AEE Solar®

Delivering Success

35TH ANNUAL CATALOG

Contents

A family of passionate, committed professionals that leverages our rich solar heritage
to ensure that our customers and partners succeed
in building the solar ecosystem that will create a planet run by the sun.

2016 AEE Solar
RENEWABLE ENERGY DESIGN GUIDE & CATALOG

2015 was another record year for AEE Solar. Thanks to our valued employees and loyal customers we continue to grow well above industry average and this trend is expected to continue. We remain committed to improving our level of service, product offering and overall support to our customers. Throughout 2015, significant investments in people and infrastructure came to fruition. Our new East Coast warehouse in Pennsylvania and the launch of AEE Express, our new Ecommerce platform, are just two great examples. We can now reach more customers with one-day delivery than ever before as well as provide our dealers with a great online shopping experience. It is now easier than ever to shop and buy products online from AEE Solar.

We are optimistic and excited about 2016! Despite a high level of uncertainty with regards to the Investment Tax Credit, we are convinced that this will be another record year. The fundamentals of our industry have not changed and, if anything, are getting better, not worse. Our cause is just, our dealers are savvy and customer demand remains very strong. AEE Solar will continue to expand its product offering, its distribution footprint and leverage the significant investments made by our parent company, Sunrun, to the benefit of AEE Solar dealers.

But 2016 marks another important milestone. This will be our 35th year publishing the AEE Solar Renewable Energy Design Guide and Catalog. I can proudly say that there is no other book in the industry that offers this level of detailed information acquired through field experience. In addition to exciting new products and the usual updates, we've revised our system-sizing worksheets and added significantly to the informational content, including an all-new glossary in the reference section that explains some of the jargon you hear around the industry.

I'm especially excited about some of the new products and services we're planning to roll out later this year, from new racking and energy-management solutions to automated system-design support. I hope you'll keep in touch via our Facebook® and YouTube® pages or our e-mail lists so that you don't miss the latest products and tools to help you grow your solar business. I look forward to supporting all of you as we make 2016 the solar industry's biggest year yet. Stay tuned!

Sincerely,
Antonio Cintra, President, AEE Solar

Help Us Keep This Resource Up-to-Date

Keeping this catalog accurate and up-to-date is very important to us. While we do our best, we cannot guarantee that every specification and detail is current since products and specifications can change without notice, as can availability. Please let us know if you suspect any information may be inaccurate. We always appreciate your feedback and can be reached anytime at salessupport@aeesolar.com.

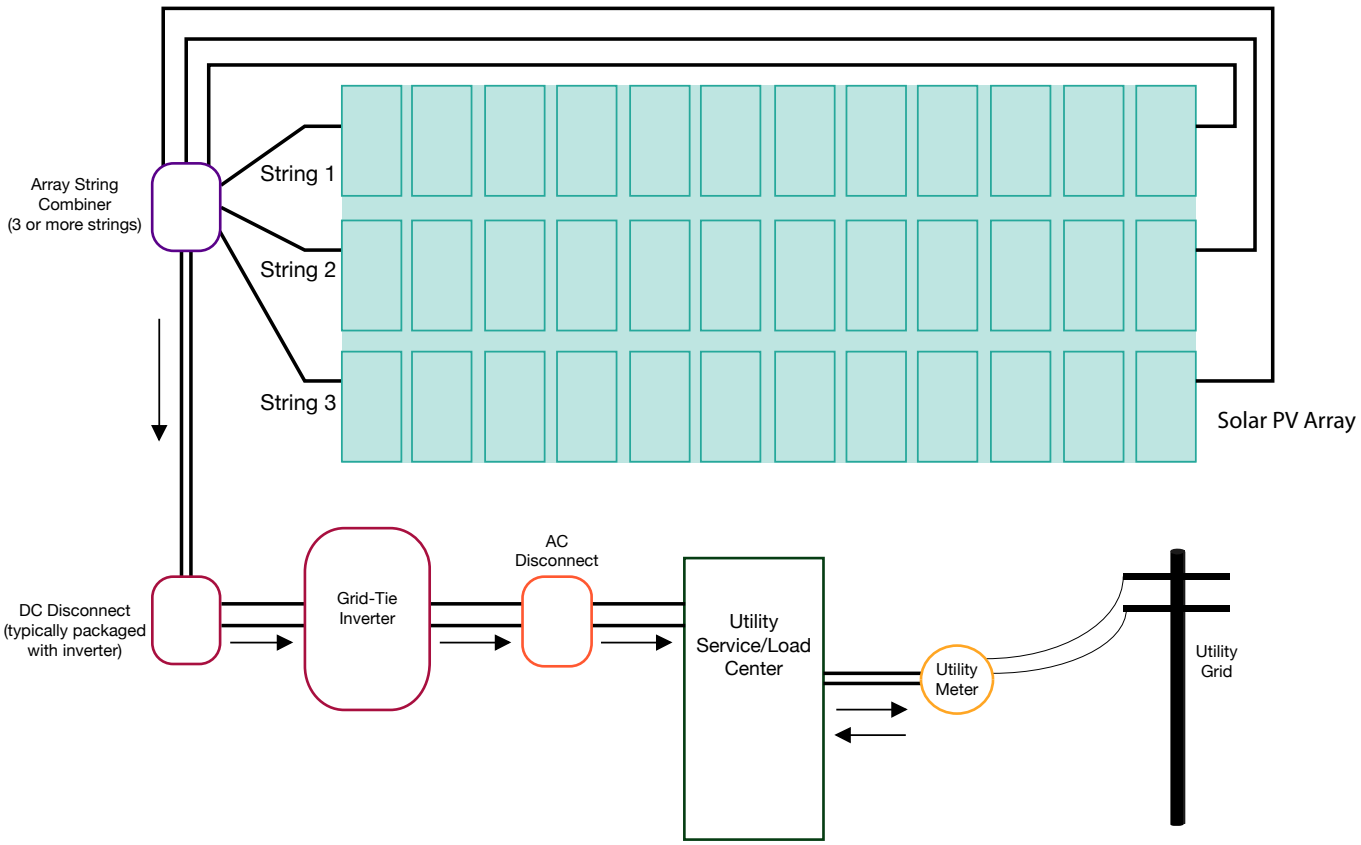
Contact Us for All Your Renewable Energy Needs

As questions arise, we look forward to answering them. Please call us at 800-777-6609, email us at salessupport@aeesolar.com, or visit our contact page at www.aeesolar.com/contact. We thank you and look forward to working closely with you to take advantage of all the great opportunities that 2016has to offer.

Utility Grid-Tie PV System Design

A grid-connected PV system consists of PV modules, output cables, a module mounting structure, AC and DC disconnect switches, inverter(s), grounding equipment, and a metering system, as shown in the diagram below. The Grid-Tie System Worksheet is designed to help size a PV array to offset a site's electrical usage with the largest system that would be cost-effective to install. A smaller system can reduce part of the electric bill, and in locations with tiered or progressive rates, it may have a faster financial payback. Compare the worksheet result with the amount of space available to mount the PV array in order to get a rough idea of the maximum PV array size.

Below is a diagram of a typical grid-tie system (utility intertie) without energy storage. Many grid-tie inverters have built-in DC disconnect switches, while some have both a DC and an AC disconnect. Many models also contain a PV array string combiner so a separate one may not be necessary. Separate overcurrent protection for each series string of modules in a PV array (typically provided in the array combiner box) is required only if there are three or more series strings of modules connected to a single inverter input. Inverters with multiple MPPT input channels can have one or two series strings per channel without individual string fusing.



AEE Solar was born in 1979, long before grid-tie, when off-grid solar was the only form of domestic solar PV. So when it comes to off-grid know-how and equipment knowledge, **AEE Solar's experience, expertise, and product selection is unsurpassed.**

Worksheet: Grid-Tie PV System Design

Determine PV array size for a grid-tied system (no energy storage)

Step 1: Determine the daily average electricity usage from the electric bills.

This will be in kilowatt-hours (kWh). Due to air conditioning, heating, and other seasonal usage, it is a good idea to add up all the kWh for the year and then divide by 365 to find the average daily usage.

Step 2: Find the location's average peak sun-hours per day.

See the map below and/or the insolation map in the Reference section near the end of the catalog. For example, the average for Central California is 5 sun-hours. NREL's PVWatts online sizing program (http://pvwatts.nrel.gov/) can provide this data as well as monthly and yearly expected AC production totals. It can also account for array tilt-angle and azimuth to get more accurate results.

Step 3: Calculate the system size (AC watts) needed to offset the average usage.

Divide the daily average electricity use by average sun-hours per day. For example, if the daily average electricity use is 30 kWh and the site is in Central California, system size would be: 30 kWh / 5 h = 6 kW AC. Multiply kW by 1,000 to get AC watts.

Step 4: Calculate total required nameplate power of the PV array.

Divide the AC watts from Step 3 by the system derate factor. Use a derate factor of 0.82 for most systems (this is the standard derate used by PVWatts). For example, if an array size of 6,000 WAC is calculated in Step 3, divide 6,000 WAC by 0.82 to get 7,318 WDC based on the module's STC rating.

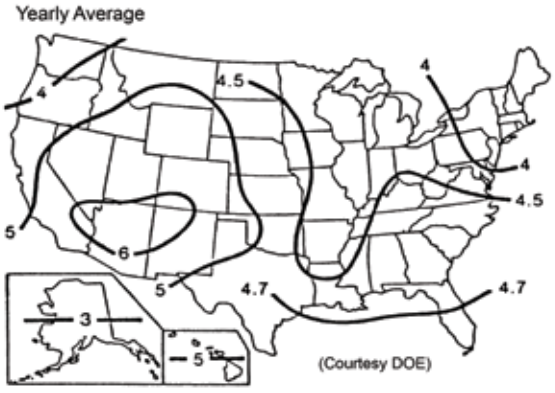
NOTE: Derating factors

The overall system derating factor represents losses in the system due to the difference between the PV module's nameplate DC ratings, and actual expected output in real-world conditions, module mismatch, losses in diodes, connections and wiring, module soiling, array shading, tracking error, system aging, and the inverter efficiency at maximum power. The default derate typically used is 0.82, but specific site conditions and equipment used may cause variations. The 0.82 derate is based on 14% systemic losses and 96% inverter efficiency.

Step 5: Calculate the number of PV modules required for this system.

Divide the system DC wattage in Step 4 by the nameplate rating of the chosen modules to calculate the number of PV modules needed to provide the desired AC output.

Step 6: Select the inverter/module combination from the table on the next page that is closest to the desired system size.



The table on the next page shows inverter and module combinations for our most popular modules and grid-tie inverters. For a given inverter and module combination, the table displays the recommended number of series strings of modules and the number of modules per string for temperatures between 14 °F and 104 °F. Where the inverter will support more than one string of modules, the table also shows the maximum number of modules that can be used with multiple strings.

Sizing is accurate in locations where the maximum temperature is lower than 104 °F and the minimum temperature is higher than 14 °F. In locations where the minimum temperature is lower than 14 °F, the maximum number of modules per string may need to be lower in order to prevent over-voltage.

The line labeled "PTC" is the expected output of the modules at normal operating temperature in full sun. The approximate power output of a system in full sun will be the number of modules multiplied by the watt rating of the modules and then multiplied by the inverter efficiency from the second column in the table. Other factors, such as high or low temperatures, shading, array orientation, roof pitch, and dirt on the modules, will affect the system's actual output.

Recommended number of modules per string
Min v > min MPPT **Updated** **8/26/2015**
temp 14 °F to 104 °F

	Inverter ↓	CEC % V ↓	Module → CEC →	REC TP REC275TP 252.4	REC TP REC280TP 257.1	LG LG310N1CG4 282.7	LG LG315N1CG4 287.4	Suniva OPT275 244.5	Suniva OPT280 249.1
Solar Edge	SE3000A-US-U	98.0%	string/max mods	8-13 / 13	8-13 / 13	8-12 / 12	8-11 / 11	8-13 / 13	8-13 / 13
	SE3800A-US-U	97.5%	string/max mods	8-17 / 17	8-16 / 16	8-15 / 15	8-15 / 15	8-17 / 17	8-16 / 16
	SE5000A-US-U	97.5%	string/max mods	8-19 / 22	8-18 / 22	8-16 / 20	8-16 / 19	8-19 / 22	8-18 / 22
	SE6000A-US-U	97.5%	string/max mods	8-19 / 27	8-18 / 26	8-16 / 24	8-16 / 23	8-19 / 27	8-18 / 26
	SE7600A-US-U	97.5%	string/max mods	8-19 / 34	8-18 / 34	8-16 / 30	8-16 / 30	8-19 / 34	8-18 / 34
	SE10000A-US-U	97.5%	string/max mods	8-19 / 45	8-18 / 44	8-16 / 40	8-16 / 39	8-19 / 45	8-18 / 44
	SE11400A-US-U	97.5%	string/max mods	8-19 / 52	8-18 / 51	8-16 / 46	8-16 / 45	8-19 / 52	8-18 / 51
Enphase	Enphase M215	96.5%	One module	No	No	No	No	No	No
	Enphase M250	96.5%	One module	Yes	Yes	Yes	Yes	Yes	Yes
Fronius	Primo 3.8-1	95.5%	string/max mods	6-13 / 17	6-13 / 17	6-13 / 15	6-13 / 15	6-13 / 17	6-13 / 17
	Primo 5.0-1	96.5%	string/max mods	7-13 / 22	7-13 / 22	7-13 / 20	7-13 / 19	7-13 / 22	7-13 / 22
	Primo 6.0-1	96.5%	string/max mods	7-13 / 27	7-13 / 26	7-13 / 24	7-13 / 23	7-13 / 27	7-13 / 26
	Primo 7.6-1	97.0%	string/max mods	7-13 / 34	8-13 / 34	7-13 / 31	7-13 / 30	7-13 / 34	7-13 / 34
	Primo 8.2-1	97.0%	string/max mods	8-13 / 37	8-13 / 36	7-13 / 33	7-13 / 32	8-13 / 37	8-13 / 36
	Primo 10.0-1	est 96.5%	string/max mods	7-13 / 45	7-13 / 44	7-13 / 40	7-13 / 39	7-13 / 45	7-13 / 44
	Primo 11.4-1	est 96.5%	string/max mods	7-13 / 51	7-13 / 50	7-13 / 46	7-13 / 45	7-13 / 51	7-13 / 50
	Primo 12.5-1	est 96.5%	string/max mods	8-13 / 56	7-13 / 55	7-13 / 50	7-13 / 49	8-13 / 56	8-13 / 55
	Primo 15.0-1	est 96.5%	string/max mods	9-13 / 68	9-13 / 66	8-13 / 60	7-13 / 59	9-13 / 68	9-13 / 66
SMA	SB3000TL-22	96.5%	string/max mods	6-13 / 13	6-13 / 13	6-12 / 12	6-11 / 11	6-13 / 13	6-13 / 13
	SB3800TL-22	97.0%	string/max mods	6-13 / 17	6-13 / 17	6-13 / 15	6-13 / 15	6-13 / 17	6-13 / 17
	SB4000TL-22	97.0%	string/max mods	6-13 / 18	6-13 / 17	6-13 / 16	6-13 / 15	6-13 / 18	6-13 / 17
	SB5000TL-22	97.0%	string/max mods	6-13 / 22	6-13 / 22	6-13 / 20	6-13 / 19	6-13 / 22	6-13 / 22
	SB6000TL-22	97.0%	string/max mods	7-13 / 27	7-13 / 26	7-13 / 24	7-13 / 23	7-13 / 27	7-13 / 26
	SB7000TL-22	96.5%	string/max mods	8-13 / 31	8-13 / 31	7-13 / 28	7-13 / 27	8-13 / 31	8-13 / 31
	SB7700TL-22	96.5%	string/max mods	8-13 / 34	8-13 / 34	8-13 / 31	8-13 / 30	8-13 / 34	8-13 / 34
ABB	PVI-3.0-OUTD-S-US-A	96.0%	string/max mods	5-13 / 13	5-13 / 13	5-12 / 12	5-11 / 11	5-13 / 13	5-13 / 13
	PVI-3.6-OUTD-S-US-A	96.0%	string/max mods	5-13 / 16	5-13 / 16	4-13 / 14	4-13 / 14	5-13 / 16	5-13 / 16
	PVI-3.8-OUTD-S-US-A	96.0%	string/max mods	5-13 / 17	5-13 / 17	5-13 / 15	5-13 / 15	5-13 / 17	5-13 / 17
	PVI-4.2-OUTD-S-US-A	96.0%	string/max mods	5-13 / 19	5-13 / 18	5-13 / 17	5-13 / 16	5-13 / 19	5-13 / 18
	PVI-5000-OUTD-S-US-A	96.5%	string/max mods	6-13 / 22	6-13 / 22	6-13 / 20	6-13 / 19	6-13 / 22	6-13 / 22
	PVI-6000-OUTD-S-US-A	96.5%	string/max mods	6-13 / 27	6-13 / 26	6-13 / 24	6-13 / 23	6-13 / 27	6-13 / 26
	UNO-7.6-TL-OUTD-S-US-A	96.5%	string/max mods	6-13 / 34	6-13 / 34	6-13 / 30	6-13 / 30	6-13 / 34	6-13 / 34
	UNO-8.6-TL-OUTD-S-US-A	96.5%	string/max mods	6-13 / 39	6-13 / 38	6-13 / 34	6-13 / 34	6-13 / 39	6-13 / 38
Ginlong	SOLIS-1K-2G-US	96.0%	string/max mods	4 / 4	4 / 4	4 / 4	-	4 / 4	4 / 4
	SOLIS-1.5K-2G-US	96.0%	string/max mods	5-6 / 6	5-6 / 6	5-6 / 6	5 / 5	5-6 / 6	5-6 / 6
	SOLIS-2K-2G-US	96.0%	string/max mods	6-9 / 9	6-8 / 8	6-8 / 8	6-7 / 7	6-9 / 9	6-8 / 8
	SOLIS-2.5K-2G-US	96.5%	string/max mods	5-11 / 11	5-11 / 11	5-10 / 10	5-9 / 9	5-11 / 11	5-11 / 11
	SOLIS-3K-2G-US	96.5%	string/max mods	5-13 / 13	5-13 / 13	5-12 / 12	5-11 / 11	5-13 / 13	5-13 / 13
	SOLIS-3.6K-2G-US	96.5%	string/max mods	6-13 / 16	6-13 / 16	6-13 / 14	6-13 / 14	6-13 / 16	6-13 / 16
	SOLIS-4K-2G-US	97.0%	string/max mods	5-13 / 18	5-13 / 17	5-13 / 16	5-13 / 15	5-13 / 18	5-13 / 17
	SOLIS-4.6K-2G-US	97.0%	string/max mods	6-13 / 21	6-13 / 20	5-13 / 18	5-13 / 18	6-13 / 21	6-13 / 20
	SOLIS-5K-2G-US	97.0%	string/max mods	6-13 / 22	6-13 / 22	6-13 / 20	6-13 / 19	6-13 / 22	6-13 / 22

Grid-Tie with Battery Backup

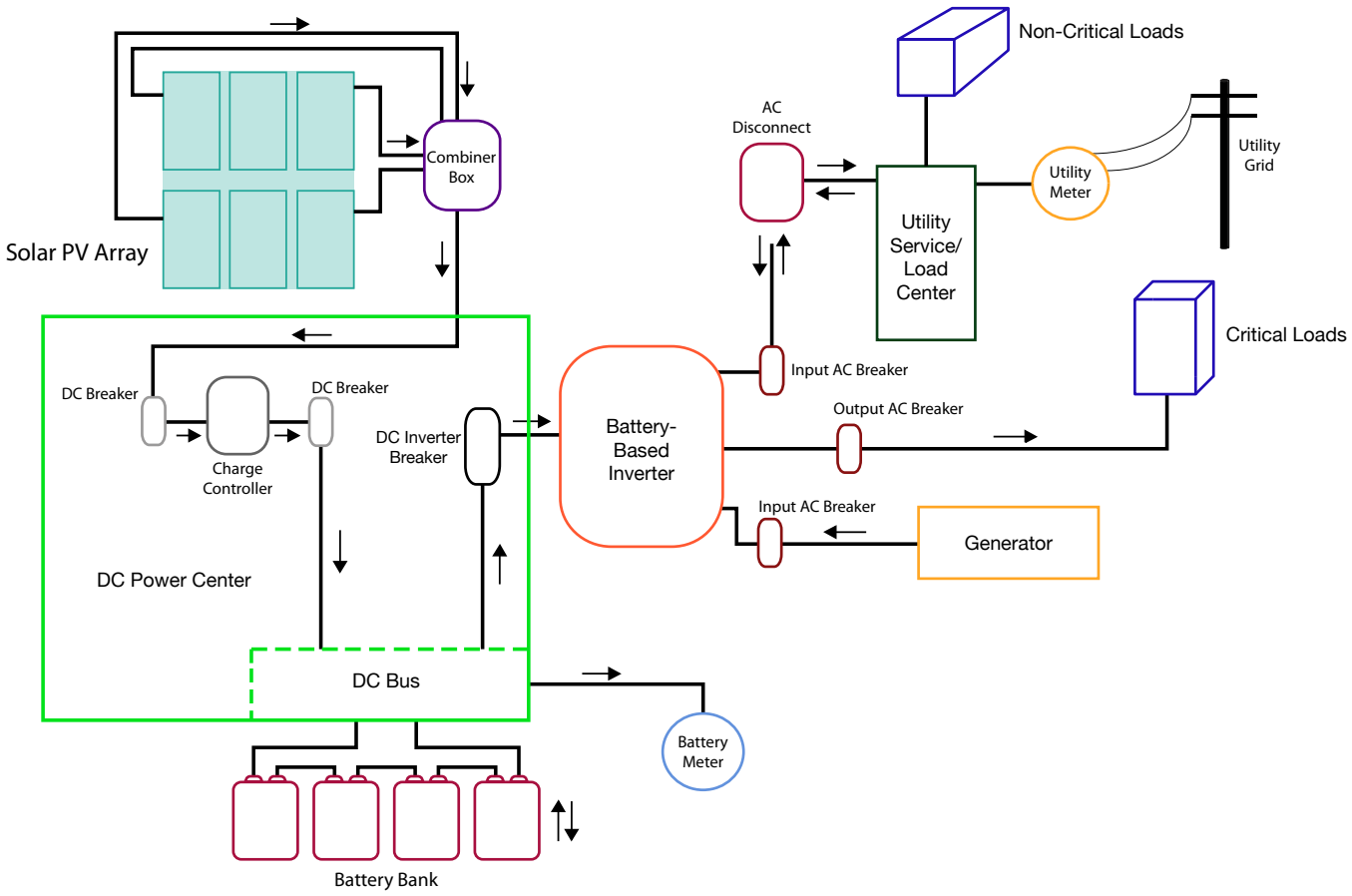
Many solar customers are surprised and disappointed to learn that their typical grid-tie solar PV system will not power their home during a utility outage. In areas where blackouts and extended weather-related outages are common, a battery backup system, like the one shown in the diagram below, can add substantial value.

Sizing and designing a grid-tie system with battery backup is more complex than designing a typical system without energy storage. They perform two separate functions: offsetting the power purchased from the electric utility, just like a standard system, and providing emergency backup power during utility outages. Both of these functions require separate design considerations and calculations.

The "grid-tie" part of the system is designed to offset kilowatt-hour energy consumption using the average peak sun-hours available where the PV array is located.

The "battery backup" part of the system is designed to meet the power draw of the critical loads that need to operate during a grid outage for however long the outage is expected to occur. These systems are generally designed to run only specific circuits located in a separate sub-panel. They are not designed to power the whole house; although this can be done, it adds considerable cost and complexity.

Battery backup systems require specialized inverters and other components and must be carefully sized, so be sure to call AEE Solar's Technical Support Team for assistance if you're unfamiliar with this type of system.



Inverters for Grid-Tie with Battery Backup

OutBack GFX and FXR inverters and switch gear, as well as OutBack Radian inverters, can power loads individually from 2 to 8 kW and multiple inverters can be combined in a single system up to 80 kW in size.

The Schneider Conext XW+ series of inverters offers grid-tie inverters with battery backup capability in 4 kW, 5.5 kW, and 6.8 kW increments. Up to four units can be paralleled for battery backup systems up to 27.2 kW.

The SMA Sunny Island inverters, in conjunction with a Sunny Boy inverter and PV array, can be used to provide backup power in a grid-tied home or business using AC-Coupling. Backup systems can be configured with up to 24 kW single-phase output using up to four Sunny Island inverters or up to 72 kW of three-phase output with up to 12 Sunny Island inverters and a Multi-Cluster Box.

See Battery-Based Inverters for more information on these inverters

Follow steps 1-6 on the Grid-Tie PV System Design Worksheet (on page 2) to determine the size of the PV array required to provide the desired percentage of total power, then calculate the inverter size and battery capacity needed using the worksheet below.

Worksheet: Inverter and Battery Sizing for Grid-Tie with Backup System

Determine energy storage requirement for backup system.

Step 1: Find the power requirements (watts) for the appliances that need power during an outage.

Make a list of the loads and appliances that need power during an outage, such as refrigerators, safety lighting, etc. Only list the essential items, since the system size (and cost) will vary widely with power needed. The wattage of individual appliances can usually be found on the back of the appliance or in the owner's manual. If an appliance is rated in amps, multiply amps by the operating voltage (usually 120 or 240 VAC) to find watts. Add up the wattage of all the items on the list that may need to run simultaneously to arrive at the total amount of watts. This is the "peak wattage" inverter requirement and will determine the minimum size of the dual-function inverter that you will need. If the PV array total wattage is larger than the peak wattage required to run the chosen loads, then ensure that the inverter capacity is equal to or greater than the PV array nameplate capacity.

Step 2: Define how long of an outage the system must accommodate.

Power outages last from a few minutes, to a day or more. This decision will greatly affect the system size and cost, so the desired length of time should be traded against the total loads supported. If the system needs to provide power for an indefinite period of time, use the array and battery bank sizing instructions for an off-grid system on the following pages.

Step 3: Determine the amount of energy (kWh or watt-hours) that would need to be consumed during the length of the expected outage.

Multiply the power requirements (in step 1) by duration in hours (in step 2). The result will be watt-hours. For example, powering a 350 W refrigerator, a 150 W computer, and a 500 W lighting system for 2 hours would require 2,000 watt-hours (or 2 kWh) of energy storage.

Step 4: Factor in the inverter losses.

Multiply the total watt-hours or kWh to be supplied to the loads by 0.87 to account for inverter losses.

Step 5: Calculate the minimum energy storage needed.

Divide the Step 3 result by 0.8 (batteries should not be discharged past 80%). For example, if the battery bank needs to supply 2 kWh of energy, at least 2 kWh ÷ 0.8 = 2.4 kWh of nominal battery energy storage is needed.

Step 6: Calculate battery capacity needed.

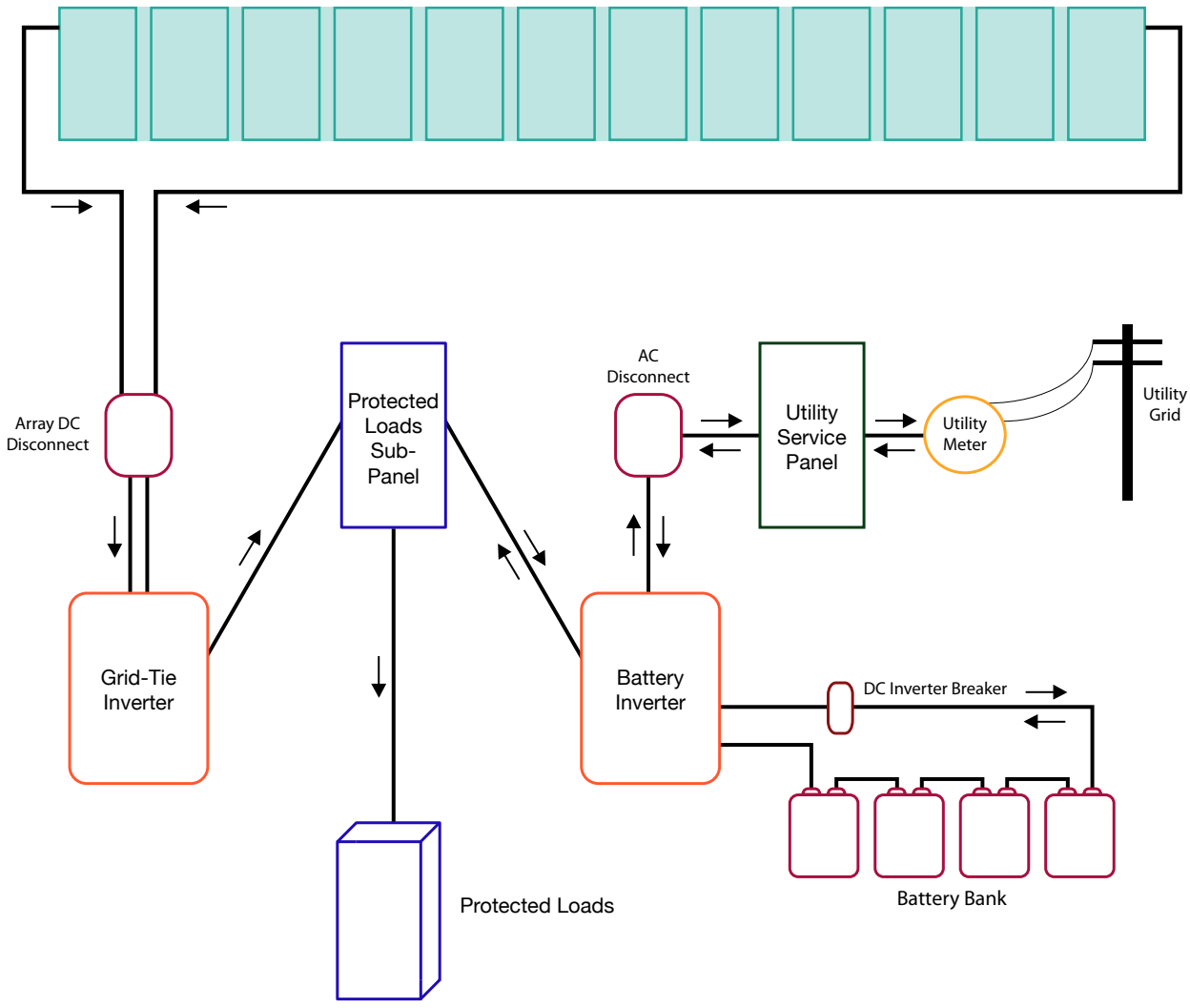
Divide the energy storage requirement from step 4 by the DC voltage of the system (usually 48 VDC, but sometimes 24 VDC) to get battery amp-hour (Ah) capacity. Most backup systems use sealed batteries due to their reduced maintenance requirements and because they can be more easily placed in enclosed battery compartments. Flooded batteries are not recommended for backup or standby applications.

AC-Coupled Systems

An AC-coupled power system is another form of battery-based system. It can be used either in a grid-tie system with a battery backup application, or in a completely off-grid system. Instead of using a battery charge controller with the PV array, these systems utilize standard grid-tie inverters that produce AC power (usually 240 VAC), which can be "sold" to the utility grid when the grid is connected or can be used by a separate battery-based inverter to charge a battery bank during a grid outage.

Along with the standard grid-tie inverter, a second, bidirectional, battery-based inverter is used with a battery bank to provide AC power during a grid outage. Both the AC output of the grid-tie inverter and the AC output of the battery inverter are connected in the protected loads sub-panel. During normal operation when the grid is "up", the power from the PV array and grid-tie inverter simply passes through the sub-panel and the battery inverter's built-in AC transfer switch and on to the utility main panel. From there it is either consumed by house loads connected there or exported to the grid. If a grid outage occurs, the grid-tie inverter will automatically shut off. At the same time, the battery-based inverter will automatically switch off the grid connection and begin to power the loads in the protected loads panel using energy drawn from the battery bank. Since the grid-tie inverter is connected in this sub-panel, it detects the AC power from the battery inverter and, (after a 5-minute delay) will turn back on. The power output from the array and grid-tie inverter will then be used directly by the protected loads connected to the sub-panel or be used to charge the batteries via the battery-based inverter/charger.

The SMA Sunny Island battery inverters are designed to work with SMA Sunny Boy inverters and will communicate with each other to control the battery charging process. Other brands of battery-based inverters, such as OutBack, Schneider XW+, and Magnum MS models can be used with most grid-tie inverters in an AC-coupled system; most however have no built-in way to control battery charging from the grid-tie inverter. A relay can be placed in the AC connection to the grid-tie inverter, controlled by a battery voltage activated switch (such as the AUX relay built into many inverters) to disconnect the grid-tie inverter when the battery voltage rises to the full-charge voltage, ending the charge cycle. Alternatively, a diversion controller connected to the battery, can be used with an AC or DC diversion load to consume the excess power and keep the batteries from being overcharged.



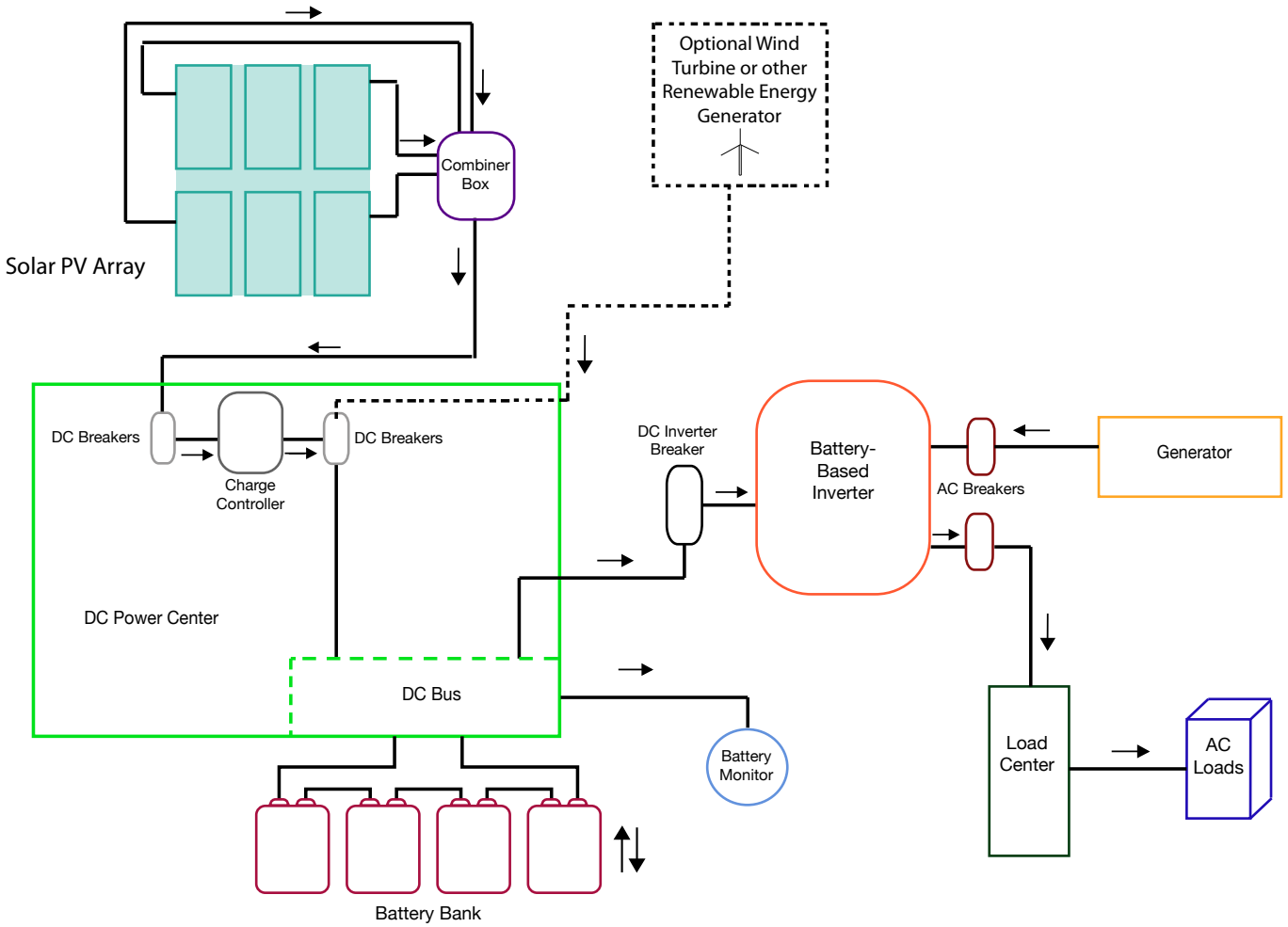
Off-Grid System Sizing Information

Off-grid solar PV systems, like the one shown in the diagram below, are one of the most economical ways to provide electricity in the absence of an electrical power grid. Off-grid systems are useful for remote homes and cabins, RVs and boats, and even for industrial applications like remote telemetry, cathodic protection, and telecommunications.

The size of an off-grid solar electric system depends on the amount of power that is required (watts), the amount of time it is used (hours), and the amount of energy available from the sun in a particular area (sun-hours per day).

Off-grid power systems are designed differently than grid-tie systems. With a typical grid-tie system, sizing calculations are based on the yearly average peak sun-hours available at the site, and are used to offset the annual power consumption drawn from the utility grid. With an off-grid system design, the calculations are usually based on the peak sun-hour figures for the darkest month of the year, rather than the yearly average, in order to provide sufficient on-site power year-round. In locations where it is not practical to install a PV power system that will provide 100% autonomy during the darkest time of the year, a generator may be used to help run loads and charge the battery bank, or if site conditions allow, other energy producing systems, such as wind or micro-hydroelectric turbines can be used to supplement the PV array.

Off-grid power system design is complex, and these systems require specialized inverters, charge controllers, and battery banks. Please contact the AEE Solar Technical Support Team for system design assistance.



Efficiency and Energy Conservation

Energy-efficient appliances and lighting, and non-electric alternatives, can help to reduce the cost of producing and storing energy in off-grid systems. Every watt that doesn't need to be used is a watt that doesn't have to be produced or stored. The information below pertains mostly to off-grid systems, but can also help to reduce the size and cost of grid-tied PV systems, with or without battery backup capability.

Cooking, Heating and Cooling

Each burner on an electric range uses about 1,500 W, which is why bottled propane or natural gas is a popular alternative for cooking. A microwave oven has about the same power draw, but since food cooks more quickly in a microwave oven, the amount of kilowatt hours used is typically lower. Propane, wood or solar-heated water are generally better alternatives for space heating than electric baseboards. Good passive solar design and proper insulation can reduce the need for winter heating. Evaporative cooling is a more reasonable load than air conditioning and in locations with low humidity, it's a great alternative.

Lighting

Lighting requires careful study since type, size, voltage and placement can all significantly impact the power required. In a small cabin, RV, or boat, low voltage DC lighting with LEDs is sometimes the best choice. DC wiring runs can be kept short, allowing the use of fairly small gauge wire. Since an inverter is not required, the system cost is lower. In a large installation with many lights, using an inverter to supply AC power for conventional lighting is more cost-effective. AC LED lights are now common and very efficient, but it is a good idea to have a DC-powered light in the same room as the inverter and batteries in case of an inverter fault. Finally, AC light dimmers will only function properly with inverters that have true sine-wave output.

Refrigeration

Gas powered absorption refrigerators can work well in small systems when bottled gas is available. Modern absorption refrigerators consume approximately 5-10 gallons of LP gas per month. If an electric refrigerator will be used in a standalone system, it should be a high-efficiency type. High-efficiency DC refrigerators are also available and can offer significant energy savings.

Major Appliances

Standard AC electric motors in washing machines, larger shop machinery and tools, swamp coolers, and pumps, are usually ¼ to ¾ horsepower and consume relatively large amounts of electricity, thus requiring a large inverter. These electric motors can also be hard to start on inverter power, due to the large surge of power they need for starting, which can be as much as three-times or more of the power as they draw while running. Variable-frequency drives can be used with large motors to provide a "soft-start", reducing the surge load on the inverter system. A standard top-loading washing machine uses between 300 and 500 watt-hours per load, but new front-loading models can use less than half the energy per load. If the appliance is used more than a few hours per week, it is often more economical to pay more for a high-efficiency appliance rather than make the electrical system larger to support a low efficiency load.

Small Appliances

Many small appliances with heating elements such as irons, toasters and hair dryers consume a very large amount of power when they are used but, by their nature, require only short or infrequent use. With a sufficiently large inverter system and batteries, they will operate, but the user may need to schedule those activities with respect to the battery charging cycle. For example, by ironing in the morning, the PV system can then recharge the battery bank during the day. Or, if these loads can be run during a sunny day, the energy from the PV array can supply the power to run the appliance without needing to draw energy from the battery bank.

Electronic equipment, such as stereos, televisions, DVD players and computers, draw less power than appliances with heating elements, but these loads can add up, so opt for more efficient models when possible, such as an LED or LCD TV instead of a plasma or CRT design.

Phantom Loads

Many appliances, especially ones with wireless remote controls, draw power even when turned "off". While each load may be small, the energy consumption of multiple appliances over a 24 hr period can add up and be quite large. Placing these loads on a switchable outlet or plug strip can save a considerable amount of energy.

Worksheet: Off-Grid Load Analysis

Determine the total kilowatt-hours (kWh) per day used by the AC and DC loads.

Step 1: List all AC loads, wattage and hours of use per week in the table below.
(If there are no AC loads, skip to Step 5)

Multiply watts by hours/week to get AC watt-hours per week. Add up all the watt hours per week to determine total AC watt-hours per week.

NOTE: Wattage of appliances can usually be determined from tags on the back of the appliance or from the owner's manual. If an appliance is rated in amps, multiply amps by operating voltage (120 or 240 VAC) to find watts. Energystar.gov lists annual Wh consumption for Energy Star electrical appliances; divide this number by 52 to get watt-hours per week.

Calculate AC loads *(If there are no AC loads, skip to Step 3)*

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

Step 2: Convert to DC watt-hours per week.
Multiply the result of Step 1 by 1.13 to correct for inverter loss.

Step 3: List all DC loads, wattage and hours of use per week in the table below.
Multiply watts by hours/week to get DC watt-hours per week (Wh/Wk). Add up all the watt hours per week to determine total DC watt-hours per week.

Calculate DC loads *(if applicable)*

Description of DC loads run by inverter	watts	x	hours/week	=	watt-hours/week
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
				Total watt-hours per week:	

Step 4: Calculate total DC watt-hours per week.
Add the total DC watt-hours per week used by AC loads from Step 2 to the watt-hours per week used by DC loads from Step 3 to get the total DC watt-hours per week used by all loads.

Step 5: Calculate your total watt-hours per day consumption.
Divide the total DC watt-hours per week from Step 4 by 7 days to get the total average watt-hours per day that needs to be supplied by the battery.

You will need this number to begin sizing the PV array and battery bank. Note that the Solar Array Sizing Worksheet in this section, as well as the Battery Sizing Worksheet in the Batteries Section, both begin with this number in their Step 1.

Worksheet: Off-Grid Solar Array Sizing

Determine how much energy (kWh) the solar array must produce to size the PV array and determine the total number of solar modules required for the system.

Step 1: List the total average watt-hours per day needed to power the electrical loads.
Obtain this number from the Off-Grid Loads Worksheet on the previous page.

Step 2: Calculate the minimum watt-hours needed per day.
Multiply the watt-hours per day needed by 1.25 to compensate for PV array and battery charge/discharge losses. This is the minimum total watt-hours that the PV array needs to produce, on average, each day. However, increasing the array size further will allow the system to provide some additional charging during cloudy weather and catch up more quickly after a cloudy period. Increasing the array size can also allow for reduced battery storage requirements.

Step 3: List the average sun-hours per day at the system's location.
Check local weather data, look at the map below, or find a city on the Solar Insolation Table in the Reference Section that has similar latitude and weather to your location. If you want year-round autonomy, use the lower winter insolation. If you want 100% autonomy only in summer, use the higher summer insolation. If you have a utility grid-tie system with net metering, use the yearly average figure.

Step 4: Determine the minimum nameplate capacity.
Divide the result of Step 2 by the average sun-hours per day from Step 3 to determine the minimum nameplate capacity of the PV array.

NOTE: Sizing Solar Arrays with PWM or MPPT Charge Controllers
If you are planning a small low-cost system with a PWM charge controller, with 12 or 24 VDC "nominal" PV modules (36 or 72 cells), continue to Step 5 below. If you are planning a system with an MPPT charge controller, go to Step 5 in "Sizing Solar Arrays with MPPT Charge Controllers". Information on the different types of PV charge controllers can be found in the Charge Controller section.

Step 5: Calculate peak amps.
Divide the total solar array wattage required from Step 4 by the system's DC battery voltage (usually 12, 24, or 48 VDC) to get the total peak amps (A) that the PV array must produce.

Step 6: Find the peak-power current (I_{mp}) of the module you will be using from its specifications or Data Sheet.

Step 7: Calculate the number of parallel strings.
Divide the result of Step 5 by the result of Step 6. Round up to the next whole number. This is the total number of parallel module strings required to produce the total array current needed.

Step 8: Use the table below to determine the number of modules in each series string needed to match the DC battery voltage of the power system.

Nominal System Voltage	Number of Series Connected Modules per String	
Volts	12 V module	24 V module
12	1	--
24	2	1
48	4	2

Step 9: Calculate the minimum number of solar modules.
Multiply the number of strings from Step 7 by the number of modules per string from Step 8 to get the total minimum number of solar modules required with a PWM charge controller.

Step 10: Calculate minimum PWM charge controller rating.
Multiply the number of strings from Step 7 by the module's short-circuit current (I_{SC}) and then by a 1.25 Code-required safety factor. The current rating of the selected PWM charge controller must exceed this number.

Sizing Solar Arrays with MPPT Charge Controllers

Step 5: Note the minimum solar array nameplate capacity required from Step 4.

Step 6: Enter the nameplate power (in watts) of the PV module you plan to use.

Step 7: Determine the minimum number of modules needed.

Divide the PV array capacity from Step 5 by the module nameplate power from Step 6 to determine the minimum number of modules needed. Round up to the nearest whole number. *(NOTE: This number may need to be adjusted in Step 10).*

Step 8: Determine the number of modules in each series string.

Use the table below to determine the number of modules needed in each series string based on the system's battery voltage and PV charge controller used.

MPPT Charge Controller Sizing Table – Range of Modules in Series[1]

Charge controller model	Max DC input voltage	Nominal battery voltage	Cell count of PV module used			
			36	54	60	72
OutBack FM 60 & 80 Schneider XW-MPPT150-60 Morningstar TriStar 45 & 60	150 VDC	12 VDC	1 to 5	1 to 3	1 to 3	1 or 2
		24 VDC	2 to 5	2 or 3	2 or 3	1 or 2
		48 VDC	4 or 5	3	3	2
MidNite Solar Classic 150	150 VDC	12 VDC	1 to 5	1 to 3	1 to 3	1 or 2
		24 VDC	2 to 6	2 to 4	2 or 3	1 to 3
		48 VDC	4 to 6	3 or 4	3	2 or 3
MidNite Solar Classic 200 Magnum PT-100	200 VDC	12 VDC	1 to 7	1 to 5	1 to 4	1 to 3
		24 VDC	2 to 7	2 to 5	2 to 4	1 to 4
		48 VDC	4 to 7	3 to 5	3 to 4	2 to 4
MidNite Solar Classic 250	250 VDC	12 VDC	1 to 9	1 to 6	1 to 5	1 to 4
		24 VDC	2 to 9	2 to 6	2 to 5	1 to 4
		48 VDC	4 to 9	3 to 6	3 to 5	2 to 4
Schneider XW-MPPT600-80	600 VDC	24-48 VDC	14 to 22	9 to 15	9 to 13	7 to 11
Morningstar TS-MPPT-60-600V-48 (DB)	600 VDC	48 VDC	5 to 23	3 to 15	3 to 12	3 to 10
Magnum PT-100	200 VDC	12 VDC	1 to 7	1 to 5	1 to 4	1 to 3
		24 VDC	2 to 7	2 to 5	2 to 4	1 to 3
		48 VDC	4 to 7	3 to 5	3 to 4	2 to 4

[1]Based on temp range of 14°F to 104°F. Adjustments may be needed in locations with temps outside this range.

Step 9: Calculate the number of series strings needed.

Divide the total number of modules from Step 7 by the number of modules per series string from Step 8. Round up to a whole number. This is the total number of array series strings needed.

Step 10: Determine the total number of modules needed.

Multiply the number of module strings from Step 9 by the number of modules per string from Step 8 to determine the total number of modules needed.

Step 11: Find the total number of chosen controllers needed.

Multiply the total number of modules needed (from Step 10) by the rated wattage of the module being used. This is the adjusted total PV array nameplate capacity. Using the chart below, find a controller rated for the total array wattage (or more). If the total array wattage is more than a single controller can handle, either use a larger controller or use multiple controllers in parallel. NOTE: Most charge controllers must have their own separate PV array, so larger arrays need to be divided into sub-arrays for each charge controller.

Max Array Wattage per Controller Size

Battery voltage	Controller rated output amps								
	15 A	20 A	30A	45 A	60 A	75 A	80 A	95 A	100 A
12 V	216 W	265 W	431 W	647 W	862 W	1100 W	1149 W	1379 W	1437 W
24 V	431 W	530 W	862 W	1293 W	1724 W	2100 W	2299 W	–	2874 W
48 V	--	–	1724 W	2586 W	3448 W	4000 W	4598 W	–	5747 W

Photovoltaic (PV) Modules

Solar photovoltaic modules, often referred to as solar panels, convert light energy into a direct electrical current (DC). As solid-state devices, solar modules have no moving parts and are extremely reliable and durable compared to any other generator technology. While solar modules have become somewhat commoditized in recent years, there are important differences in form, quality, and performance that can impact both installation time and long-term system performance. This section of our catalog presents a selection of high-quality crystalline modules with a variety of features and price points to suit virtually any project.

Output Characteristics

The output power, voltage, and current profile of the solar module will dictate the number of modules needed and what inverters or charge controllers can be used. Small off-grid applications often require 12 VDC output modules to directly charge batteries and/or operate DC loads. Larger modules with output voltages ranging from 24 to 50 VDC are more commonly used in grid-tie systems where a high DC voltage is required to operate the inverter.

Mechanical Characteristics

Basic mechanical characteristics, such as dimensions, frame profile, and static load rating, as well as grounding and mounting locations will need to be understood when designing your system. Frame and back sheet color may also come into play for residential customers, particularly when they are part of a homeowner's association. Also be sure you know what type of connector the module output has, if any, since this can impact selection of optimizers, microinverters, and cabling.

Solar Modules at a Glance[1]

Power	Brand/model	Cell type	Frame	Power tolerance	Vpeak[2]	Ipeak	Area efficiency	Dimensions (L" x W" x D")	Weight	Static load rating	Item code
260 W	Hyundai HiS-M260RG	Poly	Black	-0/+3%	31.1 VDC	8.4 A	15.9%	64.6 x 39.3 x 1.38 in	40 lbs	40 psf	**011-04000**
260 W	Q-Cells Q.PRO BFR-G4 260	Poly	Black	-0/+3%	30.2 VDC	8.5 A	15.6%	65.7 × 39.4 x 1.26 in	41 lbs	75 psf	**011-06533**
265 W	Q-Cells Q.PRO BFR-G4 265	Poly	Black	-0/+3%	30.8 VDC	8.62 A	15.9%	65.7 × 39.4 x 1.26 in	41 lbs	75 psf	**011-06532**
275 W	REC 275TP	Poly	Black	-0/+5 W	31.4 VDC	8.76A	16.7%	65.5 x 39.0 x 1.5 in	40 lbs	75 psf	**011-02599**
275 W	Suniva OPT275-60-4-1B0	Mono	Black	±3%	32.0 VDC	8.59 A	16.7%	65.4 x 39.0 x 1.37 in	40 lbs	113 psf	**011-09239**
280 W	Suniva OPT280-60-4-100	Mono	Clear	±3%	31.8 VDC	8.81 A	17.0%	65.4 x 39.0 x 1.37 in	40 lbs	113 psf	**011-09238**
280 W	REC 280TP	Poly	Black	-0/+5 W	31.9 VDC	8.78 A	17.0%	65.5 x 39.0 x 1.5 in	40 lbs	75 psf	**011-02598**
310 W	LG 310N1C-G4	Mono	Black	-0/+3%	32.8 VDC	9.45 A	18.9%	64.6 x 39.4 x 1.57 in	37 lbs	125 psf	**011-00213**
315 W	REC 315PE72	Poly	Clear	-0/+5 W	36.8 VDC	8.62 A	16.2%	77.5 x 39.0 x 1.75 in	60 lbs	75 psf	**011-02570**
315	LG 315N1C-G4	Mono	Black	-0/+3%	33.2 VDC	9.50 A	19.2%	64.6 x 39.4 x 1.57 in	37 lbs	125 psf	**011-00212**
320	LG 320N1C-G4	Mono	Black	-0/+3%	33.6 VDC	9.53 A	19.5%	64.6 x 39.4 x 1.57 in	37 lbs	125 psf	**011-00214**

[1]Module availability may vary - Visit www.AEEexpress.com for latest pricing and availability.
[2]See Dasol listing on page 17 for our selection of nominal 12 VDC modules.

ENERGIZING LIFE TOGETHER

REC

REC TWINPEAK

PREMIUM SOLAR PANELS WITH SUPERIOR PERFORMANCE

- → 120 half-cut cells
- → 265 – 285 Wp (poly)
- → Available in black or silver frame
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- → From the largest European brand of solar panels

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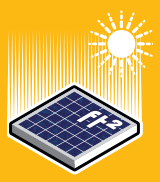

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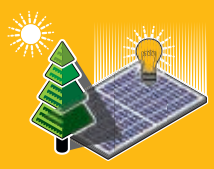


IMPROVED PERFORMANCE IN SHADED CONDITIONS

100% PID FREE

REDUCES BALANCE OF SYSTEM COSTS

REC Solar

These modules, made by REC in Singapore, offer exceptional quality and performance at a reasonable price. Rigorous quality control is applied throughout the production process from silicon to cell to module. The -0/+5 W power tolerance guarantees you the power you pay for and minimizes mismatch losses.

TwinPeak Series PV Modules

Based on a multicrystalline cell platform, the REC TwinPeak Series encompasses a number of new and innovative technologies that provide performance comparable to monocrystalline p-type and n-type modules.

Most visibly, these modules use "half-cut" cells with 60 cells on each side of the module wired in parallel. This keeps the voltage similar to 60-cell modules, while improving shade tolerance and reducing energy loss due to cell resistance.

The cells themselves feature state-of-the-art Passivated Emitter Rear Cell (PERC), aka "backside passivation" technology that improves the light capture of the cell, resulting in improved energy harvest in real-world conditions.

The modules are equipped with a novel "split" junction box that places the PV wire cables with MC4-type connectors near each side of the module. The PV wire output cables are long enough to enable landscape array layouts.

PE72 Series PV Modules

PE72 series modules are equipped with an environmentally sealed junction box and PV wire cables with MC4-type connectors. The 72-cell PE series modules have clear anodized frames and white back sheets.

Warranty

REC modules come with a ten-year workmanship warranty and a 25-year linear power guarantee that allows for no more than 0.7% degradation per year. All modules are listed to UL 1703 for the U.S.A. and Canada.

REC Solar PE Series PV Modules[1]			
Technical Data	**120-cell TP Series**		**72-cell PE series**
Cells (qty/size)	120 / 156 x 78 mm		72 / 156 mm
Power output tolerance	-0/+5 W		-0/+5 W
Nominal Operating Cell Temperature (NOCT)	112.3 +/-3.6 °F [44.6 °C (±2 °C)]		112.3 +/-3.6 °F [44.6 °C (±2 °C)]
Voltage temperature coefficient	-0.56%/°F [-0.31%/ °C]		-0.49%/°F [-0.27%/ °C]
Fire rating/type	Class C / Type 2		Class C / Type 1
Connector type	MC4		MC4 connectable
Cable length	35 in (pos) / 47 in (neg)		47 in [1.2 m]
Static load rating	75 psf [3600 Pa]		75 psf [3600 Pa]
Quantity per pallet	25		25
Quantity per 53' trailer	900		900
Max. system voltage	1,000 VDC		1,000 VDC
Series fuse rating	15 A		20 A
Dimensions (L x W x D)	65.5 x 39 x 1.5 in [1665 x 991 x 38 mm]		77.5 x 39 x 1.75 in [1969 x 991 x 44.5 mm]
Weight	39.5 lbs [18 kg]		59.5 lbs [30 kg]
Module	**REC275TP**	**REC280TP**	**REC 315PE72**
Peak power	275 W	280 W	315 W
Voltage at peak power	31.4 VDC	31.9 VDC	36.8 VDC
Current at peak power	8.76 A	8.78 A	8.62 A
Open circuit voltage	38.8 VDC	39.2 VDC	45.5 VDC
Short circuit current	9.40 A	9.44 A	9.09 A
Module area efficiency	16.7%	17.0%	16.2%
Item code	**011-02599**	**011-02598**	**011-02570**

[1]Data subject to change without notice

Hanwa Q-Cells

NEW! Q.Pro BFR-G4 Series PV Modules

The European-made BFR-G4 modules represent the latest advances in Q-Cells's workhorse multi-crystalline Q.Pro PV module line. These modules feature black anodized frames with white back sheets and are suitable for most residential and commercial applications.

As a global manufacturer of a wide variety of products, Hanwha backs these modules with 25-year linear performance guaranty and 12-year product warranty. These modules are listed to UL 1703, IEC 61215, and IEC 61730-Ed 2.

Q-Cells Q.PRO BFR-G4 PV Modules[1]		
Technical data		
Cells (qty/size)	60 / 6 in x 6 in [156.75 mm]	
Power output tolerance	-0/+5 W	
Nominal Operating Cell Temperature (NOCT)	113 +/- 5.4°F [45 °C +/-3 °C]	
Voltage temperature coefficient	-0.74%/°F [-0.41%/°C]	
Fire rating/type	Class C / Type 1	
Connector type	Tyco PV4 (MC4 connectable)	
Cable length	39.4 in [1 m]	
Static load rating	75 psf [3,600 Pa] (max load)	
Quantity per pallet	32	
Quantity per 53' trailer	1,024	
Max. system voltage	1,000 VDC	
Series fuse rating	20 A	
Dimensions (L x W x D)	65.7 × 39.4 x 1.26 in [1670 × 1000 × 32 mm]	
Weight	41.5 lbs [18.8 kg]	
Module	BFR-G4 260	BFR-G4 265
Peak power	260 W	265 W
Voltage at peak power	30.18 VDC	30.75 VDC
Current at peak power	8.53 A	8.62 A
Open circuit voltage	37.77 VDC	38.01 VDC
Short circuit current	9.15 A	9.23 A
Module area efficiency	15.6%	15.9%
Item code	**011-06533**	**011-06532**

[1]Data subject to change without notice

LG Solar

NEW! NeON2 Series PV Modules

LG's NeON2 monocrystalline PV modules are among the most efficient PV modules available thanks to a host of innovative technologies and enhancements at both the cell and module level. These modules feature high-gloss black frames, white back sheets, and thinner cell busses for a sleek appearance.

As a world-leading diversified manufacturer, LG backs these modules with 25-year linear performance guaranty and 12-year product warranty. These modules are listed to UL 1703, IEC 61215, IEC 61730-1/-2, IEC 62716, and IEC 61701 and produced in an ISO 9001 certified factory.

LG NeON2 PV Modules[1]			
Technical data			
Cells (qty/size)	60 / 6 x 6 in [156.75 mm]		
Power output tolerance	-0/+3%		
Nominal Operating Cell Temperature (NOCT)	114.8 +/-5.4 °F [46 °C +/-3 °C]		
Voltage temperature coefficient	-0.50%/°F [-0.28%/°C]		
Fire rating/type	Class C / Type 2		
Connector type	MC4 connectable		
Cable length	39.4 in [1 m]		
Static load rating	125 psf [6,000 Pa] front load / 113 psf [5,000 Pa] rear load		
Quantity per pallet	25		
Quantity per 53' trailer	850		
Max. system voltage	1,000 VDC		
Series fuse rating	20 A		
Dimensions (L x W x D)	64.57 x 39.37 x 1.57 in [1640 x 1000 x 40 mm]		
Weight	37.5 lbs [17 kg]		
Module	LG310N1C-G4	LG315N1C-G4	LG320N1C-G4
Peak power	310 W	315 W	320 W
Voltage at peak power	32.8 VDC	33.2 VDC	33.6 VDC
Current at peak power	9.45 A	9.50 A	9.53 A
Open circuit voltage	40.4 VDC	40.6 VDC	40.9 VDC
Short circuit current	9.96 A	10.02 A	10.05 A
Module area efficiency	18.9%	19.2%	19.5%
Item code	**011-00213**	**011-00212**	**011-00214**

[1]Data subject to change without notice

Suniva

Optimus Series PV Modules

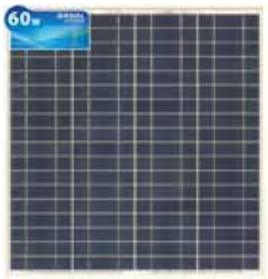
Suniva employs a variety of patented and proprietary technologies to produce their mono-crystalline cells and Optimus PV modules. Suniva modules carry a ten-year product workmanship warranty and a 25-year linear power output guaranty. The modules presented here meet Buy America Act requirements. Modules are listed to UL 1703 for the U.S.A. and Canada and CEC 61215 for Europe.

The **OPT275-60-4-100** and **OPT280-60-4-100** solar modules offer good area efficiency and performance. These high-efficiency modules feature clear-anodized aluminum frames and a white back sheet and are suitable for most commercial and residential applications.

The **OPT275-60-4-1B0** solar module offers great aesthetics without sacrificing efficiency. This 275 W module features black-anodized aluminum frames and a black back sheet for a sleek appearance on any rooftop.

Suniva Optimus PV Modules[1]		
Technical data		
Cells (qty/size)	60 / 156 mm	
Power output tolerance	-0/+3%	
Nominal Operating Cell Temperature (NOCT)	114.8 +/-3.6 °F [46.0 +/-2 °C]	
Voltage temperature coefficient	-0.60%/°F [-0.34%/°C]	
Fire rating	Class C / Type 2	
Connector type	MC4 connectable	
Cable length	43.3" [1.1 m]	
Static load rating	113 psf [5400 Pa]	
Quantity per pallet / truckload	25 / 900	
Max. system voltage	1,000 VDC	
Series fuse rating	15 A	
Dimensions (L x W x D)	65.35 x 38.98 x 1.37 in [1660 x 990 x 35 mm]	
Weight	39.5 lbs [17.9 kg]	
Module	**OPT275-4-1B0**	**OPT280-4-100**
Peak power	275 W	280 W
Voltage at peak power	32.0 VDC	31.8 VDC
Current at peak power	8.59 A	8.81 A
Open circuit voltage	39.1 VDC	38.8 VDC
Short circuit current	9.32 A	9.57 A
Module area efficiency	16.7%	17.0%
Item code	**011-09239**	**011-09238**

[1]Data subject to change without notice.



Dasol Energy

DS-A18 Series PV Modules

These 12 VDC nominal modules have an output voltage that is well-suited for charging 12-Volt batteries and can be wired in series for charging 24- or 48-Volt battery banks. They can be used with inexpensive PWM controllers (see Charge Controllers for more information).

These modules, from Dasol Energy, are efficient and robust with tempered glass, tough polymer back sheets, and anodized aluminum frames. The modules offered here are listed to UL 1703, CSA 5311-10 & 90 as well as IEC 61215 and are produced in an ISO 9001 certified facility. The **DS-A18-10** has wire leads. The **DS-A18-30** has a single-port J-box and can be ordered with a 2-conductor lead. The larger modules feature diode-accessible junction boxes with pre-assembled MC4/H4-style leads. Made in China.

Dasol Energy DS-A18 Series PV Modules					
Technical data					
Number of cells			36		
Power output tolerance			+/- 5%		
$Voltage_{oc}$ temp coefficient			-0.38%/ °C		
Fire rating			Class C		
Connector type			Wire leads (10-30 W) or J-box with MC4-type leads		
Maximum system voltage			600 VDC		
Module	**DS-A18-10**	**DS-A18-30**	**DS-A18-60**	**DS-A18-90**	**DS-A18-135**
Peak power	10 W	30 W	60 W	90 W	135 W
Voltage at max power	18.0 VDC	18.0 VDC	18.0 VDC	18.0 VDC	18.0 VDC
Current at max power	0.56 A	1.67 A	3.33 A	5.0 A	7.5 A
Open circuit voltage	22.3 VDC	22.3 VDC	22.3 VDC	22.3 VDC	22.3 VDC
Short circuit current	0.61 A	1.82 A	3.64 A	5.45 A	8.18 A
Series fuse rating	1 A	3 A	6 A	8 A	12 A
Length	27.2" [690 mm]	27.2" [690 mm]	27.2" [690 mm]	39.0" [990 mm]	56.7" [1440 mm]
Width	13.8" [350 mm]	13.8" [350 mm]	26.2" [665 mm]	26.2" [665 mm]	26.2" [665 mm]
Depth	1" [25 mm]	1" [25 mm]	1.38" [35 mm]	1.38" [35 mm]	1.38" [35 mm]
Weight	6.6 lbs [3 kg]	6.6 lbs [3 kg]	12.8 lbs [5.8 kg]	17.0 lbs [7.7 kg]	24.7 lbs [11.2 kg]
Item code	**011-08964**	**011-08960**	**011-08961**	**011-08962**	**011-08965**

Off-Grid Solar PV Lighting Kits

These portable solar lighting kits include a small PV module, three high-efficiency hanging LED lamps and a lithium ion battery pack with USB ports for charging portable devices. With at least six hours in the sun, the kits can keep the lights running for four to eight hours, give or take charging your smartphone. These kits are cost-effective solutions for camping, disaster preparedness, or even replacing costly kerosene lamps in un-electrified parts of the world.

The **S10030A3** kit is 6 VDC with a 3 W module, 353 mAh battery, and 60 lm lamps. The **SLK201003B3** kit is 12 VDC with a 10 W module, 556 mAh battery, and 100 lm lamps. This larger kit also includes an adapter for charging from an AC outlet. The **S100505B3** kit is similar to **S100303A3**, but includes a larger module and 5 Ah battery as well as brighter 100 lm lamps.

Dasol Energy Solar PV Lighting Kits		
Model	**Description**	**Item code**
S100303A3	6 VDC solar lighting kit with 3 W module and 3 LED lamps	**010-01010**
SLK201003B3	12 VDC solar lighting kit with 10 W module, 3 LED lamps and AC adapter	**010-01011**
S100505B3	6 VDC solar lighting kit with 5 W module and 3 LED lamps	**010-01012**

Mounting Structures

Mounting structures are used to fix PV modules to the roof or to the ground so they aren't moved by wind or snow. Be sure to consult the PV module manufacturer's installation manual when selecting and configuring a mounting system as not all modules are compatible with all mounting methods. If the manufacturer doesn't explicitly allow for the type of clamp and mounting locations or grounding method used by the mounting system, it may not pass inspection.

Most modules can be fastened via holes in the bottom flange of the frame but this can be awkward and time consuming. Some ground-mounting systems fasten to the bottom flange using specialized clips, enabling installers to perform virtually all of their work underneath the modules. Top clamps, which clamp the module frame to a mounting rail or roof attachment, are most popular today as the clamps can double as spacers and clamp two modules simultaneously, reducing the total number of fasteners required. Regardless of clamp type, it is also important to clamp the module in the right places.

Most PV modules are designed to be clamped at the quarter-points where the mounting holes typically are. This ensures optimal loading on the module frame and provides maximum static and dynamic load capacity. Some manufacturers also allow for mounting on the short ends of the module, which can allow two rows of modules to share a rail. However, mounting on the ends typically reduces the load ratings of the module, which is why most manufacturers don't allow it.

Early equipment grounding for module frames was accomplished with a bolt or screw with a star washer attached to the grounding wire. AEE Solar later introduced grounding lugs which provided a faster and more secure method for attaching the ground wire and these have since given way to WEEB clips (See Electrical Distribution Gear) which enabled module grounding through the rail. With the advent of the UL 2703 mounting and grounding standard, many mounting systems, such as SnapNrack, accomplish grounding through the mounting components so that the installer only needs to run a grounding wire to the end of each row.

Note that specialized PV products like frameless or flexible modules typically require their own proprietary mounting and grounding components.

SnapNrack

Solar Mounting Solutions

SnapNrack was developed by a team of veteran solar engineers working with installers in the field to ensure a quick, efficient installation using modules from virtually any manufacturer. The SnapNrack roof mounting system simplifies and reduces the cost of the solar installation process.

The rail is a lightweight aluminum extrusion that is easy to transport, handle, and install. Snap-in sliding channel nuts ensure quick and easy installation and precise alignment of module clamps. Every bolt in the system uses the same sized wrench, ensuring efficient installations and reducing labor hours on the roof. Standoffs and L-feet connect to the rails using the same snap-in channel nuts as the module clamps and no drilling is required.

SnapNrack is engineered for durability and structural integrity in all environments, providing excellent seismic, wind, and snow loading protection on all products. Its compact and efficient rail design reduces material requirements and ensures a low-profile installation on any roof. SnapNrack has been engineered from the ground up with maximum standoff adjustability for a clean, level installation even on irregular roof surfaces.

Online Configuration Tools for Series 100 and 200 are available on AEE Express or the SnapNrack website (SnapNrack.com), as are installation manuals. The SnapNrack manuals are a complete how-to guide full of color photos, illustrations, and step-by-step instructions.

UL 2703 Grounding and Bonding Compliance

SnapNrack 100 and 200 systems are fully listed to the UL 2703 Standard for Grounding and Bonding. As of January 1st, 2016, all SnapNrack system products offered through AEE have been certified by UL for electrical continuity, eliminating the need for additional grounding hardware. Bonding pins are integrated into product assemblies including module clamps and rail splices, eliminating the need for bonding washers on each PV module or rail splice jumpers. Only one SnapNrack Grounding Lug is required per individual row of modules (not per rail).

UL 2703 Class A Fire Rating Compliance

In addition to grounding and bonding, SnapNrack's UL 2703 Certification and Compliance ensures that the Series 100 roof mount system is Class A Fire Rated when installed with Type 1 and Type 2 photovoltaic modules. SnapNrack achieved the Class A fire rating through stringent testing that included the Spread of Flames tests and the Burning Brand tests. The system also meets the requirements of the California building codes set by local jurisdictions and the 2012 International Building Codes which went into effect on January 1, 2015.

Warranty

All SnapNrack products are covered by a ten-year limited warranty. For complete details please visit www.SnapNrack.com/system-overview to view the warranty PDF.

SnapNrack Series 100 Roof Attachments

SnapNrack offers a variety of roof attachment methods by combining familiar parts with more specialized hardware. The **L Foot, Flashing & Base Kit**, is recommended for simple flush mounts to a roof with composition shingles only. The **Metal Roof Base** provides a robust self-sealing EPDM rubber washer and a sealing top cap mounting base for common corrugated metal roof profiles. The **Standard and Wide Base Seam Clamps** are made from a high tensile strength aluminum that will work with a range of metal roof designs. The **Corrugated Straddle Block** allows attachment of the L Foot directly to a structural member covered with a corrugated metal roof without collapsing or crushing the ridge in the metal roof material. Units are sold individually, unless otherwise noted, but full case discounts are available when ordering multiples of 20.

Black L-Foot, Black Galv Flashing, and Base Kit

Bonding Metal Roof Base with L Foot

Standard Base Seam Clamp with L Foot

Wide Base Seam Clamp with L Foot

Corrugated Straddle Block with L Foot Kit

L Foot Mounts for Composition Roofs	
Composition L Foot Flashing Kits	
Description	**Item code**
Black L Foot, Black Galv Flashing, and Base Kit	**242-92051**
Silver L Foot, Black Galv Flashing, and Base Kit	**242-92050**
Black L Foot, Black Alum Flashing, and Base Kit	**242-92048**
Silver L Foot, Silver Alum Flashing, and Base Kit	**242-92047**
L Foot Base and Black Galv Flashing Kit (no L Foot)	**242-92049**
Composition L Foot Accessories	
Description	**Item code**
L Foot Flashing, 12" x 12", Black Galv	**232-01060**
L Foot Flashing, 12" x 12", Black Alum	**232-01151**
L Foot Flashing, 12" x 12", Silver Alum	**232-01150**
L Foot Base (includes flange nut)	**242-00016**
Black Composition L Foot (92˚)	**242-09015**
Silver Composition L Foot (92˚)	**242-09005**

L Foot Mounts for Metal Roofs	
Metal Roof Base	
Description	**Item code**
Metal Roof Base with L Foot	**242-02037**
Metal Roof Base	**242-02036**
Seam Clamp	
Description	**Item code**
Standard Base Seam Clamp with L Foot	**242-05150**
Standard Base Seam Clamp	**242-05000**
Wide Base Seam Clamp with L Foot	**242-05151**
Wide Base Seam Clamp	**242-05001**
Corrugated Straddle Block	
Description	**Item code**
Corrugated Straddle Block with L Foot Kit	**242-02046**
Corrugated Straddle Block	**232-02421**
All Purpose L Foot	
Description	**Item code**
Black All Purpose L Foot (90˚)	**242-09020**
Silver All Purpose L Foot (90˚)	**242-09019**

Flat Tile Hook & Universal Tile Hook

The **Universal Tile Hook** is designed to work with Flat, S, and W shaped tile roofs which can typically install with minimal cutting/grinding of tiles. Provides enhanced install flexibility regardless of the rafter location due to the 1.25" vertical adjustability and 6" horizontal adjustability of the tile hook in relation to the large 4" x 8" base. Its 1/4" steel arm is thicker and more rigid compared to competing products on the market, requiring less roof attachments per installation. The **Flat Tile Hook** offers the most cost effective and efficient solution for mounting on flat concrete tile rooftops. Utilizing many of the same features as the Universal Tile Hook, the design focuses on maximizing speed and efficiency for installing specifically with concrete flat tiles.

Tile Roof Hooks	
All Purpose L Foot	
Description	**Item Code**
Flat Tile Hook	**242-02045**
Universal Tile Hook	**242-02044**

Hanger Bolt Clamp

The **Hanger Bolt Clamp** allows a versatile installation on roof surfaces that will not allow for L Feet or standoffs. These can be used with EJOT solar fastening systems.

Hanger Bolt Attachments	
Hanger Bolt	
Description	**Item Code**
Hanger Bolt Clamp	**242-01102**

Standoff Kit, 5 ½"

Standoffs can be used on flat roofs or pitched roofs, comp shingle or tile and include a one-hole base, anodized standoff shaft, rubber rain collar and a standoff clamp assembly. The HD Standoffs are typically used on flat roofs with built up foam insulation where a taller standoff is required. They include a six-hole HD base, anodized HD standoff shaft, rubber rain collar and standoff clamp assembly. **Tilt Kits** can be used to tilt up arrays on low-slope roofs. The kits include two standoff mounts with base (one-hole for standard and six-hole for HD), anodized standoff shafts, rubber rain collars and the Standoff Clamp and L Foot Assembly.

10° Tilt Kit w/ 5 ½" and 10" Standoffs

Standoff Mounts for All Roof Types	
Standoff Kits	
Description	**Item code**
Standoff Kit, 5 ½"	**242-92057**
Standoff Kit, 7"	**242-92059**
Standoff Kit, 8 ½"	**242-92061**
Standoff Kit, 10"	**242-92055**
Tilt Kits	
Description	**Item code**
10° Tilt Kit w/ 5 ½" and 10" Standoffs	**242-92077**
Standoff Accessories	
Description	**Item code**
Standoff Base, one-Hole	242-00017
Standoff Base, four-Hole	232-02412
Standoff Shaft, 3"	232-01048
Standoff Shaft, 5 ½"	232-01054
Standoff Shaft, 7"	232-01055
Standoff Shaft, 8 ½"	232-01057
Standoff Shaft, 10"	232-02406
1" Standoff Spacer w/ Connector Screw	242-92081
Rubber Rain Collar	232-01000
Standoff Clamp Assembly	242-04100
Standoff Clamp and L Foot Assembly	242-09002
10° - 45° Variable Tilt Hardware Kit	242-92083

Standoff Clamp Assembly

Standoff Clamp and L Foot Assembly

HD Standoff Kit, 12"

Rubber Rain Collar

Standoff Flashing, 4" Offset Cone, 18 ¾" x 15", Galv

HD Standoff Mounts for All Roof Types	
HD Standoff Kits	
Description	**Item code**
HD Standoff Kit, 7"	**242-92073**
HD Standoff Kit, 12"	**242-92074**
HD Standoff Kit, 18"	**242-92075**
HD Tilt Kits	
Description	**Item code**
20° HD Tilt Kit w/ 7" and 18" HD Standoffs	**242-92079**
HD Standoff Accessories	
Description	**Item code**
HD Standoff Base, 6-Hole	**232-02413**
HD Standoff Shaft, 7"	**232-01062**
HD Standoff Shaft, 12"	**232-01063**
HD Standoff Shaft, 18"	**232-01021**
Rubber Rain Collar	**232-01000**
Standoff Clamp Assembly	**242-04100**
Standoff Clamp and L Foot Assembly	**242-09002**
10° - 45° Variable Tilt Hardware Kit	242-92083
Standoff Flashings	
Description	**Item code**
Standoff Flashing, 3" Straight Cone, 20" x 20", Dead Soft AL w/ Rolled Edges	**175-05001**
Standoff Flashing, 4" Offset Cone, 11" x 13", Galv (Box of 25)	**175-05012**
Standoff Flashing, 4" Offset Cone, 18 ¾" x 15", Galv	**131-01216**
Standoff Flashing, 4" Straight Cone, 18" x 18", Galv (Box of 12)	**131-01214**
Standoff Flashing, Oatey No Caulk (11830), 12 ½" x 8 ¾", Galv	**015-00162**
Standoff Sub Base Flashing, Verde Industries, 12" x 10", Galv	**175-05005**
Lag Screws	
Description	**Item code**
Lag Screw and Washer, 5/16" x 3 ½", SS (Pack of 100)	014-06508
Lag Screw and Washer, 5/16" x 5", SS (Pack of 100)	014-06509

Fast, Accurate Shipping to Your Job Site. With just-in-time delivery and blind drop shipping, we can ship directly to your customers, just as if it came straight from you.

SnapNrack
Solar Mounting Solutions

RL

Railless Residential Roof Mount System

Significant Cost Reduction

Material **Logistics** **Labor**

- Only 3 primary components with no part over 14”
- All parts are pre-assembled
- Integrated wire management
- UL2703 listed
- Only single tool required, module installation is tool free
- Underside module hook ensures all hardware is out of sight
- No holes through the flashing, no seals and nothing to fail

877-732-2860 | www.snapnrack.com/rl-aee | contact@snapnrack.com

Standard Rail, Black & Clear

Bonding Rail Splice, Black

Standard Rail End Cap

UEC Rail Cutting Tool

SnapNrack Series 100 Rails

Rail sets consist of two, six, or 112 rails and are offered in two lengths to simplify planning. 122" rail can accommodate a single row of three standard 60-cell or 72-cell modules. 162" rail will accommodate four modules. Use the **UEC Rail Cutting Tool** to protect the module frames from scratches while making a straight cut when using Universal End Clamps.

Standard Rail	
Black Standard Rails	
Description	**Item code**
Standard Rail Set, 122”, Black (Box of two)	**015-09816**
Standard Rail Set, 122”, Black (Box of six)	**015-09822**
Standard Rail, 122”, Black (Bundle of 112, priced as each)	**232-01067**
Standard Rail Set, 162”, Black (Box of two)	**015-09818**
Standard Rail Set, 162”, Black (Box of six)	**015-09826**
Standard Rail, 162”, Black (Bundle of 112, priced as each)	**232-01069**
Clear Standard Rail	
Description	**Item code**
Standard Rail Set, 122”, Clear (Box of two)	**015-09814**
Standard Rail Set, 122”, Clear (Box of six)	**015-09813**
Standard Rail, 122”, Clear (Bundle of 112, priced as each)	**232-01068**
Standard Rail Set, 162”, Clear (Box of two)	**015-09817**
Standard Rail Set, 162”, Clear (Box of six)	**015-09824**
Standard Rail, 162”, Clear (Bundle of 112, priced as each)	**232-01070**
Mill Standard Rail	
Description	**Item code**
Standard Rail, 122”, Mill (Bundle of 112, priced as each)	**232-02112**
Standard Rail, 162”, Mill (Bundle of 112, priced as each)	**232-02113**

Standard Rail Splices & Accessories	
Standard Rail Splices	
Description	**Item Code**
Bonding Standard Rail Splice, Black	**242-04015**
Bonding Standard Rail Splice, Clear	**242-04014**
Standard Rail Accessories	
Description	**Item Code**
Standard Rail End Cap	**232-01023**
UEC Rail Cutting Tool	**232-02284**

Bonding Mid Clamp Assembly, Black

Bonding Adjustable End Clamp 1.20”-1.48”, Black

Universal End Clamp

SnapNrack Module Attachments

Module Clamps are available in different sizes to match PV module frame thickness/depth. **Universal End Clamps** are a unique one-size-fits-all time saver that slips inside the module frame – completely out of sight. The rails are cut flush with the modules and finished with SnapNrack end caps to create a system with a flush, clean line homeowners love.

Module Clamps	
Mid Clamps	
Description	**Item code**
Bonding Mid Clamp, 1.20” - 1.48”, Black	**242-02053**
Bonding Mid Clamp, 1.20” - 1.48”, Clear	**242-02050**
Bonding Mid Clamp, 1.31” - 1.77”, Black	**242-02054**
Bonding Mid Clamp, 1.31” - 1.77”, Clear	**242-02051**
Bonding Mid Clamp, 1.50” - 2.00”, Black	**242-02055**
Bonding Mid Clamp, 1.50” - 2.00”, Clear	**242-02052**
Bonding Mid Clamp, 1.95" - 2.23", Black	**242-02057**
Bonding Mid Clamp, 1.95" - 2.23", Clear	**242-02056**
End Clamps	
Description	**Item code**
Universal End Clamp	**242-02215**
Bonding Adjustable End Clamp, 1.20” - 1.48”, Black	**242-02067**
Bonding Adjustable End Clamp, 1.20” - 1.48”, Clear	**242-02065**
Bonding Adjustable End Clamp, 1.49” - 2.00”, Black	**242-02068**
Bonding Adjustable End Clamp, 1.49” - 2.00”, Clear	**242-02066**

Junction Box R

SnapNrack Grounding and Wire Management

SnapNrack's **Ground Lug R** is a fully custom solution for grounding the completed system. Only one lug is required per individual row of modules (not per rail). The lug is secured with a single 5/16" bolt just like every other product in the system and requires no drilling of the rails. SnapNrack **Wire Management Solutions** comprise a set of dedicated components to reliably and cost effectively secure PV module and microinverter leads. All components are made of materials which have been selected for their ability to handle high UV exposure and extreme rooftop temperatures common under solar arrays. The SnapNrack UL-listed **Junction Box** provides a quick and easy installation utilizing snap-in features and NEMA 4X rating to conceal and protect electrical connections. It is 6" x 5" x 3" and fully integrated with DIN rail mounts inside. The **Four-Wire Clamp** and **Trunk Cable Clamp** offer a strong and reliable solution for securing up to four PV conductor cables or up to two Microinverter AC trunk cables along SnapNrack rail channels, transitioning in and out of channels, and even routing across rails. **Snap-In Wire Retention Clips** allow you to quickly secure PV conductor and AC trunk lines into our standard rail channels. Combining these solutions will not only provide a high quality wire management solution for the life of the system but will provide a faster and easier installation.

Trunk Cable Clamp & 4-Wire Clamp for Rail

SnapNRack Grounding and Wire Management	
Grounding	
Description	**Item code**
Ground Lug R for 6-12 AWG	**242-02101**
Lay-in Lug w/ Bolt and Keps Lock Nut, 4-14 AWG (Pack of ten)	**051-03418**
Wire Management	
Junction Box R	**242-01104**
Trunk Cable Clamp for Rail	**242-02103**
4-Wire Clamp for Rail	**242-02102**
Snap-in Wire Retention Clip	**232-01106**
48" Rail Cover, Aluminum	**232-01033**

Bonding & Original Channel Nut

SnapNrack Attachment Accessories

Attachment Accessories	
Module Level Power Electronics	
Description	**Item code**
MLPE Rail Attachment Kit	**232-02009**
Channel Nuts	
Description	**Item code**
Bonding Channel Nut	**232-02009**
Original Channel Nut	**232-02005**

Array Edge Screen Kit, 4"x100'

SnapNrack Array Edge Screen

The **Array Edge Screen** is designed to keep birds and rodents from making their home under the array, potentially damaging the system. The clips attach to the bottom flange of each module frame and have hooks to snap the screen into place. The clips are painted steel and can be "snapped" to the appropriate length to accommodate height variations. The mesh screen is vinyl-coated steel, rigid enough to keep out even the most industrious squirrel.

Array Edge Screen	
Description	**Item code**
Array Edge Screen Kit, 4" x 100'	**015-11176**
Array Edge Screen Kit, 8" x 100'	**015-11177**
Array Edge Screen Clip, 4"	**232-03993**
Array Edge Screen Clip, 8"	**232-03994**
Add-A-Lip Box Frame Adapter	**242-01101**

Ground Rail Set, 122", Clear

Ground Rail End Cap

SnapNrack Series 200 Ground Mount

The **SnapNrack 200 Ground Mount system** is a solar module installation system that is low profile and visually appealing. This innovative suite of racking products simplifies installation to save time and money. The SnapNrack ground rail and rail-to-pipe clamp creates a multi-pole, fixed-tilt ground mount. The ground rail accepts all Series 100 module mounting clamps and the pipe clamp is designed for 1.5" (1.9" outside diameter) schedule 40 or 80 steel pipe substructures. It can be installed with tilt angles up to 45° and in locations that may see wind speeds up to 170 mph and snow loads up to 120 psf. For module attachment hardware refer to the SnapNrack Module Attachments section.

Ground Mount System	
Ground Rail	
Description	**Item code**
Ground Rail Set, 122", Clear (Box of four)	**015-09839**
Ground Rail, 122", Clear (Bundle of 112, priced as each)	**232-02183**
Ground Rail Set, 162", Clear (Box of two)	**015-09819**
Ground Rail Set, 162", Clear (Box of four)	**015-09855**
Ground Rail, 162", Clear (Bundle of 112, priced as each)	**232-01072**
Ground Rail Accessories	
Description	**Item code**
Ground Rail End Cap	**232-01043**
Structural Fittings	
Description	**Item code**
Bonding Pipe Clamp for 1 ½"	**242-09004**
Single Socket Tee, Hollaender (5E-8), 1 ½", AL-MG	**172-05800**
Single Adjustable Socket Tee, Hollaender (17-8), 1 ½", AL-MG	**172-05803**
Double Adjustable Socket Tee, Hollaender (19E-8), 1 ½", AL-MG	**172-05804**
Rectangular Base Flange, Hollaender (46-8), 1 ½", AL-MG	**172-05807**
Plug End, Hollaender (62-8), 1 ½" Sched 40, AL	**172-05808**
Plug End, Hollaender (62P-8), 1 ½" Sched 40, Plastic	**172-05811**

Bonding Pipe Clamp for 1 ½"

Single Socket Tee, Hollaender (5E-8)

Single Adjustable Socket Tee, Hollaender (17-8)

Double Adjustable Socket Tee, Hollaender (19E-8)

Rectangular Base Flange, Hollaender (46-8)

Plug End, Hollaender (62-8)

Roof Attachments

These specialized roof attachments can be used with a variety of mounting systems to meet special requirements.

QBase Composition

Classic Composition

Classic Conduit

Conduit Penetration

Classic Shake

Classic Shake Conduit

QBase Shake

Quick Mount PV

All-In-One Waterproof Flashed Mounts

Quick Mount PV waterproof flashing and mounts are designed by roofing professionals to anchor photovoltaic racking systems to most types of roofs, including composition, tile, shake, and low-slope roofs. All Quick Mount PV flashed mounts are sold in boxes of 12, and are available with a mill, clear-anodized, or black-anodized finish, unless otherwise noted. All exposed hardware is made from stainless steel to ensure long-term protection against water intrusion.

Flashed Composition Shingle Mounts

The **QMNC** QBase Composition Mount is a base-and-post mount designed for use when integrating a solar array into new roof construction. The QBase foundation is protected by a 12" x 12" spun cone aluminum flashing. 12" x 12" **QMSC** Classic Composition and Classic Shake Mounts are ICC-ES certified (ICC-ESR-2835) and incorporate flashing seamlessly integrated with a standoff block. Stainless steel hardware attaches the block by L-foot to most racking systems, including DPW and SnapNrack, and enables an attractive low-profile array. The **QMSC** Classic Conduit Mount is similar to the Classic PV mounts but has a narrower flashing and accepts a standard conduit clamp. The **QMSE** E-Mount is a smaller, lighter more economical version of the Classic Mount. The **QMPC** Conduit Penetration Flashing provides an easy method to install conduit through the roof while protecting against water intrusion.

Quick Mount PV Shingle Mounts		
Model	**Description**	**Item code**
QMNC A 12	QBase Composition Mounts - 12", mill finish, 12-pack	**014-06313**
QMNC B 12	QBase Composition Mounts - 12", bronze anodized finish, 12-pack	**014-06314**
QMNC C 12	QBase Composition Mounts - 12", clear anodized finish, 12-pack	**014-06312**
QMSC-A 12	Classic Composition Mounts - 12" x 12", mill finish, 12-pack	**014-06315**
QMSC-B 12	Classic Composition Mounts - 12" x 12", bronze anodized finish, 12-pack	**014-06316**
QMSC-C 12	Classic Composition Mounts - 12" x 12", clear anodized finish, 12-pack	**014-06317**
QMCC-A 12	Classic Conduit Mounts - 9" x 12", mill finish, 12-pack	**014-06222**
QMCC-B 12	Classic Conduit Mounts - 9" x 12", bronze anodized finish, 12-pack	**014-06223**
QMCC-C 12	Classic Conduit Mounts - 9" x 12", clear anodized finish, 12-pack	**014-06224**
QMSE-A 12	E-Mount Composition Mount – 9" x 12", mill finish aluminum, 12-pack	**014-06332**
QMPC-A 12	Conduit Penetration Flashing – 12" mill finish, 12-pack	**014-06359**

Flashed Shake Mounts

Similar to the composition shingle mount, the **QMLC** Classic Shake Mount uses larger 18" x 18" aluminum flashing to integrate with most wood shake roofs. The **QMLCC** Classic Shake Conduit mounts for shake roofs are similar to the PV mounts but have a narrower flashing and accept a standard conduit clamp. The **QMNS** QBase Shake and Slate mount is utilized when installing solar on a new shake roof.

Quick Mount PV Flashed Shake Mounts		
Model	**Description**	**Item code**
QMLC-A 12	Classic Shake Mounts – 18" x 18", mill finish, 12-pack	**014-06319**
QMLC-B 12	Classic Shake Mounts – 18" x 18", bronze-anodized finish, 12-pack	**014-06321**
QMLC-C 12	Classic Shake Mounts – 18" x 18", clear-anodized finish, 12-pack	**014-06320**
QMLCC-A 12	Classic Shake Conduit Mounts – 12" x 18", mill finish, 12-pack	**014-06225**
QMLCC-ABA 12	Classic Shake Conduit Mounts – 12" x 18", bronze-anodized finish, 12-pack	**014-06226**
QMLCC-ACA 12	Classic Shake Conduit Mounts – 12" x 18", clear-anodized finish, 12-pack	**014-06227**
QMNS-A 12	QBase Shake and Slate Mount – 18" x 18", mill finish, 12-pack	**014-06360**
QMNS-B 12	QBase Shake and Slate Mount – 18" x 18", bronze-anodized finish, 12-pack	**014-06361**
QMNS-C 12	QBase Shake and Slate Mount – 18" x 18", clear-anodized finish, 12-pack	**014-06362**

QBase Universal Tile

Quick Mount PV Flashed Tile Mounts

The **QMUTM** Universal Tile Mount incorporates Quick Mount PV's new QBase foundation and two aluminum cone flashings. The malleable top flashing conforms to fit virtually any tile roof, including curved tile.

Quick Mount PV Flashed Tile Mounts		
Model	Description	Item code
QMUTM-A 12	QBase Universal Tile Mounts - 18" x 18", mill finish, 12-pack	**014-06328**
QMUTM-B 12	QBase Universal Tile Mounts - 18" x 18", bronze-anodized finish, 12-pack	**014-06329**

Height Extensions

Hanger Bolts

Shingle Ripper

Quick Mount PV Accessories for Composition and Shake Mounts

QMEXT Height Extensions work with any of the Classic Composition and Classic Shake Mounts to adjust the angle or clearance between the array and roof. Longer **QMHS** Hanger Bolt Sets are also available to accommodate extra thick roofing or insulation material.

Quick Mount PV's unique **QMRB** Shingle Ripper is ideal for cleanly removing nails, shingles, or shakes without damaging the roof shingles or other shakes.

Quick Mount PV Accessories		
Model	Description	Item code
QMEXT-2.5 A 12	Height Extension - 2 ½", mill finish, 12-pack	**014-06338**
QMEXT-2.5 B 12	Height Extension - 2 ½", bronze-anodized finish, 12-pack	**014-06351**
QMEXT-2.5 C 12	Height Extension - 2 ½", clear-anodized finish, 12-pack	**014-06350**
QMEXT-3.25 A 12	Height Extension - 3 ¼", mill finish, 12-pack	**014-06339**
QMEXT-3.25 B 12	Height Extension - 3 ¼", bronze-anodized finish, 12-pack	**014-06353**
QMEXT-3.25 C 12	Height Extension - 3 ¼", clear-anodized finish, 12-pack	**014-06352**
QMEXT-4.0 A 12	Height Extension - 4", mill finish, 12-pack	**014-06340**
QMEXT-4.0 B 12	Height Extension - 4", bronze-anodized finish, 12-pack	**014-06355**
QMEXT-4.0 C 12	Height Extension - 4", clear-anodized finish, 12-pack	**014-06354**
QMHS-6 12	Hanger Bolt Set - 6", stainless steel, 12-pack	**014-06344**
QMHS-8 12	Hanger Bolt Set - 8", stainless steel, 12-pack	**014-06345**
QMHS-10 12	Hanger Bolt Set - 10", stainless steel, 12-pack	**014-06346**
QMHS-12 12	Hanger Bolt Set - 12", stainless steel, 12-pack	**014-06347**
QMRB-12	24" Shingle Ripper – nail removal tool	**094-00143**

Quick Mount PV Low Slope Roof Mounts

Quick Mount PV's new **QMLSH** Low Slope Roof Mount, which also incorporates the new QBase foundation, is one of the strongest base-and-post PV mounts available for mechanically attaching commercial PV systems to TPO, PVC, EPDM, built-up asphalt, and virtually all other non-metal low slope roofs. For built-up asphalt roofs (BUR) and other bituminous and modified bitumen roofs, conical aluminum flashings are available in 4" and 8" heights (sold separately). When installing the Low Slope Roof Mount on membrane roofs, Quick Mount PV strongly recommends utilizing the roofer of record to flash the mounts using their **QMLSF** flashing.

Quick Mount PV Low Slope Roof Mounts		
Model	**Description**	**Item code**
QMLSH-3.75 A 12	QBase Low Slope Mounts - 3.75", mill finish, 12-pack	**014-06300**
QMLSH-3.75 B 12	QBase Low Slope Mounts - 3.75", bronze-anodized, 12-pack	**014-06303**
QMLSH-3.75 C 12	QBase Low Slope Mounts - 3.75", clear-anodized, 12-pack	**014-06304**
QMLSH-7 A 12	QBase Low Slope Mounts - 7", mill finish, 12-pack	**014-06301**
QMLSH-7 B 12	QBase Low Slope Mounts - 7", bronze-anodized, 12-pack	**014-06305**
QMLSH-7 C 12	QBase Low Slope Mounts - 7", clear-anodized, 12-pack	**014-06306**
QMLSH-9 A 12	QBase Low Slope Mounts - 9", mill finish, 12-pack	**014-06302**
QMLSH-9 B 12	QBase Low Slope Mounts - 9", bronze-anodized, 12-pack	**014-06307**
QMLSH-9 C 12	QBase Low Slope Mounts - 9", clear-anodized, 12-pack	**014-06308**
QMLSF-4 A 12	QBase Low Slope Flashing - 17" x 4", mill finish, 12-pack	**014-06309**
QMLSF-8 A 12	QBase Low Slope Flashing - 17" x 8", mill finish, 12-pack	**014-06310**

Quick Hook Tile Mount and Included Flashing

Quick Hook Tile Mounts

Quick Mount PV's new Quick Hook line features the **QMFTHA** 4 ½" (Flat Tile) or **QMHSS** 6" (Flat or Curved Tile) sliding base and hook to provide a low profile roof attachment. Included is a unique 9" x 12" (Flat Tile) or 9" x 14" (Flat or Curved Tile) all aluminum sub-flashing. Quick Hooks can be installed without cutting or drilling tiles, resulting in fewer broken tiles and less dust.

Quick Mount PV Quick Hook Tile Mounts		
Model	**Description**	**Item code**
QMFTH A 12	Quick Hook for Flat Tile, Mill-finish aluminum, 12-pack	**014-06330**
QMHSS A 12	Quick Hook for Curved Tile, Side Mount Rails, Mill-finish aluminum, 12-pack	**014-06331**

Chem Link

E-Curbs

E-Curbs seal penetrations by using a plastic mold and a pour-in-place polymer seal. E-Curbs are designed for use on granulated modified bitumen, asphalt and coal tar B.U.R. (built up roofing), and are specified for PVC, PIB, and TPO single-ply roofing membranes. The service temperature range for the E-Curbs is -40 °F to 200 °F, but should not be applied at temperatures below 32 °F.

Chem Link E-Curbs	
Description	**Item code**
E-Curb, 4" round, gray - four E-Curbs, 1/2 gal one-part pourable sealer, two 10.1 oz cartridge of M-1	**131-01350**
E-Curb, 6" round, gray – three E-Curbs, two 1/2 gal pouches of one-part pourable sealer, two 10.1 oz cartridges of M-1	**131-01351**
E-Curb, 6" round, TPO white – three - E-Curbs, two - 1/2 gal pouches of one-part pourable sealer, two 10.1 oz cartridge of M-1, one 1/2 pint TPO primer, CANNOT BE SHIPPED BY AIR (HAZMAT)	**131-01352**

EJOT Front Mount Roof Hook

EJOT Top Mount Roof Hook

EJOT

Cast Aluminum Roof Hook Kits

These high-quality cast-aluminum roof attachments make it easy to put solar on tile roofs without cutting or drilling the tiles. They can support up to 600 pounds and their wide mounting flange allows for correct placement on the tile even when the rafter does not line up well. The kits come complete with two T25 6.0 x100 mm stainless steel screws and a sealing washer applied to the base of the hook.

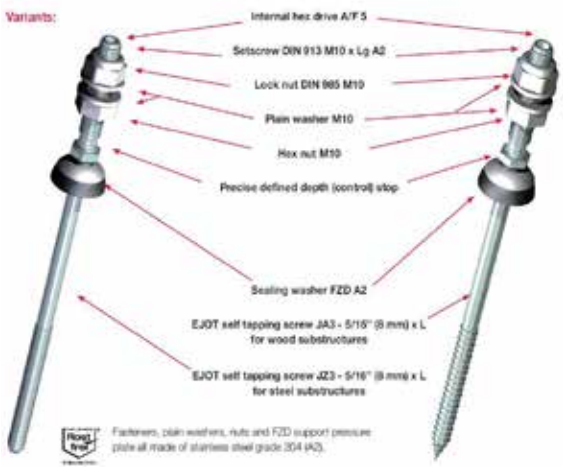
The **EJ00000002** Front-mount roof hook allows rails to run across the roof, and the **EJ00000003** Top-mount roof hook can be used with L-feet for rails running parallel or perpendicular to the roof. Roof hooks can be made to work with most popular PV mounting systems.

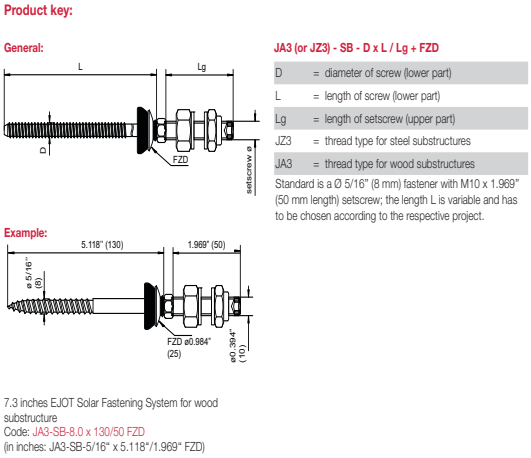
***Note:** L-Feet and mounting hardware are not included in the kits. Please order separately to attach the hook to the roof structure and the appropriate bolts, channel nuts, and L-Feet to attach to the mounting rails.*

EJOT Cast Aluminum Roof Hook Kits		
Model	**Description**	**Item code**
EJ00000002	EJOT Front-Mount Roof Hook Kit (Includes hook, two screws, seal)	**014-09813**
EJ00000003	EJOT Front-Mount Roof Hook Kit (Includes hook, two screws, seal)	**014-09814**

Solar Fastening Systems JZ3 & JA3

These specially designed solar fasteners can be used with SnapNrack Hanger Bolt Clamps to support rails on exposed fastener metal roofs. The top is threaded (length 1.969”, dia. M10) and comes with metric nuts and washers. The **wood substructure** fasteners have a 5/16” lag screw on the bottom. For **metal substructures** the bottom part is a high-quality thread-forming screw. Note that the warranty requires that metric drills be used for pre-drilling the appropriate holes before installation.





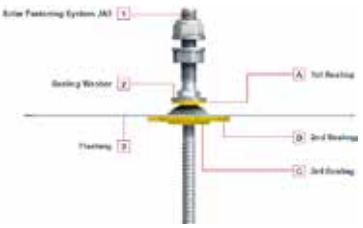
EJOT Solar Fastening System for Wood Substructures		
Model	**Description**	**Item code**
3150851905	JA3-SB-8.0 x 80/50 FZD (JA3-SB-5/16" x 3.150"/1.969" FZD)	**014-06451**
3151351905	JA3-SB-8.0 x 130/50 FZD (JA3-SB-5/16" x 5.118"/1.969" FZD)	**014-06452**
3152051905	JA3-SB-8.0 x 200/50 FZD (JA3-SB-5/16" x 7.874"/1.969" FZD)	**014-06453**
EJOT Solar Fastening System for Metal Substructures		
3130851905	JZ3-SB-8.0 x 80/50 FZD (JZ3-SB-5/16" x 3.150"/1.969" FZD)	**014-06462**
3131251905	JZ3-SB-8.0 x 125/50 FZD (JZ3-SB-5/16" x 4.921"/1.969" FZD)	**014-06464**
3132051905	JZ3-SB-8.0 x 200/50 FZD (JZ3-SB-5/16" x 7.874"/1.969" FZD)	**014-06466**
Hanger Bolt Clamp (for use with SnapNrack rail)		**242-01102**

EJOT Solar Flashing

These specially designed flashings are to be used on three-tab asphalt shingle roofs. With the three sealing elements they provide for watertight seals on top of the flashing, the top shingle and the bottom shingle. Kit includes flashing and EJOT Solar Fastening System JA3-8.0x80/70 E22/3 for wood substructures. The top portion of the fastener is threaded (length 2.756”, dia. M10) and comes with metric nuts and washers. The fastener has a 5/16” lag screw on the bottom and can be used with L-feet or SnapNrack Hanger Bolt Clamps to support rails. For the installation preparation in the shingle and wood substructure use the **9250027006** EJOT Click & Drill Hole Saw.

Products are also available upon request with the **EJOT ORKAN Storm Washer**. The Storm Washer has to be defined by crown width and angle of the trapezoidal metal roof profile. Please contact AEE Solar for assistance in determining the right solution for your project.

EJOT Solar Flashing		
Model	**Description**	**Item code**
EJ00000001	EJOT Solar Flashing (Kit)	**014-06468**
9250027006	EJOT Click & Drill Hole Saw	**094-00113**



Commercial Roof and Ground Mounting Structures

Commercial PV systems tend to be significantly larger than residential ones, but also more price sensitive – requiring installers to achieve economies of scale to keep the price per watt or kilowatt-hour as low as possible. In addition, commercial rooftops are seldom the sloped composition or tile roofs so common in residential settings, so specialized mounting systems can be make-or-break for a commercial PV project. Most of the systems presented here are highly customizable and must be specifically engineered for each building or site so you'll need to contact your AEE Solar representative with the particulars of your project for a custom quote.

AET

Rayport-B ECO Flat Roof Solar Mounting System

The **Rayport-B ECO Ballasted Mount System** for flat roof commercial installations is designed to be functional, lightweight, durable, strong, and easy to install. The ECO range of products focuses on achieving cost savings, while maintaining quality and function. The system is wind-tunnel tested; UL2703 listed, and comes with a 25-year limited warranty. It fits all major solar modules on the market. Extensive engineering and loading analysis from AET's product design group help to provide a low-cost, high-quality product that minimizes assembly time. Modules are mounted in a landscape orientation at either 5° or 10°. Installed dimensions vary depending on module width and array tilts.

Rayport ballasted systems are wind-tunnel tested to 120 mph.

Integrated fasteners and supplied grounding hardware between the modules and the frames allow for quick, easy installation. Support rails fold down to reduce shipping costs, and are assembled using two bolts on site. Optional additions include the Rayport™-I Inverter Mounting Kit, providing installers with a secure, ballasted mounting solution for storing and positioning inverters on solar installation sites. Additionally, mounts and penetrations can be added for areas that are subjected to high wind loading or seismic activity.

Contact AEE Solar with your array layout for a custom quote with ballast recommendations based on building height, module type, wind and snow load requirements, and exposure category.

Rayport-G ECO Ground Mounting System

The Rayport-G ECO Ground Mount System from AET is a lightweight galvanized steel ground mount system that minimizes components, is fast to deploy, and comes preassembled for quick deployment.

Submit your design request to AEE for a custom-engineered solution to fit the specific needs of your site and installation.

Key Features:

- Two-high portrait design optimized for maximum number of panels per post
- UL 2703 approved; Single point of connection for system ground
- G90 Galvanized for corrosion resistance

- Minimal fasteners and connection points
- Seven pre-assembled parts to order
- Top down panel clamps with integrated grounding
- No drilling or cutting required; designed for two-man assembly crews
- Fits all major solar modules
- Custom-engineered profiles, with full layout and loading analysis for every project
- Options available for Ballasted, Helical, or Screw-Pile mounts

RAYPORT™ eco

SOLAR MOUNTING SOLUTIONS

RAYPORT™-G ECO GROUND MOUNT SYSTEM

RAYPORT™-B ECO ROOF BALLAST SYSTEM

Save money and installation time with AET's ECO line of high quality solar mounting solutions.

- Lightweight, durable and cost-effective
- Fully galvanized steel
- Roof-top and ground mount availability
- Industry-leading installation time
- Engineering support from concept to completion
- More than 275 MW installed

100% on time. 100% on budget.
Zero warranty claims.

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www.AETenergy.com
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Aerocompact 2.0 South System

Aerocompact 2.0 Ballast Trays

Aerocompact+ East/West System

Aerocompact+ with ballast and trays

Aerocompact

NEW! Aerocompact 2.0 South and Aerocompact+ East/West Flat Roof Ballast Racking System

Aerocompact offers an affordable, highly aerodynamic, fast to assemble, and fully engineered ballasted racking system for flat commercial roof mounts. Each racking system is designed with site-specific information, and a detailed layout, ballast plan, and engineering report are provided for every project. The reports generated are very detailed, and can be used in sales presentations, and in obtaining permits for your projects.

Aerocompact 2.0 is the new South-oriented aerodynamic racking solution for framed modules on flat roofs. It is ETL listed to UL 2703, TUV Certified, wind tunnel tested up to 150 mph, and is provided with a 25-year limited warranty. It is fast and easy to install, and can be designed with 5°, 10°, and 15° tilt angles. Module clamps come with integrated grounding, and a new Alpine Version is available in areas with high snow loads. The redesigned ballast tray can accommodate more ballast to allow the system to be installed in high wind areas.

Aerocompact+ is a 10°, East/West mounting system. This racking solution allows more modules to be placed on a roof surface by eliminating the inter-row shading that occurs with a south facing system. The east/west solution allows the placement of up to 30% more modules on a given roof surface with a minimal loss in production per module, resulting in more generated kWh to the end customer. It also benefits from having fewer components, thus less racking cost per module. Since the modules are placed edge to edge, there is less wind loading, thus lower the ballast requirements for this system. Therefore, it can be deployed on more roofs with less roof loading. An Alpine Version is available for the Aerocompact+ where high snow loads are expected.

Both versions of Aerocompact racking can be fully ballasted with no penetrations, or with limited penetrations for reduced ballast requirements, or where required due to seismic concerns.

Contact your AEE Solar representative with your array layout and site information to receive a custom quote and engineering report with ballast recommendations. Be prepared to supply site information such as building height, roof material, module quantity and type, wind and snow load requirements, and exposure category.

AEROCOMPACT® 2.0

the unbeatable flat-roof solution

East/West

also available in south 5°, 10°, 15°

25 YEARS LIMITED WARRANTY

WIND TUNNEL TESTED

ETL listed to UL 2703

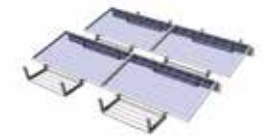
1 kWp / 2.5 min.

PATENT PENDING

CE

TÜVRheinland®

INTERTEK ETL LISTED C US



DPW Solar

POWER-FAB CRS G2 Non-Penetrating Flat Roof Mounting System

The **POWER-FAB™ CRS G2** top-clamping module mounting system is designed to install quickly and provide a secure mounting structure for any framed module. The system's ballasted design minimizes the impact of dead loads on the roof and minimizes roof penetrations. The system meets UL standards for integrated grounding. The included EPDM rubber base protects the roof surface, and the system is assembled using a single tool. The CRS system typically adds less weight per square foot than competitive products. Full-scale wind tunnel results qualify the system's performance in high wind speed areas. The POWER-FAB™ CRS system offers tilt angles of 5° to 10°, and features the flexibility to design the racking around roof obstructions and shaded areas to maximize the number of modules and total energy production. Due to the custom nature of this rack, all parts are non-returnable.

Contact AEE Solar with the details of the array layout for your project to get a custom quote for the CRS G2 system. Full-scale wind-tunnel data used to calculate ballast weights along with ASCE 07-05 and building-code requirements.

Power Xpress™ Ballasted Flat Roof Mounting System

The DPW **Power Xpress™** mounting system is a fully-ballasted, high-strength mounting structure developed with the professional installer in mind. Featuring two main components with no loose hardware and assembled with a single tool, the Power Xpress™ is designed to provide a faster assembly and shorter learning curve. Integrated grounding eliminates the need for grounding clips or WEEBs. The modular design simplifies roof layouts, ordering and final installation while stackable components reduce shipping volume and provide easy transport of materials to the roof. This racking is available in 5° and 10° tilt configurations, and has options for wire management and EPDM rubber pads to further protect the roof surface.

Contact your AEE Solar sales representative with the details of the array layout for your project to get a custom quote. Full-scale wind-tunnel data used to calculate ballast weights along with ASCE 07-05 and building-code requirements.

Ballasted Power Rail™ (BPRM) Flat Roof Mounting System

The DPW **Ballasted Power Rail™** mounting system is a 0° tilt, non-penetrating flat roof mounting system. This mounting system provides for very high module density, and provides a secure mounting structure for standard 60-cell and 72-cell framed modules, and the system can be designed for use in up to 150 mph wind zones. The system assembles fast using a single tool with no cutting, drilling or punching required and assembly requiring one tool, and the slotted ballast pans allow for leveling on uneven roof surfaces. This system requires less ballast weight when compared to other ballasted systems, and provides flexibly to design and install the mounting system around roof obstructions and avoid shaded areas. Integrated wiring channels and the top-down clamping system speeds installation, ballast pans provide precise rail alignment, and factory installed EPDM pad material protects the roof surface.

Contact your AEE Solar sales representative with the details of the array layout for your project to get a custom quote. Full-scale wind-tunnel data used to calculate ballast weights along with ASCE 07-05 and building-code requirements.

Power Peak™ AL and GS Commercial Ground Mount System

The DPW **Power Peak™** Ground System is designed for larger-scale ground-mount installations that require faster build rates, and combines high strength steel attachment components, lightweight module rails, and are optimized to site-specific conditions and assemble over pre-drilled, pile-driven galvanized steel “I” beams. Component attachments feature built-in field adjustments for post misalignment and include captive bolts and integrated wire management. The single-row, vertical-post design greatly reduces the number of ground penetrations while providing increased ground-clearance options. Power Peak™ GS utilizes galvanized components, while the Power Peak™ AL substitutes aluminum components for greater corrosion resistance in coastal and humid environments

Contact your AEE Solar sales representative with the site details for your project to get a custom quote.

DPW Ballasted Flat Roof Mount

DPW Ground Mount

DPW Top-of-Pole Mount

DPW Side-of-Pole Mount

DPW Multi-Pole Mount

Ballasted Roof Mounts (BRM)

DPW Solar Racking

DPW Solar products are made in the U.S.A. and can be ordered to fit virtually any module. DPW offers a variety of made-to-order DPW Roof/Ground Mounts, Top-of-Pole Mounts, Side-of-Pole Mounts, Multi-Pole Mounts, and Ballasted Roof Mounts. Compare the dimensions of the module you plan to use with the sizing chart below to determine the module series.

When ordering, be sure to include a copy of the data sheet for the module you plan to use. For modules having dimensions that fall outside of the chart, use the next larger size. Some DPW mounting systems fasten to the modules using the mounting holes on the module frame rather than top clamps. If you are working with modules that lack a bottom flange, be sure to check for compatibility when ordering.

The High Wind Version upgrade (not available for MPM's) is made for winds up to 130 mph, class C Wind Zones.

Stainless steel module mounting hardware is provided with all mounts. Stainless steel hardware for the racking assembly is available as an option.

Use the Module Sizing Chart below to determine the frame size of the DPW racking needed. While only options for frame size G and H modules are listed, other sizes are available upon request. Call your AEE representative for more details.

***Note:** DPW products are built to order and cannot be returned nor exchanged.*

Module Series Sizing Chart	
Module size range (W x L)	**DPW module series**
19"-23" x 35"-44"	A
20"-26" x 39"-53"	B
22"-27" x 56"-63"	C
31"-33" x 60"-67"	D
38"-40" x 51"-56"	E
38"-40" x 58"-61"	F
37"-42" x 61"-67"	G or GL*
38"-40" x 77"-82"	H or HL*
50"-52" x 65"-79"	I

*GL or HL – Includes longer module rails for module widths greater than 39.45" (i.e. SunPower 305, Sunpower 400)

DPW Solar POWER-FAB Roof/Ground Mounts (RGM)

Power-Fab Roof/Ground Mounts are available in several sizes and styles. In addition to the standard configuration, both low-profile and two-tier designs are available. Unless otherwise indicated, the rails and legs are mill-finish 6061-T6 structural aluminum angle (AL), and have adjustable, telescoping back legs (TL). Anodized or powder-coated finishes are available at an additional cost. All RGMs use DPW's Power Rail™, so be sure to order the appropriate number of mid and end clamps..

RGM Design Strength									
Wind speed	Snow load (lbs. per sq. ft.)								
	0	10	20	30	40	50	60	70	80
90 mph	SD	SD	SD	SD	HD	HD	HD	HD	HD
100 mph	SD	SD	SD	HD	HD	HD	HD	HD	
110 mph	HD	HD	HD	HD	HD	HD	HD		
120 mph	HD	HD	HD	HD	HD	HD	Please contact		
130 mph	HD	HD	HD	HD	AEE Solar				

Use the Module Series Sizing Chart on the previous page to determine module series.

Use the RGM Design Strength Chart above to determine whether an SD (Standard Design) or HD (Heavy Duty) rack is required.

Order the appropriate number of End and Mid Clamps from the RAD Mid and End Clamp table below. DPW RAD End and Mid Clamps are used in all Roof/Ground Mounts (SRGM, LPRGM, and TTRGM) as well as the Multi-Pole Mount (MPM). These units are made from Type 304 stainless steel, and the mid clamps are 3/8" wide. Please be sure to provide a module data sheet with any orders.

RAD Roof/Ground Mount Mid and End Clamps			
DPW part #	Description	Item code	
		Clear	Black
EC-XX-RAD	Module End Clamp w/ RAD Hardware (specify module thickness)	**013-10961**	**013-10962**
MC-28-33-RAD	Module Mid Clamp w/ RAD Hardware for 28-33 mm (1.1" - 1.3")	**013-10963**	**013-10964**
MC-34-39-RAD	Module Mid Clamp w/ RAD Hardware for 34-39 mm (1.31" - 1.54")	**013-10965**	**013-10966**
MC-40-46-RAD	Module Mid Clamp w/ RAD Hardware for 40-46 mm (1.55" - 1.81")	**013-10967**	**013-10968**
MC-47-52-RAD	Module Mid Clamp w/ RAD Hardware for 47-52 mm (1.85" - 2.0")	**013-10969**	**013-10970**
MC-53-59-RAD	Module Mid Clamp w/ RAD Hardware for 53-59 mm (2.1" - 2.32")	**013-10971**	**013-10972**

Pole Mounts

Pole mounts represent a simple, cost-effective approach to mounting small PV arrays without the need for complex foundations or leveling. A Schedule 40 or 80 rigid steel pole with a deep concrete anchor is typically sufficient. However, specific requirements may vary due to soil type and expected wind loads. Most pole-mount systems are made-to-order so be sure to include a module data sheet and double-check your requirements as they typically cannot be returned.

DPW Solar

POWER-FAB® Side-Pole Mounts (SPM)

Power-FAB SPM mounts are made from mill-finish aluminum. Upgrades to anodized or powder-coated aluminum are available for an additional charge. Stainless-steel module mounting hardware is provided with all mounts, and tamper-resistant hardware kits are also available for installations that may be left unattended for long periods. Stainless-steel fastener kits and high-wind upgrades are also available for the mounting structure itself.

All single-module mounts, and the two-module mounts for size A-C modules come with stainless-steel band clamps for 2-3.5" diameter pole sizes. All other SPM mounts come with stainless-steel clamps for 3-4.5" diameter poles. Upgrade clamps sized for larger diameter poles are listed below. Most SPM mounts can also be attached to flat vertical surfaces using installer-supplied lag bolts or through-bolts.

Use the Module Series Sizing Chart on page 37 to determine module series.

POWER-FAB Side-Pole Mounts (SPM)					
Module size		Number of modules			
		One	Two	Three	Four
A	DPW part #	DP-SPM1-A	DP-SPM2-A	--	--
	Item code	**013-11101**	**013-11102**	**--**	**--**
B	DPW part #	DP-SPM1-B	DP-SPM2-B	DP-SPM3-B	DP-SPM4-B
	Item code	**013-11201**	**013-11202**	**013-11203**	**013-11204**
C	DPW part #	DP-SPM1-C	DP-SPM2-C	DP-SPM3-C	DP-SPM4-C
	Item code	**013-11301**	**013-11302**	**013-11303**	**013-11304**
D	DPW part #	DP-SPM1-D	DP-SPM2-D	DP-SPM3-D	DP-SPM4-D
	Item code	**013-11401**	**013-11402**	**013-11403**	**013-11404**
E	DPW part #	DP-SPM1-E	DP-SPM2-E	DP-SPM3-E	--
	Item code	**013-11501**	**013-11502**	**013-11503**	**--**
F	DPW part #	DP-SPM1-F	DP-SPM2-F	DP-SPM3-F	--
	Item code	**013-11601**	**013-11602**	**013-11603**	**--**
G	DPW part #	DP-SPM1-G	DP-SPM2-G	DP-SPM3-G	--
	Item code	**013-11701**	**013-11702**	**013-11703**	**--**
H	DPW part #	DP-SPM1-H	DP-SPM2-H	DP-SPM3-H	--
	Item code	**013-11801**	**013-11802**	**013-11803**	**--**

DP Solar Side-Pole Mounts (SPM) – Optional Upgrades								
DPW part #		Description						Item code
HWV		High-Wind Version (add 25%)						**013-04000**
PCA		Powder-Coated Aluminum Components (add 25%)						**013-11910**
AA		Anodized Aluminum Components (add 35%)						**013-11915**
Band Clamp Upgrade								
Upgrade to	3-4.5"	4-5.5"	5-6.5"	6-7.5"	7-8.5"	9-9.5"	9-11"	10-12"
DPW part #	4"	5"	6"	7"	8"	9"	11"	12"
From 2-3.5"	**013-11930**	**013-11931**	**013-11932**	**013-11933**	**013-11934**	**013-11935**	**013-11936**	**013-11937**
From 3-4.5"	**--**	**013-11938**	**013-11939**	**013-11940**	**013-11941**	**013-11942**	**013-11943**	**013-11944**
Stainless steel hardware for rack assembly - SSH								
Number of modules					One	Two	Three	Four
Item code					**013-11921**	**013-11922**	**013-11923**	**013-11924**
Tamper-resistant hardware for module mounting - TRH								
Number of modules					One	Two	Three	Four
Item code					**013-10941**	**013-10942**	**013-10943**	**013-10944**

POWER-FAB Top-of-Pole Mounts (TPM)

DPW POWER-FAB® TPM standard mounts have heavy steel mounting sleeves, elevation pivots, and strong-backs that are coated with durable outdoor paint. The module rails are 6061-T6 mill-finish structural aluminum angles. Stainless steel module mounting hardware is provided. Standard top-of-pole mounts are adjustable from 15° to 65°, in 10° increments, and fit on Schedule 40 or 80 steel pipe.

For harsh environments, upgrades to hot-dip-galvanized steel or anodized aluminum rails are available. Use the tables below to determine the layout and minimum pipe size.

The DPW Online Configurator at dpwsolar.com can be used to generate the specific configuration and bill of materials needed based on module number and type, array location, and environmental conditions (wind, snow, desired tilt, etc.). A DPW Request for Information Form provides the TPM's foundation specifications including the correct pipe length, schedule, and foundation size requirements, and is available online at www.dpwsolar.com. An Engineering Stamp can be included from DPW through a third -party engineer for additional cost.

POWER-FAB Top-Pole Mounts (TPM)

Module size	DPW part #	# of modules	Pole size	Configuration	Item code
A	TPM1-A	1	2"SCH40	1H x 1W-P	013-10101
	TPM2-A	2		1H x 2W-P	013-10102
	TPM3-A	3	2.5"SCH40	1H x 3W-P	013-10103
	TPM4-A	4	3"SCH40	1H x 4W-P	013-10104
	TPM6-A	6	4"SCH40	2H x 3W-P	013-10106
	TPM8-A	8		2H x 4W-P	013-10108
	TPM10-A	10	6"SCH40	5H x 2W-L	013-10110
	TPM12-A	12		6H x 2W-L	013-10112
	TPM14-A	14		7H x 2W-L	013-10114
	TPM16-A	16	6"SCH80	8H x 2W-L	013-10116
B	TPM1-B	1	2"SCH40	1H x 1W-P	013-10201
	TPM2-B	2		1H x 2W-P	013-10202
	TPM3-B	3	2.5"SCH40	1H x 3W-P	013-10203
	TPM4-B	4	3"SCH40	1H x 4W-P	013-10204
	TPM6-B	6	4"SCH40	2H x 3W-P	013-10206
	TPM8-B	8		2H x 4W-P	013-10208
	TPM10-B	10	6"SCH40	5H x 2W-L	013-10210
	TPM12-B	12		6H x 2W-L	013-10212
	TPM14-B	14	6"SCH80	7H x 2W-L	013-10214
	TPM16-B	16		8H x 2W-L	013-10216

POWER-FAB Top-Pole Mounts (TPM)

Module size	DPW part #	# of modules	Pole size	Configuration	Item code
C	TPM1-C	1	2"SCH40	1H x 1W-P	013-10301
	TPM2-C	2	2.5"SCH40	1H x 2W-P	013-10302
	TPM3-C	3	3"SCH40	1H x 3W-P	013-10303
	TPM4-C	4	4"SCH40	1H x 4W-P	013-10304
	TPM6-C	6	4"SCH80	2H x 3W-P	013-10306
	TPM8-C	8	6"SCH40	4H x 2W-L	013-10308
	TPM9-C	9		3H x 3W-P	013-10309
	TPM10-C	10		5H x 2W-L	013-10310
	TPM12-C	12	6"SCH80	6H x 2W-L	013-10312
	TPM14-C	14	8"SCH40	7H x 2W-L	013-10314
	TPM16-C	16	8"SCH80	8H x 2W-L	013-10316
	TPM18-C	18		3H x 6W-P	013-10318
D	TPM1-D	1	2"SCH40	1H x 1W-P	013-10401
	TPM2-D	2	3"SCH40	1H x 2W-P	013-10402
	TPM3-D	3	4"SCH40	1H x 3W-P	013-10403
	TPM4-D	4	4"SCH80	2H x 2 W-P	013-10404
	TPM6-D	6	6"SCH40	2H x 3W-P	013-10406
	TPM8-D	8		4H x 2W-L	013-10408
	TPM9-D	9	6"SCH80	3H x 3W-P	013-10409
	TPM10-D	10	8"SCH40	5H x 2W-L	013-10410
	TPM12-D	12		3H x 4W-P	013-10412
	TPM14-D	14	8"SCH80	7H x 2W-L	013-10414
	TPM15-D	15		3H x 5W-P	013-10415
	TPM16-D	16		4H x 4W-P	013-10416
	TPM18-D	18		6H x 3W-L	013-10418
E	TPM1-E	1	2"SCH40	1H x 1W-P	013-10501
	TPM2-E	2	3"SCH40	1H x 2W-P	013-10502
	TPM3-E	3	4"SCH40	1H x 3W-P	013-10503
	TPM4-E	4		2H x 2 W-P	013-10504
	TPM6-E	6	6"SCH40	3H x 2W-L	013-10506
	TPM8-E	8		4H x 2W-L	013-10508
	TPM9-E	9	6"SCH80	3H x 3W-P	013-10509
	TPM10-E	10	8"SCH40	5H x 2W-L	013-10510
	TPM12-E	12		3H x 4W-P	013-10512
	TPM14-E	14	8"SCH80	7H x 2W-L	013-10514
	TPM15-E	15		5H x 3W-L	013-10515
	TPM16-E	16		4H x 4W-P	013-10516
	TPM18-E	18		6H x 3W-L	013-10518

POWER-FAB Top-Pole Mounts (TPM)					
Module size	DPW part #	# of modules	Pole size	Configuration	Item code
F	TPM1-F	1	2"SCH80	1H x 1W-P	**013-10601**
	TPM2-F	2	3"SCH40	1H x 2W-P	**013-10602**
	TPM3-F	3	4"SCH40	1H x 3W-P	**013-10603**
	TPM4-F	4	4"SCH80	2H x 2 W-P	**013-10604**
	TPM6-F	6	6"SCH40	3H x 2W-L	**013-10606**
	TPM8-F	8	6"SCH80	4H x 2W-L	**013-10608**
	TPM9-F	9		3H x 3W-P	**013-10609**
	TPM10-F	10	8"SCH40	5H x 2W-L	**013-10610**
	TPM12-F	12	8"SCH80	3H x 4W-P	**013-10612**
	TPM14-F	14		7H x 2W-L3	**013-10614**
	TPM15-F	15		5H x 3W-L	**013-10615**
	TPM16-F	16		4H x 4W-P2	**013-10616**
	TPM18-F	18		6H x 3W-L4	**013-10618**
G	TPM1-G	1	2"SCH80	1H x 1W-P	**013-10701**
	TPM2-G	2	3"SCH40	1H x 2W-P	**013-10702**
	TPM3-G	3	4"SCH40	1H x 3W-P	**013-10703**
	TPM4-G	4	4"SCH80	2H x 2 W-P1	**013-10704**
	TPM6-G	6	6"SCH40	3H x 2W-L	**013-10706**
	TPM8-G	8	6"SCH80	4H x 2W-L	**013-10708**
	TPM9-G	9	8"SCH40	3H x 3W-P	**013-10709**
	TPM10-G	10		5H x 2W-L	**013-10710**
	TPM12-G	12	8"SCH80	3H x 4W-P	**013-10712**
	TPM14-G	14		7H x 2W-L3	**013-10714**
	TPM15-G	15		5H x 3W-L	**013-10715**

POWER-FAB Top-Pole Mounts (TPM)					
Module size	DPW part #	# of modules	Pole size	Configuration	Item code
H	TPM1-H	1	2.5"SCH40	1H x 1W-P	**013-10801**
	TPM2-H	2	3"SCH80	1H x 2W-P	**013-10802**
	TPM3-H	3	4"SCH40	1H x 3W-P	**013-10803**
	TPM4-H	4	6"SCH40	2H x 2 W-P	**013-10804**
	TPM6-H	6		3H x 2W-L	**013-10806**
	TPM8-H	8	8"SCH40	4H x 2W-L	**013-10808**
	TPM9-H	9	8"SCH80	3H x 3W-P	**013-10809**
	TPM10-H	10		5H x 2W-L	**013-10810**
	TPM12-H	12		3H x 4W-P[1]	**013-10812**
I	TPM1-I	1	3"SCH40	1H x 1W-P	**013-10901**
	TPM2-I	2	4"SCH80	2H x 1W-L	**013-10902**
	TPM3-I	3	6"SCH40	3H x 1W-L	**013-10903**
	TPM4-I	4		2H x 2 W-P	**013-10904**
	TPM6-I	6	8"SCH40	3H x 2W-L	**013-10906**
	TPM8-I	8	8"SCH80	4H x 2W-L	**013-10908**
	TPM9-I	9		3H x 3W-P	**013-10909**
	TPM10-I	10		5H x 2W-L	**013-10960**

Configuration: Array Layout and Module Orientation (P= Portrait L=Landscape)

All pipe recommendations conform to ASCE 7-05, IBC2006, and are based on 90mph, Exposure C, 65-degree max tilt, 12" max front edge ground clearance except for those noted:

[1]6" max front edge clearance | [2]55-degree max tilt | [3]6" max front edge clearance nad 55-degree max tilt | [4]45-degree max tilt

All standard TPM mounts are available for locations with higher wind speeds of up 130 MPH or snow loads up to 60 psf by adding the High-Wind Option (adds 25% to the price). This upgrades the mount with sturdier rails, and may require changes to the pole and foundation specifications. See the table below for some configurations which require a change in the module layout.

Alternative Layouts Based on Wind Speed		
DPW part #	**90 mph standard**	**130 mph HWV**
TPM6-D	2H X 3W-P	3H X 2W-L
TPM12-D	3H X 4W-P	6H X 2W-L
TPM12-E	3H X 4W-P	6H X 2W-L
TPM12-F	3H X 4W-P	6H X 2W-L
TPM12-G	3H X 4W-P	6H X 2W-L
TPM12-H	3H X 4W-P	6H X 2W-L
TPM15-D	3H X 5W-P	5H X 3W-L

POWER-FAB Top Pole Mounts (TPM) – Upgrade Options													
Stainless steel hardware for rack assembly - SSH													
Number of modules	One	Two	Three	Four	Six	Eight	Nine	Ten	Twelve	Fourteen	Fifteen	Sixteen	Eighteen
Item code	**013-10921**	**013-10922**	**013-10923**	**013-10924**	**013-10926**	**013-10928**	**013-10929**	**013-10930**	**013-10932**	**013-10934**	**013-10935**	**013-10936**	**013-10938**
Tamper resistant hardware for module mounting - TRH													
Number of modules	One	Two	Three	Four	Six	Eight	Nine	Ten	Twelve	Fourteen	Fifteen	Sixteen	Eighteen
Item code	**013-10941**	**013-10942**	**013-10943**	**013-10944**	**013-10946**	**013-10948**	**013-10949**	**013-10950**	**013-10952**	**013-10954**	**013-10955**	**013-10956**	**013-10958**

DPW part #	Description	Item code
HWV	High-Wind Version (add 25%)	**013-04000**
HGS	Hot-dip Galvanized Steel Components (add 60%)	**013-10905**
PCS	Powder-Coated Steel Components (add 25%)	**013-10907**
PCA	Powder-Coated Aluminum Components (add 20%)	**013-10910**
AA	Anodized Aluminum Components (add 20%)	**013-10915**

Mounting sleeve upgrade						
	Upgrade to:	2.5"	3"	4"	6"	8"
Standard Mounting Pole	2"	**013-03069**	**013-03070**	**013-03071**	**013-03072**	**013-03073**
	2.5"	--	**013-03074**	**013-03075**	**013-03076**	**013-03077**
	3"	--	--	**013-03078**	**013-03079**	**013-03080**
	4"	--	--	--	**013-03081**	**013-03082**
	6"	--	--	--	--	**013-03083**

Multi-Pole Mounts

The DPW Multi-Pole Mounts (MPM) are designed to mount on 3, 4, or 6-inch Schedule 40 galvanized steel pipe (installer supplied), Multi-Pole Mounts (MPM) support two to four modules high in landscape orientation. These mounts can be horizontally expanded as far as necessary by installing additional vertical pipe supports. This type of mount requires fewer ground penetrations than traditional ground mounts and offers a full range of seasonal elevation adjustability.

MPMs use a 4" x 4" square or 4" x 5" rectangular steel horizontal tube (also installer supplied) as well as DPW's Power Rail for module mounting. Multi-Pole mounts are ideal for shade and carport structures because the design is capable of significant ground clearance. Please complete a DPW MPM Request for Quote Form in order to properly obtain the foundation design and to generate a bill-of-materials. The form can be found at www.dpwsolar.com. Use the Module Series Sizing Chart on page 37 to determine module series. Order the appropriate number of End and Mid Clamps from the RAD Mid and End Clamp table on page 38.

Multi-Pole Mounts						
Module size	For 4" x 4" square steel horizontal tube			For 5" x 4" square steel horizontal tube		
	# of modules	DPW part #	Item code	# of modules	DPW part #	Item code
D	two	MPM2-D-4x4	**013-13442**	two	MPM2-D-5x4	**013-13452**
	three	MPM3-D-4x4	**013-13443**	three	MPM3-D-5x4	**013-13453**
	four	MPM4-D-4x4	**013-13444**	four	MPM4-D-5x4	**013-13454**
E	two	MPM2-E-4x4	**013-13542**	two	MPM2-E-5x4	**013-13552**
	three	MPM3-E-4x4	**013-13543**	three	MPM3-E-5x4	**013-13553**
	four	MPM4-E-4x4	**013-13544**	four	MPM4-E-5x4	**013-13554**
F	two	MPM2-F-4x4	**013-13642**	two	MPM2-F-5x4	**013-13652**
	three	MPM3-F-4x4	**013-13643**	three	MPM3-F-5x4	**013-13653**
	four	MPM4-F-4x4	**013-13644**	four	MPM4-F-5x4	**013-13654**
G or GL	two	MPM2-G-4x4	**013-13742**	two	MPM2-G-5x4	**013-13752**
	three	MPM3-G-4x4	**013-13743**	three	MPM3-G-5x4	**013-13753**
	four	MPM4-G-4x4	**013-13744**	four	MPM4-G-5x4	**013-13754**
H or HL	two	MPM2-H-4x4	**013-13842**	two	MPM2-H-5x4	**013-13852**
	three	MPM3-H-4x4	**013-13843**	three	MPM3-H-5x4	**013-13853**
I	two	MPM2-I-4x4	**013-13942**	two	MPM2-I-5x4	**013-13952**
	three	MPM3-I-4x4	**013-13943**	three	MPM3-I-5x4	**013-13953**

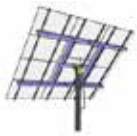
Multi-Pole Mount Pipe Caps (includes U-Bolts)		
Description	DPW part #	Item code
For connecting 3" SCH 40/80 vertical steel pipe to 4"x4" horizontal steel tube	PC -3V4x4H	**013-02093**
For connecting 4" SCH 40/80 vertical steel pipe to 4"x4" horizontal steel tube	PC-4V4x4H	**013-02094**
For connecting 4" SCH 40/80 vertical steel pipe to 5"x4" horizontal steel tube	PC-4V5x4H	**013-02095**
For connecting 6" SCH 40/80 vertical steel pipe to 4"x4" horizontal steel tube	PC-6V4x4H	**013-02096**
For connecting 6" SCH 40/80 vertical steel pipe to 5"x4" horizontal steel tube	PC-6V5x4H	**013-02097**

Multi-Pole Mount – Optional Upgrades		
DPW part #	Description	Item code
DP-MPM-PCA	Powder-Coated Aluminum Components (add 25%)	**013-14925**
DP-MPM-AA	Anodized Aluminum Components (add 35%)	**013-14915**
DP-MPM-HGS	Hot-dip Galvanized Steel Components (add 60%)	**013-14925**

Stainless steel hardware for rack assembly - SSH			
Number of modules	Two	Three	Four
Item code	**013-14932**	**013-14933**	**013-14934**

Tamper resistant hardware for module mounting - TRH			
Number of modules	Two	Three	Four
Item code	**013-10942**	**013-10943**	**013-10944**

8 Panel Pole Mount



12 Panel Pole Mount

16 Panel Pole Mount

24 Panel Pole Mount

MT Solar

Top-of-Pole Mount (TPM) Solar Rack

The MT Solar Top-of-Pole Mount Racking system is designed to be assembled and wired at ground level then lifted to final position via a chain hoist – without the need for cranes, scaffolding, or dangerous ladder work. Once installed, the mounts are fully adjustable from 0° to 90° from ground level with a hand crank. Single-pole mounts are available supporting from two to sixteen 60-cell modules and from eight to twelve 72-cell modules. Installers realize cost savings without needing to schedule a crane or scaffolding to install these mounts.

Standard engineering supports up to 130 mph wind speeds, with 30 psf. snow load. Foundation recommendations are provided, and stamped engineering documents are available for an additional fee for all 50 states. Custom engineering is also available for conditions outside those listed. Top down clamping provides a truly universal mount for most solar modules. Options are available for 10' pipe for the larger TPM mounts.

Two-pole mounts may be linked together to support larger multi-pole mounts for up to 32 modules. This racking solution is manufactured, assembled, and ships direct from the manufacturer in the state of Montana. Larger arrays requiring three or more pole mounts, and linked arrays for 72-cell modules available upon request. Contact AEE Solar for details.

	MT Solar Top of Pole Mount	
MT Part #	**Single Pole Mounts for 60-Cell Modules**	**Item code**
4-TOP-2	TPM Mount for two 60-cell modules, on 4" dia. Schd. 40 pipe	**013-00006**
4-TOP-3	TPM Mount for three 60-cell modules, on 4" dia. Schd. 40 pipe	**013-00007**
4-TOP-4	TPM Mount for four 60-cell modules, on 4" dia. Schd. 40 pipe	**013-00008**
6-TOP-6	TPM Mount for six 60-cell modules, on 6" dia. Schd. 40 pipe	**013-00009**
8-TOP-8	TPM Mount for eight 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00010**
8-TOP-9	TPM Mount for nine 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00011**
8-TOP-10	TPM Mount for ten 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00012**
8-TOP-12	TPM Mount for twelve 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00013**
8-TOP-15	TPM Mount for fifteen 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00014**
8-TOP-16	TPM Mount for sixteen 60-cell modules, on 8" dia. Schd. 40 pipe	**013-00015**
MT Part #	**Two Pole Mounts for 60-Cell Modules**	**Item code**
8-TOP-20	TPM Mount for twenty 60-cell modules, on two 8" dia. Schd. 40 pipes	**013-00016**
8-TOP-24	TPM Mount for twenty-four 60-cell modules, on two 8" dia. Schd. 40 pipes	**013-00017**
8-TOP-28	TPM Mount for twenty-eight 60-cell modules, on two 8" dia. Schd. 40 pipes	**013-00018**
8-TOP-32	TPM Mount for thirty 60-cell modules, on two 8" dia. Schd. 40 pipes	**013-00019**
MT Part #	**Single Pole Mounts for 72-Cell Modules**	**Item code**
8-TOP-8-72	TPM Mount for eight 72-cell modules, on 8" dia. Schd. 40 pipe	**013-00024**
8-TOP-9-72	TPM Mount for nine 72-cell modules, on 8" dia. Schd. 40 pipe	**013-00025**
8-TOP-10-72	TPM Mount for ten 72-cell modules, on 8" dia. Schd. 40 pipe	**013-00026**
8-TOP-12-72	TPM Mount for twelve 72-cell modules, on 8" dia. Schd. 40 pipe	**013-00027**
MT Part #	**MT Solar Accessories**	**Item code**
250155	1 Ton Chain Hoist – can be used on multiple installs	**013-00020**
SM-MICRO	MT Solar Microinver ter/Optimizer attachment kit	**013-00021**

Trackers

Tracking can increase a PV array's power production up to 40% depending on the season and location. Trackers are particularly useful when energy demand peaks during the summer months, such as for solar-powered irrigation systems. Trackers can also maximize net-metered electricity production in the summer, building up a credit toward high winter power bills.

Array Technologies

Active Trackers

Array Technologies DuraTrack® trackers use electronic sensors to track the sun from East to West. Dual Axis adds elevation tracking as well. The tracker fixes on the brightest area of the sky, capturing the maximum amount of sunlight available. Each night it returns to the morning sunrise position, ready to start tracking when the sun rises again.

These trackers are durable, and come with standard powder coating on the Steel drive and gimbal components. They are also offered with corrosion-resistant coatings on major components for harsh environments. All frames are made of galvanized steel tubing and anodized aluminum rails.

Manual controls are now standard on all trackers. These exterior switches on the controller cover plate allow the owner to turn off automatic tracking. They can then rotate the tracker east or west and/or up and down. This is useful for shedding snow, or to lay the tracker flat in extremely high wind conditions.

The **DuraTrack®-AZ** single-axis tracker automatically tracks the sun's path by rotating the PV array around the post, providing greater stability for larger arrays. The bottom edge of the array remains parallel to the ground and, therefore, requires less ground clearance than tilt-and-roll trackers. Array Technologies' azimuth trackers provide nearly 270° of rotational movement and can adjust from 5° to 60° of elevation tilt.

The **DuraTrack®-DA** gear drive, dual-axis tracker can hold up to twelve 60-cell solar modules. It is powered by a 24 VDC motor running a heavy-duty ball bearing/ worm-gear drive. Dual-axis operation ensures the maximum energy harvest. The DuraTrack®-DA mounts on a 8" Schedule 40 or 80 steel pole.

If your system's voltage is other than 24 VDC, an additional voltage converter is required to supply 24 VDC @ 5 A maximum output to power the tracker and controller. See power supply option below to power the array from a 120 or 240 VAC source. This power supply can also be used with DC input for PV-direct water pumping applications in some situations.

DA trackers are available with either the standard powder-coat finish, or with galvanized corrosion-resistant components for harsh climates. All AZ trackers come with the galvanized finish.

These mounts are also available as a manually-adjustable Top-of-Pole Mount – without the tracking features – that can be seasonally adjusted. Please call AEE for pricing and ordering. Trackers include a ten-year standard warranty on all structural materials, with two years on electronic controller and all moving parts.

Array Technologies DuraTrack Single and Dual-Axis Trackers

Cell and module size	Module quantity	Layout (Rows x columns) landscape	Single axis - AZ - corrosion resistant		Dual axis - DA - powder coated		Dual axis - DA - corrosion resistant	
			Array technologies part #	Item code	Array technologies part #	Item code	Array technologies part #	Item code
5" (72-Cell) 32" x 62"	12	4x3	15009-004	**014-08270**	15015-004	**014-08253**	15022-004	**014-08265**
	16	4x4	15009-002	**014-08268**	15015-002	**014-08251**	15022-002	**014-08263**
	20	4x5	15009-101	**014-08272**	--	**--**	--	**--**
5" (96-Cell) 41" x 62"	9	3x3	--	**--**	15015-004	**014-08253**	15022-004	**014-08265**
	12	4x3	15009-002	**014-08268**	15015-002	**014-08251**	15022-002	**014-08263**
	16	4x4	15009-101	**014-08260**	--	**--**	--	**--**
6" (60-Cell) 39" x 66"	9	3x3	15009-004	**014-08270**	15015-004	**014-08253**	15022-004	**014-08265**
	12	4x3	15009-001	**014-08267**	15015-001	**014-08250**	15022-001	**014-08262**
	16	4x4	15009-102	**014-08273**	--	**--**	--	**--**
6" (72-Cell) 39" x 77"	9	3x3	15009-005	**014-08271**	15015-005	**014-08254**	15022-005	**014-08266**
	10	3-4-3	15009-003	**014-08269**	15015-003	**014-08252**	15022-003	**014-08264**

Array Technologies Tracker Power Supply Option		
Model	**Description**	**Item code**
IDEC PS5R-SF24	Accepts 120 or 240 VAC input or 100-350 VDC input and outputs 24 VDC at 5 A maximum. One power supply unit required for each motorized tracker. Power supply unit needs to be mounted in a rain-tight box if located outside.	**014-07115**

Single-Axis Row Tracker (DT-HZLA)

Array Technologies Single-Axis Row Tracker is an East-to-West sun-tracking single-axis ground-mount system. Each rack holds up to 4 kW in portrait over its typical 50-foot length. The DT-HZLA can improve performance by 25% over a static fixed rack. All parts are made from galvanized steel and anodized aluminum. Installer must provide one 5" and four 4" vertical pipes. Above-ground height is typically 5-6' above grade. Foundation requirements are site specific, so be ready to provide wind speed and exposure category, snow load, and soil conditions. Please call AEE Solar to get a custom quote on these trackers for your project.

Array Technologies Single-Axis Row Tracker (DT-HZLA)			
Module size (approximate)	**Description**	**Module quantity**	**Item code**
1 (32" x 62")	Array Technologies DT-HZLA Seasonal Adjustable Rack for 32" x 62" modules	18	**CALL**
2 (39" x 66")	Array Technologies DT-HZLA Seasonal Adjustable Rack for 39" x 66" modules	16	**CALL**
3 (39" x 78")	Array Technologies DT-HZLA Seasonal Adjustable Rack for 39" x 78" modules	14	**CALL**

Seasonal Adjustable Rack (DR-LA)

The Array Technologies Seasonal Adjustable Rack is an adjustable single-axis ground-mount system with a tilt range from 0° to 60°. Each rack holds up to 4 kW in portrait over its typical 50-foot length. The DRLA is easily adjustable in order to maximize seasonal production, or to aid snow removal. One person can adjust the rack with a cordless drill in minutes. All parts are made from galvanized steel and anodized aluminum. Installer must provide one 5" and four 4" vertical pipes. Above-ground height is typically 5-6' above grade. Foundation requirements are site specific, so be ready to provide wind speed and exposure category, snow load, and soil conditions.

Array Technologies Seasonal Adjustable Rack (DR-LA)			
Module size (approximate)	**Description**	**Module quantity**	**Item code**
1 (32" x 62")	Array Technologies DR-LA Seasonal Adjustable Rack for 32" x 62" modules	18	**014-08301**
2 (39" x 66")	Array Technologies DR-LA Seasonal Adjustable Rack for 39" x 66" modules	16	**014-08302**
3 (39" x 78")	Array Technologies DR-LA Seasonal Adjustable Rack for 39" x 78" modules	14	**014-08303**


UTRK040


UTRF72


UTRF120


UTRF168

Zomeworks

Universal Track Rack™

Passive Solar Tracker for PV Modules

The Zomeworks passive Track Rack™ uses no motors, no gears, and no controls, eliminating common failure modes. The sun's heat moves liquid from side to side so that gravity naturally turns the Track Rack™ to follow the sun.

The Zomeworks Universal Track Rack™ system allows for adjustment in both the East-West and North-South directions. Available in five standard sizes for holding two to 32 modules, Universal Track Racks™ are designed to fit all common photovoltaic modules. The F-Series Track Racks ship partially assembled for easy installation. The new UTRF168HD comes with heavy-duty rails. Both UTRF168 trackers come with a high-wind kit. All of these mounts come with stainless steel and zinc-plated hardware and a ten-year standard warranty.

Please specify number of modules to be mounted on the tracker and include the module data sheet with your order. The tracker will be customized with the correct hardware, and in some cases the rail length will be adjusted for a better fit. Some module quantities require an additional rail set at an extra charge. These racks are made-to-order and cannot be returned or exchanged.

Passive Solar Tracker for PV Modules						
Model	**UTRK020**	**UTRK040**	**UTRF72**	**UTRF90**	**UTRF120**	**UTRF168-2**
Item code	**014-09020**	**014-09043**	**014-09072**	**014-09090**	**014-09120**	**014-09130**
Pole size SCH40 steel	2.5"	3"	6"	6"	6"	8"
Min. pole height	76"	84"	96"	108"	120"	144"
Min. pole depth	38"	42"	48"	54"	60"	72"
Shipping weight	101 lbs	170 lbs	400 lbs	490 lbs	525 lbs	650 lbs
Module type	**Number of modules that fit each Zomeworks model (top row)**					
REC						
REC PE and TP Series	one	two	three	four, five [1]	six [1]	seven[1], eight, nine[1]
Suniva						
Suniva OPT60 250-285	one	two	three	four, five [1]	six[1]	seven[1], eight, nine[1]

[1]Additional rail required for this number of modules **(Item code: 014-09155)**

Wind Power

Wind-power systems can be cost effective if the average wind speed is 9 mph or more at the location of the wind generator. Adding a secondary charging source, like wind power, to PV can make an off-grid power system more stable by increasing the amount of time that energy is being produced, reducing dependence on energy stored in the batteries. Using off-grid wind to supplement solar photovoltaic power can be cost effective even if good wind is only partially available throughout the year, especially if the solar potential is low at that time.

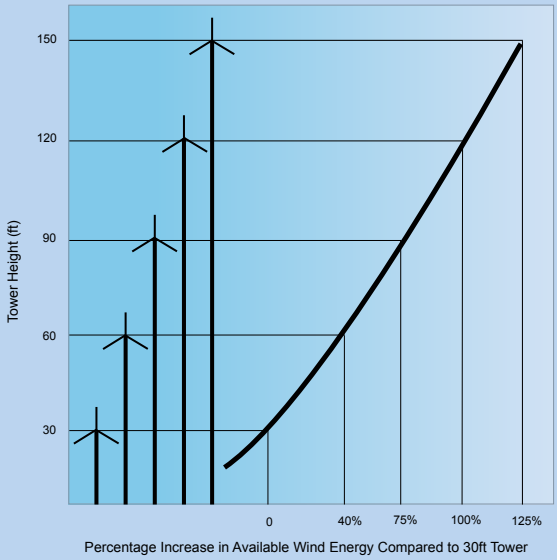
Siting Considerations

The amount of power generated by a wind turbine is dependent on wind turbulence, wind speed, and tower height. Like water, air is a fluid, and is subject to the same fluid dynamics principles, such as turbulence created by obstructions in the flow. A stream flowing over boulders becomes turbulent, creating wakes and eddies, and is robbed of much of its energy by friction.

Similarly, wind blowing over a landscape with trees and buildings obstructing its flow also becomes turbulent and loses energy to friction. Turbulence degrades the wind resource, both upwind and downwind of obstructions. Wind turbines placed in turbulent air wear out prematurely and produce little usable power.

To avoid air turbulence, wind turbines should be placed on a tower high enough that the bottom of the turbine rotor's swept area is at least 20' to 30' higher than any buildings, trees, or other obstructions within a 300' to 500' radius. If the wind at the site primarily comes from a particular direction, and the obstructions are not in the wind path, then less clearance may be allowable as long as the flowing air is laminar. In the illustration below, a kite with long streamers tied to the line at 10' intervals can be used to find the height above ground level where the air flow smooths out. Look for the first streamer to be fully furled out.

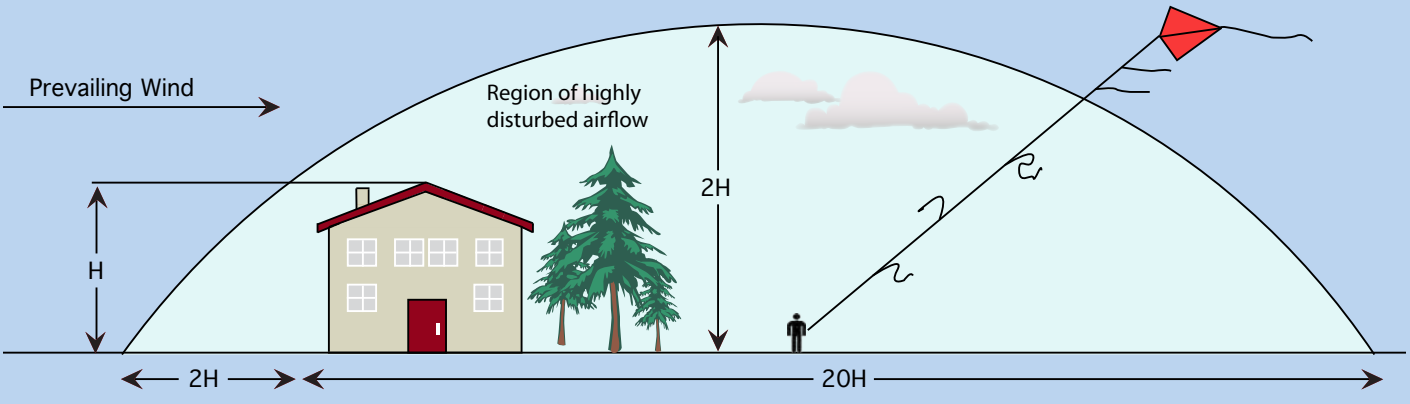
The power available in the wind increases with the cube of the wind speed. This means that there is nearly twice as much power available in a 10 mph wind as there is at an 8 mph wind. Wind speed increases as you get higher above the ground due to the loss of friction between the air and the ground. You can expect that the wind speed at 30' above the ground will be about 25% greater than at eye level (at 60', it's about 37% greater; at 90' about 45% greater; and at 120', about 50% greater). And since power output increases exponentially with increases in wind speed, a turbine mounted on a 60' tower can produce about 40% more power than the same turbine would on a 30' tower (75% more power at 90' and 100% more power at 120' compared to 30'). Therefore, increasing tower height can be a cost effective way to get more power out of a wind turbine.



The power output of a wind generator decreases roughly 3% for every 1,000' of elevation above sea level due to lower air pressure.

Measuring Wind Speed

Before installing a wind-power generator, measure the wind-power resource at the site. Local weather data will be helpful, but wind is very site-specific based on local terrain, site elevation, wind direction, and any obstructions such as trees or buildings. Average wind speeds should be calculated along with peak wind speeds during storm events. Installing a wind data logger and monitoring site conditions for a year, or for the target season, will yield enough information to predict the amount of power that can be produced by a wind turbine.



APRS

Wind Data Loggers

The **Wind Data Logger** is an affordable and easy-to-use tool for wind site evaluation and wind generator performance analysis. It records wind speed, time, and date directly to a Secure Digital (SD) card for convenient data downloads. The logging interval is adjustable from 10 to 60,000 seconds (16.6 hours). The two gigabyte SD card (included) will store a year of data at 30-second intervals or more at longer logging intervals. Common spreadsheet software (i.e. MS Excel™) can be used to view, graph, and analyze your wind data. Easy to use web-based software is provided. Simply upload the data, and the software will automatically plot the data as well as provide basic statistics. A 16-character two-line backlit LCD screen displays current information and is used for configuring the data logger. A simple menu-driven interface using the LCD and three front panel buttons makes setup easy. A bright backlight makes the data logger easy to use at night. The data logger is housed in a waterproof enclosure.

The **solar powered models** work well for wind data logging in remote areas without access to AC power. The included 10 W solar panel and sealed battery will run the data logger almost indefinitely. They come with a 10 W PV module, a side-of-pole mount for the module, a charge controller, and a 7 Ah battery. The AC model comes with a Universal AC power supply that accepts 90–264 VAC, 125-370 VDC, 47-63 Hz instead of a solar module and battery; however, it does have a space for eight D-cell alkaline batteries for 30-day power backup (batteries not included).

The optional **#40 R anemometer** is a more rugged, extra heavy duty version of the standard three-cup anemometer. Both AC and DC models are housed in a weatherproof Pelican™ case with self-resetting fusing, and have lightning protection for all sensor channels and solar input.

APRS Wind Data Loggers	
Description	**Item code**
APRS 6060 wind data logger - solar powered	**016-00270**
APRS 6063 #40 R wind data logger - solar powered	**016-00271**
APRS 6061 wind data logger - AC powered	**016-00273**
APRS 6062 #40 R wind data logger - AC powered	**016-00274**

Kestrel

Wind and Weather Meters

The **Kestrel 1000** measures instantaneous maximum and average wind speeds in knots, meters per second, kilometers per hour, miles per hour, feet per minute, and Beaufort. Hold it up to measure wind speed. It offers a large, easy-to-read liquid crystal display with ±3% accuracy, and measures down to 0.3 m/s (0.67 mph). Its impeller and protective housing pop out for easy and inexpensive replacement, and it includes a slip-on hard case that protects the impeller, buttons, and display from damage in your pocket or toolbox. It is waterproof and it floats. The replaceable battery provides up to 400 hours of use. The standard warranty is five years.

The Kestrel 2000 has all the features of the Kestrel 1000, and is also capable of measuring temperature. The Kestrel 2000's external temperature sensor and waterproof casing allow you to gauge the temperature of water and snow, as well as open air. Includes hard slip-on case and standard five-year warranty.

The **Kestrel 4000** has all the features of the Kestrel 2000, plus the capability to store up to 2,000 points of weather data in order to track changes over time with data storage, and analyze with graphing functions, and computer interface technology. You can view data as graphs on the Kestrel 4000 display, or with Kestrel's Communicator Software and a Kestrel interface. Data can be downloaded to a PC or Mac for long-term storage, in-depth analysis, and detailed charting. Kestrel Interface kits are available with either a serial or USB port connection, and include an interface cradle unit, serial or USB cable, and CD with easy-to-use software. The Kestrel 4000 is also available with integrated Bluetooth® wireless data transfer, allowing both real-time and logged data to be transferred wirelessly and automatically to a laptop or PDA, eliminating the need for a separate interface and cabling. The 4000 comes with a soft carry pouch. Carry case optional. The standard warranty is five years.

Kestrel Wind and Weather Meters	
Description	**Item code**
Kestrel 1000 pocket wind meter	**016-00253**
Kestrel 2000 pocket thermo/wind meter	**016-00256**
Kestrel 4000 pocket weather station	**016-00259**
Kestrel 4000 pocket weather station with Bluetooth	**016-00258**
Kestrel 4000 computer interface - USB	**016-00260**
Kestrel 4000 computer interface – serial port	**016-00261**
Kestrel 4000 K4000 carry case	**016-00263**
Kestrel replacement impeller for all models	**016-00255**

Primus

AIR Wind Turbines

AIR wind turbines harness the wind's energy to charge an off-grid battery bank. AIR turbines are extremely popular and frequently used in sailboats, RVs, remote cabins, and offshore platforms.

The AIR wind turbine incorporates a three-phase brushless permanent magnet alternator and integrated microprocessor-based charge controller to optimize power production capability. The microprocessor continuously adjusts the loading of the alternator to keep the turbine operating efficiently in most wind regimes.

The **AIR Breeze** is designed for battery-charging applications in coastal areas, on boats, and for other marine uses. Corrosion-resistant for use in coastal and nautical applications, it has a white powder-coated housing and sealed electronics designed to prevent damage from salt spray. The rated power is 160 W at 28 mph (12.5 m/s).

The **AIR 40** provides energy for off-grid homes, water pumping, lighting, telecom, and anywhere you need electricity and have average annual wind speeds under 15 mph. It has a bare aluminum finish for use in non-corrosive environments, so it is not suitable for marine use. The AIR 40 israted for 160 W at 28 mph (12.5 m/s).

The **AIR 30** provides reliable battery-charging in areas where average annual wind speed is above 15 mph. (The AIR Breeze or the AIR 40 should be used for slower average wind speeds). It has a bare aluminum finish for use in non-corrosive environments, so it is not suitable for marine use. The AIR 3**0** is listed by CSA to UL 1004 and C22.2 No. 100 for the U.S.A. and Canada and rated for 400 W at 28 mph (12.5 m/s).

The **AIR X Marine** is the marine version of the AIR 30. It has a white powder-coated housing and sealed electronics designed to prevent damage from salt spray. The AIR X Marine is designed for the most rugged, high-wind applications, such as SCADA, telecom, security, cathodic protection, etc.

Both the AIR Breeze and AIR 40 are designed to be very quiet and are recommended for residential use. The AIR 30 and AIR X Marine, due to the different blade design, produce more noise, and are not recommended for use in residential areas.

Select the corresponding AIR wind turbines for use in 12, 24, and 48 VDC battery systems.

All units weigh 13 lbs, have a 46" rotor diameter (11.5 ft2 swept area) and mount on a 1.5" Schedule 40 steel pipe (1 7/8" [48 mm] outer diameter). Made in U.S.A. All AIR models have a five-year limited warranty.

AIR Wind Turbines

Model	Approximate monthly kWh production vs. average annual wind speeds									DC battery voltage	Item code
	mph →	8	9	10	11	12	13	14	16	18		
	m/sec →	3.57	4	4.5	4.9	5.36	5.8	6.25	7.15	8		
AIR Breeze		13 kWh	17 kWh	22 kWh	28 kWh	38 kWh	43 kWh	50 kWh	--		12	**016-00987**
											24	**016-00989**
											48	**016-00990**
AIR 40		13 kWh	17 kWh	22 kWh	28 kWh	38 kWh	43 kWh	50 kWh	--		12	**016-01038**
											24	**016-01039**
											48	**016-01040**
AIR 30		7 kWh	10 kWh	14 kWh	20 kWh	25 kWh	31 kWh	35 kWh	50 kWh	60 kWh	12	**016-01032**
											24	**016-01035**
											48	**016-01037**
AIR X Marine		7 kWh	10 kWh	14 kWh	20 kWh	25 kWh	31 kWh	35 kWh	50 kWh	60 kWh	12	**016-01042**
											24	**016-01043**
											48	**016-01044**

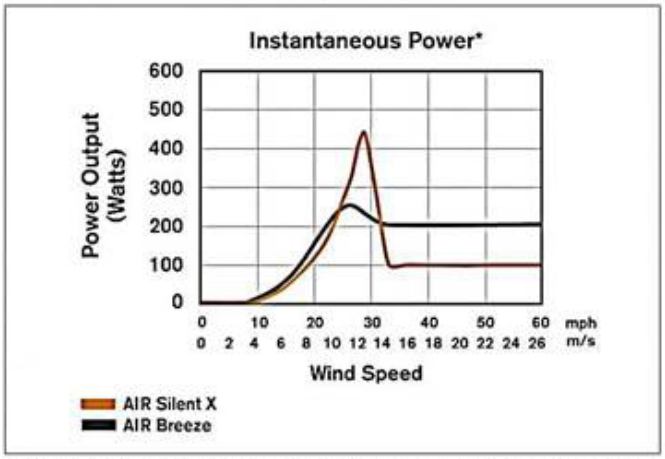
NEW! AIR Silent X Wind Turbine

The Primus AIR Silent X wind turbine utilizes the proven, AIR X turbine with a quiet carbon fiber "blue blade" set. Intended primarily for the marine market, the AIR Silent X is designed to be quiet and lightweight while providing up to 400 W from a 1.2 m rotor diameter. As with all the other AIR models, the AIR X Silent has a built-in charge controller, so no additional battery charging controller is needed.

Available for 12 VDC systems only. Made in USA with a standard five-year warranty. CSA listing is pending.

Midnite Solar Stop Switch			
Model	**Description**	**DC Voltage**	**Item code**
AIR Silent X	AIR Silent X with carbon fiber blade set	**12 VDC**	**016-01048**

AIR Power Curve



*Factors affecting turbine output include site turbulence, elevation and air temperature

Wind Control Panel

The Primus Wind Control Panel (WCP) is a low cost analog control panel for use with AIR Breeze and AIR 40 12, 24, and 48 VDC and AIR X Marine/AIR 30/Silent X 12 VDC wind turbines. The WCP controls and monitors the AIR wind turbine and is equipped with a power On/Off circuit breaker, analog ammeter (indicating wind turbine current production) and a Stop/Run switch (for direct control of the turbine). A clearly marked rear terminal block is provided for easy interconnect of the two turbine wires and two battery power wires. It is available in a 25 A version for 12 VDC systems, a 10 A version for 24 VDC systems, and a 5 A version for 48 VDC systems which are fully calibrated and ready for installation. The panel measures 3.5" x 5" and the Surface-mount black plastic enclosure allows for mounting of the WCP on a flat surface.

Primus Windpower Wind Control Panels		
Model	**Description**	**Item code**
2-ARAC-103	Primus Windpower Wind Control Panel for 12 VDC AIR Breeze/AIR 40, 25 A breaker, 15 A meter	**016-01352**
2-ARAC-104	Primus Windpower Wind Control Panel for 24 VDC AIR Breeze/AIR 40, 10 A breaker, 8 A meter	**016-01353**
2-ARAC-107	Primus Windpower Wind Control Panel for 48 VDC AIR Breeze/AIR 40, 5 A breaker, 8 A meter	**016-01355**
2-ARAC-108	Primus Windpower Wind Control Panel for 12 VDC AIR X Marine / AIR 30 / Silent X, 40 A breaker, 30 A meter	**016-01356**
2-ARAC-106	Surface-mount enclosure for Wind Control Panel	**016-01354**

AIR Accessories

The Primus AIR Stop Switch is a simple panel-mount inline brake switch used for stopping the movement of the blades.

The 30 A ammeter is an analog meter for measuring the output current of the AIR turbines. Analog meters are recommended for wind turbines as digital meters tend to scroll too fast in uneven wind to read properly.

The **Primus Circuit Breakers** are self-resetting DC breakers that can be used as simple over-current protection for mobile and marine applications. If using an AIR turbine in a power system that has a DC power center or load center in it, it's recommended to use a DC circuit breaker of the proper rating that will fit in the DC power center (OutBack GSLC or FLEXware-DC, MidNite E-Panel, Magnum MP, etc.) .

Air Turbine Accessories		
Model	**Description**	**Item code**
2-ARAC-101	AIR Stop Switch (not code compliant). No enclosure included	**016-01351**
2-ARAC-102	Amp Meter Kit (30 Amp) for all AIR units	**016-01223**
3-ELOT-1147-01	5 A circuit breaker kit - for 48 V AIR Breeze / AIR-40	**053-17005**
3-ELOT-1147-02	10 A circuit breaker kit - for 24 V AIR Breeze /AIR-40 ; 48 V AIR-30	**053-17006**
3-ELOT-1147-03	20 A circuit breaker kit - for 12 V AIR Breeze /AIR-40 ; 24 V AIR-30	**053-17007**
3-ELOT-1147-04	40 A circuit breaker kit - for 12 V AIR-30	**053-17008**
3-ELOT-1147-05	50 A circuit breaker kit - for 12 V AIR-30 (very high wind area)	**053-17009**

MidNite Solar

Stop Switch

MidNite Solar's Stop Switch allows you to stop an AIR wind generator and disconnect it from the battery, all in one motion. The MN-Stop Switch comes with a neutral bus bar and ground box terminal. Rated for wind turbines up to 63 A at up to 150 VDC. The switch is listed for the U.S.A. and Canada, measures 9"H x 5"W x 4"D and weighs 3 lbs.

Midnite Solar Stop Switch	
Description	**Item code**
MidNite Solar Stop Switch (code compliant)	**053-00121**

AIR Turbine Tower Kits and Accessories

AIR tilt-up tower kits are available as hardware kits (not including the tower pole) in 27' (8.1 m) and 45' (13.5 m) heights, and in a 29' (8.8 m) **EZ Tower™ kit** that includes the pole for the tower. All towers use a four-guy-wire set-up, and are assembled on the ground with the wind generator and tilted up into place.

The **27' and 45' tower kits** come with all the hardware necessary to install a tower, except guy-wire anchors, pipe, and concrete. All parts bolt or clamp together, and no welding is required. Purchase 1 7/8" steel tubing from a local chain link fence supplier (for up to 90 mph at 27', or 70 mph at 45'), or use 1.5" Sch 40 Galvanized water pipe (1 7/8" OD and up to 120 mph at 27' and 90 mph at 45'), to build the tower. These tower kits include a simple elbow/tee for its base that, when combined with a short length of pipe, eliminates the need for a concrete pad, swivel, and base plate. Two people can erect one of these towers without using winches or vehicles. AIR towers are PE stamped. Contact us for engineering "wet stamps" (additional cost).

The **29' EZ Tower™** kit comes with all the parts you'll need, including Galvanized tubing, cable and hardware. This tower uses lightweight tubing while providing plenty of strength to withstand winds up to 110 mph. Two people can easily erect the EZ Tower™ without winches or vehicles. The EZ Tower™ includes a simple, yet effective, tower base and anchoring system which eliminates the need for a concrete pad. The kit comes with guy-wire anchors that are driven into the ground (depending on the soil conditions, concrete may be necessary for proper guy anchoring). Can ship via UPS in one 74" (1.9 m) box weighing 80 lbs.

The **AIR Marine Tower** is the easiest way to mount your **AIR Breeze Marine** turbine on a boat and is designed to withstand even hurricane-force winds. It's simple to install on wood or fiberglass decks. The 9' (2.7 m) white powder-coated aluminum mast has an outside diameter of 1.9" (48 mm) and two 9' (2.7 m) long fully-adjustable stays with a 1" (25.4 mm) outer diameter. The **Hardware Kit** contains stainless-steel hardware with self-locking nuts, and vibration mounts to minimize sound transmission. Order the mast and hardware kit separately.

Earth Auger Sets

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

Air Turbine Tower Kits and Accessories		
Model	**Description**	**Item code**
1-TWA-20-03	AIR Marine Tower hardware kit	**016-01128**
1-TWA-20-02	9' AIR Marine aluminum mast and two stays	**016-01131**
1-TWA-19-02	Roof Mount kit without roof seal	**016-01134**
1-TWA-19-01	Roof Mount kit with roof seal	**016-01137**
2-TWA-100	Roof seal – for Roof Mount kit	**016-01140**
1-TWA-10-01	27' AIR guyed tower kit	**016-01086**
1-TWA-10-02	45' AIR guyed tower kit	**016-01092**
1-TWA-11-01	29' EZ Tower kit including pipe and anchors	**016-01081**
1-TWA-12-02	36" Galvanized Auger - set of four; use with 24' & 27' towers	**016-01116**
1-TWA-12-04	48" Galvanized Auger - set of four; use with 32'-50' towers	**016-01122**

Grid-Tie Inverters

Often referred to as the "brains" of a renewable energy system, an inverter is an electronic device that converts direct current (DC) from batteries or solar modules into alternating current (AC) at the voltage and frequency required to run electrical loads or feed into the grid.

Grid-tie, or utility intertie, inverters convert DC power from photovoltaic (PV) modules directly into AC power to be fed into the utility grid. Batteries are not needed, as any power that is not consumed by the owner's electrical loads is fed into the utility grid to be used elsewhere. Due to the high voltages involved, grid-tie inverters should be installed and serviced only by qualified personnel.

Grid-tie PV systems typically use the utility grid for energy storage. Whenever the PV array is generating more power than the loads are using, excess energy is fed into the grid, turning the meter backward. When the loads require more power than the PV array can supply, the utility makes up the difference. Known as "net metering," this arrangement is the most efficient and cost-effective for grid-tied applications since there are no batteries to maintain. However, most grid-tie inverters are required by law to shut down during a utility outage per IEEE 1547, which is incorporated into UL 1741. Battery-based grid interactive inverters (See Battery-Based Inverters) are required for back-up power applications.

Most batteryless grid-tie inverters are called "string" inverters because the PV modules must be wired together in series to obtain a higher input voltage. ***String Inverters*** are designed to run at voltages up to 600 VDC in residential systems and up to 1,000 VDC for commercial and industrial systems. String wiring is quick and easy to install, and the higher voltage helps to minimize line losses and required wire size. However, in string wiring, maximum power point tracking (MPPT), along with any monitoring output, is performed at the string or array level.

An important trend to note is that most string inverter manufacturers have introduced ***Transformerless*** (aka non-isolated) inverters due to the higher efficiency and lower manufacturing costs of that topology. While transformerless inverters have dominated the European market and are arguably even safer than their isolated counterparts, they do impose special "ungrounded system" requirements according to NEC 690.35. This includes the use of PV-Wire for DC connections, including the module outputs, as well as fusing and switching on both output legs. The term ungrounded should not be confused with the equipment ground, which is still required; it means that neither the positive nor negative outputs are connected to ground. Some jurisdictions will also require special circuit labels noting that both conductors are "hot". See Electrical Distribution Parts for compliant combiners, switches, and Tools for labels.

Module Optimizers can be deployed behind each module to provide individual module-level MPPT tracking and monitoring, optimizing the DC output that is connected to a string inverter for very high efficiency. Systems that combine optimizers with low-cost high-efficiency string inverters can simplify system design and maximize safety and energy harvest with minimal impact on cost.

Microinverters are typically mounted behind each solar module. They convert the DC output of each module to AC, replacing the high DC voltages (up to 1,000 VDC) with comparatively lower AC potentials (240 VAC or less) and simplifying system design. The microinverter output connects directly to the breakers in the AC load center using conventional wiring. Since microinverters provide MPPT tracking and monitoring for individual modules, the impact of differences in orientation or shading between modules is reduced. Microinverters are a popular solution for electrical contractors that are new to solar as DC wiring is essentially eliminated.

Three-Phase Inverters are used in larger commercial grid-tie systems, and output at 208 VAC or 480 VAC, which is more common in larger buildings. Many of these 10 to 50 kW inverters are available with input voltage ratings of 1,000 VDC. This higher input voltage enables longer module strings, which can improve design flexibility and eliminate external combiners. Traditional ***Central Inverters*** are rarely used anymore for systems under several megawatts in scale.

Enphase M215 and M250 Microinverters

Enphase

Grid-Tie Single-Phase Microinverter System

The Enphase Microinverter System consists of microinverters, Engage trunk cables, the Envoy Communications Gateway, and the web-based Enlighten monitoring and analysis service.

Through individualized MPPT, Enphase microinverters help mitigate the effects of shading, dust, debris, module mismatch, and thermal differences. With module-level monitoring, performance issues can be traced to individual modules to expedite troubleshooting. Each PV module is connected directly to its own microinverter, typically mounted on the racking underneath. The microinverters' AC wire harnesses are connected to form an AC branch circuit that leads to the AC utility distribution center. System safety is enhanced since all of the output wiring from the PV array is AC and no high-voltage DC is present once the AC power is shut down, reducing risk for maintenance personnel or firefighters. Microinverters are inherently compliant with the NEC 690.12 rapid shutdown requirement.

The Engage Trunk Cable allows Enphase Microinverters to be used for both 240 VAC single-phase and 208 VAC three-phase output. Each Enphase branch circuit is protected by a 20 A circuit breaker, and multiple circuits can be used for larger installs.

Features:

- Module-level monitoring - requires Envoy Communications Gateway
- Integrated grounding feature eliminates need for separate equipment ground wire
- Operates at full power in ambient temperatures from -40 °C (-40 °F) to 65 °C (149 °F)
- NEMA6 sealed enclosures
- 25-year warranty
- Listed to UL 1741 for U.S.A. and Canada
- Compliant with: IEEE 1547, FCC Part 15 Class B, CAN/CSA-C22.2 NO. 0-91, .4-04, and 107.1-01

Enphase M215 and M250 Microinverters

The ***M215*** microinverter is recommended for 60-cell modules up to 260 Watts. The maximum number of M215 microinverters in an AC branch circuit is 17 for 240 VAC single-phase systems and 25 for 208 VAC three-phase systems.

The ***M250*** microinverter is recommended for 60-cell modules up to 300 Watts. Each AC branch circuit must be protected with a 20 A circuit breaker. The maximum number of M250 microinverters in an AC branch circuit is 16 for 240 VAC single-phase systems and 24 for 208 VAC three-phase systems.

Enphase S230 and S280 Microinverters

NEW! Enphase S230 and S280 Microinverter

The new, fifth Generation Enphase S230 and S280 microinverters are CEC rated at 97.0% when used in a 240VAC single-phase systems. The S-Series microinverters are designed to be compatible with Enphase's forthcoming energy storage system. These microinverters work with 60-cell solar modules; use the S230 for modules up to 300 watts, and the S280 for modules up to 360 watts.

These microinverters include advanced grid functions, and can be remotely updated, via Internet, in response to changing grid requirements or regional grid profiles, like Hawaiian Electric Company (HECO) Rule 14H, California Rule 21, and others.

Enphase M215 & M250 Microinverters							
Model	**Max AC Output**	**DC module voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
M215-60-2LL-S22-IG	215 W	<45 VDC	22 to 36 VDC	96.0%	1.0 A @ 208V 0.9 A @ 240V	3.5 lbs	**030-07724**
M250-60-2LL-S22	250 W	<48 VDC	27 to 39 VDC	96.5%	1.15 A @ 208V 1.0A @ 240V	4.4 lbs	**030-07722**
Enphase S230 & S280 Microinverters							
S230-60-LL-X-US	230 W	<48 VDC	27 to 37 VDC	97.0%	1.06 A @ 208V 0.92 A @ 240V	4.0 lbs	**030-07729**
S280-60-LL-X-US	280 W	<48 VDC	27 to 37 VDC	97.0%	1.30 A @ 208V 1.13 A @ 240V	4.0 lbs	**030-07730**

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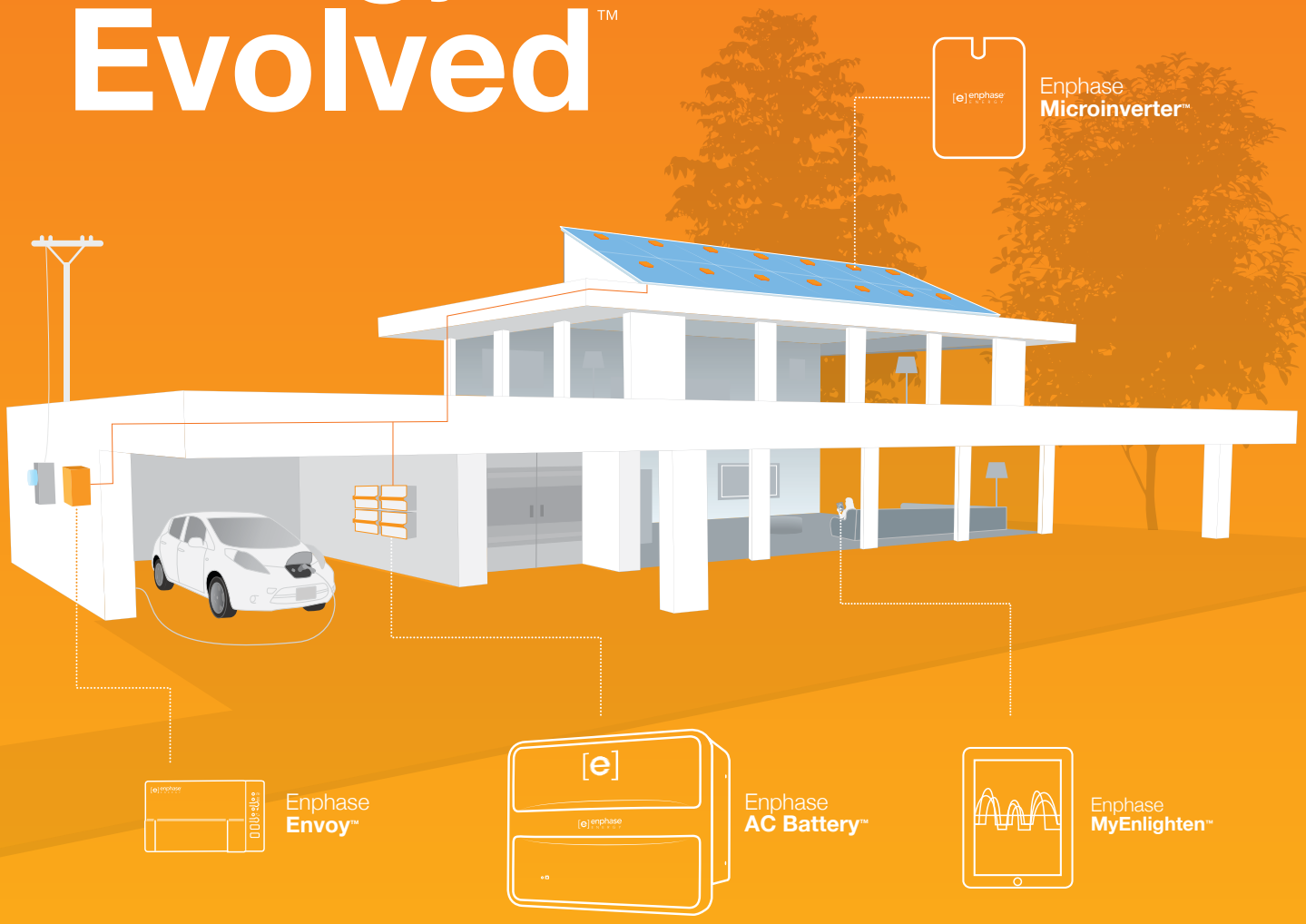

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enphase® ENERGY

Engage Cable
Inverter Attachment

Branch Terminator

Sealing Caps

Engage Coupler

Engage Cable Disconnect Tool

Frame Mount Adapter (EFM)

Enphase Connector Clip

Enphase Engage Cable System

The Enphase Engage Cable is a continuous 12 AWG (2.5 mm²) outdoor-rated cable with integrated connectors for Enphase microinverters. The connectors are preinstalled at intervals to accommodate PV module widths or lengths. The microinverters plug directly into the connectors, and the Engage cable can be terminated into a junction box that feeds electricity back to the system's AC disconnect. Engage cables are specific to portrait (***ET10***) or landscape (***ET17***) module orientation as well as 208 VAC or 240 VAC output. The gap between connectors on a portrait cable of either voltage is 40" while the landscape cable has a 67" connector spacing to accommodate the width and length of a standard 60-cell module.

The Engage cable is attached directly to the solar racking using ***Enphase Cable Clips***. One cable end is wired directly into a junction box connected to the branch circuit array wiring. The other end is sealed using an Engage Cable Branch Terminator. The AC output cable from the Enphase microinverters are plugged directly into the regularly-spaced Engage Cable connectors. Any unused connectors must be protected with an Enphase waterproof sealing cap. (The plastic covers that ship with the cable are not weather tight and cannot be used in place of a sealing cap).

Both types of Engage cables are available in bulk lengths with 240 connectors. Accessories can be ordered individually or as an ***ET-INSTL*** and ***ET10-240***, as well as ***ET17-240*** cables can be cut to order.

A Branch Terminator (ET-TERM) is used to seal the stub ends of each branch circuit. The terminator separates and insulates the individual conductors contained in the Engage trunk cable. One terminator is needed per branch circuit. NOTE: The terminator is intended for one-time use only. The latching mechanism will be damaged if the terminator is removed after installation.

A watertight ***Sealing Cap (ET-SEAL)*** is used to seal any unused trunk cable connectors to IP67 weatherproofing standards. Unused trunk cable connectors generally occur where the trunk cable transitions to another module row or needs to span a gap in the array.

The ***Engage Coupler (ET-SPLK)*** is used to connect cut ends ofEngage cable together or to join it to a lower cost standard cable without a junction box.

Stainless Steel Cable Clips (ET-CLIP) are used to fasten Engage trunk cable to racking or to secure looped cabling and are available in packs of 100.

The ***Disconnect Tool (ET-DISC)*** is required to safely disconnect the microinverter AC-output cable from the Engage Trunk Cable connector. The tool is reusable, so one per job is usually sufficient.

The ***Enphase Frame Mount Adapter (EFM)*** is used for rail-less mounting systems to attach an Enphase Microinverter directly to a solar module. There are currently two versions available, for use with 35mm and 40mm module frames, and these attachment kits come in boxes of 12.

The ***Enphase Connector Clip (EFM-CC)*** is a convenient method for attaching the Enphase Engage Cable directly to a module frame for use especially with rail-less racking systems. It is designed to be used with any module frame size. It is made from anodized aluminum, and engineered to be used with the Enphase Engage Cable. These are sold in boxes of 12.

Enphase Installation Cable Kits and Accessories		
Model	**Description**	**Item code**
ET10-240	Trunk Cable, Single Connector, Portrait, 240 VAC	**052-10106**
ET10-240-BULK	Bulk Trunk Cable, 240 Connectors, Portrait, 240 VAC	**030-07739**
ET17-240	Trunk Cable, Single Connector, Landscape, 240 VAC	**052-10107**
ET17-240-BULK	Bulk Trunk Cable, 240 Connectors, Landscape, 240 VAC	**030-07741**
ET10-208-BULK	Bulk Trunk Cable, 240 Connectors, Portrait, 208 VAC	**030-07743**
ET17-208-BULK	Bulk Trunk Cable, 240 Connectors, Landscape, 208 VAC	**030-07745**
ET-INSTL	Install Kit for M215 (includes four Branch Terminators, Cable Disconnect Tool, and five Sealing Caps)	**030-07721**
ET-TERM	Branch Terminator for M215 Trunk Cable	**030-07711**
ET-DISC	Cable Disconnect Tool - for Disconnecting Inverter Cable from Trunk Cable	**030-07715**
ET-SEAL	Sealing Cap, watertight cap for unused trunk cable connector socket	**030-07717**
ET-CLIP-100	Cable Clips, 100-pack	**030-07719**
ET-SPLK	Engage Cable Coupler - Splice Kit	**030-07713**
EFM-35MM	Frame Mount Adapter for use with 35mm framed modules, 12 pack	**300-00172**
EFM-35MM	Frame Mount Adapter for use with 40mm framed modules, 12 pack	**300-00173**
EFM-CC	Connector Clip, for attaching Engage Cable to module frame, 12 pack	**300-00174**

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Enphase Envoy Energy Management Unit

Enphase Line Communication Filter

Enphase Revenue Grade Meter with ZigBee Wireless Communications

Enphase Envoy-S Gateway Device

CT-200-SPLIT Consumption Monitoring CT

CELLMODEM-01 Enphase Mobile Connect

XAM1-120 AC Combiner Box with Envoy-S

Enphase Module-Level Monitoring

Enphase Energy's monitoring technology is integrated into their microinverters. However, the ***Envoy Energy Management Unit (ENV-120-M)*** is required to interface with the microinverters and includes access to the Enphase Enlighten online monitoring service. The Envoy plugs into any standard AC outlet and collects microinverter performance information over the existing power line. An Ethernet cable can then be used to connect the Envoy to the installation site's existing Internet access point or local area network. Once online, the Envoy will automatically access the Enphase Enlighten web service. One Envoy is required for monitoring on each installation of up to 250 inverters. The Envoy is listed to UL 60950.

Enphase's Enlighten Manager installer portal enables installers and O&M providers to monitor and manage multiple Enphase systems and receive alerts by e-mail in the event of underperforming modules or equipment faults. The accompanying MyEnlighten™ user view provides a more streamlined interface for individual system owners and includes social media sharing tools as well as simplified system performance data.

An ***Enphase Line Communication Filter (ELCF)*** is required for installations with more than 250 inverters. The ELCF includes an Envoy and terminals for connecting the combined circuits from the micro-inverters it is monitoring. Each ELCF can monitor up to 111 micro-inverters at 240 VAC single-phase, and 166 micro-inverters at 208 VAC three-phase. External communication is by Ethernet. This is all mounted in an outdoor NEMA4 enclosure. The ELCF is listed to UL508A.

The Enphase ***RGM-MTR-01*** is a revenue grade metering solution for 240 VAC single-phase Enphase systems. This Form 2S kWh meter is installed on the combined output circuits from the entire solar array.

Communication from the RGM to the envoy is via ZigBee wireless. The ***RGM-ZGB-01*** USB ZigBee stick is required for the Envoy. The ***RGM-RR-01*** ZigBee repeater can be used to increase the ZigBee wireless range.

NEW! Enphase Envoy-S Communications Gateway

The Envoy-S Gateway collects and delivers solar and energy consumption data to the Enphase Enlighten monitoring platform, for monitoring and remote maintenance and management of an Enphase system, and can monitor up to 600 connected M-series or S-series microinverters. The ***Envoy-S (ENV-S-AB-120-A)***, Standard is a +/-5% accurate reporting device used in many situations. Where revenue grade, +/-0.5% accurate reporting is required, or where optional consumption monitoring is needed, the ***Envoy-S, Metered (ENV-S-AM1-120)*** version is used.

Networking to the Enlighten Monitoring Portal can be through Ethernet, WiFi, or optional cellular connections by installing the plug and play ***Enphase Mobile Connect (CELLMODEM-01)*** cellular modem, which has an included five-year data plan.

NEW! Enphase AC Combiner Box with Envoy-S

The ***Enphase AC Combiner Box with Envoy-S Metered Gateway (XAM1-120)*** simplifies and consolidates interconnection to the utility into a single enclosure and streamlines PV installations with a pre-wired solution for residential applications. The Envoy-S is included and flexible networking supports Ethernet, WiFi, or optional cellular connection to the Enlighten Monitoring Portal. Three pre-installed 20 A / 240 VAC breakers allow up to three Enphase branch circuits to be quickly wired with a common output to the main interconnection point. The enclosure is NEMA 3R rated, and has a five-year warranty.

Enphase Module Level Monitoring		
Model	**Description**	**Item code**
ENV-120-M	Envoy Energy Management Unit, indoor enclosure	**030-03715**
WF-01	Enphase WiFi Adapter Stick	**029-09009**
EPLC-01	Enphase Power Line Carrier – Ethernet Bridge Pair	**030-03752**
RGM-MTR-01	Enphase compatible GE i210+ revenue grade meter with ZigBee wireless	**030-07710**
RGM-RR-01	ZigBee repeater for RGM	**030-07708**
RGM-ZGB-01	ZigBee USB stick for Envoy communication with RGM	**030-07709**
ECLF-120-001	ECLF-120-001, Line Communication Filter 208/240V	**030-09750**
ENV-S-AB-120-A	Envoy-S, Standard	**300-00175**
ENV-S-AM1-120	Envoy-S, Metered for revenue grade PV production metering	**300-00176**
CELLMODEM-01	Enphase Mobile Connect cellular modem with five-year data plan option for Envoy-S	**300-00177**
XAM1-120	AC Combiner Box with Envoy-S, Metered for integrated revenue grade PV production metering	**300-00178**
CT-200-SPLIT	Consumption Monitoring CTs, allows whole home consumption metering for XAM1-120	**300-00179**

SolarEdge

Distributed MPPT Grid-Tie Inverter System

The SolarEdge distributed grid intertie system combines module-level maximum power point tracking (MPPT), DC-DC power optimizers, and monitoring with high-efficiency transformerless string inverters to maximize the energy yield of a PV installation. The SolarEdge system provides design flexibility by mitigating shading, module mismatch, uneven soiling, and aging variance losses. It automatically maintains a fixed string voltage so the inverter operates at peak efficiency regardless of string size, shading, or temperature. This allows flexible string lengths ranging from eight to 25 modules for single-phase and 16 to 50 for three-phase inverters as well as varying module sizes, tilts, and orientations. The system is scalable and simplifies expansions and replacements since future modules need not electrically match existing ones. Fewer, but longer, strings can also reduce DC-side balance-of-system (BOS) requirements.

SolarEdge inverters are ungrounded (non-isolated) on the DC side, so all PV array wiring must use PV Wire. The SolarEdge power optimizers have a 25-year warranty, and the SolarEdge inverters have a 12-year warranty (extendable to 20 or 25 years). Power optimizers and inverters are listed to UL 1741 for the U.S.A. and Canada.

SolarEdge P-Series Power Optimizers

All SolarEdge power optimizers can be used with crystalline silicon PV modules to provide module-level MPPT and performance monitoring, and are designed to work exclusively with SolarEdge inverters. All power optimizers have 99.5% peak efficiency and are backward compatible with older SolarEdge products. The P300, P320, and P400 optimizers can be used with any SolarEdge inverter, while the P600 and P700 dual-module optimizers are compatible only with three-phase inverters. The P320 is designed for use with 60-cell modules that have nameplate ratings of between 300 and 320 watts DC. SolarEdge optimizers can be attached to most PV mounting systems using a single fastener; grounding can be accomplished via the included star washer, a WEEB, or through a lug, depending on racking.

Features:

- Module-level shutdown (1 VDC per module) inherently compliant with NEC 690.12 requirements
- NEMA 4, IP65 environmental protection rating
- Operating temperatures of -40 °F to +185 °F (-40 °C to +85 °C)
- Available for 60-cell PV modules up to 300 W and 72-cell modules up to 400 W
- 99.5% efficiency
- 25-year warranty
- Listed to UL 1741 for U.S.A. and Canada
- Compliant with: IEC61000-6-2, IEC61000-6-3, FCC Part 15 B, IEC62109-1 Class II

SolarEdge Power Optimizers						
Model	Max DC input	Max input voltage	MPPT range	Module type	Input connector	Item code
P300-5 SERIES	300 W	48 VDC	8 - 48 VDC	60-cell	MC4-Type	**300-00118**
P320-5 SERIES	320 W	48 VDC	8 – 48 VDC	60-cell	MC4-Type	**300-00153**
P400-5 SERIES	400 W	80 VDC	8 – 80 VDC	72-cell	MC4-Type	**300-00119**
P600-2NA4ARL	600 W	96 VDC	12.5 – 80 VDC	two 60-cell	MC4-Type	**300-00090**
P700-2NM4ARL	700 W	125 VDC	12.5 – 105 VDC	two 72-cell	MC4-Type	**300-00108**

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SolarEdge Single-Phase Inverters

SolarEdge inverters are designed to work exclusively with SolarEdge power optimizers. MPPT tracking and voltage management is handled by the power optimizers allowing for a very high-efficiency, low cost inverter. These inverters operate at a fixed voltage supplied by the SolarEdge Power Optimizers, are lightweight, and have built-in Module-Level Monitoring. They include an integrated code-compliant DC disconnect, Ethernet interface, and RS-485 serial port. All SolarEdge inverters are listed to UL 1741 and UL 1699B for the U.S. and Canada and are NEMA 3R rated. The inverters are rated for use from -4 °F to 140 °F temperatures.

The optimizers automatically limit the DC voltage to 1 VDC per module when detecting excessive heat, or when the inverter is not connected to the grid, improving installer and firefighter safety.

Features:

- 3,000 Watts to 11,400 Watts AC Output
- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011: 690.11
- Inherently compliant with NEC 2014 690.12 rapid shutdown requirement
- RS485 and Ethernet Communications interface included
- Optional ZigBee Wireless Communication Kit
- Operating temperatures of -13 °F to +140 °F (-25 °C to +60 °C)
- NEMA 3R Enclosure
- Available from 3 kW to 11.4 kW sizes
- 12-year inverter warranty, extendable to 20 or 25 years through SolarEdge
- Listed to UL 1741, UL1998 and UL1699B for U.S.A. and Canada
- Compliant with: IEEE 1547, FCC Part 15 B, CSA 22. 2

SolarEdge Single-Phase Inverters						
Model	Max AC output	CEC efficiency	Max AC current		Weight	Item code
			208 V	240 V		
SE3000A-US	3,000 W	97.5%	--	12.5 A	51 lb	**030-09469**
SE3800A-US	3,800 W	98.0%	--	16 A	51 lb	**030-09470**
SE5000A-US	5,000 W	98.0%	24 A	21 A	55 lb	**030-09471**
SE6000A-US	6,000 W	97.5%	--	25 A	55 lb	**030-09472**
SE7600A-US	7,600 W	97.5%	--	32 A	55 lb	**030-09443**
SE10000A-US	10,000 W	97.5%	48 A	42 A	88 lb	**030-09445**
SE11400A-US	11,400 W	97.5%	--	47.5 A	88 lb	**030-09446**

SolarEdge Three-Phase Inverters

SolarEdge offers three models of three-phase commercial inverters. The ***SE9kUS*** and ***SE14.4kUS*** model can be used at 208 VAC 3-P WYE or Delta configurations, and the ***SE10kUS***, ***SE20kUS***, and ***SE33.3kUS*** inverters can connect to 480 VAC 3-P WYE configuration grids. The SolarEdge inverters are designed to work exclusively with SolarEdge power optimizers, and can use either single-module optimizers, or P600/P700 dual-module optimizers. MPPT and voltage management is handled by the power optimizers, allowing for a very high-efficiency, low-cost inverter.

The SE9kUS and SE14.4kUS inverters have a fixed input voltage of 400 VDC, while the SE10kUS, SE20kUS, and SE33.3kUS inverters operate with fixed input voltage of 850 VDC. The fixed input voltage from the optimizers allows for longer module string lengths, resulting in less wire line losses and fewer system components. These wall-mountable inverters are lightweight, and have built in module-level monitoring. They include an integrated code-compliant DC disconnect, Ethernet interface, and RS-485 serial port. All SolarEdge inverters are listed to UL 1741 and UL 1699B for the U.S. and Canada and are NEMA 3R rated. The inverters are rated for use from -4 °F to 140 °F temperatures. The SE14.4kUS and the SE33.3kUS inverters also come with three fused DC+ and DC- inputs, eliminating the need for a third-party fused combiner box.

The optimizers automatically shut down the DC current and voltage when detecting excessive heat, or when the SolarEdge inverter is turned off or disconnected from the grid, to ensure installer and firefighter safety.

Monitoring can be enabled by connecting the inverter directly to an Internet router with a CAT5 cable, or through the use of the SolarEdge Zigbee Gateway Kit and Slave Modules.

Features:

- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011: 690.11
- Inherently compliant with NEC 2014 690.12
- Five Models: SE9kUS and SE14kUS with 208 VAC output, SE10kUS, SE20kUS , and SE33.3kUS with 408 VAC Output
- RS485 and Ethernet Communications interface included
- Optional ZigBee Wireless Communication Kit
- Operating temperatures of -13 °F to +140 °F (-25 °C to +60 °C)
- NEMA 3R Enclosure
- 12-year inverter warranty, extendable to 20 or 25 years through SolarEdge
- Listed to UL 1741, UL1998 and UL1699B for U.S.A. and Canada
- Compliant with: IEEE 1547, FCC Part 15 B, CSA 22. 2

SolarEdge Three-Phase Inverters							
Model	Max AC output		CEC efficiency	Max continuous AC outputcurrent per phase		Weight	Item Code
	208 WYE or 208 Delta	480 WYE		208 WYE or 208 Delta	480 WYE		
SE9kUS	9,000 W	--	96.5%	25.0 A	--	80 lbs	**030-09481**
SE14.4kUS	14,400 W	--	97.0%	40.0 A	--	106 lbs	**030-09516**
SE10kUS	--	10,000 W	98.0%	--	12.0 A	80 lbs	**030-09478**
SE20kUS	--	20,000 W	98.0%	--	24.0 A	80 lbs	**030-09500**
SE33.3kUS	--	33,000 W	98.5%	--	40.0 A	106 lbs	**030-09517**

Web-based Monitoring

SolarEdge ZigBee Gateway Kit

ZigBee Repeater

SolarEdge Module-Level Monitoring

SolarEdge provides free web-based monitoring for the first 25 years. The system provides PV performance monitoring, fault detection, and troubleshooting at module, string, and system levels. Web-based software provides real-time monitoring, facilitating increased system uptime, and lowering maintenance costs. Remote fault detection pinpoints the location of underperforming modules on a virtual PV site map. The monitoring sensors and transmitters are built-in and data is transmitted over the DC power lines. Connection between the inverter(s) and the Internet can either be by Ethernet or a wireless connection using a ZigBee gateway with connections between multiple inverters using their RS-485 connection ports.

A free monitoring iPhone app is available as a download from the Apple iTunes Store. Registered users can monitor multiple sites from their iPhone. The application provides an at-a-glance view of past and present energy production. Current weather conditions and forecasts are also presented to aid in assessing the system's performance. For commercial systems, the monitoring portal is easily configured for display in a public display through a public web address. The display is refreshed every five minutes and shows the site production, and environmental benefits, along with the installer logo and the site image.

The Site Mapping Tool software is also available free on the SolarEdge website, which allows barcode scanning for creation of a virtual site map using an iPhone. The Site Designer software and an Inverter Configuration Tool for on-site configuration and module-level installation verification are available free online as well.

The ***ZigBee Gateway Kit (SE1000-ZBGW-K5-NA)*** includes the ZigBee home gateway and a single ZigBee card with extended- range antenna for connecting a single inverter wirelessly to an existing network router. A ***ZigBee Slave Kit (SE1000-ZB05-SLV-NA)*** can be used to connect each additional inverter and the ***ZigBee Repeater (SE1000-ZBRPT05-NA)*** can be used to extend the range of the network up to 800 feet.

ZigBee Wireless for SolarEdge		
Model	**Description**	**Item code**
SE1000-ZBGW-K5-NA	ZigBee-to-Ethernet gateway kit with extended range antenna and one slave module	**029-01641**
SE1000-ZB05-SLV-NA	ZigBee wireless slave module – one per each additional inverter	**029-01642**
SE1000-ZBRPT05-NA	ZigBee repeater – range extender	**029-01643**

ABB PVI Series Inverter

ABB UNO Series Inverter

ABB

ABB Inverters

ABB inverters offer wide voltage ranges, and two MPPT circuit inputs, increasing flexibility in module installation and string sizing. Most inverters are configurable for 240 VAC single-phase, 208 VAC three-phase, or 277 VAC single-phase output.

ABB PVI Series grid-tie inverters feature high energy yield and performance efficiencies of up to 97%. These inverters have a field-adjustable "start-up voltage" point that allows low-end PV operating voltage down to 90 VDC. While there is some loss of efficiency at lower voltage settings, inverters can operate with as few as five standard 60-cell modules in series. Please see the inverter sizing chart in the System Design section for configurations that work in most areas. All ABB inverters come with a five-year warranty that can be extended to ten years.

ABB PVI and UNO Transformerless Inverters

The ***ABB PVI*** and ***UNO*** series of inverters are some of the most flexible string inverters available. These ABB inverters have two separate MPPT inputs, allowing for two sub-arrays to be configured with differing string lengths, orientations, or even different PV modules. Conditions on one MPPT will not affect the other. Additionally, the 5 kW and larger inverters have two input terminals for each separate MPPT section allowing as many as four strings of modules (two on each MPPT) to be connected without separate string fusing. Both MPPT inputs can also be paralleled for use with a single array. A wide input voltage range allows for smaller installations with reduced string sizes where needed.

An integrated LCD displays real-time operating parameters, and RS-485 and USB interfaces can connect remote monitoring systems. An integrated DC disconnect is standard on all models shown here. ABB inverters can produce full-rated power at ambient temperatures up to 122 °F (50 °C). The fan-less design and NEMA 4X enclosure enable deployment in extreme environments. Output voltage can be set for 240 VAC split-phase, or 208 VAC or 277 VAC (480 VAC WYE) for three-phase systems (three inverters required for phase balancing).

Where NEC 2014 690.12 Rapid Shutdown code requirements have been adopted, ABB has introduced three versions of the ***ABB Rapid Shutdown Box*** which cuts off DC voltage and current between the array and the inverter when activated.

ABB transformerless single-phase inverters are available in sizes covering most common residential requirements, and can be used in groups of three for commercial three-phase applications. The transformerless design reduces internal power losses for high efficiencies. Output voltage can be set to 240 VAC split-phase, or 208 VAC or 277 VAC (480 VAC WYE) for three-phase systems.

Features:

- Available in sizes from 3 kW to 12 kW with dual-MPPT DC intputs
- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011
- Field selectable 208, 240 or 277 VAC output
- RS485 Communications interface included
- Operating temperatures of -13 °F to +131 °F (-25 °C to +55 °C)
- Active and reactive power control, low voltage ride-through
- Five-year warranty, extendable up to ten years
- Listed to UL 1741-2010 for U.S.A. and Canada
- Compliant with: IEEE 1547-2003, IEEE 1547.1, UL1699B-2013, ANSI/IEEE C62.41, FCC Part 15 A & B, C22. 2 No. 107.1-01 (Sept. 2011)

ABB PVI Aurora and UNO Transformerless Inverters

Model	Max AC output	DC array voltage	MPPT range	CEC efficiency	MAX AC current			Weight	Item code
					208 V	240 V	277 V		
PVI-3.0-OUTD-US-A	3,000 W	120 to 600 VDC	160 to 530 VDC	96.0%	14.5 A		12.0 A	47 lbs	**030-09705**
PVI-3.6-OUTD-US-A	3,600 W		120 to 530 VDC		17.2 A	16.0 A		47 lbs	**030-09706**
PVI-3.8-OUTD-US-A	3,800 W		140 to 530 VDC		16.0 A			47 lbs	**030-09707**
PVI-4.2-OUTD-US-A	4,200 W		140 to 530 VDC		20.0 A			47 lbs	**030-09708**
PVI-5000-OUTD-US-A	5,000 W		200 to 530 VDC	96.5%	27.0 A	23.0 A	20.0 A	60 lbs	**030-09709**
PVI-6000-OUTD-US-A	6,000 W		200 to 530 VDC		30.0A	28.0 A	24.0 A	60 lbs	**030-09710**
UNO-7.6-TL-OUTD-S-US-A	7,600 W	200 to 600 VDC	200 to 480 VDC	96.5%	36.5 A	32.0 A	27.5 A	81.5 lbs	**030-09719**
UNO-8.6-TL-OUTD-S-US-A	8,600 W				---	36.0 A	31.0 A	81.5 lbs	**030-09720**

ABB TRIO Series Inverter

ABB TRIO Transformerless Three-Phase Inverters

The ***ABB TRIO*** inverters led the trend away from larger 600 VDC central inverters for commercial systems by shortening cable runs and eliminating external combiners and concrete foundations to reduce total installed costs. The 1,000 VDC rated input allows more modules per string, further reducing labor and BOS costs. TRIO inverters have two separate MPPT inputs, allowing for two sub-arrays to be configured with differing string lengths, orientations, or even different PV modules. Conditions on one MPPT will not affect the other.

TRIO S models feature a standard integrated DC disconnect only and have two inputs on each MPPT channel. With only two strings on each channel (four strings total), they can be connected without separate string fusing. Additional strings will require an external fused combiner. ***S1*** models integrate DC-side string overcurrent protection and provide terminals for up to eight module strings, four strings per MPPT channel. The ***S1A*** models add DC and AC surge protection and the ***S1B*** adds DC surge protection and an internal AC fused disconnect switch.

An integrated LCD displays real-time operating parameters, and RS-485 interfaces can connect remote monitoring systems.

TRIO inverters can produce full rated power at ambient temperatures up to 113 °F (45 °C) and can operate at reduced power levels up to 140 °F (60 °C). The fan-less design and NEMA 4X enclosure provide a water and airtight seal. Output voltage is 480 VAC WYE, four wires plus ground. All TRIO inverters come with a five-year warranty, and can be extended to ten years.

Features:

- Dual-MPPT DC inputs
- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011
- Output 480 VAC, three phase, four-wire + Ground
- RS485 Communications interface included
- Operating temperatures of -13 °F to +140 °F (-25 °C to +60 °C)
- Active and reactive power control, low voltage ride-through
- Available in 20 kW and 27.6 kW sizes
- Five-year warranty, extendable up to ten years
- Listed to UL 1741 and UL 1699B for U.S.A. and Canada
- Compliant with: IEEE 1547, IEEE 1547.1, FCC Part 15 B, C22. 2 No. 107.1-01-2001

ABB TRIO Three-Phase Inverters							
Model	**Max AC output**	**DC array voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
TRIO-20.0-TL-OUTD-S-US-480-A	22 kW	200 to 950 VDC	450 to 800 VDC	97.5%	27.0 A	157 lbs	**030-09751**
TRIO-20.0-TL-OUTD-S1-US-480-A	22 kW						**030-09752**
TRIO-20.0-TL-OUTD-S1A-US-480-A	22 kW						**030-09753**
TRIO-20.0-TL-OUTD-S1B-US-480-A	22 kW						**030-09754**
TRIO-27.6-TL-OUTD-S-US-480-A	30 kW	200 to 950 VDC	520 to 800 VDC	97.5%	36.0 A	168 lbs	**030-09755**
TRIO-27.6-TL-OUTD-S1-US-480-A	30 kW						**030-09756**
TRIO-27.6-TL-OUTD-S1A-US-480-A	30 kW						**030-09757**
TRIO-27.6-TL-OUTD-S1B-US-480-A	30 kW						**030-09758**

Aurora Vision Portal and Mobile App

VSN300 WiFi Logger Card

VSN700-1 Residential Data Logger

ABB Rapid Shutdown Box with Disconnect Switch

ABB Monitoring Options

ABB offers direct monitoring of their residential and commercial inverters via the 'Aurora Vision' monitoring portal, and offers free monitoring over the inverter warranty period. To connect wirelessly to the portal, one WiFi Logger card must be purchased for each inverter. This card can be used with all ABB inverters, both single and three-phase. Wired connections can be enabled by purchasing one of the ABB Data Logger units, depending on the number of inverters that are to be monitored. One Data Logger can monitor multiple inverters through an RS485 modbus wired connector by daisy chaining the inverters to the logger, and then connecting to a wired Ethernet router port. Optional third-party Ethernet wireless bridges or Ethernet-over-powerline adapters can be used if direct wired Ethernet connections are not available.

ABB Residential Data Monitoring and Communications Accessories	
Description	**Item code**
VSN300 WiFi Logger Card (300' range line-of-site, one required per inverter)	**029-07009**
VSN700-01 'Aurora Logger - Residential Data Logger', up to five single-phase inverters per site	**029-07008**
VSN700-03 'Aurora Logger - Commercial', up to ten single or three-phase inverters per site	**029-07010**
VSN700-05 'Aurora Logger - Max', up to 32 single or three-phase inverters per site	**029-07011**

ABB Rapid Shutdown Box

ABB now offers a NEC 2014 compliant box for use with ABB inverters to meet NEC 2014 690.12 rapid shutdown requirements. The shutdown occurs at the rooftop when utility power is lost or when the PV Inverter disconnect switch is opened. This box can mount directly on solar racking systems, and lay parallel to the roof surface. It is NEMA 4X rated, and can be installed at 0 to 90° angles while maintaining the water-tight seal, even from snow or driving rain.

There are three versions of the ABB Rapid Shutdown Box. One configuration allows one or two strings input with one or two strings output, and does not have an external disconnect switch. The other two boxes allow strings to be combined prior to passing to the inverter DC Disconnect. These boxes are rated for 600 VDC maximum, and each DC string has a maximum input current of 11.25A.

ABB Rapid Shutdown Box for ABB Inverters	
Description	**Item code**
ABB, Rapid Shutdown Combiner Box with Disconnect Switch , two DC strings input – one combined DC output, RS2-1CN6-KIT	**053-01800**
ABB, Rapid Shutdown Combiner Box with Disconnect Switch , two pairs of DC strings input – two sets of combined DC strings output, RS4-2CN6-KIT	**053-01802**
ABB, Rapid Shutdown Pass-Through Box, No Disconnect Switch, two DC strings input - two DC strings output, (Pass through only, no combining) RS2-2PN6-KIT	**053-01801**

Rapid Shutdown. You don’t want to worry about NEC™ 2014. So we did.

ABB’s Rapid Shutdown units are NEC 2014 code compliant and cost effective. This new solution strategically fits within 10 feet of the array and will shut power down within 10 seconds or less—all without the need of extra conduit. It’s a simple path to full compliance. This is just one of the ways that we at ABB empower solar installers with the latest technology to make their jobs easier and the world better. **Visit abb-solarinverters.com/rapidshutdown** to learn more.

Power and productivity
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ABB

Fronius

Primo Single Phase Inverters

The ***Fronius Primo*** is a lightweight, transformerless, single-phase inverter that allows for fast installation and easy setup. The Primo utilizes the Fonius SnapINverter™ hinge mounting system, which allows for tool-free attachment and removal of the inverter from the wall mounting plate and integrated disconnect, making it practical for one person to install. The NEMA 4X enclosure allows installation in harsh environments. Dual MPPT circuits and wide voltage windows allow for flexible design on two exposures with different module-string lengths.

Larger Primo inverters have been introduced this year, in 10.0 kW, 11.4 kW, 12.5 kW, and 15.0 kW configurations. These inverters feature four DC inputs for MPPT1 and two DC inputs for MPPT2 with integrated fuse holders, eliminating the need for third-party combiner boxes.

The built-in WiFi Fronius Datamanager 2.0 card enables Internet monitoring via the Fronius Solar.web portal on computer or smartphone. The RS485 port can also be used when a WiFi network is not available

All Primo Inverters are designed to work with the Fronius Rapid Shutdown box for NEC 2014 690.12 compliance. Rapid Shutdown is triggered whenever AC is not present, and the DC voltage and current between the array and the inverter is quickly discharged. One box is required per DC string. Fronius Primo inverters are covered by a ten-year warranty, which can be extended to 15 or 20 years.

These transformerless inverters work with an ungrounded PV array topology so the requirements of NEC 690.35 apply, including use of PV Wire for exposed array string wiring.

Features:

- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011
- Inverter sizes available from 3.8 kW to 8.2 kW
- Dual MPPT inputs
- WiFi, wired Ethernet, or Serial monitoring through preinstalled Datamanager Card
- Easy-to-mount SnapINverter concept and NEMA 4X enclosure
- Monitoring included via Fronius Solar.Web Portal
- Ten-year warranty, extendable up to 20 years
- Listed to UL 1741-2010 and UL1699B-2013 for U.S.A. and Canada

Fronius Primo Inverters								
Model	**Max AC output**	**AC voltage**	**DC array voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
Primo 3.8-1	3,800 W	240 VAC 208 VAC	80-600 VDC	200-480 VDC	95.0%	15.8 A 18.3 A	47.0 lbs	**030-08514**
Primo 5.0-1	5,000 W	240 VAC 208 VAC		240-480 VDC	95.5%	20.8 A 24.0A		**030-08515**
Primo 6.0-1	6,000 W	240 VAC 208 VAC		240-480 VDC	96.0%	25.0 A 28.8 A		**030-08516**
Primo 7.6-1	7,600 W	240 VAC 208 VAC		250-480 VDC	96.0%	31.7A 36.5 A		**030-08517**
Primo 8.2-1	8,200 W	240 VAC 208 VAC		270-480 VDC	96.5%	34.2 A 38.0 A		**030-08518**
Primo 10.0-1	10 kW	240 VAC 208 VAC	80-600 VDC	220-480 VDC	96.9%[1]	41.7 A 48.1 A	76.7 lbs	**030-08528**
Primo 11.4-1	11.4 kW	240 VAC 208 VAC		240-480 VDC	96.9% [1]	47.5 A 54.8 A		**030-08529**
Primo 12.5-1	12 kW	240 VAC 208 VAC		260-480 VDC	96.9% [1]	52.1 A 60.1 A		**030-08530**
Primo 15.0-1	13.75 kW 15 kW	240 VAC 208 VAC		320-480 VDC	96.9% [1]	62.5 A 66.1 A		**030-08531**

Fronius Symo Three-Phase Commercial Inverters

The Fronius Symo Three-Phase Commercial inverter utilizes the Fonius SnapINverter™ hinge mounting system, which enables tool-free attachment and removal of the inverter from the wall mounting plate and integrated disconnect, making it easier than ever to install large solar arrays. Power ranges from 10 kW to 24 kW. A wide MPPT voltage range, two MPPT input circuits, and the NEMA 4X enclosure provides greater flexibility in system design even in extreme environments. Each MPPT circuit has built-in fuse holders for up to three DC inputs to fuse both positive and negative wires. Fuse holders ship with slugs, so appropriate fuses must be ordered separately (See Electrical Distribution Parts).

Fronius Symo inverters can be equipped with the WiFi Fronius Datamanager 2.0 card that enables Internet monitoring via the Fronius Solar.web portal on computer or smartphone. Only one card is required for multiple Symo inverters installed in the same location. The inverters also support a Modbus interface for third-party monitoring and datalogging. The Fronius.Web monitoring portal can also utilize the free Fronius Solar.TV service, to transmit monitoring data to a public display, which includes system yield, energy production, and environmental benefits.

Fronius Symo inverters are covered by a ten-year warranty, which can be extended to 15 or 20 years.

These transformerless inverters work with an ungrounded PV array topology so the requirements of NEC 690.35 apply, including use of PV Wire for exposed array string wiring.

Features:

- Dual-MPPT DC inputs
- Internal Arc Fault Circuit Interrupter (AFCI) for added safety per NEC 2011
- Inverter sizes available from 10.0 kW to 24.0 kW
- Easy-to-mount SnapINverter concept and NEMA 4X enclosure
- WiFi, wired Ethernet, or Serial monitoring through preinstalled Datamanager Card
- Monitoring included via Fronius Solar.Web Portal
- 10-year warranty, extendable up to 20 years
- Listed to UL 1741-2010, UL 1699B Issue 2-2013 and CSA TIL M-07 Issue 1-2013 for USA and Canada
- Complies with: IEEE 1547-2003, IEEE 1547.1, ANSI/IEEE C62.41, FCC Part 15 A & B, C22.2 No. 107.1-01 (Sept 2001)

Fronius Symo Inverters								
Model	Max AC output	AC voltage	DC array voltage	MPPT range	CEC efficiency	Max AC current	Weight	Item code
SYMO 10.0-3 208/240	9,995 W	240 VAC 208 VAC	200-600 VDC	300-500 VDC	96.5% 96.5%	24.0A 27.7 A	91.9 lbs	**030-08424**
SYMO 10.0-3 480	9,995 W	480 VAC	200-1,000 VDC	300-800 VDC	96.5%	12.0 A	76.7 lbs	**030-08425**
SYMO 12.0-3 208/240	11,995 W	240 VAC 208 VAC	200-600 VDC	300-500 VDC	96.5% 96.5%	28.9 A 33.3 A	91.9 lbs	**030-08426**
SYMO 12.5-3 480	12,495 W	480 VAC	200-1,000 VDC	350-800 VDC	97.0%	15.0 A	76.7 lbs	**030-08427**
SYMO 15.0-3 480	14,995 W	480 VAC	200-1,000 VDC	350-800 VDC	97.0%	18.0 A	95.7 lbs	**030-08428**
SYMO 17.5-3 480	17,495 W	480 VAC	200-1,000 VDC	400-800 VDC	97.5%	21.0A	95.7 lbs	**030-08429**
SYMO 20.0-3 480	19,995 W	480 VAC	200-1,000 VDC	450-800 VDC	97.5%	24.0 A	95.7 lbs	**030-08430**
SYMO 22.7-3 480	22,727 W	480 VAC	200-1,000 VDC	500-800 VDC	97.5%	27.3 A	95.7 lbs	**030-08431**
SYMO 24.0-3 480	23,995 W	480 VAC	200-1,000 VDC	500-800 VDC	97.5%	28.9 A	95.7 lbs	**030-08432**

Inverter technology is complex and constantly evolving. Get the best inverter tech support in the industry – **give us a call at 800-777-6609.**

Fronius Monitoring and Accessories

Datamanager Card

The ***Fronius Datamanager 2.0 Card*** is a plug-in card that sends data directly to the free Fronius Solar.web online portal. The connection from the Datamanager card to the site router can be made with either WiFi or Ethernet cable. Open interfaces allow connection to third-party monitoring solutions. Only one Datamanager card is needed for up to 100 Fronius inverters.

Additional Fronius inverters can be connected by adding a ***Fronius Com Card***, and daisy chaining them together with Ethernet Cable to the inverter with the Datamanager Card. Alternatively, each inverter can have a Datamanager card for all wireless communications.

(***Note***: the Fronius Primo inverters have factory-installed DM 2.0 Cards, and therefore have built in WiFi and Ethernet connectivity. Symo inverters instead ship with a Com Card instead of the DM 2.0 card, as only one DM 2.0 card is required for a bank of Symo commercial inverters.)

Com Card

The ***Fronius Modbus Card*** is required for some third-party monitoring systems utilizing Modbus RTU protocol. One Modbus Card is required for each inverter to be monitored.

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

Modbus Card

Sensor Box

Irradiance Sensor

Wind Speed Sensor

Fronius Solar Web Portal

Fronius Inverter Accessories			
Model	**Mfg. #**	**Description**	**Item code**
Datamanager 2.0 Card	4,240,038,Z	Datamanager 2.0 Card for Galvo, Primo, and Symo inverters	**300-00132**
Modbus Card	4,240,021,Z	Modbus card for third-party monitoring	**300-00066**
Sensor card	4,240,004,Z	Monitoring interface with six sensor input channels-mounts in inverter	**030-03443**
Sensor box	4,240,104	Monitoring interface with six sensor input channels	**030-03442**
Sensor, wind speed	42,0411,0027	Measures wind speed, requires Sensor box	**030-03446**
Sensor, ambient temperature	43,0001,1188	Measures ambient temperature, requires Sensor box	**030-03448**
Sensor, module temperature	43,0001,1190	Adheres to back of PV module and measures temperature, requires Sensor box	**030-03449**
Sensor, irradiance	43,0001,1189	Measures solar insolation, requires Sensor box	**030-03444**
Cat 5 cable 3.3 feet	43,0004,2435	Connects inverters to each other or to Sensor Box and Datalogger Box	**030-03455**
Smart Converter USB	4,240,119	Converts the DATCOM system interface into USB interface	**030-03447**

Fronius Rapid Shutdown Box

The ***Fronius Rapid Shutdown Box*** enables compliance with NEC 2014 article 690.12 which requires a rapid shutdown function for PV systems on buildings. The box is reliable and easy to install for Fronius Galvo and Primo single-phase inverters from 1.5 kW to 15 kW.

The box is triggered whenever AC is not present, and the voltage and current within the DC wiring between the array and the inverter is quickly discharged. The box is NEMA4X rated, and can accommodate a single string with a maximum rating of 600 VDC and 20 A.

Fronius Rapid Shutdown Box for Fronius Inverters	
Description	**Item code**
Fronius Rapid Shutdown Box, one string input, one string output,12 A max, 600 VDC max (4,240,151)	**300-00137**

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Fronius

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FRONIUS PRIMO: NOW AVAILABLE FROM 3.8 - 15.0 KW

/ Experience high quality power conversion from a leader in innovation.
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/ Rapid Shutdown NEC 690.12 compliant with the Fronius Rapid Shutdown Box, a simple solution to safety.
/ New option recently debuted allows for easy revenue grade metering by being completely integrated into the inverter.
/ Conveniently installed in under 15 minutes.

SMA TL-22 Inverter

SMA Secure Power Supply

SMA

SMA Sunny Boy Grid-Tie Inverters

SMA Sunny Boy string inverters are available in sizes from 3 kW to 24 kW and can be used in a wide range of applications from small residential systems at 240 VAC to very large 480 VAC three-phase industrial installations. All SMA inverters come standard with built-in LCD digital monitors that display instantaneous power output, the current day's power production, and the total energy produced since installation. All SMA inverters presented here are listed to UL 1741, UL 1998 for the U.S.A. and Canada, and are compliant with IEEE-929, IEEE-1547, and FCC Part 15 A & B and are covered by a standard ten-year warranty, with five and ten-year extensions available.

SMA Sunny Boy 3000 to 7700 TL-22 Inverters with Secure Power Supply

The ***Sunny Boy TL-22*** transformerless inverters feature high efficiency and reduced weight along with both ground and arc fault detection per NEC 2011. A wide input voltage range of 175 VDC to 600 VDC and dual MPPT inputs dramatically increases module selection and string-sizing flexibility as well as better production when parts of the solar array are shaded. A graphic display and an integrated DC disconnect switch are included.

The unique SMA Secure Power Supply feature enables these inverters to supply up to 12 A (1,500 W) at 120 VAC to a single dedicated outlet for recharging portable devices or a small UPS directly from the PV array. Optional RS485 or Webconnect data modules enable web-based system monitoring with SMA Sunny Portal. These transformerless inverters work with an ungrounded PV array topology so the requirements of NEC 690.35 apply, including use of PV Wire for exposed array string wiring.

Features:

- CEC Rated Efficiencies of 96.5%
- Secure Power Supply (requires dedicated outlet)
- Operating temperatures of -40 °F to +140 °F
- Dual MPPT input circuits – with tracking range from 175 to 500 VDC
- Integrated AFCI for arc-fault protection
- Available in sizes from 3 kW to 7.7 kW
- Field selectable 240 VAC Single-Phase or 208 VAC Three-Phase output
- Ten-year warranty, extendable up to 20 years
- Listed to UL 1741 and UL1699B for U.S.A. and Canada
- Compliant with: IEEE 1547, IEEE 929, FCC Part 15 A& B , CSA C22.2 107.1-1

SMA Sunny Boy TL-US-22 Inverters								
Model	**Max AC output**	**AC voltage**	**DC array voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
SB3000TL-US-22	3,000 W	240 VAC 208 VAC	125-600 VDC	125-500 VDC	96.5%	15 A	61 lbs including DC disconnect	**030-03204**
SB3800TL-US-22	3,840 W	240 VAC 208 VAC			97.0% 96.5%	16 A		**030-03207**
SB4000TL-US-22	4,000 W	240 VAC 208 VAC			97.0% 96.5%	20 A		**030-03205**
SB5000TL-US-22	5,000 W 4,550 W	240 VAC 208 VAC			97.0% 96.5%	22 A		**030-03206**
SB6000TL-US-22	6,000 W 5,200 W	240 VAC 208 VAC			97.0% 96.5%	25 A		**030-03007**
SB7000TL-US-22	7,000 W 6,000 W	240 VAC 208 VAC			96.5%	29.2 A		**030-03008**
SB7700TL-US-22	7,680 W 6,650 W	240 VAC 208 VAC			96.5%	32 A		**030-03009**

SMA Tripower Three-Phase Commercial Inverter

CU1000-US-10 Combiner/ Disconnect

SMA Cluster Controller

SMA ReadyRack for Tripower Inverters

SMA Tripower Three-Phase Inverters

SMA offers five three-phase commercial inverter options, ranging from 12 kW to 30 kW. All inverters connect to 480 VAC three-phase utility service. The Detachable DC Connection Unit has fusing for both MPPT inputs, and allows for easy swap out of the inverter for servicing. Tripower inverters all feature Integrated DC AFCI.

MPPT Circuits and a wide MPPT operating voltage range, combined with a low startup voltage, allow for very high efficiencies. They can be configured for either 600 VDC or 1,000 VDC installations.

The Tripower inverters can be mounted on the roof, next to the array. This allows compliance with NEC 2014 Rapid Shutdown requirements without additional components. The optional ***SMA ReadyRack™*** allows for simplified installation of the AC Disconnect, combiners, and cabling on flat commercial rooftops.

Monitoring through the free SMA Sunny Portal can be easily configured, as these inverters come pre-installed with the SMA Speedwire Card. Up to four inverters can be daisy chained together and viewed as a plant. For larger installations, the optional ***SMA Cluster Controller*** can be added for plant-level monitoring of up to 75 SMA inverters, and communication to third-party devices through Modbus protocol. The cluster controller enables multiple inverters to be viewed and reported on at the plant level, and enables remote operation of reactive power adjustments as well as remote shutdown of the PV Plant, if required. (Alternatively, the ***SMA Webbox*** can be utilized to connect to the SMA Sunny Portal, but ***RS485 cards*** must be purchased and exchanged for the preinstalled Speedwire Cards.) *NOTE: Cluster controller requires a 24 VDC power supply, which is not included.*

Features:

- Three-phase 480 VAC output
- Five models: 12 kW, 15 kW, 20 kW, 24 kW , and 30 kW
- 600 VDC or 1,000 VDC input configuration
- Dual MPPT DC inputs
- DC reverse polarity indicator
- Internal Arc-Fault Detection (AFCI) and Ground Fault Detection (GFCI) per NEC 2011
- Integrated SMA Speedwire Card for monitoring connection with free monitoring
- Optional SMA Cluster Controller for plant-level monitoring of multiple Tripower inverters
- Operating temperatures of -13 °F to +140 °F (-25 °C to +60 °C)
- Listed to UL 1741, UL1998, UL 1699B
- Compliant with: IEEE 1547-2003, IEEE 1547.1, FCC Part 15 A&B, CAN/CSA C22. 2 No. 107.1-01

SMA Tripower Three-Phase 480V Inverters							
Model	**Max AC output**	**DC array voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
Tripower 12000TL-US	12 kW	150 to 1000 VDC	300 to 800 VDC	97.5%	14.4 A	121 lbs	**030-03055**
Tripower 15000TL-US	15 kW		300 to 800 VDC	97.5%	18.0 A		**030-03056**
Tripower 20000TL-US	20 kW		380 to 800 VDC				**030-03044**
Tripower 24000TL-US	24 kW		450 to 800 VDC	98.0%	29.0 A		**030-03047**
Tripower 30000TL-US	30 kW		500 to 800 VDC	98.5%	36.2 A		**030-03039**
SMA String Combiner w/ Disconnect (CU1000-US-10)							**030-03160**
SMA Cluster Controller (CLCON-10)							**300-00076**
SMA, Readyrack for Tripower STP12000							**014-10003**
SMA, Readyrack for Tripower STP15000							**014-10002**
SMA, Readyrack for Tripower STP20000							**014-10001**
SMA, Readyrack for Tripower STP24000							**014-10000**

SMA Sunny Boy Data Monitoring and Communications Accessories

SMA offers free monitoring for their entire line of inverter solutions through the SMA Sunny Portal

The Sunny Portal can be accessed by computer, smartphone or tablet, allowing users to access key data at any time. Users can configure the portal to analyze data in many ways. Multiple inverters at a site can be monitored and tracked, and reporting functions can provide updates via e-mail to help ensure yields. Connection to the portal via a customer-supplied Internet access point varies by the SMA inverter used.

SMA Webconnect Cards – Sunny Portal Connection

The SMA SpeedWire Webconnect card provides a connection to the free Sunny Portal (www.sunnyportal.com) through an Ethernet connection to the customer's router. The ***SWPB-US-10*** card is used to connect one US-12 or TLUS-12 inverter, while the ***SWDM-US-10*** card allows the TL-22 model inverters to be connected to monitoring. Multiple inverters with Webconnect Cards can be daisy chained together, and up to four inverters can be viewed as a single plant on the Sunny Portal.

SMA Webconnect Cards for SMA US, TL-12, TL-22 Inverters	
Description	**Item code**
SpeedWire SWDM-US-10 WebConnect card for TL-22 inverters	**300-00069**
SpeedWire SWPB-US-10 WebConnect card for US-12 or TLUS-12 inverters	**300-00094**

SMA Sunny WebBox – Sunny Portal Connection

Sunny WebBox

The ***Sunny WebBox*** provides a connection between SMA inverters and the free Sunny Portal website (www.sunnyportal.com). The Sunny WebBox stores system performance data in its internal 8 MB memory (12.5 MB with the Bluetooth version) or on a standard SD memory card and can be set to upload the data to the Sunny Portal website at user-selectable intervals. The WebBox can be connected to Sunny Boy or Sunny Island inverters, and to ***Sunny SensorBox*** devices (up to 50 units total). The Sunny WebBox reports faults immediately by e-mail or text message. Measurement data can be transmitted to the Sunny Portal via GSM modem from remote locations where no DSL or telephone connection is available. Connections to inverters or SensorBox devices are made with a four-conductor twisted-pair cable between the inverter's RS-485 output and the WebBox terminals. Each inverter requires an ***RS-485-N Communication Card***. The Sunny WebBox connects to a local area network (LAN) with an Ethernet cable or to a phone line with a modem. Both are password protected and are covered by a five-year warranty.

Sunny SensorBox

The compact ***Sunny SensorBox*** installs at the PV array to continuously monitor solar irradiation and module temperature, which can be used to calculate the expected output of the PV array for comparison to the actual power output of the inverters. This can help identify and troubleshoot reductions in energy yield. The included Power Injector feed-in unit connects to the SensorBox via the RS485 communication bus to provide power to the SensorBox and includes a plug-in power supply (120 VAC required).

Sunny SensorBox Temperature Sensor

The Sunny SensorBox sends data to the Sunny WebBox via an RS-485 data link or by wireless communication with the addition of the Bluetooth version of the Power Injector (purchased separately). From there, the data can be transferred to a PC for further processing or to the Sunny Portal for automatic performance analysis. The Sunny SensorBox can accommodate up to three additional sensors, such as ambient temperature, wind speed, and an additional irradiance sensor. The Sunny SensorBox is covered by a five-year warranty.

Sunny Anemometer

SMA Sunny Boy Data Monitoring and Communications Accessories	
Description	**Item code**
Sunny WebBox - RS-485 connection port (US-12, TL-12, TL-22 , and SI inverters)	**030-03141**
Sunny SensorBox with Irradiance Sensor - RS-485 connection port	**030-03191**
Sunny SensorBox Anemometer	**030-03193**
Sunny SensorBox Ambient Temp Sensor	**030-03195**
Sunny SensorBox Additional Module Temp Sensor	**030-03197**
RS 485 Communication Card for Sunny Boy (US-12 and TLUS-12 inverters)	**030-03123**
RS 485 Communication Card for Sunny Boy (TL-22 inverters)	**300-00068**

Solis 4kW Inverter

WiFi Datalogging Stick

Datalogging Box WiFi Internet Gateway

Ginlong

NEW! Solis Series Grid-Tie Inverters

Ginlong Solis inverters offer exceptional value with sizes up to 5 kW AC output with integrated AFCI and Ground Fault protection. All Solis inverters feature low start-up voltages, with wide MPPT operating ranges. The 1 kW, 1.5 kW, and 2 kW inverters have one MPPT channel, and can accommodate one string of modules with a 500 VDC max input limit. The 2.5 kW to 5 kW inverters have two MPPT operating channels, with a 600 VDC max input limit. These inverters can also be configured for 208VAC three-phase output.

The Solis inverters come with an integrated DC Disconnect switch, and a standard ten-year warranty. The inverters feature a RS485 output jack that can connect to an Internet router or switch to connect to the Solis monitoring portal. The optional WiFi Datalogging Stick can connect a single inverter to the monitoring portal through an existing WiFi network. Alternatively, the Data Logging Box WiFi Internet Gateway can connect up to ten daisy-chained inverters to the monitoring portal through a WiFi or wired connection to the Internet .

Features:

- Dual MPPT input circuits (2.5 kW and larger)
- CEC efficiencies on inverters range from 96.0% to 97.0%
- NEMA 4X enclosure
- Operating temperatures of -13 °F to +140°F (-25 °C to +60 °C)
- Configurable for 240 VAC single phase or 208 VAC three-phase output
- Integral Arc Fault Detection (AFCI) and Ground Fault Detection (GFCI
- Integrated Wi-Fi communications or RS485 port monitoring connection
- Listed to UL 1741-2010, UL 1998, and UL 1699B for U.S. and Canada
- Compliant with:
  - FCC Part 15 Class B
  - CAN/CSAC22.2 No. 107.1

Ginlong Solis Inverters									
Model	Nominal AC output power	Mac AC output current	DC input voltage range (startup to max)	Full power MPPT voltage range	# of MPPT inputs / # of inputs per MPPT	Max usable input current per MPPT	CEC efficiency 240 V / 208 V	Weight	Item code
Solis-2K-2G-US	2000 W	10.5 A	120 to 500 VDC	200 to 400 VDC	1 / 1	10 A	96.5% / 96.5%	21.6 lbs	**030-11002**
Solis-2.5K-2G-US	2500 W	13.3 A	120 to 600 VDC	125 to 500 VDC	2 / 1	10+10 A	96.5% / 96.5%	33.1 lbs	**030-11003**
Solis-3K-2G-US	3000 W	15.7 A	120 to 600 VDC	150 to 500 VDC	2 / 1	10+10 A	96.0% / 97.0%	33.1 lbs	**030-11004**
Solis-3.6K-2G-US	3600 W	16.0 A	120 to 600 VDC	180 to 500 VDC	2 / 1	10+10 A	96.5% / 96.5%	33.1 lbs	**030-11005**
Solis-4K-2G-US	4000 W	21.0 A	120 to 600 VDC	145 to 500 VDC	2 / 1+2	10+18 A	97.0% / 97.0%	38.6 lbs	**030-11006**
Solis-4.6K-2G-US	4600 W	23.8 A	120 to 600 VDC	165 to 500 VDC	2 / 1+2	10+18 A	97.0% / 97.0%	38.6 lbs	**030-11007**
Solis-5K-2G-US	5000 W	23.8 A	120 to 600 VDC	180 to 500 VDC	2 / 1+2	10+18 A	97.0% / 97.0%	38.6 lbs	**030-11008**

Ginlong Solis Inverter Accessories	Item code
Ginlong Solis Data Logging Box WiFi (GL-WE01)	**300-00161**
Ginlong Solis Datalogging WiFi Stick (GINLONG-DLS)	**300-00160**

HiQ Solar 8kW480V TrueString Inverter

HiQ Solar Gateway

HiQ Solar AC Splice Box

HiQ Solar

NEW! HiQ Solar 8kW 480V TrueString™ Inverter

The new HiQ Solar TrueString™ Inverter System is a small, flexible, reliable, roof-mounted, 480 VAC three-phase commercial inverter solution. The modular HiQ Solar TS-480-8K inverters have NEMA6 -rated enclosures, and can be mounted on the solar racking under the PV array. Each inverter has two MPPT inputs and can be strung at either 600 VDC or 1,000 VDC, due to the wide MPPT tracking window. Strings may be different lengths, increasing layout flexibility. Inverters are small and each unit weighs just 24 lbs.

Each inverter allows for two strings of modules on separate DC inputs for the two MPPT circuits. These inverters are ideal for new or retrofit installs, installation in desert and coastal environments, and do not require any wall space or concrete pads. They have arc-fault protection and are 690.12 (rapid shutdown) compliant when mounted under the solar array.

Installers will utilize the HiQ Solar AC Trunk Cables, offered in 5, 15, and 30-foot lengths, to connect the inverters to the HiQ Solar AC Splice Box or Subpanel. The HiQ Solar AC Splice Box enables combining up to three HiQ Solar Inverters into one common AC home run, which then terminates in a subpanel on a 40 A three-phase breaker. Multiple combiners can be used for larger solar arrays.

The HiQ Solar Gateway Device connects to a 120 or 277 VAC power source and auto-discovers any connected inverters then communicates via data over power line technology. The entire HiQ system is fast and easy to commission, and can easily track performance and detect issues on each module string.

A 5.75 kW HiQ Solar Truestring™ 208V three-phase inverter is expected in early 2016.

Features:

- Three-Phase 480 VAC output transformerless inverter with dual-MPPT DC inputs
- NEC 690.11 compliant arc-fault protection
- NEC 2014 690.12 rapid shutdown compliant
- Ten-year standard warranty, extendable to 25 years
- Monitoring Gateway over powerline communications with plant, inverter, and MPPT level visibility[a]
- High reliability with NEMA6 enclosure, and no electrolytic capacitors, operating temperature range of -40 °F to 145 °F (-40 °C to +65 °C)
- No high-voltage DC-wiring runs outside of array, and utilizes common AC branch-circuit wiring from inverters to interconnection.
- Listed to UL 1741
- Designed and manufactured in the USA

HiQ Solar TrueString 480 VAC Three-Phase Inverter and Accessories								
Model	**Description**	**Max AC output**	**DC array voltage**	**MPPT range**	**CEC efficiency**	**Max AC current**	**Weight**	**Item code**
HiQ Solar TS480-8k Truestring Inverter	Roof Mounted, 8kW, 480 VAC, isolated string inverter	8 kW	200 to 1,000 VDC	425 to 850 VDC	98.0%	9.6 A	24 lbs	**030-12000**
HiQ Solar AC Trunk Cables	CBL-480A-05, 5-foot AC Trunk Cable							**030-02011**
	CBL-480A-15, 15-foot AC Trunk Cable							**300-00164**
	CBL-480A-30, 30-foot AC Trunk Cable							**300-00165**
HiQ Solar AC Splice Box	ACSPL-40, AC Combiner Splice Box, NEMA 4X Enclosure (Used to combine up to three HiQ Solar 8 kW Inverters to common AC output)							**300-00162**
HiQ Solar Gateway Communications Device	GW-A HiQ Communications Gateway with Ethernet Cable and memory card							**300-00166**
HiQ Solar Gateway Power Supply	CBL-GW120A-6, HiQ Gateway with 120 VAC 6-foot plug							**300-00167**
	CBL-GW277A-6, HiQ Gateway with 277 VAC 6-foot plug							**300-00168**
HiQ Solar Warranty Extension	Extended warranty for HiQ Solar TrueString inverters from ten to 25 years (15-year warranty extension)							**300-00169**
HiQ Solar AC Connector Unlatching Tool	Tool for unlatching HiQ Solar AC Trunk connectors							**100-04156**

Conext CL Three-Phase Inverter

Conext Smartbox Datalogger

Schneider Electric

Schneider Conext CL Three-Phase Inverters

The Conext CL Series of commercial inverters from Schneider Electric is highly suitable for three-phase, 480 VAC installations, and is designed for high efficiency and flexibility, as well as easy installation and servicing. These inverters feature wide MPPT voltage windows on dual MPPT input circuits. The NEMA 3R enclosure enables outdoor use. Inverters may be installed at an angle from 10 to 90°allowing the inverters to be mounted on the roof next to the array if necessary to comply with NEC 690.12 Rapid Shutdown requirements. Two inverter sizes are offered; the ***CL18000NA*** has an 18-kilowatt maximum AC power output and supports 600 VDC and 1,000 VDC solar arrays, while the ***CL2500NA*** has a 25-kilowatt maximum AC power output supporting 1,000 VDC solar arrays.

Conext CL inverters include an embedded Ethernet gateway, enabling connection of up to eight inverters to the Conext Insight Portal without any additional hardware required, by directly wiring them to an Internet router. For advanced features, including real-time event logging and reactive-power control, or for monitoring more than eight inverters, the outdoor-rated ***Conext Smartbox Datalogger*** device is available in 'basic' and 'essential' configuration models. The communication interface on these inverters also supports RS485 MODBUS RTU and Ethernet MODBUS TCP connection to third-party monitoring devices and services.

The inverters offered through AEE feature arc-fault protection, touch-safe fuse holders, and included AC and DC disconnect switches. The upgraded models feature integrated DC and AC Surge Suppression Devices.

Features:

- Two models available 18 kW and 25 kW:
  - 18 kW model allows 600 VDC or 1,000 VDC input configurations
  - 25 kW model supports 1,000 VDC installation
- Three-phase 480 VAC output
- DC to AC Conversion Efficiencies up to 98%
- Dual-MPPT DC Inputs
- Internal Arc Fault Detection (AFCI) and Ground Fault Detection (GFCI) per NEC 2011
- Operating temperatures of –13 °F to +140 °F (-25 °C to +60 °C)
- Listed to UL 1741 and 1699B
- Compliant with: IEEE 1547.1, CSA C22.2 107.1-01

Schneider Electric Conext CL Series Three-Phase Inverters

Model	Description	Max AC output	DC array voltage	MPPT range	CEC efficiency	Max AC current	Weight	Item code
PVSCL18NA201	Touch Safe Fuse Holder, DC Switch, and AC Connector, AFD	18 kW	250 to 1,000 VDC	300 to 800 VDC	97.5%	25.0 A	152 lbs	**030-02010**
PVSCL18NA301	Touch Safe Fuse Holder, DC Switch, and AC Connector, AFD, preinstalled AC and DC Surge Protection Device	18 kW						**030-02011**
PVSCL25NA201	Touch Safe Fuse Holder, DC Switch, and AC Connector, AFD	25 kW	250 to 1,000 VDC	500 to 800 VDC	98.0%	33.0 A		**030-02012**
PVSCL25NA301	Touch Safe Fuse Holder, DC Switch, and AC Connector, AFD, preinstalled AC and DC Surge Protection Device	25 kW						**030-02013**

Battery-Based Inverters

A battery-based inverter converts direct current (DC) from batteries into alternating current (AC) at the appropriate voltage and frequency to operate lights, appliances or anything else that normally operates on electricity supplied by the utility grid. All battery-based inverters can be used in off-grid systems and some can also feed power back into the utility grid using net metering, similar to the more common grid-tie inverters. All of these battery-based inverters require a battery bank to function.

Grid-Interactive Inverters for Backup Power Applications

Grid-interactive inverters, also called dual-function or hybrid inverters, can export power to the utility grid, but can also supply backup power to protected loads during a grid outage. These inverters use a battery bank for energy storage, will not operate without batteries, and include an automatic transfer switch that enables them to safely operate off-grid during a blackout.

The grid-interactive inverter is connected to the battery bank (usually 24 or 48 VDC), an AC sub-panel for protected loads, and the building's utility entrance load center. The battery bank is charged by the PV array connected through a charge controller (see Charge Controllers) or through the battery inverter via AC coupling. Under normal conditions, it will export surplus power produced by the PV array. During a grid outage, the inverter will automatically disconnect from the grid and supply AC power to the protected load subpanel by drawing energy from the battery bank and solar array. When the outage is over, the inverter will automatically switch back to grid-tie operation and recharge the batteries.

It is important to note that a significant amount of energy is used to maintain the battery bank. For this reason, systems with battery backup typically provide 5 to 10% less energy (kWh) per kW of PV array than equivalent grid-tie systems that don't include batteries.

Off-Grid Inverters

Off-grid battery-based inverters convert DC electricity from a battery bank to AC. In this case, the PV array and/or wind generator is used to charge the batteries via a charge controller (see Charge Controllers for more information) and only the power demanded by the loads is inverted to AC. Because these systems do not have access to the electrical grid, it is important to properly size the inverter and battery bank (see System Design and Batteries for more information on sizing inverters and battery banks).

The nameplate capacity of an inverter is measured by its maximum continuous output in watts. The inverter capacity limits the sum of all AC loads you can operate simultaneously. Most AC appliances list their consumption on a tag located near the power cord and/or in the owner's manual. You will need to add up the consumption of all the appliances you may need to operate at once – that will represent your minimum inverter size. If your appliances include induction motors, like washers, dryers, dishwashers, furnace electronic controls, and large power tools, be sure to select an inverter with sufficient surge capability to accommodate the higher start-up loads.

Off-grid inverters will output either sine-wave or modified-sine-wave (modified-square-wave) AC waveforms. Sine-wave inverters can closely mimic utility-grid power and will run virtually any AC appliance. Modified-sine-wave inverters are an economical choice when waveform is not critical. They often have a high surge capacity for motor starting and generally retain good efficiency when partially loaded. Unfortunately, this type of inverter may damage or fail to operate some sensitive appliances, such as rechargeable tools and flashlights, laser printers, copiers, variable speed drives, and any equipment with silicon controlled rectifiers (SCRs). Some audio equipment will have a background buzz when operated with a modified-sine-wave inverter.

Output Voltage

In the past, most battery-based inverters supplied only 120 VAC 60 Hz single-phase outputs. Now, many of the more popular residential-sized inverters, like the OutBack Radian, Schneider XW, and Magnum MS-PAE inverters, deliver 120/240 VAC power from one inverter. These inverters can also be wired in parallel for greater power output. Pairs of some 120 VAC output inverters like the OutBack FX series and Sunny Island inverters can also be wired in series for 120/240 VAC split-phase, or 120/208 VAC three-phase output.

Inverters that supply 50 Hz power are also available for most product lines. Please contact us with any special requirements you may have.

Interference

Battery-based inverters may interfere with radio and television reception, causing noise on telephones or buzz in audio equipment. Interference can be minimized by using sine wave inverters and by locating the inverter as close to the batteries as practical, twisting together the cables that connect the inverter to the battery, running AC lines separate from other wiring (such as telephone wires), and locating the inverter away from appliances that are susceptible to interference. All inverters can cause interference with AM radio reception.

Wiring Considerations

Battery-based inverters require high current from a battery bank to operate large loads. A 2 kW inverter will draw nearly 200 A from a 12 VDC battery bank. Large cables and good connections are required for safe operation. Use caution when plugging a small inverter into a lighter outlet in a vehicle, as these outlets are usually not robust enough to handle high current for long periods of time. All battery-based inverters require proper fusing between the battery and the inverter.

Pre-wired power systems are available with most battery-based inverters to minimize design and wiring issues. Custom configurations are available for most OutBack FLEXware-based power systems. Please contact us for additional information.

OutBack Power

Radian Grid-Hybrid™ Inverters

OutBack Radian inverters work equally well as a grid-tie or off-grid inverter. There are two separate AC inputs, one for the bi-directional grid connection and one for a backup generator. There is a built-in 50 A transfer switch at 120/240 VAC. The output is 120/240 VAC split phase in each unit for easy tie-in to US standard wiring and grid connections. The Radian features 4 kW **(GS4048A)** or 8 kW **(GS8048A)** of continuous output power and can support large dynamic load variations and surge loads, making it well suited for demanding commercial applications as well as residential use. With two power stages (one on the GS4048A), it is able to provide high efficiency and redundancy for critical applications, and the modular design is field serviceable. The Radian can be parallel stacked with up to ten inverters for 80 kW total output. The Radian also has auxiliary controls that include a contact closure, a 12 VDC output signal, and terminals for a remote on/off switch as well as a remote temperature sensor (RTS) for the battery bank. Each GS8048A inverter requires dual 2/0 AWG battery cables (two positive and two negative) for connection to the battery bank. In fully off-grid applications, the minimum recommended battery size is 175 Ah for the GS4048A and 350 Ah for the GS8048A for each inverter installed in a power system (See Batteries).

The GS4048A and GS8048A inverters are made to work in off-grid, grid-tied, or grid-supported systems using OutBack's "GridZero" mode, optimizing solar production where net metering is not available. The "A" inverters also have an adjustable input-voltage range so they can be made to work with most lithium-ion, aqueous sodium-ion and other advanced battery technologies.

EXPORT Radian Grid-Hybrid Inverters

The **GS3548E** and **GS7048E** include a built-in 50 A transfer switch at 230 VAC. The output is 230 VAC 50 Hz (or 60 Hz) single-phase in each unit for easy tie-in to most international standard wiring and grid connections. These inverters feature 3.5 kW or 7 kW of continuous output power and can support large dynamic load variations and surge loads up to 11.5 kW. The Radian can be parallel stacked with up to ten inverters for 70 kW total output. The Radian also has auxiliary controls which include a contact closure, a 12 VDC output signal and terminals for a remote on/off switch.

Each inverter comes with a standard five-year warranty. An optional ten-year extended warranty is available where required by state incentive programs. The Radian is not rated for outdoor use. Dimensions are 28"H x 16"W x 8.7"D. Weight is 84 lbs for the GS4048A/GS3548E and 125 lbs for the GS8048/GS8048A/GS7048E. Listed to UL 1741 for U.S.A. and Canada.

A MATE3, HUB4 or HUB10, and an appropriate GSLC are needed to complete a Radian system.

OutBack Radian Inverters										
Model	**CEC rating**	**CEC grid-tie output**	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge**	**Weight**	**Item code**
GS4048A	92.5%	3,600 W	4,000 W	48 VDC	124/240 V 60 Hz	34 W	57 A	6,000 W	82 lbs	**030-04058**
GS8048A	92.5%	7,650 W	8,000 W	48 VDC	124/240 V 60 Hz	34 W	115 A	12,000 W	125 lbs	**030-04060**

EXPORT OutBack Radian Inverters								
Model	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger amps**	**AC surge output**	**Weight**	**Item code**
GS3548E	3,500 W	48 VDC	230 V/50 Hz	N/A	50 A	5,800 W	84 lbs	**030-04059**
GS7048E	7,000 W	48 VDC	230 V/50 Hz	30 W	100 A	11,500 W	125 lbs	**030-04038**

OutBack POWER™
member of The alpha Group™

DELIBERATE DESIGN

As an industry leader in full system solutions for off-grid and Grid-Hybrid renewable energy applications, **all OutBack components are deliberately designed to function together**.

Seamlessly. As a complete system.

The result?

System efficiency, simplified installation and single-source product and technical support.

Deliberate design means every OutBack product is engineered to provide best-in-class reliability, serving one of the three key functions in a complete renewable energy system:

- **Make the Power**
- **Store the Energy**
- **Manage the System**

For more information, please visit **www.outbackpower.com**

Radian GSLC Load Centers

The **GS Load Center (GSLC)** is a wiring and circuit-protection enclosure that mounts under the Radian inverter. It is available in multiple versions:

The **base GSLC** includes positive and negative main inverter busbars, a 500 A 50 mV shunt with negative terminal bar, the main DC positive breaker plate, ground and neutral terminal bars, and two PV-positive terminal bars. It can also accommodate up to 18 AC or DC panel-mount breakers (ten top, eight bottom), two main 175 A DC breakers and a FLEXnetDC, which can be purchased separately. Up to two charge controllers can mount on the right side (mounting brackets sold seperately), and either the HUB4 or HUB10 can mount on the left side.

The **GSLC175-120/240** includes the base unit plus two 175 A DC main breakers, an AC output and bypass breakers with interlock plate, AC grid and generator-input breakers (50 A two-pole), and six AC terminal bars (three black, three red). It can also accommodate ten additional panel-mount breakers, (purchased separately).

The **GSLC175-120/240** includes the base unit plus two 175 A DC main breakers, an AC output and bypass breakers with interlock plate, AC-grid and generator-input breakers (50 A two-pole), and six AC terminal bars (three black, three red). It can also accommodate ten additional panel-mount breakers, (purchased separately).

The **GSLC175-PV-120/240** works with the GS8048A inverters, or the GS4048A inverter with an extra 175 A breaker, and includes items in the 175-120/240 unit plus two 80 A PV array breakers, a two-pole GFDI 80 A breaker, three 500 A 50 mV shunts with shunt bus, and a FLEXnetDC. The GFDI acts as the breaker between the control and positive bus; there are no other breakers added for this purpose. It can also accommodate five additional panel-mount breakers, (purchased separately).

The **GSLC175-PV1-120/240** works with the GS4048A inverter and one charge control, and includes one 175 ADC main breaker plus one 80 A PV breaker, one two-pole GFDI 80 A breaker, two 500 A 50 mV shunts with shunt bus, and a FLEXnetDC.

The **AC bypass** assembly is only for use with a single Radian inverter. For multiple inverters, use the base GSLC with added DC and AC breakers as needed (no bypass) and use external transfer switches for bypass and external AC load centers for output combining and input distribution. One GSLC is required for each Radian inverter. Each 8 kW inverter requires two 175 A main DC breakers and each 4 kW inverter requires one.

Outback's **GSLC175-AC-120/240** load center simplifies installation of Radian inverters into an AC-coupled system. It has all of the connections, breakers and relays needed for adding a battery-based backup system to an existing or new grid-tie system utilizing a Radian inverter and battery bank. There are controls and relays to manage battery charging from the grid-tie system with battery-temperature compensation. A second AC input is available for a backup generator to assist in powering the loads during an extended outage if there is not enough sun or there are more loads than expected. There is an auto generator start relay with grid-tie inverter lockout when under generator power. No diversion loads or other external relays are required. There are connection points for the utility grid, the protected loads panel, the grid-tie inverter, an optional backup generator, and the battery bank. The required MATE3 now has a new AC-coupling function which should be used with this GSLC. The rating of the grid-tie inverter should not exceed 6 kW when used with a GS8048A, and not more than 3 kW when used with the GS4048A. You will also need a GS inverter, MATE3, battery bank, protected load center, and the existing GT inverter system to complete an AC-coupled Radian system.

The GSLC is not rated for outdoor use. Dimensions are 17"H x 16"W x 8.5"D. Weight is 26, 37, or 38 lbs. Listed to UL 1741 for U.S.A. and Canada. More accessories for OutBack Power can be found on the following pages.

GS Load Centers		
Model	**Description**	**Item code**
GSLC	GS Load Center with inverter bars, breaker bus, shunt, neg, ground, neutral, and PV-pos busbars	**053-02250**
GSLC175-120/240	GS Load Center with all items above plus two main 175 A breakers, AC IO/Bypass, and 6 AC busbars	**053-02251**
GSLC175-PV-120/240	GS Load Center with all items above with three shunts, FNDC, two-pole GFDI, and dual PV-input breakers	**053-02252**
GSLC175-PV1-120/240	GS Load Center with one 175A main breaker with two shunts, FNDC, single-pole GFDI, and single PV-input breakers	**053-02256**
GSLC175-AC-120/240	GS Load Center for AC Coupling, with generator & GT inverter inputs & lockouts	**053-02255**
GS Load Center Accessories		
GS-IOB-120/240 VAC	GS AC input/output/bypass kit split phase 120/240VAC for single inverter only	**053-07818**
GS-IOB-AC-120/240	GS AC-coupling parts kit , one ROCB, one 12VDC relay, one 48 VDC relay	**053-07816**
GS-SBUS	DC shunt bus for GS Load Center	**053-00130**
STBB-BLACK	Short busbar kit with black insulators for GS Load Center	**053-00132**
STBB-RED	Short busbar kit with red insulators for GS Load Center	**053-00133**
STBB-WHITE	Short busbar kit with white insulators for GS Load Center	**053-00134**
PNL-50D-AC-120/240	Circuit breaker, 50 A, 120/240 VAC, two-pole, panel mount for GSLC (takes two ¾" spaces)	**053-17004**
PNL-175-DC	Circuit breaker, 175 A, 125 VDC, single-pole, main DC breaker for GS inverter (two required per inverter)	**053-01053**
EXPORT GS Load Centers		
GSLC	GS Load Center with inverter bars, breaker bus, shunt, neg, ground, neutral, and PV pos busbars	**053-02250**
GSLC175-230	GS Load Center with all base items plus two main 175 A breakers, single-leg 230 VAC IO/Bypass, and three AC busbars	**053-02253**
GSLC175-PV-230	GS Load Center with all items above plus three shunts, FNDC, two-pole GFDI, and dual PV-input breakers	**053-02254**
GSLC175-PV1-230	GS Load Center with one 175A main breaker plus two shunts, FNDC, single-pole GFDI, and single PV-input breakers	**053-02257**
EXPORT GS Load Center Accessories		
GS-IOB-230VAC	GS AC input/output/bypass kit, one-leg 230 VAC for single inverter only	**053-07817**
GS-SBUS	DC-shunt bus for GS Load Center	**053-00130**
STBB-BLUE	Short busbar kit with blue Insulators for GS Load Center for EXPORT GSLC	**053-00135**
STBB-BROWN	Short busbar kit with brown Insulators for GS Load Center for EXPORT GSLC	**053-00136**
PNL-30-AC	Circuit breaker, 30 A, 250 VAC, single-pole, panel mount for 230 VAC GSLC (takes one ¾" space)	**053-16998**
PNL-50-AC-240	Circuit breaker, 50 A, 250 VAC, single-pole, panel mount for 230 VAC GSLC (takes one ¾" space)	**053-16999**
PNL-175-DC	Circuit breaker, 175 A, 125 VDC, single-pole, main DC breaker for GS inverter (two required per inverter)	**053-01053**

NEW! OutBack VFXR and FXR Hybrid Inverters

The OutBack FXR series inverters are a more advanced version of the venerable FX series. These new inverters are a good choice for off-grid or, with the 24 VDC and 48 VDC inverters, can be used in a grid-tied system. They have expanded voltage ranges for use with advanced-technology batteries, and have the advanced OutBack features including Grid Zero and Offset modes.

The ventilated OutBack VFXR inverters offer more power in high ambient-temperature applications, and more throughput for generator-powered battery charging. The sealed, externally fan-cooled FXR is designed to be used in coastal or dusty environments.

Each inverter/charger is a multi-mode power conversion unit that includes an inverter, battery charger, and an AC transfer switch. Up to ten inverters can be stacked in parallel (120 VAC), up to eight inverters can be stacked in a series configuration (120/240 VAC), and up to nine inverters can be stacked for three-phase (120Y208 VAC) configurations. The 50 Hz export inverters can be stacked up to ten in parallel (230 VAC), and up to nine inverters in a three-phase configuration (230Y400 VAC). When stacking, all of the inverters must be the same model. The X-240 and similar transformers are not used with the FXR inverters. Due to the added control features, FXR series inverters should be deployed with the MATE3 controller (or AXS Port) and the Hub10.3; older models may not function properly. These inverters, with the MATE3 or AXS port, are compatible with OutBack OpticsRE.

VFXR inverters have a programmable, auxiliary relay output connection (AUX) that provides 12 VDC output to run cooling or ventilation fans or to operate an external relay for other functions, such as remote generator starting (two-wire). Sealed FXR inverters use this relay to power the external cooling fan, so it is not available for other uses.

The internal transfer switch is rated for 60 A. When an external source of AC power (either a generator or the utility grid) is detected at the “AC in” terminal on the inverter, the switch operates to transfer the loads to the external power source, and then activates the battery charger to recharge the battery bank depending on what mode is programmed. Use the FlexWare 250, 500, or 1000 components with these inverters or refer to the pre-wired FLEXpower systems featuring FXR series inverters.

Dimensions: 16.25"L x 8.25"W x 11.5"H. Listed to UL 1741 (2nd edition) and CSA 22.2 by ETL for the U.S.A. and Canada and covered by a five-year warranty.

OutBack VFXR and FXR Inverters								
Model	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge output**	**Weight**	**Item code**
US Models - can be connected in series 120/240, parallel or three-phase Y 120/208 VAC								
Ventilated Cooled Inverters								
VFXR2812A	2,800 W	12 VDC	120 V/60 HZ	34 W	125 A	4,800 W	61 lbs	**030-04064**
VFXR3524A	3,500 W	24 VDC		34 W	82 A	6,000 W	61 lbs	**030-04065**
VFXR3648A	3,600 W	48 VDC		34 W	45 A	6,000 W	61 lbs	**030-04066**
Sealed/Turbo-Cooled Inverters								
FXR2012A	2,000 W	12 VDC	120 V/60 HZ	34 W	100 A	4,800 W	62 lbs	**030-04061**
FXR2524A	2,500 W	24 VDC		34 W	55 A	6,000 W	62 lbs	**030-04062**
FXR3048A	3,000 W	48 VDC		34 W	35 A	6,000 W	62 lbs	**030-04063**
EXPORT Models - can be connected in parallel or 3-phase Y 230/400 VAC								
Ventilated Inverters								
VFXR2612E	2,600 W	12 VDC	230 V/50 HZ	34 W	120 A	4,600 W	61 lbs	**030-04070**
VFXR3024E	3,000 W	24 VDC		34 W	80 A	5,750 W	61 lbs	**030-04071**
VFXR3048E	3,000 W	48 VDC		34 W	40 A	5,750 W	61 lbs	**030-04072**
Sealed/Turbo-Cooled Inverters								
FXR2012E	2,000 W	12 VDC	230 V/50 HZ	34 W	100 A	4,600 W	62 lbs	**030-04067**
FXR2024E	2,000 W	24 VDC		34 W	55 A	5,750 W	62 lbs	**030-04068**
FXR2348E	2,300 W	48 VDC		34 W	35 A	5,750 W	62 lbs	**030-04069**

OutBack Inverter Accessories

Use the **FX-DCA** to connect 2" conduit to the DC side of the inverter or to connect inverters to the FW- 500DC or FW-1000DC. Use the **FX-ACA** or **SP-ACA** to connect to the AC side of the inverter.

The **FW-SP-ACA** can be used in place of the **FXACA** and offers surge protection. Use either one to connect inverters to the **FW-500DC** or **FW-1000DC**. Use the **FW-SP-250** to replace the lid on the **FW250**. These surge protectors offer protection on both input and output AC and inverter DC surge protection. A separate SP should be used with each inverter.

OutBack Inverter Accessories		
Model	**Description**	**Item code**
DCA	2" conduit adapter – required to mount inverter to FLEXware 500 or 1000	**030-04163**
FW-ACA	AC wiring compartment extension – required to mount FX or VFX to FLEXware 500 or 1000	**030-04169**
FW-SP-ACA	AC wiring compartment extension with AC and DC surge arrestor	**030-04290**
FW-SP-250	Surge arrestor for FW250 - replaces the lid of the FW250	**030-04292**
FW-SP-R	Replacement surge protector board for FW-SP-ACA and FW250	**030-04294**

OutBack MATE Remote Monitors

The OutBack **MATE** is able to connect multiple inverter/chargers to OutBack FM charge controllers and to other OutBack power conversion and control products. Up to ten OutBack products can be connected to a single MATE via Cat 5 cabling with eight-wire RJ45 modular connectors and the OutBack HUB-10 communication manager. The OutBack MATE also includes an opto-isolated RS-232 port with a DB9 jack for connection to the serial port of a PC or laptop. The **MATE2** has a flush-mount black face for panel or in-wall mounting, but offers the same functionality as the MATE.

The **MATE3** system display and controller is the latest generation communication interface – providing control of every aspect of an OutBack Power System. Program and monitor your power system with an intuitive user interface and integrated configuration wizard. An easy-to-read backlit graphical LCD display, a user-set favorite key, and scroll-wheel operation allow easy adjustment of system set points. Expandable SD card memory allows you to increase data-logging capacity as well as upgrade units in the field. Built-in clock and calendar enable timer-based programming, permitting the user to set the system up to work with time-of-use utility rates, or set up a generator to only run at certain times of the day or week. The MATE3 has permanent memory and includes OutBack's best-in-class OPTICS Internet monitoring platform.

OPTICS RE is a user-friendly online monitoring and control system that displays instantaneous and historical system performance via the Internet as well as provides remote troubleshooting and control functionality. Automated e-mail alerts can be set up to notify when faults or other events occur, enabling proactive maintenance. Most MATE3 system settings can be viewed and adjusted remotely via OPTICS RE – minimizing the need for on-site troubleshooting.

The **MATE3-USB** card can be installed in the MATE3 so it can be connected to a local PC via a USB port. This enables PC command and control of the MATE3 system. The USB cable is included. The USB driver and manual are available for download at www.outbackpower.com.

The SunSpec-compliant **AXS Port** Modbus/TCP Interface provides similar functionality to the MATE3, including access to OutBack's OPTICS RE platform, but must be accessed via Ethernet. Custom user interfaces can be developed if an independent monitoring system is used. System data logs can be downloaded using Modbus-read or FTP transfer.

MATE Remote Monitors		
Model	**Description**	**Item code**
MATE	Original MATE, grey oval housing with a Cat 5 cable	**030-04180**
MATE-B	Black version of original MATE, oval black housing with cable	**030-04180-B**
MATE2	Flush-mount version of original MATE, black square housing with cable	**030-04181**
MATE3	System Control with full graphical display and CAT 5 cable	**030-04178**
MATE3-USB	MATE3 USB card for PC connection to a MATE3	**300-00065**
AXS Port	AXS MODBUS interface for Internet control of selected OutBack devices	**029-06500**

OutBack FLEXnet DC System Monitor

The **FLEXnet DC** System Monitor integrates with an OutBack MATE communications device, providing data concerning system health, performance and efficiency. Easily see your system's current condition with this at-a-glance display. The FLEXnet DC shows battery state-of-charge and monitors the amount of power your system is currently producing and consuming as well as the amount of power going IN or OUT of your battery bank. It allows the MATE3 to display real-time production monitoring of DC sources, such as a solar array or small wind turbine, as well as consumption by loads. It also displays the cumulative energy your system has produced and consumed as well as the total amount of energy that has gone to charging your batteries each day. You can also view each day's lowest state-of-charge, see how your overall system production compares to system consumption, review historical energy production and consumption data for the most recent 128 days, including the minimum battery state-of-charge reached for each day, and watch power system production and consumption trends. A HUB is required to use the FLEXnet DC.

A **HUB** is required to connect inverters, MATEs, FLEXnet DCs and FLEXmax charge controllers to allow programming and monitoring of the entire system by the MATE3 as well as deploying multiple inverters in the same system.

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

HUBs and The FLEXnet DC System Monitor		
Model	**Description**	**Item code**
FLEXnet DC	Advanced DC System Monitor, uses one DC breaker space, requires a MATE	**030-04187**
HUB10.3	Communications HUB for up to ten devices (inverters, charge controllers, FNDC) in addition to a MATE	**030-04188**
RTS	Remote temperature sensor for inverter or charge control with 20' cable	**030-04190**

OutBack FLEXware

FLEXware 250

The **FW250** offers a low-cost solution for single-inverter installations where space and budget are of primary concern. Use one FLEXware250 on each end of the inverter, one for DC and one for AC. There is space for an array breaker and single-pole GFDI for one charge controller. Use panel-mount breakers (see Electrical Distribution) for both DC and AC circuits, and one 175 A or 250 A breaker for the main inverter breaker.

FLEXware 500 and 1000

The **FW500** supports up to two inverter/chargers and two charge controllers in an attractive, versatile, and code-compliant package for installations where more power is needed. The **FW1000** accommodates up to four inverter/chargers and four charge controllers. Multiple power panels can be used for systems up to 36 kW. Both the FLEXware 500 and 1000 systems provide ample locations for AC and DC breakers, DC current shunts, an autotransformer, and other items required in higher kW systems. The **FW-MP** mounting plate is used with both FW500 and FW1000 enclosures. Use two mounting plates for the FW 1000. Use ¾" panel-mount breakers for DC circuits up to 100 A and 1" or 1 ½" panel-mount breakers (see Electrical Distribution Parts) for 125, 175, or 250 A inverter breakers. For AC, use DIN mount breakers.

FLEXware Integration Hardware FW250, FW500, and FW1000			
Model	**FLEXware 250 Power System Box and IOB Kits**	**Inverters**	**Item code**
FW250	FLEXware 250 enclosure with TBB-ground, for one inverter (one for DC and one for AC) and one charge control	one	**030-04205**
FW-IOBS-120VAC	IOB kit includes three 60 A 120 VAC breakers and AC breaker bypass slide plate		**030-04230**
FW-IOBS-230VAC	IOB kit includes three 30 A 230 VAC breakers and breaker bypass slide plate - EXPORT		**030-04233**
FLEXware Mounting Plate			
FW-MP	FLEXware Mounting plate for FLEXware 500 and 1000 enclosures (two required for FW1000 systems)	two	**030-04260**
FLEXware 500 Power System Boxes and IOB Kits			
FW500-AC	FLEXware 500 enclosure with TBB-ground, DIN rail for AC breakers	one or two	**030-04215**
FW500-DC	FLEXware 500 enclosure with DC breaker bracket, TBB, BBUS, 500 A shunt		**030-04212**
FW-IOBD-120/240VAC	IOB kit includes six 60 A 120 VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04237**
FW-IOBD-120VAC	IOB kit includes six 60 A 120 VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04240**
FW-IOBD-230VAC	IOB kit includes six 30 A 230 VAC breakers and breaker bypass slide plate, TBB, wire - EXPORT		**030-04243**
FLEXware 1000 Power System Boxes and IOB Kits			
FW1000-AC	FLEXware 1000 enclosure with TBB-ground, DIN Rail for AC breakers	up to four	**030-04223**
FW1000-DC	FLEXware 1000 enclosure with DC Breaker bracket, TBB, two SBUS, BBUS, 500 A Shunt	up to four	**030-04221**
FW-IOBQ-120/240VAC	IOB kit includes twelve 60 A 120 VAC breakers and AC breaker bypass slide plate, busbars, wire	four	**030-04247**
FW-IOBQ-230/AC	IOB kit includes twelve 30 A 230 VAC breakers and bypass slide plate, TBB, wire EXPORT		**030-04251**
FW-IOBT-120/208VAC	IOB kit includes nine 60 A 120 VAC breakers and AC breaker bypass slide plate, busbars, wire	three	**030-04253**
FW-IOBT-230/400VAC	IOB kit includes nine 30 A 230 VAC breakers and bypass slide plate, TBB, wire - EXPORT ONLY		**030-04255**

FLEXware Options

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

FLEXware Options		
Model	**Description**	**Item code**
FW-X2401	4 kVA 120/240 VAC autotransformer with 20 A two-pole breaker for mounting inside FLEXware 500 and 1000 AC enclosures	**030-04270**
OBR-16-30 VDC250 VAC-DIN	Relay 16 A maximum 30 VDC/250 VAC rated DIN-rail mount	**030-04193**
PNL-GFDI-80	PV ground-fault detector interrupter, 150 VDC, 80 A, one-pole, panel mount	**053-03144**
PNL-GFDI-80D	PV ground-fault detector interrupter, 150 VDC, 80 A, two-pole, panel mount	**053-03145**
PNL-GFDI-80Q	PV ground-fault detector interrupter, 150 VDC, 80 A, four-pole, panel mount	**053-03146**
FW-SHUNT250	500 A 50 mv current shunt for top of vented inverter under top cover, with busbar to connect to negative post	**030-04275**
FW-SHUNT500	500 A 50 mv current shunt for FW500 and FW1000 includes terminal busbar with white insulator	**030-04277**
TBB-GROUND	Ground/neutral terminal busbar with mounting screws (no insulators)	**030-04356**
TBB-WHITE	Busbar with white insulators for grounded conductors (usually negative or neutral)	**030-04354**
TBB-BLACK	Busbar with black insulators	**030-04353**
TBB-RED	Busbar with red insulators	**030-04355**
TBB-BLUE	Busbar with blue insulators (for three-phase and EXPORT versions)	**030-04359**
TBB-BROWN	Busbar with brown insulators (for EXPORT versions)	**030-04352**
FW-BBUS	FLEXware Breaker Bus connector two 175-250 A, three 100-125 A, four 1-80 A DC breakers or three 500 A DC shunts	**030-04280**
FW-SBUS	FLEXware shunt bus connector allows up to four high-current cable connections on same side of DC shunt	**030-04284**
FW-CCB	FLEXmax charge-controller mounting bracket for one side-mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04263**
FW-CCB2	FLEXmax charge-controller mounting bracket for two side-mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04265**
FW-CCB2-T	FLEXmax charge controller mounting bracket for two top-mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04267**
FW-MB1	MATE mounting bracket for the side of a FLEXware enclosure	**030-04182**
FW-MB2	MATE2 mounting bracket for the side of a FLEXware enclosure	**030-04183**
FW-MB3	MATE3 mounting bracket for the side of a FLEXware enclosure	**030-04175**
FW-MB3-F	MATE3 flat mounting plate for flush mounting	**030-04176**
FW-MB3-S	MATE3 surface-mounting bracket	**030-04177**

[1]The FW-X240 Autotransformer cannot be used for stacking with a grid-interactive FX system. However, the FW-X240 can be used to step up the AC output of a single grid-interactive FX system from 120 VAC to 240 VAC.

FLEXpower ONE Pre-Wired Power System

The FLEXpower One (**FP1**) pre-wired power panel integrates one inverter/charger, one charge control, and all the essential protective devices in a small space at a low installed cost. They are ideal for applications with modest power requirements, such as cabins, chalets, homes, remote communication sites, and backup-power systems. Utilizing a compact design all on one back panel, they are fully pre-wired and factory tested as well as NRTL marked for streamlined inspections.

The FP1 with VFXR and FXR inverters can be used for either grid-tied or off-grid systems and have the capacity to use and charge a variety of battery types, and have the advanced OutBack features including Grid Zero™ and Offset modes.

Each FP1 power panel includes a single inverter/charger, AC and DC wiring boxes, and a single FM 80 charge controller, MATE3, HUB, FLEXnet DC, and AC-DC surge protector. The system is also equipped with an inverter breaker, PV array breaker, PV GFDI breaker, and AC input-output-bypass assembly. There are mounting locations for both AC GFCI Type B and EU Type F style outlets and additional AC breakers. FP1 components are listed to applicable UL standards for a code-compliant installation. Dimensions are 33.44"H x 19.69"W x 12.88"D. Weight is 98 lbs.

FXR FLEXpower ONE Pre-Wired			
Model	**Description**	**Inverter**	**Item code**
FLEXpower ONE Pre-Wired			
FP1 VFXR3524A	Pre-wired inverter system, 3.5 kW 120 VAC, 24 VDC, 80 A PV control	VFXR3524	**033-04090**
FP1 VFXR3648A	Pre-wired inverter system, 3.6 kW 120 VAC, 48 VDC, 80 A PV control	VFXR3648A	**033-04091**
FP1 FXR2524A	Pre-wired inverter system, 2.5 kW 120 VAC, 24 VDC, 80 A PV control	FXR2524A	**033-04088**
FP1 FXR3048A	Pre-wired inverter system, 3.0 kW 120 VAC, 48 VDC, 80 A PV control	FXR3048A	**033-04089**
EXPORT FLEXpower ONE Pre-Wired			
FP1 VFXR3024E	Pre-wired inverter system, 3.0 kW 230 VAC 50 Hz, 24 VDC, 80 A PV control	VFXR3024E	**033-04082**
FP1 VFXR3048E	Pre-wired inverter system, 3.0 kW 230 VAC 50 Hz, 48 VDC, 80 A PV control	VFXR3048E	**033-04083**

FLEXpower Multi-inverter Pre-Wired Power Systems

The OutBack FLEXpower pre-wired power panels integrate inverter/chargers, FM80 charge controls, and all of the essential protective devices in an easy-to-install, fully pre-wired and factory-tested system. The FLEXpower is applicable for either grid-tied or off-grid applications with modest power requirements, such as homes, light commercial or larger backup-power systems. Utilizing a compact all-on-one mounting plate design, they are fully pre-wired and factory tested. A FLEXpower can be mounted in either a horizontal or vertical orientation to allow installation in space-limited locations. There are also mounting locations for an AC GFCI Type B outlet and additional DC and AC breakers.

FP systems with VFXR or FXR inverters can be used for either grid-tied or off-grid applications and have the capacity to work with a variety of batteries, as well as advanced OutBack features including Grid Zero and Offset modes.

Each **FP2** is designed for 120/240 VAC single-phase output. Each power panel includes two inverter/chargers, two FM80 charge controllers, FlexNetDC, AC and DC wiring boxes, a MATE3, HUB10, and an AC/DC Surge Protector, X-240 transformer (not on FXR systems), inverter and controller breakers with GFDI, and an AC Input-Output-Bypass Assembly. Dimensions are 59"W x 21"H x 13"D. Weight is 260 lbs.

Each **FP3** is designed for 120/208 VAC three-phase output. Each power panel includes three inverter/chargers, three FM80 charge controllers, FlexNetDC, AC and DC wiring boxes, a MATE3, HUB10, and an AC/DC Surge Protector, inverter and controller breakers with GFDI, and an AC Input-Output-Bypass Assembly. Dimensions are 59"W x 46"H x 13"D. Weight is 430 lbs.

Each **FP4** is designed for 120/240 VAC single-phase output. Each power panel includes four inverter/chargers, four FM80 charge controllers, FlexNetDC, AC and DC wiring boxes, a MATE3, HUB10, and an AC/DC Surge Protector, X-240 transformer (not on FXR systems), inverter and controller breakers with GFDI, and an AC Input-Output-Bypass Assembly. Dimensions are 59"W x 46"H x 13"D. Weight is 520 lbs.

FLEXpower components are listed to applicable UL standards for code-compliant installation.

FXR FLEXpower Pre-Wired			
Model	**Description**	**Inverter**	**Item code**
FLEXpower TWO Pre-Wired			
FP2 VFXR3524A	Pre-wired dual-inverter system, 7.0 kW 120/240 VAC, 24 VDC	VFXR3524A	**033-04094**
FP2 VFXR3648A	Pre-wired dual-inverter system, 7.2 kW 120/240 VAC, 48 VDC	VFXR3648A	**033-04095**
FP2 FXR2524A	Pre-wired dual-inverter system, 5.0 kW 120/240 VAC, 24 VDC	FXR2524A	**033-04092**
FP2 FXR3048A	Pre-wired dual-inverter system, 6.0 kW 120/240 VAC, 48 VDC	FXR3048A	**033-04093**
EXPORT FLEXpower TWO - System Description			
FP2 VFXR3024E	EXPORT pre-wired dual-inverter system, 6 kW 230 VAC 50 Hz, 24 VDC	VFXR3024E	**033-04284**
FP2 VFXR3048E	EXPORT pre-wired dual-inverter system, 6 kW 230 VAC 50 Hz, 48 VDC	VFXR3048E	**033-04285**
FLEXpower THREE - System Description			
FP3 VFXR3648A	Pre-wired triple-inverter system, 10.8 kW 120/208 3Ø VAC, 48 VDC	VFXR3648A	**033-04097**
FP3 FXR3048A	Pre-wired triple-inverter system, 9.0 kW 120/208 3Ø VAC, 48 VDC	FXR3048A	**033-04096**
FLEXpower FOUR - System Description			
FP4 VFXR3648A	Pre-wired quad-inverter system, 14.4 kW 120/240 VAC, 48 VDC	VFXR3648A	**033-04099**
FP4 FXR3048A	Pre-wired quad-inverter system, 12.0 kW 120/240 VAC, 48 VDC	FXR3048A	**033-04098**

NEW! OutBack FLEXpower Radian Pre-Wired Power Systems

The OutBack FLEXpower **FPR** pre-wired power panels integrate Radian inverter/chargers, FM80 charge controls, and all of the essential protective devices in an easy-to-install, fully pre-wired and factory-tested system. FLEXpower FPR systems are available with either 4.0 kW or 8.0 kW inverter sizes. The Radian inverters can be used for either grid-tied or off-grid systems and have the capacity to use and charge any technology batteries, as well as advanced OutBack features including Grid Zero and Offset modes. Dual AC inputs allow connection to both the utility and a backup generator set. Compatible with system monitoring and control via OpticsRE. Utilizing a compact all-on-one mounting plate design, they are fully pre-wired and factory-tested.

Each **FPR** is designed for 120/240 VAC single-phase output. Each power panel includes one inverter/chargers, one or two FM80 charge controllers, FlexNetDC, AC and DC wiring box, a MATE3, HUB10, inverter and controller breakers with GFDI, and an AC Input-Output-Bypass Assembly. FLEXpower components are listed to applicable UL standards and the assemblies are marked for streamlined inspections. Dimensions are 47"H x 33.5"W x 9.84"D. Weight is 195 lbs for the FPR-4048A and 250 lbs for the FPR-8048A

FLEXpower Radian Pre-Wired			
Model	**Description**	**Inverter**	**Item code**
FPR-4048A	Pre-wired inverter system, 4.0 kW 120/240 VAC, 48 VDC, single FM80	GS-4048A	**033-04080**
FPR-8048A	Pre-wired inverter system, 8.0 kW 120/240 VAC, 48 VDC, dual FM80	GS-8048A	**033-04081**

SMA

Sunny Island Battery-Based Inverter

The **Sunny Island** inverters are bi-directional battery-based inverter/chargers that can be used completely off-grid, or for battery backup in grid-tie systems either with charge controllers or with Sunny Boy grid-tie inverters. The Sunny Island includes sine-wave output power and low idle losses as well as a 100 A battery charger, and offers an integrated data monitoring system with battery disconnect.

Grid-Tie System Backup with AC Coupling

The Sunny Island can provide backup power for protected loads during utility grid blackouts. Combined with a Sunny Boy grid-tie inverter system and a bank of batteries, the Sunny Island will enable the PV array to power loads and charge the batteries. As an "AC-Coupled" system, the AC output of a Sunny Boy grid-tie inverter is connected to a protected-loads subpanel rather than the main panel. The subpanel is also connected to the AC output of one or more Sunny Island inverters. Under normal conditions, the power from the PV array and the Sunny Boy inverters passes through the subpanel and the Sunny Island's built-in transfer switch on its way to the grid, without loss of efficiency. Likewise, grid power can pass the other direction when needed. During a power outage, the Sunny Island isolates itself from the grid and provides AC power to the protected-loads subpanel, drawing energy from the battery bank. The grid-tie Sunny Boy inverter will shut down during a blackout but will turn back on (after a five-minute period) when AC power from the Sunny Island is present. The Sunny Boy inverter(s) will supply AC power to the backup load panel and, if enough power is available, will be used by the Sunny Island to charge the batteries. If the batteries are full, and the PV system is producing more power than the loads require, the Sunny Island will communicate with the Sunny Boy inverter to curtail its power output. If there are no loads and the batteries are full, the Sunny Boy inverter will automatically shut off to prevent battery over-charging. The battery bank is recommended to have 100 Ahr of capacity per kilowatt of PV array for best performance.

Off-Grid Power

In off-grid systems, the Sunny Island works with Sunny Boy inverters exactly as it does with grid-tie systems during a grid outage. A generator can be connected to the Sunny Island's AC input to provide backup and battery charging. The battery bank can also be charged using a PV array with a standard PWM or MPPT charge controller, or by other power sources like micro-hydro and wind turbines.

Data Monitoring

The Sunny Island utilizes removable SD cards to store performance data from the integrated data logger and to perform firmware upgrades. State-of-charge metering helps with battery management to ensure maximum battery life. The Sunny Island works with the SMA Sunny WebBox and SensorBox monitoring accessories, but not Bluetooth. One RS485 card is needed for communications. Only one card is needed for the master inverter in a multiple Sunny Island system. For an AC-coupled system an RS485 card **(SI-485PB-NR)** is needed in each Sunny Boy inverter.

The Sunny Island inverters are 24"H x 18"W x 9"D, listed to UL 1741 for the U.S.A. and Canada and carry a five-year warranty.

SMA Sunny Island										
Model	**CEC rating**	**CEC grid-tie output**	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge output**	**Weight**	**Item code**
SI4548-US	94.5%	4,000 W	4,500 W	48 VDC	120 VAC/60 Hz	25 W	100 A	11,000 W	139 lbs	**030-03068**
SI6048-US	94.0%	5,000 W	5,750 W	48 VDC	120 VAC/60 Hz	25 W	100 A	11,000 W	139 lbs	**030-03069**
SI-485PB-NR	RS 485 card, terminator, and RJ45 cable for Sunny Island									**310-00113**

SMA SI-TD-BOX-10 Smartformer for the Sunny Island

The **SI-TD-BOX-10** Smartformer for the Sunny Island makes an easily-installed solution to AC couple a single Sunny Island inverter with a single Sunny Boy inverter for either an off-grid system or a grid-tied battery-backup system. The Smartformer provides the transformer needed to couple the 120 VAC Sunny Island to the 240 VAC Sunny Boy inverters, and provide 120/240 VAC power to the protected-load panel. The grid-tie feed is 120 VAC only. The Smartformer also provides a pre-wired bypass function and load-shedding contactor and disconnects for all of the AC wiring.

The Smartformer has a NEMA 1 enclosure that measures 24"H x 24"W x 9.25"D, weighs 124 lbs, is listed to UL 1741 for the U.S.A. and Canada and is covered by a five-year warranty.

SMA Multicluster Box for the Sunny Island

The **Multicluster Box MC-12U** for Sunny Island inverters enables easy installation of three-phase hybrid systems. Connect up to four parallel three-phase clusters, each consisting of three Sunny Island battery inverters, for up to 72 kW of inverter capacity. The Multicluster Box is pre-wired with 300 A main disconnect breakers for the grid or generator connections, loads, Sunny Boy inverters, plus 70 A AC input breakers for up to 12 Sunny Island battery inverters. The Multicluster Box also includes a load -hedding contactor and communication cables. Each Multicluster Box requires a Piggyback card and each Sunny Boy and Sunny Island inverter requires an RS485 card.

NEMA 12 enclosure standard: NEMA 4 or 4X available. Either enclosure measures 65"H x 48"W x 14"D and weighs 485 lbs. Multicluster boxes are listed to UL 508A and covered by a five-year warranty.

SMA Sunny Island		
Model	**Description**	**Item code**
SI-TD-BOX-10	SMA Smartformer	**300-00060**
MC-12U	SMA Multicluster Box, three-phase only, up to 72 kW	**030-03152**
MC-PB	SMA Multicluster Piggyback Board, one per cluster	**030-03153**
DM-485CB-US-10	SMA RS-485 card, one per SB TL-22 inverter	**300-00068**
SI-485PB-NR	RS 485 card, terminator, and RJ45 cable for Sunny Island	**310-00113**

See Electrical Distribution Parts section for additional Sunny Island integration equipment.

Schneider Electric

Conext XW+ Grid-Tie or Off-Grid Inverters and Systems

The **Conext XW+ Series** hybrid inverter/charger has an innovative, integrated design that minimizes external balance-of-system components allowing for quick and easy installation as either a grid-tie battery backup system or a fully off-grid power system. The XW+ offers split-phase 120/240 VAC output from a single inverter. Up to four inverters can be paralleled for up to 27 kW of total output in a 120/240 VAC split-phase system. The XW+ inverters can be converted to 120 VAC only and three inverters can be configured into a 120/208 VAC three-phase system. Charge controllers, such as the Schneider Electric XW-MPPT60-150 or the XW-MPPT80-600, are required for use with any PV array (see Charge Controllers).

Dual AC inputs enable AC generator input as well as grid interaction. An optional automatic generator start (**AGS**) unit is also available. A configurable auxiliary relay with an output of 250 mA at 12 VDC is included in each inverter. A battery-temperature sensor is included with each inverter, but only one is needed per system. The inverter is field-serviceable on the wall.

The **XW+ Mini Power Distribution Panel** mounts under an XW+ inverter and has all AC/DC disconnects and AC bypass with wiring to support a single inverter. This distribution panel has enough space to install two DC breakers for charge controllers.

The **XW+ Power Distribution Panel** includes a conduit box and all AC/DC disconnects with wiring to support a single inverter. The distribution panel has enough space and knockouts to add up to three inverters and/or four charge controllers. A field-reversible door with a magnetic catch simplifies access to wiring. Each charge controller requires the input breaker, or DC disconnect, and output breaker listed in the table below.

The **XW+ Connection Kit** and **XW+ split phase 120/240 VAC breaker kit** contain everything needed to add a second inverter. For a third inverter, use one more Connection Kit and one of the AC breaker kits depending on split or three-phase configuration, plus a pair of 5-ft 4/0 AWG inverter cables (see Wire and Cable). An external transfer switch will be required to enable the inverter bypass function. For four inverters, use two Power Distribution Panels and two Connection Kits. Use the XW+ conduit box to retrofit XW+ inverters into existing systems that already have AC/DC disconnects .

The XW+ comes with a five-year warranty and is listed to UL 1741 for the U.S.A. and Canada. Dimensions of the inverter are 23"H x 16"W x 9"D.

A Conext System Control Panel, is needed to complete a Schneider system. This and other accessories are on the next page.

Schneider Electric Inverter/Charger System										
Model	**CEC rating**	**CEC grid-tie output**	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge output**	**Inverter weight**	**Item code**
XW+5548NA	93.5%	4,491 W	5,500 W	48 VDC	120/240 VAC 60 Hz	26 W	110 A	9,500 W	118 lbs	**030-01227**
XW+6848NA	92.5%	6,000 W	6,800 W	48 VDC	120/240 VAC 60 Hz	28 W	140 A	12,000 W	122 lbs	**030-01228**
EXPORT Schneider Electric Inverter/Charger System										
XW+7048E	N/A	N/A	5,500 W	48 VDC	230 V 50 Hz	26 W	110 A	9,500 W	118 lbs	**030-01229**
XW+8548E	N/A	N/A	6,800 W	48 VDC	230 V 50 Hz	28 W	140 A	12,000 W	122 lbs	**030-01230**
XW Accessories										
RNW865101301	XW+ Mini Power Distribution Panel for only one XW+ inverter									**030-01185**
RNW865101501	XW+ Power Distribution Panel with conduit box for one XW+ inverter (add a connection kit for each additional inverter)									**030-01168**
RNW865102002	XW+ Connection Kit is needed for each additional inverter, includes DC breaker and conduit box, add AC breaker kit									**030-01170**
RNW865102501	XW+ empty conduit box raceway									**030-01174**
RNW865101401	XW+ Power Distribution Panel with conduit box for one XW inverter, without any AC breakers									**030-01171**
RNW865131501	XW+ three-phase 120/208 VAC breaker kit									**030-01173**
RNW865121501	XW+ split-phase 120/240 VAC breaker kit									**030-01180**

Expand the possibility of energy independence, self-consumption, and secure backup power.

Conext™ XW+, the scalable hybrid solution for off-grid solar, self-consumption, and long-term backup for homes, small businesses, and remote communities.

Storage available from 5.5 - 102 kW

Introducing the next generation hybrid inverter, the Conext™ XW+, with new adaptable and scalable features:

- Energy management solutions: Priority***Power***, Parallel***Power***, Grid***Sell***, Charge***Power***
- Modular multi-cluster architecture up to 102 kW
- Flexible combination of AC and DC coupled PV power
- Equipped with smart inverter features for grid stability
- Remote system monitoring and configuration

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Conext SW Off-Grid Inverters and Systems

The **Conext SW** is an economical sine wave, off-grid or backup-power inverter-charger. The SW series offers generator support for loads larger than the generator can power on its own. The US version has split-phase 120/240 VAC output from each inverter, while the EXPORT version has 230 VAC 50 Hz output. Use the stacking kits for two inverters to double the power output per system. Battery input for all Conext SW inverters is 24 VDC. The XW System Control Panel (SCP), Automatic Generator Start (AGS), and Conext CM Communication devices work with these inverters. Compatible with XW and other charge controls. Comes with a battery temperature sensor. 16.5"H x 13.4"W x 7.6"D. Listed to UL 1741, CE for EXPORT versions and covered by a two-year standard warranty.

Conext SW Inverters and Accessories								
Model	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge output**	**Weight**	**Item code**
SW 2524	2,400 W	24 VDC	120/240 VAC 60 Hz	38 W	65 A	4,000 W	49 lbs	**030-02059**
SW 4024	3,400 W	24 VDC	120/240 VAC 60 Hz	27 W	90 A	7,000 W	62 lbs	**030-02060**
SW 4048	3,400 W	48 VDC	120/240 VAC 60 Hz	27 W	45 A	7,000 W	62 lbs	**030-02058**
Conext SW Inverters - EXPORT								
SW 2524 E	2,500 W	24 VDC	230 VAC 50 Hz	38 W	65 A	5,000 W	49 lbs	**030-02061**
SW 4024 E	3,400 W	24 VDC	230 VAC 50 Hz	27 W	90 A	7,000 W	62 lbs	**030-02062**
SW 4048 E	3,400 W	48 VDC	230 VAC 50 Hz	27 W	45 A	7,000 W	62 lbs	**030-02057**
Conext SW Accessories								
RNW8651016	Conext SW DC Breaker Panel, 250 A main breaker, Positive and Negative busbars							**053-00050**
RNW8651017	Conext SW AC Breaker Panel, 120/240 VAC output/bypass and input breakers, pre-wired							**053-00051**
RNW865101761	Conext SW Export AC Breaker Panel, 230 VAC output/bypass and input breakers, pre-wired							**053-00052**
RNW8651019	Conext SW AC Breaker kit stacked 120/240 VAC							**053-00053**
RNW865101961	Conext SW Export AC Breaker kit stacked 230 VAC							**053-00054**
RNW8651052	Conext SW Remote On/Off switch							**053-00055**

Conext XW and SW Accessories

The Conext **SCP System Control Panel** plugs into the Xanbus network and provides a central user interface to configure and monitor all components in the system. One is used per XW+ or SW system. The **Conext Battery Monitor** can be used in the Xanbus network to keep track of the battery state of charge. The **Conext AGS** auto generator start can be used in the Xanbus network to supply the logic to remotely start a backup generator.

The **Conext ComBox** can be used to view, datalog, and control XW and SW inverters over the Internet. With a web browser or Android device, the user or installer can view current and historical system performance, see system alerts, and remotely change settings. A Micro-SD card provides additional data storage. 6.7"W x 4.5"H x 2.1"D. Five-year warranty.

The **Conext Modbus Converter** links the Conext devices to a third-party monitoring system.

For more information on the Schneider charge controls listed here, see the Charge Controllers section.

Conext SW Inverters and Accessories		
Model	**Description**	**Item code**
RNW865105001	Conext SCP System Control Panel central user interface for XW and SW systems	**300-00128**
RNW865108001	Conext Battery Monitor for XW and SW systems	**030-01182**
RNW865106001	Conext AGS automatic generator start module for XW and SW systems	**030-01183**
RNW8651058	Conext ComBox for XW and SW inverters	**300-00073**
RNW8651059	Conext Modbus Converter	**300-00074**
808-0232-02	Replacement BTS Battery Temperature Sensor for XW and SW	**300-00129**
XW-MPPT60-150	XW 60 A MPPT charge controller with built-in ground fault protection - 150 VDC max input voltage	**020-08040**
BREAKER 60A	Input circuit breaker for MPPT60-150 charge controller; 60 A 160 VDC	**053-01038**
BREAKER 80A	Output circuit breaker for MPPT60-150 charge controller; 80 A 125 VDC	**053-01039**
XW-MPPT80-600	XW 80 A MPPT charge controller with built-in ground fault protection - 600 VDC max input voltage	**020-08048**
SQD HU361RB	Input disconnect for MPPT80-600 charge controller; 30 A 600 VDC 3 pole	**053-02312**
BREAKER 100A	Output circuit breaker for MPPT80-600 charge controller; 100 A 125 VDC	**053-01034**

Magnum Energy

True Sine-Wave Off-Grid Inverter/Chargers

MMS-Series Sine-Wave Inverter/Charger

The MMS Series sine-wave inverters provide a cost-effective solution for smaller power needs in mobile applications. The MMS is smaller, lighter, and less expensive, while retaining all the built-in protection and reliability of the larger ME and MS models. The MMS charger has an 85% efficient PFC (power factor corrected) charger. The **MMS1012G** model comes with a flexible cord on the AC input and a GFCI outlet for easy connection to AC appliances. Optional **MMS-RC-25** remote control available. The MMS Series is listed to UL 458 for the U.S.A. and Canada. MMS units have a two-year warranty. Made in U.S.A.

MS-Series Sine-Wave Inverter/Chargers

The **MS Series** inverter/charger is a sine-wave inverter designed for the most demanding mobile and off-grid applications. The powerful easy-to-use MS Series inverters are available in 12, 24, and 48 VDC versions. The **MS4024** can be series stacked, using the ME-SSI, for 120/240 VAC operations, and 8 kW total output. The **MS2012-20B** has two 20 A AC breakers built-in. The **M4024-PAE** and **MS4448-PAE** have 120/240 VAC split-phase output and can power 240 VAC loads without stacking. As many as four MS-PAE inverters can be paralleled for larger systems up to 17.6 kW with 120/240 VAC split-phase output (ME-RTR router required). The ME-RC50, ME-ARC50, or ME-RTR controller is required for inverter programming. The MS Series is listed to UL 458 for mobile use and UL 1741 for off-grid installations. The MS-PAE series is listed to UL1741. Dimensions: 13.75"H x 12.65"W x 8"D. MS units have a three-year warranty, which is extended to five-years when installed with the Magnum panels. Made in U.S.A.

MSH-Series Sine Wave Inverter/Chargers

The Magnum **MSH** series inverters are similar to the MS Series, but add the generator-support feature. When the generator is supplying power through the inverter, and the load is too large for the generator alone, the inverter will add battery power to help power the loads. The RE version is listed to UL 1741 and the M versions are listed to UL 458 for mobile applications. The MSH inverters use the same options and accessories as the MS inverters.

Magnum True Power Systems Sine Wave Inverter/Chargers								
Model	**Continuous output**	**Battery voltage**	**AC out volts/hertz**	**No load draw**	**Charger output**	**AC surge output (5 sec)**	**Weight**	**Item code**
MMS1012	1,000 W	12 VDC	120 VAC / 60 Hz	19 W	50 A	1,750 W	23 lbs	**030-02320**
MMS1012G								**030-02321**
MS2012	2,000 W	12 VDC		25 W	100 A	3,300 W	42 lbs	**030-02332**
MS2012-20B								**030-02334**
MS2812	2,800 W	12 VDC		30 W	125 A	3,900 W	55 lbs	**030-02336**
MS2024	2,000 W	24 VDC		25 W	105 A	5,800 W	55 lbs	**030-02338**
MS4024	4,000 W	24 VDC		25 W	105 A	5,800 W	55 lbs	**030-02338**
MS4048	4,000 W	48 VDC		25 W	60 A	8,500 W	55 lbs	**030-02363**
MS4024-PAE	4,000 W	24 VDC	120/240 VAC / 60 Hz	27 W	105 A	5,800 W	55 lbs	**030-02342**
MS4448-PAE		48 VDC		25 W	60 A	8,500 W	55 lbs	**030-02341**
Magnum Sine Wave MSH Inverter/Chargers								
MSH4024RE	4,000 W	24 VDC	120 VAC / 60 Hz	25 W	110 A	5,800 W	58 lbs	**030-02347**
MSH3012M	3,000 W	12 VDC		30 W	125 A	3,900 W	55 lbs	**030-02348**
MSH4024M	4,000 W	24 VDC		25 W	110 A	5,800 W	55 lbs	**030-02349**
Magnum Sine Wave Inverter/Chargers - EXPORT								
MMS912E	900 W	12 VDC	230 VAC / 50 Hz	19 W	40 A	1,600 W	23 lbs	**030-02346**
MS1512E	1,500 W	12 VDC		20 W	75 A	3,100 W	53 lbs	**030-02345**
MS2712E	2,700 W	12 VDC		34 W	125 A	4,100 W	53 lbs	**030-02344**
MS4124PE	4,100 W	24 VDC		30 W	105 A	6,300 W	53 lbs	**030-02343**
MS4348PE	4,300 W	48 VDC		28 W	55 A	7,500 W	53 lbs	**030-02331**

Magnum Energy Modified-Square-Wave Inverter/Chargers

MM-Series Inverters for mobile use

The MM Series inverter and inverter/charger are designed for small appliances in mobile systems, boats and RV's. The **MM** is smaller, lighter, and less expensive than the **ME** while retaining all the built-in protection and reliability of ME models. The **MM1212** model uses an efficient PFC (power-factor- corrected) charger. The **MM612** model comes with an AC transfer switch but does not have a battery charger. The easy-to-use MM Series are cost-effective and come with a two-year warranty. Listed to UL 458. Dimensions: 16.6"H x 8.4"W x 4.7"D.

ME-AE Series Inverters for residential use

The **MM-AE Series** inverter/charger is designed for entertainment systems and small appliances in smaller remote homes. The **MM** is smaller, lighter, and less expensive than the **ME** while retaining all the built-in protection and reliability of ME models. The MM models use an efficient PFC (power-factor-corrected) charger and the same charger topology as all Magnum models. The 600 and 1,500 W models have a 12 VDC input; a 1,500 W model with a 24 VDC input is also available. The powerful, easy-to-use MM-AE Series are cost-effective and come with a two-year warranty. Not listed. Dimensions: 16.6"H x 8.4"W x 4.7"D.

ME-Series Inverters for mobile use

Designed for RV use, the ME Series 12 VDC inverter/charger charges batteries efficiently even at low AC voltage from low-cost generators. The modified-square-wave inverter keeps the cost down and a battery-temperature sensor optimizes charging. ME inverters have three power levels and built-in ground switching required for mobile inverters that may connect to utility power. ME inverters are listed to UL 458 in the U.S.A. and Canada for RV, marine and mobile use and come with a two-year warranty. Dimensions: 13.8"H x 12.7"W x 8"D.

RD-Series Inverters

The **RD** Series 12 VDC inverter/charger is designed specifically for off-grid use with the same chassis as the MS sine-wave inverters. Includes power-factor-corrected charger, modified-square-wave inverter and battery-temperature sensor. The RD inverters are listed to UL 1741 and include a two-year warranty. Dimensions: 13.8"H x 12.7"W x 8"D.

Magnum Modified-Sine Wave Inverter/Chargers								
Model	Continuous output	Battery voltage	AC out volts/hertz	No load draw	Charger output	Peak AC surge	Weight	Item code
MM612	600 W	12 VDC	120 VAC / 60 Hz	10 W	N/A	1,100 W	14 lbs	030-02308
MM1212	1,200 W	12 VDC		16 W	70 A	2,100 W	20 lbs	030-02309
MM612-AE	600 W	12 VDC		10 W	30 A	1,100 W	16 lbs	030-02302
MM1512-AE	1,500 W	12 VDC		18 W	70 A	2,100 W	22 lbs	030-02306
MM1524-AE	1,500 W	24 VDC		9 W	35 A	2,650 W	22 lbs	030-02303
ME2012	2,000 W	12 VDC		20 W	100 A	3,700 W	37 lbs	030-02305
ME2512	2,500 W	12 VDC		23 W	120 A	5,000 W	41 lbs	030-02311
ME3112	3,100 W	12 VDC		25 W	160 A	6,000 W	46 lbs	030-02315
RD2212	2,200 W	12 VDC		20 W	110 A	3,700 W	37 lbs	030-02326
RD1824	1,800 W	24 VDC		12 W	50 A	4,000 W	35 lbs	030-02322
RD2824	2,800 W	24 VDC		19 W	80 A	6,000 W	42 lbs	030-02324
RD3924	3,900 W	24 VDC		25 W	105 A	9,000 W	53 lbs	030-02328

Magnum Energy Accessories and Options

The optional **ME-RC50** remote control is simple to use yet enables use of all the set-up features of the ME, MS, MS-ME, and RD Series inverters. The ME-RC50 controls the ME-AGS automatic generator start using a network connection to the inverter. This remote has convenient fingertip operation, including one-knob programming. The **ME-ARC50** advanced remote offers even more control of the setup including custom battery-charge set-points. The **ME-RTR** has all of the functions of the ME-ARC50 and is required for paralleling PAE inverters. An ME-RC50 can be used with the ME-RTR as a remote display. The **MM-RC25** provides on/off control and a quick indication of inverter and charger operation for the MM and MMS inverters.

The **ME-BMK** monitors battery percentage state-of-charge (SOC), along with amps, voltage, amp-hours and min/max DC volts, and then provides this information in an easy-to-understand display via the ME-ARC50, or ME-RTR remotes. Kit includes a sense module, shunt, and wiring.

The **ME-MW-E** Magweb with Ethernet connects the Magnum system to the Internet for remote monitoring via the data.magnumenergy.com site. This unit connects to your broadband router via Ethernet cable. It monitors the inverter, battery monitor and generator-start module. The **ME-MW-W** is similar to the Ethernet version except that it will communicate to your broadband router via a wireless bridge. Maximum range for the wireless is up to 300' if unobstructed. There is both a transmitter and receiver gateway that wires to your network. The receiver gateway requires 120 VAC power. Both units are supplied with all the needed cables. They are compatible with the ME-RC50, ME-ARC50, and ME-RTR. With the ME-RTR it can only monitor one inverter in the system.

The optional Auto Generator Start (**ME-AGS**) module automatically starts and stops most major-brand generators. The generator can automatically start based on low battery voltage or on the inside temperature, starting a generator to run an air conditioner when the temperature of an RV or cabin rises to a user-defined level.

The **ME-AGS-S** is the stand-alone version of Magnum Energy's Automatic Generator Start controllers and can be used in power systems that don't have a Magnum inverter.

The **ME-AGS-N** is the network version of Magnum Energy's Automatic Generator Start controllers and is set up and operated via a Magnum Energy Inverter and ME-RC50 or ME-ARC50 remote panel. When using the **ME-RC50** Remote, the ME-AGS-N has basic adjustments starting on battery voltage or temperature. When using the **ME-ARC50** Remote, the ME-AGS-N has advanced start and stop settings based on: time of day, battery State-of-Charge, battery voltage, high temperature, or inverter load amps. The ME-AGS-N also includes the ability to manually turn the generator on and off, generator exercise, warm-up and cool-down.

The optional **ME-SSI** allows a series connection of two MS4024 inverters for 120/240 VAC split-phase output at 8 kW total output power.

Magnum Accessories and Options

Model	Descriptions	Weight	Item code
MM-RC25	Remote control for MM, MM-AE, and MMS inverters	2 lbs	**030-02355**
ME-RC50	Remote control for Magnum inverters with 50' cable for all inverters	2 lbs	**030-02351**
ME-ARC50	Advanced Remote for Magnum inverters with 50'cable for ME, MS, MS- PAE, RD	2 lbs	**030-02352**
ME-RTR	Magnum Router for parallel stacking of MS-PAE inverter, Stacking cables included	2 lbs	**030-02350**
ME-BMK	Battery monitor kit - ME-ARC50 or ME-RTR required with this item	4 lbs	**020-06379**
ME-BMK- NS	Battery monitor kit without Shunt- ME-ARC50 or ME-RTR required with this item	2 lbs	**020-06380**
ME-MW-W	Magweb Web-based monitoring kit - Wireless	3 lbs	**029-08000**
ME-MW-E	Magweb Web-based monitoring kit - Ethernet	3 lbs	**029-08001**
ME-AGS-N	Automatic generator start – network version for use with Magnum inverters and ME-RC50	4 lbs	**020-06377**
ME-AGS-S	Automatic generator start – standalone version	4 lbs	**020-06375**
ME-SSI	Series stacking cable kit for MS-4024 ONLY	10 lbs	**030-02362**
ME-CB	Conduit Box for ME, MS, ME-AE, and RD inverters	4 lbs	**030-02360**
ME-RC-BZ	Bezel for RC50 (standard on the ARC50)	1 lb	**310-00115**
PT-100	Magnum 100 A MPPT charge control	13.6 lbs	**020-06371**
ACLD-40	Magnum 4 kW AC Load Diversion Control	20 lbs	**020-06372**

Magnum Energy MMP Mini Magnum Panel

The **MMP -** Mini Magnum Panel is an inclusive, easy-to-install panel designed to work with one Magnum MS-AE, MS, RD or other inverter/charger. The MMP features a small footprint and comes prewired for fast installation. Circuit breakers and the optional remote control mount on the front of the cabinet. Dimensions are 12.5"W x 18"H x 8"D. They are listed to UL 1741 and CSA C22.2 107-01. Each MMP includes one DC breaker – 175 A or 250 A, one AC bypass breaker – 30 A two-pole or 60 A single-pole, one AC input breaker – 30 A two-pole or 60 A single-pole, a 500 A/50 mV shunt, DIN rail provided for up to eight DC ½" DIN-mount breakers, or if the DIN rail is removed, four 1" wide surface-mount breakers (see Electrical Distribution Parts). Panels are available for inverters with 120 VAC output and 120/240 VAC output.

MMP Mini Magnum Panel				
Model	**DC main breaker**	**AC output breaker**	**Use with**	**Item code**
MMP250-30D	250 A	30 A @120/240 VAC	MS4024-PAE	**030-02380**
MMP250-60S	250 A	60 A @ 120 VAC	All ME, MS4024, MS2812, MS2012, RD3924	**030-02381**
MMP175-30D	175 A	30 A @120/240 VAC	MS4448-PAE	**030-02382**
MMP175-60S	175 A	60 A @ 120 VAC	RD2824, RD1824	**030-02383**
BP-MMP	Back Plate MMP (fits 1 - MMP)			**030-02396**
Export MMP Mini Magnum Panel				
MMP250-30S-E	250 A	30 A @ 230 VAC	MS1512E, MS2712E, MS4124E	**030-02390**
MMP175-30S-E	175 A	30 A @ 230 VAC	MS4348E	**030-02391**
Magnum Panel Parts				
BR-DC175	Replacement main inverter breaker, 175 A			**053-01059**
BR-DC250	Replacement main inverter breaker, 250 A			**053-01060**

Magnum Energy MP Magnum Panels

The MP Magnum Panels are available in three sizes, each with either a 30 A two-pole 120/240 VAC output breaker or a 60 A 120 VAC output breaker. They are designed for use with two series-stacked MS4024 inverters, or up to four parallel-connected MS-PAE inverters.

The **MPSL** (Magnum panel, single enclosure, low capacity) accommodates one or two inverters with the use of an MPX Extension Box. It includes a 175 or 250 A DC breaker, a 125 A AC bypass breaker, a 500 A/50 mV shunt and inverter AC input protection, and all AC/DC wiring for dual inverters (source/load wiring not included). There is space for five 1" back-mount breakers or ten ½" DIN-mount breakers on the DC side.

The **MPSH** (Magnum panel, single enclosure, high capacity) accommodates a maximum of three inverters. One inverter can be connected directly to the MPSH. Each additional inverter requires an MPX. The MPSH includes one 175 or 250 A DC breaker, a 125 A AC bypass breaker, a 1,000 A/100 mV shunt and inverter AC input protection, and AC/DC wiring for dual inverters (source/load wiring not included). ***NOTE:*** There are no spaces for extra DC breakers in the MPSH, so it may be limited to backup systems. Use the MPDH for three or four-inverter systems with solar or other DC input.

The **MPDH** (Magnum panel, dual enclosure, high capacity) accommodates as many as four inverters with two enclosures – one for AC and one for DC connections. Two inverters can be connected to the MPDH. The third and fourth inverters require one MPX for each. The MPDH includes two 175 or 250 A DC breakers, a 125 A AC bypass breaker, a 1,000 A/100 mV shunt and inverter AC input protection, and all AC/ DC wiring for dual inverters (source/load wiring not included). There is room for seven 1" back-mount breakers or fourteen ½" DIN-mount breakers on the DC side.

Mount and connect additional inverters to MP Series Systems Panels using **MPX** Series Extension Boxes. They mate to the bottom of Magnum MS4024 or the MS-PAE inverters. The boxes include a 175 or 250 A DC breaker and wiring for an additional inverter. Left and right-hand versions mount on either side of an MP Panel. An **MP-HOOD** inverter hood (not shown) allows vertical mounting. Choose the extension box model that corresponds to the MP enclosure and which side it will be installed on.

MP Magnum Panels					
Model	**DC main breaker quantity**	**Main breaker spaces**	**AC bypass breaker assembly**	**Use with**	**Item code**
MPSL175-30D	1 - 175 A	two	60 A	MS4448-PAE	**030-02406**
MPSL250-30D	1 - 250 A	two	60 A	MS4024-PAE	**030-02384**
MPSL250-60S	1 - 250 A	two	60 A	MS4024	**030-02385**
MPSH175-30D	1 - 175 A	three	125 A	MS4448-PAE	**030-02407**
MPSH250-30D	1 - 250 A	three	125 A	MS4024-PAE	**030-02388**
MPDH175-30D	2 - 175 A	four	125 A	MS4448-PAE	**030-02408**
MPDH250-30D	2 - 250 A	four	125 A	MS4024-PAE	**030-02389**
MPXS175-30D-L	1 - 175 A	LEFT-side mounting		MPSL175-30D, MPSH175-30D	**030-02409**
MPXS175-30D-R	1 - 175 A	RIGHT-side mounting			**030-02410**
MPXS250-30D-L	1 - 250 A	LEFT-side mounting		MPSL250-30D, MPSH250-30D	**030-02399**
MPXS250-30D-R	1 - 250 A	RIGHT-side mounting			**030-02400**
MPXS250-60S-L	1 - 250 A	LEFT-side mounting		MPSL-60S	**030-02401**
MPXS250-60S-R	1 - 250 A	RIGHT-side mounting			**030-02402**
MPXD175-30D-L	1 - 175 A	LEFT-side mounting		MPHD175-30D	**030-02411**
MPXD175-30D-R	1 - 175 A	RIGHT-side mounting			**030-02412**
MPXD250-30D-L	1 - 250 A	LEFT-side mounting		MPHD250-30D	**030-02403**
MPXD250-30D-R	1 - 250 A	RIGHT-side mounting			**030-02404**
BP-S	Back plate single (fits 1 MPSL, 1 MPSH, 1 MPX)				**030-02394**
BP-D	Back plate double (fits 1 MPDH, or 1 MPSL + 1 MPX, or 1 MPSH + 1 MPX)				**030-02395**
MP-CCB	Charge-controller bracket for mounting controller on MP or MMP				**030-02405**
MPX-CB	Panel-extension conduit box (conduit box only – no AC or DC breakers, no wiring)				**030-02397**
MP-RFC	Router front-cover for MP enclosures				**310-00117**

Morningstar

SureSine™ 300 W Off-Grid Inverters

The Morningstar SureSine™ **SI-300** pure-sine-wave inverter is designed to meet the needs of rural PV electrification requiring AC power. This inverter is also a good choice for small PV systems for telecom, remote cabins and weekend homes, as well as RV/caravans and boats. The SureSine handles a 200% surge to a maximum of 600 W.

The SureSine uses epoxy encapsulation, conformal coating, stainless-steel hardware, and an anodized -aluminum enclosure to protect against harsh tropical and marine environments. AC output connection does not have an AC receptacle and must be hardwired. These inverters are covered by a two-year warranty.

Dimensions are 8.4"H x 6"W x 4.1"D. The 115 VAC inverter is UL listed for the U.S.A. and to CSA C22.2 No. 107.1-01 for Canada.

Morningstar SureSine 300 W								
Model	Continuous output	Battery voltage	AC out volts/hertz	No load draw	Standby draw	AC surge output	Weight	Item code
SI-300-115VUL	300 W	12 VDC	115 V/60 Hz	450 mA	55 mA	600 W	10 lbs	**030-08022**
SI-300-220V	300 W	12 VDC	220 V/50 Hz	450 mA	55 mA	600 W	10 lbs	**030-08033**

Samlex

PST Sine Wave Off-Grid Inverters

Samlex **PST** sine-wave inverters offer a small, affordable, sine-wave inverter for remote homes, RVs and boats. The 120 VAC output is overload protected. All of these inverters have AC receptacles and low-battery alarms. If you plan to use these inverters with reactive loads, such as motors and compact fluorescent lights or other ballasted light, size the inverter for four times the continuous watts required. Listed to UL 458 (except PST-15S-12A). Each inverter includes a two-year warranty.

The Samlex **RC-15A** is a remote control panel for the PST-600 and PST-1000 inverters. It has three LED indicators for overload, over-temperature, and power and includes an on/off switch. The Samlex **RC-200** is a remote control panel for the PST-1500 and PST-2000 inverters. It has three LED indicators for overload, over-temperature, and power. It has an LCD display showing AC Voltage (V), AC current (A), frequency (Hz), active power (Watts), apparent power (VA) and power factor (PF) in addition to the LED indicators. Both remotes are flush-mount and come with a 15' cable to connect to the inverter. Each unit is covered by a two-year warranty.

Samlex Sine Wave Inverters								
Model	Continuous output	Battery voltage	AC out volts/hertz	No load watts	Surge watts	Dimensions (H" x W" x D")	Weight	Item code
PST-15S-12 A	150 W	12 VDC	120 V/60 Hz	7 W	250 W	8.3 x 5.8 x 2.5	4.2 lbs	**030-07123**
PST-300-12	300 W	12 VDC	120 V/60 Hz	8 W	500 W	8.3 x 5.8 x 2.5	4.2 lbs	**030-07126**
PST-600-12	600 W	12 VDC	120 V/60 Hz	10 W	1,000 W	11 x 9.5 x 3.5	6.8 lbs	**030-07129**
PST-1000-12	1,000 W	12 VDC	120 V/60 Hz	10 W	1,500 W	15.5 x 9.5 x 3.5	8.2 lbs	**030-07130**
PST-1500-12	1,500 W	12 VDC	120 V/60 Hz	12 W	3,000 W	16 x 11.3 x 4	12.6 lbs	**030-07128**
PST-600-24	600 W	24 VDC	120 V/60 Hz	11 W	1,000 W	11 x 9.5 x 3.5	6.8 lbs	**030-07132**
PST-1000-24	1,000 W	24 VDC	120 V/60 Hz	14 W	1,500 W	15.5 x 9.5 x 3.5	8.2 lbs	**030-07134**
PST-1500-24	1,500 W	24 VDC	120 V/60 Hz	19 W	3,000 W	16 x 11.3 x 4	12.6 lbs	**030-07127**
PST-2000-24	2,000 W	24 VDC	120 V/60 Hz	19 W	3,500 W	18.5 x 10.4 x 4.2	15.6 lbs	**030-07125**
RC-15A	Remote for PST-600 / PST-1000					3.54 x 2.54 x 1.1	0.1 lbs	**310-00111**
RC-200	Remote for PST-1500 and PST-2000					4.33 x 2.56 x 0.97	0.12 lbs	**310-00112**

MidNite Solar

MidNite Solar offers pre-assembled and tested power panels using Magnum, SMA, and Schneider inverters. These power panels offer a space-saving fully-integrated power-panel system. All assemblies are thoroughly tested and crating is included.

Pre-Wired Magnum Power Panels

Magnum inverters are installed on the MidNite MNE250(175)STM-L gray steel E-Panel with an ME-RC50 remote display, a BMK-NS, 1 MNEPV2 breaker for BMK, a MidNite Classic 150 charge controller with built in DC-GFP and arc-fault detector, an MNDC array breaker, an MNDC charge- control breaker, two or three MNSPD surge arrestors, and battery-temperature sensors. (See Electrical Distribution Parts for details on these components) Also available with CL200 and CL250 charge controls. (See Charge Controllers)

The MidNite **MND3R4024PAE-UPS** is a battery-based backup system in a battery and equipment enclosure. It is made specifically for AC backup power. It has 120/240 VAC output, and is fully assembled and tested. Includes a Magnum MS4024 PAE inverter, Magnum ARC50, and MidNite Enclosure. It can hold four Group 31 or GC2 or GC2 tall batteries (batteries not included). 49”H x 39”W x 21”D

The MidNite **MNEMS4024PAEACCPL** is a Magnum battery-based inverter system, made for AC coupling to a grid-tie inverter. It is available with 120/240 VAC output, and is fully assembled and tested. Includes a Magnum MS4024 PAE inverter, Magnum RTR router, MidNite E-Panel, two SPD surge arrestors, and GT-inverter-circuit relay. The maximum size grid-tie inverter that can be installed with this system is 3.6 kW. 30”H x 16”W x 12”D.

The MidNite **MND3RACCPLME** is a Magnum battery-based inverter system, made for AC coupling to a grid-tie inverter, in an outdoor enclosure with room for batteries. It has 120/240 VAC output, and is fully assembled and tested. Includes a Magnum MS4024 PAE inverter, Magnum RTR router, MidNite E-Panel, two SPD surge arrestors, and GT-inverter-circuit relay. This is all installed inside a MidNite MNBE-D3R battery enclosure which, in this configuration, can hold four Group 31 or GC2 or GC2 tall batteries (batteries not included). The maximum size grid-tie inverter that can be installed with this system is 3.6 kW. 49”H x 39”W x 21”D. The dimensions and weights are approximate and do not include crating.

Please note that not all grid-tie inverters are suitable for AC coupling; check with the inverter manufacturer.

MidNite Pre-Wired Magnum Power Systems				
Model	**Description**	**Inverter**	**Weight**	**Item code**
MNEMS4024CL150	Magnum 120 VAC Off-Grid 4,000 Watt 24 VDC Inverter with Classic 150	MS4024	140 lbs	**033-04301**
MNEMS4024PAECL150	Magnum 120/240 VAC Off-Grid 4,000 Watt 24 VDC Inverter with Classic 150	MS4024PAE	140 lbs	**033-04303**
MNEMS4448PAECL150	Magnum 120/240 VAC Off-Grid 4,400 Watt 48 VDC Inverter with Classic 150	MS4448PAE	140 lbs	**033-04305**
MND3R4024PAE-UPS	Magnum 120/240 VAC Off-Grid 4,000 Watt 24 VDC Inverter Backup system, outdoor equipment and battery enclosure	MS4024PAE	200 lbs	**033-04330**
MidNite Pre-Wired Magnum AC Coupled Power Systems				
MNEMS4024PAEACCPL	Magnum 120/240 VAC AC coupled 4 kW/24 VDC Inverter system, GT inverter not included	MS4024PAE	140 lbs	**033-04322**
MND3RACCPLME	Magnum 120/240 VAC AC coupled 4 kW/24 VDC Inverter system, outdoor equipment and battery enclosure, GT inverter not included	MS4024PAE	200 lbs	**033-04323**

MidNite Pre-Wired SMA Power Panels

The MidNite MNSMA SMA Sunny Island systems are available with 120 VAC, 120/240 VAC, or 120/208 VAC three-phase output, fully assembled and tested.

The **MNSI6048-CL150** single-inverter system includes one SMA SI6000-US inverter, MidNite E-Panel, one Classic 150 charge controller, SPD surge arrestors, all on a mounting plate. The Classic 150 charge controller and Sunny Island communicate over the SMA network to coordinate charging and display system performance. 50”W x 27”H x 12”D.

The **MNSI6048-240V-CL150** single inverter system includes one SMA SI6000-US inverter, One MN-X240 autoformer for 120/240 VAC output, MidNite E-Panel, one Classic 150 charge controller, SPD surge arrestors, all on a mounting plate. The Classic 150 charge controller and Sunny Island communicate over the SMA network to coordinate charging and display system performance. 66”W x 27”H x 12”D.

The **MNSI6048D-2CL150** dual inverter system includes two SMA SI6000-US inverters, MidNite E-Panels, two Classic 150 charge controllers, SPD surge arrestors, all on two mounting plates. The Classic 150 charge controllers and Sunny Island communicate over the SMA network to coordinate charging and display system performance. Two panels at 50”W x 27”H x 12”D each.

Also available with CL200 and CL250 charge controls. (See Charge Controllers)

The **MNSI6048-ACCPL** is based on the SMA Sunny Island battery-based inverter setup for AC coupling to a grid-tie inverter. This system can be retrofitted to an existing Sunny Boy grid-tied system, or many other grid-tie inverter systems, for battery-backup power during an outage. It comes with 120/240 VAC output and connection to the grid-tie inverter, but only 120 VAC for the grid connection. Includes a Sunny Island SI6000-US, MidNite E-Panel, MidNite Autoformer, all on a mounting plate, and is fully assembled and tested. 66”W x 24”H x 12”D. The **MNSI6048-ACCPL-SMARB** also includes a relay board for up to 12 kW of grid-tie inverter input.

The **MNSI6048D-ACCPL** is a dual-inverter system with 120/240 VAC output and grid connection. Includes two Sunny Island SI6000-US inverters, MidNite E-Panels, on two mounting plates, and is fully assembled and tested. Two panels at 50”W x 24”H x 12”D each. The **MNSI6048D-ACCPL-SMARB** also includes a relay board for up to 18 kW of grid-tie inverter input.

The **MNSI6048-3PHASE** is a three-inverter system with 120/208 VAC three-phase output and grid connection. Includes three Sunny Island SI6000-US inverters, MidNite E-Panels, on three mounting plates, and is fully assembled and tested. Three panels at 50”W x 24”H x 12”D each.

The **MNSI6048-QUAD** is a four inverter system with 120/240 VAC output and grid connection. Includes four Sunny Island SI6000-US inverters, MidNite E-Panels, on four mounting plates, and is fully assembled and tested. Four panels at 50”W x 24”H x 12”D each.

Dimensions and weights are approximate and do not include crating.

MidNite Pre-Wired SMA Power Systems				
Model	**Description**	**Inverter**	**Weight**	**Item code**
MNSI6048-CL150	SMA Sunny Island, Classic 150, 120 VAC 6 kW 48 VDC system	SI6048-US	225 lbs	**033-04320**
MNSI6048-240V-CL150	SMA Sunny Island, Classic 150, 120/240 VAC 6 kW 48 VDC system	SI6048-US	400 lbs	**033-04356**
MNSI6048D-2CL150	SMA dual Sunny Island, dual Classic 150, 120/240 VAC 12 kW 48 VDC system	2x SI6048-US	450 lbs	**033-04336**
MNSI6048-ACCPL	SMA Sunny Island, 120/240 VAC 6 kW 48 VDC AC-coupled system	SI6048-US	375 lbs	**033-04321**
MNSI6048-ACCPL-SMARB	SMA Sunny Island, 120/240 VAC 6 kW 48 VDC AC-coupled system w/ SMARB for 12kW GT input	SI6048-US	375 lbs	**033-04324**
MNSI6048D-ACCPL	SMA dual Sunny Island, 120/240 VAC 12 kW 48 VDC AC-coupled system	2x SI6048-US	450 lbs	**033-04337**
MNSI6048D-ACCPL-SMARB	SMA dual Sunny Island, 120/240 VAC 12 kW 48 VDC AC-coupled system w/ SMARB for 18kW GT input	2x SI6048-US	450 lbs	**033-04363**
MNSI6048-3PHASE	SMA triple Sunny Island, 120/208 VAC three-phase 18 kW 48 VDC AC-coupled system	3x SI6048-US	675 lbs	**033-04339**
MNSI6048-QUAD	SMA quad Sunny Island, 120/240 VAC 24 kW/48 VDC AC-coupled system	4x SI6048-US	900 lbs	**033-04340**

MidNite Pre-Wired Schneider-Electric Power Panels

The MidNite Schneider Electric XW+ power panels are available as either single or dual-inverter systems. The **MNXWP6848-CL150** includes one XW+6848 inverter, MidNite E-panel, SCP, four MNSPD, and one MidNite Classic 150 charge control. The **MNXWP6848D-2CL150** includes two XW+6848 inverters, two MidNite E-panels, SCP, five MNSPD, and two MidNite Classic 150 charge controls. This system is partially pre-wired and will require 6 AWG wire between the E-panels. Also available with the XW+5548 inverter.

The MidNite **MNXWPAC6846** and **MNXWPAC6848D** power panels are set up for AC-coupled systems with an existing grid-tie inverter; similar to the off-grid power panels above, but without a charge control. Each XW+6848 inverter can have up to 5,400 W of grid-tie inverter capacity connected. These are also available with XW+5548 inverters and/or CL200 and CL250 charge controls. The MNXWP6848-CL150 is 50"H x 27"W x 12"D. The MNXWP6848D-2CL150 is two panels, each 50"H x 27"W x 12"D.

MidNite Pre-Wired Schneider-Electric Off-Grid Power Systems				
Model	**Description**	**Inverter**	**Weight**	**Item code**
MNXWP6848-CL150	Schneider XW+ single 120/240 VAC Grid-Tie or Off-Grid 6800 Watt 48 VDC Inverter	XW+6848	200 lbs	**033-04343**
MNXWP6848D-2CL150	Schneider XW+ dual 120/240 VAC Grid-Tie or Off-Grid 13600 Watt 48 VDC Inverters	2 x XW+6848	400 lbs	**033-04344**
MNXWP5548-CI150	Schneider XW+ single 120/240 VAC Grid-Tie or Off-Grid 5500 Watt 48 VDC Inverter	XW+5548	200 lbs	**033-04360**
MNXWP5548D-2CL150	Schneider XW+ dual 120/240 VAC Grid-Tie or Off-Grid 11000 Watt 48 VDC inverters	2 x XW+5548	400 lbs	**033-04361**
MidNite Pre-Wired Schneider-Electric AC Coupled Power Systems				
MNXWPAC6848	Schneider XW+ single 120/240 VAC AC coupled 6,800 W 48 VDC Inverter	XW+6848	215 lbs	**033-04374**
MNXWPAC6848D	Schneider XW+ dual 120/240 VAC AC coupled 13,600 W 48 VDC Inverters	2 x XW+6848	440 lbs	**033-04375**
MNXWPAC5548	Schneider XW+ single 120/240 VAC AC coupled 5,500 W 48 VDC Inverter	XW+5548	215 lbs	**033-04388**
MNXWPAC5548D	Schneider XW+ dual 120/240 VAC AC coupled 11,000 W 48 VDC Inverters	2 x XW+5548	440 lbs	**033-04389**

The MidNite **MNSW** off-grid power panels are available with any of the SW inverters and either a KID or Classic charge controller. They come with one Schneider Electric SW inverter, Conext SCP, MidNite SW E-panel with DC breakers and AC bypass, either KID or Classic 150 charge control, WhizBangJr, and MNSPD. Also available with CL200 and CL250 charge controls.

MidNite Pre-Wired Power Systems for Schneider SW				
Model	**Description**	**Inverter**	**Weight**	**Item code**
MNSW2524-KID-B	Schneider SW single 120/240 VAC Off-Grid 2400 W 24 VDC Inverter, KID control	SW2524	120 lbs	**033-04378**
MNSW4024-KID-B	Schneider SW single 120/240 VAC Off-Grid 3400 W 24 VDC Inverter, KID control	SW4024	120 lbs	**033-04379**
MNSW4048-KID-B	Schneider SW single 120/240 VAC Off-Grid 3400 W 48 VDC Inverter, KID control	SW4048	120 lbs	**033-04381**
MNSW2524-CL150	Schneider SW single 120/240 VAC Off-Grid 2400 W 24 VDC Inverter,CL150 control	SW2524	130 lbs	**033-04366**
MNSW4024-CL150	Schneider SW single 120/240 VAC Off-Grid 3400 W 24 VDC Inverter, CL150 control	SW4024	130 lbs	**033-04367**
MNSW4048-CL150	Schneider SW single 120/240 VAC Off-Grid 3400 W 48 VDC Inverter, CL150 control	SW4048	130 lbs	**033-04382**

AC Transformers

Use an autotransformer as a step-down to connect the 240 VAC output of a generator to the 120 VAC input on an inverter. This allows full output power of a 240 VAC generator to be used for battery charging. Autotransformers can also step-up voltage to operate 240 VAC appliances and motors from the 120 VAC output of an inverter.

OutBack Power

PSX-240 Autotransformer

The OutBack **PSX-240** autotransformer can be used for step-up, step-down, generator, and split-phase output balancing, or with series-stacked inverters as a load-balancing auto-former.

The PSX-Relay version has a relay assembly, which is required when split-phase stacking with 120/208 VAC power sources.

Both units have a built-in two-pole 20 A AC breaker and cooling fan.

OutBack PSX-240 Autotransformer		
Model	**Description**	**Item code**
PSX-240	6 kW autotransformer	**030-04429**
PSX-240-Relay	6 kW autotransformer with relay	**030-04430**

DC-DC Converters

DC-to-DC converters are used to power appliances requiring a different voltage than the battery bank supplies. For example, powering a 12 VDC appliance that needs to be run from a 24 VDC or 48 VDC battery bank. Using a DC-DC converter is preferred for powering loads that require a different voltage than the battery bank's system voltage as center-tapping causes cell imbalances that shorten the useful life of the battery bank.

Samlex

DC-Step-Down Power Converters

These switching DC-DC step-down power converters are designed to decrease DC voltage. They operate at high efficiency and provide regulated 13.8 VDC output from an input of 20-30 VDC. Use them to power 12 VDC lights and appliances from a 24 VDC system. Covered by a two-year warranty.

Samlex DC-Step-Down Power Converters		
Model	**13.8 VDC output max amps**	**Item code**
SDC-15	12 A	**030-08720**
SDC-23	20 A	**030-08725**
SDC-30	30 A	**030-08727**

Isolated DC-DC Converters

These **isolated, enclosed DC-DC converters** are designed to increase or decrease DC voltage. 100 W, 200 W, and 360 W versions are available.

Samlex Isolated DC-DC Converters				
Model	Input voltage	Output voltage	Max output amps	Item code
IDC-100A-12	9-18 VDC	12.5 VDC	8 A	**030-08740**
IDC-100B-12	20-35 VDC	12.5 VDC	8 A	**030-08741**
IDC-100C-12	30-60 VDC	12.5 VDC	8 A	**030-08742**
IDC-100A-24	9/18 VDC	24.5 VDC	4 A	**030-08744**
IDC-100C-24	30-60 VDC	24.5 VDC	4 A	**030-08746**
IDC-200A-12	9-18 VDC	12.5 VDC	16 A	**030-0xxxx**
IDC-200B-12	20-35 VDC	12.5 VDC	16 A	**030-08748**
IDC-200C-12	30-60 VDC	12.5 VDC	16 A	**030-08749**
IDC-200A-24	9-18 VDC	24.5 VDC	8 A	**030-08751**
IDC-200C-24	30-60 VDC	24.5 VDC	8 A	**030-08753**
IDC-360A-12	9-18 VDC	12.5 VDC	30 A	**030-08755**
IDC-360B-12	20-35 VDC	12.5 VDC	30 A	**030-08756**
IDC-360C-12	30-60 VDC	12.5 VDC	30 A	**030-08757**
IDC-360A-24	9-18 VDC	24.5 VDC	15 A	**030-08758**
IDC-360C-24	30-60 VDC	24.5 VDC	15 A	**030-08760**
IDC-360B-48	20-35 VDC	48 VDC	7.5 A	**030-0xxxx**

Solar Converters Inc.

DC-Step-Down Power Converters

These high-efficiency DC to DC converters can be used to step down from a higher voltage battery to power lower voltage loads. The output voltage is set at the factory but can be user adjusted. These are covered buy a one-year warranty.

Solar Converters DC-DC Converters				
Model	Min input voltage	Output voltage	Output amps	Item code
PPT 12/24-2 R5	22 VDC	5 VDC	2 A	**038-08738**
PPT 12/24-5 R9	22 VDC	9 VDC	5 A	**038-08739**
PPT 12/24-20 R13.8	22 VDC	13.8 VDC	20 A	**038-08740**
PPT 12/24-30 R13.8	22 VDC	13.8 VDC	30 A	**038-08764**
PPT 12/24-40 R13.8	22 VDC	13.8 VDC	40 A	**038-08765**
PPT 36-20 R13.8	33 VDC	13.8 VDC	20 A	**038-08741**
PPT 48-10 R13.8	44 VDC	13.8 VDC	10 A	**038-08742**
PPT 48-10 R27.6	44 VDC	27.6 VDC	10 A	**038-08743**
PPT 48-20 R13.8	44 VDC	13.8 VDC	20A	**038-08766**
PPT 48-20 R27.6	44 VDC	27.6 VDC	20 A	**038-08767**
PPT 48-30 R13.8	44 VDC	13.8 VDC	30A	**038-08768**
PPT 48-30 R27.6	44 VDC	27.6 VDC	30 A	**038-08769**

Generator Start Controls

It is very important to prevent battery banks from being discharged too far. These specialized controllers send a start-up signal to a backup or remote power generator when the battery bank reaches a given voltage set point. It is important to note that not all start controllers work with all generators. Please contact AEE Solar to assess or confirm compatibility.

Magnum

AGS - RV Auto Generator Start

The **Magnum Automatic Generator Start (AGS)** is designed to automatically start a mobile generator based on low battery condition or the inside temperature of the RV and is compatible with most major generators, including Onan, Powertech, Generac, and Weterbeke.

Battery start voltage can be set from 10-12.2 VDC or 20-24.4 VDC or 40-48.8 VDC, the start temperature from 65-95 °F, the run time from 0.5 to 25.5 hours, and the quiet time with an easy-to-set clock. Automatic Generator Start settings do not interfere with the manual start/stop operation of the generator.

Two models are available. The standalone **AGS-S** works well for installation and operation without an inverter. The networked **AGS-N** allows operation of the AGS via the ME Series remote panel.

Magnum Auto Generator Start		
Model	**Description**	**Item code**
AGS-S	Automatic generator start standalone	**020-06375**
AGS-N	Automatic generator start network version (for use with Magnum inverters only)	**020-06377**

Atkinson

GSCM

The **Atkinson GSCM** (generator start controller module) is a microprocessor-based generator-starting controller that receives start commands from any 12 VDC output or dry-contact switch, including an inverter or charge controller's auxiliary relay, a voltage-controlled relay, a timer, a water-tank float switch, or any user-supplied contact closure. It automatically controls a gas/propane or diesel powered generator or pump, and is sealed for harsh-environment operation.

The GSCM provides contact signal relays to start the engine and to disconnect the starter when a minimum generator frequency output is measured. It can monitor the generator operation, shutting it down and displaying the fault conditions detected. The GSCM must be manually reset after a generator fault.

The GSCM is powered by 12 to 24 VDC from a battery bank and will start generators for 12 to 48 VDC systems. For 48 VDC systems the GSCM must be powered by a 24 VDC-or-less tap on the 48 VDC battery bank, or from the generator's starting battery. The GSCM provides a 30-day exercise function that can be synchronized with a photovoltaic input to only start each 30-day period at the beginning of the solar charge day. It also has a timed relay that can be used for diesel engine glow plugs and is covered by a two-year limited warranty. Dimensions are 5.5"H x 3.3"W x 1.5"D.

GSCM-mini

This **GSCM-mini** start controller is optimized for use with OutBack inverters. It supports three types of three-wire gas-generator control: momentary, maintained, or ignition. It has a fixed crank time and over and under frequency shutdown and is covered by a two-year limited warranty.

Atkinson Auto Generator Start		
Model	**Description**	**Item code**
GSCM	Generator start control module	**020-06341**
GSCM-mini	Generator start control module - mini	**020-06343**

Relays and Controls

The simple controls presented here enable you to automate certain functions for your renewable energy system, such as turning on/off a load or starting/stopping a generator, or inverter, based on logical conditions, such as, battery voltage, time of day, or sensor reading. Relays enable a small control voltage signal to open or close a switch for a much larger voltage and current. Select relays and design your system so that it will "fail safe" if the control signal is lost.

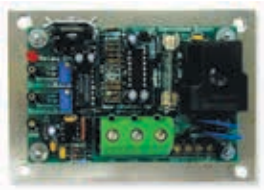
Morningstar

Relay Driver

The **Morningstar Relay Driver** is a logic module that provides control functions such as high/low-voltage alarms, load control, and generator start functions for 12, 24 or 48 VDC battery systems. It controls four independent relay driver outputs by reading battery voltage or by digital data inputs from any Morningstar controller or inverter, which includes an RJ-11 meter port (TriStar, TriStar MPPT, SunSaver Duo, SunSaver MPPT or SureSine). Multiple Relay Drivers can connect to a single controller or to multiple devices in a MeterHUB/MeterBus network. Outputs can be used to operate any mechanical or solid-state relay with a coil voltage that is the same as the battery voltage used to power the Relay Driver. Maximum current for each output channel is 750 mA.

The Relay Driver is pre-programmed with four commonly-used settings and may be mounted to a DIN rail or a flat surface. An RS-232 port and PC software (MS View or MODBUS commands) is included for custom programming, detailed monitoring and driver control. The driver terminals can accept 16 or 24 AWG wire. Self-consumption is less than 20 mA and the unit operates from 8 to 68 VDC. The Relay Driver is highly reliable: each channel has complete electronic protections for short circuit, overcurrent, reverse polarity, as well as lightning and transient surges. LED indicators display power and status for each channel as well as faults and data sampling intervals. Operating temperature range is -40 °C to +45 °C. Dimensions are 6.4"H x 3.2"W x 1.3"D and it weighs 0.4 lb. These are covered by a five-year warranty.

Morningstar Relay Driver		
Model	**Description**	**Item code**
RD-1	Morningstar Relay Driver	**020-01255**
RSC-1	Communications Adapter EIA-485 / RS-232	**020-01256**
HUB-1	MeterHUB	**020-01260**
DIN-1	DIN Rail Clips for Installing the Relay Driver to DIN Rails	**020-01259**



Solar Converters Inc.

Voltage-Controlled Switches

These **Voltage-Controlled Switches** are user-adjustable voltage-activated relays with single pole, double throw (SPDT) contacts rated for 30 A. The relay coil in the “Active-High” version is powered when the voltage rises to the high set point; “Active-Low” is powered when voltage drops to the low set point. The SPDT relay allows the switch to either connect or disconnect a circuit or turn one load on while turning another off. Voltage settings are user adjustable and can be read with a voltmeter.

An active-high relay can be used as a DC pump controller, a diversion load controller, or to operate a large relay for a high-powered charge controller. An active-low relay can be used as a 2-wire generator start controller or as a low-battery-voltage load disconnect. These devices consume 17 mA when off. Maximum switched current is 30 A at 12/24 VDC, 3 A at 48 VDC. VCS-1 measures approximately 3"H x 5.3"W x 1.75"D. VCS-2 comes in a 5"H x 7"W x 2"D enclosure and is covered by a one-year warranty.

Voltage Controlled Switches			
Model	**Mode of operation**	**Enclosure**	**Item code**
VCS-1AH	Active high	No	**020-06218**
VCS-2AH	Active high	Yes	**020-06215**
VCS-1AL	Active low	No	**020-06221**
VCS-2AL	Active low	Yes	**020-06224**

SPDT 12 VDC 40 A Relay

This single-pole, double-throw (SPDT), 40 A enclosed relay is widely used in the automotive industry. Wires may be attached with ¼" quick-connect terminals or a relay socket. Nominal operating current is 140 mA. The corresponding Relay Socket has 2' of wire.

SPST N.O. 12 VDC 75 A Relay

This enclosed single-pole, single-throw (SPST) relay has one set of contacts that closes when power is applied to the coil terminals. It can be used to turn on 12 VDC loads of up to 75 A. Power terminals are #10-32 screws and coil terminals are quick disconnects. Nominal operating current is 300 mA.

DPDT 30 A Relay

This double-pole, double-throw (DPDT) relay can be used for up to 30 A at 12, 24, or 48 VDC or 120 or 240 VAC. All contact surfaces are silver alloy with gold flashing. Contact terminals are #8-32 screws, and coil terminals are #6-32 screws. Relays with 120 VAC or 240 VAC coils can be used to build simple transfer switches. Relays with DC coils can be used for remote operation of pumps and fans. By connecting a relay with a DC coil to a voltage-controlled switch, AC or DC loads may be turned on or off based on battery voltage levels.

Omron SPST 10 A Relay

This enclosed surface-mount single-pole, single-throw (SPST) relay has one set of contacts that closes when power is applied to the coil terminals. It can be used with an inverter or charge controller's 12 VDC auxiliary output to provide a contact closure for generator start or other controls. The terminals are quick connect. It draws a small 44 mA coil current.

Relays		
Description	**Coil current**	**Item code**
40 A SPDT 12 VDC relay	140 mA	**053-08290**
Relay socket for 40 A relay	--	**053-08291**
75 A SPST relay	300 mA	**053-08293**
DPDT 30 A relay - 12 VDC coil	170 mA	**053-08281**
DPDT 30 A relay - 24 VDC coil	53 mA	**053-08287**
DPDT 30 A relay - 48 VDC coil	42 mA	**053-08288**
DPDT 30 A relay - 120 VAC coil	83 mA	**053-08278**
DPDT 30 A relay - 240 VAC coil	42 mA	**053-08284**
Omron relay SPST 10 A 12 VDC coil	44 mA	**053-08298**

Battery Chargers

AC input battery chargers can be used with AC generators to provide battery charging on an emergency basis or in the absence of a renewable energy source. Since proper charging is vital to battery health, a high-quality charger is recommended if you plan to charge batteries from an engine generator.

IOTA

DLS Converter/Chargers

The IOTA DLS series converter/chargers quickly and efficiently charge batteries with full rated output and then maintain the batteries using only the output required by the load or battery self-discharge, cutting back to milliamps as the battery requires. They are protected against low line-voltage spikes from the AC power source, and are reverse-polarity and short-circuit protected on the DC side. They also have current limit, thermal and overload protection

When used as a DC power supply, the DLS converter/chargers will only supply the amount of power required by the load, with very clean output power. When not in use, it is essentially off, minimizing electricity usage.

The Power Factor Correction (PFC) design provides efficient energy consumption, operating at a power factor of greater than 0.9 at full load with typical operating efficiency greater than 80%. The proportional fan control enables quiet, efficient operation. External fuses can be quickly and easily replaced and there is a socket and jumper that can be used to change the charge voltage limit to either 13.6 or 14.2 VDC (multiply by two for 24 VDC and four for 48 VDC batteries).

These converter/chargers can also be wired in series to increase voltage or in parallel to increase the charging amperage, or a combination of both. For example, four 12V/55 A chargers connected in series would have a total output of 55 A at 48 VDC. Or the same four 12V/55 A chargers can be wired in parallel for 12 VDC and 220 A output.

For 120 VAC / 60 Hz input the DLS-75 and DLS-27-40 models have 120 VAC 20 A plugs (NEMA 5-20). All other 120 VAC models have standard 15A AC plugs (NEMA 5-15). 240 VAC models come with NEMA 6-15P three-prong 240 VAC plugs. The 240 VAC models can also operate on 230 VAC/50 Hz power.

DLS chargers are UL-listed for the US and Canada (except for models DLS-90 and DLS-54-13) and are covered by a two-year warranty.

IOTA Battery Chargers							
Model	**Battery voltage**	**Charge current**	**AC input voltage**	**Max AC amps**	**Dimensions (L" x W" x H")**	**Weight**	**Item code**
DLS-15	12 VDC	15 A	120 VAC	3.7 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02112**
DLS-30	12 VDC	30 A		7.3 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02115**
DLS-45	12 VDC	45 A		11 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02118**
DLS-55	12 VDC	55 A		13.4 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02121**
DLS-75	12 VDC	75 A		18.2 A	13 x 6.7 x 3.4	7.8 lbs	**045-02124**
DLS-90	12 VDC	90 A		21.8 A	13 x 6.7 x 3.4	7.8 lbs	**045-02127**
DLS-27/15	24 VDC	15 A		7.3 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02130**
DLS-27/25	24 VDC	25 A		12.2 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02133**
DLS-27/40	24 VDC	40 A		19.5 A	13 x 6.7 x 3.4	7.8 lbs	**045-02136**
DLS-54/13	48 VDC	13 A		12.6 A	9.7 x 6.7 x 3.4	5.0 lbs	**045-02147**
IOTA 230/240 VAC 50/60 Hz Converters / Battery Chargers							
DLS-240-30	12 VDC	30 A	230 - 240 VAC	3.7 A	9.7 x 6.7 x 3.4	5.0 lbs	**054-02152**
DLS-240-45	12 VDC	45 A		5.5 A	9.7 x 6.7 x 3.4	5.0 lbs	**054-02153**
DLS-240-55	12 VDC	55 A		6.7 A	9.7 x 6.7 x 3.4	5.0 lbs	**054-02154**
DLS-240-27-25	24 VDC	25 A		6 A	9.7 x 6.7 x 3.4	5.0 lbs	**054-02155**
DLS-240-27-40	24 VDC	40 A		10 A	13 x 6.7 x 3.4	7.8 lbs	**054-02156**

IOTA IQ-4 Smart Controller

The **IQ-4** module upgrades any DLS battery charger to an automatic four-stage charger, using bulk, absorption, float charging, and equalization stages

The Bulk Stage of the IQ4 allows the batteries to be charged from the full rated output of the charger. It will bulk charge to 14.8 VDC (multiply by two for 24 VDC and four for 48 VDC batteries). It will then absorb charge at 14.2 VDC for up to eight hours, and then drop to float charge at 13.6 VDC. If the battery remains in float stage for seven days, the IQ4 will switch the DLS charger into a pre-programmed Equalization Stage, which will cycle the battery through the Bulk and Absorption Stages before returning the battery to the Float Stage.

IQ4 for Parallel Charging

IOTA offers a specialized IQ4 module for use with parallel battery-charging applications. The specialized IQ4 Parallel attaches to two DLS chargers operating in parallel and monitors both units for delivering the appropriate charge level. Contact AEE Solar for IQ4 options for parallel charging with more than two DLS chargers.

IOTA also makes DLS converter/chargers with the IQ4 Smart Controller built-in. Contact AEE for information.

NOTE: The IQ-4 Smart Controllers are not recommended for generator-powered battery charging if the generator is only run for short periods of time. In this case, it's better to not taper the charging current, but instead control the charging time by limiting generator run times.

IOTA Accessories			
Model	**DC Voltage**	**Description**	**Item code**
IQ4	12-24 VDC	Smart controller for 12 to 24 VDC chargers	**045-02103**
IQ4-54V	48 VDC	Smart controller for 48 VDC charger	**045-02104**
IQ4 Parallel	12-24 VDC	Smart Controller for parallel operation of two 12 or 24 VDC DLS chargers	**045-02105**

Schneider Electric

Truecharge2 12 VDC Battery Charger

The **Truecharge2** is available as a 20 or 40 A electronic battery charger for deep-cycle batteries. Switch settings give correct charge for flooded, gel, or absorbed glass mat (AGM) batteries. These chargers include: selectable two or three-stage charging (three-stage includes float charge), manual equalize charge button, and manual or automatic temperature compensation. The optional temperature sensing probe corrects charge voltage for actual battery temperature. These chargers have full output even with low-cost 1,000 to 3,000 W generators and are covered by a one-year warranty.

Schneider Truecharge2 Battery Charger					
Model	**Battery voltage**	**Charge current**	**Dimensions (L" x W" x H")**	**Weight**	**Item code**
TC2-40	12 VDC	40 A	9.8 x 6.7 x 2.8	4.8 lbs	**045-02896**
TC2-20	12 VDC	20 A	9.8 x 6.7 x 2.8	4.8 lbs	**045-02895**
808-0232-01	Remote temperature sensor				**045-02898**
808-8040-01	Remote control panel				**045-02897**

Diversion Loads

Wind and hydroelectric generators can be damaged if they are allowed to run without a steady load. Battery banks can also be compromised if they are overcharged. Diversion loads, usually resistive heating elements, are used to provide a safety load for when the battery bank is fully charged and cannot accept more energy. The diversion load is generally switched on by a controller, or relay, driven by battery voltage.

Low-Voltage Water Heating Elements

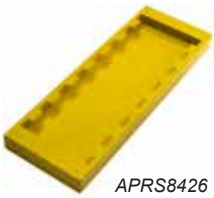
These low-voltage water heating elements are used as diversion loads for wind or hydroelectric systems. Use one or more of these heating elements with a charge controller designed for load diversion, such as the Xantrex C-40 or C-60, or the Morningstar TriStar PWM controllers to turn your excess power into hot water. They fit most electric water heaters with screw-in elements. One model is available for **12 and 24 VDC** systems and another for higher power **24 and 48 VDC** systems. Each unit has two elements that can be wired in series, parallel, or used individually, depending on voltage and desired current draw. See table below to determine what each element will draw at various charging voltages.

These elements have 1" NPT male pipe threads and are covered by a two-year warranty.

If your water heater tank is designed for square flange elements, use one square flange adapter for each element.

Low-Voltage Water Heating Elements

Regulation voltage			14 V		28 V		56 V		Item code
Model	Wiring	Ohms	Amps	Watts	Amps	Watts	Amps	Watts	
12/24 VDC	series	0.96 Ω	14.6 A	204 W	29.2 A	817 W	--		021-09275
	single	0.48 Ω	29.2 A	408 W	--		--		
	parallel	0.24 Ω	58.3 A	817 W	--		--		
12/24/48 VDC	series	2.48 Ω	5.6 A	79 W	11.3 A	316 W	22.6 A	1,265 W	021-09279
	single	1.24 Ω	11.3 A	158 W	22.6 A	632 W	--		
	parallel	0.62 Ω	22.6 A	316 W	45.2 A	1,265 W	--		
Square flange element adapter									021-09285



APRS8426

APRS8426

NEW! APRS World DC Air Heater Dump Loads

APRS World's dump load is a building block element. The base block is a 600 watt load which can be purchased as a 12/24 VDC model or a 48 VDC model. Wall mounting boxes are required and are available for single and multiple dump loads. Designed for safe, easy, and Code-compliant wiring.

APRS World DC Air Heater Dump Loads

Model	DC voltage	Resistance	Load amps	Weight	Item code
APRS8420	12 VDC	0.375 Ω	40 A	8 lbs	021-09340
	24 VDC	1.5 Ω	20 A		021-09341
APRS8421	48 VDC	6.0 Ω	10 A		021-09342
APRS8425	Wall mount – single 600 W dump load				021-09350
APRS8426	Wall mount for up to four 600 W dump loads				021-09351

MidNite Solar Clipper

The MidNite Clipper is designed to control wind or hydro turbines and work with the MidNite Classic charge controllers. The Clipper communicates with the Classic to slow the turbine when the batteries are full, and also contains a stand-alone self-powered adjustable max V_{OC} limiting circuit, which protects the turbine from over-speed. The Clipper has a settable voltage threshold and a breaking feature that provides convenient switching between run/turbine slowing, all in a rugged powder-coated enclosure.

The Clipper protects charge controllers and other electronics by sensing the incoming voltage from the turbine and using its internal loads as needed to hold down the incoming voltage to a field-adjustable set-point.

When used with a Classic MPPT charge controller, the Classic uses its auxiliary output to control the Clipper for optimum performance. The internal load should be sized according to the turbine that it is used with to provide adequate braking, without overloading the turbine. When the slider on the side of the Clipper is in the stop position, the input voltage (DC or three-phase) is held to zero volts through 50 A circuit breakers to provide emergency braking. All models have a temperature-controlled internal fan.

The Clipper should be installed only in a protected dry indoor location with adequate ventilation on all sides. The air exiting the exhaust of the Clipper will be hot when the Clipper is slowing the turbine. A minimum of 8" of clearance on the sides and bottom and 24" above the Clipper are recommended.

The AC Clippers are designed to work with AC turbines that have wild three-phase AC output and they convert the AC into DC for input into charge controllers such as the MidNite Classic. The AC Clipper contains two 277 VAC 50 A three-phase AC breakers (one for a stop switch) and a 1,200 V 200 A three-phase bridge rectifier.

The 1,500 W AC Clipper is for AC turbines up to 1,500 W. Standard values available are 0.8 and 2.0 Ω per phase.

The 4,000 W AC Clipper is for AC turbines up to 4,000 W. Standard values available are 0.4, 1.0, 1.6 and 4.0 Ω per phase.

The 1,500 W DC Clipper is for DC turbines up to 1,500 W. Standard values available are 0.7 and 2.4 Ω.

The 4,000 W DC Clipper is for turbines with direct DC output. The standard values available are 0.5, 1.2, 1.3, 3.0, 4.8 and 12 Ω.

MidNite Solar can custom-build other resistance values upon request and have designed an easy-to-change resistor insert for the Clipper allowing changes in the field. Please contact AEE Solar for help selecting the correct resistance or if you need a value not listed.

Dimensions for all Clipper models are 25.5"H x 15.5"W x 5.25"D and weight is 50 lbs.

MidNite Solar Clipper				
Model	**Input power type**	**Rated wattage (max)**	**Resistance value**	**Item code**
MNCLIP1.5KAC0.8	AC	1,500 W	0.8 Ω	**021-00201**
MNCLIP1.5KAC2.0			2.0 Ω	**021-00202**
MNCLIP4KAC0.4		4,000 W	0.4 Ω	**021-00301**
MNCLIP4KAC1.0			1.0 Ω	**021-00303**
MNCLIP4KAC1.6			1.6 Ω	**021-00305**
MNCLIP4KAC4			4.0 Ω	**021-00307**
MNCLIP1.5DC0.7	DC	1,500 W	0.7 Ω	**021-00203**
MNCLIP1.5DC2.4			2.4 Ω	**021-00204**
MNCLIP4DC0.5		4,000 W	0.5 Ω	**021-00401**
MNCLIP4DC1.2			1.2 Ω	**021-00403**
MNCLIP4DC1.3			1.3 Ω	**021-00405**
MNCLIP4DC3.0			3.0 Ω	**021-00407**
MNCLIP4DC4.8			4.8 Ω	**021-00408**
MNCLIP4DC12			12.0 Ω	**021-00410**

Charge Controllers

A charge controller is used to keep the voltage across the battery within acceptable limits. The charge controller automatically tapers, stops, or diverts power when batteries become fully charged. Charge controller capacities range from 4 A to 100 A and multiple charge controllers can be used in parallel for larger systems. Some charge controllers offer additional features including charge status display, data logging, automatic battery equalization charging, generator starting, and even lighting controls.

The simplest charge controllers disconnect the power source when the battery reaches a set voltage, and turn it on when a low voltage set point is reached. Pulse Width Modulated (PWM) charge controllers turn on and off very rapidly, maintaining the batteries at full charge voltage, which results in quicker and more complete battery charging. Maximum Power Point Tracking (MPPT) charge controllers optimize the voltage of the PV array to maximize total power output then convert that to the correct voltage to charge the battery. This process significantly increases the power from a solar array, particularly in low temperatures when battery voltage is significantly below the PV array voltage. Most MPPT charge controllers work with higher array voltages, which can greatly reduce the required wire size between the array and the charge controller. While more expensive than PWM controllers, MPPT charge controllers can boost system performance by up to 30% making them very cost effective.

MPPT Charge Controllers

The table below shows **recommended maximum nameplate PV array sizes**. The wattages shown can be exceeded by up to 20% without damaging the controller, but some "clipping" of potential peak current may occur under cool, clear conditions at the peak of the day. While exceeding these wattages may reduce power harvest at peak times of the day, the total daily amp-hours delivered to the battery bank will be greater because the larger array will produce more power in less-than-peak conditions such as mornings, afternoons, and in hazy or cloudy weather.

MPPT Charge Controllers at a Glance

Model	Max output current	Maximum recommended PV array size			Max PV array voltage (V_{oc})	Item code
		12 VDC	24 VDC	48 VDC		
OutBack FLEXmax 60	60 A	862 W	1,724 W	3,448 W	150 VDC	**020-02017**
OutBack FLEXmax 80	80 A	1,149 W	2,299 W	4,598 W	150 VDC	**020-02020**
OutBack FLEXmax Extreme	80 A	1,149 W	2,299 W	4,598 W	150 VDC	**020-02030**
MidNite Classic 150 Or Classic SL Or Classic Lite	96 A at 12 VDC [1] 94 A at 24 VDC [1] 86 A at 48 VDC [1]	1,379 W	2,701 W	4,770 W	150 VDC [2]	**020-02405** **020-02404** **020-02412**
MidNite Classic 200 Or Classic SL Or Classic Lite	79 A at 12 VDC [1] 78 A at 24 VDC [1] 76 A at 48 VDC [1]	1,106 W	2,126 W	4,023 W	200 VDC [2]	**020-02407** **020-02406** **020-02413**
MidNite Classic 250 Or Classic SL Or Classic Lite	61 A at 12 VDC [1] 62 A at 24 VDC [1] 55 A at 48 VDC [1]	876 W	1,782 W	3,161 W	250 VDC [2]	**020-02409** **020-02408** **020-02414**
MidNite KID	30 A	431 W	862 W	1,724 W	150 VDC	**020-02400**
Magnum PT-100	100 A	1437 W	2,874 W	5,747 W	200 VDC [2]	**020-06371**
Schneider XWMPPT60-150	60 A	862 W	1,724 W	3,448 W	150 VDC	**020-08040**
Schneider XWMPPT80-600	80 A	--	2,299 W	4,598 W	600 VDC	**020-08048**
Morningstar SS-15MPPT	15 A	216 W	431 W	--	75 VDC	**020-01261**
Morningstar TS-MPPT-30	30 A	431 W	862 W	1,724 W	150 VDC	**020-01116**
Morningstar TS-MPPT-45	45 A	647 W	1,293 W	2,586 W	150 VDC	**020-01109**
Morningstar TS-MPPT-60	60 A	862 W	1,724 W	3,448 W	150 VDC	**020-01110**
Morningstar TS-MPPT-60-600	60 A	800 W	1,600 W	3,200 W	600 VDC	**020-01103**
Blue Sky SB3000i	30 A w / 36-cell input 22 A w / 60-cell input	400 W 290 W	--	--	50 VDC	**020-03121**
Blue Sky SB2512i-HV	20 A w / 60-cell input	264 W	--	--	50 VDC	**020-03164**
Blue Sky SB1524iX	20 A at 12 VDC 15 A at 24 VDC	250 W	375 W	--	57 VDC	**020-03118**
Blue Sky SB3024iL	40 A at 12 VDC 30 A at 24 VDC	500 W	750 W	--	57 VDC	**020-03158**

[1]Amps shown are reduced at the higher end of the controller's array voltage range. Consult product manual for details.
[2]Absolute max open circuit voltage is the value listed, plus the nominal battery voltage.

PWM Charge Controllers

It is important to note that PWM charge controllers have limited voltage correction capabilities and should only be used with 36 or 72-cell modules (See Solar Modules) in series or parallel to match the battery voltage.

PWM Charge Controllers at a Glance					
Model	Max output current	Maximum recommended PV array size			Item code
		12 VDC	24 VDC	48 VDC	
SmartHarvest SCCP10-050	10 A	120 W	240 W	--	**020-02039**
SmartHarvest SCCP05-050	5 A	60 W	120 W	--	**020-02038**
MidNite MNBRAT	20 A charger w/10 A load control or 30 A charger	360 W	720 W	--	**020-02435**
Schneider C-35	35 A	420 W	840 W	--	**020-08004**
Schneider C-40	40 A	480 W	960 W	1,920 W	**020-08005**
Schneider C60	60 A	720 W	1,440 W	--	**020-08040**
Schneider C-12	12 A	144 W	--	--	**020-08048**
Morningstar TS-45	45 A	540 W	1,080 W	2,160 W	**020-01105**
Morningstar TS-60	60 A	720 W	1,440 W	2,880 W	**020-01108**
Morningstar PS-15 Morningstar PS-15M	15 A	180 W	360 W	--	**020-01120** **020-01123**
Morningstar PS-15M-48 Morningstar PS-15M-48-PG	15 A	--	--	720 W	**020-01126** **020-01129**
Morningstar PS-30 Morningstar PS-30M Morningstar PS-30M-PG	30 A	360 W	720 W	1,440 W	**020-01132** **020-01135** **020-01138**
Morningstar SS-6-12V Morningstar SS-6L-12V	6 A	72 W	--	--	**020-01230** **020-01233**
Morningstar SS-10-12V Morningstar SS-10L-12V	10 A	120 W	--	--	**020-01230** **020-01233**
Morningstar SS-10L-24V	10 A	--	240 W	--	**020-01236**
Morningstar SS-20L-12V	20 A	240 W	--	--	**020-01239**
Morningstar SS-20L-24V	20 A	--	480 W	--	**020-01242**
Morningstar SL-10-12V	10 A	120 W	--		**020-01218**
Morningstar SL-10-24V	10 A	--	240 W		**020-01221**
Morningstar SL-20-12V	20 A	240 W	--		**020-01224**
Morningstar SL-20-24V	20 A	--	480 W		**020-01227**
Morningstar SG-4	4.5 A	54 W	--	--	**020-01215**
Morningstar SK-6	6 A	72 W	--	--	**020-01252**
Morningstar SK-12	12 A	144 W	--	--	**020-01253**
Morningstar SSD-25RM	25 A	300 W	--	--	**020-01250**
Blue Sky SC30 Blue Sky SC30-LVD	30 A	360 W	--	--	**020-03180** **020-03181**
Atkinson PVLC-15 Atkinson PVLC-15MD	15 A	180 W	360 W	--	**020-05425** **020-05432**
Atkinson PVLC-40 Atkinson PVLC-40MD	40 A	480 W	960 W	--	**020-05427** **020-05435**

OutBack Power

FLEXmax MPPT Charge Controllers

The original maximum power point tracking (MPPT) charge controller, the **FLEXmax**, increases PV array yield b y up to 30% compared to non-MPPT controllers. FLEXmax charge controllers can operate at their maximum rated current in ambient temperatures up to 104 °F (40 °C) and can be used with battery systems from 12 to 60 VDC with PV open-circuit voltage as high as 150 VDC. The controller's set points are fully adjustable to allow use with a variety of battery types and charging profiles.

Maximum PV Array				
Battery bank voltage	Model	12 VDC	24 VDC	48 VDC
Max PV array	FM 60	862 W	1,724 W	3,448 W
	FM 80	1,149 W	2,299 W	4,598 W

FLEXmax controllers come standard with a four-line, 80-character backlit LCD screen that displays PV system performance with a 128-day history and can also be used for programming and monitoring system operation. Both controllers have a programmable AUX relay that can be used for control functions such as battery-enclosure fans, generator starting, or load control. The AUX output is 200 mA at 12 VDC. Use it to power a separate relay with a 12 VDC coil if you need to control more current or to control voltages (AC or DC) other than 12 VDC. For larger systems, OutBack's MATE3 system controller enables monitoring of up to 8 FM controllers from up to 300' away (also requires HUB).

FLEXmax charge controllers are covered by a five-year standard warranty and are listed to UL 1741 and C22.2 No. 107.1 for the U.S.A. and Canada.

FLEXmax Extreme MPPT Charge Controller

OutBack Power's sealed, outdoor-rated charge controller has improved thermal management capabilities and sealed construction designed for the most extreme environmental conditions. The FLEXmax Extreme provides full power output from -20 °C to 45 °C without a cooling fan. With circuit boards and other sensitive electronics fully protected from dust, dirt, insects, and other external sources of contamination, the charge controller ensures reliability and quiet long-term operation. An OutBack MATE or AXS Card MODBUS/TCP interface is required to program these controllers.

The FLEXmax Extreme can be used in negative, positive, or floating ground systems. It has ample wire-bending space and oversized terminals for easier installation with larger gauge wire, and a mechanical design that permits servicing and replacing all power components while the unit is mounted on a wall and attached to conduit.

Output is rated 80 A at 40 °C (104 °F), and the operating temperature range is -40 °C to +60 °C. The optional external **Extreme Fan** is available to keep the controller cool in hotter conditions. It can be used to charge 12, 24, 36, 48, and 60 VDC battery systems from PV arrays with voltage up to 150 VDC (open circuit).

NEMA 3R rated. Dimensions: 18.6"H x 8.8"W x 6.0"D. Listed to UL1741, IEC 62109 and IEC 62509 and covered by a five-year warranty.

The optional remote temperature sensor (**RTS**) comes with a 20' cable to read the battery temperature. This will allow all OutBack charge controllers to adjust the charge set-points if the battery is above or below 77 °F (25 °C). Works with all FLEXmax charge controllers. Charge controls connected to an OutBack inverter system with a HUB, can use the system RTS connected to the master inverter.

OutBack MPPT Charge Controllers				
Model	Description	Dimensions (H" X W" x D")	Weight	Item code
FM80	OutBack 80 A MPPT charge control	16.25 x 5.75 x 4	12 lbs	**020-02020**
FM60	OutBack 60 A MPPT charge control	13.5 x 5.75 x 4	12 lbs	**020-02017**
Extreme	OutBack Extreme 80 A charge control	18.6 x 8.8 x 6	22.6 lbs	**020-02030**
Extreme fan	OutBack Extreme Turbo Fan			**020-02035**
RTS	OutBack Remote Temperature Sensor with 20' cable			**030-04190**
AXS Card	OutBack AXS communication card for Extreme			**029-06501**

NEW! SmartHarvest Charge Controllers

SmartHarvest, by OutBack Power, are value-priced charge controllers for small PV systems. These charge controllers are ideal for worldwide markets for residential, rural power, backup lighting, communications and monitoring systems.

MPPT Charge Controllers

The **SCCM20-100** and **SCCM10-100** charge controls utilize Maximum Power Point Tracking to get the maximum yield from modern PV modules. They work with a wide variety of modules including those with 36, 60, or 72 cells in series with a maximum array voltage under 100 VDC. They can be used to charge either 12 or 24 VDC nominal battery systems, and have a three or four-stage charging algorithm. three LED lights indicate control status, and there is internal protection for mis-connections and overloads. These are for use only indoors, protected from the elements, with an operating temperature range from -40 °C to 60 °C. A remote probe is included for temperature-compensated charging. A load connection is included with low-voltage disconnect. These controllers are CE, IEC/EN 62109-1 certified and covered by a two-year standard warranty.

NOTE: *The RJ-45 port on the SmartHarvest controllers is not compatible with most Ethernet devices, including HUBs, and connecting such devices may damage them.*

MPPT Charge Controllers			
Battery bank voltage	**Model**	**12 VDC**	**24 VDC**
Max PV array	SCCM10-100	150 W	300 W
	SCCM20-100	300 W	600 W

PWM Charge Controllers

The **SCCP10-050** and **SCCM05-05**0 charge controls utilize pulse-width modulation (PWM) to control the charge from modules for either 12 V or 24 V batteries. They can be used with 36-cell modules for charging a 12 VDC battery, or with 72-cell modules (or a pair of 36-cell modules) for charging a 24VDC battery. There is a three or four-stage charging algorithm, and three LED lights to indicate the control status. Internal protection is included for mis-connections and overloads. These are for use only indoors, protected from the elements, with an operating temperature range from -40 °C to 60 °C. A remote probe is included for temperature-compensated charging. A load connection is included with low-voltage disconnect. These controllers are CE, IEC/EN 62109-1 certified and covered by a two-year standard warranty.

NOTE: *The RJ-45 port on the SmartHarvest controllers is not compatible with most Ethernet devices, including HUBs, and connecting such devices may damage them.*

Maximum PV Array				
Model	**Description**	**Dimensions (H" x W" x D")**	**Weight**	**Item code**
SCCM20-100	Smart Harvest 20 A MPPT charge control	4.3 x 7.8 x 2.2	2.16 lbs	**020-02037**
SCCM10-100	Smart Harvest 10 A MPPT charge control	4.3 x 7.8 x 1.8	1.10 lbs	**020-02036**
SCCP10-050	Smart Harvest 10 A PWM charge control	2.6 x 6.3 x 1.0	0.39 lbs	**020-02039**
SCCP05-050	Smart Harvest 5 A PWM charge control	2.6 x 6.3 x 1.0	0.39 lbs	**020-02038**

Full Version

MidNite Solar

Classic MPPT Charge Controller

MidNite Classic charge controllers offer many useful features including arc-fault detection (not currently listed to UL 1699B) and Ground Fault Protection (GFP) which eliminates the need for a separate GFP breaker assembly.

Three sizes are available to accommodate solar arrays with operating voltages up to 150, 200, or 250 VDC. A feature called HyperVOC protects the controller from damage when open-circuit voltage exceeds the operating voltage by a margin equal to or less than the battery bank voltage. The table below represents maximum power only – be sure to consult the power curves in the user's manual when sizing your PV array as allowable current varies with array voltage.

Maximum PV Array Size			
Battery bank voltage → (nominal)	12 VDC	24 VDC	48 VDC
Classic 150	1,379 W	2,701 W	4,770 W
Classic 200	1,106 W	2,126 W	4,023 W
Classic 250	876 W	1,782 W	3,161 W

Lite Version

MidNite Solar's Classic controllers have MPPT modes for solar, wind, or hydro with user-adjustable power curves, and a learning mode for self-optimization. Classics can be stacked to act as one large controller without a separate hub. They have two auxiliary outputs, a dry-contact relay and a 12 VDC output. The Classic has built-in Ethernet and USB and RS-232 ports for two-way communication. Each unit has 32 MB of internal memory for data storage. Firmware is user upgradeable using downloaded files. Each unit includes a sealing kit for dusty or salt-air environments, but sealing can reduce output by up to 20%. Use MidNite 300 VDC breakers (see Electrical Distribution Parts) for power-source voltages over 150 VDC. Make sure that the breaker will fit into your DC power center, or use a separate MidNite Big Baby Box (see Electrical Distribution Parts) to accommodate the breaker. On the battery side of the controller, breakers need only be rated for the highest battery-charging voltage.

The **Classic 150, 200 and 250** are listed to UL 1741 and CAN/CSA C22.2 No. 107.1:2001/09/01 Ed: 3 (R2006) and are covered by a five-year warranty. Dimensions are 15"H x 6"W x 4"D, and weight is 11.5 lbs for all units. Made in USA.

NEW! The **Classic SL** is a lower-cost solar-only version similar to the standard Classic. They do not have wind or hydro modes. SL versions have a streamlined menu, and built in ground-fault protection, but no arc-fault detection. BTS sold separately for these models.

The **Classic Lite** is a lower-cost version of each controller that omits the programmable user interface in favor of simple DIP-switch programming. The Lite does not have arc-fault detection. BTS sold separately for these models.

MNGP

The **MidNite Graphics Display Panel (MNGP)** is a remote LCD display that mimics the interface on the Classic charge controllers. It can also be used with the Lite versions of the Classic series.

The **MidNite MNSICOMM** is an adapter that allows the SMA Sunny Island to control the set points on a Classic control and will read the Classic data on SMA's monitoring platform.

MidNite Solar Classic MPPT Charge Controllers						
Model	Maximum output current at battery voltage[1]			Item code		
	12 VDC	24 VDC	48 VDC	Lite version	SL version	Full version
Classic 150	96 A	94 A	86 A	**020-02412**	**020-02404**	**020-02405**
Classic 200	79 A	78 A	76 A	**020-02413**	**020-02406**	**020-02407**
Classic 250	61 A	62 A	55 A	**020-02414**	**020-02408**	**020-02409**
MNGP	MidNite Classic remote graphics display					**020-02422**
MNSICOMM	MidNite communication modules for use with Sunny Island					**020-02434**
MNBTS	MidNite Battery Temperature Sensor					**020-02425**
MNNW10	MidNite 10 inch long communications cable					**020-02420**
MNNW3	MidNite 3 foot long communications cable					**020-02423**

[1]Maximum output current is reduced at higher array voltages. See manual for more detail.

MNKID

Assembly Kit

Whiz Bang Jr.

KID 30 A MPPT Charge Controllers

The **MNKID** 30 A MPPT charge controllers from MidNite Solar are versatile charge controllers for small to medium-sized renewable energy systems. The KID works with 12, 24, 36, and 48 VDC battery systems and has a 150 VDC operating limit; but is not damaged with DC voltages as high as 162 VDC, due to MidNite's HyperVOC circuitry. The KID has a three-LED bar graph, showing battery-charge status, and a keypad to access extensive menu items and set-points.

The KID controllers include a load control with load low-voltage disconnect (LVD). This can also be programmed as a lighting controller with dusk-to-dawn or various other on and off times. There is also a programmable AUX relay.

Sealed electronics and passive cooling (no fans) make it ideal for use in harsh environments. There are front-panel breakers for input, battery, and load. The controller's operating temperature range is -40 ºC to +50 ºC but the controller will automatically de-rate at temperatures above 25 ºC. Add the battery-temperature sensor (BTS) to these models.

Listed for the U.S.A. and Canada. CE Certified. FCC Class B compliant. Dimensions are 9.25"L x 5"H (6.6"H with wall-mount adaptor) x 3.4"D. NEMA 1 (IP64) indoor rating. Available in either white or black casing, the KID is made in the USA and is covered by a two-year warranty.

The **MNKID-M** Marine version comes standard with the **MNKID-M-BKT** Boat Mounting Bracket, flexible conduit, battery-temperature sensor and extra conformal coating.

MNKID-ASSY KIT comes with Boat Mounting Bracket, knobs, screws, 3' flex conduit, battery-temperature sensor, and four 1/2" connectors. Available in White or Black.

MNKID-CDT KIT contains two 1/2" straight connectors, two 1/2" elbow connectors and 3 ft flex con- duit.

The MidNite **Whiz Bang Jr** is a current-sense module that attaches to a standard Deltec 500 A / 50 mV shunt and wires into the MidNite Classic or KID charge controllers to give amperage readings from the shunt enabling absorb charge to stop according to a current set point. In this mode, if the battery current falls below a programmable threshold for one minute, the Classic or KID will recognize that the batteries are fully charged and switch to float mode.

NEW! BRAT 30 A PWM Charge Controllers

The MNBRAT is a PWM charge controller with either a 20 A charger and 10 A load control, or a 30 A charger without load control. Usable with 36-cell modules to charge 12 or 24 VDC battery banks, with three or four-stage charging. It has no relays, fans or external heat sink, and is in a clear polycarbonate NEMA 3R outdoor enclosure with 4 LED's to display system status. The 10 A load control can be used as a low voltage disconnect or a 16-position lighting control. The controller's operating temperature range is -40 ºC to +60 ºC but the controller will automatically de-rate at temperatures above 25 ºC. Ambient temperature sensing for charge voltage compensation is internal to these models. Dimensions are 7" H x 6" W x 2.4" D, 2 year warranty, made in USA.

MidNite Solar KID Charge Controllers and Accessories		
Model	**Description**	**Item code**
MNKID-B	MidNite KID charge controller with Wall-Mount Bracket - black	**020-02400**
MNKID-W	MidNite KID charge controller with Wall-Mount Bracket - white	**020-02401**
MNKID-M-B	MidNite KID Marine charge controller with Boat-Mount Bracket - black	**020-02403**
MNKID-M-W	MidNite KID Marine charge controller with Boat-Mount Bracket - white	**020-02402**
Whiz Bang Jr	Current-sense module	**020-02426**
MNBTS	Battery -temperature sensor	**020-02425**
MNKID-M-BKT-B	Boat mount bracket - black	**020-02428**
MNKID-M-BKT-W	Boat mount bracket - white	**020-02427**
MNKID-ASSY KIT-B	KID Assembly Kit - black	**020-02430**
MNKID-ASSY KIT-W	KID Assembly Kit - white	**020-02429**
MNKID-CDT KIT	KID Conduit Kit	**020-02431**
MNKID-BREAKER-30A	Replacement 30 A breaker for KID charge control	**053-03074**
MNBRAT	BRAT 20 A with load or 30 A without load PWM charge controller	**020-02435**

Magnum-Dimensions

NEW! Magnum PT-100 Charge Controller

The **PT-100** is an MPPT (Maximum Power Point Tracker) charge control with a maximum 100 A output. It can charge 12, 24, and 48 VDC battery banks with typical 99% efficiency. It comes standard with both arc-fault detection (not currently listed to UL 1699B) and ground-fault protection (GFP) which eliminates the need for a separate GFP breaker assembly. The array open-circuit voltage can be as high as 200 VDC + battery voltage or 240 VDC, whichever is lower. The array operating voltage is up to 187 VDC, and battery-charging voltage range is 10 to 66 VDC.

An auxiliary dry-contact relay is available for control of generator start or load shedding or similar functions. The wiring box can be separated from the control for convenient installation and ease of service. There is extensive electronic protection for PV short circuit, high voltage, over-current, and power derating with over-temperature.

A digital screen and LED indicators provide system information. There is internal data logging with harvest information data up to 255 days. Use the Magnum system remote display to read this information. Firmware is user upgradeable using downloaded files. Use 300 VDC breakers (see Electrical Distribution Parts) for power source voltages over 150 VDC. On the battery side of the controller, breakers need only be rated for the highest battery-charging voltage.

Listed to UL 1741 and CSA C22.2 No. 107.1, CE. Covered by a five-year warranty and made in USA.

NEW! Magnum ACLD-40 AC Diversion Charge Controller

The **ACLD-40** diversion charge control is made specifically for battery charge control in an AC-coupled grid-tied system. It provides PWM (Pulse-Width Modulation) three-stage battery charging utilizing common AC heater loads when an AC-coupled system is functioning in off-grid mode. This is more effective than the on/off mode used in most AC-coupled systems for getting the battery to a full state of charge during extended utility outages. Up to 4,000 W of AC loads can be utilized with the option of having primary and secondary loads. It works with 12, 24, and 48 VDC battery systems, and must be connected to an MS-PAE inverter system. Listed to UL 1741 and CSA C22.2 No. 107.1. Covered by a three-year warranty extended to five years when used with a Magnum MP or MMP panel and made in USA.

Maximum PV Array				
Model	**Description**	**Dimensions (H" x W" x D")**	**Weight**	**Item code**
PT-100	Magnum 100 A MPPT charge control	15.5 x 8.5 x 4.0	13.6 lbs	**020-06371**
ACLD-40	Magnum 4 kW AC Load Diversion Control	13.75 x 11.5 x 7	20 lbs	**020-06372**

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Your customers have come to rely on Magnum Energy products for their vital off-grid applications. Easy-to-install, easy-to-use, and reliable. We have expanded our balance of system components with the new PT-100 Charge Controller. The PT-100 links with Magnum Inverter/Chargers to provide a complete solution to maximize their PV yield.

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Sensata Technologies

Schneider Electric

Schneider Electric XW-MPPT60-150 Charge Controller

The **XW-MPPT60-150** can be used with PV arrays at voltages up to 150 VDC and can support an output of up to 60 A for battery voltages between 12 to 60 VDC. Maximum power point tracking (MPPT) maximizes energy harvest and provides increased flexibility in module selection and string sizing.

A large aluminum heat sink eliminates the need for an internal fan for added reliability. Built-in ground fault protection (GFP) eliminates the need for a separate GFP breaker. The XW-MPPT60-150 can be mounted on the side or top of the XW power distribution panel, or used stand-alone in other PV systems. The front panel features a 2-line 16-character display and 4 buttons for configuration and system monitoring. A **battery temperature sensor** is included with the controller.

The charge controller has a configurable single-function auxiliary output (producing 5 to 13 VDC at 200 mA) that can drive a relay for load control or activate devices, such as vent fans or indicator alarms. The XW-MPPT60-150 is able to communicate its settings and activity to other Xanbus- enabled devices, such as XW Series inverter/chargers, the System Control Panel II **(SCP)**, XW Automatic Generator Start **(XW-AGS)**, and other XW-MPPT solar charge controllers through the Xanbus network.

The dimensions are 14"H x 5"W x 5"D, weight is 12 lbs and it is covered by a five-year warranty with an optional extension to 10 years. Listed to UL 1741 for the U.S.A. and Canada.

Schneider Electric XW-MPPT80-600 Charge Controller

The **XW-MPPT80-600** can accommodate open circuit voltages of up to 600 VDC, which reduces wiring needs, increases module selection and string sizing flexibility, and enables greater distance between the power source and battery bank. The MPPT PV array input window is 195 to 550 VDC, which supports an output of up to 80 A for 24 or 48 VDC battery banks. Standby power draw is less than 1 W.

The charge controller has a configurable single-function auxiliary output to drive a load control relay or to activate devices such as vent fans or indicator alarms. Full output current of 80 A is available without de-rating in ambient temperatures up to 113 °F (45 ºC). Over-temperature protection de-rates the power throughput when ambient temperatures are higher. The XW-MPPT80-600 also features protections for input over/under voltage, output over current, and back-feed (reverse current). Built-in ground-fault protection (GFP) eliminates the need for a separate GFP breaker. This unit is configurable for positive, negative, and ungrounded PV systems.

The XW-MPPT80-600 can be used with the XW power distribution panel, or stand-alone in other PV systems, with a **Square-D HU361RB** 600 VDC array disconnect. For two strings, wire two poles of the disconnect into the controller terminals. Use a 100 A breaker on the battery side of the control.

A **battery temperature sensor** is included with the controller. The XW-MPPT80-600 is compatible with Xanbus-enabled devices, such as the XW Series inverter/charger, the System Control Panel, XW Automatic Generator Start Module, and other XW solar charge controllers through the Xanbus network. It can also be installed in a stand-alone mode with an XW System Control Panel.

XW-MPPT80-600 dimensions are 30"H x 8.63"W x 8.63"D, weight is 29.8 lbs. and it is covered by a five-year warranty with an optional extension to 10 years. Listed to UL 1741 and CSA 107.1 for the U.S.A. and Canada.

Schneider Electric XW Charge Controllers		
Model	**Description**	**Item code**
XW-MPPT60-150	XW 60 A 150 VDC MPPT charge control	**020-08040**
XW-MPPT80-600	XW 80 A 600 VDC MPPT charge control	**020-08048**
SQD HU361RB	PV Array disconnect switch for MPPT80-600 charge controller	**053-02312**
XW SCP	XW System Control Panel - provides central user interface for Xanbus network	**300-00128**
XW AGS	XW Automatic Generator Start Module	**030-01183**

Schneider Electric C-35, C-40 and C-60 PWM Controllers

The Schneider Electric C-35, C-40, and C-60 PWM (pulse-width modulation) controllers can be used as either PV charge controllers, DC load controllers or DC diversion regulators in 12 and 24 VDC systems (the C-40 can also be used in 48 VDC systems). Two controllers can be used together to provide multiple functions.

As DC load controllers, they disconnect the load at a user-defined low voltage and reconnect at a higher voltage reconnect point. As diversion controllers, they send excess power to a diversion load (see Controls and Relays) to regulate hydroelectric or wind generators. The maximum current throughput is reduced by 25% when used in diversion mode.

All Schneider Electric C-Series charge controllers have field-adjustable bulk and float set points and perform automatic equalization every 30 days or whenever low-voltage disconnect (LVD) is reached. Equalization can be manually initiated with automatic shut-off. The optional **BTS-15** Battery Temperature Sensor can be used to increase accuracy of the control algorithms. The optional **CM/R50** display shows battery voltage, array current and power, cumulative amp-hours, and a separately resettable "trip" amp-hour measurement. The digital display can be mounted on the front of the charge controller, or with a cable for remote mounting in a double-gang electrical box up to 100' away.

These controllers are listed to UL 1741 and CSA 22.2 No 107.1-95 and covered by a two-year warranty.

Schneider Electric C-Series PWM Charge Controllers				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
C-35	Charge/Load/Diversion controller	12 or 24 VDC	13.6 lbs	**020-06371**
C-40	Charge/Load/Diversion controller	12, 24, or 48 VDC	40 A	**020-08005**
C-60	Charge/Load/Diversion controller	12 or 24 VDC	60 A	**020-08009**
BTS-15	Battery temperature sensor with 15' cable (C-series only)			**020-08025**
CM/R50	Remote display with 50' cable			**020-08019**

Schneider Electric C-12 Charge & Lighting Controller

The C-12 controller is PWM microprocessor-based and has a 12 A low-voltage disconnect (LVD) and an automatic lighting control, making it well suited for small remote loads such as signs, cabins and bus shelters. The lighting control activates the light at dusk, has an adjustable duration timer for 2 to 8 hours of run time, and can be set to run until dawn. The LVD shuts off the load when the battery voltage falls below a user-defined set-point.

Use one of the C-Series **Battery Temperature Sensors** for more accurate battery charging.

For use in 12 VDC systems only. The C-12 can be mounted outdoors. Its dimensions are 6.5" x 4.3" x 1.5" and it is UL listed and covered by a two-year warranty.

Schneider Electric C-12 Charge/Lighting Controller				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
C-12	Schneider C-12 Charge controller / Lighting controller	12 VDC	12 A	**020-08002**

Morningstar

TriStar MPPT 600 VDC Charge Controllers

The **TS-MPPT-600V** uses Morningstar's TrakStar™ MPPT technology coupled with the widest PV input operating-voltage range available in a PV controller. The high-speed sweeping algorithm of the TrakStar™ MPPT technology enables this charge controller to harvest the maximum energy from a solar array under all ambient conditions.

The TS-MPPT-600V charge controllers are rated for 60 A output to charge 48 VDC battery systems, and can be programmed to charge 24 VDC or 60 VDC battery systems. Their wide input operating voltage range of 100-525 VDC, 600 VDC maximum open-circuit voltage limit, and buck-boost design, allow flexible string sizing that also mitigates PV shading. A four-stage charging algorithm helps to optimize battery health.

The TS-MPPT-600V controller is Ethernet enabled for remote communications, data logging, adjustability, and metering. Communication ports/interfaces include Ethernet, EIA-485, RS-232 and MeterBus.

Built-in lightning protection protects the circuitry from nearby lightning-induced voltage/current spikes. The large heat sink provides convective cooling without fans, so there are no moving parts. Continuous full power operation up to 45 °C ambient temperatures. The printed circuit boards are conformal coated for protection against moisture and dust. Self-diagnostics and electronic error protections help reduce the risk of installation missteps.

The TriStar MPPT 600 V charge controller is available with or without a pre-wired DC Disconnect Box. The pre-wired DC Disconnect Box version, the **TS-MPPT-60-600V-48-DB**, can be used with positively-grounded or negatively-grounded PV systems and has both array and battery disconnects.

NEW! TriStar MPPT 600 VDC Charge Controllers w/ Array Transfer Switch

The TriStar charge controller is now available as the **TS-MPPT-60-600V-48-DB-TR** with an array transfer switch. This 30 A, 600 VDC double-pole, double-throw switch will enable the Tristar to be installed between the PV array and a grid-tie inverter so that during a utility outage, the array can be switched to charge a battery-backup system. This arrangement does not require any compatibility between the grid-tie inverter and battery inverter, and is extremely reliable as a retrofit backup-power solution to a grid-tie PV system. The backup system can be made to fit only the backup requirements, not the equipment requirements. A larger PV array can be fed into one charge control for higher output during cloudy periods, and will simply limit the charge at 60 A (or lower setting) when there is more power available from the array.

The **TS-MPPT-60-600V-48-DB-TR-GFPD** is the same control with transfer switch, and includes Morningstar's advanced ground-fault-protection device with the control.

A battery-temperature sensor (**RTS**) is included. Wire terminals accept #14 to #2 AWG wire. All units are NEMA1 rated for indoor installation (IP20). Listed to UL 1741 and Canadian CSA C22.2 No. 107.1.01. FCC Class B Part 15 compliant. Ambient operating temperature range: -40 ºF to +113 ºF (-40 ºC to +45 ºC).

Morningstar TriStar MPPT 600 VDC Charge Controllers

Model	Description	Dimensions (H" x W" x D")	Weight	Item code
TS-MPPT-60-600V- 48	TriStar 60 A/600 VDC 48 V MPPT charge controller	15.4 x 8.7 x 5.9	19.8 lbs	**020-01103**
TS-MPPT-60-600V-48-DB	TriStar 60 A/600 VDC 48 V MPPT charge controller with DC disconnect	21.4 x 8.7 x 5.9	28.1 lbs	**020-01104**
TS-MPPT-60-600V-48-DB-TR	TriStar 60 A/600 VDC 48 V MPPT charge controller w/ DC disconnect and transfer switch	21.4 x 8.7 x 5.9	28.1 lbs	**020-01101**
TS-MPPT-60-600V-48-DB-TR-GFPD	TriStar 60 A/600 VDC 48 V MPPT charge controller w/ DC disconnect and transfer switch and GFPD	35.5 x 8.7 x 5.9	37 lbs.	**020-01102**

TriStar MPPT Charge Controllers

Morningstar's TriStar **TS-MPPT-30**, **TS-MPPT-45**, and **TS-MPPT-60** solar charge controllers with TrakStar™ Technology are advanced maximum power point tracking (MPPT) controllers for photovoltaic (PV) systems up to 3 kW. These controllers work well in a variety of applications including: residential and commercial systems, remote telecommunications, 12 VDC RV & marine applications, traffic & highway telemetry, industrial automation & control, and solar outdoor lighting. The TS-MPPT controllers can be used with arrays having a maximum open-circuit voltage of 150 VDC and have a charging range of 8 to 72 VDC.

Optional local and remote meters (see accessories section) provide detailed operating data, alarms and faults with three LED indicators to display system status. The TS-MPPT has a simple DIP-switch setup for plug-and-play operation or is fully programmable with a PC connection. The chassis on the TriStar controllers is isolated from the power circuits, allowing use in both negative and positive-grounded systems.

Extensive Networking and Communications Capabilities enable system monitoring, data logging, and remote adjustments. All models offer open standard MODBUS protocol and Morningstar's MS View software and allow a Serial RS-232 connection to a PC or laptop. In addition, the TS-MPPT-60 includes a built-in Ethernet port for a fully web-enabled interface to view data from a web browser to display up to 200 days of data logging and send email/text and messages. The TS-MPPT-60 also has a built-in RS-485 port for connecting to an EIA-485 network.

A remote temperature sensor (RTS) is included. Dimensions are 11.4"H x 5.1"W x 5.6"D, weight is 9.2 lbs. Covered by a five-year warranty and listed to UL 1741.

Morningstar TriStar MPPT Charge Controllers

Model	Description	Web enabled	Nominal maximum array power			Item code
			12 VDC	24 VDC	48 VDC	
TS-MPPT-30	TriStar MPPT 30 A charge controller	Yes*	431 W	862 W	1,724 W	**020-01116**
TS-MPPT-45	TriStar MPPT 45 A charge controller	Yes*	647 W	1,294 W	2,588 W	**020-01109**
TS-MPPT-60	TriStar MPPT 60 A charge controller	Yes	862 W	1,724 W	3,448 W	**020-01110**

* Requires HUB-1

TriStar MPPT Accessories

Optional TriStar Meters have a 2 x 16 character LCD display that shows extensive system and controller information, logged data, bar graph metering as well as alarms and fault codes for easy troubleshooting. The information may be shown in English, French, German, Portuguese or Spanish. The **TS-M-2-600V** can be mounted on the front of the TS-MPPT-60-600V-48 controllers, the **TS-M-2** can be mounted on the front of the TS-MPPT 150 VDC controllers. The **TS-RM-2** is a remote display with a 100 ft cable.

In addition to computer networking, Morningstar has developed the ability to set up a separate Meterbus network. The meter ports allow for communications between compatible products and Morningstar's MeterHub (**HUB-1**) allows multiple Morningstar products to communicate over an expanded Meterbus network to provide improved data monitoring, additional capabilities, and lower system cost. It enables multiple controllers to share a single TriStar meter and display individual controller data as well as aggregated data for the entire system. The HUB-1 also enables multiple controllers to share a single Relay Driver (**RD-1**). See Converters and Controls for more info on the RD-1

The **RSC-1** communications adapter converts an RS-232 serial connector to a standard RS-485 port and may be used to include the TS-MPPT-30, TS-MPPT-45 and TriStar (PWM) controllers and Morningstar's Relay Driver in an TIA-485 Network.

The Morningstar **GFPD-150V** and **GFPD-600V** are advanced ground fault detection and protection devices. See Electrical Distribution Parts for more information.

TriStar MPPT Accessories		
Model	**Description**	**Item code**
TS-M-2-600V	Optional digital display for front of all TS-MPPT-60-600V-48 controls	**020-01114**
TS-M-2	Optional digital display for front of all TS-MPPT 150 V controls	**020-01111**
TS-RM-2	TriStar Remote Meter Display with 100' cable	**020-01112**
HUB-1	MeterHub controller communications HUB for up to 15 devices	**020-01260**
RD-1	Relay driver with four independent outputs for system control functions	**020-01255**
RSC-1	Communications adapter RS-232 to TIA-485 (For TS-MPPT-30 and TS-MPPT-45 only)	**020-01256**
RTS	Remote temperature sensor (replacement – one RTS is included with the controller)	**020-01141**
GFPD-600V	DC Ground-Fault-Protection Device, two-pole, 50 A, 600 VDC	**053-03165**
GFPD-150V	DC Ground-Fault-Protection Device, two-pole, 60 A, 150 VDC	**053-03164**

SunSaver MPPT 15 A Charge Controller

The SunSaver MPPT (Maximum Power Point Tracking) charge controller is designed for 12 and 24 VDC battery charging from a PV array with a maximum open circuit voltage of 75 VDC. Use up to three 36-cell PV modules in series or a single 60-cell or 72-cell module to provide up to 200 W when charging a 12 VDC battery or up to 400 W when charging a 24 VDC battery. The SunSaver MPPT maximizes the output of the PV array by rapidly finding the array's peak power point with extremely fast sweeping of the entire I-V curve, providing an estimated 5-25% power boost over PWM or simple on-off controllers, especially during periods of colder temperatures and low battery voltages when it is most needed.

The controller features electronic protection from short circuit, overcurrent, reverse polarity, high temperature, high voltage, lightning, and transient surges. An adjustable low-battery load disconnect protects the battery from over-discharge. LED indicators indicate charging, low-battery and faults. The optional meter provides detailed system information, 30 days of logged data, alarms, and faults. The **SS-15MPPT** has a simple DIP-switch setup for plug-and-play operation or is fully programmable for custom and advanced programming with a PC connection using the **PC MeterBus Adapter (MSC)** and Morningstar's **MSView** software (available for free on Morningstar's website). Also compatible with Morningstar's **MeterHub** (see previous page). The **UMC-1** communications adapter converts the Morningstar MeterBus RJ-11 electrical interface to a standard USB 2.0 interface which allows communication between a Morningstar charge controller or inverter and a PC computer.

The SunSaver MPPT now features programmable lighting control for up to four time periods and is adjustable with respect to hours/minutes after/before – Dusk/Dawn/Solar Midnight/Solar Noon. Mounts on DIN rail with DIN-1 rail clip.

SS-15MPPT dimensions are 6.6"H x 2.75"W x 2.2"D, weight is 1.65 lbs, and it is covered by a five-year warranty. Listed to UL 1741 CSA 107.1 for U.S.A. and Canada

Morningstar SunSaver MPPT Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
SS-15MPPT	SunSaver MPPT charge controller	12 or 24 VDC	15 A	**020-01261**
RM-1	SunSaver MPPT remote meter			**020-01258**
RTS	Battery-temperature sensor			**020-01141**
MSC	MeterBus adapter			**020-01257**
UMC-1	Communications adapter Morningstar MeterBus to USB			**020-01251**
DIN-1	Din-rail clip - each			**020-01259**

TriStar PWM Charge Controllers

The **TriStar** pulse-width modulation (PWM) controllers can operate as solar charge controllers, load controllers, or diversion regulators in 12, 24 or 48 VDC systems. They can also be custom programed for 36 VDC. Two or more controllers can be used to provide multiple functions. PWM may be changed to on/off operation to prevent telecom noise.

Two models are available with current ratings of 45 A and 60 A. Seven different set points are selectable via DIP switches for plug-and-play operation. An RS-232 communications port enables PC or laptop connection to adjust controller set points, to download internally-logged data, or to configure detailed PC data logging. A PC can communicate with the TriStar via open-standard MODBUS protocol and Morningstar's MS View software. The RSC-1 communications adapter can be used to convert the RS-232 serial connector to TIA-485 to be included in an TIA-485 network.

The TriStar also has a lighting control feature with 7 DIP-switch presets or custom programmed settings with up to two ON-OFF time periods after/before dusk and dawn.

An optional **TS-M-2** Digital Display can be mounted on the front of the controller or up to 100' away using four-conductor phone cable with RJ-11 jacks. The meters can provide in-depth system information, including 60 days of internally-logged data. They can also be connected to a MeterHub network with the **MeterHub (HUB-1)** to be displayed on a TriStar Meter or networked with a Relay Driver for relay switch operation.

Battery-temperature compensation may be added with the optional **Remote Temperature Sensor (RTS)**. Dimensions: 10.25"H x 5"W x 2.8"D, weight is 3.5 lbs. and covered by a five-year warranty. Listed to UL 1741 for U.S.A. and Canada.

Morningstar TriStar PWM Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
TS-45	TriStar 45 charge controller	12, 24, or 48 VDC	45 A	**020-01105**
TS-60	TriStar 60 charge controller	12, 24, or 48 VDC	60 A	**020-01108**
RTS	Battery-temperature sensor			**020-01141**
TS-M-2	TriStar Meter-2 mounts on front of charge controller			**020-01111**
TS-RM-2	TriStar Remote Meter-2 display with 100' cable			**020-01112**

ProStar PWM Charge Controllers

ProStar (**PS**) PWM charge controllers have automatic equalization and temperature compensation, and provide four-stage charging including a monthly equalization charge. The ProStar controllers can be used on 12, 24, and 48 VDC systems with AGM, gel, and flooded lead-acid batteries. Front-panel LEDs indicate charging status and state-of-charge. Reverse-polarity protection on input and output prevents inadvertently damaging the controller. Short-circuited loads are automatically disconnected.

M models include an LCD meter to display battery voltage, PV charging current, and load current. Low-voltage disconnect (LVD) is current-compensated to prevent false disconnect when the battery is heavily loaded. Internal circuitry is conformal coated to guard against corrosion.

ProStar dimensions are 6.01"H x 4.14"W x 2.2"D and it is covered by a five-year warranty.

Morningstar Prostar PWM Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
PS-15	ProStar 15	12 or 24 VDC	15 A	**020-01120**
PS-15M	ProStar 15 with digital display	12 or 24 VDC	15 A	**020-01123**
PS-15M-48	ProStar 15 48 VDC with digital display	48 VDC	15 A	**020-01126**
PS-15M-48-PG	ProStar 15 48 VDC with digital display, positive ground	48 VDC	15 A	**020-01129**
PS-30	ProStar 30	12 or 24 VDC	30 A	**020-01132**
PS-30M	ProStar 30 w/ digital display	12 or 24 VDC	30 A	**020-01135**
PS-30M-PG	ProStar 30 w/ digital display positive ground	12 or 24 VDC	30 A	**020-01138**
RTS	Remote temperature sensor			**020-01141**

SunSaver Gen3 Charge Controllers

SunSaver Gen3 controllers are advanced PWM solar battery charging and load controllers for smaller stand-alone 12 and 24 VDC PV systems. A rugged anodized-aluminum case, marine-rated terminals, and epoxy-encapsulated electronics enhance durability. A temperature-compensation sensor in the charge controller varies full-charge voltage with temperature.

SunSavers are field-selectable for sealed or flooded batteries and have a four-stage battery charging process (including auto-equalization for flooded batteries) optimized for long battery life and improved system performance. Self-diagnostics and electronic error protection prevent damage when installation mistakes or system faults occur and reset automatically when resolved. The Gen3 controllers include a multi-color status LED as well as three Battery LED indicators, which together communicate system status, battery state of charge and 13 possible error conditions. The terminal cover prevents contact with the wiring terminals. The load output connections can provide power to DC loads up to the unit's current rating, and "L" models provide low-voltage disconnect (LVD) for connected loads. Telecom mode and 15 VDC charge limit for sensitive loads.

Negative ground only. Operating temperature range of –40 °C to +60 °C.

SunSaver dimensions are 6"H x 2.2"W x 1.3"D. These Gen3 SunSaver Controllers are approved for Class 1 Div 2 for hazardous locations and are Listed to UL1741 for the U.S.A. and Canada, CSA C22.2 No. 107.1-01 certification and are covered by a five-year warranty.

Morningstar TriStar MPPT 600 VDC Charge Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**LVD current**	**Item code**
SS-6-12V	SunSaver	12 VDC	6 A	N/A	**020-01245**
SS-6L-12V	SunSaver with LVD	12 VDC	6 A	6 A	**020-01248**
SS-10-12V	SunSaver	12 VDC	10 A	NA	**020-01230**
SS-10L-12V	SunSaver with LVD	12 VDC	10 A	10 A	**020-01233**
SS-20L-12V	SunSaver with LVD	12 VDC	20 A	20 A	**020-01239**
SS-10L-24V	SunSaver with LVD	24 VDC	10 A	10 A	**020-01236**
SS-20L-24V	SunSaver with LVD	24 VDC	20 A	20 A	**020-01242**
DIN 1	DIN-rail clip for mounting SunSaver and SunLight controllers on a DIN rail - each (two needed per controller)				**020-01259**

SunLight Charge Controller with Lighting Control

The SunLight (SL) is a SunSaver Gen2 controller that includes a rotary switch which allows it to turn on the loads after dusk for 2, 4, 6, 8, or 10 hours. One option turns loads on at dusk then off and on again before dawn. In this configuration, you can choose the following settings (in hours): 3/off/1, 4/ off/2, or 6/off/2. "On" from dusk to dawn is also possible. A test button turns light(s) on for five minutes. Covered by a five-year warranty with dimensions of 6.6"H x 2.2"W x 1.3"D.

Morningstar SunLight Charge/Lighting Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**LVD current**	**Item code**
SL-10-12V	SunLight with LVD	12 VDC	10 A	10 A	**020-01218**
SL-20-12V	SunLight with LVD	12 VDC	20 A	20 A	**020-01224**
SL-10-24V	SunLight with LVD	24 VDC	10 A	10 A	**020-01221**
SL-20-24V	SunLight with LVD	24 VDC	20 A	20 A	**020-01227**

SunGuard Charge Controller

The SunGuard **SG-4** uses the same charging circuit as the SunSaver and works well as a 12 VDC, low-power controller for up to 75 W of PV module(s). Since it is epoxy encapsulated, it can be used outdoors in harsh environments. The SunGuard's dimensions are 2.5"H x 2"W x 1.6"D with wire leads for connecting module and battery, and it is covered by a five-year warranty.

Morningstar SunGuard Charge Controller				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
SG-4	SunGuard	12 VDC	4.5 A	**020-01215**

SunKeeper Charge Controller

Morningstar's SunKeeper solar controller provides a low cost regulated output directly from the solar module to maximize battery life in small solar power applications. The SunKeeper is epoxy encapsulated and rated for outdoor use. By mounting directly to the module junction box and wiring through the junction box knockout, the connection is weather-proof. This eliminates the need for an additional housing for the controller. It's designed to mount in a ½" knockout in a PV module junction box or other enclosure.

The SunKeeper is available in 6 A or 12 A versions for small 12 VDC systems, and provides PWM three-stage charging. Includes temperature compensation at the controller or alternatively at the battery when used with the optional Remote Temperature Sensor. A bi-color LED indicates solar charging, regulation, normal nighttime operation, and any controller or system faults

The SunKeeper has been designed with extremely efficient power electronics and is rated to 70 °C so it can be mounted behind a PV module. The SunKeeper is also certified for use in Class 1, Division 2 hazardous locations, making it well suited for solar powered oil/gas applications. It's covered by a five-year warranty and listed to UL 1604 and CSA 22.2.

Morningstar SunGuard Charge Controller				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
SK-6	SunKeeper 6	12 VDC	6 A	**020-01252**
SK-12	SunKeeper 12	12 VDC	12 A	**020-01253**
RTS	Remote battery temperature sensor			**020-01141**

SunSaver Duo RV Charge Controller

The SunSaver Duo two-battery charge controller will charge two separate and isolated batteries at the same time, such as a 'house' battery and an engine battery in an RV or yacht. This controller also includes a backlit remote meter that may be flush or surface mounted, and displays alpha-numeric and graphical information about the solar power system status. Epoxy-encapsulated electronics for environmental protection. User adjustable via DIP switch or connection to a personal computer.

Optional Remote Temperature Sensor for battery bank. Covered by a five-year warranty.

Morningstar SunGuard Charge Controller				
Model	**Description**	**DC system voltage**	**Charge / load current**	**Item code**
SSD-25RM	SunSaver Duo with remote meter	12 VDC	25 A	**020-01250**
RTS	Remote temperature sensor			**020-01141**
MSC	MeterBus adapter			**020-01257**
UMC-1	Communications adapter Morningstar MeterBus to USB			

Blue Sky Energy

Solar Boost™ Charge Controllers

The Blue Sky Solar Boost charge controllers feature Maximum-Power-Point Tracking (MPPT), reverse-polarity protection, selectable charge-voltage set points, and an equalize function. An optional user-friendly digital display is available to monitor PV charge performance. The display shows battery voltage, solar current, charge current, and charge mode, either in the controller, as a remote panel installed up to 300' away, or both. Optional temperature compensation of charge voltage is also available to further improve charge controller and battery performance. Solar Boost controllers are available with or without the digital display and optional remote display. Covered by a five-year limited warranty.

Solar Boost 3024iL

The **SB3024iL** is designed to charge 12 and 24 DC battery systems from a 24 VDC array (maximum open-circuit voltage is 57 VDC). Maximum charge current is 40 A output at 12 VDC and 30 A at 24 VDC. It has an auxiliary output that can serve as a 20 A load controller or as a 2 A battery charger.

The **SB3024DiL** version converts the 20 A auxiliary output into a separate 20 A diversion-type charge controller for hydroelectric, wind, or similar generator-type power sources. The Diversion-Control upgrade also allows the 3024 to divert full available PV and generator power which is not required for battery charging to a useful purpose, such as heating water.

The SB3024iL and SB3024DiL are both IPN network interface enabled, and include load-control outputs so they can also serve as lighting controllers. An **IPNPro** remote is required to enable and configure dusk-to-dawn lighting control. Listed to UL 1741 and CSA STD E335-1/2E.

Solar Boost 2512i-HV and 2512iX-HV, and 1524iX

The **SB 2512i-HV** is a fully automatic three-stage charge controller system. A partial IPN network interface is also included to allow use of the Universal Communication Module (UCM), and IPN-Remote and IPN-ProRemote displays. This controller is a cost-effective choice for 12 VDC systems. Rated for 25 A maximum output with a 36-cell module, and 20 A with a 60-cell module.

The Solar Boost **SB2512iX-HV** and **SB1524iX** provide additional features including automatic or manual equalization, remote battery-temperature sensor input, full IPN network compatibility, and an auxiliary output. The user-configurable auxiliary output can serve as either a 25 A (15/20 in 1524iX) load controller or a 2 A auxiliary battery charger for a separate battery, such as the starter battery in an RV. The auxiliary output can also provide fully-adjustable dusk-to-dawn lighting control.

All three of these Solar Boost charge controllers can charge a 12 VDC battery from a single **60-cell module** or by using 36-cell modules. The **1524i**X can be used for 24 VDC systems, however two 36-cell modules in series, or a 72-cell module should be used in 24 VDC systems with this controller.

Open frame construction with conformal-coated electronics mounted to rear of 5.3" x 5.3" (13.5 cm x 13.5 cm) clear-anodized aluminum face plate. Black ABS corrosion-proof **mounting box is included**, 2.5" (6.4 cm) deep.

Blue Sky Energy IPN Charge/Lighting Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**Max PV array voltage**	**Item code**
SB3024iL	Charge controller	12 / 24 VDC	40 / 30 A[1]	57 VDC	**020-03158**
SB3024DiL	Controller with digital display	12 / 24 VDC	40 / 30 A[1]	57 VDC	**020-03159**
SB3024PDiL	Front cover with digital display for SB3024i – retrofit for unit without display				**020-03157**
SB2512i-HV	Charge controller	12 VDC	25 / 20 A[2]	50 VDC	**020-03164**
SB2512iX-HV	Charge controller	12 VDC	25 / 20 A[2]	50 VDC	**020-03165**
SB1524iX	Charge controller	12 or 24 VDC	20 / 15 A[2]	57 VDC	**020-03118**
930-0022-20	Battery-temperature sensor				**020-03149**

[1] With 12 VDC battery / with 24 VDC battery
[2] With 36-cell modules / 60-cell modules

Solar Boost 3000i

Blue Sky Energy's **SB3000i** panel-mount solar charge controller charges 12 VDC batteries at up to 30 A from conventional 36-cell 12 VDC PV modules (up to about 400 W), or with a single 60-cell PV module at up to 22 A of output current (up to about 290 W). The maximum input voltage limit is 50 VDC, so it cannot be used with72-cell modules.

Solar Boost 3000i's sophisticated three-stage charge control plus auto/manual equalization optimally charges flooded, gel and AGM lead-acid batteries. A user-configurable auxiliary output is also provided which can serve as a 20 A LVD load controller, 20 A lighting controller with LVD, or 2 A auxiliary battery charger for a second battery such as the engine-starting battery in an RV. All set-points for charge control and load control are user adjustable.

The LED display combines excellent readability with very low power consumption and includes an automatic night-time diming feature, or it may be turned off completely.

Solar Boost 3000i may also operate as an IPN Network Master controlling up to seven remote Blue Sky Energy IPN-compatible charge controllers such as the SB3024iL. All networked controllers display through the SB3000i's digital display and may share a battery-temperature sensor. Dimensions are 6.4"W x 4.6"H x 2.2"D. Operating temperature range of -40 ºC to +45 ºC. Can be panel or wall mounted using the optional surface-mount box (see Accessories).

Sun Charger 30 PWM Charge Controller

Blue Sky Energy's **Sun Charger 30** (**SC30**) panel-mount solar charge controller will charge a 12 VDC battery bank at up to 30 A from a 12 VDC (nominal) PV array, but cannot be used with 60-cell or 72-cell modules. It uses PWM charge voltage control (not MPPT) with a three-stage charge algorithm to charge flooded, gel, or AGM lead-acid batteries. All charge settings are user adjustable.

The built-in low-power LED digital display combines readability with very low power consumption, includes an automatic night-time diming feature and may be turned off completely.

Conformal-coated electronics, anodized face plate and stainless-steel fasteners resist corrosion. Built-in protection for reverse polarity, battery/PV swap, transient voltage, over-current, and over-temperature helps prevent installation errors from damaging the unit. The operating temperature range is -40 °C to+45 °C.

The **SC30-LVD** is similar to the SC-30 but includes a low-voltage disconnect & lighting-control feature via a 50 mA drive signal to a power relay with a 12 VDC coil (not included - see Converters and Controls for the Omron SPST 10 A relay which draws 44 mA) The dimensions of the Solar Boost Sun Charger 30 are 4 5/8"H x 6 3/8"W x 1 1/4"D and is covered by a five-year warranty.

Blue Sky Energy RV Charge Controllers				
Model	**Description**	**System voltage**	**Max charge current**	**Item code**
SB3000i	30 / 22 A MPPT panel-mount charge controller	12 VDC	30 / 22 A*	**020-03121**
SC30	30A PWM panel-mount charge controller	12 VDC	30 A	**020-03180**
SC30-LVD	30A PWM panel-mount charge controller w/ low-voltage disconnect signal	12 VDC	30 A	**020-03181**
720-0011-01	Wall-mount box for SB3000i, SC30, SC30-LVD			**020-03119**
SC30-ADAPTER	7.5" x 4.6" (19.1 cm x 11.7 cm) Black-panel existing-cutout adapter. Covers existing large cutout & accepts SC30			**020-03184**
930-0022-20	Battery-temperature sensor			**020-03149**

*30 A with 36-cell modules and 22 A with 60-cell module

IPN Remotes and Optional Controller Accessories

Blue Sky Energy's Integrated Power Net™, or IPN Network provides an integrated charge-controller communication strategy. The advanced high-speed digital network allows up to eight IPN-capable charge controllers to communicate with each other and operate in a master/slave configuration. Charge parameters are set in the master, and the slaves automatically take on these settings and work with the master to behave as a single charge-control machine. The IPN Network also allows networked controllers to share an optional battery-temperature sensor and remote display. The IPN Network does not require an additional controller, display, or other special communication hardware or software to operate.

The Solar Boost 3024iL, 2512iX-HV, and 1524iX charge controllers include load-control outputs so they can also serve as lighting controllers. An IPN Pro-remote is required to enable and configure dusk-to-dawn lighting control but does not need to remain connected to the system.

The **IPNPRO** Remote combines charge-controller monitoring and battery system monitoring in a single remote display, eliminating the need for a separate battery monitor. A high-accuracy calculation of remaining battery capacity compensates for a variety of factors, including charge/discharge current, battery size, type, and temperature. Information learned from past battery behavior is used to continuously improve metering accuracy. The IPN-ProRemote also monitors and controls Blue Sky's IPN-based charge controllers. It can monitor both the combined total and individual status of up to 8 IPN charge controllers on a single IPN network. Dimensions are 4½"H x 4½"W x 1½"D (11.4 cm x 11.4 cm x 3.8 cm) and it fits in a standard duplex wall-mount box.

The **IPNREM** remote display provides basic monitoring for IPN compatible charge controllers. The unit displays battery voltage, output current and charge controller system status for up to eight controllers on a single IPN network. An LED display is used to provide readability in any lighting. The charge-status indicator displays system status and battery state-of-charge. When the battery is being charged, the display toggles between battery voltage and charge-controller-output current. The current display can be configured to show the total output current from all controllers on the IPN network, or the output current from a particular controller. Multiple IPN remote displays can be placed on a single IPN network even if an IPN Pro-Remote is already present. Dimensions are 2 ½"H x 3"W x 1 □"D (6.3 cm x 7.6 cm x 2.8 cm).

The Universal Communications Module (**UCM**) acts as a bridge between Blue Sky's IPN Network and external systems. A standard MODBUS RTU interface is provided both as isolated RS-485 and TCP\IP Ethernet based MODBUS/IP and includes a built-in HTTP web server allowing data view and parameter setup with a standard web browser either locally or globally over the Internet.

The **Battery Temperature Sensor** has 20' of cable can be used with any Solar Boost controller. Optional shunts allow the IPN remotes to monitor other charging sources and loads.

The IPN Remotes are designed to be panel mounted (through a hole in a wall or panel). Use the **MTG BOX 2512** Wall-Mount Box for surface mounting.

Blue Sky Energy IPN Network Monitors and Controller Accessories		
Model	**Description**	**Item code**
IPNPRO-S	IPN Pro-Remote display with 500 A shunt	**020-03161**
IPNPRO	IPN Pro-Remote display	**020-03162**
IPNREM	IPN-Remote	**020-03163**
UCM	Universal Communication Module – IPN to RS-485/Ethernet connection module	**020-03166**
930-0022-20	Battery-temperature sensor	**020-03149**
CS-100	Remote shunt 100 A / 100 mV	**028-09245**
CS-500	Remote shunt 500 A / 50 mV	**028-09253**
720-0011-01	Wall-Mount box for SB2000E, SC30, SC30-LVD, 3000i	**020-03119**
MTG BOX 2512	Plastic ABS wall-mount box - 2.50" (7 cm) deep. For SB2512i(X) and SB1524iX	**020-03120**

Atkinson

Atkinson Electronics Lighting Controllers

The fully-waterproof PVLC series charge and lighting controllers can be used with 12 or 24 VDC systems and are well suited for operating area lighting or signage. MD-designated controllers have a motion sensor to activate the light or load when motion is sensed. Controllers with and without motion detectors are available in 15 A and 40 A versions.

All controllers have low-voltage load disconnect (LVD) and temperature compensation and can be used with sealed or flooded batteries.

Atkinson Lighting Controllers				
Model	**System voltage**	**PV and load current**	**Dimensions (H" x W" x D")**	**Item code**
PVLC-15	12 or 24 VDC	15 A	2 x 3 x 1.25	**020-05425**
PVLC-40	12 or 24 VDC	40 A	3.3 x 5.5 x 1.7	**020-05427**
PVLC-15MD	12 or 24 VDC	15 A	2 x 3 x 1.25	**020-05432**
PVLC-40MD	12 or 24 VDC	40 A	3.3 x 5.5 x 1.7	**020-05435**

Battery Meters

Battery-capacity meters serve as a fuel gauge for a battery bank and are an important part of any battery system, both to ensure usability and to properly maintain the battery bank. Simple battery-capacity meters read the voltage across the battery bank and determine a state of charge accordingly. More sophisticated monitoring systems also use a DC shunt to monitor charge and discharge amp-hours. In both cases, it is important that they be installed and calibrated according to manufacturer's instructions to ensure accuracy. See Battery-Based Inverters for battery meters that are deployed as part of a larger power system, such as OutBack's FLEXnet™ DC.

MidNite Solar

Battery-Capacity Meter

Designed to simplify battery management, this **Battery-Capacity Meter** can be used on 12, 24, 36, and 48 VDC battery systems using flooded, AGM, and gel batteries. LEDs on the upper dial show present battery capacity. Three lower LEDs show the time frame of the last full charge as "less than one week," "longer than one week," or "longer than two weeks." Handy for at-a-glance readings on golf carts, forklifts, or any battery-powered devices. The meter face is 5"W x 4"H.

MidNite Solar Battery Capacity Meter	
Description	**Item code**
MidNite Battery-Capacity Meter	**028-02260**

TM 2030 A-F

TM2030-RV-F

Bogart Engineering

TriMetric 2030 and 2030-RV

This meter operates on 12, 24 or 48 VDC. LEDs show volts, amps, and amp-hours. Amp-hours can be displayed directly or as "% full." One LED indicates charging and fully-charged states. Another LED indicates when charging or equalization is needed and warns of low battery-voltage events. The meters also record minimum and maximum voltage, days since last charge, days since last equalized, and total lifetime amp-hours withdrawn. The TriMetric can be located up to hundreds of feet away from batteries using inexpensive four-conductor twisted-pair meter wire. A shunt is required for operation. Use the 500 A shunt on a 12 VDC inverter larger than 800 W, or a 24 VDC inverter larger than 1,600 W. Use a 1,000 A, 100 mV shunt for systems with stacked inverters or where continuous current is over 300 A. The 1,000 A/100 mV shunt has the same resistance as the 500 A/50 mV shunt and may be used interchangeably. Order the shunt separately. These meters work with battery banks up to 2,500 Ah.

The positive lead to the TriMetric should be fused with the included 1 A fuse. This meter can be mounted flush or with a wire mold. Trimetric meters are made in U.S.A., have dimensions of 4.5"W x 4.75"H, and are covered by a two-year warranty.

Bogart Engineering TriMetric Amp-Hour Meters and Accessories	
Description	**Item code**
TriMetric 2030-A-F amp-hour meter	**028-00028**
TriMetric 2030-RV-F amp-hour meter	**028-00027**
Surface-mount box	**028-00026**
Four-conductor 18 AWG wire	**050-01237**
Shunts	
500 A/50 mV shunt	**028-09253**
100 A/100 mV shunt	**028-09245**
1,000 A/100 mV shunt	**028-09254**

PM100D

Bogart Engineering PentaMetric Battery Monitor

The PentaMetric Battery Monitor measures up to two separate battery systems with a common negative. The meter monitors battery current plus two charging sources/loads. The complete system consists of an input unit placed near the batteries, a display unit that can be placed up to 1,000' from the battery bank, and a computer-interface unit. It can monitor up to three shunts; for example, it can measure solar input, wind input, and battery state-of-charge. Audible and visual alarms warn of high and low battery conditions. An optional Windows software interface allows control of and access to all data from the computer. A relay output enables control of a generator or external alarm. The PentaMetric is covered by a standard two-year warranty.

Basic measurements

- Two voltage channels: 8-100 VDC
- Three current channels
  - 200 ± 0.01 A with 100 A/100 mV shunt
  - 1,000 ± 0.1 A with 500 A/50 mV or 1,000 A/10 mV shunt
- Temperature -20 °C to +65 °C

Secondary measurements

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

Data-logging functions

The Pentametric Battery Monitor has three data-logging modes that can run simultaneously. With the computer interface, all three types can be output to a spreadsheet file. Periodically Logged data mode records three amp-hour channels, two watt-hour channels, temperature max/min, voltage, and current at regular intervals (once per day to once per minute). Battery Discharge Voltage Profile mode logs voltage and current every time the charge level changes by 5% (or 10%) for up to two battery systems. Battery Cycle Efficiency mode documents system efficiency for up to two battery systems.

500 A/50 mV shunt

100 A/100 mV shunt

1,000 A/100 mV shunt

Bogart Engineering PentaMetric Battery Monitor and Accessories	
Description	**Item code**
PentaMetric display unit PM-100D	**028-00011**
PentaMetric input unit PM-5000U	**028-00013**
Computer interface PM-100C with RS232 port	**028-00015**
Computer interface PM-101CE with Ethernet	**028-00016**
Computer interface PM-101USB with USB	**028-00010**
Temperature sensor TS-1	**028-00018**

Shunts

Use these shunts with Bogart Engineering TriMetric and Pentametric Battery Monitoring systems. These shunts can also be used in other types of DC amp meters that use a remote shunt.

Shunts	
Description	**Item code**
500 A/50 mV shunt	**028-09253**
100 A/100 mV shunt	**028-09245**
1,000 A/100 mV shunt	**028-09254**

AC Kilowatt-Hour Meters

These meters are like those found near a typical residential or commercial utility-service entrance and can be used to meet financing or incentive-program requirements for PV-system output metering. Be sure to verify which meters are approved by the financing provider or incentive program you are using.

AC Kilowatt-Hour Meters

The ITRON LCD meter is the standard utility-grade meter seen on most homes. These reconditioned, certified, utility-grade meters are an economical means for keeping track of how much net energy is exported to the utility grid. The 028-03012 meter (Form 2S) works for 120 VAC or 120/240 VAC systems with a maximum current of less than 200 A.

AC Kilowatt-Hour Meters	
Description	**Item code**
Kilowatt hour meter Form 2S ITRON LCD Digital 240 VAC CL200	**028-03012**

Vision Meter

These utility-grade digital smart kilowatt-hour meters employ current transformers for extremely accurate measurement and long-term stability, even at low power levels. Non-volatile memory protects data in the event of a power failure. The Vision Meter can display kWh delivered, kWh received, kWh net, instantaneous demand, voltage, current, phase angle, and segment check.

Vision Meter Smart Kilowatt-Hour Meters	
Description	**Item code**
Vision kilowatt-hour meter form 2S	**028-03061**
Vision kilowatt-hour meter 3-phase form 14/15/16S	**028-03063**

Performance Based Initiative Approved Meters

These Smart meters appear on the gosolarcalifornia.org website list of approved meters for Performance Based Initiative (PBI) systems. The **ABB Alpha-A1D+** is designed for especially harsh climates and is suitable for 600 VDC applications.

The **Form 2S** meter is used for single-phase, 120/240 VAC, three-wire installations.

The **Form 9S** meter is used for three-phase, 208 VAC, four-wire delta installations.

The **Form 16S** meter is used for three-phase, 208 or 480 VAC, four-wire Wye installations

PBI Approved Kilowatt-Hour Meters	
Description	**Item code**
ABB kilowatt-hour meter - PBI APPROVED, single-phase Form 2S, SP-AB-ALPHA-A1D+-FM2S	**028-03093**
ABB kilowatt-hour meter - PBI APPROVED, three-phase Form 9S, PP-AB-ALPHA-A1D+-FM9S	**028-03094**
ABB kilowatt-hour meter - PBI APPROVED, three-phase Form 16S, PP-AB-ALPHA-A1D+-FM16S	**028-03095**

Analog Form 2S Meters

These are 120/240 VAC Form 2S meters with visual cyclometer and analog gauges, with 100 A and 200 A rated versions available. These meters are great for use as demonstration meters or for off-grid applications.

Itron Digital Meter with Cellular Modem	
Description	**Item code**
Analog kWh meter, EZ-read cyclometer, Form 2S, 240 V, 100A, Reconditioned	**029-09016**
Analog kWh meter, Form 2S, CL200, 200A, 240V, Reconditioned	**029-09018**

Kilowatt-Hour Meter Sockets

There are two types of kilowatt-hour meter bases available for single-phase two- or three-wire 100 A service, and each includes a sealing ring.

The cast, **Round** base has 1 ½" threaded holes in the top and bottom and is ***not*** UL Listed.

The sheet-metal four-terminal sockets are rated for 100 A or 200 A, 240 VAC, and are used with the Form 2S meter for 120/240 VAC systems. UL listed and NEMA 3R rated for outdoor use.

For three-phase systems, use the appropriate socket for the meter form. The **seven-terminal socket** is 13"W x 19"H, rated at 200 A, 600 VAC and is used with Form 16S meters. It is a ringless socket with a lever bypass, which allows removal of the meter without interrupting service. Use this socket for the Locus Energy L-Gate 320 monitoring option. UL listed and NEMA 3R rated for outdoor use. The **closing plate** is used to cover the overhead entry into the sheet metal base when entering from either the side or the bottom.

Kilowatt-Hour Meter Sockets	
Description	**Item code**
Kilowatt-hour meter socket 2S 120/240 VAC – Round, four-terminal	**028-03025**
Kilowatt-hour meter socket 2S 120/240 VAC NEMA 3R, 100 A, #12-1/0 AWG, four-terminal	**048-09220**
Kilowatt-hour meter socket 2S 120/240 VAC NEMA 3R, 200 A, #6 AWG-350 kcmil, four-terminal	**048-09200**
Kilowatt-hour meter socket 16S three-phase, four wire Wye, seven -terminal	**048-09215**
Closing plate	**028-03032**

Grid-Tie System Monitoring

As grid-tied solar PV systems become more popular, online monitoring is playing an increasingly important role in both residential and commercial systems. Most commercial PPA and residential leasing financiers require revenue-grade monitoring to be coupled with online reporting tools. Many incentive programs, particularly performance-based and renewable energy credit-based ones, also require accurate real-time monitoring and some form of automated reporting. Many commercial and residential customers want something they can point to when bragging about their solar PV system and an online monitoring system with a smart-phone app fits the bill nicely. Savvy installers are also finding that online monitoring enables them to be proactive in managing their brand and often pair a monitoring system with a service agreement that includes periodic cleaning and maintenance of the system. Whatever the motive, a good online monitoring system can help reinforce the value of a solar PV system for years after installation.

In addition to the proprietary monitoring offered by most inverter manufacturers, we offer a variety of solutions that work with most inverters to meet different application needs. Our monitoring partners can also set up branded solutions for your company that enable you to centrally monitor all of your installed systems while putting your brand in front of the end-users every time they view their system performance. Contact our AEE Solar (800-777-6609) for details.

EnGenius ENH202

EnPhase Power Line Carrier Ethernet Bridge Pair

Wireless Communications

EnGenius Outdoor-Rated Long-Range Wireless Bridge

The **EnGenius ENH202** is a long-range, commercial grade, 802.11b/g/n outdoor 2.4 GHz wireless access point/client bridge for transmitting monitoring data from a ground mount or remote building directly to a wireless router. Capable of ranges as far as 2.5 miles (limited to the range of the router). For long range transmission, two units may be needed with one unit located near the router. 64/128-bit WEP data encryption and WPA/ WPA2 data security protocols are supported. A MAC address filter can be used to limit network access to specific computers or devices.

Enphase Power Line Carrier – Ethernet Bridge Pair

The **Enphase Power Line Carrier** connects two Ethernet devices through existing electrical lines in place of a hard-wired Ethernet cable. One device is plugged in to a nearby wall socket and the other device is plugged into a socket near the router. Both devices should be plugged into a circuit fed by the same main/sub panel to avoid noise from other appliances interfering with the signal. An Ethernet cable is used to connect the bridge to either the monitoring device or router.

Ethernet Bridges	
Description	**Item code**
EnGenius outdoor-rated long-range wireless bridge	**029-01607**
Enphase Power Line Carrier - Ethernet bridge pair, EPLC-01	**030-03752**

Need assistance? Call your AEE Solar rep, or Sales Support at **800-777-6609**.

DECK

DECK Monitoring, now part of ALSO Energy, pairs advanced software with customer service to provide a flexible and scalable monitoring solution that is suitable for most residential and commercial applications. The customizable DECK Dashboard has many features to promote the end user's organization and generate green PR. DECK alarms and analytics provide clear, actionable data and responsive support services are available to assist in every aspect of system management.

DECK Monitoring

The monitoring solution from DECK is web-based software that lets you see your system data on computers and mobile devices. Each monitoring package includes a revenue-grade meter along with a gateway device to prepare data for the web. Data is pushed out through the local web network (or by a cellular modem for remote locations). Data goes first to DECK web servers, then it populates to your two web interfaces: the Dashboard and the Admin Panel. Here you will find a suite of software tools to help manage your system, along with customizable "green PR" tools to promote your project and organization.

Additional features for expanded monitoring capabilities:

- Inverter communications (available with most brands)
- On-site weather station
- Satellite irradiance data
- DC-side granular monitoring
- Wireless communication aids
- Touchscreen monitors
- Software contract extensions

DECK monitoring solutions are highly customizable. Contact AEE Solar with the particulars of your project to get a custom quote or go with one of the meter-based solutions on the following page.

Deck Residential and Light Commercial Monitoring Solutio

Deck Monitoring has released a new socket-meter-based solution that eliminates he need for on-site Internet connection. Each meter includes a cellular modem, so the installer won't have to deal with comunications wiring and IT connections. The meter will measure the total kWh production of your rsidential PV system. Data is recorded in 15-minute intervals throughout the day. Data sets are uploaded o DECK data servers once daily at midnight, so your website displays show data from the previous day. Also included is a five-year data plan from Verizon.

DECK Residential is meant for 120/240 VAC split-phase residential systems up to 200 A, and utilizes the I-210+c socket meter from GE. 2S meter socket not included.

Commercial Light projects must be three-phase four-wire projects with a system size no larger than 200 A. Qualifying systems also must not require any additional meters or devices; this solution is limited to one revenue-grade meter for total system generation. The Commercial Lite utilizes the kV2c meter from GE. 16S meter socket not included.

Deck Residential and Light Commercial Cellular Based Meters		
Deck #	**Description**	**Item code**
211A	Deck Residential meter with five years monitoring, Form 2S	**029-04099**
2121	Deck Residential meter with ten years monitoring, Form 2S	**029-04100**
211B	Deck Commercial meter with five years monitoring, Form 16S	**029-04101**
2120	DeckCommercial meter with ten years monitoring, Form 16S	**029-04102**
210A	Revenue-grade-meter, DataLogger and CT's, 100-277 VAC, five-year subscription, unassembled	**029-04000**
--	Kilowatt-hour meter socket 2S 120/240 VAC NEMA 3R, 200 A, #6 AWG-350 kcmil, four-terminal	**028-09200**
--	Kilowatt-hour meter socket 16S three-phase, four-wire Wye, seven-terminal	**048-09215**
--	Meter-socket closing plate	**028-03032**

Solar-Log 350 & GE Meter

Solar-Log 360 Including Self-Consumption CTs

Solar-Log 370 Including Ethernet & RS-485 Ports

Solar Data Systems

Solar-Log® Residential PV Monitoring and Metering

The Solar-Log® Residential PV Monitoring solution is integrated into a high-quality General Electric (GE) residential meter, and can be installed in a standard Form 2S meter socket for single-phase 120/240 VAC systems with up to 200 A output current. Direct connection and reporting is through the AT&T cellular network, with the cellular plan and portal access included for the initial five years. Additional five-year portal access and monitoring can be added at time of purchase, or in the future. Units utilizing the T-Mobile network are also available upon request. System performance can be viewed over the Solar-Log Dashboard monitoring portal, viewable on computer, iPhone, or Android devices. The monitoring system is compatible with both micro and string inverters, and certified Revenue Grade Metering (RGM) for incentive reporting.

The **Solar-Log 350 & GE Meter** is a plug-and-play device, and does not require onsite configuration, allowing portal view of the PV plant yield and revenue-grade reporting. The **Solar-Log 360** adds site power and self-consumption data from current transformers placed around the utility-feed connections, and allows plant owners to verify utility bills in addition to plant PV monitoring and reporting. The **Solar-Log 370** offers numerous I/O ports, like Ethernet and two RS485 ports that provide access to multiple inverters, weather stations, or for additional power management current transformers to be added.

Solar-Log WEB® Online Monitoring Portal

Solar-Log WEB® enables installers and their customers to monitor installed systems from either PC or Mac computers. The centralized control center provides easy management of an entire installed base of systems. Precautionary monitoring identifies faults quickly and easily to improve system uptime, increasing customer loyalty and revenue from service contracts. For commercial systems, damage scope analysis helps document insurance claims against loss of revenue due to system failure.

Solar-Log® Smart Phone Apps

The Solar-Log® Apps allow the convenient monitoring of solar PV plants from smart phones and tablets. Customized daily, monthly, and annually, and overall performance information is presented graphically and numerically in an easy-to-understand way. Both iOS (iPod / iPhone / iPad) and Android devices are supported.

Solar-Log Residential Revenue Grade Meter		
Model	**Description**	**Item code**
255850	Solar-Log 350 & GE Meter, with five-year cellular plan and portal access, AT&T Network	**029-06024**
255851	Solar-Log 360 & GE Meter, adds site consumption monitoring, current transducers included, AT&T Network	**029-06025**
255852	Solar-Log 370 & GE Meter, adds I/O ports allowing consumption monitoring, inverter-direct monitoring, and/or weather station through additional communication accessories, AT&T Network	**029-06026**

Solar-Log Accessories for Solar-Log 370 & GE Meter			
Model	**Application**	**Description**	**Item code**
220060	Solar-Log® Weather Monitoring	Weather monitoring kit, includes irradiation and module temperature sensors	**029-06309**
220061		Wind sensor - connects to irradiation sensor	**029-06310**
220062		Ambient temperature sensor - connects to irradiation sensor	**029-06311**
806320	Solar-Log Meter CTs	Solar-Log CT 200 A (200 A CT for Solar-Log® Meter - closed core 200 A:200 mA)	**029-06027**
255640		Solar-Log CT 100 A (100 A CT for Solar-Log® Meter - closed core 100 A:200 mA)	**029-06375**
255638		Solar-Log CT 100 A (100 A CT for Solar-Log® Meter - split core 100 A:200 mA)	**029-06376**

Locus Energy

Locus Energy offers pre-packaged metering and communications hardware with web-based software to provide monitoring solutions for solar PV and thermal integrators. Locus hardware ships preconfigured to upload system performance data to hosted servers. Installers and site owners can then track energy generation via customized web portals.

Installers have access to fleet monitoring tools to streamline operations and maintenance activities. Individual site owners are given logins to portals branded by their installers so they can easily visualize and understand how their systems are performing. The datalogger can communicate over Ethernet, power line carrier (PLC), or cellular networks. Data is transmitted only in outbound sessions over open ports requiring no additional network or firewall configuration. All data feeds are stored in nonvolatile memory and then uploaded with unique identifiers to provide maximum flexibility in online data presentation. LED lights indicate communication status without installers having to log in or call home. The datalogger is housed in a NEMA 3R enclosure for the **LGate 101**.

LGate 101

The **LGate 101** is a CT-based revenue-grade residential monitoring solution. It uses solid-core CTs to measure power. There are inputs for up to three CTs allowing the LGate to measure both solar-energy generation and whole-house electrical consumption. It can also gather data from up to 16 third-party devices simultaneously, which is collected via RS485 and Modbus RTU protocols. Hard-wired Ethernet is the preferred connection method, but the LGate also features a built-in 110 VAC outlet for easy installation of a PLC adapter or Ethernet bridge.

LGate 120

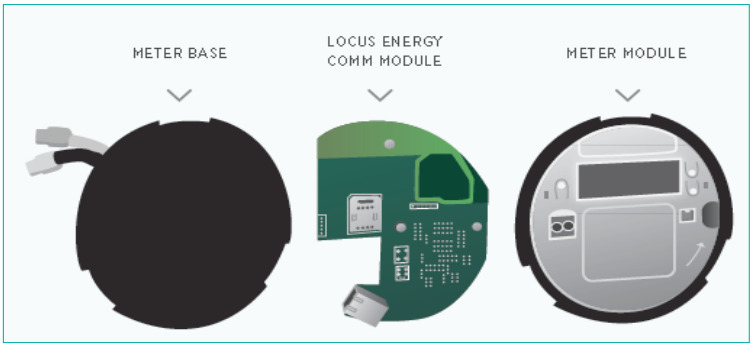
The **LGate 120** combines a 240 VAC revenue-grade, solid-state power meter with an integrated datalogger, communications gateway, and a 3G GSM cellular modem. These components work in conjunction to remotely monitor the performance of residential solar-energy installations regardless of panel or inverter type. The LGate 120 is a one-piece, completely-under-glass-meter, which installs easily using a standard Form 2S socket base. Performance data is uploaded in near real-time to the Locus Energy SolarOS monitoring platform, which provides a suite of tools and analytics for asset managers.

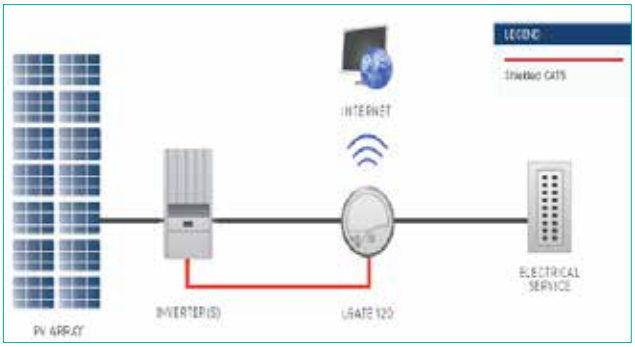
The communications gateway inside the LGate 120 supports plug-and-play connectivity through Ethernet or cellular network connection through AT&T. Additional system performance data, including inverter-direct from supported inverters and meteorological sensors, can be collected directly via RS-485 or Zigbee connections.

LGate 320

The **LGate 320** is a three-phase 208 or 480 VAC electronic watt-hour meter for remote monitoring of light commercial solar PV systems up to 320 A. Like the LGate 120, the LGate 320 combines a revenue-grade, solid-state power meter with an advanced communications gateway which can communicate over cellular or Ethernet networks.

The meter installs easily on a Form 16S meter socket. Additional system performance data, including inverter-direct from supported inverters and meteorological sensors, can be collected directly via RS-485 or Zigbee connections.





Locus Energy L Gate PV Monitoring Systems		
Model	**Residential bundles**	**Item code**
SPPVB5-101	Single-Phase Revenue-grade PV monitoring. Includes LGate101 data logger & five years PV monitoring	**029-05205**
SP-ADD-CONS-5YR	Two split-core CTs (200 A rated) & five years consumption monitoring	**029-05211**
SP-ADD-CONS-600-5YR	Two split-core CTs (600 A rated) & five years consumption monitoring	**029-05212**
LGate-120-5YR	LGate 120 single-phase revenue-grade PV monitoring. Includes socket meter, one time set-up fee, cellular modem, & five years PV monitoring. (Note: add cellular service plan below)	**029-05243**
CPLAN-ATT-1MB-5YR	Five-year cellular service plan AT&T - 1 MB (LGate 120)	**029-05247**
Light Commercial Bundles Including Metering Hardware and Monitoring Service		
LGate-320-5YR	LGate 320 three-phase revenue-grade PV monitoring. Includes socket meter (rated up to 320 A AC), one time set-up fee, cellular modem & five years PV monitoring. (Note: add cellular service plan above)	**029-05244**
CPLAN-ATT-10MB-5YR	Five-year cellular service plan AT&T - 10 MB (LGate 320)	**029-05248**
KPC	Hard drive pre-configured for kiosk	**029-02526**
KSOF-001	Kiosk software per location	**029-02525**
KCT-001	Kiosk custom tab or additional images	**029-05246**
Licensing and Data Hosting		
C-PVM-5YR	Three-phase PV data feed for five years	**029-02529**
C-LOM-5YR	Three-phase load monitoring for five years	**029-05236**
C-IDM-5YR	Large three-phase inverter-direct monitoring for five years	**029-02545**
C-MS-IDM-5YR	Mid-Size three-phase inverter-direct monitoring for five years	**029-05237**
C-SM-IDM-5YR	Small or single-phase inverter-direct monitoring for five years	**029-05238**
C-STM-5YR	String monitoring - first feed for five years	**029-05239**
C-COM-5YR	Commercial combiner-box monitoring - first feed for five years	**029-02547**
C-DCC-1YR	Commercial DC combiner-box monitoring - first feed for one year	**029-05240**
C-ADM-5YR	Additional feed for string or combiner-box monitoring ONLY	**029-05241**
Hardware Accessories		
WIS114-101	Irradiance sensor measures panel temp, single port	**029-02520**
F-IMT	Full weather station with irradiance, ambient temp, cell temp, and wind speed	**029-05245**
WIS114-102	Irradiance sensor with two ports, allows for the ability to measure ambient temp and wind speed	**029-02517**
WAT114-100	Ambient temperature sensor	**029-02518**
WPT114-103	Back-panel-temperature sensor	**029-02515**
WWS114	Wind-speed sensor	**029-02519**

eGauge EG3000

Split Core AC-CT

Revenue Grade AC Accu-CT

Solid Core DC-CT

eGauge Consumption Level and Renewable Energy Monitoring

eGauge combines consumption and renewable energy production monitoring in one unit for both commercial and residential applications. Up to 12 current transformers (CT's) can be attached to the Datalogger and up to 16 registers can be reported per datalogger and monitored through the web portal. Multiple dataloggers may be linked together and set up on one portal display if more CT inputs or output registers are needed.

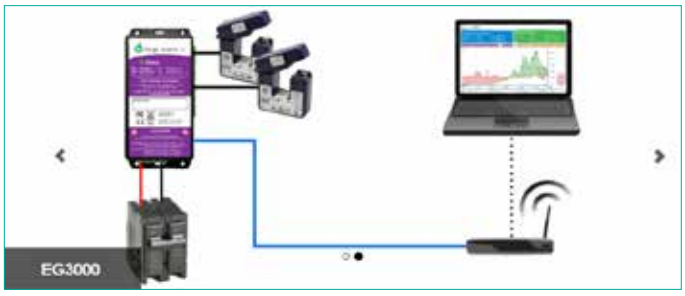
The eGague **EG3000** datalogger can be mounted directly in a power distribution panel for easy access and wiring or inside a separate enclosure if space inside the panel is limited, and is directly wired to the power panel on a 20 A two or three-pole breaker. The eGague **EG3010** includes an Ethernet-over-powerline adapter allowing additional Internet connection options. eGague can be utilized for single-phase 240 VAC applications, as well as 208 VAC or 480 VAC three-phase applications.

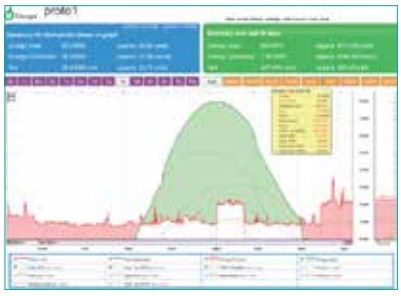
The eGauge CT's are installed around the service conductors to the building to determine utility supply, around the renewable energy source circuits to determine PV production, and around individual circuits for specific consumption monitoring. Users may choose which information is displayed on the portal view. **Split Core AC-CTs** are used for AC circuits, and **Solid Core DC-CTs** can be used for DC circuits. Specify amperage of circuits when ordering. Typical CT's for residential and commercial applications are listed, other ranges available upon request. **Revenue Grade AC Accu-CTs** are available with +/-0.5% Accuracy when paired with an eGauge datalogger that has been certified to higher accuracy levels.

The eGauge monitoring system can be configured to provide:

- Real-time energy consumption from utility or per-load circuits
- Renewable energy production monitoring for multiple inverters
- Establishing building benchmark and LEED points
- Analyzing and reducing peak demand
- Providing analysis for Energy Efficiency Product and system commissioning
- User-defined email or text alerts

eGauge Systems EG3000 Series Energy Meters		
Model	**Description**	**Item code**
A000-ETH-016	EG3000 datalogger with Ethernet connection	**029-05300**
A005-ETH-016	EG3000 with Ethernet connection and +/- 0.5% certification report	**029-05301**
A000-PLC-016	EG3010 datalogger with Ethernet connection and HomePlug® AV	**029-05302**
A005-PLC-016	EG3010 datalogger with Ethernet connection, HomePlug® AV, and +/- 0.5% certification report	**029-05303**
SCT0400-050	Split-core CT – AC current sensor - #14 to #2 AWG, 50 A (other amperages available)	**029-05304**
SCT0750-100	Split-core CT – AC current sensor – 1/0 to 4/0 AWG, 100 A (other amperages available)	**029-05305**
SCT0750-150	Split-core CT – AC current sensor – 1/0 to 4/0 AWG, 150 A (other amperages available)	**029-05306**
SCT1250-200	Split-core CT – AC current sensor – 250 to 750 MCM, 200 A (other amperages available)	**029-05307**
SCT1250-400	Split-core CT – AC current sensor – 250 to 750 MCM, 400 A (other amperages available)	**029-05308**
ACT-0750-xxx	Split-core Accu-CT – Revenue-grade AC current sensor (specify amperage rating)	**CALL**
CR-5220-xxx	Solid-core DC-CT – DC current sensor, with 120 VAC power supply (specify amperage rating)	**CALL**





Batteries

Virtually all power generation systems require some form of energy storage. For grid-tied systems, the utility accepts surplus power and gives it back when needed. A battery bank is required for systems that need to function without the grid, either all of the time or during an outage. In these systems, the solar array or wind turbine charges the batteries whenever they are producing power, and the batteries supply power whenever it is needed.

Battery Technologies

The most common battery technology used is **lead-acid**, in which lead plates are used with a sulfuric acid electrolyte. The electrolyte can be fluid or absorbed in fiberglass mats (AGM), or gelled. AGM and gel batteries are together known as VRLA (Valve Regulated Lead Acid) and are sealed, do not require water addition, and do not emit gases when operated within specifications. Lead-acid batteries are relatively inexpensive and readily available compared to other battery types. New advanced lead-acid batteries have carbon additives in the negative plate to prevent sulfation at partial states of charge (PSoC), while remaining less expensive than high-technology batteries.

Lithium Ion batteries can handle large charging and load currents. They are also lighter weight and compact for their power and energy capacity. One advantage of Li-Ion batteries is their long life even when cycled heavily, and without needing to be brought to a full state of charge each cycle. This makes them particularly suitable for short to long-duration use in self-consumption systems where net metering is unavailable or utility rate structures otherwise disincentivize energy exports during peak solar production hours.

Aqueous hybrid sodium-ion batteries, e.g. Aquion, have significant safety and environmental advantages over traditional batteries. They are made from non-toxic materials and have an aqueous electrolyte that is non-flammable. They have the ability to cycle for many years at any state of charge, making them suitable for systems that need to take advantage of charging when available, and do not need to be fully charged like lead batteries. They are ideal for long duration applications such as off-grid systems, or larger capacity self-consumption systems. These batteries are very robust, but are similar in size and weight to lead-acid batteries and must be sized carefully to ensure appropriate current for loads or charging.

Standby or Cycling Batteries

Batteries come in a wide variety of sizes and types, but the most important designation is whether they are made for daily cycle service or standby service. Automobile starting batteries should not be used for renewable energy systems.

Standby power batteries are designed to supply power to loads for occasional use, and are preferred for grid-tied solar systems with battery backup. They are optimized to supply moderate to large amounts of power only during utility power outages, and float at full charge most of the time. They are designed to use a minimal amount of energy to stay fully charged. They are not made for frequent deep discharges and have a limited cycle life but often very long calendar life when kept in float conditions. AGM batteries are most common for standby power applications as they are less expensive, have low self-discharge and require little to no manual maintenance.

Deep cycle batteries, are designed to be repeatedly discharged by as much as 80% of their capacity and are therefore a better choice for off-grid PV systems. Even when designed to withstand deep cycling, most batteries will have a longer life if the cycles are kept shallower. Deep cycle batteries can be either flooded or sealed lead-acid variants or, increasingly, newer chemistries like lithium-ion or sodium-ion.

Caring for Batteries

Maintenance requirements vary by battery chemistry and configuration. Additionally, some maintenance tasks, such as adding water or equalization, require on-site manual operations and/or oversight, while charge regulation, voltage checks and related measurements can be automated via sophisticated charge controllers or battery management systems, which are a de facto requirement for lithium-ion batteries.

Sealed lead-acid batteries, gel cells and AGM (Absorbed Glass Mat), are often referred to as maintenance-free because they don't require watering or an equalization charge. This makes them well-suited for remote or unattended power systems. However, sealed batteries require accurate regulation to prevent overcharge and over-discharge.

Lead-acid batteries should always be recharged as soon as possible. The positive plates change from lead oxide, when charged, to lead sulfate, when discharged. The longer they remain in the lead sulfate state, the more of the plate remains lead sulfate when the battery is recharged. The portion of the plates that become "sulfated" can no longer store energy. Batteries that are deeply discharged and then only partially charged on a regular basis often fail in less than one year. The new lead-carbon batteries substantially reduce sulfation. Always use temperature compensation when charging batteries to prevent over or under-charging. NOTE: Battery warranties do NOT cover damage due to poor maintenance or loss of capacity from sulfation.

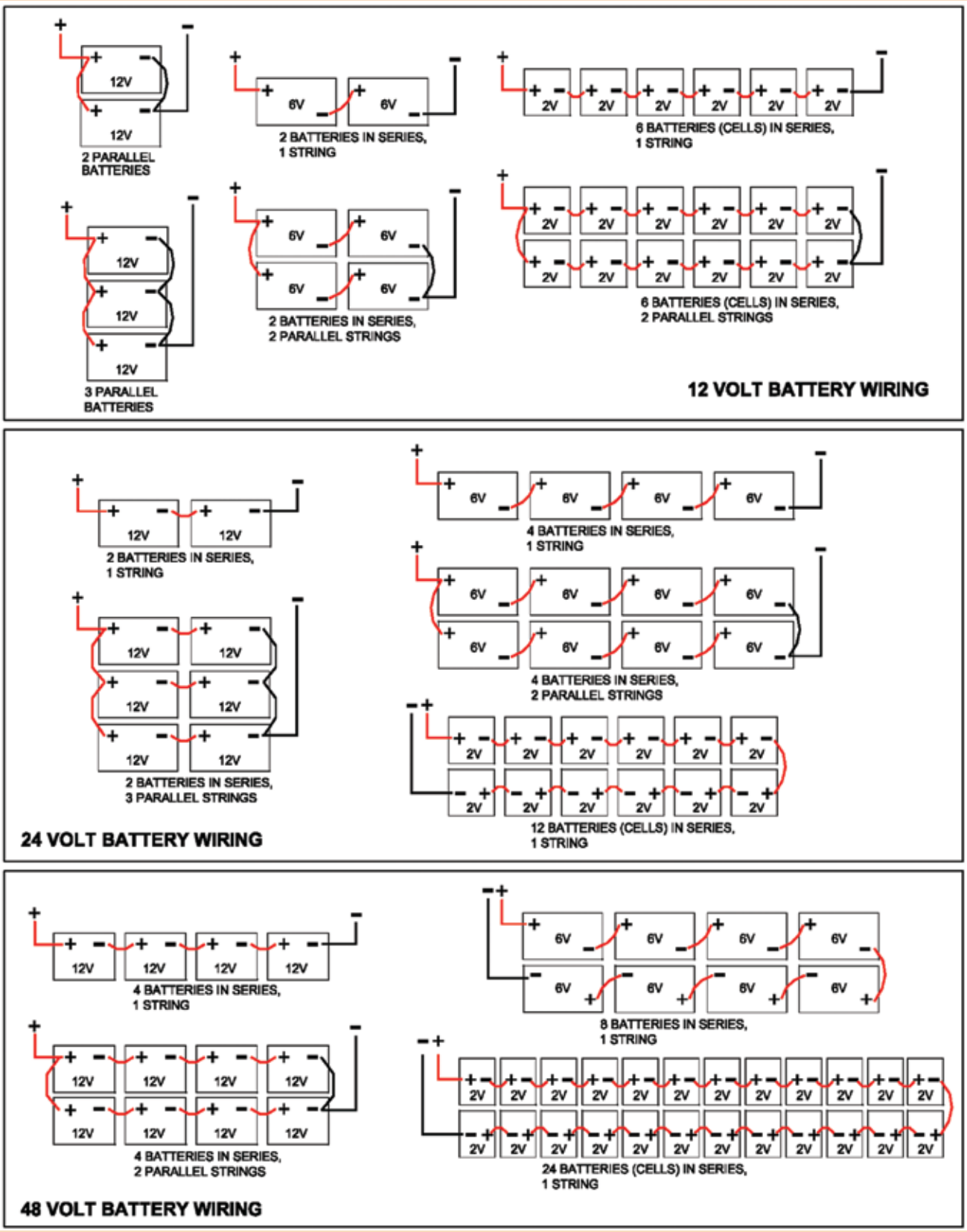
Check the electrolyte level in wet-cell, or "flooded" batteries, at least once every three months and top-off each cell with distilled water. Do not add water to discharged batteries! Electrolyte is absorbed when batteries are discharged, so if you add water at this time and then recharge the battery, electrolyte will overflow and create a safety hazard. Keep the tops of your batteries clean and check that cables are tight. Do not tighten or remove cables while charging or soon after charging! Any spark around batteries can cause a hydrogen explosion inside the case and potentially ignite a fire or an even larger explosion if the batteries are not properly vented. Use a hydrometer to check the specific gravity of your flooded lead-acid batteries. If batteries are cycled very deeply and then recharged slowly, the specific gravity reading will be lower because of incomplete mixing of electrolyte. An equalizing charge will help mix the electrolyte.

An "equalization" charge should be performed on flooded batteries whenever cells show a variation of 0.05 or more in specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize VRLA batteries! With proper care, lead-acid batteries will have a long service life and work very well in almost any power system.

Always use extreme caution when handling batteries and electrolyte (sulfuric acid). Wear appropriate personal protective equipment, including electrical- and chemical-resistant gloves with sleeves, goggles, and acid-resistant clothing. “Battery acid” will instantly burn skin and eyes and destroy cotton and wool clothing. Similar precautions apply to other battery types – always read and adhere to manufacturer safety recommendations when handling batteries. For any type of battery, be sure to remove any metal jewelry and avoid shorting the battery terminals.

Battery Wiring Diagrams

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



Battery State-of-Charge

Battery state-of-charge (SOC) can be measured by an amp-hour meter, voltage, or by specific gravity. Some care and knowledge is required to interpret state-of-charge from voltage or specific gravity readings. We recommend amp-hour meters for all systems with batteries. An amp-hour meter is like a fuel gauge for batteries and provides all the information needed to keep batteries charged. At a glance, the user can see system voltage, current, and battery condition (see Meters and Monitoring).

Battery voltage will vary for the same state-of-charge depending on whether the battery is being charged or discharged, and what the current is in relation to the size of the battery. The table below shows typical battery voltages at each state-of-charge for various battery conditions in flooded lead-acid batteries. Voltage varies with temperature. While charging, a lower temperature will increase battery voltage. Full-charge voltage on a 12 VDC battery is 0.9 VDC higher at 32 °F than at 70 °F. While discharging, a higher temperature will increase battery voltage. There is little temperature effect while a battery is idle, though higher temperatures will increase the self-discharge rate.

Source: Ralph Heisey of Bogart Engineering.

Battery Voltage at Various States of Charge			
Battery condition at 77 °F	Nominal battery voltage		
	12 VDC	24 VDC	48 VDC
Battery during equalization charge	> 15 VDC	> 30 VDC	> 60 VDC
Battery near full charge while charging	14.4 – 15 VDC	28.8 – 30 VDC	57.6 – 60 VDC
Battery near full discharge while charging	12.3 – 13.2 VDC	24.6 – 26.4 VDC	49.2 – 52.8 VDC
Battery fully charged with light load	12.4 – 12.7 VDC	24.8 – 25.4 VDC	49.6 – 50.8 VDC
Battery fully charged with heavy load	11.5 – 12.5 VDC	23 – 25 VDC	46 – 50 VDC
No charge or discharge for six hours - 100% charged	12.7 VDC	25.4 VDC	50.8 VDC
No charge or discharge for six hours - 80% charged	12.5 VDC	25 VDC	50 VDC
No charge or discharge for six hours - 60% charged	12.2 VDC	24.4 VDC	48.8 VDC
No charge or discharge for six hours - 40% charged	11.9 VDC	23.8 VDC	47.6 VDC
No charge or discharge for six hours - 20% charged	11.6 VDC	23.2 VDC	46.4 VDC
No charge or discharge for six hours -fully discharged	11.4 VDC	22.8 VDC	45.6 VDC
Battery near full discharge while discharging	10.2 – 11.2 VDC	20.4 – 22.4 VDC	40.8 – 44.8 VDC

A **hydrometer** is very accurate at measuring battery state-of-charge in flooded lead-acid batteries if you measure the electrolyte near the plates. Unfortunately, you can only measure the electrolyte at the top of the battery, which is not always near the plates. When a battery is being charged or discharged, a chemical reaction takes place at the border between the lead plates and the electrolyte. The electrolyte changes from water to sulfuric acid while charging. The acid becomes stronger, increasing the specific gravity, as the battery charges. Near the end of the charging cycle, gas bubbles rising through the acid stir the fluid. It takes several hours for the electrolyte to mix so that you get an accurate reading at the top of the battery. Always try to take readings after the battery has been idle or slowly discharging for some time.

This table shows the battery state-of-charge corresponding to various specific gravities for a battery bank in an ambient temperature of 75 °F. Some batteries will have a different specific gravity density by design, check with the manufacturer.

Hydrometer Readings at Ambient Temperature of 75˚F	
State-of-charge	Specific gravity
100% charged	1.265
75% charged	1.239
50% charged	1.2
25% charged	1.17
Fully discharged	1.11

Worksheet: Battery Size

To properly design a battery bank, you need to account for the storage capacity required, the maximum discharge rate (the sum of all the loads which might be run simultaneously), the maximum charge rate (the current output from the solar array or wind turbine though the charge controller), and the minimum ambient temperature at which the batteries will be used. Whichever of these factors requires the largest capacity will dictate the size of the battery bank. The storage capacity of a battery, the amount of electrical energy it can hold, is usually expressed in amp-hours (Ah). Using one amp for 100 hours means 100 Ah have been used. The Ah capacity of a battery will change depending on the rate of discharge. The faster the power is drawn out, the less overall capacity the battery will have. A battery bank in a PV power system should have sufficient capacity to supply needed power during the longest expected period of cloudy weather when the solar array cannot keep up. This can be anywhere from two days to two weeks or more. If there is a source of on-demand backup power, such as a standby generator with a battery charger, the battery bank does not have to be sized for worst-case weather conditions. In an off-grid system the battery is usually three or more days at 80% depth of discharge, sizing for two days or less will degrade the system performance and require more frequent use of a backup generator.

Use this worksheet to determine what size battery bank is required for your system. Battery voltage is determined by the number of "cells" in series. All lead-acid battery cells have a nominal output of 2 VDC. Actual cell voltage varies from about 1.7 VDC at full discharge to 3.0 VDC at full charge. 12 VDC lead-acid batteries are made of six separate cells in one case. 6 VDC batteries are made of three cells in one case. Putting battery cells in parallel increases amp-hour capacity, but does not change voltage.

Contact AEE technical support for systems with particularly large loads, charging currents, or other unusual parameters.

_____ **Step 1:** Total watt-hours per day required (see Off-Grid Load Worksheet on page 9).

_____ **Step 2:** Maximum number of continuous cloudy days of desired backup (usually three or more days).

_____ **Step 3:** Multiply Step 1 result by Step 2 result.

_____ **Step 4:** Divide the Step 3 result by 0.5 for 50% depth of discharge or by 0.8 for 80% depth of discharge (Using 0.5 will maintain a 50% reserve and maximize battery life, 0.8 will maintain a 20% reserve and minimize battery bank size).

_____ **Step 5:** If you are using a lead-acid battery, select the multiplier from the table that corresponds to the battery's wintertime average ambient temperature and multiply by the result from Step 4 to get total energy storage required in kilowatt-hours (Battery temperature varies over a period of many days, not day to night).

Battery Bank Average Low Temperature Sizing Multiplier

Battery temperature	Multiplier
80 ºF [26.7 ºC]	1
70 ºF [21.2 ºC]	1.04
60 ºF [15.6 ºC]	1.11
50 ºF [10.0 ºC]	1.19
40 ºF [4.4 ºC]	1.3
30 ºF [-1.1 ºC]	1.4
20 ºF [-6.7 ºC]	1.59

_____ **Step 6:** Divide the energy storage requirement from step 5 by the DC voltage of the system (48 VDC is preferred, but sometimes 24 VDC) to get battery amp-hour (Ah) capacity needed.

_____ **Step 7:** Capacity of preferred battery in amp-hours.

_____ **Step 8:** Divide the Step 6 result by the Step 7 result and round up to a whole number to determine total parallel strings required. (Best to have two or fewer parallel strings, not more than three strings. Check battery specs to make sure the charging current will not be too high for the chosen battery).

_____ **Step 9:** Divide the system voltage (12 VDC, 24 VDC, or 48 VDC) by the voltage of the chosen battery (2 VDC, 6 VDC or 12 VDC) to determine the number of batteries in each string.

_____ **Step 10:** Multiply the Step 8 result by the Step 9 result to determine the total number of batteries needed.

OutBack POWER™
member of The alpha Group™
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Take the guesswork out of your best work—

with custom systems from OutBack Power.

FLEXpower Radian

NEW

OutBack Power based its FLEXware platform on proven customer designs to provide a **factory-built**, **pre-configured**, **pre-wired and pre-tested alternative to designing individual projects from scratch**. FLEXpower quickly became a best seller in the demanding off-grid market.

Now **there are FLEXpower solutions for all renewable energy projects**, **including the NEW FLEXpower Radian**—based on OutBack's Grid/Hybrid Radian Series. All advanced Radian Series features, including GridZero energy blending, Advanced Battery Charging and dual AC inputs, are available in 4kW or 8kW systems designed to take the guesswork out of your installations.

FLEXpower ONE

FLEXpower FOUR

OutBack's industry-leading FX-based FLEXpower systems are also **now available with the advanced FXR**, putting the latest Grid/Hybrid technology into OutBack's classic FX form factor.

Your time is valuable—with FLEXpower you can spend less time on balance-of-system, and more time adding value to all of your installations.

Optimize Your FLEXpower System with EnergyCell Batteries

Large or small, off-grid or on, OutBack power has EnergyCell batteries to fit virtually any renewable energy scenario. Designed for a wide range of applications, every EnergyCell battery is optimized for use with OutBack power electronics.

OutBack Power

EnergyCell™ RE Top-Terminal Batteries

The EnergyCell™ RE Top-Terminal Absorbed Glass Mat (AGM) batteries are available in a variety of capacities from 33 to 100 Ah. These 12 VDC batteries feature low profile terminals with threaded copper alloy inserts that take 10-32 UNF screws for the 34RE and 52RE sizes, and 1/4"-20 UNC for the larger sizes. These are rated for 1,800 cycles at 50% depth of discharge. They are appropriate for most moderate power applications and are designed to fit in standard Case 31 enclosures. Made in U.S.A.

EnergyCell™ RE Batteries

These front-terminal (FT) batteries and enclosure install more easily and in less space than other rack-mounted solutions. As sealed AGM batteries, they require no electrolyte maintenance and are made for both cycle and float service. The large capacity of these batteries reduces the number of parallel strings required to serve a stand-alone or backup power system. These are rated for 1,800 cycles at 50% depth of discharge. Maximum continuous charge rate is 35 A. The protected front-terminal cable attachment allows safe, easy, space-efficient installations. One busbar is included with each battery and is used to make series connections between side-by-side batteries. Made in U.S.A.

EnergyCell™ GH Batteries

The OutBack EnergyCell™ GH front-terminal rack-mount batteries are made for backup power applications. These have very low self-discharge and very high charge and discharge efficiency, making them ideal for grid-tied solar systems with backup. GH batteries are rated for ten years or more of service in float charge but are not intended for repeated deep cycle applications. Maximum charge rate is 102 A. The protected front-terminal cable attachment allows safe, easy, space-efficient installations. One busbar is included with each battery and is used to make series connections between side-by-side batteries. Imported.

OutBack EnergyCell Batteries and Racks

Model	Volts	Capacity				Dimensions (L" x W" x H")	Weight	Item code
		3-hr rate	8-hr rate	20-hr rate	100-hr rate			
34RE	12 VDC	26 Ah	30 Ah	33 Ah	34 Ah	7.8 x 5.2 x 6.8	27 lbs	**040-01175**
52RE	12 VDC	39 Ah	46 Ah	50 Ah	52 Ah	9.0 x 5.5 x 8.1	40 lbs	**040-01176**
78RE	12 VDC	58 Ah	70 Ah	75 Ah	78 Ah	10.8 x 6.8 x 8.0	54 lbs	**040-01177**
95RE	12 VDC	66 Ah	79 Ah	88 Ah	95 Ah	12.5 x 6.9 x 8.1	64 lbs	**040-01178**
106RE	12 VDC	70 Ah	89 Ah	100 Ah	106 Ah	13.5 x 6.8 x 8.5	69 lbs	**040-01179**
170RE	12 VDC	114 Ah	137 Ah	153.8 Ah	169.8 Ah	22 x 4.95 x 11.14	115 lbs	**040-01170**
200RE	12 VDC	132 Ah	158 Ah	178 Ah	200 Ah	22 x 4.95 x 12.6	131 lbs	**040-01171**
200GH	12 VDC	148 Ah	169 Ah	191 Ah	200 Ah	22.1 x 4.9 x 11.1	116 lbs	**040-01173**
220GH	12 VDC	166 Ah	189 Ah	214 Ah	220 Ah	22.1 x 4.9 x 12.4	132 lbs	**040-01174**

OutBack Integrated Battery Racks and Enclosures

The **IBR-2** and **IBR-3** racks are designed to work with the OutBack EnergyCell™ front-terminal batteries and provides best-in-class safety and ease of install. They are set up for a 48 VDC nominal battery system with one, two, or three parallel strings of OutBack EnergyCell™ front-terminal RE, NC, or GH batteries. Each string is wired with 1/0 AWG cable and a 175 A circuit breaker. The enclosure is heavy powder-coated aluminum with clear polycarbonate covers for the front and electrical connections.

The **OBE-3-48-FT** and **OBE-3-48** are outdoor enclosures made to fit up to 12 of the front-terminal or top-terminal batteries respectively. These racks feature welded aluminum construction with a 175 A breaker and pre-installed cables for each 48 VDC string. It has screened vents, and lockable doors. The OBE-3 PAD is available for ground mounting the OBE-3-48.

The **IBE-1** and **IBE-2** are indoor enclosures made to hold up to one or two strings of 106RE or smaller batteries in strings of four in series for 48 VDC systems. They are welded aluminum assemblies with screened vents and locking doors. Each enclosure includes cables and a 175 A fuse for each string.

All enclosures and racks come pre-assembled. Made in U.S.A.

OutBack Battery Racks and Enclosures

Model	Description	Dimensions (W" x D" x H")	Weight	Item code
IBR-3-48-175	Indoor integrated battery rack, three shelves, up to twelve front terminal batteries	27 x 24.4 x 48.6	89 lbs	**048-03000**
IBR-2-48-175	Indoor integrated battery rack, two shelves, up to eight front terminal batteries	27 x 21.25 x 33	60 lbs	**048-03001**
OBE-3-48-FT	Outdoor integrated battery enclosure, three shelves, up to twelve front terminal batteries	30 x 34.6 x 51	308 lbs	**048-03008**
OBE-3-48	Outdoor integrated battery enclosure, three shelves, up to twelve 106RE batteries	41.5 x 17 x 46.8	64 lbs	**040-01178**
OBE-3 PAD	Polymer concrete mounting pad for OBE-3-48	44 x 27 x 3	190 lbs	**048-03007**
IBE-1-48	Indoor battery enclosure for up to four 106RE batteries	26 x 15 x 33.5	61 lbs	**048-03005**
IBE-2-48	Indoor battery enclosure for up to 8 106RE batteries	26 x 15 x 48	75 lbs	**048-03004**

NEW! OutBack Nano-Carbon Batteries

OutBack's new EnergyCell™ Nano-Carbon AGM maintenance-free batteries have carbon on the negative plate to prevent battery sulfation. This allows for prolonged use at Partial State of Charge (PSoC) and opportunistic charging applications such as off-grid, generator-supported, Grid-Zero, energy arbitrage, and load shifting due to net-metering limitations. Cycle life is comparable to the traditional battery in float applications, but is increased up to 44% in partial state-of-charge use. They have a particularly long life when cycled between 30% and 80% state of charge. With PSoC cycling, round-trip energy efficiency is as high as 95%. A full charge is only needed once per month to once per quarter. The standard cycle life of the 12 VDC batteries is 1,800 cycles at 50% depth of discharge. For the high-capacity batteries, the rating is 2,000 cycles at 50% depth of discharge. The 12 VDC NC batteries will fit all the same enclosures and racks as their RE equivalents. The high-capacity NC batteries come with a rack, interconnect bars, terminals, and covers. Two-year warranty in PSoC applications. Made in USA.

OutBack Nano-Carbon Batteries								
Model	Volts	Capacity				Dimensions (L" x W" x H")	Weight	Item code
		4-hr rate	8-hr rate	20-hr rate	100-hr rate			
106NC	12 VDC	76 Ah	89 Ah	100 Ah	106 Ah	13.5 x 6.8 x 8.52	69 lbs	**040-01167**
170NC	12 VDC	121 Ah	137 Ah	153.8 Ah	169.8 Ah	22 x 4.95 x 11.14	115 lbs	**040-01168**
200NC	12 VDC	140 Ah	158 Ah	178 Ah	200 Ah	22 x 4.95 x 12.6	131 lbs	**040-01169**
1100NC	48 VDC	674 Ah	794 Ah	918 Ah	1,060 Ah	28.3 x 26.4 x 45.8	3230 lbs	**040-01163**
1600NC	48 VDC	1,012 Ah	1,191 Ah	1,376 Ah	1,600 Ah	28.3 x 26.4 x 63.8	4420 lbs	**040-01164**
2000NC	48 VDC	1,264 Ah	1,490 Ah	1,720 Ah	1,990 Ah	28.3 x 26.4 x 77.3	5365 lbs	**040-01165**
2200NC	48 VDC	1,349 Ah	1,589 Ah	1,834 Ah	2,130 Ah	28.3 x 26.4 x 81.8	5740 lbs	**040-01166**

EnergyCell™ RE High-Capacity Batteries

OutBack's new EnergyCell™ RE high-capacity battery employs a modular design concept with an integral racking system that can be installed more quickly and easily than most Valve Regulated Lead Acid (VRLA) batteries of this size.

The Absorbed Glass Mat (AGM) cell design incorporates thick positive plates to extend battery life. These are rated for 1,800 cycles at 50% depth of discharge. The maximum continuous charge rate for these is 22% of the capacity at the 20-hour rate. Each module (one or two cells depending on cell size) is encased in its own steel can and features a welded/epoxy dual-post sealed design and large copper posts to enhance performance and safety in high current applications. Unlike flooded batteries, these high capacity AGM cells provide full rated capacity from the first cycle and do not require watering or active venting.

The included racking system is deployed with four cells per shelf so a 48 VDC system typically uses six shelves. The 1600RE is three modules per shelf and eight high. The 24 VDC batteries are half as high. Terminals and connecting plates as well as clear safety covers are also included. Standard string terminations are for the top of the rack, but optional side terminations can be specified with longer lead time. Made in China.

OutBack EnergyCell Batteries and Racks

Model	Volts	Capacity				Dimensions (L" x W" x H")	Weight	Item code
		3-hr rate	8-hr rate	20-hr rate	100-hr rate			
800RE	48 VDC	492 Ah	600 Ah	672 Ah	810 Ah	27.4 x 23.5 x 60.7	2,622 lbs	**040-01180**
1100RE		702 Ah	864 Ah	960 Ah	1,150 Ah	37.2 x 23.5 x 60.7	3,797 lbs	**040-01181**
1300RE		822 Ah	1,008 Ah	1,148 Ah	1,340 Ah	37.2 x 26.3 x 60.7	4,330 lbs	**040-01182**
1600RE		987 Ah	1,208 Ah	1,378 Ah	1,600 Ah	33.3 x 26.3 x 78.0	5,082 lbs	**040-01183**
2000RE		1,260 Ah	1,512 Ah	1,716 Ah	2,070 Ah	44.4 x 27.5 x 74.9	6,464 lbs	**040-01184**
2200RE		1,317 Ah	1,616 Ah	1,836 Ah	2,140 Ah	55.2 x 26.3 x 60.7	6,707 lbs	**040-01185**
2700RE		1,680 Ah	2,016 Ah	2,288 Ah	2,770 Ah	56.4 x 27.5 x 74.9	8,266 lbs	**040-01186**
800RE-24	24 VDC	492 Ah	600 Ah	672 Ah	810 Ah	27.4 x 23.5 x 34.8	1,351 lbs	**040-01187**
1100RE-24		702 Ah	864 Ah	960 Ah	1,150 Ah	37.2 x 23.5 x 34.8	1,935 lbs	**040-01188**
1300RE-24		822 Ah	1,008 Ah	1,148 Ah	1,340 Ah	37.2 x 26.3 x 34.8	2,202 lbs	**040-01189**
1600RE-24		987 Ah	1,208 Ah	1,378 Ah	1,600 Ah	33.3 x 26.3 x 43.5	2,577 lbs	**040-01190**
2000RE-24		1,260 Ah	1,512 Ah	1,716 Ah	2,070 Ah	44.4 x 27.5 x 41.9	3,273 lbs	**040-01191**
2200RE-24		1,317 Ah	1,616 Ah	1,836 Ah	2,140 Ah	55.2 x 26.3 x 34.8	3,396 lbs	**040-01192**
2700RE-24		1,680 Ah	2,016 Ah	2,288 Ah	2,770 Ah	56.4 x 27.5 x 41.9	4,177 lbs	**040-01193**

East Penn

MK Sealed PV/Solar Batteries

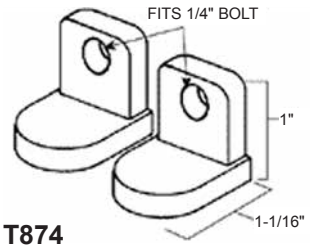
MK sealed batteries are designed for maintenance-free operation for the life of the battery. Sealed construction eliminates periodic watering, corrosive acid fumes, and spills. Tank-formed plates ensure voltage matching between cells. Most models are rated non-spillable by ICAO, IATA, and DOT, allowing them to be transported by air and requiring no special containers for ground shipping. Exceptions are noted in the table, which must be shipped by truck freight on pallets. MK sealed gel and AGM batteries are covered by a one-year warranty. Delivered from one of 20 East Penn Battery warehouses across the U.S.A. Made in U.S.A.

MK Sealed Gel Batteries

The gelled electrolyte won't stratify, so no equalization charging is required. Less than 2% per month standby loss means low dis- charge during transport and storage. These batteries are rated for 1,000 cycles at 50% depth of discharge. Gel batteries are often the best choice for cycling operations where very cold temperatures are expected. They can operate at temperatures from -76 to 140 °F. The maximum continuous charge rate for these is 30% of the capacity at the 20-hour rate.

MK HD Sealed Gel Batteries

The **8GGC2** battery has long been known for its superior industrial deep-cycle capability. With its special active material, this battery is rated for 2,000 cycles at 50% depth of discharge. The **8G4DLTP** and **8G8DLTP** batteries are made using the same construction for similar deep-cycle capability and ruggedness.



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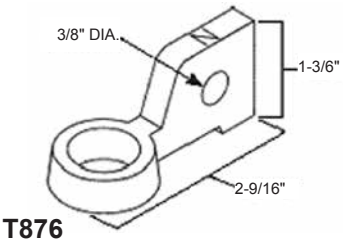

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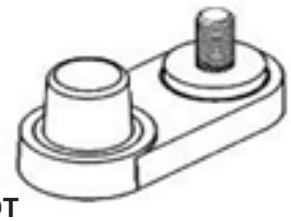
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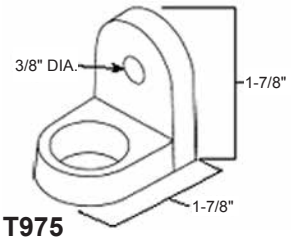


T975

MK Sealed Gel Solar Batteries									
Model	Volts	Terminal	Capacity				Dimensions (L" x W" x H")	Weight	Item code
			3-hr rate	8-hr rate	20-hr rate	100-hr rate			
8GU1	12 V	T874	25.5 Ah	28.5 Ah	31.2 Ah	36.1 Ah	7.8 x 5.2 x 7.3	24 lbs	**040-03015**
8G22NF	12 V	T881	40 Ah	46 Ah	50 Ah	57 Ah	9.38 x 5.5 x 9.25	38 lbs	**040-03018**
8G24UT	12 V	T881	59 Ah	66 Ah	73.6 Ah	84 Ah	10.9 x 6.8 x 9.9	53.6 lbs	**040-03022**
8G27	12 V	T876	70 Ah	78 Ah	86.4 Ah	99 Ah	12.75 x 6.75 x 9.75	63.2 lbs	**040-03024**
8G30H	12 V	T876	79 Ah	88 Ah	97.6 Ah	108 Ah	12.94 x 6.75 x 9.75	71.7 lbs	**040-03027**
8G5SHP	12 V	T876	88 Ah	104 Ah	125 Ah	137 Ah	13.58 x 6.77 x 11.42	85 lbs	**040-03029**
MK Sealed HD Gel Solar Batteries									
8G4DLTP	12 V	T975	148 Ah	166 Ah	183 Ah	210 Ah	21.0 x 8.5 x 10.8	137 lbs	**040-03030**
8G8DLTP	12 V	T975	182 Ah	204 Ah	225 Ah	265 Ah	21.0 x 11 x 10.8	166 lbs	**040-03033**
8GGC2	6 V	DT	136 Ah	160 Ah	180 Ah	198 Ah	10.3 x 7.2 x 10.9	68 lbs	**040-03036**

East Penn MK Sealed AGM Batteries

These are completely sealed, absorbed glass mat, valve-regulated batteries with efficient recombination. AGM batteries are recommended for battery backup standby power systems where batteries are in float service with occasional deep discharges. These batteries are rated for 500 cycles at 50% depth of discharge. They can operate at temperatures from -40 to 140 °F. Delivered from one of 20 MK warehouses across the U.S.A.

MK Sealed AGM Batteries									
Model	Volts	Terminal	Capacity				Dimensions (L" x W" x H")	Weight	Item code
			3-hr rate	8-hr rate	20-hr rate	100-hr rate			
8AU1H	12 V	T874	26.4 Ah	29.6 Ah	32.5 Ah	37 Ah	7.8 x 5.2 x 7.3	24 lbs	**040-03117**
8A22NF	12 V	T881	45 Ah	50 Ah	55 Ah	63 Ah	9.38 x 5.5 x 9.25	38 lbs	**040-03120**
8A24DT	12 V	T881	65 Ah	72 Ah	79 Ah	91 Ah	10.9 x 6.8 x 9.9	53.6 lbs	**040-03123**
8A27	12 V	T876	75 Ah	84 Ah	92 Ah	106 Ah	12.75 x 6.75 x 9.75	63.2 lbs	**040-03126**
8A31DT[1]	12 V	DT	85 Ah	90 Ah	105 Ah	116 Ah	12.94 x 6.75 x 9.75	71.7 lbs	**040-03129**
8A4DLTP[1]	12 V	T975	150 Ah	176 Ah	200 Ah	216 Ah	20.8 x 8.5 x 10	130 lbs	**040-03132**
8A8DLTP[1]	12 V	T975	182 Ah	212 Ah	245 Ah	257 Ah	20.8 x 11 x 10	161 lbs	**040-03135**
8AGC2	6 V	DT	145 Ah	174 Ah	190 Ah	220 Ah	10.3 x 7.2 x 10.9	69 lbs	**040-03137**

[1]Must be shipped by truck freight

East Penn Unigy I AGM Battery

These Deka Unigy I sealed AGM batteries are well suited for use in backup power systems with occasional cycling during power outages. They have very high efficiency in float charge, and low self-discharge. Front terminal design for easy installation in battery racks. Rated for a ten-year life in backup use, made in U.S.A.

Unigy I Sealed AGM Batteries								
Model	Volts	Terminal	Capacity			Dimensions (L" x W" x H")	Weight	Item code
			3-hr rate	8-hr rate	20-hr rate			
12AVR-170ET	12 V	Front	138 Ah	170 Ah	188 Ah	22.0 x 4.9 x 12.6	120 lbs	**040-03152**
12AVR-200ET	12 V	Front	181 Ah	200 Ah	212 Ah	24.3 x 4.97 x 12.74	151 lbs	**040-03153**

Deka Unigy II Sealed Industrial Batteries

The **Deka Unigy II** line features a wide range of capacities to fit the requirements of renewable energy applications. These batteries are well-suited for float applications with an occasional deep discharge, such as battery backup for grid-connected systems. These are rated for 1,800 cycles at 50% depth of discharge. The maximum continuous charge rate for these is 15% of the capacity at the 20-hour rate. The front safety shield easily clips on and off without tools for quick assembly. The modules are coated with acid-resistant paint, and each module has mounting holes for a grounding option. They come with flame retardant polyethylene cases.

These batteries are available with interlocked frames to meet local seismic requirements, and non- interlocked frames where this is not required. The interlocking module frames require only front access bolts for mounting, providing quick and safe installation. Their standard one-piece base can be used as an anchoring template or anchors can be drilled and installed with the base in place. They are certified to UBC 97 Zone 4 Top of Building up to eight modules high.

The non-interlock modules require front and rear access bolts for mounting. The standard two-piece base enables anchors to be drilled and installed with base in place. The non-interlock version is certified to UBC 97 Zone 2B Top of Building up to eight modules high. Made in USA.

Deka Unigy II Sealed Industrial Batteries

Model	Volts	Capacity				Dimensions [1, 2] (W" x H" x D")	Weight	Item code[3]
		3-hr rate	8-hr rate	20-hr rate	100-hr rate			
6AVR95-7	12 VDC	228 Ah	285 Ah	388 Ah	400 Ah	19 x 9.48 x 27.12	339 lbs	**040-06006-NL**
6AVR95-9	12 VDC	305 Ah	380 Ah	452 Ah	540 Ah	23.5 x 9.48 x 27.12	426 lbs	**040-06007-NL**
6AVR95-11	12VDC	381 Ah	475 Ah	564 Ah	670 Ah	28 x 9.48 x 27.12	512 lbs	**040-06008-NL**
6AVR95-13	12 VDC	457 Ah	570 Ah	678 Ah	810 Ah	32.5 x 9.48 x 27.12	600 lbs	**040-06009-NL**
6AVR95-15	12 VDC	533 Ah	665 Ah	791 Ah	941 Ah	37 x 9.48 x 27.12	688 lbs	**040-06028-NL**
3AVR95-17	6 VDC	609 Ah	760 Ah	904 Ah	1,076 Ah	21.9 x 9.48 x 27.12	404 lbs	**040-06029-NL**
3AVR95-19	6 VDC	685 Ah	855 Ah	1,016 Ah	1,210 Ah	24.15 x 9.48 x 27.12	448 lbs	**040-06030-NL**
3AVR95-21	6 VDC	761 Ah	950 Ah	1,129 Ah	1,345 Ah	26.4 x 9.48 x 27.12	491 lbs	**040-06031-NL**
3AVR95-23	6 VDC	838 Ah	1,045 Ah	1,242 Ah	1,479 Ah	28.65 x 9.48 x 27.12	535 lbs	**040-06032-NL**
3AVR95-25	6 VDC	914 Ah	1,140 Ah	1,355 Ah	1,614 Ah	30.9 x 9.48 x 27.12	578 lbs	**040-06033-NL**
3AVR95-27	6 VDC	990 Ah	1,235 Ah	1,468 Ah	1,748 Ah	33.15 x 9.48 x 27.12	618 lbs	**040-06034-NL**
3AVR95-29	6 VDC	1,066 Ah	1,330 Ah	1,581 Ah	1,882 Ah	35.4 x 9.48 x 27.12	665 lbs	**040-06035-NL**
3AVR95-31	6 VDC	1,142 Ah	1,425 Ah	1,694 Ah	2,017 Ah	37.65 x 9.48 x 27.12	705 lbs	**040-06036-NL**
3AVR95-33	6 VDC	1,218 Ah	1,520 Ah	1,807 Ah	2,151 Ah	39.9 x 9.48 x 27.12	749 lbs	**040-06037-NL**
2AVR125-33	4 VDC	1,551 Ah	2,000 Ah	2,367 Ah	2,930 Ah	27.32 x 11.7 x 31.12	753 lbs	**040-06038-IL**

[1] Height, depth and weight are slightly greater for interlock modules
[2] Overall battery height = (module height - 1.44") x # modules + 4"
[3] For interlock use -IL instead of -NL suffix (040-06038 is IL only)

East Penn MK 8L-16 Flooded 6-Volt Deep Cycle Battery

East Penn's version of the L-16 flooded battery features flag terminals and a heavy-duty polymer case. MK 8L-16 batteries are made in the U.S.A. Cycle life is 825 cycles at 50% depth of discharge. This is one of the most economical deep-cycle lead-acid batteries available.

MK L16 Flooded Batteries

Model	Volts	Terminal	Capacity			Dimensions (L" x W" x H")	Weight	Item code
			6-hr rate	20-hr rate	100-hr rate			
8L-16	6 V	DT	295 Ah	370 Ah	420 Ah	11.75 x 7 x 17.3	113 lbs	**040-01957**

Absolyte GP Industrial Sealed Batteries

GNB Industrial Power

The **Absolyte GP** series of industrial sealed battery is a valve-regulated lead-acid (VRLA) large-capacity, deep-cycle battery. In float conditions, these batteries can last up to 20 years at 25 °C (77 °F) with proper charging; in cycling conditions, they are designed for 1,200 cycles to 80% DOD with proper charging. Sealed cells with absorbed-glass-mat (AGM) separators eliminate the need for periodic water additions. Periodic visual inspections, voltage readings, and connection re-torqueing are still required.

Protective steel tray housings offer maximum installation flexibility, and the Absolyte GP is normally stacked horizontally up to eight high for use in earthquake-prone areas. This yields high capacity in a small footprint and frees up floor space for other equipment, and because they are sealed, they do not require a separate battery room. These batteries meet the stringent IEC 896 and BS 6290 standards and are UL recognized. They are manufactured in accordance to ISO 9001:2000 standards and are designed to meet Network Equipment Building System (NEBS) level 3 requirements.

When ordering, please specify the positive and negative terminal locations and stacking configuration. All cell connections are included for single series-string configurations. Connections for parallel strings are sold separately.

GNB Absolyte GP Industrial Sealed Batteries								
Model	Volts	Capacity				Dimensions (W" x H" x D")	Weight	Item code
		3-hr rate	8-hr rate	20-hr rate	100-hr rate			
Six-Cell 12 VDC Battery Modules								
6-90G07	12 VDC	207 Ah	256 Ah	300 Ah	360 Ah	21.69 x 8.53 x 23.56	316 lbs	**040-04430**
6-90G09	12 VDC	276 Ah	344 Ah	400 Ah	480 Ah	26.19 x 8.53 x 23.56	396 lbs	**040-04433**
6-90G11	12 VDC	345 Ah	432 Ah	500 Ah	600 Ah	30.69 x 8.53 x 23.56	477 lbs	**040-04436**
6-90G13	12 VDC	414 Ah	520 Ah	600 Ah	720 Ah	35.19 x 8.53 x 23.56	557 lbs	**040-04439**
6-90G15	12 VDC	486 Ah	608 Ah	700 Ah	840 Ah	39.69 x 8.59 x 23.56	637 lbs	**040-04442**
Three-Cell 6 VDC Battery Modules								
3-100G13	6 VDC	474 Ah	600 Ah	680 Ah	790 Ah	19.93 x 8.53 x 26.38	328 lbs	**040-04313**
3-100G15	6 VDC	552 Ah	696 Ah	800 Ah	920 Ah	22.18 x 8.59 x 26.38	374 lbs	**040-04316**
3-100G17	6 VDC	633 Ah	800 Ah	900 Ah	1,000 Ah	24.5 x 8.59 x 26.38	424 lbs	**040-04319**
3-100G19	6 VDC	711 Ah	896 Ah	1,020 Ah	1,100 Ah	26.75 x 8.59 x 26.38	470 lbs	**040-04322**
3-100G21	6 VDC	792 Ah	1,000 Ah	1,140 Ah	1,300 Ah	29 x 8.59 x 26.38	515 lbs	**040-04325**
3-100G23	6 VDC	870 Ah	1,096 Ah	1,260 Ah	1,400 Ah	31.25 x 8.59 x 26.38	561 lbs	**040-04328**
3-100G25	6 VDC	948 Ah	1,200 Ah	1,360 Ah	1,500 Ah	33.5 x 8.59 x 26.38	608 lbs	**040-04331**
3-100G27	6 VDC	1,029 Ah	1,296 Ah	1,460 Ah	1,700 Ah	35.75 x 8.59 x 26.38	653 lbs	**040-04334**
3-100G29	6 VDC	1,107 Ah	1,400 Ah	1,580 Ah	1,800 Ah	38 x 8.59 x 26.38	704 lbs	**040-04337**
3-100G31	6 VDC	1,188 Ah	1,496 Ah	1,700 Ah	1,900 Ah	40.25 x 8.59 x 26.38	750 lbs	**040-04340**
3-100G33	6 VDC	1,266 Ah	1,600 Ah	1,820 Ah	2,100 Ah	42.5 x 8.59 x 26.38	795 lbs	**040-04343**
Parallel-Cell 2 VDC Battery Modules								
1-100G39	2 VDC	1,422 Ah	1,800 Ah	2,040 Ah	2,370 Ah	19.93 x 8.53 x 26.38	328 lbs	**040-04225**
1-100G45	2 VDC	1,656 Ah	2,088 Ah	2,340 Ah	2,760 Ah	22.18 x 8.59 x 26.38	374 lbs	**040-04228**
1-100G51	2 VDC	1,899 Ah	2,400 Ah	2,700 Ah	3,000 Ah	24.5 x 8.59 x 26.38	424 lbs	**040-04231**
1-100G57	2 VDC	2,133 Ah	2,688 Ah	3,060 Ah	3,300 Ah	26.75 x 8.59 x 26.38	470 lbs	**040-04234**
1-100G63	2 VDC	2,376 Ah	3,000 Ah	3,420 Ah	3,900 Ah	29 x 8.59 x 26.38	515 lbs	**040-04237**
1-100G69	2 VDC	2,610 Ah	3,288 Ah	3,780 Ah	4,200 Ah	31.25 x 8.59 x 26.38	561 lbs	**040-04240**
1-100G75	2 VDC	2,844 Ah	3,600 Ah	4,080 Ah	4,500 Ah	33.5 x 8.59 x 26.38	608 lbs	**040-04243**
1-100G81	2 VDC	3,087 Ah	3,888 Ah	4,440 Ah	5,100 Ah	35.75 x 8.59 x 26.38	653 lbs	**040-04246**
1-100G87	2 VDC	3,321 Ah	4,200 Ah	4,800 Ah	5,400 Ah	38 x 8.59 x 26.38	704 lbs	**040-04249**
1-100G93	2 VDC	3,564 Ah	4,488 Ah	5,100 Ah	5,700 Ah	40.25 x 8.59 x 26.38	750 lbs	**040-04252**
1-100G99	2 VDC	3,798 Ah	4,800 Ah	5,460 Ah	6,300 Ah	42.5 x 8.59 x 26.38	795 lbs	**040-04255**

Trojan Battery Company

Trojan Reliant™ AGM with C-Max Technology™

Trojan's new Reliant™ line of sealed AGM batteries are a deep-cycle design that will work well in off-grid applications or as backup to grid-tied systems. These batteries are manufactured in Trojan's new advanced factory located in Sandersville, Georgia. C-Max technology™ assures high-quality paste formula and separators for a long-life design. These are rated for 1,000 cycles at 50% depth of discharge. Each cell has its own pressure vent and flame arrestor for safety. They are made with a high-strength polymer case and come with low-profile threaded insert terminals for corrosion-free connections. Four of the J305-AGM will fit into the MidNite MND3RACCPLM (AC-coupled Magnum in battery cabinet). They feature a limited two-year warranty.

MK L16 Flooded Batteries							
Model	Volts	Capacity			Dimensions (L" x W" x H")	Weight	Item code
		3-hr rate	8-hr rate	20-hr rate			
T1275-AGM	12 VDC	111	132	150	12.96 x 7.06 x 10.96	97.3	**040-02038**
J185-AGM	12 VDC	139	166	200	14.97 x 6.94 x 14.07	118.3	**040-02039**
T875-AGM	8 VDC	120	138	160	10.3 x 7.06 x 10.73	69.1	**040-02040**
T105-AGM	6 VDC	155	181	217	10.3 x 7.06 x 10.73	68.4	**040-02041**
J305-AGM	6 VDC	225	266	310	11.66 x 6.94 x 13.99	96.8	**040-02042**
L16-AGM	6 VDC	259	309	370	11.66 x 6.94 x 16.31	115.3	**040-02043**

Fast, Accurate Shipping to your Job Site. With just-in-time delivery and blind drop shipping, we can ship directly to your customers, just as if it came straight from you.

Trojan Premium Deep Cycle Lead-Acid Batteries with Smart Carbon™

Trojan's Premium line of deep-cycle lead-acid batteries are optimized for renewable energy applications, such as solar PV, small wind, and micro-grid. They have heavy-duty separators and plates designed for longer life. They feature a full warranty up to two years and are prorated up to five years.

Trojan Industrial Deep Cycle Lead-Acid Batteries with Smart Carbon™

Trojan's Industrial line of batteries is made specifically for off-grid renewable energy systems and other deep cycle applications where a long lifetime with daily cycling is desired. Designed for reliable power, they feature dual container housings for extra protection against acid spills and case damage. Rated for 1,500 cycles at 80% depth of discharge. They feature a full warranty for three years and are prorated up to eight years.

Smart Carbon™

For enhanced life and improved performance in applications operating in Partial State of Charge (PSOC), Trojan's Industrial and Premium Line batteries now feature Smart Carbon™ technology to improve partial state-of-charge performance and longevity. Trojan's propriety carbon formula, Smart Carbon™, increases the electrochemically active surface area which enhances charge acceptance and efficiency in applications where the batteries are not fully recharged on a regular basis.

Model	Volts	Capacity			Dimensions (L" x W" x H")	Weight	Item code
		6-hr rate	20-hr rate	100-hr rate			
T-105 RE	6 VDC	185 Ah	225 Ah	250 Ah	10.30 x 7.11 x 11.67	67 lbs	**040-01937**
L16RE-A	6 VDC	267 Ah	325 Ah	360 Ah	11.67 x 6.95 x 17.56	115 lbs	**040-01965**
L16RE-B	6 VDC	303 Ah	370 Ah	410 Ah	11.67 x 6.95 x 17.56	118 lbs	**040-01967**
L16RE-2V	2 VDC	909 Ah	1,110 Ah	1,235 Ah	11.67 x 6.95 x 17.56	119 lbs	**040-01920**
IND9-6V	6 VDC	365 Ah	464 Ah	601 Ah	15.32 x 10.24 x 23.54	220 lbs	**040-02026**
IND13-6V	6 VDC	545 Ah	695 Ah	902 Ah	22.36 x 10.34 x 23.92	315 lbs	**040-02027**
IND17-6V	6 VDC	727 Ah	925 Ah	1,202 Ah	27.21 x 10.38 x 23.73	415 lbs	**040-02028**
IND23-4V	4 VDC	1,000 Ah	1,270 Ah	1,654 Ah	22.38 x 10.34 x 23.56	370 lbs	**040-02029**
IND29-4V	4 VDC	1,274 Ah	1,618 Ah	2,105 Ah	27.10 x 10.35 x 23.81	465 lbs	**040-02030**
IND27-2V	2 VDC	1,215 Ah	1,520 Ah	1,954 Ah	15.28 x 10.38 x 24.00	228 lbs	**040-02031**
IND33-2V	2 VDC	1,455 Ah	1,849 Ah	2,405 Ah	17.33 x 10.22 x 24.01	278 lbs	**040-02032**

Trojan Industrial Line Accessories

Model	Description	Item code
210100	RE Battery Watering Kit 12 VDC with tubing, fittings, hand pump, manual	**040-09924**
210101	RE Battery Watering Kit 24 VDC with tubing, fittings, hand pump, manual	**040-09925**
210102	RE Battery Watering Kit 48 VDC with tubing, fittings, hand pump, manual	**040-09926**
210073	L16RE-2V Battery Watering Kit 12 VDC with tubing, fittings, hand pump, manual	**040-09928**
210114	L16RE-2V Battery Watering Kit 24 VDC with tubing, fittings, hand pump, manual	**040-09929**
210113	L16RE-2V Battery Watering Kit 48 VDC with tubing, fittings, hand pump, manual	**040-09930**
220006	IND Battery Owners Kit with hydrometer, log book and manual	**040-09920**
220003	IND Battery Watering Kit 12 VDC with tubing, fittings, hand pump, manual	**040-09921**
220004	IND Battery Watering Kit 24 VDC with tubing, fittings, hand pump, manual	**040-09922**
220005	IND Battery Watering Kit 48 VDC with tubing, fittings, hand pump, manual	**040-09923**

Protective polycarbonate covers not shown.

Rolls

S-Series Batteries

These **S-4000** series L16-sized batteries are rated at 800 cycles to 80% depth of discharge. The **S-4500 EX** series batteries, **S-500EX** and **S-1400EX**, are made with extra thick industrial-grade plates for longer cycle life. These are rated at 1,750 cycles to 80% depth of discharge. Shipping requirements and free-shipping threshold quantities vary by region, so be sure to indicate your commercial ship-to address when ordering.

Rolls S-Series Batteries

Model	Volts	Capacity			Dimensions (L" x W" x H")	Weight	Item code
		6-hr rate	20-hr rate	100-hr rate			
S-480	6 VDC	278 Ah	375 Ah	486 Ah	12.5 x 7.12 x 16.8	113 lbs	**040-02107**
S-550	6 VDC	317 Ah	428 Ah	554 Ah	12.5 x 7.12 x 16.8	123 lbs	**040-02108**
S-605	6 VDC	346 Ah	468 Ah	605 Ah	12.5 x 7.12 x 16.8	125 lbs	**040-02111**
S-1450	2 VDC	832 Ah	1,124 Ah	1,452 Ah	12.5 x 7.12 x 16.8	120 lbs	**040-02116**
S-1660	2 VDC	950 Ah	1,284 Ah	1,660 Ah	12.5 x 7.12 x 16.8	127 lbs	**040-02117**
S-1860	2 VDC	1,069 Ah	1,445 Ah	1,869 Ah	12.5 x 7.12 x 16.8	131 lbs	**040-02118**
S-500EX	6 VDC	253 Ah	357 Ah	504 Ah	12.5 x 7.12 x 16.8	132 lbs	**040-02119**
S-1400EX	2 VDC	710 Ah	1,000 Ah	1,410 Ah	13.4 x 7.12 x 17	128 lbs	**040-02120**

Deep-Cycle Industrial Flooded Batteries

These dual-container Rolls Deep-Cycle Industrial Flooded batteries are high-capacity batteries with a heavy-duty plate grid to resist positive plate breakdown. The plates are double insulated with a glass mat and a polyethylene envelope to prevent separator misalignment, cracked separators, treeing, or shorting at the bottoms or sides. Rolls batteries are rated at 3,200 cycles at 50% depth of discharge. Each 2 VDC cell is built into its own lightweight container made of durable polypropylene with the cover thermally bonded to the container to prevent acid leakage. The cells are then assembled into a tough, lightweight polyethylene outer container with a removable lid. Even if the outer case is broken, the battery remains operable and spill-free. The individual cells of the **CS** and **KS** series are bolted together, allowing the battery to be disassembled. The cells can be independently removed, which facilitates easy on-site installation, disassembly, assembly, or replacements of individual cells without special tools. All 5000 Series Rolls Batteries, including the CS & KS models, come with a ten-year limited warranty, three-year full warranty, and seven-year prorated warranty.

Rolls Deep Cycle Industrial Flooded Batteries

Model	Volts	Capacity			Dimensions (L" x W" x H")	Weight	Item code
		6-hr rate	20-hr rate	100-hr rate			
12-CS-11P	12 VDC	253 Ah	357 Ah	503 Ah	22 x 11.25 x 18.25	272 lbs	**040-02259**
4-CS-17P	4 VDC	388 Ah	546 Ah	770 Ah	14.38 x 8.25 x 18.25	128 lbs	**040-02223**
6-CS-17P	6 VDC	388 Ah	546 Ah	770 Ah	22 x 8.25 x 18.25	221 lbs	**040-02232**
8-CS-17P	8 VDC	388 Ah	546 Ah	770 Ah	28.25 x 8.25 x 18.25	294 lbs	**040-02247**
6-CS-21P	6 VDC	485 Ah	683 Ah	963 Ah	22 x 9.75 x 18.25	271 lbs	**040-02235**
6-CS-25P	6 VDC	582 Ah	820 Ah	1,156 Ah	23 x11.25 x 18.25	318 lbs	**040-02238**
8-CS-25P	8 VDC	582 Ah	820 Ah	1,156 Ah	28.25 x 11.25 x 18.25	424 lbs	**040-02250**
4-KS-21P	4 VDC	784 Ah	1,104 Ah	1,557 Ah	15.75 x 9.38 x 24.75	267 lbs	**040-02226**
4-KS-25P	4 VDC	959 Ah	1,350 Ah	1,900 Ah	15.75 x 10.63 x 24.75	315 lbs	**040-02229**
2-KS-33P	2 VDC	1,254 Ah	1,766 Ah	2,491 Ah	15.44 x 8.31 x 24.81	208 lbs	**040-02220**
2-YS-31P	2 VDC	1,725 Ah	2,430 Ah	3,435 Ah	15.50 x 9 x 31.63	285 lbs	**040-02221**

Solar-One®

HuP® Industrial Batteries

The Solar-One® battery with HuP® Technology is optimized for renewable energy systems. It has a slightly enlarged epoxy-coated steel case that allows cell removal so it can be installed by parts without a forklift or crane. Solar-One® batteries are designed with 0.310" thick positive plates and a patented technology that allows them to be warranted for 4,000 cycles to 50% depth of discharge. The ten-year warranty, seven-year full replacement, and three-year prorated, is the best in the industry. Each Solar-One® battery is made up of six 2 VDC cells and comes with stainless steel hardware, lead-plated copper busbars, a cell-lifting strap and an operator/installation manual. Order two for 24 VDC systems or four for 48 VDC systems. Please allow up to eight weeks for delivery. Free shipping to commercial locations in the continental U.S.A.

Solar-One® HuP® Batteries						
Model	Volts	Capacity		Dimensions (L" x W" x H")	Weight	Item code
		6-hr rate	20-hr rate			
SO-6-85-17	12 VDC	680 Ah	845 Ah	40 x 7.75 x 25	742 lbs	**040-05269-A**
SO-6-85-19	12 VDC	765 Ah	950 Ah	40 x 8.25 x 25	808 lbs	**040-05272-A**
SO-6-85-21	12 VDC	850 Ah	1,055 Ah	40 x 8.75 x 25	880 lbs	**040-05275-A**
SO-6-85-23	12 VDC	935 Ah	1,160 Ah	40 x 9 x 25	959 lbs	**040-05278-A**
SO-6-85-25	12 VDC	1,020 Ah	1,270 Ah	40 x 10.25 x 25	1,036 lbs	**040-05281-A**
SO-6-85-27	12 VDC	1,105 Ah	1,375 Ah	40 x 11.25 x 25	1,102 lbs	**040-05284-A**
SO-6-85-31	12 VDC	1,275 Ah	1,585 Ah	40 x 12.75 x 25	1,252 lbs	**040-05290-A**
SO-6-85-33	12 VDC	1,360 Ah	1,690 Ah	40 x 13.5 x 25	1,336 lbs	**040-05293-A**
SO-6-100-33	12 VDC	1,600 Ah	1,990 Ah	40 x 13.5 x 28	1,550 lbs	**040-05295**
SO-6-125-33	12 VDC	2,000 Ah	2,490 Ah	40 x 13.5 x 33	1,695 lbs	**040-05296**

Aquion

NEW! Aqueous Hybrid Ion Batteries

The aqueous hybrid ion battery by Aquion is the only battery that is Cradle to Cradle™ Certified. They are made from non-toxic materials and have a safe aqueous electrolyte that is neither flammable nor caustic. The electrolyte is absorbed and the battery is sealed and does not require watering. They have the ability to cycle for many years at any state of charge, making them suitable for systems that need to take advantage of charging when available, but do not need to be always fully charged. They are ideal for long duration applications such as off-grid systems, or larger capacity self-consumption systems. These batteries are very robust, but are similar to lead-acid batteries in terms of size and weight. They must be sized properly to supply the appropriate current for loads or charging.

They are rated for 6,000 cycles at 50% depth of discharge and 3,000 cycles at 100% depth of discharge. Their life is less affected by high temperatures than most other batteries. Optimum life is attained when used between -5 °C (23 °F) and 40 °C (104 °F). It comes as a 48 VDC package, either as separate stacks at about 2 kWh each or as a pre-assembled module with 12 stacks at about 24 kWh. Please allow up to ten weeks for delivery. Made in U.S.A.

MK L16 Flooded Batteries							
Model	Volts	Capacity			Dimensions (L" x W" x H")	Weight	Item code
		4-hr rate	8-hr rate	20-hr rate			
S30-008	48	28.7	37	48.3	13 x 122.2 x 36.8	260	**040-08200**
M110-LS83	48	344.4	444	580	52 x 40 x 45.6	3,309	**040-08202**
BMS200	Battery monitoring system, must be ordered with battery						**040-08220**

MNBE-A

MNBE-C

MNBE-D

MNBE-8D2X2

MidNite Solar

Battery Enclosures

Choose the proper enclosure for the size and number of batteries needed. Use multiple enclosures, side-by-side, for larger battery banks. These are all designed for use with sealed batteries only.

The **MNBE-A**, **MNBE-C** and **MNBE-D** are grey powder-coated steel battery enclosures with locking doors and are listed for indoor use in the U.S. and Canada. The **MNBE-D3R** and **MNBE-8D2x2** are white aluminum outdoor enclosures.

The **MNBE-C** comes in versions with two, three or four shelves depending on which battery it is made for. Extra shelves can be added to the MNBE-C and MNBE-D.

The **MNBE-8D2x2** enclosures hold two 4D or 8D batteries on each shelf for a total of four batteries. The MNBE-8D2x2 BASIC has spaces for a single 175 A or 250 A and up to four MNDC breakers, which are not included. The **MNBE-8D2x2 DELUXE** comes with a 250 A breaker, two 12” 4/0 AWG cables, and one 36” 4/0 AWG cable for interconnecting batteries. It also has spaces for up to 4 MNDC breakers. The MNBE- 8D2x2 enclosures can be stacked two high or side-by-side.

The MNBE-A may ship via UPS, but all other sizes ship by truck freight.

MidNite Solar Battery Enclosures

Model	Battery type	Battery capacity	Shelves included	Dimensions (L" x W" x H")	Shipping dimensions (L" x W" x D")	Weight	Item code
MNBE-A	27 or 31 8D	six two	two	27.25 x 14.5 x 29.5	30 x 33 x 8 knockdown	65 lbs	**048-05501**
MNBE-C	27 or 31 or GC2	twelve	three	36.5 x 16 x 55	Ships by truck on a 42 x 42 x 60 pallet	190 lbs	**048-05505 add crate fee[1]**
MNBE-C8D	4D or 8D	four	four				**048-05509 add crate fee[1]**
MNBE-CL16	L-16	eight	two				**048-05510 add crate fee[1]**
MNBE-D	27, 31, GC2	eight	two	34 x 15.5 x 42	43 x 19 x 8 & 43 x 19 x 9 knockdown	117 lbs	**048-05506**
MNBE-D3R					49 x 19 x 8 & 50 x 19 x 9 knockdown	82 lbs	**048-05507**
MNBE-8D2x2 BASIC	4D or 8D	four	one	28.5 x 26.3 x 36	38 x 28 x 11 knockdown	90 lbs	**048-05502**
MNBE-8D2x2 DELUXE						91 lbs	**048-05522**
Fan Bracket	Fan bracket for adding 120 mm square fan in MNBE-C or D enclosures						**048-05521**
MN-SHELF	Extra shelf for MNBE-C, MNBE-D, MNBE-D3R or MNBE-E						**048-05520**

[1]Crate fee applies, up to two enclosures on one fee

Heavy Duty Plastic Battery Enclosures

These battery enclosures are made from high-density polyethylene (HDPE), the same material used to manufacture the outside cases of batteries. A removable lid with handles allows easy access to the batteries for service. Enclosures for L-16s are made with a removable middle section that minimizes lifting when installing the batteries. The HDPE is acid resistant and very strong but easy to drill with a hole saw for adding conduit fittings or battery filling tubes. The hydrogen vent fitting on the lid should be extended to the exterior of the building. Not intended for outdoor use.

Heavy Duty Plastic Battery Enclosures				
Battery type	Battery capacity	Drain	Dimensions (W" x L" x H")	Item code
L16	four	No	33 x 14 x 22.5	**048-04014**
L16	four	Yes		**048-04015**
L16	eight	No	33 x 27 x 22.5	**048-04016**
L16	eight	Yes		**048-04017**
T105	four	No	32.5 x 12.5 x 17	**048-04018**
T105	four	Yes		**048-04019**
T105	eight	No	32.5 x 23.5 x 17	**048-04020**
T105	eight	Yes		**048-04021**

DPW Solar

POWER-FAB Pole-Mount Aluminum Battery Boxes

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

DPW POWER-FAB Pole-Mount Battery Boxes				
Battery type	Part #	Batteries spaces	Dimensions (D" x W" x H")	Item code
27/30	BB1-8G30H-HC	one	9 x 16 x 20	**048-04179**
	BB2-8G30H-HC	two	16 x 16 x 20	**048-04188**
	BB4-8G30H-HC	four	16 x 16 x 34	**048-04200**
	BB6-8G30H-HC	six	16 x 25 x 34	**048-04201**
Golf Cart GC2	BB2-6V/220AH-HC	two	14 x 18 x 22	**048-04197**
4D	BB1-8G4D-HC	one	12 x 24 x 22	**048-04282**
	BB2-8G4D-HC	two	12 x 24 x 36	**048-04291**
8D	BB1-8G8D-HC	one	15 x 24 x 22	**048-04285**
	BB2-8G8D-HC	two	15 x 24 x 36	**048-04294**

DPW Solar POWER-FAB Chest Style Battery Enclosures

Pad-mount, chest-style enclosures are manufactured with 0.125" 5052-H32 aluminum sheets. All die marks and welds are sanded smooth, and the boxes are finished with a reflective bright white polyester powder coat to minimize internal heat gain. All enclosures are provided with integrated louvers located to promote convective air flow through the enclosure to reduce internal temperatures and remove gasses. Filters are located over the louvers to keep out dust and insects. The filters are removable for cleaning or replacement. All standard enclosures are built to meet NEMA 3R specifications. Other sizes are available. Contact your AEE Solar Sales Representative for sizes not listed here.

DPW Solar POWER-FAB Chest-Style Battery Enclosures

Battery size	Model	Battery spaces	Layout	Dimensions (W" x L" x H", non-insulated)	Weight (non-insulated)	Item code	
						Non-insulated	Insulated
27/30	BB2-GRP30	two	2 x 1	16 x 16 x 16	26 lbs	048-04030	048-04033
	BB4-GRP30	four	2 x 2	18 x 30 x 16	39 lbs	048-04031	048-04034
	BB4-GRP30-1X4	four	1 x 4	16 x 34 x 16	37 lbs	048-04032	048-04035
	BB6-GRP30	six	2 x 3	25 x 30 x 16	50 lbs	048-04140	048-04143
	BB8-GRP30	eight	2 x 4	30 x 33 x 16	60 lbs	048-04036	048-04043
	BB12-GRP30-4X3	twelve	4 x 3	33 x 44 x 16	79 lbs	048-04038	048-04039
4D, 8D	BB2-8G8D	two	2 x 1	24 x 26 x 16	44 lbs	048-04057	048-04065
	BB4-8G8D	four	2 x 2	26 x 46 x 16	68 lbs	048-04116	048-04119
	BB4-8G8D-1X4	four	1 x 4	24 x 50 x 16	65 lbs	048-04066	048-04067
	BB6-8G8D	six	2 x 3	38 x 46 x 16	90 lbs	048-04128	048-04131
	BB8-8G8D	eight	2 x 4	46 x 50 x 16	111 lbs	048-04068	048-04069
	BB12-8G8D-4X3	twelve	4 x 3	50 x 68 x 16	150 lbs	048-04071	048-04078
Golf cart GC2	BB2-6V200	two	2 x 1	13 x 18 x 17	25 lbs	048-04080	048-04079
	BB4-6V200-1X4	four	1 x 4	14 x 35 x 17	36 lbs	048-04076	048-04081
	BB8-6V200	eight	2 x 4	25 x 32 x 17	56 lbs	048-04152	048-04155
	BB12-6V200-4x3	twelve	4 x 3	34 x 35 x 17	74 lbs	048-04084	048-04091
	BB16-6V200-4X4	sixteen	4 x 4	35 x 47 x 17	89 lbs	048-04040	048-04041
L-16, S460, S530	BB2-SS530	two	2 x 1	16 x 19 x 24	31 lbs	048-04088	048-04095
	BB4-SS530-1X4	four	1 x 4	16 x 36 x 24	46 lbs	048-04096	048-04097
	BB8-SS530	eight	2 x 4	29 x 36 x 24	70 lbs	048-04158	048-04161
	BB12-SS530-4X3	twelve	4 x 3	36 x 43 x 24	91 lbs	048-04171	048-04172
	BB16-SS530-2X8	sixteen	2 x 8	29 x 70 x 24	114 lbs	048-04176	048-04177
	BB16-SS530-4X4	sixteen	4 x 4	36 x 56 x 24	111 lbs	048-04178	048-04181

Power Vent 12 VDC

Zephyr

Power Vent Battery Box Vent

Lead-acid batteries produce hydrogen gas when charging, but leaving a battery box lid open to vent gas in cold climates can reduce battery capacity. Proper venting and thermal management is especially important when battery boxes are placed in basements, garages and sheds. As heat rises in the structure, a low pressure area forms around the battery box and pushes cool air into the box, which forces gases out and into the structure. The Power Vent controls battery box venting, removing hydrogen gas while reducing cold air infiltration into the box. The Power Vent contains a gravity-operated damper that normally stays closed. When connected to a voltage-controlled relay, the fan operates only when the batteries are being charged and blows gas vapors out. Designed for battery banks under 2,200 Ah and charge rates under 125 A. The fan can be operated from the auxiliary relay on high-end charge controllers or by a voltage-controlled switch (see Converters and Controls). The 12 and 24 VDC units use 3 W and push air at 6 CFM. They are 4" in diameter and 7.25" long with a 2" PVC pipe socket on the inlet and outlet. The 48 VDC unit uses 6 W and pushes 8 CFM. It measures 4" in diameter and is 10" long, with a 3" PVC pipe socket on the inlet and outlet.

Zephyr Power Vent Battery Box Vents	
Description	**Item code**
Power Vent 12 VDC	**085-08205**
Power Vent 24 VDC	**085-08207**
Power Vent 48 VDC	**085-08209**

QuickCote

Anti-Corrosion Protectant

QuickCote offers a complete acid neutralizing coating formulated especially for battery terminals and exposed electrical connections. The 8 oz can has a brush-on applicator that will give years of use and will not clog like aerosol coatings.

QuickCote Anti-Corrosion Protectant	
Description	**Item code**
QuickCote 8 oz	**046-00195**

Water Miser Battery Caps

Water Misers are molded plastic “flip-top” vent caps designed to reduce and ease maintenance on flooded lead-acid batteries. There is no need to remove the caps when charging, filling, or equalizing the batteries.

When charging, the plastic pellets capture up to 90% of the moisture and acid droplets. This reduces acid fumes and corrosion, and keeps the battery tops much cleaner and dryer. Excess water is dropped back into the battery cell. Water loss is reduced, which extends time between watering. These caps fit all batteries with standard bayonet caps.

Water Miser Battery Caps	
Description	**Item code**
Water Miser battery cap	**040-09913**

MidNite Hydro-volt hydrometer

An easy to use, temperature-compensated and accurate hydrometer. Use for measuring the specific gravity of flooded-battery electrolyte for state-of-charge determination. Made in Switzerland.

MidNite Hydro-volt	
Description	**Item code**
Hydro-volt battery hydrometer	**040-09918**

Power Panels

Power panels provide a central location for mounting inverters and charge controllers in battery systems and include enclosures for wiring, over-current protection, ground-fault and surge protection, bypasses and related hardware. See Battery-Based Inverters for OutBack Flexware™ power panels as well as prewired OutBack Power and MidNite Solar power systems.

MNE STM Series E-Panel (Inverter Not Included)

MidNite Solar

E-Panel

The MidNite Solar E-Panel can help streamline the installation of battery-based inverters. They come standard with the basic overcurrent protection and disconnects required to install your renewable energy system in compliance with the NEC. They are internally pre-wired and labeled to save time and hassle in the field. E-Panels are listed to applicable UL and CSA standards for the U.S.A. and Canada. See Battery-Based Inverters for pre-wired MidNite Solar E-Panels.

MidNite Solar E-Panels for Magnum Inverters

Magnum inverters are mounted on a unique hinged door to minimize system footprint. Mounting brackets are included to aid in one-person installations. They come with a main breaker, inverter connection, a 500 A/50 mV shunt for battery monitoring systems, an AC input and bypass, PV input busbars, DIN rails, 3 panel-mount breaker knockouts, ground bus, remote display mounting brackets, a charge controller bracket, a wall-mount bracket and other hardware. 120/240 VAC models are for Magnum MS-PAE inverters.

MidNite Solar E-Panels for Magnum Inverters		
Model	**Description**	**Item code**
MNE175STM-L	Gray steel chassis with 125 A inverter breaker	**034-05160**
MNE250STM-L	Gray steel chassis with 250 A inverter breaker	**034-05164**
MNE175ALM-L	White aluminum chassis with 175 A inverter breaker	**034-05168**
MNE250ALM-L	White aluminum chassis with 250 A inverter breaker	**034-05166**
MNE175STM-L-240	White steel chassis with 175 A inverter breaker 120/240 VAC	**034-05167**
MNE250STM-L-240	White steel chassis with 250 A inverter breaker 120/240 VAC	**034-05169**

MNE AL-PLUS Series E-Panel (Inverter And Controller Not Included)

MidNite Solar E-Panels for OutBack Inverters

OutBack inverters are mounted on a unique hinged door to minimize system footprint. They come standard with a left-hand hinge, allowing the charge controller to be mounted on the right. The **STS** version has additional space for the OutBack AC box with a surge arrestor for grid-tie applications, and the **AL-PLUS** version has room to mount an inverter and a charge controller on the door. Right-hand hinged doors are available by special order. Mounting brackets are included to aid in one-person installations. A main breaker, inverter cables, a 500 A/50 mV shunt for battery monitoring systems, a 175 A AC power-distribution block, a 50 A AC-input disconnect for a generator or utility input, and a 50 A AC bypass switch are included and pre-wired. E-Panels for OutBack inverters also include a mounting bracket for an OutBack FM-series controller. Cutouts for mounting up to six additional 13 mm DIN-mount breakers are provided, as are cutouts for GFCI-style AC outlets and three panel-mount DC-breaker slots. Circuit breakers and DC GFP are sold separately.

MidNite Solar E-Panels for OutBack Inverters		
Model	**Description**	**Item code**
MNE125STS-L	Gray steel stretched chassis with 125 A inverter breaker 15" wide – left hinge	**034-05127**
MNE175STS-L	Gray steel stretched chassis with 175 A inverter breaker 15" wide – left hinge	**034-05131**
MNE250STS-L	Gray steel stretched chassis with 250 A inverter breaker 15" wide – left hinge	**034-05135**
MNE125AL-PLUS	White alum wide chassis with 125 A inverter breaker with charge-controller mount	**034-05147**
MNE175AL-PLUS	White alum wide chassis with 175 A inverter breaker with charge-controller mount	**034-05148**
MNE250AL-PLUS	White alum wide chassis with 250 A inverter breaker with charge-controller mount	**034-05149**

MidNite Solar E-Panel for Schneider Electric Conext XW+

The **MNE250XWP-SINGLE** or **MNE175XWP-SINGLE** is mounted directly below the XW+ inverter. It includes a 250 A, or 175 A inverter/battery breaker, AC inputs for generator and utility, knockouts for up to seven DIN-mount breakers and 12 panel-mount breakers, and a 500 A shunt. Tin-plated copper busbars connect to the XW's battery terminals. There are busbars for AC inputs, AC output, neutral, ground, PV + in, PV - in, Bat +, and Bat - covered by a metal dead-front behind the reversible door. Charge controllers mount to either or both sides. The AC bypass can be configured as input and output on/off as well as AC bypass. The XW MPPT controller requires no mounting bracket. **FM60**, **FM80**, and **Classic** controllers require right or left E-Panel charge controller **mounting brackets**. A right-hand bracket is included. The color-matched enclosure is 16"W x 17"H x 8.5"D, and weighs 38 lbs.

The **MNE250XWP-MASTER** and **MNE250XWP-SLAVE**, and the 175 A versions, can be used for a dual-inverter setup. The master E-panel has a 120 A AC bypass assembly and all of the other items listed for the single E-panel. The master E-panel is mounted under one XW+ inverter and the slave E-panel is mounted under the second inverter. They can then be wired together. The slave E-panel has 60A AC input breakers for utility and generator and knockouts for up to seven DIN-mount breakers and 12 panel-mount breakers, and a 500 A shunt, as well as the bus bars for DC and AC connections. The color-matched enclosure is 16"W x 17"H x 8.5"D, and weighs 38 lbs.

MidNite Solar E-Panels for Schneider Electric Conext XW+ Inverters		
Model	**Description**	**Item code**
MNE250XWP-SINGLE	E-Panel for one XW+ inverter, 250 A main DC breaker	**034-05181**
MNE175XWP-SINGLE	E-Panel for one XW+ inverter, 175 A main DC breaker	**034-05184**
MNE250XWP-MASTER	E-Panel for dual XW+ inverter system, 250 A main DC, add one slave E-Panel	**034-05175**
MNE175XWP-MASTER	E-Panel for dual XW+ inverter system, 175 A main DC, add one slave E-Panel	**034-05176**
MNE250XWP-SLAVE	E-Panel slave for dual XW+ inverter system, 250 A main DC	**034-05177**
MNE175XWP-SLAVE	E-Panel slave for dual XW+ inverter system, 175 A main DC	**034-05178**

MidNite Solar E-Panel for Schneider Electric Conext SW

The **MNE250SW** or **MNE175SW** is mounted next to the SW inverter. It includes a 250 A, or 175 A inverter/battery breaker. There are knockouts for up to seven DIN-mount breakers and 12 panel-mount breakers, and a 500 A shunt. Tin-plated copper busbars connect to the XW's battery terminals. There are busbars for AC inputs, AC output, neutral, ground, PV + in, PV - in, Bat +, and Bat -. There are knockouts on top for two charge controllers. The color-matched enclosure is 17.6"W x 15.2"H x 7.5"D, and weighs 23 lbs.

The **MNSW-SLIDER-30** has 30 A input and 50 A output/bypass breakers for a single-inverter installation. The **MNSW-SLIDER-50** has 50 A input/output/bypass breakers for a dual-inverter installation.

The **MNSW-BACKPLATE** will mount both the SW E-panel and one SW inverter. Dimensions are 20"H x 33"L x 1.5"D, and weighs 15 lbs.

MidNite Solar E-Panels for Schneider Electric Conext SW Inverters		
Model	**Description**	**Item code**
MNE250SW	E-Panel for one SW inverter, 250 A main DC breaker	**034-05188**
MNE175SW	E-Panel for one SW inverter, 175 A main DC breaker	**034-05189**
MNSW-BACKPLATE	Backplate for one SW E-panel and inverter	**034-05190**
MNSW-SLIDER-50	AC breakers and bypass assy for 120/240 VAC, 50 A breakers	**034-05191**
MNSW-SLIDER-30	AC breakers and bypass assy for 120/240 VAC, 30 A breakers, 50 A bypass	**034-05192**

MidNite Solar E-Panels for SMA Sunny Island Inverters

MidNite Solar E-Panels and accessories are color matched to the Sunny Island inverter. SMA E-Panels are available to work with single, two or four-inverter configurations with 120/240 VAC or 120/208 VAC three-phase output (Requires three inverters). These can be used in either AC-coupled or DC-coupled systems, either grid-tied or off-grid. For AC-coupled systems with Sunny Boy inverters, an RS 485 card should be used in each Sunny Island master inverter and each Sunny Boy inverter (see Grid-Tie Inverters). Use the appropriate back plates.

The **MNE250SMA-AC-SINGLE** is an E-Panel used with the MNSMA Autoformer in an AC-coupled system with a single Sunny Island inverter. It is mounted directly below the Sunny Island inverter. The protected loads panel will have 120/240 VAC available and the utility connection will be 120 VAC only.

The **MNE250SMA-OG-SINGLE** is an E-Panel used in an off-grid system with a single Sunny Island inverter. For a dual Sunny Island installation, either AC-coupled or off-grid, use one **MNE250SMA-OG/AC-DM** and one MNE250SMA-SLAVE E-Panel. For a quad-stack Sunny Island installation, either AC-coupled or off-grid, use one **MNE250SMA-QUAD MASTER** and three MNE250SMA-SLAVE E-Panels. For a three-phase triple-stack Sunny Island installation, either AC-coupled or off-grid, use one **MNE250SMA-3PH MASTER** and two MNE250SMA-SLAVE E-Panels.

The **MNE250SMA-SLAVE** works with the dual, quad and three-phase master E-Panels.

Included in each master E-Panel is a 250 A inverter battery breaker, 60 AAC bypass (125 A on the Quad master), input and output breakers, terminal busbars for all connections, 500 A shunt, spaces for DIN and panel-mount DC breakers, and wiring for the connections to the Sunny Island.

The **MNX-240 AUTOFORMER** is used in single Sunny Island systems to produce 120/240 VAC output for AC coupling. It mounts above the Sunny Island.

One **MNSMA Back Short** back plate is used for each Sunny Island and E-Panel combination.

The **MNSMA Back Long** back plate is used for a single Sunny Island, E-Panel and MNX-240.

The **MNSMA E-Panels** are 20.5” x 18.6” x 9.6”, weight 42 lbs. The MNSMA-Autoformer is 18.1” x 16.4” x 9.2”, weight 74 lbs.

The **MNSICOMM** translator box will allow the SMA system to read and control up to four Classic charge controllers to make an integrated system.

The **MNTRB-80** is a relay board that can be used to transfer the AC input from grid to generator.

The **MNSMARB-KIT** is used to allow greater grid-tie inverter capacity for an AC-coupled system, up to 12 kW for a single Sunny Island, and up to 18 kW for dual Sunny Island.

MidNite Solar E-Panels for SMA Sunny Island Inverters		
Model	**Description**	**Item code**
MNE250SMA-AC-SINGLE	E-Panel for single Sunny Island inverter for AC-coupled system, 250 A DC main	**034-00000**
MNE250SMA-OG-SINGLE	E-Panel for single Sunny Island inverter for off-grid system, 250 A DC main	**034-00001**
MNE250SMA-OG/AC-DM	E-Panel for dual SI inverter system, add one slave E-Panel, 250 A DC main	**034-00002**
MNE250SMA-QUAD MSTR	E-Panel for quad SI inverter system, add three slave E-Panels, 250 A DC main	**034-00004**
MNE250SMA-3PH MASTER	E-Panel for three-phase SI inverter system, add two slave E-Panels, 250 A DC main	**034-00003**
MNE250SMA-SLAVE	E-Panel Slave for multiple-inverter systems, 250 A DC main breaker	**034-00005**
MNX-240 AUTOFORMER	Autoformer for 120/240 VAC output from single Sunny Island, use with AC SINGLE	**038-00001**
MNSMA-TALL-BP	Back plate for one Sunny Island, Autoformer, and E-Panel	**034-00007**
MNESMAXW-SHORT BP	Back plate for each Sunny Island and one E-Panel	**034-00008**
MNSICOMM	Translator box so MidNite Classic control can be read by the SMA system	**020-02434**
MNTRB-80	Transfer relay board, 80 A, 240 VAC for grid-to-generator transfer	**053-02951**
MNSMARB-KIT	Relay-board kit for extra PV capacity in an AC-coupled system	**034-00048**

MNDC Series E-Panel

MNDC PLUS Series E-Panel

MidNite Solar Mini-DC Disconnect Power Center (MNDC)

Use this small DC disconnect, which includes the inverter breaker (not in the MNDC-C), to provide overcurrent protection for any single inverter. The **MNDC** comes with a DIN rail for five additional DC breakers for DC loads, a charge controller disconnect, and a battery-status monitor. They also include a ground bus, and a 5/16" bonding battery-negative stud. Mounting holes for a 500 A shunt are built in. The white powder-coated aluminum chassis measures 10"H x 5"W x 18"D and weighs 7 lbs. Three main-breaker sizes are available. Left-side main-breaker placement is available by special order.

The **MNDC Plus version** has an additional DIN rail allowing up to ten DIN-mount breakers. Two DIN rail cover plates and two panel-mount plates are included. The panel-mount plates allow for mounting the 3/4" 150 VDC breakers that range from 60 A to 100 A. Additional configurations include: an MNDC-GFP80 with four panel-mount breakers, or one MNDC-GFP, one 3/4" panel-mount breaker and five DIN-mount breakers with a 125-250 A inverter breaker. Circuit breakers and DC GFP are sold separately. Mounting is provided for a 500 A shunt and an MNTBB-R terminal busbar. Battery-negative stud and ground busbar included.

The **MINI DC X2** versions have two DC battery breakers, one on each side of the enclosure. The MINI DC 125 X2 Disconnect is a white powder-coated aluminum enclosure while the MINI DC 175 X2 and the 250 X2 are powder-coated gray steel. They all come with the 125, 175 or 250 A battery breakers. The MNDC X2 accepts an additional five din-rail breakers or three panel-mount breakers. The boxes all come with grounding busbars and space to mount a 500 A shunt.

The MNDC125-X2 measures 25"H x 11"W x 4"D and weighs 13 lbs.

The MNDC175-X2 and the MNDC250-X2 measure 25"H x 16"W x 4"D and weigh 29 lbs.

MidNite Mini-DC Disconnect Power Center (MNDC)		
Model	**Description**	**Item code**
MNDC-C	Mini DC disconnect with space for 3/4" panel-mount breaker	**053-00094**
MNDC125	125 A Mini DC disconnect	**053-00091**
MNDC175	175 A Mini DC disconnect	**053-00092**
MNDC250	250 A Mini DC disconnect	**053-00093**
MNDC125-Plus	125 A Mini DC disconnect Plus version	**053-00096**
MNDC175-Plus	175 A Mini DC disconnect Plus version	**053-00097**
MNDC250-Plus	250 A Mini DC disconnect Plus version	**053-00098**
MNDC125-X2	125 A Mini DC X2 with two 125 A DC breakers	**053-00122**
MNDC175-X2	175 A Mini DC X2 with two 175 A DC breakers	**053-00123**
MNDC250-X2	250 A Mini DC X2 with two 250 A DC breakers	**053-00124**

Baby Box

Big Baby Box

Quad Box

MNDC-15

MN Battery Combiner

MidNite Solar Breaker Boxes and Wiring Accessories

The **Baby Box** and **Big Baby Box** are small general purpose breaker boxes that will hold up to four DIN-mount breakers from 1 to 63 A. The Big Baby Box also includes a ground box lug and mounting provisions for a short insulated busbar. The Big Baby Box's dimensions are 9"H x 5"W x 4"D, and it weighs 3 lbs. The **MNEDC Quad** is the same size as the Big Baby but holds up to 4 MNEDC-type panel-mount AC/DC breakers or panel-mount GFP breakers. The **MNDC15** is a general-use enclosure that will hold up to 15 MNEDC type panel-mount breakers, and one larger 175 or 250 A breaker on the end. Breakers are sold separately. The MNDC15 dimensions are 23"H x 12"W x 3.5"D, and it weighs 25 lbs. These breaker boxes are listed to applicable UL standards.

The **MNBCB-1000/100** Battery Combiner can be used to combine circuits from multiple inverters or battery strings or both. There are spaces for six large 175 A or 250 A breakers on both ends. 35.5" W x 22"H x 9.75"D, and weighs 50 lbs. The **MNBCB-1000/50** is similar, but has a shunt with the correct ratio for the SMA Sunny Island system.

Add the **MNBCB-Busbar** for more connections, useful for the inverter side of the shunt. It has five 3/8" studs and hole for the shunt connection and comes with red and white insulators.

Busbars

These UL-listed busbars can be used in the Mini-DC Disconnect above. Each **MNT** bar has colored insulation, four 0 AWG and eleven 6 AWG usable wire slots with 10-32 UNF screws, and is 4.63" long. The **MNS** is a shorter version, useful for PV + input on the narrow OB E-Panel, Big Baby Box, Quad box and for a separate PV busbar for charge controllers. The MNS has four 6 AWG and two 0 AWG wire slots. The MNG ground busbar is 3.45" long with green screws and has two 0 AWG and seven 6 AWG wire slots with mounting screws. The **MNIBIGBUSBAR** is a pair for positive and negative with five battery connections and six small wires. The **MNSHUNT** has four studs besides the shunt connection. The **MNBREAKER-BB-PLUS** has eight studs besides the large breaker connection.

The **MNBREAKERADAPTER** allows the mounting of a 3/4"-wide panel-mount breaker in a 1" breaker space.

MidNite Breaker Boxes and Busbars		
Model	**Description**	**Item code**
MNBABYBOX	Baby Box breaker center holds four DIN-mount breakers	**053-00089**
MNBIGBABY	Big Baby Box breaker center holds four DIN-mount DC breakers	**053-00088**
MNEDC QUAD	Quad breaker center holds four MNEDC 3/4" DC breakers	**053-00087**
MNDC-15	Circuit breaker box for 15 panel-mount and one large panel-mount breaker	**053-00086**
MNBCB-1000/100	Combiner for multiple inverters or battery strings w/ 1000 A 100 mv shunt	**034-00006**
MNBCB-1000/50	Combiner for multiple inverters or battery strings w/ 1000 A 50 mv shunt for SMA Sunny Island	**034-00009**
MNTBB-R	Long red terminal busbar	**053-00105**
MNTBB-B	Long black terminal busbar	**053-00106**
MNTBB-W	Long white terminal busbar	**053-00107**
MNGBB	Long ground busbar - 3.45" long	**053-00100**
MNSBB-R	Short red terminal busbar	**053-00108**
MNSBB-B	Short black terminal busbar	**053-00109**
MNSBB-W	Short white terminal busbar	**053-00110**
MNBIGBUSBAR	Big busbar with five studs, insulator mounts, aux terminal bar, 280 A	**053-00115**
MNSHUNT	Shunt busbar with four studs and short aux terminal bar	**053-00117**
MNBREAKER-BB-PLUS	Big breaker bus with eight studs	**053-00116**
MNBREAKER ADAPTER	Adapter to mount a 3/4" panel mount breaker in a larger breaker space	**053-03106**
MNBCB-BUSBAR	1,000 A bus bar for the Battery Combiner	**053-00118**

Long Terminal Busbar

Short Terminal Busbar

Big Busbar

Shunt Busbar

Big Breaker Plus

Fuses and Breakers

Fuses and breakers are designed to prevent excessive current from overheating conductors or devices by opening the circuit. Specialized breakers can also be deployed to open the circuit in case of ground or arc-fault conditions. Fuses and breakers should be sized according to NEC and/or manufacturer guidelines to ensure that they open the circuit before conductors or equipment can become damaged. See Reference for typical ampacity limits by wire size.

Morningstar

NEW! DC Ground-Fault Protection Devices

These two GFPD devices from Morningstar Corp. have more advanced safety features than the traditional method of breaking the grounded conductor bond. It detects a current imbalance between the conductors and breaks both conductors in the faulted circuit, isolating the circuit. It does not break the grounded conductor bond to ground and allows unaffected controller circuits to continue to function normally. The battery and DC loads in the system will continue to function in a safe grounded manner. The trip threshold is 300 mA for extra safety and is more accurate than a breaker-type GFP. There is visual and audible trip notification, LED status, and a test button. It does require a small amount of power from the system battery bank at 12 VDC to 48 VDC. Both units are listed to UL 1741, additionally the **GFPD-150V** is listed to UL-489 and the **GFPD-600V** is listed to UL-1077.

DC Ground Fault Protection Devices						
Model	Poles	Current	Voltage rating	Dimensions (H" x W' x D")	Weight	Item code
GFPD-150V	two	60 A	150 VDC	10.6 x 5.1 x 4.4	5 lbs	**053-03164**
GFPD-600V	two	50 A	600 VDC	14.1 x 8.7 x 4.2	9 lbs	**053-03165**

Circuit Breakers

DC Ground-Fault-Protection Circuit Breakers

These breakers use a trip mechanism to connect battery negative and earth ground to open the larger breaker in case of a ground fault. The NEC requires DC ground-fault protection on all solar installations. The DIN rail mount GFPs will mount in the Magnum MMP and MidNite E-Panels. The panel-mount GFPs will mount in the OutBack FLEXware enclosures and one or two poles in MidNite E-Panels. The 100 A unit can be used normally as a two-pole GFP, or with ungrounded arrays breaking positive and negative, or shunt tripped by a signal from a MidNite Classic charge controller or MNBDM.

DC Ground Fault Protection Circuit Breakers						
Amps	Poles	Mount type	Voltage rating	Width	Model	Item code
80 A	one	Panel with ¼" studs	150 VDC	1.5"	PNL-GFDI-80	**053-03144**
80 A	two	Panel with ¼" studs	150 VDC	2.25"	PNL-GFDI-80D	**053-03145**
80 A	four	Panel with ¼" studs	150 VDC	3.75"	PNL-GFDI-80Q	**053-03146**
63 A	one	DIN rail with screw lugs	150 VDC	1"	MNDC-GFP63	**053-03147**
80 A	one	Panel with ¼" studs	150 VDC	1.5"	MNDC-GFP80	**053-03148**
50 A	one	DIN rail with screw lugs	300 VDC	2"	MNDC-GFP50-300	**053-03149**
100 A	two	Panel with ¼" studs	150 VDC	3"	MNDC-GFP100RT-2P	**053-03150**

DIN-mount AC Circuit Breakers

These are DIN-mount AC breakers with set-screw compression terminals for 14 to 2 AWG wire. Use these for AC in OutBack FLEXware, MidNite E-Panels, and Magnum panels.

DIN-mount AC Circuit Breakers						
Amps	**Poles**	**Voltage rating**	**Width**	**OutBack model**	**MidNite model**	**Item code**
10 A	one	120 VAC	0.5"	DIN-10-AC-277	MNEAC10	**053-03060**
15 A	one	120 VAC	0.5"	DIN-15-AC	MNEAC15	**053-03061**
15 A	two	120/240 VAC	1"	DIN-15D-AC	MNEAC15-2P	**053-03062**
20 A	one	120 VAC	0.5"	DIN-20-AC	MNEAC20	**053-03063**
20 A	two	120/240 VAC	1"	DIN-20D-AC	MNEAC20-2P	**053-03064**
25 A	two	120/240 VAC	1"	DIN-25D-AC	MNEAC25-2P	**053-03065**
30 A	one	120 VAC	0.5”	--	MNEAC30	**053-03171**
30 A	two	120/240 VAC	1"	--	MNEAC30-2P	**053-03175**
35 A	two	120/240 VAC	1"	--	MNEAC35-2P	**053-03176**
40 A	one	120 VAC	0.5”	--	MNEAC40	**053-03172**
40 A	two	120/240 VAC	1"	--	MNEAC40-2P	**053-03177**
50 A	one	120 VAC	0.5”	--	MNEAC50	**053-03173**
50 A	two	120/240 VAC	1"	--	MNEAC50-2P	**053-03178**
60 A	one	120 VAC	0.5”	--	MNEAC60	**053-03174**
60 A	two	120/240 VAC	1"	--	MNEAC60-2P	**053-03179**
10 A	one	277 VAC	0.5"	DIN-10-AC-277	MNEAC10QZD	**053-03060**
15 A	one	277 VAC	0.5"	DIN-15-AC-277	MNEAC15QZD	**053-03066**
30 A	one	277 VAC	0.5"	DIN-30-AC-277	MNEAC30QZD	**053-03067**
30 A	two	277 VAC	1"	DIN-30D-AC-480	MNEAC30QZD2P	**053-03068**
30 A	three	277/480 VAC	1.5"	DIN-30T-AC-480	MNEAC30QZD3P	**053-03069**
50 A	one	277 VAC	0.5"	DIN-50-AC-277	MNEAC50QZD	**053-03070**
50 A	two	277 VAC	1"	DIN-50D-AC-480	MNEAC50QZD2P	**053-03071**
50 A	three	277/480 VAC	1.5"	DIN-50T-AC-480	MNEAC50QZD3P	**053-03072**
60 A	one	277 VAC	0.5"	DIN-60-AC-277	--	**053-03073**
60 A	two	277 VAC	1"	DIN-60D-AC-480	MNEAC60QZD2P	**053-03036**

DIN-mount DC Circuit Breakers

DIN-mount breakers fit MidNite and Magnum enclosures, and MNPV and OutBack PV array combiners. The positive line should be connected to the + pole of the breaker. The maximum PV array voltage must not exceed the voltage rating of the breakers used. The 600 VDC breakers also have a remote-trip actuator, useful for Rapid Shutdown.

DIN-mount 150 VDC Circuit Breakers					
Amps	**Voltage rating**	**Width**	**OutBack model**	**MidNite model**	**Item code**
1 A	150 VDC	0.5"	DIN-1-DC	MNEPV1	**053-03033**
2 A	150 VDC	0.5"	DIN-2-DC	MNEPV2	**053-03034**
3 A	150 VDC	0.5"	DIN-3-DC	MNEPV3	**053-03024**
4 A	150 VDC	0.5"	DIN-4-DC	MNEPV4	**053-03020**
5 A	150 VDC	0.5"	DIN-5-DC	MNEPV5	**053-03025**
6 A	150 VDC	0.5"	DIN-6-DC	MNEPV6	**053-03021**
8 A	150 VDC	0.5"	DIN-8-DC	MNEPV8	**053-03022**
9 A	150 VDC	0.5"	DIN-9-DC	MNEPV9	**053-03023**
10 A	150 VDC	0.5"	DIN-10-DC	MNEPV10	**053-03026**
12 A	150 VDC	0.5"	--	MNEPV12	**053-03027**
15 A	150 VDC	0.5"	DIN-15-DC	MNEPV15	**053-03029**
20 A	150 VDC	0.5"	--	MNEPV20	**053-03030**
30 A	150 VDC	0.5"	--	MNEPV30	**053-03032**
40 A	150 VDC	0.5"	--	MNEPV40	**053-03039**
50 A	150 VDC	0.5"	--	MNEPV50	**053-03035**
60 A	150 VDC	0.5"	--	MNEPV60	**053-03037**
63 A	150 VDC	0.5"	--	MNEPV63	**053-03038**
80 A	150 VDC	1.0"	--	MNEPV80	**053-03133**
100 A	150 VDC	1.0"	--	MNEPV100	**053-03134**

DIN-mount 300 VDC Circuit Breakers					
Amps	**Mount type**	**Voltage rating**	**Width**	**MidNite model**	**Item code**
7 A	DIN rail with screw lugs	300 VDC	1"	MNEPV7-300	**053-03107**
10 A	DIN rail with screw lugs	300 VDC	1"	MNEPV10-300	**053-03110**
12 A	DIN rail with screw lugs	300 VDC	1"	MNEPV12-300	**053-03112**
15 A	DIN rail with screw lugs	300 VDC	1"	MNEPV15-300	**053-03115**
20 A	DIN rail with screw lugs	300 VDC	1"	MNEPV20-300	**053-03120**
30 A	DIN rail with screw lugs	300 VDC	1"	MNEPV30-300	**053-03125**
50 A	DIN rail with screw lugs	300 VDC	1"	MNEPV50-300	**053-03130**
DIN-mount 600 VDC Circuit Breakers					
16 A	DIN rail with screw lugs	600 VDC	2"	MNEPV16-600-RT	**053-03116**
20 A	DIN rail with screw lugs	600 VDC	2"	MNEPV20-600-RT	**053-03121**

Panel-mount AC/DC Circuit Breakers

These are single-pole ¾"-wide breakers with ¼" stud connections and require ring terminals on wires connected to them. These breakers can be used for DC protection in OutBack FLEXware enclosures, and MidNite E-Panels (three spaces), or as AC breakers in the OutBack FLEXware 250. The 300 VDC and two-pole AC breakers are double width and take two spaces. The AC breakers are for use with the Radian inverter GSLC panels.

Panel-mount AC/DC Circuit Breakers							
Amps	Poles	AC voltage rating	DC voltage rating	Width	OutBack model	MidNite model	Item code
1 A	one	120 VAC	150 VDC	0.75"	PNL-1-AC/DC	--	**053-03135**
5 A	one	120 VAC	150 VDC	0.75"	PNL-5-AC/DC	MNEDC-5	**053-03136**
10 A	one	120 VAC	150 VDC	0.75"	PNL-10-AC/DC	MNEDC-10	**053-03137**
15 A	one	120 VAC	150 VDC	0.75"	PNL-15-AC/DC	MNEDC-15	**053-03138**
20 A	one	120 VAC	150 VDC	0.75"	PNL-20-AC/DC	MNEDC-20	**053-03139**
30 A	one	120 VAC	150 VDC	0.75"	PNL-30-AC/DC	MNEDC-30	**053-03140**
40 A	one	120 VAC	150 VDC	0.75"	PNL-40-AC/DC	MNEDC-40	**053-03141**
50 A	one	120 VAC	150 VDC	0.75"	PNL-50-AC/DC	MNEDC-50	**053-03142**
60 A	one	120 VAC	150 VDC	0.75"	PNL-60-AC/DC	MNEDC-60	**053-03143**
70 A	one	--	150 VDC	0.75"	--	MNEDC-70	**053-03151**
80 A	one	--	150 VDC	0.75"	PNL-80-DC	MNEDC-80	**053-03152**
90 A	one		150 VDC	0.75”		MNEDC-90	**053-03156**
100 A	one	--	150 VDC	0.75"	--	MNEDC-100	**053-03153**
30 A	one		300 VDC	1.5”	--	MNEDC30-300	**053-03126**
60 A	one	--	300 VDC	1.5"	--	MNEDC60-300	**053-03132**
80 A	one	--	300 VDC	1.5"	--	MNEDC80-300	**053-03131**
30 A	one	250 VAC	--	0.75"	PNL-30-AC	--	**053-16998**
50 A	one	250 VAC	--	0.75"	PNL-50D-AC-250	--	**053-16999**
50 A	two	240 VAC	--	1.5"	PNL-50D-AC-120/240	--	**053-17004**

CD and GJ Panel-mount DC Circuit Breakers

These are single-pole panel-mount breakers with stud terminals that require ring terminals on the wires connected to them (except the two items with lugs). Breakers up through 80 A can be used in the Conext XW+ Distribution Panel. The 100 A and larger DC breakers fit in the OutBack FLEXware enclosures and MidNite E-Panels. Rated for 125 VDC only (except the 60 A lug breaker, which is rated at 160 VDC). The remote trip breakers can be used with the MNBDM for Rapid Shutdown.

Panel-mount DC Circuit Breakers CD and GJ									
Amps	Poles	Stud size	Voltage rating	Width	OutBack model	MidNite model	Generic model	Item code	With remote trip
10 A	one	1/4"	125 VDC	1"	--	--	CD10	**053-01010**	--
15 A	one	1/4"	125 VDC	1"	--	--	CD15	**053-01015**	--
20 A	one	1/4"	125 VDC	1"	--	--	CD20	**053-01020**	--
30 A	one	1/4"	125 VDC	1"	--	--	CD30	**053-01025**	--
50 A	one	1/4"	125 VDC	1"	--	--	CD50	**053-01030**	--
60 A	one	1/4"	125 VDC	1"	--	--	CD60	**053-01035**	--
60 A	one	1/0 AWG	160 VDC	1"	--	--	BKR 60	**053-01038**	--
75 A	one	1/4"	125 VDC	1"	--	--	CD75	**053-01040**	--
80 A	one	1/4"	125 VDC	1"	--	--	CD80	**053-01045**	--
80 A	one	1/0 AWG	125 VDC	1"	--	--	BKR 80	**053-01039**	--
100 A	one	1/0 AWG	125 VDC	1"	--	--	BKR 100	**053-01034**	--
100 A	one	5/16"	125 VDC	1"	PNL-100-DC	--	--	**053-01050**	--
125 A	one	5/16"	125 VDC	1"	PNL-125-DC	MNEDC125-RT	---	**053-01052**	**053-01047**
175 A	one	3/8"	125 VDC	1.5"	PNL-175-DC	MNEDC175	--	**053-01053**	**053-01048**
250 A	one	3/8"	125 VDC	1.5"	PNL-250-DC	MNEDC250	--	**053-01054**	**053-01049**

CF and GJ Surface (Back) Mount DC Circuit Breakers

These are surface-mount breakers with screw lug terminals and a 10,000 A interrupting current for direct connection to a battery. Mounting feet on 10-100 A allow them to be bolted to the back panel in an enclosure. The breakers up through 100 A can be used in the Magnum MP panels and the Conext XW+ Distribution Panel and for custom DC control panels. All are rated for 125 VDC. The 175 A and 250 A require one rear-mount kit each. These breakers can also be panel-mounted from the front; however the panel may prevent access to the wire terminal screws on the breaker.

CF and GJ Surface (Back) Mount DC Circuit Breakers					
Amps	Max lug wire size	DC voltage rating	Width	Generic model	Item code
10 A	1 AWG	125 VDC	1"	CF-10	**053-01011**
15 A	1 AWG	125 VDC	1"	CF-15	**053-01016**
20 A	1 AWG	125 VDC	1"	CF-20	**053-01021**
30 A	1 AWG	125 VDC	1"	CF-30	**053-01026**
50 A	1 AWG	125 VDC	1"	CF-50	**053-01031**
60 A	1 AWG	125 VDC	1"	CF-60	**053-01036**
75 A	1 AWG	125 VDC	1"	CF-75	**053-01041**
100 A	1 AWG	125 VDC	1"	CF-100	**053-01051**
175 A	4/0 AWG	125 VDC	1.5"	GJ1-175-H3	**053-01056**
250 A	4/0 AWG	125 VDC	1.5"	GJ1-250-H3	**053-01061**
Rear-mount kit for GJ1 breakers above					**053-01066**

Square D QO Plug on Circuit Breakers

QO circuit breakers snap into QO load centers and are UL-listed for DC branch circuits up to 48 VDC (not for use in 48 VDC systems). They can be used for 120 VAC (single-pole), 120/240 VAC (two-pole) circuits, and 120/208 VAC three-phase (3-pole). Circuit breakers in 10 A to 30 A sizes can handle one or two 14 to 10 AWG or one 8 AWG wire. Circuit breakers 40 A to 70 A will handle 8 to 2 AWG wire.

Square D QO Plug on (For SqD Load Centers) Circuit Breakers						
Poles	**Amps**	**AC voltage rating**	**Width**	**Panel spaces**	**Model**	**Item code**
One	10 A	120 VAC	0.75"	one	QO110	**053-02063**
	15 A	120 VAC	0.75"	one	QO115	**053-02065**
	20 A	120 VAC	0.75"	one	QO120	**053-02071**
	30 A	120 VAC	0.75"	one	QO130	**053-02075**
	40 A	120 VAC	0.75"	one	QO140	**053-02080**
	50 A	120 VAC	0.75"	one	QO150	**053-02083**
	60 A	120 VAC	0.75"	one	QO160	**053-02086**
	70 A	120 VAC	0.75"	one	QO170	**053-02090**
Two	15 A	120/240 VAC	1.5"	two	QO215	**053-02067**
	20 A	120/240 VAC	1.5"	two	QO220	**053-02073**
	25 A	120/240 VAC	1.5"	two	QO225	**053-02076**
	30 A	120/240 VAC	1.5"	two	QO230	**053-02077**
	40 A	120/240 VAC	1.5"	two	QO240	**053-02081**
	45 A	120/240 VAC	1.5"	two	QO245	**053-02079**
	50 A	120/240 VAC	1.5"	two	QO250	**053-02084**
	60 A	120/240 VAC	1.5"	two	QO260	**053-02088**
Three	15 A	120/208 VAC	2.25"	three	QO315	**053-16451**
	20 A	120/208 VAC	2.25"	three	QO320	**053-16453**
	25 A	120/208 VAC	2.25"	three	QO325	**053-16454**
	30 A	120/208 VAC	2.25"	three	QO330	**053-16450**
	40 A	120/208 VAC	2.25"	three	QO340	**053-16455**
	50 A	120/208 VAC	2.25"	three	QO350	**053-16452**
	60 A	120/208 VAC	2.25"	three	QO360	**053-00209**

[1]Not rated for use in 48 VDC systems

Square D QOU Pass-Through Circuit Breakers

QOU circuit breakers are designed for surface or DIN mounting. They are UL-listed for DC branch circuits up to 48 VDC (not for use in 48 VDC systems) and can be used for 120 VAC (single-pole) and 120/240 VAC (two-pole). Circuit breakers in 10 A to 30 A sizes can handle one or two 14 to 10 AWG or one 8 AWG wire. Circuit breakers in 40 A to 70 A sizes will handle 8 to 2 AWG wire.

Square D QOU (DIN or Surface Mount) Pass-Through Circuit Breakers						
Poles	**Amps**	**AC voltage rating**	**DC voltage rating[1]**	**Width**	**Model**	**Item code**
One	10 A	120 VAC	48 VDC	0.75"	QOU110	**053-02006**
	15 A	120 VAC	48 VDC	0.75"	QOU115	**053-02009**
	20 A	120 VAC	48 VDC	0.75"	QOU120	**053-02015**
	30 A	120 VAC	48 VDC	0.75"	QOU130	**053-02024**
	40 A	120 VAC	48 VDC	0.75"	QOU140	**053-02030**
	50 A	120 VAC	48 VDC	0.75"	QOU150	**053-02036**
	60 A	120 VAC	48 VDC	0.75"	QOU160	**053-02042**
	70 A	120 VAC	48 VDC	0.75"	QOU170	**053-02048**
Two	15 A	120/240 VAC	48 VDC	1.5"	QOU215	**053-02012**
	20 A	120/240 VAC	48 VDC	1.5"	QOU220	**053-02018**
	30 A	120/240 VAC	48 VDC	1.5"	QOU230	**053-02027**
	40 A	120/240 VAC	48 VDC	1.5"	QOU240	**053-02033**
	50 A	120/240 VAC	48 VDC	1.5"	QOU250	**053-02039**
	60 A	120/240 VAC	48 VDC	1.5"	QOU260	**053-02045**

[1]Not rated for use in 48 VDC systems

Fuses

600 and 1,000 VDC Midget Fuses and DIN Rail Mount Fuse Holders

The fuse holder and fuses below fit MidNite MNPV and OutBack FLEXPV and other 600 and 1,000 VDC array combiners, but these fuse holders do NOT fit SolaDeck combiners. These fuses are also used in the integrated combiners in many commercial grid-tie inverters.

Midget Fuses 600 VDC		
Amps	**Description**	**Item code**
--	CHM1 Fuse Holder - 600 V 30 A Max - DIN-mount	**053-03040**
--	USM1-DC1000 Fuse Holder 1000 VDC – DIN-mount	**053-03170**
1 A	1 A 600 VDC fuse, KLKD or equivalent	**053-03155**
2 A	2 A 600 VDC fuse, KLKD or equivalent	**053-03052**
4 A	4 A 600 VDC fuse, KLKD or equivalent	**053-03051**
6 A	6 A 600 VDC fuse, KLKD or equivalent	**053-03050**
8 A	8 A 600 VDC fuse, KLKD or equivalent	**053-03048**
10 A	10 A 600 VDC fuse, KLKD or equivalent	**053-03046**
12 A	12 A 600 VDC fuse, KLKD or equivalent	**053-03044**
15 A	15 A 600 VDC fuse, KLKD or equivalent	**053-03043**
20 A	20 A 600 VDC fuse, KLKD or equivalent	**053-03042**
30 A	30 A 600 VDC fuse, KLKD or equivalent	**053-03041**
Midget Fuses 1,000 VDC		
1 A	1 A 1,000 VDC fuse, HP10M01 or equivalent	**053-03166**
15 A	15 A 1,000 VDC fuse, HP10M15 or equivalent	**053-03167**
20 A	20 A 1,000 VDC fuse, HP10M20 or equivalent	**053-03168**
30 A	30 A 1,000 VDC fuse, HP10M30 or equivalent	**053-03169**

Class-R Fuses

The **250 VAC/125 VDC** Class R fuses can be used in AC circuits up to 250 VAC or DC circuits up to 125 VDC. The **600 VAC/VDC** fuses can be used for AC or DC circuits. They have the high amp interrupting capacity (AIC) required for fusing circuits powered by batteries. They can be used to protect wiring to small inverters (100-700 W) and wiring from charging sources. These UL-listed fuses can be used in fused safety disconnect switches and most large system sub-array combiners.

Class-R Fuses		
Amps	Item code	
	250 VAC/125 VDC	600 VAC/VDC
10 A	053-02441	053-02442
15 A	053-02444	053-02447
20 A	053-02450	053-02453
30 A	053-02456	053-02459
40 A	053-02462	053-02463
50 A	053-02465	053-02466
60 A	053-02468	053-02471
70 A	053-02469	053-02470
80 A	053-02475	053-02472
90 A	053-02476	053-02473
100 A	053-02474	053-02477
110 A	053-02484	053-02445
125 A	053-02478	053-02481
150 A	053-02479	053-02482
200 A	053-02480	053-02483

Class-R Fuse Holders

Use these fuse blocks with the Class-R 250 VAC fuses. Bare wire ends fit into the screw terminals on each end of the fuse block. The **0.1-30 A** and **31-60 A** holders accept up to 2 AWG wire and are available in single-pole and two-pole versions. The **61-100 A** block accepts up to 0 AWG wire. These do NOT fit the 600 V fuses.

Class-R Fuse Holders 250 VAC/125 VDC	
Description	Item code
Class-R fuse block 0.1-30 A single-pole	053-02423
Class-R fuse block 0.1-30 A two-pole	053-02426
Class-R fuse block 31-60 A single-pole	053-02429
Class-R fuse block 31-60 A two-pole	053-02432
Class-R fuse block 61-100 A single-pole	053-02435

Class-T Fuse Blocks with Fuses

Use these single-pole fuse blocks to fuse inverters or other large loads. A 5/16" stud-mount at each end of the fuse allows connection of a cable with a ring-lug terminal end. To connect an inverter, order two cables with lugs on both ends: one to go from the battery to the fuse and one to go from the fuse to the inverter. Class T fuses exceed the 10,000 A interrupting capacity (AIC) required to protect Square-D brand circuit breakers in DC load centers. They are UL-listed for up to 160 VDC and NEC compliant for inverter use. A fuse comes installed in the block. Order spare fuses separately.

Class-T Fuse Holders and Fuses		
Model	Description	Item code
FB1-200	200 A fuse and holder with studs	053-02526
FB2-300	300 A fuse and holder with studs	053-02544
FB2-400	400 A fuse and holder with studs	053-02559

Class-T JJN Fuses

These Class T fuses are rated for 160 VDC and 300 VAC as protection for circuit breakers, load centers, and inverters where high available short-circuit currents are possible. These fuses fit the fuse blocks described above.

Class-T Fuses		
Model	Description	Item code
JJN110	110 A replacement fuse	053-02509
JJN200	200 A replacement fuse	053-02520
JJN300	300 A replacement fuse	053-02538
JJN400	400 A replacement fuse	053-02556

Surge Protection

Photovoltaic, wind, and hydroelectric systems usually have long runs of exposed wire that can pick up surges from lightning, even if the lightning strike is only nearby. These power surges can damage sensitive electronic components in meters, charge controllers, and inverters. Surges can also damage telephone, audio, and video equipment connected to the power system. It is a good idea to install surge protection on all incoming wires in the system, including incoming photovoltaic, wind, or hydroelectric power lines; AC generator lines; and telephone and antenna leads. Proper grounding is absolutely necessary for lightning protection to be effective. In the event of a direct strike, damage may occur, even with surge protectors installed. Type 1 heavy-duty surge protectors are recommended when a direct lightning strike is possible on the installation.

MidNite Solar

MidNite Surge-Protector Device (MNSPD)

The **MidNite Solar Surge-Protector Device (MNSPD)** is a Type 2 device designed for both AC and DC systems and provides protection to service panels, load centers, or where the SPD is directly connected to the electronic device requiring protection. Maximum protection will only be achieved if the SPD is properly installed.

The MidNite Solar SPD is offered in four versions to maximize the required protection level. Protection is achieved by reducing the clamping voltage to a safe voltage that your system can sustain without damaging the electronics. The MidNite Solar SPD voltage rating should be chosen according to the nominal voltage of the system. Response time is 8/20 μs to clamp 128,000 A. There are two LEDs in each unit that will indicate when the unit is functioning correctly and there is voltage to it.

Install the **MNSPD-115** for surge protection on wires coming from a 12, 24, or 48 VDC PV array, DC wind generator or DC hydroelectric turbine. The **MNSPD-300-DC** unit works well for systems rated at 150 VDC and larger systems with sources up to 300 VDC. The **MNSPD-300-AC** can be used on120/240 VAC split-phase or two legs each on 208 VAC circuits. The **MNSPD-600** is designed for high-voltage grid-tie PV arrays, or two legs each on 480 VAC circuits. Lightning protection can be installed in a combiner box, DC or AC load center or grid-tie inverter. These devices can be used on your AC load center to protect your equipment from surges from the utility lines and on AC wiring running outside of the building, to generators, to pumps, or to outbuildings. These surge arrestors mount in a ½" knockout and are covered by a five-year material and workmanship warranty.

MidNite Solar Surge Protector Devices				
Model	**Description**	**Nominal DC voltage**	**Nominal AC voltage**	**Item code**
MNSPD-115	Surge-Protector Device	0-115 VDC	--	**053-04141**
MNSPD-300-DC	Surge-Protector Device	0-300 VDC	--	**053-04143**
MNSPD-300-AC	Surge-Protector Device	--	120/240 or 208 VAC	**053-04142**
MNSPD-600	Surge-Protector Device	0-600 VDC	480 VAC	**053-04146**
MNSPD FMB	Flush-mount box for SPD			**053-04140**

Citel

Citel DS2xxDC Off-Grid Surge Arrestors

The Citel **DS2xxDC** series is designed to protect the charge controller and other system electronics in 12 VDC, 24 VDC, 48 VDC, 150 VDC and 250 VDC off-grid PV systems. The maximum voltage should not be exceeded in any conditions; use the next higher rated unit if necessary. DS2xxDC series protectors automatically reset after each lightning surge or electrical transient. These DIN-mount surge arrestors offer superior protection for charge controllers and inverters in low-voltage DC systems.

Citel DS50PV and DS60VGPV Grid-Tie Surge Arrestor

The **DS50PV-600** is designed to protect the solar array at the solar PV array combiner box for a utility-interactive PV system. The DIN-mount DS50PV is designed for moderate lightning areas and has replaceable modules. Use the DS50PV-600 for systems with inverters that have an upper limit of up to 600 VDC. The **DS60VGPV-1000 (1500G)** are DIN-mount heavy-duty surge protectors, recommended for high lightning areas. Use the DS60VGPV-1000 for systems with inverters that have an upper limit of up to 600 VDC or 1,000 VDC. Use the DS60VGPV-1500G/51 for systems with inverters that have an upper limit of up to 1,500 VDC. The use of a surge protector is recommended at both ends of the DC power supply line (solar array side and inverter/converter side).

Citel DS7xRS-120 and SP120 AC Surge Arrestor

The **DS7xRS-120** series are DIN-mount Type 4 heavy-duty surge protectors recommended for the AC side of PV inverters and branch AC panels. The **DS73RS-120** is a three-pole design to be used with 120/240 VAC split-phase and the **DS74RS-120** is a four-pole design to be used with 120/208 VAC WYE connections. The **DS25xVG-120** is a DIN-mount heavy-duty surge protector, recommended for high lightning areas or wherever extra protection is desired. The **DS253VG-120** is a three-pole design to be used with 120/240 VAC split-phase and the **DS254VG-120** is a four-pole design to be used with 120/208 VAC WYE connections. Additional Citel surge arrestors for specialized applications are available by special order.

DC Citel Surge Arrestors				
Model	**Maximum volts**	**Max surge rating**	**Width**	**Item code**
DS220-12DC	24 VDC	20 kA 8/20 µs	0.7" (18 mm)	**053-04234**
DS220-24DC	38 VDC	20 kA 8/20 µs	0.7" (18 mm)	**053-04235**
DS230-48DC	65 VDC	30 kA 8/20 µs	0.7" (18 mm)	**053-04236**
DS240-130DC	180 VDC	40 kA 8/20 µs	0.7" (18 mm)	**053-04237**
DS240-280DC	350 VDC	40 kA 8/20 µs	0.7" (18 mm)	**053-04238**
DS50PV-600	680 VDC	40 kA 8/20 µs	1.4" (36 mm)	**053-04219**
DS60VGPV-1000	1,200 VDC	40 kA 8/20 µs	2.8" (72 mm)	**053-04231**
DS60VGPV-1500G/51	1,500 VDC	40 kA 8/20 µs	2.8" (72 mm)	**053-04239**

AC Citel Surge Arrestors				
Model	**Maximum volts**	**Max surge rating**	**Width**	**Item code**
DS73RS-120	240 VAC	70 kA 8/20 µs	2.1" (54 mm)	**053-04228**
DS74RS-120	208 VAC 3Ph	70 kA 8/20 µs	2.8" (72 mm)	**053-04229**
DS253VG-120	240 VAC	70 kA 8/20 µs	4.25" (108 mm)	**053-04232**
DS254VG-120	208 VAC 3Ph	70 kA 8/20 µs	5.67" (144 mm)	**053-04233**

Grounding

Proper equipment grounding helps to ensure that any electrical faults that may develop in a PV system have minimal opportunities to cause fires or electrical shocks. It is just as important to be familiar with NEC 250's general grounding requirements when installing PV as it is to know 690. Jurisdictions and inspectors may vary on the grounding equipment and techniques they consider acceptable, so it is also important to know what your inspector will be looking for.

SnapNrack, as well as some other mounting system brands, now offer UL 2703 listed racking packages that incorporate much of the equipment grounding by bonding modules and related gear to the rails. However, not all equipment is considered compatible or likely to be accepted by a particular inspector, so it's important to have some other options like those offered here.

Lay-in Lugs for Module Grounding

These UL -listed tin-plated copper lugs have stainless-steel set screws and come with either stainless-steel thread-forming screws and lock washers, or a longer thread-cutting stainless steel screw with stainless-steel star-washer captive on the nut. Consult the module manufacturer's installation guide to see which type(s) meet NEC requirements for connecting a continuous ground wire to that module. Available in packages of ten.

Lay-in Lugs	
Description	**Item code**
Bag of ten lay-in lugs with screws	**051-03414**
Bag of ten lay-in lugs with long screws and nuts	**051-03418**

Tyco Grounding Connector

This all-stainless steel grounding lug is like a split bolt with a mounting stud and can be used on most modules and mounting rails. The mounting stud is 8 AWG and comes with a star washer captive on the nut. It takes 6 or 8 AWG solid copper ground wire. Use this grounding lug where corrosion is a consideration. Listed to UL 467.

Tyco Grounding Connector	
Description	**Item code**
Tyco solar grounding connector	**051-03420**
Tyco solar grounding connector, 100 pack	**051-03419**

Burndy

Wiley WEEB Grounding Products

Washer, electrical equipment bonding (WEEB) products are used to bond solar modules to aluminum solar mounting rails. This replaces the lay-in lug and ground wire to each module since the mounting rails can be wired to an equipment grounding terminal in the inverter or disconnect, grounding the entire assembly. Listed to ANSI-UL 467.

WEEB-9.5

The WEEB-9.5 is used for bonding modules to mounting structures when the modules are directly bolted to the rails using ¼" bolts through the mounting holes on the rear of the module frames. This type of mounting is typical on DPW systems (see Mounting Systems) and on ArrayTech and Zomeworks trackers. The WEEB-9.5NL is used for bonding strong-back structures and legs to the rail where 3/8" bolts are used. Available in packages of ten.

WEEB Grounding Clips

WEEB grounding clips are used between modules and rails when front-mount clamps are used to hold the module to the rails. One clip grounds the frame of two adjoining modules to one of the mounting rails. Two clips are required for each pair of modules so that the modules will be bonded to both rails. available in packages of ten.

WEEB-PMC for SnapNrack and ProSolar rails

WEEB-DMC for Direct Power PowerRail

WEEB-UMC for UniRac Solar Mount rails

WEEBLug-6.7

The WEEBLug-6.7 provides a connection to the mounting system and has lay-in provision for an equipment ground conductor. The WEEBLug-6.7 kit includes the lay-in lug, matching WEEB washer, bolt, nut, flat washer, and lock washer. Two WEEB lugs and a short piece of bare wire or a WEEB bonding jumper can be used to connect across a rail splice.

WEEBLug-8.0

The WEEBLug-8.0 is similar to the WEEBLug-6.7 but is slightly wider and is used to bond Direct Power PowerGrid and CRS using a 5/16” bolt (not included).

WEEB-BJ-6.7

The WEEB Bonding Jumper is used to electronically bond mounting rails together at a splice. Use one at each splice.

Wiley Electronics WEEB Grounding		
Model	**Description**	**Item code**
WEEB-9.5	WEEB for 1/4" bolted connections, order in multiples of 10	**051-04007**
WEEB-9.5NL	WEEB for 3/8" bolted connections, order in multiples of 10	**051-04008**
WEEB-11.5	WEEB for 3/8" bolted connections, order in multiples of 10	**051-04009**
WEEB-PMC	WEEB for use with SnapNrack and ProSolar rails, order in multiples of 10	**051-04001**
WEEB-DMC	WEEB for use with DPW Power Rail, order in multiples of 10	**051-04004**
WEEB-UMC	WEEB for use with Unirac SolarMount Rail, order in multiples of 10	**051-04003**
WEEBLug-6.7	Lay-in lug with mounting hardware and WEEB, 0.71" wide, for 1/4" bolt	**051-04015**
WEEBLug-8.0	Lay-in lug with mounting hardware and WEEB, 0.87" wide, for 5/16" bolt, 100 pack	**051-04025**
WEEB-BJ-6.7	Splice jumper with two WEEB	**051-04019**

Array Combiners

Array combiners are used to electrically combine the output of multiple series strings of PV modules into a single wire to simplify the connection to an inverter or charge controller. They typically include string-level overcurrent protection and sometimes host other functions such as monitoring, a disconnect, or even AFCI and remote shutdown. It is important that the combiner used be rated for the worst-case voltage and current the array can output.

OutBack

FLEXware PV Combiners

The **FLEXware PV8** and **PV12** accommodate overcurrent protection requirements for off-grid and grid-connected applications. The DIN rail can be fitted with 150 VDC circuit breakers for low-voltage PV arrays or 600 VDC fuse holders for grid-tie arrays. Rated NEMA 3R, the powder-coated aluminum chassis can be mounted on a wall, a sloped roof, or a pole. Dual output lugs allow connection for up to 2/0 AWG wire. An easily-removable flame-retardant polycarbonate deadfront panel prevents accidental contact with live terminals. **FWPV8** has one output circuit and **FWPV12** can be configured to have one or two output circuits. Negative and ground terminal busbars are included. The two output circuits can be used for fuses in both the negative and positive legs for up to four strings into transformerless inverters. Limited to 15 A breakers or fuses. Listed to UL 1741.

FLEXware ICS PV Combiners

The FLEXware ICS PV combiners come with or without fuse holders pre-installed in the combiner, and include distribution blocks and cable gland. The **FWPV6** can be used with up to six strings at 600 VDC. Fuse holders need to be added in the quantity needed. The **FWPV6-FH600** comes with six touch-safe midget fuse holders, and **FWPV4-FH600** comes with four touch-safe midget fuse holders. Listed to UL 1741.

OutBack FLEXware PV Combiners					
Model	**# of breakers**	**# of fuse holders**	**Dimensions (L"x W"x H")**	**Weight**	**Item code**
FWPV8	eight (not incl.)	six (not incl.)	15.2 x 9.2 x 3.9	4.4 lbs	**053-03012**
FWPV12	twelve (not incl.)	eight (not incl.)	15.2 x 12.7 x 3.9	5.9 lbs	**053-03014**
OutBack FLEXware ICS PV Combiners					
FWPV6	--	six (not incl.)	11.5 x 8.25 x 3.75	2.5 lbs	**053-03006**
FWPV6-FH600	--	six	11.5 x 8.25 x 3.75	3.2 lbs	**053-03007**
FWPV4-FH600	--	four	11.5 x 8.25 x 3.75	3.5 lbs	**053-03008**

COMING SOON! FLEXware ICS Plus Combiner Solution

The FLEXware ICS Plus system will offer a complete UL-listed solution to meet the new 2014 NEC requirements for arc-fault protection, rapid shutdown, advanced ground fault, and combiner DC disconnect. Used with OutBack power conversion and energy storage equipment, it represents the only end-to-end single manufacturer UL-1741 solution on the market for battery-based systems.

MNPV3

MidNite Solar

MNPV Combiners

These powder-coated aluminum rainproof array combiners will accept DIN-mount 150 V circuit breakers, MidNite 300 VDC breakers, Midnite 600 VDC breakers, or 600 VDC fuse holders for grid-tie arrays. A plastic cover provides a dead front for safety and can be knocked out for either breakers or fuse holders. Both a negative and ground busbar are included. The aluminum NEMA 3R enclosures are approved to be mounted at angles from 90° to 14° (vertical to 3/12 slope). Listed to UL 1741 for the U.S.A. and Canada. Breakers and fuse holders are not included.

The **MNPV3** will accept three single-pole 150 VDC (MNEPV) breakers or two 600/1,000 VDC fuse holders. Includes a 60 A positive busbar, six-position PV-negative busbar and a six-position ground busbar. A single 300 VDC breaker from 7 to 50 A may be installed as a disconnect (no combining busbar).

MNPV6 with 150VDC breakers and with 600VDC fuses

The **MNPV6** will accept six single-pole 150 VDC breakers or four 600/1,000 VDC fuse holders. Includes 15-position PV-negative bus bar, 14-position ground busbar, 120 A positive bus bar for breakers and 80 A busbar for fuses. The positive busbar may be split to support two grid-tie inverters or two charge controllers. Most charge controllers and grid-tie inverters can have a common negative PV bus (except Schneider XW and BlueSky).

The **MNPV6-250** will hold up to three single-pole 300 VDC circuit breakers for charge controllers accepting input voltages up to 300 VDC.

MNPV12

The **MNPV12** will accept 12 single-pole 150 VDC breakers or ten 600/1,000 positive VDC fuse holders. It includes a 15-position PV-negative busbar, 15-position ground bus bar, and two 200 A Plus busbars for breakers or fuses. Positive busbars can be combined or separated to support two grid-tie inverters or two charge controllers. Most charge controllers and grid-tie inverters can have a common negative PV bus (except Schneider XW and BlueSky).

The **MNPV12-250** will hold up to six single-pole 300 VDC circuit breakers for charge controllers accepting input voltages up to 300 VDC.

The **MNPV16** will accept 16 single-pole 600 VDC fuse holders. Includes 21-position PV-negative busbar, 18-position ground busbar, and 240 A positive and negative busbars.

The **MNPV16-24 PV** combiner can hold up to 24 single-pole 150 VDC breakers. The 240 A busbar can take two dozen 10 A breakers or sixteen 15 A breakers or twelve 20 A breakers.

The **MNPV16-250** will accept 12 single-pole 300 VDC breakers. Includes 21-position PV-negative busbar, 18-position ground busbar, and 240 A positive and negative busbars.

The **MNPVxx-1000** combiners use 1,000 VDC fuse holders and fuses, which are not included and must be added. The MNPV10-1000 only can be split into two output circuits.

MidNite PV Combiners without Disconnect											
Model	PV source circuit options					Output circuits		Max output wire size	MNPV combiner dimensions (L" x W" x H")	Weight	Item code
	Max # 150 VDC breakers	Max # 300 VDC breakers	Max # 600 VDC breakers	Max # 600 VDC fuses	Max # 1,000 VDC fuses	Max # output circuits	Max current output				
MNPV3	three	--	--	two	--	one	60 A	1/0 AWG	10.5 x 4.5 x 3.5	2 lbs	**053-03017**
MNPV6	six	--	one	four	--	two[1]	120 - 80[2] A	1/0 AWG	13.5 x 8 x 3.5	4 lbs	**053-03018**
MNPV6-250	--	three	--	--	--	one	120 A	1/0 AWG	13.5 x 8 x 3.5	4 lbs	**053-03081**
MNPV12	twelve	--	two	ten	--	two	200 A	2/0 AWG	14.5 x 12 x 3.5	6 lbs	**053-03015**
MNPV12-250	--	six	--	--	--	two	168 A	2/0 AWG	14.5 x 12 x 3.5	6 lbs	**053-03082**
MNPV16	--	--	--	sixteen	--	one	240 A	250 mcm	21.8 x 16 x 3	13 lbs	**053-03016**
MNPV16-24	twenty-four	--	--	--	--	one	240 A	250 mcm	21.8 x 16 x 3	13 lbs	**053-03087**
MNPV16-250	--	twelve	--	--	--	one	240 A	2/0 AWG	21.8 x 16 x 3	13 lbs	**053-03083**
MNPV2-1000	--	--	--	--	two	one	40 A	1/0 AWG	10.5 x 4.5 x 3.5	2 lbs	**053-03078**
MNPV4-1000	--	--	--	--	four	one	80 A	1/0 AWG	13.5 x 8 x 3.5	4 lbs	**053-03079**
MNPV10-1000	--	--	--	--	ten	two	200 A	1/0 AWG	14.7 x 12.2 x 3.5	6 lbs	**053-02960**

[1] Only with breakers, and one negative busbar
[2] 120 A for 150 VDC breakers and 80 A with 600 VDC fuses

MidNite Solar MNPV Combiners with Disconnect Switch

The **MidNite Disco** line of PV combiners with disconnects are made to meet NEC requirements. The disconnect handle is bright red for visibility and can be locked in the off position. Several models can be configured for bi-polar or non-isolated inverters where both the positive and negative legs of the array need circuit protection. Models are available for 150 VDC, 300 VDC, or 600 VDC arrays. All of the combiners are made from powder-coated aluminum for long life in harsh conditions. A clear see-through dead front is supplied with all Disco combiners. Models are available with either NEMA 3R or NEMA 4X ratings. Many of these come with a shunt-trip disconnect and when supplied with the PSB circuit board, are compatible with the MidNite Rapid-Shutdown system to meet NEC 2014 requirements. Breaker versions do not include breakers. **HV** versions come with fuse holders except for the **MNPV4HV Disco 3R Basic** which needs fuse holders added.

The MidNite **DLTL** disconnect combiners have both dual-string fusing and dual-channel output. These work for inverters with ungrounded conductors and dual-MPPT input channels which are becoming common. Both the positive and negative legs are fused, and the fuse holders are included. They are also available with the Rapid-Shutdown PSB circuit board installed.

The MidNite **SOB** disconnect boxes, are not actually combiners but are used to transition from array to conduit wiring with an array disconnect. They have either two or four poles, so can disconnect dual channel output, either one or two strings. These work for inverters with grounded or ungrounded conductors and dual-MPPT input channels. The MNSOB boxes with suffix "-75A" are rated at 75A per pole for use with combined circuits. They are also available with the Rapid-Shutdown PSB circuit board installed.

MidNite PV Disconnect Combiners

Model	PV source circuit options				Outputs	MNPV combiner dimensions (L" x W" x H")	Weight	Birdhouse compatible?	Item code	Item code w/ PSB
	Max # 150 VDC breakers	Max # 300 VDC breakers	Max # 600 VDC breakers	Max # 600 VDC fuses	Max # output circuits					
MNPV6 Disco	six	--	one	--	two	13.2 x 8 x 6.2	6 lbs	No	**053-03000**	--
MNPV6-250 Disco	--	three	--	--	one	13.2 x 8 x 6.2	6 lbs	No	**053-03001**	--
MNPV4HV Disco 3R Basic	--	--	--	four	one	13.7 x 10.4 x 4.4	8 lbs	No	**053-02990**	--
MNPV4HV Disco 3R Dlx	--	--	--	four	one	13.7 x 10.4 x 4.4	10 lbs	Yes	**053-02991**	**053-02972**
MNPV6HV Disco 4X	--	--	--	six	one	16.8 x 12.4 x 5.6	14 lbs	Yes	**053-02992**	**053-02973**
MNPV8HV Disco 3R	--	--	--	eight	two	18.5 x 14 x 4.6	16 lbs	Yes	**053-02993**	**053-02974**
MNPV8HV Disco 4X	--	--	--	eight	two	19.5 x 14.8 x 5.8	18 lbs	Yes	**053-02994**	**053-02975**
MNPV16HV Disco 4X	--	--	--	sixteen	two	21.6 x 19.9 x 5.8	27 lbs	Yes	**053-02995**	**053-02976**
MNPV8HV-DLTL-3R	--	--	--	eight	two	19.5 x 14.8 x 5.8	18 lbs	Yes	**053-02969**	**053-02977**
MNPV8HV-DLTL-4X	--	--	--	eight	two	19.5 x 14.8 x 5.8	18 lbs	Yes	**053-02970**	**053-02978**
MNPV16HV-DLTL-4X	--	--	--	sixteen	two	26 x 24 x 6	25 lbs	Yes	**053-02971**	**053-02979**
MNSOB 3R-2P	--	--	--	--	two	13.7 x 10.4 x 4.4	10 lbs	Yes	**053-02961**	**053-02962**
MNSOB 4X-2P	--	--	--	--	two	16.8 x 12.4 x 5.6	14 lbs	Yes	**053-02963**	**053-02966**
MNSOB 3R-4P	--	--	--	--	four	13.7 x 10.4 x 4.4	10 lbs	Yes	**053-02964**	**053-02967**
MNSOB 4X-4P	--	--	--	--	four	16.8 x 12.4 x 5.6	14 lbs	Yes	**053-02965**	**053-02968**
MNSOB 3R-2P-75A	--	--	--	--	two	13.7 x 10.4 x 4.4	10 lbs	Yes	**053-02947**	**053-02948**
MNSOB 4X-4P-75A	--	--	--	--	four	16.8 x 12.4 x 5.6	14 lbs	Yes	**053-02949**	**053-02950**

NEW! MidNite Solar Micro-inverter and Enphase combiners

The MidNite **MNPV6-DISCO AC MICRO** is a basic disconnecting combiner for up to three 120/240 VAC micro-inverter circuits. The disconnect handle is bright red for visibility and can be locked in the off position. Made from powder-coated aluminum for long life in any environment. Add AC DIN-mount breakers from page 176. Add one two-pole breaker for each micro-inverter circuit, up to three circuits.

The MidNite **MNACENPR** combiners were developed in conjunction with Enphase. They give the installer a single outdoor enclosure for combining two or three Enphase 120/240 VAC micro-inverter circuits, and the Envoy. This makes installation of an Enphase system easy and saves installation time. It is available for either two or three circuits, and with or without the Envoy included. The close proximity of the Envoy to the Enphase circuits ensures the best power line carrier performance from the inverters. The Envoy can be connected to an Internet router by direct Ethernet cable, a WiFi stick on the Envoy (there is room in the enclosure for this), or by Ethernet-over-power-line adapters. There is a 5A receptacle inside for an Ethernet-over-power-line adapter if it is used. The enclosure easily accommodates a MidNite SPD300AC for surge protection. They are made of polycarbonate for toughness and corrosion resistance, which also allows maximum WiFi transmission.

All of these combiners come with a clear dead front and are NEMA 3R rated. Listed to UL1741, and made in the USA.

MidNite PV Disconnect Combiner Accessories					
Model	**# of circuits**	**Description**	**Dimensions (L" x W" x H")**	**Weight**	**Item code**
MNPV6-DISCO AC MICRO	three	Disconnecting combiner three 20 A AC circuits, add breakers	13.2 x 8 x 6.2	**7 lbs.**	**053-02984**
MNACENPR-2P20NE	two	Enphase two-circuit combiner, Envoy not included	15.4 x 14.6 x 7.6	**11 lbs.**	**053-02955**
MNACENPR-3P20NE	three	Enphase three-circuit combiner, Envoy not included	15.4 x 14.6 x 7.6	**11 lbs.**	**053-02954**
MNACENPR-2P20	two	Enphase two-circuit combiner, with Envoy	15.4 x 14.6 x 7.6	**13 lbs.**	**053-02953**
MNACENPR-3P20	three	Enphase three-circuit combiner, with Envoy	15.4 x 14.6 x 7.6	**13 lbs.**	**053-02952**

Envoy Not Included

MidNite Solar Rapid Shutdown Components

The firefighter-approved **MNBirdhouse1** remote actuator should be installed in a visible, easily accessible location so that the array combiners can safely be disconnected from the ground when necessary. The hard-wired connection to the disconnect combiners provides positive feedback that the disconnect on the roof has actually been thrown. One MNBirdhouse1 can be used to disconnect multiple combiners. The MNBirdhouse1 has a speaker and will announce when it is safe to climb onto the roof, and during the day it will inform that there is still voltage present up to the combiner. At night, it will announce that there is no PV voltage present. The MNBirdhouse1 is powered by multiple redundant sources. It is available in either red or gray. Each combiner can be powered using the array with the **MNDiscoPSB** power supply that will also power the MNBirdhouse1. The MNBirdhouse1 also comes with an indoor 120 VAC power supply that can be used as a DC supply, and has an internal backup battery. The power draw of the MNBirdhouse1 is only 1 W. Use the special **MNCAT5-600** 600 V CAT5 USE-2 compliant wire to connect the Birdhouse and combiners. The **MNBDM** battery disconnect module can be used to power a remote actuating breaker to disconnect other circuits including battery or generator circuits. The **MNFX-CABLE** should be used in the MNBirdhouse1 when there are no combiners connected to it.

MidNite PV Disconnect Combiner Accessories			
Model	**Description**	**Dimensions (L" x W" x H")**	**Item code**
MNBirdhouse1-Red	Emergency remote disconnect switch - Red	12.1 x 8.3 x 4.6	**053-02985**
MNBirdhouse1-Gray	Emergency remote disconnect switch - Gray	12.1 x 8.3 x 4.6	**053-02959**
MNDiscoPSB	Power supply for disconnect combiners	9.5 x 4 x 3.25	**053-02987**
MNBDM-48	Power supply 48 VDC for remote-actuated breakers	4 x 2 x 1.25	**053-02958**
MNBDM-24	Power supply 24 VDC for remote-actuated breakers	4 x 2 x 1.25	**053-02957**
MNFX-CABLE	Cable for use in Birdhouse when no PSB combiner is used	--	**053-02956**
MNCAT5-600	Communication cable 600 V CAT5 USE-2 outdoor wire, per foot	--	**053-02983**

SnapNrack

NEW! SnapNrack Junction Box R

The SnapNrack UL-listed Junction Box provides a quick and easy installation utilizing snap-in features and NEMA 4X rating. It is large enough for wire management but small enough to be adaptable to any mounting configuration. It works well to conceal and protect electrical connections under the array. It has internal dimensions approximately 6” x 5” x 3” with DIN-rail mounting bosses inside. The lid is hinged and gasketed, and has a single screw to close. It comes with a SnapNrack channel nut and is made of polycarbonate as well as covered under a ten-year product warranty.

Tyco Grounding Connector		
Model	**Description**	**Item code**
JUNCTION BOX R	SnapNrack array J-box for SnapNrack rails	**242-01104**

SolaDeck

PV Roof-Mount Enclosure/Combiner

These are NEMA 3R enclosures that provide a flashed roof penetration for the array cables. They are all made from 18 gauge galvanized steel with a powder-coated finish providing a professional look. All have a dual ground lug, a 6" (150 mm) universal DIN rail to mount fuse holders or terminal blocks. There are three roof-deck knockouts (½", ¾", and 1") and dimples to center a punch or drill for entry conduit or fittings, as well as a built-in roof flashing.

The **SD-0786-41** is a DC combiner and can be used with terminals or fuse holders for array wiring. For combining circuits, use up to four DIN-mount fuse holders, each 18 mm wide, a positive and negative busbar, and a **PASS-THRU** kit to combine up to four module strings. Or use the two-position positive **(0784 BB)** and negative **(0785 BB)** busbars for combining two strings, with or without fuses (fuses not included). These are listed to UL 1741 for DC Photovoltaic Combiner Enclosures.

The **SD-0786-3R** is listed as a j-box and can be used for pass-through wiring of both DC and AC circuits without combining. Both SD-0786 are only 2.5" deep and can fit under the array.

The **SD-0760-41 AD** is a combiner for both AC and DC circuits and has a bump in the lid to accommodate DIN-mount DC or AC breakers. The **SD-0766-41 AD** is 6" deep for use on tile roofs. It comes with a 30" square soft aluminum flashing and can be used as both AC and DC combiner or pass-through. These are listed to UL 1741 for DC Photovoltaic Combiner Enclosures.

To make pass-through connections inside a SolaDeck, use one or more **PASS-THRU** kits. This kit has four DIN-mount terminals that can be used with 16 to 6 AWG wire and hardware to hold them in place. Each terminal is 10 mm wide. See the next page for Soladeck combiner and pass-through kits.

For combining two AC micro-inverter circuits, use **0784 AC 2K** and two appropriately rated **S202U** breakers. For combining three AC micro-inverter circuits, use **0784 AC 3K** and three S202U breakers

SolaDeck PV Roof-Mount Enclosures and Accessories		
Model	**Description**	**Item code**
SD-0786-41	SolaDeck enclosure combiner DC only	**053-00226**
SD-0786-3R	SolaDeck enclosure pass-through AC/DC (no combining)	**053-00225**
SD-0760-41 AD	SolaDeck enclosure combiner AC/DC bump lid fits breakers	**053-00223**
SD-0766-41 AD	SolaDeck enclosure combiner AC/DC deep tile roof, large soft flashing	**053-00224**
0784 BB	Positive busbar for four fuse holders	**053-00227**
0785 BB	Negative busbar for four terminals	**053-00228**
0784 FBB-2	Positive busbar for two fuse holders	**053-00229**
0785 TBB-2	Negative busbar for two terminals	**053-00230**
1452	Fuse holder for DIN-mount 600 VAC/DC	**053-00240**
0784 AC 2K	Dual busbar kit for two AC branch circuits 240 V	**053-00232**
0784 AC 3K	Dual busbar kit for three AC branch circuits 240 V	**053-00233**
S202U Z20A	AC breaker two-pole 240 VAC 20 A	**053-00210**
S202U Z15A	AC breaker two-pole 240 VAC 15 A	**053-00211**
S280UC K16	DC breaker single-pole 250 VDC 16 A	**053-00212**
1440.080	Distribution block 80 A three-pole primary 14-4 AWG, four-pole secondary 14-100AWG	**053-00241**
1440	Distribution block 175 A two-pole primary 8-2/0 AWG, four-pole secondary 14-8 AWG	**053-00243**

SolaDeck Combiner Kits

These kits simplify selection of combiner-box components. Select a kit that has the configuration you need for the parts that will allow you to put it together. The combiner kits come with fuse holders and 15 A fuses. All kits come with strain-relief fittings. The kits with breakers must use the bump-lid enclosure.

SolaDeck Pass-Through and Combiner Kits		
Model	**Description**	**Item code**
DC Pass-Through Kits		
01601	SolaDeck DC pass-through kit for one string	**053-00250**
01602	SolaDeck DC pass-through kit for two strings	**053-00251**
01603	SolaDeck DC pass-through kit for three strings	**053-00252**
01604	SolaDeck DC pass-through kit for four strings	**053-00253**
01605	SolaDeck DC pass-through kit for five strings	**053-00254**
DC Fused Combiner Kits		
0786K-2C	SolaDeck DC combiner kit for two strings	**053-00259**
0786K-3C	SolaDeck DC combiner kit for three strings	**053-00260**
0786K-4C	SolaDeck DC combiner kit for four strings	**053-00261**
0786K-5C	SolaDeck DC combiner kit for five strings	**053-00262**
DC Dual Fused Combiner Kits		
01632	SolaDeck DC combiner kit for two strings, both positive and negative fused	**053-00273**
01633	SolaDeck DC combiner kit for three strings, both positive and negative fused	**053-00274**
01634	SolaDeck DC combiner kit for four strings, both positive and negative fused	**053-00275**
AC Pass-Through Kits		
01611	SolaDeck AC pass-through kit for one string	**053-00255**
01612	SolaDeck AC pass-through kit for two strings	**053-00256**
01613	SolaDeck AC pass-through kit for three strings	**053-00257**
01614	SolaDeck AC pass-through kit for four strings	**053-00258**
AC Fused Kits		
01641	SolaDeck AC fused pass-through kit for one circuit	**053-00263**
01642	SolaDeck AC fused combiner kit for two circuits	**053-00264**
01643	SolaDeck AC fused combiner kit for three circuits	**053-00265**
AC Breaker Kits		
0760K2AC-PB15	SolaDeck 15A AC breaker combiner kit for two circuits, use bump lid box	**053-00276**
0760K3AC-PB15	SolaDeck 15A AC breaker combiner kit for three circuits, use bump lid box	**053-00277**
0760K2AC-PB20	SolaDeck 20A AC breaker combiner kit for two circuits, use bump lid box	**053-00278**
0760K3AC-PB20	SolaDeck 20A AC breaker combiner kit for three circuits, use bump lid box	**053-00279**

NEW! Rapid Shutdown Devices

These rapid shutdown devices meet the NEC 690.12 requirements in a single box. These are made for all grid-tie inverters, and will disconnect the solar array and discharge the inverter capacitors on loss of the grid or an optional stop switch. When the power supply or stop switch interrupts the low voltage current to the unit, it will shut down the connection and discharge the capacitors in the inverter. The signal power to operate the system is 15-30 VDC or 12-18 VAC. 2.5 W is needed per unit to operate, make sure the power supply is adequate for all of the units installed. They are not made to work with charge controllers, and should not be used with them. They are available in three forms, inside a Soladeck enclosure, in a small polycarbonate box, and in a larger box. The RS6-D2-S1CAC is installed in a Soladeck enclosure, the RS6-D2-P1CAC is in a NEMA 4X polycarbonate enclosure, and both units have two channels with two poles each, one positive and one negative. The RS6-D4-S2CAC has four channels with one positive and one negative each, in a NEMA 3R box. Each pole is rated at 600 VDC and 20 A continuous (16 A I_{sc}) so for most modules is limited to one string per pole. The units include surge protection to 20 kA at 8/20 μs impulse. Rated at -40 °C to 70 °C ambient temperatures. TUV tested to UL1741. Covered by a ten-year warranty.

The E-stop switches can be used to shut down the array in addition to the loss of utility power.

Rapid Shutdown Devices					
Model	**# of circuits**	**Description**	**Dimensions (L" x W" x H")**	**Weight**	**Item code**
RS6-D2-S1CAC	two	Rapid shutdown box in Soladeck enclosure	10.4 x 8.7 x 2.6	**10 lbs**	**053-00215**
RS6-D2-P1CAC	two	Rapid shutdown box in NEMA 4X enclosure	9.5 x 8.5 x 3.5	**3.5 lbs**	**053-00216**
RS6-D4-S2CAC	four	Rapid shutdown box in NEMA 3R enclosure	23.6 x 7.9 x 3.1	**13.1 lbs**	**053-00217**
0232-00/A	E-stop switch, w/ power supply				**053-00220**

AMtec Combiners

AMtec manufactures a variety of 600 VDC to 1500 VDC combiners and re-combiners, including options for string monitoring, disconnect, and remote contactor. A choice between enclosure materials is available including fiberglass, painted steel, and stainless steel. Custom devices are also available. Call AEE for assistance in choosing a combiner for your needs. Made to UL standards in USA.

SolarBOS Combiners

SolarBOS manufactures a wide variety of 600 VDC to 1500 VDC combiners and re-combiners for commercial applications, including options for string monitoring, disconnect, remote contactor, and arc fault protection. A choice between enclosure materials is available including fiberglass, painted steel, and stainless steel. Custom devices are also available. Call AEE for assistance in choosing a combiner for your needs. Made to UL standards in USA.

Disconnects

Disconnect switches provide a means for safely opening a circuit between the power supply and any loads that may be present. Some disconnects also offer fusing, remotely-actuated contactors or other specialized functions. The NEC requires listed disconnects in a variety of situations. Be sure to choose a disconnect that is rated for the AC or DC voltage and current that may be present on the circuit.

Square-D

240 V and 600 V NEMA 3R Safety Switch Disconnects

For inverters that do not include a DC disconnect, or when an additional DC disconnect is required, one of these 600 VDC disconnects can be used. Many utilities require an AC disconnect between a grid-tie inverter and the AC load center, close to the AC service entrance, and with a visible and lockable handle.

The Square-D 600 VDC-rated 30 A, 60 A, and 100 A three-pole safety switches are rated by Square-D to handle one 600 VDC circuit per pole for PV (although they are not UL-listed for this purpose). The 30 A switch is rated for 16 A short-circuit current (I_{sc} at PV module STC) for non-fused versions, and 12.8 A (I_{sc}) for fused versions. The 60 A switch is rated for 48 A (I_{sc}) for non-fused versions and 38 A (I_{sc}) for fused versions. The 100 A switch is rated for 80 A (I_{sc}) for non-fused versions and 64 A (I_{sc}) for fused versions.

All of the Square-D 600 VDC non-fused disconnects are rated for disconnecting one circuit at full rated current using two poles in series. Fused disconnects are rated for 80% of switch current rating at up to 600 VDC.

Use Class-R fuses of the proper voltage and amperage for fused disconnects. 600 V fuses will not fit into 240 VDC disconnects, and 250 VAC/125 VDC fuses will not fit into 600 V disconnects, and vice-versa.

Heavy-Duty (HD) switches are rated for "Service duty". Use the fused versions for AC line-side taps.

Square-D Disconnects									
Amps	AC/DC	Fused	Poles	Neutral kit	Ground kit	Dimensions (H" x W" x D")	Weight	Model	Item code
600 VAC or DC 3-Pole NEMA 3R Heavy-Duty Switches									
30 A	Yes	No	three	SN03	GTK03	14.88 x 6.63 x 4.88	9.3 lbs	HU361RB	**053-02312**
30 A	Yes	Yes	three	SN03	GTK03	14.88 x 6.63 x 4.88	9.8 lbs	H361RB	**053-02313**
60 A	Yes	No	three	SN0610	GTK0610	17.50 x 9 x 6.38	16 lbs	HU362RB	**053-02339**
60 A	Yes	Yes	three	SN0610	GTK0610	17.50 x 9 x 6.38	16 lbs	H362RB	**053-02341**
100 A	Yes	No	three	SN0610	GTK0610	21.25 x 8.50 x 6.38	24 lbs	HU363RB	**053-02357**
100 A	Yes	Yes	three	SN0610	GTK0610	21.25 x 8.50 x 6.38	24 lbs	H363RB	**053-02355**
200 A	Yes	No	three[1]	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	44 lbs	HU364RB	**053-02364**
200 A	Yes	Yes	three[1]	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	--	H364NRB	**053-02366**
400 A	Yes	Yes	three[1]	included	PKOGTA2	50.31 x 27.88 x 10.13	--	H365NR	**053-02407**
800 A	Yes	Yes	three[1]	included	PKOGTA7	69.13 x 36.62 x 17.75	--	H367NR	**053-02373**
1,200 A	Yes	Yes	three[1]	included	PKOGTA8	69.13 x 36.62 x 17.75	--	H368NR	**053-02409**
240 VAC/125 VDC[2] NEMA 3R Heavy-Duty Switches									
30 A	Yes	Yes	three	included	GTK03	14.88 x 6.63 x 4.88	9.8 lbs	H321NRB	**053-02315**
60 A	Yes	Yes	three	included	GTK03	14.88 x 6.63 x 4.88	10 lbs	H322NRB	**053-02336**
100 A	Yes	Yes	three	included	GTK0610	21.25 x 8.50 x 6.38	19 lbs	H323NRB	**053-02351**
200 A	Yes	Yes	three	included	PKOGTA2	29.25 x 17.25 x 8.50	43 lbs	H324NRB	**053-02363**

[1] Uses two poles (and two fuses) in series for 600 VDC, no PV rating per pole.
[2] Switches are rated for 250 VDC, but available fuses are only rated for 125 VDC.

AC-Only NEMA 3R Safety Switch Disconnects

Use these General-Duty Square-D AC safety switches for single-phase or three-phase grid-tie inverter outputs if you are back-feeding a circuit breaker to make the connection to the service panel. They can also be used as a disconnect for the AC output of off-grid inverters.

Use Class-R 250 VAC/125 VDC fuses with the fused versions of these disconnects.

Square-D NEMA 3R General-Duty Switches - 240 V Max AC Only									
Amps	AC/DC	Fused	Poles	Neutral kit	Ground kit	Dimensions (H" x W" x D")	Weight	Model	Item code
30 A	AC only	No	two	SN20A	PK3GTA1	9.63 x 7.25 x 3.75	4.4 lbs	DU221RB	**053-02318**
30 A	AC only	Yes	two	included	PK3GTA1	9.63 x 7.25 x 3.75	4.5 lbs	D221NRB	**053-02326**
30 A	AC only	No	three	SN20A	PK3GTA1	9.63 x 7.25 x 3.75	4.7 lbs	DU321RB	**053-02319**
30 A	AC only	Yes	three	included	PK3GTA1	9.63 x 7.25 x 3.75	5.1 lbs	D321NRB	**053-02329**
60 A	AC only	Yes	two	included	GTK03	14.88 x 6.63 x 4.88	9.7 lbs	D222NRB	**053-02334**
60 A	AC only	No	three	SN20A	PK3GTA1	9.63 x 7.25 x 3.75	5.0 lbs	DU322RB	**053-02342**
60 A	AC only	Yes	three	included	GTK03	14.88 x 6.63 x 4.88	9.8 lbs	D322NRB	**053-02343**
100 A	AC only	Yes	two	included	GTK0610	17.50 x 8.50 x 6.50	16 lbs	D223NRB	**053-02358**
100 A	AC only	No	three	SN0610	GTK0610	17.50 x 8.50 x 6.50	15 lbs	DU323RB	**053-02359**
100 A	AC only	Yes	three	included	GTK0610	17.50 x 8.50 x 6.50	16 lbs	D323NRB	**053-02361**
200 A	AC only	Yes	two	included	PKOGTA2	29.25 x 17.25 x 8.25	29 lbs	D224NRB	**053-02371**
200 A	AC only	Yes	three	included	PKOGTA2	29.25 x 17.25 x 8.25	30 lbs	D324NRB	**053-02372**

SN0610 Neutral busbar

SN20A Neutral busbar

PKOGTA2 Ground busbar

Top Mount hub 3/4"

Square-D Disconnect Accessories

These conduit **Top-Mount Hubs** connect conduit or a kWh meter socket to the top of the disconnect. The neutral and ground busbars are used to land these conductors in the disconnect switch box. Appropriate busbars for each disconnect are identified in the tables above.

Square-D Disconnect Switch Accessories	
Description	Item code
SN03 Neutral busbar	**053-02389**
SN0610 Neutral busbar	**053-02381**
SN20A Neutral busbar	**053-02383**
GTK03 Ground busbar	**053-02387**
PK3GTA1 Ground busbar	**053-02395**
GTK0610 Ground busbar	**053-02386**
PKOGTA2 Ground busbar	**053-02388**
PKOGTA7 Ground busbar	**053-02385**
PKOGTA8 Ground busbar	**053-02384**
Top Mount hub 3/4"	**053-02305**
Top Mount hub 1"	**053-02306**
Top Mount hub 1-1/4"	**053-02307**
Top Mount hub 1-1/2"	**053-02308**
Top Mount hub 2"	**053-02309**

Load Centers

Load centers provide a central location for mounting busses and breakers to feed multiple load circuits from a single power supply, such as a utility service or inverter output. The NEC requires NRTL-listed load centers for most applications. Be sure to choose a load center that is rated for the AC or DC voltage and current supplied as well as any application-specific requirements.

QO24L70RB

QO612L100RB

QO312L125GRB

GOC30US

PK15GTA

Square-D QO Load Centers

Square-D brand load centers are multi-purpose for wiring that meets the National Electric Code (NEC). These can be used as AC load centers or subpanels. Panels using QO plug-in breakers are rated up to 48 VDC for use as 12 VDC or 24 VDC load centers. They can also be used to combine the AC output from multiple inverters feeding the grid. When used as DC load centers, they should be protected by a high-interrupt capacity fuse or circuit breaker between the load center and the battery. The Class-T and R fuses, as well as the DC breakers used in the OutBack and Xantrex DC power centers, work in these load centers.

When used to combine the AC output of multiple grid-tie inverters, in order to meet the requirements of NEC 690.64(B)(2), the bus amp rating for the load center must be larger than the sum of all of the overcurrent devices feeding it, from both the utility and all inverters. Load centers are not supplied with breakers—order breakers and conduit hubs for outdoor load centers separately.

Square-D QO Load Centers[1]									
Spaces (single)	Bus rating	Outdoor	Cover	Max wire main lug	Ground kit	Dimensions (L" x W" x H")	Weight	Model	Item code
120/240 V AC Single-Phase Main Lug Load Centers									
two	70 A	yes	incl.	4 AWG	PK4GTA	9.38 x 4.88 x 4	5 lbs	QO24L70RB	**053-02141**
two	70 A	no	incl.	4 AWG	PK4GTA	9.30 x 4.81 x 3.19	3.8 lbs	QO24L70S	**053-02144**
six	100 A	yes	incl.	1 AWG	PK7GTA	12.62 x 8.88 x 4.27	9.7 lbs	QO612L100RB	**053-02147**
six	100 A	no	incl.	1 AWG	PK7GTA	12.57 x 8.88 x 3.8	8.3 lbs	QO612L100DS	**053-02153**
12	125 A	yes	incl.	2/0 AWG	incl.	19 x 14.25 x 4.5	23 lbs	QO112L125GRB	**053-02163**
12	125 A	no	add	2/0 AWG	incl.	18 x 14.25 x 3.75	15 lbs	QO112L125G	**053-02162**
12	200 A	yes	incl.	250 kcmil	incl.	26.25 x 14.25 x 4.5	27 lbs	QO112L200GRB	**053-02165**
12	200 A	no	add	250 kcmil	PK15GTA	29.86 x 14.25 x 3.75	18 lbs	QO112L200G	**053-02164**
120/208 V AC Three-Phase Main Lug Load Centers									
12	125 A	yes	incl.	2/0 AWG	incl.	19 x 14.25 x 4.52	22 lbs	QO312L125GRB	**053-02181**
12	125 A	no	add	2/0 AWG	incl.	19 x 14.25 x 3.75	11 lbs	QO312L125G	**053-02183**
18	200 A	yes	incl.	250 kcmil	incl.	30 x 14.25 x 4.52	31 lbs	QO318L200GRB	**053-02185**
18	200 A	no	add	250 kcmil	incl.	30 x 14.25 x 3.75	17 lbs	QO318L200G	**053-02187**

[1]Uses QO plug-in breakers

Square D Load Center Covers and Ground Busbars for QO Load Centers			
Description	Weight	Model	Item code
Surface cover for twelve-space 125 A Load Centers 053-02162 & 053-02183	6 lbs	GOC16US	**053-02159**
Flush cover for twelve-space 125 A Load Centers 053-02162 & 053-02183	7 lbs	GOC16UF	**053-02156**
Surface cover for all 200 A Load Centers 053-02164 & 053-02187	9.2 lbs	GOC30US	**053-02169**
Flush cover for all 200 A Load Centers 053-02164 & 053-02187	11 lbs	GOC30UF	**053-02170**
Ground Busbar for two-space Load Centers		PK4GTA	**053-02390**
Ground Busbar for six-space Load Centers		PK7GTA	**053-02391**
Ground Busbar for twelve-space Load Centers		PK9GTA	**053-02392**
Ground Busbar for twelve-space 200 A Load Centers		PK15GTA	**053-02393**
Ground Busbar for 30-space Load Centers		PK18GTA	**053-02394**

Insulated Cable Connector Blocks

This insulated connector is molded for a precise fit and supplied with removable access plugs over the hex screws. Available with two to four wire-entry ports on one side for 14 to 4 AWG wire. This can be used to transition from exposed PV-wire cables to conduit wiring on roof to PV arrays or for any parallel wiring connection. Use the two-pole units just to splice two wires together (one in and one out). The three-pole block can be used to splice two wires together, such as two strings of PV modules, with a single wire output. The four-pole block can be used to splice three wires together with a single wire output.

Use one block for positive and one block for negative in DC circuits. Use one block for each phase, and one block for the neutral, in AC circuits. UL-listed for 600 Volts.

Insulated Cable Connector Blocks		
Number of poles	**Wire range**	**Item code**
two	14 to 4 AWG	**054-01142**
three	14 to 4 AWG	**054-01143**
four	14 to 4 AWG	**054-01144**

IPC-4/0-6 AWG

IPC-4/0-2/0 AWG

Wire Connectors, Outdoor Wire Nuts, J-Boxes

Piercing Tap Connectors are for making wire connections where termination is not possible or desirable. **Twist-on Wire Nuts** are filled with silicone sealant for use in damp/wet locations. General purpose **Rigid Non-Metallic Conduit Junction Boxes** are rated NEMA 6P and are UL Listed.

Insulated Cable Connector Blocks		
Description	**Wire range**	**Item code**
Insulation-piercing tap connector, silicone filled, 600 V, IPC-4/0-6 AWG	Main 4 to 4/0 AWG tap 14 to 6 AWG stranded	**157-04550**
Insulation- piercing tap connector, silicone filled, 600 V, IPC-4/0-2/0 AWG	Main 4 to 4/0 AWG tap 6 to 2/0 AWG stranded	**157-04551**
Wire nut with silicone fill, blue/red, IDEAL 62 AWG (100pk)	Up to three 10 AWG	**157-04011**
Wire nut with silicone fill, blue/purple, IDEAL 63 AWG (100pk)	Up to two 8 AWG and one 10 AWG	**157-04016**
Rigid non-metallic NEMA 6P J-box 4" x 4" x 4"		**048-06590**
Rigid non-metallic NEMA 6P J-box 6" x 6" x 4"		**048-06595**
Rigid non-metallic NEMA 6P J-box 6" x 6" x 6"		**048-06600**
Rigid non-metallic NEMA 6P J-box 8" x 8" x 4"		**048-06610**
Rigid non-metallic NEMA 6P J-box 12" x 12" x 6"		**048-06620**

Waterproof Strain Reliefs

Use the 1/2" NPT threaded connectors to provide a waterproof entrance or exit for wiring on PV module junction boxes and outdoor combiner boxes. Use the 3/4" NPT connector for cables up to 5/8" diameter Made of Nylon with Buna-N seals. Resistant to salt water, and most mild chemicals and oils, these strain reliefs are noncorrosive and suitable for direct-burial installations. The oval-hole 1/2" strain relief works for two-conductor TC cable used for module interconnects, PV outputs, or UF cable. The two-hole 1/2" connector is designed for use with two 10 or 12 AWG type USE conductors. UL-listed for use in NEMA 4, 6 and 12 applications.

Waterproof Strain Reliefs		
Description	**Fits cable size**	**Item code**
½" thread with one round hole	USE 12 to 10 AWG	**054-03243**
½" thread with two round holes	USE 12 to 10 AWG	**054-03252**
½" thread with two round holes	PV WIRE 0.20" to 0.27" diameter	**054-03242**
½" thread with one round hole	0.25" to 0.5" diameter wire	**054-03241**
½" thread with one oval hole	14/2, 12/2, 10/2 TC	**054-03257**
¾" thread with one round hole	0.4" to 0.7" diameter cable	**054-03261**
¾ " thread with two round holes	PV WIRE 0.20" to 0.35" diameter	**054-03247**
1" thread with five round holes	PV WIRE 0.10" to 0.33" diameter	**054-03255**
Steel lock nut ½"		**054-03238**
Steel lock nut ¾"		**054-03244**

Barrel Connectors

These UL-listed connectors are tin-plated high strength aluminum alloy and can be used with copper or aluminum wire. Single- and double-barrel connectors utilize set screws to secure wires in place. These are not approved for use with fine stranded wire.

Barrel Connectors			
Type	Wire size	Hole size	Item code
Single	14 to 2 AWG	1/4"	**051-03319**
Single	14 to 2/0 AWG	1/4"	**051-03327**
Double	14 to 2/0 AWG	1/4"	**051-03324**
Single	6 to 4/0 AWG	3/8"	**051-03334**
Double	6 to 4/0 AWG	3/8"	**051-03330**

Power Distribution Blocks

Use these two-pole blocks to split primary power into secondary circuits, or join cables from a solar array to a power lead-in cable. Just install cables and tighten the set screws. Terminal blocks are made of zinc-plated aluminum for use with aluminum or copper conductors. Primary side accepts one large cable; secondary side accepts six smaller cables. UL recognized for up to 600 VDC.

Power Distribution Blocks					
Primary wire size	Taps	Secondary wire size	Taps	Rating	Item code
2/0 to 8 AWG	one	14 to 6 AWG	six	175 A	**054-01024**
6/0 to 6 AWG	one	14 to 4 AWG	six	350 A	**054-01027**
500 mcm to 4 AWG	one	14 to 2/0 AWG	four	380 A	**054-01025**
350 mcm to 8 AWG	one	14 to 4 AWG	twelve	310 A	**054-01023**

Splicer Blocks

Use these blocks to splice wires of up to 2/0 AWG. The terminal blocks are made of zinc-plated aluminum, for use with aluminum or copper conductors. Two-pole and three-pole blocks have one connection on each side. UL recognized for up to 600 VDC.

Splicer Blocks			
Wire size	Poles	Rating	Item code
8 to 2/0 AWG	two	175 A	**054-01030**
8 to 2/0 AWG	three	175 A	**054-01033**

MidNite Solar Manual Transfer Switch

These 120/240 VAC manual transfer switches have a neutral busbar and ground box lug terminal. Dimensions are 9" H x 5" W x 4" D. It can be used with up to 6 AWG wire to connect utility power and a generator to inverters with one AC input.

Manual Transfer Switch		
Description	Weight	Item code
Dual 30 amp 240 VAC transfer switch	4 lbs	**053-07851**
Dual 60 amp 240 VAC transfer switch	4 lbs	**053-07853**

Battery Cables

Why Use Larger Cable?

Low-voltage power systems with inverters can have very high current through the cables that connect the inverter to the batteries. Large AC loads like microwave ovens, toasters, irons, and washers can cause an inverter operating on a 12 VDC battery system to draw over 100 A. Large motors may draw 300 to 500 A during startup. When cables between batteries, and from the battery bank to the inverter, are too small, the current available to the inverter is limited and it may fail to supply larger loads. Properly sized cables also impose less resistance and thereby help maximize system efficiency. See the table showing recommended cables sizes for inverters in the Reference Section.

Plated Copper Lugs

These UL-listed lugs are made from tin-plated copper tubing with 3/8" holes. Solder or crimp to stranded cable.

Plated Copper Lugs	
Description	**Item code**
Copper lug 3/8" ring 2 AWG	**051-03234**
Copper lug 3/8" ring 2/0 AWG	**051-03231**
Copper lug 3/8" ring 4/0 AWG	**051-03228**

Heat Shrink Tubing

Use this tubing to insulate copper lugs and compression terminals. Tubing shrinks and glue inside melts when heated with a heat gun or torch, sealing wires against corrosion and moisture. Maximum shrinkage is listed below. Sold in 6" lengths.

Heat Shrink Tubing		
Description	**Shrinks to**	**Item code**
Heat shrink tubing 1/2" x 6" black	3/16"	**051-01132-B**
Heat shrink tubing 1/2" x 6" red	3/16"	**051-01132-R**
Heat shrink tubing 1/2" x 6" white	3/16"	**051-01132-W**
Heat shrink tubing 3/4" x 6" black	1/4"	**051-01135-B**
Heat shrink tubing 3/4" x 6" red	1/4"	**051-01135-R**
Heat shrink tubing 3/4" x 6" white	1/4"	**051-01135-W**
Heat shrink tubing 1" x 6" black	3/8"	**051-01137-B**
Heat shrink tubing 1" x 6" red	3/8"	**051-01137-R**
Heat shrink tubing 1" x 6" white	3/8"	**051-01137-W**

UL-listed Battery Cable

This fine-stranded, very flexible cable is UL listed for use as battery cable. It is rated MTW or THW or AWM, 600 V, sunlight resistant, direct burial, 105 °C. 2, 2/0 and 4/0 AWG sizes are available with red or black insulation.

UL Listed Battery Cable	
Description	**Item code**
X-Flex battery cable 4/0 AWG black	**050-01470**
X-Flex battery cable 4/0 AWG red	**050-01472**
X-Flex battery cable 2/0 AWG black	**050-01476**
X-Flex battery cable 2/0 AWG red	**050-01478**
X-Flex battery cable 2 AWG black	**050-01487**
X-Flex battery cable 2 AWG red	**050-01488**

Battery Cables with Lugs

Use these cables between a battery bank and inverter, fuse or power center. They have flexible stranded UL-listed copper wire and 3/8" diameter lugs. Lug barrels are covered with glue-filled heat-shrink tubing. Cables are marked in red heat-shrink tubing for positive and white heat-shrink tubing on black wire for negative. ***Append –R to the item number for a red cable with red ends (positive), -B for a black cable with black ends, or –W for a black cable with white ends (negative). For example, a red 4/0 AWG cable with a 2' length would be 052-04002-R.***

Battery Cables with Two Lugs		
Cable	**Length**	**Item code**
4/0 AWG	2'	**052-04002**
	3'	**052-04003**
	4'	**052-04004**
	5'	**052-04005**
	6'	**052-04006**
	7'	**052-04007**
	8'	**052-04008**
	10'	**052-04010**
	12'	**052-04012**
	15'	**052-04015**
2/0 AWG	2'	**052-02002**
	3'	**052-02003**
	4'	**052-02004**
	5'	**052-02005**
	6'	**052-02006**
	7'	**052-02007**
	8'	**052-02008**
	10'	**052-02010**
	12'	**052-02012**
	15'	**052-02015**
2 AWG	2'	**052-01002**
	3'	**052-01003**
	5'	**052-01005**
	8'	**052-01008**
	10'	**052-01010**

Battery Interconnects

Use these cables between individual battery cells or between battery banks. Circuits protected by 250 A breakers or 400 A fuses should use 4/0 AWG cables. Use 2/0 AWG cables for 175 A breakers and 200 A fuses. Use 2 AWG cables for 110 A or smaller fuses or breakers. Cables with red ends are for positive battery parallel jumpers. Cables with white ends are for negative battery parallel jumpers. Cables with black both ends, or red and black ends, are used for series battery interconnects. ***When ordering, append "-R" to the item number for red (positive), "-W" for white (negative), "-B" for black or "-BR" for one end red and one end black (series connections). For example, a red 9" cable used to connect positive cells in parallel would be 052-05122-R.***

Battery Interconnects		
Wire size	**Length of cable**	**Item code**
2/0 AWG	9"	**052-05122**
2/0 AWG	12"	**052-05121**
2/0 AWG	20"	**052-05124**
4/0 AWG	12"	**052-05142**
4/0 AWG	20"	**052-05145**

Bulk Wire

PV Wire Sunlight Resistant Cable

This single-conductor wire features heat and moisture resistant, crosslinked-polyethylene insulation (XLPE) (Type PV wire, USE-2, RHH, RHW, RHW-2). Rated for direct burial or in conduit this cable is sunlight resistant, flame retardant, and rated for temperatures from -40 to 90°C. This cable is listed to UL 854 as Type PV Wire, USE-2 1,000V for use with transformerless inverters.

PV Wire Sunlight Resistant Cable	
Description	**Item code**
10 AWG, PV wire, USE-2, 1,000V, black, 500' roll	**050-01149**

Tray Cable (TC)

This flexible two-conductor wire is well-suited for outdoor applications such as PV array lead-in and sub-array wiring. It may be buried directly in the ground or exposed to direct sunlight. 10 and 12 AWG stranded type THHN/THWN conductors often work well for array interconnects with currents less than 25 A. Conductor insulation is red for positive and black for negative. UL-listed.

Tray Cable (TC)	
Description	**Item code**
8 AWG two-conductor TC cable, 100'	**050-01157**
10 AWG two-conductor TC cable, 100'	**050-01163**
12 AWG two-conductor TC cable, 100'	**050-01175**
16 AWG two-conductor TC cable, 100'	**050-01178**
18 AWG two-conductor TC cable, 100'	**050-01181**

Pump Cable

This 10 AWG two-conductor cable works well with the SHURflo 9300 submersible pump, providing a good seal in the cable gland. Grundfos SQFlex pumps require cables with a ground.

Shielded Control and Communication Cable

This 16 AWG, two-conductor cable is useful for pump controls that are far from a remote tank. It is a shielded, twisted-pair cable rated for 600 volts, direct burial, and is sunlight resistant. Shielded cable can help prevent transient surges caused by lightning. Shielding should be grounded on one end of cable run only. Sold in 50’ increments.

Pump Cable and Sensor Wire	
Description	**Item code**
10 AWG two-conductor without ground	**050-01637**
12 AWG two-conductor with ground	**050-01635**
10 AWG two-conductor with ground	**050-01638**
8 AWG two-conductor with ground	**050-01643**
16 AWG two-conductor Shielded Control cable	**050-01151**
Underwater wire splice kit. Enough parts for ten splices.	**075-00130**

It’s your best source for timely, comprehensive information on federal, state, local and utility incentives: **www.dsireusa.org**

Array Cables and Connectors

Grid-tie modules generally ship with attached cables that are listed to UL 1703 with the module. The cable connectors on these are fully waterproof when connected, touch-protected and designed for up to 1,000 VDC and 30 A, but cannot be safely disconnected under load.

Our output cables are made with 10 AWG PV Wire, and Amphenol H4 connectors, and can be used in solar arrays up to 1,000 VDC. All of our array output cables are made with PV wire that is listed to UL 854, which is required by the NEC for use with transformer-less inverters (See bulk PV Wire description on previous page for more information).

Additionally, we stock the common styles of crimp-on connectors for use with 10 AWG PV stranded wire. Proper crimping to the wire and insulator assembly requires special tools (see Tools).

PV Wire Array Cables

These **Output Cables** feature Amphenol H4 connectors and are compatible with most module brands to connect strings to junction boxes or grid-tie inverters. They have a male connector on one end and a female connector on the other end, so they can be used to extend the cables on the modules or be cut in half and used to connect to a roof-top j-box or combiner. For example, if you need a 30' male and a 20' female, order a 50' cable. Made with black 10 AWG 1,000 VDC-rated PV-WIRE cable.

PV Wire Array Cables	
Cable length	**Item code**
6'	**052-09720**
15'	**052-09722**
30'	**052-09724**
50'	**052-09725**
70'	**052-09726**
100'	**052-09727**
125'	**052-09728**

Amphenol Helios H4 Connectors

The 1,000 VDC-rated Amphenol Helios H4 connector includes the pins and can be made quickly, enabling custom cables to be made at the job site. A special crimping tool and wrench set are required to assemble the connector (See Tools). These connectors are for use with 10 AWG PV wire and sold in packs of 25.

Amphenol Helios H4 Connectors	
Description	**Item code**
Amphenol Helios H4 male neutral connector, 25 pack	**097-01414**
Amphenol Helios H4 female negative connector, 25 pack	**097-01415**

MC4-Solarline 2 Connectors

The 600 VDC-rated MC-4 connectors include pins and can be assembled quickly enabling custom cables to be made at the job site. A special crimping tool and wrench set are required to assemble the connector (See Tools). These connectors are for use with 10 AWG PV wire and sold in packs of 25.

MC4-Solarline 2 Connectors	
Description	**Item code**
Male MC4 locking connector for PV wire	**097-01411**
Female MC4 locking connector for PV wire	**097-01413**

MC4-Solarline 2 Branch Connectors

These waterproof Y-connectors make it possible to parallel wire PV modules with Multi-Contact output cables. Branch connectors are rated for maximum current of 30 A and maximum voltage of 600 VDC.

MC4-Solarline 2 Branch Connectors	
Description	**Item code**
Solarline 2 branch cable coupler female - two male	**052-09403**
Solarline 2 branch cable coupler male - two female	**052-09404**

Wire-Management Hardware

As most experienced PV installers will attest, good wire management is a hallmark of high-quality installations, and its lack can lead to inspectors and customers alike looking for other potential issues. Cables and wires should be kept off the roof or ground and water should not be allowed to pool at the entrances of enclosures, splices and junction boxes. Given that a solar PV system is designed to last for 25 years or more, it is vital to use wire-management hardware that will hold up in the environment and allow deployment with minimal strain on the components.

Stainless-steel cable clips

Use these clips to keep PV-Wire module-interconnect cables and PV-array output cables neatly secured to module frames so they do not drop below the array. **Use these clips with REC modules.** These clips are available in packs of 25 or 100.

Stainless steel cable clips for PV wire	
Description	**Item code**
Stainless steel cable clips Pack of 25	**052-09126**
Stainless steel cable clips Pack of 100	**052-09125**

HellermannTyton

Solar E-clips

Stainless Steel Cable Clip

HellermannTyton's 304-Stainless-Steel **Cable Clip** can hold one or two cables at a time, accommodating cable diameters from 0.20" (5 mm) to 0.30" (7.6 mm). These clips use a dedicated spring to hold the cables in place without causing abrasion. The flat pushing surface also makes it much easier to install on module frames or other edges from 0.04" (1 mm) to 0.12" (3 mm) without sacrificing pull-out resistance. These clips are available in packs of 100.

Parallel Edge Clip with Cable Tie

HellermannTyton's **Edge Clip with Cable-Tie Assemblies** are an easy and cost-effective way to secure thick cables, such as microinverter trunk lines as well as bundles of smaller cables. The clips feature an integrated metal clamp that secures the assembly while enabling easy installation. The cable ties are made from UV-stabilized polyamide material which will not chafe cable insulation. The 1-3 mm clips will fasten securely to most module frame flanges while the 3-6 mm clips can be fastened to SnapNrack rail. Once secured, the clips can only be removed by prying them apart, which means they can't be reused. Removing a clip will also leave scratches on the surface it was attached to. These clips are available in packs of 100.

Perpendicular Edge Clip with Cable Tie

HellermannTyton's **Edge Cable Clips** are similar to the edge clips above, but have a re-closable clam shell rather than a cable tie. There is a single-cable version and a dual-cable version, either of which should secure a pair of PV-wire cables in most situations.

Edge Cable Clip Single Wire

Edge Cable Clip Double Wire

Stainless Steel Cable Clip				
Module edge thickness	**Cable diameter**	**Orientation to edge**	**Quantity**	**Item code**
0.04" - 0.12" (1 - 3 mm)	0.20" - 0.30" (5 - 7.6 mm)	Parallel under	100	**052-09140**
Edge Clips with Cable Ties				
Module edge thickness	**Max cable bundle diameter**	**Orientation to edge**	**Quantity**	**Item code**
0.04" - 0.12" (1 - 3 mm) (Attaches to Module Frame)	1.8" (45 mm)	Perpendicular under	100	**052-09141**
		Parallel under	100	**052-09142**
0.12" - 0.23" (3 – 6 mm) (Attaches to Mounting Rail)		Parallel	100	**052-09143**
		Perpendicular	100	**052-09144**
		Perpendicular under	100	**052-09145**
		Parallel under	100	**052-09146**
Edge Cable Clip				
Edge thickness	**Max cable diameter**	**Orientation to edge**	**Quantity**	**Item code**
0.04" - 0.12" (1 - 3 mm) (Attaches to Module Frame)	0.62" (15.6 mm) (single)	Parallel	250	**052-09147**
	0.32" (8 mm) (double)	Parallel	750	**052-09148**

C Clip with Fir-Tree Mount

C Clip with Cable-Tie Mount

Cable Tie with Fir-Tree Mount

Cable Ties

Self-Adhesive Mounting Base

HellermannTyton's **C Clips** are available with an integrated cable tie that can accommodate up to 1.8" diameter or with a "fir tree" base that can be pushed into a 0.25" diameter threaded or unthreaded hole. The cable-tie version comes in packs of 500 and works well for attaching cables from 0.16" to 0.4" diameter to conduit, rails or posts. The UV-stabilized polyamide fir-tree version comes in packs of 100 and works well for quickly securing 0.24" to 0.30" diameter cables using available mounting holes, such as a SnapNrack channel nut or module-mounting hole.

A **Cable Tie with Fir-Tree Mount** is also available for securing bundles up to 1.4" (35 mm) to a quarter-inch diameter hole. These are made from the same material as the C-Clip with Fir-Tree Mount and come in packs of 1,000.

Cable Clips			
Mounting type	**Cable diameter**	**Quantity**	**Item code**
C clip with Cable Tie	0.16" – 0.40" [4 – 10 mm]	500	**052-09149**
C clip with Fir Tree – 0.24" - 0.28" [6.3 – 7 mm]	0.24" to .0.30" [6 – 7.6 mm]	100	**052-09150**
Cable Ties with Fir Tree – 0.24" - 0.28" [6.3 – 7 mm]	0.06" - 1.40" [1.5 - 35 mm]	1,000	**052-09151**

Specially designed for prolonged use in extreme outdoor environments, these **Cable Ties** are made from UV-stabilized polyamide material to ensure long-term performance. The tensile strength of these ties varies according to the width.

The corresponding **Mounting Base** will accommodate cable ties up to 0.18" wide. The base is UV stabilized and employs a VHB acrylic adhesive to achieve a strong bond to most smooth surfaces. As with any adhesive product, be sure to clean the mounting surface thoroughly for best results.

Note: *Mounting anything to a module's back sheet may void the module warranty.*

Cable Ties					
Strength	**Max bundle**	**Length**	**Width**	**Quantity**	**Item code**
30 lbs	1.38" (35 mm)	5.9" (150 mm)	0.14" (3.5 mm)	100	**052-09152**
50 lbs	1.97" (50 mm)	7.9" (200 mm)	0.18" (4.6 mm)	100	**052-09153**
50 lbs	4.33" (110 mm)	15.4" (390 mm)	0.18" (4.6 mm)	100	**052-09154**
120 lbs	4.13" (105 mm)	15.2" (387 mm)	0.30" (7.6 mm)	100	**052-09155**
Mounting Base			0.18" (4.6 mm)	500	**052-09156**

Solar Water Pumping

Solar pumps operate anywhere the sun shines, making them ideal for an independent water supply. While energy production from solar pumps is impacted by cloudy weather, having adequate water storage and decreasing water needs during cool or rainy weather mitigates these impacts.

Most solar water pumping systems operate on direct current (DC). The output of the solar power system varies throughout the day and with changes in sunlight intensity and weather conditions, requiring specialized pumps and controls that operate within a wider range of voltage and current compared to most AC pumps.

Conventional AC pumps are usually centrifugal pumps that spin at high speed to pump as many gallons per minute as possible. They also consume a large amount of power and their efficiency suffers at low speeds and when pumping against high pressure. If you run a centrifugal pump at half speed, it pumps one quarter of the volume.

To minimize the size of the solar PV system required, solar pumps generally use more efficient motors and pumping mechanisms. The most efficient pumps are "positive displacement" pumps, which pump a fixed amount of water with each rotation. If it is cloudy or early morning, the pump will receive less energy and run more slowly, but with no loss of efficiency—so at half speed, it simply pumps half the amount of water at the same pressure.

To use solar energy economically, solar pumping systems typically pump more slowly than conventional well pumps (many solar pumps are designed to produce less than 6 gallons per minute) and they don't run at all between sunset and sunrise, so an adequately-sized storage tank is usually required. Instead of pumping a large volume of water in a short time and then turning off, the solar water pump works slowly and efficiently all day to provide the same volume of water. Often, a solar pump can be used in a well with a recovery rate too slow for a conventional AC pump.

If your water sources are remote from power lines, compare the cost of a low-maintenance solar pumping system to what you would spend on a generator, with continual fuel and maintenance costs, or on a utility power-line extension. In most cases, a good solar pumping system is far more economical, which is why many non-profits and NGOs use solar pumping to provide clean water to remote villages around the world.

Submersible Pumps

If you are pumping from a well, we have solar pumps that can deliver from 1 gallon per minute to over 75 gpm at peak output.

The SHURflo 9300 and Aquatec SWP pumps can be powered by a PV array as small as two 50 to 100 W solar modules, or a single larger 60-cell or 72-cell module, depending on the "head" (vertical distance or elevation change) they are pumping. They can pump 500 to 1,000 gallons per day and lift water up to 230 feet. These pumps require service every two to four years.

If you have a higher lift, need more water, or want a pump that does not require service for 15 to 20 years, the Grundfos SQFlex pumps are a good choice. These pumps can be used in wells up to 800 feet deep and can pump up to 20,000 gallons per day from shallower wells using solar modules, a fuel-powered generator, an inverter/battery system, the utility grid, or a combination of these power sources.

Surface Pumps

Surface pumps are typically less expensive than submersible pumps and can draw water from a spring, pond, river, or tank, and push it far uphill and through long pipes to fill a storage tank or to pressurize it for home use or for irrigation, livestock, etc. The pump may be placed at ground level, or suspended in a well in some cases.

All pumps are better at pushing than pulling, since the vacuum a pump can draw is limited to atmospheric pressure (about 14 psi). At sea level, a pump can be placed no higher than 10 or 20 feet, depending on the type of pump, above the surface of the water source (subtract one foot per 1,000 feet elevation). Most wells are much deeper than this and therefore require a submersible pump, which can push the water up to the surface.

Suction piping for surface-type pumps must be oversized a bit and not allow air entrapment (much like a drain line) and should be as short as possible.

Pumps can push water very long distances through a pipe. The vertical lift and flow rates are the primary factors that determine power requirements.

Water Storage and Pressurization

Many conventional AC-powered water systems pump from a well or other water source into a pressure tank that stores water and stabilizes the pressure for household use. When you turn on a tap in the house, an air-filled bladder in the tank forces the water into the pipes. When the pressure drops, a pressure switch turns on the pump, refilling and re-pressurizing the tank. This works because an AC pump delivers high volume and pressure on demand; however, this will not work with pumps operating directly from PV modules because the sun may not be shining when you want to take a long hot shower.

For pumps operating directly from PV modules, a non-pressurized water tank or cistern is used to store water for use during times when the sun is not shining. If the tank can be located above the house on a hill or on a tower, gravity can supply the water pressure. Gravity water pressure can be calculated in two ways:

Pressure (in psi) = Head (in feet) ÷ 2.31, or
Head (in feet) = Pressure (in psi) x 2.31

For reasonable pressure, the tank needs to be at least 40 feet above the house, although to obtain a pressure of 30 psi will require about 70 feet of elevation.

Alternatively, a DC or AC pressure booster pump, powered from a battery or battery/inverter system, can be used to maintain a pressure tank as needed from a storage tank that is filled by a solar pump during the day. You must use a pressure pump that can deliver the maximum flow rate required by the house, or have a pressure tank that is large enough to make up the difference between what the pressure pump can deliver and what is required for as long as it may be required. This is called the "draw-down volume" of the pressure tank.

Calculation of Solar Power Needs

If you are using a pump driven directly by PV modules, the array's nameplate output should be at least 20% higher than the power required by the pump to achieve the desired head and flow rate. A larger array or a tracking system can maximize the amount of time each day that full rated power is available to the pump, providing more gallons per day.

Since the pump will only draw the power it needs, it will not be damaged by oversizing the array. A larger array will produce the needed power in less light, extending the pumping time and volume delivered in the morning, afternoon, and on cloudy days. For instance, a 1 kW array will produce 200 W in 1/5 the amount of sunlight that you would get on a sunny day at noon.

Designing a Solar Pumping System

AEE Solar carries many types of pumps that can be used in a variety of applications. Which pump and related equipment are needed for a solar pumping system depends on many factors, including what the water source is, how much water is needed, when the water is needed, how far the water source is from another power source, etc.

If the well or other water source is close to an existing source of power, such as the utility grid or the power system of an off-grid house, it's usually better to power the pump from that existing source rather than set up a dedicated PV array. If grid power is available, it can be used to power a water pump, and if desired, a grid-tied PV system can be installed to offset the cost of the grid power.

In off-grid situations, if the well or other water source is close to the house's off-grid power system, it's usually easier to power the pump using the house's power system, either directly from the battery bank with DC, or with AC from the inverter. Additional PV modules may be needed to accommodate the pump's energy requirement, but they can be added to the house's PV system and used to help charge the batteries when the pump isn't running.

AEE Solar is happy to help you design a pumping system, but please have the following information ready when you call:

- Total amount of water, on average, needed in **gallons per day (gpd)**. Because solar pumps deliver water in variable amounts due to the variable nature of sunlight, you will need to know the total daily water need. Any seasonal changes in water requirements also need to be considered.
- **Total head** that the pump has to lift. This is the actual elevation difference between the water level in the well (or other water source) and the top of the storage tank. This is not just the length of the water line, although internal pipe friction needs to be considered if the distance is great or the pipe is small.
- **Solar insolation at the site**. Local insolation data can be obtained using PV Watts (online) or using the charts and maps at the end of this catalog. Any shading of the potential array needs to be taken into account, along with seasonal variations.

Additional information, such as well-casing diameter, water quality, well-regeneration capacity, etc., may also be needed, depending on the specific application.

Grundfos

Grundfos SQFlex Submersible Pumps

The Grundfos SQFlex are industry-leading submersible pumps for water lifts of up to 800 feet. SQFlex pumps can be directly powered by a PV array or can be run on an inverter, generator, 48 VDC battery, utility grid, or any combination of these sources. Virtually any source of power, 30 to 300 VDC or 90 to 240 VAC, can be used to run these pumps.

SQFlex pumps feature Maximum Power-Point Tracking (MPPT) of the PV array, and can operate on a series string of PV modules with a total peak-power voltage of at least 30 VDC. Efficiency will be highest at voltages over 100 VDC (10% less efficient at 60 VDC, and 20% less efficient at 35 VDC). The motor has a maximum current draw of 8.4 A.

Designed for high efficiency and reliability, the motor features integrated electronics, which eliminate the need for complicated external controls. A single motor size covers the entire pump range.

The 11 different pump models available can deliver from 77 gpm at 6' of head to 3.5 gpm at 800' with a 1.6 kW or smaller solar array. Systems with even larger arrays will produce the required power with less light, extending the pump's peak running time, and delivering more water per day.

Helical Rotor Versions

The models **3SQF, 6SQF and 11SQF**, are helical rotor pumps, for high-head applications, and will fit into a 3-1/4" ID or larger well casing (4" or larger recommended). The positive displacement helical pump ends are 3" in diameter and available in five models ranging from 3 to 11 gpm (0.68 to 2.50 m^3/h) of peak output. These pumps are designed for higher head and/or lower flow requirements. The pump's rotor is a single-twisted helix (spiral) made of hard-chromium-plated stainless steel. During operation, the rotor rotates eccentrically in a double-helical elastic stator.

The **16SQF, 25SQF, 40SQF** and **60SQF** models are centrifugal pumps, for lower-head/ higher-volume applications, and will fit into a 4-1/4" ID or larger well casing (5" or larger recommended).

The SQFlex pumps have built-in protection from dry-running, overloading, and overheating. A dry-running sensor is integrated in the pump's wire lead, about 18" above the pump. However, this sensor only has a differential of about 1 inch in water level, and should not be used as the primary dry-run system in wells that consistently run low on water. A separate water level pump control should be used, which will allow longer on/off cycling periods if he well runs dry often.

While these pumps were designed to pump water from wells, they can also be installed in tanks or cisterns to pump water further uphill, provided that they are installed inside of a 4" or 6" pipe sleeve to providedproper cooling water flow.

Grundfos makes several accessories for these pumps (see next page for details).

Centrifugal Versions

SQFlex pumps have a two-year warranty from the date of purchase. A five-year extended warranty is available. These pumps cannot be used in GFDI protected AC circuits.

CU 200 Interface Box

IO 50 Control Box

IO 101 AC Interface Box

CIU 273 Communication Interface Unit

Grundfos SQFlex Optional Controls

SQFlex controls can be combined if you need more features than one control can provide.

The **CU 200 interface box** communicates with the pump and monitors operating conditions. Built-in diagnostics indicate faults and dry-running, as well as display operating status, power consumption, and water level switch input. The water **Level Switch** interfaces with the CU 200 control to turn off the pump when the tank is full.

Since the CU 200 control circuit uses only 15 mA, the water level switch can be located in a tank as far away as 2,000 feet from the pump, using a minimum 18 AWG two-conductor wire. Shielded cable is recommended to minimize the potential for voltage surges due to lightning (see the Wire and Cable section for shielded wire.) The CU 200 is covered by a standard two-year warranty.

The **IO 50 switch box** includes cable terminations and a simple manual on/off switch that interfaces between a solar array and the pump to allow you to turn off the high-voltage array when servicing the pump or plumbing. This switch can also be used at the PV array, as an array disconnect switch, if the array is a long distance from the wellhead.

The **IO 101 AC interface box** is for using AC backup on a solar pump. It must be manually switched to the AC power source, such as a generator, utility connection, or inverter. However, when the AC power stops or is disconnected, it automatically reconnects to the PV array to let the sun continue pumping. Available for either 120 VAC or 240 VAC input. The SQFlex pumps will not function with an AC GFCI in the supply circuit and should not be used where a GFCI is required.

NOTE: *the IO-101 is* ***only rated for 225 VDC****, so make sure that the PV array will not exceed this voltage, even in cold weather.*

Grundfos SQFlex CIU 273 GRM Control Unit

The **CIU 273 SQFlex Communication Interface Unit** is designed to work directly with the SQFlex pump and is a combined monitoring, control and communication unit for these pumps. The CIU 273 enables monitoring of the system's operation anywhere in the world through Grundfos Remote Monitoring. It also has connections for a start/stop switch, level switch and pulsating water meter. It comes in a NEMA 3R enclosureand has a voltage range of 24-240 VAC/VDC.

The CIU 273 offers system monitoring and alarm indication. It monitors the float-switch pump running status, and provides alarm indications for dry running, no contact to pump, over-voltage, over-temperature, and over-load.

Communication between the CIU 273 and the Grundfos pump takes place via the pump power-supply cable (power-line communication), so no extra cables between the CIU 273 and the pump are required. It is possible to start, stop and reset the pump with the start/stop switch.

With the addition of a **CIM communication interface module** the CIU enables data communication via open and interoperable networks such as Modbus RTU, GSM/GPRS, and by using Grundfos Remote Management (contract required). Connection through twisted-pair wire (24-12 AWG) with a maximum length of 4,000 ft. Will also operate with Profibus DP, LONWorks, and BACnet MS/TP® networks with the proper CIM module (call for availability).

NOTE: *CIU 273 can replace the CU 200 in the installation.*

Grundfos SQFlex Pump and Array Sizing

To choose a pump and array size appropriate for your project, consult the table on the opposite page. The left column shows total head in feet and meters, the top row shows array wattage/number and suggested type of modules, and the boxes show seasonal pump performance and maximum flow. Select the row with the head (total lift) that most closely matches your application then move across the row to the column that contains the desired daily volume or peak flow rate. Note the pump model in that block and wattage of the PV array in that column.

Table Key

60 SQF-3	← **Pump model**
24,885 gpd	← **Estimated daily summer volume (gpd)**
19,944 gpd	← **Estimated daily winter volume (gpd)**
42 gpm	← **Peak flow rate (gpm)**

NOTE: *Daily volume and flow calculations in the table are based on Fresno, CA data at a 36° fixed tilt. Daily summer volume assumes 7.8 kWh/m²/day of insolation and winter volume assumes 4.7 kWh/m²/day. These figures, and therefore the volume of water delivered, will need to be adjusted to the local insolation conditions at the actual installation site.*

Larger PV array wattages than shown in the chart can also be used to increase water delivery quantities. Since the pump will only draw the power it needs, it will not be damaged by oversizing the array. A larger array will produce the needed power in less light, extending the pumping time and volume delivered in the morning, afternoon, and on cloudy days. The only requirement is that the PV array's open-circuit voltage (corrected for low temperature) does not exceed the 300 VDC limit for the SQFlex pump (typically six to seven 60-cell modules in series (depending on maximum low temperature of the site). If more power is desired, parallel strings of PV modules can be used.

Most solar pumping systems will provide significantly more output in Summer than in Winter. The typical flow rate is calculated at 800 W/m² and can be up to 25% greater under bright conditions. Also, up to 40% more water can be pumped in the summer if the array is on a tracking mount. The output can vary by location and weather patterns, and is not guaranteed. Contact AEE Solar if you need help sizing your specific system.

Grundfos SQFlex Pumps and Accessories	
Description	**Item code**
SQFlex 3 SQF-2 pump - helical rotor, 3" diameter	**075-01012**
SQFlex 3 SQF-3 pump - helical rotor, 3" diameter	**075-01013**
SQFlex 6 SQF-2 pump - helical rotor, 3" diameter	**075-01015**
SQFlex 6 SQF-3 pump - helical rotor, 3" diameter	**075-01016**
SQFlex 11 SQF-2 pump - helical rotor, 3" diameter	**075-01018**
SQFlex 16 SQF-10 pump - centrifugal, 4" diameter	**075-01020**
SQFlex 25 SQF-3 pump - centrifugal, 4" diameter	**075-01021**
SQFlex 25 SQF-7 pump - centrifugal, 4" diameter	**075-01025**
SQFlex 40 SQF-3 pump - centrifugal, 4" diameter	**075-01027**
SQFlex 40 SQF-5 pump - centrifugal, 4" diameter	**075-01028**
SQFlex 60 SQF-3 pump - centrifugal, 4" diameter	**075-01029**
SQFlex extended five-year warranty	**075-01001**
IO 50 On/Off switch	**075-01038**
CU 200 status, control and communications interface	**075-01033**
Level switch (use with CU 200 or CIU 273 only) – stops pump when tank is full	**075-01042**
Pressure switch – reverse-action (use with CU 200 or CIU 273 only)	**075-01044**
IO 101 AC interface box (115 V)	**075-01036**
IO 101 AC interface box (230 V)	**075-01037**
CIU 273 SQFlex GRM Communications Interface Unit – product number 97980341	**075-01050**
Antenna, roof mounting, complete – for CIU 273 - product number 97631956	**075-01051**
Antenna, desk mounting, complete – for CIU 273 - product number 97631957	**075-01052**
CIM communication interface module - Modbus	**075-01055**
CIM communication interface module - GSM/GPRS	**075-01056**

Grundfos SQFlex Submersible Pump Selection Chart

Head	Module watts	250 W 60-cell modules					
	X # of modules →	2	3	4	5	6	7
	= Array watts →	500 W	750 W	1,000 W	1,250 W	1,500 W	1,750 W
6' (2 m)	Model	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3
	7.8 kWh/m²	24,885 gpd	31,609 gpd	37,627 gpd	42,809 gpd	46,335 gpd	49,272 gpd
	4.7 kWh/m²	19,944 gpd	26,177 gpd	31,410 gpd	35,264 gpd	38,204 gpd	40,675 gpd
	Max flow	42 gpm	52 gpm	61 gpm	68 gpm	73 gpm	77 gpm
25' (8 m)	Model	40 SQF-3	40 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3	60 SQF-3
	7.8 kWh/m²	13,027 gpd	20,089 gpd	26,345 gpd	31,950 gpd	35,680 gpd	38,605 gpd
	4.7 kWh/m²	9,539 gpd	15,049 gpd	19,889 gpd	24,146 gpd	27,295 gpd	30,149 gpd
	Max flow	24 gpm	35 gpm	47 gpm	56 gpm	62 gpm	66 gpm
50' (15 m)	Model	11 SQF-2	40-SQF-5	40 SQF-5	40 SQF-5	40 SQF-5	40 SQF-5
	7.8 kWh/m²	5,582 gpd	10,139 gpd	14,817 gpd	19,166 gpd	22,462 gpd	25,183 gpd
	4.7 kWh/m²	4,287 gpd	7,001 gpd	10,684 gpd	13,909 gpd	16,552 gpd	18,838 gpd
	Max flow	9.6 gpm	19 gpm	27 gpm	35 gpm	40 gpm	44 gpm
75' (23 m)	Model	11 SQF-2	11 SQF-2	25 SQF-7	25 SQF-7	40 SQF-5	40 SQF-5
	7.8 kWh/m²	4,580 gpd	6,300 gpd	9,221 gpd	11,832 gpd	14,602 gpd	17,381 gpd
	4.7 kWh/m²	3,410 gpd	5,067 gpd	6,691 gpd	8,624 gpd	10,184 gpd	12,345 gpd
	Max flow	8.0 gpm	11 gpm	17 gpm	21 gpm	27 gpm	31 gpm
100' (30 m)	Model	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	25 SQF-7	25 SQF-7
	7.8 kWh/m²	3,606 gpd	5,617 gpd	6,695 gpd	7,303 gpd	10,833 gpd	12,536 gpd
	4.7 kWh/m²	2,639 gpd	4,182 gpd	5,439 gpd	6,021 gpd	7,662 gpd	9,065 gpd
	Max flow	6.4 gpm	10 gpm	12 gpm	14 gpm	19 gpm	22 gpm
125' (38 m)	Model	11 SQF-2	11 SQF-2	11 SQF-2	16 SQF-10	16 SQF-10	25 SQF-7
	7.8 kWh/m²	2,897 gpd	4,769 gpd	6,145 gpd	7,864 gpd	7,693 gpd	10,006 gpd
	4.7 kWh/m²	2,085 gpd	3,435 gpd	4,807 gpd	5,833 gpd	5,664 gpd	7,055 gpd
	Max flow	5.3 gpm	8.3 gpm	11 gpm	12 gpm	14 gpm	18 gpm
150' (46 m)	Model	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	16 SQF-10
	7.8 kWh/m²	2,454 gpd	4,041 gpd	5,675 gpd	6,565 gpd	6,952 gpd	7,535 gpd
	4.7 kWh/m²	1,851 gpd	2,903 gpd	4,198 gpd	5,114 gpd	5,543 gpd	5,531 gpd
	Max flow	4.5 gpm	7.2 gpm	10 gpm	12 gpm	12 gpm	13 gpm
175' (53 m)	Model	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2
	7.8 kWh/m²	2,282 gpd	3,450 gpd	5,024 gpd	6,114 gpd	6,633 gpd	6,926 gpd
	4.7 kWh/m²	1,672 gpd	2,442 gpd	3,594 gpd	4,682 gpd	5,233 gpd	5,531 gpd
	Max flow	4.1 gpm	6.3 gpm	8.8 gpm	11 gpm	12 gpm	12 gpm
200' (61 m)	Model	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2
	7.8 kWh/m²	2,050 gpd	2,885 gpd	4,237 gpd	5,593 gpd	6,199 gpd	6,586 gpd
	4.7 kWh/m²	1,480 gpd	2,288 gpd	3,015 gpd	4,036 gpd	4,777 gpd	5,207 gpd
	Max flow	3.8 gpm	5.4 gpm	7.6 gpm	10 gpm	12 gpm	12 gpm
250' (76 m)	Model	6 SQF-2	6 SQF-2	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2
	7.8 kWh/m²	1,584 gpd	2,585 gpd	3,056 gpd	4,202 gpd	5,268 gpd	5,816 gpd
	4.7 kWh/m²	1,097 gpd	1,970 gpd	2,466 gpd	2,872 gpd	3,720 gpd	4,425 gpd
	Max flow	3.0 gpm	4.9 gpm	5.5 gpm	7.5 gpm	9.6 gpm	11 gpm
300' (91 m)	Model	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m²	1,524 gpd	2,516 gpd	3,058 gpd	3,379 gpd	3,556 gpd	3,628 gpd
	4.7 kWh/m²	1,091 gpd	1,835 gpd	2,439 gpd	2,752 gpd	2,957 gpd	3,058 gpd
	Max flow	2.8 gpm	4.5 gpm	5.7 gpm	5.9 gpm	5.9 gpm	5.9 gpm
400' (122 m)	Model	3 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m²	974 gpd	1,859 gpd	2,613 gpd	3,025 gpd	3,216 gpd	3,365 gpd
	4.7 kWh/m²	719 gpd	1,315 gpd	1,942 gpd	2,360 gpd	2,564 gpd	2,737 gpd
	Max flow	1.8 gpm	3.4 gpm	4.8 gpm	5.7 gpm	5.7 gpm	5.7 gpm
500' (152 m)	Model	3 SQF-3	3 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m²	814 gpd	1,287 gpd	2,000 gpd	2,593 gpd	2,857 gpd	3,025 gpd
	4.7 kWh/m²	585 gpd	987 gpd	1,402 gpd	1,902 gpd	2,212 gpd	2,398 gpd
	Max flow	1.5 gpm	2.4 gpm	3.7 gpm	4.9 gpm	5.5 gpm	5.5 gpm
650' (198 m)	Model	3 SQF-3	3 SQF-3	3 SQF-3	3 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m²	498 gpd	990 gpd	1,298 gpd	1,470 gpd	2,149 gpd	2,415 gpd
	4.7 kWh/m²	316 gpd	692 gpd	1,015 gpd	1,170 gpd	1,473 gpd	1,819 gpd
	Max flow	0.9 gpm	1.9 gpm	2.5 gpm	2.6 gpm	4.1 gpm	4.9 gpm
800' (244 m)	Model	--	--	--	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m²	--	--	--	871 gpd	1,325 gpd	1,741 gpd
	4.7 kWh/m²	--	--	--	470 gpd	796 gpd	1,111 gpd
	Max flow	--	--	--	1.6 gpm	2.5 gpm	3.4 gpm

SHURflo

SHURflo 9300 Submersible Pump

The **SHURflo 9300** is a positive-displacement diaphragm pump with very high efficiency; however, its diaphragm should be replaced every two to four years, depending on the pumping volume.

The SHURflo 9300 can be operated on a 12 or 24 VDC battery, or using a SHURflo pump controller, directly with a PV array. The pump can lift 1.3 gpm to 230' and can pump nearly 2 gpm from very shallow wells. It measures only 3.75" diameter and 12" long. Performance on a 12 VDC battery or solar array will be less than half the flow shown on the table below.

The 9300 carries a one-year warranty, and the pump should be pulled up out of the well every two to four years to replace the brushes, diaphragm, and valves. Occasionally, the cable plug, which is the connection between the cable and the pump, also needs to be replaced due to corrosion or abrasion. To reduce current loss and plug corrosion in SHURflo 9300 installations, always use a 10 AWG, two-conductor, no ground, solid-core submersible pump cable. The selected pump cable, such as the sub pump cable **10-2C** listed in the table below, needs to have a smooth outer jacket with no "valleys" in the shape (round or oval) in order to properly seal out water.

SHURflo 9300 Solar Pump Controllers

These solid-state controllers will protect the 9300 pump from over-voltage and over-current conditions and will provide current boosting in low sunlight conditions, providing both protection and maximum water delivery.

SHURflo 9300 Pump Controllers optimize your solar water pumping system by translating the current and voltage available from your photovoltaic panels into a combination better matched to the pump requirements. With an optional **Float Switch** installed, the controller will automatically stop pumping when the storage reservoir is full. One of these controllers is required for PV array-direct pumping systems with the SHURflo 9300 submersible pump.

The **SHURflo 902-100 pump controller** is not waterproof, so it must be mounted in a dry location or an appropriate weather-tight enclosure. For use with a 24 VDC nominal PV array (two 36-cell 12 VDC nominal modules wired in series—see Solar Modules). Maximum input voltage is 45 VDC, and max output is 28 VDC and 5 A.

The **SHURflo 902-200 pump controller** has all the features of the 902-100 and more. This controller is switch-selectable for 12 or 24 VDC operation and includes a manual on/off switch for easy pump maintenance. The 902-200 controller comes complete with three high/low water level sensors and sensor wire. Water sensors hang in the well and are used to prevent dry-running in low yield wells. Maximum input voltage is 45 VDC, and max output is 28 VDC and 7 A. Use a single 36-cell 12 VDC module (reduced water delivery) or two in series for 24 VDC nominal operation. The 902-200 includes a weatherproof enclosure suitable for outdoor mounting.

A single common **60-cell module** can also be used with either controller, and will produce the 4 A max current that the pump draws with only about 50% of full sunlight. This will increase the amount of water delivered per day by increasing water output early and late in the day or in cloudy weather.

SHURflo 9300 Submersible Pump and Accessories	
Description	**Item code**
SHURflo 9300 submersible pump 12-24 VDC	**075-05817**
SHURflo 902-100 pump controller 24 VDC only	**075-05823**
SHURflo 902-200 pump controller 12-24 VDC	**075-05820**
Sub pump cable 10-2C (no ground)	**050-01637**
Replacement Parts for 9300 Pump	
SHURflo 9300 end-bell brush kit	**075-05742**
SHURflo 9300 diaphragm kit -lower housing	**075-05838**
SHURflo 9300 valve kit	**075-05832**
SHURflo 9300 cable-plug kit	**075-05826**
SHURflo 9300 O-ring kit	**075-05841**
SHURflo 9300 motor kit - replacement motor	**075-05829**
SHURflo 9300 canister kit	**075-05845**
SHURflo 9300 lift-plate kit	**075-05835**

SHURflo 9300 Array Direct Performance (Nominal 24 VDC Array)			
Vertical lift	**Minimum solar array size**	**Flow**	**Current draw @ 30V**
20 ft	2 x 32 W	1.95 gpm	1.5 A
40 ft	2 x 32 W	1.90 gpm	1.7 A
60 ft	2 x 50 W	1.81 gpm	2.1 A
80 ft	2 x 50 W	1.76 gpm	2.4 A
100 ft	2 x 50 W	1.71 gpm	2.6 A
120 ft	2 x 50 W	1.68 gpm	2.8 A
140 ft	2 x 80 W	1.65 gpm	3.1 A
160 ft	2 x 80 W	1.63 gpm	3.3 A
180 ft	2 x 80 W	1.55 gpm	3.6 A
200 ft	2 x 80 W	1.52 gpm	3.8 A
230 ft	2 x 80 W	1.36 gpm	4.1 A

Aquatec

Aquatec SWP-4000 Submersible Pump

The Aquatec SWP-4000 submersible pump is designed for home or livestock water needs in off-grid locations. It is a positive-displacement diaphragm pump, constructed with high-grade materials and is NSF approved for potable water use.

This pump is designed to operate from any 12-30 VDC power source, including a 72-cell series array, a 60 or 72-cell module, or a 12 or 24 VDC battery bank. The pump requires about 110 W for nominal rated performance; however a larger array will produce the needed power in less light, extending the pumping time and volume delivered in the morning, afternoon, and on cloudy days.

For PV-direct operation, an LCB pump controller should be used. Either the Aquatec APC-30-250 (see next page), the SHURflo pump controllers (see previous page), or the Solar Converters PPT 12/24-7 (see page 230) can be used. The pump can also be powered from a 12 or 24 VDC battery bank. 12 VDC operation reduces water flow and production by about half of the 24 VDC rating. An LCB is not needed when the pump is powered from a battery, however a DC fuse or circuit breaker rated for 5 A should be installed in the positive conductor.

The SWP-4000 can pump up to 230' of head (elevation change from top of water surface in the well to the top of the storage tank). It measures 3.75" at its maximum diameter, so it will fit into a 4" or larger diameter well casing.

It is protected from internal over-pressure and moisture intrusion by double O-rings. A rugged stainless steel outer shell provides high durability and corrosion resistance. The built-in 50-mesh stainless steel water intake screen prevents debris intrusion. It comes with a factory installed 36" cable lead (use underwater splice kit for attaching power cable). Dual-size stainless-steel outlet nipple fits 1/2" hose-barb tubing (0.50 inch ID) or 1/2" poly pipe (0.62 inch ID). Outlet pipe should be rated for at least 150 psi.

The SWP-4000 is field serviceable and should be serviced after two to four years of operation (replace diaphragm, valves and motor brushes). Made in U.S.A. Warranty is 12 months from date of purchase or 18 months from date of manufacture.

NOTE: *The amperages in the table below represent the current drawn by the pump when running. PV array nameplate current needs to exceed these figures by at least 25%.*

Aquatec SWP-4000 Pump Performance						
Pressure	**12 VDC Performance**		**24 VDC Performance**		**30 VDC Performance**	
Head [psi]	**Flow**	**Current draw**	**Flow**	**Current draw**	**Flow**	**Current draw**
20 ft [9 psi]	0.62 gpm [2.35 lpm]	1.3 A	1.35 gpm [5.11 lpm]	1.3 A	1.70 gpm [6.44 lpm]	1.40 A
40 ft [17 psi]	0.60 gpm [2.27 lpm]	1.6 A	1.32 gpm [5.00 lpm]	1.6 A	1.65 gpm [6.25 lpm]	1.70 A
60 ft [26 psi]	0.58 gpm [2.20 lpm]	1.8 A	1.28 gpm [4.84 lpm]	1.8 A	1.60 gpm [6.06 lpm]	1.90 A
80 ft [35 psi]	0.57 gpm [2.15 lpm]	2.0 A	1.25 gpm [4.73 lpm]	2.0 A	1.55 gpm [5.87 lpm]	2.10 A
100 ft [43 psi]	0.56 gpm [2.12 lpm]	2.3 A	1.22 gpm [4.62 lpm]	2.3 A	1.50 gpm [5.68 lpm]	2.40 A
120 ft [52 psi]	0.53 gpm [2.00 lpm]	2.5 A	1.20 gpm [4.54 lpm]	2.5 A	1.48 gpm [5.60 lpm]	2.60 A
140 ft [61 psi]	0.52 gpm [1.97 lpm]	2.6 A	1.15 gpm [4.35 gpm]	2.6 A	1.42 gpm [5.37 lpm]	2.80 A
160 ft [69 psi]	0.51 gpm [1.93 lpm]	2.8 A	1.12 gpm [4.24 lpm]	2.8 A	1.40 gpm [5.30 lpm]	3.00 A
180 ft [78 psi]	0.49 gpm [1.85 lpm]	3.1 A	1.08 gpm [4.09 lpm]	3.1 A	1.35 gpm [5.11 lpm]	3.20 A
200 ft [87 psi]	0.48 gpm [1.82 lpm]	3.3 A	1.06 gpm [4.01 lpm]	3.3 A	1.30 gpm [4.92 lpm]	3.40 A
230 ft [100 psi]	0.43 gpm [1.63 lpm]	3.5 A	1.00 gpm [3.79 lpm]	3.5 A	1.25 gpm [4.73 lpm]	3.70 A

Aquatec SWP-4000 Submersible Pump and Replacement Parts		
Aquatec model	**Description**	**Item Code**
SWP-4000	SWP-4000 Submersible Pump	**075-04850**
SWP-4000 Replacement Parts		
SWP4000LHA	Diaphragm kit – replacement lower housing and diaphragm assembly for SWP-4000	**075-04855**
SWP4000VHA	Valve kit – replacement valve assembly for SWP-4000	**075-04856**
SWP4000EBK	Motor-brush kit (motor end cap) – replacement motor brushes for SWP-4000	**075-04857**
SWP4000MTR	Motor kit - complete replacement motor for SWP-4000	**075-04858**
SWP4000SKA	Screen kit – replacement water-inlet strainer	**075-04859**

Aquatec SWP-6000

The new **Aquatec SWP-6000** is a larger version of the SWP-4000 model, providing all the same features while allowing for greater pumping volume from depths to 80 feet.

This pump requires a well casing diameter of 6" or greater.

The SWP-6000 is field serviceable and should be serviced after two to four years of operation (replace diaphragm, valves and motor brushes). Made in U.S.A. Warranty is 12 months from date of purchase or 18 months from date of manufacture.

NOTE: *The amperages in the table below represent the current drawn by the pump when running. PV array nameplate current needs to exceed these figures by at least 25%.*

Aquatec SWP-6000 Pump Performance						
Pressure	12 VDC Performance		24 VDC Performance		30 VDC Performance	
	Flow	Current draw	Flow	Current draw	Flow	Current draw
0 ft [0 psi]	2.10 gpm [7.95 lpm]	0.80 A	4.00 gpm [15.14 lpm]	2.00 A	5.00 gpm [18.92 lpm]	2.00 A
20 ft [9 psi]	1.75 gpm [6.62 lpm]	1.70 A	3.80 gpm [14.38 lpm]	2.50 A	4.70 gpm [17.80 lpm]	2.50 A
40 ft [17 psi]	1.60 gpm [6.05 lpm]	2.30 A	3.40 gpm [12.87 lpm]	3.30 A	4.50 gpm [17.03 lpm]	3.10 A
60 ft [26 psi]	1.40 gpm [5.30 lpm]	3.00 A	3.20 gpm [12.11 lpm]	3.50 A	3.90 gpm [14.76 lpm]	3.70 A
80 ft [35 psi]	1.30 gpm [4.92 lpm]	3.50 A	3.10 gpm [11.73 lpm]	4.30 A	3.70 gpm [14.00 lpm]	4.30 A

Aquatec SWP-6000 Submersible Pump and Replacement Parts		
Aquatec model	Description	Item Code
SWP-6000	SWP-6000 DC Submersible Pump	**075-04870**
SWP-6000 Replacement Parts		
SWP6000LHA	Diaphragm kit – replacement lower-housing diaphragm assembly for SWP-6000	**075-04875**
SWP6000VHA	Valve kit – replacement valve assembly for SWP-6000	**075-04876**
SWP6000EBK	Motor brush kit (motor end cap) – replacement motor brushes for SWP-6000	**075-04877**
SWP6000MTR	Motor kit - complete replacement motor for SWP-6000	**075-04878**
SWP6000SKA	Screen kit – replacement water-inlet strainer	**075-04879**

Aquatec Pump Controller

The US-made **APC-30-250** Linear Current Booster & Pump Controller features high quality and innovative state-of-the-art micro-processor controlled functions. This LCB controller is designed as the interface between a DC-powered pump and any DC power source. The APC-30-250 will protect DC pumps from over-voltage, over-current, and dry-run conditions and will provide current boosting in low sunlight conditions, providing both protection and maximum water delivery. The APC-30-250 incorporates terminals for remote float switch sensing (flow or pressure) to stop pumping when the storage reservoir is full.

The APC-30-250 functions to maximize daily water delivery, protect the pump, and protect the power source.

Features:

- UV-stabilized NEMA 4 Weather-proof enclosure
- Incorporates Linear Current Booster
- Nominal output voltage 30 VDC and Maximum open-circuit voltage 45 VDC
- Maximum load current 8 A
- Maximum load power 250 W
- Terminals for remote switch (float or pressure)
- Dry-run protection with automatic restart at incremental intervals while the well recovers, but can also be manually reset

Aquatec Pump Controller		
Aquatec model	Description	Item Code
APC-30-250	Linear Current Booster & Pump Controller	**075-04895**

Grundfos

Grundfos CRFlex Surface Pumps

Grundfos CRFlex solar surface pumps provide a reliable and cost-efficient solution for water systems where a conventional AC power supply is not available. The CRFlex is designed for applications such as irrigation, livestock watering, fish farming, water transfer, and pressure boosting. They can also be used to supply water and pressure for cabins, off-grid homes, or remote villages. With the addition of a suitable leaf and debris trap installed on the input, they can be used for swimming pools.

Grundfos has developed the MGFlex brushless DC motors for optimal performance using solar power for surface pump applications. In addition to a PV array, Grundfos solar surface pumps can be run from the grid or a generator providing 120 or 240 VAC. With variable speed operation and motor protection built in, Grundfos CRFlex solar surface pumps offer easy installation, virtually no maintenance, and highly efficient pumping.

The MGFlex motors provide Maximum Power Point Tracking (MPPT) of the PV array, assuring maximum output and efficiency. The motor continuously optimizes the speed according to the input power available from the PV array. The wide voltage range enables the motor to operate at any voltage from 30-300 VDC or 90-240 VAC at 50 or 60 HZ. The 1 HP motor draws up to 880 W, with a maximum input current of 4.6 A. The 2 HP motor draws up to 1,730W with a maximum input current of 8.9 A. Both motors have a speed range of 1,000 – 3,600 RPM.

Max suction lift is 19 feet at sea level (subtract 1 foot per 1,000 ft above sea level). Use a foot valve on the inlet pipe if water source is below pump level, or a check valve on the output if the water source is above the pump (flooded input). The built-in Advanced Function Module (FM 300) has connections for a dry-running sensor and/or a float switch, along with multiple analog and digital sensor inputs and outputs designed for control and alarm functions.

The MGFlex motors will cut out if the voltage falls outside the permissible voltage range, and they will restart automatically when the voltage returns to its normal operating range. No extra protection relay is required. The motor is supplied with built-in thermal protection according to IEC60034-11, for both a steady overload and a stalled condition. These pumps are not outdoor rated, so they must be protected from direct sunlight and rain.

Nine models are available for heads (lift) up to 490 feet and max flows to 140 gallons per minute (gpm).

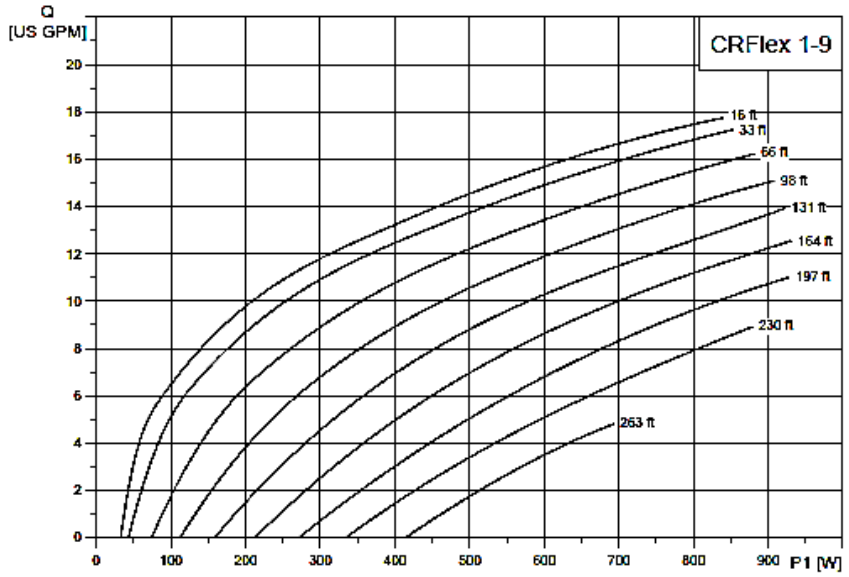
The Grundfos **IO-50** switchbox enables manual starting and stopping of the pump in a solar-powered system, or can act as a DC disconnect switch for the PV array, while providing a connection box to join all necessary cables, and is outdoor rated.

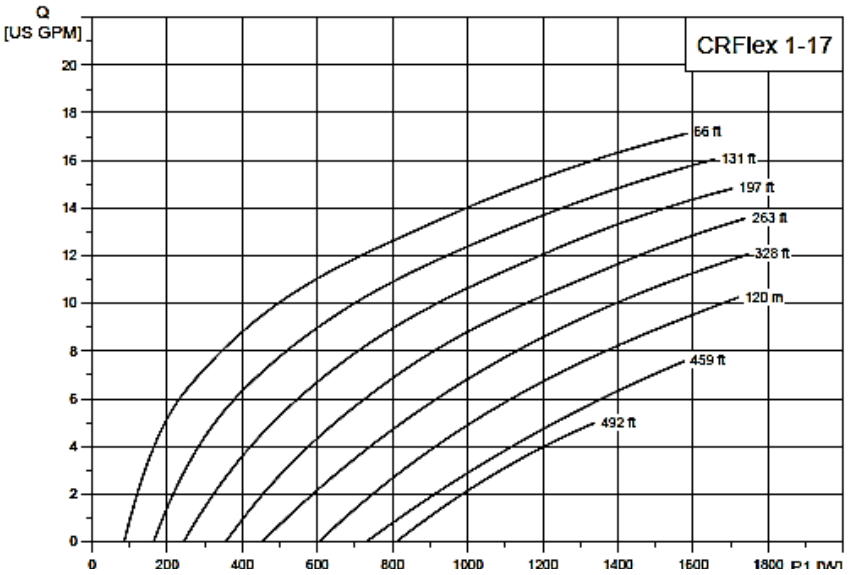
The Grundfos **IO-101** control enables the connection of a backup generator, or other AC power source, if there is insufficient solar energy to pump enough water. The switching between the PV array and the generator must be made manually, but if the generator is stopped manually or runs out of fuel, the IO 101 will automatically switch back to the PV array. Max DC voltage is 225 VDC, so make sure that the PV-array voltage does not exceed this limit in the coldest expected weather. The IO-101 comes in an outdoor-rated enclosure.

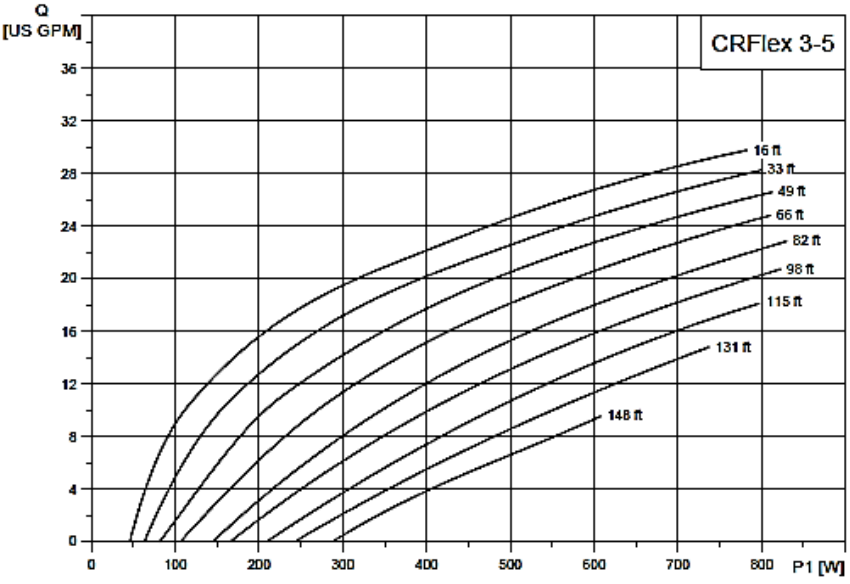
The **Dry-Run Sensor** prevents damage to the pump if the suction prime is lost, or the water source runs dry.

Grundfos CRFlex Surface Pumps					
Model	**Max head**	**Max flow**	**Power rating**	**Pipe connection size**	**Item code**
CRF 1-9	263 ft	17.5 gpm	1 hp	1" NPT	**075-01111**
CRF 1-17	492 ft	17 gpm	2 hp	1" NPT	**075-01112**
CRF 3-5	148 ft	29 gpm	1 hp	1" NPT	**075-01113**
CRF 3-11	328 ft	30 gpm	2 hp	1" NPT	**075-01114**
CRF 5-2	59 ft	51 gpm	1 hp	1-1/4" NPT	**075-01116**
CRF 5-6	181 ft	57 gpm	2 hp	1-1/4" NPT	**075-01117**
CRF 10-01	46 ft	82.5 gpm	1 hp	2" NPT	**075-01118**
CRF 10-02	82 ft	90 gpm	2 hp	2" NPT	**075-01119**
CRF 15-01	59 ft	141 gpm	2 hp	2" NPT	**075-01121**
Description					**Item code**
IO-50 On/Off switch					**075-01038**
IO-101 AC interface box (115 VAC)					**075-01036**
IO-101 AC interface box (230 VAC)					**075-01037**
Dry-run sensor for CRFlex pumps					**075-01130**

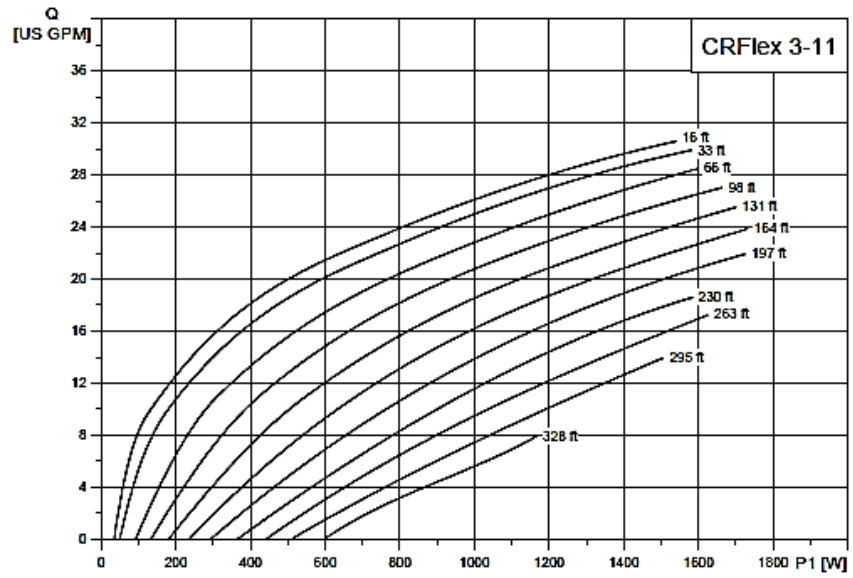
Grundfos CRFlex Pump Performance Charts

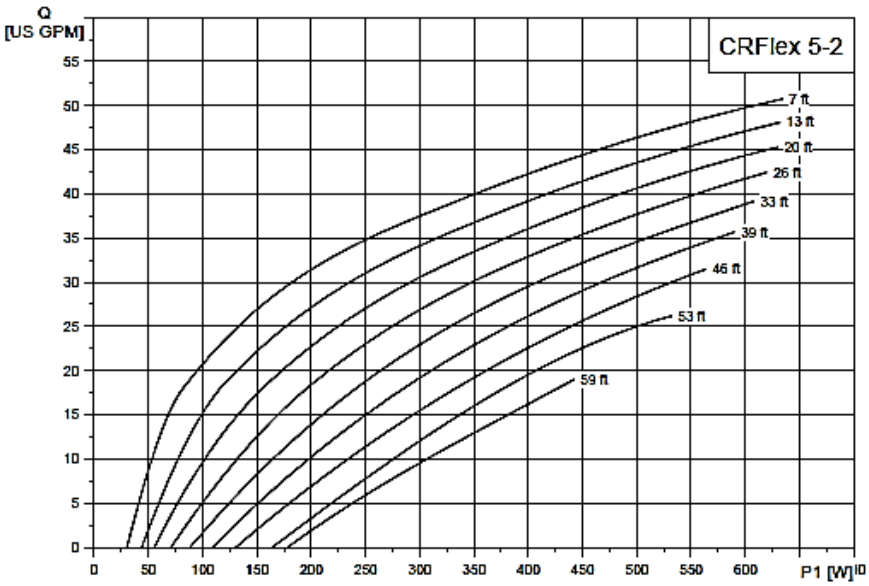


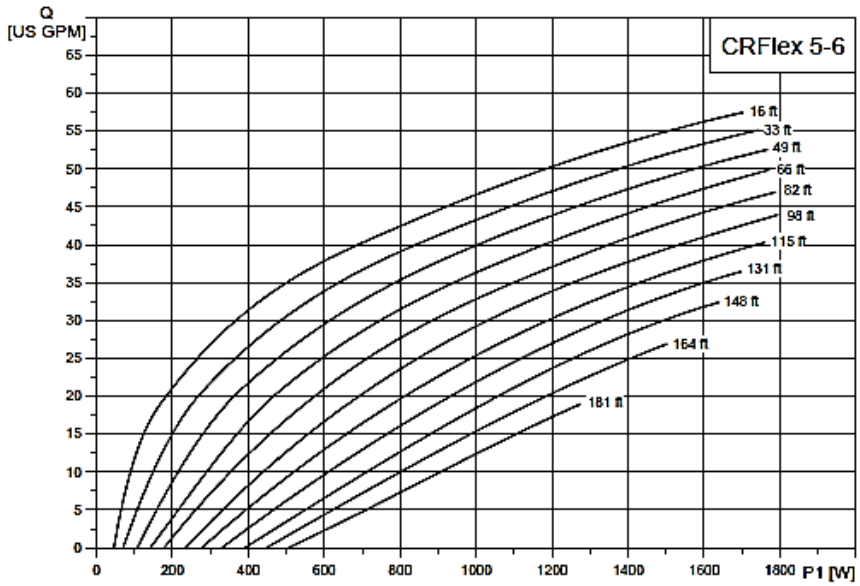




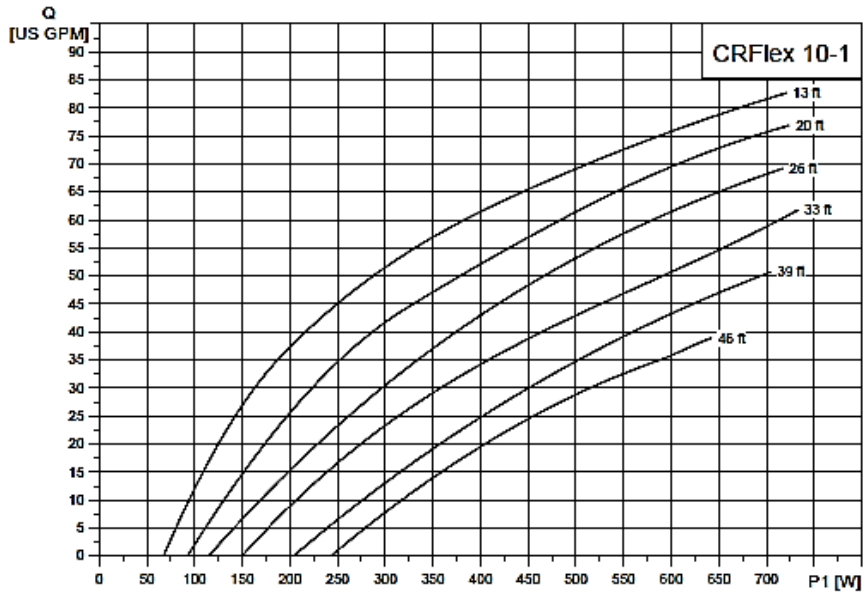
Grundfos CRFlex Pump Performance Charts

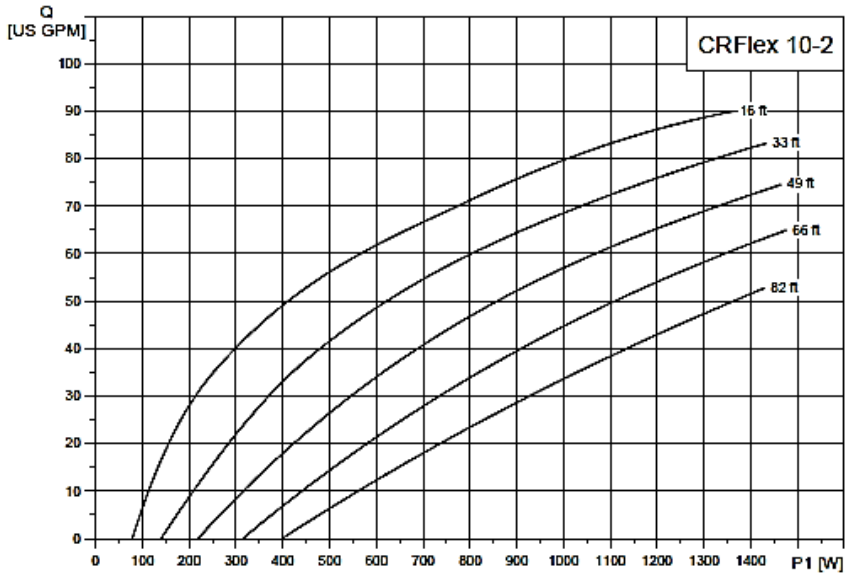


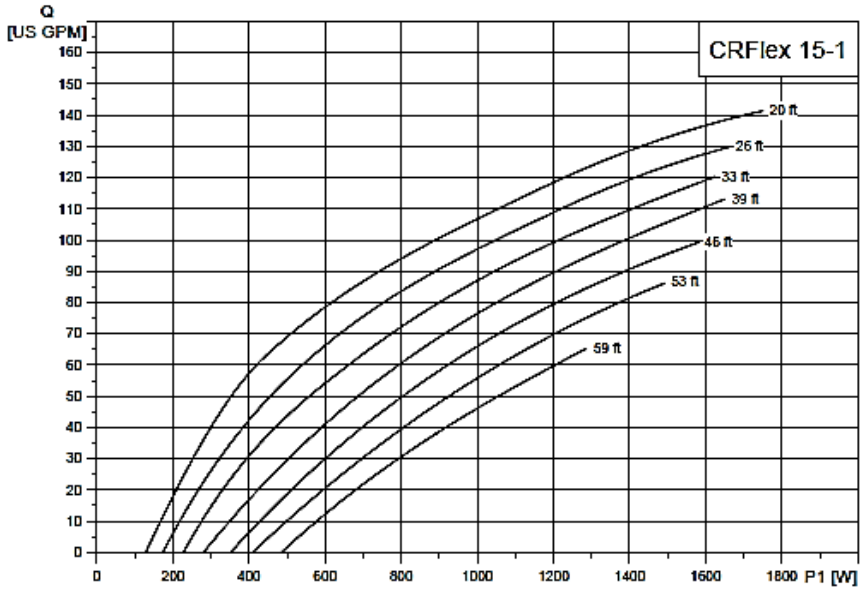




Grundfos CRFlex Pump Performance Charts







Aquatec Diaphragm Pumps

Aquatec 550 Series Pressure Pumps

These Aquatec booster pumps provide “town pressure” for remote home water supplies where 12 or 24 VDC power is available, or the 120 VAC version can be used on remote power systems with inverters. They have a longer life and greater flow rate than other diaphragm booster pumps, and they use less than half the energy consumed by an AC jet pump.

Aquatec’s 550 pressure pumps deliver up to 4.5 gpm flow rates at pressures up to 60 psi. These pumps operate with minimal pulsations and noise and are designed for intermittent duty, though most models can be run continuously for hours at a time. They are commonly used to pressurize water from an atmospheric tank, to deliver purified water to a specific point of use, or simply to increase pressure when required. The built-in pressure switch is set for 60 psi off and 40 psi on. The pumps come with straight threaded male 1/2” fittings that snap into the quick-disconnect ports. The optional strainer is highly recommended to keep debris out of the pump and thereby prolong diaphragm life.

All Aquatec 550 pressure pumps are made in the USA, weigh 8 lbs each and are covered by a one-year warranty.

Aquatic 550 Pressure Pumps					
Model	**Voltage**	**Flow**	**Operating pressure**	**Current draw**	**Item code**
5503-AEE-B636	12 VDC	4.10 gpm [15.52 lpm] 3.80 gpm [14.38 lpm] 3.55 gpm [13.44 lpm]	30 psi 40 psi 50 psi	11.0 A 13.0 A 14.6 A	**075-04805**
5503-AEE-B736	24 VDC	4.10 gpm [15.52 lpm] 3.80 gpm [14.38 lpm] 3.55 gpm [13.44 lpm]	30 psi 40 psi 50 psi	5.5 A 6.5 A 7.3 A	**075-04809**
5503-AEE-B656	120 VAC	4.10 gpm [15.52 lpm] 3.80 gpm [14.38 lpm] 3.55 gpm [13.44 lpm]	30 psi 40 psi 50 psi	1.4 A 1.6 A 1.8 A	**075-04813**
25-181	High flow 50-mesh in-line strainer				**075-04821**
QTS-556	1/2" NPT male pipe fitting, straight, replacement				**075-04820**
QBS-554	1/2" barbed pipe fitting, straight				**075-04818**
QBE-554	1/2" barbed pipe fitting, 90° elbow				**075-04819**
Aquatec 550 Pump Replacement Parts					
55-LHA-AEE	Lower housing kit (Diaphragm kit)				**075-04822**
55-VHA-AEE	Valve-housing assembly kit (Valve kit)				**075-04823**
55-UHA-AEE	Upper-housing assembly kit (includes pressure switch)				**075-04824**
55-PHK-AEE	Complete pump-head kit with 60 psi pressure switch (for all models)				**075-04825**
12VDCEBK	Motor-brush kit – 550 pumps (motor end-cap with brushes) 12 VDC				**075-04826**
24VDCEBK	Motor-brush kit – 550 pumps (motor end-cap with brushes), 24 VDC				**075-04827**
115VACEBK	Motor-brush kit – 550 pumps (motor end-cap with brushes), 48 VAC				**075-04828**

Dankoff Solar Pumps

Dankoff Water Pump Matrix

Dankoff makes water pumps for a wide range of uses. Use this handy guide, and the information on the following pages for the individual models, to choose the correct pump for your needs.

Pump Features Matrix





Feature / Capability	SlowPump	Flowlight Booster	SunCentric	Solar Force Piston Pump	Solaram
Dirty-Water Tolerance	No	No	Yes	Yes	Yes
Dry-Run Tolerance *short intervals only	No	No	High Temp: Yes Standard Temp: No	Yes	Yes
Intended for Pressure Applications	Yes	Yes	No	Yes	Yes
Pump Controller *if/when solar-direct model available	Yes	No	No	Yes	Yes
Max Flow per Hour	372gal (1408 ltr)	270gal (1022 ltr)	4200gal (15898 ltr)	558gal (2112 ltr)	564gal (2135 ltr)
Max Suction Lift *at Sea Level	20ft (6m)	Standard Speed (2920): 10ft (3m) Low Speed (2910): 20ft (6m) Heavy Duty (2930): 20ft (6m)	10ft (3m)	25ft (7.6m)	25ft (7.6m)
Max Total Dynamic Head (TDH)					
Expressed in Vertical Distance	560ft (170m)	150ft (46m)	90ft (27m)	230ft (70m)	1000ft (305m)
Expressed in Pressure	242psi (16.7 bar)	65psi (4.5 bar)	39psi (2.7 bar)	100psi (6.8 bar)	433psi (30 bar)
High-Temp Upgrade Option	Yes	Yes	Yes	No	No
Stainless Steel Upgrade Option	Yes	Yes	No	Yes	No
Warranty *against defects in materials & workmanship	1 Year	1 Year	2 Years	2 Years	1 Year
Maintenance	Consistent filter changes Large Parts Replacement: 7-10 years	Consistent filter changes Large Parts Replacement: 7-10 years	Small Parts Replacement: 5-7 years	Light Maintenance: Every year Large Parts Replacement: 7-10 years	Light Maintenance: Every year Large Parts Replacement: 7-10 years
Life Expectancy *with proper installation & maintenance	15-20 Years	15-20 Years	15-20 Years	20 Years	20 Years
Weight	12-29lbs (5-13kg)	15lbs (7kg)	49-70lbs (23-32kg)	115lbs (53kg)	150lbs (68kg)

For the latest on AEE Solar products, trainings and dealer services, visit www.aeesolar.com

Dankoff SIP Kits™

Dankoff Pump's **Simple Independent Pumping Kits (SIP Kits™)** are pre-engineered and pre-assembled stand-alone off-grid water pumping systems designed for moving and pressurizing surface water with solar panels and batteries. They are turn-key easy-to-install kits which can produce flow rates between 200 and 375 gallons per hour (gph).

They are available as PV-direct units, with or without batteries, to provide a backup water supply at night or during inclement weather. They use Dankoff's high-efficiency SlowPumps to provide water flow of up to 6 gallons per minute (gpm) with total lifts (head) of up to 280' (84 m or about 87 psi).

Save time and the potential for error in sizing, selecting, and sourcing the various plumbing and electrical parts and save installation time by having pre-wired and pre-plumbed major system components, securely mounted inside an outdoor-rated enclosure that has pre-installed water-tight input/output connections. No time wasted fabricating an enclosure on-site. They solve the finer points of the installation process - proper system ventilation, system grounding, over-current protection, portability, battery and charge controller sizing and selection and priming of the pump.

Each kit contains a SlowPump™, a Dry-Run Switch , a SlowPump EZ Install Kit, a 10" filter kit (including mounting bracket and spanner wrench), one set of 10" replacement filters (two total), a disconnecting combiner box with external throw switch, PV-module connectors, a switch connection for automatic control (for a float switch, timer or pressure switch), a 0.6 gallon expansion tank, a pressure-relief valve, a pressure gauge, 1/2" electrical fittings, 1" electrical fittings, 1" plumbing fittings, wire, and hardware.

The SIP PV-direct kits also include a pump controller (LCB), PV module(s), a choice of either a ballasted ground mount or a pole mount for the PV. Available with 1, 2, or 3 PV modules.

The **SIP SP1-B** battery kits also include gel-cell sealed deep-cycle batteries, a charge controller, battery-interconnect cables, a dedicated load controller, battery-system DC circuit breakers, and a junction box to protect the electronics from water. The Small Trusted (ST) and Large Trusted (LT) models are designed for non-essential needs and have 2.5 days of back-up power. The Small Ideal (SI) and Large Ideal (LI) systems are designed for essential needs and have 4.5 days of back-up power.

SIP Kits™ are available with either a **ballasted ground mount (BGM)** or a **top-of-pole mount (TPM)**, for the PV modules.

NOTE: *Listed specifications and product appearance are subject to change.*

Dankoff SIP Kits™

Model	SlowPump model	Max lift (head)	Flow range	Enclosure size (L" x W" x H")	Type of PV mount	Number of PV modules	Number of batteries	Item code
SP1-BGM	2507-24	140 ft	3.65-4.0 gpm	24 x 24 x 36	Ballasted Ground	one	N/A	**075-11001**
SP1-TPM					Top-of-Pole			**075-11002**
SP2-1-BGM	2607-24	60 ft	5.59 - 6.2 gpm		Ballasted Ground	one		**075-11010**
SP2-1-TPM					Top-of-Pole			**075-11011**
SP2-2-BGM		200 ft			Ballasted Ground	two		**075-11020**
SP2-2-TPM					Top-of-Pole			**075-11021**
SP2-3-BGM		280 ft			Ballasted Ground	three		**075-11030**
SP2-3-TPM					Top-of-Pole			**075-11031**
SP1-B-ST-BGM	2507-24	60 ft	2.65 - 3.37 gpm	24 x 24 x 36	Ballasted Ground	one	two	**075-11040**
SP1-B-ST-TPM					Top-of-Pole			**075-11041**
SP1-B-LT-BGM		140 ft			Ballasted Ground	two	four	**075-11050**
SP1-B-LT-TPM					Top-of-Pole			**075-11051**
SP1-B-SI-BGM		60 ft			Ballasted Ground	one	four	**075-11060**
SP1-B-SI-TPM					Top-of-Pole			**075-11061**
SP1-B-LI-BGM		140 ft		48 x 24 x 36	Ballasted Ground	two	eight	**075-11070**
SP1-B-LI-TPM					Top-of-Pole			**075-11071**

Dankoff SlowPump™ Surface Pumps

The SlowPump™ can push water uphill as high as 450 vertical feet. It runs on very low power, with or without batteries, to supply between 200 and 2,600 gallons per day (gpd). The rotary-vane pump mechanism is housed in forged brass for durability. Because of tight tolerances, the water must be very clean, so fine filtration is required to protect the pump (10 micron filtration is recommended).

The chart below shows the gallons per minute (gpm) output from the pump and power (Watts) consumed by the pump for various vertical lifts (this is the "total head" or the lift from the water level at the source to the top of the storage tank, in actual elevation change, not simply pipe distance). The pump performance in the chart is measured at array-direct voltages. The peak power voltage of a nominal 12 VDC PV module is about 18 VDC. A battery-powered pump will have about 20% lower output and power draw because the battery is operating at a lower voltage. Flow rates are in gpm. To estimate the gallons per day delivered, multiply the gpm by 60 (minutes) to get the gallons per hour (gph) amount. Then multiply by the peak-sun-hours per day at the site location (this data is available from NREL's PVWATTS Solar Calculator) to get the gallons per day (gpd).

For PV-direct operation (without batteries), the PV-array nameplate output must exceed the required pump power by at least 20%. Oversizing the array will increase the amount of water delivered per day because a higher wattage array will enable the pump to run at full speed for more hours each day, or in cloudy weather. For example, a 100 W module will produce 50 W in half the amount of sunlight present at noon on a sunny day. The extra available power will not damage the pump as long as the array voltage is within the voltage range of the pump motor.

For array-direct operation, a **linear current booster (LCB)** with the required output current must be used. Determine the correct amperage rating for the LCB by dividing pump power shown below by pump voltage. (See page 228 for a selection of LCB units). For 48 VDC models, use the Solar Converters **PPT 48-10** LCB listed on page 230. AC models use a low-surge permanent-magnet motor that greatly reduces starting surge, relieving stress on inverters and generators.

SlowPumps are NSF approved for pumping potable water and can also be used to pump saltwater. These pumps are 5.7" W x 15.5" L, weigh 16 lbs. and are covered by a one-year warranty.

1/4 HP SlowPumps (model series **1300** and **2500**) are available with 12, 24 or 48 VDC motors, for array-direct operation or with battery systems. Performance will be slightly lower on battery systems due to the lower operating voltage compared to PV-direct. These are also available in 120 VAC versions for inverter, generator, or grid connection. These models have 1/2" female pipe fittings.

1/2 HP SlowPumps (model series **1400** and **2600**) are available with 24 or 48 VDC motors, for use with battery systems, or PV direct with a 36 VDC nominal array. Also available in 120 VAC versions for inverter, generator, or grid connection. These models have 3/4" male pipe fittings.

SlowPump™ Model, Performance, and Power Requirement

Vertical lift (head)	Model 1322		Model 1308		Model 1303		Model 2507		Model 1408		Model 1403		Model 2607	
	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W	gpm	W
20 ft	0.51	27	1.25	30	2.50	48	4.00	57						
40 ft	0.51	32	1.25	48	2.50	60	3.95	78						
60 ft	0.51	36	1.20	54	2.40	78	3.90	102						
80 ft	0.49	40	1.20	60	2.30	93	3.90	120						
100 ft	0.49	45	1.20	66	2.30	105	3.85	144						
120 ft	0.48	50	1.20	70	2.25	121	3.80	165						
140 ft	0.47	56	1.20	75	2.20	138	3.65	195						
160 ft	0.47	62	1.20	84	2.20	153							4.30	283
180 ft	0.47	66	1.18	93	2.15	165							4.25	305
200 ft	0.45	74	1.16	101	2.15	180							4.20	338
240 ft	0.44	90	1.14	117	2.15	204					2.55	266	4.05	396
280 ft	0.41	102	1.12	135							2.50	302	4.00	444
320 ft	0.41	120	1.10	153							2.50	338		
360 ft	0.41	134	1.05	171							2.50	374		
400 ft	0.40	150	1.00	198							2.50	406		
440 ft	0.39	168							1.10	269	2.50	451		

Dankoff SlowPump™ Surface Pumps					
Model	Power	Item code			
		12 V PV direct or battery	24 V PV direct or battery	48 V PV direct or battery	120 VAC
1303	1/4 hp	075-04172	075-04174	075-04178	075-04139
1308		075-04160	075-04162	075-04161	075-04137
1322		075-04168	075-04170	075-04176	075-04135
2507		075-04180	075-04182	075-04184	075-04141
1403	1/2 hp	--	075-04193	075-04195	075-04144
1408		--	075-04185	075-04187	075-04142
2607		--	075-04201	075-04203	075-04146

Dankoff SlowPump™ Accessories

Inline filter – This is a plastic filter housing with 3/4" female NPT inlet and outlet fittings. Filter Cartridges are sold separately.

30" Intake filter/foot valve – This filter, with a 3/4" female pipe fitting, replaces an intake strainer and foot valve in a single unit. Use in silty streams or other problem applications. A spare 30" filter cartridge is included.

Dry-run switch – This switch provides automatic shut-off in case the pump runs dry. Order the correct model for the SlowPump that you are using.

Dankoff SlowPump™ Accessories		
Description	Weight	Item code
Dry-run switch - for 1300 and 1400 series SlowPumps	1 lbs	075-04213
Dry-run switch - for 2500 and 2600 series SlowPumps	1 lbs	075-04215
Inline filter housing - 10" with 3/4" female NPT pipe ports	3 lbs	078-01125
Filter for above housing - 10", 10-micron (two-pack)	4 lbs	078-01130
30" filter and foot-valve assembly	3 lbs	075-04207
Filter cartridge for 30" filter assembly above (three-pack)	6 lbs	075-04209

Dankoff SunCentric® Centrifugal Pumps

The SunCentric® Centrifugal Pumps use solar-electric power to pump as much as 50,000 gallons (200 m^3) per day from shallow water sources. Applications include irrigation, livestock, domestic water, pond management, water treatment, solar water heating, hydronic space heating, hot-water circulation, and fire protection. They can tolerate silty water and deliver up to 70 gpm.

These centrifugal pumps have been in worldwide use since 1989. They can be used PV array-direct without batteries and do not require a pump controller or linear current booster (LCB). Maximum suction lift is 10 vertical feet (3 m). Use a **foot valve** on the intake pipe if the pump is mounted higher than the water source. For pumps mounted below the source's water level, use a **check valve** on the outlet pipe to keep water from back-draining from the outlet pipe. The pump must be kept from freezing.

No routine maintenance is required. These pumps can be repaired in the field using ordinary tools and skills, without removing the pipes. They feature a cast-iron pump body with polycarbonate impeller. The included instruction manual shows illustrated repair details. For best reliability, minimize or eliminate suction lift by placing the pump low and close to the water source, minimizing the possibility of cavitation, which causes excessive wear and loss of performance.

The chart on the next page for the SunCentric® pumps is for PV-array-direct applications. Models for 12, 24, and 48 VDC batteries are available; call for information. PV-array size should exceed the pump wattage shown in the chart by at least 25%. Larger array sizing will improve pumping in low-light conditions, in the morning, afternoon, and on cloudy days. A PV array twice the size as listed (plus 25%), will produce the pump's rated power in one-half the amount of sunlight and can greatly enhance the quantity of water pumped per day.

The temperature limit for the standard pumps listed here is 140 °F (60 °C). The SunCentric® pumps are also available in High-Temperature models, which raise the temperature limit to 240 °F (115 °C). The High-Temperature versions have a brass impeller which reduces flow by about 15% using the same wattage. Call AEE Solar for more information on High-Temperature models.

Array voltages shown are "nominal" voltages, and are based on using 36-cell modules with one (12 VDC), two (24 VDC), three (36 VDC), or four (48 VDC) per series string. 72-cell modules can be used in parallel for 24 VDC pumps, and in series strings of two for 48 VDC pumps. 12 VDC and 36 VDC pumps must use 36-cell modules.

If using 60-cell PV modules, use them in parallel for 24 VDC pumps and in series strings of two for 48 VDC pumps. Pumping speed, and water delivery, will be lower when using 60-cell modules compared to using 36-cell or 72-cell modules, due to lower operating voltage. However, daily pumping volumes can be raised by using a higher wattage 60-cell PV array.

These pumps are covered by a two-year warranty.

Dankoff SunCentric® Centrifugal Pumps

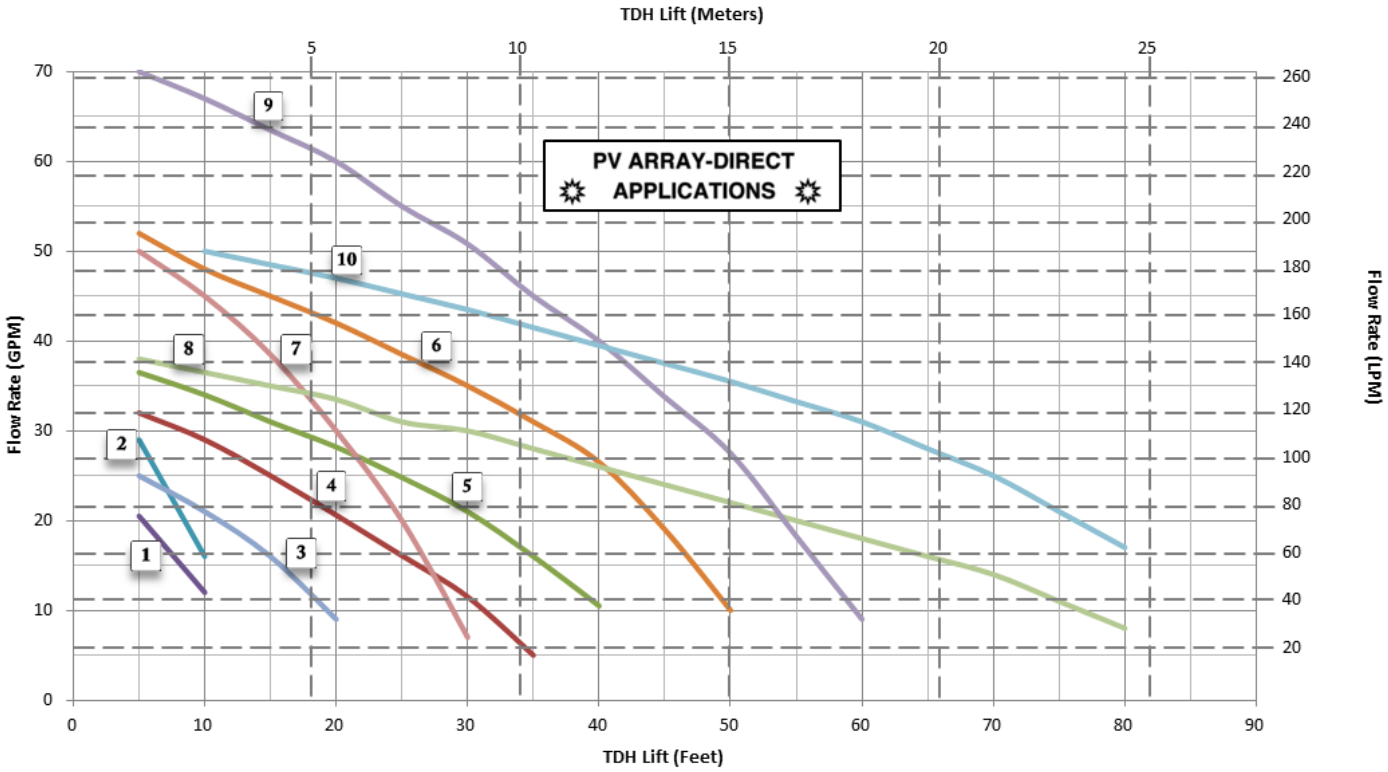
Model	Nominal PV array voltage	Pump load			Min PV array nameplate	Item code
		Voltage	Current	Power		
7212	12 VDC	15 V	19.3 A	290 W	380 W	**075-04299**
7322	24 VDC	30 V	9.7 A	290 W	380 W	**075-04307**
7324	12 VDC	15 V	6.0 A	90 W	117 W	**075-04311**
7325	12 VDC	15 V	7.4 A	111 W	144 W	**075-04313**
7424	24 VDC	30 V	16.0 A	480 W	624 W	**075-04319**
7442	36 VDC	45 V	3.5 A	158 W	205 W	**075-04325**
7444	48 VDC	60 V	8.0 A	480 W	624 W	**075-04329**
7445	24 VDC	30 V	3.7 A	111 W	144 W	**075-04331**
7446	36 VDC	45 V	6.9 A	311 W	404 W	**075-04333**
7521	36 VDC	45 V	16.4 A	738 W	960 W	**075-04337**
7526	24 VDC	30 V	24.4 A	732 W	960 W	**075-04339**
7622	36 VDC	45 V	19.0 A	855 W	1,120 W	**075-04341**

See the next page for a SunCentric® pump-curve chart to pick the correct model pump for your needs.

Dankoff SunCentric® Pump Application Chart

To use the chart below:

- Use the bottom of the chart for Total Dynamic Head (TDH) in feet, and use the top of the chart for Total Dynamic Head (TDH) in meters.
- Use the left side of chart for flow in gallons per minute (gpm) and use the right side for flow in liters per minute (l/m).
- Locate the intersection of the lines for the required head and flow then find the pump curve that is nearest to that point.
- If there is more than one curve to choose from, compare the power requirements.
- The curve that goes higher will work better in low-light conditions.
- For PV-Direct systems, array size (watts) is critical. Do not undersize the array. Oversizing the array will improve performance in low sunlight conditions.
- Multiple pumps can be used to provide greater flow.



Dankoff SunCentric® PV-Direct Application Chart Key

POWER REQUIREMENTS							MIN. PV
#	CURVE	MODEL number	VOLTS nominal	Power at the Pump VOLTS	AMPS	WATTS	ARRAY WATTS
1		7324	12	15	6.0	90	117
2		7325	12	15	7.4	111	144
		7445	24	30	3.7	111	144
3		7442	36	45	3.5	158	205
4		7212	12	15	19.3	290	377
5		7322	24	30	9.7	290	377
6		7446	36	45	6.9	311	404
7		7424	24	30	16.0	480	624
		7444	48	60	8.0	480	624
8		7521	36	45	16.4	739	959
9		7526	24	30	24.4	732	952
10		7622	36	45	19.0	855	1112

Dankoff Solar Force™ Piston Pumps

The Solar Force™ piston pumps operate directly from a PV array or battery bank. They can draw water from a shallow well, pond, stream, river, or storage tank and push water up-hill (230' maximum head), through miles of pipeline, or pressurize a water system (100 psi max; minimum 60 gallon pressure tank required). They can be used for domestic, agricultural, commercial, or industrial applications. Suction capacity is 25' at sea level (subtract 1' for each 1,000' above sea level) with 5 to 9 gpm pumping capacity.

Solar Force™ pumps use less energy per gallon of water delivered than any other pump that we sell. The pump head is cast iron with a brass cylinder. These pumps have a proven design with a 20-year life, and are simple to maintain with common hand tools. Leather piston seals are easy to replace (five to ten-year maintenance interval). The illustrated installation and repair manuals make it easy to install and service.

The DC models are the most efficient, but the AC models use low-surge motors with low starting torque, reducing inverter and wire-size requirements. Available with 12, 24, or 48 VDC motors, or with 120 VAC or 230 VAC, 50-60 Hz motors.

For PV-array-direct systems, a linear current booster (LCB) with the required output current is required. Use the Solar Converters LCB controllers on the LCB page of this catalog section (determine the correct amperage rating for the LCB by dividing pump power shown below by pump voltage).

For pressurized systems, whether battery-powered or AC-powered, use a pressure switch and a captive-air pressure tank at least 60 gallons in size.

Solar Force™ pumps have 1.5" NPT female intake ports and 1" NPT female outlet ports. A surge tank is included and will reduce the amount of water pulsation that the pump produces. They measure about 22" x 13" x 16", and have a maximum weight of 115 lbs. ship in two boxes and are covered by a two-year warranty.

The watt values listed in the following chart represent power used by the pump. For PV-array-direct operation, the array must be at least 20% larger. Oversizing the array further will increase the amount of water delivered per day as a larger array will enable the pump to run at full speed for more hours each day, or in cloudy weather. A tracking PV mount will also increase the amount of daily water delivery.

For example, a 560 W array will produce 280 W in half the amount of sunlight present at noon. The extra available power will not damage the pump motor or LCB as long as the array voltage doesn't exceed the voltage range of the pump motor or LCB.

Dankoff Solar Force™ Piston-Pump Sizing Chart

Lift (head)	Pressure	Model 3010		Model 3020		Model 3040	
		Flow	Power	Flow	Power	Flow	Power
20 ft	8.7 psi	5.9 gpm	77 W	5.2 gpm	110 W	9.3 gpm	168 W
40 ft	17.4 psi	5.6 gpm	104 W	5.2 gpm	132 W	9.3 gpm	207 W
60 ft	26 psi	5.3 gpm	123 W	5.1 gpm	154 W	9.2 gpm	252 W
80 ft	35 psi	5.2 gpm	152 W	5.1 gpm	182 W	9.2 gpm	286 W
100 ft	43 psi	5.1 gpm	171 W	5 gpm	202 W	9.1 gpm	322 W
120 ft	52 psi	4.9 gpm	200 W	5 gpm	224 W	9.1 gpm	364 W
140 ft	61 psi	4.9 gpm	226 W	5 gpm	252 W	9.1 gpm	403 W
160 ft	70 psi	--	--	4.9 gpm	269 W	--	--
180 ft	78 psi	--	--	4.9 gpm	280 W	--	--
200 ft	86 psi	--	--	4.8 gpm	308 W	--	--
220 ft	95 psi	--	--	4.7 gpm	314 W	--	--

Dankoff Solar Force™ Piston Pumps			
Model	**Operating voltage**	**Power source**	**Item code**
3010-12B	12 VDC	Battery	**075-04265**
3010-24B	24 VDC	Battery	**075-04267**
3010-48B	48 VDC	Battery	**075-04268**
3020-12B	12 VDC	Battery	**075-04271**
3020-12PV	12 VDC	PV array direct	**075-04273**
3020-24B	24 VDC	Battery	**075-04275**
3020-24PV	24 VDC	PV array direct	**075-04277**
3020-48B	48 VDC	Battery	**075-04279**
3020-48PV	48 VDC	PV array direct	**075-04281**
3020-120VAC	120 VAC	Inverter, generator or grid	**075-04269**
3020-230VAC	230 VAC	Inverter, generator or grid	**075-04282**
3040-12B	12 VDC	Battery	**075-04285**
3040-12PV	12 VDC	PV array direct	**075-04287**
3040-24B	24 VDC	Battery	**075-04289**
3040-24PV	24 VDC	PV array direct	**075-04291**
3040-48B	48 VDC	Battery	**075-04293**
3040-48PV	48 VDC	PV array direct	**075-04295**
3040-120VAC	120 VAC	Inverter, generator or grid	**075-04283**
3040-230VAC	230 VAC	Inverter, generator or grid	**075-04284**

Dankoff Solar Force™ Piston Pump Accessories & Parts

The **Solar Force™ Easy Installation Kit** contains: Brass Manifold, Ball Valve, Check Valve, Pressure Gauge, Pressure Switch, Hose Bibb, and Fittings.

Use the empty tank float switch, **11002**, to turn the pump off if the tank or cistern that the pump is drawing water from runs dry. Use the full-tank float switch, **11003**, to turn the pump off when the tank it is pumping into gets full. Both switches can be used on the same pump.

The basic repair parts kits, **3521** & **3522**, contain: one packing kit, and one set each of water-box gaskets, neoprene valve discs, valve springs w/washers & cotter pins, and one set of cup leathers.

Long-term repair kits are available that contain two packing kits, one drive belt, one pair of motor brushes, one brass cylinder, three pairs of cup leathers, and two water-box gaskets, valve springs w/ washers & cotter pins, and eight neoprene valve discs, (does not include oil). These kits are specific for each model of Solar Force™ pump. Contact AEE Solar for more information.

Dankoff Solar Force™ Piston Pump Accessories and Parts		
Model	**Description**	**Item code**
EZ3000	Easy-install kit for Solar Force™ piston pumps	**075-04248**
11002	Float-switch kit for LCB - empty-tank shutoff	**075-04217**
11003	Float-switch kit for LCB - full-tank shutoff	**075-04218**
11023	Pressure switch, heavy-duty 1HP DC rated	**075-04297**
3513	Quart of food-grade 30wt non-toxic oil	**075-10380**
3521	Basic repair kit for 3010/3020 models	**075-10250**
3522	Basic repair kit for 3040 models	**075-10251**

Dankoff Solaram™ Diaphragm Pumps

Solaram™ diaphragm pumps use industrial-grade, high-pressure, multiple-diaphragm pump heads, and permanent-magnet motors for either 24 VDC array-direct or battery operation, or 120 VDC (nominal) array-direct operation. Solaram™ pumps can be used for most pumping applications.

The Solaram™ is Dankoff's most powerful surface pump. They can draw water from a shallow well, pond, stream, river or storage tank. They can push water very high uphill (960' maximum head), through miles of pipeline, or pressurize water systems (415 psi max; minimum 60 gallon pressure tank required).

Suction capacity is 20' at sea level (subtract 1' for each 1,000' above sea level). With 2.5-9 gpm of pumping capacity, Solaram pumps can supply up to 5,400 gallons per day (gpd), while using less power than any other pump in its range. They start pumping even in low light conditions.

These pumps are rugged and reliable, as well as dirt and dry-run tolerant. They feature multiple-diaphragm industrial construction, a cast-aluminum body, ball bearings, and permanent-magnet motors. An oil change (non-toxic oil) and diaphragm replacement are required for every two years of continuous use, but these pumps otherwise have a 20-year life expectancy. A pressure-relief valve is included.

For array-direct operation at 24 VDC, use 36-cell PV modules in strings of two to get the total power needed, or use 60-cell or 72-cell modules in parallel. For array-direct operation at 120 VDC, use ten 36-cell modules in series, five 72-cell modules in series, or six 60-cell modules in series. Add module strings in parallel if more power is needed. As with other array-direct pumps, the PV array needs to be sized at least 20% larger than the pump watts, and even larger arrays can be used to extend pumping in lower light conditions. An **11053** or **11054** linear current booster (LCB) is required to prevent stalling in low light conditions. LCB's for 120 VDC Solaram™ pumps are custom built by special order. Contact AEE Solar for more information.

Solaram pumps can develop pulsating water pressure up to 400 psi, so the piping system must be designed for high-pressure use; a rating of at least 600 psi is recommended for the first 200' or more of head (this generally requires steel pipe). The pulsation and pressure diminishes as the pipe climbs the hill, so pipe with a lower pressure rating can often be used closer to the output.

Suction capacity is 25' at sea level (subtract 1' for each 1,000' above sea level). Fittings are 1"-1.25" on the intake, and 1" on the outlet. Dimensions are 28"W x 16.5"H x 16"D, weight is 150 lbs (max, depending on model) and they are covered by a one-year warranty.

Dankoff Solaram™ Diaphragm Pump-Sizing

Total head ↓	Last 2 digits of model number ↓												First 2 digits of model # ↓
	Model _ _ 21		Model _ _ 22		Model _ _ 23		Model _ _ 41		Model _ _ 42		Model _ _ 43		
	Flow	Watts	Flow	Watts	Flow	Watts	Flow	Watts	Flow	Watts	Flow	Watts	
0-80'	3.0 gpm	170 W	3.7 gpm	207 W	4.6 gpm	285 W	6.2 gpm	258 W	7.5 gpm	339 W	9.4 gpm	465 W	
120'	2.9 gpm	197 W	3.7 gpm	238 W	4.5 gpm	319 W	6.0 gpm	305 W	7.3 gpm	396 W	9.1 gpm	539 W	81_ _ 24 V
160'	2.9 gpm	225 W	3.6 gpm	268 W	4.5 gpm	352 W	5.8 gpm	354 W	7.2 gpm	453 W	8.9 gpm	619 W	
200'	2.9 gpm	247 W	3.6 gpm	296 W	4.5 gpm	388 W	5.7 gpm	400 W	7.1 gpm	513 W	8.9 gpm	693 W	
240'	2.8 gpm	265 W	3.6 gpm	327 W	4.5 gpm	427 W	5.6 gpm	453 W	7.0 gpm	572 W	8.6 gpm	724 W	
280'	2.8 gpm	286 W	3.6 gpm	356 W	4.4 gpm	466 W	5.5 gpm	499 W	6.9 gpm	628 W	8.4 gpm	801 W	82_ _ 24 V
320'	2.8 gpm	315 W	3.5 gpm	388 W	4.4 gpm	496 W	5.4 gpm	548 W	6.8 gpm	686 W	8.3 gpm	869 W	
360'	2.8 gpm	342 W	3.5 gpm	416 W	4.4 gpm	536 W	5.4 gpm	592 W	6.6 gpm	733 W	8.2 gpm	927 W	
400'	2.7 gpm	363 W	3.4 gpm	450 W	4.4 gpm	572 W	5.3 gpm	649 W	6.5 gpm	782 W	8.7 gpm	1,122 W	
480'	2.7 gpm	416 W	3.4 gpm	505 W	4.3 gpm	649 W	5.3 gpm	717 W	6.5 gpm	900 W	8.5 gpm	1,265 W	83_ _ 120 V
560'	2.7 gpm	456 W	3.3 gpm	570 W	4.3 gpm	693 W	5.2 gpm	800 W	6.5 gpm	1,045 W	8.4 gpm	1,397 W	
640'	2.7 gpm	502 W	3.3 gpm	623 W	4.2 gpm	774 W	5.1 gpm	893 W	6.5 gpm	1,116 W	8.2 gpm	1,540 W	
720'	2.6 gpm	551 W	3.2 gpm	690 W	4.1 gpm	856 W	--	--	6.4 gpm	1,287 W	8.1 gpm	1,683 W	
800'	2.6 gpm	589 W	3.2 gpm	715 W	4.1 gpm	931 W	--	--	--	--	8.0 gpm	1,815 W	85_ _120 V
880'	2.6 gpm	647 W	3.2 gpm	774 W	--	--	--	--	--	--	8.0 gpm	1,958 W	
960'	2.6 gpm	705 W	3.1 gpm	838 W	--	--	--	--	--	--	8.0 gpm	2,145 W	

Dankoff Solaram™ Diaphragm Pumps					
Model	DC voltage	Item code	Model	DC voltage	Item code
8121-24	24 VDC	**075-08121**	8342-120	120 VDC	**075-08342**
8122-24		**075-08122**	8343-120		**075-08343**
8123-24		**075-08123**	8543-120		**075-08543**
8141-24		**075-08140**			
8142-24		**075-08142**			
8143-24		**075-08143**			
8221-24		**075-08221**			
8222-24		**075-08222**			
8223-24		**075-08223**			
8241-24		**075-08241**			
8242-24		**075-08242**			
8243-24		**075-08243**			

Dankoff Solaram™ Diaphragm Pump Accessories and Parts

Choose the correct **Linear Current Booster (LCB)**, **11053** or **11054**, based on the voltage of the pump motor. Use the **Empty-Tank Float Switch**, **11002**, to turn the pump off if the tank or cistern that the pump is drawing water from runs dry. Use the **Full-Tank Float Switch**, **11003**, to turn the pump off when the tank it is pumping into gets full. Both switches can be used on the same pump.

Dankoff Solaram Accessories		
Dankoff model #	Description	Item code
11053	30 Amp Solaram™ LCB controller for 24 VDC models	**075-08560**
11054	10 Amp Solaram™ LCB controller for 120 VDC models	**075-08561**
11056	Heat sink and diode kit for combining like PPT controllers in parallel	**075-08562**
11002	Float-switch kit for LCB - empty-tank shutoff	**075-04217**
11003	Float-switch kit for LCB - full-tank shutoff	**075-04218**
11044	Foot valve, 1 ¼" lead-free bronze w/ stainless-steel screen	**075-08570**
11045	Foot valve, 2" lead-free bronze w/ stainless-steel screen	**075-08571**
11017	Check valve, lead-free bronze, 3/4"	**075-08572**
11025	Check valve, lead-free bronze , 1"	**075-08573**
11100	Check valve, lead-free bronze, 2"	**075-08574**
3513	Quart of food-grade 30wt non-toxic oil	**075-10380**

Dankoff Flowlight® Booster Pumps

The Flowlight® Booster Pumps provide "town pressure" for off-grid home water supplies. They have longer life, greater flow rates, and quieter operation than diaphragm pumps, and use about half the energy consumed by an AC jet-pump running on an inverter.

The Flowlight® needs to have clean water to prevent damage to the pump head, and can also be damaged by running dry. The optional filter and Dry-Run Switch are highly recommended. To make installation easier, flexible hose connectors with 3/4" threaded adaptors are included.

A pressure tank with a minimum size of 40 gallons, available at most local plumbing supply stores, is required for all Flowlight® installations. The larger the tank size, the more water is stored under pressure, allowing the pump to come on less often and run for a longer period each time. This reduces wear on the pump. Wearing parts are replaceable and typically last five to ten years. Overall life expectancy is 15-20 years. Pumps can be mounted horizontally or vertically.

The **Standard** model has the highest water flow and should be used where suction lift is less than 10'. The Standard is available with 12, 24 or 48 VDC motors for battery operation, or with a 120 VAC PM motor (300 W or larger inverter required).

The **Low-Flow** model has a higher pressure capacity and should be used where suction lift is over 10' or where the suction pipe is smaller than 1" inside diameter. Maximum suction lift at sea level is 20'. Deduct 1' for each 1,000' above sea level. The Low-Flow models are available with 12, 24, or 48 VDC motors for battery operation.

Both models are NSF approved for potable water. Flowlight® Booster pumps can also be used to pump saltwater. These pumps are 5.7"W x 16.5"L, Weigh 15 lbs. and are covered by a one-year warranty.

The **E-Z Installation Kit** includes an accessory tee, adjustable pressure switch, pressure gauge, check valve, drain valve, shutoff valve, and flexible pipe nipples. All components are copper or brass. Order filter housing and filter cartridges (30" or 10") separately (see listings under "SlowPump™ Accessories"). The **Dry-Run Switch** provides automatic shut-off in case the pump runs dry, preventing costly damage to the pump head.

Dankoff Flowlight® Booster Pumps and Accessories					
Model	**Voltage**	**Max flow**	**Pressure**	**Current draw**	**Item code**
Standard 12 VDC 2920-12	12 VDC	4.5 gpm	30 psi 50 psi	13.0 A 16.0 A	**075-04125**
Standard 24 VDC 2920-24	24 VDC	4.5 gpm	30 psi 50 psi	6.5 A 8.0 A	**075-04127**
Standard 48 VDC 2920-48	48 VDC	4.5 gpm	30 psi 50 psi	3.25 A 4.0 A	**075-04129**
Standard 48 VDC 1/2 HP 2930-48	48 VDC	5.5 gpm	30 psi 50 psi	3.75 A 4.0 A	**075-04130**
Standard 120 VAC 2920-115	120 VAC	4.5 gpm	30 psi 50 psi	1.7 A 2.1 A	**075-04131**
Low Flow 12 VDC 2910-12	12 VDC	3.4 gpm	30 psi 50 psi	10.0 A 12.0 A	**075-04121**
Low Flow 24 VDC 2910-24	24 VDC	3.4 gpm	30 psi 50 psi	5.0 A 6.0 A	**075-04123**
Low Flow 48 VDC 2910-48	48 VDC	3.4 gpm	30 psi 50 psi	2.5 A 3.0 A	**075-04124**
Accessories for Booster Pumps					
E-Z installation kit - includes an accessory tee, adjustable pressure switch, pressure gauge, check valve, drain valve, shutoff valve, and pipe nipples – EZ2900					**075-04205**
Dry-Run Switch for Booster pumps					**075-04215**

Water Pumping Accessories

Linear Current Boosters for DC Pumps

Linear current boosters from Solar Converters Inc. are used in solar-direct pumping applications. They can achieve a 30-90% increase in water pumped compared to connecting the pump directly to the solar modules. The pump motor will last longer as well because the LCB will keep the motor from stalling in low-light conditions. These LCB's are covered by a one-year warranty.

90 and 120 VDC LCB units that can operate 12, 24, 36 and 48 VDC pumps from several modules in series are available by special order. These can be useful when the array must be a long distance from the motor as they allow smaller-gauge wire since the current is reduced. The wire savings alone can offset the cost of the controller. Call AEE Solar for details.

All units have terminals for connection of a float or pressure switch. Use a "reverse-action" switch to turn the pump off when the storage tank is full.

Solar Converters Inc. Linear Current Boosters			
Model	**DC array voltage (nominal)**	**Max DC current**	**Item code**
PPT 12/24-7	12 or 24 VDC	7 A	**075-00124**
PPT 12/24-10		10 A	**075-00125**
PPT 12/24-30		30 A	**075-00128**
PPT 48-10	48 VDC	10 A	**075-00136**
PPT 48-20		20 A	**075-00137**
PPT 90-12	90 VDC	12 A	**075-00141**

Float Switch

SPDT Float Switch

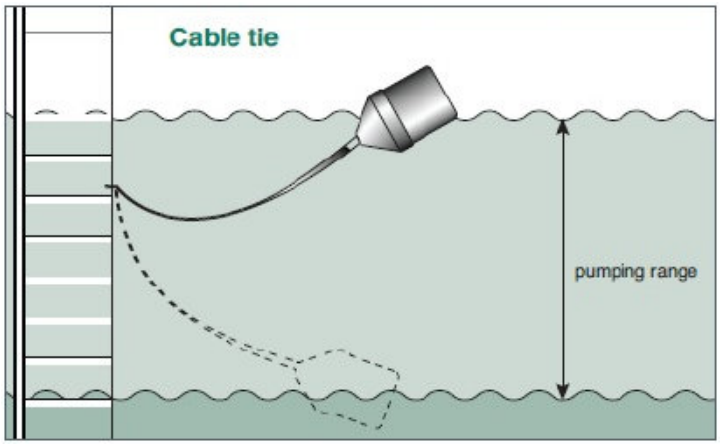
This SPDT float switch can be used to turn a pump on and off in tank-filling or tank-emptying operation, depending on which two of the three wires are connected.

Contacts located in the float will switch at 12° above and below horizontal. Use a pipe clamp or cable tie to secure the cable to a pipe or weight in tank. The length of cable from clamp to float determines the difference between turn-on level and turn-off level.

Maximum amp rating is 5 A. For larger pumps, use the float switch to turn a relay on and off and let relay contacts control the pump. This switch can also be used with LCBs and other pump controllers that have float switch contacts.

These mercury-free switches are safe for domestic water systems and are covered by a two-year warranty.

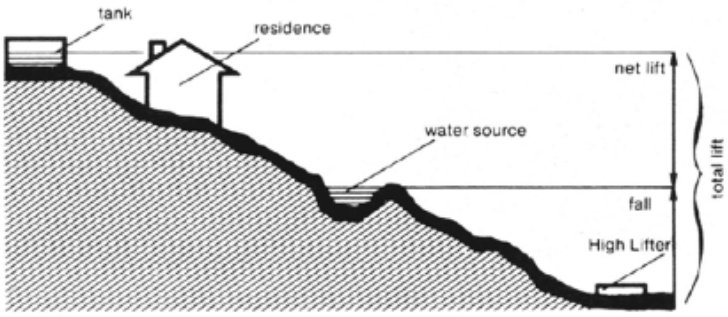
SPDT Float Switch		
Description	**Maximum amps**	**Item code**
Single-pole double-throw (SPDT) float switch	5 A	**075-05270**

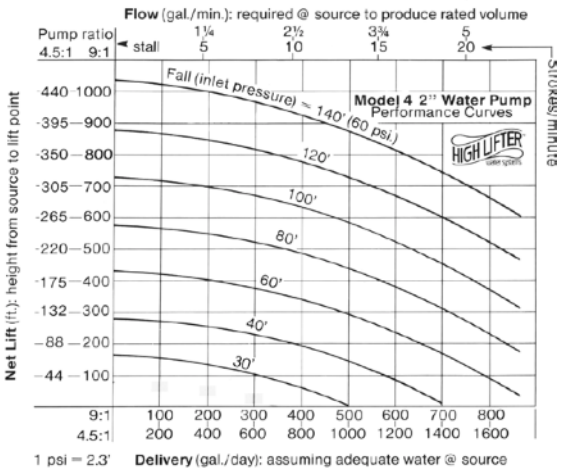


High Lifter Water-Powered Pumps

The **High Lifter Water-Powered Pump** is designed to move water uphill without using gasoline or electricity. Positioned below the water source (see figure, below), the High Lifter uses gravity-induced pressure to lift water up to nine times the head (See performance chart, below). With adequate water and pressure, it can pump up to 1,500 gallons of water per day as high as 300', or it can pump 200 gallons per day as high as 1,000'. It can also pump smaller amounts on as little as one quart per minute of source water, and can pump to lower elevations with as little as a 30' drop from the water source.

It is self-starting and requires no lubrication, priming, or tuning, and is quiet compared to gas engine pumps. Due to its light weight, ease of installation, and lack of fuel requirements, it is ideally suited for hilly or remote terrain. Simply run a pipe downhill to your High Lifter from a pond, stream, or spring, lay out a pipe to your high tank, and start pumping. Designed to be installed and maintained by the user with basic hand tools, the High Lifter requires little attention, other than filter cleaning, for years of service. Depending on how clean the water source is, a High Lifter can operate continuously for up to three years between piston replacements; longer if the inlet water is processed through a settling tank to remove grit.





The High Lifter can be used for domestic water pumping, irrigation, range cattle and similar applications. All High Lifter parts are made from stainless steel, Teflon and polyethylene.

As illustrated in the chart, the High Lifter responds to both inlet and output pressure. Increasing the elevation between the pump and the water source will increase pressure and/or flow rate. Conversely, if the outlet is too high relative to the water source, the pump may stall. Stalling will not damage the pump, but no water will be delivered. To determine how much water will be pumped, find the net lift for either the 4.5:1 or 9:1 pump on the left side of the performance chart. Move across the graph horizontally to the right until you cross the curve for the fall (inlet pressure). From the point where lift and fall cross, move vertically down to the bottom of the graph and read the "Delivery (gal/day)" for the type of pump being used. To get this delivery amount, the input flow to the pump must be equal to or greater than the "Flow (gal/min)" at the top of the graph in line with the point where the lift and fall lines cross. If the input flow is less than this number, the output will be correspondingly lower.

Both models of the High Lifter pump are 26" long. One-year warranty on materials and workmanship.

High Lifter Water-Powered Pumps

Model	Pump ratio	Max output/day	Max net lift	Max total lift	Item code
H44	4.5:1	1,500 gal	440 ft	580 ft	**076-09002**
H49	9:1	750 gal	1,000 ft	1,140 ft	**076-09005**
Rebuild kit for H44 High Lifter - 4.5:1					**076-01118**
Rebuild kit for H49 High Lifter - 9:1					**076-01124**

PV Cable Assembly Tools

Crimp-on PV cable connectors (See Wire and Cable section) require special tools to properly attach the connectors. Single-purpose tools from **Multi-Contact** or **Amphenol** work with only that type of connector and are often the best option for installers who work only with modules that have that same connector type. For those who encounter several different types of connectors, one of the **Rennsteig** tool sets that have a set of dies and positioners can be more convenient and economical than carrying a different tool for each connector type.

MC4 and Helios Crimp Tools

The Multi-Contact MC4 **crimping tool** is used to assemble MC4 (Solarline 2) locking connectors with10 or 12 AWG stranded wire. A set of two plastic wrenches is used to tighten the sealing nut in the connector and to unlock the male and female connector. The Amphenol Helios H4 Crimp Tool, Wrench, and Assembly/Disconnect Tool are used with the Helios H4 connectors, and are similar to the MC4 tools. The Amphenol Helios H4 Ring Tool can be worn on a finger and used to unlock the H4 male and female connectors.

Multi-Contact MC4 & Amphenol H4 Tools	
Description	**Item code**
MC Solarline 2 MC4 pin crimper for 10/12 AWG wire	**094-00104**
MC Solarline 2 MC4 open-end spanner set (2-pack)	**094-00112**
Amphenol Helios H4 Crimp Tool, 2.5mm – 6mm	**094-00007**
Amphenol Helios H4 Wrench and Disconnect Tool	**094-00008**
Amphenol Helios H4 Ring Tool	**094-00010**

Hammer Crimp Tool

This simple, inexpensive crimping tool can be used to crimp ring-terminal lugs and other connectors onto 8 through 4/0 AWG wire. Spring-loaded pin locks in “up” position for loading connector and cable. When released, the pin holds the connector securely during crimping. Use with a hammer or vice.

Hammer Crimp Tool	
Description	**Item code**
Hammer crimp tool	**094-00013**

Battery Cable Tools

Use the cable crimper to crimp battery terminals, copper lugs, and splices on wire from 8 to 4/0 AWG. Adjustable crimp dies are clearly marked and easy to rotate into position. This UL-listed, 26" tool gives you plenty of leverage for secure crimping.

Use the 22" long cutter to cut inverter cables and battery interconnects up to 6/0 AWG. Available in a bench-mount version as well as hand-held, the high-carbon steel blades are removable for sharpening or replacement. All of these tools are made in the U.S.A.

Battery Cable Tools	
Description	**Item code**
Cable cutter with 22" handles	**094-00004**
Cable crimper with 26" handles	**094-00011**

Rennsteig

Crimping Tool Sets and Accessories

These Rennsteig tool sets are helpful for installers who wish to make their own extensions and connections. The tools presented here cover the most popular connectors, including those using MC4 or Amphenol H4 connectors. Tools for crimping other connector types are available upon request. All of these tools are made in Germany.

The **Tyco/MC4/H4 Solarkit** comes with three die-sets and three pin locators for crimping Tyco Solar-Lok, Solar-Line 2 (MC4), or Amphenol Helios (H4) pins as well as a cutter and stripper tool, all in a hard-shell case.

The **Solar Crimp Tools** include the preassembled tool frame, die, and pin locator, but no case. Additional dies and pin locators can be added to expand the tool. The **Insulation Stripper** strips and removes the insulation in a single motion. The **blades** are replaceable. The **Wire Cutter** features a specially curved set of shears that cuts stranded wire without significant deformation. The **Empty Tool Frame** can be used with separately-purchased crimping **Dies** and **Pin Locators**, which are interchangeable.

Rennsteig Kits, Sets and Crimping Tools				
Description	**Connector type**	**Wire size**	**Model**	**Item code**
Solarkit	Tyco, MC4, H4	Varies by connector	624 105-H4M4TE	**094-00148**
Solar Crimp Tool	MC4 Solarline 2	12/10/8 AWG	624 1193 3 1	**094-00144**
Solar Crimp Tool	Amphenol H4	14/12/10/8 AWG	624 1194 3 1	**094-00135**
Insulation Stripper	NA	16/14/12/10 AWG	707-226-1-6US	**094-00128**
Replacement Blades			708 226 1 3 0	**094-00138**
Wire Cutter			700-016-36	**094-00129**
Empty tool frame	(Use with pins & dies)	NA	624 000 3	**094-00146**
Die only	MC4 Solarline 2	12/10/8 AWG	624 570 3 0	**094-00126**
Pin Locator only			624 194 0 01	**094-00132**
Die only	Amphenol H4	14/12/10/8 AWG	624 1194 3 0	**094-00130**
Pin Locator only			624 1194 0 01	**094-00131**

System Survey and Commissioning Tools

Commissioning a PV system is an important final step in the installation process, and it's worth doing properly and consistently. Commissioning standards, such as IEC 62446 and related NABCEP guidelines, provide visual and physical inspections as well as electrical tests that should be performed prior to activating a new PV system. Common electrical tests made during commissioning include: continuity, phasing, and voltage for AC circuits; continuity of grounding conductors; DC circuit polarity verification; string I-V curves; string open-circuit voltage; string short circuit current; insulation resistance testing of PV source and output circuits; and, finally, a full-up system functionality test. With proper documentation, these same tests can be repeated periodically as systems age to ensure that they are operating efficiently.

Nikon

Forestry Pro Laser Rangefinder

The Nikon **Forestry Pro Laser Rangefinder** can be used during field survey work to determine distance, height, and angle measurements that are useful for refining aerial-imagery-based estimates. This tool is equipped with three-point measurement in addition to the conventional vertical separation. Three-point measurement provides the difference in height between two targets by measuring horizontal distance to a target then angles to the target base and the top. It is very useful when the laser beam is blocked by the bushes or branches that cover the base or top of a tree. Results are displayed on internal and external LCD panels. The high-quality 6x monocle with multilayer coating produces clear, bright images.

Solar Site Survey Tools	
Description	**Item code**
Nikon Forestry Pro Laser Rangefinder	**094-000240**

Seaward Solar

Solar Installation Test Kit

The **PV150 Solar Link Kit** includes everything needed to test to the IEC 62446 system commissioning standard as well as the latest NABCEP recommendations. The all-in-one PV installation tester, using simple direct connections to PV systems, performs open circuit voltage, short circuit current, and insulation resistance tests with a single button press. It can also be used to perform operating current (using the supplied current clamp) and Earth continuity measurements as well as determine voltage polarity.

The connectors feature non-accessible conductive parts for safe use with PV systems that may be energized. The PV150 can also wirelessly receive and record irradiance and temperature measurements from the Solar Survey 200R in real-time as electrical tests are conducted.

The PV150 solar PV tester has memory to store up to 200 complete test records, and USB connectivity enables these to be downloaded to a PC. Seaward's SolarCert Elements software program (supplied separately) can then be used to automate generation of test certificates and documentation.

The PV150 Test Kit includes: a PV150 solar installation tester, AC/DC current clamp, carry bag, MC4 test lead adaptors, red and black test leads, test probe with detachable alligator clips, Quick Start Guide, support-software CD, and calibration certificate.

Solar Survey Multifunction Solar-Irradiance Meters

These handheld solar-irradiance meters include a built-in inclinometer to measure roof pitch, compass to measure roof orientation, and thermometer to measure ambient air and module temperature. These meters display irradiance measurements in either W/m^2 or $BTU/hr\text{-}ft^2$, so they work for both solar photovoltaic (PV) and solar thermal applications.

The use of a photovoltaic reference cell provides a more representative measurement of solar energy and greater accuracy and repeatability compared to irradiance meters that use simple photo-diode detectors. The **Solar Survey 100** and **200R** irradiance meters both incorporate a display-hold feature, which enables the user to easily capture readings in difficult locations.

The 200R can wirelessly give the PV150 Solar Installation Test Kit real-time irradiance, ambient temperature, and PV module-temperature measurement results simultaneous to electrical tests, as required by MCS and IEC 62446 standards. The PV150 can then download the data into the SolarCert Elements software program. The 200R model also includes data logging with a USB interface for data download

to a PC. This allows for irradiance and temperature to be recorded at user-defined intervals over a number of hours or days. The collected data can then be downloaded to a PC for analysis or for inclusion in solar installation reports.

Solar Power Clamp

Seaward's Solar Power Clamp is a specialized power meter that clamps over the cable to measure the AC or DC current. If a PV system isn't generating the expected level of power under known irradiance and temperature conditions, this may indicate a fault with one or more components in the system. In addition to power and efficiency measurements, the harmonic analysis function of the Solar Power Clamp can be used as a means of detecting faults within the inverter.

Solar Power Clamp functions include: DC power measurement, AC and AC+DC true continuous power (RMS) reading, power factor, total harmonic distortion and harmonics 1 – 25, phase-rotation indication, current and voltage measurement, smart data hold and peak hold, and non-contact voltage indicator.

SolarCert Elements Solar PV Software

The Seaward SolarCert Elements Solar PV Software enables solar PV system installers to produce customized client-facing test reports and certificates using user input or data downloaded from the PV150 tester.

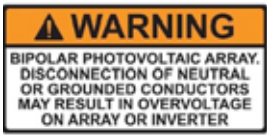
The software allows PV installers to create customized test certification and inspection reports and installation layout diagrams that can be stored alongside photographs and other information relevant to PV installations, such as datasheets or operating manuals. A checklist feature helps ensure that all of the necessary information is included. Company logos and signatures can be added to the templates for a branded professional image. Once compiled, the complete data package can quickly be searched within the solar PV software and emailed or printed for delivery to the client.

Seward Solar Commissioning Tools	
Description	**Item code**
PV150 Solar Link Kit (Includes PV150, AC/DC current clamp, SolarLink Connectivity, SolarCert Elements Software, and Accessories)	**094-00279**
PV150 Installation Tester	**094-00282**
Solar Survey 100 irradiance meter	**094-00290**
Solar Survey 200R irradiance meter with SolarLink wireless data transfer	**094-00291**
AC/DC Solar Power Clamp power analyzer	**094-00292**
SolarCert Elements software	**094-00289**

Solar Safety Labels

The NEC and International Fire Code (IFC) require specific components of a PV system to be labeled for the safety of operators, maintenance, and emergency-responder personnel. The Code also requires these labels to be appropriately weather resistant (IFC 605.11.1.1.3) and durable (NEC 110.21). These labels are UV and weather resistant and should meet Code requirements in most jurisdictions. Note that some jurisdictions may still require engraved placards. The labels are designed to permanently adhere to metallic, baked enamel, or powder-coated surfaces in most outdoor environments.

Local jurisdictions and company policies often call for unique language or types of labels that are not available in preprinted form. If this is a frequent requirement, a label printing system can be an economical way to get exactly what you need when you need it. The ability to produce custom labels also presents opportunities for branding as well as organization, theft prevention, and identification.



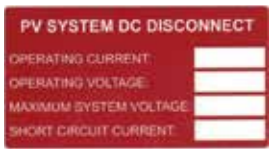
HellermannTyton

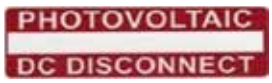
Preprinted Safety Labels

The language and letter height on these Standard Labels is designed to meet NEC 110, NEC 690 and IFC 605 requirements and have been updated for NEC 2014 compliance. Reflective Labels are available for disconnect and conduit markers as required by the Code. The Fill-In-The-Blank Labels have white blanks that can be filled in with system parameters ahead of time using a 4" or larger thermal transfer printer, such as the TT230SMC. They can also be filled out in the field using a permanent marker so long as the transparent laminate is then placed over them. The labels will remain adhered in temperatures down to -40 °C and as high as 175 °F [79 °C] but must be applied when temperatures are above 50 °F [10 °C]. UL 969 Recognized.

Standard Labels				
Placement[1]	Label text	Dimensions	Pkg qty	Item code
Combiners, Enclosures, AC Disconnect	"WARNING ELECTRICAL SHOCK HAZARD DO NOT TOUCH TERMINALS. TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION"	3.75" x 2"	10	188-09043
			50	188-09029
DC Disconnect	Includes label above and appends "DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT"	3.75" x 2.5"	10	188-09042
			50	188-09028
Meter, Breaker panel, Inverter	"WARNING ELECTRICAL SHOCK HAZARD IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED"	4.12" x 2"	10	188-09044
			50	188-09030
Combiners, Enclosures, Breaker panel	"WARNING ELECTRIC SHOCK HAZARD THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED"	4.12" x 2"	10	188-09047
			50	188-09031
Combiners, Breaker panels, Service disconnect	"WARNING TURN OFF PHOTOVOLTAIC AC DISCONNECT PRIOR TO WORKING INSIDE PANEL"	4.12" x 2"	10	188-09045
			50	188-09032
Breaker panel	"WARNING DUAL POWER SOURCE SECOND SOURCE IS PV SYSTEM"	4.12" x .75"	10	188-09041
			50	188-09027
Breaker panel	"CAUTION PV SYSTEM CIRCUIT IS BACKFED"	4.12" x .75"	10	188-09046
			50	188-09033
Breaker panel	"WARNING - 120-VOLT SUPPLY DO NOT CONNECT MULTIWIRE BRANCH CIRCUITS"	3.75" x 2"	10	188-09050
			50	188-09034
Breaker panel	"WARNING - INVERTER OUTPUT CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE"	4.12" x .75"	10	188-09048
			50	188-09036
Combiners, Enclosures, Breaker panel	"WARNING - BIPOLAR PV ARRAY DISCONNECTION OF NEUTRAL OR GROUNDED CONDUCTORS MAY RESULT IN OVERVOLTAGE ON ARRAY OR INVERTER"	3.75" x 2"	10	188-09049
			50	188-09035

[1] Placement suggestions are the most common applications for the given label; it is, by no means, an exhaustive list of where the label may be required.





Fill-In-The-Blank Labels				
Placement[1]	**Label text**	**Dimensions**	**Pkg qty**	**Item code**
DC module rating	"RATED MAX POWER POINT CURRENT _____ RATED MAX POWER POINT VOLTAGE _____ MAXIMUM SYSTEM VOLTAGE _____ SHORT CIRCUIT CURRENT _____ MAX RATED OUTPUT CURRENT OF THE CHARGE CONTROLLER IF INSTALLED _____"	4" x 2"	50	**188-09014**
DC backup system rating	"RATED AC OPERATING CURRENT _____ MAX RATED AC OPERATING CURRENT _____ RATED AC OPERATING VOLTAGE _____ MAX RATED AC OPERATING VOLTAGE _____ RATED SHORT CIRCUIT CURRENT _____ MAXIMUM SYSTEM VOLTAGE _____"	4" x 2"	50	**188-09015**
System DC disconnect	"**PV SYSTEM DC DISCONNECT** OPERATING CURRENT _____ OPERATING VOLTAGE _____ MAXIMUM SYSTEM VOLTAGE _____ SHORT CIRCUIT CURRENT _____"	3.75" x 2"	50	**188-09016**
System AC disconnect	"**PHOTOVOLTAIC AC DISCONNECT** MAXIMUM AC OPERATING CURRENT _____ MAXIMUM AC OPERATING VOLTAGE _____"	3.75" x 1"	50	**188-09017**
AC disconnect	"PHOTOVOLTAIC ____ AC DISCONNECT"	3.75" x 1"	50	**188-09018**
DC disconnect	"PHOTOVOLTAIC ____ DC DISCONNECT"	3.75" x 1"	50	**188-09019**
Over lamination for field-written labels	"CLEAR ADHESIVE LAMINATE"	4.2" x 2.25"	10 50	**188-09059** **188-09020**
System label for AC modules and microinverter systems	"NOMINAL OPERATING VOLTAGE _____ NOMINAL OPERATING AC FREQUENCT _____ MAXIMUM AC POWER _____ MAXIMUM AC CURRENT _____ MAX OVERCURRENT DEVICE RATING FOR AC MODULE PROTECTION _____"	4" x 2"	50	**188-09021**
Reflective Labels				
Breaker panel	"DO NOT DISCONNECT UNDER LOAD"	6.5" x 1"	10 50	**188-09052** **188-09007**
Service disconnect	"CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED" (White on Red background)	6.5" x 1"	50	**188-09008**
Service disconnect	"CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED" (Black on Yellow background)	5.5" x 1"	10 50	**188-09057** **188-09037**
Combiners, Enclosures, Conduit	"CAUTION: SOLAR CIRCUIT" (White on Red background)	6.5" x 1"	10	**188-09009**
Combiners, Enclosures, Conduit	"CAUTION: SOLAR CIRCUIT" (Black on Yellow background)	6.5" x 1"	10 50	**188-09058** **188-09038**
Service disconnect	"SOLAR DISCONNECT"	6.5" x 1"	10 50	**188-09053** **188-09010**
Service disconnect	"MAIN PV SYSTEM DISCONNECT"	5.5" x 1.75"	10 50	**188-09051** **188-09011**
Service disconnect	"MAIN PV SYSTEM AC DISCONNECT"	5.5" x 1.75"	10 50	**188-09055** **188-09012**
Combiners, Enclosures, Conduit	"PHOTOVOLTAIC POWER SOURCE"	6.5" x 1"	10 50	**188-09054** **188-09013**
Service disconnect	"PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN"	5.5" x 1.75"	10	**188-09056**

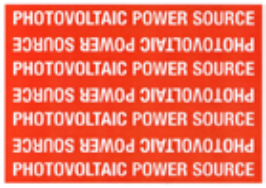
[1] Placement suggestions are the most common applications for the given label; it is, by no means, an exhaustive list of where the label may be required.

Label Kits

For convenience, pre-cut Safety Label Kits are available in two sizes. The small kit is suitable for most systems under 7 kW while the large kit is suitable for most systems between 7 and 15 kW. The label 188-09031 is included and used when installing non-isolated (transformerless) inverters or systems with all ungrounded DC conductors.

Safety Label Kits			
Placement[1]	Labels included	Label quantity	
		Small kit	Large kit
AC disconnecting means-switch or circuit breaker	188-09029	2	2
DC combiner, DC disconnect, any wire-splice JBOX	188-09028	3	6
Inverter	188-09030	1	3
DC combiner, DC disconnect, wire-splice JBOX	188-09031	1	3
Interconnection point supplied by a tap connection	188-09027	1	1
Interconnection point	188-09037	1	1
DC disconnect	188-09019	2	3
EMT conduit inside building	188-09013	10	20
DC disconnect and/or Inverter	188-09014	1	3
AC disconnecting means	188-09017	1	1
AC disconnect	188-09018	1	1
Lamination for field-written labels	188-09020	5	8
	Item Code	**188-09100**	**188-09101**

[1] Placement suggestions are the most common applications for the given label; it is, by no means, an exhaustive list of where the label may be required.



Solar Circuit Markers

These markers are pre-printed, non-adhesive, coiled labels that can be opened and recoiled around cables up to 0.25" diameter and conduit up to 1" diameter. The markers are made from UV-stable vinyl and come in packages of 25.

Non-Adhesive Circuit Markers				
Placement[1]	Label text (repeated in alternating directions)	Dimensions	Pkg qty	Item code
PV cables	"CAUTION: SOLAR CIRCUIT"	4" x 2"	25	**188-09022**
Conduit	"CAUTION: SOLAR CIRCUIT"	7.2" x 5"	25	**188-09023**
PV cables	"PHOTOVOLTAIC POWER SOURCE"	4" x 2"	25	**188-09024**
Conduit	"PHOTOVOLTAIC POWER SOURCE"	7.2" x 5"	25	**188-09025**

[1] Placement suggestions are the most common applications for the given label; it is, by no means, an exhaustive list of where the label may be required.

Thermal-Transfer Printers

The HellermannTyton **TT230MC** desktop thermal-transfer printer is designed for printing safety and identification signs and labels up to 4" wide. Use black or white printer ink ribbons to print on blank continuous vinyl material. This printer also incorporates a cutter that automatically cuts the labels as they are printed, saving time in the field. An optional hard-shell case and battery pack are also available to enable operation on a jobsite.

The **TT230MC Starter Kit** includes the printer, plus a sturdy hard-shell case, white and black ribbons, the label caddy, and TagPrint Pro 3.0 label design software.

The portable HellermannTyton **TT130MC** enables shop or jobsite printing of all current solar and safety warning labels. Prints on 250' continuous vinyl rolls of material up to 2" wide using continuous black or white printer ink ribbon. Values can also be printed on rolls of preprinted labels where site-specific information such as voltage and current values need to be added. The printer has an Ethernet port, allowing connection to a network or wireless router, and includes a label caddy and integrated label cutter.

The **TT130MC Starter Kit** includes the printer, a hard case that can accommodate two TT130MC units, white and black print ink ribbons, the label caddy, and the TagPrint 3.0 label design software.

The **TagPrint Pro 3.0** software is required for using the printer with a Windows PC. The software is preloaded with standard NEC safety-label templates and enables customization of those as well as design capability. TagPrint Pro can also be set up to print sets of consecutively-numbered labels and similar batch processes.

Blank self-adhesive 250' continuous **rolls of vinyl** are available in white, black, red, and yellow with widths of 1" or 2" (4" vinyl available by special order). The vinyl material is UV stable and rated for a minimum of five years of outdoor use without significant fading or adhesive degradation.

Thermal Transfer Printers and Accessories	
Description	**Item code**
TT230MC printer only	**094-09000**
White ink ribbon for TT230MC	**094-09001**
Black ink ribbon for TT230MC	**094-09002**
TT230MC Starter Kit (includes printer, software, black and white ink ribbons, and case)	**094-09033**
TagPrint Pro 3.0 software	**094-09011**
Hard-shell case for TT230MC	**094-09012**
Battery pack for TT230MC	**094-09013**
TT130MC printer (includes integrated label cutter and label caddy)	**094-09036**
White ink ribbon for TT130MC (2"x154')	**188-09060**
Black ink ribbon for TT130MC (2"x242')	**188-09061**
TT130MC Starter Kit (includes printer, software, black and white ink ribbons, and case)	**094-09035**
TagPrint Pro 3.0 software	**094-09011**
Hard-shell case for TT130MC (Case holds up to two printers)	**094-09037**

Blank Vinyl for Desktop Thermal Transfer Printers			
Color	**Width**	**Roll length**	**Item code**
White	1"	250'	**094-09003**
	2"		**094-09004**
Yellow	1"	250'	**094-09005**
	2"		**094-09006**
Red	1"	250'	**094-09007**
	2"		**094-09008**
Black	1"	250'	**094-09009**
	2"		**094-09010**
White with Orange Header	2"	250'	**188-08997**
Orange	1"	250'	**188-08998**
Red Reflective	1"	250'	**188-08999**

The Solar Advantage

Doing it Right the First Time
Saves You Money Every Time

HellermannTyton Delivers Proven Performance and Savings to the Solar Energy Market

SOLAR TIES

- Specially designed and manufactured in materials suited for solar applications
- Offered in an assortment of sizes, lengths and tensile strengths

UV Stabilized Nylon

UV & Heat Stabilized Nylon w/High Impact Resistance

Nylon 12

Stainless Steel

SOLAR E-CLIPS

- Engineered from specially-formulated UV stabilized materials, these fasteners allow for the flexible routing of PV cable, with or without pre-drilled holes
- Designed for easy placement and removal for faster installations and reduced labor costs

Edge Fastening Solutions

Through-Hole Fastening Solutions

SOLAR IDENTIFICATION

- Printers, software and labeling options to create distinguishing identification to meet industry regulations
- Assorted labeling products for tagging assets, organizing relays, and identifying circuits and switches

Labeling Software

Thermal Transfer Printers

Solar Label Design Mobile App

Solar Specific Labels

SOLAR WIRE PROTECTION

- A line of durable enclosure products for organizing and safeguarding wires and cables within combiner boxes, inverters and control panels
- Lightweight and flexible protection offering superior performance and reduced installation complexity

Nylon 6 Slit Conduit

Nylon 12 Slit Conduit

Nylon 6 Double Slit conduit

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HellermannTyton

Electric Vehicle Charging Stations

A charging station is a great companion to a grid-tied PV system because it extends the financial and environmental savings of solar power to transportation, directly offsetting oil consumption and vehicle exhaust.

There are three categories of EV charging stations:

Level 1: This is a simple device that plugs into a 120 VAC 20 A outlet. It looks like a conventional AC outlet but with one blade turned 90°. Typically delivered with the vehicle from the dealer or manufacturer, Level 1 charging stations are limited to a maximum of 2 kW and take 10 to 20 hours to fully charge an all-electric car.

Level 2: These charging stations are typically hardwired into a 240 VAC 40 A circuit and range in output from 6 to 12 kW. Level 2 charging stations can fully charge an electric vehicle in 3 to 8 hours. Installed on a dedicated circuit, they feed power to the vehicle's built-in charger through an SAE J1772 plug that resembles the nozzle of a gas pump. Most residential and commercial charging stations currently available are Level 2.

Level 3: This is a high-powered charger that delivers 20 kW or more of 300+ VDC power directly to the EV battery. These chargers require three-phase power and a large commercial service panel. Level 3 CHAdeMO connectors are an option on the Nissan Leaf and other electric vehicles, but Level 3 charging stations are best suited for commercial vehicle and fleet applications due to their size and cost.

Federal and state tax credits may be available to lower the cost of equipment and installation of charging stations.

EV230WS

Schneider Electric

Schneider Electric offers a suite of electric vehicle charging stations for both residential and commercial applications. These Level 2 charging stations can charge most EV batteries in three to eight hours via the standard SAE J1772 compliant output plug, which fits the receptacles of the most popular EVs and Plug-in Hybrid- Electric Vehicles such as the Nissan Leaf, Chevy Volt, and Toyota's new plug-in Prius.

The Schneider EVlink™ charging stations also feature a user-friendly interface, integrated ground-fault protection, and automatic restart following a corrected ground fault or temporary loss of power.

For maximum output, installation will require a 240 VAC source with a 40 A two-pole circuit breaker capable of a 30 A continuous load per charging unit. Dual chargers require twice the current or two separate circuits.

EV230WSRR

EVlink Wall-Mounted Level 2 Charging Stations

These charging stations mount on the wall of a garage or outdoors on the side of a building. Installation with a standard 240 VAC socket and plug can be used to keep the unit portable, but be sure to check with your local code inspector as some jurisdictions have additional requirements for these outlets. RFID access is only available on the outdoor version, which also features a NEM A 3R weatherproof enclosure. Listed to UL 2594, 2231, 991, 1998, and 2251.

Schneider Electric EVlink Wall Mounted EV Charging Stations		
Model	**Description**	**Item code**
EV230WS	Indoor-only 120/240 VAC	**089-01500**
EV230WSR	Outdoor 120/208/240 VAC	**089-01501**
EV230WSRR	Outdoor 120/208/240 VAC with RFID access	**089-01504**

EV230PDR

EVlink Pedestal-Mounted Level 2 Charging Stations

These NEMA 3R rated outdoor Level 2 charging stations can be deployed in parking spaces or dedicated EV charging areas. Both the single and dual output versions are available with RFID access to ensure security. Listed to UL 2594, 2231, 991, 1998, and 2251.

Schneider Electric EVlink Pedestal EV Charging Stations		
Model	**Description**	**Item code**
EV230PSR	Outdoor 120/208/240 VAC single output	**089-01502**
EV230PDR	Outdoor 120/208/240 VAC dual output	**089-01503**
EV230PSRR	Outdoor 120/208/240 VAC single output with RFID Access	**089-01505**
EV230PDRR	Outdoor 120/208/240 VAC dual output with RFID Access	**089-01506**

EVRFIDHP

EVlink RFID Accessories

RFID-accessible versions are available for all outdoor-rated EVlink charging stations. This enables the user to set up and manage up to 480 users for each charging station by issuing authentication cards. **Authentication cards** and associated pin numbers can be activated or inactivated for each charging station using the handheld programmer.

Scheider Electric EVlink RFID Accessories		
Model	**Description**	**Item code**
EVRFIDHP	RFID Handheld programmer	**089-01507**
EVRFIDKF-10	RFID Authentication cards, 10 pack	**089-01508**

EV230PDRACG

EVlink Level 2 Charging Stations with ChargePoint®

These Outdoor charging stations are similar to the other EVlink NEMA 3R rated outdoor Level 2 charging stations but offer cellular communication with the ChargePoint® network to process contactless credit card or ChargePoint® card payments. These stations also feature a backlit color LCD screen to facilitate payment and charging instructions. At least one gateway unit is required to facilitate the cellular network connection. The gateway unit will then network each non-gateway station within a 150-foot line-of-sight range. An **EVNETCOMM** service plan is required for each station output (dual-output stations require two service plans). The service plans enable centralized management of the charging stations and facilitate pricing updates, payment options, reservations, advertising and revenue reporting.

Schneider Electric EVlink Outdoor Charging Stations with ChargePoint®		
Model	**Description**	**Item code**
EV230PSRACG	Pedestal 208/240 VAC single output gateway	**089-01529**
EV230PSRACNG	Pedestal 208/240 VAC single output	**089-01530**
EV230PDRACG	Pedestal 208/240 VAC dual output gateway	**089-01531**
EV230PDRACNG	Pedestal 208/240 VAC dual output	**089-01532**
EV230WDRACG	Wall Mount 208/240 VAC dual output gateway	**089-01533**
EV230WDRACNG	Wall Mount 208/240 VAC dual output	**089-01534**
EVNETCOMM1	One-year Service plan	**089-01535**
EVNETCOMM2	Two-year Service plan	**089-01536**
EVNETCOMM3	Three-year Service plan	**089-01537**
EVNETKF50	ChargePoint® payment cards (50-pack)	**089-01538**

Need assistance? Call your AEE Solar rep, or Sales Support at **800-777-6609**.

Reference

Maximum Ampacities for Wire

The table below shows allowable ampacities of conductors (wires) in conduit, raceway, and cable or directly buried, in an ambient temperature of 30 °C (86 °F). National Electrical Code (NEC) allows rounding up cable ampacity to the next size standard fuse or breaker.

For ambient temperatures above 30 °C (86 °F), multiply the allowable ampacities shown at right by the correction factor listed under the insulation temperature rating below.

Maximum Ampacity of Copper and Aluminum Conductors at 30 °C				
Wire size	Copper conductor-temperature rating (A)		Aluminum conductor-temperature rating (A)	
	75 °C (167 °F)	90 °C (194 °F)	75 °C (167 °F)	90 °C (194 °F)
[1]14 AWG	20 A	25 A	--	--
[1]12 AWG	25 A	30 A	20 A	25 A
[1]10 AWG	35 A	40 A	30 A	35 A
8 AWG	50 A	55 A	40 A	45 A
6 AWG	65 A	75 A	50 A	60 A
4 AWG	85 A	95 A	65 A	75 A
2 AWG	115 A	130 A	90 A	100 A
1 AWG	130 A	150 A	100 A	115 A
1/0 AWG	150 A	170 A	120 A	135 A
2/0 AWG	175 A	195 A	135 A	150 A
3/0 AWG	200 A	225 A	155 A	175 A
4/0 AWG	230 A	260 A	180 A	205 A

[1]NEC specifies that the overcurrent-protection device not exceed 30 A for 10 AWG wire, 20 A for 12 AWG wire, and 15 A for 14 AWG wire.

Temperature-Correction Factors for Ampacity			
Temperature range		75 °F insulation	90 °F insulation
31-35 °C	87-95 °F	0.94	0.96
36-40 °C	96-104 °F	0.88	0.91
41-45 °C	105-113 °F	0.82	0.87
46-50 °C	114-122 °F	0.75	0.82
51-55 °C	123-131 °F	0.67	0.76
56-60 °C	132-140 °F	0.58	0.71

Recommended Inverter Cable and Overcurrent Protection

Use this table to determine cable size and fuse or breaker size for common battery-based inverter models. Smaller cable sizes can be used if fuse or breaker size is reduced, but this can cause nuisance-tripping if the inverter is running near its maximum output. Larger cables may be necessary if the distance from the inverter to the battery is greater than 10'.

Use this table to choose the correct inverter breaker or fuse size required when choosing a pre-assembled power center that contains an over-current protection device (fuse or circuit breaker). Examples are MidNite Solar's E-Panels, Magnum Energy's MP and MMP panels, and OutBack Power's FLEXware power centers.

AEE Solar stocks battery-to-inverter cables in 2, 2/0 and 4/0 AWG.

Cable and Overcurrent Protection Sizing					
Inverter input voltage	Continuous watts	Max inverter input	Fuse size	Circuit breaker	Recommended wire size
12 VDC	300 W	40 A	50 A	50 A	4 AWG
	600 W	80 A	110 A	100 A	2 AWG
	800 W	107 A	110 A	110 A	2 AWG
	1,000 W	135 A	200 A	175 A	2/0 AWG
	1,500 W	200 A	300 A	250 A	4/0 AWG
	2,000 W	265 A	300 A	250 A	4/0 AWG
	2,400 W	320 A	400 A	250* A	4/0 AWG
	2,500 W	334 A	400 A	250* A	4/0 AWG
	2,800 W	382 A	400 A	250* A	4/0 AWG
	3,000 W	400 A	400 A	250* A	4/0 AWG
24 VDC	600 W	40 A	50 A	50 A	6 AWG
	800 W	54 A	70 A	75 A	4 AWG
	1,000 W	67 A	80 A	75 A	2 AWG
	1,500 W	100 A	110 A	110 A	2/0 AWG
	2,000 W	135 A	200 A	175 A	2/0 AWG
	2,400 W	160 A	200 A	175 A	2/0 AWG
	2,500 W	167 A	200 A	175 A	2/0 AWG
	3,000 W	200 A	300 A	250 A	4/0 AWG
	3,500 W	230 A	300 A	250 A	4/0 AWG
	4,000 W	265 A	300 A	250 A	4/0 AWG
48 VDC	3,000 W	100 A	110 A	110 A	2/0 AWG
	3,600 W	120 A	200 A	125 A	2/0 AWG
	4,000 W	135 A	200 A	175 A	2/0 AWG
	4,500 W	155 A	200 A	175 A	2/0 AWG
	5,500 W	185 A	200 A	250 A	4/0 AWG
	6,800 W	200 A	300 A	250 A	4/0 AWG
	8,000 W	270 A	400 A	175 A (2 each)	2/0 AWG (2 each)

*These amperages exceed the capacity of a 250 A breaker and 4/0 AWG cable. Use two 2/0 AWG cables with two 175 A breakers if possible, or reduce loads to prevent tripping the breaker or blowing the fuse.

Wire Loss Tables for 12 VDC and 24 VDC Systems

Use this table to determine the maximum distance from power source to load for 2% voltage drop. If a 4% loss is acceptable, the distance can be doubled, but do not exceed 2% drop for wire between PV modules and batteries. A 4% to 5% loss is acceptable between batteries and lighting circuits in most cases.

Note that a 24 VDC array can be placed much further from the battery bank than a 12 VDC array of the same wattage size because the voltage is doubled and the current is cut in half. This increases distance by a factor of four with the same wire gauge.

12-volt System Maximum Wire Runs										
AMPS	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG	1/0 AWG	2/0 AWG	4/0 AWG
2% voltage drop										
1 A	45'	70'	115'	180'	290'	456'	720'	--	--	--
2 A	22.5'	35'	57.5'	90'	145'	228'	360'	580'	720'	1,060'
4 A	10'	17.5'	27.5'	45'	72.5'	114'	180'	290'	360'	580'
6 A	7.5'	12'	17.5'	30'	47.5'	75'	120'	193'	243'	380'
8 A	5.5'	8.5'	15'	22.5'	35.5'	57'	90'	145'	180'	290'
10 A	4.5'	7'	12'	18'	28.5'	45.5'	72.5'	115'	145'	230'
15 A	3'	4.5'	7'	12'	19'	30'	48'	76.5'	96'	150'
20 A	2'	3.5'	5.5'	9'	14.5'	22.5'	36'	57.5'	72.5'	116'
25 A	1.8'	2.8'	4.5'	7'	11.5'	18'	29'	46'	58'	92'
30 A	1.5'	2.4'	3.5'	6'	9.5'	15'	24'	38.5'	48.5'	77'
40 A	--	--	2.8'	4.5'	7'	11.5'	18'	29'	36'	56'
50 A	--	--	2.3'	3.6'	5.5'	9'	14.5'	23'	29'	46'
100 A	--	--	--	--	2.9'	4.6'	7.2'	11.5'	14.5'	23'
150 A	--	--	--	--	--	--	4.8'	7.7'	9.7'	15'
200 A	--	--	--	--	--	--	3.6'	5.8'	7.3'	11'

24-volt System Maximum Wire Runs										
AMPS	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG	1/0 AWG	2/0 AWG	4/0 AWG
2% voltage drop										
1 A	90'	140'	230'	360'	580'	912'	1,440'	--	--	--
2 A	45'	70'	115'	180'	290'	456'	720'	1,160'	1,440'	2,120'
4 A	20'	35'	55'	90'	145'	228'	360'	580'	720'	1,160'
6 A	15'	24'	35'	60'	95'	150'	240'	386'	486'	760'
8 A	11'	17'	30'	45'	71'	114'	180'	290'	360'	580'
10 A	9'	14'	24'	36'	57'	91'	145'	230'	290'	460'
15 A	6'	9'	14'	24'	38'	60'	96'	153'	192'	300'
20 A	4'	7'	11'	18'	29'	45'	72'	115'	145'	232'
25 A	3.6'	5.6'	9'	14'	23'	36'	58'	92'	116'	184'
30 A	3'	4.8'	7'	12'	19'	30'	48'	77'	97'	154'
40 A	--	--	5.6 '	9'	14'	23'	36'	58'	72'	112'
50 A	--	--	4.6'	7.2'	11'	18'	29'	46'	58'	92'
100 A	--	--	--	--	5.8'	9.2'	14.4'	23'	29'	46'
150 A	--	--	--	--	--	--	9.6'	15.4'	19.4'	30'
200 A	--	--	--	--	--	--	7.2'	11.6'	14.6'	22'

Wire Loss Tables - 48 V and 120 V

Use these tables to determine the maximum distance one-way in feet of two-conductor copper wire from power source to load for 2% voltage drop in 48 VDC and 120 VDC system wiring. You can go twice the distance where a 4% loss is acceptable but do not exceed 2% drop for wire between PV modules and batteries. A 4 to 5% loss is acceptable between batteries and lighting circuits in most cases.

48-volt System Maximum Wire Runs										
AMPS	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG	1/0 AWG	2/0 AWG	4/0 AWG
2% voltage drop										
1 A	180'	280'	460'	720'	1,160'	1,824'	2,880'	--	--	--
2 A	90'	140'	230'	360'	580'	912'	1,440'	2,320'	2,880'	4,240'
4 A	40'	70'	110'	180'	290'	456'	720'	1,160'	1,440'	2,320'
6 A	30'	48'	70'	120'	190'	300'	480'	772'	972'	1,520'
8 A	22'	34'	60'	90'	142'	228'	360'	580'	720'	1,160'
10 A	18'	28 '	48'	72'	114'	182'	290'	460'	580'	920'
5 A	12'	18'	28'	48'	76'	120'	192'	306'	384'	600'
20 A	8'	14'	22'	36'	58'	90'	144'	230'	290'	464'
25 A	7.2'	11.2'	18'	28'	46'	72'	116'	184'	232'	368'
30 A	6'	9.6'	14'	24'	38'	60'	96'	154'	194'	308'
40 A	--	--	11.2'	18'	28'	46'	72'	116'	144'	224'
50 A	--	--	9.2'	14.4'	22'	36'	58'	92'	116'	184'
100 A	--	--	--	--	11.6'	18.4'	28.8'	46'	58'	92'
150 A	--	--	--	--	--	--	19.2'	30.8'	38.8'	60'
200 A	--	--	--	--	--	--	14.4'	23.2'	29.2 '	44'

120-volt System Maximum Wire Runs										
AMPS	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG	1/0 AWG	2/0 AWG	4/0 AWG
2% voltage drop										
1 A	450'	700'	1,150'	1,800'	2,900'	4,560'	7,200'	--	--	--
2 A	225'	350'	575'	900'	1,450'	2,280'	3,600'	5,800'	7,200'	10,600'
4 A	100'	175'	275'	450'	725'	1,140'	1,800'	2,900'	3,600'	5,800'
6 A	75'	120'	175'	300'	475'	750'	1,200'	1,930'	2,430'	3,800'
8 A	55'	85'	150'	225'	355'	570'	900'	1,450'	1,800'	2,900'
10 A	45'	70'	120'	180'	285'	455'	725'	1,150'	1,450'	2,300'
15 A	30'	45'	70'	120'	190'	300'	480'	765'	960'	1,500'
20 A	20'	35'	55'	90'	145'	225'	360'	575'	725'	1,160'
25 A	18'	28'	45'	70'	115'	180'	290'	460'	580'	920'
30 A	15'	24'	35'	60'	95'	150'	240'	385'	485'	770'
40 A	--	--	28'	45'	70'	115'	180'	290'	360'	560'
50 A	--	--	23'	36'	55'	90'	145'	230'	290'	460'
100 A	--	--	--	18'	29'	46'	72'	115'	145'	230'
150 A	--	--	--	--	--	--	48'	77'	97'	150'
200 A	--	--	--	--	--	--	36'	58'	73'	110'

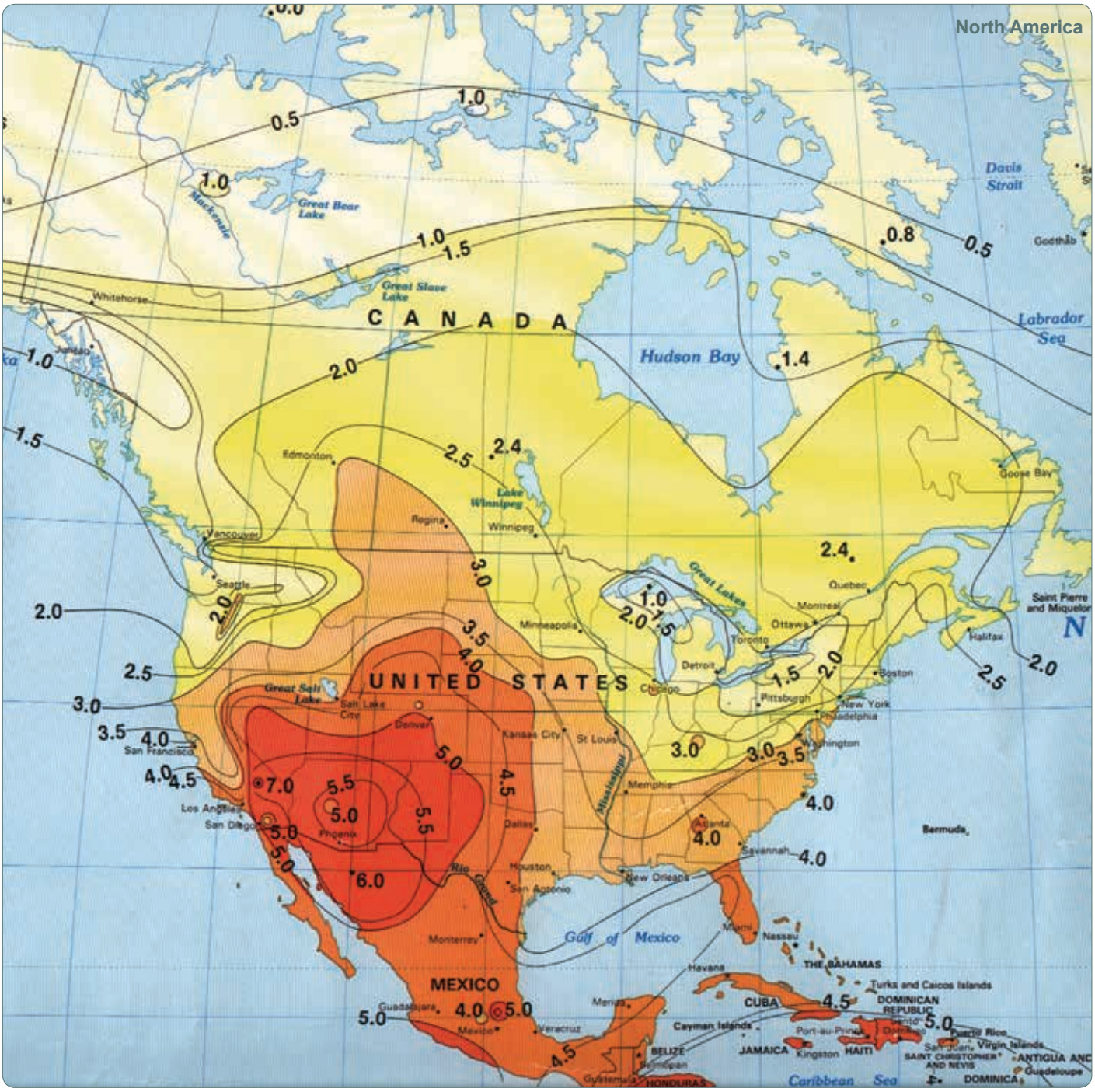
Solar Insolation

This table shows solar insolation in kilowatt-hours per square meter per day in many U.S. locations, known as “sun-hours" per day. To find average sun-hours per day in your area, check local weather data, look at the maps on the following pages, or find a city in the table below that has similar latitude and weather to your location.

For year-round autonomy, use the low figure. For autonomy in summer only, use the high number. For a utility grid-tie system with net metering, use the average figures.

State	City	High	Low	Avg
AK	Fairbanks	5.87	2.12	3.99
	Matanuska	5.24	1.74	3.55
AL	Montgomery	4.69	3.37	4.23
AR	Bethel	6.29	2.37	3.81
	Little Rock	5.29	3.88	4.69
AZ	Tucson	7.42	6.01	6.57
	Page	7.30	5.65	6.36
	Phoenix	7.13	5.78	6.58
CA	Santa Maria	6.52	5.42	5.94
	Riverside	6.35	5.35	5.87
	Davis	6.09	3.31	5.10
	Fresno	6.19	3.42	5.38
	Los Angeles	6.14	5.03	5.62
	Soda Springs	6.47	4.40	5.60
	La Jolla	5.24	4.29	4.77
	Inyokern	8.70	6.87	7.66
CO	Granby	7.47	5.15	5.69
	Grand Lake	5.86	3.56	5.08
	Grand Junction	6.34	5.23	5.85
	Boulder	5.72	4.44	4.87
DC	Washington	4.69	3.37	4.23
FL	Apalachicola	5.98	4.92	5.49
	Belie Is.	5.31	4.58	4.99
	Miami	6.26	5.05	5.62
	Gainesville	5.81	4.71	5.27
	Tampa	6.16	5.26	5.67
GA	Atlanta	5.16	4.09	4.74
	Griffin	5.41	4.26	4.99
HI	Honolulu	6.71	5.59	6.02
IA	Ames	4.80	3.73	4.40
ID	Boise	5.83	3.33	4.92
	Twin Falls	5.42	3.42	4.70
IL	Chicago	4.08	1.47	3.14
IN	Indianapolis	5.02	2.55	4.21
KS	Manhattan	5.08	3.62	4.57
	Dodge City	6.50	4.20	5.60
KY	Lexington	5.97	3.60	4.94
LA	Lake Charles	5.73	4.29	4.93
	New Orleans	5.71	3.63	4.92
	Shreveport	4.99	3.87	4.63
MA	E. Wareham	4.48	3.06	3.99
	Boston	4.27	2.99	3.84
	Blue Hill	4.38	3.33	4.05
	Natick	4.62	3.09	4.10
	Lynn	4.60	2.33	3.79
MD	Silver Hill	4.71	3.84	4.47
ME	Caribou	5.62	2.57	4.19
	Portland	5.23	3.56	4.51
MI	Sault Ste. Marie	4.83	2.33	4.20
	E. Lansing	4.71	2.70	4
MN	St. Cloud	5.43	3.53	4.53
MO	Columbia	5.50	3.97	4.73
	St. Louis	4.87	3.24	4.38
MS	Meridian	4.86	3.64	4.43
MT	Glasgow	5.97	4.09	5.15
	Great Falls	5.70	3.66	4.93
	Summit	5.17	2.36	3.99
NM	Albuquerque	7.16	6.21	6.77
NB	Lincoln	5.40	4.38	4.79
	N. Omaha	5.28	4.26	4.90
NC	Cape Hatteras	5.81	4.69	5.31
	Greensboro	5.05	4	4.71
ND	Bismarck	5.48	3.97	5.01
NJ	Sea Brook	4.76	3.20	4.21
NV	Las Vegas	7.13	5.84	6.41
	Ely	6.48	5.49	5.98
NY	Binghamton	3.93	1.62	3.16
	Ithaca	4.57	2.29	3.79
NY	Schenectady	3.92	2.53	3.55
	Rochester	4.22	1.58	3.31
	New York City	4.97	3.03	4.08
OH	Columbus	5.26	2.66	4.15
	Cleveland	4.79	1.99	3.94
OK	Stillwater	5.52	4.22	4.99
	Oklahoma City	6.26	4.98	5.59
OR	Astoria	4.67	1.99	3.72
	Corvallis	5.71	1.90	4.03
	Medford	5.84	2.02	4.51
PA	Pittsburgh	4.19	1.45	3.28
	State College	4.44	2.79	3.91
RI	Newport	4.69	3.58	4.23
SC	Charleston	5.72	4.23	5.06
SD	Rapid City	5.91	4.56	5.23
TN	Nashville	5.20	3.14	4.45
	Oak Ridge	5.06	3.22	4.37
TX	San Antonio	5.88	4.65	5.30
	Brownsville	5.49	4.42	4.92
	El Paso	7.42	5.87	6.72
	Midland	6.33	5.23	5.83
	Fort Worth	6.00	4.80	5.43
UT	Salt Lake City	6.09	3.78	5.26
	Flaming Gorge	6.63	5.48	5.83
VA	Richmond	4.50	3.37	4.13
WA	Seattle	4.83	1.60	3.57
	Richland	6.13	2.01	4.44
	Pullman	6.07	2.90	4.73
	Spokane	5.53	1.16	4.48
	Prosser	6.21	3.06	5.03
WI	Madison	4.85	3.28	4.29
WV	Charleston	4.12	2.47	3.65
WY	Lander	6.81	5.50	6.06

These maps show the average value of total solar energy received in peak-sun-hours per day on an optimally-tilted surface during the **month with the lowest solar radiation (not the yearly average)**. This is the best number to use in off-grid system design where the electrical demand is continuous or is not expected to vary seasonally and the system must be designed to operate year-round (Use this number for line 3 in the Off-Grid Solar-Array Sizing Worksheet in the System Design section).

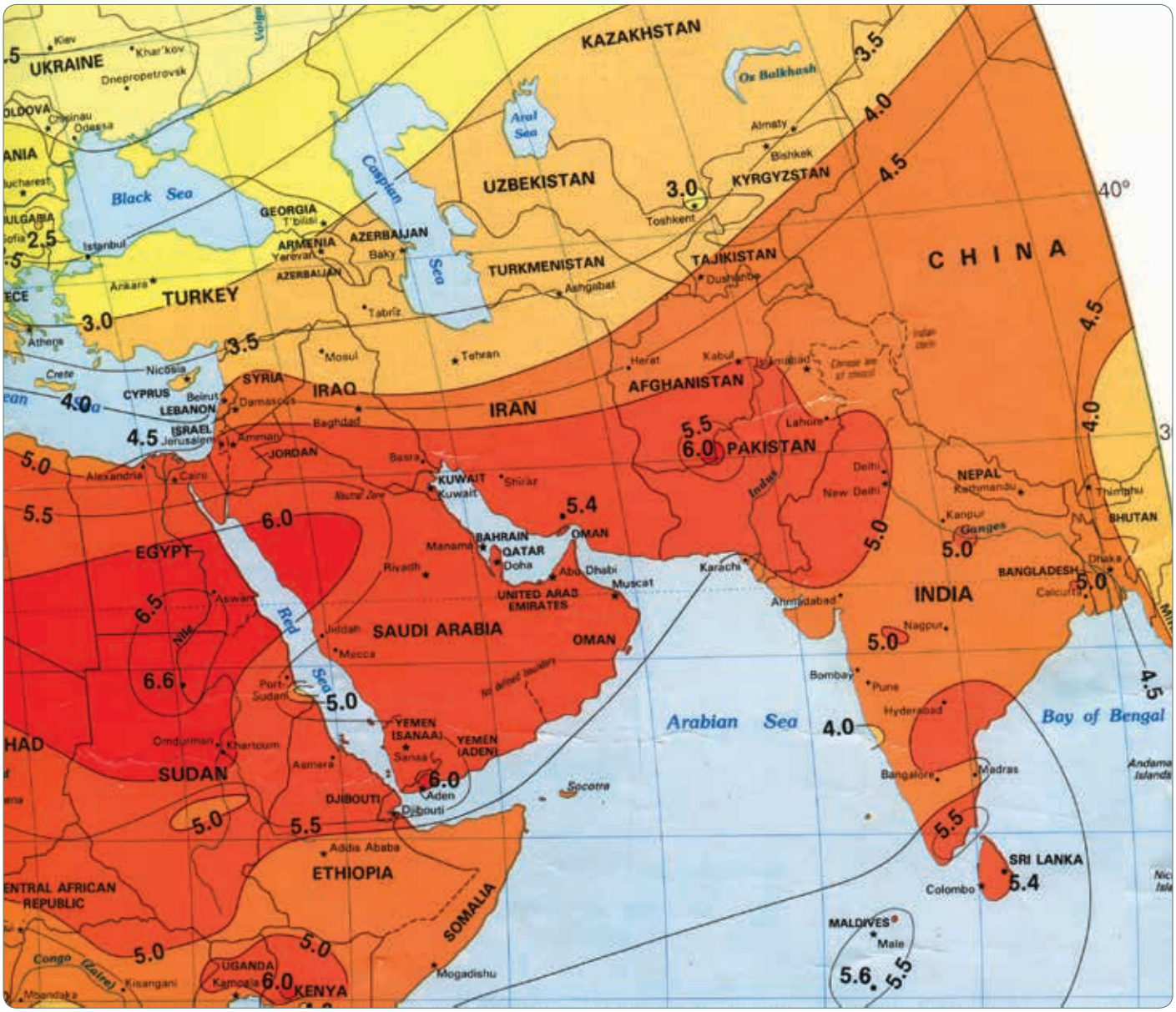


South America

Europe

Africa

India


KAZAKHSTAN
UKRAINE
Kiev
Khar'kov
Dnepropetrovsk
Odessa
Chisinau
Black Sea
Caspian Sea
Aral Sea
Ozbekhash
Almaty
Bishkek
UZBEKISTAN
KYRGYZSTAN
Toshkent
TURKMENISTAN
Ashgabat
TAJIKISTAN
Dushanbe
CHINA
GEORGIA
T'bilisi
ARMENIA
Yerevan
AZERBAIJAN
Baky
Istanbul
Ankara
TURKEY
Tabriz
Athens
Crete
Nicosia
CYPRUS
SYRIA
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Damascus
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Amman
JORDAN
IRAQ
Mosul
Baghdad
Basra
Tehran
IRAN
Herat
Kabul
AFGHANISTAN
Islamabad
Lahore
PAKISTAN
Delhi
New Delhi
NEPAL
Kathmandu
BHUTAN
Thimphu
Kanpur
Ganges
Indus
Alexandria
Cairo
EGYPT
Aswan
Nile
Nuclear Zone
KUWAIT
Kuwait
Shiraz
BAHRAIN
Manama
QATAR
Doha
OMAN
Muscat
Abu Dhabi
UNITED ARAB EMIRATES
Riyadh
Karachi
Ahmadabad
INDIA
BANGLADESH
Dhaka
Calcutta
Nagpur
Bombay
Pune
Hyderabad
Red Sea
Jiddah
Mecca
SAUDI ARABIA
OMAN
Port Sudan
No defined boundary
Arabian Sea
Bay of Bengal
Andaman Islands
Omdurman
Khartoum
SUDAN
Asmera
YEMEN (SANAA)
Sanaa
YEMEN (ADEN)
Aden
Socotra
DJIBOUTI
Djibouti
Bangalore
Madras
Addis Ababa
ETHIOPIA
SRI LANKA
Colombo
CENTRAL AFRICAN REPUBLIC
SOMALIA
MALDIVES
Male
Congo (Zaire)
Kisangani
Mogadishu
UGANDA
Kampala
KENYA
Nairobi
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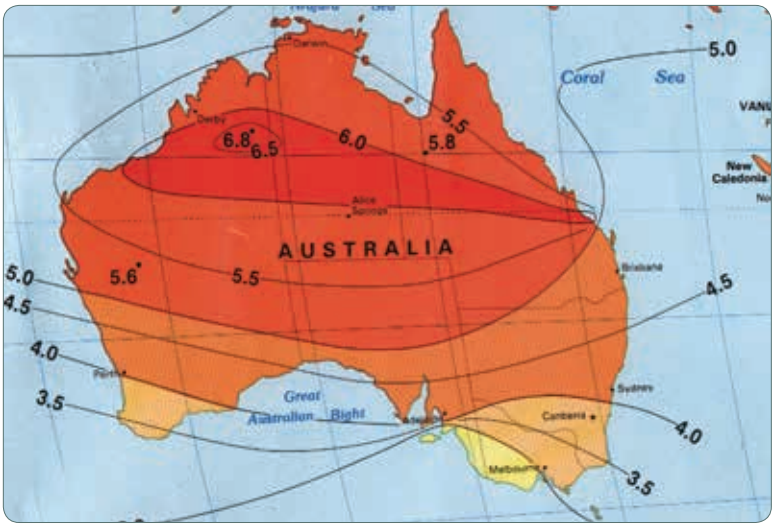
5.6
40°

Asia

Australia



New Zealand

Glossary

Absorbed Glass Mat (AGM): A valve-regulated lead-acid battery with the electrolyte suspended in a fiberglass matrix. (See also: Lead-acid battery)

Alternating Current (AC): An electric current which switches voltage polarity at a given frequency; the US electrical grid supplies AC electricity with a frequency of 60 Hz.

American National Standards Institute (ANSI): Originally established by multiple engineering societies and several government agencies as the American Engineering Standards Committee, ANSI is responsible for reviewing, approving and maintaining standards for measurements, manufacturing and safety.

Ampere (A or Amp): The standard unit of electrical current, equal to 1 Coulomb per second.

Anode: The proper term for the "negative" terminal in a discharging battery, an anode is any material or component that acts as a current input point for an electrochemical reaction. The anode eventually dissolves in such reactions and coats the positively charged cathode material. Recharging a battery effectively reverses the anode and cathode. (See also: Cathode)

Anodized: Refers to metal components, such as aluminum module frames or rails, that have a thick layer of oxidation to protect them from the environment. Anodized components are typically also sealed and can be dyed as well.

Arc-Fault Circuit Interrupter (AFCI): A device designed to detect an unintended electrical arc and disconnect the power before the arc starts a fire.

American Society of Civil Engineers (ASCE): The oldest national engineering society, ASCE publishes a wide variety of engineering standards and recommendations, such as wind-loading guidance and soil mechanics data.

Amorphous silicon (a-Si): A non-crystalline form of silicon used in some thin-film transistors and PV cells.

Authority Having Jurisdiction (AHJ): The state or local agency responsible for permitting and inspection of new construction or electrical installations.

Azimuth: For PV systems, the azimuth is the angle between a line normal to the face of the PV modules and true North. Ideal azimuth for PV arrays in the Northern hemisphere is typically 180°.

Back Plate: A specialized wall-mount bracket for mounting inverters or power systems.

Back Sheet: The material, usually high-density polyethylene, that protects the rear surface of a PV module.

Balance of System (BOS): All parts needed to complete the PV system that are not expressly called out. i.e. "modules, inverter and BOS."

Ballasted mounting: Typically refers to PV mounting systems on flat roofs that use ballast blocks or stones to reduce the number of roof penetrations.

Battery: A device that stores electrical energy by converting it to chemical energy. Several chemistries and form-factors are used for batteries. (See Also: Lead-Acid Battery, Lithium-ion Battery, Sodium-ion battery, Nickel-iron battery)

Battery Backup: A battery bank and inverter used to provide power during a grid outage.

Battery-based inverter: An inverter that converts DC power from a battery bank into AC power suitable for use by common loads or for export to the grid. Typically, battery-based inverters must be installed with batteries in order to function and may or may not be grid interactive. (See also: Inverter, Grid-interactive)

Battery Management System (BMS): A computer-controlled-electronics package that ensures a battery bank is properly charged and discharged. Many advanced chemistries, such as lithium-ion, require a BMS for safety and longevity.

Bonding (electrical): Bonding refers to the practice of electrically connecting all exposed metal components so that they can be reliably connected to ground for safety. Also referred to as equipment grounding.

British Standard (BS) 6290: A safety standard relating to stationary lead-acid batteries that specifies mechanical, electrical and material requirements.

Bronze anodized: Typically refers to aluminum rail or other mounting components that are anodized with a dark bronze dye so as to appear black. (See also anodized)

Bus/busbar: A conductor used to distribute current between multiple sources and loads, analogous to a manifold.

Cathode: The proper term for the "positive" terminal of a discharging battery, a cathode is the material and/or point where current leaves an electrochemical reaction.

Cell: A photovoltaic cell generates a DC voltage (usually ~0.5 V) when exposed to light. Cells are typically assembled into modules prior to use.

California Energy Commission (CEC): The CEC is California's primary energy policy and planning agency. It is responsible for energy forecasting, setting energy efficiency standards, supporting, promoting and developing renewable energy technologies and resources, certifying thermal power plants and responding to energy emergencies.

Canadian Standards Association (CSA): Now CSA Group, CSA is a standards organization similar to Underwriters' Laboratories (See UL) in the USA. Like UL, CSA also performs certification testing as an NRTL to its own and many other US and Canadian standards.

Combiner: A bus assembly used to connect module strings in parallel. Usually includes overcurrent protection for each string. May be integrated with inverter or in separate enclosure.

Composition (Comp) shingle: Also known as asphalt shingles, this thin, flexible roofing material is common on sloped residential roofs and is relatively easy to work with.

CSA 22: Also known as the Canadian Electrical Code, CSA 22.1 contains prescriptive standards for electrical and related work while CSA 22.2 contains safety and testing standards for related equipment. Analogous to the NEC and associated UL standards used in the USA.

Class I Division 2 (CI-D2): Usually encountered in oil & gas extraction applications, special equipment certification (typically by Factory Mutual) is required to operate in a Class I environment – where flammable gasses or vapors are likely to be present in sufficient concentrations to ignite. Division refers to whether the flammables are normally present (Division 1) or only in abnormal conditions (Division 2). Certification testing is designed to verify that the product does not present an ignition source, such as a spark or hot surface.

Cradle to Cradle™ (C2C): A product standard that evaluates products with respect to material health and reutilization, energy and carbon management, water stewardship and social fairness.

Current transducer (CT): A current sensor that generates a voltage signal proportional to the current passing through a conductor it is placed around. Most revenue-grade metering systems use CTs.

Demand Charge: Part of a utility rate structure that assesses a fixed charge based on the peak kW demand, usually sustained for 15 minutes or more.

Derate Factor (Derate): Can apply to any reduction of a device's safety or output ratings when normal operating conditions (usually temperature) are exceeded. Often also applied to a value used in the PVWatts calculator where it represents losses in the system due to the difference between the PV module's nameplate DC ratings, and actual expected output in real-world conditions, module mismatch, losses in diodes, connections and wiring, module soiling, array shading, tracking error, system aging, and the inverter efficiency at maximum power. The default 0.82 derate is based on 14% systemic losses and 96% inverter efficiency.

Direct Current (DC): An electric current with constant voltage; PV modules and batteries supply DC electricity.

Dual in-line package (DIP) switch: A manual switch packaged in a group on a circuit board; typically used to customize an electrical device, such as a charge controller, by changing settings or logic.

Delta: A three-phase power configuration where transformers or loads are connected between each of the current-carrying lines. (See also: Three-phase power)

Deutsches Institut für Normung (DIN) rail: A standard rail used to mount circuit breakers or other control equipment in enclosures or racks. Several DIN standards are used globally, but the top hat EN 50022 profile is most common in the USA.

Disconnect (Disco): A switch that electrically isolates a given component or portion of a system from the load or generator. i.e. Most inverters feature a DC Disco that isolates the PV array from the inverter.

Dynamic load: A load who's direction and amplitude changes with time, i.e. a PV module in gusty winds will tend to flex toward and away from the roof.

Electric Current: The flow of an electric charge, typically carried by electrons through a conductor; analogous to the flow of liquid through a pipe.

Electrolyte: Any substance that forms an electrically conductive solution with water. While electrolytes such as sulfuric acid are vital to battery chemistry, others, such as salt water or even rain, are the primary cause of corrosion in metal components.

Energy: The ability of a system to perform work; the standard unit of energy is the Joule, but electrical energy is most often measured in kilowatt-hours.

Equalization charge (Equalize): A sustained charge cycle intended to "boil" the electrolyte in a flooded battery in order to prevent or correct stratification of varying electrolyte concentration.

Flash test: A test performed on PV modules to determine their nameplate capacity. The flash test is performed under standard test conditions (1,000 W/m^2 of light at 25 °C) typically at the factory or by an NRTL.

Flashing: Thin pieces of material, usually aluminum or steel, used to prevent water intrusion through a roofing system at joints and transitions.

Federal Communications Commission (FCC) Part 15: Properly known as the Code of Federal Regulations, Title 47, part 15, "FCC Part 15" regulates unlicensed radio emissions, such as those from power electronics like inverters. Any product sold in the USA that emits radio energy, but doesn't require a license to operate, must comply with 47 CFR 15.

Float Charge: A low-current charge applied to a battery bank at roughly the rate of self-discharge. Float charge voltage is regulated to prevent overcharging the battery.

Flooded battery: Refers to battery types where the electrolyte is in liquid form and can be added to or spilled. Typically applied to traditional lead-acid batteries, but also describes some nickel-iron batteriesl.

Galvanized: Refers to iron or steel that has been coated with zinc to prevent corrosion. The zinc provides both a protective layer as well as a sacrificial anode to both prevent and mitigate rust formation.

Galvanic corrosion: Dissimilar metals, such as copper and steel, brought into contact by a conductive electrolyte, such as rain or salt-spray, will react much like a battery and dissolve the anode into the electrolyte. This is why equipment grounding methods must prevent dissimilar metals from coming into contact with one another.

Grid: The electric grid is an electric distribution system that provides power to connected loads from geographically-dispersed generators.

Grid-interactive: Able to export power to the electrical grid. Usually refers to a battery-based "Hybrid" or "dual-function" inverter that can operate with or without a grid connection.

Grid-tied: Connected to the electrical grid; usually referring to a PV system.

Hanger bolt: A specialized fastener used for mounting structures that has wood-screw thread on the bottom and machine thread on the top.

Harmonic: A whole-number multiple of a fundamental frequency. i.e. an inverter outputting 60 Hz may have harmonic outputs at 120 Hz, 180 Hz and so on, so distortions caused by certain types of loads (battery chargers, variable frequency drives, etc.) will also have effects at each of the higher harmonic frequencies.

Harmonic Distortion: The extent to which certain types of electrical loads can cause increased peak currents, heating and EMF emissions in an inverter or other AC power source.

Head: The vertical distance, typically expressed in feet, between a water source and where it is being delivered. Also used as a shorthand for pressure, 1 foot of head = .43 psi.

Hybrid Inverter: A battery inverter that can interconnect with the grid for net metering.

IEEE 1547: The Standard for Interconnecting Distributed Resources with Electric Power Systems establishes acceptable frequency and voltage windows, and related parameters, that govern how and when a generator or inverter can feed into the electrical grid. Compliance with IEEE 1547 is part of the UL 1741 test standard.

IEEE 929: IEEE's Recommended Practice for Utility Interface of Photovoltaic (PV) Systems contains guidance to ensure that grid-tied PV systems are safe and effective.

IEEE C62.41: IEEE's Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits provides guidance for testing whether a given device can withstand surge voltage.

IEC 60034: IEC's standard for rotating electrical machines, such as motors and generators.

IEC 60896: This section of IEC's battery standard covers stationary lead-acid batteries. Various subsections cover materials and test protocols.

IEC 61000: Refers to IEC standards starting with 61, which covers most electrical devices.

IEC 61215: The IEC standard for testing PV modules, analogous to UL 1703.

IEC 62109: The IEC standard defining minimum requirements for power-conversion equipment in PV systems. IEC 62109 is analogous to UL 1741, but includes performance requirements as well as safety standards.

IEC 62509: The IEC standard that establishes minimum requirements for function and performance of battery charge controllers used with lead-acid batteries in PV systems.

IEC 62446: IEC's Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection defines the minimal tests, inspections and documentation that should be presented to a customer upon completion of a PV installation.

Institute of Electrical and Electronics Engineers (IEEE): The largest association of electrical engineers, IEEE is very active in the development of codes and standards. While not typically binding as such, IEEE standards are often incorporated into IEC, UL, ANSI and other standards that are referenced by building and electrical codes.

International Electrotechnical Commission (IEC): The leading global standards developer and publisher. IEC standards are commonly referred to in the European Union and other parts of the world, much like UL standards in the USA. While IEC standards are not binding in the USA, they are often incorporated, in part or in whole, into UL, ANSI and other standards that are referenced by building and electrical codes.

International Fire Code (IFC): A comprehensive fire safety code, similar to the NFPA, parts of which are incorporated into the building codes of some jurisdictions in the USA.

Inspector: A Code inspector is a representative of the AHJ who physically inspects construction or electrical installations to determine whether they are compliant with the standards of the jurisdiction.

Inverter: A device that converts DC electric power into AC power for use by AC loads and/or for export to the electric grid.

Ingress Protection (IP ##): The IP rating specifies the level of environmental protection provided by an enclosure. The first number rates protection from particulates (e.g. dust) from zero to six, with zero being unprotected and six being completely protected. The second number rates protection against liquid ingress from zero (no protection) to eight, which denotes fully submersible. IP 67 is typical for module junction boxes.

Insolation: The amount of solar energy received over a unit of time per a unit of surface area. Often expressed as sun-hours, which is equivalent to kWh/m^2. Most solar resource maps provide sun-hours per day. (See also: irradiance)

Irradiance: The amount of electromagnetic or solar power received by a unit surface area. Standard solar irradiance is considered to be 1,000 W/m^2, also referred to as one sun. (See also: insolation)

Junction Box (J-box): A container for electrical connections that protects them from weather and/or tampering. Many types of electrical j-box are used for PV installation and modules typically feature a sealed j-box on the back which connects the output leads to the positive and negative bus.

Jurisdiction Having Authority (JHA): See: Authority Having Jurisdiction.

Kilowatt (kW): A commonly used unit of power equal to 1,000 W. A PV system is typically referred to by the kilowatt rating of either the modules or inverter

Kilowatt-hour (kWh): A common unit of energy used to express the consumption or production of electrical power over time, especially for billing purposes. A PV system which produces 1 kW consistently for 1 hour will have produced 1 kWh.

Laminate: A subassembly of a PV module consisting of the cells, busses, encapsulant, glass and back sheet.

Lead-acid battery: A rechargeable battery which makes use of the conversion between lead-oxide and lead-sulfate in sulfuric acid to charge and discharge. Common variants include flooded, sealed and valve-regulated.

Listed: Certified by an NRTL as meeting the requirements of a given standard. PV modules must be listed to UL 1703 and inverters must be listed to UL 1741 per NEC article 690.

Lithium-ion (Li-ion) battery: A rechargeable battery which relies on the transfer of lithium ions to charge and discharge. Lithium-ion batteries offer higher energy and power density than most other battery chemistries but require sophisticated battery management systems to operate.

Lithium-cobalt-oxide ($LiCoO_2$): Most notably used by Tesla for both EVs and stationary power, $LiCoO_2$ batteries provide greater energy density than other common lithium chemistries, but are susceptible to thermal runaway when overcharged or over-heated.

Lithium-iron-phosphate ($LiFePO_4$) battery: Common in power tools and most stationary energy storage with lithium-ion batteries, $LiFePO_4$ batteries provide less energy density than their cobalt counterparts, but offer improved safety and cycle life due to greater thermal stability.

Marked: Products listed by an NRTL are allowed to bare the mark of that laboratory. Inspectors look for these marks whenever a listing is required by the Code.

Maximum-Power Point (MPP): The corresponding voltage and current that yields maximum power from a PV cell, module, or array in the given conditions. The MPP will vary according to available light and cell temperature.

Maximum-Power-Point-Tracking (MPPT): A feature of most grid-tie inverters, optimizers and MPPT charge controllers that continually seeks the maximum-power point of the module or array to ensure maximum energy harvest.

Meter: An electric meter is used to measure the amount of energy produced or consumed. (see also: Meter form, Revenue-grade metering)

Meter form: The meter form designation, i.e. Form 2S, Form 16S, etc, describes the number and arrangement of meter terminals as well as the number and internal connection of meter elements.

Microinverter: A small inverter used with a single module.

Mill-finish: Typically refers to stamped or extruded metals that have been formed but not polished, anodized, painted nor otherwise finished.

Modbus: Originally developed by Modicon (now part of Schneider Electric) and maintained by the non-profit Modbus Organization, Modbus is an open serial-communications protocol commonly used for communication between industrial devices and controllers. Most PV inverters use Modbus to communicate with third-party monitoring or control platforms.

Module-Level Power Electronics (MLPE): Refers to optimizers or microinverters used with each module. (See also: Microinverters, Optimizers)

Module: An assembly of PV cells (usually 36, 60 or 72 in series) that outputs a DC voltage when exposed to light. "AC modules" incorporate a microinverter to output AC power.

Monocrystalline (mono): Refers to wafers or cells made from a single crystal of silicon, which tend to have higher efficiencies than multi-crystalline cells.

Multicrystalline: Commonly referred to as "poly-crystalline," this refers to wafers or cells that are made from a silicon casting, which tends to have lower production costs than the monocrystalline process.

National Electrical Code (NEC): Also known as NFPA 70, the NEC is a standard published by the National Fire Protection Association (NFPA) for the safe installation of electrical wiring and related equipment. It is generally adopted with or without modification by states or city/county AHJs. Article 690 addresses solar PV installation specifically but many other sections, such as article 250, apply as well.

Nationally Recognized Testing Laboratory (NRTL): Laboratories designated by the federal Occupational Safety & Health Administration (OSHA) to test products for adherence to applicable standards. Solar products sold in the USA are most often Listed by Underwriters' Laboratories (UL) or Intertek (ETL).

Nameplate Capacity: The nominal output or throughput of a device or machine. PV modules typically have a nameplate capacity based on the output of the module at standard test conditions as determined by a "flash test"

National Electrical Manufacturers Association (NEMA): An association of electrical equipment and medical imaging manufacturers, NEMA provides standards for electrical connectors and Enclosures. (See also: NEMA enclosure types, Ingress Protection)

NEMA enclosure types: Defined in the NEMA ICS 6 Enclosures Standard, common NEMA enclosure types include NEMA 1 – indoor use only, NEMA 3/3R – weather resistant and 4 – watertight. X (as in NEMA 4X) denotes additional corrosion resistance.

Net Energy Metering (NEM): The prevalent utility billing mechanism for distributed energy systems, such as solar PV, which credits energy exported to the grid at the same (retail) rate as energy consumed from the grid. Such systems are said to be "net metered."

Network Equipment Building System (NEBS): Developed by Bell Labs, NEBS provides a standard for communications equipment used in a central office and is now managed by Telcordia. NEBS has three levels that each refer to various parts of the GR-63-CORE and GR-1089-CORE standards. Level 1 concerns just personnel and equipment safety while Levels 2 and 3 expand to cover operability and reliability requirements.

Non-isolated: Most transformerless inverters are "ungrounded" on the DC side in that there is no "neutral" wire. Rather, both the positive and negative inputs have an absolute voltage and require "bipolar" combiner circuits with overcurrent protection on both legs.

Normal Operating Cell Temperature (NOCT): The temperature of a particular PV cell when operated at 800 W/m^2 of irradiance in average 20 °C ambient air with a 1 m/s average wind velocity across the back of the module. In order to better understand the performance of a PV module through a variety of operating conditions, the NOCT is typically measured by an NRTL for a sample set and reported on the module data sheet.

Off-grid: Not connect to the electrical grid; usually referring to a standalone PV or wind system on a home or industrial site. See also: Grid

Ohm (Ω): The standard unit of electrical resistance; a circuit with 1 Ω resistance will induce 1 A of current when 1 V of electric potential is applied.

Ohm's Law (V=IR): The mathematical relationship between the current (I), voltage (V) and resistance (R) of an electric circuit.

Open-circuit voltage (V_{oc}): The absolute difference in electrical potential across a device, such as a battery or PV module, when it is not connected in a circuit. For PV modules, V_{OC} is typically measured and reported at standard test conditions and must be corrected for actual temperature and irradiance.

Optimizer: module-level power-electronics device that provides MPPT and monitoring for each individual module in the array.

Panel:

- Several PV modules mounted together on a single rail set.
- An electrical load center or breaker access point.
- A solar-radiation collector used for a solar hot-water system.
- See: Module

Parallel: Electrical wiring scheme where the positive leads/terminals from multiple modules, batteries or strings are connected together to increase current.

Partial State of Charge (PSoC): PSoC refers to the status of batteries that are less than fully charged. Lead-acid batteries can experience irreversible sulfation if in a PSoC condition for more than a week or two. (See also: Sulfation)

Photovoltaic (PV): Famously characterized by Einstein, the photovoltaic effect is the physical phenomenon at the heart of all technology for generating electricity from light. See also: Cell and Module

Powder coated: A type of surface coating that is applied as a powder then cured at elevated temperatures. Powder coating can provide thicker layers in a single coat than is achievable from liquid paints and is often used for metal components, such as steel racking or metal enclosures.

Power: The rate at which work is performed or energy converted from one type to another.

Power factor: The ratio, from -1 to 1, of real power (ability to do work) going to the load vs. apparent power (V x I) in the circuit. A power factor less than 1 indicates that voltage and current waveforms are out of phase, leading to losses in the power system.

Polyamide 6,6 (PA66): More commonly known as Nylon 66, PA66 is a common industrial polymer often used in molded parts for its high strength and dimensional stability. The addition of carbon to improve UV resistance typically renders it black.

Polycrystalline (poly): See Multi-crystalline.

Polysilicon (poly-Si): Typically refers to the purified silicon feedstock used to produce multicrystalline and monocrystalline silicon wafers, the precursors to PV cells.

PV-direct (or Array-direct): A type of off-grid system where the load is run directly from a PV module or array rather than from a battery bank.

PV System: Usually refers to complete system and includes all components necessary for energy production: modules, inverter, racking, etc.

Photovoltaics for Utility Scale Applications (PVUSA): A joint government/industry project in the 1980's that included a 650 kW PV array in Davis, CA and another in Kerman, CA. The project led to a number valuable insights and established some of the earliest benchmarks and best practices for utility-scale solar, most notably the PTC module rating.

PVUSA Test Conditions (PTC): Developed by the PVUSA project to better characterize field performance of PV modules, PTC tests are performed at 1,000 W/m^2 with 20 °C ambient temperature and a 1 m/s average wind speed. The California Energy Commission lists PTC values in the equipment listings for the CSI incentive program.

Quarter points: The ideal mounting points for a beam (or PV module frame) are 25% of the total length from each end. i.e. if a module frame is 1 m long, the quarter points are located 25 cm from each end. This is typically where the mounting holes in the bottom flange of the module are located.

Racking: Typically refers to the module mounting system, which fixes the PV modules to a roof, carport or other ground-mount structure.

Rapid Shutdown (RSD): NEC 2014 article 690.12 requires a means of shutdown, accessible to emergency responders, that can limit the DC voltage in any conductor on a building that is more 10 feet from the PV array to 40 VDC or less within 10 seconds. Most module-level power electronics are inherently compliant, but string inverters typically require a separate device.

Rate Structure: The calculation method used by the electric utility to determine how a rate payer's electricity use is billed. Common rate structures include "flat" $/kWh rates, "tiered" rates that increase as more energy is consumed and "time-of-use (TOU)" rates which vary throughout the day. Commercial rate structures often include demand charges based on peak kW use.

Relay: An electrically-operated switch where a low-voltage/low power control signal is used to switch a much larger load or power source. A wide variety of relay types are used for different applications.

Remote Temperature Sensor (RTS): Also referred to as a battery temperature sensor (BTS) this is a temperature probe, usually a thermocouple, used to measure the operating temperature of a battery so that the associated charge controller can adjust charging voltage appropriately. A missing or improperly installed RTS is the leading cause of premature battery failure.

Revenue-Grade Metering (RGM): RGM as a requirement or capability typically refers to an electric meter that meets ANSI C12.20 standards. RGM can be Class .5 (± 0.5%) or Class .2 (± 0.2%). Which class is required depends on whose revenue you're interested in.

Recommended Standard (RS)-485: Officially known as TIA-485-A, the RS-485 standard is maintained by the Telecommunications Industry Association (TIA) and defines the electrical characteristics of the signal generator and receiver in a local communications network. Most solar inverter communication gear is compliant to RS-485 regardless of protocol.

Rectifier: An electrical device that converts AC into DC power.

Registered Jack (RJ): A standardized telecommunications network interface for voice and data signals.

RJ-11: This four-pin connector is most commonly used for single-line telephone jacks but is often adapted for use with proprietary Datacom systems, such as connecting temperature sensors to battery-based inverters.

RJ-45: Also specified by IEEE 802, this eight-pin connector is used world-wide for Ethernet devices and often for many RS485/Modbus devices used in PV installations.

S-Tile: A type of roof tile, usually terra cotta or ceramic, with an "S" shaped cross-sectional profile. This type of roofing material requires special care and often special attachment hardware to prevent breaking the tiles and/or leaving the under layer exposed.

Self-Consumption: In solar industry parlance, self-consumption refers to an application were all PV electricity generated on site is consumed rather than exported to the grid – as distinct from net-metered applications. Most self-consumption applications require batteries.

Self-Discharge: Batteries slowly lose charge over time, even when no loads are applied. The rate of self-discharge increases with temperature and varies according to battery type and chemistry.

Series: Electrical wiring scheme where the positive lead/terminal from a module or battery is connected to the negative lead lead/terminal of the next one to increase the voltage of the resulting string.

Shake: Typically refers to a wooden roofing material. Primarily used for aesthetic reasons, shake roofs can become fire hazards and are not recommended for use with PV systems.

Short Circuit Current (I_{SC}): In solar PV applications, I_{SC} usually refers to the prospective short-circuit current or available fault current. In this case, it represents the maximum electrical current that a device, such as a battery or PV module, can output. I_{SC} is typically measured and reported at standard test conditions and may need to be adjusted for expected temperature, irradiance, etc. I_{SC} is important to know for sizing current-carrying components such as breakers, wires, charge controllers and inverters.

Sodium-Ion Battery: A type of rechargeable battery that uses sodium ions as charge carriers. While comparable to lead-acid batteries in terms of size and weight, sodium-ion batteries have much longer cycle life, can remain at low states of charge for extended periods without damage and can be manufactured without hazardous or toxic materials. Aquion Energy is the first commercial manufacturer of sodium-ion batteries.

Standard Test Conditions (STC): Typically refers to the conditions, (1,000 W/m^2 of light at 25 °C) under which, a PV module's nameplate capacity is measured. More broadly, the term can refer to any set of conditions deemed standard for rating a particular device.

Static Load: A load that is steady or fixed for a long period of time, i.e. snow or constant wind on a PV module.

String: A group of modules or batteries wired in series is a string.

Sulfation: The crystallization of lead sulfate on the plates of lead-acid batteries. Sulfation typically results from leaving the battery at a partial state of charge for an extended period of time.

Sun-hour: A unit of solar insolation equivalent to 1 kWh/m^2. (See also: Insolation)

SunSpec Alliance: A solar/storage distributed energy trade alliance dedicated to establishing standards, protocols and related documents that improve the interoperability of solar and energy storage equipment.

Three-phase power (3-P or 3Φ): Commonly used for larger, non-residential loads, a three-phase power system applies an AC current using three separate conductors with the voltage waveform offset by one-third of the period. This arrangement enables much greater power delivery using fewer conductors since each of the conductors can serve as a return path for the others. (See also: Wye and Delta)

Transformerless (TL): Most inverter manufacturers have transitioned to topologies that use high-speed switching to avoid the need for a transformer. These inverters are typically non-isolated.

Telcordia Technologies: Formerly known as Bellcore and now a subsidiary of Ericsson, Telcordia provides technology and other standards for the telecommunications industry.

Telcordia SR4228: Now GR-4228, this standard covers the design, testing, installation and maintenance of VRLA batteries used in telecommunications backup applications.

Thin-film PV: Refers to a class of photovoltaic cells that are produced by depositing nm or µm-thick layers of PV material on a metal, glass or polymer substrate. Popular thin-film PV chemistries include Amorphous silicon (a-Si), Cadmium telluride (CdTe or Cad-tel), Copper indium gallium selenide (CIGS) and Gallium Arsenide (GaAs).

Tilt Angle (Array tilt): Typically refers to the angle between a line normal to the face of the PV modules and flat ground. Tilt is an important variable when determining expected kWh production of a PV array.

Ungrounded System: See Non-isolated.

Uniform Building Code (UBC): Now the International Building Code, the UBC is published by the International Council of Building Officials and contains construction and materials standards for buildings.

Underwriter's Laboratory (UL): Both an NRTL and a creator of safety-related testing standards, UL standards are some of the most referenced in the NEC and related safety codes. (See also: Marked, Listed)

UL 1004: The NEC-referenced test standard for motors and generators, including wind turbines.

UL 1703: The NEC-referenced test standard for PV modules includes tests for fire resistance, electrical insulation, etc. The tests are designed to demonstrate safety of the module in operation or failure conditions. (See also: Listed)

UL 1741: The NEC-referenced test standard for inverters and related equipment incorporates IEEE 1547 interconnection requirements as well as additional safety requirements. (See also: Listed)

UL 2703: The NEC-referenced test standard for PV module racking and grounding systems.

UL 1699B: The NEC-referenced standard for Arc-Fault Circuit Interrupt (AFCI) devices

UL 1998: A safety standard for software used in programmable embedded microprocessors that is primarily concerned with preventing fires.

UL 467: The NEC-referenced standard for grounding and bonding equipment.

UL508A: The NFPA-referenced standard for industrial control panels.

UL 60950: The NEC-referenced standard for IT equipment.

Valve-Regulated Lead Acid (VRLA): A type of "sealed" lead-acid battery where the electrolyte is suspended in some form and outgassing is regulated by check valves on the lid; includes Gel and AGM battery types.

Volt (V): The standard unit of electric potential; One V of potential with an electric current of 1 A will dissipate 1 W of power between the points, across which, it is measured.

Watt (W): The standard unit of power; equal to 1 Joule/second.

Washer, Electrical Equipment Bonding (WEEB): Used to bond solar modules to aluminum solar mounting rails, eliminating the need for a bare copper wire to each module.

Wild AC: Wind turbines with brushless AC generators often output voltage and frequency that varies with wind speed. Wild AC typically must be rectified before it can be used by loads.

Wye: A three-phase power configuration where three current-carrying lines use a common reference point and/or neutral line. (See also: Three-phase power)

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