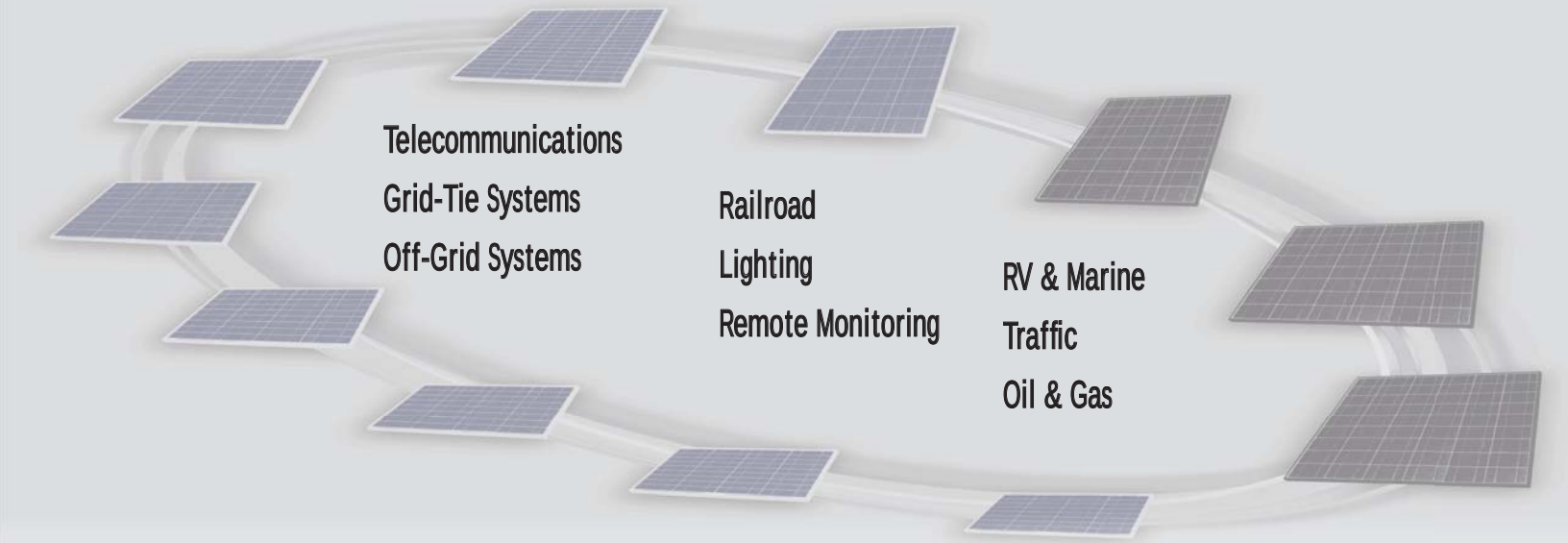
Solar Electric Products Catalog



Kyocera Empowers Your Future ®

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 integrated solar energy systems are used for variety of applications. These applications include grid-connected systems for homes and commercial facilities, telecommunications, the oil and gas industry, railway safety and traffic management systems, village electrification, remote home power generation, marine and RV applications.

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 network.

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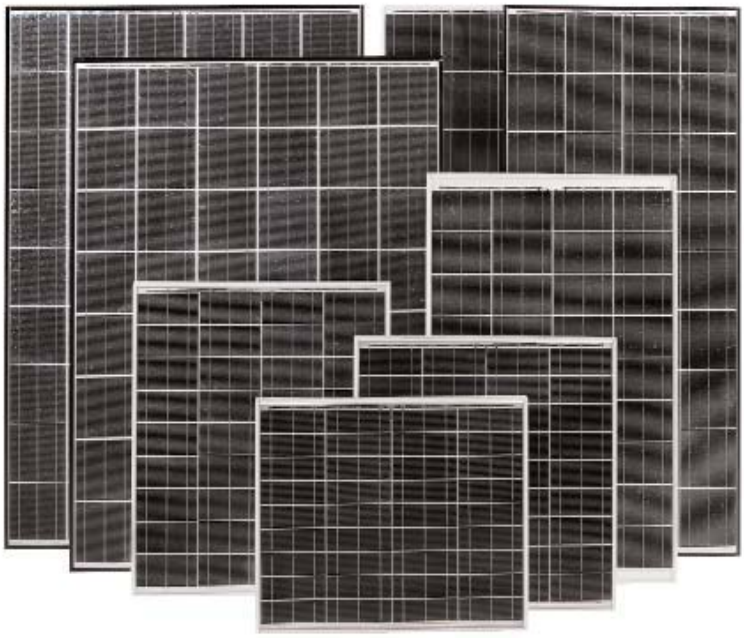
The Power of Choice

KYOCERA



- Power Range 40 - 210 watts
- NEW -0, +5 Watt Power Tolerance (KD 210, 205 only)
- Class 1 Div 2 for KC40T -KC85T
- UL Listed
- Building Quality Modules Since 1975
- Now Manufactured in North America

From our comprehensive family of modules to our 20 year warranty, Kyocera Solar takes a pro-active approach to anticipating the needs of our customers.

Now Available

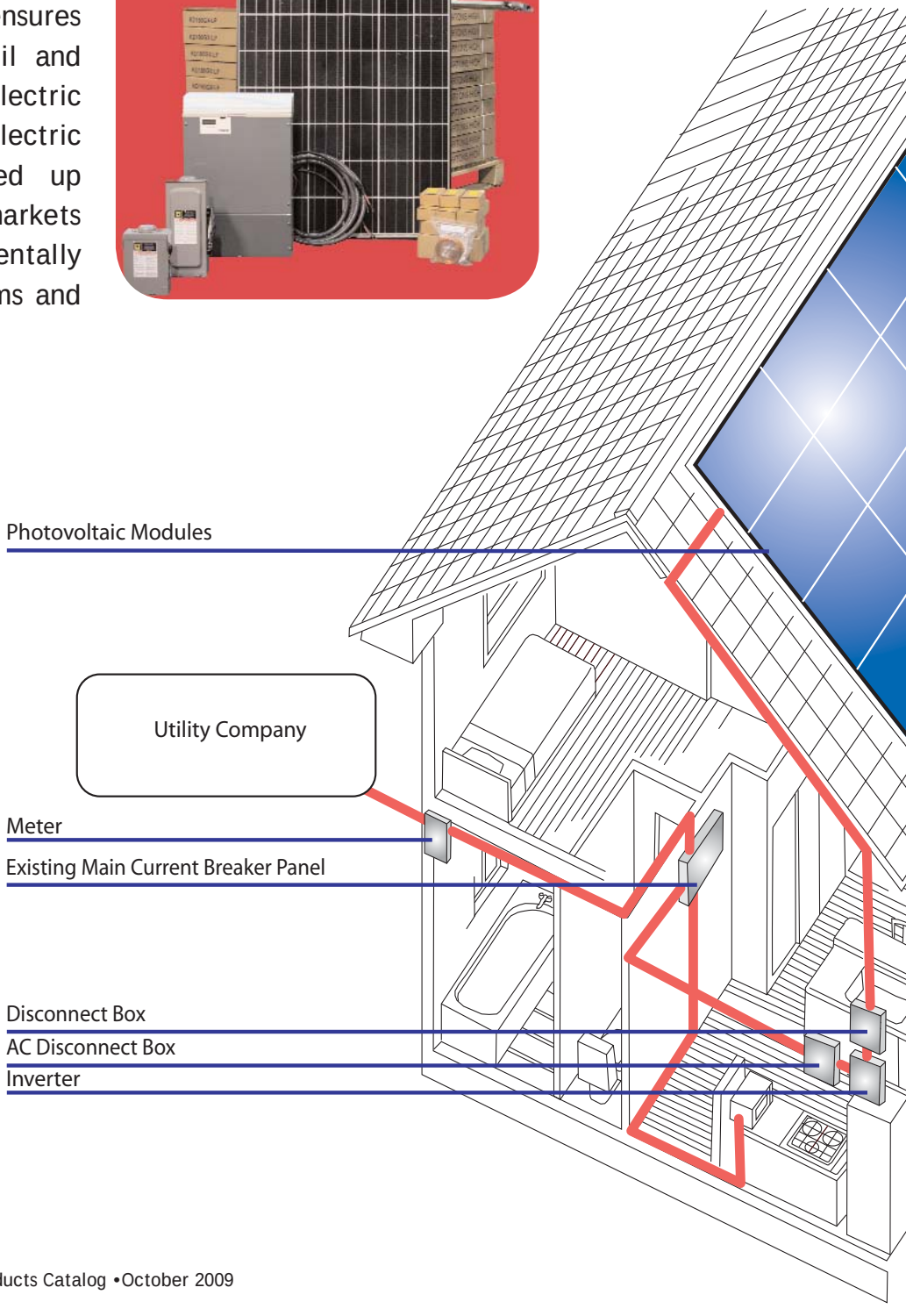
Kyocera has perfected it's new three-bus cells which also feature our exclusive d.Blue surface treatment technology. Together they become one of the highest efficiency polycrystalline solar modules on the market.

See Page 18 For Complete Details

MyGen™ Utility Interactive System

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 household and business use, but also allow surplus energy to be sold back to the utility.



See Page 13 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 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!

QUALITY BUILT-IN TO EVERY MODULE

Kyocera's multi-crystalline silicon modules carry 20-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.

Kyocera d.Blue Module

KYOCERA has perfected its surface treatment technology with the line of modules named d.Blue, for its dark blue color.

The newly developed treatment method processes multicrystalline 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.

KYOCERA

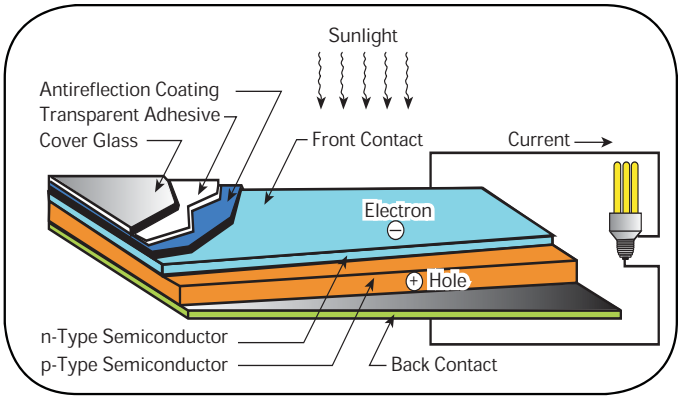
See Page 18 For Complete Details

Frequently Asked Questions

Q1…
How do solar cells generate electricity?

A1…

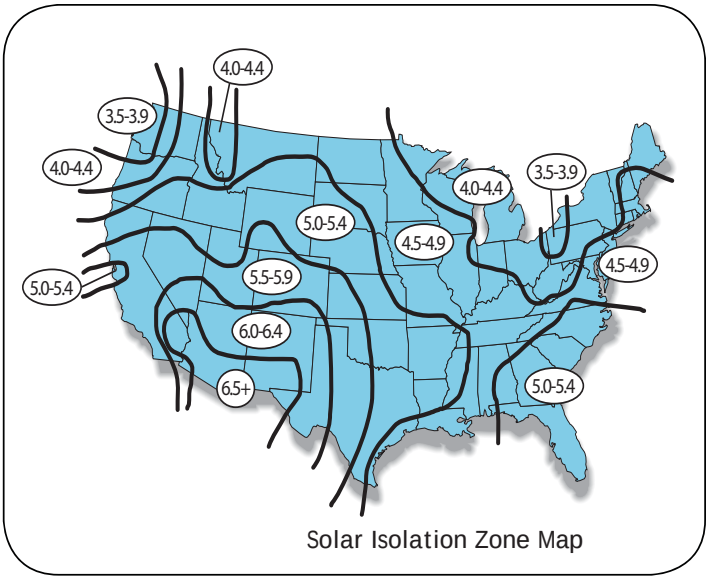
Photovoltaics (PV) can be thought of as a direct current (DC) generator powered by the sun. When light photons of sufficient energy strike a solar cell, they knock electrons free in the silicon crystal structure forcing them through an external circuit (battery, inverter or direct DC load), and then 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 14-20%, that means we can expect to generate about 140-200W 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 Isolation Zone Map

Q3…
What components do I need for an off-grid system?

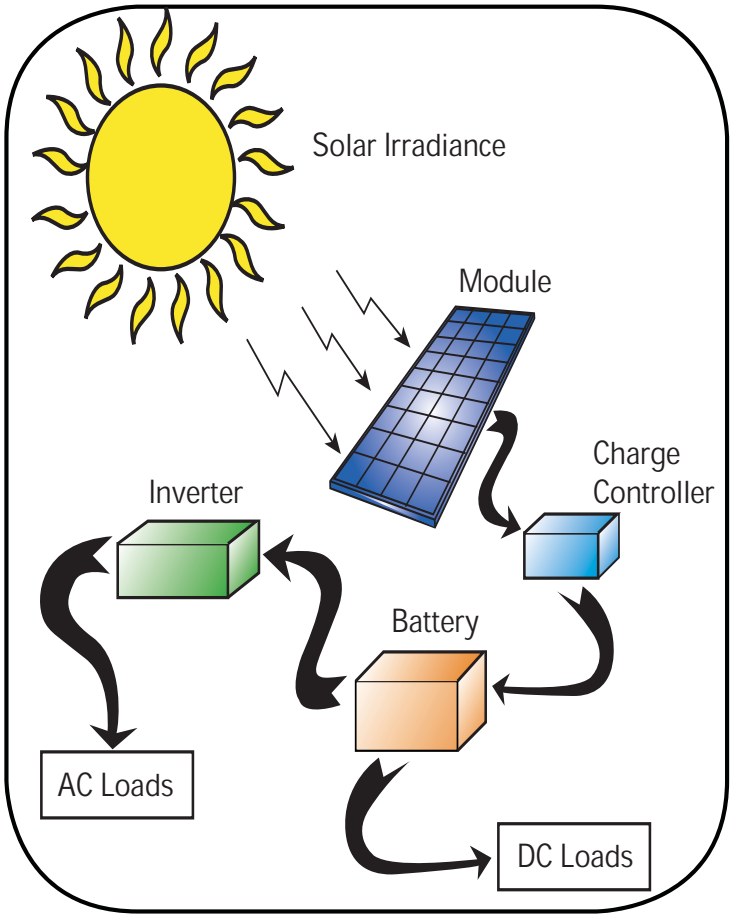
A3…

There are many components that make up a complete solar energy system, but the 4 main items on an off-grid stand-alone system are: solar modules, charge controller(s), battery(s) and inverter(s).The solar modules are physically mounted on mount structure (see question 6) 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 16. 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 34 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 41. 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 54.

Q4…
What components do I need for a grid-tie system?

A4…

Other than safety disconnects, mounting structure and wiring, a grid-tie system is just solar modules and an inverter! Today's sophisticated 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



Q5…
How much will solar cost for a 2000 square foot home?

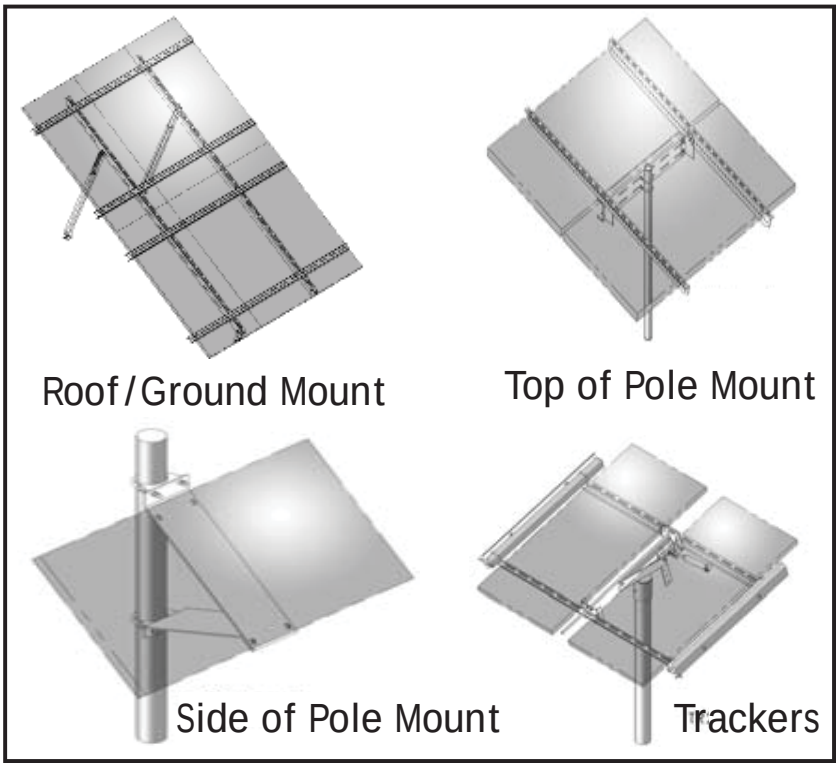
A5…

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. To find this amount, simply look at your monthly electric bill. Using this information, your authorized Kyocera Solar Dealer can design a system to meet your needs.

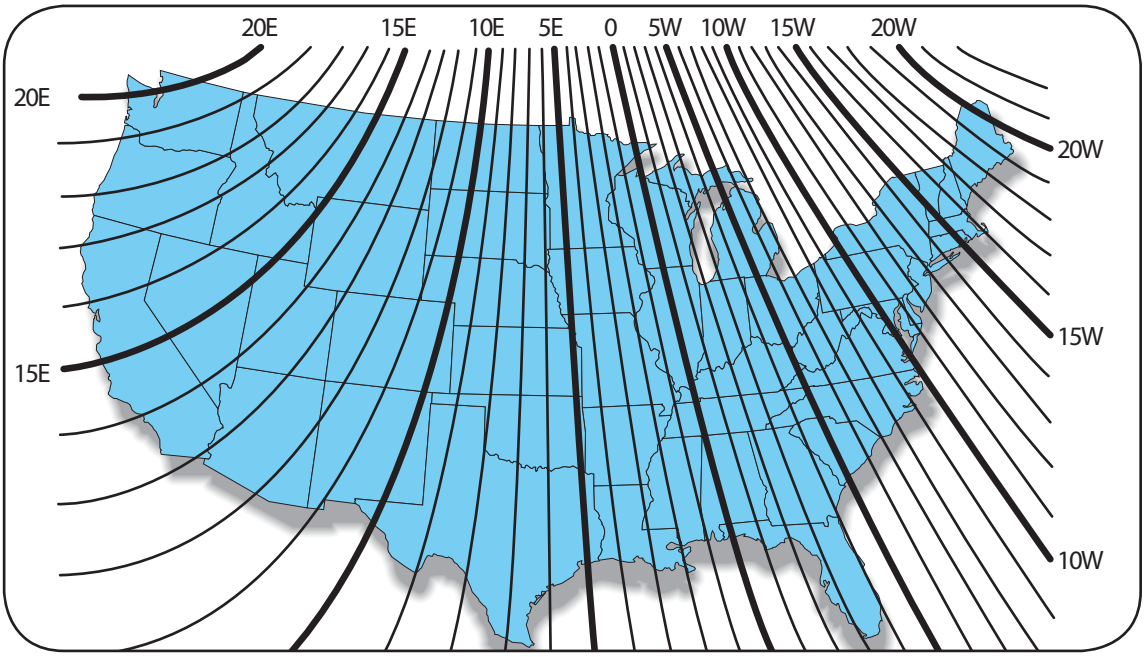
Q6…
What type of solar module mounting structure should I use?

A6…

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.



Q7...
Where should I mount the solar modules and what direction should I face them?



A7...

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.

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.

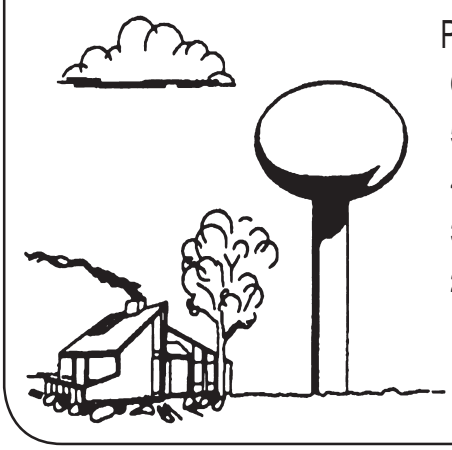
In a simple system, a power source like a solar module provides the voltage which pushes the amperage through a conductor (wire) and on through a load that offers resistance to the current flow which in turn consumes power (watts). Power is measured in watts and is the product of voltage multiplied by 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.

When wiring solar modules or batteries together in a 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.

Appliances	Watts	Appliances	Watts	Appliances	Watts
Coffee Pot	200	Garage door opener	350	Compact fluorescent	
Coffee Maker	800	Ceiling fan	10-50	Incandescent equivalents	
Toaster	800-1500	Table fan	10-50	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	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	30		
Iron	1000	Stereo	10-30	Refrigerator/Freezer	
		Clock radio	1	20 cu. ft. (AC)	1411 watt-
Clothes dryer		AM/FM Radio	8	16 cu. ft. (AC)	hours/day*
Electric NA	4000	Satellite dish	30		1200 watt-
Gas heated	300-400	CB Radio	5		hours/day*
		Electric Clock	3	Freezer	
Heater				15 cu. ft. (Upright)	1240 watt-
Engine block NA	150-1000	Radiotelephone		15 cu. ft. (Chest)	hours/day*
Portable NA	1500	Receive	5		1080 watt-
Waterbed NA	400	Transmit	40 150		hours/day*
Stock tank NA	100	Lights:			
Furnace blower	300-1000	100 watt incandescent	100		
Air conditioner NA		25 watt compact flour.	28		
Room	1000	50 watt DC incandescent	50		
Central	2000-5000	40 watt DC halogen	40		
		20 watt DC compact fluor.	22		

Note: Tv's, VCR's and other devices left plugged in, but not turned on, still draw power.

* 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.

Kyocera Solar Electric Products Catalog •October 2009

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 6 and list the nearest figures.

2. Take your daily kwh load from your energy bill

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 KC130TM'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	100 watt-hours per day	
3	200 watts	
4	(7.1x13)=92.3i	
5	2.17	

PRE-PACKAGED SYSTEMS

Kyocera Solar, Inc. specializes in pre-packaged, integrated solar electric systems for all power applications. 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™ BY KYOCERA — Grid-Tie PV Power Systems

The MyGen System is designed for use on residential and small commercial buildings of typical construction.

The system consists of photovoltaic modules, a direct current to alternating current (DC-to-AC) power conversion device, DC wiring,DC and AC overcurrent protection, surge protection, component mounting and mechanical support.

Photovoltaic mounting is rafter-secured for structural compliance with most local building codes.

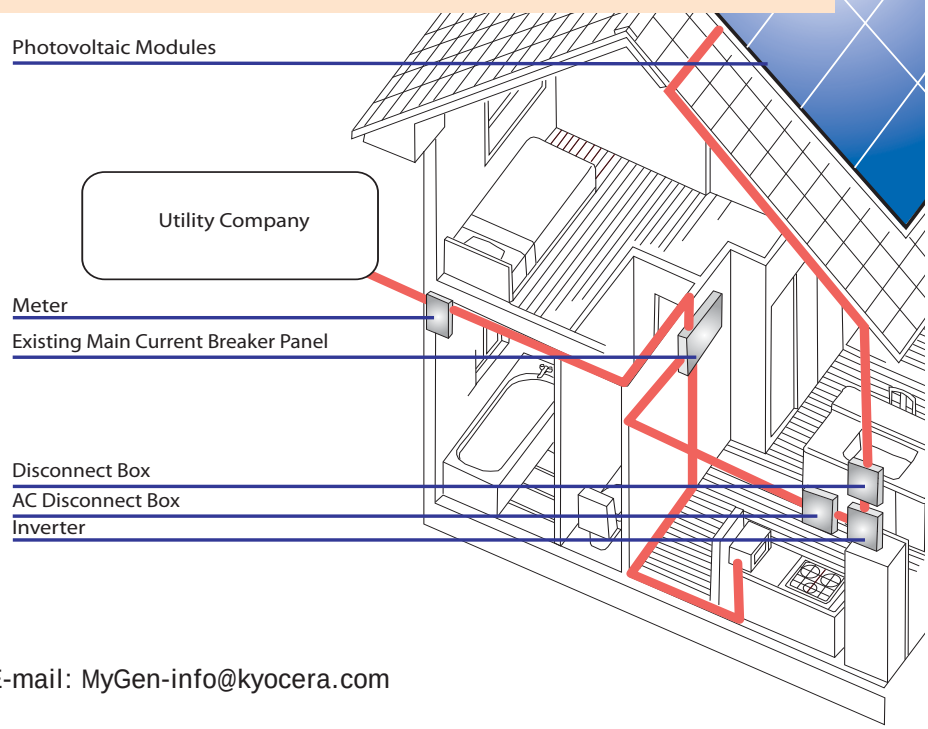
Features

- Worry-free operation with virtually no maintenance
- 20 year limited warranty on module power output
- 10 year limited warranty on inverter
- 2 year limited warranty on module materials and workmanship
- KD180GX-LP has 48 multi-crystalline cells connected in series
- Complete Kyocera documentation for easy installation and permitting
- All original manufacturers' documentation; including user manuals and warranty statements

Quality Assurance

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

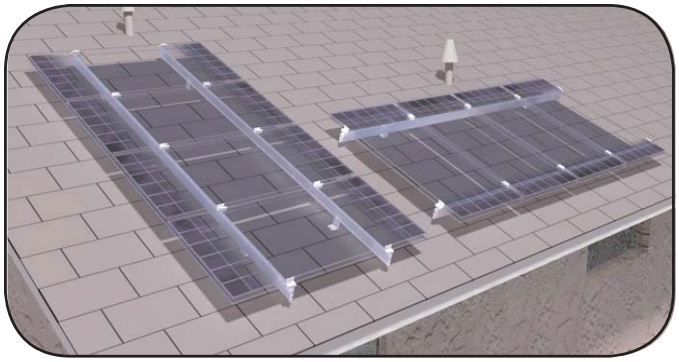
- Thermal cycling test
- Thermal shock test
- Thermal/Freezing and high humidity cycling test
- Electrical insolation test
- Hail impact test
- Mechanical, wind and twist loading test
- Salt mist test
- Light and water exposure test
- Field exposure test



Kyocera Solar, Inc. is a proud member of the U.S. Green Building Council to promote environmentally responsible and resource-efficient building structures.

E-mail: MyGen-info@kyocera.com

The MyGen Systems are designed for use on residential and small commercial buildings and are ideal for either new construction or retrofit applications. The easy to install systems are compatible with a wide variety of roof types and materials. MyGen Systems feature solar modules integrated into arrays that can be sized to meet a wide range of power requirements for maximum flexibility. MyGen Systems include all the components necessary for a complete installation.



Zone Map of U.S.A

Kyocera MyGen™ System Sizing Chart

MyGen™ System	Roof space in sq. feet	ZONE 6	ZONE 5	ZONE 4	ZONE 3	ZONE 2	ZONE 1
		kWh / DAY					
ECONOMY	115	7.3	6.2	5.1	4.0	2.8	1.7
SMALL	175	11.3	9.5	7.8	6.1	4.3	2.6
MEDIUM	290	19.0	16.0	13.1	10.2	7.3	4.4
LARGE	350	23.2	19.7	16.1	12.5	8.9	5.4
MEGA	400	27.3	23.1	18.9	14.7	10.5	6.3

Miami, Florida Example

Example of a home owner located in Miami, Florida (Zone 5), with 16.6 kWh used daily (based on sample electrical bill) and 304 square feet of roof space.

	MyGen Economy	MyGen Small	MyGen Medium	MyGen Large	MyGen Mega
Part Number	602460	602461	602462	602463	602464
Price	$10,080.00	$15,120.00	$25,200.00	$30,240.00	$35,280.00
STC-Lab Rated Power (1,2) (DC Watts)	1440	2160	3600	4320	5040
PTC-Lab Rated Power (1,2) (DC Watts)	1248	1872	3120	3744	4368
KD185GX-LP Quantity	8	12	20	24	28
Inverter Efficiency	90.5%	92.0%	93.5%	95.5%	96.0%
PV Panel+Mount Weight (lbs.)	420.0	560.0	700.0	700.0	875.0
String Quantity	1	1	2	2	2
Weight (lbs.) /Pallets / Bundles	610 / 2 / 1	765 / 2 / 1	1051 / 2 / 1	1397 / 3 / 1	1594 / 3 / 1

(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 variables 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.

The MyGen Grid-Connected Residential System must be installed by a licensed electrician and/or a licensed solar contractor.

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 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 megawatt 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.

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.

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.

Kyocera Solar Electric Products Catalog •October 2009

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.

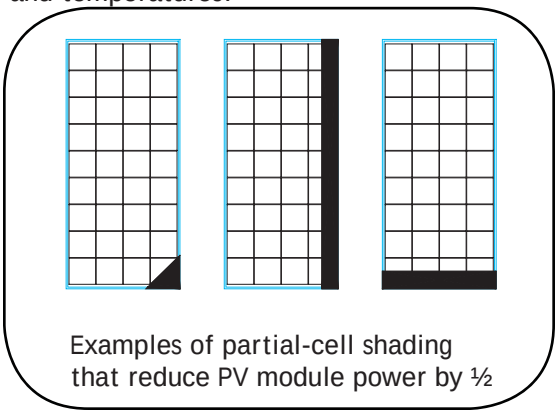
Solar Module Power Characteristics

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.

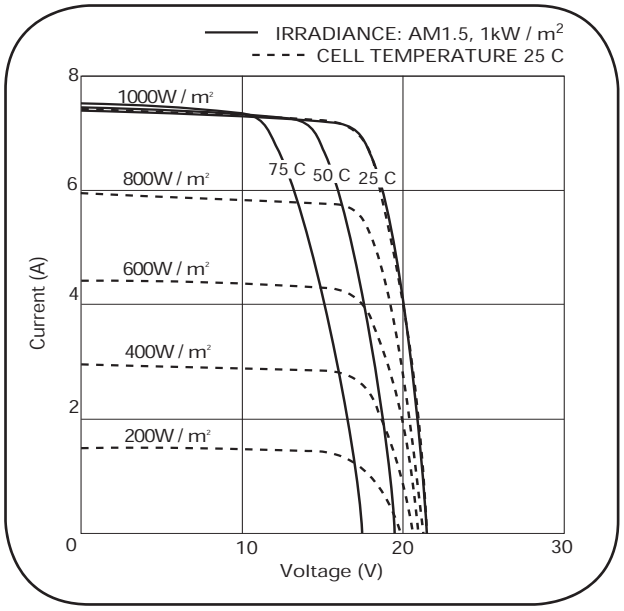
A module which is rated at 17 volts will put out less than its rated power when used in a battery system. This is because the working voltage will be between 12 and 15 volts. As wattage (power) is the product of volts times amps, the module output will be reduced. For example: a 50 watt module working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



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



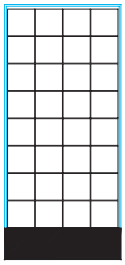
Shading

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.

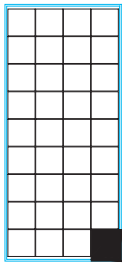
Shading obstructions can be defined as soft or hard sources. If a tree branch, roof vent, chimney or other item is shading from a distance, the shadow is diffuse or dispersed. These soft sources significantly reduce the amount of light reaching the cell(s) of a module. Hard sources are defined as those 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.

Partial-shading even one cell of a 36-cell module, such as the KD135SX, 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

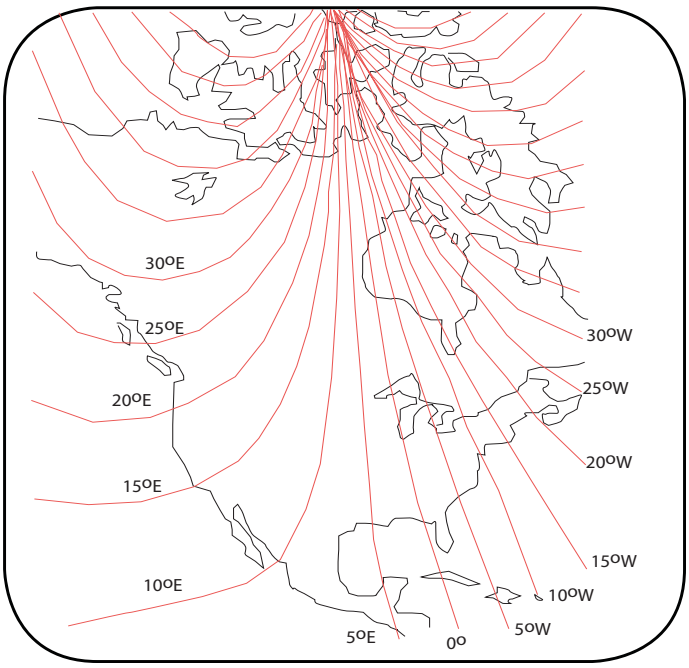
To capture the maximum amount of solar radiation over a year, the solar array should be tilted at an angle approximately equal to a site's latitude, and facing within 15º of due south. To optimize winter performance, the solar array can be tilted 15º more than the latitude angle, and to optimize summer performance, 15º 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 15º 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 15º 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 15º 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.

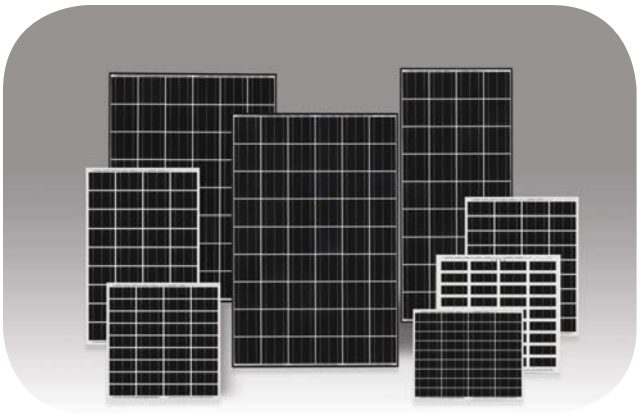
Magnetic declination, the angle difference between magnetic south and true solar south, must also be taken into account when determining proper solar array orientation. If a magnetic compass alone is used to determine where to point the array, you may not capture the maximum amount of solar radiation. For a general view of the magnetic declination field lines in North America, see the map on the right. If you wish to gain in-depth information about magnetic declination, visit the following web site:
http://www.ngdc.noaa.gov/seg/geomag/declination.shtml.



Magnetic declination map of North America for the year 1995

Kyocera Solar Modules [KC/KD]

Kyocera's advanced cell processing technology and automated production facilities have produced multi-crystalline solar cells with efficiencies of over 18.5%. 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.



KD Module Family

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.

KD 210GX-LP

Features

- KC65T - KC130TM modules have a +10/-5% power tolerance, KC40T-50T: +15/-5%
- KD135GX-LP - KD210GX-LP modules have a +5%/-5% tolerance
- UL listed
- Low iron, tempered glass, EVA encapsulant and anodized aluminum frame construction
- 20 year output warranty on Kyocera modules
- Weather resistant junction box (KC40T-KC130TM) or multi-contact connectors (KD130GX-LP, 180GX-LP, 205GX-LP & 210GX)

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

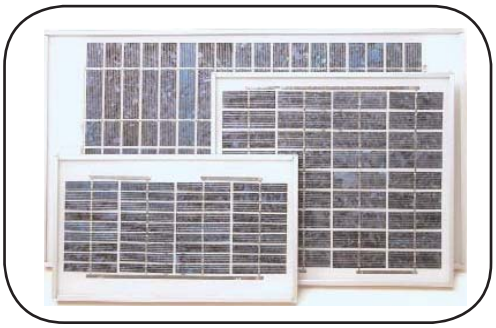
Product Name and Descriptions	KD 210GX-LP	KD 205GX-LP	KD 180GX-LP	KD 135GX-LP	KC 130TM	KC85T	KC65T	KC50T	KC40T
Part Number	**503091**	**501015**	**501014**	**501013**	**501004**	**703004**	**703005**	**703007**	**703008**
Rate of Power(Watts)	210	205	180	135	130	87	65	54	43
Series Fusing(Amps)	15.0	15.0	15.0	15.0	15.0	7.0	6.0	6.0	6.0
Current at Max. Power(Amps)	7.90	7.71	7.63	7.63	7.39	5.02	3.75	3.11	2.48
Voltage at Max Power(Volts)	26.6	26.6	23.6	17.7	17.6	17.4	17.4	17.4	17.4
Short Circuit Current(Amps)	8.58	8.36	8.35	8.37	8.02	5.34	3.99	3.31	2.65
Open Circuit Voltage(Volts)	33.2	33.2	29.5	22.1	21.9	21.7	21.7	21.7	21.7
Length (Inches)	59.1	59.1	52.8	59.1	56.0	39.6	29.6	25.2	20.7
Width (Inches)	39.0	39.0	39.0	26.3	25.7	25.7	25.7	25.7	25.7
Depth of Frame (Inches)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Depth including j-box	1.4	1.4	1.4	1.4	2.2	2.2	2.1	2.1	2.1
Shipping Weight (lbs.)	45.8	45.8	41.4	33.0	33.0	24.0	18.0	16.0	13.0

Replacement bypass diodes for Kyocera J-Box equipped modules are sold in packs of 25; part number 705070

All specification at 25°C. cell temperature, 1.5 AM and 1000W/m2. KC "T" and "TM"modules have a conduit ready junction box. "GX" modules have locking multi-contact connectors. See Appendix A for module dimensions and shipping information.

Solartec KS Modules

Using highly efficient KYOCERA multi-crystalline 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. All modules terminate with 23 ft. (7m) of 16-2 AWG cable. See Appendix A for more information. 10 year output warranty.



Small Wattage Modules

Applications

- Gate openers
- Power for medical facilities, security posts and community centers
- Warning lights, traffic systems and railroad signals
- Telecommunications, radios, sensing and signaling equipment
- Battery charging for boats and RV's

Product Name and Description	KS 20	KS 10	KS 5
Part Number	**703022**	**703020**	**703019**
Price	**$210.00**	**$129.00**	**$78.00**
Rated Power (Watts)	20.0	10.0	5.0
Current and Max. Power (Amps)	1.16	0.58	0.29
Voltage at Max. Power (Volts)	17.40	17.40	17.40
Short Circuit Current (Amps)	1.26	0.63	0.31
Open Circuit Voltage	21.70	21.70	21.70
Length (Inches)	20.5	12.0	8.1
Width (Inches)	13.78	13.86	13.86
Depth (Inches)	0.87	0.87	0.87
Shipping Weight (lbs.)	6.0	4.4	3.0

Mini Module

The 1.4 * watt Mini Module is perfect for charging small NiCad or NMH batteries. These Acrylic encapsulated modules feature crystalline cells and can be wired for either 12 or 6 volt nominal. Wire leads are 24 gauge. * Values nominal due to manufacturing tolerance

SOLD IN BOXES OF 50 ONLY

Product Name and Description	Wired for 6 Volt	Wired for 12 Volt
Part Number	**703017**	
Price	**$26.00**	
Rated Power (Watts)	1.4 *	
Current at Max. Power (mA)	182 mA *	91 mA *
Voltage at Max. Power (Volts)	8 Vmp *	16 Vmp *
Short Circuit Current (mA)	190 mA *	95 mA *
Open Circuit Voltage	10.7 Voc *	20.0 Voc *
Length (Inches)	6.02 (153mm)	
Width (Inches)	4.64 (118mm)	
Depth (Inches)	.16 (4mm)	
Shipping Weight (lbs.)	.20 (90.7g)	

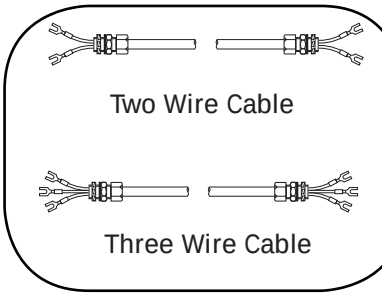
Mini Module

Module Interconnects

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

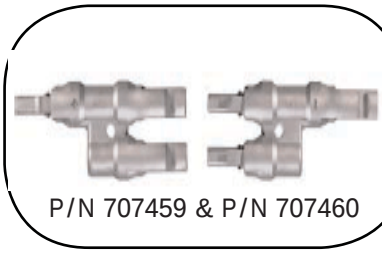
All of these interconnects are pre-assembled, featuring tin-plated copper fork terminals crimped and soldered to #10 AWG stranded copper wire with adhesive "melt wall" shrink tubing heat sealed over the crimp connection. All cables are UL type TC, 600V, 90°C with black PVC sunlight resistant jacket and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



Product Names and Description	Part Number	Price
Kyocera KC65T/85T/130TM 10-2 x 30"	501116	$23.00
Kyocera KC65T/85T/130TM 10-3 x 30"	501117	$24.00

Multi-Contact Assemblies

These wire harnesses are terminated on one or both ends with UL-listed Multi-Contact (MC4) connectors. Use to extend cable from existing MC4 connectors. Cable assemblies are made with UL-listed, 600 Volt, multi-stranded, #12 AWG RHH/RHW/USE-2, outdoor-rated, sunlight resistant cable."



Product Name and Description	Part Number	Price
Double-ended 10 ft. 12ga.MC4 extension (M/F single)	503026	$18.00
Pair 30 in. 12ga., w/fork term. & gland (1 male MC4, 1 female MC4)	503027	$33.00
Single-ended 30 foot 12ga MC4 extension set (cut wire one end, w/p gland) (1 Male MC4, 1 female MC4)	503029	$48.00
Double-ended 30 foot MC4 extension (M/F single)	503028	$24.00
Mult-Contact MC3 Branch Connectors (M/F/F) Used for paralleling modules with Multi-Contact connectors	704055	$19.50
Mult-Contact MC3 Branch Connectors (F/M/M) Used for paralleling modules with Multi-Contact connectors	704056	$19.50
Mult-Contact MC4 Branch Connectors (M/F/F) Used for paralleling modules with Multi-Contact connectors	707460	$24.00
Mult-Contact MC4 Branch Connectors (F/M/M) Used for paralleling modules with Multi-Contact connectors	707459	$24.00

High Voltage Wire Connectors

Polaris insulated wire connectors are used in the array junction box to transition from the single wire M/C connectors used in the array to conventional cable used in the home run wiring. For copper cables only, cold rated to -45C, rated 600VDC, 90C. #4 - #14 AWG.

Product Name and Description	Part Number	Price
#IT-4 2 Port wire connector	703881	$20.00

Solar Modules 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 for sizing information

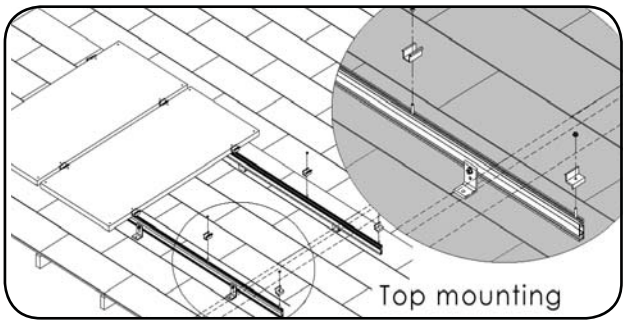
Roof / Ground Mounts

SOLARMOUNT™ UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

SolarMount Rail Kits 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 clear anodized aluminum Rail Set contains 2 rails,L-feet and fasteners. Lag bolts not included. Clamp Sets and Clip Sets (page 23) contain all hardware required for fastening the modules to the SolarMount rails.

Standard Two-Rail Kits

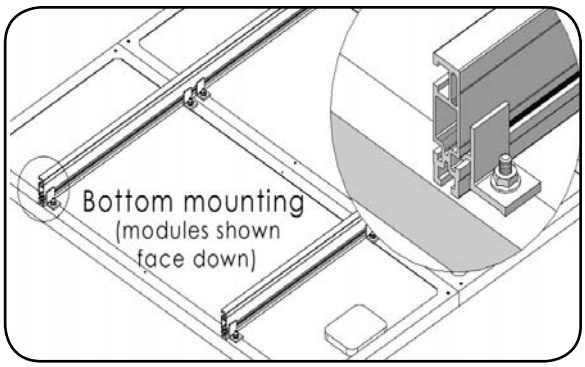
Product Name and Description	Part Number	Number of L-Feet	Price	Weight (lbs.)
303201	704423	4	$110.00	13.0
303202	704424	4	$126.50	14.0
303203	704425	4	$144.50	16.0
303204	704426	4	$161.50	17.0
303205	704427	4	$178.50	19.0
303206	704428	4	$195.00	20.0



+ Rail sets below are not UPS shippable. For a special UPS shippable version (except 300215),which includes split rails and splices, add $30.00 (990201,P/N UPS CUT-SPLICE FEE).

Standard Two-Rail Sets

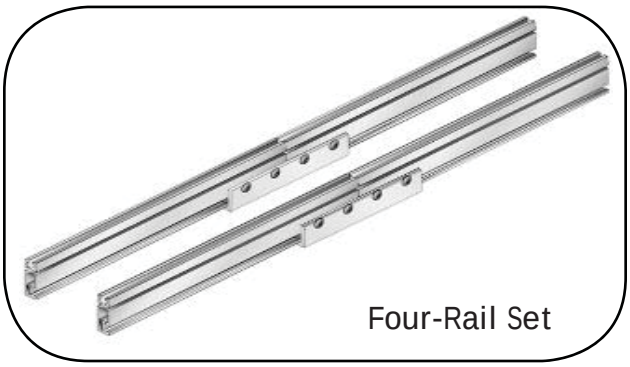
Product Name and Description	Part Number	Number of L-Feet	Price	Weight in (lbs.)
300207 +	703760	6	$217.00	22.0
300208 +	703761	6	$234.00	24.0
300209 +	703762	6	$250.50	25.0
300210 +	705982	6	$267.00	27.0
300211 +	703763	6	$284.00	28.0
300212 +	703764	6	$307.00	30.0
300213 +	705424	8	$323.50	31.0
300214 +	703765	8	$340.50	33.0
300215 *	705425	8	$357.00	34.0



*Ships via truck freight only.

Standard Four-Rail Sets (Includes two splice kits) *

Product Name and Description	Part Number	Number of L-Feet	Price	Weight (lbs.)
300225 *	705396	10	$407.50	42.0
300226 *	703694	10	$424.50	44.0
300228 *	705397	10	$453.00	47.0
300229 *	705398	10	$469.50	48.0
300231 *	705399	12	$508.50	52.0
300232 *	705400	12	$525.00	53.0



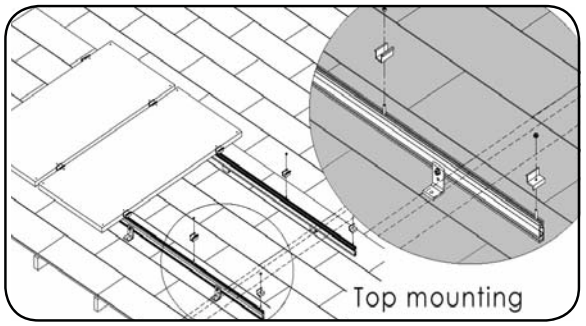
SolarMount® Light

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Lower-cost SolarMount Light rail employs 38 percent less aluminum than standard rail, yet it's more than strong enough for flush applications. Use the same top mounting clamps and footing components that make SolarMount standard rail so easy to install. **Light 2-rail kits** Each kit contains 2 rails equal to the row length, L-feet and hardware to join to rails **Light 4-rail kits, spliced** Each kit contains four rail segments, two splices, L-feet and hardware to join L-feet to rails. Rail segments and splices assemble into two spliced rails equal to the row length. These kits ship via truck freight only.

Light Two-Rail Kits

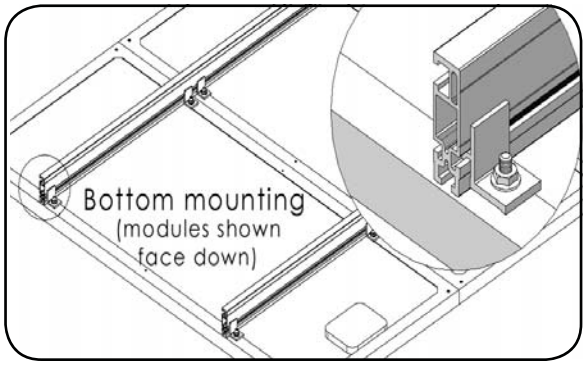
Product Name and Description	Part Number	Number of L-Feet	Price	Weight (lbs.)
303201	704423	4	$91.50	9.0
303202	704424	4	$103.50	10.0
303203	704425	4	$116.00	11.0
303204	704426	4	$127.50	12.0
303205	704427	6	$140.00	13.0
303206	704428	6	$152.50	14.0



+ Rail sets below are not UPS shippable. For a special UPS shippable version (except 300215),which includes split rails and splices, add $30.00 (990201,P/N UPS CUT-SPLICE FEE).

Light Two-Rail Sets

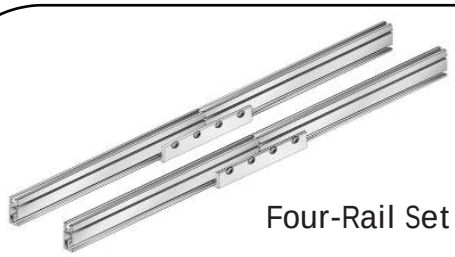
Product Name and Description	Part Number	Number of L-Feet	Price	Weight (lbs.)
303207+	704429	6	$164.50	15.0
303208+	704430	8	$176.50	17.0
303209+	704431	8	$188.50	18.0
303210+	704432	8	$201.00	19.0
303211+	704433	8	$212.50	20.0
303212+	704434	10	$225.00	21.0
303213+	704435	10	$237.50	22.0
303214+	704436	10	$249.50	23.0
303215 *	704437	10	$261.50	22.0

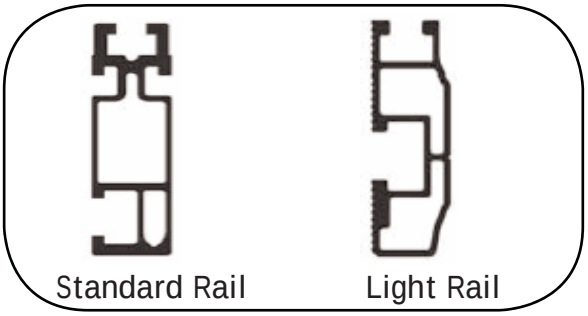


*Ships via truck freight only.

Light Four-Rail Sets (Includes two splice kits)

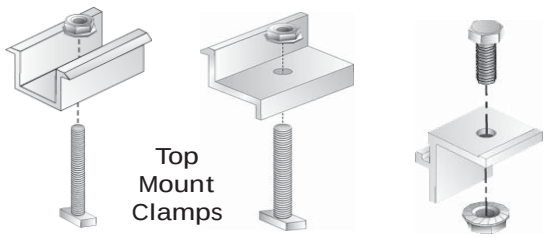
Product Name and Description	Part Number	Number of L-Feet	Price	Weight (lbs.)
303225 *	704438	16	$417.50	38.0
303226 *	704439	18	$430.00	39.0
303228 *	704440	18	$454.50	41.0
303229 *	704441	20	$467.00	42.0
303231 *	704442	20	$492.00	45.0
303232 *	704443	20	$504.00	46.0





Top Mounting Clamps

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
320026 (Clr) 2 Mods	705426	$27.00	1.0
320034 (Clr) 3 Mods	703766	$32.50	2.0
320042 (Clr) 4 Mods	703767	$38.50	2.0
320050 (Clr) 5 Mods	703768	$43.00	2.0
320058 (Clr) 6 Mods	703769	$47.00	2.0
320064 (Clr) 7 Mods	703770	$53.50	2.0
320070 (Clr) 8 Mods	703771	$58.50	3.0
320088 (Brz) 2 Mods	703674	$28.00	1.0
320089 (Brz) 3 Mods	703675	$34.00	2.0
320090 (Brz) 4 Mods	703676	$40.00	2.0
320091 (Brz) 5 Mods	705986	$45.00	2.0
320092 (Brz) 6 Mods	703677	$48.50	2.0
320093 (Brz) 7 Mods	705391	$55.00	2.0
320094 (Brz) 8 Mods	705392	$60.50	3.0



Order 4 clip sets for each module in your array.
Clip sets include stainless steel bolts and flange nuts.

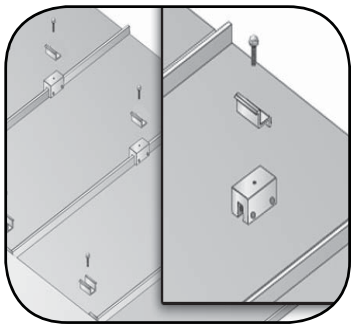
Bottom Mounting Clips

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
321001 (1 clip set)	705393	$2.29	1.0
321218 (4 clip sets)	703678	$10.67	1.0
321002 (20 clip sets)	703736	$39.00	5.0

SOLARMOUNT™ S-5 PV Clamp Sets

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

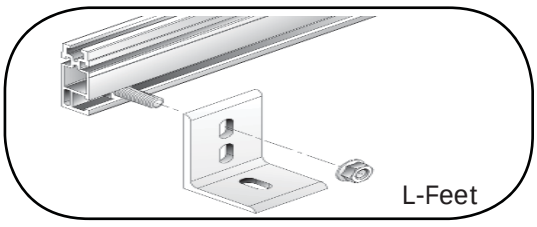
		Clear Anodized			Dark Bronze Anodized			
Product Name and Description	Qty	Part #1	KSI Part #	Price	Part #	KSI Part #	Price	Shipping Weight (lbs)
S-5 + Mid Clamp Set	1	321224	703684	$29.00	321226	705395	$30.00	1.0
	20	321236	703685	$527.00	321238	703688	$527.00	10.0
S-5 + End Clamp Set	1	321229	704418	$29.00	321233	704420	$30.00	1.0
	20	321241	704419	$513.00	321245	704421	$527.00	10.0



L-Feet

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
310068 (1 PK)	704422	$5.63	1.0
310067 (20 PK)	703724	$86.50	5.0



Standing Steam Roofing Clamps

S-5!™

Use to mount module racks to standing seam metal roofing.

Product Name and Description	Part Number	Price
S-5-U	703613	$16.00

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, and 2) low profile, as illustrated in the adjacent drawings.

Use this chart to select the Low Profile Tilt Leg Kits required for your modules. For instance, if you selected KC180GX modules, and you wish to tilt them at 35 degrees, you will require 310122 tilt leg kits (20-50 degrees). Total tilt legs must equal half the total number of SolarMount L-feet in your installation (see SolarMount Price List for number of feet per SolarMount).

Each low profile tilt leg kit contains (1) one square tube and one strut insert, (2) two L-feet and (3) stainless steel hardware for use with SolarMount rail kits. If ordering kits for use with SolarMount rail kits no other items are required. If ordering for use with Pro-Pak rails, then L-feet must also be ordered.

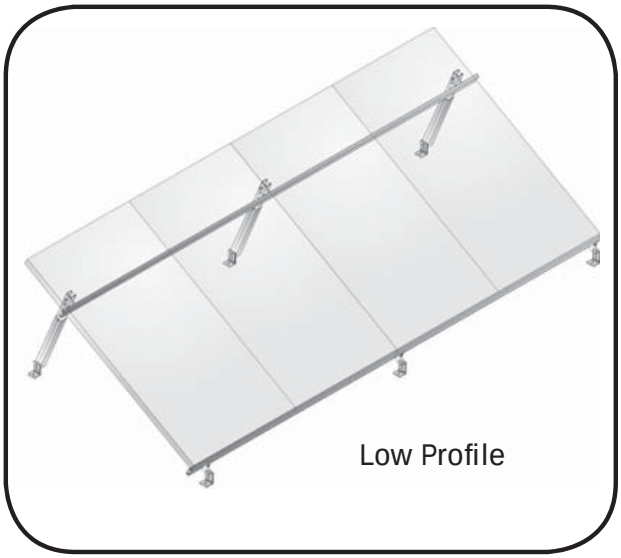
	Angle Range		
Module Make and Model	310121	310122	310123
Leg Lengths	12”	30”	44”
KC85T, 130TM, 135GX	11 - 25	27 - 60+	39 - 60+
KC180GX	9 - 19	20 - 50	29 - 60+
KC205GX	8 - 17	18 - 45	26 - 60

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
Low Profile Tilt Leg Kits			
310121	703682	$36.50	2.0
310122	703683	$45.50	3.0
310123	703394	$53.00	4.0

Quantity of tilt legs required

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

Rail length per row	Tilt legs required per row
48” to 106”	2
120” to 180”	3
192” to 216”	4
226” to 288”	5
300” to 336”	6
348” to 408”	7
420” to 432”	8



Low Profile

High Profile Tilt Leg Kits

Use this chart to select the High Profile Tilt Leg Kits required for your SolarMounts. For instance, if you have selected the 300201 SolarMount Rail Set, and you wish to tilt it at 35 degrees, you will require a 310108 tilt leg kit (31-60 degrees). Order one Tilt Leg Kit for each SolarMount.

	Angle Range				Angle Range		
SolarMount Rail Set	310107	310108	310109	SolarMount Rail Set	310111	310112	310110
300201	9 - 21	31 - 60+	NA	300207	5 - 10	17 - 38	36 - 60+
300202	7 - 17	24 - 60	40 - 60+	300208	4 - 9	15 - 35	32 - 60+
300203	6 - 14	20 - 54	35 - 60+	300209	4 - 8	14 - 32	30 - 57
300204	5 - 12	17 - 46	28 - 60+	300210	4 - 8	13 - 29	27 - 52
300205	4 - 10	15 - 40	24 - 60+	300211	3 - 7	12 - 27	25 - 48
300206	4 - 9	13 - 36	22 - 60	300212	3 - 7	11 - 25	23 - 45

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
High Profile Tilt Leg Kits			
310107 (2 legs per kit)	703743	$52.00	3.0
310108 (2 legs per kit)	705420	$79.50	7.0
310109 (2 legs per kit)	705421	$104.50	10.0
310111 (4 legs per kit)	703744	$97.50	7.0
310112 (4 legs per kit)	703745	$163.50	16.0
310110 (4 legs per kit)	703746	$220.50	20.0

For rails 48 to 106 inches long, use leg kits with a single leg per rail, 2 legs per kit.

Rails 120 to 180 inches long require leg kits with a long and a short leg for each rail, 4 legs per kit.

Security Hardware

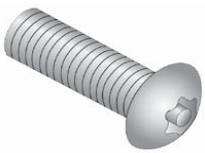
UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Product Name and Description	Qty	Part Number	KSI Part Number	Price
Starhead Bolt s/s 1/4" x 3/4"	1	321205	705381	$1.49
	20	321220	703672	$25.00
Starhead Bolt s/s 3/8" x 1 1/4"	1	321206	705386	$3.95
	20	321221	705387	$64.00
Breakaway nut, aluminum, 1/4" Approx. 5 lb. ft. Breakoff	1	321207	705382	$1.44
	20	321222	703673	$22.50
Breakaway nut, aluminum, 3/8" Approx. 5 lb. ft. Breakoff	1	321208	705388	$1.85
	20	321223	705389	$29.75
Star key, 1/4"	1	321209	705383	$18.67
Star key, 3/8"	1	321210	705390	$22.50

Before Installation

Installed

Breakaway Nut



Starhead Bolt

SOLARMOUNT™ Pro-Pak Bulk Packaging

Product Name	Description	Part Number	Price	Shipping Weight (lbs.)
Light Rails: Consult SolarMount price list and sizing chart for rail sizing for your modules				
303102	10 each 60” rails	704468	$268.50	30.0
303104	10 each 84” rails	704469	$358.00	41.0
303107	10 each 120” rails	704470	$493.00	55.0
303108	10 each 132” rails	704471	$538.00	59.0
303109	10 each 144” rails	704472	$582.00	64.0
303110	10 each 156” rails	704473	$627.50	75.0
303111	10 each 168” rails	704474	$672.50	82.0
303112	10 each 180” rails	704475	$717.50	88.0
303113	10 each 192” rails	703677	$762.50	93.0
303114	10 each 204” rails	704477	$807.50	98.0
303115	10 each 216” rails	704478	$852.00	104.0
Pro-Pak Splices: For light rail				
310231	1 each Bar with hardware	704479	$6.99	1.0
310232	20 each Bars with hardware	704466	$82.00	5.0
Serrated L-feet: with s/s bolts and flange nuts, no lag bolts				
310068	1 each L- feet	704422	$5.63	1.0
310067	20 each L-feet	703724	$86.50	5.0

SOLARMOUNT™ Pro-Pak Grounding Hardware

Product Name	Description	Part Number	Price	Shipping Weight (lbs.)
UniRac Grounding Clip 1 (UGC-1)				
980005	10 each	706560	$23.00	1.0
980006	50 each	706561	$111.00	1.0
980002	100 each	704482	$218.00	1.0
980003	250 each	704483	$350.00	2.0
980004	500 each	704484	$685.00	4.0
Pro-Pak Ground Lugs: Order two lugs for each rail splice and one additional lug for each rail				
980010	1 each	704485	$13.30	1.0
980011	10 each	704486	$119.50	2.0
980012	100 each	704487	$1061.50	8.0

UGI-1

Light Rail

Light Splice Bar

SOLARMOUNT™ Pro-Pak Bulk Packaging

Product Name	Description	Part Number	Price	Shipping Weight (lbs.)
Standard Rails: Consult SolarMount price list and sizing chart for rail sizing for your modules				
300102	8 each 60” rails	705436	$307.00	36.0
300104	8 each 84” rails	703692	$399.00	50.0
300107	8 each 120” rails	703732	$542.00	67.0
300108	8 each 132” rails	705413	$593.00	72.0
300109	8 each 144” rails	705411	$644.50	78.0
300110	8 each 156” rails	705414	$695.50	92.0
300111	8 each 168” rails	703733	$746.50	100.0
300112	8 each 180” rails	705412	$799.00	108.0
300113	8 each 192” rails	703734	$850.00	114.0
300114	8 each 204” rails	705415	$901.50	120.0
300115	8 each 216” rails	705416	$952.50	128.0
300116	8 each 228” rails		$974.50	135.0
End Clamps: with s/s bolts and flange nuts				
320014	20 each “C” clamps	703738	$44.50	2.0
320081	20 each “C” clamps-Dark Bronze	703739	$63.50	2.0
Mid Clamps: with s/s bolts and flange nuts				
320020	20 each “C” clamps	703735	$49.50	2.0
320084	20 each “C” clamps-Dark Bronze	703740	$102.50	2.0
Bottom Mounting Clips: with s/s bolts and flange nuts				
321002	20 each bottom mounting clips	703736	$39.00	1.0
L-feet: with s/s bolts and flange nuts, no lag bolts				
310067	20 each L-feet	703724	$86.50	5.0
Module Mounting and/or Safety Hardware				
321204	20 each 1/4” x 5/8” bolts and flange nuts	705419	$9.07	1.0
Cable ties				
990104	100 each push mount cable ties, black	703729	$12.80	1.0
Flashings for all standoffs				
990101	12 each galv. 12.5” x 8.75” base, No-Calk collar	705378	$92.50	11.0
990102	12 each aluminum 12.5” x 8.75” base, No-Calk collar	705401	$134.50	6.0
990103	12 each soft alum. 18” x 18” base, No-Calk collar	705407	$192.00	14.0

SOLARMOUNT™ Pro-Pak Bulk Packaging (cont.)

Product Name	Description	Part Number	Price	Shipping Weight (lbs.)
Standoffs: 1 1/4" zinc plated steel with lag bolts				
310047	12 each 3" Raised Flange standoffs	705356	$221.00	16.0
310048	12 each 4" Raised Flange standoffs	705357	$244.62	18.0
310049	12 each 6" Raised Flange standoffs	705417	$261.11	22.0
310050	12 each 7" Raised Flange standoffs	705418	$274.43	25.0
310051	12 each 3" Flat Top standoffs	705358	$213.27	16.0
310052	12 each 4" Flat Top standoffs	705410	$223.20	18.0
310053	12 each 6" Flat Top standoffs	705354	$232.29	22.0
310054	12 each 7" Flat Top standoffs	705355	$255.00	24.0
310553	12 each 3" Flat Top 2pc alum. standoffs, clear anodized	705350	$155.50	9.0
310554	12 each 4" Flat Top 2pc alum. standoffs, clear anodized	705351	$230.50	10.0
310556	12 each 6" Flat Top 2pc alum. standoffs, clear anodized	705349	$192.00	12.0
310557	12 each 7" Flat Top 2pc alum. standoffs, clear anodized	705352	$205.00	13.0
Splices				
310216	20 each splice plates with s/s bolts and flange nuts	703737	$276.00	14.0
310229	20 each splice bars with hardware	703711	$114.00	10.0
310232	20 each Light Rail splice bars with hardware	704466	$82.00	5.0
Standard Fasteners				
990336	20 each s/s 3/8" x 3/4" bolts and flange nuts	705380	$21.50	3.0
990335	1 each s/s 3/8" x 3/4" bolts and flange nuts	705402	$1.28	.5
990338	20 each s/s 3/8" x 11/4" bolts and flange nuts	705403	$23.50	3.0
990337	1 each s/s 3/8" x 11/4" bolts and flange nuts	705404	$1.33	.5

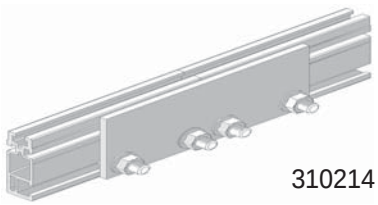
Splice Kits

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.)
310214 Plate w/bolts, flange nuts	703691	$15.24	1.0
310230 Bar w/self-tapping screws	704446	$12.80	1.0
310228 Bar w/self-tapping screws Dark Bronze	703719	$8.16	1.0

310201



310214

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. Sun Frame 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 130TM, 135GX, 180GX and 205GX. No sizing is necessary.

Product Name and Description	Anodize Color	Part Number	Price	Shipping Weight (lbs.)
Rails: Includes 8 ea. rails				
302011 (192")	Dark Bronze	703777	$1533.00	144.0
302015 (192")	Clear	705432	$1331.00	144.0
302013 (96")	Dark Bronze	703706	$804.50	72.0
302017 (96")	Clear	705983	$697.50	72.0
302014 (1 ea.-96")	Dark Bronze	703707	$110.00	10.0
302018 (1 ea.-96")	Clear	705431	$96.00	10.0
Cap Strips: Includes 8 ea. pre-punched cap strips				
321103 (192")	Dark Bronze	703780	$467.00	42.0
321106 (192")	Clear	705427	$407.50	42.0
321110 (96")	Dark Bronze	703697	$248.50	23.0
321112 (96")	Clear	705405	$218.50	23.0
321111 (1 ea.-96")	Dark Bronze	703698	$34.00	6
321113 (1 ea.-96")	Clear	705406	$30.00	6
Cap Strip Screws: Box of 100 screws				
321153	Dark Bronze	705067	$88.50	2.0
321159	Clear	703725	$66.00	2.0
End Caps: Includes 20 end caps and 2 screws per end cap				
310226	Dark Bronze	703778	$64.50	2.0
310225 (2 ea.)	Dark Bronze	703708	$12.38	.5
L-feet: Includes L-feet and rail mounting hardware				
310067 (20 ea.)	Clear	703724	$86.50	5.0
310068 (1 ea.)	Clear	704422	$5.63	.5
310065 (20 ea.)	Dark Bronze	703717	$90.50	5.0
310066 (1 ea.)	Dark Bronze	703718	$5.81	.5
Splices: Includes 20 splices and self-tapping screws				
310227	Dark Bronze	705428	$120.50	10.0
L-foot adjusting sliders: Includes 2 lag bolts & s/s footing bolt-nut				
310223 (1)	Mill finish	704444	$15.50	1.0
310224 (20)	Mill finish	704445	$293.50	18.0

Components:

- **Inter-Module Rails (1)** provide support shelves for the modules.
- **Full Length Cap Strips (2)** secure modules and finish the array topside forming a gap-free frame. Screws at 16-in intervals provide the holding power.
- **End Caps (4)** finish the rail ends to complete the frame.
- **L-Feet (5)** 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 (6)** safely extend rails.
- **Standoffs (7)** (optional), designed for standard flashing, support L-feet above tile or shake roofs. A range of heights ensure a low profile.
- **L-foot adj. sliders (not illustrated)** 11x9x4 inch rail for adjusting foot position.

Standoffs

UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

Standoffs are used for flashed, roof-mounted installations. Part numbers 310017-31024 have 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 21) for quantity of L-feet packed with each SolarMount. Part numbers 310009-310016 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.)
310009 (3" flat top)	703773	$20.00	2.0
310010 (4" flat top)	705359	$21.00	2.0
310011 (6" flat top)	705360	$21.50	2.0
310012 (7" flat top)	705361	$22.00	2.0
310017 (3" vertical flange)	705362	$24.00	2.0
310018 (4" vertical flange)	705433	$25.00	2.0
310019 (6" vertical flange)	705363	$25.50	2.0
310020 (7" vertical flange)	705364	$26.00	2.0
310503 (3" flat top 2pc alum.)	705346	$14.90	1.0
310504 (4" flat top 2pc alum.)	703669	$16.00	1.0
310506 (6" flat top 2pc alum.)	705347	$18.10	1.0
310507 (7" flat top 2pc alum.)	705348	$19.20	1.0
310603 (3" flat top 2pc alum.) Dark Bronze	703699	$16.00	1.0
310604 (4" flat top 2pc alum.) Dark Bronze	705353	$17.10	1.0
310606 (6" flat top 2pc alum.) Dark Bronze	705985	$19.20	1.0
310607 (7" flat top 2pc alum.) Dark Bronze	705984	$20.50	1.0
310046 20 pk 3/8" Hanger bolt s.s.	703690	$205.00	10.0
310025 3/8" Hanger bolt s.s.	705372	$12.80	1.0
310026 3/8" Hanger bolt driver	703670	$22.50	1.0
990095 Side Mount Tile Hook 25 pack	707309	$778.00	25.0
990096 Front Mount Tile Hook 25 pack	707320	$778.00	25.0
990097 Top Mount Tile Hook 25 pack	707321	$778.00	25.0

310009-310012

990097

990095

990096

310025

310026

310017-310020

Shims

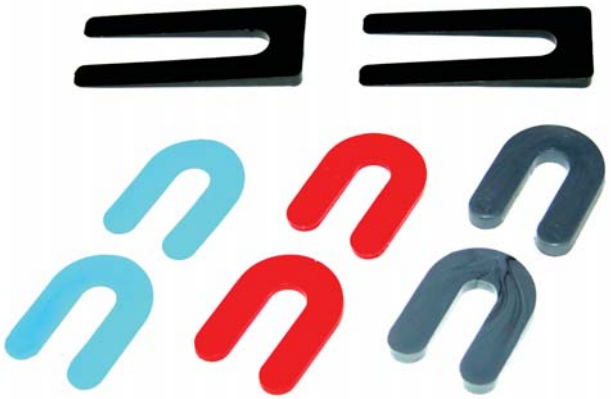
UNIRAC THE STANDARD IN PV MODULE RACKS™

Use these shims to level or raise standoffs and L feet when installing module racks. They also come in handy to align SunFrame rails. The shims are made of industrial, UV resistant material. There are 20 shims in a package.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
990105 (20 pk)	705373	$1.60	0.5
990106 (20 pk)	705374	$3.20	0.5
990107 (20 pk)	705375	$4.80	1.0
990108 (20 pk)	705376	$11.73	1.0

PN 990108 used to level a PN 310029 Standoff

990108 (black)
1 1/2"x3 3/8" tapered



990105 (blue)
1 1/2"x2"x1/16"

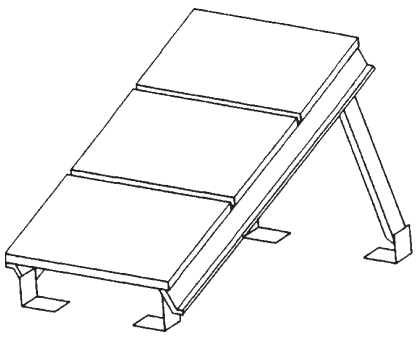
990106 (red)
1 1/2"x2"x1/8"

990107 (gray)
1 1/2"x2"x1/4"

KSI Adjustable Ground Mounts

KYOCERA 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 40T, 50T, 65T, 85T, 130TM and 135GX modules. KCS-2 series is designed to mount 2 KC 180GX's or 205/210GX's. Includes (4) 1/4 inch thick aluminum angle mounting feet and all necessary stainless steel fasteners-type 316. Adjustable tilt angle structures are available 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-2-15	706083	$175.00	23.0
KCS-2-20/40	501409	$240.00	30.0
KCS-2-45/65	706083	$255.00	35.0
KCS-3-0	706085	$169.00	21.0
KCS-3-20/40	501068	$235.00	29.0
KCS-3-45/65	501408	$375.00	34.0
KCS-5-0	501065	$239.00	31.0
KCS-5-20/40	501069	$312.00	42.0
KCS-5-45/65	502850	$347.00	51.0

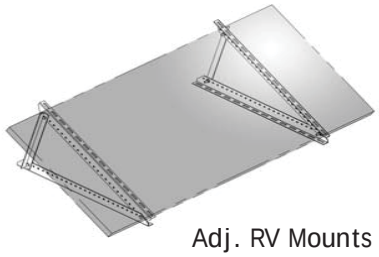


3 Module Adjustable Support Structure

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.

Manufacturers Part Number	Part Number	Modules	Price	Shipping Weight (lbs.)
990013	705987	1 - KC 40T - 130GT/TM	$88.00	6
990017	703753	2 - KC 40T-130GT/TM	$126.00	12.0

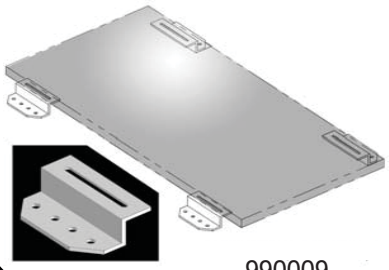


Adj. RV Mounts

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.)
990009	703752	$18.75	1

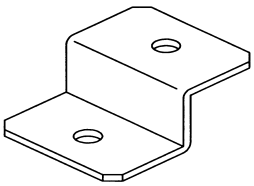


990009

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	703643	$18.00



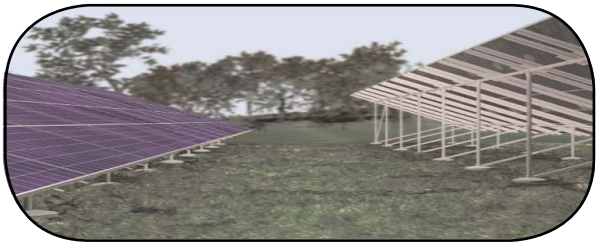
UFB-01

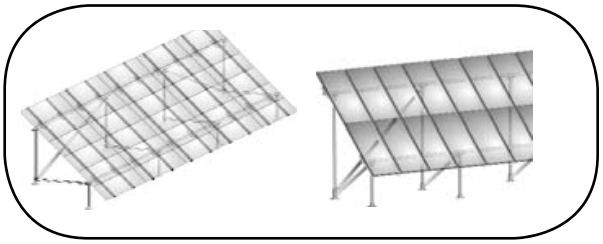
UNIRAC® The New Standard in PV Module Racks™

Large Array Ground Mounts

U-LA Series large array mounting system is ideal for large ground or roof 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).Mill finish aluminum.

Consult your Kyocera representative for assistance in configuring your U-LA system for any ground based array of 12 or more modules.





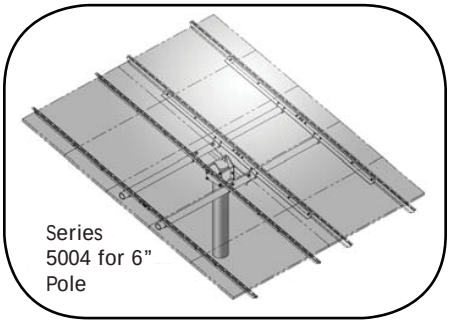
See Appendix C for sizing information

PV POLETOPS™

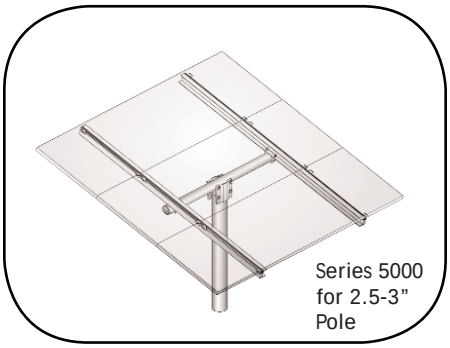
UNIRAC THE NEW STANDARD IN PV MODULE RACKS™

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.

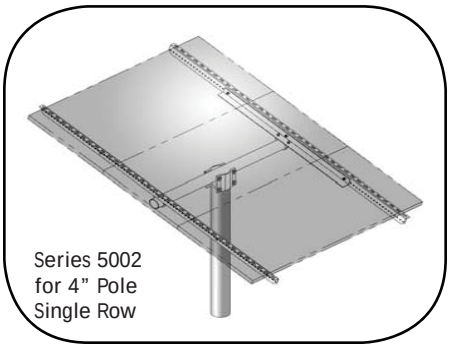
Manufacturers Part Number	Part Number	Nom. Size Pole I.D. (O.D.) (in.)	Price	Shipping Weight (lbs.)
500014	704447	2.5 (2.875)	$161.00	12
500025	703639	2.5 (2.875)	$141.00	9
500031	706088	2.5 (2.875)	$168.50	12
500039	705377	2.5 (2.875)	$159.00	12
500043	703666	2.5 (2.875)	$146.00	12
500107	703679	3.0 (3.50)	$303.00	25
500113	706084	3.0 (3.50)	$344.50	31
500128	703640	3.0 (3.50)	$282.50	22
500131	705365	3.0 (3.50)	$319.00	27
500132	704448	3.0 (3.50)	$322.00	27
500228	705434	4.0 (4.50)	$499.00	40
500243	704449	4.0 (4.50)	$521.50	44
500313	704450	4.0 (4.50)	$601.50	59
500315	704451	4.0 (4.50)	$639.00	63
500325	705366	4.0 (4.50)	$558.00	55
500330	705969	4.0 (4.50)	$635.50	63
500342	703642	4.0 (4.50)	$632.50	62
501429	705369	6.0 (6.625)	$1,115.50	106
501430	704454	6.0 (6.625)	$1,213.00	114
501432	706564	6.0 (6.625)	$950.50	89
501440	704455	6.0 (6.625)	$1,092.50	104
501456	706565	6.0 (6.625)	$964.50	94
501457	706566	6.0 (6.625)	$971.50	93
501462	704457	6.0 (6.625)	$1061.50	102
501486	706567	6.0 (6.625)	$921.50	84
502401	704462	6.0 (6.625)	$842.50	77



Series 5004 for 6" Pole



Series 5000 for 2.5-3" Pole



Series 5002 for 4" Pole Single Row

Mfg. Part #	KSI Part #	Description	Price
990204	703671	Conversion Charge to make any 3" PV PoleTop as a 4" PV PoleTop	$69.00

U-Bolt Substitution for 5000 Series (2 U-bolts plus hardware)

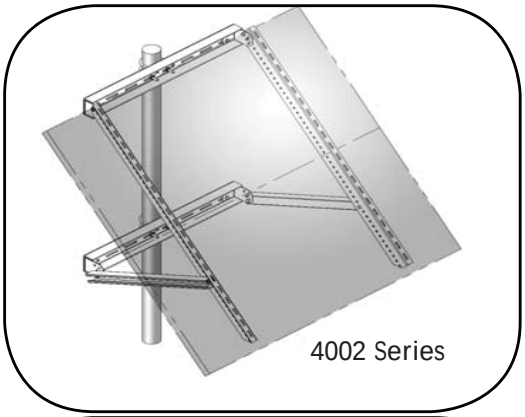
Special order U-bolts up to 13 inches available, please call

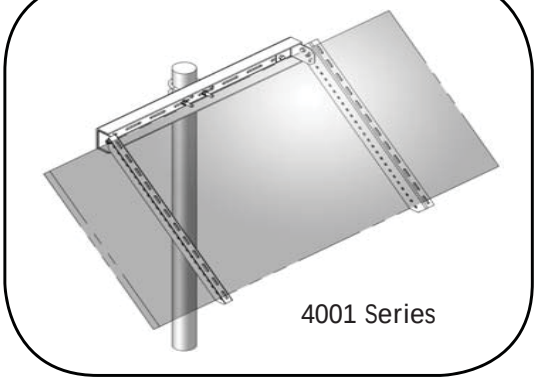
Mfg. Part #	KSI Part #	Description	Price
990323	43583	For 3" Sch. 40 Pole	$6.00
990324	43594	For 4" Sch. 40 Pole	$7.00

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

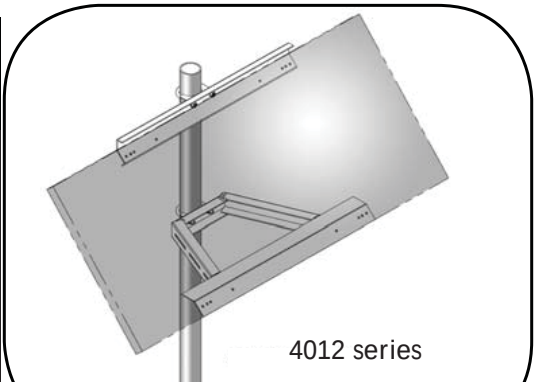
Product Name and Description	Part Number	Price	Nom. Size Pole I.D. (O.D.) (in.)	Shipping Weight (lbs.)
400107	703637	$136.50	2.5 (2.875)	8.0
400209	705368	$226.00	2.5 (2.875)	20.0
400213	706000	$309.50	3.0 (3.50)	20.0
400214	703662	$335.00	3.0 (3.50)	22.0
400233	707544	$341.50	3.0 (3.50)	24.0
400223	706086	$384.00	4.0 (4.50)	25.0
400224	705435	$409.50	4.0 (4.50)	27.0
400229	703663	$429.00	4.0 (4.50)	30.0
400236	707545	$207.00	2.5 (2.875)	15.0
400246	704463	$448.00	4.0 (4.50)	30.0
400257	704464	$196.50	2.5 (2.875)	14.0


4002 Series


4001 Series

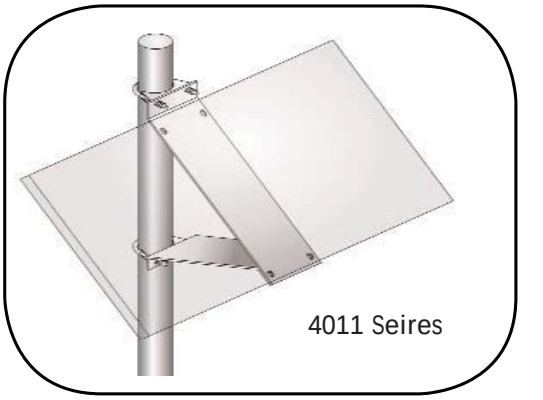
Fixed Tilt

Product Name and Description	Fixed Tilt Angle (deg.)	Part Number	Price	Nom. Size Pole I.D. (O.D.) (in.)	Shipping Weight (lbs.)
401102	45	703664	$35.00	2.0 (2.375	3.0
401260	45	703748	$105.50	2.0 (2.375)	6.0
401262	60	703749	$101.50	2.0 (2.375)	6.0
401264	45	703750	$116.50	2.0 (2.375)	6.0
401266	60	703751	$112.00	2.0 (2.375)	6.0
401278	45	705422	$132.50	2.0 (2.375)	7.0
401279	60	705385	$125.00	2.0 (2.375)	7.0

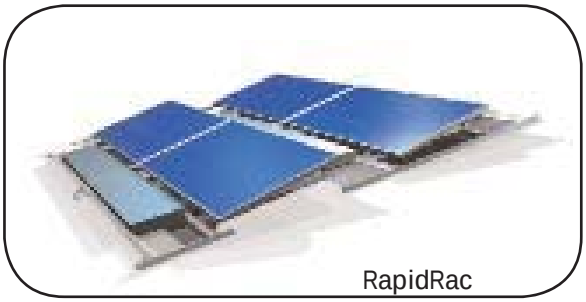

4012 series

U-Bolt Substitute for 1.5” Sch. 40/80 Pole

UniRac Part Number	Part Number	Price
990334	705371	$ 1.60

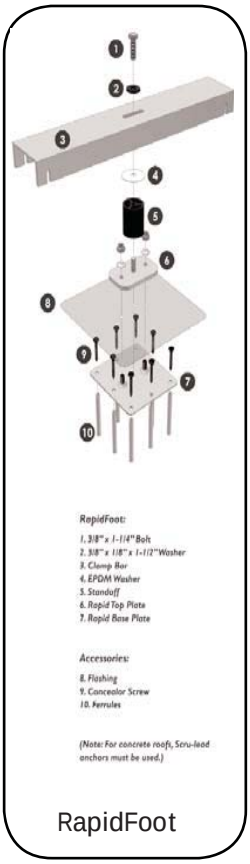

4011 Seires

The RapidRac G10 combines innovative technology with experienced customer input to deliver requirements for reduced installation time and increased labor savings, along with lighter weight and minimal penetration. The unique design of the RapidRac G10 allows installation in less than half the time as the primary competitive products, requiring only 2 tools and 6 parts to complete the install, a significant reduction over current offerings. The flexibility of design allows it to meet most weight, height and wind conditions. The RapidRac G10 accommodates most PV modules, providing the market with tremendous versatility and choice. 10 year limited product, 5 year limited finish warranty.



RapidRac

Product Name and Description	Part Number	RapidRac Part Number	Price	Shipping Weight
1 Bay RapidRac/KD210GX-LP (ballast Frame only)	707637	310351-0911	$99.00	8.0
1 Bay RapidRac/KD210GX-LP (With module mount)	707638	310355-0911	$198.00	12.0
1 Bay RapidRac/KD205GX-LP (ballast Frame only)	707641	310351-0909	$99.00	8.0
1 Bay RapidRac/KD205GX-LP (With module mount)	707642	310355-0909	$198.00	12.0
1 Bay RapidRac/KD180GX-LP (ballast Frame only)	707643	310351-0912	$99.00	8.0
1 Bay RapidRac/KD180GX-LP (With module mount)	707644	310355-0912	$198.00	12.0
1 Bay RapidRac/KD135GX-LP (ballast Frame only)	707636	310351-0914	$99.00	8.0
1 Bay RapidRac/KD135GX-LP (With module mount)	707635	310355-0914	$198.00	12.0
1 Bay RapidRac/KD130TM (ballast Frame only)	707639	310351-0910	$99.00	8.0
1 Bay RapidRac/KD130TM (With module mount)	707640	310355-0910	$198.00	12.0
RapidFoot assembly	706022	310370	$68.50	5.0
Galvalume Flashing #1	706026	990120	$6.68	1.0
Patch, EPDM Blk	706025	990160	$3.19	1.0
Patch, EPDM Blk, Peal & Stick	706023	990161	$6.68	1.0
Concealor Screw 1.5"(14ga or less, wood/metal)	706015	990430-100pk	$24.00	5.0
Concealor Screw 2" (14ga or less, wood/metal)	706014	990431-100pk	$26.50	5.0
Concealor Screw 3" (14ga or less, wood/metal)	706000	990432-100pk	$34.50	5.0
Concealor Screw 4" (14ga or less, wood/metal)	706010	990433-100pk	$42.00	5.0
Concealor Screw 4.5"(14ga or less, wood/metal)	705999	990434-100pk	$48.50	5.0
Concealor Screw 5" (14ga or less, wood/metal)	705997	990435-100pk	$54.00	5.0
Concealor Screw 6" (14ga or less, wood/metal)	705996	990436-100pk	$66.00	5.0
Concealor Screw 7" (14ga or less, wood/metal)	706994	990437-100pk	$75.50	5.0
Concealor Screw 1.375" (12ga or less, metal)	706016	990410-100pk	$51.50	5.0
Concealor Screw 2.75" (12ga or less, metal)	706013	990411-100pk	$53.50	5.0
Concealor Screw 3.75" (12ga or less, metal)	706011	990412-100pk	$59.50	5.0
Concealor Screw 4.75" (12ga or less, metal)	705998	990413-100pk	$71.50	5.0
Concealor Screw 5.75" (12ga or less, metal)	706017	990414-100pk	$77.50	5.0
Concealor Screw 6.75" (12ga or less, metal)	705995	990415-100pk	$83.00	5.0
Concealor Screw 7.75" (12ga or less, metal)	705993	990416-100pk	$90.50	5.0
Ferrules #1, 4ft.	706027	310450	$22.50	1
Anchors #14 - 25pk	706028	310440	$16.20	6.0
Anchors #14 - 100pk	706029	310445	$64.50	22.0



RapidFoot

Charge Controllers / Regulators

Why you need a Controller

The main function 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 shunts 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.

ProStar Charge Controllers

Morningstar has 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

Product Name and Description	Part Number	Array/Load Amperage	Meter	Price
PS-15	703062	15	No	$115.00
PS-15M	703063	15	Yes	$184.00
PS-15M/48V	703064	15	Yes	$229.00
PS-30	703057	30	No	$157.00
PS-30M	703056	30	Yes	$226.00
PS-15M/48V-PG	703050	15	Yes	$246.00
PS-30M-PG	703070	30	Yes	$243.00

Morningstar SunSaver

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 38 for details and pricing on the SunLight controllers. Five year warranty.

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.

Morningstar SunGuard Controller

SHS and SunKeeper Controllers

The SHS was specifically designed to meet the needs of solar home systems in developing countries. This controller meets World Bank specifications and features protections such as blinking the loads as a warning prior to LVD disconnect. They also have built-in electronic fuses that do not require : **These controllers switch the negative leg and do not meet NEC code. The voltage is preset at 14.3 volts and is not adjustable.** If the system is grounded in more than 1 point, charging or load control may be disabled. Two year warranty. The SK controller provides a low cost regulated output directly from the solar module and mounts directly to the module junction box. Class 1,Div 2 rated for hazardous locations. Regulates at 14.1 volts. Optional temp comp (RTS).5yr warr.

Morningstar SHS Controller

Product Name and Description	Part Number	Array Amperage	Load Amperage	Voltage	LVD	Price
SunSaver 6	703058	6.5	N/A	12	No	$50.00
SunSaver 6L	703059	6.5	6	12	Yes	$61.00
SunSaver 10	703060	10	N/A	12	No	$57.00
SunSaver 10L	703061	10	10	12	Yes	$73.00
SunSaver 20L	703048	20	20	12	Yes	$99.00
SunSaver 10L-24	703051	10	10	24	Yes	$79.00
SunSaver 20L-24	703049	20	20	24	Yes	$105.00
SunGuard 4	703045	4.5	N/A	12	No	$31.00
SHS 6	703046	6	6	12	Yes	$30.00
SHS 10	703047	10	10	12	Yes	$40.00
SK-6	703076	6	N/A	12	No	$63.00
SK-12	703078	12	N/A	12	No	$89.00
DIN-1 Mounting Clips	706332	50 pair	with screws	-	-	$50.00

Morningstar SK-12

TriStarTM 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.

- 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

TriStar Controller

Relay Driver

The Relay Driver is a logic module which provides high level system control functions such as high/low voltage alarms, load control and generator start. The Relay Driver is less expensive than other alarm and generator start packages. It controls four independent relay driver outputs by reading digital data inputs from Morningstar's TriStar controller or by reading battery voltage when used in systems with other controllers.

The relay Driver may be mounted to a DIN rail and is fully programmable with the included PC software via serial RS- 232 port connection. Other key product benefits include high reliability, flexibility to choose the exact relay needed for each application and advanced generator control.

Relay Driver

Product Name and Description	Part Number	Voltage	Load Amperage	Price	Shipping Weight (lbs.)
TriStar-45	703065	12V, 24V, 48V	45	$175.00	4.5
TriStar-60	703066	12V, 24V, 48V	60	$226.00	4.5
TriStar Digital Meter	703067	-	-	$102.00	0.5
TriStar Remote Digital Meter	703068	-	-	$141.00	0.5
Remote Temperature Sensor (33 ft.)	703069	-	-	$32.00	1.0
Relay Driver	703071	12V, 24V, 48V	750mA	$169.00	0.4
PC Meterbus Adapter	706953	-	-	$39.00	0.5
Remote Meter RM-1(fits; Suresine, MPPT, Duo)	706951	-	-	$97.00	0.5

SunSaver MPPT

Morningstar's SunSaver MPPT solar controller with TrakStar Technology is an advanced maximum power point tracking (MPPT) battery charger for off-grid photovoltaic (PV) systems. The controller features a smart tracking algorithm that maximizes the energy harvest from the PV and also provides load control to prevent over discharge of the battery. Adjustable via PC or on-board switches. Remote meter and battery temperature sensor are options. Five year warranty.

Product Name and Description	Part Number	Voltage	Amperage	Price	Shipping Weight (lbs.)
SS-MPPT-15L	706347	12 or 24	15	$278.00	1.3

SunSaver MPPT

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	703052	12	10	$111.00	.69
SL10-24	703053	24	10	$119.00	.69
SL20	703054	12	20	$145.00	.69

SunLight 10

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.

Product Name and Description	Part Number	Volts	Amp Capacity	Price
ASC 12/8	703884	12.0	8.0	$53.00
ASC 12/8A - with Temp. Comp.	703885	12.0	8.0	$62.00
ASC 12/8AE - with Temp. Comp. Low Voltage Disconnect	703887	12.0	8.0	$76.00
ASC 12/16	703888	12.0	16.0	$70.00
ASC 12/16A - with Temp. Comp.	703889	12.0	16.0	$81.00
ASC 24/16	703891	24.0	16.0	$70.00

- 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.

ASC Controller

RV / Cabin Controllers

Specialty Concepts, Inc.

MARKSeries 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	703893	15	$134.00
MARK/22-12	703894	22	$147.00

MARK/15-12

MORNINGSTAR corporation

Morningstar's SunSaver Duo is an advanced PWM two battery controller for RV's,caravans,boats and cottages. The product will charge two separate and isolated batteries at the same time,such as a house and an engine battery, based on user selectable priorities. The remote meter and LED's display system status data and any system errors. Custom icons and back lighting make the meter easy to read and understand. Five year warranty.

Product Name and Description	Part Number	Amp Capacity	Price
SunSaver Duo	703079	25	$188.00

SunSaver Duo

FLEXmax 60

The OutBack FM60 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 145 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 FM60 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, including built-in data logging with 128 days of memory.

The FM60 can also be connected to the OutBack MATE system controller and display to allow control & monitoring of up to eight FM60 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 62 for more information on the MATE.

FLEXmax 60

Model Number	FM 60
Part Number	**706660**
Price	**$699.00**
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	150 VDC absolute max coldest conditions/145 VDC startup & op. max.
Standby Power Consumption	Less than 1 Watt typical
Charging Regulation Methods	Five Stage: Bulk, Absorption, Float, Silent, Equalization
Charging Regulation Set Points	10 - 60 VDC
Data Logging	Last 128 days of operation
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 lower voltage battery from a higher voltage PV array
Power Conversion Efficiency	98.1% @60A with a 48V battery & nominal 48V PV array
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 oC Power derated above 40 oC
Environmental Rating	Indoor Type 1
Conduit Knockouts	Two 1/2 & 3/4" on the back; One 3/4" & 1" on each side;Two 1" 3/4" on the bottom
Warranty	5 years / optional 10 year warranty
Dimensions (HxWxD) (in)	Enclosure: 13.5 x 5.75 x 4 / Shipping Box: 18 x 11 x 8
Shipping Weight (lbs.)	14.0

OutBack Charge Controller Accessory

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
RTS - Outback Remote Temperature Sensor w/ 20' cable	704275	1.0	$29.00

FM80

The FLEXmax 80 is the latest innovation in Maximum Power Point Tracking (MPPT) charge controllers from OutBack Power Systems. The FLEXmax 80's innovative MPPT algorithm is both continuous and active, increasing your renewable energy yield up to 30%.Thanks to enhanced cooling, the FLEXmax 80 can operate at its full 80 amp maximum current rating in ambient temperatures as high as 104°F (40°C).

Included in the FLEXmax 80 are all of the features first developed by OutBack Power in the revolutionary MX60, such as support for a wide range of nominal battery voltages and the ability to step-down a high voltage solar array to recharge a low voltage battery. A built-in backlit display shows status information at the touch of a button. Enhanced network communications allow the FLEXmax 80 to be remotely programmed via the optional MATE system display and controller.

The new FLEXmax 80 is the only choice when you demand a high performance, efficient and customizable charge controller for your advanced power system.

FM80

Model Number	FM 80
Part Number	**705981**
Price	**$749.00**
Output Current Rating	80.0 Amps DC at 104F (40C) w/adj. current limit
Nominal Battery Voltage	12, 24, 32, 36, 48, 54, or 60 VDC
PV Maximum Open Circuit Voltage	150 VDC absolute max coldest conditions/145 VDC startup & op. max.
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 user adjustable with password protection
Data Logging	Last 128 days of operation
Equalization Voltage	Programmable voltage setpoint and duration - Auto termination
Temperature compensation	Automatic with optional RTS installed / 5.0 mVper degree C per 2V cell
Voltage Step-Down Capability	Can change a lower voltage battery from a higher voltage PV array
Power Conversion Efficiency	97.5% @80A with a 48V system - Typical
Digital Display	4 line 80 character 3.1" backlit LCD Display
Remote Interface	RJ45 Modular Connector CAT 5 Cable 8 wire
Operating Temperature Range	-40 to 60 oC Power derated above 40 oC
Environmental Rating	Indoor Type 1
Conduit Knockouts	One 1" on the back; One 1" - 1" on the left side; Two 1" on the bottom
Warranty	5 year warranty
Dimensions (HxWxD) (in)	Enclosure: 16.25 x 5.75 x 4 / Shipping Box: 21 x 10.5 x 9.75
Shipping Weight (lbs.)	15.75

Solar Charge Controller

The simplicity and high performance of the Steca Solarix PRS solar charge controller makes it particularly appealing. At the same time, it offers a modern design and a convenient display, all at an extremely attractive price. Several LEDs in various colours emulate a tank display, which gives information on the battery's state of charge. Here, Steca's latest algorithms are employed, resulting in optimal battery maintenance. The Solarix PRS charge controllers are equipped with an electronic fuse, thus making optimal protection possible. They operate on the serial principle, and separate the solar module from the battery in order to protect it against overcharging. For larger projects, the charge controllers can also be equipped with special functions. These include a night light function, a selectable charging plateau and deep-discharge protection voltages. Two year warranty.

Secta Solarix PRSt

More Features

- Temperature-adjusted SOC
- Automatic voltage detection
- PWM control
- Multistage charging technology
- Current compensated load disconnection
- LEDs, fixed / flashing, different colors, provide SOC and operation status-on Solarix line
- Reverse polarity protection of load,module & battery
- Extremely low electromagnetic emissions
- Integrated self test

Product Name and Description	Solariz PRS 1010	Solarix PRS 1515	Solarix PRS 2020	Solariz PRS 3030	Solarix PA RC 100
Part Number	**707063**	**706206**	**706207**	**706208**	**707123**
Price	**$67.60**	**$72.80**	**$80.60**	**$106.60**	**$130.00**
Max charge current at 25°C	10A	15A	20A	30A	N/A
Max load current at 25°C	10A	15A	20A	30A	N/A
Temperature compensation	-4mv/k/zelle				N/A
Admissible ambient temperature	-25 to 50°C				N/A
Connection terminal (fine/single wire)	#6/4 AWG				N/A
Weight (lbs.)	0.8				
Dimensions (mm)	187 x 96 x 45				
Enclosure	IP 32				
System voltage	12/24V				

SolSum™

The new Steca Solsum F-Line continues the huge success of one of the most used SHS controllers. With a power range of up to 10 A it automatically recognizes 12 V or 24 V it accommodates system sizes up to 240 W.
The circuit board is completely electronically protected and with the new designed LED user interface it is easy to check the battery state of charge at any time. Large terminals guarantee a simple connection of solar panels, battery and load. The brand new Solsum works on PWM as a low loss serial controller. Two year warranty.

Solsum 6.6F

More Features

- Overvoltage protection
- Series PWM controller
- Built-in electronic fuse
- Automatic voltage detection 12/24V
- Reverse polarity protection
- CE Certified
- Temperature Compensation
- Current compensated load disconnection

Product Name and Description	Solsum 6.6F (with LVD)	Solsum 8.8F (with LVD)	Solsum 10.10F (with LVD)
Part Number	707109	707120	707121
Price	$24.00	$32.00	$42.00
Max charge current at 50oC	6A	8A	10A
Load current at 50oC	6A	8A	10A
Connection terminal (fine/single wire)	#9/12 AWG		
Weight (lbs.)	0.33		
Dimensions (mm)	145 x 97 x 24		
Enclosure	IP32		
Ambient temperature	-25 to 50oC		
System voltage	12/24V		

XW Solar Charge Controller (XW SCC)

The Xantrex Solar Charge Controller is a photovoltaic (PV) charge controller that tracks the electrical maximum power point of a PV array to deliver the maximum available current for charging batteries. The XW SCC can be used with 12, 24, 36, 48, and 60-volt DC battery systems. Two or three-stage charging process, with manual equalization to maximize system performance and maintain expected battery life

- Maximum Power Point Tracking (MPPT) to deliver the maximum available power from a PV array to a battery bank
- Configurable auxiliary power output
- Two-line, 16-character liquid crystal display (LCD) and four buttons for configuration and system monitoring in stand alone applications
- Battery Temperature Sensor (BTS) to provide automatically temperature-compensated battery charging
- The Charge Controller is able to communicate its settings and activity to other Xanbus™ enabled devices
- Integrated PV ground-fault protection

Xantrex
XW-MPPT60-150

Model Number	XW-MPPT60-150
Part Number	705199
Price	$685.00
Array Short Circuit Current	60.0 Amps DC Maximum
Nominal Battery Voltage	12, 24, 36, 48 or 60 VDC
PV Maximum Open Circuit Voltage	150 VDC (140VDC operating)
Charging Regulation Methods	Three Stage: Bulk, Absorption, Float
Charging Regulation Set Points	13 - 80 VDC
Temperature compensation	Remote BTS included
Voltage Step-Down Capability	Can charge a lower voltage battery from a higher voltage PV array
Digital Display	2 line 16 character LCD Display
System Interface	Xanbus
Operating Temperature Range	-4 to 113F (-20 to +45 oC)
Environmental Rating	Indoor Type 1
Warranty	5 year warranty
Shipping Dimensions (HxWxD)	19 x 9 x 9.75" (483 x 229 x 350mm)
Shipping Weight (lbs.)	17.6 (8kg)

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 standalone 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 10. 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

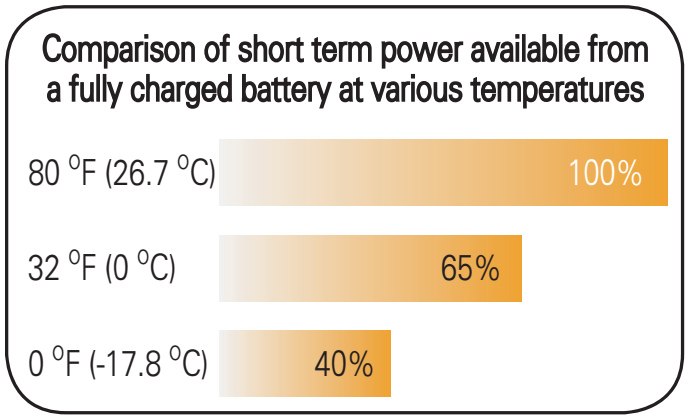
In battery lingo, a cycle on your battery bank occurs when you discharge your battery and then charge it back up to the same level. A lead acid battery is designed to absorb and give up electricity by a reversible electrochemical reaction. How deep a battery is discharged is termed **depth of discharge (DOD)** while the **state of charge (SOC)** is 100% minus the DO D. 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 are not 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 leadacid 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 charginging or discharging occuring, at 77 degrees F. **Discharging or charging will vary these voltages substantially.**

Source- Trojan Battery Company

Monitoring and 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 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

Equalization (EQ)

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.

Kyocera Solar Electric Products Catalog •October 2009

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 (20/100 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
2-KS-33PS	705191	2	1,750 / 2,470	13.75 x 8.25 x 24.81	$1,184.00	208.0
4-KS-21PS	705190	4	1,104 / 1,557	15.75 x 9.75 x 24.75	$1,703.00	230.0
4-KS-25PS	703091	4	1350 / 1,900	15.75 x 10.63 x 24.75	$2,130.00	315.0
6-CS-17PS	703121	6	546 / 770	22.0 x 8.25 x 18.25	$1,316.00	221.0
6-CS-21PS	703123	6	683 / 963	22.0 x 9.75 x 18.25	$1,643.00	271.0
6-CS-25PS	703122	6	820 / 1156	22.0 x 11.25 x 18.25	$1,905.00	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 S-460

Product Name and Description	Part Number	Amp Hour (20/100 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
Surrette S-460	703120	350 / 460	12.3 x 7.125 x 16.75	$484.00	117.0
Surrette S-530	703118	400 / 530	12.3 x 7.125 x 16.75	$550.00	127.0

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 Solar Batteries

MK Power-Tech Batteries

Power-Tech Batteries are specially designed for the long, deep discharges typical of marine, wheelchair, RVs, emergency lighting, golf cars, other deep cycle applications as well as engine starting. The absorbed glass mat (AGM) design provides maintenance-free service and insures that the Power-Tech Batteries are spill proof and leakproof.

More Features:

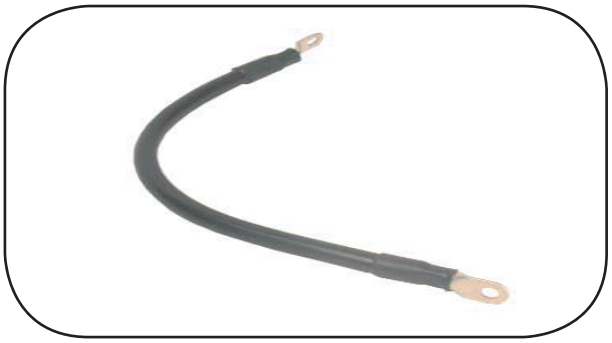
- Valve-regulated
- Gelled-electrolyte or Absorbed Glass Mat
- Compucast, power path grids are computer controlled oxide
- Low standing loss (less than 2%)
- Tank formed plates
- Rated non-spillable by ICAO, IATA and DOT
- Lead calcium construction
- Sealed construction eliminates periodic watering, corrosive acid fumes and spills.
- Electrolyte will not stratify, no equalization charging required.
- Increases durability and deep-cycle ability for heavy demand applications.
- 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 (20/100 Hr. Rate)	Size (in.) (L x W x H)	Price	Shipping Weight (lbs.)
8GU1 Gel	703095	31.6 / 36.5	7.75 x 5.13 x 7.25	$120.00	24.0
8G22NF Gel	703100	50.9 / 58.2	9.38 x 5.50 x 9.25	$198.00	37.0
8G24 Gel	703096	73.6 / 84.0	10.25 x 6.75 x 9.88	$270.00	53.0
8G27 Gel	703104	86.4 / 99.0	12.75 x 6.75 x 9.88	$315.00	63.0
8G4D LTP Gel	703098	183.0 / 210.0	20.75 x 8.50 x 11.0	$656.00	127.0
8G8D LTP (T975 Term)	703099	225.0 / 265.0	20.75 x 11.0 x 11.0	$788.00	157.0
8G8D LTP (SAE Term)	703105	225.0 / 265.0	20.75 x 11.0 x 10.88	$788.00	157.0
8A27 AGM	703107	92.0 / 106.0	12.75 x 6.88 x 9.88	$286.00	63.0
8AU1 AGM	705182	33.0 / 38.0	8.31 x 5.13 x 7.25	$104.00	24.0
8A31DT AGM	705183	105.0 / 121.0	12.94 x 6.75 x 9.75	$328.00	70.0
8A4D LTP AGM	705181	200.0 / 230.0	20.75 x 8.5 x 10.0	$612.00	129.0

Battery Accessories

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 Used

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
#2/0 x 7.5 in. Red	501410	$15.00	0.38
#2/0 x 7.5 in. Black	501102	$15.00	0.38
#2/0 x 12 in. Black	501101	$20.00	0.50

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
#2/0 x 18 in. Red	501106	$22.00	0.75
#2/0 x 18 in. Black	501107	$22.00	0.75
#2/0 x 60 in. Pair	501132	$68.00	8.0
#4/0 x 18 in. Red	501108	$30.00	1.50
#4/0 x 18 in. Black	501109	$30.00	1.50

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	703130	$7.00

Water Miser Cap

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.

SMA PV Combiner Boxes

The Sunny Boy Combiner Boxes, SBCB 6-90 & SCCB 28-420, make installing large projects easier. The large NEMA 3R enclosures provide ample room for conductors and will help reduce installation time. Designed with installers in mind, you'll find the new SBCB & SCCB Combiner Boxes, a welcome addition to the SMA product line.

Product Name and Description	Part Number
SBCB 6 Combiner box 600VDC Max, 90 Amps Max output current (72A continuous),3R Enclosure, 6 positive, 6 negative PV inputs, 10-6 AWG input wire size, 6-300MCM output wire size, 1-20 Amp circuits. Midget input fuse, 10"H x 8"W x 6"D, Shipping weight: 12 lbs.	705454
SBCB 12 Combiner box 600VDC Max, 3R Enclosure, 12 PV inputs, 10-6 AWG input wire size, 6-300MCM output wire size, 1-20 Amp circuits. Midget input fuse, 16"H x 16"W x 6"D, Shipping weight: 30 lbs	705455
SCCB 28 Combiner box 600VDC Max, 420 Amps Max output current (340A continuous),3R Enclosure, 28 positive, 28 negative PV inputs, 10-6 AWG input wire size, 6-300MCM output wire size, 15 Amps 600VDC Midget Max. input fuse size, 20"H x 20"W x 8"D, Shp. wt.: 55 lbs	704184
SCCB 52 Combiner box 600VDC Max, 4 - 8 Amp circuits, 3R Enclosure, 52 positive, 52 negative PV inputs, 10-6 AWG input wire size, 6-300MCM output wire size, 42"H x 30"W x 8"D, Ships via truck, call for details	705456
Combi-Switch - Combination DC disconnect and PV combiner box. The combi-Switch is designed for the Sunny Boy 6000U inverter. Four-circuit fused protection in a NEMA 3R steel enclosure. 5 year warranty	704200
DC Disconnect - 600VDC, 18A (per pole), 30A (2 poles in series) Square D HU361RB Lockable, Visable blade disconnect. ETL listed, NEMA 3R Enclosure, 5 year warranty	704196
Fused DC Disconnect - 600VDC, 18A (per pole), 30A (2 poles in series) Square D H361RB Lockable, Visable blade disconnect. ETL listed, NEMA 3R Enclosure,5 year warranty, Fuses not included.	704197

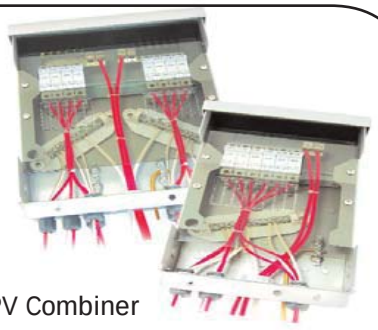
SMA SBCB 6

Combi-Switch - DC Disconnect
Fused DC Disconnect

Outback Power System PV Combiner [FWPV]

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 150 VDC) or touch safe type fuse holders for high voltage systems (up to 600 VDC). FWPV 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 FWPV is easily field configured to match your PV system design and ampacity requirements. The FWPV PV Combiner provides series over-current protection of PV module circuits allowing NEC compliant installation. FWPV-8 includes space for up to **eight** 150 VDC rated breakers or **six** 600 VDC rated fuse holders. Includes one positive output bus bar with two #2/0 terminals, one insulated negative TBB and one ground bar. The FWPV-12 accommodates up to **twelve** 150 VDC rated breakers or **eight** 600 VDC fuse holders. Includes two insulated neg. TBB's, one ground bar and two combiner bus bars. Enclosure only without breakers or fuse holders.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
FWPV-8	706358	$139.00	5.0
FWPV-12	706359	$199.00	10.0



FWPV Combiner

PV Array Breakers

DIN rail snap-in mount with #2 AWG setscrew type compression terminals. ETL listed for up to 150 VDC. **Maximum of twelve breakers.** Fits in the PSPV only.

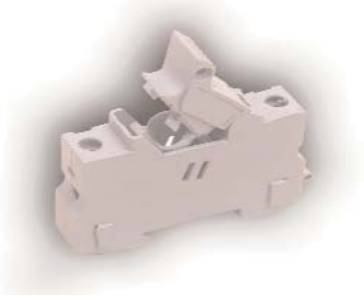
Product Name and Description	Part Number	Price
OBB-6-150VDC-DIN	704245	$14.00
OBB-9-150VDC-DIN	705483	$14.00
OBB-10-150VDC-DIN	704246	$14.00
OBB-15-150VDC-DIN	704247	$14.00
OBB-20-125VDC-DIN	705484	$14.00
OBB-30-125VDC-DIN	704248	$14.00

OBB-15-125VDC-DIN

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 eight fuseholders in one PSPV enclosure.**

Product Name and Description	Part Number	Price
OBFH-30-600VDC-DIN (Fuse Holder)	704244	$18.00
OBF-6-600VDC (1A fuse)	705460	$18.00
OBF-10-600VDC (10A fuse)	704578	$18.00
OBF-15-600VDC (15A fuse)	705459	$18.00



OBFH-30-600VDC-DIN

OutBack Power Systems

PV Ground Fault Protection

OutBack DC Ground Fault Protection System

The OutBack Power systems GFP is required for PV arrays mounted on dwelling roofs. A GFP protects wiring and system components for one or two PV arrays: Dual 80 amp PV circuits 125 VDC max Voc. Requires three small breaker spaces. The GFP has 1/4" stud terminals. The OBB-GFP-80D-125VDC PNL system includes the GFP unit, a ground bus bar, neutral and ground connection wiring and mounting hardware. The PSR includes mounting for only one GFP along with two PV disconnects and one large battery breaker. For use in OutBack PSR, FW1000-DC and FW500-DC's.

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
OBDC-GFP-80D-125VDC-PNL	704571	$129.00	2.0

OBDC

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).	704219	$329.00	16.0
DC175 - 175 Amp breaker and enclosure (for #2/0 cables).	704222	$329.00	16.0
GJ250 - Additional 250 Amp breaker	704223	$195.00	3.0
GJ175 - Additional 175 Amp breaker	705225	$195.00	3.0
CD60DC - 60 Amp circuit breaker	704225	$39.00	1.0
CD15 - 15 Amp circuit breaker	705451	$35.00	1.0
CD20 - 20 Amp circuit breaker	704226	$35.00	1.0
DCBB - Negative / ground block handles up to four #4/0 cables	704224	$75.00	1.0

DC250
Breaker / Enclosure

CD15 Circuit Breaker

MidNite Solar, Inc. PV Combiner [MNPV]

The MNPV3 and MNPV6 combiners are rated for outdoor use. Although designed primarily for combining PV strings up to 150VDC, the MNPV may be used for combining high voltage strings using MNATM fuses up to 15 Amps. The use of touch safe DIN rail mount fuse holders and fuses allow operation up to 600 Volts. The MPNPV6 combiner comes with two copper bus bars. One for circuit breakers and one for fuses. The MNPV3 busbar is designed for circuit breakers only. MNPV6 is rated for 150VDC, 120 Amps total output.
MNPV6 excepts up to four strings using touch safe fuse holders rated for 600VDC, 60 Amps.
Can be used for a DC load center by using MNPV breakers.
MNPV combiners are powder coated aluminum.
PV negative bus bar and chassis ground bus bar have 14 usable openings (10 #14-6 and 4 #1/0-14)
Both feature a dead front cover for safety.
Knock outs on bottom and sides.
ETL listed for exterior use in the US and Canada for up to 3/12 pitch MNEPV breakers are available in: 1,2,3,4,5,6,7, 8,9,10,12,15,20,30,40,50 & 63 Amps

MNPV 6 Combiner

Product Name and Description	Part Number	Price	Shipping Weight (lbs.)
MNPV-3	706521	$89.00	2.0
MNPV-6	706947	$109.00	4.0
MNTS Touch Safe fuse holder	706949	$13.00	<1.0
MNATM6 600VDC, 6 Amp fuse	706971	$13.00	<1.0
MNATM10 600VDC, 10 Amp fuse	706972	$13.00	<1.0
MNATM15 600VDC, 15 Amp fuse	706973	$13.00	<1.0
MNPV6 BUSBAR	706522	$15.00	<1.0
MNPV6 FUSE BUSBAR	706528	$13.00	<1.0
MNPV3 BUSBAR	706523	$13.00	<1.0
MNEPV15 DIN rail mount breaker	706524	$13.00	<1.0
MNEPV20 DIN rail mount breaker	706974	$13.00	<1.0
MNEPV30 DIN rail mount breaker	706975	$13.00	<1.0

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.)
OBB-250-125VDC-PNL	704254	250	3/8"	$137.00	3.0
OBB-175-125VDC-PNL	704255	175	3/8"	$137.00	3.0
OBB-125-125VDC-PNL	704249	125	5/16"	$63.00	1.0
OBB-100-125VDC-PNL	704256	100	5/16"	$63.00	1.0
OBB-80-150VDC-PNL	705480	80	1/4"	$27.00	1.0
OBB-60-150VDC-PNL	704257	60	1/4"	$27.00	1.0
OBB-50-150VDC-PNL	705468	50	1/4"	$27.00	1.0
OBB-40-150VDC-PNL	704258	40	1/4"	$27.00	1.0
OBB-30-150VDC-PNL	704259	30	1/4"	$27.00	1.0
OBB-20-125VDC-PNL	704279	20	1/4"	$27.00	1.0
OBB-15-150VDC-PNL	704260	15	1/4"	$27.00	1.0
OBB-10-150DC-PNL	704261	10	1/4"	$27.00	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
OBB-60-277VAC-DIN	704567	60	1/2"	$20.00
OBB-50T-480VAC-DIN	704567	50	1 1/2"	$63.00
OBB-50D-480VAC-DIN	704243	50	1"	$41.00
OBB-50-277VAC-DIN	704242	50	1/2"	$20.00
OBB-30T-480VAC-DIN	704565	30	1 1/2"	$63.00
OBB-30D-480VAC-DIN	704564	30	1"	$41.00
OBB-30-277VAC-DIN	705470	30	1/2"	$20.00
OBB-15-277VAC-DIN	704563	15	1/2"	$20.00
OBB-10-277VAC-DIN	704562	10	1/2"	$20.00
OBB-25D-240VAC-DIN	705466	25	1"	$41.00
OBB-20D-240VAC-DIN	704561	20	1"	$41.00
OBB-20-120VAC-DIN	704241	20	1/2"	$20.00
OBB-15D-240VAC-DIN	705469	15	1"	$41.00
OBB-15-120VAC-DIN	704240	15	1/2"	$20.00

AC Overcurrent Protection

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 96%) 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. Most utility line-tie inverters produce 208,240 or 480VAC.

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 ini an enclosure which can also house shunts and additional equipment or circuit breakers.

Shunts

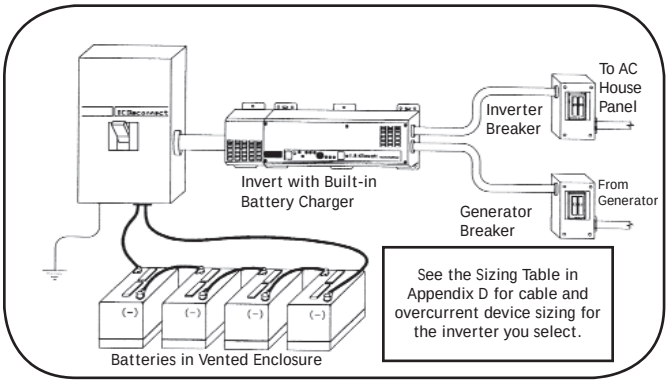
Used to read the amperage flowing between the battery and inverter, this device is installed in the negative conductor. It can easily be housed in the disconnect or its own enclosure.

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.

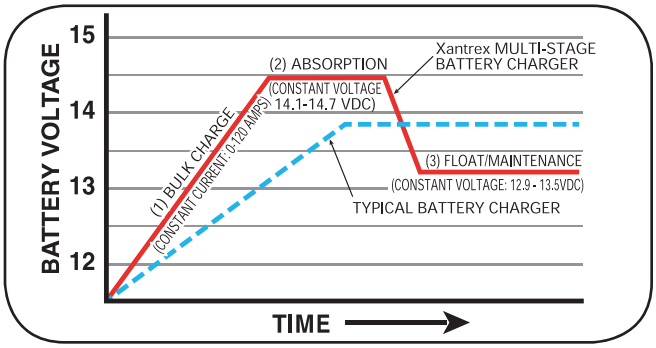
Factory battery charger settings on most inverter-charger combinations are optimal for a lead acid (liquid electrolyte) battery bank of 250-300 amp hours in a 70°F environment. If your installation varies from these conditions, you will obtain better performance from your batteries if you adjust the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

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.



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.

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 GT Utility Interactive Inverters

The GT Series 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. GT inverters incorporate all of the NEC and IEEE required AC and DC input/output and grounding connections as well as an AC/DC disconnect switch. Ground fault protection is included for installer convenience. With a NEMA 3R rated enclosure the inverter can even be mounted on an outside wall near your utility service entrance. Conduit box is removable. **Standard ten year warranty.**

GT Inverter

The GT's proprietary Maximum Power Point Tracking (MPPT) technology maximizes power extraction from a PV array of any type (single crystal, poly-crystalline or amorphous).

GT inverters come with a built-in backlit LCD display that shows system status and cumulative energy production 24 hours a day with just a knock. They also use the Xanbus Communications protocol, enabling them to communicate with other units connected in parallel within the system. From any inverter in the chain, you can read the system performance or that individual inverters performance.

The GT is listed to UL 1741-2005. It also meets IEEE 1547. Complies with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.

Product Name	GT2.8	GT3.3N	GT3.8	GT4.0N	GT5.0
Part Number	**705226**	**705227**	**706354**	**704135**	**704136**
Price	**$2,375.00**	**$2,875.00**	**$3,130.00**	**$3,130.00**	**$3,950.00**
Nominal output power	2.8 kVA	3.3 kVA	3.8 kVA	4.0 kVA	5.0 kVA
AC Voltage - Nominal	240 VAC/208 VAC	240 VAC/208 VAC	240 VAC/208 VAC	240 VAC/208 VAC	240 VAC/208 VAC
AC Voltage - Min/Max	211-264 (240) / 183-229 (208)				
MPPT Voltage range (CEC)	195-550 VDC	200-400 VDC	195-550 VDC	240-480 VDC	240-550 VDC
MPPT Operating range	193-550 VDC	200-550 VDC	195-550 VDC	235-550 VDC	235-550 VDC
Max. input current DC	15.4A (240) -14.9 (208)	17.5A (240) -16.5 (208)	20.8A (240) -19.5 (208)	17.0A (240) -17.0 (208)	22.0A (240) -20.0 (208)
Maximum array ISC	24 ADC				
Maximum Array VOC	600 VDC				
AC Output Characteristics	Current source				
Frequency - Nominal	60Hz				
Certifications	IEEE 1547 and UL 1741-2005				
CEC Efficiency (240 - 208)	94.0 - 93.5%	95.5 - 95.0%	95.0 - 95.0%	95.5 - 95.0%	95.5 - 95.0%
Max Inverter Efficiency	95.0 - 94.6%	95.9 - 95.6%	95.9 - 95.6%	96.0 - 95.7%	95.9 - 95.5%
AC Output Waveform	Sine wave				
THD	<3%				
Max. Cont. Output Current	11.7 - 13.0 A	13.8 - 14.9 A	15.8 - 16.8 A	16.7 - 18.3 A	21.0 - 22.0 A
Rated Temp. Range	-13° - 149°F (-25°C - +45°C)				
User Display: tap on the Xantrex logo to cycle through the screens.	Backlit alphanumeric LCD display - AC watts, kWh today, array voltage/current, and lifetime status messages, time on line, grid voltage and Hz.				
Enclosure Type	NEMA 3R, Rainproof				
Disconnect Switch	Integrated switch (disconnects both AC/DC & meets NEC 690)				
Inverter Dimensions	28.5" x 16" x 5.75" (724 mm x 403 mm x 145 mm)				
Inverter Weight	49.0 lbs (22.2 kg)		58.0 lbs (25.8 kg)		
Shipping Weight	57.0 lbs (25.9 kg)		65.0 lbs (27.2 kg)		

GT Inverter Accessories

Product Name and Description	Part Number	Price
GT Solar Inverter Monitor *Just plug in the Cat 5 cable and mount the monitor for full system information*	704133	$300.00

xantrex™ TR Series Modified Sine Wave Inverters

The TR 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 TR Series inverters utilize the same enclosure, only the input voltage, output wattage and weight vary.

More Features

- 1500 to 3600 watts of continuous power.
- Digital display with a robust ON/OFF membrane switch
- Standard, built-in programmable battery charger.
- Series stackable for 240 VAC output (excluding 50hz).
- 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.

TR Series Inverter

Product Name and Description	TR1512-120-60	TR2412-120-60
Part Number	**706325**	**706327**
Price	**$950.00**	**$1145.00**
Nominal Input Voltage (Volts)	12VDC	12VDC
Continuous Power (Watts)	1500	2400
Surge Short Circuit (Amps Peak-10 sec)	50 +/-5	80 +/-8
Efficiency - Peak	>90%	>92%
Continuous Output (Amps AC)	12.5	20.0
Surge Overload (10 sec)	3000 VA	4800 VA
Search Mode Consumption	0.35 Amps	
DC Current @ Rated Power (Amps)	157.0	252.0
Input Voltage Range DC	11 - 15	
Output Voltage / Regulation	120VAC / +/- 5%	
Waveform	Modified sine wave	
Power Factor Allowed	0.8 to 1.0 (leading or lagging)	
Frequency	60Hz +/- 0.04%	
Adjustable Load Sensing	5 to 240W	
Series Stackable - 240VAC	Yes - Stacking cable included	
Automatic Transfer Relay	30A	
Maximum Charger Rate (Adjustable)	10-70A	14-100A
Three Stage Charging	Yes	
Temp. Comp. Probe	Yes - included	
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.)	50.0	52.0

Product Name	TR1524-120-60	TR2424-120-60	TR3624-120-60	TR1512-230-50	TR1524-230-50	TR2424-230-50
Part Number	**706326**	**706328**	**706329**	**706340**	**706341**	**706342**
Price	**$950.00**	**$1145.00**	**$1425.00**	**$1000.00**	**$1000.00**	**$1250.00**
Nominal Input Voltage (Volts)	24VDC	24VDC	24VDC	12.6VDC	25.2VDC	25.2VDC
Continuous Power (Watts)	1500	2400	3600	1500	1500	2400
Surge Short Circuit (Amps Peak-10 sec)	50.0 +/-5	80.0+/-8	120.0+/-12	26.5+/-2.5	26.5+/-2.5	42.0+/-4
Efficiency - Peak	>92%	>93%	>94%	>92%	>91%	>94%
Continuous Output (Amps AC)	12.5	20.0	30.0	6.5	6.5	10.4
Surge Overload (10 sec)	3000 VA	4800 VA	7200 VA	3000 VA	3000 VA	4800 VA
Search Mode Consumption	0.17 Amps		0.20 Amps	0.35 Amps	0.20 Amps	
DC Current @ Rated Power (Amps)	76.0	120.0	186.0	158.0	77.0	121.0
Input Voltage Range DC	22 - 30			11 - 15	22 - 30	
Transfer Time (typical)	<40ms (wide), <20ms (narrow)					
Waveform	Modified sine wave					
Power Factor Allowed	.8 to 1.0 (leading or lagging)					
Frequency	60Hz +/- 0.04%			50Hz / +/- 0.04%		
Adjustable Load Sensing	5 to 240 W					
Series Stackable - 240VAC	Yes - Stacking cable included			No		
Automatic Transfer Relay	30A			15A		
Maximum Charger Rate (Adjustable)	5-35A	10-70A	10-70A	10-70A	5-35A	10-70A
Three Stage Charging	Yes					
Temp. Comp. Probe	Yes - included					
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.)	50.0	55.0	55.0	52.0	52.0	52.0

TR Series Inverter Options

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
TR-Remote on/off Switch Remote battery temp. sensor with 15 ft. cable	706344	1.0	$150.00
TR-Conduit Box Conduit box - Can be used on the AC or DC side of inverter	706343	5.0	$250.00

xantrex™

GT Series Inverters

The Xantrex GT100 and GT250 incorporate an advanced Maximum Power Point Tracking (MPPT) algorithm to maximize the energy harvested from a PV array. To reduce power losses during the conversion process, the inverter uses the latest switching devices and a high-efficiency transformer to achieve a weighted CEC efficiency of 96%.

To ensure reliability, the Xantrex GT100 and GT250 and their sub-components are tested using Highly Accelerated Life Testing (HALT). HALT combines thermal and vibration technologies to stress a product beyond its specifications. This enables Xantrex to develop products and test them to a much higher standard than other inverter manufacturers. High reliability of the Xantrex GT100 and GT250 reduces system downtime and results in higher energy production.

Xantrex GT Series Grid Tie Solar Inverters are based on a reliable platform that is used in grid-connected photovoltaic (PV) and wind turbine applications throughout North America and Europe.

GT Series Inverter

Features

- Ultra-efficient design with industry-leading CEC efficiency of 96%, including isolation transformer
- Integrated design with transformer and AC/DC disconnects in one unit
- Night-time disconnect to reduce tare loss
- Integrated ground-fault detection and interruption
- Soft-start circuit to reduce nuisance trips
- Sealed design does not require filters or external air to cool sensitive components
- Back and sides of unit designed for zero clearance installations to minimize inverter space requirements
- Wiring access points on bottom, sides, back and top of inverter
- Removable air outlet allows inverter to be mated with venting ductwork
- Designed for forklift or sling transportation
- E-coated and powder coated steel enclosure for maximum corrosion resistance
- Designed for maximum reliability with film-type capacitors, bus bars in the power path, and uses compression lugs and disc springs to maintain torque
- Bright fluorescent green vacuum display with UV cover for ease of reading in sunlight
- RS485/Modbus and RS232 communications
- Available with either a five-year or ten-year warranty

Options:

- Fused sub-array combiner integrated in the inverter enclosure
- Positive-ground configuration
- Remote monitoring and control options using either Xantrex or third-party products
- Preventative maintenance programs

See next page for specifications and part numbers

Model	GT 100-208	GT100-480	GT250-480
Part Number	**705205**	**705206**	**705207**
Price	**$64,142.86**	**$61,285.71**	**$103,071.43**
Nominal Input Voltage (Volts)	208VAC	480VAC	480VAC
Continuous Power (Watts)	100 kW	100 kW	250 kW
Max. AC Line Current	309 A rms	137 A rms	342 A rms
Power Factor	> 0.99		
Efficiency - CEC rating	96.0%		
Max. DC Input Current	347 ADC	347 ADC	867 ADC
DC Input Voltage Range	300 - 600 VDC		
PowerTracking Window Range	300 - 600 VDC		
Frequency	60Hz (+0.5Hz / -3.0Hz)		
Ambient Temperature	-5F to 122F (-15C to 50C)		
Enclosure Rating	NEMA 3R (outdoor rating)		
Dimensions (HxWxD)	73.3" x 67.0" x 46.1" (1862 x 1702 x 1171mm)		86.3x90.0x46.1 (2192x2286x1171)
Shipping Weight	3000 lb (1361 kg)	3000 lb (1361 kg)	4000 lb (1814)

Morningstar Inverters

Model	SureSine-115V-UL	SureSine-115V	SureSine-220V
Part Number	**706331**	**703077**	**703072**
Price	**$310.00**	**$299.00**	**$308.00**
Nominal Input Voltage (Volts)	12VDC		
Continuous Power (Watts)	300		
Surge Power (10 minutes)	600		
Efficiency - Peak	92%		
Total Harmonic Distortion (THD)	<4%		
Self Consumption	450mA (on, no load) 25mA (off) 55mA (stand-by)		
Standby Threshold	~ 8 watts		
Low Voltage Disconnect (user selectable)	11.5v or 10.5v		
Low Voltage Reconnect (user selectable)	12.6v or 11.6v		
LVD Delay Period	4 minutes		
Input Voltage Range DC	10.0 - 15.5		
High Voltage Disconnect	15.5v		
High Voltage Reconnect	14.5v		
High Temperature Disconnect	95°C (heatsink)		
High Temperature Reconnect	80°C (heatsink)		
AC Wire Terminals	12AWG max		
DC Wire Terminals	14 - 2 AWG		
Remote On/Off Terminals	24 - 16 AWG		
Output Voltage / Regulation	120VAC / +/- 10%	120VAC / +/- 10%	220VAC / +/- 10%
Frequency	60Hz +/- 0.01%	60Hz +/- 0.01%	50Hz +/- 0.01%
Enclosure	IP20 Cast Anodized Aluminum		
Operating Ambient Temp	-40 to +45°C		
Dimensions (H x W x D)	8.4 x 6.0 x 4.1 in - 213 x 152 x 105 mm		
Shipping Weight (lbs.)	10.0 lbs - 4.5 kg		

* 300 Watt Pure Sine Wave Inverter
* Up to 600 Watt Surge Capability
* High Efficiency and Low Self-consumption
* No Internal Cooling Fan
* Reverse Polarity Fused
* AC Short Circuit Protected
* AC Overload Protected
* High Voltage Disconnect
* Low Battery Disconnect
* High Temperature Disconnect
* Two Year Warranty
* Epoxy Encapsulated Transformer & Inductors
* Conformal Coated Circuit Boards

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 FX Series is also available in export versions. Up to eight FX inverter / chargers can be connected together to provide up to 24 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. 2 year warranty.

FX Series Inverter
Shown with optional FX-ACA& FX-DCA

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	FX2524T	FX2012T	FX3048T
Part Number	**704310**	**705474**	**704311**
Price	**$2369.00**	**$2369.00**	**$22369.00**
Continuous Output Power	2500 VA	2000 VA	3000 VA
Continuous Output Current at 25^{o}	20.8 amps AC RMS	17 amps AC RMS	25 amps AC RMS
Idle Power (120 VAC Output No Load)	20W DC		23W DC
Output Voltage	120 VAC / 60Hz		
DC Input Voltage (Nominal)	24 VDC	12 VDC	48 VDC
Efficiency - Typical	92%	90%	93%
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	55 Amps DC	80 Amps DC	35 Amps DC
Frequency Range	54-66Hz		
DC Input Voltage Range	21 - 34 VDC	10 - 16 VDC	42-68 VDC
Min. Recommended DC Breaker	OBDC-175	OBDC-250	OBDC-100
Dimensions (in.) (H x W x L)	13 x 8.25 x 16.25 (Shipping: 21.75 x 13 x 22)		
Shipping Weight (lbs.)	67.0	67.0	67.0

Product Name	FX2012ET	FX2024ET	FX2348ET
Part Number	**705477**	**705478**	**705479**
Price	**$2469.00**	**$2469.00**	**$2469.00**
Continuous Output Power	2000 VA	2000 VA	2300 VA
Continuous Output Current at 25o	8.7 amps AC RMS	8.7 amps AC RMS	10 amps AC RMS
Idle Power (120 VAC Output No Load)	20 W DC	20 W DC	23 W DC
Output Voltage	230 VAC / 50 Hz		
DC Input Voltage (Nominal)	12 VDC	24 VDC	48 VDC
Efficiency - Typical	90%	92%	93%
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	100 Amps DC	55 Amps DC	35 Amps DC
Frequency Range	44-56 Hz		
DC Input Voltage Range	10.5-17 VDC	21-34 VDC	42-68 VDC
Min. Recommended DC Breaker	OBDC-250	OBDC-175	OBDC-100
Dimensions (in.) (H x W x L)	13 x 8.25 x 16.25		
Shipping Weight (lbs.)	67.0	67.0	67.0

GTFX Series

OutBack grid-tie inverters feature Battery back-up with close-to batteryless inverter system performance. 2 year warranty-5 yr. optional

Features

- UPS grade AC transfer switch system
- Built-in automatic “silent” sell mode
- More tolerant of partially shaded PV arrays
- Easy system expansion and flexible design
- Single, split or three phase AC output
- Long battery life through intelligent control of charging process
- MATE display can be placed indoors with RS 232 PC connection
- 24 or 48 VDC battery banks
- ETL Listed
- Export versions are available

GTFX Series

Product Name	GTFX2524 Sealed	GTFX3048 Sealed	GVFX3524 Vented	GVFX3648 Vented
Part Number	**705461**	**705462**	**704298**	**704299**
Price	**$2369.00**	**$2369.00**	**$2569.00**	**$2569.00**
Continuous Output Power	2500 VA	3000 VA	3500 VA	3600 VA
Continuous Output Current at 25o	21 Amps AC RMS	25 Amps AC RMS	29 Amps AC RMS	30 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 / 60 Hz			
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	85 Amps DC	45 Amps DC
Frequency Range	Grid-tie mode +/- 5 Hz / Line-tie mode +/- 2.0 Hz			
DC Input Voltage Range	20-33 VDC	40-66 VDC	20-33 VDC	40-66 VDC
Min. Recommended DC Breaker	OBDC-175	OBDC-100	OBDC-250	OBDC-175
Dimensions (in.) (H x W x L)	13 x 8.25 x 16.25		12 x 8.25 x 16.25	
Shipping Weight (lbs.)	67.0	67.0	62.2	62.2

VFX Series

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. Standard 2 year warranty, optional 5 year.

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	**704293**	**704292**	**704291**
Price	**$2569.00**	**$22569.00**	**$2569.00**
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 / 60 Hz		
DC Input Voltage (Nominal)	12 VDC	24 VDC	48 VDC
Efficiency - Peak	> 90%	92%	93%
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
Min. Recommended DC Breaker	OBDC-250	OBDC-250	OBDC-175
Dimensions (in.) (H x W x L)	12 x 8.25 x 16.25		
Shipping Weight (lbs.)	62.2		

Product Name	VFX2612E	VFX3024E	VFX3048E
Part Number	**705471**	**705476**	**705475**
Price	**$2679.00**	**$2679.00**	**$2679.00**
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	100 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
Min. Recommended DC Breaker	OBDC-250	OBDC-250	OBDC-175
Dimensions (in.) (H x W x L)	12 x 8.25 x 16.25		
Shipping Weight (lbs.)	62.2		

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. Standard 2 year warranty-optional 5 year.

More Features

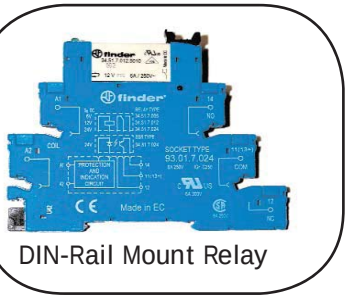
- Ultra clean AC power
- Extremely rugged
- Extremely efficient
- Intelligent battery charger
- Very quiet
- Easy system expansion
- Serviceable
- Defeatable neutral to GND switching
- Capable tech support help
- Coolness factor

Product Name	FX2532MT	FX2524MT	FX2012MT
Part Number	**705481**	**705482**	**705472**
Price	**$2369.00**	**$2369.00**	**$2369.00**
Continuous Output Power	2500 VA	2500 VA	2000 VA
Continuous Output Current at 25o	20.8 amps AC RMS	20.8 amps AC RMS	17 amps AC RMS
Idle Power (120 VAC Output No Load)	~21 W DC	~20 W DC	~20 W DC
Output Voltage	120 VAC / 60Hz		
DC Input Voltage (Nominal)	32 VDC	24 VDC	12 VDC
Efficiency - typical	92%	92%	90%
Output Voltage Regulation	+/- 2% typical		
Continuous DC Charge Rate	35 amps DC	55 amps DC	80 amps DC
Frequency Range	54-66 Hz		
DC Input Voltage Range	28-45.3 VDC	21-34 VDC	10.5-17 VDC
Min. Recommended DC Breaker	OBDC-125	OBDC-175	OBDC-250
Dimensions (in.) (H x W x L)	13 x 8.25 x 16.25		
Shipping Weight (lbs.)	67.0		

Product Name	VFX3524M	VFX2812M
Part Number	**705473**	**704296**
Price	**$2569.00**	**$2569.00**
Continuous Output Power	3500 VA	2800 VA
Continuous Output Current at 25o	29.2 amps AC RMS	23.3 amps AC RMS
Idle Power (120 VAC Output No Load)	~20 W DC	~20 W DC
Output Voltage	120 VAC / 60Hz	
DC Input Voltage (Nominal)	24 VDC	12 VDC
Efficiency - typical	92%	90%
Output Voltage Regulation	+/- 2% typical	
Continuous DC Charge Rate	85 amps DC	125 amps DC
Frequency Range	50 - 70 Hz	
DC Input Voltage Range	21.34 VDC	10.5 - 17 VDC
Min. Recommended DC Breaker	OBDC-250	OBDC-250
Dimensions (in.) (H x W x L)	12 x 8.25 x 16.25	
Shipping Weight (lbs.)	62.2	

OutBack FX Series Inverter Options

Product Name and Description	Part Number	Price
DCA Aluminum conduit adapter required when mounting a FX inverter to any OutBack DC enclosure or to a 2" conduit.	704269	$45.00
FW-ACA -AC wiring compartment extension and 2" conduit adapter. Also needed to connect an FX inverter to an OutBack AC enclosure.	704270	$45.00
FW-SP-ACA Surge Protector, fits in the FW-ACA for FW-500 & 1000 systems. 120-240VAC/12-48VDC operating range.	705485	$259.00
FW-SP-250 Surge Protector, fits inside FW-250 AC side. Specs are the same as above.	705486	$259.00
FW-SP-R Surge Protector replacement board.	703487	$209.00
RTS -Outback Remote Temperature Sensor w/ 20' cable	704275	$29.00
DIN-Rail Mount Relay - Use to control up to a 6A/250V~ circuit such as an aux fan or generator start from the aux output on the FX.	704308	$45.00



DIN-Rail Mount Relay

RTS

OutBack System Management Remote Monitor and Control

The OutBack MATE and MATE2 are complete system controllers and displays for the OutBack FX inverter/charger. They provide a display of operations as well as allow for control and adjustment of the product se points. The OutBack MATEs also coordinate the operation of the entire inverter/charger system to maximize performance and to prevent multiple products from conflicting.

Through the use of an OutBack HUB communications manager, a single OutBack MATE, MATE2 or MATE2M is able to connect to multiple FX inverter/chargers and other OutBack products. A maximum of ten OutBack products will be able to be connected to a single MATE via a HUB using CAT 5 type Ethernet cabling with 8 wire RF45 modular connectors.

Product Name and Description	Part Number	Price
MATE (White) -Shipped with 50ft CAT 5 interconnect cable with RS232 port	704272	$295.00
MATE_B (Black) -Shipped with 50ft CAT 5 interconnect cable with RS232 port	704302	$295.00
MATE2 -Flush mount Mate for wall mounting. Same as standard MATE, except flush mount. with RS232 port	704305	$295.00
MATE2M - Reduced menu (non-grid-tie) for use in RV's and boats. Without RS232 port	704306	$219.00
HUB-4 Communications **Manager** -Allows the MATE to control up to four FX2000 inverters / chargers and MX60 MPPT charge controllers.	704273	$195.00
HUB-10 Communications **Manager** -Allows the MATE to control up to ten FX2000 and MX60.	704276	$375.00
FN-DC FLEXnet DC -Advanced DC System Monitor.	707388	$379.00

MATE

MATE2

Sunny Boy 3000US/4000US

SMA is proud to introduce our new line of inverters updated with our latest technology and designed specifically to meet the new IEEE 1547 requirements. Compact design makes them ideal for residential use and the integrated DC disconnect makes installation more cost effective. They are field-configurable for positive ground systems making them more versatile than ever. Increased efficiency means better performance and shorter payback periods. With over 500,000 fielded units, Sunny Boy has become the benchmark for PV inverter performance and reliability throughout the world.

Sunny Boy
3000US/4000US

Features:

- Certified to the new UL1741/IEEE 1547
- 10 year standard warranty
- Improved CEC efficiency
- Integrated load-break rated DC disconnect switch
- Integrated fused series string combiner
- Sealed electronics enclosure & Opticool
- Comprehensive SMA communications and data collection options
- Ideal for residential or light commercial applications
- Rugged cast aluminum outdoor rated enclosure

Model	SB 3000US	SB4000US
Part Number	704195	704191
AC Input Voltage	208, 240 VAC	
Max AC Output Power	3000 W	4000 W
Max DC Voltage	500 VDC	600 VDC
Max DC Current	17 A	18 A
CEC Efficiency	95.0%@208 - 95.5%@240	95.5%@208 - 96.0%@240
MPPT Voltage (DC)	180-400@208 / 200-400@240	220-480@208 / 250-480@240
Cooling	Forced, convection	
Dimensions (cm)(WxHxD)	45.2 x 35.0 x 23.6	
Shipping Weight (lbs.)	94	94

Sunny Boy Invert Accessories

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 excellent real-world energy capture. 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 communication capability allows for extensive data acquisition from one or many inverters. 5 year warranty standard. 5 year warranty extension available for extra cost. Call for details.

Sunny Boy 700U Inverter

Model	700U SBD with LCD
Part Number	**706192**
AC Input Voltage	120 VAC (106-132)
Max AC Power Output (Watts)	700/600/460 (Jumper adj.)
Max DC Voltage	250 VDC
Max DC Input Current	7.0 A
Total Harmonic Distortion	THD < 3%
Peak Efficiency	93.6/93.3/92.4%
Output Frequency	60 Hz (59.3-60.5)
Max. Peak Power Tracking Voltage	250/200/150 VDC
Min. Peak Power Tracking Voltage	123/100/77 VDC
Cooling	Convection Cooling (No fan)
Dimensions (in.) (L x W x D)	12.7 x 12.6 x 7.09
Weight (lbs.)	42.87

Product Name and Description	Part Number
RS232-N Module Communication option for directly linking one inverter directly to your computer or control	704209
RS485-N Module	704210
RS485 Cable, 15 meter, shielded	704213
DC Disconnect Fuseless Disconnect for Sunny Boy inverters.	703961

Sunny Boy 5000US/6000US/7000US

The Sunny Boy 5-7000US is SMA's latest addition to the Sunny Boy family of utility interactive inverters. It features their new cast-aluminum enclosure which together with the Opticool cooling design make the SB6000US/7000US a great performer. The SB 5-7000US is designed for use with PV, fuel cell, wind-turbine and micro-turbine technologies. the SB 5-7000US follows SMA's modular system design philosophy for utility, commercial and residential PV installations from 5kW and up. Automatic sensing of the site utility voltage makes installation on almost any utility system trouble-free. Just wire the inverter into an 208, 277 or 240 VAC system, make one internal jumper setting and the SB 5-7000US does the rest. Our proven peak-power-point tracker results in maximum energy capture. The SB 5-7000US uses the same SMA communication accessories as every other inverter in the Sunny Boy family. Choose the system package that best suits your needs. SMA offers a variety of hardware and software solutions from low cost wireless system monitoring, to complex data acquisition systems that integrate large numbers of inverters with external sensors to networked PC's and the internet. All include DC disconnect. 10 year warranty.

Model	Sunny Boy 5000US	Sunny Boy 6000US	Sunny Boy 7000US
Part Number	704186	704202	704190
AC Output Voltage	208, 277, 240 VAC		
AC Output Frequency	59.3 - 60.5 (60Hz)		
Max. DC Input Voltage	600 VDC		
Max AC Output Power	5000 (at 277 or 240 VAC)	6000 (at 277 or 240 VAC)	7000 (at 277 or 240 VAC)
Current THD	THD < 4%		
Efficiency - Peak	96.8%	> 97%	> 97.1%
Max DC Current	21 ADC	25 ADC	30 ADC
DC Voltage Ripple	< 5%		
MPPT Voltage	250-480 VDC		
Enclosure	NEMA 3R		
Power Consumption	<7 W (standby), 0.25 W (nighttime)		
Ambient Temperature	-25°C - +45°C		
Cooling	Temperature regulated fan cooling		
Dimensions (icm) (W x H x D)	184 x 241 x 95		
Weight (lbs.)	143.0		

Sunny Boy 5-7000US

Sunny Tower

SMAbrings you the best in commercial inverter solutions: The Sunny Tower. Designed with the installer in mind; we've combined ease of installation, the lowest specific cost ($/Watt), and the highest efficiency to maximize rebates and power production while minimizing your payback period. The Sunny Tower combines all the advantages of string inverters with the installation advantages of central inverters. The Sunny Tower offers you the flexibility and the reliability you've come to expect from SMA. 10 year warranty.

Model	Sunny Tower 42	Sunny Tower 42 w/web box	Sunny Tower 36	Sunny Tower 36 w/web box
Part Number	**704192**	**704187**	**704194**	**704193**
AC Max. Output Power	42 kW		36 kW	
AC Output Voltage	208, 240, 277 nomimal			
DC Input Voltage Range	250 - 600 VDC			
MPPT Voltage	250 - 480 VDC			
DC Max. Current	6 x 30 A			
Enclosure	NEMA 3R			
Efficiency-CEC	95.5%			
Ambient Temperature	-13°F - +113°F			
Operating Temp. Range	-13°F - +149°F			
Cooling	Temperature regulated fan cooling			
Shipping Weight (lbs.)	1,700			

Sunny Tower 6

Sunny WebBox

The Sunny WebBox from SMAis a powerful communications tool that allows the operating data of your solar system to be logged and easily transmitted via modem or Ethernet to the Web or directly to your PC. It can also send the data to SMA's new internet portal (Sunny Portal) which provides free long-term data storage and graphical display of your system data. Collected information is stored in comman file formates so that you can use it in various spread-sheets, graphs or your own web site. The Sunny WebBox is extremely versatile; making thestorage, transmission, management and display of your system data easier than ever before. 5 year warrany.

Product Name and Description	Part Number
Sunny WebBox The Sunny WebBox features: System access from any Web browser - anywhere in the world. Recording of daily, monthly and annual energy yield via Sunny Portal. Remote plant diagnosis and system configuration. Automatic data transfer at chosen intervals. Data storage and display via Ethernet. Compatible with all SMA utility interactive inverters.	705453

Sunny WebBox

Sunny Island

The Sunny Island 4248U and 5048U battery based inverters are simple to install and use, yet loaded with powerful and advanced features. The Sunny Island 4248U and 5048U are designed to meet the needs of off-grid as well as back-up power system applications. These inverters will not grid-tie. They feature: integrated DC breaker, near silent operation, non-volatile memory, compatible with all Sunny Controls, sealed electronics compartment, generator overload protection and generator reactive power compensation. Two units can be "stacked" for 240 VAC output.

The Sunny Island 4248U & 5048U also help to optimize the overall life of the batteries through their advanced battery management system. The Sunny Island can also be utilized as a back-up system in grid-tied applications. Seamless transfer allows existing Sunny Boy inverters to be utilized during daytime grid outages. The Sunny Island is an extremely robust and sophisticated unit providing both off-grid and backup users with the highest quality available in the industry today.

Sunny Island 4248U

Model	Sunny Island 4248U	Sunny Island 5048U
Part Number	704323	707620
AC Output Voltage	120 VAC	120 VAC
AC Output Frequency	60Hz	60Hz
DC Input Voltage	48 VDC	48 VDC
AC Output Power (25 C)	4200 Watts (3400@45 C)	5000 Watts (4000@45 C)
Current THD	THD < 3%	THD < 3%
Enclosure	NEMA 1	NEMA 1
Power Consumption	<4 W (standby),<22 W No load	<4 W (standby),<25 W No load
Ambient Temperature	-20°C - +45oC	-20°C - +45°C
Cooling	Temperature regulated fan cooling	Temperature regulated fan cooling
Dimensions (in.) (L x W x D)	23.23 x 15.35 x 9.65	24.1 x 18.4 x 9.3
Weight (lbs.)	86.0	139.0

* Certified to the new UL 1741 / UL 1998 standards
* 5-year warranty
* Suitable for systems from 3 kW to 26 kW
* AC coupling of all energy sources
* DC coupling with optional equipment
* 1, 3 and split-phase, connectable in parallel
* Excellent overload characteristics for motor starting
* Long battery service life due to optimum battery management system
* Memory card

POWER PANEL SYSTEMS

xantrex™ XW Series Inverters

XW Hybrid Inverter/Charger

Xantrex brings the next generation of inverter/charger to market, with the XW Hybrid Inverter/Charger, the heart of the XW System. The XW Hybrid Inverter/Charger (XW) is a true sine wave, 120/240-volt AC, split-phase, inverter/charger that incorporates a DC to AC inverter, a battery charger, and a 60A AC auto-transfer switch. It is the foundation for battery- based residential and commercial applications up to 18 kilowatts (kW)
Capable of being grid-interactive or grid-independent, the XW can operate with generators and renewable energy sources to provide full time or backup power. Includes wall mount, backplate. See specifications on following page.

XW Series

XW Power Distribution Panel (XW PDP)

The XW Power Distribution Panel with conduit box is factory-wired and labeled to support a code-compliant single- inverter installation. The XW PDP can be configured to mount on either side of the inverter/charger. Internal wiring and breakers can be added to expand the XW System with up to three inverters, four charge controllers, or other equipment to support larger systems, including three-phase. Amounting plate and XW conduit box is supplied with each XW PDP.

XW Power Distribution Panel (XW PDP)

67.2 lbs, 48”x21”x13.5” Shipping Dimensions

Product Name and Description	Part Number	Price
XW Power Distribution Panel	705208	$1500.00
XW Connection Kit	705219	$750.00
XW Conduit Box	705220	$175.00

XW System Control Panel

The **XW SCP** is a Xanbus™-enabled device featuring a graphical, backlit LCD screen that displays system configuration and diagnostic information for all devices connected to the network. When installed as an XW System accessory, the XW SCP eliminates the need for separate control panels for each device and gives a single point of control to set up and monitor an entire XW Power System. 5 year warranty. 6”x4”x1 9/16” (152x103x40mm) 1lb

Interfaces with:
XW4024, XW4548, XW6048
Inverter/Charger(s), XW Solar Charge Controller, XW Auto Generator Start **See next page for price.**

The **XW Connection Kit** is a wiring kit and conduit box used to connect additional inverters into an XW Power Distribution Panel. All wires are measured, pre-cut and labeled to facilitate easy installation. 23.1lb 17.5”x13”x12” Shipping Dimensions

Interfaces with:
XW4024, XW4548, XW6048
Inverter/Charger(s),
XW Power Distribution Panel

XW Connection Kit

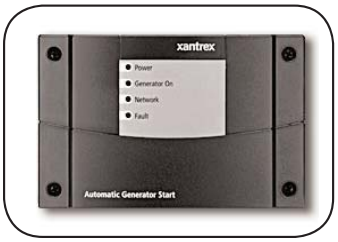
The **XW Conduit Box** is a bare conduit box (no wires) that can be used to create systems larger than two inverters or to retrofit XW Inverters into existing systems which may already have AC/DC disconnects. 10.0 lb 17.5”x13”x12” Shipping Dinensions

Interfaces with:
XW4024, XW4548, XW6048
Inverter Chargers,
XW Power Distribution Panel

XW Conduit Box

XW Solar Charge Controller
See Page 42

Model	XW6048-120/240-60	XW4548-120/240-60	XW4024-120/240-60
Part Number	**705200**	**705201**	**705202**
Price	**$4500.00**	**$3950.00**	**$3950.00**
Output Power (Watts)	6000	4500	4000
Surge rating (10 seconds)	12000	9000	8000
Efficiency - Low Load	95%		
Efficiency - CEC weighted	92.5%	93%	91%
CEC power rating	5752 W	4500 W	4000 W
DC Current at rated power	130A	96A	178A
Frequency / Regulation	60Hz/ +/- 0.1Hz		
AC Voltage	120/240 VAC split-phase		
Typical transfer time	8 ms		
Temp. Comp. Probe	Included		
Input Voltage Range (VDC)	44 to 64		22 to 32
Total Harmonic Distortion	< 5%		
Power Factor Corrected Charging	.98		
Max. Continuous Charge Rate (Amps)	100	85.0	150.0
Automatic Transfer Relay (Amps)	60.0		
Specified Temperature Range	-13°F - 158°F (-25°C - 70°C)		
Multiple-unit Configurations	Up to three parallel units in 120/240-volt split-phase configuration		
Standard Warranty	5 years		
Forced Air Cooling (4 speed fan)	Thermally Activated		
Inverter Dimentions	23 x 16 x 9" (580 x 410 x 230mm)		
Weight - Inverter Only (lbs.)	35.0 (16 kg)		
Shipping Weight (lbs.)	132.0 (60kg)	122.0 (55kg)	



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

Product Name and Description	Part Number	Price
System Control Panel	705203	$300.00
Communications Gateway	706346	$650.00
3 ft. Network Cable	705209	$6.00
5 ft. Network Cable	705210	$7.50
7 ft. Network Cable	705211	$9.00
10 ft. Network Cable	705212	$11.00
14 ft. Network Cable	705213	$14.00
25 ft. Network Cable	705214	$17.00
50 ft. Network Cable	705215	$26.00
75 ft. Network Cable	705216	$38.00
Network Terminator male (2pk)	705217	$9.00
Network Terminator female (2pk)	705218	$12.00
Automatic Generator Start	705204	$200.00

See Page 42 for the XW-MPPT60-150

PS Based 2.8 thru 14.4 kW Power System

The OutBack Flexware 1000 is a fully expandable system for up to four FX series inverters, up to four MX60 MPPT charge controllers, a MATE system controller and all the associated AC and DC components of a large renewable energy power conversion system. Two Flexware systems can be stacked using a HUB-10 for up to 28,880 watt of power. Choose from 120V 120/240 split phase or even 3 phase.

OutBack Flexware 1000
2.8 thru 14.4kW Power System

PS Based 2 thru 7.2 kW Power System

The OutBack Flexware 250-500 is a compact power system for one or two FX series inverter/chargers, up to three MX60 MPPT charge controllers, a MATE system controller and all the associated AC and DC components of a renewable energy power conversion system.

CALL 1-800-544-6466 AND ASK FOR MORE INFORMATION ON HOW TO ORDER.

OutBack Flexware 250
(Inverter not included)

OutBack Flexware 500
2 thru 7.2kW Power System

OutBack Power Systems

FLEXware 1000-DC

The OutBack Flexware 1000-DC 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 52) OBDC-GFP ground fault protection system can be added to the FW1000-DC 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 aluminum enclosure with plenty of conduit knockouts - 3/4", 1" and 2"
- Mounting space for up to six large 1.5" wide 175 or 250 amp or nine medium 1.0" wide 60 to 100 amp breakers - sizes can be mixed.
- Eleven spaces for small 0.75" wide 15, 30 or 60 amp breakers and OBDC-GFP (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
- Easily connected to other inverter models and enclosures via conduit or race way
- For negative or positive ground systems
- Requires optional DCA's for connection of each FX Inverter

Flexware 1000 DC
(Interior view)

Product Name and Description	Part Number	Price	Dimension (in.) (H x W x D)	Shipping Weight (lbs.)
FW1000-DC	704521	$509.00	38.5 x 11.4 x 12.1	21.0

FW-SBUS

OutBack FLEXware System Options

Product Name and Description	Part Number	Price
FW-BBUS Allows connection of two 175/250A or three 100A DC breakers. 500A rated copper plate. (One included standard w/PS2DC / three w/PS4DC)	705458	$24.00
FW-SBUS DC Shunt Bus allows up to 4 high current cable connections on the same side of a DC shunt, 1000 Amp rated brass and 3/8" bolts for cable ring terminals.	704315	$29.00
FW-CBUS Combiner Bus connects up to eight DIN mounted breakers of four DIN mounted fuse holders. Includes one 1/0 set screw lug. Plated copper rated for 200 Amps.	704554	$22.00
TBB - Terminal Bus Bar Use for adding more wire terminations or for isolating multiple positive / negative & ground circuits.TBB-White insulators (P/N 704280), TBB-Red insulators (P/N 704281), TBB-Blue (P/N 705463), TBB-Ground (P/N 704547), TBB-Black insulators (P/N 704252), TBB-Brown insulators (PN 704552)	704252 (Black)	$19.00
FW-CCB2-T - Charge Control Bracket Holds two MX-60 controllers on the top of FW500/1000 enclosure.	704316	$49.00
FW-CCB - Charge Control Bracket Holds one MX-60 controller on the side of FW500/1000 enclosure.	704317	$29.00
FW-CCB2 - Charge Control Bracket Holds two MX-60 controllers on the side of FW500/1000 enclosure.	704318	$49.00
FW-MP - Mounting Plate Use one for the FW-500 or two for the FW-1000. (14lbs)	704251	$169.00
FW-SHUNT250 - Shunt kit 500A DC shunt w/attached terminal bus bar. Mounts on FX inv.	704545	$50.00
FW-SHUNT500 - Shunt kit 500A DC current shunt with attached terminal bar. One FW-SHUNT500 included on FLEXware 500 and FLEXware 1000 DC enclosures.	704546	$35.00

FW1000-AC

The OutBack FW1000-AC 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 aluminum enclosure
- Dual snap-in DIN rail type mounting brackets for up to 32 AC circuit breakers
- Wireway included to run communication wires between AC and DC sides
- Two inches deeper than PS4 for increased working space when wiring
- Designed to mount directly to the AC end of up to four FX inverter/chargers
- Plenty of room for additional current sensors and control relays for advanced system designs.
- Lighter color for better visibility within the enclosure and a more neutral apperance so systems blend-in after installation.
- Requires optional ACA's for connection of each FX inverter

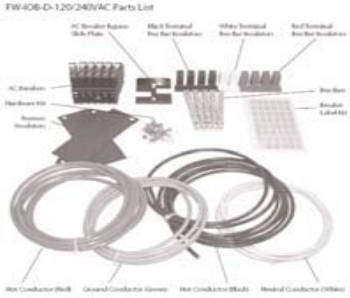
FW1000-AC
Interior View

Product Name and Description	Part Number	Price	Inverter(s)	Dimension (in.) (H x W x D)	Shipping Weight (lbs.)
FW1000-AC Includes (2) AC breaker surrounds and DIN rails, TBB-Ground (to be used as neutral), FLEXware mounting plate alignment straps.	704522	$509.00	Up to four FX Series	38.5 x 11.4 x 12.1	21.0

AC Input / Output / Bypass Assemblies

For field installation in FW1000-AC version. 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.

FW-IOB-D-120/240VAC



Product Name and Description	Part Number	Price	Application	Includes
FW-IOB-S-120VAC	704523	$105.00	120 VAC output 60 Amp 7.2kW	(3) 60A 120VAC SP DIN mount breakers
FW-IOB-S-230VAC	704524	$105.00	230 VAC output 30 Amp 6.9kW	(3) 30A 230VAC SP DIN mount breakers
FW-IOB-D-120/240VAC	704525	$249.00	120/240 VAC output 60 Amp 14.4kW	(6) 60A 120VAC SP DIN mount breakers
FW-IOB-D-120VAC	704526	$219.00	120 VAC output 120 Amp 14.4kW	(6) 60A 120VAC SP DIN mount breakers
FW-IOB-D-230VAC	704527	$199.00	230 VAC output 60 Amp 13.8kW	(6) 30A 230VAC SP DIN mount breakers
FW-IOB-Q-120/240VAC	704531	$409.00	120/208 VAC output 60 Amp 21.6kW	(9) 60A 120VAC SP DIN mount breakers
FW-IOB-Q-230VAC	704529	$349.00	120 VAC output 240 Amp 28.8kW	(12) 60A 120VAC SP DIN mount breakers
FW-IOB-T-120/208VAC	704528	$309.00	120/240 VAC output 120 Amp 28.8kW	(12) 60A 120VAC SP DIN mount breakers
FW-IOB-T-230/400VAC	704530	$309.00	230 VAC output 120 Amp 27.6kW	(12) 30A 230VAC SP DIN mount breakers

OutBack FLEXware

OutBack Power Systems offers a new compact enclosure for all the AC and DC components of a renewable energy power conversion system.The FW250/500 saves time, money and space by combining the disconnects, overcurrent protection devices, grounding and control components into easy to install enclosures.The FW250/500 is designed to accompany one or two FX inverter/chargers.

FW250 Features

- Indoor type powder-coated aluminum enclosure for single FX inverter
- Can be wall of shelf mounted
- Can be used for DC or AC components or both
- Knock-out provided for connection to MX60 charge controller
- Breaker spaces for battery, PV array or PV GFP breakers
- Mounting locations for AC GFCI outlet and AC breakers

FW250

FW500 Features

- ETL listed indoor type powder-coated aluminum enclosure with plenty of conduit knockouts
- Knockouts for two 1.5” or 3 - 1” breakers and eight 3/4” breakers (FW500-DC) and up to 16 DIN breakers on the FW500-AC
- 500 amp 50 mVDC current shunt standard
- Battery negative/ground bus bar standard
- Knockouts for battery conduit, MX 60 interconnect and stacking another FW500
- For negative or positive ground systems
- Knockouts on five surfaces to facilitate conduit and inverter connection and additional MX60s

FW500

Product Name and Description	Part Number	Price	Dimension (in.) (H x W x D)	Shipping Weight (lbs.)
FW250 DC and/or AC breaker enclosure - Secures directly to either end of an FX series inverter. Includes ground bus bar and DC breaker handle guard. Holds up to 8-1 to 80 amp, 1-175 or 250A breaker. KO for GFCI AC outlet. (DC current shunt not included)	704518	$99.00	7.5” x 6.5” x 8.6”	5
FW500-DC DC breaker enclosure - fits at the DC side of one or two FX series inverters. Includes ground bus bar, 500 amp DC shunt assembly w/negitive TBB, breaker mountng screws.	704519	$309.00	18.2” x 11.4” x 12.1”	15
FW500-AC AC breaker enclosure - fits at the AC side of one or two FX series inverters. Includes ground bus bar and DIN mounting bracket for up to 16 DIN type breakers (not included)	704520	$309.00	18.2” x 11.4” x 12.1	15

Grid-Tie Solar with Battery Backup

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

The SmartRE is a versatile product and can be installed both indoor and outdoors.Available in power levels up to 6 kw SmartRE is capable of providing as much as 69 kWh of storage during outages, there is a SmartRE solution for your application. With matching type 3R raintight power and electronics enclosures constructed of aluminum a SmartRE solution can be either wall or pad mounted making this the most versatile gridtie with battery backup solution on the market.This solution is designed and manufactured by OutBack Power to ensure that a SmartRE solution works reliably for years to come.

OutBack SmartRE

A standard 5-year warranty provides peace of mind.

SmartRE Features

- Easy to Install
- Grid-Interactive Battery Back-Up
- UPS Quality Battery Back-Up
- Up to 6.0kW of Solar
- Indoor and Outdoor Rated
- Wall or Pad Mountable

Product Name	SRE2500-120-NA	SRE2500-120/240-NA	SRE3000-120-NA	SRE3000-120/240-NA	SRE5000-120/240-NA	SRE6000-120/240-NA
Part Number	**707131**	**707133**	**707134**	**707135**	**707136**	**707137**
Max. Continuous Power	2500VA		3000VA		5000VA	6000VA
Nominal output voltage: Sell (Invert)	120-(120VAC)	120-(120/240)	120-(120VAC)	120-(120/240)	120/240 (120/240)	120/240 (120/240)
Nominal Battery Voltage	48 Volts DC					
MPPT operating voltage range	50-145 VDC					
PV Array / Max.Wattage STC	3125 WDC		3750 WDC		6250WDC	7500WDC
Typical Efficiency - inverter/system	Up to 93%					
Dimension (H x W x D) in. (cm)	42x19x19 (107x48x48cms)			2 Enclosures 42x19x19 (107x48x48cms)		
Shipping Weight lbs. (kgs)	128 (58kgs)			2 Enclosures 167 (76KGS) / 60 (27kgs)		

Inverter Accessories

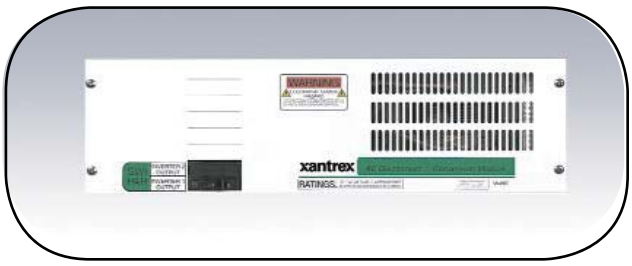
OutBack Transformer

Product Name and Description	Part Number	Price
FW-X240 - 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. For use inside FLEXware 500-AC or FLEXware 1000-AC	704264	$399.00
PSX-240 - 6kVA 120/240 VAC Autotransformer This auto-transformer is the same as the X-240 except that it comes with an enclosure that includes a cooling fan and two 25 Amp AC breakers.	704322	$539.00
PSX-240-RELAY 6kVA rated Autotransformer with enclosure, cooling fan and relay assembly. Required when split-phase stacking with 120/208VAC power sources. (Includes dual-pole 25 Amp AC breaker)	704580	$599.00

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. 46 lbs.



T-240 Transformer

Product Name and Description	Part Number	Price
T-240 Transformer	704234	$425.00

Kyocera Solar Electric Products Catalog •October 2009

Accessories

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	704060	$2.00
O-Ring Seal for SL-13	705734	$0.30
SLN-12 - 1/2" NPT (w/o Locknut) Fits #10-2 Round, TC Cable	704062	$2.00
SLRN-12 - 1/2" NPT (w/o Locknut) Fits #10, 8, 6 AWG Single XLP Wire	704063	$2.00
CD-13N4-BK - 1/2" NPT (w/o Locknut) 2 hole cord connector. Perfect for installing MC connectors in combiner boxes. Fits #10 MC connector wire.	704069	$7.50

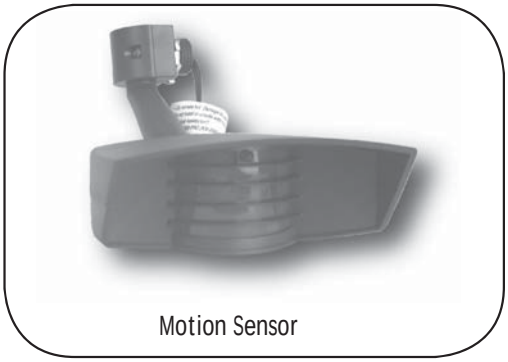
SL-13

CD13N4-BK

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 degree detection pattern.

Product Name and Description	Part Number	Voltage	Amperage	Price
Motion Sensor - 12 V	703044	12	10	$75.00



Motion Sensor

Appendix A

Kyocera Solar Mounting Hole Location

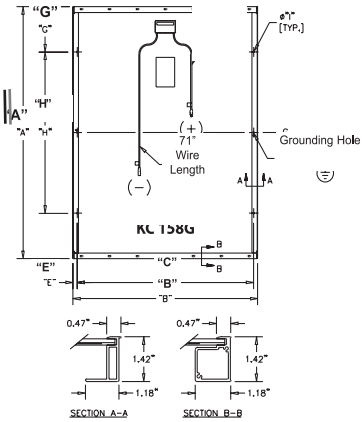
Model	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E
KD210GX-LP	59.1 / 1499.0	39.0 / 990.0	37.24 / 945.9	-	0.87 / 22.1
KD205GX-LP	59.1 / 1499.0	39.0 / 990.0	37.24 / 945.9	-	0.87 / 22.1
KD180GX-LP	52.8 / 1341.0	39.0 / 990.0	37.24 / 945.9	-	0.87 / 22.1
KD135SX-LP KD135GX-LP	59.1 / 1499.0	26.3 / 668.0	24.6 / 624.0	-	0.87 / 22.1
KC130TM	56.0 / 1425.0	25.67 / 652.0	24.13 / 613.0	53.82 / 1367.0	0.77 / 20.0
KC85T/TS	39.65 / 1007.0	25.67 / 652.0	24.13 / 613.0	37.36 / 949.0	0.77 / 20.0
KC65T	29.57 / 751.0	25.67 / 652.0	24.13 / 613.0	27.28 / 693.0	0.77 / 20.0
KC50T	25.16 / 639.0	25.67 / 652.0	24.13 / 613.0	22.87 / 581.0	0.77 / 20.0
KC40T	20.7 / 526.0	25.67 / 652.0	24.13 / 613.0	18.43 / 468.0	0.77 / 20.0

Dimensions shown in inches / millimeters

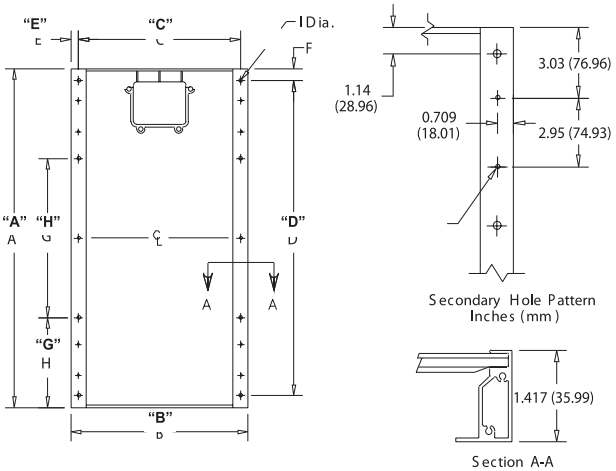
Model	Dim. F	Dim. G	Dim. H	J-Box/Connection
KD210GX-LP	-	11.0 / 278.5	37.12/ 942.0	MC
KD205GX-LP	-	11.0 / 278.5	37.12/ 942.0	MC
KD180GX-LP	-	10.2 / 259.0	32.48 / 825.0	MC
KD135SX-LP KD135GX-LP	-	11.0 / 278.5	37.12 / 942.0	M/MC
KC130TM	1.14 / 29.0	9.48 / 240.0	37.12 / 942.0	M
KC85T/TS	1.14 / 29.0	9.48 / 240.0	20.67 / 525.0	M
KC65T	1.14 / 29.0	9.48 / 240.0	10.6 / 270.0	G
KC50T	1.14 / 29.0	6.0 / 152.0	13.19 / 335.0	G
KC40T	1.14 / 29.0	6.0 / 152.0	8.74 / 222.0	G

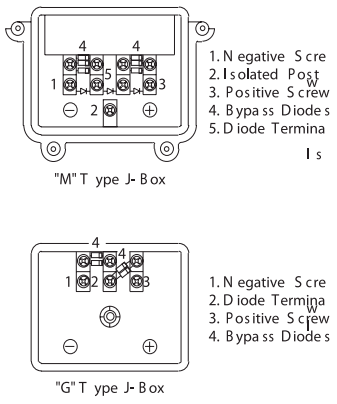
Dimensions shown in inches / millimeters

KC180GX-KC210GX



All other KC Modules





Torque J-box terminals to 21 inch pounds (25 kg-cm)

Kyocera Solar Modules Standard Packaging Details

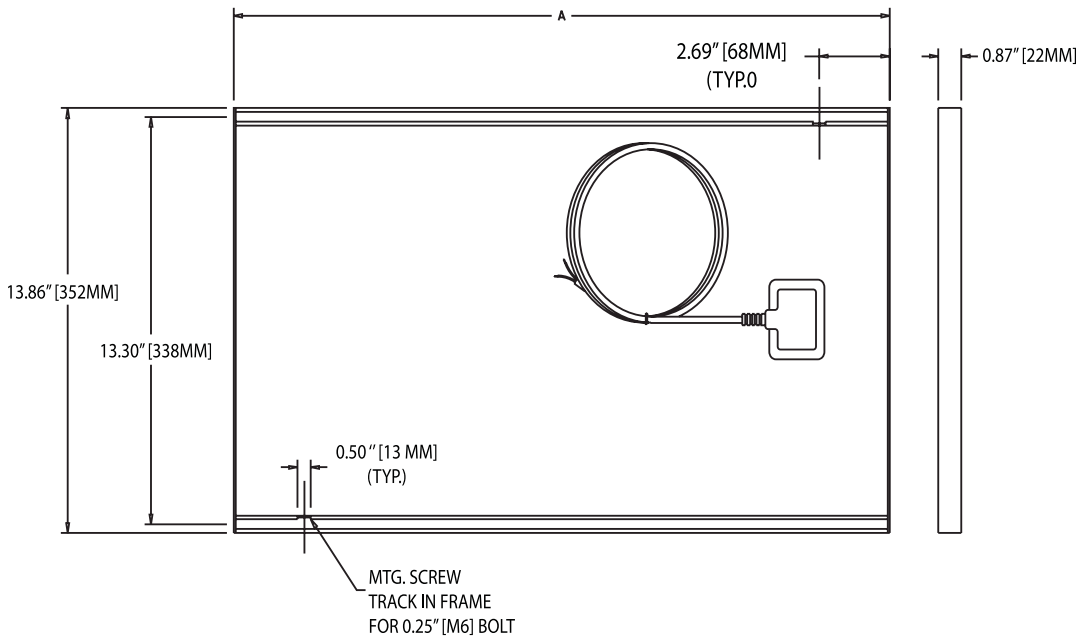
Model	KD205/210GX-LP	KC180GX-LP	KD135GX-LP	KC130TM
Module Quantity Per Carton	2	2	2	2
Carton Size (in.) (L x W x D)	64 x 44 x 4	55 x 44 x 4	64 x 29 x 3.5	60 x 28 x 3.5
Carton Size (cm) (L x W x D)	163 x 112 x 10	138 x 110 x 9	163 x 74 x 9	153 x 71 x 9
Carton Gross Weight (lbs./kg)	94.0 / 43.0	80.0 / 36.3	65.5 / 30.0	69.0 / 31.2
Number of Cartons per Pallet	10	10	10	10
Number of Modules per Pallet	20	20	20	20
Maximum Pallet Dimensions (in.) (L xWx D)	64 x 44 x 40	56 x 44 x 40	64 x 29 x 40	60 x 28 x 39
Maximum Pallet Area (ft3/m3)	78.2 / 2.2	68.4 / 1.94	51.5 / 1.46	45.5 / 1.3
Gross Weight of Max. Pallet (lbs. kg)	940 / 426	844 / 385	655 / 297	690 / 312
Number of Modules per 20' Container	240	320	360	400
Number of Modules per 40' Container	560	640	840	880

Model	KC85T	KC65T	KC50T	KC40T
Module Quantity Per Carton	2	2	2	2
Carton Size (in.) (L x W x D)	43 x 28 x 3.5	34 x 28 x 3.5	28 x 30 x 4	25 x 28 x 4
Carton Size (cm) (L x W x D)	109 x 71 x 9	86 x 71 x 9	71 x 76 x 9	64 x 71 x 9
Carton Gross Weight (lbs./kg)	48.0 / 21.7	32.0 / 14.5	25.0 / 11.3	23.0 / 10.5
Number of Cartons per Pallet	20	20	20	20
Number of Modules per Pallet	40	40	40	40
Maximum Pallet Dimensions (in.) (LxW xD)	59 x 43 x 39	55 x 43 x 39	28 x 58 x 39	26 x 50 x 39
Maximum Pallet Area (ft3/m3)	57.0 / 1.62	53.0 / 1.5	33.6 / 1.0	33.6 / 1.0
Gross Weight of Max. Pallet (lbs. kg)	900 / 408	662 / 301	575 / 261	475 / 197
Number of Modules per 20' Container	560	560	960	520
Number of Modules per 40' Container	1280	1280	2000	1080

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. KC85T and KC130TM modules include an isolated post inside the J-Box for parallel splicing wiring from adjacent modules.
2 'M' style junction box standard with KC85T and KC130TM solar modules.'G' style junction box standard with KC40T, KC50T and KC65T modules.Multi-contact connectors used on KD135GX-LP, KD180GX-LP & KD205GX-LP. 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

Dimensions show in Inches / milimeters



Model	Dim. A
KS 40	40.0 / 990.0
KS 20	20.50 / 520.0
KS 10	12.00 / 304.0
KS 5	8.10 / 205.0

Solartec KS Modules Standard Packaging Details

Model	KS 40	KD 20	KS 10	KS 5
Module Quantity Per Carton	2	1	1	1
Carton Size (in.) (L x W x D)	41.7 x 14.6 x 3.3	21.25 x 15 x 1.6	12.2 x 15 x 1.6	8.5 x 15 x 1.6
Carton Size (cm) (L x W x D)	106 x 37 x 8.5	54 x 36.5 x 4	31.0 x 36.5 x 4	21.5 x 36.5 x 4
Carton Gross Weight (lbs./kg)	25.4 / 11.5	6.00 / 2.7	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)		43.3x43.3x33.5	39.4x39.4x35.4	43.3x43.3x35.4
Maximum Pallet Area (ft3/m3)		36.33 / 1.03	31.78 / 0.90	38.46 / 1.09
Gross Weight of Max. Pallet (lbs./ kg)		1190.0 / 540.0	645.0 / 292.5	688.0 / 312.0
Number of Modules per 20' Container		1800	3000	4800
Number of Modules per 40' Container		2000	6000	9600

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 (oC): 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

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 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 (oC): 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

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 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: 24V **Voltage Drop: 4.00%** **Temperature (oC): 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 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 (below) and Top Mounting Clamp Sets or Bottom Mounting Clip Sets (See page 22).
2 Select SolarMount Tilt Leg Kits, if required.(See page 23.)
3 Select SolarMount Standoffs, if required.(See page 28.)
4 Select SolarMount Splice Kits, if required. (See page 26.)

		Number of Modules						
Module Make and Model		2	3	4	5	6	7	8
	SolarMount Rail Sets for use with Top Mounting Clips							
KC40T, 50T, 65T, 85T, 130TM	Rail Set	300202	300204	300207	300209	300211	300213	300215
KD130GX-LP, KD135GX-LP	Rail Set	300202	300204	300207	300209	300211	300214	use ProPak 300116
KD180GX-LP, 205GX-LP, 210GX-LP	Rail Set	300204	300208	300211	300214	300226	300229	300232
	SolarMount Rail Sets for use with Bottom Mounting Clips							
KC40T, 50T, 65T, 85T, 130TM	Rail Set	300202	300204	300206	300208	300210	300212	300215
KD135GX-LP	Rail Set	300202	300204	300206	300208	300211	300213	300215
KD180GX-LP, 205GX-LP, 210GX-LP	Rail Set	300204	300207	300210	300214	300225	300228	300231

Pole Top Mounts

(More than one part number indicates multiple wind ratings. Wind ratings are listed on www.UniRac.com)

	Number of Modules							
Module Make and Model	1	2	3	4	6	8	10	12
KC40T, 50T, 65T, 85T (May need to trim cross tubes \on smaller modules)	500025	500031	500107	500113	500325/ 501486	500330	501429	501430
KC130TM	500043	500128	500131	500228	500342/501456	501462	-	-
KD135GX-LP	500044	500129	500132	500239	500315	501463		
KD180GX-LP	500039	500132	500243	500313/501432	501440	-	-	-
KD205GX-LP, 210GX-LP	500014	500132	500243	500315/501457	-	-	-	-

Side of Pole Mounts - Adjustable Tilt

	Number of Modules			
Module Make and Model	1	2	3	4
KC40T, 50T, 65T, 85T	400107	400213	400223	400229
KC130TM	400257	400214	400224	400246
KD135GX-LP	400236	400233	400224	400246
KD180GX-LP	400209	400224	-	-
KD205GX-LP, 210GX-LP	400209	400224		

SunFrame Components for KC130TM / KD135GX-LP

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

Side of Pole Mounts - Fixed Tilt

Module make and model		UniRac Model
KS 5 - 20	45 degree	401102
KC 40T - 85T	45 degree	401260
KC 40T - 85T	60 degree	401262
KC 85T - 130GT/TM	45 degree	401264
KC 85T - 130GT/TM	60 degree	401266
KD135GX-LP	45 degree	
KD135GX-LP	60 degree	
KD180GX-LP	45 degree	401278
KD180GX-LP	60 degree	401279

SunFrame Components for KC 175GT / 200GT

Kyocera Solar Electric Products Catalog •October 2009

APPENDIX D

Inverter Overcurrent Protection and Cable Sizing

Brand	Model	Max. Continuous Power (Watts)	Voltage	Max. Input Amps* DC	Min. Overcurrent Protection (Breaker/Fuse)	Min. Cable Size ** (In conduit)	Min. Cable Size ** (In free air)
Xantrex TR1512	TR1512 [2]	1500	12	201	200	#4/0	#4/0
	TR2412 [2]	2400	12	321	350	#4/0	#4/0[1]
	TR1524 [2]	1500	24	100	100	#2/0	#2/0
	TR2424 [2]	2400	24	160	175	#2/0	#2/0
	TR3624 [2]	3600	24	241	250	#4/0	#4/0[1]
	XW6048-120/240-60	6000	48	130	250	#4/0	#4/0
	XW4548-120/240-60	4500	48	96	175	#2/0	#2/0
	XW4024-120/240-60	4000	24	178	250	#4/0	#4/0
	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 2012T[2]	2000	12	202	250/300	#4/0	#4/0
	FX 2524T[2]	2500	24	101	175/200	#2/0	#2/0
	FX 3048T[2]	2500	48	63	100/110	#2	#2
	VFX 2812[2]	2800	12	282	250/300	#4/0	#4/0
	VFX 3524[2]	3500	24	176	250/300	#4/0	#4/0
	VFX 3648[2]	3600	48	91	175/200	#2/0	#2/0
	GTFX 2524	2500	24	126	175/200	#4/0	#4/0
	GTFX 3048	3000	48	76	100/110	#2/0	#2/0
	GVFX 3524	3500	24	176	250/300	#4/0	#4/0
	GVFX 3648	3600	48	91	175/200	#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.

* With OutBack inverters, the full power efficiency should be calculated with a lowest expected full power eficiency factor of 0.90 instead of 0.85 as used with the other brands of inverters.

2The cable size is the same for free air as in conduit.This preserves the performance of the inverter (motor starting surge) and maximizes the conversion efficiency of the system.

** 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.

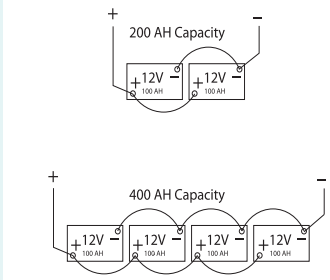
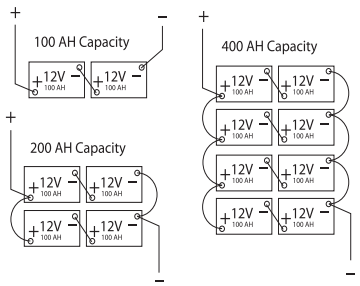
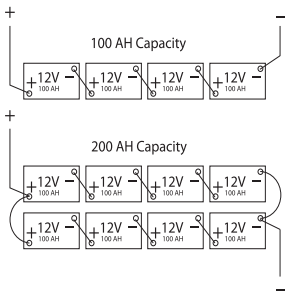
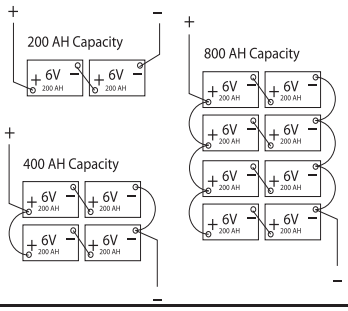
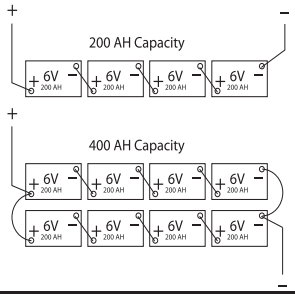
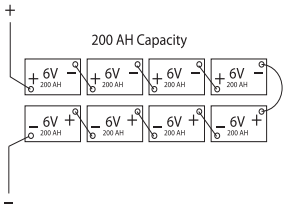
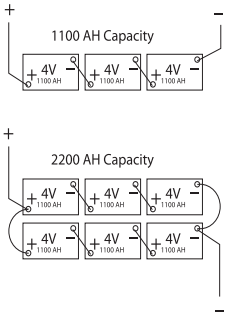
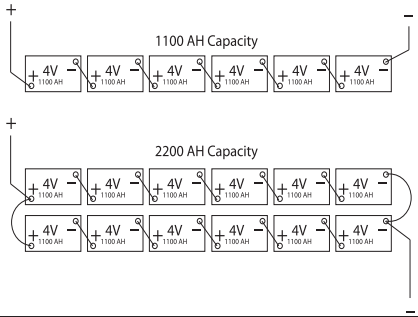
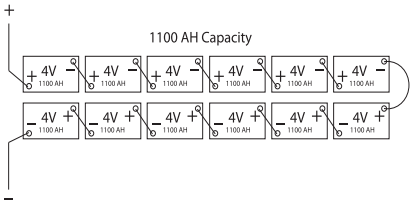
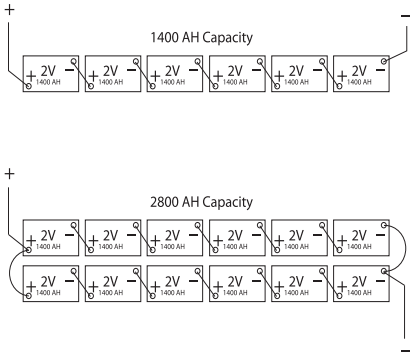
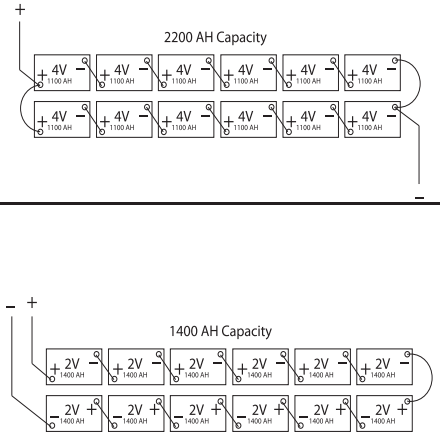
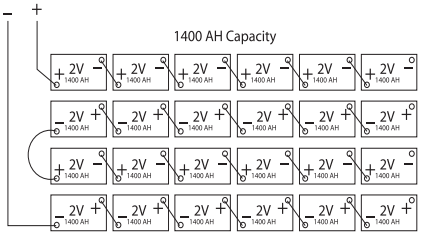
1Cable is sized for 10 feet total length. From 10 feet to 20 feet total length, double the recommended wire size.

2Cable 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

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 wiringbatteries 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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