screen to protect air intake and internal fan
- UL 94V0 plastic vent grills to protect the air exhaust. All openings are 0.0025 inches square to keep out dirt, bugs, and other critters.
- Air inlet comes with removable, washable foam filter insert to trap small particles
- Conformal coated circuit boards to resist corrosion
- Higher output power when inverting or battery charging when compared with the sealed FX inverter versions
- Designed to allow easy field servicing and repair

Applications

- Montana or Arizona etc. where salt air is not a problem and climate is dry
- More watts per dollar
- Installations where well protected environments are available

Product Name	VFX2812	VFX3524	VFX3648
Part Number	**55342**	**55341**	**55340**
Price	**$2345.00**	**$2345.00**	**$2345.00**
Continuous Output Power	2800 VA	3500 VA	3600 VA
Continuous Output Current at 25º	23.3 amps AC RMS	29.2 amps AC RMS	30.0 amps AC RMS
Idle Power (120 VAC Output No Load)	19 - 21 W DC	18 - 20 W DC	21 - 23 W DC
Output Voltage	120 VAC / 60Hz		
DC Input Voltage (Nominal)	12 VDC	24 VDC	48 VDC
Efficiency - Peak	> 90%		
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	125 amps DC	85 amps DC	45 amps DC
Frequency Range	50-70 Hz		
DC Input Voltage Range	10 - 16 VDC	20 - 33 VDC	40 - 66 VDC
Dimensions (in.) (L x W x H)	21.6 x 12.75 x 15.5		
Shipping Weight (lbs.)	62.0		

Product Name	VFX2612E	VFX3024E	VFX3048E
Part Number	**55352**	**55362**	**55361**
Price	**$2345.00**	**$2345.00**	**$2345.00**
Continuous Output Power	2600 VA	3000 VA	3000 VA
Continuous Output Current at 25º	11.3 amps AC RMS	13.0 amps AC RMS	13.0 amps AC RMS
Idle Power (120 VAC Output No Load)	19 - 21 W DC	18 - 20 W DC	21 - 23 W DC
Output Voltage	230 VAC / 50Hz		
DC Input Voltage (Nominal)	12 VDC	24 VDC	48 VDC
Efficiency - Peak	> 90%		
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	120 amps DC	85 amps DC	45 amps DC
Frequency Range	40-60 Hz		
DC Input Voltage Range	10 - 16 VDC	20 - 33 VDC	40 - 66 VDC
Dimensions (in.) (L x W x H)	21.6 x 12.75 x 15.5		
Shipping Weight (lbs.)	62.0		

Mobile Series

Both FX and VFX inverter/chargers are available to be used in RV, marine, truck, and other mobile applications. OutBack Mobile Series supplies smooth, true sine wave AC output power. They are built to survive dust, bugs, even rain and salt air. Choice of sealed FX or bug-proof VFX versions. Installation of the inverter in an RV is now less of a problem.

More Features

- Ultra clean AC power
- Extremely rugged
- Extremely efficient
- Intelligent battery charger
- Very quiet
- Easy system expansion
- Serviceable
- Defeatable neutral to GND switching
- Capabile tech support help
- Coolness factor

Product Name	FX2024M	FX2024MT	FX2012M
Part Number	**55354**	**55353**	**55355**
Price	**$1895.00**	**$1995.00**	**$1895.00**
Continuous Output Power	2000 VA	2300 VA	1700 VA
Continuous Output Current at 25º	19 amps AC RMS	17 amps AC RMS	14 amps AC RMS
Idle Power (120 VAC Output No Load)	17-19 W DC	17 - 19 W DC	19 - 21 W DC
Output Voltage	120 VAC / 60Hz		
DC Input Voltage (Nominal)	24 VDC	24 VDC	12 VDC
Efficiency - Peak	> 90%		
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	55 amps DC	55 amps DC	100 amps DC
Frequency Range	50-70 Hz		
DC Input Voltage Range	20 - 33 VDC	20 - 33 VDC	10 - 16 VDC
Dimensions (in.) (L x W x H)	21.6 x 12.75 x 15.5		
Shipping Weight (lbs.)	63.0		

Product Name	FX2012MT	VFX3524M	VFX2812M
Part Number	**55356**	**55357**	**55358**
Price	**$1995.00**	**$2345.00**	**$2345.00**
Continuous Output Power	2000 VA	3500 VA	2800 VA
Continuous Output Current at 25º	17 amps AC RMS	29.2 amps AC RMS	23.3 amps AC RMS
Idle Power (120 VAC Output No Load)	19-21 W DC	18-20 W DC	19-21 W DC
Output Voltage	120 VAC / 60Hz		
DC Input Voltage (Nominal)	12 VDC	24 VDC	12 VDC
Efficiency - Peak	> 90%		
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	100 amps DC	85 amps DC	125 amps DC
Frequency Range	50 - 70 Hz		
DC Input Voltage Range	10 - 16 VDC	20 - 33 VDC	10 - 16 VDC
Dimensions (in.) (L x W x H)	21.6 x 12.75 x 15.5		
Shipping Weight (lbs.)	63.0	62.0	62.0

OutBack FX Series Inverter Options

Product Name and Description	Part Number	Price
FX-DCC Aluminum cover protects DC connections and accessories in the DC wiring area.	55292	$65.00
FX-DCA Aluminum conduit adapter required when mounting a FX2000 to an OutBack PSDC or to a 2" conduit.	55293	$45.00
FX-ACA AC wiring compartment extension and 2" conduit adapter.	55294	$35.00
FXA Accessory Kit - Includes FX-DCC, FX-DCA and FX-ACA	55298	$129.00
STACK-2 - Stacking kit for 2 units	53301	$85.00
RTS - Outback Remote Temperature Sensor w/ 20' cable	55300	$29.00
STACK-4 - Stacking kit for 4 units	55330	$125.00

FX-DCC

OutBack System Management Remote Monitor and Control

The OutBack MATE is a complete system controller and display for both the OutBack FX2000 inverter / charger and MX60 MPPT PV charge controller (page 47). It provides a display of the operation, as well as allows control and adjustment of the setpoints. The OutBack MATE also coordinates the operation of the entire system from a location up to 1000 feet away to maximize performance and to prevent multiple products from conflict. The MATE also includes an opto-isolated RS232 port for connection to a PC for data logging and system monitoring.

Product Name and Description	Part Number	Price
MATE - Shipped with 50ft CAT 5 interconnect cable	55296	$295.00
HUB-4 Communications Manager - Allows the MATE to control up to four FX2000 inverters / chargers and MX60 MPPT charge controllers.	55297	$195.00
HUB-10 Communications Manager - Allows the MATE to control up to ten FX2000 and MX60.	55302	$375.00

MATE

Sunny Boy

The SMA Sunny Boy inverter is UL 1741 listed and available in North America. Sunny Boy's extensive track record in some of the world's most demanding markets has made it a favorite among PV professionals everywhere. SMA's state of the art maximum power point tracking performance, results in greater real-world energy capture than any other grid-tied PV inverter currently available in the North American marketplace. Sunny Boy's safety and reliability record is also exceptional due to the inverter's redundant grid monitoring and built-in ground fault detection and interruption protection. The inverter's IGBT power stage generates a nearly perfect sine wave with the lowest harmonic distortion in the industry and meets new ultra-strict FCC EMC standards. SMA's unique string inverter technology makes future system expansion simple. Sunny Boy's optional power line carrier communication capability allows for extensive data acquisition from one or many inverters with no additional wiring. Other communication options are available to satisfy almost any application.

Sunny Boy Inverter

Model	Sunny Boy 700 U no LCD	Sunny Boy 700 U with LCD	Sunny Boy 1100 U no LCD	Sunny Boy 1000 U with LCD	Sunny Boy 1800 U no LCD
Part Number	**52986**	**52987**	**52984**	**52985**	**52979**
Price	**$1250.00**	**$1350.00**	**$1470.00**	**$1550.00A S**	**$2250.00**
AC Input Voltage	120 VAC	120 VAC	240 VAC	240 VAC	120VAC
Max AC Output Power	700	700	1100	1100	1800W
Max DC Voltage	250 VDC	250 VDC	400VDC	400VDC	400VDC
Max AC Current	6.8A	6.8A	10A	10A	15A
Total Harmonic Distortion	THD < 4%				
Peak Efficiency	93.5%				
Output Frequency	60Hz				
Peak Power Tracking Voltage	156 - 350 VDC				
Cooling	Convection Cooling (No fan)				
Dimensions (in.) (L x W x H)	17.0 x 11.6 x 8.4				
Shipping Weight (lbs.)	40.7	40.7	40.7	59.5	59.5

Model	Sunny Boy 1800 U **SBD** with LCD	Sunny Boy 2500 U no LCD	Sunny Boy 2500 U **SBD** with LCD	Sunny Boy 2500 **208VAC** no display	Sunny Boy 2500 **208VAC** with display
Part Number	**52983**	**52981**	**52980**	**53016**	**53006**
Price	**$2400.00**	**$2600.00**	**$2800.00**	**$2600.00**	**$2800.00**
AC Input Voltage	120VAC	240VAC	240VAC	208VAC	208VAC
Max AC Output Power	1800W	2500W	2500W	2200W	2200W
Max DC Voltage	400VDC	600VDC	600VDC	600 VDC	600 VDC
Max AC Current	15A	10.4A	10.4A	10.5A	10.5A
Total Harmonic Distortion	THD < 4%				
Peak Efficiency	93.5%				
Output Frequency	60Hz				
Peak Power Tracking Voltage	156-350 VDC	234 - 550 VDC			
Cooling	Convection Cooling (No fan)				
Dimensions (in.) (L x W x H)	17.0 x 11.6 x 8.4				
Shipping Weight (lbs.)	59.5	70.5	70.5	70.5	70.5

SMA Inverter Accessories

Product Name and Description	Part Number	Price
Sunny Boy Control Ideal for monitoring PV system. Each Control can report on, store information from, and monitor up to 50 SMA inverters.Communication between the Sunny Boy inverters and the Sunny Boy Control can be accomplished through the Powerline, RS 485, or RS 232.	52996	$840.00
Sunny Boy Control Plus Extra analog and digital channels for increased data monitoring, the Control Plus is the foremost tool for PV plant analysis. Additional communication port on the Control Plus can talk to a BetaBrite lobby display in addition to its normal communication channel to a PC.	52305	$2100.00
Sunny Boy Control w/ RS485 This unit is a Sunny Boy Ctonrol with the optional RS485 communciations card installed.	53010	$1200.00
Sunny Boy Plus Control w/ RS485 This unit is a Sunny Boy Ctonrol Plus with the optional RS485 communciations card installed.	53015	$2460.00
SMA SWR-DA-ENG Software The Sunny Data software was developed for convenient PV plant monitoring by PC and is normally based on simple data transmission via Powerline.	52306	N/A
SMA SBC-DA-ENG Software	52307	N/A

Sunny Boy Control

Product Name and Description	Part Number
RS232 Module Communication option for directly linking one inverter directly to your computer or Control.	52989
RS232 Module w/ 6.5 ft Cable	52999
RS485 Module	52995
RS485 Cable, 15 meter, shielded	53014
DC Disconnect - Special Fuseless Disconnect	36627
LED Display Board & Beta Brite Lobby Display	53011
Sunny Breeze Fan Kit - For heatsink for 2500U/1800U	52303

Sunny Central 125

The Sunny Central is the culmination of many years of experience with the Sunny Boy and European Sunny Central photovoltaic inverters. The design incorporates the same proven MPP tracker found in more than 100,000 fielded Sunny Boys'. The high efficiency power stage produces a perfect AC sine wave exceeding the latest FCC and IEEE requirements. The AC system isolation transformer is incorporated into the inverter cabinet and is disconnected whenever the inverter is not producing power. This eliminates the unnecessary and costly power losses.

The enclosure is powder-coated aluminum and stainless steel designed for long-term outdoor installation in the harshest of environments. The power electronics are air cooled and protected in an isolated enclosure. The magnetics and isolation transformer are housed in a separate enclosure, thermally isolated from sensitive electronics.

The Sunny Central is equipped with a special version of the Sunny Boy Control Plus advanced data acquisition and control system. A 4-line display and keypad allow simple configuration and system monitoring. A wide variety of different interfaces for plant monitoring and remote configuration with a PC are also available. The Sunny Central Control can acquire data from nearly any known external sensor type for sophisticated plant monitoring and data logging.

The Sunny Central incorporates the same communication protocol found in all SMA PV products. This allows the Sunny Central to be monitored and controlled with the same advanced software found in the Sunny Boy inverter family.

Model	Sunny Central 125
Part Number	To Be Announced
Price	To Be Announced
AC Output Voltage	480 VAC
AC Output Frequency	60Hz
DC Input Voltage	275 - 600 VDC
Max AC Output Power	125000
Current THD	THD > 4%
Efficiency - Peak	94%
Max DC Current	400 ADC
PV Start Voltage	300 VDC
Power Consumption	30 W (standby)
Ambient Temperature	-25°C - 50°C
Cooling	Forced fan cooling with optional sealed heat exchanger
Dimensions (in.) (L x W x H)	92.5 x 70.8 x 23.6
Shipping Weight (lbs.)	2645.5

Sunny Cenral 125

Power Panel Systems

xantrex™ PP Series Power Panel Systems

A factory engineered and professionally assembled alternative energy power system with SW or DR inverters mounted on a panel pre-wired and ready to install. Models can be configured for 120 or 240VAC power delivery up to 11kW in size, from battery banks of 12, 24, or 48 VDC with connections for generator and/or utility input, including all necessary AC and DC overcurrent protection devices required by the NEC with additional AC section.

All PP series assemblies include: one or two Xantrex inverters, a white powder-coated steel backplate, a DC disconnect assembly with 500A shunt negative bond block and one or two battery disconnect breakers, an AC input/output breaker section with inverter bypass breaker interlock. All inverters include a conduit box with connecting cables; conduits, dual inverter systems include stacking interface cable for 240 V operation, and two AC breaker sections. ETL listed. Inverter to battery cable sets for dual inverter models require two sets. E models for European export available in 230V / 50Hz. Call your Kyocera Authorized Dealer for pricing. Two year warranty.

PP Series optional factory installed equipment can be installed with order, see Power Panel Options for part numbers.

- Xantrex model **PPO- C40** installed charge controller (maximum 2) for solar electric, wind or hydroelectric battery charging sources. Note: BTS-15 remote sensor is recommended.
- Optional digital meter **PPO-C40DVM** (maximum 2)
- Additional installed DC rated circuit breaker order **PPO- CD** (15, 20, or 60) (maximum 4)
- For inverter to battery flexible conduit/cable sets order **PPO-BC(length)-(wire gauge)** (See page 92), supplied with assembly, packed separately, see options list

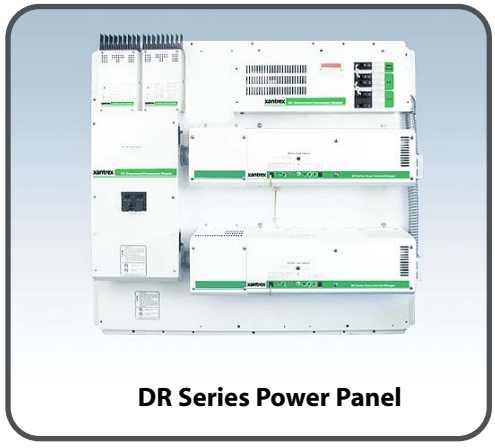
Note: Power panels are shipped in wood crates. 47.0 in x 44.0 in x 19.0 in, 22.6 cu.ft. All power panels are 43"L x 40"W.

DR Series Power Panel Systems

The DR Power Panel system comes ready for installation, pre-wired with the following:

- DR Series modified sine wave AC power inverter with high efficiency and bi-directional operation includes:
  - 30 amp AC pass-thru power at 120VAC (/S = Single System) or 120/240VAC (/D = Dual System)
  - Adjustable three stage, temperature compensated battery charging
- 175 or 250 amp DC disconnect breaker*
- 60 amp AC disconnect/bypass breaker in box*
- AC and DC wiring in conduit (battery cables not included)*
- Powder coated steel back-plate (40.0"H x 43.0"W x 1.0"D)
- Battery Temperature Sensor*
- Inverter Conduit Box*
- Negative/Ground Bonding Block
- 500 amp/50mV shunt (for remote metering)

*These items are doubled on /D (Dual = two inverters) system



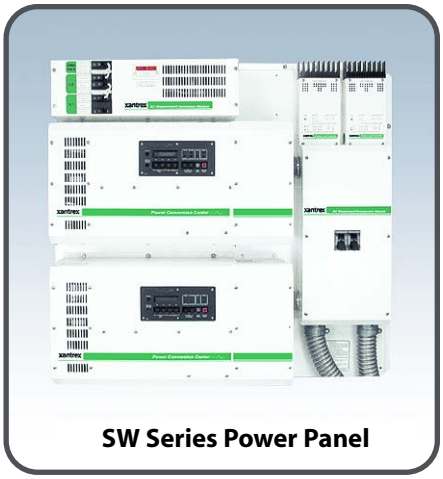
DR Series Power Panel

Product Name	PP-DR1512/S	PP-DR1512/D	PP-DR1524/S	PP-DR1524/D	PP-DR2412/S	PP-DR2412/D	PP-DR2424/S	PP-DR2424/D	PP-DR3624/S	PP-DR3624/D
Part Number	**50310**	**50311**	**50313**	**50314**	**50316**	**50317**	**50318**	**50319**	**50321**	**50322**
Price	**$1979.00**	**$3637.00**	**$1879.00**	**$3529.00**	**$2295.00**	**$4337.00**	**$2295.00**	**$4337.00**	**$2529.00**	**$4795.00**
Inverter(s)	DR1512	DR1512x2	DR1524	DR1524x2	DR2412	DR2412x2	DR2424	DR2424x2	DR3624	DR3624x2
Max. Continous Power	1.5kW	3.0kW	1.5kW	3.0kW	2.4kW	4.8kW	2.4kW	4.8kW	3.6kW	7.2kW
DC Input	12VDC		24VDC		12VDC		24VDC		24VDC	
Min. Battery Cable Size	2/0AWG	2/0AWGx2	2/0AWG	2/0AWGx2	4/0AWG	4/0AWGx2	2/0AWG	2/0AWGx2	4/0AWG	4/0AWGx2
VAC Output	120 @60Hz	120/240 @60Hz	120 @60Hz	120/240 @60Hz	120 @60Hz	120/240 @60Hz	120@ 60Hz	120/240 @60Hz	120@ 60Hz	120/240 @60Hz
Battery Charger	70A	70Ax2	35A	35Ax2	120A	120Ax2	70A	70Ax2	70A	70Ax2
Shipping Weight (lbs.)	145.0	220.0	145.0	220.0	155.0	240.0	155.0	240.0	159.0	248.0

SW Series Power Panel Systems

Xantrex power panels are complete, pre-assembled electrical systems that are NEC compliant as well as ETL listed to UL and CSA standards. These systems may cost a little bit more than the individual components, but will save you a lot of time and hassle during system installation and inspection. The SW Power Panel system comes ready for installation, pre-wired with the following:

- SW Series sine wave AC power inverter with high efficiency and bi-directional operation includes:
  - 60 amp AC pass-thru power at 120VAC (/S = Single System) or 120/240VAC (/D = Dual System)
  - Adjustable three stage, temperature compensated battery charging
- 175 or 250 amp DC disconnect breaker*
- 60 amp AC disconnect/bypass breaker in box*
- AC and DC wiring in conduit (battery cables not included)*
- Powder coated steel back-plate (40.0"H x 43.0"W x 1.0"D) (inches)
- Battery Temperature Sensor*
- Inverter Conduit Box*
- Negative / Ground Bonding Block
- 500 amp/50mV shunt (for remote metering)



SW Series Power Panel

*These items are doubled on /D (Dual = two inverters) system

Product Name	PP-SW4024/S	PP-SW4024/D	PP-SW4048/S	PP-SW4048/D	PP-SW5548/S	PP-SW5548/D
Part Number	**50333**	**50334**	**50337**	**50338**	**50340**	**50342**
Price	**$4995.00**	**$8995.00**	**$4995.00**	**$9137.00**	**$5695.00**	**$9995.00**
Inverter(s)	SW4024	SW4024x2	SW4048	SW4048x2	SW5548	SW5548x2
Max. Continous Power	4.0kW	8.0kW	4.0kW	8.0kW	5.5kW	11.0kW
DC Input	24VDC		48VDC			
Min. Battery Cable Size	4/0AWG	4/0AWGx2	2/0AWG	2/0AWGx2	4/0AWG	4/0AWGx2
VAC Output	120@60Hz	120/240@60Hz	120@60Hz	120/240@60Hz	120@60Hz	120/240@60Hz
Battery Charger	120A	120Ax2	60A	60Ax2	70A	70Ax2
Shipping Weight (lbs.)	215.0	360.0	215.0	360.0	246.0	422.0

PP Series Power Panels Options

Product Name and Description	Part Number	Price
PPK-C40 - A field installation kit for adding a C40 controller assembly to an existing Power Panel installation. Kit includes C40 controller with a 60A DC breaker, hook-up wiring, connections and fasteners.	50361	$249.00
PPO-C40 - C-40 DC Charge or load controller, includes pre-wired 60A DC breaker.	50350	$258.00
PPO-C40DVM - Digital meter with LCD display installed onto the C40 controller.	50351	$99.00
PPO-CD15 - 15A DC load or input breaker installed in the DC disconnect.	50352	$59.00
PPO-CD20 - 20A DC load or input breaker installed in the DC disconnect.	50353	$59.00
PPO-CD60 - 60A DC load or input breaker installed in the DC disconnect.	50354	$59.00

xantrex Power Modules (PM)

The Xantrex Power Module (PM), is a balance of system stackable enclosure package that allows installation of components, wiring and safety circuitry in a lockable outdoor rated cabinet while maintaining access to all breakers. Cabinets can be stacked up to four units. Each module can house separate individual component types, such as electronics, inverters, controllers and additional AC/DC breakers, or combinations of electronics or sealed batteries. Inverters and C40 controllers sold separately.

Power Module

More Features

- Powder-coated aluminum shell with stainless steel mounting hardware
- Removable latching door
- Weatherproof louvers for ventilation and waterproof-lockable circuit breaker covers
- Complete with wiring between breakers and inverter. DC Battery disconnect, AC input / output / bypass breakers, DC shunts and bonding block and AC neutral and grounding blocks
- Add optional inverter (and PV charge controllers) to complete electronics.
- PMO options are factory assembled
- Single cabinet (34.0"H x 19.0"W x 19.0" D, 57.0 lbs.)
- 2 year warranty

Model	Part Number	Price	Fits Inverter (s)	Shipping Weight (lbs.)
PM-SW250/S - Single Cabinet	50250	$1120.00	SW4024, PS2512	57.0
PM-SW175/S - Single Cabinet	50252	$1120.00	SW4048, SW5548	57.0
PM-DR250/S - Single Cabinet	50254	$1120.00	DR3624, DR2412	57.0
PM-DR175/S - Single Cabinet	50256	$1120.00	DR1512, DR1524, DR2424	57.0
PM-SW250/D - Dual Cabinet	50251	$1845.00	PS2512 / SW4024 / SW5548 x 2	114.0
PM-SW175/D - Dual Cabinet	50253	$1845.00	SW4048 / SW5548 x 2	114.0
PM - Base Power Module without electrical components for stand-alone vented battery cabinet or other equipment.	50260	$495.00	-	52.0
PM-Add - Adder for PM unit to double its capacity. Used as a base with other modules stacked on top.	50261	$395.00	-	50.0
PM-Ext - Add to PM for taller batteries. Does not have a bottom and cannot be stacked on. Can house (with a PM) four (4) L-16 batteries.	50262	$295.00	-	33.0

Power Module Options (PMO)

Product Name and Description	Part Number	Price
PMO-C40 - C40 charge/load/diversion controller installed in the Power Module. Includes 60A DC breaker, #6 AWG wiring (between breaker, C40) and all ring terminals and mounting hardware	50263	$255.00
PMO-LOCKS - Lock kit for one front door. Includes two keys. Replaces screwdriver-slot type latches provided with the standard Power Module.	50267	$45.00
PMO-TRAY - Fiberglass battery tray for Power Module, protects cabinet from electrolyte. Will hold up to four (4) group 27-31, six golf cart type, or four (4) L-16 type batteries.	50269	$65.00
PMO-FEET - Feet for securing Power Module stack to ground. constructed of (3) 0.1875" x 1.5" x 1.5" aluminum angle. Does not include anchor bolts.	50270	$100.00
PMO-DC250 - Additional 250A DC Heineman™ breaker and #4/0 AWG cabling to inverter to allow addition of a second DR series inverter into a single Power Module.	50272	$320.00
PMO-DC175 - Same as PMO-DC250, except 175A DC Heineman™ breaker and #2/0AWG cabling.	50273	$320.00

OutBack PSAC / PSDC

Power System AC (PSAC)

The OutBack PSAC provides the AC electrical system overcurrent protection, disconnect and bypass functions for up to to four inverters, a utility connection and a back-up generator connection.

More Features

- ETL listed indoor type powder-coated steel enclosure
- Dual snap-in DIN rail type mounting brackets for up to sixteen AC circuit breakers (15, 20, 25, 30 or 60 amps)
- Available with or without a 30 or 60 amp 120 VAC or 120/240 VAC input/output/bypass disconnect breakers with interlock safety switch.
- Ground terminal bus bar
- Isolated neutral terminal bus bar
- Hot terminal bus bar for connecting additional AC load circuits
- Designed to mount directly to the AC end of up to four FX2000 inverter/chargers or one or two SW or DR series inverters
- Plenty of room for additional current sensors and control relays for advanced system designs.

PSAC Interior View

Product Name and Description	Part Number	Price	Inverter(s)	AC Breaker	Dimension (in.) (H x W x D)	Shipping Weight (lbs.)
PSAC-60D	55299	$445.00	Dual FX2000, SW Series	60 amp@120/240VAC	36 x 12.75 x 13.75	32.0
PSAC-60	55271	$369.00	FX2000, SW Series	60 amp@120VAC	36 x 12.75 x 13.75	32.0
PSAC-30D	55272	$445.00	Vanner RE	30 amp@120/240VAC	36 x 12.75 x 13.75	32.0
PSAC-30	55274	$369.00	Small Inverters (DR Series)	30 amp@120VAC	36 x 12.75 x 13.75	32.0
PS2AC50D AC Breaker Box	55326	$385.00	N/A	N/A	N/A	26.0

AC Input / Output / Bypass Assemblies

For additional inverter / chargers. Packed as a complete kit with detailed instructions and drawings. Includes safety interlock. Allows "bypassing" of an inverter for maintenance or repair while keeping the AC loads powered from a generator or utility grid.

AC-IOB-60

Product Name and Description	Part Number	Price	Inverter(s)	AC Breaker	Space Required
AC-IOB-60D	55321	$159.00	2 Series Stacked Inverters	60 amp@120/240 VAC	Six breaker spaces
AC-IOB-60	55273	$85.00	One FX2000, SW, or PS	60 amp@120 VAC	Three breaker spaces
AC-IOB-30D	55275	$159.00	Vanner RE	30 amp@120/240 VAC	Six breaker spaces
AC-IOB-30	55276	$85.00	Small Inverters (DR Series)	30 amp@120 VAC	Three breaker spaces

Power System DC (PSDC)

The OutBack PSDC provides the DC electrical system overcurrent protection, disconnect and manual control functions for one or more inverters, multiple PV arrays and other charging sources and the storage battery system. It can also function as a load distribution panel for DC loads. The optional (page 65) OBDC-GFP/2 ground fault protection system can be added to the PSDC which disconnects the PV array(s) if a DC or AC ground fault occurs in the DC system.

More Features

- ETL listed indoor type powder-coated steel enclosure with plenty of conduit knockouts - 3/4", 1" and 2"
- Mounting space for up to four large 1.5" wide 175 or 250 amp or six medium 1.0" wide 60 to 100 amp breakers - sizes can be mixed.
- Ten spaces for small 0.75" wide 15, 30 or 60 amp breakers and OBDC-GFP/2 (uses 3 spaces)
- 500 amp 50mV DC current shunt standard
- Battery negative / ground bus bar standard
- Battery positive bus bar for DC loads and PV arrays included standard
- Designed to mount directly to the DC end of 1 or 2 Xantrex DR or SW series inverters without needing additional conduit boxes or fittings
- Easily connected to other inverter models and enclosures via conduit or race way
- Knockouts on top for up to three OutBack MX60, two RVPP Solar Boost or three C-series controllers
- For negative or positive ground systems

PSDC Interior View

Product Name and Description	Part Number	Price	DC Breaker	Dimension (in.) (H x W x D)	Shipping Weight (lbs.)
PSDC-100	55306	$459.00	125 amp	36 x 19 x 12	38.0
PSDC-175	55254	$519.00	175 amp	36 x 19 x 12	38.0
PSDC-250	55253	$519.00	250 amp	36 x 19 x 12	38.0
PSDC175 Breaker Box	55324	$385.00	N/A	N/A	24.0

OutBack Power System Options

Product Name and Description	Part Number	Price
BIG BUS	55328	$75.00
TBB - Terminal Bus Bar Use for adding more wire terminations or for isolating multiple positive / negative circuits. TBB-W= White insulators (P/N 55316), TBB-R= Red insulators (P/N 55320).	55259 (Black)	$19.00
PSA Adapts the side opening of a PSAC or PSDC to match one PS series inverter / charger. Two adapter plates are required for each PS inverter when using both PSDC and PSAC.	55257	$19.00
CCB - Charge Control Bracket For up to three additional C-Series controllers on either side.	55258	$39.00
GBB - Ground Bus Bar Kit For isolating the negative from ground (included with GFP/2).	55260	$15.00
PSMP - Mounting Plate For assembling a complete power system.	55255	$179.00
PS2MP - Mounting Plate	55325	$129.00

xantrex

Portable Household Inverter

XPower Powerpack 1500 produces household electricity for products rated at 1500 watts or less. A clean and quiet alternative to a generator, XPower Powerpack 1500 integrates a 60 amp-hour AGM battery with a 1500-watt inverter and produces a 3000-watt surge. This system is built to run a range of appliances such as a standard size refrigerator and microwave oven, and office equipment such as a computer and monitor, and fax machine.

Designed for indoor or outdoor use, **XPower 300** is a portable and rechargeable system that provides household power away from a utility outlet. The system offers short-term backup power to run a wide variety of electronic equipment and appliances rated at 300 watts or less (such as lights radios, TVs, etc.). XPower 300 also jump starts a car, truck or boat and can operate a wide variety of DC power products.

XPower 1500

Product Name	XPower 300	XPower 600	XPower 1500
Part Number	**35900**	**35901**	**35902**
Price	**$149.95**	**$279.95**	**$379.95**
Max. Continuous Power	300 W	600 W	1350 W
DC Input Voltage	12 VDC	12 VDC	12 VDC
AC Output Frequency	60Hz +/-4Hz		
Output Voltage / Waveform	115 VAC / Modified Sine wave		
Dimension (H x W x D) (in.)	12.6 x 9.4 x 5.7	14.5 x 12.3 x 15.6	14.5 x 12.3 x 15.6
Shipping Weight (lbs.)	18.5	48.0	60.0

INVERTER ACCESSORIES

Inverter Cables

Available in two wire sizes (#2/0 and #4/0 AWG), two wire types (welding and UL rated) and several lengths (5', 10' & 15'). These flexible cables are pre-cut to the proper length and have ring terminals crimped on each end with color coded (red & black) heat shrink applied over the terminal connection to minimize corrosion build-up. Consult the "Inverter Overcurrent Protection & Cable Sizing Chart" in Appendix D to determine the proper size cable to use with your particular inverter.

Note: Welding cable does not have the proper insulation to withstand the corrosive environment inside a battery box and therefore is not approved by the NEC for use between a battery bank and inverter.

Domestic Use (UL Listed)

Product Name and Description	Part Number	Price
BC5 - 2/0 - 5'	49121	$79.00
BC10 - 2/0 - 10'	49122	$129.00
BC5 - 4/0 - 5'	49124	$105.00
BC10 - 4/0 - 10'	49125	$169.00
BC15 - 4/0 - 15'	49126	$200.00

Non-Domestic Use (Non- UL Listed)

Product Name and Description	Part Number	Price
#2/0 - 5'	49050	$42.00
#2/0 - 10'	49100	$62.00
#2/0 - 15'	44254	$79.00
#4/0 - 5'	49075	$60.00
#4/0 - 10'	49080	$94.00
#4/0 - 15'	49112	$129.00

PPO-BC Series Inverter Cables xantrex

Power Panel to battery conduit/cable sets - with connectors, same as BC series within 2 inch indoor flexible conduit that is 3 feet shorter than cable.

Product Name and Description	Part Number	Price
#2/0 AWG 5' PPO-BC5-2/0	50362	$79.00
#2/0 AWG 10' PPO-BC10-2/0	50363	$129.00
#4/0 AWG 5' PPO-BC5-4/0	50364	$169.00
#4/0 AWG 10' PPO-BC10-4/0	50365	$200.00
#4/0 AWG 15' PPO-BC15-4/0	50366	$200.00

PPO-BC Inverter Cable

DC Combiners / Converters

Solar Converters, Inc.

Solar Converters, Inc. manufactures a wide variety of DC components ranging from charge controllers to transformers. These products can prove to be very helpful in optimizing your system or getting you out of a pinch. We don't have enough room in this catalog to list all of their products, but two of their most popular product lines are their DC Autotransformer/Equalizers and Linear current Boosters. The DC Autotransformer/Equalizer can efficiently convert DC power up or down from one voltage to another (for example from 12V to 24V or 48V to 12V). This can be especially helpful when trying to charge a 12V battery from a distant solar array since these units allow you to wire your solar array for 24 or 48V to minimize line loss. The Linear Current Boosters are typically used in solar water pumping systems to maximize the power produced and hence water pumped in low light level conditions in the morning and evening. Several different models of each product line are available with different amperage capacities and operating voltages.

Product Name and Description	Part Number	Price
E/Q 12/24-20A - DC/DC Converter	51570	$203.00
E/Q 24/48-10A - DC/DC Converter	51571	$229.00
E/Q 12/48-10A - DC/DC Converter	51572	$250.00
PPT-24/18 - DC/DC Converter	51575	$125.00

EQ 12/24-20

OutBack Transformer OutBack Power Systems

Product Name and Description	Part Number	Price
X-240 - 4kVA 120/240 VAC Autotransformer This auto-transformer is used for step-up, step-down or for generator balancing applications. Includes a 25 amp two pole breaker for manual control and overload protection of the transformer and wiring.	55277	$290.00
X-FAN - Cooling Fan Kit for X-240 Increases the power rating of an X-240 to a maximum of 6kVA continuous. 120 VAC powered.	55278	$29.00

X-240 Autotransformer

Xantrex T-240 Transformer

The T-240 transformer from Xantrex can be used in several ways; step-up, step-down or as a balancing transformer. Typical use of this transformer is to operate a 240 VAC well pump from a 120 VAC source like a single inverter. The other application for the T-240 transformer is to better balance the output of a 120/240 VAC generator feeding into a single 120 VAC inverter/charger. The T-240 has a 3400 VA continuous output at 25°C with a 12 W idle power consumption. The T-240 is mounted in an indoor-rated powder-coated steel enclosure with numerous 3/4 inch and 1 inch knockouts. Two year warranty.

T-240 Transformer

Product Name and Description	Part Number	Price
T-240 Transformer	54012	$350.00

Transfer Switches

The ITS Series Transfer Switches from IOTA provide automatic power supply switching for a variety of applications. Switch between AC powercords, on-board generators, on-board inverters, or all three. Switching is automatic, and the ITS senses the presence of the available supplies and automatically selects the proper one, providing safe and appropriate levels of power at all times. And the ITS comes in a variety of models for use in a wide range of power applications. Models available include Relay-Based (R) and Contactor-Based (C) switches, and also units designed for special applications. In addition, all ITS Transfer Switches are backed by a standard two-year warranty.

ITS-50R Transfer Switch

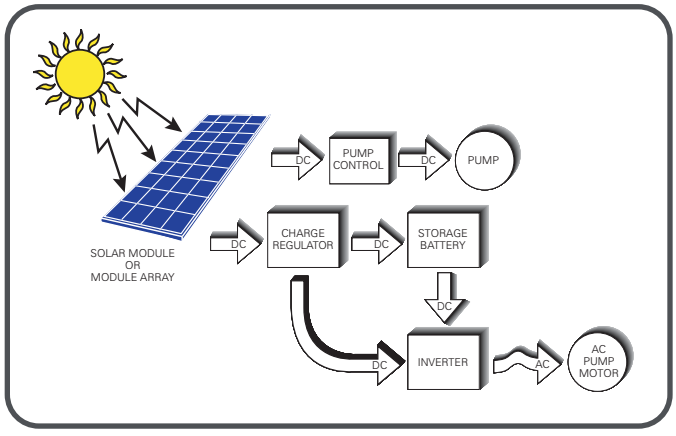
Product Name and Description	Part Number	Price
ITS-30R	36080	$69.00
ITS-50R	36155	$150.00
ITS-75C	36156	$318.40
ITS-100R	36157	$352.00

WATER PUMPING

How does the sun power a pump?

The photovoltaic effect produces a flow of electrons. Electrons are excited by particles of light and find the attached electrical circuit the easiest path to travel from one side of the solar cell to the other. Envision a piece of metal such as the side panel of a car. As it sits in the sun, the metal warms. This warming is caused by the exciting of electrons, bouncing back and forth, creating friction, and therefore, heat. The solar cell merely takes a percentage of these electrons and directs them to flow in a path. This flow of electrons is, by definition, electricity.

Photovoltaics or solar electric cells convert sunlight directly into electricity. This electricity is collected by the wiring in the module, then supplied to the DC pump controller and motor, which, in turn, pumps water whenever the sun shines. At night, or in heavy cloud conditions, electrical production and pumping ceases.



Where do solar pumping systems work?

Solar pumping systems work anywhere the sun shines. The majority of the continental U.S. enjoys plenty of sun to operate a pumping system economically.

The intensity of light varies greatly throughout the day. Morning and afternoon sunlight is less intense because it is entering the earth's atmosphere at a high angle and passing through a greater cross section of atmosphere, which reflects and absorbs a portion of the light.

We measure sun intensity in equivalent full sun hours. One hour of full sun is roughly equivalent to the sunlight on a clear summer day at noon.
The sunlight or insolation levels also vary seasonally. Fortunately, most needs for water correspond with the sunniest seasons of the year – spring, summer and fall.

Small to medium solar electric pumping systems are easily portable. By mounting the solar system on an axle or trailer, a system can be moved from well to well. This increases the economic return of a system by increasing the seasons of use. It may also correspond with the rotation of grazing areas.

Economics of Solar Water Pumping

The economy and reliability of solar electric power make it an excellent choice for remote water pumping. Cattle ranchers in the Western U.S., Canada, Mexico, and Australia are enthusiastic solar pump users. Their water sources are spread over many miles of rangeland where power lines are few and refueling and maintenance costs are substantial for generator use.

If your water source is 1/3 mile or more from the power line, solar is a favorable economic choice. This fact is reinforced by a number of Rural Electric Co-Operatives across the U.S. These Co-Ops actively advocate the use of solar pumps, as the cost to extend new lines is subsidized by other rate payers.

A solar pump minimizes future costs and uncertainties. The fuel is free. Moving parts are reduced to as few as one. A few spare parts can assure you many years of reliable water supply at near-zero operating costs.

Mounting Structures and Array Placement

Solar modules should be located in a sunny spot where no shading occurs. Even shadows from a tree limb, tall grass, or fence rails can substantially reduce power output.

For these reasons we typically mount the solar modules on a pole or ground mount above any obstacles. Remember the solar array can be placed some distance from the water source if shading is a problem. Wire size can be increased to compensate for longer cable runs and the associated voltage drop.

Windmills: Yesterday's Answer to Remote Water Delivery

There are still thousands of windmill water pumping units standing in the western U.S. Regrettably, many are inoperable. These pumpers were very valuable for remote (off grid) sites, with the proper minimum wind conditions, and manpower was plentiful and cheap. Windmills, though potentially long lasting, need dedicated maintenance. The downhole leathers require inspection and high winds can cause mechanical damage to the blades. Parts for these mills are expensive and sometimes hard to find.

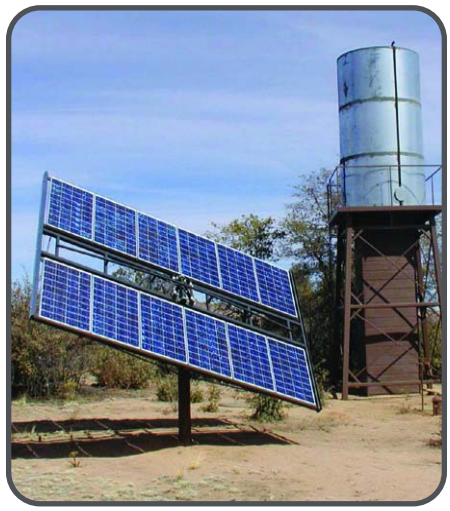
Solar water pumping systems have many advantages over windmill water pumpers. Though the initial cost of solar powered systems can be similar to that of a windmill (however, in many cases far less) the life time costs are much lower. Windmills must be used where there is a steady, constant wind for maximum results while solar pumps operate anywhere the sun shines. Solar pumping systems can be installed in less than a day by an individual or small crew and can be portable, while windmills (because of the need to erect a tower) can take a larger crew a much longer time to install. Windmills are secured to the ground and are stationary. Solar powered water pumping systems are the modern day upgraded version of the windmill which uses natural resources to deliver water in off grid locations.

Solar power and water pumping are a natural. Generally, water is needed most when the sun shines its brightest. Solar modules generate maximum power in full sun conditions when we typically need larger quantities of water. Because of this "sun synchronous" matching, solar is an economical choice over windmills and engine driven generators for most locations where utility power is non-existent. Owners of solar water pumping systems enjoy a reliable power system that requires no fuel and very little attention.

Fixed vs. Tracking Mount Structure

Fixed Mount structures are less expensive and tolerate higher wind loading. By fixing the modules due south, less water is pumped than a tracking system which orients the modules towards the sun as it arcs across the southern sky.

Tracking mount structures keep the modules at a 90 degree angle to the sun all day long. This provides more power to the pump over a longer period of the day, which produces 20 to 40 percent more water daily in the summertime.



Trackers offer a great advantage when pumping water. Passive single axis trackers are known for their excellent reliability and service life. They take no power from the system as they operate from the heat of the sun striking the frame members, causing freon to move from one cylinder to another. Passive trackers come with a 10 year warranty and are highly recommended in all but the windiest locations. High winds can pull the array off the correct sun angle and will negatively affect power production if winds are consistent.

Why we don't recommend batteries in water pumping systems

While batteries may seem like a good idea, they have a number of disadvantages in pumping systems. They reduce the efficiency of the overall system. The solar modules operating voltage is dictated by the battery bank and is reduced substantially from levels which are achieved by operating the pump directly. Batteries also require additional maintenance and under and over-charge protection circuitry which adds to the cost and complexity of a given system. For these reasons, only about five percent of solar pumping systems employ a battery bank.

Gas Fired Generators vs. Solar Energy

Generators are commonly used to provide power beyond the power line. We have several economic studies of solar versus generators as a power choice. These studies consider all costs involved: modules, mounting structure, pumps, miscellaneous components, installation, operation, maintenance, yearly inspection, component replacement and salvage value. With this we can determine a life cycle cost and a present value. One such comparison was done by the Bureau of Land Management at Battle Mountain, Nevada specifically comparing solar water pumping systems. For one 3.8 gpm system with a 275 foot design head, the PV system cost only 64% as much over 20 years as the generator system did over only 10 years. This remote solar site also used only 14% as many labor hours.

In 1989, Sandia National Laboratories noted that photovoltaic pumping systems in remote locations would often be cost effective compared to generators, even with 5 times the initial capital cost. Low end generators, which are initially inexpensive, require consistent maintenance and have a design life of approximately 1,500 hours. Small to medium sized solar pumping systems often initially cost less than a durable slow speed engine driven generator. Most larger pump systems initially cost more than generator systems, but tend to be far more economical in the end.

System Type	Advantages	Disadvantages
Solar Electric Power System	◆ Low maintenance ◆ Clean ◆ No fuel needed ◆ Easy to install ◆ Reliable long life ◆ Unattended operation ◆ Low recurrent costs ◆ System is modular and can be matched closely to	◆ Relatively high initial cost ◆ Lower output in cloudy weather
Diesel (or Gas) Power Systems	◆ Moderate capital costs ◆ Can be portable ◆ Extensive experience available ◆ Easy to install	◆ Needs maintenance and replacement ◆ Maintenance often inadequate, reducing life ◆ Fuel often expensive and supply intermittent ◆ Noise, dirt and fume problem ◆ Site visits necessary
Windmill	◆ Potentially long-lasting ◆ Works well in windy site	◆ High maintenance ◆ Costly repair ◆ Difficult to find parts ◆ Seasonal disadvantages ◆ Need special tools for installation ◆ Labor intensive ◆ No wind, no power, no water

Water Pumping Questionnaire

To help design your water pumping system, please complete this form. With this information your dealer can supply an accurate cost estimate and equipment list.

1. **Well and water depths**
   from ground level to end of bore hole _____ft.
   from ground level to water surface (static level) _____ft.
   from ground level to draw down level _____ft.

2. **Pumping distance & height**
   from well head to top of storage tank or outlet pipe:
   Horizontal distance from well head to storage tank ____ft.
   Vertical _____ft.

3. **Well recovery or recharge rate**
   How many gpm will the well produce continuously? ___gpm

4. **Well casing size**
   Inside diameter _____inches

5. **What is the water for?** _____
   examples: domestic, livestock, drip irrigation

6. **Seasons of use and water required daily**

Jan. _____ gpd	May _____ gpd	Sep. _____ gpd
Feb. _____ gpd	June _____ gpd	Oct. _____ gpd
Mar. _____ gpd	July _____ gpd	Nov. _____ gpd
Apr. _____ gpd	Aug. _____ gpd	Dec. _____ gpd

7. **Do you have a pump installed presently at this site? If so, please describe pump system and use.**

8. **Is the water clear, silty, high mineral content or have any other special considerations?** _____

9. **Is there an existing storage tank at the site?**
   If yes, what is the capacity? _____ gals.
   Pipe diameter well to tank _____ inches.

10. **Do you have good, unobstructed sunlight available near the water source?**
    If not, how far away from the water source? _____ ft.

11. **What is your site elevation? _____ ft.**

12. **A single sketch can save a thousand words, please draw us a picture and include any other factors not covered.**

Daily Water Requirements

Each person, for all purposes_____75 gal/day
Cow/calf pair_____10 to 30 gal/day
Each horse, dry cow or beef animal___10 to 20 gal/day
Each milking cow_____35 gal/day
Each sheep_____2 gal/day
Each hog or 100 chickens_____4 gal/day

These figures are generalizations, many factors affect water consumption, such as forage, moisture content, etc.

KYOCERA Solar, Inc.

Kyocera SD Series Water Pumps

The Kyocera SD Series of submersible solar pumps are highly efficient, low-voltage, DC powered, diaphragm-type positive-displacement pumps designed specifically for water delivery in remote locations.

They operate on 12 to 30 volts of direct current that may be supplied from a variety of independent power sources including solar panels and/or batteries. Power requirements can be as little as 35 watts. Constructed of marine grade bronze and 304 stainless steel, these pumps are the highest quality submersible pumps in their class.

Kyocera's SD series pumps can be installed below water level in a pond, river or cistern, or installed by hand into a ground water well. They can be used to fill an open tank or in a pressurized water delivery system.

Simplicity is the key feature of the SD series pumps. They are easy to install, require very little maintenance and are completely field serviceable.

The SD series pumps are designed for use in stand-alone water delivery systems. They are pollution-free, corrosion-resistant and quiet. It is the ideal way to provide water for livestock, remote homes, campsites, small farms or any other need beyond the commercial power grid.

SD 3-70 & SD 6-35

Product Name and Description	Part Number	Flow Rate lpm/gpm	Max. Total Dynamic Head (meter/ft.)	Price	Shipping Weight (lbs.)
SD 3-70	85221	up to 3.0/0.8	70/230	$879.00	21.0
SD 6-35	85222	up to 6.0/1.6	35/115	$879.00	21.0
SD 12-30	85220	up to 12.0/3.15	30/100	$959.00	23.4

KYOCERA Solar, Inc.

Kyocera SC Series Water Pumps

The Kyocera SC Series of submersible solar pumps are high quality, maintenance-free, DC powered pumps designed specifically for water delivery in remote locations.

They operate on 140 to 1000 watts of direct current at 30 to 120 volts. The power may be supplied from a variety of independent sources including solar modules and/or batteries.

The motors are state of the art, brushless DC, permanent magnet type constructed from marine grade bronze and 304 stainless steel. Designed with a pump motor face, they bolt directly to standard 4.0 inch diameter submersible pump ends. Internal pressure equalization allows motor submergence to any depth without damage to seals.

The pump ends are multi-stage centrifugal. They are manufactured by Goulds Pumps, Inc., constructed from 304 stainless steel and plastics. The impellers and diffusers are constructed from a rugged thermoplastic and are extremely resistant to mineral and algae deposits. Field replacement of the pump end is easily accomplished without the use of specialized tools.

SC 500 Series

The SC series pumps can be installed below the water level in a well, lake, river or cistern. They can be used to fill open tanks or used to pressurize water systems with heads up to 550 feet (167 meters). They are designed for use in stand-alone water delivery systems. They are pollution-free, corrosion resistant, permanently lubricated and quiet. There is no better way to provide water for livestock, remote homes, campsites, small farms or any other need beyond the commercial power grid.

Product Name and Description	Part Number	Optimal Flow GPM (LPM)	Optimal Head Feet (Meters)	Power (Watts)	Diameter in (cm)	Total Weight lbs (kg)	Pump Outlet Connection Size	Price
SC 500 15-60	85750	3.70 (14)	203.4 (62)	550	3.75 (9.53)	26.0 (11.8)	1-1/4" NPT	$1907.00
SC 500 25-40	85751	6.08 (23)	137.8 (42)	550	3.75 (9.53)	25.0 (11.4)	1-1/4" NPT	$1837.00
SC 500 35-35	85752	9.25 (35)	108.3 (33)	550	3.75 (9.53)	25.0 (11.4)	1-1/4" NPT	$1771.00
SC 500 40-25	85753	11.1 (42)	88.6 (27)	550	3.75 (9.53)	24.0 (10.9)	1-1/4" NPT	$1832.00
SC 1000 15-105	85754	4.49 (17)	374.0 (114)	1050	3.75 (9.53)	33.0 (14.8)	1-1/4" NPT	$2182.00
SC 1000 25-85	85755	6.34 (24)	315.0 (96)	1050	3.75 (9.53)	32.0 (14.3)	1-1/4" NPT	$2102.00
SC 1000 35-70	85756	8.98 (34)	236.2 (72)	1050	3.75 (9.53)	31.0 (13.9)	1-1/4" NPT	$2041.00
SC 1000 45-60	85757	11.62 (44)	193.6 (59)	1050	3.75 (9.53)	29.0 (13.0)	1-1/4" NPT	$1956.00
SC 1000 60-45	85758	16.11 (61)	147.6 (45)	1050	3.75 (9.53)	29.0 (13.0)	1-1/4" NPT	$2028.00
SC 1000 105-30	85759	22.45 (106)	98.4 (30)	1050	3.75 (9.53)	31.0 (13.9)	2" NPT	$2137.00

KYOCERA
KYOCERA Solar, Inc.

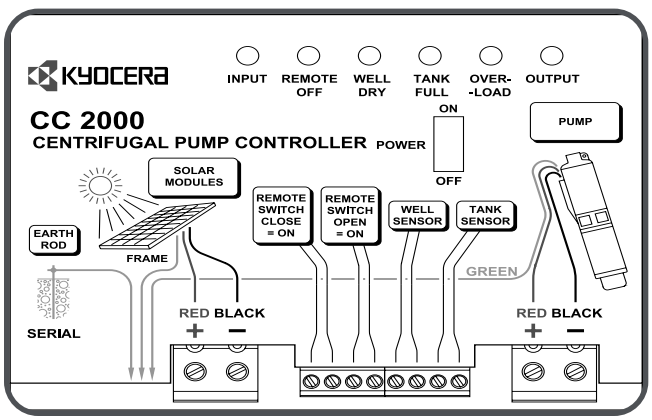
Kyocera Pump Controllers

The CD 300 and CC 2000 pump controllers are designed to connect solar modules to Kyocera Solar's SD and SC series submersible motors and pumps. The controller provides current boosting combined with true Maximum Power Point Tracking (MPPT) of the solar modules. The pump controller's microprocessor constantly monitors the incoming solar power and boosts current to operate the solar modules at their peak power point and maximize pump output. The controller is entirely self-configuring and requires no setup or adjustment by the user to ensure proper operation.

In addition to solar modules, the controller will also operate from 12 or 24 Volt (CD 300) and 24 to 144 Volt (CC 2000) battery banks for use in a broad range of applications. The CD 300 and CC 2000 controllers are only intended for use with Kyocera Solar pump motors.

The controller's unique design simplifies control and troubleshooting of pumping systems. Inputs are provided for remote switches and Kyocera Solar's unique water level sensor. Indicators provide convenient information about voltages, switch and sensor status, and overload conditions.

Kyocera Solar's newly designed pump controller is user friendly. It is designed to provide maximum power under varying conditions and requires no programming by the user. We are proud to introduce the Kyocera Solar line of pump controllers and are confident you will be satisfied.



CC 2000

CC 2000 Cover

Product Name and Description	CD 300	CC 2000
Part Number	**85223**	**85224**
Price	**$559.00**	**$669.00**
Ambient Temperature	-20 to 50°C	-20 to 50°C
Max. Solar/Input Voltage (total VOC @-20°C)	50V	300V
Max. Output Current - Current Boost Mode	10A	14A
Max. Output Power - Current Boost Mode	300W	2000W
Max. Output Current - Voltage Boost Mode	5A	-
Max. Output Power - Voltage Boost Mode	150W	-
Input Current Limiting	12A	15A
High Temperature Protection	85°C	85°C
Solar and Pump Wire Sizes	0.5 - 16 mm^2 (6 -20 AWG)	0.5 - 16 mm^2 (6 -20 AWG)
Sensor and Remote Wire Sizes	0.2 - 2.5 mm^2 (14 -24 AWG)	0.2 - 2.5 mm^2 (14 -24 AWG)

KYOCERA Solar, Inc.

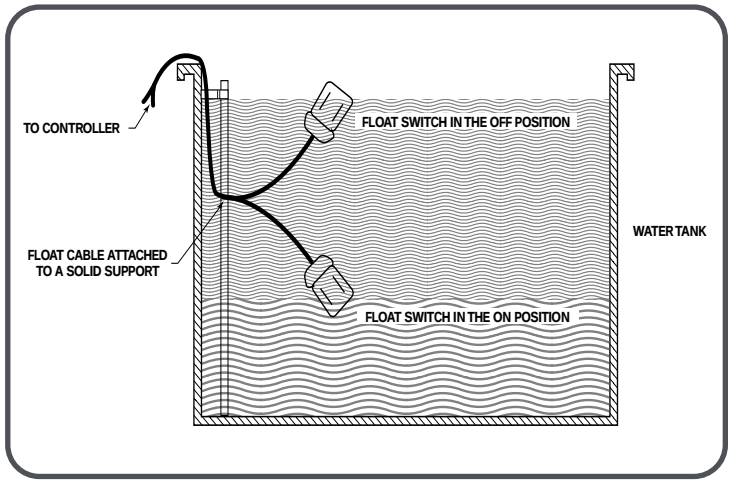
Kyocera Water Pumping System Accessories

Water Sensor, Float Switches and Submersible Pump Wire

All of the pumping systems we list have water sensing circuitry included. A float switch or SS 100 Water Sensor is all that is required to enable this function.

This can be used in one of two ways. First, a float switch can be used to turn the pump on and off when the storage tanks are low or full.

Secondly, an SS 100 Water Sensor can be placed near the pump to shut the pump off if the water falls below a certain level and start the pump again once water has reached a normal operating level. This sensor can be utilized either at the water source or on the storage tank.



Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Float Switch (open on rise)	85931	$66.00	3.0
Float Switch (close on rise)	85932	$33.00	3.0
SS 100 Water Sensor (150' wire included)	85230	$152.00	3.0
Splice Kit (SS 100)	85235	$14.00	1.0
#12-2 Submersible Pump Wire, 0.16lb./ft.	43403	$50.00/50ft.	-
#10-2 Submersible Pump Wire, 0.211lb./ft.	43433	$75.00/50ft.	-
#8-2 Submersible Pump Wire, 0.28lb./ft.	43423	$100.00/50ft.	-
#6-2 Submersible Pump Wire, 0.48lb./ft.	43453	$150.00/50/ft.	-
SS 100 Water Sensor Cable #20-2	43397	$0.55 / ft.	-

Float Switch

Repair Kit

Product Name and Description	Part Number	Price
Kyocera SD 12-30 Minor Repair Kit	86100	$148.00
Kyocera SD 6-35 Minor Repair Kit	86110	$122.00
Kyocera SD 3-70 Minor Repair Kit	86120	$145.00
Kyocera SD 12-30 Major Repair Kit	86105	$320.00
Kyocera SD 6-35 Major Repair Kit	86115	$228.00
Kyocera SD 3-70 Major Repair Kit	86125	$260.00
SDS-D-128 Minor Repair Kit	85960	$64.00
SDS-D-228 Minor Repair Kit	85970	$67.00
SDS-Q-128 Minor Repair Kit - Round	85951	$109.00
SDS-Q-128 Minor Repair Kit - Square	85950	$77.00
SDS-D-128 Major Repair Kit	85962	$254.00
SDS-D-228 Major Repair Kit	85972	$255.00
SDS-Q-128 Major Repair Kit - Square	85952	$287.00
SDS Pump Puller	85915	$79.00
D Series Rebuild Tool Kit	85916	$308.00

Drop Kit

Product Name and Description	Part Number	Price
SD 6-35 / 3-70 Drop Kit		
50' Tube, 75' 12-2 Cable	85254	$125.00
100' Tube, 125' 12-2 Cable	85258	$161.00
150' Tube, 175' 10-2 Cable	85262	$267.00
200' Tube, 225' 10-2 Cable	85266	$288.00
225' Tube, 275' 10-2 Cable	85268	$400.00
SD 12-30 Drop Kit		
50' Tube, 75' 12-2 Cable	85272	$180.00
100' Tube, 125' 10-2 Cable	85276	$245.00

Splice Kit

Product Name and Description	Part Number	Price
SD Series Splice Kit	85946	$11.00
SC Series Splice Kit	85902	$8.00
Water Sensor Splice Kit	85235	$14.00

Sand Shroud

Sand shrouds protect SD pumps by eliminating destructive sand intrusion into the pumps. Constructed of rugged PVC and polyethylene. Also includes reusable nylon coated stainless steel ties.

Product Name and Description	Part Number	Price
SD 3-70 / 6-35 Sand Shroud	85226	$129.00
SD 12-30 Sand Shroud	85225	$142.00

Sensor Splice Kit

SD 12-30 Drop Kit

SD 3-70/ 6/35 Sand Shroud

Shurflo Pressure Pumps

The versatility of this pump makes it an excellent choice for use as an array direct or battery based domestic pressure pump. The built-in adjustable pressure switch activates the pump at 25 PSI and shuts off at an adjustable 40 to 50 PSI. This allows the unit to easily be used in a vacation cabin pressure tank type system. It will fill a cistern from a shallow source of water, such as a creek or pond and will self prime up to 10 feet (subtract 1 foot of lift for every 1000 feet above sea level). Because of their positive displacement diaphragm design, this pump will not be hurt by running dry for short periods of time nor be harmed by dirty or silty water.

PUMP #80125

Head (ft.)	Flow Pressure	GPM	Power Consumption in Watts
0	Open Discharge	3.60	70.0
23	10	3.23	73.0
46	20	3.04	89.0
70	30	2.85	104.0
93	40	2.68	116.0

Product Name and Description	Part Number	GPM Open Discharge	Price	Shipping Weight (lbs.)
Continuous Run Rated - 12VDC	80125	3.6	$159.00	11.0
8000 - 100ft. Lift 12VDC	80000	1.5	$90.00	5.0
8000 - 200ft. Lift 12VDC	80010	1.5	$114.00	5.0
Standard Duty - 12 VDC	80011	2.8	$135.00	10.0
Standard Duty - 24 VDC	80160	3.3	$136.00	10.0
Standard Duty - 115 VAC	80129	3.3	$183.00	10.0
Dual Head Pump - 12 VDC	80169	5.6	$249.99	28.0
Dual Head Pump - 24 VDC	80171	6.5	$259.99	28.0
12V Pump/Accumulator Combo - 3.8GPM	80173	3.8	$299.99	19.0
12V Pump/Accumulator Combo - 5.6GPM	80174	5.6	$395.00	20.0
24V Pump/Accumulator Combo - 6.5GPM	80176	6.5	$399.99	20.0
Rebuild Kit - Diaphragm	80003	-	$24.00	0.65
Rebuild Kit - Valve Kits	80005	-	$13.00	0.09
10" Filter housing with one 10-micron Filter	81390	-	$54.00	3.0
(2) 10" Refill for PN 81390 10-micron Filters	81391	-	$14.00	2.0

Pressure Pump 12 V

Pump/ Accumulator Combo

SHURflo Bilge Pumps

Piranha™ Bilge Pumps

Smart. Reliable. Attractive. Efficient. Everything you are looking for in a bilge pump. Our tough, high density nylon housing and heavy duty water cooled motor gives the SHURflo Bilge Pump unparalleled reliability. Installations are a snap with our unique swivel base plate and extended 6' tinned wire assembly. All Piranha™ Series Bilge Pumps have a removable cartridge for easy cleaning. Ideal for pumping ponds, hot tubs, and water falls.

Product Name and Description	Part Number	Max Amp Draw	GPM	Price	Shipping Weight (lbs.)
380 Bilge Pump - 12 Volt	80166	2.0	6.3	$17.95	30.0
500 Bilge Pump - 12 Volt	80167	2.2	8.3	$22.95	30.0
1000 Bilge Pump - 12 Volt	80168	3.9	16.6	$33.95	30.0

Bilge Pump

SHURflo AquaTIGER™ SS

Agua Tiger SS

This high quality SHURflo Stainless Steel pump is a centrifugal pump designed for general plumbing applications where a flooded intake is provided. Typical applications include livewell filling and circulation; liquid transfer, shower/ hot tub pump-out, fish box and high flow washdrawn systems.

Product Name and Description	Part Number	GPM	Price	Shipping Weight (lbs.)
Aqua TIGER SS 12V	80177	21	$169.15	38.0

AquaTIGER SS

SHURflo Submersible Pump 9300

Submersible Pump 9300

Compact, powerful, easy to install and highly reliable, thousands in service. Diaphragm type positive displacement pump with unique watertight electrical connectors. Delivers up to 2 gpm. Can deliver water from 250 feet. Uses up to 100 watts of peak solar power.

Product Name and Description	Part Number	GPM	Price	Shipping Weight (lbs.)
Submersible Pump 9300	79850	2	$745.00	6.0

Submersible Pump 9300

WIND GENERATORS

The Perfect Compliment to Any Solar System

Electricity produced by wind generation can be used directly, as in water pumping applications, or it can be stored in batteries for household use when needed. Wind generators can be used alone, or they may be used as part of a hybrid system, in which their output is combined with that of photovoltaics, and/or a fossil fuel generator. Hybrid systems are especially useful for winter backup of home systems where cloudy weather and windy conditions occur simultaneously.

The most important decision when considering wind power is determining whether or not your chosen site has enough wind to generate the power for your needs, whether it is available consistently, and if it is available in the season that you need it. The power available from the wind varies as the cube of the wind speed. If the wind speed doubles, the power of the wind (ability to do work) increases 8 times. For example, a 10 mile per hour wind has one eighth the power of a 20 mile per hour wind. (10 x 10 x 10 = 1000 versus 20 x 20 x 20 = 8000).

One of the effects of the cube rule is that a site which has an average wind speed reflecting wide swings from very low to very high velocity may have twice or more the energy potential of a site with the same average wind speed which experiences little variation. This is because the occasional high wind packs a lot of power into a short period of time. Of course, it is important that this occasional high wind come often enough to keep your batteries charged. If you are trying to provide smaller amounts of power consistently, you should use a generator that operates effectively at slower wind velocities.

Wind speed data is often available from local weather stations or airports, as well as the US Dept. of Commerce, National Climatic Center in Asheville, N.C. You can also do your own site analysis with an anemometer or totalizer and careful observation. Installation of generators should be close to the battery bank to minimize line loss, and 30 feet higher than obstructions within a 300 foot radius. The tower should be well grounded.

Southwest Windpower

Southwest Windpower

The AIR-X combines what has made AIR the world's number one selling small wind turbine with new technology previously found only in today's state-of-the-art mega-watt-class wind turbines. All of these features are primarily found within the body of the turbine. The new microprocessor based speed control results in increased performance, improved battery charging capability and the elimination of "flutter" noise from the machine. The controller allows for peak-power tracking of the wind by optimizing the alternators output on all points of the cubic curve and then efficiently delivers the energy to the battery. The turbine's smart controller allows it to actually control blade rotation speed thus eliminating the buzzing noise commonly found with the previous models in high winds. Furthermore, a new series of carbon-reinforced blades with a modified pitch angle further increases power production.

The new electronics are a considerable improvement over the previous models. To the customer this means:

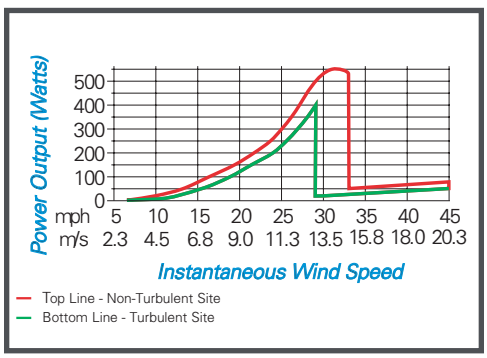
Much Lower Noise: Previous AIR wind modules relied on their aero-elastic blade design for over speed protection in high winds, causing loud flutter noise in winds above 35 mph (16 m/s). AIR-X's circuit monitors the wind speed and slows the blades as it reaches its rated output preventing it from going into flutter. The result is a much quieter, neighbor friendly wind turbine. In high winds, the AIR-X will continue to produce power at a reduced level until the wind decreases, at which point maximum output will resume. Additionally, when the battery has reached its charged state, the AIR-X will slow to an almost complete stop. Only when the battery has dropped below its user adjustable voltage set point will it startup and resume charging.

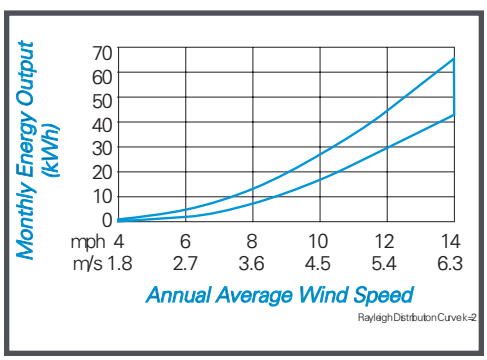
Improved battery charging: Previous AIR designs required 300-400 amp-hour battery banks so the trickle charge of the wind turbine could be adequately absorbed. The AIR-X's charge controller periodically stops charging, reads the battery voltage, compares it to the voltage setting and if the battery is charged, it completely shuts off all current going to the battery. This function is performed within a few milliseconds. The closer the battery is to reaching its full state of charge, the more often the AIR-X's circuit repeats this action. This means any size battery from 25 A/h or higher can be charged safely.

Lower stress design: AIR-X limits power on the input side of the electronics by controlling the torque from the blades. The power no longer has to be dissipated by the electronics resulting in lower heat stress on the circuit, bearings and other materials. Furthermore, stress on wind turbines occurs primarily in high winds. Under these conditions, the electronic stall design reduces the speed to 600 rpm, thereby significantly reducing turbine and tower loading.

The AIR-X is Southwest Windpower's most valuable venture to date. Thousands of hours of research, development and testing have gone into the design. We are confident you will love the improvements the AIR-X has to offer.

Product Name and Description	AIR-X			AIR-X Marine	
	12V	24V	48V	12V	24V
Part Number	**76017**	**76018**	**76999**	**76997**	**76998**
Price	**$649.00**	**$649.00**	**$855.00**	**$875.00**	**$875.00**
Rated Power (Watts)	400				
At Rated Wind Speed	28.0				
Available System Voltages (Volts)	12	24	48	12	24
Controller	Microprocessor-based smart internal regulator with Peak Power Tracking				
Start Generator Speeds (MPH)	7				
Rotor Diameter (in.)	46.0				
Mount Tower Diameter (SCH 40) (in.)	1.5				
Blade Type	Carbon Fiber Composite				
Body	Cast Aluminum				
Shipping Weight (lbs.)	17.0				





Whisper Wind Generators

Whisper Wind generators are easily installed by the owner, require no scheduled maintenance and feature the highest power-to-weight ratio in the industry. Attractive design, sealed ball bearings throughout, protection to winds of 120 mph and high quality materials make the Whisper a reliable source of electricity from the wind for decades. With extra-large propeller diameters, Whisper wind generators are optimized for the low average wind speeds of locations where most people choose to live.

More Features:

- Unique "angle governing" (patented) is fool-proof and generates power in high winds while protecting itself.
- Brushless permanent magnet generator.
- Survival wind speed to 120 mph.
- 2 year warranty (5 year extended warranty optional, call for details).
- Optional high voltage transformer, low voltage transformer available for long cable runs for 1,000 watt units and higher.
- Red signal light on unit indicates charging, visible from ground.
- EZ wire system center standard with all Whisper units. Includes monitoring and diversion controller for both wind and optional PV input.

Product Name and Description	Whisper H40	Whisper H80	Whisper 175
Part Number (12V)	**77090**	**77030**	**n/a**
Part Number (24V)	**77020**	**77040**	**77011**
Part Number (48V)	**77022**	**77042**	**77010**
Price	**$1595.00**	**$1995.00**	**$5455.00**
Price (12V)	**$1895.00**	**$2365.00**	**n/a**
Rated Power (Watts)	900	1000	3200
At Rated Wind Speed	28.0	28.0	28.0
Available System Voltages (Volts)	12, 24, 48	12, 24, 48	12, 24, 48
User Adjustable System Voltage (Volts)	Yes	Yes	Yes
Start Generator Speeds (MPH)	7.5	7.0	7.0
Rotor Diameter (in.)	84.0	120.0	180.0
Mount Tower Diameter (SCH 40) (in.)	2.5	2.5	5.0
Blade Type	Fiberglass, Carbon Fiber		
Number of Blades	3	3	2
Transformer avail. for long wire dist.	No	Yes	Yes
Shipping Weight (lbs.)	85.0	100.0	175.0

Wind Electric Water Pumping System

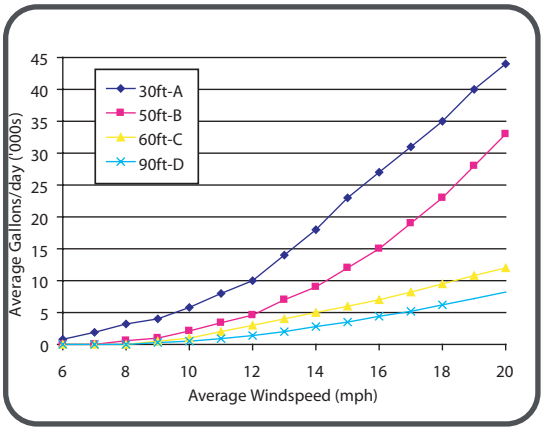
This revolutionary technology combines the wind capture capabilities of a modern high speed wind generator with the reliability of a standard 4 inch submersible pump. This system can pump nearly 3 times as much water as a mechanical windmill with the same rotor diameter. The wind generator can be placed up to 1000 feet away from the well. All models use the Whisper H80 high voltage wind generator with these new features:

- New 10 foot diameter blades in durable polypropylene carbon composite
- New patented, "Angle-Governor System" for constant, maintained peak water flow in the wide range of 22 to more than 50 mph.
- New outdoor rated rainproof electrical controller automatically connects the pump to the wind generator during sufficient wind and is suitable to mount on the tower. A separate "brake" system, or on-off control removes all electrical power from the controller and is lockable.
- New switch controlled cut-in wind speed provides improved matching of pumping system to water depth within each pump range.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
H80 Wind Generator - Including Controller	76089	$1995.00	80.0

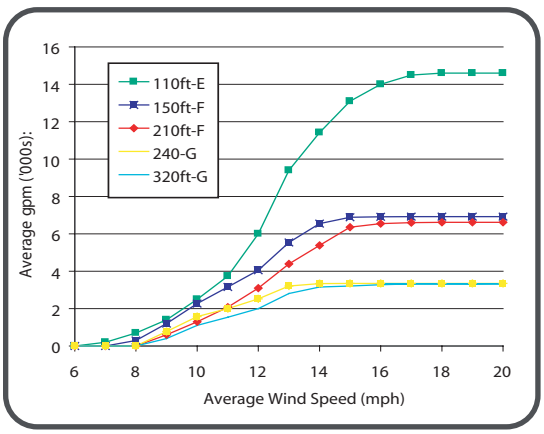
Wind Electric Water Pumps Available

1) For depths of 90ft (30m) or less Total Dynamic Head, use the H80 Water pumper wind turbine with an AY McDonald or Grundfos 3/4 hp Centrifugal water pump. Use the table and chart to select the model for your total head requirement:



Pump Depth \ Wind Speed Avg.	9-12 MPH (4-5.5 M/S)	12+ MPH (5.5+ M/S)	Part Number	Pump Price
0-30ft (10m)	¾ hp 3 phase surface pump AY McDonald = **PUMP A**	¾ hp 3 phase surface pump AY McDonald = **PUMP A**	A: 80303	$862.00
30-60ft (10-20m)	¾ hp 3 phase 12 stage centrifugal = **PUMP C**	¾ hp 3 phase 8 stage centrifugal = **PUMP B**	B: 80304	$682.00
		Pending	C: 80305	$687.00
60-90ft (20-25m)	11SQF series = **PUMP E** (refer below)	¾ hp 3 phase 15 stage centrifugal = **PUMP D**	D: 80306	$745.00

2) For depths of 100ft (35m) or greater Total Dynamic Head, we suggest the H80 Water pumper turbine and the new "SQ Flex" series of pumps which are "helical rotor" positive displacement pumps, more efficient at depth. Use the table and chart to select the model for your total head requirement:



Pump Depth \ Wind Speed Avg.	9-12 MPH (4-5.5 M/S)	12+ MPH (5.5+ M/S)	Part Number	Pump Price
90-120ft (30-40m)	11SQF-2 = **PUMP E**	11SQF-2 = **PUMP E**	E: 80307	$1655.00
120-180ft (40-60m)	6SQF-2 = **PUMP F**	6SQF-2 = **PUMP F**	F: 80308	$1655.00
180-270ft (60-90m)	3SQF-2 = **PUMP G**	6SQF-2 = **PUMP F**	F: 80308	$1655.00
270-350ft (90-115m)	3SQF-2 = **PUMP G**	3-SQF-2 = **PUMP G**	G: 80309	$1655.00

Accessories

Product Name and Description	Part Number	Price
24 Foot (7.8m)	77094	$230.00
27 Foot (8.2m)	76216	$139.00
30 Foot (9.6m)	77095	$385.00
45 Foot (13.7m)	76217	$440.00
50 Foot (16.7m)	77096	$480.00
65 Foot (21.0m)	77097	$620.00
80 Foot (26.2m)	77100	$740.00
AIR 403 stop switch	76020	$18.00

To complete this basic system you will need:

- A tower kit
- Three conductor wire from wind generator to controller
- Subpump three conductor wire from controller to pump
- Splice Kit
- Tower pipe, 2.5 inch Schedule 40 (O.D. 2.875inches or 73mm), available from fence or water pipe supplier.
- Polyurethane or galvanized pipe from pump to tank.
- Safety rope (S/S)for pump raising/lowering.
- Pipe fittings.

ACCESSORIES

Standard Wire

General purpose wiring for power circuits in residential and commercial buildings. XLP Cross linked polyethylene, 600V, 90ºC wet / dry, UL listed. Wire is sold in 50' multiples only. (ex. 50, 100, 150')

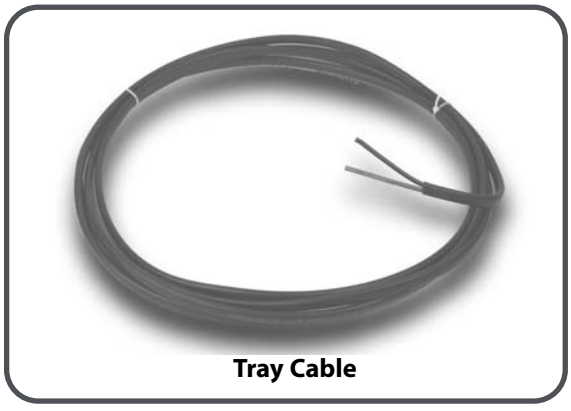
Product Name and Description	Part Number	Price / 50'	Shipping Weight per 50' (lbs.)
#12 AWG Red XLP	43200	$8.00	1.55
#12 AWG Black XLP	43210	$8.00	1.55
#10 AWG Red XLP	43220	$12.00	2.25
#10 AWG Black XLP	43230	$12.00	2.25
#8 AWG Red XLP	43240	$25.00	3.6
#8 AWG Black XLP	43250	$25.00	3.6

Product Name and Description	Part Number	Price / 50'	Shipping Weight per 50' (lbs.)
#6 AWG Red XLP	43260	$30.00	5.35
#6 AWG Black XLP	43270	$30.00	5.35
#4 AWG Red XLP	43280	$50.00	8.05
#4 AWG Black XLP	43290	$50.00	8.05
#2 AWG Red XLP	43300	$80.00	12.2
#2 AWG Black XLP	43310	$80.00	12.2

Tray Cable

Designed for power and control cabling. For direct burial or raceways. Tray cable is UL listed, 90ºC sunlight resistant, UL 1277, 600V type TC, standard bare copper wire - THHN insulated. Overall jacket black PVC. May be used in class 1 DV2 locations. #10 AWG Cables are color coded - two conductors are Red/Black and three conductors are Red/Black/Blue. (Sold in 50' multiples only)

Product Name and Description	Part Number	Price / 50'	Shipping Weight per 50' (lbs.)
#14-2 Tray Cable Flat	43390	$14.50	3.20
#12-2 Tray Cable Flat	43411	$25.00	4.15
#10-2 Tray Cable Flat	43410	$30.00	5.75
#10-3 Tray Cable Round	43415	$38.50	8.35
#8-2 Tray Cable Round	43420	$49.00	11.00
#8-3 Tray Cable Round	43421	$60.00	14.50
#6-2 Tray Cable Round	43440	$72.00	15.50
#6-3 Tray Cable Round	43450	$80.00	19.50



Tray Cable

Power Distribution Blocks

Use these PDBs as an in-line splice, to combine multiple wires into one or to reduce the conductor size. UL recognized and CSA certified to 90°C and 600V. Made of tin plated 6061-T6 aluminum alloy. Suitable for use with either copper or aluminum conductors.

Product Name and Description	Part Number	Number of Poles	Price	Shipping Weight (lbs.)
14-2/0-1	36882	1	$20.00	1.0
14-2/0-2	36883	2	$30.00	1.0
26-350-1	3663215	1	$80.00	2.0
26-350-2	3663220	2	$135.00	2.0
112-350-1	3663225	1	$80.00	3.0
112-350-2	3663230	2	$150.00	3.0

PDB CONNECTOR		
MODEL NO.	PRIMARY	SECONDARY
14-2/0	2/0-14	4-14
26-350	350MCM-6	2/0-14
112-350	350MCM-6	4-14

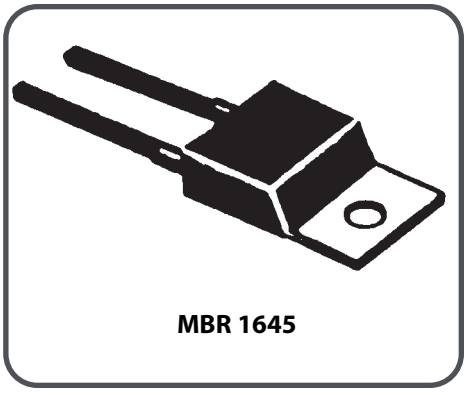
Diodes

Diodes are electrical check valves, which only allow current to flow in one direction with a small voltage drop across them in the forward direction. There are many different types of diodes available based on what material they are made of (which determines its voltage drop in the forward direction, reverse voltage limit and breakdown characteristics) and what its amperage limit is. The terms "blocking" and "bypass" diode simply refer to where and how a diode is wired into a photovoltaic system.

Blocking Diodes

Blocking (or insolation) diodes prevent reverse current flow from the batteries to the solar array at night or from a high voltage series string of solar modules to a low voltage string of solar modules (low voltage could be due to physical damage to one solar module or improper wiring of the solar modules). Since current is always flowing through a blocking diode in the forward direction during the day, it is important to choose a diode that has a low voltage drop such as a Shottky type with a typical 0.5V drop. Despite what some solar module manufacturers say, we do not recommend installing a blocking diode inside the sealed confines of a solar module junction box due to their high operating temperature. Most solid-state charge regulators (Morningstar, Xantrex) have the blocking diodes built into their electronics so an external blocking diode is not required.

Product Name and Description	Part Number	Price
1N5822 - 3A device rated at 1.5A 40V, plastic-axial lead for up to (21W) module	36992	$1.00
MBR1045 - 10A device rated at 5A 45V, flat pack for up to a (80W) module	36994	$2.00
MBR1645 - 16A device rated at 8A 45V, flat pack for up to a (120W) module	36995	$3.00



MBR 1645

Bypass Diodes

Bypass diodes wired inside the junction box of a solar module simply allow current in a series string of solar modules to bypass a failed or shaded module or string of solar cells within a solar module. Factory installed bypass diodes are usually adequate to protect the solar modules . Since current is only flowing through a bypass diode under partial shade conditions, the above mentioned temperature concern for blocking diodes does not apply.

Product Name and Description	Part Number	Price
MR754 - General purpose 400V, 4.0A axial lead	36984	$1.00
Replacement Bypass Diode for KC 40 - 120-1 modules	1414100	$1.00

MR754

Lightning Protection

Direct or nearby lightning strikes can wreak havoc on a photovoltaic system by subjecting the system components and wiring to an extremely fast rise in voltage and inrush of current. While no lightning protection system is foolproof (especially in the case of a direct strike), properly grounding your system and installing transient suppression devices, such as silicon oxide varistors (SOVs) on the incoming AC and DC wiring will certainly help. SOVs are typically wired between three conductors (DC: positive, negative and ground, AC: hot, neutral and ground) and will shunt excess voltage to ground.

Product Name and Description	Part Number	Price
LA302 - DC (300V)	36978	$33.00
LA602 - DC (600V)	36999	$33.00
LA302R - AC (120V)	36975	$33.00
LA303R - AC (240V)	36983	$38.00
Mounting Bracket	36976	$3.00

Lightning Arrestor and Mounting Bracket

Cord Connectors

Cable entry strain relief fitting's Metric size fits Kyocera J-box. Dimensions indicate wire range.

Product Name and Description	Part Number	Price
SL-13 - PG 13 metric - (for Kyocera) Fits #10-2 Round	43231	$1.53
O-Ring Seal for SL-13	09672	$0.09
SLN-12 - 1/2" NPT (w/o Locknut) Fits #10-2 Round, TC Cable	43233	$1.51
SLRN-12 - 1/2" NPT (w/o Locknut) Fits #10, 8, 6 AWG Single XLP Wire	43234	$1.69

SL-13

SLN-12

Locknuts - Sealing

Zinc plated steel with silicone bead. Sold individually.

Product Name and Description	Part Number	Price
1/2" NPT	36511	$1.27
3/4" NPT	36513	$1.89
1" NPT	36515	$2.20
1 1/4" NPT	36517	$3.57
1 1/2" NPT	36518	$4.53
2" NPT	36516	$5.76

Locknuts

LIGHTING

PV System Charge / Light Controller

SunLight™ Solar Lighting Controllers

MORNINGSTAR corporation

This controller performs both battery charging and light controlling functions by utilizing your solar array as a photocell. It turns your DC light on at dusk when the solar array voltage drops and will operate the light for a user selectable time period from 2 hours to dusk-to-dawn. Built-in temperature compensation, low voltage disconnect and manual test button greatly simplify system operation. Sunrise overrides lighting timer and the controller turns the light off. Five year warranty.

Product Name and Description	Part Number	Voltage	Amperage	Price	Shipping Weight (lbs.)
SL10	34945	12	10	$108.00	.69
SL10-24	34946	24	10	$116.00	.69
SL20	34947	12	20	$141.00	.69
SL20-24	34948	24	20	$148.00	.69

SunLight 10

Xantrex Lighting Controller

xantrex

Sophisticated, compact, 12A, 12V controller/timer. Standard features include: low voltage disconnect and reconnect, (with reset button) adjustable run time dial 3-stage charging, battery monitor, status indicator for over-temperature, overload and low voltage disconnect. ETL approved. Two year warranty.

Product Name and Description	Part Number	Voltage	Amperage	Price
C12	33722	12	12	$110.00

Xantrex C12

STECA Lighting Controller

steca

STECA Lighting Controllers combine 24-hour timed control capability with light-level sensing. Nightlight function including an integrated clock sets itself automatically based on the levels of brightness detected during a 24 hour day. Pulse-width modulated IV-charging, time control equalization charging, temperature compensation and deep discharge protection provide the best protection and optimal lifetime conditions for the battery.

Product Name and Description	Part Number	Voltage	Amperage	Price
SLX 0606 Night	62641	12/24	6	$64.00
SLX 1010 Night	62642	12/24	10	$78.00

SLX 0606 Night

Motion Sensor - Switch

Passive infrared sensor which "sees" small temperature changes caused by the motion of people and cars and turns on light. 12V, 10A, adjustable from 5 seconds to 20 minutes. 0.05 watt @ 12V power consumption, 50 foot by 110° detection pattern.

Product Name and Description	Part Number	Voltage	Amperage	Price
Motion Sensor - 12 V	34600	12	10	$60.00

Motion Sensor

Lighting Fixtures

THIN-LITE® DC Fluorescent Fixtures

Offered in a wide variety of sizes. DC with advanced ballast design. The most popular DC lighting fixtures with thousands in service. All include on/off switch and lamps. UL listed.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
111 - F8T5 Lamp (12V)	65110	$34.00	2.08
115 - F15T8 Lamp (12V)	65150	$35.00	3.08
116 - F15T8 Lamp x 2 (12V)	65160	$45.00	4.2
162 - F8T5 Lamp x 2 (12V)	65620	$57.00	2.0
191 - F8T5 Lamp (12V)	65910	$32.00	1.75
193 - F15T8 Lamp (12V)	65930	$34.00	2.4
195 - F24T8 Lamp (12V)	65950	$44.00	3.2
197 - F30T8 Lamp (12V)	65970	$48.00	4.08
215 - F15T8 Lamp (24V)	66150	$45.00	3.08
216 - F15T8 Lamp x 2 (24v)	66160	$54.00	4.2

THL-111

THL-116

THIN-LITE® 12 Volt DC Compact Fluorescent Fixtures

The 900 Series compact fluorescent DC fixture features advanced RFI suppressant inverter ballasts, aluminum housings and acrylic clear diffuser lenses. The four pin, straight across, fluorescent tubes offer excellent light efficiency and quality. Available in 9W to 36W configurations. Does not include switch. All 12VDC operation.

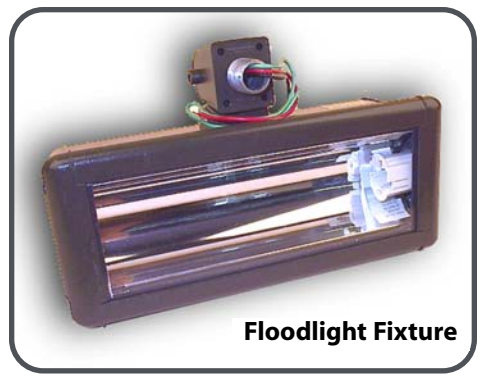
Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
945 - 9W, PL Lamp	66014	$51.00	0.92
949 - 13W, Delux SE Lamp	66018	$51.00	0.92
951 - 18W, PL-L Lamp	66020	$55.00	1.34
957 - 36W, PL-L Lamp	66024	$65.00	1.7

THL-900 Series

Outdoor DC Floodlight Fixtures

12VDC, solid state ballast with parabolic reflector and Lexan lens. Architectural bronze finish. Suitable for use in wet locations. UL listed, attaches to pole. 1/2" NPT mount. Lamp not included.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
1213 - 13 W includes PL-S 13 Lamp	64180	$98.00	3.0
1226 - 26W for PL-S 13 Lamp x 2	63440	$172.00	4.0
PL-S 13, Compact fluorescent replacement lamp	60270	$6.0	-



Floodlight Fixture

Outdoor Wall / Ceiling Fixtures

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
VR-13 - 13 W, PL-S 13 Lamp	61955	$97.00	3.0

Vandal resistant, 12VDC, virtually indestructible, molded clear polycarbonate prismatic lens, flush mount housing features solid-state electronic DC ballast. Includes: compact fluorescent PL lamp, tamperproof one-way screws, specular aluminum reflector, bug and dirt proof, UL listed wet locations.

DC CFL's

These high efficiency, energy saving lights are designed to retrofit into standard medium screw base fixtures wired for DC operation. The 7 and 11watt models are 12 VDC only, one piece lamp and base. The life of the lights are considerably higher than regular light bulbs.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
ESL-712 - 7W, 12V	62604	$14.00	1.0
ESL-1112 - 11W, 12V	62606	$14.00	1.0

CFL's

APPLIANCES AND LOADS

Fans

Solar Fan Kit

16" kit will move 1215 cubic feet per minute at peak sun using the included 21 watt module and will run proportional to the sun intensity, making it ideal for cooling a space or venting a greenhouse. 12" kit uses a smaller fan and a 10 watt module to move 970 cfm at peak sun. Using unbreakable modules allows for quick and simple installation.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Solar Fan Kit - 16"	97722	$315.00	24.0
Solar Fan Kit - 12"	97723	$242.00	22.0

Solar Fan Kit

DC Vent Fan

DC fans operate daily in direct sunlight from a single nominal 12 VDC solar module, without controls or batteries. Includes permanent magnet-ball bearing enclosed motor, three wing aluminum fan blade, shroud bracket. Fully assembled. One year warranty.

Product Name and Description	Part Number	CFM at 18 Volts	Input Amps	Price	Shipping Weight (lbs.)
RS-800 - 13"	97724	600	1.4	$155.00	5.0
RS-1250 - 17"	97725	800	1.6	$175.00	6.0

RS-1250

Sunvent Fan

The Sunvent Fan is designed to keep water and back drafts out. It may even be used on the deck of a boat. Sunvent extracts 680 cubic feet of air per hour in full sun conditions. Unit requires a 4.75 inch diameter hole for mounting and can accommodate up to 1.5 inch wall thickness (vent pipe can extend). 8.5 inch diameter overall, 2 inch outside protrusion. 1.5 inch inside protrusion. The unit is made of high impact polypropylene and is easy to mount. Great for RVs, hot tub rooms, lofts, stables, boats, farm building, port-a-potties or outside toilets.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Sunvent Fan	84640	$66.00	2.0

Sunvent Fan

Specialty Tools

Crimping Tool

This tool is used to crimp solderless terminals to large #2 through #4/0 cable. A handy tool to have when making your own cables.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Crimping Tool	44210	$35.00	7.0

Crimping Tool

Solar Pathfinder

"Simply the best tool for solar site analysis"

The Solar Pathfinder is extremely simple to use and at a glance will show you if any obstructions (such as trees, buildings, power lines, hills, etc.) will cast a shadow across your proposed solar array site at any time of the day or year. The Solar Pathfinder uses a latitude specific sun path diagram mounted under a clear plastic dome that when viewed from directly above will give you a quick and accurate "solar blueprint" of your site for the entire year. The Solar Pathfinder is available in either a handheld or tripod based unit and both come with an instruction manual, region specific solar radiation data and 20 sun path diagrams. Please specify city/state and your latitude when ordering Solar Pathfinder.

Product Name and Description	Part Number	Price
Solar Pathfinder with tripod and case	99051	$455.00
Handheld Solar Pathfinder	99052	$285.00

Solar Pathfinder

KYOCERA Solar, Inc.

Reference Cell

The solar energy illuminating a module or array is influenced by several factors. Angle of incidence, atmospheric dust and moisture, cloud cover, nearby reflective surfaces all contribute to the true solar energy incident on the solar array. Since solar modules and arrays are seldom irradiated by the standard 1000 W/m^2 by which they are rated, a reference cell is required to calculate the correction. The Kyocera Reference Cell can be used for the evaluation of solar module and array performance under off angle illumination and hazy sky conditions.

The Kyocera Solar Reference Cell is made of a multi-crystal silicon solar cell housed in a rugged metal case and connects to standard hand held meters via banana jacks. The reference cell is calibrated to produce a specified mV reading at 1000 watts per square meter (1000W/m^2) or defined as (1) sun illumination.

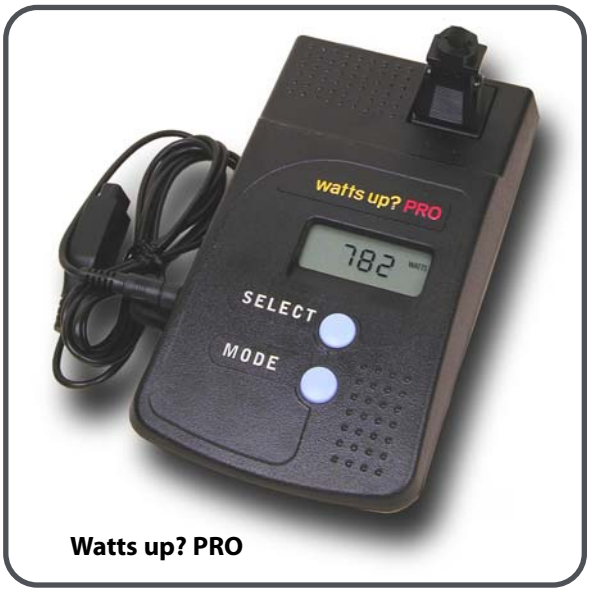
Product Name and Description	Part Number	Price
Kyocera Solar Reference Cell	10110	$229.00

Kyocera Solar Reference Cell

Watts up?

WATTS UP? incorporates sophisticated digital electronics that enable precise and accurate measurements in an easy-to-use format. State-of-the-art digital microprocessor design utilizes high-frequency sampling of both voltage and current measurements for true power. Power factor is captured so even phase-shifted loads are accurately measured. Fast, intuitive and easy-to-use, Watts up? quickly and accurately measures any 120 VAC appliances.

The Watts up? PRO model stores data into memory and can download the data to a computer. The data is stored every second until 1000 records are stored. At that point, the sample rate doubles and the data is stored every 2 seconds. When 1000 records are stored, the sample rate again doubles to 4 seconds. The sample rate continues to double as needed so Watts up? PRO can record indefinitely. If Watts up? PRO is unplugged, or if power is lost, the data in memory is maintained and data will continue to be recorded once power is restored. The Payback Calculator determines the time required for a new energy efficient appliance to pay for itself.



Watts up? PRO

More Features

- Displays cost of electricity in dollars and cents
- Save money by lowering your electric bill
- Tracks true RMS power over time
- Sixteen values displayed, updated in real time
- Peak readings capture surges
- Unique design is exceptionally easy to use
- Duty cycle identifies how often devices operate
- Elapsed time displayed in hours and days
- Monthly averages for cost and kWh
- Cumulative power and power factor
- Two-tier pricing incorporates volume pricing
- Home automation magazine top 50 Editors Pick
- PC software included

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Watts up? PRO	71001	$149.00	1.5

Solar Lantern / Emergency Lights

These solar lanterns are the best value and most useful that we have found. They operate from 12 volts DC, 120 volts AC and the built-in solar module. Both double as emergency lights. By plugging them into an AC outlet and turning the light on, they will remain charged and when the AC fails automatically turn the 9 watt compact fluorescent light on. The solar module is built-in, so there are no cords to plug-in or separate modules to lose or break.

Product Name and Description	Part Number	Price
SL 9100MRC w/ a passive infrared sensor that detects motion and serves as the receiver for the keychain remote control.	40000	$85.00
SL 9100W w/ an AM/FM weather radio	40001	$85.00

Sales Aids / Educational Material

10th Edition Solar Electric Products Catalog

Listing of over 500 solar electric products and systems. Includes descriptions, sizes, weights, illustrations, prices and solar basics.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Solar Electric Products Catalog	10017	$6.00	1.0

Solar Electric Water Pumping Guide

Includes information and product selection for shallow and deep well solar electric pumping systems.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Solar Electric Water Pumping Applications Guide	10012	$3.00	1.0

Power with Nature

This book will walk the solar neophyte through the entire solar world. A great book to sell to customers who want an easy to read primer on solar systems.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Power with Nature	00607	$24.95	1.0

Secrets of Lead Acid Batteries

44 page booklet for anyone living with, selling or installing lead-acid batteries. Thomas J. Lindsay describes chemical reaction, construction, ratings, factors which determine capacity, charging, equalizing and testing.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Secrets of Lead Acid Batteries	00592	$7.50	1.0

Battery Book for Your Home

Written by Jeffery Fowler, this book starts with chemical reaction of the lead acid battery and covers installation, wiring, maintenance and equalization. Highly recommended.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Battery Book for Your Home	00593	$8.00	1.0

Practical Photovoltaics 3rd Edition

Written by Richard J. Komp Ph.D. for those that really want to understand how photovoltaics work.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Practical Photovoltaics	00621	$17.95	1.0

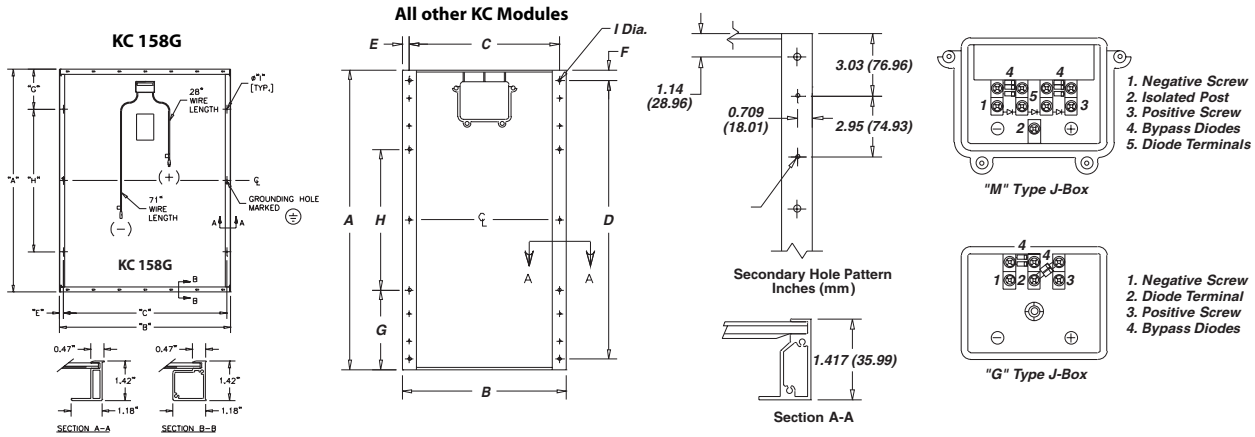
APPENDIX A

Kyocera Solar Module Mounting Hole Location

KYOCERA Solar, Inc.

Model	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Dim. F	Dim. G	Dim. H	J-Box/ Connection
KC 158G	50.80 / 1290.0	39.00 / 990.0	37.24 / 945.9	-	0.87 / 22.1	-	9.15 / 232.4	32.48 / 825.0	MC
KC 120-1	56.10 / 1424.0	25.67 / 651.0	23.97 / 608.0	53.82 / 1366.0	0.87 / 22.1	1.14 / 28.9	9.48 / 240.0	37.12 / 942.0	M
KC 80	38.42 / 975.0	25.67 / 651.0	24.13 / 613.0	36.14 / 968.0	0.77 / 19.5	1.14 / 28.9	9.48 / 240.0	19.46 / 494.0	M
KC 70	34.06 / 865.1	25.67 / 651.0	24.13 / 613.0	31.77 / 806.9	0.77 / 19.5	1.14 / 28.9	9.48 / 240.0	15.08 / 383.0	M
KC 60	29.56 / 750.0	25.67 / 651.0	24.13 / 613.0	27.28 / 692.0	0.77 / 19.5	1.14 / 28.9	9.48 / 240.0	10.6 / 270.0	G
KC 50	25.16 / 640.1	25.67 / 651.0	24.13 / 613.0	22.87 / 581.7	0.77 / 19.5	1.14 / 28.9	N/A	N/A	G
KC 45	22.52 / 572.0	25.67 / 651.0	24.13 / 613.0	20.28 / 515.1	0.77 / 19.5	1.14 / 28.9	N/A	N/A	G
KC 40	20.67 / 525.0	25.67 / 651.0	24.13 / 613.0	18.39 / 467.0	0.77 / 19.5	1.14 / 28.9	N/A	N/A	G
KC 35	18.54 / 471.0	25.67 / 651.0	24.13 / 613.0	16.26 / 413.0	0.77 / 19.5	1.14 / 28.9	N/A	N/A	G

Dimensions shown in inches / millimeters



Kyocera Solar Modules Standard Packaging Details

Model	KC 167G/ 158G	KC 125G/ 120-1	KC 80	KC 70	KC 60	KC 50	KC 45	KC 40	KC 35
Module Quantity Per Carton	2	2	2	2	2	2	2	2	4
Carton Size (in.) (L x W x D)	55 x 44 x 4	60 x 28 x 3.5	43 x 28 x 3.5	36 x 29 x 4	34 x 28 x 3.5	28 x 30 x 4	27 x 28 x 4	25 x 28 x 4	21 x 29 x 7
Carton Size (cm) (L x W x D)	1380 x 1100 x 90	153 x 71 x 9	109 x 71 x 9	91.7 x 73.0 x 9	86 x 71 x 9	71 x 76 x 9	69 x 71 x 9	64 x 71 x 9	51 x 73 x 18
Carton Gross Weight (lbs./kg)	80.0 / 36.3	69.0 / 31.2	45.0 / 20.4	38 / 17.2	32.0 / 14.5	25.0 / 11.3	22.0 / 9.9	23.0 / 10.5	40.0 / 18.2
Number of Cartons per Pallet	10	10	20	20	20	20	20	40	20
Number of Modules per Pallet	20	20	40	40	40	40	40	80	80
Maximum Pallet Dimensions (in.) (L X W x D)	56 x 44 x 40	60 x 28 x 39	59 x 43 x 39	36x 57 x 41	55 x 43 x 39	28 x 58 x 40	28 x 50 x 40	28 x 50 x 40	42 x 59 x 39
Maximum Pallet Area (ft^3/m^3)	57.0 / 1.62	38.0 / 1.1	57.0 / 1.62	48.7 / 1.38	53.0 / 1.5	33.6 / 1.0	33.6 / 1.0	33.6 / 1.0	55.9 / 1.6
Gross Weight of Max. Pallet (lbs. kg)	844 / 385	690 / 312	900 / 408	772 / 350.2	662 / 301	560 / 254	499 / 226	960 / 435.4	840 / 381
Number of Modules per 20' Container	320	440	560	640	560	960	960	1040	640
Number of Modules per 40' Container	640	960	1280	1280	1280	2000	2000	2160	1440

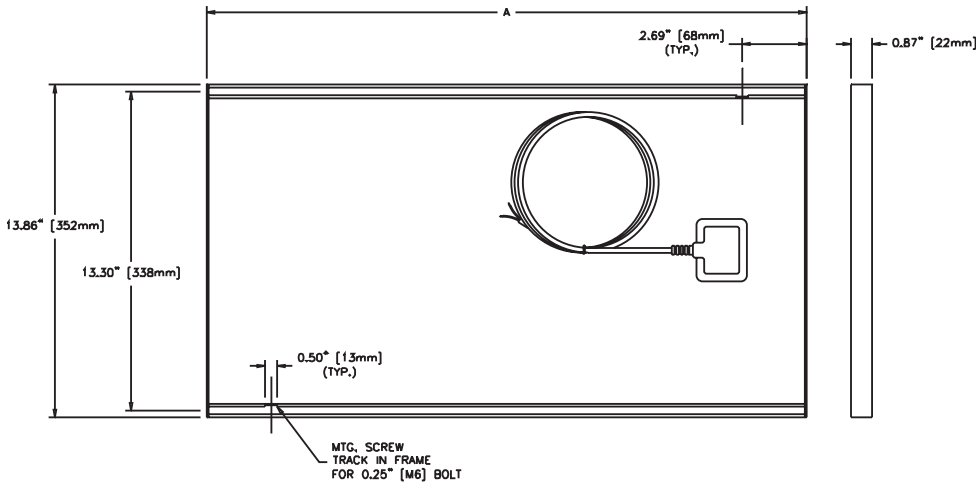
1 All Kyocera KC series solar modules are supplied with bypass diodes installed inside of the junction box. Bypass diodes are installed across eighteen series cells, accomplished by the diode terminal in the J-Box. This diode terminal is not usable for interconnection wiring between modules. KC80 and KC120-1 modules include an isolated post inside the J-Box for parallel splicing wiring from adjacent modules.

2 'M' style junction box standard with KC80 and KC120-1 solar modules. 'G' style junction box standard with KC35, KC40, and KC60 modules. Multi-contact connectors used on KC 158G. All Kyocera solar modules have one opening in the junction box for wiring purposes. In some cases, wiring multiple solar modules together may result in one module with a remaining opening in the J-Box. A sealing hole plug may be required.

Solartec KS Module Mounting Hole Location

Model	Dim. A
KS 20	25.00 / 635.0
KS 16	20.47 / 520.0
KS 12	16.26 / 413.0
KS 10	16.26 / 413.0
KS 5	16.26 / 413.0

Dimensions shown in inches / millimeters



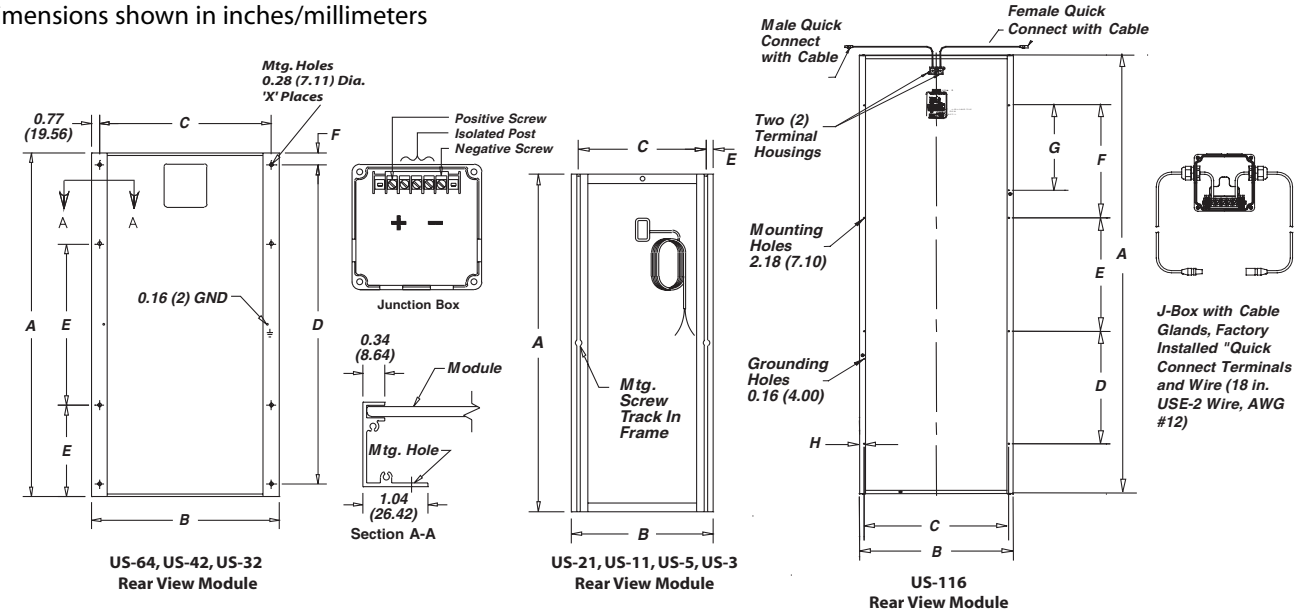
Solartec KS Modules Standard Packaging Details

Model	KS 20	KS 10	KS 5
Module Quantity Per Carton	1	1	1
Carton Size (in.) (L x W x D)	26 x 15 x 1.6	15 x 13 x 1.6	15 x 9 x 1.6
Carton Size (cm) (L x W x D)	65 x 36.5 x 4	36.5 x 32 x 4	36.5 x 22 x 4
Carton Gross Weight (lbs./kg)	6.95 / 3.15	4.30 / 1.95	2.87 / 1.30
Number of Cartons per Pallet	90	150	240
Number of Modules per Pallet	90	150	240
Maximum Pallet Dimensions (in.) (L X W x D)	43.3 x 43.3 x 33.5	39.4 x 39.4 x 35.4	43.3 x 43.3 x 35.4
Maximum Pallet Area (ft^3/m^3)	36.33 / 1.03	31.78 / 0.90	38.46 / 1.09
Gross Weight of Max. Pallet (lbs./ kg)	575	679.0 / 308.0	721.0 / 327.0
Number of Modules per 20' Container	1800	3000	4800
Number of Modules per 40' Container	2000	6000	9600

UNI-SOLAR Module Mounting Hole Location

Model	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Dim. F	Dim. G	Dim. H	'X' Places
US-116	96.03 / 2432.25	30.16 / 766.18	27.64 / 702.0	24.61 / 625.08	24.81 / 630.29	24.61 / 625.08	18.47 / 472.06	1.18 / 30.00	8
US-64	53.78 / 1366.0	29.18 / 741.0	27.64 / 702.0	N/A	0.77 / 19.5	N/A	11.08 / 281.0	31.62 / 803.0	4
US-42	36.54 / 928.0	29.18 / 741.0	27.64 / 702.0	35.05 / 890.0	0.77 / 19.5	0.75 / 19.1	9.51 / 242.0	17.52 / 445.0	8
US-32	53.78 / 1366.0	15.07 / 383.0	13.52 / 344.0	52.28 / 1328.0	0.77 / 19.5	0.75 / 19.1	11.08 / 281.0	31.62 / 803.0	8
US-21	36.54 / 928.0	15.07 / 383.0	13.52 / 344.0	35.05 / 890.0	0.77 / 19.5	0.75 / 19.1	9.51 / 242.0	17.52 / 445.0	8
US-11	19.33 / 491.0	15.07 / 383.0	13.52 / 344.0	N/A	0.31 / 7.9	N/A	N/A	N/A	N/A
US-5	19.33 / 491.0	8.07 / 205.0	7.45 / 189.0	N/A	0.31 / 7.9	N/A	N/A	N/A	N/A
US-3	11.26 / 286.0	8.07 / 205.0	7.45 / 189.0	N/A	0.31 / 7.9	N/A	N/A	N/A	N/A

Dimensions shown in inches/millimeters



UNI-SOLAR Modules - Master Carton Packaging Details

Model	US-116	US-64	US-42	US-32	US-21	US-11	US-5	US-3
Module Quantity Per Carton	1	1	4	5	5	10	10	20
Carton Size (in.) (L x W x D)	98 x 32 x 2.7	56 x 31 x 2.7	39 x 31 x 12	57 x 17 x 15	39 x 16 x 8	20 x 16 x 10	20 x 9 x 10	18 x 12 x 11
Carton Size (cm) (L x W x D)	244 x 76 x	142 x 79 x 7	100 x 80 x 31	145 x 44 x 39	98 x 41 x 21	51 x 40 x 27	51 x 23 x 26	45 x 31 x 28
Carton Gross Weight (lbs./kg)	44.0 / 19.9	26.0 / 11.8	76.0 / 34.5	73.0 / 33.2	41.0 / 18.6	40.0 / 18.2	29.0 /13.2	40.0 / 18.2
Number of Cartons per Pallet	30	30	8	6	18	20	40	N/A
Number of Modules per Pallet	30	30	32	30	90	200	400	N/A
Maximum Pallet Dimensions (L X W x D)	98 x 81 x 32	86 x 31 x 56	49 x 39 x 67	57 x 32 x 56	52 x 49 x 39	59 x 32 x 40	59 x 36 x 40	N/A
Maximum Pallet Area (ft^3/m^3)	147 / 4.16	86.0 / 2.5	74.3 / 2.1	59.0 / 1.7	58.0 / 1.6	44.0 /1.2	49.0 / 1.4	N/A
Gross Weight of Max. Pallet (lbs. kg)	1676.5 / 760.0	810.0 / 368.0	684.0 / 311.0	413.0 / 188.0	1040.0 / 473.0	930.0 / 423.0	1176.0 / 535.0	N/A
Number of Modules per 20' Container	140	390	416	390	1170	2600	5200	N/A
Number of Modules per 40' Container	280	750	800	750	2250	5000	10000	N/A

1 *UNI-SOLAR* series US-32, US-42 and US-64 solar modules include a weather proof-junction box with four removable knockouts. Knockouts are sized for 1/2 inch NPT size conduit fittings (.875 diameter hole). The barrier terminal strip inside the J-Box has five, stainless steel # 8-32 binding clamp screws. Barrier width accepts a 3/8 inch terminal. Module output wiring connections are on terminal 1 and 5. Terminals 2, 3 & 4 are non-conductive spares and can be used for bypass or blocking diode applications.

2 All *UNI-SOLAR* US series solar modules are supplied with a bypass diode laminated inside across each solar cell. For installing a module bypass or blocking diode, please refer to the manufacturers instructions supplied with the product.

APPENDIX B

Wire Sizing Tables

Use these tables to determine the appropriate wire size for charging circuits in your PV power system. These tables will show you the maximum one way wire distance the conductor will pass current at the rated voltage drop. Resistance in wiring has been calculated for the round trip based on one way distance. Cross-reference by wire gauge and current (amps) to find length. For example, on the 48V table, 30A with #6 wire will run a maximum distance of 81.5 feet. This is based on 5% voltage drop and maximum temperature of 75°C. R=Resistance in Ohms per 1000 feet of wire.

System Voltage: 48V **Voltage Drop: 5.00%** **Temperature (°C): 75**

R	3.14	1.98	1.24	0.778	0.491	0.308	0.245	0.194	0.154	0.122	0.0967	0.0766	0.0608	0.0515
	Wire Gauge													
Amps	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#3**	**#2**	**#1**	**#1/0**	**#2/0**	**#3/0**	**#4/0**	**250MCM**
1.00	382.17	606.06	967.74	1542.42	2443.99	3896.10	4897.96	6185.57	7792.21	9836.07	12409.51	15665.80	19736.84	23300.97
2.00	191.08	303.03	483.87	771.21	1222.00	1948.05	2448.98	3092.78	3896.10	4918.03	6204.76	7832.90	9868.42	11650.49
4.00	95.54	151.52	241.94	385.60	611.00	974.03	1224.49	1546.39	1948.05	2459.02	3102.38	3916.45	4934.21	5825.24
6.00	63.69	101.01	161.29	257.07	407.33	649.35	816.33	1030.93	1298.70	1639.34	2068.25	2610.97	3289.47	3883.50
8.00	47.77	75.76	120.97	192.80	305.50	487.01	612.24	773.20	974.03	1229.51	1551.19	1958.22	2467.11	2912.62
10.00	38.22	60.61	96.77	154.24	244.40	389.61	489.80	618.56	779.22	983.61	1240.95	1566.58	1973.68	2330.10
12.00	31.85	50.51	80.65	128.53	203.67	324.68	408.16	515.46	649.35	819.67	1034.13	1305.48	1644.74	1941.75
14.00	27.30	43.29	69.12	110.17	174.57	278.29	349.85	441.83	556.59	702.58	886.39	1118.99	1409.77	1664.36
16.00	23.89	37.88	60.48	96.40	152.75	243.51	306.12	386.60	487.01	614.75	775.59	979.11	1233.55	1456.31
18.00	21.23	33.67	53.76	85.69	135.78	216.45	272.11	343.64	432.90	546.45	689.42	870.32	1096.49	1294.50
20.00	19.11	30.30	48.39	77.12	122.20	194.81	244.90	309.28	389.61	491.80	620.48	783.29	986.84	1165.0
25.00	15.29	24.24	38.71	61.70	97.76	155.84	195.92	247.42	311.69	393.44	496.38	626.63	789.47	932.04
30.00	12.74	20.20	32.26	51.41	81.47	129.87	163.27	206.19	259.74	327.87	413.65	522.19	657.89	776.70
35.00	10.92	17.32	27.65	44.07	69.83	111.32	139.94	176.73	222.63	281.03	354.56	447.59	563.91	665.74
40.00	9.55	15.15	24.19	38.56	61.10	97.40	122.45	154.64	194.81	245.90	310.24	391.64	493.42	582.52
45.00	8.49	13.47	21.51	34.28	54.31	86.58	108.84	137.46	173.16	218.58	275.77	348.13	438.60	517.80
50.00	7.64	12.12	19.35	30.85	48.88	77.92	97.96	123.71	155.84	196.72	248.19	313.32	394.74	466.02
55.00	6.95	11.02	17.60	28.04	44.44	70.84	89.05	112.46	141.68	178.84	225.63	284.83	358.85	423.65
60.00	6.37	10.10	16.13	25.71	40.73	64.94	81.63	103.09	129.87	163.93	206.83	261.10	328.95	388.35
65.00	5.88	9.32	14.89	23.73	37.60	59.94	75.35	95.16	119.88	151.32	190.92	241.01	303.64	358.48
70.00	5.46	8.66	13.82	22.03	34.91	55.66	69.97	88.37	111.32	140.52	177.28	223.80	281.95	332.87
75.00	5.10	8.08	12.90	20.57	32.59	51.95	65.31	82.47	103.90	131.15	165.46	208.88	263.16	310.68
80.00	4.78	7.58	12.10	19.28	30.55	48.70	61.22	77.32	97.40	122.95	155.12	195.82	246.71	291.26
85.00	4.50	7.13	11.39	18.15	28.75	45.84	57.62	72.77	91.67	115.72	145.99	184.30	232.20	274.13
90.00	4.25	6.73	10.75	17.14	27.16	43.29	54.42	68.73	86.58	109.29	137.88	174.06	219.30	258.90
95.00	4.02	6.38	10.19	16.24	25.73	41.01	51.56	65.11	82.02	103.54	130.63	164.90	207.76	245.27
100.00	3.82	6.06	9.68	15.42	24.44	38.96	48.98	61.86	77.92	98.36	124.10	156.66	197.37	233.01
125.00	3.06	4.85	7.74	12.34	19.55	31.17	39.18	49.48	62.34	78.69	99.28	125.33	157.89	186.41
150.00	2.55	4.04	6.45	10.28	16.29	25.97	32.65	41.24	51.95	65.57	82.73	104.44	131.58	155.34
175.00	2.18	3.46	5.53	8.81	13.97	22.26	27.99	35.35	44.53	56.21	70.91	89.52	112.78	133.15
200.00	1.91	3.03	4.84	7.71	12.22	19.48	24.49	30.93	38.96	49.18	62.05	78.33	98.68	116.50
225.00	1.70	2.69	4.30	6.86	10.86	17.32	21.77	27.49	34.63	43.72	55.15	69.63	87.72	103.56
250.00	1.53	2.42	3.87	6.17	9.78	15.58	19.59	24.74	31.17	39.34	49.64	62.66	78.95	93.20
275.00	1.39	2.20	3.52	5.61	8.89	14.17	17.81	22.49	28.34	35.77	45.13	56.97	71.77	84.73
300.00	1.27	2.02	3.23	5.14	8.15	12.99	16.33	20.62	25.97	32.79	41.37	52.22	65.79	77.67
400.00	0.96	1.52	2.42	3.86	6.11	9.74	12.24	15.46	19.48	24.59	31.02	39.16	49.34	58.25

Wire Sizing Tables

Use these tables to determine the appropriate wire size for charging circuits in your PV power system. These tables will show you the maximum one way wire distance the conductor will pass current at the rated voltage drop. Resistance in wiring has been calculated for the round trip based on one way distance. Cross-reference by wire gauge and current (amps) to find length. For example, on the 24V table, 30A with #6 wire will run a maximum distance of 32.5 feet. This is based on 4% voltage drop and maximum temperature of 75°C. R=Resistance in Ohms per 1000 feet of wire.

System Voltage: 24V **Voltage Drop: 4.00%** **Temperature (°C): 75**

R	3.14	1.98	1.24	0.778	0.491	0.308	0.245	0.194	0.154	0.122	0.0967	0.0766	0.0608	0.0515
	Wire Gauge													
Amps	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#3**	**#2**	**#1**	**#1/0**	**#2/0**	**#3/0**	**#4/0**	**250MCM**
1.00	152.87	242.42	387.10	616.97	977.60	1558.44	1959.18	2474.23	3116.88	3934.43	4963.81	6266.32	7894.74	9320.39
2.00	76.43	121.21	193.55	308.48	488.80	779.22	979.59	1237.11	1558.44	1967.21	2481.90	3133.16	3947.37	4660.19
4.00	38.22	60.61	96.77	154.24	244.40	389.61	489.80	618.56	779.22	983.61	1240.95	1566.58	1973.68	2330.10
6.00	25.48	40.40	64.52	102.83	162.93	259.74	326.53	412.37	519.48	655.74	827.30	1044.39	1315.79	1553.40
8.00	19.11	30.30	48.39	77.12	122.20	194.81	244.90	309.28	389.61	491.80	620.48	783.29	986.84	1165.05
10.00	15.29	24.24	38.71	61.70	97.76	155.84	195.92	247.42	311.69	393.44	496.38	626.63	789.47	932.04
12.00	12.74	20.20	32.26	51.41	81.47	129.87	163.27	206.19	259.74	327.87	413.65	522.19	657.89	776.70
14.00	10.92	17.32	27.65	44.07	69.83	111.32	139.94	176.73	222.63	281.03	354.56	447.59	563.91	665.74
16.00	9.55	15.15	24.19	38.56	61.10	97.40	122.45	154.64	194.81	245.90	310.24	391.64	493.42	582.52
18.00	8.49	13.47	21.51	34.28	54.31	86.58	108.84	137.46	173.16	218.58	275.77	348.13	438.60	517.80
20.00	7.64	12.12	19.35	30.85	48.88	77.92	97.96	123.71	155.84	196.72	248.19	313.32	394.74	466.02
25.00	6.11	9.70	15.48	24.68	39.10	62.34	78.37	98.97	124.68	157.38	198.55	250.65	315.79	372.82
30.00	5.10	8.08	12.90	20.57	32.59	51.95	65.31	82.47	103.90	131.15	165.46	208.88	263.16	310.68
35.00	4.37	6.93	11.06	17.63	27.93	44.53	55.98	70.69	89.05	112.41	141.82	179.04	225.56	266.30
40.00	3.82	6.06	9.68	15.42	24.44	38.96	48.98	61.86	77.92	98.36	124.10	156.66	197.37	233.01
45.00	3.40	5.39	8.60	13.71	21.72	34.63	43.54	54.98	69.26	87.43	110.31	139.25	175.44	207.12
50.00	3.06	4.85	7.74	12.34	19.55	31.17	39.18	49.48	62.34	78.69	99.28	125.33	157.89	186.41
55.00	2.78	4.41	7.04	11.22	17.77	28.34	35.62	44.99	56.67	71.54	90.25	113.93	143.54	169.46
60.00	2.55	4.04	6.45	10.28	16.29	25.97	32.65	41.24	51.95	65.57	82.73	104.44	131.58	155.34
65.00	2.35	3.73	5.96	9.49	15.04	23.98	30.14	38.07	47.95	60.53	76.37	96.40	121.46	143.39
70.00	2.18	3.46	5.53	8.81	13.97	22.26	27.99	35.35	44.53	56.21	70.91	89.52	112.78	133.15
75.00	2.04	3.23	5.16	8.23	13.03	20.78	26.12	32.99	41.56	52.46	66.18	83.55	105.26	124.27
80.00	1.91	3.03	4.84	7.71	12.22	19.48	24.49	30.93	38.96	49.18	62.05	78.33	98.68	116.50
85.00	1.80	2.85	4.55	7.26	11.50	18.33	23.05	29.11	36.67	46.29	58.40	73.72	92.88	109.65
90.00	1.70	2.69	4.30	6.86	10.86	17.32	21.77	27.49	34.63	43.72	55.15	69.63	87.72	103.56
95.00	1.61	2.55	4.07	6.49	10.29	16.40	20.62	26.04	32.81	41.42	52.25	65.96	83.10	98.11
100.00	1.53	2.42	3.87	6.17	9.78	15.58	19.59	24.74	31.17	39.34	49.64	62.66	78.95	93.20
125.00	1.22	1.94	3.10	4.94	7.82	12.47	15.67	19.79	24.94	31.48	39.71	50.13	63.16	74.56
150.00	1.02	1.62	2.58	4.11	6.52	10.39	13.06	16.49	20.78	26.23	33.09	41.78	52.63	62.14
175.00	0.87	1.39	2.21	3.53	5.59	8.91	11.20	14.14	17.81	22.48	28.36	35.81	45.11	53.26
200.00	0.76	1.21	1.94	3.08	4.89	7.79	9.80	12.37	15.58	19.67	24.82	31.33	39.47	46.60
225.00	0.68	1.08	1.72	2.74	4.34	6.93	8.71	11.00	13.85	17.49	22.06	27.85	35.09	41.42
250.00	0.61	0.97	1.55	2.47	3.91	6.23	7.84	9.90	12.47	15.74	19.86	25.07	31.58	37.28
275.00	0.56	0.88	1.41	2.24	3.55	5.67	7.12	9.00	11.33	14.31	18.05	22.79	28.71	33.89
300.00	0.51	0.81	1.29	2.06	3.26	5.19	6.53	8.25	10.39	13.11	16.55	20.89	26.32	31.07
400.00	0.38	0.61	0.97	1.54	2.44	3.90	4.90	6.19	7.79	9.84	12.41	15.67	19.74	23.30

Wire Sizing Tables

Use these tables to determine the appropriate wire size for charging circuits in your PV power system. These tables will show you the maximum one way wire distance the conductor will pass current at the rated voltage drop. Resistance in wiring has been calculated for the round trip based on one way distance. Cross-reference by wire gauge and current (amps) to find length. For example, on the 12V table, 30A with #6 wire will run a maximum distance of 12.2 feet. This is based on 3% voltage drop and maximum temperature of 75°C. R=Resistance in Ohms per 1000 feet of wire.

System Voltage: 12V **Voltage Drop: 3.00%** **Temperature (°C): 75**

R	3.14	1.98	1.24	0.778	0.491	0.308	0.245	0.194	0.154	0.122	0.0967	0.0766	0.0608	0.0515
	Wire Gauge													
Amps	**#14**	**#12**	**#10**	**#8**	**#6**	**#4**	**#3**	**#2**	**#1**	**#1/0**	**#2/0**	**#3/0**	**#4/0**	**250MCM**
1.00	57.32	90.91	145.16	231.36	366.60	584.42	734.69	927.84	1168.83	1475.41	1861.43	2349.87	2960.53	3495.15
2.00	28.66	45.45	72.58	115.68	183.30	292.21	367.35	463.92	584.42	737.70	930.71	1174.93	1480.26	1747.57
4.00	14.33	22.73	36.29	57.84	91.65	146.10	183.67	231.96	292.21	368.85	465.36	587.47	740.13	873.79
6.00	9.55	15.15	24.19	38.56	61.10	97.40	122.45	154.64	194.81	245.90	310.24	391.64	493.42	582.52
8.00	7.17	11.36	18.15	28.92	45.82	73.05	91.84	115.98	146.10	184.43	232.68	293.73	370.07	436.89
10.00	5.73	9.09	14.52	23.14	36.66	58.44	73.47	92.78	116.88	147.54	186.14	234.99	296.05	349.51
12.00	4.78	7.58	12.10	19.28	30.55	48.70	61.22	77.32	97.40	122.95	155.12	195.82	246.71	291.26
14.00	4.09	6.49	10.37	16.53	26.19	41.74	52.48	66.27	83.49	105.39	132.96	167.85	211.47	249.65
16.00	3.58	5.68	9.07	14.46	22.91	36.53	45.92	57.99	73.05	92.21	116.34	146.87	185.03	218.45
18.00	3.18	5.05	8.06	12.85	20.37	32.47	40.82	51.55	64.94	81.97	103.41	130.55	164.47	194.17
20.00	2.87	4.55	7.26	11.57	18.33	29.22	36.73	46.39	58.44	73.77	93.07	117.49	148.03	174.76
25.00	2.29	3.64	5.81	9.25	14.66	23.38	29.39	37.11	46.75	59.02	74.46	93.99	118.42	139.81
30.00	1.91	3.03	4.84	7.71	12.22	19.48	24.49	30.93	38.96	49.18	62.05	78.33	98.68	116.50
35.00	1.64	2.60	4.15	6.61	10.47	16.70	20.99	26.51	33.40	42.15	53.18	67.14	84.59	99.86
40.00	1.43	2.27	3.63	5.78	9.16	14.61	18.37	23.20	29.22	36.89	46.54	58.75	74.01	87.38
45.00	1.27	2.02	3.23	5.14	8.15	12.99	16.33	20.62	25.97	32.79	41.37	52.22	65.79	77.67
50.00	1.15	1.82	2.90	4.63	7.33	11.69	14.69	18.56	23.38	29.51	37.23	47.00	59.21	69.90
55.00	1.04	1.65	2.64	4.21	6.67	10.63	13.36	16.87	21.25	26.83	33.84	42.72	53.83	63.55
60.00	0.96	1.52	2.42	3.86	6.11	9.74	12.24	15.46	19.48	24.59	31.02	39.16	49.34	58.25
65.00	0.88	1.40	2.23	3.56	5.64	8.99	11.30	14.27	17.98	22.70	28.64	36.15	45.55	53.77
70.00	0.82	1.30	2.07	3.31	5.24	8.35	10.50	13.25	16.70	21.08	26.59	33.57	42.29	49.93
75.00	0.76	1.21	1.94	3.08	4.89	7.79	9.80	12.37	15.58	19.67	24.82	31.33	39.47	46.60
80.00	0.72	1.14	1.81	2.89	4.58	7.31	9.18	11.60	14.61	18.44	23.27	29.37	37.01	43.69
85.00	0.67	1.07	1.71	2.72	4.31	6.88	8.64	10.92	13.75	17.36	21.90	27.65	34.83	41.12
90.00	0.64	1.01	1.61	2.57	4.07	6.49	8.16	10.31	12.99	16.39	20.68	26.11	32.89	38.83
95.00	0.60	0.96	1.53	2.44	3.86	6.15	7.73	9.77	12.30	15.53	19.59	24.74	31.16	36.79
100.00	0.57	0.91	1.45	2.31	3.67	5.84	7.35	9.28	11.69	14.75	18.61	23.50	29.61	34.95
125.00	0.46	0.73	1.16	1.85	2.93	4.68	5.88	7.42	9.35	11.80	14.89	18.80	23.68	27.96
150.00	0.38	0.61	0.97	1.54	2.44	3.90	4.90	6.19	7.79	9.84	12.41	15.67	19.74	23.30
175.00	0.33	0.52	0.83	1.32	2.09	3.34	4.20	5.30	6.68	8.43	10.64	13.43	16.92	19.97
200.00	0.29	0.45	0.73	1.16	1.83	2.92	3.67	4.64	5.84	7.38	9.31	11.75	14.80	17.48
225.00	0.25	0.40	0.65	1.03	1.63	2.60	3.27	4.12	5.19	6.56	8.27	10.44	13.16	15.53
250.00	0.23	0.36	0.58	0.93	1.47	2.34	2.94	3.71	4.68	5.90	7.45	9.40	11.84	13.98
275.00	0.21	0.33	0.53	0.84	1.33	2.13	2.67	3.37	4.25	5.37	6.77	8.54	10.77	12.71
300.00	0.19	0.30	0.48	0.77	1.22	1.95	2.45	3.09	3.90	4.92	6.20	7.83	9.87	11.65
400.00	0.14	0.23	0.36	0.58	0.92	1.46	1.84	2.32	2.92	3.69	4.65	5.87	7.40	8.74

APPENDIX C

UniRac Universal Mounts and Trackers Sizing Guide

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

SolarMount Rail Sets with Clamp Sets or Clip Sets

Select your PV module and complete a layout of your roof or other installation area before selecting the SolarMount components required for your installation. There are just 4 easy steps to selecting a complete SolarMount system – 3 of which are optional.

1 Select the required SolarMount Rail Sets and Top Mounting Clamp Sets or Bottom Mounting Clip Sets.

2 Select SolarMount Tilt Leg Kits, if required. (See next page)

3 Select SolarMount Standoffs, if required. (See page 31)

4 Select SolarMount Splice Kits, if required. (See page 31)

		Number of Modules						
Module Make and Model		2	3	4	5	6	7	8
	SolarMount Rail Sets with Top Mounting Clamp Sets							
KC 70, 80, 120-1, 125G	Rail Set	SMR60	SMR84	SMR120	SMR144	SMR168	SMR192	SMR216
	Clamp Set	CT2C	CT3C	CT4C	CT5C	CT6C	CT7C	CT8C
KC 158G, 167G	Rail Set	SMR84	SMR132	SMR168	SMR204			
	Clamp Set	CT2C	CT3C	CT4C	CT5C			
US-64	Rail Set	SMR72	SMR96	SMR132	SMR156	SMR192	SMR216	
	Clamp Set	CT2B	CT3B	CT4B	CT5B	CT6B	CT7B	
US-116	Rail Set	SMR72	SMR96	SMR132	SMR168	SMR192	-	
	Clamp Set	CT2E	CT3E	CT4E	CT5E	CT6E		
	SolarMount Rail Sets with Bottom Mounting Clips							
KC 70, 80, 120-1, 125G	Rail Set	SMR60	SMR84	SMR106	SMR132	SMR156	SMR180	SMR216
	Clip Set	CB2	CB3	CB4	CB5	CB6	CB7	CB8
KC 158G, 167G	Rail Set	SMR84	SMR120	SMR156	SMR204			
	Clip Set	CB2	CB3	CB4	CB5			
US-64	Rail Set	SMR60	SMR96	SMR120	SMR156	SMR180	SMR216	
	Clip Set	CB2	CB3	CB4	CB5	CB6	CB7	
US-116	Rail Set	SMR72	SMR96	SMR132	SMR156	SMR192	SMR216	
	Clip Set	CB2	CB3	CB4	CB5	CB6	CB7	

Pole Top Mounts

	Number of modules							
Module make and model	**1**	**2**	**3**	**4**	**6**	**8**	**10**	**12**
KC 60, 70, 80	U-22/28M	U-22/52M	U-PT/40S	U-PT/52S	U-PT/80S	U-PT/104S	U-PT/136S	U-PT/160S
KC 120-1, 125G	U-22/28XL	U-22/52XL	U-PT/40L	U-PT/52L	U-PT/80L	U-PT/104L	U-PT/136L	-
KC 158G, 167G	U-22/40XL	U-PT/40M	NA	U-PT/80M	U-PT/120L	-	-	-
US-64	U-22/32L	U-PT/30M	U-PT/44M	U-PT/60L	U-PT/96L	U-PT/120L	U-PT/152L	-

Side of Pole Mounts

	Number of modules			
Module make and model	**1**	**2**	**3**	**4**
KC 60, 70, 80	U-11/28M	U-PS/52M	U-PS/80M	U-PS/104M
KC 120-1, 125G	U-PS/26XXL	U-PS/52XL	U-PS/80XL	-
KC 158G, 167G	U-PS/40XL	U-PS/80XL	-	-
US-64	U-PS/30XL	U-PS60L	U-PS/88L	-

Solar Mount Tilt Leg Kits

High Profile	Low Profile
Use this chart to select the High Profile Tilt Leg Kits required foryour SolarMounts. For instance, if you have selected the SMR106 SolarMount Rail Set, and you wish to tilt it at 30 degrees, you will require a TLH2-44 tilt leg kit (13-36 degrees). Order one TLH Tilt Leg Kit for each SolarMount. TLH2 kits have 1 leg per rail (2 total); TLH4 kits have 2 legs per rail (4 total).	Use this chart to select the Low Profile Tilt Leg Kits required for your modules. For instance, if you selected KC158G modules, and you wish to tilt them at 35 degrees, you will require TLL2-30 or TLL3-30 tilt leg kits (20-50 degrees). TLL2 kits have 2 legs; TLL3 kits have 3 legs. Total tilt legs (not kits) must equal half the total number of SolarMount L-feet in your installation (see SolarMount Price List for number of feet per SolarMount).

	Angle Range				Angle Range		
SolarMount Rail Set	TLH2-12	TLH2-44	TLH2-72	**Module Make and Model**	TLL2-12 or 3-12	TLL2-30 or 3-30	TLL2-44 or 3-44
SMR48	9 - 21	31 - 60+	NA	KC 80, 70	11 - 25	27 - 60+	39 - 60+
SMR60	7 - 17	24 - 60	40 - 60+	KC 120-1, 125G	8 - 17	18 - 45	26 - 60
SMR72	6 - 14	20 - 54	35 - 60+	KC 158G, 167G	9 - 19	20 - 50	29 - 60+
SMR84	5 - 12	17 - 46	28 - 60+	US-64	8 - 18	19 - 47	26 - 60+
SMR96	4 - 10	15 - 40	24 - 60+	US-116	4 - 10	10 - 26	15 - 39
SMR106	4 - 9	13 - 36	22 - 60				
	TLH4-18	TLH4-64	TLH4-104				
SMR120	5 - 10	17 - 38	36 - 60+				
SMR132	4 - 9	15 - 35	32 - 60+				
SMR144	4 - 8	14 - 32	30 - 57				
SMR156	4 - 8	13 - 29	27 - 52				
SMR168	3 - 7	12 - 27	25 - 48				
SMR180	3 - 7	11 - 25	23 - 45				

Side of Pole Mounts - Fixed Tilt

Module make and model	UniRac Model
KS 5 - 20	U PS/14D
KC 35, 40, 50	U PS/26F
KC 60, 70	
KC 80, 120-1, 125G	U PS/26FL

Module make and model	UniRac Model
US-3, 5	U PS/14D
US-11	U PS/20D
US-21, 32	U PS/12F
US-64	U PS/29FL

SunFrame Components for KC 120-1 / 125G

16 ft. Length of Rail and Cap Strips per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	1	1	2	2	2	2	3	3	3
2	1	2	2	3	3	3	4	4	5
3	2	2	3	3	4	4	5	5	6
Cap Strip Screws per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	16	16	32	32	32	32	48	48	48
2	16	32	32	48	48	48	64	64	80
3	32	32	48	48	64	64	80	80	96
L-feet per Installation - 4 ft. Spacing									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	4	4	6	6	8	8	10	10	12
2	6	6	9	9	12	12	15	15	18
3	8	8	12	12	16	16	20	20	24
Splices per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	0	0	0	0	0	0	2	2	2
2	0	0	1	1	2	0	3	3	4
3	0	0	1	1	3	0	4	4	5
End Caps per Installation									
Number of Rows	Any Number of Modules per Row								
1	4								
2	6								
3	8								

SunFrame Components for KC 158G / 168G

16 ft. Length of Rail and Cap Strips per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	1	2	2	3	3	3	4	4	5
2	2	2	3	4	4	5	5	6	7
3	2	3	4	5	5	6	7	8	9
Cap Strip Screws per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	16	32	32	48	48	48	64	64	80
2	32	32	48	64	64	80	80	96	112
3	32	48	64	80	80	96	112	128	144
L-feet per Installation - 4 ft. Spacing									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	4	6	8	10	10	12	14	16	18
2	6	9	12	15	15	18	21	24	27
3	8	12	16	20	20	24	28	32	36
Splices per Installation									
	Number of Modules per Row								
Number of Rows	2	3	4	5	6	7	8	9	10
1	0	0	0	2	2	2	2	2	4
2	0	1	0	3	3	3	4	4	7
3	0	1	0	4	4	4	6	6	10
End Caps per Installation									
Number of Rows	Any Number of Modules per Row								
1	4								
2	6								
3	8								

Large Array Ground Mounts - Rail Sets

	Number of modules				
Module make and model	2	3	4	5	6
KC 50 - 120-1	-	U-LA/84	U-LA/108	U-LA/132	U-LA/156
KC 158G, 167G	U-LA/84	U-LA/120	U-LA/156	-	-
US-42, 64	-	U-LA/96	U-LA/120	U-LA/156	-

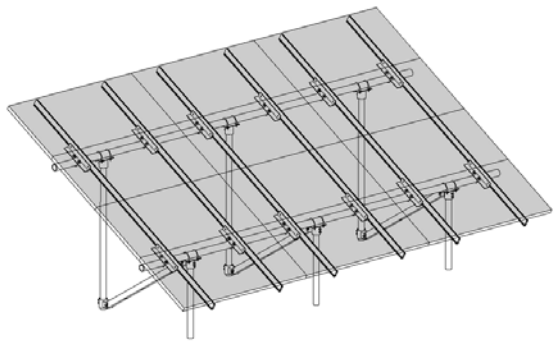
Large Ground Mounts - Basic Leg Length

The support structure of a U-LA Mounting System uses 2-inch Schedule 40 galvanized pipe or Rigid conduit (2-3/8-inch O.D.), which can be obtained from any plumbing or electrical wholesaler. Pipe/conduit will be required for both horizontal supports and support legs. Calculate the amount of pipe required for each as follows:

Horizontal Supports – Two horizontal support pipes, front and rear, run the full east/west array length. The amount of pipe required for the horizontal supports is equal to 2 times the array length.

Support Legs – Based on your choice of U-LA rail set and tilt angle, determine your front and rear basic leg length from the chart below. Adjust each basic leg length for any differences in your installation from the dimensions for 1) the distance of the front edge of your array above level ground, and/or 2) the depth that you will be inserting your support legs into the ground.

Add the adjusted leg lengths together for the total length of pipe required for each pair of the legs. Multiply the result by the number of Truss Sets required for the total length of pipe required for support legs for the entire array.



U-LA mounting system

U-LA Model		Tilt Angle								
		15°	20°	25°	30°	35°	40°	45°	50°	55°
U-LA/84	Front Leg	52	54	55	56	58	59	60	61	62
	Rear Leg	61	65	69	73	77	80	84	87	89
U-LA/96	Front Leg	53	55	56	58	59	60	62	63	64
	Rear Leg	63	68	72	77	81	85	89	92	95
U-LA/106	Front Leg	54	55	57	59	60	62	63	65	66
	Rear Leg	65	70	75	80	85	90	94	98	101
U-LA/120	Front Leg	54	56	58	60	62	63	65	66	68
	Rear Leg	67	73	78	84	89	94	99	103	107
U-LA/132	Front Leg	55	57	59	61	63	65	67	68	70
	Rear Leg	69	75	82	88	93	99	104	109	113
U-LA/144	Front Leg	55	58	60	62	65	67	68	70	72
	Rear Leg	70	78	85	91	98	104	109	114	119
U-LA/156	Front Leg	56	59	61	64	66	68	70	72	74
	Rear Leg	72	80	88	95	102	108	114	120	125
U-LA/168	Front Leg	57	59	62	65	67	70	72	74	-
	Rear Leg	74	82	91	98	106	113	119	125	-

Two-Tier Tilt Up Mounts

	Number of modules		
Module make and model	**4**	**6**	**8**
KC 70, KC 80, KC 120-1	U-DD/60	U-DD/84	U-DD/104
KC 158G	U-DD/84	-	-
US-42, 64	U-DD/60	U-DD/96	-
US-116	U-DD/72	U-DD/96	-

Number of U-LA Truss Sets Required

1. Determine the wind load requirement for your array based on local building requirements. The wind load requirement is defined as pounds per square foot. It is a function of wind speed and exposure zone. If necessary, consult your local building department or professional engineer for assistance.
2. Determine the tilt angle for your system.
3. To determine the number of U-LA trusses that you will need, calculate as follows:
   - **A.** Use the chart below to determine the maximum distances between trusses. For example, assume these wind load requirements: 90mph design wind speed in Exposure Zone C (30 lbs/ft^2) and an optimum tilt angle of 40 degrees. If you are using U-LA/120 rail sets, then the maximum distances between trusses is 106 inches.
   - **B.** Determine the array length by multiplying the number of module rows by the length of your module.
   - **C.** To determine the required number of trusses, divide the array length by the maximum distances between trusses and round up to the nearest whole number. For example, a 600 inch array length divided by 106 inches (the maximum distances between trusses determined in B) = 5.7. Round up to the nearest integer. You will require 6 U-LA truss sets.

Wind Load Requirement				Tilt Angle (Deg.)	Maximum Distance Between Trusses (in.)							
Nominal Design Wind Speed			lbs/ft^2		U-LA/							
Exposure Zone B	Exposure Zone C	Exposure Zone D			84	96	108	120	132	144	156	168
100 mph or less	75 mph or less	N/A	20	<40	157	146	138	131	125	119	115	111
				45	157	146	138	131	125	119	111	104
				50	149	144	133	123	113	105	98	83
				55	105	100	96	91	87	83	79	90
120 mph	90 mph	80 mph or less	30	<35	128	119	113	107	102	97	94	79
				40	128	119	113	106	98	90	84	
				45	123	111	101	93	86	79	74	
				50	99	96	89	82	75			
135 mph or more	105 mph	90 mph	40	<30	111	103	97	92	88	84		
				35	111	103	97	92	84	78		
				40	106	96	87	79	73			
				45	92	83	76					
				50	74	72						
N/A	120 mph or more	100 mph or more	50	<30	99	92	87	83	79			
				35	99	89	80	73				
				40	85	76						
				45	74							

Note: An engineering safety factor of 1.5 is incorporated into this guide.

Exposure Zone B: Has terrain with buildings, forest, or other surface irregularities covering at least 20 percent of the ground level area extending 1 mile or more from the site.

Exposure Zone C: Has terrain that is flat and generally open extending half a mile or more from the site in any full quadrant.

Exposure Zone D: Has the most severe exposure in areas with basic wind speeds of 80 mph or greater and has terrain that is flat and unobstructed facing large bodies of water over 1 mile in width relative to any quadrant of the building site. Exposure D extends inland from the shoreline a quarter mile

T200 Trackers

Module make and model	Tracker Type
KC 35 - 125G	T200/68
US-64	T200/80

Zomeworks Universal Mounts and Trackers Sizing Guide

ZOMEWORKS CORPORATION

Scroll down the column to the left to find the photovoltaic module make and model you will use. Follow the row to the right until you find the box with the number of modules you plan to place on your rack. Follow the column up to the "Model Number" (UGMLP ***) indicates rail length in inches.

Universal Ground Mounts

Module Make and Model	UGM 24	UGM 30	UGM 36	UGM 48	UGM 54	UGM 60	UGM 66	UGM 72+	UGM 84+	UGM 90+	UGM 96+	UGM 102+	UGM 108+	UGM 114+	UGM 120+
KC 35, 40	1	-	-	2	-	-	3	-	-	4	-	-	-	5	-
KC 60, 80,120-1	-	1	-	-	-	2	-	-	3	-	-	-	4	-	-
US-32	1	-	2	-	3	-	-	4	5	-	-	6	-	-	7
US-42,64	-	-	-	-	1	-	2	-	-	-	3	-	-	-	4

+ Indicates oversize. UPS charges a minimum, as for a package weighing 70lbs.

Universal Ground Mounts - Low Profile

Module Make and Model	UGML P 72	UGML P84+	UGML P96+	UGML P108	UGML P120	UGML P132	UGML P144	UGML P156+	UGML P168+	UGML P180+	UGML P192+	UGML P204+	UGML P216
KC 40	3	-	4	-	5	6	-	7	-	8	-	9	-
KC 60	-	3	-	4	-	5	-	6	-	-	7	-	8
KC 80	-	3	-	4	-	5	-	6	-	-	7	-	8
KC 120-1, 125G	-	3*	-	4*	-	5*	-	6*	-	-	7*	-	8*
US-32	4	5	6	-	7	8	9	-	10	11	12	-	13
US-42	2	-	3	-	4	-	-	5	-	6	-	-	7
US-64	2	-	3	-	4	-	-	5	-	6	-	-	7

+ Indicates oversize. UPS charges a minimum, as for a package weighing 70lbs.
* Indicates UGMLP Fixed Rack 5ft. Vertical Rail and Leg Assembly - Add $20.00 to Retail Price.

Pole Top Fixed Rack FX 3 Series

Module Make and Model	FX 3-24	FX 3-28	FX 3-32	FX 3-48	FX 3-52	FX 3-60	FX 3-64	FX 3-80	FX 3-92+	FX 3-96+
KC 40, 60, 80-S	-	1	-	-	2	-	-	3	-	-
KC 120-1-L	-	1	-	-	2	-	-	3	-	-
US-32-L	1	-	2	3	-	-	4	5	-	6
US-42-S	-	-	1	-	-	2	-	-	3	-
US-64-L	-	-	1	-	-	2	-	-	3	-

(L), (S) Indicates cross bar sizes
+ Indicates oversize. UPS charges a minimum, as for a package weighing 70lbs.

Pole Top Fixed Rack FX 4 Series

Module Make and Model	FX 4-452	FX 4-552	FX 4-852	FX 4-560	FX 4-860	FX 4-864	FX 4-480	FX 4-580	FX 4-880	FX 4-592+	FX 4-892+
KC 40, 60	4	-	-	-	-	-	6	-	-	-	-
KC 80	-	4	-	-	-	-	-	6	-	-	-
KC 120-1, 125G	-	-	4	-	-	-	-	-	6	-	-
US-32	-	-	-	-	-	8	-	-	10	-	-
US-42	-	-	-	4	-	-	-	-	-	6	-
US-64	-	-	-	-	4	-	-	-	-	-	6

+ Indicates oversize. UPS charges a minimum, as for a package weighing 70lbs.

Pole Top Fixed Rack FX 6 Series

Module Make and Model	FX 6-4-352+	FX 6-4-416+	FX 6-4-448	FX 6-5-416+	FX 6-5-480	FX 6-6-528*	FX 6-6-624*	FX 6-8-320+	FX 6-8-368+	FX 6-8-384+	FX 6-8-416+	FX 6-8-608+*	FX 6-9-528*	FX 6-9-624*	FX 6-9-704+**	FX 6-9-800**	FX 6-9-896**
KC 40	8	-	10	-	-	12	14	-	-	-	-	-	-	-	16	18	20
KC 60	-	8	-	-	-	10	12	-	-	-	-	-	-	-	-	-	-
KC 80	-	-	-	8	-	-	-	-	-	-	-	-	10	12	-	-	-
KC 120-1	-	-	-	-	-	-	-	6	-	-	8	-	-	-	-	-	-
US-32	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-
US-42	-	-	-	-	8	-	-	-	-	-	-	10	-	-	-	-	-
US-64	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-

+ Indicates FX 6 Series Fixed Racks that can be shipped by UPS. UPS charges a minimum, as for a package weighing 70lbs.
* Indicates 3 rows of modules
** Indicates 4 rows of modules

Pole Top Fixed Rack FX Series

Module Make and Model	FX 90	FX 120
KC 60	14* - 16*	18*
KC 80	-	14* - 16*
KC 120-1, 125G	-	10 - 12
US-32	14 - 16 - 18	20
US-42	12*	14*
US-64	8	10

* Indicates that an extra rail set is required - $200.00 Retail.

Universal Track Rack

Module Make and Model	UTR 020	UTR 040	UTR F 64	UTR F 90	UTR F 120
KC 40	1 - 2 - 3	4	16*	24**	32***
KC 60	1 - 2	4	6 - 8 - 10 - 12	14*	16* - 18*
KC 80	1 - 2	4	6 - 8	10 - 12*	14* - 16*
KC 120-1, 125G	1 - 2	4	-	6 - 8	10 - 12
US-32	1 - 2 - 3	6	-	8 - 10 - 12 - 14 -16	18 - 20
US-42	1 - 2	4	6 - 8	10 - 12*	14*
US-64	1 - 2	4	-	6 - 8	10

* Indicates that an extra rail set is required - $200.00 Retail.
** Indicates that two extra rail sets are required - $400.00 Retail.
*** Indicates that three extra rail sets are required $600.00 Retail

Wattsun Trackers Sizing Guide

Wattsun Solar Trackers for KC 60

Tracker Part Number	# of Modules	# of Cols	# of Rows	Width (ft)	Height (ft)	Sq ft	Module Orientation	Array Watts	Wattsun Drive	Dual-Axis Option	SCH40 Pipe ID	Mounting Pole Height (ft)
20410*	2	2	1	4.3	2.5	10.6	Portrait	120	TR-15	N/A	2”	4.6
20411*	4	2	2	4.3	4.9	21.3	Portrait	240	TR-75	N/A	4”	5.4
20412*	6	2	3	4.3	7.4	32.0	Portrait	360	TR-75	N/A	4”	6.4
20413	8	2	4	4.3	9.9	42.6	Portrait	480	TR-75	N/A	4”	7.5
20414	12	3	4	7.4	8.6	64.1	Portrait	720	TR-75	N/A	4”	7.7
20415	16	4	4	9.9	8.6	85.5	Landscape	960	AZ-125	Available	6”	5.7
20416	20	5	4	12.4	8.6	108.9	Landscape	1200	AZ-125	Available	6”	5.7

* Ships UPS. All other via motor freight

Wattsun Solar Trackers for KC 80

Tracker Part Number	# of Modules	# of Cols	# of Rows	Width (ft)	Height (ft)	Sq ft	Module Orientation	Array Watts	Wattsun Drive	Dual-Axis Option	SCH40 Pipe ID	Mounting Pole Height (ft)
20417*	2	2	1	4.3	3.2	13.8	Portrait	160	TR-15	N/A	2”	4.6
20418*	4	2	2	4.3	6.4	27.6	Portrait	320	TR-75	N/A	4”	6.0
20419*	6	3	2	6.5	6.4	41.5	Portrait	480	TR-75	N/A	4”	6.7
20420*	8	4	2	8.6	6.4	55.4	Portrait	640	TR-75	N/A	4”	7.4
20421*	10	3-4-3	3	9.6	8.6	66.5	Portrait	800	TR-75	N/A	4”	8.2
20422	12	3	4	9.6	8.6	83.2	Landscape	960	AZ-125	Available	6”	5.7
20423	16	4	4	12.9	8.6	111.0	Landscape	1280	AZ-125	Available	6”	5.7
20424	24	4	6	12.9	12.9	166.6	Landscape	1920	AZ-125	Included	8”	5.7

* Ships UPS. All other via motor freight

Wattsun Solar Trackers for KC 120-1

Tracker Part Number	# of Modules	# of Cols	# of Rows	Width (ft)	Height (ft)	Sq ft	Module Orientation	Array Watts	Wattsun Drive	Dual-Axis Option	SCH40 Pipe ID	Mounting Pole Height (ft)
20456	4	2	2	4.3	9.4	40.3	Portrait	480	TR-75	N/A	4”	7.2
20457	6	3	2	6.5	9.4	60.6	Portrait	720	TR-75	N/A	4”	7.7
20458	8	2	4	9.4	8.6	80.9	Landscape	960	AZ-125	Available	6”	5.7
20459	10	2	5	9.4	10.8	101.1	Portrait	1200	AZ-125	Available	6”	6.7
20466	12	3	4	14.1	8.6	121.4	Landscape	1440	AZ-125	Available	6”	5.7
20467	18	6	3	13.0	14.1	182.2	Portrait	2160	AZ-225	Included	6”	8.3

* Ships UPS. All other via motor freight

Wattsun Solar Trackers for KC 158G

Tracker Part Number	16	# of Cols	# of Rows	Width (ft)	Height (ft)	Sq ft	Module Orientation	Array Watts	Wattsun Drive	Dual-Axis Option	SCH40 Pipe ID	Mounting Pole Height (ft)
20425*	4	2	2	6.5	8.5	55.3	Portrait	632	TR-75	N/A	4”	7.4
20426	6	3	2	9.8	8.5	83.1	Landscape	948	AZ-125	Available	6”	8.5
20427	8	4	2	13.1	8.5	110.9	Landscape	1264	AZ-125	Available	6”	5.6
20428	12	3	4	12.7	13.1	166.4	Portrait	1896	AZ-225	Included	8”	7.8
20429	16	4	4	17.0	13.1	222.0	Landscape	2528	AZ-225	Included	8”	7.8

* Ships UPS. All other via motor freight

Wattsun Solar Trackers for US-64

Tracker Part Number	# of Modules	# of Cols	# of Rows	Width (ft)	Height (ft)	Sq ft	Module Orientation	Array Watts	Wattsun Drive	Dual-Axis Option	SCH40 Pipe ID	Mounting Pole Height (ft)
20430*	2	2	1	4.9	4.5	21.9	Portrait	128	TR-15	N/A	4”	5.5
20431*	4	2	2	4.9	9.0	43.9	Portrait	256	TR-75	N/A	4”	7.2
20432*	6	3	2	7.3	9.0	65.9	Portrait	384	TR-75	N/A	4”	7.9
20433	8	4	2	9.8	9.0	87.9	Landscape	512	AZ-125	Available	6”	5.8
20434	10	5	2	12.2	9.0	110.0	Landscape	640	AZ-125	Available	6”	5.8

* Ships UPS. All other via motor freight

APPENDIX D

Inverter Overcurrent Protection and Cable Sizing

BRAND	MODEL	MAXIMUM CONTINUOUS POWER (WATTS)	VOLTAGE	MAX INPUT AMPS*	MINIMUM OVERCURRENT PROTECTION	MINIMUM CABLE SIZE** (IN CONDUIT)	MINIMUM CABLE SIZE** (IN FREE AIR)
XANTREX	PORTAWATTZ 600	600	12	80	80	#4	#8
	PORTAWTTZ 1000	800	12	107	110	#2	#4
	PORTAWATTZ 1750	1500	12	201	200	#3/0	#1
	PORTAWATTZ 3000	2500	12	334	350	350 MCM	#3/0
	PROSINE 1000-12	1000	12	134	150	#1	#3
	PROSINE 1800-12	1800	12	241	250	#4/0	#1/0
	PROSINE 2000-12	2000	12	267	350	250 MCM	#2/0
	PROSINE 2500-12	2500	12	334	350	350 MCM	#3/0
	PROSINE 2500-24	2500	24	167	175	#2/0	#2
	PROSINE 3000-12	3000	12	400	400	500 MCM	#4/0
	PROSINE 3000-24	3000	24	200	200	#3/0	#1
	UX612[2]	600	12	80	80	#2	#2
	UX1112[2]	1100	12	147	150	#2/0	#2/0
	UX1412[2]	1400	12	187	200	#4/0	#4/0
	DR1512[2]	1500	12	201	200	#4/0	#4/0
	DR2412[2]	2400	12	321	350	#4/0	#4/0[1]
	DR1524[2]	1500	24	100	100	#2/0	#2/0
	DR2424[2]	2400	24	160	175	#2/0	#2/0
	DR3624[2]	3600	24	241	250	#4/0	#4/0[1]
	SW2524[2]	2500	24	167	175	#2/0	#2/0
	SW2548[2]	2500	48	84	100	#2/0	#2/0
	SW4024[2]	4000	24	267	250	#4/0	#4/0[1]
	SW4048[2]	4000	48	134	150	#2/0	#2/0
	SW5548[2]	5500	48	184	200	#4/0	#4/0
OutBack	FX 2024	2000	24	-	200	#2/0	#2/0
	FX 2548	2500	48	-	110	#2	#2
	VFX 2512	2800	12	-	300	#4/0	#4/0
	VFX 3524	3500	24	-	300	#4/0	#4/0
	VFX 3648	3600	48	-	200	#2/0	#2/0

*The maximum input current is calculated by multiplying the inverter's maximum continuous power output by 1.25 and then dividing by 0.85 and the lowest voltage that the inverter will operate at (11V for a 12V unit, 22V for a 24V unit and 44V for a 48V unit). For example, a SW4024 is a 24V unit with a 4000W continuous output so you would multiply 4000W by 1.25 to get 5000W. You would then divide 5000W by the lowest inverter efficiency of 0.85 to get 5882.4W and then divide that by the lowest inverter voltage of 22 volts to get 267 amps. We downsize the overcurrent protection to 250 amps for the SW4024 so that we can still use #4/0 AWG cables.

**Minimum cable sizes are for 90° C rated cable from NEC Tables 310-16 & 310-17. Also refer to NEC articles 240-3b and 240-6a for proper sizing of overcurrent protection devices. Cable sizes are good up to 10' of one way distance. If you use "free air" size cable in conduit, the NEC requires that you use double conductors (two positive and two negative cables). Multiply the rated cable ampacity by 0.8 for parallel conductors.

Smaller cable sizes than those listed here may be used as long as the overcurrent protection is reduced as well. We typically sell #2, #2/0 and #4/0 AWG inverter cables that should be matched with 110A, 175A and 250A overcurrent protection devices respectively. Using larger cables is perfectly acceptable, but you might run into problems fitting them into various disconnects and fuse blocks.

MCM stands for "thousands of circular mils" and it represents the cross sectional area of cables larger than #4/0 AWG. See NEC Table 8 "Conductor Properties" for details.

[1]Cable is sized for 10 feet total length. From 10 feet to 20 feet total length, double the recommended wire size.
[2]Cable sizes are recommended by the manufacturer for inverter performance, i.e. surging, ripple and voltage drop. For that reason, cable size given is the same for conduit and free air.

APPENDIX E

Friction Loss Table

Use the following friction loss charts to select the proper size pipe to use for your water pumping systems. The values listed in the body of these charts are in feet of head loss per 100' of pipe and were calculated by the Hazen-Williams method using friction coefficients of 150 for PVC pipe and 100 for 10 year old steel.

Friction Loss for Fittings in Equivalent Meters of Pipe

Type of Fitting and Application	Nominal size of Pipe Fitting (NPT)					
	15.8mm	20.9mm	26.6mm	35.1mm	40.9mm	52.5mm
	Equivalent Length of Pipe (In Meters)					
Insert Coupling	0.9	0.9	0.9	0.9	0.9	0.9
Threaded Adapter (Plastic to Thread)	0.9	0.9	0.9	0.9	0.9	0.9
90° Standard Elbow	0.6	0.6	0.9	1.2	1.2	1.5
Standard Tee (Straight flow)	0.3	0.6	0.6	0.9	0.9	1.2
Standard Tee (90° Flow)	1.2	1.5	1.8	2.1	2.4	3.3
Gate Valve	0.3	0.3	0.3	0.3	0.6	0.6
Swing check Valve	1.5	2.1	2.7	3.7	4.0	5.2

Friction Loss for Fittings in Equivalent Feet of Pipe

Type of Fitting and Application	Nominal Size of Pipe Fitting (NPT)					
	1/2”	3/4”	1”	1 1/4”	1 1/2”	2”
	Equivalent Length of Pipe (In Feet)					
Insert Coupling	3	3	3	3	3	3
Threaded Adapter (Plastic to Thread)	3	3	3	3	3	3
90° Standard Elbow	2	2	3	4	4	5
Standard Tee (Straight flow)	1	2	2	3	3	4
Standard Tee (90° Flow)	4	5	6	7	8	11
Gate Valve	1	1	1	1	2	2
Swing check Valve	5	7	9	12	13	17

Friction Loss for SCH 40 PCV Pipe in Equivalent Meters

Flow in Liters per minute	Nominal Pipe Size Loss in Meters of Head per One Meter of Pipe					
	15.8mm 1/2"	20.9mm 3/4"	26.6mm 1"	35.1mm 1 1/4"	40.9mm 1 1/2"	52.5mm 2"
5 10 15	0.0058 0.021 0.044	 0.0053 0.011				
20 25 30	0.076 0.11 0.16	0.019 0.029 0.041	0.0057 0.0086 0.012			
35 40 45	0.21	0.054 0.069 0.086	0.016 0.021 0.026	 0.0055 0.0069		
50 60 70		0.1 0.14 0.19	0.031 0.043 0.058	0.0084 0.012 0.016	 0.0073	
80 90 100			0.074 0.092 0.11	0.020 0.025 0.030	0.0093 0.012 0.014	 0.0047
125 150 175			0.17	0.046 0.064 0.085	0.021 0.030 0.040	0.0071 0.010 0.013
200 225 250				0.11 0.14 0.17	0.051 0.061 0.077	0.017 0.021 0.026

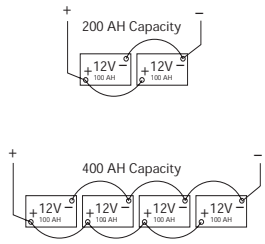
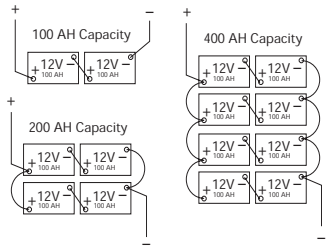
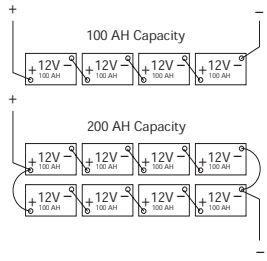
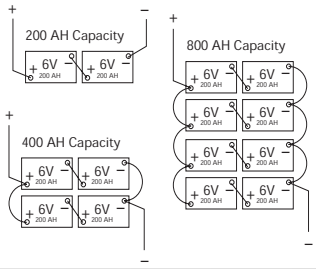
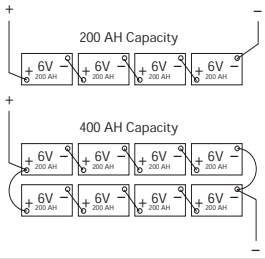
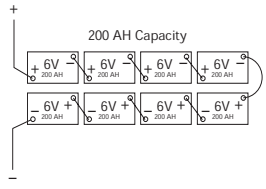
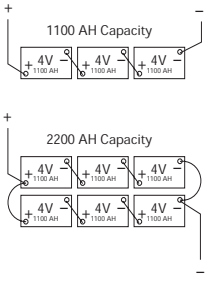
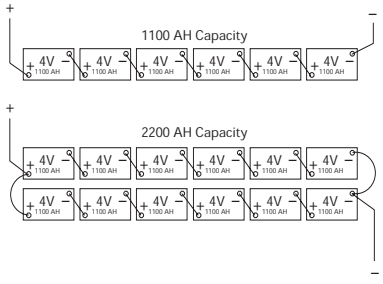
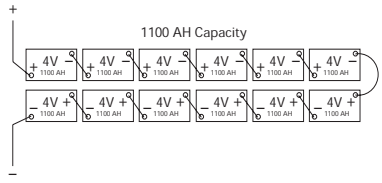
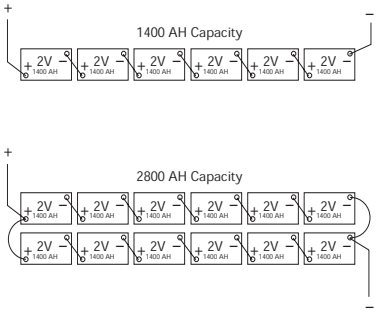
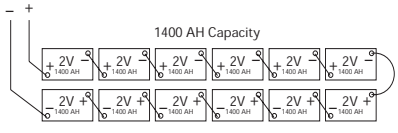
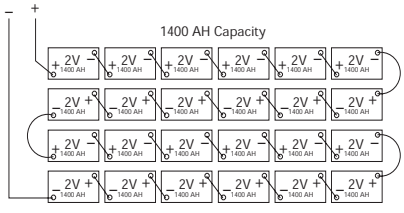
Friction Loss for SCH 40 PCV Pipe in Equivalent Feet

Flow in gallons per minute	Nominal Pipe Size Loss in Meters of Head per One Foot of Pipe					
	1/2" 15.8mm	3/4" 20.9mm	1" 26.6mm	1 1/4" 35.1mm	1 1/2"\ 40.9mm	2" 52.5mm
2 3 4	0.041 0.087 0.148	 0.022 0.037				
5 6 7	0.222 0.312 0.415	0.057 0.08 0.106	0.018 0.025 0.033			
8 9 10	0.53 0.66 0.805	0.135 0.168 0.204	0.042 0.052 0.063	 0.017		
12 14 16		0.286 0.38 0.486	0.089 0.118 0.151	0.023 0.031 0.04	 0.014 0.019	
20 25 30		0.605	0.228 0.387	0.06 0.091 0.127	0.028 0.043 0.06	 0.013 0.018
35 40 45				0.169 0.216 0.28	0.08 0.102 0.125	0.024 0.03 0.038
50 60 70					0.154 0.216 0.287	0.046 0.064 0.085

APPENDIX F

Battery Installation and Wiring

Batteries may be wired in either series or parallel configuration. When a battery is wired in series the positive terminal is wired to the next battery's negative terminal. This increases the voltage while maintaining amperage of the two batteries. With parallel wiring the positive terminal is wired to the next battery's positive terminal, and the negative to the next negative. This arrangement increases amperage while maintaining voltage. One common mistake is to believe that both amperage and voltage will increase when wiring batteries together. It will not; only one value will increase with respect to the arrangement. A battery bank may combine both series and parallel wiring configurations. Series strings of batteries are used to achieve the correct voltage, then a number of these series strings are attached in parallel to increase the amp-hours of the total battery bank.

	12 Volt Systems	24 Volt Systems	48 Volt Systems
12 volt Batteries			
6 Volt Batteries			
4 Volt Batteries			
2 Volt Batteries			

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Power with Style

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This aesthetically integrated photovoltaic system sets a new standard in ease of installation, roof space utilization and beauty. It uses two different size modules and a unique custom racking system to get the most power out of your available roof space while blending into your home's architecture better than traditional solar modules.

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