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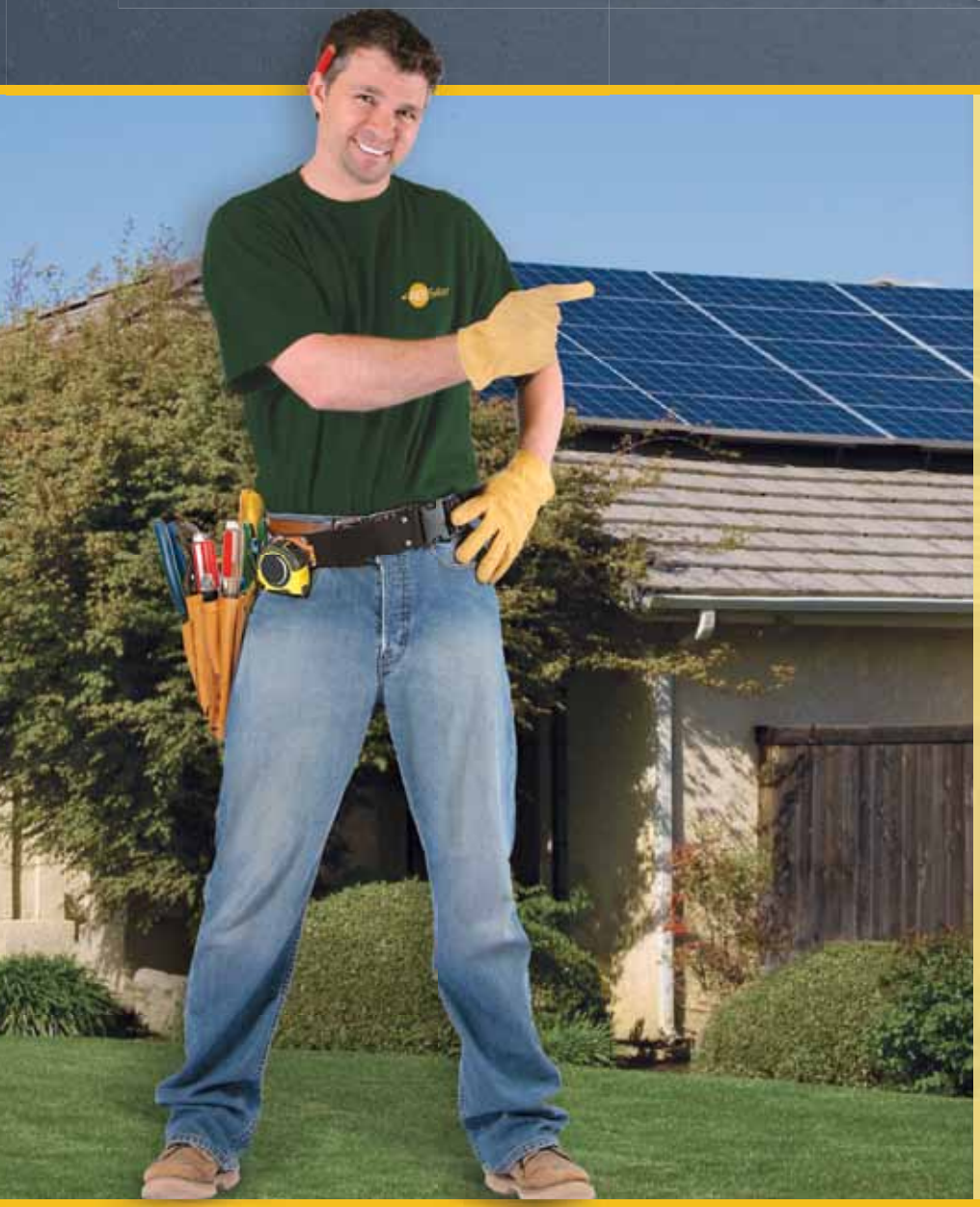
30TH EDITION!

2011 RENEWABLE ENERGY DESIGN GUIDE & CATALOG

The Essential Hands-On Guide to Everything Solar PV!

Grid-Tie
Off-Grid
Remote



- PV Modules
- Mounting & Racking
- Wind Power
- Inverters
- Charge Controllers
- Power Systems
- Meters & Monitoring
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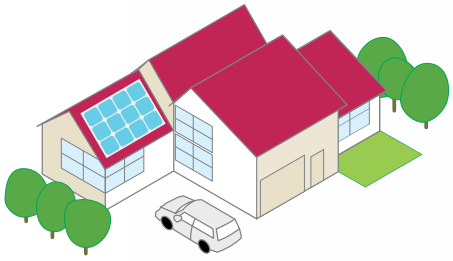
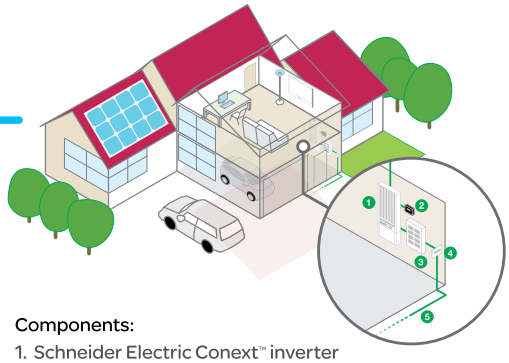
Easy to install. Shade tolerant. And from a provider you can trust.

> Introducing the Conext™ line of inverters with Fast Sweep shade tolerant maximum power point tracking technology.





- Available models: 2.8, 3.3, 3.8, 5.0 kW
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- High efficiency
- Integrated AC/DC disconnects
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- Shade tolerant Fast Sweep MPPT technology

Components:

1. Schneider Electric Conext™ inverter
2. Xantrex™ Gateway
3. Square D™ load center
4. Utility meter
5. Utility grid

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Welcome to the 2011

Renewable Energy

DESIGN GUIDE & CATALOG

THIS 30TH EDITION of the ***Renewable Energy Design Guide & Catalog*** is our best and most useful yet. The 2011 edition has been strategically designed to deliver you, the AEE Solar Dealer, the most relevant renewable energy product portfolio in the industry. Every item is selected to provide the products, services and information you need to delight your customers and prosper in today's renewable energy marketplace.

As the market continues to grow each year, we evaluate countless products vying to break into this exciting, fast-paced marketplace. We believe the new products we have selected for this year's catalog have the best potential to become significant additions to the renewable energy industry in the months and years ahead.

Among many promising new products in this year's book, we are especially excited about a whole new section for **Electric Vehicle Charging Stations** starting on page 192.

Proven Products and Trustworthy Advice

In addition to all the new products, this catalog contains hundreds of items that have been **field-tested and proven by our own experience** during 30+ years in the solar industry. You can depend on these products to work as described. And all have updated specs, photos and text.

Product descriptions offer not only manufacturer-sourced data, but the seasoned advice of AEE Solar staff, many of whom have spent decades in the renewable energy business. You'll find their tips and guidance invaluable to your understanding of system design and installation, product applications, equipment and parts compatibility, maintenance, and more. It's detailed, hands-on knowledge from people who have directly experienced the topics they cover. There is no other book like this in the industry.

New in the 2011 catalog, our dealers will notice that manufacturers' list prices have been removed. In a market with constantly changing pricing, we will be directing you to our online store **AEE Express – aeeexpress.com** - to obtain both up-to-date MSRPs and your own dealer pricing.

Help Us Keep This Resource Up to Date

Keeping this catalog accurate and up to date is an ongoing effort. While we do our very best, we cannot, of course, guarantee that every specification and detail herein is correct. Products and specifications can and do change without notice. Check with us for the latest information.

You can help us keep this information accurate by telling us about any errors, changes or updates you become aware of. Please send any and all feedback about this catalog to: **salessupport@aeesolar.com**

Contact Us for All Your Renewable Energy Needs

We are pleased to answer your inquiries about the systems, equipment and components in this catalog. If you would like to talk to us about renewable energy systems, please call us at 800-777-6609, email us at sales@aeesolar.com, or visit the contact page on our website.

We look forward to working closely with you to make 2011 another banner year for solar!

The Fronius **IG Plus** PV Inverter

With a certified operational temperature range of -13° to +131° F

The innovative Fronius **IG Plus** PV inverter for residential and commercial installations just got cooler with an operational temperature range of -13° to +131°F (-25° to +55°C) for functionality even in the harshest climates. The **IG Plus** also offers:

- Lightweight – even the commercial size inverters
- Smart, integrated MIX™ technology to maximize energy harvest even on cloudy days
- A built-in six circuit string combiner
- Field programmable to 208, 240, and 277 volts with no loss in output power
- Removable power stage for field service
- Standard 10-year warranty, upgradable to 15 years

Models from 3 to 12 kW available in a single inverter.

Visit **www.fronius-usa.com**, or call 810-220-4414, for more information on this exciting line in the Fronius family.

Fronius

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" AEE has been there for us since the beginning, helping us grow our company. From the terrific service your sales team gives us to great advice from your engineers, doing business with AEE Solar is always a pleasure."

JOHN ROGERS
Pacific Blue Solar, Inc.

" AEE Solar consistently offers us sales and product support on demand. You go above and beyond to make sure we have the products we need and the ability to deliver them in a timely manner. Having a supplier like AEE definitely gives us a competitive advantage."

TERRY HUFFT
Top Hat Energy

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Utility Grid-Tie System Design

Budget, roof dimensions and other site-specific factors often call for custom system design. If you are planning to mount your array on a roof, decide which module best fits into the available roof space, taking into consideration obstructions such as chimneys, plumbing vents and skylights. See Solar Modules, page 14, for dimensions of modules. A grid-connected PV system consists of PV modules, output cables, module mounting structures, AC and DC disconnect switches, inverter(s), grounding equipment and a metering system. This worksheet will help you decide what size PV array would be required to eliminate your electric bill. This will be the largest system that would be cost-effective to install. A smaller system can reduce part of your bill, or eliminate higher cost electricity in locations that have progressively increasing rates as consumption increases. Use this information and the amount of available space to get a rough idea of your PV array size.

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

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

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

Step 2 Find your daily average electricity use. _____

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

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

See the maps on page 12, and/or the insolation map on page 199. For example, the average for California is 5 peak sun hours

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

Divide your daily average electricity use by average sun hours per day. For example, if the daily average electricity use is 30 kWh, and the site is in California, system size would be: 30 kWh / 5 h = 6 kW AC. (Multiply kWh by 1000 to get AC watts.)

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

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

Use table below and on next 3 pages to find recommended array size/inverter combinations

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

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

Inverter		CEC efficiency	*Module >*	REC			SolarWorld		Yingli	Kyocera	Sanyo
				REC220	REC230	REC235	SW235 BLK	SW245	YL230	KD235GX-LFB	HIT 220A
Maker	**Model**		*CEC rating >*	**195.20**	**204.30**	**208.80**	**209.8**	**219.6**	**206.6**	**212.6**	**204.4**
				Recommended Number of Modules per String							
SolarEdge	SE3300US-ER	97.5%	one string	8 to 15	8 to 14	8 to 14	8 to 14	8 to 13	8 to 14	8 to 14	8 to 15
	SE4000US-ER	97.5%	one string	8 to 19	8 to 18	8 to 17	8 to 17	8 to 17	8 to 18	8 to 17	8 to 19
	SE5000US-ER	97.5%	one string	8 to 24	8 to 23	8 to 22	8 to 22	8 to 21	8 to 23	8 to 22	8 to 24
	SE6000US-ER	97.5%	one string	8 to 25	8 to 25	8 to 25	8 to 25	8 to 25	8 to 25	8 to 25	8 to 25
			two strings	max 28	max 26	max 26	max 26		max 26	max 26	max 28
Enphase	Enphase M190/ D380	95.0%		Yes	Yes	Maybe*	Maybe*	No	Yes	Maybe*	Yes M210

*Don't use for high altitude or cool, sunny place

Inverter		CEC efficiency	*Module* >	REC			SolarWorld		Yingli	Kyocera	Sanyo
				REC220	REC230	REC235	SW235 BLK	SW245	YL230	KD235GX-LFB	HIT 220A
Maker	Model		*CEC rating* >	195.20	204.30	208.80	209.8	219.6	206.6	212.6	204.4
				Recommended Number of Modules per String							
SMA	SB2000HFUS	95.0%	one string	9 to 11	9 to 10	9 to 10	9 to 10	8 to 10	9 to 10	9 to 10	6 to 10
	SB2500HFUS	95.0%	one string	9 to 14	9 to 13	9 to 13	9 to 13	8 to 12	9 to 13	9 to 13	6 to 10
			two strings								6 to 7
	SB3000HFUS	95.0%	one string	11 to 14	11 to 14	11 to 14	11 to 14	10 to 14	11 to 14	11 to 14	7 to 10
			two strings								7 to 8
	SB3000US 95% 208v	95.5%	one string	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			two strings								8 to 10
	SB4000US 95.5% 208v	96.0%	one string	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			two strings								8 to 10
	SB5000US	95.5%	one string	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			two strings	13 to 14	12 to 13	12 to 13	12 to 13	12	13	12 to 13	8 to 10
			three strings								8 to 9
	SB6000US 96% 277v	95.5%	one string	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			two strings	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			three strings								8 to 10
			four strings								8
	SB7000US 96% 277v	96.0%	one string	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			two strings	13 to 14	12 to 14	12 to 14	12 to 14	12 to 14	13 to 14	12 to 14	8 to 10
			three strings	13	12	12	12			12	8 to 10
			four strings								8 to 9
	SB8000US	96.0%	one string	14	14	14	14	14	14	14	10
			two strings	14	14	14	14	14	14	14	10
			three strings	14	14	14	14		14	14	10
			four strings								10
Advanced Energy - PV Powered	PVP2000	92.5%	one string	6 to 11	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	4 to 8
			two strings								4 to 5
	PVP2500	93.5%	one string	7 to 12	7 to 12	7 to 12	7 to 11	7 to 11	7 to 11	7 to 12	5 to 8
			two strings	7							5 to 7
	PVP3000	93.0%	one string	9 to 12	9 to 12	8 to 12	8 to 11	8 to 11	9 to 11	9 to 12	6 to 8
			two strings								6 to 8
	PVP 3500	94.0%	one string	10 to 12	10 to 12	10 to 12	10 to 11	9 to 11	10 to 11	10 to 12	7 to 8
			two strings								7 to 8
	PVP 4800	94.0%	one string	10 to 12	10 to 12	10 to 12	10 to 11	9 to 11	10 to 11	10 to 12	7 to 8
			two strings	10 to 12	10 to 12	10 to 12	10 to 11	9 to 11	10 to 11	10 to 12	7 to 8
			three strings								7 to 8
	PVP 5200	94.5%	one string	12	12	12	12 (18F min)	12 (20F min)	12 (16F min)	12	8
			two strings	12	12	12	12 (18F min)	12 (20F min)	12 (16F min)	12	8
			three strings								8

Inverter		CEC efficiency	*Module >*	REC			SolarWorld		Yingli	Kyocera	Sanyo
				REC220	REC230	REC235	SW235 BLK	SW245	YL230	KD235GX-LFB	HIT 220A
Maker	**Model**		*CEC rating >*	**195.20**	**204.30**	**208.80**	**209.8**	**219.6**	**206.6**	**212.6**	**204.4**
				Recommended Number of Modules per String							
Fronius	IG2000	93.5%	one string	8 to 11	8 to 10	7 to 10	7 to 10	7 to 10	8 to 10	8 to 10	5 to 8
			two strings								5
	IG3000	94.0%	one string	8 to 12	8 to 12	7 to 12	7 to 11	7 to 11	8 to 11	8 to 12	5 to 8
			two strings			7					5 to 7
	IG4000	94.0%	one string	8 to 12	8 to 12	7 to 12	7 to 11	7 to 11	8 to 11	8 to 12	5 to 8
			two strings	8 to 11	8 to 10	7 to 10	7 to 10	7 to 10	8 to 10	8 to 10	5 to 8
			three strings			7	7				5 to 7
	IG5100	94.5%	one string	8 to 12	8 to 12	7 to 12	7 to 11	7 to 11	8 to 11	8 to 12	5 to 8
			two strings	8 to 12	8 to 12	7 to 12	7 to 11	7 to 11	8 to 11	8 to 12	5 to 8
			three strings	8 to 9	8 to 9	7 to 8	7 to 8	7 to 8	8 to 9	8 to 9	5 to 8
			four strings								5 to 7
	IG+ V 3.0-1	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
	IG+ V 3.8-1	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings								8 to 10
	IG+ V 5.0-1	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 13	11 to 12	11 to 12	11 to 12	11	12	11 to 12	8 to 10
			three strings								8
	IG+ V 6.0-1	96.0%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			three strings								8 to 10
	IG+ V 7.5-1	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			three strings	12 to 13	11 to 12	11 to 12	11 to 12	11	12	11 to 12	8 to 10
			four strings								8 to 9
	IG+ V 10.0-1	95.5%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			three strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			four strings	12 to 13	11 to 12	11 to 12	11 to 12	11	12	11 to 12	8 to 10
			five strings								8 to 10
			six strings								8
	IG+ V 11.4-1 240v IG+ V 11.4-3 208v	95.5% 95.0%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			three strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			four strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 13	12 to 14	11 to 14	8 to 10
			five strings		11	11	11			11	8 to 10
			six strings								8 to 9
	IG+ V 12.0-3 277v only	96%	one string	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			two strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			three strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			four strings	12 to 14	11 to 14	11 to 14	11 to 14	11 to 14	12 to 14	11 to 14	8 to 10
			five strings	12	11 to 12	11	11	11	12	11	8 to 10
			six strings								8 to 10

Inverter		CEC efficiency	*Module >*	REC			SolarWorld		Yingli	Kyocera	Sanyo
				REC220	REC230	REC235	SW235 BLK	SW245	YL230	KD235GX-LFB	HIT 220A
MFG	**Model**		*CEC rating >*	**195.20**	**204.30**	**208.80**	**209.8**	**219.6**	**206.6**	**212.6**	**204.4**
				Recommended Number of Modules per String							
Schneider	GT 2.8	94.0%	one string	10 to 14	10 to 14	10 to 14	10 to 14	9 to 13	10 to 14	10 to 14	7 to 10
			two strings								7
	GT 3.3	95.0%	one string	10 to 14	10 to 14	10 to 14	10 to 14	9 to 14	10 to 14	10 to 14	7 to 10
			two strings								7 to 9
	GT 3.8	95.0%	one string	10 to 14	10 to 14	10 to 14	10 to 14	9 to 14	10 to 14	10 to 14	7 to 10
			two strings	10				9			7 to 10
	GT 5.0	95.5%	one string	12 to 14	12 to 14	12 to 14	12 to 14	11 to 14	12 to 14	12 to 14	8 to 10
			two strings	12 to 13	12 to 13	12	12	11 to 12	12 to 13	12	8 to 10
			three strings								8 to 9
Power-One Aurora (NOTE: combinations of strings with different lengths are possible)	PVI-3.0-OUTD-S-US	96.0%	one string	5 to 14	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			two strings	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	3 to 7
	PVI-3.6-OUTD-S-US	96.0%	one string	5 to 14	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			two strings	5 to 9	5 to 9	5 to 8	5 to 8	5 to 8	5 to 9	5 to 9	3 to 9
			three strings								3 to 6
	PVI-3.8-I-OUTD-S-US	96.0%	one string	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			two strings	5 to 9	5 to 9	5 to 9	5 to 9	5 to 9	5 to 9	5 to 9	3 to 9
			three strings	5 or 6	5 or 6	5 or 6	5 or 6	5 or 6	5 or 6	5 or 6	3 to 6
	PVI-4.2-OUTD-S-US	96.0%	one string	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			two strings	5 to 10	5 to 10	5 to 10	5 to 10	5 to 9	5 to 10	5 to 10	3 to 10
			three strings	5 to 7	5 to 7	5 or 7	5 to 7	5 or 6	5 to 7	5 to 7	3 to 7
			four strings								3 to 5
	PVI-4.6-I-OUTD-S-US	96.0%	one string	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			two strings	5 to 12	5 to 11	5 to 11	5 to 11	5 to 11	5 to 11	5 to 11	3 to 9
			three strings	5 to 8	5 to 7	5 or 7	5 to 7	5 to 7	5 to 7	5 to 7	3 to 7
			four strings	5 or 6	5	5	5	5	5	5	3 to 5
	PVI-5000-OUTD-S-US	96.5%	one string	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			two strings	5 to 10	5 to 10	5 to 10	5 to 10	5 to 9	5 to 10	5 to 10	3 to 10
			three strings	5 to 9	5 to 8	5 to 8	5 to 8	5 to 7	5 to 8	5 to 8	3 to 8
			four strings	5 or 6	5 or 6	5 or 6	5 or 6	5	5 or 6	5 or 6	3 to 6
	PVI-6000-OUTD-S-US	96.5%	one string	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			two strings	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	5 to 13	3 to 10
			three strings	5 to 10	5 to 10	5 to 10	5 to 10	5 to 9	5 to 10	5 to 10	3 to 10
			four strings	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	5 to 7	3 to 7
	PVI-10-I-OUTD-S-US	96.5% (208V) 96.0% (480V)	one string	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			two strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			three strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			four strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			five strings	5 to 10	5 to 10	5 to 10	5 to 10	5 to 10	5 to 10	5 to 10	3 to 9
			six strings	5 to 8	5 to 8	5 to 8	5 to 8	5 to 8	5 to 8	5 to 8	3 to 8
	PVI-12-I-OUTD-S-US	97.0%	one string	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			two strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			three strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			four strings	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	3 to 9
			five strings	5 to 12	5 to 12	5 to 11	5 to 11	5 to 11	5 to 12	5 to 11	3 to 9
			six strings	5 to 10	5 to 10	5 to 9	5 to 9	5 to 9	5 to 10	5 to 9	3 to 9

Grid-Tie with Battery Backup

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

Inverters for Grid-Tie with Battery Backup

OutBack makes G-Series inverters and switchgear, page 97, that can power loads up to 7.2 kW.

The Schneider Xantrex XW series of inverters, page 102, offers grid-tie inverters with battery backup capability in 4kW, 4.5kW, and 6kW increments and up to four units can be paralleled for battery backup systems up to 24kW.

The SMA Sunny Island inverter, page 96, in conjunction with a Sunny Boy inverter and PV array, can be used to provide high-efficiency backup power in a grid-tied home or business. Backup systems can be configured with up to 20kW single-phase output using up to 4 Sunny Island inverters or up to 60kW of three-phase output with up to 12 Sunny Island inverters and a Multi-Cluster Box.

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

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

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

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

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

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

Step 3 **Find the amount of stored power required.** _____

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

Step 4 **Calculate the power storage needed.** _____

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

Step 5 **Calculate battery capacity needed.** _____

Divide the power storage requirement needed from step 4 by the DC voltage of the system (usually 48V, but sometimes 24V) to get battery amp-hour (Ah) capacity. See the battery section on page 146 for more information on batteries. Most backup systems use sealed batteries due to their greatly reduced maintenance requirements, and because they can be more easily placed in enclosed battery compartments.

Off-Grid System Sizing Information

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

Conservation

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

Cooking, Heating and Cooling

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

Lighting

Lighting requires the most study since many options exist in type, size, voltage and placement. The type of lighting that is best for one system may not be right for another. The first decision is whether your lights will be run on low voltage direct current (DC) or conventional 120-volt alternating current (AC). In a small home, an RV, or a boat, low voltage DC lighting is often the best choice. DC wiring runs can be kept short, allowing the use of fairly small gauge wire. Since an inverter is not required, the system cost is lower. When an inverter is part of the system, and the lights are powered directly by the battery, a home will not be dark if the inverter fails. In addition to conventional-size medium-base low voltage bulbs, the user can choose from a large selection of DC fluorescent lights, which have 3 to 4 times the light output per watt of power used compared with incandescent types. High quality fluorescent lights are available for 12- and 24-volt systems. LED lighting is improving rapidly and already meets or beats the light output and efficiency of fluourescent lighting.

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

Refrigeration

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

Major Appliances

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

Small Appliances

Many small appliances such as irons, toasters and hair dryers consume a very large amount of power when they are used but by their nature require very short or infrequent use periods. If the system inverter and batteries are large enough, they will be usable. Electronic equipment, such as stereos, televisions, VCRs and computers have a fairly small power draw.

Off-Grid Load Worksheet

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

Calculate your AC loads

If there are no AC loads, skip to Step 5

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

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

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

Calculate your DC loads

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

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

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

Calculate your amp-hours per day

10. Divide line 9 by 7 days. This is total average amp-hours per day that needs to be supplied by the battery. Enter this number on line 1 on the Number-of-Modules Worksheet on page 12, and on line 1 of the Battery Sizing Worksheet on page 149. _____

Off-Grid Solar Array Sizing Worksheet

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

To find average sun-hours per day in your area (line 3), check local weather data, look at the map below or find a city on page 198 that has similar weather to your location. If you want year- round autonomy, use the lower of the two figures. If you want 100% autonomy only in summer, use the higher figure. If you have a utility grid-tie system with net metering, use the yearly average figure. The peak amperage of the module you will be using can be found in the module specifications. You can also get close enough if you divide the module's rated wattage by the peak power point voltage, usually 17 to 17.5 for a 12-volt module or 34 to 35 volts for a 24-volt module.

Step 1 Total average amp-hours per day needed (line 10 of the Off-Grid Loads Worksheet, page 11) _____

Step 2 Multiply line 1 by 1.2 to compensate for loss from battery charge/discharge _____

Step 3 Average sun-hours per day in your area _____

Step 4 Divide line 2 by line 3. This is the total solar array amps required

If you are using a PWM charge controller, continue to Step 5 below.
If you are using an MPPT charge controller, go to step 5 on page 13

Step 5 Peak-power amps of solar module used. See module specifications _____

Step 6 Total number of solar modules in parallel required. Divide line 4 by 5 _____

Step 7 Round off to the next highest whole number _____

Step 8 Number of modules in each series string to provide DC battery voltage – see table below _____

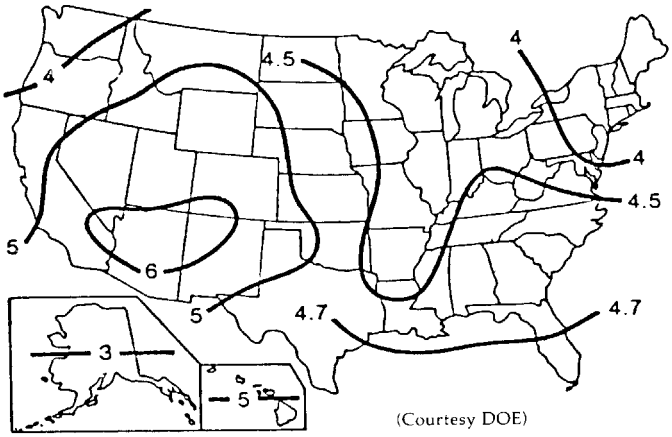
Step 9 Multiply line 7 by line 8 to get the total number of solar modules required. _____

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

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

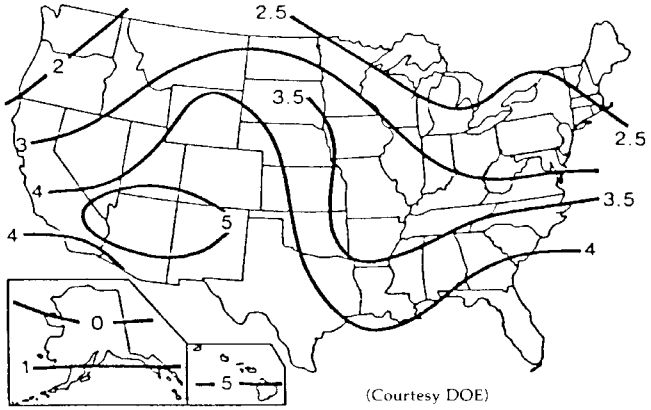
See a larger version of the USA map on page 199.

Yearly Average



(Courtesy DOE)

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



(Courtesy DOE)

Solar Array Sizing Worksheet for use with MPPT Charge Controllers

Begin on page 12, steps 1 - 4 before starting on this page.

Step 5 Total solar array amps required from Step 4 of module worksheet for standard controllers. _____

Step 6 Enter average changing voltage: use 13.5V for 12V systems; use 27V for 24V systems; use 54V for 48V systems. _____

Step 7 Multiply Step 5 result by Step 6 result. This is the total PV array wattage required. _____

Step 8 Enter the peak power wattage of the chosen PV module. (Use the module's Peak Power wattage at STC.) _____

Step 9 Divide the wattage on Step 7 by the wattage on Step 8. **This is the total number of modules needed**. Round up to the nearest whole number. (NOTE: this number may need to be adjusted in Step 11.) _____

Step 10 Number of modules in each series string. See table below, and add number here. _____

MPPT Charge Controller Sizing Table – Range of modules in series

Charge Controller Model	Max DC Input Voltage	Nominal Battery Voltage	Cell Count of PV Module Used				
			36	54	60	72	Sanyo 220N
OutBack FM 60 & 80 Apollo H80 Schneider XW-MPPT150-60 Morningstar TriStar 45 & 60	150VDC	12V	1 to 5	1 to 3	1 to 3	1 or 2	1 or 2
		24V	2 to 5	2 or 3	2 or 3	1 or 2	1 or 2
		48V	4 or 5	3	3	2	2
Apollo H80-HV	200VDC	12V	2 to 5	1 to 4	1 to 4	1 to 3	1 to 3
		24V	2 to 5	2 to 4	2 to 4	1 to 3	1 to 3
		48V	4 to 7	2 to 4	2 to 4	2 or 3	2 or 3
MidNite Solar Classic 150	200VDC	12V	1 to 5	1 to 3	1 to 3	1 or 2	1 or 2
		24V	2 to 6	2 to 4	2 or 3	1 to 3	1 or 2
		48V	4 to 6	3 or 4	3	2 or 3	2 or 3
MidNite Solar Classic 200	250VDC	12V	1 to 7	1 to 5	1 to 4	1 to 3	1 to 3
		24V	2 to 7	2 to 5	2 to 4	1 to 4	1 to 3
		48V	4 to 8	3 to 6	3 to 5	2 to 4	2 or 3
MidNite Solar Classic 250	300VDC	12V	1 to 9	1 to 6	1 to 5	1 to 4	1 to 4
		24V	2 to 9	2 to 6	2 to 5	1 to 4	1 to 4
		48V	4 to 9	3 to 7	3 to 6	2 to 5	2 to 4
Schneider XW-MPPT600-80	600VDC	24V, 48V	14 to 22	9 to 15	8 to 14	7 to 11	6 to 10

Step 11 Divide the number of total modules in Step 9 by the number of modules per series string from Step 10. This is the total number of array series strings. If this is not a whole number, either increase or decrease the number of modules in Step 9 to obtain a whole number of series strings. CAUTION: decreasing the total number of modules may result in insufficient power production. _____

Step 12 Determine wattage of each series string. Multiply module wattage from Step 8 by number of modules per string on Step 10. This is the total wattage per string. _____

Step 13 Determine number of module strings per controller. Divide appropriate wattage figure from the chart below by the wattage per string from Step 12. Round down to a whole number. This is the total number of module strings per controller. If you have more module strings (from Step 11) than can be handled by the chosen controller, either use a larger controller, or use multiple controllers. _____

Step 14 Divide total number of strings from Step 11 by the number of strings per controller from Step 13. Round up to a whole number. This is the total number of chosen controllers needed. _____

Max Array Wattage per Controller Size

	Controller rated output amps							
Battery voltage	15A	30A	45A	50A	60A	75A	80A	95A
12V	200W	400W	560W	650W	750W	900W	1000W	1150W
24V	400W	800W	1125W	1300W	1500W	1800W	2000W	N/A
48V	N/A	1600W	2250W	2600W	3000W	3600W	4000W	N/A

REC Solar

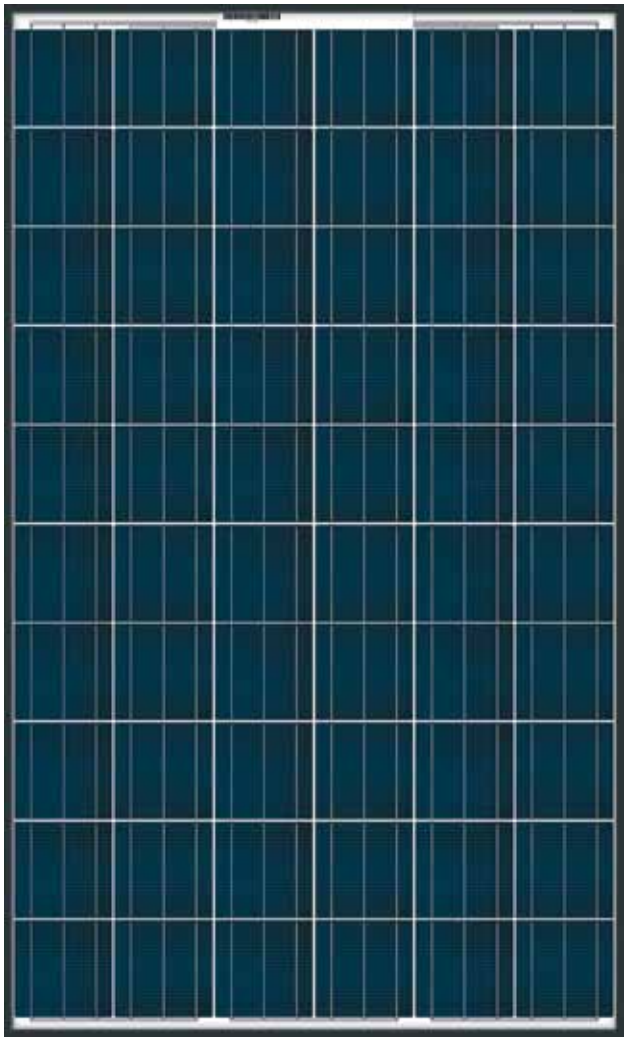
PE Series PV modules

The REC PE Series modules, made by REC in Singapore, are a series of PV modules designed to meet the growing demand for solar modules with exceptional quality and performance.

Quality and Performance

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

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



Installation

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

Technical data		
Cells	qty/size	60/156 mm
Power output tolerance	W	-0/+5
Temperature $_{NOCT}$	°C	47.9
Voltage$_{oc}$ temp coefficient	%/°C	-0.32
Fire rating	class	C
Connector type PE(BLK)		Radox
Cable length	inch (m)	+ 35 (0.9) - 47 (1.2)
Design load rating	lbs/ft^2	75
Quantity per pallet		40
Quantity per 53-ft trailer		760

Warranty

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

Module		REC215 PE	REC220 PE	REC225 PE	REC230 PE	REC235 PE	REC240 PE
Peak power	watts	215	220	225	230	235	240
Peak power voltage	volts	28.3	28.7	29.1	29.4	29.8	30.4
Peak power current	amps	7.6	7.7	7.7	7.8	7.9	7.9
Open circuit voltage	volts	36.3	36.6	36.8	37.1	37.4	37.7
Short circuit current	amps	8.1	8.2	8.2	8.3	8.3	8.4
Max. system voltage (UL)	volts	600					
Series fuse rating	amps	15					
Length	inch (mm)	65.55 (1665)					
Width	inch (mm)	39.02 (991)					
Depth	inch (mm)	1.5 (38)					
Weight	lbs (kg)	39.6 (18)					
Item code Black anodized frame, Radox		**011-02572**	**011-02573**	**011-02574**	**011-02575**	**011-02576**	**011-02583**

WE MAKE YOU HAPPY EVEN WHEN SKIES ARE GRAY

While solar power is most effective when the sun is shining, REC panels are superior performers even on cloudy days. REC Peak Energy panels have an improved cell and glass design, increasing energy production by 2 percent in all sunlight conditions.

Learn more about our high performance solar panels at recgroup.com

REC

SolarWorld

MADE IN USA

Mono and Poly Sunmodules

SolarWorld ingots, cells, and modules are made in the USA ensuring high quality, performance and output. SolarWorld California is the largest manufacturer of solar modules in the U.S.

Plus-Sorting

Every module is factory flash tested to determine the peak rated power output, then sorted in 5 watt bin increments. SolarWorld only delivers modules that have equal to or greater than the nameplate rated power.

Construction and Performance

These modules are designed for use in high-voltage grid-tie applications, using 60 six-inch square polycrystalline or semi-square monocrystalline cells in series behind tempered glass. They feature clear- or black-anodized aluminum frames and a sealed junction box with bypass diodes and Multi-Contact MC4 locking connector and PV Wire double-insulated output cables. The Sunmodule is certified to meet or exceed UL 1703 and IEC 61215. All U.S.

SolarWorld bonds the tempered glass laminate deep into the aluminum frame with a continuous bead of silicone adhesive, which prevents the frame from pulling away from the glass caused by heavy snow or handling.

In Q1 2011 these modules will have a new low-profile aluminum frame with die-cast aluminum corners. A grounding hole in each corner reduces the ground lug mounting hardware required. This new frame does not have an internal flange or backside mounting holes. Top mounting clips are the preferred method. Special clamps will be available for bottom side mounting.

Warranty

5-year workmanship warranty and a 25-year linear power warranty. Power guaranteed within 3% the first year and within less than 0.7% each year after. Guaranteed 80% minimum at 25 years. UL Listed for the U.S. and Canada.

Technical data		Mono	Poly
Cells	qty/size	60/156 mm	60/156 mm
Power tolerance	%	-3/+3	-3/+3
Temperature $_{NOCT}$	°C	47	46
Voltage$_{oc}$ temp coefficient	%/°C	-0.33	-0.34
Fire rating	class	C	C
Connector type		MC4	MC4
Cable length	inch (m)	37.4 (0.95)	37.4 (0.95)
Design load rating wind /snow	lbs/ft²	33.3 / 75	33.3 / 75
Quantity per pallet		30	30
Quantity per 53-ft trailer		540	540

Module		SW 235 mono black	SW 240 mono black	SW 245 mono	SW 250 mono	SW 220 Poly	SW 225 Poly	SW 230 Poly	SW 235 Poly	SW 240 Poly
Peak power	watts	235	240	245	250	220	225	230	235	240
Peak power voltage	volts	30.3	30.8	30.8	31.1	29.2	29.5	29.8	30	30.2
Peak power current	amps	7.77	7.96	7.96	8.05	7.54	7.63	7.72	7.85	7.96
Open circuit voltage	volts	37.5	37.7	37.7	37.8	36.6	36.8	36.9	37.0	37.2
Short circuit current	amps	8.19	8.25	8.25	8.28	8.08	8.17	8.25	8.35	8.44
Max. system voltage (UL)	volts	600								
Series fuse rating		16								
Length	inch (mm)	65.94 (1675)								
Width	inch (mm)	39.41 (1001)								
Depth	inch (mm)	Old frame 1.34 (34) New frame 1.22 (31)								
Weight	lbs (kg)	46.7 (21.2)								
Item codes 31mm frame		**011-02277**	**011-02276**	**011-02275**	**011-02274**	**011-02278**	**011-02279**	**011-02280**	**011-02281**	**N/A**
Item codes 34mm frame		**011-02295**	**011-02294**	**011-02297**						

Sunmodule®

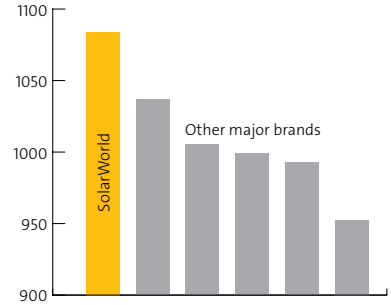
TEST WINNER

No. 1

PHOTON MODULE TEST 2008 AND 2009

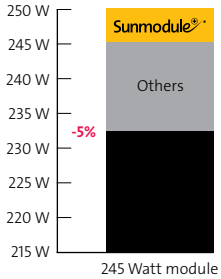
Independent Photon magazine confirms: SolarWorld® modules maximize energy yield. The SolarWorld® module ranks first among 16 tested modules.

Superior energy performance



Normalized annual output (kWh/kW), according to multi-year testing performed by Photon magazine

Get all the watts you pay for



You get at least 245 Watts from *every* module

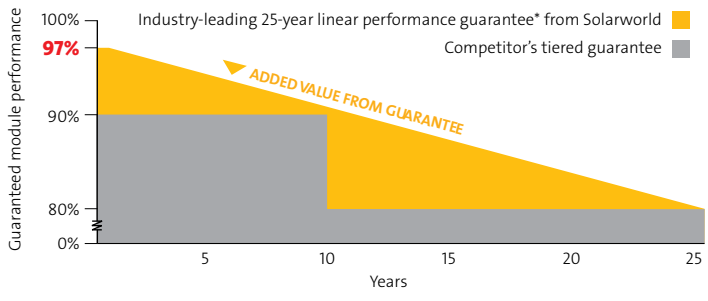
Without plus sorting, you don't know what you're getting

MADE IN USA

TOP QUALITY

CADMIUM FREE

Reliability performance you can count on



Clear added value compared to standard guarantees

* See warranty statement for details

SOLARWORLD

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www.solarworld.com

Kyocera

KD Series Modules

Kyocera has been manufacturing solar modules for 35 years. All solar cells are fabricated with a proprietary etching and coating process which translates into more watts per square foot while maintaining the same grid line and busbar design. KD series modules have black anodized frames for clean looking grid-tie installations. The KD 235, 215 and 210 module designs have been tested to 5400 Pa. The 210 and 215 modules use 54 cells in series for more flexibility in string sizing, and 60 cells in series in the 235 modules. The 60 cell modules are compatible with Enphase inverters, and have PV Wire double-insulated output cables for use with transformer-less inverters.

KD135SX-UPU Module

This 135-watt module has 36 cells and can be used for on grid or off-grid applications. It is ideal for charging storage batteries to power remote homes, recreational vehicles, telecommunications systems, and other consumer and commercial applications. It can be used with lower cost PWM charge controls for 12, 24, 36 and 48-volt battery charging. An industrial-grade junction box is used that allows installation with nominal half-inch conduit fittings. This module is rated class 1, division 2 for hazardous locations.

Kyocera modules feature tempered low-reflection glass covers, built-in bypass diodes and a 2 year workmanship and 20-year power output warranty. UL Listed and ISO 9001 and ISO 14001 certified. Kyocera modules are made in Mexico or, when specified, in the U.S.

Model Number suffixes:

-UPU (j-box type)

-LPU, LPB (P cell type)

-LPB US (P cell U.S. made)

Technical data		KD135SX-UPU	KD210-54	KD235-60
Cells	qty/size	36/156MM	54/156 mm	60/156 mm
Power output tolerance	%	-5/+5	-0/+5	-0/+2
Temperature NOCT	°C	47.9	47.9	47.9
$Voltage_{oc}$ temp coefficient	%/°C	-0.36	-0.36	-0.36
Fire rating	class	C	C	C
Connector type		J-Box	MC4	MC4
Cable length	inch (m)	n/a	+37.4 (0.95) -29.5 (0.75)	+40.6 (1.03) -32.7 (0.83)
Design load rating	lbs/ft2	113	113	113
Quantity per pallet		20	20	20
Quantity per 53-ft trailer		n/a	760	760

Kyocera module		KD135SX-UPU	KD210GX-LPU	KD215GX-LPU	KD235GX-LPB	KD235GX-LPB US
Peak power	watts	135	210	215	235	
Peak power voltage	volts	17.7	26.6	26.6	29.8	
Peak power currrent	amps	7.63	7.9	8.09	7.89	
Open circuit voltage	volts	22.1	33.2	33.2	36.9	
Short circuit current	amps	8.37	8.58	8.78	8.55	
Max. system voltage (UL)	volts	600	600		600	
Series fuse rating	amps	15	15		15	
Length	inch (mm)	59.1 (1500)	59.1 (1500)		65.43 (1662)	
Width	inch (mm)	26.3 (668)	38.98 (990)		38.98 (990)	
Depth (frame only)	inch (mm)	1.81 (46)	1.81 (46)		1.81 (46)	
Weight	lbs (kg)	27.5 (12.5)	39.7 (18)		46.3 (21.0)	
Item code		**011-07753**	**011-07766**	**011-07754**	**011-07769**	**011-07747**

KYOCERA

Proven Reliabilty. Validated Performance.

Unmatched performance testing

Best-in-class technology for over 35 years

Validated superior field performance

Advanced cell-processing technology

OUR COMMITMENT Kyocera's headquarters building in Kyoto is a perfect example of our commitment to the environment and our success with creating solutions that integrate energy efficiency and architectural aesthetics. The building, completed in 1998, includes the first large-scale BIPV system ever installed and features 1,392 solar panels integrated into the south wall.

KYOCERA Solar, Inc. 800-223-9580 www.kyocerasolar.com

SOLAR by KYOCERA

NEW! Yingli Solar

YGE235 Series Modules

Yingli Solar modules are made by Yingli Green Energy Holding Company, one of the world's largest vertically integrated PV manufacturers with over 2 GW of modules in operation worldwide. Founded in 1998, the company established its North American presence in 2009 when it opened offices in San Francisco and New York.

Yingli controls the entire production process, with automated manufacturing of polysilicon, ingots, wafers, cells and modules. The high-performance, high-quality multicrystalline PV cells in the YGE235 Series deliver a module series efficiency of up to 14.4%, reducing installation costs and maximizing the kWh output per unit area. Yingli YGE modules have PV Wire output cables making them compatible to use with transformerless inverters.

Production Standards

The robust, corrosion resistant aluminum box frame has been independently tested to withstand wind and snow loads of up to 50 psf and 113 psf, respectively. Yingli's manufacturing facility is certified to ISO9001 quality management system standards.

Warranty and Certifications

10 year 90% power warranty, 25 year 80% power warranty. 5-year limited product warranty.

UL 1703 and ULC 1703, UL Fire Safety Class C, CEC, FSEC ISO 9001:2008, ISO 14001:2004, BS OSHAS 18001:2007, SA8000.

Made in China.

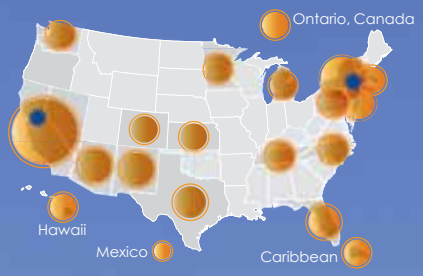
Technical data		YGE235 Series
Cells	qty / size	60 / 156mm
Power output tolerance	%	-3 /+3
$Temperature_{NOCT}$	°C	46
$Voltage_{oc}$ temp coefficient	%/°C	-0.37
Fire rating	class	C
Connector type		MC4 or H4
Cable lengths	inch (m)	47.24 (1.20)
Design load rating wind / snow	lbs/ft^2	50 / 113
Quantity per pallet		20
Quantity per 53-ft trailer		720

Yingli module		YL225P-29b	YL230P-29b	YL235-29b
Peak power	watts	225	230	235
Peak power voltage	volts	29.5	29.5	29.5
Peak power current	amps	7.63	7.80	7.97
Open circuit voltage	volts	36.5	37.0	37.0
Short circuit current	amps	8.28	8.40	8.54
Max. system voltage (UL)	volts	600		
Series fuse rating	amps	15		
Length	inch (mm)	64.96 (1650)		
Width	inch (mm)	38.98 (990)		
Depth (including j-box)	inch (mm)	1.97 (50)		
Weight	lbs (kg)	43.7 (19.8)		
Item code		**011-07770**	**011-07771**	**011-07772**

YINGLI SOLAR

YINGLISOLAR.COM | NYSE:YGE

SINCE 2004, OVER 2,000 MEGAWATTS IN OPERATION WORLDWIDE



Modules

TRUSTED IN OVER 1500 SYSTEMS ACROSS THE U.S.

DEPLOYED IN OVER 20 STATES, CANADA, MEXICO AND THE CARIBBEAN

2010 LEADING SUPPLIER OF CALIFORNIA SOLAR INSTALLATIONS
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SANYO

HIT Power N Series Modules

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

Efficiency

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

Performance

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

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

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

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

Warranty

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

Technical data		
Cells	qty/size	72/125 mm
Power output tolerance		-0/+10
$Temperature_{NOCT}$	°C	46
$Voltage_{oc}$ temp coefficient	%/°C	-0.28
Fire rating	class	C
Connector type		MC4
Cable length + / -	inch (m)	+46.5 (1.18) -40.6 (1.03)
Design load rating wind/ snow	lbs/ft^2	60 / 39
Quantity per pallet		34
Quantity per 53-ft trailer		952

Module		HIT-N210A01	HIT-N215A01	HIT-N220A01
Peak power	watts	210	215	220
Peak power voltage	volts	41.3	42.0	42.7
Peak power current	amps	5.09	5.13	5.17
Open circuit voltage	volts	50.9	51.6	52.3
Short circuit current	amps	5.57	5.61	5.65
Max. system voltage (UL)	volts	600		
Series fuse rating	amps	15		
Length	inch (mm)	62.2 (1580)		
Width	inch (mm)	31.4 (798)		
Depth	inch (mm)	1.8 (46)		
Weight	lbs (kg)	35.3 (16)		
Item code		**011-00129**	**011-00130**	**011-00131**

SCHOTT Solar

MADE IN USA

SCHOTT POLY Solar Modules

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

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

Output Tolerance

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

Warranty

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

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

Technical data		
Cells	qty/size	60/156 mm
Power output tolerance	%	-0/+2
Temperature $_{NOCT}$	°C	45.5
Voltage$_{oc}$ temp coefficient	%/°C	-0.32
Fire rating	class	C
Connector type		Tyco
Cable length	inch (m)	43.3 (1.1)
Design load rating	lbs/ft^2	113
Quantity per pallet		30
Quantity per 53-ft trailer		540

SCHOTT POLY module		POLY 220	POLY 225	POLY 230	POLY 235
Peak power	watts	220	225	230	235
Peak power voltage	volts	29.7	29.8	30.0	30.2
Peak power currrent	amps	7.41	7.55	7.66	7.78
Open circuit voltage	volts	36.5	36.7	36.9	37.1
Short circuit current	amps	8.15	8.24	8.33	8.42
Max. system voltage (UL)	volts	600			
Series fuse rating	amps	15			
Length	inch (mm)	66.34 (1685)			
Width	inch (mm)	39.09 (993)			
Depth	inch (mm)	1.97 (50)			
Weight	lbs (kg)	50.6 (23)			
Item code - black frame		**011-04539**	**011-04540**	**011-04541**	**011-04542**
Item code - clear frame		**011-04535**	**011-04536**		

NEW! Solartech Power

Small Off-Grid Modules

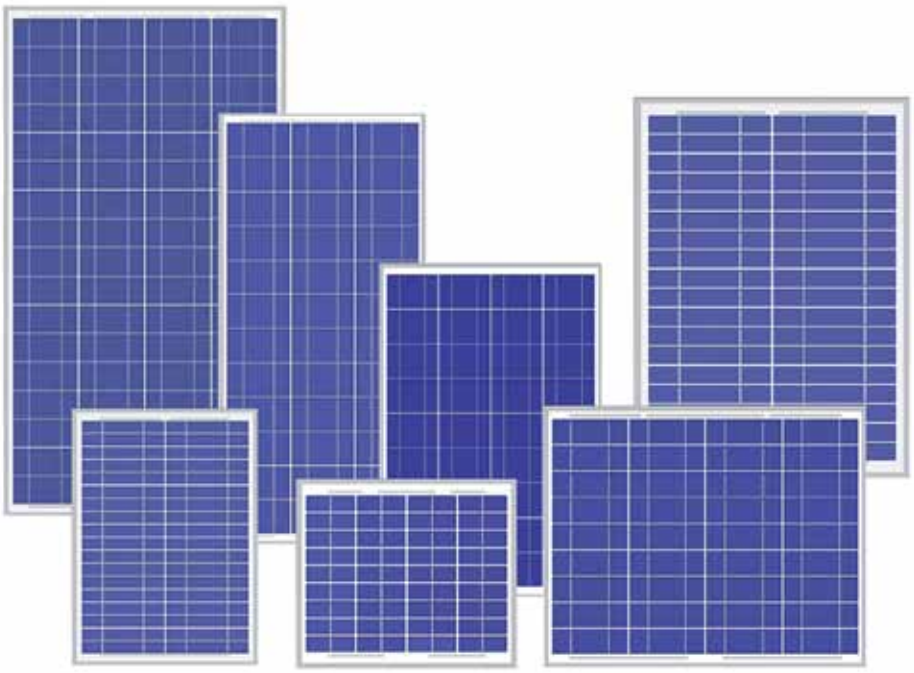
These smaller modules are used for off-grid smaller systems, anywhere from a small monitoring system, to radio repeaters, to water pumping. Their voltage is set for battery charging with all types of controllers, in all climates.

Solartech Power advanced cell processing technology and automated production facilities produce a highly efficient multicrystalline PV module. The cells are encapsulated between a 3.2 mm tempered glass cover and a pottant with back sheet to provide efficient protection from the severest environmental conditions. The entire laminate is installed in an anodized aluminum frame to provide structural strength and ease of installation.

The 5W -30W modules come with an attached output cable and the larger ones come with a J-box with one strain relief and the ability to take one extra half-inch strain relief.

UL or ETL listed. 25-year limited warranty. Made in China.

Technical data		
Cells	qty	36
Power output tolerance	%	-5/+5
$Temperature_{NOCT}$	°C	NA
$Voltage_{oc}$ temp coefficient	%/°C	-0.35
Fire rating	class	C
Connector type		J-Box
Cable length 5w to 30w	inch (m)	6' (3.0)
Design load rating	lbs/ft2	113



Module		SPM005P	SPM010P	SPM020P	SPM030P	SPM045P	SPM055P	SPM065P	SPM085P-TL	SPM125P-S
Peak power	watts	5	10	20	30	45	55	65	85	125
Peak power voltage	volts	17.1	17.3	17.2	17.3	18.3	18.2	18.1	17.9	18.0
Peak power currrent	amps	0.29	0.59	1.17	1.77	2.52	3.1	3.69	4.84	7.11
Open circuit voltage	volts	21.7	21.8	21.7	21.9	22.2	21.1	22.0	21.9	21.9
Short circuit current	amps	0.31	0.64	1.25	1.93	2.69	3.31	3.90	5.17	7.68
Max. system voltage (UL)	volts	600	600	600	600	600	600	600	600	600
Series fuse rating	amps	10	10	10	10	12	12	12	12	12
Length	inch (mm)	8.8 (224)	11.8 (300)	21.7 (550)	26.2 (666)	26.2 (666)	25.7 (652)	38.9 (987)	52.4 (1331)	58.3 (1482)
Width	inch (mm)	13.8 (350)	13.8 (350)	13.8 (350)	16.2 (412)	21.1 (537)	25.2 (639)	21.3 (540)	20.0 (508)	26.6 (676)
Depth (frame only)	inch (mm)	0.98 (25)	0.98 (25)	0.98 (25)	0.98 (25)	1.38 (35)	1.38 (35)	1.38 (35)	1.38 (35)	1.97 (50)
Weight	lbs (kg)	2.86 (1.3)	3.11 (1.4)	6.17 (2.8)	7.71 (3.5)	11.0 (5.0)	13.2 (6.0)	13.2 (6.0)	19.8 (9.0)	26.5 (12.0)
Item code		**011-08921**	**011-08924**	**011-08927**	**011-08930**	**011-08933**	**011-08936**	**011-08939**	**011-08942**	**011-08945**

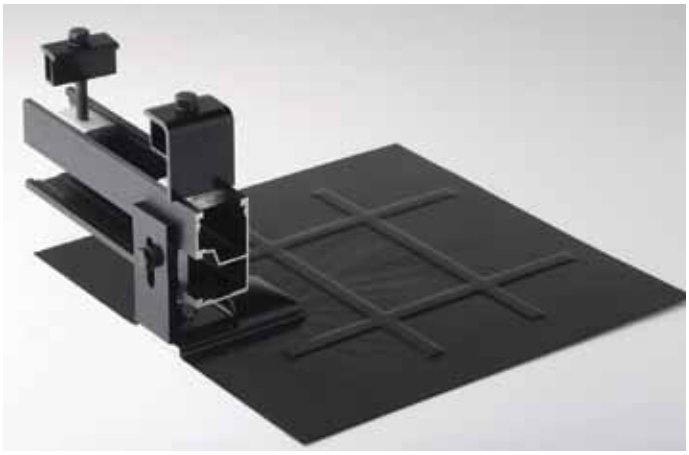
SnapNrack

Roof Mounting System

SnapNrack was developed by a team of veteran solar engineers working with installers in the field and dedicated to overcoming the limitations of conventional racking to ensure quick, efficient installation. It marks a significant advance in simplifying and reducing the cost of the solar installation process.

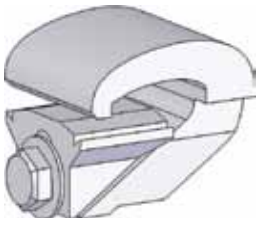
SnapNrack is a top-down roof mounting solution, load tested and engineered for up to 150 mph wind load. The rail design is a light-weight anodized aluminum extrusion to maximize transportation and installation efficiency. SnapNrack is compatible with modules from virtually any manufacturer. Snap-in sliding module clips ensure quick and easy installation and precise alignment of module clamps. Mid-clips are a half-inch wide to keep the math simple. Every bolt in the system uses the same size wrench, ensuring efficient installation and reducing man-hours on the roof.

There's no need to drill any holes in the rails to connect standoffs and L-feet. The channels in the rail profiles can enclose running module leads, providing better aesthetics and improved wire management. SnapNrack is engineered for durability and structural integrity in all environments. Excellent seismic, wind, and snow loading protection on all components. Its compact and efficient rail design reduces material requirements and ensures a low profile installation on your roof. SnapNrack has been engineered from the ground up to ensure maximum standoff adjustability for a clean, level installation even on uneven roof surfaces. Tilt-up can be achieved with pieces of cut rail and the tilt leg kit. Rails and components have a 10-year warranty.



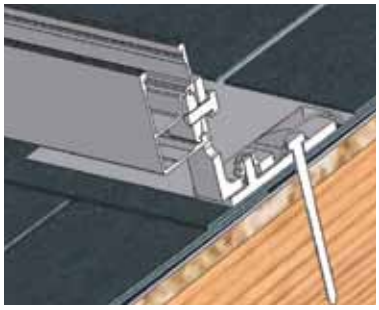
SnapNrack Sample Kit

Description	Item code
SnapNrack Sample Kit (Kit includes sample of rail, module clamps, universal end clamp, flashing, and L-foot)	**015-09960**

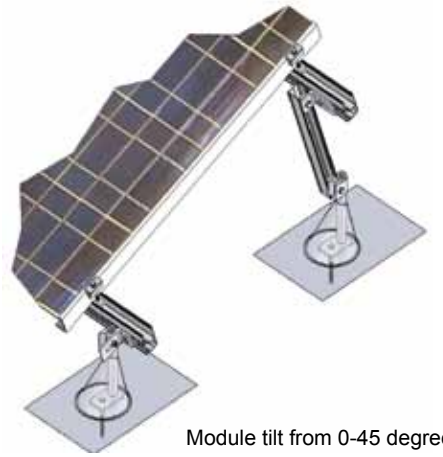


Universal End Clamps allow rails to be cut flush with the end of the modules.

Clean, sleek lines with concealed clamps



Fully flashed roof penetrations



Module tilt from 0-45 degrees

Robust rail splices for versatile array configuration

SnapNrack

Universal Roof Mount Kits

SnapNrack Universal Roof Mount Kits come in both black and clear anodized rail, Universal End Clamps (UEC), black mid clamps and black rail end caps so they are suitable for use with black- and clear-framed modules. The Universal End Clamp is unique because it slips beneath the bottom edge of the module frame. UECs are not dependent on module frame depth like typical end clamps so one size fits all. Secured out of sight beneath the modules, the UECs lend a smooth, finished look to the array.

Module quantities in the table below are applicable for modules listed in this catalog, as well as any other brand of modules with a width of 39.5" or less. Aluminum rails may be cut to length as needed. Roof attachment parts are sold separately and depend on the type of roof to which the mounting structure will be secured.

Grounding Kits

These grounding kits match up with the roof mount kits and come with all the grounding hardware needed for each rack. The WEEB kits include the WEEB washers, any splice jumpers needed, and two rail lugs. The lay-in lug kits include enough lugs for each module and piece of rail. Ground wire is not included. Use the kit needed to meet module and inspector requirements.

SnapNrack Universal Roof Mount Kits

Module quantity	Black frame 1.3" - 1.8" thick	Black frame greater than 1.8" thick	Clear frame 1.3" - 1.8" thick	Clear frame greater than 1.8" thick
	Item code			
3	015-09950	015-10070	015-10050	015-10060
4	015-09951	015-10071	015-10051	015-10061
5	015-09952	015-10072	015-10052	015-10062
6	015-09953	015-10073	015-10053	015-10063
7	015-09954	015-10074	015-10054	015-10064
8	015-09955	015-10075	015-10055	015-10065
9	015-09956	015-10076	015-10056	015-10066
10	015-09957	015-10077	015-10057	015-10067

SnapNrack Grounding Kits

Number of modules	WEEB kit	Lay in lug kit w/ long screw and nut
	Item code	
9 or 10 modules	051-04070	051-04080
7 or 8 modules	051-04071	051-04081
5 or 6 modules	051-04072	051-04082
3 or 4 modules	051-04073	051-04083

Description	Item code
Pack of 10 lay in lugs with long screw and nut	051-03418
Pack of 10 lay in lugs with long screw and nut w/ Ilsco lug	051-03418-I

Rail Sets

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

Standard Rail Sets

Description	Fits quantity of modules	Clear anodized	Black anodized
		Item code	Item code
SnapNrack standard rail set 122"	3 module	015-09814	015-09816
SnapNrack standard rail set 162"	4 module	015-09817	015-09818
SnapNrack standard rail bulk 122" - 112 rails	3 module	015-09850	015-09851
SnapNrack standard rail bulk 162" - 112 rails	4 module	015-09852	015-09853
Splice kit - single bar with hardware		015-09967	015-09969
Rail cut fee - includes splice kit (for UPS shipping)		015-09829	015-09828
Rail Tools & Accessories			
Rail cutting tool		015-11201	
Array edge screen - 50 linear-foot kit (critter guard)		015-11211	

Roof Attachment Components

SnapNrack offers a variety of roof attachment components. Some may be used individually, while others require a combination of components. The flashed L-foot is recommended for simple flush mounts to a roof with composition shingles. Roofs with tile or thick roofing material will probably require standoffs. The Corrugated Roof Block allows attachment of the L-foot directly to structural members covered with corrugated metal without collapsing or crushing the ridge in the roof material. The Hanger Bolt Clamp allows a versatile installation on roof surfaces which won't allow L-feet or standoffs.

Configuring tilt angles from 0 to 10 degrees simply requires SnapNrack standoffs. A 5-1/2" standoff on the lower rail and a 7" stand-off for the upper rail allows adjustability for shallow tilts. For angles from 10 to 45 degrees, use standoffs for both upper and lower rails, then extend the upper edge with sections of rail cut to length and drilled with two holes. Tilt leg rails can be cut and drilled in advance to save time on the job site. A simple drill guide will help with locating the holes in the tilt leg. If the length of the cut-rail leg exceeds 4 feet, consult a structural engineer before proceeding.


Stand-off with flashing


Corrugated Roof Block


Hanger Bolt


L-foot


Seam Clamp

Roof Attachment Components						
	Clear aluminum			Black anodized		
	Single pieces	12 pack	48 pack	Single pieces	12 pack	48 pack
Description	Item code	Item code	Item code	Item code	Item code	Item code
SnapNrack L-foot	015-09978	015-09977	015-11060	015-09979	015-09980	015-11061
SnapNrack flashed L-foot	015-11063	015-09975	015-11064	015-09985	015-09981	015-11065
SnapNrack standoff spacer - 1"		015-09983	015-11090			
SnapNrack standoff - 3"		015-11074	015-11075			
SnapNrack standoff - 5.5"	015-09973	015-09986	015-11080	015-11079	015-09987	015-11081
SnapNrack standoff - 7"	015-11084	015-11083	015-11082	015-09974	015-09988	015-11085
SnapNrack standoff - heavy duty 7"		015-09965	015-11101			
SnapNrack standoff - heavy duty 12"		015-09966	015-11102			
SnapNrack hanger bolt clamp	015-10301	015-10306	015-10311			
Tilt leg hardware kit - clear (2 L-foot with hardware)	015-09972	015-11113	015-11114			
Oatey flashing #11830 12" x 8.75"	015-00162					
Oatey flashing #11831 18" x 18"	015-00163					
Commercial Metal Roof Attachment						
Metal roof standing seam standard clamp	015-09945	015-09946	015-11104			
Metal roof standing seam wide clamp	015-10103	015-10104	015-11105			
Corrugated roof straddle block		015-09989	015-11106			

The Corrugated Roof Block was designed to allow the attachment of the L-Foot directly to a structural member beneath corrugated metal without collapsing or crushing the ridge in the roof material.


Stand-off with flashing


L-foot with flashing


Installation with Tilt Hardware Kit

SnapNrack

Module Clamps

Module Clamps come in different sizes you must pick the correct size to match your PV module frame thickness also referred to as depth. Please refer to your PV module specification document to determine the correct Clamps for your system.

For frame thickness not listed we recommend the Universal End Clamps.

Hardware Accessories

SnapNrack has a full complement of hardware solutions for all PV module installation needs.

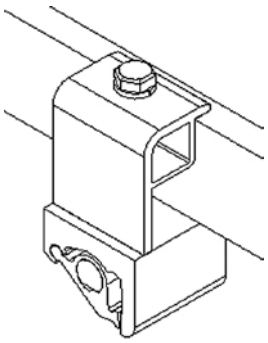
- Splice Kits are used to attach two lengths of rail together to create a strong single module support.
- Rail End Caps cover the ends of the rail to create a seamless line to the end of the array.
- Rail Cover provides a complete wire management solution and a clean look to an installation.
- Micro-Inverter Attachment kit includes all of the hardware needed to attach micro-inverters to a system.
- Channel Nuts snap into the rail and provide a mounting location for a 5/16"-18 standard bolt.

Bulk Module Clamps w/ Bolts & Nuts									
			Clear aluminum			Black anodized			
			Single pieces	12 pack	48 pack	Single pieces	12 pack	48 pack
Description	Frame depth	Modules	Item code	Item code	Item code	Item code	Item code	Item code
Mid clamp	1.3"-1.8"		015-09903	015-09904	015-11010	015-09906	015-09907	015-11012
Mid clamp	1.81"+		015-09905	015-09902	015-11011	015-09871	015-09872	015-11013
Universal end clamp*	All	All brands	015-09943	015-09944	015-11054			
End clamp	1.22	SolarWorld				015-11036	015-11037	015-11038
End clamp	1.34	SolarWorld	015-09909		015-11020	015-09912		
End clamp	1.4	Kyocera GX-LP	015-09915		015-11022	015-09918		015-11023
End clamp	1.5	REC - PE	015-09947	015-09948	015-11026	015-09940	015-09941	015-11027
End clamp	1.6	Evergreen ES-C	015-09921		015-11030	015-09924		
End clamp	1.69	REC AE-US	015-09923	015-09938		015-09922	015-09935	
End clamp	1.8	Evergreen ES-A, Mitsubishi, Kyocera GX-LPU & GX-LB	015-09927	015-09928	015-11034	015-09930		015-11035
End clamp	1.97	Schott Poly Yingli	015-09933	015-09942		015-09936		
SnapNrack Hardware Accessories								
SnapNrack splice kit - single bar with hardware			015-09967	015-09968	015-11000	015-09969	015-09970	015-11001
SnapNrack rail end cap - black rubber							015-09994	015-11121
SnapNrack rail cover clear - two 48" pieces			015-09995		015-11109			
SnapNrack channel nut 12 pack				015-09993	015-11111			
Micro-Inverter Attachment Kit w/ WEEB grounding			015-09971					

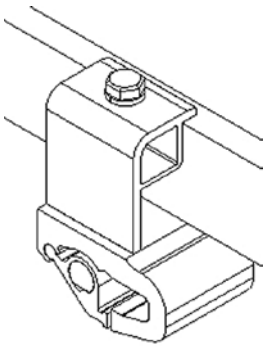
* Universal End Clamp is reliant on a standard "L" shaped module frame and will not work on all modules

Metal Roof Seam Clamp

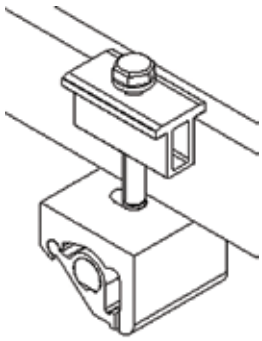
The Metal Roof Seam Clamp was designed to allow the attachment of the L-Foot or PV module directly to a commercial grade standing seam metal roof, without penetrating the metal or collapsing the ridge in the metal roof material. The design is simple, low cost, and very effective. The clamp is made from high-tensile strength aluminum and has a shape that will work with a range of metal roof designs. See the Seam Clamp Technical Bulletin for application and installation. Available for download at www.snapnrack.com.



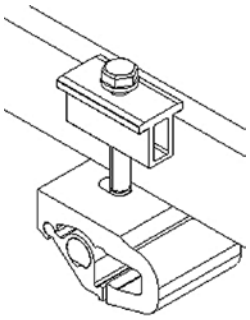
Standard Base
w/ End Clamp



Wide Base w/
End Clamp



Standard Base
w/ Mid Clamp



Wide Base w/
Mid Clamp

Metal Roof Attachement Hardware			
	Single pieces	12 pack	48 pack
Description	Item code	Item code	Item code
Metal roof standing seam standard clamp	015-09945	015-09946	015-11104
Metal roof standing seam wide clamp	015-10103	015-10104	015-11105
Seam Clamp & Top Mount Hardware Kits			
Seam clamp & end clamp 1.4" kit standard base	015-10126	015-10127	015-10128
Seam clamp & end clamp 1.4" kit wide base	015-10166	015-10167	015-10168
Seam clamp & end clamp 1.5" kit standard base	015-10129	015-10130	015-10131
Seam clamp & end clamp 1.5" kit wide base	015-10169	015-10170	015-10171
Seam clamp & end clamp 1.6" kit standard base	015-10132	015-10133	015-10134
Seam clamp & end clamp 1.6" kit wide base	015-10172	015-10173	015-10174
Seam clamp & end clamp 1.8" kit standard base	015-10138	015-10139	015-10140
Seam clamp & end clamp 1.8" kit wide base	015-10178	015-10179	015-10180
Seam clamp & end clamp 1.69" kit standard base	015-10135	015-10136	015-10137
Seam clamp & end clamp 1.69" kit wide base	015-10175	015-10176	015-10177
Seam clamp & end clamp 1.97" kit standard base	015-10141	015-10142	015-10143
Seam clamp & end clamp 1.97" kit wide base	015-10181	015-10182	015-10183
Seam clamp & mid clamp (up to 1.5") kit standard base	015-10110	015-10111	015-10112
Seam clamp & mid clamp (up to 1.5") kit wide base	015-10151	015-10152	015-10153
Seam clamp & mid clamp (1.6" to 1.8") kit standard base	015-10113	015-10114	015-10115
Seam clamp & mid clamp (1.6" to 1.8") kit wide base	015-10154	015-10155	015-10156
Seam clamp & mid clamp (1.97" to 2.26") kit standard base	015-10116	015-10117	015-10118
Seam clamp & mid clamp (1.97" to 2.26") kit wide base	015-10157	015-10158	015-10159

SnapNrack

Series 200 Ground Mount system

The SnapNrack Series 200 system is a low profile, visually appealing, photovoltaic (PV) module installation system. This innovative suite of racking components simplifies the process of installing solar modules to shorten install times and lower installation costs.

The SnapNrack ground rail and rail-to-pipe clamp is a multi-pole, fixed-tilt ground mount. The ground rail accepts all standard module mounting clamps, and the pipe clamp is designed for 1.5-inch schedule 40 steel pipe substructures. It can be installed with tilt angles up to 45 degrees and in locations that may see wind speeds up to 105 mph. For module attachment hardware refer to the SnapNrack roof mount section of this catalog, page 25. Full Code Compliant Instruction Manual and structural engineering certificates available at www.snapnrack.com/ground-mount.html.

Ground Rail		
	Standard rail set	Bulk rail - 112 pc
Description	Item code	Item code
SnapNrack ground rail 162" - clear	015-09819	015-09854

Ground Rail Parts			
	Single piece	12 pack	48 pack
Description	Item code	Item code	Item code
SnapNrack pipe clamp 1.5"	015-09998	015-09999	015-10000
SnapNrack ground rail end cap - gray		015-09840	015-11122
SnapNrack ground rail end cap - black		015-09841	015-11121
Tee, single socket, 1.5" pipe, Kee Klamp 10-8	172-05310		
Swivel socket, 1.5" pipe, Kee Klamp 50-88	172-05410		
Double swivel socket, 1.5" pipe, Kee Klamp 51-888	172-05412		
Plug end, plastic pipe cap 1.5", Kee Klamp 77-8	172-05510		

Homeowners love our sleek lines.

You'll appreciate the bottom line.

Your customers will be delighted by the clean, finished edges of their solar electric system. And you'll spend less time on the roof, thanks to SnapNrack's many design-integrated time and money savers – innovations like one-wrench-fits-all fasteners, a no-ties wire management system, universal module clamps, and snap-in channel nuts.

Contact us today to find out how we can help you sell more systems with less hassle.

SnapNrack systems work with all leading PV module brands in pitched roof, metal roof and ground installations.

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Unirac

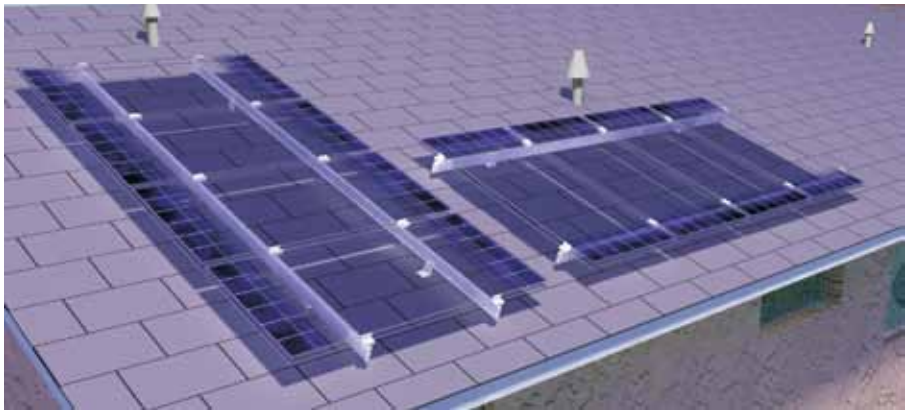
SolarMount

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

Once you've selected the PV modules and planned your installation layout, you're ready to choose SolarMount components. The table on the following page shows what components to use if you are bottom-mounting the modules. The table on page 33 shows what parts to use if you are top-mounting the modules. If you need tilt legs for the mounts, see the explanation on page 36. Rail and parts to complete your mounting system can be found on pages 34 to 35.

When sizing is complete, rails, splices, and L-feet may be ordered in two ways: In kits or in bulk. 2- and 4-rail kits on page 34 contain just the right quantities of each component for a given installation.

The 8-piece bulk rail bundles on page 34 require the addition of L-feet, and splices when necessary, along with top-mount clamps or back mount clips. All Unirac components have a 10-year product warranty and a 5-year finish warranty.



Unirac SolarMount rails can be mounted vertically or horizontally.

Choose a Top-Mounting or Bottom-Mounting System

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

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

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

Shims

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

Unirac part #	Description	Item code
990105	20 ea. 1/16″ shims (blue)	**014-00649**
990106	20 ea. 1/8″ shims (red plastic)	**014-00651**
990107	20 ea. 1/4″ shims (black)	**014-00653**
990108	20 ea. tapered shims (black)	**014-00655**

Cable Ties

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

Unirac #	Description	Quantity	Item code
990104	100 ea. push mount cable ties	1	**014-00895**

SolarMount Top-Mounting Sizing

Clamp sizes & rail set lengths

Use this table to determine the size of top mounting clamps for your modules and the length of the rails required for your array. When sizing is complete, rails, clamps, splices, and L-feet may be ordered in kits that contain just the right quantities for a given installation or in bulk packaging (Pro-Paks).

Rail Length Sizing - Top Mounts

Module brand and model		Clamp size	Rail length in inches, by number of modules per row										
			2	3	4	5	6	7	8	9	10	11	12
Evergreen	ES-A-200 to ES-A-210	F	84	120	156	204	240	276	312	360	396	432	
Kyocera	KD135SX-UPU	F	60	84	120	144	168	204	226	252	276	312	336
	KD180GX, KD205-210, 235	F	84	132	168	204	252	288	324	372	408		
REC Solar	PE series	D	84	132	168	204	252	288	324	372	408		
SANYO	HIT-N205, N210, N215	F	72	106	132	168	204	240	264	300	336	360	396
SCHOTT	POLY 220 to 235	E	84	132	168	204	252	288	324	372	408		
Sharp Solar	ND-U208 to NU-U235	F	84	132	168	204	252	288	324	372	408		
SolarWorld	SW220 to 245 34mm frame	C	84	132	168	216	252	288	336	372	408		
SolarWorld	SW220 to 245 31mm frame only	B	84	132	168	216	252	288	336	372	408		
SunPower	SPR and E19 210 to 238	F	72	106	132	168	204	240	264	300	336	360	396
	E19 305 to 318	F	96	132	180	216	264	300	348	384	432		
Suntech	STP185 to 190	C	72	106	144	168	204	240	276	300	336	372	408
	STP190 to 210	C	84	132	168	204	252	288	324	372	408		
	STP260 to 280	E	84	132	168	204	252	288	324	372	408		
Yingli	YL230P-29b	E	84	132	168	204	252	288	324	372	408		

SolarMount Bottom-Mounting Sizing

Rail set lengths

This table lists the length of the rails required for many common modules. If you need rail sizing for a module not listed below, please contact us. Order bulk bottom mount clips on page 33.

Rail Length Sizing - Bottom Mount Clips

Module brand and model		Rail length (inches) by number of modules per row										
		2	3	4	5	6	7	8	9	10	11	12
Evergreen	ES-A series	84	120	156	192	216	264	312	348	384	420	
Kyocera	KD135SX-UPU	60	84	106	132	168	192	216	240	264	300	324
	KD180GX, KD205-210, 235	84	120	156	204	240	276	312	360	396	432	
REC Solar	AE & PE series	84	120	168	204	240	276	324	360	396	432	
SANYO	HIT-205N, 210N,215N	72	96	132	168	192	226	252	288	324	348	384
SCHOTT	POLY 220 to 235	84	120	168	204	240	276	324	360	396	432	
Sharp Solar	ND-U208 to NU-U235	84	120	168	204	240	276	324	360	396	432	
SolarWorld	SW220 to 245 34mm frame only	84	120	168	204	240	288	324	360	396		
SunPower	SPR and E19 210 to 238	72	96	132	168	192	226	252	288	324	384	
	E19 305 to 318	84	132	168	216	252	300	336	372	420		
Suntech	STP185 to 190	72	96	132	168	192	226	264	288	324	360	384
	STP190 to 210 & STP260 to 280	84	120	168	204	240	276	324	360	396	432	
Yingli	YL230P-29b	84	120	156	204	240	276	312	360	396	432	

Unirac

SolarMount Standard Rail Kits

Each kit mounts a single row of modules and consists of rails plus L-feet and hardware to attach feet to rails. Splice bars are also included in four-rail kits. To determine row lengths required for your installation, see the sizing table on page 33 for arrays with top mounting clamps, or the table on page 33 for arrays with bottom mounting clips. Rails, L-feet, and splices are clear-anodized.

Bulk Rail Bundles

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

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

Pro-Pak Standard Rail Bundles – 8 rails

Rail Length	Unirac part #	Ship wt. (lbs)	Item code
48	300101	32	**014-00810**
72	300103	48	**014-00812**
84	300104	54	**014-00813**
96	300105	62	**014-00814**
106	300106	68	**014-00815**
120	300107	80	**014-00820**
132	300108	88	**014-00821**
144	300109	95	**014-00822**
156	300110	102	**014-00823**
168	300111	109	**014-00824**
180	300112	116	**014-00825**
192	300113	123	**014-00826**
204	300114	130	**014-00827**
216	300115	137	**014-00828**
228	300116	144	**014-00831**
240	300117	152	**014-00829**

Splice Bars and Plates

Splice bars are used to join together lengths of SolarMount Rail or SunFrame. Splice plates are also structural.

Splices for Standard Rail with Hardware

Unirac part #	Description	Wt. (lbs)	Item code
310216	20 ea splice plates	14	**014-00888**
310229	20 ea splice bars	10	**014-01267**

2-rail kits in lengths up to 216 inches

Each kit contains: two rail segments equal to the row length; L-feet; and hardware to join L-feet to rails. Rail kits 106 inches and shorter ship by UPS. Longer rail sets ship by truck freight. To make up long rail kits that are UPS shippable, use two rail kits of 106 inches or less and splices to connect them together.

Two-Rail Unirac SolarMount Kits – L-feet Included

Rail length	Unirac part #	# of L-ft	Weight (lbs)	Item code
48	300201	4	13	**014-01020**
60	300202	4	14	**014-01024**
72	300203	4	16	**014-01028**
84	300204	4	17	**014-01032**
96	300205	4	19	**014-01036**
106	300206	4	20	**014-01040**
120	300207	6	22	**014-01044**
132	300208	6	24	**014-01048**
144	300209	6	25	**014-01052**
156	300210	6	27	**014-01056**
168	300211	6	28	**014-01060**
180	300212	6	30	**014-01064**
192	300213	8	31	**014-01068**
204	300214	8	33	**014-01072**
216	300215	8	34	**014-01076**

4-rail kits for long rows

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

Four-Rail Unirac SolarMount Kit - L-feet Included

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

Low-Profile Tilt Legs

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

Tilt angles for low-profile legs

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

Quantity of tilt legs required

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

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

Sizing Table for Unirac Low-Profile Tilt Legs

(Tilt angle range given in degrees from horizontal.)

	Low profile leg length:	12-inch	30-inch	44-inch
	Unirac part #	310121	310122	310123
	Item code	014-01185	014-01189	014-01193
Module make and model		Tilt angle range (degrees)		
Evergreen	ES-A-200	16-20	34-53	48-60
Kyocera	KD135SX-UPU	12-21	24-38	35-57
	KD180GX, KD205-210, 235	7-14	22-40	33-60
REC Solar	PE series	14-18	30-47	43-60
SANYO	HIT205N, 210N, 215N	12-15	25-39	36-60
SCHOTT	POLY 220 to 235	14-18	30-47	43-60
Sharp Solar	ND-U208 to NU-U235	14-18	30-47	43-60
SolarWorld	SW220 to 245	14-18	30-47	43-60
REC	AE-US and PE	14-18	30-47	43-60
SunPower	SPR and E19 210 to 238	17-22	37-58	53-60
Yingli	YL230P-29b	7-14	22-40	33-60

High-Profile Adjustable Tilt Legs

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

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

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

Sizing Table for High-Profile Tilt Legs

(Tilt angle range is in degrees from horizontal.)

One Leg Per Rail (2 legs per kit) – for Rails 48" to 106"			
Maximum leg length	12 "	44 "	72 "
Unirac part #	310107	310108	310109
Item code	014-01160	014-01164	014-01168
Rail Length	Tilt angle range (degrees)		
48	9 - 21	30 - 60	N/A
60	7 - 17	24 - 60	37 - 60
72	6 - 14	19 - 54	31 - 60
84	5 - 12	17 - 46	26 - 60
96	4 - 10	14 - 40	23 - 60
106	4 - 9	13 - 36	21 - 60
Two Legs per Rail (4 legs per kit) – for Rails 120" to 180"			
Maximum leg length	18 inch	64 inch	104 inch
Unirac part #	310111	310112	310110
Item code	014-01172	014-01176	014-01180
Rail length	Tilt angle range (degrees)		
120	5 - 10	17 - 38	26 - 60
132	6 - 10	17 - 37	24 - 60
144	6 - 9	16 - 33	22 - 43
156	5 - 10	14 - 30	20 - 49
168	5 - 7	13 - 28	18 - 46
180	3 - 7	12 - 26	17 - 43

Unirac

Standoffs, Flashings and Accessories

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

Height (in)	Wt. (lbs)	Unirac part #	Item code
Flat-top 2-piece, Clear-anodized 1-5/8" OD Aluminum Standoffs			
3	9	310553	**014-00789**
4	10	310554	**014-00791**
6	12	310556	**014-00793**
7	13	310557	**014-00795**
Flat-top 2-piece, Bronze-anodized 1-5/8" OD Aluminum Standoffs			
3	9	310653	**014-00797**
4	10	310654	**014-00799**
6	12	310656	**014-00801**
7	13	310657	**014-00803**
Flat-top One Piece Zinc-Plated Steel 1-5/8" O.D. Standoffs			
3	16	310051	**014-00661**
4	18	310052	**014-00662**
6	22	310053	**014-00664**
7	24	310054	**014-01233**
Raised-Flange Zinc-Plated Steel 1-5/8" O.D. Standoffs			
3	16	310047	**014-01237**
4	18	310048	**014-01241**
6	22	310049	**014-01245**
7	25	310050	**014-01249**

L-Feet

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

Unirac part #	Description	Weight (lbs)	Item code
310067	20 ea. L-feet	5	**014-00891**
310065	20 ea. Bronze L-feet	5	**014-00893**
310077	1 ea. double L-foot		**014-00886**

Pro-Pak Top Clamps

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

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

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

Bottom-Mount Clips

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

Bottom mounting clip

Unirac part #	Description	Weight (lbs)	Item code
321002	20 ea. clips	5	**014-00875**

Flashings

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

Description	Wt. (lbs)	Unirac part #	Item code
No-Calk Collar Flashings for Standoffs	**Bulk 12-piece pack**		
12 ea. galvanized, 121/2″ x 83/4″ base (Oatey # O-11840)	11	990101	**014-00621**
12 ea. aluminum, 121/2″ x 83/4″ base (Oatey # O-12920)	11	990102	**014-00623**
12 ea. soft aluminum, 18″ x 18″ base (Oatey # O-12836)	14	990103	**014-00625**

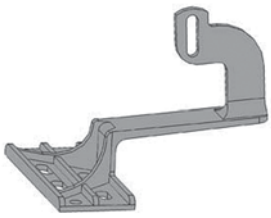
CreoTecc

Cast Aluminum Roof Hooks

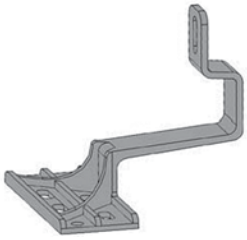
These high quality German-made cast aluminum roof attachments make it easy to put solar on tile roofs without cutting the tiles. They can support up to 600 pounds and their wide mounting flange allows for perfect placement on tile while still screwing into a rafter.

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

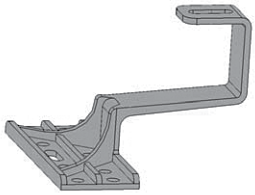
CreoTecc Aluminum Roof Hooks



Description	Item code
Side mount roof hook	**014-09811**



Description	Item code
Front mount roof hook	**014-09813**



Description	Item code
Bottom mount roof hook	**014-09815**

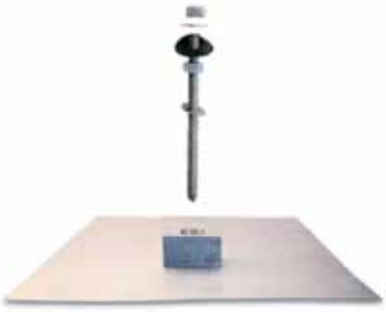
Security Hardware

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

Unirac part #	Description	Quantity	Item code
321221	Star head bolt, s/s, 3/8" x 11/4"	20	**014-02116**
321222	Breakaway nut, aluminum, 1/4"	20	**014-02106**
321223	Breakaway nut, aluminum, 3/8"	20	**014-02110**
321209	Star Key (Tool) 1/4"	1	**014-02125**
321210	Star Key (Tool) 3/8"	1	**014-02126**

Quick Mount PV

All-In-One Waterproof Flashing



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

Composition Shingle Flashing

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

Curved Tile Flashing

The curved tile mount is comprised of all-aluminum standoff and flashing. All hardware is included. The tile is removed, the standoff is bolted into position, the tile is cut to allow for the standoff to pass through. An additional peel-and-stick flashing is included for waterproofing at the sub-roof. The aluminum flashing is then placed and molded to the shape of the tiles.

Flat Tile Mount

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

Shake Mount Flashing

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

Roofing Bar

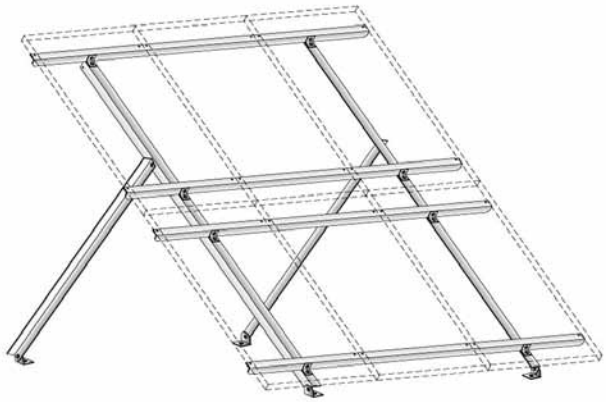
This 24" roofing bar removes nails.

Quick Mount model	Description	Weight (lbs)	Item code
QMSC-A 12	Composition mounts - mill finish 12" x 12" – 12 pack	16	**014-06315**
QMSC-C 12	Composition mounts - clear anodized finish 12" x 12" – 12 pack	16	**014-06317**
QMSC-B 12	Composition mounts - bronze anodized finish 12" x 12" – 12 pack	16	**014-06316**
QMLC-A 12	Shake mounts - mill finish 18" x 18" mount – 12 pack	30	**014-06319**
QMLC-C 12	Shake mounts - clear anodized finish 18" x 18" – 12 pack	30	**014-06320**
QMLC-B 12	Shake mounts - bronze anodized finish 18" x 18" – 12 pack	30	**014-06321**
QMFTM-A 12	Flat tile mounts w/flashing - mill finish 12" x 17" - 12 pack	25	**014-06324**
QMFTM-B 12	Flat tile mounts w/flashing - bronze anodized finish 12" x 17" - 12 pack	25	**014-06325**
QMCTM A 12	Curved tile mounts w/flashing - mill finish 18" x 18" - 12 pack	65	**014-06327**
QMCTM B 12	Curved tile mounts w/flashing - bronze anodized finish 18" x 18" - 12 pack	65	**014-06328**
QMCC A 12	Conduit mount - mill finish 9" x 12" - 12 pack	12	**014-06222**
QMCC C 12	Conduit mount - clear anodized finish 9" x 12" - 12 pack	12	**014-06224**
QMCC B 12	Conduit mount - bronze anodized finish 9" x 12" - 12 pack	12	**014-06223**
QMRB 1	24" Roofing bar - nail removal tool	4	**094-00143**

DPW Solar

POWER-FAB Two-Tier Ground Mounts

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



Module type	DPW two-tier mount part number	# of modules	Item code
Evergreen ES-A-200	DP-TTRGM4-ESA200	4	013-08756
	DP-TTRGM6-ESA200	6	013-08757
	DP-TTRGM8-ESA200	8	013-08758
Kyocera KD135SX-UPU	DP-TTRGM6-KD135SX	6	013-08760
	DP-TTRGM8-KD135SX	8	013-08761
Kyocera KD205GX to KD215GX	DP-TTRGM4-KD205	4	013-08767
	DP-TTRGM6-KD205	6	013-08768
	DP-TTRGM8-KD205	8	013-08769
Kyocera KD230GX to KD235GX	DP-TTRGM4-KD230	4	013-09777
	DP-TTRGM6-KD230	6	013-09778
	DP-TTRGM8-KD230	8	013-09779
REC Solar AE and PE	DP-TTRGM4-REC210	4	013-08778
	DP-TTRGM6-REC210	6	013-08779
	DP-TTRGM8-REC210	8	013-08780
SANYO HIT-N210A to N220A	DP-TTRGM4-SY215	4	013-09765
	DP-TTRGM6-SY215	6	013-09766
	DP-TTRGM8-SY215	8	013-09767
Sharp 208, 216, 224, 230	DP-TTRGM4-SHP208	4	013-08791
	DP-TTRGM6-SHP208	6	013-08792
	DP-TTRGM8-SHP208	8	013-08793
SCHOTT POLY 220 to 235	DP-TTRGM4-SCT220	4	013-09771
	DP-TTRGM6-SCT220	6	013-09772
	DP-TTRGM8-SCT220	8	013-09773
SolarWorld 220 to 250 (old 34mm frame only)	DP-TTRGM4-SWD230	4	013-09774
	DP-TTRGM6-SWD230	6	013-09775
	DP-TTRGM8-SWD230	8	013-09776
SunPower SPR and E19 210 to 238	DP-TTRGM4-SPR200	4	013-08798
	DP-TTRGM6-SPR200	6	013-08799
	DP-TTRGM8-SPR200	8	013-08800
	DP-TTRGM10-SPR200	10	013-08801
Yingli 230	DP-TTRGM4-YL230	4	013-09783
	DP-TTRGM6-YL230	6	013-09784
	DP-TTRGM8-YL230	8	013-09785

DPW Solar

POWER-FAB Side Pole Mounts (SPM)

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

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

Most SPM mounts can be shipped by UPS.

Mounts for other modules are available. Call for information.

Module type & TPM Series	DPW pole-side mount part number	# of modules	Item code
Evergreen ES-A 200 to 215w	DP-SPM1-ESA200	1	013-09708
	DP-SPM2-ESA200	2	013-09709
	DP-SPM3-ESA200	3	013-09710
Kyocera KD135SX	DP-SPM1-KD135	1	013-09719
	DP-SPM2-KD135	2	013-09720
	DP-SPM3-KD135	3	013-09721
	DP-SPM4-KD135	4	013-09722
Kyocera KD210GX	DP-SPM1-KD210	1	013-09715
	DP-SPM2-KD210	2	013-09716
	DP-SPM3-KD210	3	013-09717
	DP-SPM4-KD210	4	013-09718
Kyocera KD235GX	DP-SPM1-KD235	1	013-09723
	DP-SPM2-KD235	2	013-09724
	DP-SPM3-KD235	3	013-09725
REC Solar AE & PE 200+ series	DP-SPM1-REC210	1	013-09735
	DP-SPM2-REC210	2	013-09736
	DP-SPM3-REC210	3	013-09737
SANYO HIT N215A	DP-SPM1-SY215	1	013-09688
	DP-SPM2-SY215	2	013-09689
	DP-SPM3-SY215	3	013-09690
	DP-SPM4-SY215	4	013-09691
Sharp 208, 216, 224, 230	DP-SPM1-SHP205	1	013-09924
	DP-SPM2-SHP205	2	013-09925
	DP-SPM3-SHP205	3	013-09926
SCHOTT POLY 217, 220, 225	DP-SPM1-SCT220	1	013-09927
	DP-SPM2-SCT220	2	013-09928
	DP-SPM3-SCT220	3	013-09929
SolarWorld 220 to 250 (old 34mm frame only)	DP-SPM1-SWD230	1	013-09930
	DP-SPM2-SWD230	2	013-09931
	DP-SPM3-SWD230	3	013-09932

Need assistance?
Call you AEE Solar rep, or Sales Support, at **800-777-6609.**

POWER-FAB Top Pole Mounts (TPM)

POWER-FAB TPM standard mounts have heavy steel mounting sleeves, elevation pivots and strongbacks that are painted with durable outdoor paint. The module rails are 6061-T6 mill-finish structural aluminum angle. Stainless steel module mounting hardware is provided. Standard top-of-pole mounts are adjustable from 15 degrees to 65 degrees in 10-degree increments and fit on Schedule 40 steel pipe. For harsh environments, these mounts are available with hot-dip-galvanized steel and anodized aluminum rails. The table on page 43 can be used to determine the layout and pipe size for any module that fits one of the DPW module series sizes.

Module type and TPM Series	DPW TPM model	No. of modules	Item code
Evergreen ES-A 200 to 215w Series G	TPM1-G-EVGR-ES-A200	1	013-06251
	TPM2-G-EVGR-ES-A200	2	013-06252
	TPM3-G-EVGR-ES-A200	3	013-06253
	TPM4-G-EVGR-ES-A200	4	013-06254
	TPM6-G-EVGR-ES-A200	6	013-06256
	TPM8-G-EVGR-ES-A200	8	013-06258
	TPM9-G-EVGR-ES-A200	9	013-06259
	TPM10-G-EVGR-ES-A200	10	013-06260
	TPM12-G-EVGR-ES-A200	12	013-06261
	TPM14-G-EVGR-ES-A200	14	013-06262
	TPM15-G-EVGR-ES-A200	15	013-06263
Kyocera KD135SX Series C	TPM1-C-KYOC-KD135SX	1	013-06171
	TPM2-C-KYOC-KD135SX	2	013-06172
	TPM3-C-KYOC-KD135SX	3	013-06173
	TPM4-C-KYOC-KD135SX	4	013-06174
	TPM6-C-KYOC-KD135SX	6	013-06176
	TPM8-C-KYOC-KD135SX	8	013-06178
	TPM9-C-KYOC-KD135SX	9	013-06179
	TPM10-C-KYOC-KD135SX	10	013-06180
	TPM12-C-KYOC-KD135SX	12	013-06182

Module type & TPM Series	DPW TPM model	No. of modules	Item code
Kyocera KD210GX Series F	TPM1-F-KYOC-KD210GX	1	013-06151
	TPM2-F-KYOC-KD210GX	2	013-06152
	TPM3-F-KYOC-KD210GX	3	013-06153
	TPM4-F-KYOC-KD210GX	4	013-06154
	TPM6-F-KYOC-KD210GX	6	013-06155
	TPM8-F-KYOC-KD210GX	8	013-06156
	TPM9-F-KYOC-KD210GX	9	013-06157
	TPM10-F-KYOC-KD210GX	10	013-06158
	TPM12-F-KYOC-KD210GX	12	013-06159
	TPM14-F-KYOC-KD210GX	14	013-06160
	TPM15-F-KYOC-KD210GX	15	013-06161
	TPM16-F-KYOC-KD210GX	16	013-06162
	TPM18-F-KYOC-KD210GX	18	013-06163
Kyocera KD235GX Series G	TPM1-G-KYOC-KD235GX	1	013-06211
	TPM2-G-KYOC-KD235GX	2	013-06212
	TPM3-G-KYOC-KD235GX	3	013-06213
	TPM4-G-KYOC-KD235GX	4	013-06214
	TPM6-G-KYOC-KD235GX	6	013-06215
	TPM8-G-KYOC-KD235GX	8	013-06216
	TPM9-G-KYOC-KD235GX	9	013-06217
	TPM10-G-KYOC-KD235GX	10	013-06218
	TPM12-G-KYOC-KD235GX	12	013-06219
	TPM14-G-KYOC-KD235GX	14	013-06220
	TPM15-G-KYOC-KD235GX	15	013-06221
REC Solar AE & PE 200+ series Series G	TPM1-G-REC-230PE	1	013-06301
	TPM2-G-REC-230PE	2	013-06302
	TPM3-G-REC-230PE	3	013-06303
	TPM4-G-REC-230PE	4	013-06304
	TPM6-G-REC-230PE	6	013-06306
	TPM8-G-REC-230PE	8	013-06308
	TPM9-G-REC-230PE	9	013-06309
	TPM10-G-REC-230PE	10	013-06310
	TPM12-G-REC-230PE	12	013-06312
	TPM14-G-REC-230PE	14	013-06314
	TPM15-G-REC-230PE	15	013-06222
SANYO HIT N210A to N220A Series D	TPM1-D-SANYO-N220A	1	013-06429
	TPM2-D-SANYO-N220A	2	013-06428
	TPM3-D-SANYO-N220A	3	013-06427
	TPM4-D-SANYO-N220A	4	013-06426
	TPM6-D-SANYO-N220A	6	013-06425
	TPM8-D-SANYO-N220A	8	013-06424
	TPM9-D-SANYO-N220A	9	013-06417
	TPM10-D-SANYO-N220A	10	013-06423
	TPM12-D-SANYO-N220A	12	013-06422
	TPM14-D-SANYO-N220A	14	013-06421
	TPM15-D-SANYO-N220A	15	013-06415
	TPM16-D-SANYO-N220A	16	013-06420
	TPM18-D-SANYO-N220A	18	013-06419

continued on next page

Module type & TPM Series	DPW TPM model	No. of modules	Item code
Sharp 208, 216, 224, 235 Series G	TPM1-G-SHARP-224	1	013-04895
	TPM2-G-SHARP-224	2	013-04896
	TPM3-G-SHARP-224	3	013-04897
	TPM4-G-SHARP-224	4	013-04898
	TPM6-G-SHARP-224	6	013-04899
	TPM8-G-SHARP-224	8	013-04900
	TPM9-G-SHARP-224	9	013-04901
	TPM10-G-SHARP-224	10	013-04902
	TPM12-G-SHARP-224	12	013-04903
	TPM14-G-SHARP-224	14	013-04904
	TPM15-G-SHARP-224	15	013-04905
SCHOTT POLY 217 to 235 Series G	TPM1-G-SCHOTT-POLY225	1	013-04760
	TPM2-G-SCHOTT-POLY225	2	013-04761
	TPM3-G-SCHOTT-POLY225	3	013-04762
	TPM4-G-SCHOTT-POLY225	4	013-04763
	TPM6-G-SCHOTT-POLY225	6	013-04764
	TPM8-G-SCHOTT-POLY225	8	013-04765
	TPM9-G-SCHOTT-POLY225	9	013-04766
	TPM10-G-SCHOTT-POLY225	10	013-04767
	TPM12-G-SCHOTT-POLY225	12	013-04768
	TPM14-G-SCHOTT-POLY225	14	013-04769
	TPM15-G-SCHOTT-POLY225	15	013-04770
SolarWorld 220 to 250 (34mm frame only) Series G	TPM1-G-SWD-SW240	1	013-04695
	TPM2-G-SWD-SW240	2	013-04696
	TPM3-G-SWD-SW240	3	013-04697
	TPM4-G-SWD-SW240	4	013-04698
	TPM6-G-SWD-SW240	6	013-04699
	TPM8-G-SWD-SW240	8	013-04700
	TPM9-G-SWD-SW240	9	013-04701
	TPM10-G-SWD-SW240	10	013-04702
	TPM12-G-SWD-SW240	12	013-04703
	TPM14-G-SWD-SW240	14	013-04704
	TPM15-G-SWD-SW240	15	013-04705
SunPower 210 to 238 Series D	TPM1-D-SUNPOWER-210	1	013-06371
	TPM2-D-SUNPOWER-210	2	013-06372
	TPM3-D-SUNPOWER-210	3	013-06373
	TPM4-D-SUNPOWER-210	4	013-06374
	TPM6-D-SUNPOWER-210	6	013-06376
	TPM8-D-SUNPOWER-210	8	013-06378
	TPM9-D-SUNPOWER-210	9	013-06379
	TPM10-D-SUNPOWER-210	10	013-06380
	TPM12-D-SUNPOWER-210	12	013-06382
	TPM14-D-SUNPOWER-210	14	013-06384
	TPM15-D-SUNPOWER-210	15	013-06385
	TPM16-D-SUNPOWER-210	16	013-06386
	TPM18-D-SUNPOWER-210	18	013-06388

Module type & TPM Series	DPW TPM model	No. of modules	Item code
Solartech Power SPM065P Series A	TPM1-A-STP-SPM065P	1	013-04993
	TPM2-A-STP-SPM065P	2	013-04994
	TPM3-A-STP-SPM065P	3	013-04995
	TPM4-A-STP-SPM065P	4	013-04996
Solartech Power SPM085P-TL Series B	TPM1-B-STP-SPM085P-TL	1	013-05001
	TPM2-B-STP-SPM085P-TL	2	013-05002
	TPM3-B-STP-SPM085P-TL	3	013-05003
	TPM4-B-STP-SPM085P-TL	4	013-05004
Solartech Power SPM125P-S Series C	TPM1-C-STP-SPM125P-S	1	013-05009
	TPM2-C-STP-SPM125P-S	2	013-05010
	TPM3-C-STP-SPM125P-S	3	013-05011
	TPM4-C-STP-SPM125P-S	4	013-05012
	TPM6-C-STP-SPM125P-S	6	013-05013
	TPM8-C-STP-SPM125P-S	8	013-05014
	TPM9-C-STP-SPM125P-S	9	013-05015
	TPM10-C-STP-SPM125P-S	10	013-05016
	TPM12-C-STP-SPM125P-S	12	013-05017
	TPM14-C-STP-SPM125P-S	14	013-05018
	TPM16-C-STP-SPM125P-S	16	013-05019
	TPM18-C-STP-SPM125P-S	18	013-05020
Yingli 225 to 235 Series G	TPM1-G-YINGLI-YL230P-29b	1	013-06471
	TPM2-G-YINGLI-YL230P-29b	2	013-06472
	TPM3-G-YINGLI-YL230P-29b	3	013-06473
	TPM4-G-YINGLI-YL230P-29b	4	013-06474
	TPM6-G-YINGLI-YL230P-29b	6	013-06475
	TPM8-G-YINGLI-YL230P-29b	8	013-06476
	TPM9-G-YINGLI-YL230P-29b	9	013-06477
	TPM10-G-YINGLI-YL230P-29b	10	013-06478
	TPM12-G-YINGLI-YL230P-29b	12	013-06479
	TPM14-G-YINGLI-YL230P-29b	14	013-06480
	TPM15-G-YINGLI-YL230P-29b	15	013-06481
Top of Pole mount options			
High wind	HWV	Adds 35%	013-04000
Galvanized steel	HGS	Adds 80%	013-04001
Anodized rails	AA	Adds 35%	013-04021
Tamper resistant hdw	TRHW-4		013-06315
Tamper resistant hdw	TRHW-6		013-06316

POWER-FAB Top of Pole Mount Size and Configuration Guide

Selection Guide Instructions:

1. Determine the Module Series by matching dimensions to size range (left column) or the series letter given in the table on the previous page
2. Select the number of modules to mount (move across chart)
3. When placing an order you must include the specific complete module model number as shown on the manufacturers spec sheet.

TPM Configuration

6"SCH40 <--- Size of Schedule 40 or Schedule 80 rigid steel pole.

4H x 2W-L <-- Array Layout and Module Orientation (P=Portrait. L=Landscape)

Module size range (W x L)	DPW TPM model	Number of modules						
		1	2	3	4	6	8	9
19-23" x 35-44"	A	2"SCH40 1H x 1W-P	2"SCH40 1H x 2W-P"	2.5"SCH40 1H x 3W-P"	3"SCH40 1H x 4W-P	4"SCH40 2H x 3W-P	4"SCH40 2H x 4W-P	n/a
21-26" x 39-50"	B	2"SCH40 1H x 1W-P	2"SCH40 1H x 2W-P	2.5"SCH40 1H x 3W-P	3"SCH40 1H x 4W-P	4"SCH40 2H x 3W-P	4"SCH40 2H x 4W-P	n/a
22-27" x 56-60"	C	2"SCH40 1H x 1W-P	2.5"SCH40 1H x 2W-P	3"SCH40 1H x 3W-P	4"SCH40 1H x 4W-P	4"SCH80 2H x 3W-P	6"SCH40 4H x 2W-L	6"SCH40 3H x 3W-P
31-33" x 60-67"	D	2"SCH40 1H x 1W-P	3"SCH40 1H x 2W-P	4"SCH40 1H x 3W-P	4"SCH80 2H x 2W-P	6"SCH40 2H x 3W-P	6"SCH40 4H x 2W-L	6"SCH80 3H x 3W-P
38-40" x 51-53"	E	2"SCH40 1H x 1W-P	3"SCH40 1H x 2W-P	4"SCH40 1H x 3W-P	4"SCH40 2H x 2W-P	6"SCH40 3H x 2W-L	6"SCH40 4H x 2W-L	6"SCH80 3H x 3W-P
38-42" x 58-62"	F	2"SCH80 1H x 1W-P	3"SCH40 1H x 2W-P	4"SCH40 1H x 3W-P	4"SCH80 2H x 2W-P	6"SCH40 3H x 2W-L	6"SCH80 4H x 2W-L	6"SCH80 3H x 3W-P
37-42" x 61-67"	G	2"SCH80 1H x 1W-P	3"SCH40 1H x 2W-P	4"SCH40 1H x 3W-P	4"SCH80* 2H x 2W-P	6"SCH40 3H x 2W-L	6"SCH80 4H x 2W-L	8"SCH40 3H x 3W-P
38-40" x 77-78"	H	2.5"SCH40 1H x 1W-P	3"SCH80 1H x 2W-P	4"SCH40 1H x 3W-P	6"SCH40 2H x 2W-P	6"SCH40 3H x 2W-L	8"SCH40 4H x 2W-L	8"SCH80 3H x 3W-P

Module size range (W x L)	DPW TPM model	Number of modules					
		10	12	14	15	16	18
19-23" x 35-44"	A	6"SCH40 5H x 2W-L	6"SCH40 6H x 2W-L	6"SCH40 7H x 2W-L	n/a	6"SCH80 8H x 2W-L	n/a
21-26" x 39-50"	B	6"SCH40 5H x 2W-L	6"SCH40 6H x 2W-L	6"SCH80 7H x 2W-L	n/a	6"SCH80 8H x 2W-L	n/a
22-27" x 56-60"	C	6"SCH40 5H x 2W-L	6"SCH80 6H x 2W-L	8"SCH40 7H x 2W-L	n/a	8"SCH80 8H x 2W-L	8"SCH80 3H x 6W-P
31-33" x 60-67"	D	8"SCH40 5H x 2W-L	8"SCH40 3H x 4W-P	8"SCH80 7H x 2W-L	8"SCH80 3H x 5W-P	8"SCH80 4H x 4W-P	8"SCH80 6H x 3W-L
38-40" x 51-53"	E	8"SCH40 5H x 2W-L	8"SCH40 3H x 4W-P	8"SCH80 7H x 2W-L	8"SCH80 5H x 3W-L	8"SCH80 4H x 4W-P	8"SCH80 6H x 3W-L
38-42" x 58-62"	F	8"SCH40 5H x 2W-L	8"SCH80 3H x 4W-P	8"SCH80*** 7H x 2W-L	8"SCH80 5H x 3W-L	8"SCH80** 4H x 4W-P	8"SCH80**** 6H x 3W-L
37-42" x 61-67"	G	8"SCH40 5H x 2W-L	8"SCH80 3H x 4W-P	8"SCH80*** 7H x 2W-L	8"SCH80 5H x 3W-L	n/a	n/a
38-40" x 77-78"	H	8"SCH80 5H x 2W-L	8"SCH80* 3H x 4W-P	n/a	n/a	n/a	n/a

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

* 6" max front edge ground clearance

** 55-degree max tilt

*** 6" max front edge ground clearance and 55-degree max tilt

**** 45-degree max tilt

DPW Solar

Multi-Pole Mounts

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

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

Multi-pole Mount Rail Sets
(includes module rails and clamp sets, rail-to-pipe brackets, and associated hardware)

Module	Qty	DPW #	Item code	Module	Qty	DPW #	Item code
Evergreen ES-A-200/205/210	2	MPM2-EG200	013-02006	SCHOTT POLY 217 to 235	2	MPM2-SCT220	013-02050
	3	MPM3-EG200	013-02001		3	MPM3-SCT220	013-02051
	4	MPM4-EG200	013-02007		4	MPM4-SCT220	013-02052
Canadian Solar CS6P-170 to 210	2	MPM2-CS1200	013-02011	Sharp ND-208 to 240	2	MPM2-SHP224	013-02032
	3	MPM3-CS1200	013-02012		3	MPM3-SHP224	013-02033
	4	MPM4-CS1200	013-02013		4	MPM4-SHP224	013-02034
Kyocera KD205/210GX	2	MPM2-KD205	013-02020	SolarWorld SW220 to 250 34mm frame	2	MPM2-SWD230	013-02038
	3	MPM3-KD205	013-02021		3	MPM3-SWD230	013-02039
	4	MPM4-KD205	013-02022		4	MPM4-SWD230	013-02040
Kyocera KD235GX	2	MPM2-KD235	013-02073	SunPower SPR210 to 230	2	MPM2-SPR220	013-02041
	3	MPM3-KD235	013-02074		3	MPM3-SPR220	013-02042
	4	MPM4-KD235	013-02075		4	MPM4-SPR220	013-02043
REC AE or PE 210 to 240	2	MPM2-REC210	013-02014	Suntech STP170/175/ 180S-24/Ab-1	2	MPM2-STP175	013-02044
	3	MPM3-REC210	013-02015		3	MPM3-STP175	013-02045
	4	MPM4-REC210	013-02016		4	MPM4-STP175	013-02046
Sanyo HITN215A	2	MPM2-SY215	013-02026	Suntech STP190/200/ 210Ub	2	MPM2-STP200	013-02047
	3	MPM3-SY215	013-02027		3	MPM3-STP200	013-02048
	4	MPM4-SY215	013-02028		4	MPM4-STP200	013-02049
				Yingli YL230P-29b	2	MPM2-STP200	013-02070
					3	MPM3-STP200	013-02071
					4	MPM4-STP200	013-02072

Multi-Pole Mount Pipe Caps (includes U-bolts)

Size	Description	DPW #	Item code
3" SCH40	For connecting 3" vertical to 3" horizontal steel pipe	PC-3V3H	013-02002
4" SCH40	For connecting 4" vertical to 3" horizontal steel pipe	PC-4V3H	013-02000
4" SCH40	For connecting 4" vertical to 4" horizontal steel pipe	PC-4V4H	013-02003
6" SCH40	For connecting 6" vertical to 3" horizontal steel pipe	PC-6V3H	013-02005
6" SCH40	For connecting 6" vertical to 4" horizontal steel pipe	PC-6V4H	013-02004

Commercial Grade Ground Mount Racking

The following pages include large ground mount racks from several leading manufacturers. They are designed to be a cost effective solution for installing large quantities of PV modules, from kilowatts to megawatts. Each product has its benefits. Some can be adjusted seasonally and some are a fixed tilt angle. Please contact us for system design assistance.

Unirac

U-LA

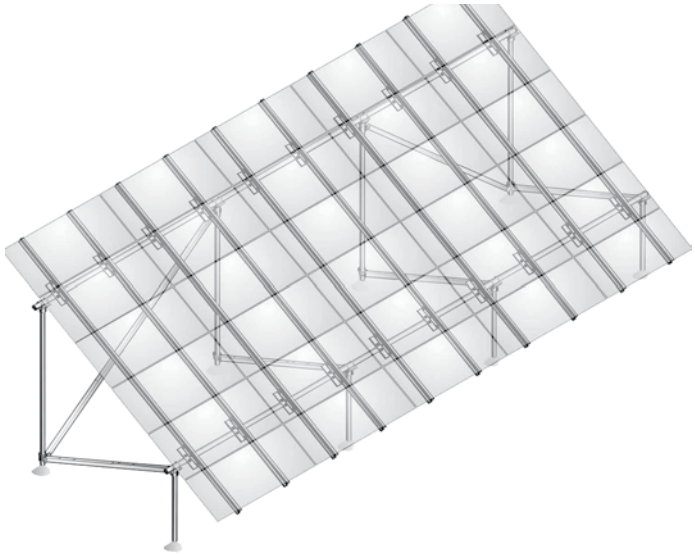
U-LA is a mounting system using large arrays of PV modules designed to generate 3 kilowatts or more. The size of the system is limited only by the available space for the array. The U-LA can be installed on the ground or on commercial flat roofs.

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

unirac.com/equestionnaire.php

... to generate a bill of materials.

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



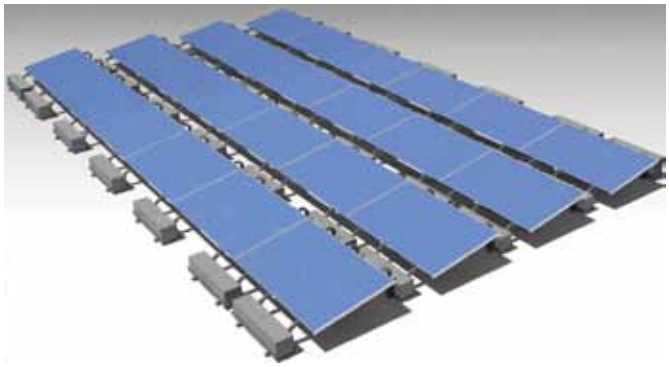
AET

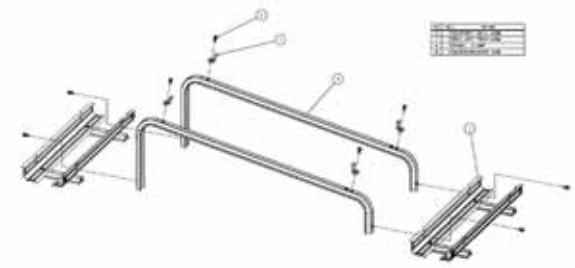
Rayport Ballasted Flat Roof Mounting System

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

Rayport mounts are wind tunnel tested to 120 mph.

Integrated fasteners and supplied grounding hardware between the modules and the frames allow for quick, easy installation. Contact us with your array layout for help with the parts needed and the required ballast which will depend on building height, module type and exposure category.





Ballasted Flat Roof Mounts (beginning on the previous page)

Ballasted PV mounting systems are used when the roof is a flat or very slightly pitched surface and the installation requires minimal or no penetrations. They are usually used in commercial systems. The advantages are short installation time, minimal penetrations of the roof means less chance of leakage, but there can be high weight loading on the roof, and the modules will a have very low tilt angle. It is critical that the proper amount of ballast is applied in a ballasted system and at the correct location. Professional design assistance and engineering support is highly recommended when using a ballasted system.

DPW Solar

POWER-FAB CRS Non-Penetrating Flat Roof Mounting System

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

Standard Product Wind Loading Specifications			
Wind load	**Standard tilt angle***	**Roof loading**	**Category**
90 mph	10 degree	< 5 lbs/ft^2	Exposure C
130 mph	5 degree	< 5 lbs/ft^2	Exposure C

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

*Tilt angles from 5 - 25 degrees available.

Unirac

RapidRac G10 Ballasted Flat Roof Mounting System

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

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

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

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

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

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

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

Description	Unirac part #	Item code
RapidRac Ballast Tray (only)	Call	**Call**
RapidRac ballast tray with module mount	Call	**Call**
RapidFoot assembly	310370	**015-02261**
Galvalume flashing #1	990120	**015-02265**
Patch for flashing	990161	**015-02269**

Wattsun

Active Trackers

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

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

AZ-125 Trackers

The AZ-125 gear-drive, azimuth tracker comes standard as a single-axis tracker with manual seasonal tilt adjustment. It is powered by a 24 VDC drive motor running a high quality worm and gear drive. With the addition of the dual-axis option (order separately), the AZ-125 can capture virtually all the available power the sun delivers. The AZ-125 trackers mount on a 6-inch Schedule 40 steel pole or 6-inch Schedule 80 pole if designated as "6"/80.

AZ-225 Trackers

The AZ-225 gear-drive, azimuth tracker is for very large arrays. It can hold over 2 kW of solar modules. It is powered by a 24VDC motor running a heavy-duty ball bearing/ worm gear drive. It comes standard with the dual-axis option, enabling it to capture the maximum amount of solar energy. Mounts on an 8-inch Schedule 40 steel pole, or 8-inch Schedule 80 pole if designated as "8"/80.

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

Wattsun model	Description	Item code
12-24 15W (for 12V battery)	Required to get 24v for tracker from 12 VDC Battery	**014-07118**
48-24 LVC	Steps down 48 VDC from battery or 36VDC from array to 24 VDC for controller on AZ-125 tracker	**014-07116**
BZ X8a	Steps down 48 VDC from battery to 24 VDC for controller. One required per two AZ-125 or one AZ-225	**014-07117**
DR-4524 (for pumping)	Accepts 120-370 VDC input to power tracker controller from a high voltage water pumping array. Needs to be mounted in a raintight box if located outside. Also accepts 115 or 230 VAC for one AZ-125 tracker	**014-07112**
IDEC PS5R-SF24	Accepts 115 or 230 VAC input to power tracker controller from the AC grid when no backup battery bank is present. One required per two AZ-125 trackers or one AZ-225 tracker. Needs to be mounted in a raintight box if located outside	**014-07115**
Dual-axis option	Add automatic elevation tracking to the AZ-125 tracker. The DA Option is included with the AZ-225 trackers	**014-07018**
Manual controls	Exterior switches on the controller cover plate. Allows for the owner to turn off automatic tracking and then rotate the tracker east or west and/or up and down. Useful for dumping snow or to lay the tracker flat in extremely high winds	**014-07030**
Manual control kit	Field upgrade kit for Version 3 controllers. V3 controllers are "two-piece" style and the sensor is independent of the main control box. Should be installed by an electrician or other certified personnel	**014-07032**

Wattsun Trackers

Module	Module quantity	Wattsun drive	Dual axis	Steel pipe ID	Item code
Evergreen ES-A-200 205, 210	6	AZ-125	optional	6"	014-07347
	9	AZ-225	included	6"	014-07349
	12	AZ-225	included	8"	014-07350
Kyocera KD135	8	AZ-125	optional	6"	014-07466
	10	AZ-125	optional	6"	014-07467
	15	AZ-225	included	8"	014-07469
	16	AZ-225	included	8"	014-07470
	20	AZ-225	included	8"	014-07471
Kyocera KD215GX	8	AZ-125	optional	6"/80	014-07474
	12	AZ-225	included	8"/80	014-07475
Kyocera KD205GX-LDU	6	AZ-125	optional	6"	014-07473
	8	AZ-125	optional	6"	014-07474
	12	AZ-225	included	8"	014-07475
Kyocera KD235GX	6	AZ-125	optional	6"	014-07478
	9	AZ-225	included	8"	014-07480
	12	AZ-225	included	8"/80	014-07481
REC AE & PE 205 to 245	4	AZ-125	optional	6"	014-08204
	6	AZ-125	optional	6"	014-08205
	8	AZ-225	included	8"	014-08208
	9	AZ-225	included	8"	014-08209
	12	AZ-225	included	8"/80	014-08212
SANYO HIT N210A to N220A	6	AZ-125	optional	6"	014-07557
	8	AZ-125	optional	6"	014-07558
	9	AZ-125	optional	6"/80	014-07559
	12	AZ-225	included	8"	014-07560
	16	AZ-225	included	8"/80	014-07561
SCHOTT POLY 217 to 235	6	AZ-125	optional	6"	014-07585
	8	AZ-225	included	8"	014-07586
	9	AZ-225	included	8"	014-07587
	12	AZ-225	included	8"/80	014-07588
Sharp 165, 175,185	6	AZ-125	optional	6"	014-07653
	8	AZ-125	optional	6"	014-07655
	9	AZ-125	optional	6"/80	014-07656
	12	AZ-225	included	8"	014-07657
	16	AZ-225	included	8"/80	014-07658
Sharp 208, 216, 224, 230	6	AZ-125	optional	6"	014-07692
	8	AZ-225	included	8"	014-07694
	9	AZ-225	included	8"	014-07696
	12	AZ-225	included	8"/80	014-07698
SolarWorld SW220 to SW250 (34mm frame only)	6	AZ-125	optional	6"	014-07765
	9	AZ-225	included	8"	014-07766
	12	AZ-225	included	8"/80	014-07767
SunPower SPR210 to 230	6	AZ-125	optional	6"	014-07845
	8	AZ-125	optional	6"	014-07846
	9	AZ-125	optional	6"/80	014-07849
	12	AZ-225	included	8"	014-07847
	16	AZ-225	included	8"/80	014-07848
Yingli YL230P-29b	4	AZ-125	optional	6"	014-08110
	6	AZ-125	optional	6"	014-08111
	9	AZ-225	included	8"	014-08113
	12	AZ-225	included	8"/80	014-08114

Zomeworks

Universal Track Rack

Passive Solar Tracker for PV Modules

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

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

Please specify how many of which brand of module are to be placed on the tracker. The tracker will be customized with the correct amount of hardware, and in some cases the rail length will be adjusted for better fit. Module quantities followed by an asterisk require one additional rail set at an extra charge, specified in the last row of table below. If the quantity is followed by double asterisks, order two additional rail sets. Call us about Zomeworks trackers for modules not listed.

Zomeworks model	UTR020	UTRK040	UTRF64	UTRF90	UTRF120	UTRF168-2	UTRF168-2-HD
Item code	014-09020	014-09043	014-09064	014-09090	014-09120	014-09130	014-09132
Pole size schd 40 steel	2.5"	3"	6"	6"	6"	8"	8"
Min. pole height	76"	84"	96"	108"	120"	144"	144"
Min. pole depth	38"	42"	48"	54"	60"	72"	72"
Shipping weight	101 lbs	170 lbs	400 lbs	490 lbs	525 lbs	650 lbs	680 lbs
Module type	Number of modules that fit each Zomeworks model (top row)						
ES-A-200 to 210	1	2	3, 4	5*	6	7*, 8, 9*	10
Kyocera							
KD-135	1, 2	3	4, 5*, 6*	7*, 8	9*, 10, 11*	12, 13*, 14*, 15*	N/A
KD-205GX	1	2	3, 4	5*	6, 7*	8, 9*, 10*	10
KD-205GX	1	1, 2	2, 3	4, 5*	6*	7*, 8, 9*	N/A
REC							
PE & AE 205 to 235	1	2	3	4, 5*	6*	7*,8, 9*	N/A
SANYO							
HIT N205A to N220A	1	2, 3	4, 5*	6, 7*	8, 9*	10, 11*, 12*	12
SCHOTT Solar							
POLY 217 to 235	1	2	3	4, 5*	6*	7*, 8, 9*	N/A
Sharp							
ND 208 to 240	1	2	3	4, 5*	6*	7*, 8, 9*	N/A
SolarWorld (old 34mm frame only)							
SW 220 to 245	1	1, 2	2, 3	4, 5*	6*	7*, 8, 9*	N/A
SunPower							
SPR 210 to 230	1	2, 3	4	5*, 6, 7*	8, 9*	10, 11*, 12*	N/A
Yingli							
YL230P-29b	1	2	3	4, 5*	6*	7*, 8, 9*	N/A

Description	Item code
* Additional rail for mounts with a quantity followed by an asterisk in chart.	014-09155

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

Wind-powered systems can be cost effective if the average wind speed is 9 mph or more at the location of the wind generator. If you are using wind off grid in combination with photovoltaic power, it may be cost effective if good wind is available only during part of the year. When the wind speed doubles, the power delivered is eight times as great. Most wind generators are designed to deliver maximum power at a wind speed of 30 mph. At 15 mph, they will deliver about 1/8 their rated power. To avoid turbulence, a wind generator should be mounted at least 20 feet higher than any obstruction within 300 feet. If you measure wind speed at ground level, you can expect about 1.5 times the wind speed 30 feet up, which equates to about three times the power. At 120 feet above the ground, wind speed will be twice what is measured at ground level and power output will be more than twice the output at 30 feet, and about 6 times the output at ground level.

The power output of a wind generator decreases roughly 3% for every 1000 feet of elevation.

Measuring Wind Speed

Before installing a wind-power generator, make a measurement for 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.

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 to provide convenient data downloads. The logging interval is adjustable from 10 to 50,000 seconds (16.6 hours). The 2 gigabyte SD card (included) will store a year of data at 30 second intervals and many years of data at longer logging intervals. Microsoft Excel, OpenOffice.org, or practically any spreadsheet program can be used to view, graph, and analyze your wind data. 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. The DataLogger is housed in a waterproof enclosure.

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

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

Kestrel

Wind and Weather Meters

The **Kestrel 1000** measures instantaneous maximum and average wind speeds. Measurement unit options are knots, meters per second, kilometers per hour, miles per hour, feet per minute and Beaufort. Hold it up to measure wind speed. Large, easy-to-read liquid crystal display with +/-3% accuracy. Measures down to 0.3 m/s (0.67 mph). Impeller and protective housing pop out for easy and inexpensive replacement. Includes slip-on hard case that protects the impeller, buttons and display from damage in your pocket or toolbox. It is waterproof and it floats. The replaceable battery provides 400 hours of use. 5-year warranty.

The **Kestrel 2000** has all the features of the model 1000, and is also capable of measuring both wind temperatures as well as speed. 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. Hard slid-on case included. 5-year warranty.

The **Kestrel 4000** has all the features of the model 2000, plus the capability to store up to 2000 points of weather data in order to track changes over time, with data storage, 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 port connection or USB port connection, and include an interface cradle unit, serial or USB cable and CD with upload easy-to-use software. The 4000 comes with a soft carry pouch. Carry case optional. 5-year warranty.

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 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**

Southwest Windpower

Skystream 3.7

The Southwest Windpower Skystream 3.7 is the first all-inclusive UL Recognized wind generator (with controls and inverter built in) that provides quiet, clean electricity in low winds. Designed to be grid tied and to supplement or completely cover the power needs of residential homes or small businesses. Available for 120, 240 and 208 VAC operation (120VAC model for off-grid only). Comes with a guy-less monopole or sectional monopole tower, or a kit for assembling a guyed tower with locally purchased pipe and anchors. Its sleek 12-ft diameter, swept-wing blades and elegant form make Skystream an attractive addition to any home, and because it operates at a low rpm, Skystream is as quiet as the trees blowing in the wind.

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

- At least 10 mph average wind speed (best results at 12 mph or more)
- The property is at least a half acre and has unobstructed views
- The local zoning allows a structure that is at least 54 inch tall
- The utility has an existing interconnection agreement for homeowners

With a rated capacity of 2.4 kW, the Skystream grid-tie models can provide an estimated energy production of 400 kWh per month in areas with a 12 mph average windspeed. The Skystream will begin producing power at about 8 mph. At about 20 mph, the blades achieve a rotational speed of 330 rpm. This is Skystream's rated speed and will remain at that speed if the wind speed increases. In very high winds, the Skystream will automatically shut down.

The Skyview Wireless PC Interface works with the Skyview Software to send and receive data to and from the Skystream wind turbine so that you can monitor system performance, change setup options, install updates, and troubleshoot the wind turbine. Connection to the PC is via the included wireless-to-USB interface.

NOTE: The 120 volt model of Skystream is NOT Underwriters Laboratories (UL) Recognized and MAY NOT be connected to the electric utility grid. The 120 VAC version is limited to 1.5kW continuous power, as is designed for off-grid "AC-coupled" systems with a bi-directional battery-based inverter (Sunny Island, OutBack, Magnum sine wave, or Schneider XW)

To order, use the item code determination table below to get the item code for the Skystream wind system that you want to order. Each Skystream wind system includes the Skystream 3.7, choice of monopole or guyed tower, Skyview monitoring software and wireless-to-USB adaptor, the Skylevel tower leveling kit, and a 5-year limited warranty.

Item code determination	Choose digits from each section to get part number									
	Base part number	Land	Marine	Tower height (feet)			Tower type	Voltage		
Monopole Tower	016-1	1	2	45	55	70	2	-120	-240	-208
Guyed Tower Kit	016-1	1	2	-	42	70	3	-120	-240	-208

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

Model	Description	Item code
SMarT Foundation kit 45' monopole	Complete Foundation kit including anchor bolts for 45' monopole towers	**016-01421**
SMarT Foundation kit 55' monopole	Complete Foundation kit including anchor bolts for 55' monopole towers	**016-01431**
SMarT Foundation kit 70' monopole	Complete Foundation kit including anchor bolts for 70' monopole towers	**016-01437**
42" Foundation bolt kit	Includes bolts and bolt template for 45-ft monopole tower on pier or pad-pier foundation	**016-01023**
42" Foundation bolt kit	Includes bolts and bolt template for 55-ft monopole tower on pier or pad-pier foundation	**016-01433**
52" Foundation bolt kit	Includes bolts and bolt template for 70-ft monopole tower on pier or pad-pier foundation	**016-01439**
Gin pole kit for 45' sectional	Gin pole and hardware for 45' 0" sectional monopole towers	**016-01114**
Hinge plate kit for 45' sectional	Hinge plate and hardware for 45' sectional monopole towers	**016-01427**
Motorized mechanical lift	Mechanical Jack Screw Lifting Device or 70' sectional monopole tower	**016-01441**
Tower adaptor kit (5")	Incl alum casting and hdwe to attach Skystream to Whisper 500 guyed tower kits or any 5" Sch 40 pipe	**016-01017**
Skylevel	Skylevel monopole tower leveling kit - extra unit (one included with Skystream system already)	**016-01405**
Skylever viewer	Skylevel viewer interface software kit - extra unit (one included with Skystream system already)	**016-01406**
Skyview Interface Kit	Extra Skyview Interface Kit (in addition to the one included with Skystream system)	**016-01019**

Southwest Windpower

The Whisper 100 and 200 from Southwest Windpower are shipped in a 24-volt configuration, but can easily be changed to 12, 36, or 48 volts by the installer. The included controller is adjustable for use with 12-, 24-, 36- and 48-volt battery systems and the voltage can be adjusted for any battery type. The control can be set to stop the blade from spinning when the battery is fully charged, avoiding wear when power is not needed. The control has a "selectable silent mode" setting that allows the user to select any specific period to automatically turn the wind turbine on or off. Whisper 200 is also available with nominal 120V and 230V output.

An optional digital display may be added to the control to display total kilowatt hours, peak amps, and peak and average wind speed. To measure wind speed, the optional wind speed sensor must be ordered. Use NRG model #40 anemometer available at: www.nrgsystems.com/

All Whisper generators have a 5-year warranty.

Whisper 100 Wind Generator

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

Whisper 200 Wind Generator

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

Whisper 500 Wind Generator

The Whisper 500 is a 3000-watt rated turbine that will deliver in excess of 500 kWh per month in a 12 mph wind. This machine has a 14-foot, 2 blade rotor providing 500 sq. ft. of swept area. It features a handmade fiberglass and foam core blade for smooth, high efficiency operation and low wind start-up. It also incorporates the patented "angle governor" design for quiet operation in high winds. The 500 is an excellent machine for village power projects, farms, ranches, backup power and remote homes with large energy demands. The Whisper 500 comes in two boxes and is shipped truck freight. Available in 24- and 48-volt DC versions.

Description	Weight	Item code
Whisper 100 w/ charge controller	73 lbs	**016-01154**
Whisper 100 w/o charge controller	70 lbs	**016-01155**
Whisper 100 Marine w/ charge controller	80 lbs	**016-01162**
Whisper 200 w/ charge controller	85 lbs	**016-01180**
Whisper 200 w/o charge controller	80 lbs	**016-01181**
Whisper 200-120 volt w/o charge controller	80 lbs	**016-01199**
Whisper 200-230 volt w/o charge controller	80 lbs	**016-01198**
Whisper 200 Marine w/ charge controller	90 lbs	**016-01189**
Charge controller display for 100/200/500	1 lb	**016-01211**
Whisper 500 w/ charge controller 24V	310 lbs	**016-01144**
Whisper 500 w/ charge controller 48V	310 lbs	**016-01145**

Whisper 500 high voltage (HV) generators and transformers available for long distance applications. Call for info.

Towers

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

Whisper 100/200 Tower Kits

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

Whisper 500 Tower Kits

Whisper 500 Tower Kits are available in 30' (9.1m), 42' (12.8m) and 70' (21.3m) heights. Uses 5" Schedule 40 pipe.

Earth Auger Sets

Screw-in auger-type guy anchors can be used in loamy and gravelly soils. Other soil types may require concrete footings or expansion bolts. Use 36" and 48" augers with Whisper 100/200 installations and 48" and 60" augers on Whisper 500 installations. Consult an engineer or geologist if you have questions about guy supports. Do not use these auger sets with Whisper 500 towers.

Description	Item code
Whisper 100 & 200 24' guyed tower kit	**016-01083**
Whisper 100 & 200 30' guyed tower kit	**016-01089**
Whisper 100 & 200 50' guyed tower kit	**016-01095**
Whisper 100 & 200 65' guyed tower kit	**016-01098**
Whisper 100 & 200 80' guyed tower kit	**016-01101**
Whisper 500 30' guyed tower kit	**016-01110**
Whisper 500 42' guyed tower kit	**016-01104**
Whisper 500 70' guyed tower kit	**016-01107**
36 Galvanized auger set of 4 - 24' 27' towers	**016-01116**
48 Galvanized auger set of 4 - 32'-50' towers	**016-01122**
60 Galvanized auger set of 4 - 65'-80' towers	**016-01125**
Whisper 100/200 60 amp brake switch	**016-01227**

AIR X 400W and AIR Breeze 200W Wind Generators

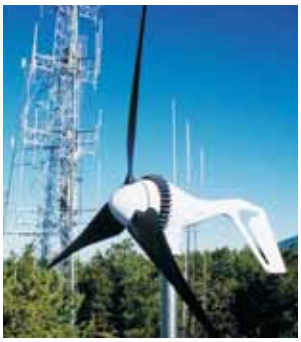
The AIR Breeze, introduced in 2007, is the next generation of the AIR X turbine. Both are available in land and marine versions. The quieter AIR Breeze features newly designed blades and higher power output at wind speeds below 12 MPH. Because of its increased efficiency at lower wind speeds and advanced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

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

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

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

AIR-Industrial Wind Generators



The Air-Industrial is capable of resisting the harsh environments that generally accompany mountaintop telecommunication sites, environmental monitoring sites and off-shore oil platforms. It has specially formulated blade material that can stand up to sub-zero temperatures, and its blades are spaced farther from the tower so that it can operate at sustained winds up to 130 miles per hour. Maintenance-free performance, easy installation and high power output make the AIR-Industrial ideal for any remote battery-charging application. The AIR-Industrial does not have an internal controller, so an external controller must be installed on the battery bank. The recommended external controllers are Morningstar TriStar TS-45 or TS-60, or a Xantrex C40. Set controller in "diversion load" configuration and add an air- or water-heating diversion load (see page 137). 3-year warranty.

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

AIR Tower Kits

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

Earth Auger Sets

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

MidNite Solar Stop Switch

MidNite Solar's Stop Switch allows you to stop an AIR wind generator and disconnect it from the battery, all with one motion. NEMA 1 indoor enclosure.

Description	Item code
AIR Marine tower hardware kit	016-01128
9' AIR Marine aluminum mast and 2 stays	016-01131
Roof kit without roof seal	016-01134
Roof kit with roof seal	016-01137
Roof seal – for roof mount kit	016-01140
27' AIR guyed tower kit (AIR only)	016-01086
45' AIR guyed tower kit (AIR only)	016-01092
29' EZ Tower kit including pipe and anchors	016-01081
36" Auger – set of 4; use with 24' & 27' towers	016-01113
36 Galvanized auger set of 4; for 24' & 27' towers	016-01116
48 Auger set of 4 32' - 50' towers	016-01119
48 Galvanized auger set of 4 32'-50' towers	016-01122
MidNite Solar Stop Switch	053-00121
30 amp circuit breaker kit	016-01225
50 amp circuit breaker kit	016-01226
100 amp circuit breaker kit	016-01222
Amp meter kit	016-01223
Stop Switch for Land Versions	016-01351
Diversion load for Air Industrial	016-01078

American Zephyr

Airdolphin Wind Generators

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

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

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

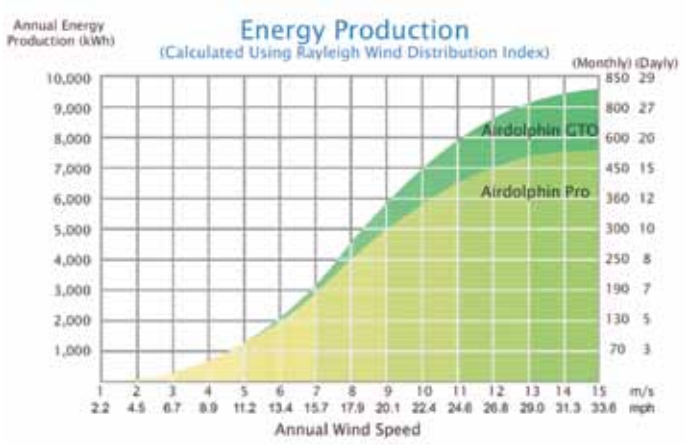
Intelligent Power Management System

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

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

24-volt and 48-volt battery charging models have built in charge controllers. The grid-tie GTO has a 250 VDC output and requires a separate grid-tie inverter. Zephyr recommends using an SMA 3000US or 4000US inverter for grid-tie applications

All turbines mount on a 1.5-inch Schedule 40 pipe at the top of the tower. Maximum pipe diameter is 1-15/16 inches. American Zephyr towers are made by American Resource and Energy (ARE) and are very heavy-duty sectional monopole (guy-less) towers. The 30-, 45-, and 60-foot towers can be raised with a crane or with the optional Gin Pole kit. 80-foot and 100-foot towers, and motorized lifting jacks for them, are available – call for pricing and lead time (typically 90-days).



Airdolphin model	Description	Item code
Wind Turbine		
Z-1000-24	Mark-Zero 24 VDC 1000-watt charger	**016-03011**
Z-1000-48	Pro 48 VDC 1000-watt charger	**016-03013**
Z-1000-250	GTO 1000-watt 250 V for grid-tie	**016-03015**
Accessory		
RM-1000(E)-24	Remote monitor for 24 volt turbine	**016-03020**
RM-1000(E)-24	Remote monitor for 48 volt turbine	**016-03022**
RM-1000(E)-24	Remote monitor for 250 volt turbine	**016-03024**
Monopole tower - 30 foot		**016-03041**
Monopole tower - 45 foot		**016-03043**
Monopole tower - 60 foot		**016-03045**
Gin pole for 30', 45', 60' towers with 8 anchor bolts and 2 templates		**016-03062**

Inverters

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

Off-Grid Inverters

Off-grid, or battery-based inverters convert DC power stored in batteries to AC power that is used by common appliances and other electrical loads. Select an inverter for the power system based on the maximum load it will be powering, the maximum surge required, AC output voltage required, input battery voltage and features needed. High quality battery-based inverters are available in sizes from 120 watts, for powering notebook computers and fax machines from your car, to 60 kilowatts, for powering a commercial operation. The size of an inverter is measured by its maximum continuous output in watts. This rating must be larger than the total wattage of all of the AC loads you plan to run at one time. Wattage of most AC loads can be determined from a tag or label on the appliance, usually located near where the power cord enters, or from the owner's manual. If the inverter is expected to run induction motors, like the ones found in top loading washers, dryers, dishwashers and large power tools, it must be designed to surge, or deliver power many times its rating for short periods of time while these motors start.

Off-grid inverters are available with two basic power output waveforms: sine wave, and modified sine wave (the proper term is actually modified square wave, but since modified sine wave is much more commonly used, we use that term in this catalog). Grid-tie inverters, dual-function inverters and utility companies deliver a sine wave. Exeltech, Xantrex XW Series, SMA Sunny Island, Magnum MS and OutBack FX inverters are sine wave off-grid inverters. Sine wave inverters have a higher cost, but they can operate almost anything that can be operated on utility power. Exeltech sine wave inverters are an excellent choice for power systems running audio or telecommunications equipment and other electronics that are waveform-sensitive. The OutBack and Xantrex XW series inverters can be ganged together for up to 36 kW of output and can operate off-grid or grid-tie. We now carry Samlex sine wave PST inverters for a lower cost, small system sine wave alternative. Magnum's MM, ME, and RD inverters have modified sine wave output with harmonic distortion of around 40%. They are an economical choice in power systems where waveform is not critical. Their high surge capacity allows them to start large motors while their high efficiency makes them economical with power when running small loads like a stereo or a small light. They can power most lighting, televisions, appliances and computers very well. Unfortunately, this type of inverter may destroy some rechargeable tools and flashlights, and laser printers and copiers. They may not allow many laser printers, copiers, light dimmers and some variable speed tools to operate. Equipment with silicon controlled rectifiers (SCRs) will not operate. Some audio equipment will have a background buzz that may be annoying to music connoisseurs.

Grid-Tie Inverters

Grid-tie, or utility intertie, inverters convert DC power from PV modules directly into AC power to be fed into the utility grid. Storage batteries are not needed, as all power produced is either used directly during production by the owner's electrical loads, or is fed into the utility grid to be used elsewhere. There are two major types of grid-tie inverters; string inverters and microinverters. Most battery-less grid-tie inverters are string inverters. The name "string" comes from the way the PV modules are wired together in series to achieve a higher voltage. These inverters are designed to run at voltages up to 600 VDC. String wiring is faster to install, more efficient and allows the use of smaller gauge wire. DC voltage this high can be very dangerous and life-threatening, so string inverters should be installed and serviced by qualified electricians.

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

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

Central inverters are used in larger commercial grid-tie systems, usually of 30 kilowatts to 1 megawatt or more in size. They are the most economical way to convert the DC output of PV systems this large to AC for connection to the utility grid.

All grid-tie PV systems use the utility company, in effect, as a storage battery. When the sun is shining, electricity used by on-site appliances and other loads comes from the PV array, via the

inverter. If the PV array is generating more power than the loads are using, the excess is sold to the power company through the utility's electric meter; in such cases, the meter actually runs backward, giving the owner credit on their utility account. When you need more power than the PV array can supply, the utility makes up the difference. This is called "net metering" and is the type of system that makes the most sense in most cases where you have utility power, because there are no batteries to maintain or replace. Unfortunately, if the utility power goes down, this type of inverter will go off, too, regardless of whether or not the sun is shining

Dual-Function Inverters

Using a dual-function inverter allows the inverter to sell excess power to the utility, and also maintain a battery bank for standby power in the event of a utility power failure. In a typical installation, the inverter is connected to a battery bank, a subpanel for critical loads that will be powered during a power outage, and the building's load center. If the utility is available, the inverter will supply the loads from the utility. If the utility fails, the inverter will supply power to the loads from the battery. When the utility is available again, the inverter will switch the loads back to the utility, and recharge the batteries. If the batteries become fully charged by another power source, such as photovoltaic modules or a wind or hydroelectric generator, excess power may be sold back to the utility in locations where net metering is allowed.

The Xantrex XW series and the OutBack GFX series inverters are primarily off-grid inverters that can function as an intertie inverter at the same time, but with a slightly lower efficiency than a battery-less inverter designed for grid-tie only. They are designed to provide battery backup power when the utility fails. The PV array charges the batteries through a separate charge controller. Once the batteries are full, excess power produced by the PV system is "sold" to the grid. The SMA Sunny Island inverter is designed to work with a Sunny Boy inverter in an "AC-coupled" system to provide utility intertie with battery backup. In an AC-coupled system, the PV array is connected to a battery-less Sunny Boy inverter, just like a standard grid-tie system, except that the Sunny Boy's AC output goes to the critical loads panel subpanel connected to the AC output of the Sunny Island inverter. Normally, power produced by the grid-tie system passes through the Sunny Island and out to the grid. If the grid fails, power is drawn from the batteries to energize the subpanel. The Sunny Boy inverter can now re-activate and provide power from the PV array to help power loads and charge the batteries.

Output Voltage

Most of the battery-based inverters we stock supply standard 120VAC /60Hz single-phase outputs. The SMA Sunny Island, the Magnum MS-4024, and OutBack inverters can be stacked in pairs for 240VAC, such as is available from utility companies and internal combustion generators. Pairs of OutBack and Sunny Island inverters can also be wired in parallel to provide more output power at 120VAC single-phase, or 120/240VAC split-phase. The Xantrex XW and the Magnum MS-PAE inverters deliver 120/240VAC power from one inverter, and can also be wired in parallel for greater power output . Most of them can be special ordered with other output voltages and frequencies for use anywhere in the world. See our export models and contact us with any special requirements that you have.

Interference

The electronic circuitry in inverters, especially battery-based inverters, may cause problems with radio and television reception, noise on telephones and buzz in audio equipment. Sine wave inverters cause the least amount of interference. Interference can be minimized by locating the inverter 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 cause interference on AM radio!

Wiring Considerations

Battery-based inverters require very high current from a battery to operate large loads. A 2kW inverter running at full power in a 12-volt system will be drawing nearly 200 amps from the battery. Large cables and good connections are required for proper operation. Use caution when plugging a small inverter into a lighter outlet 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.

More Energy
Active Management
Enhanced Safety

Start Maximizing your solar energy output today

With Tigo Energy, you get all the benefits of module-level electronics, delivered by the most efficient and reliable system available.
You can use Tigo Energy with your favorite inverter, and install your system using standard, proven design approaches.

Tigo Energy combines unmatched system performance with never-before available system visibility. Find out why the Module Maximizer is becoming the product of choice for installers worldwide.

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BAY AREA GREEN BUSINESS

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CE

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Tigo Energy

Module Maximizer Solution

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

The Tigo Energy Maximizer technology corrects for performance mismatch issues, which drag down the energy output of arrays. Each Tigo Energy Module Maximizer communicates with the Tigo Energy Management Unit (MU), which sets the Maximum Power Point (MPP) of each module through a patented method of impedance matching (rather than DC to DC power conversion).

Enhanced Safety

The Tigo Energy Maximizer Solution improves the safety of arrays through its PV-Safe technology, which stops the flow of energy through system cables when commanded by the system operator. This can be done remotely from the management software or on-site by pressing the PV-Safe button on the Management Unit. When this feature is used alongside the standard DC disconnect at the inverter, the system or sub-section voltage can be turned off for safer maintenance or emergency services.

The Maximizer Solution also has an optional theft prevention solution which alerts the system owner if modules are unexpectedly disconnected from the system day or night. This triggers alerts that can be sent directly to the owner, security companies, and law enforcement.

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

Module Maximizer-ES (MM-ES)

With the Tigo Energy Series Solution (MM-ES), modules are connected in series as in a normal array (1 Module Maximizer per module). The MM-ES solution provides an industry-leading 99.5% average conversion efficiency, the smallest electronics footprint of its kind. The polycarbonate enclosure eliminates the need for extra grounding. The MM-ES enhances the performance of shaded and un-shaded arrays.

The Maximizer plugs directly into the module cables and attaches to the underside of the module frames. The enclosures are non-metallic and do not require grounding.

The Maximizers have a 20 year warranty.

Tigo has four MM-ES models to cover a broad range of PV modules. Choose the correct model based on your PV module's maximum temperature corrected open-circuit voltage (Voc). Be sure to choose a model with module cable connectors that will match the connectors on your chosen PV module.

Purchasing a Tigo Energy Maximizer System

Example 1

4kW residential system

(20) 215W modules

(1) 4kW string inverter

Tigo Energy System:

(20) ES50 4W (Maximizers)

(1) MMU (Management Unit)

(1) MP-RES (residential 5-year monitoring)

Example 2

350 kW commercial system

(1,520) 230W modules

(2) roof surfaces

(1) 350kW central inverter

Tigo Energy System:

(1,520) ES50 4W (Maximizers)

(4) MMU (1 Management Unit per 400 modules)

(1,520) Units of MP-COM (commercial monitoring)

Maximizer Management Unit (MMU)

Active System Management

The Tigo Energy Maximizer Management Unit (MMU) communicates between the Module Maximizers and the inverter, controls processes in real time and sends data to a remote server in order to allow multiple users to observe and interact with the monitoring system. The Tigo Energy management software provides many applications to provide greater control over performance, including module-level granularity, alerts and maintenance reports. Understanding the performance levels of each system component allows for quick and cost-effective maintenance. On-demand maintenance reports help crews directly target problem areas, reducing time in the field and O&M costs. Crews arrive on site with the correct replacement components and tools to get the job done quickly.

Each Tigo Energy Maximizer system includes one MMU, with the option of a second unit for system redundancy. The MMU mounts near the inverter and has a manual user interface and LCD display housed in a NEMA 3 enclosure for on-site programming. It communicates with each PV module in the system, provides management and control functions for the module Maximizers, and serves as a gateway to the Data Center. The Maximizer Management Unit is pre-configured with CAT-5 Ethernet access and each Management Unit kit includes a complimentary Gateway to extend the range of wireless communication to the Maximizer.

The Tigo Energy PV-Safe feature allows system owners to disconnect the module from the bus at the Maximizer. This feature can be activated with a safety button located on the Management Unit and automatically activated upon tripping the AC main switch. This allows for system installation, maintenance, and emergency work to be done without endangering personnel with high DC voltage.

Sensor Box and Sensors

Additional sensors may be ordered with the Tigo Energy Maximizer System for measuring light intensity, back panel temperature, or revenue-grade metering. The sensor accessories are powered RS-485 devices and are connected through the Gateway. Install the accessories within the array as desired and place the Tigo Energy Sensor Box in close proximity to the sensor(s). The sensor accessories are provided with an extension Y-cable (one male and two female connectors).

Tigo model	Maximizer type	Max module watts	Module voltage (Vmp Range)	Max voltage (Voc)	Max input current (Isc)	Max continuous current (Imp)	Module connector type	Item code
ES050V300W-3W	ES (Series)	300	16-48	52 V	10A	9.5 A	MC3	**030-09301**
ES050V300W-4W	ES (Series)	300	16-48	52 V	10A	9.5 A	MC4	**030-09302**
ES050V300W-5W	ES (Series)	300	16-48	52 V	10A	9.5 A	Tyco	**030-09303**
ES050V300W-6W	ES (Series)	300	16-48	52 V	10A	9.5 A	H+S Radox	**030-09304**
ES075V350W-4W	ES (Series)	350	30-65	75 V	7.5 A	6.5 A	MC4	**030-09305**
ES075V350W-5W	ES (Series)	350	30-65	75 V	7.5 A	6.5 A	Tyco	**030-09306**
ES110V300W-3W	ES (Series)	300	30-89	110 V	5A	4.7 A	MC3	**030-09307**
ES110V300W-4W	ES (Series)	300	30-89	110 V	5A	4.7 A	MC4	**030-09308**
ES170V300W-4W	ES (Series)	300	30-140	170 V	3A	2.6 A	MC4	**030-09309**
MU-ESW	Tigo Energy Maximizer Management Unit (for series configurations)							**030-09277**
MU-GTWY	Extra Gateway (boost signal strength for large systems, with Y-cable)							**030-09289**
TS	Accessory - temperature sensor (with Y-cable)							**030-09282**
LS	Accessory - light sensor (with Y-cable)							**030-09280**
REVAC	Accessory - revenue grade AC meter (for PBI reporting)							**030-09288**
MP-RES	5-year monitoring service for systems under 10kW DC							**030-09285**
MP-COM	5-year monitoring service for systems over 10kW DC (per unit)							**030-09287**

SolarEdge

Distributed MPPT inverter system

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

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

The SolarEdge built-in SafeDC feature ensures installer and firefighter safety at all times by automatically shutting off the PowerBox's DC current and voltage if they sense heat of nearby fire. DC current and voltage is also automatically shut off when the SolarEdge inverter is turned off or disconnected from the grid. A safe module voltage eliminates electrocution risk during installation and servicing, and protects power company personnel, maintenance personnel, and firefighters.

Because SolarEdge inverters are "transformerless" all PV array wiring must use double-insulated PV Wire (including factory-installed module wire leads). The SolarEdge PowerBoxes have a 25-year warranty and the SolarEdge inverters have a 12-year warranty (extendable to 20 years). PowerBoxes and inverters are ETL Listed to UL 1741 for the U.S. and Canada and are NEMA 3R.

SolarEdge Components

SolarEdge **PowerBoxes** can fit almost any crystalline silicon or thin-film module. The PowerBox optimizes energy output and enables performance monitoring for each module. Further, the PowerBoxes automatically maintain a fixed string voltage, giving installers greater flexibility to design optimal PV systems, and providing higher fault tolerance.

An **AOB PowerBox** can be connected to one or several crystalline silicon modules with a total maximum output of 350 watts since more than 2 modules can be connected in some cases and maximum power voltage under 60VDC. Available with either MC4 compatible, Tyco, or H&S Radox module connections. Output connections are MC4 compatible.

A **TFI PowerBox** can be connected to between two and four modules with a total maximum output of 300 watts and a maximum power voltage under 95VDC, and can be used with low power thin-film modules. Available with fused inputs of 2A or 3A, or without a fuse (6A max). MC4 compatible module and output connectors only.

SolarEdge PowerBox model	Description	Module connector	Item code
PB250-AOB-4S3C	AOB PowerBox 250W with MC4 output connector	MC4	**030-09465**
PB250-AOB-TR3C	AOB PowerBox 250W with MC4 output connector	Tyco	**030-09467**
PB250-AOB-HS3C	AOB PowerBox 250W with MC4 output connector	H&S Radox	**030-09466**
PB350-AOB-4S3C	AOB PowerBox 350W with MC4 output connector	MC4	**030-09461**
PB350-AOB-TR3C	AOB PowerBox 350W with MC4 output connector	Tyco	**030-09463**
PB350-AOB-HS3C	AOB PowerBox 350W with MC4 output connector	H&S Radox	**030-09462**
PB350-TFI-3F3C	TFI Thin-Film PowerBox with MC4 connectors, no fuse	MC4	**030-09458**
PB350-TFI-3F3C-2A	TFI Thin-Film PowerBox with MC4 connectors, 2A fuse	MC4	**030-09459**
PB350-TFI-3F3C-3A	TFI Thin-Film PowerBox with MC4 connectors, 3A fuse	MC4	**030-09460**

SolarEdge inverters are the only inverters designed to work exclusively with power optimizers. These simple, reliable, ungrounded inverters perform only DC to AC inversion of incoming power from one or multiple strings, because MPPT and voltage management are handled by the PowerBoxes. They work with 208 and 240VAC systems, have built-in AC and DC disconnects, weigh 52 pounds and reach 97.5% CEC weighted efficiency. ETL Listed to UL 1741 for the U.S. and Canada.

SolarEdge Inverter model	Description	Inverter watts	Maximum AC output current		Item code
			208VAC	240VAC	
SE3000US-Ex	3 kW, 1Ø grid-tie inverter, Ethernet (coming Q2/2011)	3000	16.5A	14A	**030-09448**
SE3300US-ER	3.3 kW, 1Ø grid-tie inverter, Ethernet, RS-485 included	3300	17.5A	15A	**030-09450**
SE3800US-ER	3.8 kW, 1Ø grid-tie inverter, Ethernet, RS-485 included	3800	20A	16A	**030-09449**
SE5000US-ER	5.0 kW, 1Ø grid-tie inverter, Ethernet, RS-485 included	5000	26A	23A	**030-09452**
SE6000US-ER	6.0 kW, 1Ø grid-tie inverter, Ethernet, RS-485 included	6000	N/A	26A	**030-09453**

POWER REDEFINED

SolarEdge offers the first end-to-end Distributed Power Harvesting system complete with module-embedded DC power optimizers, specialized DC-AC inverters, module-level monitoring and automatic safety mechanisms.

- Module-embedded power optimizers enabling optimized MPPT for maximum energy gain from every module
- Module-level monitoring for precise, remote troubleshooting through web portal and iPhone
- SafeDC™ - Automatic DC voltage shutdown during installation, maintenance and firefighting
- 97%+ CEC weighted efficiency inverters specifically designed for power optimizers
- Significant cost-efficiency, including savings on wiring, DC disconnects & fuses, and built-in communication hardware
- Optimal roof utilization through connection of strings of different length and orientation

Photon Magazine:

"The SolarEdge PowerBox improved the system's output by almost one third."

power optimizers survey, Nov. 2010

www.solaredge.com

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architects of energy™

SolarEdge

Module-Level Monitoring

SolarEdge's monitoring system is a web-based application that provides PV performance monitoring, fault detection and troubleshooting at module-level, string-level and system-level. Web-based software provides real-time monitoring, facilitating increased system uptime and lowering maintenance costs. Installation feedback and troubleshooting are immediate and accurate. Remote fault detection allows faster fault resolution via a semi-automatic troubleshooting process that pinpoints the location of underperforming modules on a PV site map. No hardware or wiring is required between the SolarEdge PowerBoxes and inverter as the monitoring sensors and transmitters are built in, and data is transmitted over the regular DC power lines. Connection between the inverter(s) and the internet can either be by RS-232 to a modem (one inverter only with a max distance of 50 ft), or by Ethernet with connection between multiple inverters with CAT5 cable using their RS-485 connection ports. Wireless connection is also possible using ZigBee interfaces. ZigBee interface models are available either with an internal antenna or external antenna for wireless transmission up to a 250 m (820 ft) range, and are installed inside the inverter. Wireless transceivers save wiring and offer better lightning protection. No external power is required. Use a Master unit for a single inverter or for the first of multiple inverters, with slave units in the additional inverters. Data can be transmitted to a ZigBee equipped modem, or use the ZigBee-to-Ethernet interface.

SolarEdge wireless connectivity between inverters and gateway

ZigBee transceivers can be installed inside SolarEdge inverters, and offer full mesh topology for communication between one or more inverters and an Ethernet gateway. Models with an internal antenna or external antenna available. Up to 250 m (820 ft) range. Wireless transceivers save wiring and offer better lightning protection. No external power required.

SolarEdge wireless connectivity between inverters and a remote router

For direct connection to the SolarEdge monitoring portal from remote installation sites, use the ZigBee Ethernet interface for communicating with a home or office Ethernet router. External antenna extends range up to 250 m (820 ft). Wireless connection saves wiring and offers better lightning protection. Requires internal ZigBee transceiver on one of the inverters (sold separately).

Model	SolarEdge communications component description	Item code
SE1000-ZB01-MST	ZigBee Interface for SE Inverter, Internal Antenna, Master Digi International	030-09490
SE1000-ZB01-SLV	ZigBee Interface for SE Inverter, Internal Antenna, Slave Digi International	030-09491
SE1000-ZB02-MST	ZigBee Interface for SE Inverter, External Antenna, Master Digi International	030-09492
SE1000-ZB02-SLV	ZigBee Interface for SE Inverter, External Antenna, Slave Digi International	030-09493
SE1000-ZB00-DG2	ZigBee to Ethernet interface, ConnectPort X2, Digi International	030-09494
SE1000-GSEG-20E	GSM modem for SE inverter (available mid 2011)	030-09495

Software Tools

A free iPhone app is available as a download from the Apple iTunes Store website. Registered users can monitor multiple sites from their iPhone, anytime, anywhere. The application provides an at-a-glance view of energy production levels. Present and past data are available at the flick of a finger. In addition, current weather conditions and forecasts are presented to aid in assessing the system's performance.

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

Monitoring Combiner Boxes - available mid-2011

The SolarEdge Smart Monitoring Combiner Boxes provide a high level of system performance monitoring and exceptional system safety in larger systems using larger commercial and industrial inverters. The combiners incorporate string level GFDI (Ground-Fault Detector & Interrupter) to detect and isolate faulty strings so other strings are not affected. The system includes a built-in TCP-IP interface and immediately provides on-site and web monitoring as well as email fault notification. Additionally the detection and isolation components are continuously monitored and an alert is sent in case of any internal fault, promising an uninterrupted detection system. The boxes include built in fuses that meet the US string fusing requirements for grounded arrays, eliminating the need for additional fuses. Communication via ZigBee, RS-485 or Ethernet allows remote control of combiners from the web server. Available in three sizes for up to 16, 36 or 64 strings. ETL Listed to UL 1741 standard. NEMA 4 or 4X enclosures. 10-year warranty.

SolarEdge model	Description	Item code
SECB-16SM-ERZ-X	16 string combiner monitoring, NEMA 4X enclosure	053-01500
SECB-16GF-ERZ	16 string combiner w/ GFDI and monitoring, NEMA 4 enclosure	053-01501
SECB-16GF-ERZ-X	16 string combiner w/ GFDI and monitoring, NEMA 4X enclosure	053-01502
SECB-36SM-ERZ-X	36 string combiner monitoring, NEMA 4X enclosure	053-01504
SECB-36GF-ERZ	36 string combiner w/ GFDI and monitoring, NEMA 4 enclosure	053-01505
SECB-36GF-ERZ-X	36 string combiner w/ GFDI and monitoring, NEMA 4X enclosure	053-01506
SECB-64SM-ERZ-X	64 string combiner monitoring, NEMA 4X enclosure	053-01508
SECB-64GF-ERZ	64 string combiner w/ GFDI and monitoring, NEMA 4 enclosure	053-01509
SECB-64GF-ERZ-X	64 string combiner w/ GFDI and monitoring, NEMA 4X enclosure	053-01510

Enphase

Grid-Tie Microinverter System

The Enphase Energy Microinverter System improves energy capture, increases reliability, and dramatically simplifies design, installation and management of solar power systems. The Enphase System includes the Microinverter, the Envoy Communications Gateway, and the web-based Enlighten monitoring and analysis service.

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

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

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

System safety is enhanced since all of the output wiring from the PV array is AC, and therefore doesn't contain hazardous DC voltages once the AC power is shut down for service or emergency. If the AC to the array is shut off, only the DC voltage of a single module (typically under 50VDC) is present in the array creating a much safer situation for maintenance personnel or firefighters.

Model Selection

Enphase makes microinverters for most popular PV modules:

The M190 inverters can be used with modules of up to 230 watts made with 60 to 72 cells in series. Available with either 240VAC single-phase output, or 208VAC output for three-phase systems. Max branch circuit size is 15A (up to 15 inverters in 240VAC single-phase systems and up to 21 inverters in 208VAC three-phase systems).

The M210 is a higher input voltage version of the M190, and can be used with modules of up to 240 watt with peak power voltage of 31-50 volts. This version is designed for high-efficiency modules like SunPower and SANYO.

The New D380 TwinPack Microinverter is comprised of two Enphase microinverters in a single enclosure. Its innovative cabling system further reduces balance-of-system and installation costs because it's possible to install 33% more modules per circuit with the D380. The D380 has a black anodized housing, which improves aesthetics and allows for better thermal dissipation. The D380 TwinPack is optimized for commercial applications, but is applicable to many residential installations as well. D380 Microinverter TwinPacks are auto-sensing and compatible with 240Vac split-phase and 208Vac WYE three-phase utility systems. Maximum branch circuit size is 20A.

The Enphase Microinverter is qualified to a NEMA 6 environment rating and operates at full power at temperatures from -40°C (-40°F) to 65°C (149°F), allowing applications in harsh environments.

CSA Listed to UL 1741 for the U.S. and Canada. 15-year standard warranty.

Enphase model	Module watts	Module inputs	AC output volts	AC output watts (max)	Max DC voltage	DC MPPT voltage	Module connector	CEC Rated Efficiency	Item code
M190-72-240-S12	150 - 230	1	240	190	54	22-40	MC4	95.00%	**030-03740**
M190-72-208-S12	150 - 230	1	208	190	54	22-40	MC4	95.00%	**030-03742**
M190-72-240-S13	150 - 230	1	240	190	54	22-40	Tyco	95.00%	**030-03734**
M190-72-208-S13	150 - 230	1	208	190	54	22-40	Tyco	95.00%	**030-03735**
D380-72-2LL-S12	150 - 230	2	208 or 240	380	54	22-40	MC4	95.00%	**030-03724**
D380-72-2LL-S13	150 - 230	2	208 or 240	380	54	22-40	Tyco	95.00%	**030-03725**
M210-84-240-S12	150 - 240	1	240	210	62	31-50	MC4	95.50%	**030-03744**
M210-84-208-S12	150 - 240	1	208	210	62	31-50	MC4	95.50%	**030-03745**

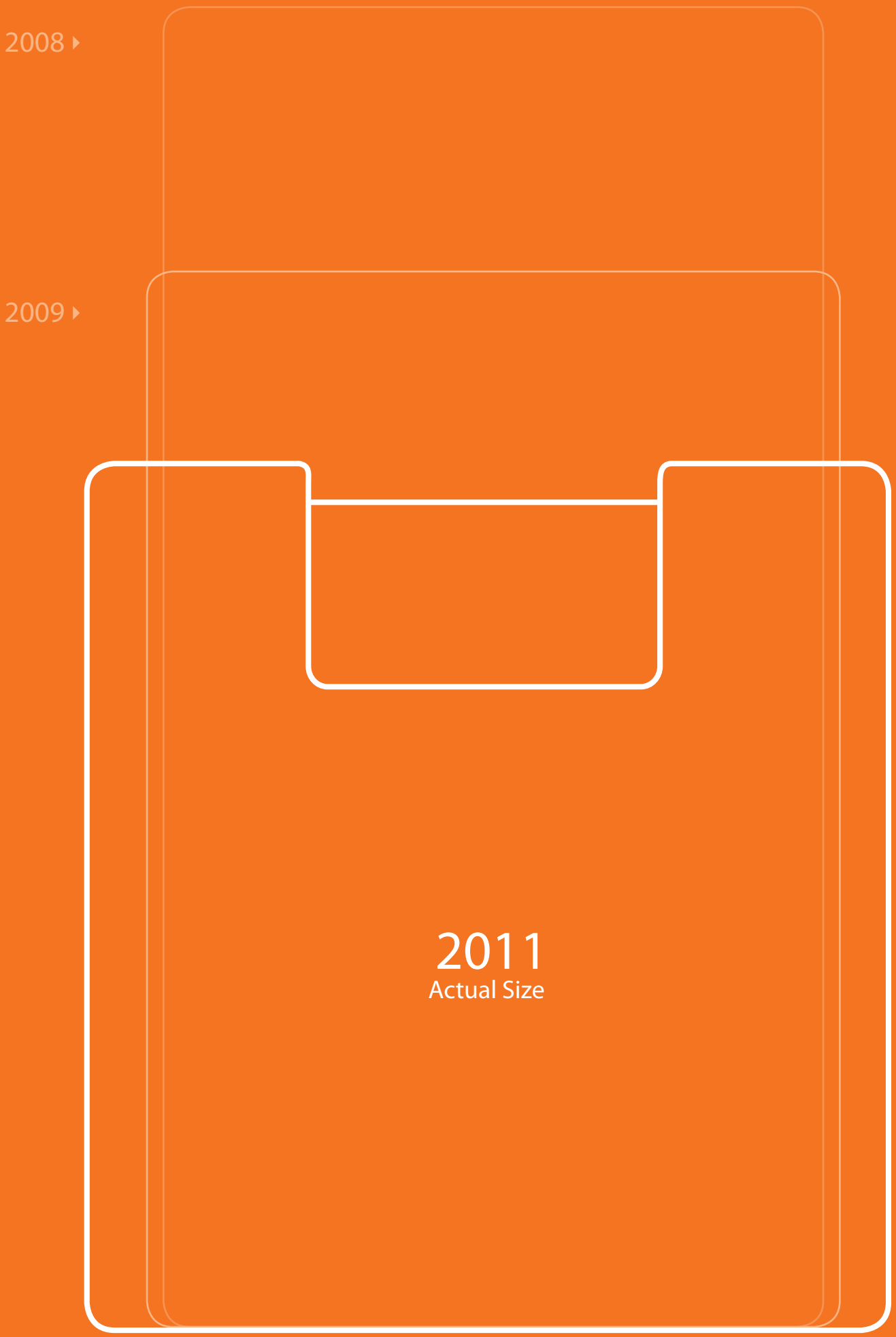
THE BIGGEST THING IN SOLAR MAY ACTUALLY BE QUITE SMALL.

Coming this spring, the next-generation Enphase Microinverter achieves a smaller footprint, higher power and 96% CEC efficiency.

This small inverter represents enormous breakthroughs in performance and design.

[e] enphase ENERGY

1 877 797 4743 enphaseenergy.com


2008
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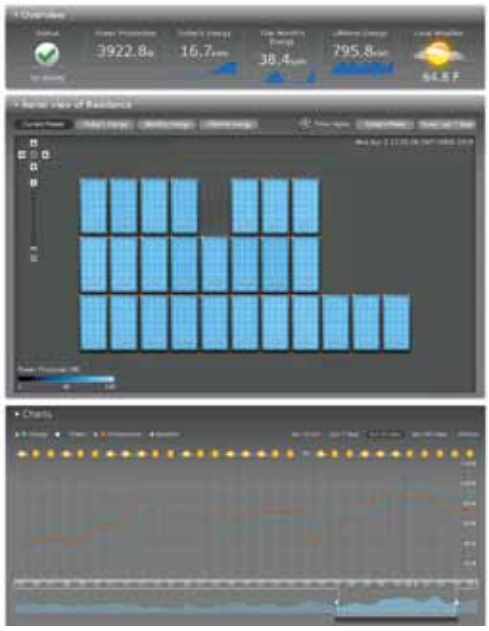
Actual Size

Enphase

Module Level Monitoring

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



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

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

Environ Smart Thermostat

Environ is a smart thermostat device that integrates with the Enphase Enlighten website, allowing owners to simultaneously manage their solar system along with their heating and cooling system in a single web-based platform. Environ makes it easy to take control of energy usage and lets owners set or adjust their home temperature at anytime and from anywhere, using a web browser or smart phone, as well as directly with the thermostat device.

Environ wirelessly connects to the Envoy Communions Gateway using the ZigBee communications protocol. The Envoy connects the Environ to the internet, allowing it to transmit and receive information from the Enlighten website.

- Controls nearly any common residential heating and cooling system
- Supports 3 stages of heat, 2 stages of cool, multi-stage heat pumps, humidifier, de-humidifier and external air baffles
- Programmable up to 7 periods per day, 7 days a week
- Large LCD touch-screen display
- 1, 3, and 5-year subscriptions available

Enphase model	Environ Smart Thermostat	Item code
EVRN-RT-01	Enphase Environ Smart Thermostat w/ ZigBee kit	**030-03701**
EVRN-RT-02	Enphase Environ Smart Thermostat w/ ZigBee (additional)	**030-03702**
EVRN-ENL-01-Y1	Enphase Environ Smart Thermostat 1 YR subscription	**085-03721**
EVRN-ENL-03-Y3	Enphase Environ Smart Thermostat 3 YR subscription	**085-03723**
EVRN-ENL-05-Y5	Enphase Environ Smart Thermostat 5 YR subscription	**085-03725**
EVRN-RR-01	Enphase Environ repeater for ZigBee interface (optional)	**085-03711**

M-Series Inverter Installation Accessories

Order one install kit for each AC branch circuit of up to 15 modules in a 240-volt M190 system, 13 modules in a 240-volt M210 system, 21 modules for a 208-volt M190 installation and 18 modules for a 208-volt M210 system. Each kit contains one interconnect cable (to connect to wire run to AC distribution panel), one end plug, and a bracket to mount a small junction box to the array's racking. An extension cable is required when inverters are mounted more than 6 feet apart from each other.

Enphase model	Enphase installation kits	Item code
EKIT-01-001	M-series installation kit for one AC branch circuit	**030-03748**
EKIT-12-001	M-series installation kit for one AC branch circuit (quantity 12)	**030-03762**
EEXC-01-06	M-series extension cable with connectors at both ends - 6 foot	**030-03753**
EEXC-01-12	M-series extension cable with connectors at both ends - 12 foot	**030-03754**
EEXC-01-20	M-series extension cable with connectors at both ends - 20 foot	**030-03755**
ECWP-01-06	M-series interconnect cable with connector at one end - 6 foot	**030-03766**
ECWP-01-12	M-series interconnect cable with connectors at one end - 12 foot	**030-03770**
ECWP-01-20	M-series interconnect cable with connectors at one end - 20 foot	**030-03772**
EMBK-50-001	Mounting bracket (for a junction box)	**030-03749**
ECAP-01-002	End cap (for sealing cable socket on end inverter in circuit)	**030-03775**
ECAP-50-002	End cap - 50 pack	**030-03774**

D-Series Inverter Installation Accessories

Each 20A AC branch circuit may have up to 20 modules in a 240-volt system and 30 modules in a 208-volt ystem. The D-series cables are ordered separately from the inverter. An extension cable is required when inverters are mounted more than 6 feet apart from each other. The "3-drop" trunk cables allow connection for three D380 inverters (for six PV modules). End caps seal off unused drops and the end of the branch circuit.

Enphase model	Enphase installation kits	Item code
ET3R-G2-06	Enphase AC trunk cable with three drops for D380, 240VAC	**030-03776**
ET3C-G2-06	Enphase AC trunk cable with three drops for D380, 208VAC	**030-03777**
ET1RC-G2-06	Enphase AC trunk cable with one drop for D380, 240VAC or 208VAC	**030-03786**
ECWP-G2-06	Enphase AC interconnect cable 6 ft. for D380	**030-03778**
ECWP-G2-12	Enphase AC interconnect cable 12 ft. for D380	**030-03780**
ECWP-G2-20	Enphase AC interconnect cable 20 ft. for D380	**030-03781**
EEXC-G2-06	Enphase extension cable, connectors/both ends, 6 ft. for D380	**030-03782**
EEXC-G2-12	Enphase extension cable, connectors/both ends, 12 ft. for D380	**030-03783**
EEXC-G2-20	Enphase extension cable, connectors/both ends, 20 ft. for D380	**030-03784**
ECAP-50-002	End cap for sealing end of D380 trunk cable	**030-03785**

SMA

Sunny Boy Grid-Tie Inverters

The popular SMA Sunny Boy inverters are available in sizes from 700 watts to 8000 watts, making them ideal for a wide range of applications from small residential systems to very large 3-phase industrial applications. All SMA inverters come standard with built-in LCD digital monitors that display instantaneous power output, the current day's power production, and the total energy produced since installation. All SMA inverters are compliant with UL 1741, UL 1998, IEEE-929, IEEE-1547, FCC Part 15 A & B. The new SMA inverters now have a standard 10-year warranty, with 5- and 10-year extensions available.

Sunny Boy 2000HFUS / 2500HFUS / 3000HFUS

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

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

UL Listed for the U.S. and Canada.

Sunny Boy SB700

The SB700 has a 120 VAC output and three different configurable input voltage ranges. The 120 volt output allows it to be used on 120/240 VAC systems as well as 208 VAC systems. Evergreen ES-A modules and typical 60-cell grid-tie modules cannot be used with this inverter because their voltage is too low to reach the MPPT voltage of this inverter before exceeding the maximum wattage allowed. It can be used with SANYO modules and with 36-cell and 72-cell modules. The SB700 is housed in a completely sealed stainless steel enclosure. Outdoor installation is recommended for the sealed inverters so natural air-flow can cool the heat-sink.

Model	Maximum AC power	AC output volts	DC array voltage	MPPT voltage range	CEC efficiency	Max AC output 208V/240V		Dimensions H" x W" x D"	Weight (lbs)	Item code
SB700USBD	700	120VAC	150-250	123-250	91.5%	7A @ 120V		12.7 x 12.6 x 7.1	43	**030-03113**
	600		125-250	100-200		6A @ 120V				
	460		95-250	77-150		4A @ 120V				
SB2000HFUS	2000W	208VAC or 240VAC	175-600	175-480	95.0%	10A	8.5A	28 x 13.7 x 7.2	51	**030-03074**
SB2500HFUS	2500W					12A	10.4A			**030-03075**
SB3000HFUS	3000W			220-480		14.4A	12.5A			**030-03076**
Flush Mount Kit	Mounting-flashing plate for recessed mounting of inverter between studs in wall									**030-03200**

SB7000USAEE-AUS1110116

Installers worldwide know SMA inverters are the key to a successful solar project.

SMA's innovation has set the standard in solar technology for more than 25 years. The Sunny Boy inverter is a prime example of this success and is ideally suited for residential and commercial applications. When investing in an inverter, reliability and performance are paramount. World-class German engineering and manufacturing standards assure long term, trouble-free performance; and with a peak efficiency of over 97%, energy harvest is unmatched.

SMA Inverters: Ask for them by name.

The Future of Solar Technology

SMA

SMA

Sunny Boy 3000US, 3800US, and 4000US

The compact design of the Sunny Boy 3000US, 3800US, and 4000US inverters makes them suitable for residential and light commercial use and the integrated DC disconnect helps keep installations cost effective. They are field configurable for positive ground systems. The 3000US and 4000US are auto-sensing for use on 240 and 208 VAC applications. The 3800US is for 240VAC only, and is specifically sized for buildings with a 100A service entrance panel (16A max AC current). They come with a DC disconnect and a 4-circuit integrated fused series string combiner that can be used with fuses up to 20 amps. It is shipped with 15-amp fuses. Now ARRA compliant.

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

The 5000US, 6000US and 7000US can be used in 208, 240 and 277 VAC applications. The 8000US can be used in 240 and 277 VAC applications. These inverters also come with a DC disconnect switch that connects to the bottom of the inverter. The disconnect has a 4-circuit integrated fused series string combiner that can be used with fuses up to 20 amps. The disconnect also has an input main lug for array DC input if the system has a separate combiner box. It is shipped with 15-amp fuses. All four models are field-configurable for positive ground systems. All inverters are compliant with UL 1741, UL 1998, IEEE-929, IEEE-1547, FCC Part 15 A & B. SMA inverters have a standard 10-year warranty. Now ARRA compliant.

Model	Maximum AC power	AC output volts	DC array voltage	MPPT voltage range	CEC rated efficiency	Max AC current	"Dimensions H"" x W"" x D""	Weight (lbs)	Item code
SB3000US	3000W	208VAC 240VAC	200-500	175-400 200-400	95.0%	15A 13A	17.8 x 13.8 x 9.3	88.6	**030-03163**
SB3800US-10	3800W	240VAC	250-480	250-480	96.0%	16A	17.8 x 13.8 x 9.3	88.6	**030-03162**
SB4000US	3500W 4000W	208VAC 240VAC	250-600	220-480 250-480	95.5% 96.0%	17A 17A	17.8 x 13.8 x 9.3	88.6	**030-03084**
SB5000US	5000W	208VAC 240VAC 277VAC	250-600	250-480	95.5%	24A 21A 18A	18.4 x 24.1 x 9.5	141	**030-03165**
SB6000US	6000W	208VAC 240VAC 277VAC	250-600	250-480	95.5% 96.0%	29A 25A 22A	18.4 x 24.1 x 9.5	141	**030-03166**
SB7000US	7000W	208VAC 240VAC 277VAC	250-600	250-480	95.5% 96.0% 96.0%	34A 29A 25A	18.4 x 24.1 x 9.5	141	**030-03167**
SB8000US	8000W	240VAC 277VAC	300-600	300-480	96.0% 96.0%	32A 29A	18.4 x 24.1 x 9.5	148	**030-03168**

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NEW! Sunny Boy 8000TL-US/9000TL-US/10000TL-US

Transformerless design, maximum yields

The new Sunny Boy TL-US series inverters feature SMA's innovative H5 topology, resulting in superior efficiencies of up to 98 percent and unmatched solar yields. The transformerless design reduces weight, increases the speed of payback and provides optimum value for commercial PV systems. The Sunny Boy TL-US inverters are a good choice for commercial 208VAC three-phase applications of any size. They come with an integrated DC disconnect, but require a separate combiner box with fusing on both the positive and negative DC conductors. Use the SMA TLUS Combiner Box below.

Inverter dimensions (without DC disconnect) are 18.5"W x 24"H x 9"D. Weight of all models is 77 lbs.

DC disconnect dimensions – 7'W x 12"H x 7.5"D. Weight 8 lbs.

TL inverters are UL Listed for the U.S. and Canada and IEEE-1547 compliant.

SMA model	Maximum AC power	AC output voltage	DC array voltage	MPPT voltage range	CEC rated efficiency	Max AC current	Item code
SB8000TL-US	8000W	208	300-600	300-480	98.0%	40	**030-03175**
SB9000TL-US	9000W				98.0%	44	**030-03176**
SB10000TL-US	10000W				97.5%	49	**030-03177**

NEW! Sunny Boy TL-US Combiner Box

Sunny Boy TL-US Combiner Box has six positive and six negative fused inputs for up to six module strings and meets the requirement for overcurrent protection on both polarities when using transformerless inverters. Fuses are not included. Use 600VDC rated KLKD fuses on page 117. The maximum string fuse size is 20A, however use the chart below to determine the combined maximum amperage of the array that can be used.

TL-US Combiner dimensions 17.2"W x 12.1"H x 3.8"D Weight 8.6 lbs. NEMA 3R enclosure.

SMA model	Description	Item code
SBCBTL6 TL-US	6-String fused combiner for TL inverters	**053-03002**

SMA TL-US Combiner Box current limits		
Number of strings	Maximum string current	Maximum continuous string current
3	18.7A	12A
4	14A	9A
5	11.2A	7.2A
6	9.4A	6A

Sunny Beam Bluetooth Wireless Monitor

SMA monitoring and communications accessories	Item code
SMA Sunny Beam Bluetooth	**030-03120**
SMA Bluetooth Piggyback Card	**030-03121**

The Sunny Beam features Bluetooth wireless technology for improved performance and versatility. The Sunny Beam communicates wirelessly with up to 12 Sunny Boy inverters and graphically displays all the key performance data of your solar system. It features fully automatic system monitoring, including an audible alert signal and it is powered by an integrated solar module and rechargeable battery. The Sunny Beam simultaneously displays power output, daily energy production and the total energy production of the system. It may also be configured to display other parameters such as the overall CO2 offset of your system, as well as your earnings in dollars. A hundred days of system performance data can be recorded and stored, and then simply transferred to a PC via a USB interface. Using the new and included Sunny Beam Webconnect software, the data can in turn be transferred to the Sunny Portal website for long-term storage, display, and evaluation. Setting up the Sunny Beam is fast and easy via an intuitive set of user menus. The Sunny Beam has a standard range of up to 150 feet but that can be extended or strengthened, in case of obstruction, through the use of the optional SMA Bluetooth repeater.

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

Sunny Boy Inverter Accessories

Sunny WebBox – Sunny Portal Connection

The SMA Sunny WebBox provides a connection between the operator's computer and the free Sunny Portal website (www.sunnyportal.com). The Sunny WebBox stores system performance data in its internal 8 MB memory or on a standard SD memory card and can be set to upload the data to the Sunny Portal website at user-selectable intervals. The WebBox can be connected to a Sunny Boy, Sunny Tower, Sunny Island, or Sunny Central inverter, and Sunny SensorBox devices (up to 50 units total). Password protected. 5-year warranty.

With the standard Sunny WebBox, connection to the inverter or SensorBox device is made with 4-conductor twisted pair cable between the inverter's RS-485 output and the WebBox terminals. Each inverter requires a RS-485-N Communication Module.

With the Bluetooth version, communication between the inverter(s) and the WebBox is wireless. Distance can be up to 330 ft or further with the addition of one or more Bluetooth Repeaters. Each inverter requires a WebBox Bluetooth Piggyback card. Any Sunny SensorBox devices must be equipped with Bluetooth.

Both Sunny WebBox versions connect to a local area network (LAN) with an Ethernet cable or to a phone line with the optional modem.

Sunny SensorBox

The Sunny SensorBox is compact in size and installs easily at the PV array. Its integrated sensors continuously monitor solar irradiation and module temperature. By using irradiation and module temperature, it is possible to calculate the expected output of the PV array for comparison to the actual power output of the inverters. This can help identify and troubleshoot reductions in energy yield. The Sunny SensorBox sends data to the Sunny WebBox via an RS-485 data link, or by wireless communication with the Bluetooth version. From there, the data can be transferred to a PC for further processing or to the Sunny Portal for automatic performance analysis. The Sunny SensorBox can accommodate up to 3 additional sensors such as ambient temperature, wind speed and an additional irradiance sensor making the performance data even more accurate. Shading, dust and dirt, defects and gradual module degradation have adverse effects on the overall performance of the PV array. 5-year warranty.

SMA monitoring and communications accessories	Item code
Sunny WebBox - RS-485 connection port	**030-03141**
Sunny WebBox-BT-20 - Bluetooth wireless connection	**030-03139**
Sunny SensorBox - RS-485 connection port	**030-03191**
Sunny SensorBox - Bluetooth wireless connection	**030-03134**
Sunny SensorBox Anemometer	**030-03193**
Mounting bracket for mounting the wind speed sensor	**030-03196**
Sunny SensorBox Ambient Temp Sensor	**030-03195**
Sunny SensorBox Additional Module Temp Sensor	**030-03197**

Model	SMA Sunny Boy communications cards and accessories	Item code
BTPBINV-NR	SMA Bluetooth Piggyback Card. For wireless communications between inverters and the Bluetooth version of the WebBox or the Sunny Beam. One needed for each inverter to be monitored. Up to 150 ft range in open air. Walls and other obstructions will decrease usable distance	**030-03121**
BTREP-IN	SMA Bluetooth repeater for increasing the range of SMA Bluetooth products. For use indoors. For greater distances, more than one repeater can be used from point to point.	**030-03119**
RS-485-N	RS-485 Module for remote communication between Sunny Boy Inverter(s) and Sunny WebBox or 3rd party monitoring system. 4-conductor CAT5 cable required. For Sunny WebBox model with RS-485 port. One module is required for each inverter to be monitored.	**030-03123**
RS-485 Cable	Cable to connect to multiple inverters using RS-485 modules – 50 feet (15 meters).	**030-03148**
Service Cable	Cable to connect a USB port to change software configuration parameters	**030-03154**
BEAM-BT-SUPPLY	USB plug-in power supply to charge the Sunny Beam batteries	**030-03117**
PWRSUPPLY	Plug-in power supply for Bluetooth Repeater, Sunny WebBox, and the Power Injector of the Sunny SensorBox	**030-03188**
SensorBox Power-Injector	Replacement RS-485 Power Injector Feed-in unit for power supply via the RS-485 communication bus, incl. plug-in power supply	**030-03189**

Fronius

Residential and Commercial IG Inverters

Fronius IG inverters offer high efficiency, precision maximum power point tracking, and intelligent thermal management to maximize energy output from grid-tie photovoltaic systems. Their wide input voltage range permits the use of modules in any power and voltage range. Their light weight and innovative mounting hardware make them easy to install. Fronius IG inverters come standard with an integrated LCD that displays and records over 20 parameters pertaining to inverter and system operation. Fronius inverters have 3 expansion slots that allow you to add features like external sensors and remote displays. You can use a personal computer to update the inverter with the latest software upgrades. The larger inverters (4 kW and larger) are built with multiple power stages. When these inverters see array capacity at less than half, one stage turns off, giving the inverter higher efficiency during periods of low insolation. CSA Listed to UL 1741 for the U.S. and Canada. 10-year warranty. 5-year warranty extension available.

IG Plus Inverters

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

Model	Maximum AC power	DC array voltage	CEC rated efficiency			Maximum AC current			AC output volts	Weight (lbs)	Item code
			208V	240V	277V	208V	240V	277V			
IG 2000	2000 W	150-450	n/a	93.5%	n/a	8.35 A	n/a	n/a	240 VAC	26	**030-03402**
IG 2500-LV	2350 W		93.0%	n/a	n/a	n/a	11.25 A	n/a	208 VAC		**030-03410**
IG 3000	2700 W		n/a	94.0%	n/a	11.25 A	n/a	n/a	240 VAC		**030-03403**
IG 4000	4000 W		n/a	94.0%	n/a	16.7 A	n/a	n/a	240 VAC	42	**030-03405**
IG 4500-LV	4500 W		93.5%	n/a	n/a	n/a	21.6 A	n/a	208 VAC		**030-03412**
IG 5100	5100 W		n/a	94.5%	n/a	21.3 A	n/a	n/a	240 VAC		**030-03407**
IG Plus V 3.0	3000 W	230-500	95.0%	95.5%	96.0%	14.4 A	12.5 A	10.8 A	All models operate at: 208 VAC or 240 VAC or 277 VAC	55	**030-08481**
IG Plus V 3.8	3800 W		95.0%	95.5%	96.0%	18.3 A	15.8 A	13.7 A			**030-08483**
IG Plus V 5.0	5000 W		95.5%	95.5%	96.0%	24.0 A	20.8 A	18.1 A		84	**030-08485**
IG Plus V 6.0	6000 W		95.5%	96.0%	96.0%	28.8 A	25.0 A	21.7 A			**030-08487**
IG Plus V 7.5	7500 W		95.5%	95.5%	96.0%	36.1 A	31.3 A	27.1 A			**030-08489**
IG Plus V 10.0	10,000 W		95.0%	95.5%	96.0%	48.1 A	41.7 A	36.1 A		108	**030-08491**
IG Plus V 11.4	11,400 W		95.0%	95.5%	96.0%	54.8 A	47.5 A	41.2 A			**030-08493**
IG Plus V 11.4-3	11,400 W		95.0%	96.0%	n/a	31.6 A	27.4 A	n/a	208/240VAC		**030-08495**
IG Plus V 12.0-3	12,000 W		n/a	n/a	96.0%	n/a	n/a	14.4	277VAC		**030-08497**
Extended warranty - 15 years total for IG 4, 4.5 and 5.1 kW inverters (5-year extension over standard)											**030-03470**
Extended warranty - 15 years total for IG 4, 4.5 and 5.1 kW inverters (5-year extension over standard)											**030-03471**
Extended warranty - 15 years total for IG Plus V 3.0 and 3.8 kW inverters (5-year extension over standard)											**030-03477**
Extended warranty - 15 years total for IG Plus V 5, 6 & 7.5 kW inverters (5-year extension over standard)											**030-03476**
Extended warranty - 15 years total for IG Plus V 10, 11.4 & 12 kW inverter											**030-03475**

Fronius IG Wireless Personal Display

The Fronius IG Personal Display readout and interface are based on the same display that comes standard on all Fronius IG Series inverters. Although tested to 150 feet indoors and 500 feet outdoors, there are many reports from the field of the units transmitting from much farther distances. The Personal Display can aggregate data for up to 15 Fronius IG inverters or show data for each individual inverter in a system – i.e., data from a system that is over 75 kW AC can be viewed together or as sub-systems. It shows instantaneous data such as power, voltage and current, and it will store the daily and cumulative data. The display offers two levels of access: easy and pro. In the easy level, homeowners can view system basics like power, energy output, CO_2 offset, and the number of dollars saved. The pro level offers more advanced information like voltage, current and grid frequency. The display can mount on a wall, or be placed on table. A wireless card is required for each inverter to be monitored. 2-year warranty.

IG DATCOM Accessories

Datalogger Boxes and Cards

Add these data communications and data logging features to your inverter and turn it into a data acquisition system and weather monitoring station. DATCOM components and accessories connect to the inverter and each other with standard Cat 5 network cables and RS-232 cables. Datalogging requires a COM card to be installed in each inverter in the system and a Datalogger Box or Card or a Datalogger Web. 2-year warranty on all Fronius DATCOM equipment.

Datalogger Web

Datalogger Web provides data storage and PC Interface over a network connection. It works in tandem with COM Cards within the DATCOM System to provide real-time and archival data. The built in Web server enables the use of network-based monitoring as well as Fronius free web-hosted data access. It supports up to 100 FRONIUS Solar Inverters per Datalogger Box.

Datalogger Box

Datalogger Box stores the data collected from the inverters and any weather sensors, and connects to a PC or an external modem to allow you to monitor your PV system from anywhere in the world. The Datalogger Easy monitors one IG inverter. The Datalogger Pro can monitor up to 100 Fronius IG inverters.

Datalogger Cards

Datalogger Cards perform the same function as the Boxes. The Easy card works for one inverter; the Pro card works for up to 100 inverters. Both cards work with a COM card and DATCOM systems. Output is RS-232.

Sensor Box, Sensor Card and Sensors

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

Interface Box and Card

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

Fronius Inverter Accessories

Model	Description	Item code
IG Plus V Buss Bar	Use these to bypass the internal string combiner. Two are required when a single input is over 20A	030-03464
IG Personal Display	Wireless display for IG inverters - wireless card required to monitor each inverter	030-03417
Personal Display Wireless Card	Wireless card for personal display	030-03419
COM card, retrofit	Communications card for all Fronius IG inverters	030-03425
Datalogger Web - wireless enabled (WLAN)	Data storage and PC Interface over a network connection. Built in Web server. For up to 100 IG inverters	030-03437
Datalogger Web Wireless Card	one card required for each inverter for wireless connection to Datalogger Web	030-03456
WLAN USB Stick	Connect wirelessly to Datalogger Web. indoor use only and operational from 32 to 113 degrees F	030-03450
WLAN USB Adapter	Connect wirelessly to Dataloggear Web. outdoor rated and operational from -4 to 158 degrees F	030-03451
Datalogger Pro Card	Control and monitoring data storage and PC interface for up to 100 IG inverters	030-03432
Datalogger Pro Box	Control and monitoring data storage and PC interface for up to 100 IG inverters	030-03431
Datalogger Easy Card	Control and monitoring data storage and PC interface for 1 IG inverter	030-03434
Datalogger Easy Box	Control and monitoring data storage and PC interface for 1 IG inverter	030-03435
Datalogger Interface Box	Combines benefits of the Datalogger Pro and interface box	030-03436
Interface Box	Use to export real time data without data storage – for up to 100 inverters	030-03440
Interface Card	Use to export real time data without data storage – for up to 100 inverters - mounts in inverter	030-03438
Interface Card - Easy	To export data without data storage from 1 inverter	030-03441
DATCOM power supply	Used when Datalogger boxes are to far from inverters to be power over com cable	030-03439
Sensor card	Monitoring interface with 6 sensor input channels	030-03443
Sensor box	Monitoring interface with 6 sensor input channels	030-03442
Sensor, wind speed	For measuring wind speed. Sensor box (above) is required.	030-03446
Sensor, ambient temperature	For measuring outside temperature. Sensor box is required.	030-03448
Sensor, module temperature	For measuring module temperature. Sticks to back of PV module. Sensor box is required.	030-03449
Sensor, irradiance	Reference PV cells for measuring solar insolation. Sensor box is required.	030-03444
RS-232 null modem cable	For connection of Datalogger cable to PC or cable.	030-03453
Cat 5 cable 3.3 feet	Network cable for connecting inverters to each or to Sensor Box and Datalogger Box	030-03455
Smart Converter RS-232 Card	Converts the DATCOM system RS-485 interface to an RS-232 interface. Mounts in inverter. IG Plus V only	030-03460
Smart Converter RS--232 Box	Converts the DATCOM system RS-485 interface into an RS-232 interface. IG Plus V only	030-03445
Smart Converter USB	Converts the DATCOM system RS-485 interface into a USB interface	030-03447

Advanced Energy (*formerly* PV Powered)

PV Powered Residential & Small Commercial Grid-Tie Inverters

Advanced Energy's PV Powered line of residential and small commercial grid-tie inverters deliver high reliability and technical innovations designed to lower the total cost of PV systems installation. Founded in Bend, Oregon, in 2003 and recently acquired by Advanced Energy, PV Powered inverters are engineered to operate for 20+ years.

Each inverter comes with an integrated AC/DC PV system disconnect that is listed to the UL 98 Standard (called "Enclosed and Dead-front Switches") which ensures that the integrated disconnect meets all installation and inspection requirements of a PV system disconnect. Housed within an NEC compliant wire raceway, PV Powered's innovative disconnect consists of one enclosure with ample working room for installation. In addition to providing for a single point of connection from the utility service and PV array, the wire raceway's optimized knockout locations also provide options for side, bottom and back entry with minimized conduit bending. The wire raceway enables flush side-by-side mounting, eliminating the need for extra equipment and resulting in a cleaner, less expensive installation.

All PV Powered inverters are field-configurable for positive ground applications with a simple jumper selection.

Made in USA and ARRA compliant. ETL Listed to UL 1741 for the U.S and Canada.

10-year warranty with compensation for replacement labor.

PVM1010 Data Monitoring Module

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

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

Model	Maximum AC power	DC array voltage	Maximum DC volts	CEC efficiency	Maximum AC current	AC output volts	Weight (lbs)	Item code
PVP2000-SD-240 PVP2000-SD-240-PVM	2000 W	115-450	500	92.0%	9 A	240VAC	65	**030-03821** **030-03821-M**
PVP2500-SD-240 PVP2500-SD-240-PVM	2500 W	140-450		94.5%	11 A	240VAC	70	**030-03822** **030-03822-M**
PVP2800-SD-208 PVP2800-SD-208-PVM	2800 W	180-450	500	92.0%	13 A	208VAC	70	**030-03823** **030-03823-M**
PVP3000-SD-240 PVP3000-SD-240-PVM	3000 W	170-450		93.5%	13 A	240VAC	80	**030-03824** **030-03824-M**
PVP3500-SD-240 PVP3500-SD-240-PVM	3500 W	200-450	500	95.5%	15 A	240VAC	85	**030-03825** **030-03825-M**
PVP4600-SD-208 PVP4600-SD-208-PVM	4600 W	205-450		95.5%	23 A	208VAC	135	**030-03814** **030-03814-M**
PVP4800-SD-240 PVP4800-SD-240-PVM	4800 W	200-450	500	96.0%	21 A	240VAC	135	**030-03816** **030-03816-M**
PVP5200-SD-240 PVP5200-SD-240-PVM	5200 W	240-450		96.0%	23 A	240VAC	135	**030-03818** **030-03818-M**
PVM1010	Monitor card - 1 required for each inverter to be monitored - retrofit						1	**030-03803**

Schneider Electric

NEW! Conext Grid-Tie Inverters

The new Schneider Electric Conext Grid Tie inverters have been redesigned to offer improved reliability and a lower installed cost through ease of installation and integrated features. The Conext inverter is a proven, high-frequency design in a compact enclosure and may be installed as a single inverter, for a single PV array, or in a multiple-inverter configuration for large PV systems. Conext Series inverters feature an NEC compliant, integrated Square D DC/AC disconnect, eliminating the need for external DC (PV) disconnects, and in some jurisdictions, AC disconnects. Sealed inverter enclosure can be quickly separated from the wiring box allowing DC/AC connections to remain intact in the event the inverter needs to be serviced. The NEMA 3R enclosure has a large wiring area with eight knockouts (¾" and 1"). The inverters are lightweight and easy to install and can be mounted side by side with zero clearance. They utilize large heat-sinks which allow for heat dispersion without the need for a cooling fan. A liquid crystal display (LCD) provides instantaneous information – power level, daily energy and lifetime production, system status, and installer customized screens. With auto-detect 240VAC or 208VAC operation, Conext inverters work right out of the box for single phase residential and three phase commercial applications.

CSA Certified to UL 1741 for the U.S. and Canada. Ten-year standard warranty.

Inverter Monitor

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

The Communication Gateway

The Communication Gateway connects Schneider Electric solar inverters and the system owner's computer. It logs performance data directly from the Schneider Electric Conext inverters, and transmits it to the included Yahoo Widget-based monitoring software for a simple and graphically rich view of system performance. In addition to data logging, the Gateway offers a web page with the ability to configure automated email reports and fault status to the user or installer. The Gateway includes both built-in Wi-Fi and Ethernet connectivity allowing for flexible and simple set up for wireless or wired connection to a router or direct to a PC. The Gateway logs and transmits system power production, inverter-specific power production, lifetime power production history (daily, weekly, monthly) and inverter faults. It can monitor a network consisting of up to 20 single-phase Conext inverters through a Cat 5 connection between each inverter and the Gateway. The Gateway can also be used with the XW Series inverters on page 102.

Schneider Electric Conext model	Maximum AC output watts		Maximum AC output amps		AC output breaker size	MPPT voltage range	Maximum DC voltage	CEC rated efficiency		Item code
	208VAC	240VAC	208VAC	240VAC				208V	240V	
Conext 2.8	2700W	2800W	13.0A	11.7A	20A	195-550VDC	600	93.5%	94.0%	030-01814
Conext 3.3	3100W	3300W	14.9A	13.8A	25A			95.0%	95.0%	030-01815
Conext 3.8	3500W	3800W	16,8A	15.8A	20A			94.5%	95.0%	030-01816
Conext 5.0	4500W	5000W	22A	21A	30A	235-550VDC		95.0%	95.5%	030-01818
Conext solar inverter monitor - Monitor up to 5 inverters. Use Cat 5 cable to connect										030-01838
Communications Gateway - Monitor up to 20 inverters with a PC. Use Cat 5 cable to connect										030-01813
Gateway power supply										030-01822

NEW! Power One

Aurora Grid-Tie Inverters

Power-One's Aurora PVI inverters have dual input sections to process two strings with independent MPPT, precise MPPT algorithms for real-time power tracking and high energy yield, as well as high performance efficiencies up to 97%. Two input sections and independent MPPTs optimize power from two subarrays that can be oriented in different directions, with different string sizes, or with different PV module models. The inverter will track the optimal power point for each of the two arrays independently. Both MPPT sections can also be paralleled for use with a single array. The wide input voltage range allows for low wattage installations with reduced string sizes where needed (strings as short as four 60-cell modules are possible). Combined with the dual independent string inputs, this wide voltage range lets you use two strings with different numbers of PV modules in each, greatly expanding possible array layout possibilities.

Front-panel mounted LCD display provides real-time updates for all critical operating parameters. It has RS-485 and USB communications interfaces. Integrated DC disconnect switch, in compliance with NEC Article 690, is standard on all "S" models (shown in the table; models without the DC disconnect are also available). Aurora PVI inverters can produce full-rated power at ambient temperatures up to 122°F (50 °C). Fanless design removes a venerable failure point.

Aurora Communicator software, included with each inverter, simplifies monitoring via PC. Optional RS-485 to USB communication module required for connection to PC. The **PVI-DESKTOP** device provides a remote monitoring solution with a color touch-screen display. Use in the home or business and connect up to 6 inverters with either a wired or wireless option. Bluetooth models will connect to PC wirelessly for free firmware updates. The **Aurora Easy Control** datalogger is available for remote monitoring via Internet, modem or GSM.

All Power-One Aurora PVI inverters use sealed NEMA 4X enclosures to withstand harsh environmental conditions. They are certified to UL 1741/IEEE1547 and CSA-C22.2 N.107.1-01 for the U.S. and Canada, and come with a 10-year warranty, optionally extendable to 15 or 20 years.

PVI-OUTD-S-US Transformerless Inverters

Power-One's Aurora transformerless inverters are available in sizes covering the most common residential requirements, or they can be used in groups of three for small to medium sized commercial three-phase applications. Transformerless design reduces internal power losses, allowing these PVI inverters to perform at high efficiencies. Output voltage can be set for 240V split-phase, or 208V or 277V (480V WYE) three-phase.

Transformerless inverters require that all PV array wiring (including PV module output cables) use double-insulated wire, and combiner boxes (if used) must have fusing on both positive and negative conductors. All five units have dimensions of 33.75H x 12.75W x 8.25D, including the "S" disconnect box.

Model	Maximum AC power	AC output volts	DC array voltage (VDC)	MPPT voltage range	CEC rated efficiency	Max AC current	Weight (lbs)	Item code
PVI-3.0-OUTD-S-US	3000W	208 240 277	90-600	160-530	96.0%	12A 14.5A 14.5A	47	**030-09713**
PVI-3.6-OUTD-S-US	3600W	208 240 277	90-600	220-530 200-530 200-530	96.0%	17.2A 16A 16A	47	**030-09714**
PVI-4.2-OUTD-S-US	4200W	208 240 277	90-600	220-530 200-530 200-530	96.0%	20A	47	**030-09715**
PVI-5000-OUTD-US	5000W	208 240 277	90-600	140-530	96.5%	24A 20A 18A	66	**030-09716**
PVI-6000-OUTD-US	6000W	208 240 277	90-600	170-530	96.5%	29A 25A 21.6A	66	**030-09717**

Aurora Isolated /Transformer-Based Inverters

Aurora transformer-based (isolated) inverters for residential and small commercial applications work in either negative or positive-grounded systems. They have all of the Aurora benefits in more conventional grounded design, however their high frequency isolated topology allows them to be lightweight and compact.

The **Aurora PVI 3.8kW** and **4.6kW** inverters are settable for 240V split-phase, or 208V or 277V (480V WYE) three-phase output. Dimensions for both units: 33.75H x 12.75W x 8.25D, including "S" disconnect box. See table top of next page.

Model	Maximum AC power	AC output volts	DC array voltage (VDC)	MPPT volt-age range	CEC rated efficiency	Max AC current	Weight (lbs)	Item code
PVI-3.8-I-OUTD-S-US	3800W	208 240 277	90-600	160-530	96.0%	12A 14.5A 14.5A	61	**030-09721**
PVI-4.6-I-OUTD-S-US	4600W	208 240 277	90-600	220-530 200-530 200-530	96.0%	17.2A 16A 16A	61	**030-09723**

The **Aurora PVI 10kW** and **12kW** inverters have full three-phase power output. The 10kW unit is settable for 208VAC three-phase Delta, or 277V (480V WYE) three-phase output. The 12kW unit has 277V (480V WYE) three-phase output. Both models are also available with 600VAC output for the Canadian market. These inverters do not contain any electrolytic capacitors, for a longer product lifetime.

"S" models have a DC disconnect box and the "S2" models have both a DC and an AC disconnect for locations where an integrated AC switch is acceptable. Both the 10kW and the 12kW inverters, S and S2 models, are 37.7"H x 25.4"W x 8.8"D. The 10kW Aurora PVI inverter received an A+ from Photon International after their independent laboratory tests.

Model	Maxi-mum AC power	AC output volts	DC array voltage (VDC)	MPPT VDC voltage range parallel MPPTs	MPPT VDC voltage range separate MPPTs	CEC rated efficiency	Max AC current	Weight (lbs)	Item code
PVI-10-I-OUTD-S-208-US	10.0kW	208	120-540	220-470	170-470	95.5%	30A	107	**030-09731**
PVI-10-I-OUTD-S2-208-US								114	**030-09732**
PVI-10-1-OUTD-S-480-US		480				96.0%	14A	107	**030-09733**
PVI-10-1-OUTD-S2-480-US								114	**030-09734**
PVI-10-1-OUTD-S-600-CAN		600	120-520	220-470	170-470	97.0%	10.6A	107	**030-09735**
PVI-10-1-OUTD-S2-600-CAN								114	**030-09736**
PVI-12-1-OUTD-S-480-US	12.0kW	480	120-520	250-470	170-470	97.0%	16A	107	**030-09737**
PVI-12-1-OUTD-S2-480-US								114	**030-09738**
PVI-12-1-OUTD-S-600-CAN		600	120-520	250-470	170-470	97.0%	13.3A	107	**030-09739**
PVI-12-1-OUTD-S2-600-CAN								114	**030-09740**

PVI DESKTOP monitor

Ideal for residential and small commercial PV applications, the PVI DESKTOP features touch screen color TFT display and can communicate with the PVI inverters either wirelessly or connected through RS-485 and CAT5 cables. The DESKTOP system can also be linked via Bluetooth or USB to a personal computer and the Internet. Watch energy production data for up to six Aurora inverters at once. Wireless communication requires an additional radio transceiver (PVI-RADIOMODULE) fitted within each inverter.

The new **Aurora Easy Control** system provides PV system performance data from a remote location using either an Ethernet/Internet connection or mobile phone technology. Information such as energy production, power, voltage and current data is available in real time with high speed updates. Its modular design allows for future expansion with further features created using add-on modules. You can link up to 128 devices with the Easy Control system using RS-485 communication port data.

Model	Description	Item code
PVI-DESKTOP	Aurora desktop monitor with RS-485 or wireless to inverter, USB to PC computer, up to 6 inverters	**030-09777**
PVI-DESKTOP-BT	Aurora desktop monitor with RS-485 or wireless to inverter, USB or Bluetooth to PC computer, up to 6 inverters	**030-09778**
PVI-AEC-LIGHT-Ethernet	Aurora Easy Control Light w/ ethernet	**030-09781**
PVI-AEC-BASIC-DSL	Aurora Easy Control Basic w/dsl and ethernet, up to 31 inverters	**030-09784**
PVI-AEC-PRO-DSL	Aurora Easy Control Pro w/display, dsl and ethernet, up to 31 inverters	**030-09786**
PVI-AEC-PRO-EVO	Aurora Easy Control Pro w/display, ethernet, up to 128 inverters	**030-09787**
PVI-AEC-PRO-GPRS	Aurora Easy Control Pro w/display, GPRS, up to 128 inverters	**030-09788**
PVI-RS232/485	Aurora Adapter RS-232/-485 to a PC, with power supply	**030-09775**
PVI-USB-RS486-232	Aurora adapter RS-485 to USB and RS-232 to a PC	**030-09776**
PVI-RADIOMODULE	Aurora wireless tranceiver with antenna for string inverters	**030-09779**

SMA

Sunny Central 250U/500U Inverters

The Sunny Central 250U and 500U have integrated isolation transformers and deliver excellent efficiency for large PV power plant inverters. The user interface now features a large LCD screen that provides a graphical view of daily plant production and the status of the PV array, inverter, and utility grid. With SMA's OptiCool temperature management system, the units can be installed practically anywhere.

The Sunny Centrals offer a variety of remote monitoring options. Users can choose from RS-485, Ethernet, or wireless communications via Bluetooth or GSM with the optional WebBox. Daily performance data can be automatically uploaded to the free Sunny Portal website. Optional Sunny Central String-Monitor-US smart combiners allow string level monitoring. The accuracy of performance data can be increased by using the optional Sunny SensorBox which provides monitoring of local irradiance, temperatures, and wind speed.

Sunny Central 500HE-US Inverter

The Sunny Central 500HE-US couples to an external medium voltage transformer to accommodate long distance power feeds to distribution substations and delivers the highest efficiency available for large PV inverters. An updated user interface features a large LCD that provides a graphical view of the daily plant production as well as the status of the inverter and the utility grid. With the optional Sunny WebBox, users can now choose from either RS-485, Ethernet or Bluetooth wireless communications. Optional AC and DC disconnects and combiner boxes with string monitoring available. Outdoor enclosure and OptiCool intelligent temperature management makes it suitable for ambient temperatures of up to 60 °C (140 °F). 97% CEC rated efficiency.

All Sunny Central inverters are UL Listed to UL 1741 for the U.S. and Canada / IEEE-1547 compliant.

SMA model	Continuous output (kW)	AC output voltage	Max AC amps	Max DC array volts	MPPT voltage range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code
SC250U	250	480	300	600	330-600	97.0%	80 x 110 x 33	4200	**030-03041**
SC500U	500	480	600	600	330-600	97.0%	80 x 140 x 37	7165	**030-03046**
SC500HEUS	500	200*	1470@200V	600	330-600	98.0%	90 x 98 x 35	3970	**030-03036**

* For connection to MV transformer (not included)

Sunny Tower 36kW, 42kW and 48kW Systems

The Sunny Tower combines the advantages of central inverters with the performance and installation advantages of string inverters by offering assembled 36kW, 42kW and 48kW systems. Each Sunny Tower consists of six 8kW, 7kW or 6kW inverters mounted on a stainless steel structure. Two Sunny Towers can be combined as 96, 84 or 72kW systems. The Sunny WebBox comes standard making the Sunny Tower internet-ready. This type of system offers the advantage of multiple array MPP tracking, optimum operation under partial load, 96% CEC efficiency and quick delivery. Sunny Towers can be assembled on-site, eliminating the need for specialized heavy equipment. The system is NEMA 3R outdoor rated and is designed for use only in three-phase systems at 208 VAC, 240 VAC or 277 VAC. Total weight is 1,115 lbs. (Tower is 330 lbs, plus six inverters.) 10-year warranty standard. UL Listed for the U.S. and Canada

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

Model	3-phase AC voltage	Max AC power	Max AC amp output (per phase)			MPPT voltage range	Max DC current	Item code
			208V	240V	277V			
ST36	208/240/277	36 kW	100A	87A	44A	250-480	6 x 25A	**030-03060**
ST36+WebBox	208/240		100A	87A	n/a			**030-03061**
ST36+WebBox 277	277		n/a	n/a	44A			**030-03062**
ST42	208/240/277	42 kW	117A	101A	51A	250-480	6 x 30A	**030-03070**
ST42+WebBox	208/240		117A	101A	n/a			**030-03071**
ST42+WebBox 277	277		n/a	n/a	51A			**030-03072**
ST48	240/277	48 kW	n/a	116A	58A	300-480	6 x 30A	**030-03057**
ST48+WebBox	240		n/a	116A	n/a			**030-03058**
ST48+WebBox 277	277		n/a	n/a	58A			**030-03059**

NEW! Sunny Central Inverters For Utility-Scale PV

Sunny Central 400HE/500HE/630HE Inverters for Utility-Scale PV

The new Sunny Central High Efficiency (HE) inverters couple to an external medium voltage transformer to accommodate long distance power feeds to distribution substations and delivers the highest efficiency available for large PV inverters. An updated user interface features a large LCD that provides a graphical view of the daily plant production as well as the status of the inverter and the utility grid. With the optional Sunny WebBox, users can now choose from either RS-485, Ethernet or Bluetooth wireless communications. Models available for 400kW, 500kW, and 630kW power output. Max DC array voltage of 1000VDC. Optional AC and DC disconnects and combiner boxes with string monitoring available. Outdoor enclosure and OptiCool intelligent temperature management makes it suitable for ambient temperatures of up to 60 °C (140 °F). For "behind the fence" MV installation only. 98.6% peak efficiency.

SMA model	Rated AC output (kW)	AC output voltage*	Max AC amps	Max DC array volts	MPPT DC voltage range	CEC rated efficiency	"Dimensions H"" x W"" x D""	Weight (lbs)	Item code
SC400HEUS	400	270V	855A	1000	450-820	97.0%	90 x 98 x 35	3970	**030-03035**
SC500HEUS	500	270V	1070A		450-820				**030-03036**
SC630HEUS	630	315V	1155A		510-820				**030-03037**

* For connection to MV transformer (not included)

Sunny Central CP Series Inverters For Utility-Scale PV

SMA's Sunny Central Compact Power (CP) line of solar inverters includes the Sunny Central 500CP, 630CP, 720CP, 760CP and 800CP, and won the Intersolar Award 2010 in the photovoltaics category. These inverters join the Sunny Central High Efficiency (HE) line in SMA's North American utility-scale lineup. With industry-leading power output with efficiencies of 98.6% and 98.7% (630CP), the Sunny Central CP inverters are the ideal building blocks for utility power plants of any size.

The Sunny Central CP features a compact design that not only makes it easy to load and transport, but also able to be installed almost anywhere, providing integrators with a variety of configuration options. The outdoor-rated CP series inverters can be placed on a simple concrete pad or under a basic shade structure. Two Sunny Central CP inverters can be combined with one medium voltage transformer to provide up to a 1.6MW packaged skid solution, which simplifies large-scale deployment.

In addition to protecting against chemical-aggressive environments, the Sunny Central CP's weatherproof enclosure is partitioned to shield sensitive electronics from dust and debris. These two sections are cooled by direct ventilation and a heat exchanger via SMA's patented OptiCool® active temperature-management system, which allows the Sunny Central CP inverters to maintain full power in ambient temperatures up to 122 F. In temperatures below 77 F, their peak continuous power is 110 percent of rated output, resulting in increased yields and a lower levelized cost of energy.

Integrated grid management features such as remote control of active and reactive power; automatic over-frequency response; automatic power factor adjustment; power curtailment; and low voltage ride through provide system operators with essential grid stability tools, making Sunny Central CP inverters extremely grid-friendly. SCADA options via modbus and the SMA OPC Server ensure optimum communication and control.

Another cost-reducing feature found in the CP line is SMA's intuitive OptiProtect technology, which monitors up to 1,600 individual strings for potential failures while differentiating between extended and temporary disturbances. An auto-adaptive start-up, without configuration, and a short automated learning phase simplify and shorten installation time.

Sunny Central CP inverters are also available with an industry-best 99 percent uptime guarantee and optional extended warranties up to 20 years. For "behind the fence" MV installation only. Call for pricing and lead time.

SMA model	Rated AC output (kW)	AC output voltage*	Max AC amps	Max DC array volts	MPPT DC voltage range	CEC rated efficiency	"Dimensions H"" x W"" x D""	Weight (lbs)	Item code
500CP	500	270V	1069A	1000	430-820	97.0%	101 x 90 x 38	3970	**030-03028**
630CP	630	315V	1271A		500-820				**030-03029**
720CP	720	324V	1411A		515-820				**030-03030**
760CP	760	342V	1411A		545-820				**030-03031**
800CP	800	360V	1411A		570-820				**030-03032**

* For connection to MV transformer (not included)

SMA

NEW! Sunny Central String-Monitor-US

SMA's Sunny Central String-Monitor-US provides detailed PV array monitoring by continuously measuring and monitoring the DC currents of the individual system strings. . By measuring and comparing individual string currents, power deviations in the solar array are accurately detected and are analyzed in the Sunny Central inverter. The String-Monitor-US transfers any error messages to the Sunny Central String-Monitor Controller (SCSMC). The operator can then access the data via a Sunny WebBox

Available in three sizes for connection of 24, 32 or 64 strings in a PV system. The Sunny Central String-Monitor-US is contained in a NEMA 3R steel enclosure for wall or pole mounting, according to preference (stainless enclosures are available). Detachable side and base plates provide for convenient installation preparation. For negative or positive ground systems. Dual 350mcm power output lugs. Rated to 600VDC.

Connect up to 9 Sunny Central String-Monitor US combiners via Sunny Central String-Monitor Controller and RS-485 hubs to a Sunny WebBox. Multiple String-Monitor US combiners can be "daisy chained" together and connected to one hub. Up to 4 communication busses can be connected via four RS-485 hubs, making connections from four directions possible. Up to 3.900 ft. communication range per hub with data cable (two twisted pair, shielded cable, AWG 24). One Sunny Central String-Monitor Controller is needed per system.

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

Model	Max number of module strings	Max fuse size per string	Max temp corrected Isc per string	Max DC Continuous Current	Max DC short-circuit current	Fused inputs per measuring channel	Dimensions (H x W x D)	Weight (lbs)	Item code
String-Monitor-US 24	24	20	12.82A	308A	480A	3	31.5 x 31.5 x 10	143	**030-03049**
String-Monitor-US 32	32	15	9.6A	308A	480A	4	31.5 x 31.5 x 10	143	**030-03050**
String-Monitor-US 64	64	8	5.12A	328A	512A	8	31.5 x 47 x 12	194	**030-03051**
SCSMC	Sunny Central String-Monitor-US Controller. One required to connect to Sunny WebBox								**030-03052**
Sunny Central RS485-Hub	RS-485 communications hub								**030-03053**

Help us keep this catalog accurate and up-to-date. Send any feedback or corrections to **salessupport@aeesolar.com**

Fronius

NEW! CL Commercial Inverters

The Fronius CL inverter has modular system architecture with up to 15 identical power modules contained in one central unit. Configurations of 9, 12, or 15 power modules are available for outputs ranging from 33.3kW to 60kW. Using Fronius' MIX power module management, individual power modules can be automatically activated or disabled depending on solar conditions; combined with automatic transformer switching, this allows the Fronius CL to achieve three separate efficiency peaks. The CL's wide DC input MPPT voltage range provides high flexibility for system configuration.

The CL's control unit automatically calculates how many power modules, and which ones, will be turned on and off in partial load conditions by analyzing the respective operating hours of each unit. This helps to equalize the work load on individual power modules, increasing the service life of the inverter. It also provides redundancy, ensuring that the inverter remains operating even when there is a fault in an individual power module. If service is required, individual power modules can be removed and replaced easily via the plug and play drawer design. This ensures the highest serviceability and quick repair times. Another advantage of the modular design is that power modules can be removed for housing installation, reducing the weight of the housing and making it easier to move and install.

The Fronius CL has a NEMA 3R enclosure, with integrated AC and DC disconnects. An innovative ventilation design eliminates dust and moisture from getting into the power module area. For indoor installation there is an optional exhaust air guide, allowing the Fronius CL to channel the exhaust air to the outside. An integrated relay contact can also be used to control an external fan.

The CL is 100% compatible with the Fronius DATCOM system for comprehensive system monitoring. A Fronius Com Card and a Signal Card are already integrated in to the unit. Other components such as the Fronius Datalogger, the Sensor Box and environmental sensors can be added at any time. For string-level monitoring, use the Fronius String Control 250/25 below. For more information on Fronius DATCOM components, see page 75.

CSA Listed to UL 1741 for the U.S. and Canada. Dimensions (in inches) including base (4-inch and optional): 72 H x 43.5 W x 28.5D The CL comes with a 10-year warranty.

Fronius String Control 250/25

The Fronius String Control 250/25 combiner and string monitor continually compares the string currents with each other, providing early detection and localization of problems in individual array strings. It can be used to combine up to 25 module strings with a total current of up to 250A. Fuses are installed into the String Control via easy-to-use fuse holders. Max string fuse size is 20A. The Fronius String Control 250/25 is compatible with all Fronius inverters and is particularly effective in combination with Fronius central inverters.

Dimensions (in inches): 26.8H x 19.7W x 16.7D. Weight: 225 lbs

Model	Max. AC Power (watts)	AC output volts	Max. AC Current	Max DC voltage	MPPT DC voltage range	CEC rated efficiency	Weight (lbs)	Item code
CL 33.3 Delta	33300	208 240	92.4 80.1	600	230-500	94.5% 95.0%	661	**030-08433**
CL 36.0 WYE 277	36000	277	43.3			95.5%		**030-08436**
CL 44.4 Delta	44400	208 240	123.2 106.8			94.5% 95.0%	721	**030-08444**
CL 48.0 WYE 277	48000	277	57.8			95.5%		**030-08448**
CL 55.5 Delta	55500	208 240	154.1 133.5			94.5% 95.0%	783	**030-08455**
CL 60 WYE 277	60000	277	72.2			95.5%		**030-08460**
CL Mounting Base		Optional cabinet base - 4-inch						**030-08473**
Fronius String Control 250/25		25 string combiner box, 250A total current rating						**030-08475**

Satcon

PowerGate Plus 3-Phase Commercial/Industrial Inverters

Satcon PowerGate Plus 3-phase PV inverters provide efficient and stable power, even in harsh climates. With 11 power ratings, ranging from 30 kW to 1 MW (UL and CE certified) Satcon offers a wide range of solar PV inverter solutions. PowerGate Plus increases efficiency by combining sophisticated system intelligence with in-depth performance monitoring, providing you with a high level of PV system command and control.

Satcon has a wide range of inverter sizes to match the need for any sized commercial or industrial PV system. The PVS-30, -50 and -75 inverters are changeable between 208, 240 and 480 VAC. Larger models with a -2UL suffix can be changed from 208 to 240 VAC. Larger models with a -4UL suffix are for use with 480 VAC. The PVS-500 and PVS-1MW with external transformer are designed for use on medium voltage systems. Satcon inverters come standard with a 5-year warranty, with 10-, 15- and 20-year warranties available. **Optional fused subarray combiners are integrated within the inverter enclosure and must be factory installed and ordered with inverter.**

Satcon model	Continuous AC output (kW)	AC output voltage	Max AC amps per phase	MPPT voltage range	Fused subarray input options	CEC efficiency	Weight (lbs)	Item code
PVS-30-UL	30	208 240 480	84 70 36	305-600	4@50A or 5@40A	95.0%	1,204	**030-03242**
PVS-50-UL	50	208 240 480	139 121 60	305-600	4@80A or 5@63A	95.5%	1,732	**030-03239**
PVS-50-S-UL	50	208 240 480	139 121 60	265-600	4@100A or 5@ 80A	95.5%	1,732	**030-03239**
PVS-75-UL	75	208 240 480	208 181 91	315-600	5@100A or 6@80A	96.0%	2,150	**030-03244**
PVS-100-2UL	100	208 240	278 241	315-600	5@110A or 6@100A	96.0%	2,350	**030-03280**
PVS-100-4UL		480	121					**030-03240**
PVS-100-6UL		600	96					**CALL**
PVS-110-S-2UL	110	208 240	305 265	265-600	9@100A	95.5%	2,684	**030-03215**
PVS-110-S-4UL		480	132					**030-03258**
PVS-135-2UL	135	208 240	375 325	310-600 320-600	5@160A or 9@100A	96.0%	2,684	**030-03245**
PVS-135-4UL		480	163	310-600				**030-03241**
PVS-210-S-2UL	210	208 240	583 505	265-600	10@160A or 15@100A	95.5%	4,500	**030-03227**
PVS-210-S-4UL		480	253					**030-03228**
PVS-250-2UL	250	208 240	694 601	320-600	10@160A or 15@100A	96.0%	4,500	**030-03247**
PVS-250-4UL		480	301					**030-03248**
PVS-250-6UL		600	241					**CALL**
PVS-375-4UL	375	480	451	320-600	15@160A or 24@100A	95.5%	5,500	**030-03246**
PVS-500 ext. transformer	500	200*	1433	320-600	20@160A or 30@100A	97.0%	5,900	**030-03250**
PVS-500-4UL	500	480	602	320-600		96.0%	9,100	**030-03249**
PVS-1MW ext. transformer	1,000	265*	2178	420-815	28@160A or 40@100A	96.0%	12,000	**030-03251**
SSC-12 input-UL-Negative	Smart Sub-Combiner box with 12 string UL for negatively grounded arrays							**030-03314**
SSC-12 input-UL-Positive	Smart Sub-Combiner box with 12 string UL for positively grounded arrays							**030-03315**

* For connection to external MV transformer (not included)

Satcon PV View Plus

Monitor and control system performance to increase uptime, output, and overall profitability. Satcon PV View Plus provides a comprehensive view of an array's performance. PV View Plus adds an advanced layer of intelligence to PowerGate Plus, giving you complete visibility into and control over the variables that affect energy conversion. Real-time data acquisition and performance monitoring make it easy to assess array output, evaluate site conditions, pinpoint problems, and identify maintenance needs rapidly before performance is compromised. Critical performance information is delivered through a centralized dashboard. By aggregating data, PV View Plus establishes benchmarks for normal performance, predicts anomalies, and

provides system health information, helping a PV plant operate at peak performance.

Satcon options	Item code
Satcon PV View direct monitoring - 10 years	030-03350
Satcon PV View direct monitoring - 5 years	030-03352
Satcon Revenue Meter Assembly	030-03351
Satcon PV View Gateway	030-03353
Satcon PV View Weather Station	030-03354

Accessories and Warranties for Satcon Inverters

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

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

For use with model #	Satcon accessories				Extended warranties		
	Number of input strings	Fuse size amps	Subarray combiners	PV zone monitoring	10-year	15-year	20-year
			Item code		Item code		
PVS-30	4	50	030-03317	030-03362	030-03260-10	030-03260-15	030-03260-20
	5	40	030-03318	030-03363			
PVS-50	4	80	030-03319	030-03364	030-03261-10	030-03261-15	030-03261-20
	5	63	030-03320	030-03365			
PVS-75	5	100	030-03321	030-03366	030-03262-10	030-03262-15	030-03262-20
	6	80	030-03322	030-03367			
PVS-100	5	110	030-03323	030-03368	030-03263-10	030-03263-15	030-03263-20
	6	100	030-03324	030-03369	030-03264-10	030-03264-15	030-03264-20
PVS-110-S	9	100	030-03337	030-03355	030-03277-10	030-03277-15	030-03277-20
PVS-135	5	160	030-03325	030-03370	030-03265-10	030-03265-15	030-03265-20
	9	100	030-03326	030-03371	030-03266-10	030-03266-15	030-03266-20
PVS-210-S	10	160	030-03339	030-03357	030-03378-10	030-03278-15	030-03278-20
	15	100	030-03340	030-03358	030-03379-10	030-03279-15	030-03279-20
PVS-250	10	160	030-03328	030-03373	030-03267-10	030-03267-10	030-03267-20
	15	100	030-03329	030-03374	030-03268-10	030-03268-10	030-03268-20
PVS-375	15	160	030-03330	030-03375	030-03269-10	030-03269-15	030-03269-20
	24	100	030-03332	030-03377			
PVS-500	20	160	030-03334	030-03379	030-03271-10	030-03271-15	030-03271-20
	30	100	030-03335	030-03380	030-03270-10	030-03270-15	030-03270-20
PVS-1MW	28	160	030-03341	030-03359	030-03272-10	030-03272-15	030-03272-20
	40	100	030-03342	030-03381			

Satcon

NEW! Prism Platform

Satcon Prism Platform is a fully integrated one megawatt medium voltage (MV) solution optimized for utility scale solar PV installations. Leveraging Satcon's PowerGate Plus 500kW solar PV inverters, Prism Platform comes complete with factory integrated step-up transformers, MV disconnect switches, and power conversion electronics.

Prism Platform contains two PVS-500 (MVT) 500kW inverters, 1000 kVA oil-filled transformer (biodegradable fluid), Integrated HV disconnect switch. The inverter and transformer are on the same transportable base frame allowing for "ship and drop" installation. Negative ground is standard; positive ground is optional.

Note: The transformer selected for each project is largely dependent on the system design requirements set by the customer. Transformer specifications significantly impact the structural and physical layout of the final integrated design. Drawings suitable for construction will not be available until project requirements are firmly established.

Weight: 28,000 lbs (without transformer). Shipping Dimensions 22' 2" L x 8' 5" W x 8' 7" H (Final dimensions will vary according to transformer size. Dimensions and weight shown are for a 12.47 kV transformer.) Call for pricing and lead time.

NEW! Solstice

Solstice, Satcon's distributed energy management system, is an optimized end-to-end, panel-to-grid, solar PV electrical power generation system that focuses on improving total system performance, reducing overall balance of system costs, and increasing system controllability, safety and uptime. Solstice is engineered from the ground up to provide granular control over every component in the array—from a single string, to the inverter, to power delivered to the grid. By breaking a large array down to the string level, including string level MPPT, Solstice can deliver higher total energy yield, ensuring that the negative effects of shading, soiling and aging mismatch are localized and minimized while also being identified and reported.

With its sophisticated central command and control center, Solstice reacts to changing conditions with remarkable speed providing the industry's first complete power harvesting and management solution for utility class power plants.

Satcon model	Continuous AC output (kW)	AC output voltage	Max AC amps per phase	MPPT voltage range	Fused subarray input options	CEC rated efficiency	Weight (lbs)	Item code
100kW-2UL Solstice, 4 SSB	100	208 240	278 241	50-600 (with SSB)	4@100A or 5@80A or 6@80A	95.0%	Inverter = 2605 4 SSB = 1100	**030-03281**
100kW-4UL Solstice, 4 SSB		480	120					**030-03282**
500kW-320-UL Solstice, 22 SSB	500	320*	902*		24@ 100A	98% (w/o xfmr)	inverter = 4100 22 SSB = 6050	**030-03283**
500kW-480-UL Solstice, 22 SSB		480	601					**030-03284**
SSB-Solstice	Solstice Smart Sub Combiner - additional unit						275	**030-03316**

* For connection to external MV transformer (not included)

NEW! Equinox

The Satcon Equinox 500 kW PV inverter has a significant impact on the profitability dynamic of large-scale solar PV systems. With its system intelligence, next-generation Edge MPPT technology, and industrial-grade engineering, the Equinox 500 kW inverter maximizes system uptime and power production, even in the harshest environments.

Equinox features 98.5% efficiency combined with three extreme climate packages for the highest levels of system performance and uptime and the utility scale solar industry's widest thermal operating range. Equinox comes complete with a NEMA 3R/IP54 enclosure and is available in three separate climate packages in order to deliver optimal yield in a wide range of environments.

Equinox Desert Package

Designed to maximize total system power production in extreme heat and airborne contaminants, the Equinox Desert Package offers operating temperatures up to 55°C at full power and protection against blowing sand.

Equinox Tropical Package

The Equinox Tropical Package delivers the same high temperature operating range along with a ruggedized outdoor-rated enclosure that protects against heavy rainfall and provides corrosion resistance in harsh salt environments.

Equinox Cold Weather Package

The Equinox Cold Weather package provides protection against sleet, snow and ice, with an optional operating temperature down to -40°C.

Satcon Equinox is UBC Seismic Zone 4 compliant with built-in DC and AC disconnect switches. Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance. Covers protect exposed power connections.

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

Satcon model	Continuous AC output (kW)	AC output voltage	Max AC amps per phase	MPPT voltage range	Fused subarray input options	CEC rated efficiency	Weight (lbs)	Item code
EQX-0500-US-208-XN	500	200*	1443	320-600	30@100 or 20@160A	97.5% (w/o xfmr) 96.5% (with xfmr)	6,000	**030-03291**
EQX-0500-US-480-TN		480	601					**030-03292**

* For connection to external MV transformer (not included)

Advanced Energy (*formerly* PV Powered)

Commercial Grid-Tie Inverters

Advanced Energy's PV Powered line of commercial inverters combine high reliability, low lifetime cost and high efficiency into one easy-to-install system. They are designed for 20-plus years of operation, enabled by an array of new features including busbars for all power connections, a sealed electronics module and an instrumented cooling system. The highly integrated system was designed to save commercial installers time with load break rated AC and DC service disconnects, certification for installation without a neutral conductor, cable landing points sized for maximum NEC-compliant cables and a well-planned cable bending radius for top, bottom and side cable entry options. Choose the proper subarray combiner for the inverter size you are using from the table below. PV Powered commercial three-phase inverters offer a voltage window of 295-600VDC, a wide operating range with low standard MPPT voltage. This provides the ability to string with all PV modules currently available including new thin film modules. Serviceability is enhanced by a modular design that divides the inverter into easy-to-maintain subsystems. 10-year warranty, with extension to 20 years available at 20% of inverter price. ETL Listed to UL 1741 for the U.S.

PVP260kW-LV-480

The PVP260kW-LV-480 has a standard full power 265VDC minimum MPPT- the lowest MPPT voltage of any commercial inverter in the industry. This low input voltage option enables stringing with all PV module technologies including new thin film modules.

Advanced Energy simplifies performance monitoring by offering inverter-integrated solutions from Fat Spaniel, Draker and Energy Recommerce. Additional options include integrated revenue grade meter and sub-combiner monitoring. See the table below.

See the Advanced Energy IntelliString Smart Combiner boxes on page 169 to provide string-level performance monitoring.

PV Powered model	Continuous output (kW)	AC output voltage	Max AC amps	Max DC array voltage	MPPT voltage range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code
PVP30kW-LV-208	30	208	82	600	295-500	93.0%	47.7 x 30.4 x 25.9	760	**030-03826**
PVP30kW-LV-480		480	36			93.5%			**030-03828**
PVP35kW-208	35	208	100		295-595	95.5%	67.2 x 48.8 x 29.5	1200	**030-06800**
PVP35kW-480		480	54						**030-06801**
PVP50kW-208	50	208	143			96.0%	73.7 x 48.8 x 32	1500	**030-06802**
PVP50kW-480		480	62						**030-06803**
PVP75kW-208	75	208	208		295-500	95.5%	93 x 65.5 x 35	2750	**030-03830**
PVP75kW-480		480	90						**030-03832**
PVP100kW-208	100	208	278			96.0%	93 x 65.5 x 35	3000	**030-03833**
PVP100kW-480		480	120						**030-03835**
PVP260kW-480	260	480	316			97.0%	109 x 104 x 41	4800	**030-03820**
PVP260kW-LV-480		480	316		265-500	96.5%			**030-03827**

PV Powered Subarray Combiner Options for Commercial Inverters					
Subarray combiner model	For Inverter model	Number of fused DC circuits	Max total fusing amps	Description	Item code
PVP50kW-SC-2-200	PVP-50kW	2	300A	Two 200A fuse blocks with choices of 200A, 175A, 150A or 125A fuses	**030-06830**
PVP50kW-SC-3-100		3		Three 100A fuse blocks with choices of 100A, 90A, 80A, 75A, and 70A fuses	**030-06831**
PVP50kW-SC-4-60		4		Four 60A fuse blocks with choice of 60A or 50A fuses	**030-06832**
PVP75kW-SC-450	PVP-75kW	1	675A	One circuit fused with single 450A fuse	**053-01201**
PVP75kW-SC-2-225		2		Two circuits fused with two 225A fuses	**053-01203**
PVP75kW-SC-3-150		3		Three circuits fused with three 150A fuses	**053-01205**
PVP75kW-SC-4-100		4		Four circuits fused with four 100A fuses	**030-06841**
PVP75kW-SC-6-75		6		Six circuits fused with six 75A fuses	**053-01207**
PVP75kW-SCM-6-75		6		Six circuit fused subarray combiner with Monitoring: 6 x 75A, modbus output (NOTE: Modbus master device required to collect & report data)	**053-01208**
PVP75kW-SC-9-75		9		Nine circuit fused with nine 75A fuses	**053-01209**
PVP100kW-SC-600	PVP-100kW	1	675A	One circuit fused with single 600A fuse	**053-01211**
PVP100kW-SC-2-300		2		Two circuits fused with two 300A fuses	**053-01213**
PVP100kW-SC-3-200		3		Three circuits fused with three 200A fuses	**053-01215**
PVP100kW-SC-4-150		4		Four circuits fused with four 150A fuses	**053-01214**
PVP100kW-SC-5-110		5		Five circuits fused with five 110A fuses	**053-01216**
PVP100kW-SC-6-100		6		Six circuits fused with six 100A fuses	**053-01217**
PVP100kW-SCM-6-100		6		Six circuit fused array-subcombiner w/monitoring: 6 x 100A, modbus output (NOTE: Modbus master device required to collect & report data)	**053-01218**
PVP100kW-SC-9-75		9		Nine circuits fused with nine 75A fuses	**053-01219**
PVP260kW-SC-4-400	PVP-260kW	4	1600A	Four circuits fused with four 400A fuses	**053-01220**
PVP260kW-SC-5-300		5		Five circuits fused with five 300A fuses	**053-01221**
PVP260kW-SC-8-200		8		Eight circuits fused with eight 200A fuses	**053-01222**
PVP260kW-SCM-8-200		8		Eight circuit fused subarray combiner w/monitoring: 8 x 200A, modbus output (NOTE: Modbus master device required to collect & report data)	**053-01223**
PVP260kW-SC-10-150		10		Ten circuits fused with ten 150A fuses	**053-01224**
PVP260kW-SC-16-100		16		Sixteen circuits fused with sixteen 100A fuses	**053-01225**
PVP260kW-SCM-16-100		16		Sixteen circuit fused subarray combiner w/monitoring: 16 x 100A, modbus output (NOTE: Modbus master device required to collect & report data)	**053-01226**
PVP260kW-SC-20-75		20		Twenty circuits fused with twenty 75A fuses	**053-01227**

PV Powered Inverter-Integrated Data Monitoring Systems		
Model	Description	Item code
PVP-FST-001	Fat Spaniel Inverter-Integrated Solution: UL 508A industrial panel with control transformer, power supply, Fat Spaniel gateway, Ethernet switch (NOTE: Not available on PVP30kW)	**029-05020**
PVP-FST-002	Fat Spaniel Cell Modem: Quad Band/GSM industrial grade cell modem with antennae. AT&T or T-Mobile service. Power supply included. Cell service not included.	**029-05021**
PVP-DKR-001	Draker Integrated Solution: UL 508A industrial panel with control transformer, power supply, fusing, CR-1000 data logger, Ethernet switch, and two 485-232 converters. (NOTE: Not available on PVP30kW)	**029-05026**
PVP-DKR-002	Draker Cell Modem: GSM industrial grade cell modem with antennae. Can use any available carrier. Power supply included. Cell service not included.	**029-05027**
PVP-ERI-001	ERI Integrated Solution: UL 508A industrial panel with control transformer, power supply, fusing, ERI gateway, Ethernet switch. (NOTE: Not available on PVP30kW)	**029-05030**
PVP-ERI-002	ERI Cell Modem: GSM cell modem with antenna and serial cable. Compatible with T-Mobile and ATT. Power supply not included. Cell service not included.	**029-05031**
PVP-RGM-100	Inverter Integrated Revenue Grade Meter: Electro Industries Shark 100 meter (NOTE: Not available on PVP30kW). Requires connection to modbus gateway to collect and store data. Use above systems or any third-party monitoring system.	**029-05001**

Advanced Energy

NEW! PV Powered PowerVault

DC-to-Medium-Voltage Building Block for MW Scale Projects

The PowerVault is an integrated power conversion solution for MW-scale PV projects requiring medium voltage (MV) AC output. The PowerVault is built around the PV Powered line of reliable, efficient commercial inverters with an expected 20+ year operating life. The PowerVault also offers a wide MPPT input range.

The pre-wired outdoor-rated enclosure reduces project engineering costs and on-site labor time. The entire package is also designated to be pier mounted to further simplify installation. A wide range of sub-combiner fusing options are available. Select AC output from 4,160V to 35kV AC, loop feed or radial feed, and multiple protection and switching options. A single-phase load center with branch breakers provides tracker power and other on-site power requirements.

The enclosure is certified to UL QRNZ for walk-in electrical equipment, and houses the inverters, distribution switchboard, and single-phase service power panel. The transformer with integrated medium-voltage switch is a compact package that enables low-cost loop-feed installations and minimizes the need for individual pieces of medium voltage switchgear. The design offers several configuration options to meet local utility requirements and installation preferences.

Inverter-integrated, pre-engineered monitoring solutions from Fat Spaniel, Draker, or Energy Recommerce are available from Advanced Energy, the maker of PV Powered inverters. Monitoring hardware is housed on a UL 508A panel to deliver a high level of safety and reliability. Optional inverter factory-installed integrated sub combiner monitoring offers subarray DC current data. Sub-combiner monitoring data is delivered to the web as soon as the inverter is connected to the monitoring system. Data can be displayed in graphical format and historic data can be analyzed. The user can also set alarms based on absolute values or differential values, or both, depending on the chosen software provider. Or obtain monitoring at the string level by using PV Powered's IntelliString combiner boxes (see page 90). Revenue grade metering can be selected for each inverter at the switchboard, and at the medium voltage output.

PV Powered inverters come with a 10-year nationwide warranty, with an optional 20-year warranty.

PV Powered PowerVault with AC output up to 15kV

Model	Inverter configuration	Continuous output power	AC output voltage	CEC rated efficiency	Max DC input voltage	MPPT voltage range	Item code
PVMV-1040	4 x 260kW	1040kW	4.16kV - 35kV	97.0%	600	295-500	**030-08621**
PVMV-880	3 x 260kW	880kW		96.9%			**030-08623**
PVMV-780	3 x 260kW	780kW		97.0%			**030-08625**
PVMV-620	2 x 260kW	620kW		95.8%			**030-08627**
PVMV-520	2 x 260kW	520kW		97.0%			**030-08629**

PowerVault Accessories

Model	Description	Item code
PVMV-1040-FR3	Non-toxic transformer coolant: envirotemp FR-3 biodegradable transformer coolant	**030-08661**
PVMV-1040-VFI	VFI medium voltage breaker: transformer integrated vacuum fault interrupter breaker. Oil immersed. (Call about options other than PVMV-1040.)	**030-08663**
PVMV-1040-MCB	Switchboard main breaker: Main breaker for models MV-780kW, MV-880kW and MV-1040kW	**030-08665**
PVMV-620-MCB	Switchboard main breaker: main breaker for model PV620	**030-08667**
PVMV-1040-RGM	Switchboard revenue meter: switchboard integrated revenue grade meter (monitors output of all four PowerVault inverter in aggregate)	**030-08669**
PVMV-1040-25KV	25kV rated transformer: adder for >15kV AC output on primary side of medium voltage transformer (call about options other than PVMV-1040)	**030-08671**
PVMV-1040-35KV	35kV rated transformer: adder for >25kV AC output on primary side of medium voltage transformer (call about options other than PVMV-1040)	**030-08673**

Schneider Electric

Xantrex GT Series 3-Phase Commercial/Industrial Inverters

Schneider Electric's Xantrex GT three-phase inverters offer an easy to integrate solution for a variety of applications from small commercial installations to utility scale plants. These high efficiency inverters are available in sizes from 30 kW to 250 kW. The GT Commercial Series grid-tie inverters make industrial-commercial power production affordable and attractive.

The compact, 165-pound, 30 kW inverter is in a wall-mounted aluminum enclosure and requires a symmetrical array input (split array +/- 180-430VDC). 100 kW and 250 kW inverters have pad-mounted epoxy-coated steel enclosures with integrated transformers and disconnects. These inverters can be configured as positive ground for use with SunPower modules. They require zero clearance on back and sides and can fit through standard doors.

With warranties available for up to 10 years of coverage, service contracts and uptime guarantees for up to 20 years, Xantrex GT inverters helps maximize your return on investment and lower your total cost of ownership. All inverters are listed to UL 1741 and IEEE 1547 and are listed with the California Energy Commission.

Xantrex GT30 Grid Tie Solar Inverter

The Xantrex GT30 solar grid-tie inverter features transformerless bipolar design with high conversion efficiency and a wide PV maximum power tracking voltage range. Transformerless design increases efficiency by reducing energy losses, and also reduces the size, weight and noise of the inverter. The GT30 is significantly smaller (22" W x 48" H x 13" D) and lighter (165 lb) than other 30 kW inverters allowing greater installation flexibility, and greatly reducing structural loading in rooftop installations.

The Xantrex GT30 bipolar design requires a symmetrical array input (split array +/- 180-430VDC) with two identical photovoltaic subarrays, PV1 and PV2, of opposite polarities with respect to ground. The negative terminal of monopole PV1 and the positive terminal of monopole PV2 will be automatically grounded inside the Xantrex GT30. Both subarrays need PV modules to be of the same type, number, orientation and electrical configuration. Bipolar design, coupled with internal inverter ground points, eliminate the need for double-insulated DC conductors.

The GT30's outdoor rated, aluminum, corrosion resistant cabinet, low weight, and included wall mount bracket allow for flexible installation. Operator interface controls are located on the front face of the inverter enclosure, and include a 4-line LCD display, an AC disconnect switch handle, and a PV disconnect switch handle. AC and DC switchgear are included to reduce installation expense and visual clutter. Multiple inverters are easily paralleled for 60 kW, 90 kW, 120 kW and larger for modular growth applications for larger PV plants. Nominal output voltage of the GT30 is 208VAC, but autotransformers are available from Schneider Electric for connection of 1, 2, or 3 inverters to a 480VAC service.

The Xantrex GT30 provides an option for communicating system status and data logging with a PC through the RS-485/modbus connection, or via an RS-232 connection and a modem, using the PV View Graphic User Interface (GUI) software. The PV View Graphic User Interface software is a Windows-based program that displays system status and set-points, accesses and enables adjustment of inverter controls, and accesses metering and data logging capabilities.

Fully compliant with the NEC and UL Listed to UL 1741 for the U.S. and Canada; 96% CEC efficiency; Standard 5-year warranty with 5-year extension available.

Schneider Electric model	Continuous output (kW)	AC output voltage	Max DC amps	Max DC array voltage	MPPT range	CEC efficiency	Dimensions H" x W" x D"	Weight (lbs)	Item code
GT30-208	28.8	208	80	430*	180-400*	96.0%	48 x 22 x 13	165	**030-02003**
GT100-208	100	208	278	600	300-480	95.0%	74x 67 x 46	2995	**030-02017**
GT100-480		480	121			96.0%			**030-02015**
GT100-600		600	97						**030-02016**
GT250-480	250	480	301				86 x 90 x 46	4450	**030-02026**
GT250-600		600	241						**030-02025**
GT500-480	500	480	602		310-480	96.5%	89x 150 x 50	5000	**030-02007**
GT500-600		600	482			96.5%			**030-02008**
GT500 MVX		208**	1388			97.0%		3500	**030-02009**

* per monopole array

** for connection to MV transformer (not included)

Schneider Electric

Xantrex GT100, GT250 and GT500 Grid Tie Inverters

The Xantrex GT100 and GT250 grid-tie inverters feature integrated design with isolation transformer in one unit and CEC efficiency of 96%, including isolation transformer. The sealed design requires no filters or external air to cool sensitive components. The back and sides of unit are designed for zero clearance installations to minimize inverter space requirements. A removable air outlet allows the inverter to be mated with venting duct work. Wiring access points are on the bottom, sides and back of the inverter. AC and DC disconnects are included. Zinc primed and powder coated steel enclosures offer maximum corrosion resistance. Negative- or positive-ground system configuration is possible. Optional fused subarray combiners with 100A, 150A or 200A circuits are integrated with the inverter enclosure (must be factory installed and ordered with inverter). Optional RS-485/modbus or Ethernet communications interface kit. All GT Series Inverters are backed by a standard 5-year warranty with 10- or 15-year optional extended warranties available. Optional uptime guarantee and preventative maintenance programs are available.

The GT500 offers the same features as the GT100/GT250 inverters, but the GT500 offers 500kW of output and is supplied with an external transformer. The GT500 MVX is for direct connection to a MV transformer (not included).

Optional subarray combiners are available for all GT inverters 100kW and larger. SEE CHART BELOW. Subarray combiners are integrated into the inverter and must be ordered with the inverter at time of inverter order

Optional extended warranties, preventive maintenance, and uptime guarantees are available for 100kW and larger inverters. Schneider also has an on-site commissioning contract available. Call for pricing on these options.

GT Commercial Inverter Options

Fits Inverter model	Description	Number of fused inputs	Fuse size	Item code
GT30	30 KVA Autotransformer 208V to 480V for one GT30			030-02083
	75 KVA Autotransformer 208V to 480V for two GT30's			030-02084
	112.5 KVA Autotransformer 208V to 480V for three GT30's			030-02085
GT100	Subarray combiner	3	200A	030-02063
		4	150A	030-02064
		6	100A	030-02065
GT250	Subarray combiner	7	200A	030-02068
		10	150A	030-02069
		15	100A	030-02070
GT500	Subarray combiner	16	200A	030-02075
	Subarray combiner with String Monitoring			030-02076
	Subarray combiner	30	100A	030-02077
	Subarray combiner with String Monitoring			030-02078
	Other fuse combinations for GT500 with and without String Monitoring			CALL
GT500	GT500 Space Heaters for Low Temperature Option			030-02090

NEW! PV BOX

The Schneider Electric PV BOX is a pre-wired equipment package specifically designed to meet the growing demand of large scale grid-tied solar farms and large commercial rooftop solar installations. The PV BOX is a complete solution for electrical distribution, automation, security, monitoring and control available from one vendor. Installers can reduce total electrical installation costs and project cycle time with the PV BOX. In addition, by placing the inverters into a structure with a controlled environment, the PV BOX can be installed into a variety of climates, including harsh desert environments.

The PV BOX consists of solar inverters, DC combiner boxes, step-up transformers and a medium voltage switch housed in a prefabricated building to allow quick field wiring from both the PV arrays and the utility grid connection point. Other items can be added to the package including climate controls, security equipment, array string monitoring, SCADA monitoring equipment, and power metering. Standard and custom designs are available using Xantrex GT250 and GT500 MVX inverters, with outputs of 250 kW, 500 kW, 1 MW and 2 MW.

The first BiPolar transformerless 30 kW inverter on the market!

Introducing an inverter that is small, lightweight, has a 96% efficiency and can help simplify your installation, no matter the size or scale of your project.

1. Schneider Electric GT30 inverter
2. Square D™ utility panel
3. Utility meter
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Solectria Renewables

3-Phase Commercial Inverters

Solectria PVI inverters use DSP-controlled IGBT circuitry to achieve high efficiency, reliability and low installed cost. The NEMA 3R enclosure with forced ventilation allows these inverters to be mounted in full sun, on roof tops or indoors. Inverter electronics are in a sealed enclosure within the housing. Their fully integrated design includes transformer, filters and AC and DC disconnects. Disconnects face to the side. Units can also be configured to use multiple inverters with the disconnects facing forward to minimize distance required between inverters. Optional integrated fused DC sub-combiners are available in all units.

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

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

Inverters are ETL Listed to UL 1741 for the U.S. and Canada, and IEEE Standard 1547, and certified to IEEE 6241 NY SIR surge test requirements. Solectria inverters come with a 5-year warranty. 10-year and 15-year warranties are available. These units ship from the Solectria factory in Massachusetts. Made in USA.

SolrenView Monitoring

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

Inverter model	AC power	AC output voltage	Max AC amps	Max. DC array Voc	MPPT range volts DC	CEC rated efficiency	Weight (lbs)	Dimension H"xW"xD"	Item code
PVI 10kW-208VAC	10 kW	208	28	475	205-380	94.0%	364	34.5x 26x13.6	**030-03864**
PVI 10kW-480VAC		480	12			94.5%		34.5x 26x13.6	**030-03865**
PVI 13kW-208VAC	13.2 kW	208	37			94.0%	376	34.5x 26x13.6	**030-03863**
PVI 13kW-480VAC		480	16			94.5%		34.5x 26x13.6	**030-03867**
PVI 15kW-208VAC	15 kW	208	42			94.0%	398	34.5x 26x13.6	**030-03871**
PVI 15kW-480VAC		480	18			94.5%		34.5x 26x13.6	**030-03875**
PVI 60kW-208VAC	60 kW	208	166	600	315-500	94.0%	1526	76x56x29.3	**030-03885**
PVI 60kW-480VAC		480	73			95.5%		76x54x25.3	**030-03889**
PVI 82kW-208VAC	82 kW	208	229			94.5%	1615	76x56x29.3	**030-03893**
PVI 82kW-480VAC		480	100			95.5%		76x54x25.3	**030-03897**
PVI 95kW-208VAC	95 kW	208	261			94.5%	1748	76x56x29.3	**030-03901**
PVI 95kW-480VAC		480	115			95.5%		76x54x25.3	**030-03905**
SGI 225kW-480VAC	225 kW	480	271	625	300-500	97.0%	5170	79x109x37	**030-03926**
SGI 250kW-480VAC	250 kW		301			97.0%	5170		**030-03928**
SGI 266kW-480VAC	266 kW		320			97.0%	5170		**030-03930**
SGI 300kW-480VAC	300 kW		360			97.0%	5650		**030-03940**
SGI 500kW-480VAC	500 kW		600			97.0%	6980		**030-03950**
Integrated fused string combiner option for 10 kW, 13.2 kW, 15 kW inverters. Specify 5, 6 or 7 fuses and fuse size (10A or 15A). Add:									**030-03859**
Integrated fused subarray combiner option for 60kW and larger inverters. Specify 2-8 fuses and fuse size (40-250A). Add:									**030-03860**

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10kW to 2MW

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Low voltage ride through
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Sunny Island SI5048-US

The Sunny Island 5048-US is a bi-directional battery-based inverter/charger that can be used completely off-grid, or for battery backup in grid-tie systems with Sunny Boy grid-tie inverters. The Sunny Island is a complete power center with 5kW of sine wave output power, low idle losses, high efficiency, integrated battery disconnect, 100A battery charger, and integrated data monitoring and system control, all in a compact wall-mounted package.

The SI5048-US has a single-phase output of 120V at 60Hz. Two inverters can be "stacked" to provide 120/240V 60Hz split-phase output. Connect up to four SI5048-US inverters in series/parallel for up to 20kW at 120/240V 60Hz. Or, use three inverters for 15kW at 120/208VAC three-phase power. Add a Multi-Cluster Box and connect up to four sets of three inverters (called "clusters") for up to 60kW of three-phase power.

Grid-Tie System Backup

The Sunny Island can back up critical loads during utility grid blackouts. Combine it with a Sunny Boy grid-tie inverter system and connect it to a bank of batteries, and the Sunny Island will allow the PV array to power loads and charge the batteries. This is done as an "AC-Coupled" system, where the AC output of Sunny Boy grid-tie inverters is connected to a critical-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, all at the same high efficiency as a regular Sunny Boy grid-tie system. During night or cloudy days, grid power flows through the SI5048's transfer switch to power loads connected to the subpanel. During a power outage, the Sunny Island opens the grid connection to provide AC power to the emergency subpanel, drawing energy from the battery bank. The power outage will turn off any Sunny Boy inverters connected to the subpanel; they turn back on (after a 5-min period) when they sense the AC from the Sunny Island. Loads smaller than the output of the PV system are powered directly off of the array. When the load is larger than PV array's output, and at night, energy is drawn from the batteries to make up the difference. If the batteries need charging, AC power from the Sunny Boy inverter(s) flows backwards through the Sunny Island(s) to charge the batteries. If the batteries are full, and the PV system is producing more power than the loads require, the Sunny Island(s) will communicate with the Sunny Boy inverter to decrease its power output. If there are no loads and the batteries are full the Sunny Boy inverter(s) will shut off completely, preventing battery over-charging. All of this is completely automatic.

Off-Grid Power

In off-grid systems, the Sunny Island works with Sunny Boy inverters exactly as it does with grid-tie systems, with one difference: Rather than act exclusively as a back-up, the system operates as if there were a permanent grid outage, and the critical loads panel becomes the main panel. A generator can be connected to the Sunny Island's AC input to provide back-up 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 sources like micro-hydro and wind turbines.

Data monitoring

The SI5048-US utilizes removable SD cards to store performance data from the integrated data logger and allow easy firmware upgrades. State-of-charge metering helps with battery management to ensure maximum battery life. The SI5048-US works with the SMA Sunny WebBox and SensorBox monitoring accessories. (see page 73)

The Sunny Island SI5048-US is UL Listed to UL 1741 for the U.S. and Canada. A 5-year warranty is standard, and 5-year warranty extensions are available.

NEW! MCB-12U Multi-Cluster Box for the Sunny Island 5048U

The new Multi-cluster Box for the Sunny Island 5048-US is the ideal solution for the easy installation o¬f three-phase hybrid systems. Connect up to four parallel three-phase clusters, each consisting of three Sunny Island battery inverters, for 30kW, 45kW, or 60 kW of inverter capacity. The Multi-Cluster Box is pre-wired with 300A main disconnect breakers for the grid or generator connections, loads, Sunny Boy inverters, plus 70A AC input breakers for up to 12 Sunny Island battery inverters. There is also a load shedding contactor. Includes required communication cables.

NEMA 12 enclosure standard: NEMA 4 or 4X available. Size: 65"H x 48"W x 14"D, and weighs 485 lbs. ETL Listed to UL 508A. 5-year warranty; 5-year extensions up to 20 years available.

Model	Watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code
SI5048-US	5000	48 VDC	120 VAC / 60HZ	25 watts	100A	150 A	139	**030-03095**
MC-12U	SMA Multi-Cluster Box, three-phase only, up to 60kW						280	**030-03152**
MC-PB	SMA Multi-Cluster Piggy Back Board - CAN and RS-485 bus, one required for each cluster							**030-03153**

OutBack

GTFX and GVFX Grid-Tie Inverters and Systems

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

OutBack Inverters for Latin America

OutBack GTFX-LA and GVFX-LA grid-tie inverters are designed to be used in Mexico and other parts of Latin America where the grid power is uneven. They have 127VAC/60Hz output, and have widened grid input voltage and frequency ranges to work better with the Mexican utility grid. As with the other OutBack inverters, the "T" models have a sealed chassis and an external cooling fan, and the "V" models have a fan-cooled, vented chassis. NOTE: OutBack LA inverters are NOT ETL Listed to UL 1741. NOT intended for use in the U.S. or Canada.

The OutBack GFX International Series

The OutBack GFX International Series grid-tie inverters are designed for use in countries that have utility grids that frequently experience power instability such as surges, spikes, or brownouts; or where standard inverters have trouble syncing to the utility grid. The GFX International Series grid-reconnect timers have been shortened to reduce overall sell-back downtime and improve system functionality. Otherwise, the International Series inverters are similar to other OutBack GFX models, but without an exterior cooling fan. The built-in transfer relay automatically disconnects your loads from the utility grid and powers them from the inverter in the event of an outage, allowing you to continue using your solar and battery back-up power. They have a sealed chassis that can operate in the harshest environmental conditions such as high humidity and corrosive salt air. Models are available for areas with nominal AC voltages of 230 VAC/50Hz, and for areas with 120 VAC/60Hz. DC cover included. 5-year warranty.

NOTE: OutBack GFX International Series inverters are NOT ETL Listed to UL 1741. NOT intended for use in the U.S. or Canada.

OutBack model	Continuous watts	Battery voltage	AC out volts/hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code
GTFX and GVFX Grid-Tie Inverters for the U.S. and Canada								
GTFX2524	2500	24 VDC	120V/60Hz	18-20W	55A	70A	56	**030-04025**
GTFX3048	3000	48VDC		21-23W	35A		66	**030-04030**
GVFX3524	3500	24VDC		18-20W	85A		54	**030-04032**
GVFX3648	3600	48VDC		21-23W	45A		54	**030-04036**
GTFX and GVFX Grid-Tie Inverters for Latin America								
GTFX2524LA	2500	24 VDC	120V/60Hz	20W	55A	70A	56	**030-04020**
GTFX3048LA	3000	48VDC		23W	35A		66	**030-04021**
GVFX3524LA	3500	24VDC		20W	85A		54	**030-04022**
GVFX3648LA	3600	48VDC		23W	45A		54	**030-04023**
OutBack Grid-Tie Inverters International Series								
GFX1312	1300	12VDC	120V/60Hz	18W	70	56A	50	**030-04013**
GFX1424	1400	24VDC			40			**030-04014**
GFX1548	1500	48VDC			20			**030-04015**
GFX1312E	1300	12VDC	230V/50Hz	18W	70	29A	50	**030-04016**
GFX1424E	1400	24VDC			40			**030-04017**
GFX1448E	1400	48VDC			20			**030-04018**

OutBack

Off-Grid Inverters

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

Each inverter/charger is a complete power conversion system – DC to AC inverter, battery charger and AC transfer switch. Additional inverter/chargers can be added at any time either in parallel (120VAC), series (120/240VAC), or even three-phase (120Y208 VAC) configurations, allowing the system to be tailored to the specific needs of the application, both at the time of installation and into the future. With the addition of an X-240 autotransformer, multiple inverter systems can be set up to provide 120/240 VAC split-phase output with the ability to provide full power on either 120VAC leg of the system. Up to 10 inverters can be connected together to provide up to 36 kW of continuous power capacity with the use of the HUB and the MATE controller. The inverter's powerful battery charger operates in five stages: BULK (constant current output), ABSORB (constant voltage output), FLOAT (reduced voltage output), SILENT (no charger output) and EQUALIZE (constant voltage regulation overcharging). Charge time in each stage is adjustable to provide control and to maximize the performance of the charger and battery system.

Each OutBack inverter has a programmable, auxiliary relay output connection (AUX) that provides 12VDC output to run 12V cooling or ventilation fans or operate an external relay to perform other functions, such as remote generator starting (two-wire), to disconnect external charging sources (such as PV), or to turn on a diversion load for voltage regulation. Note: The AUX relay is used to power the external cooling fan of the FX sealed inverters, so it is not available for other uses.

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

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

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

FLEXware 500 and 1000

The FLEXware 500 supports up to two inverter/chargers and two charge controllers in an attractive, versatile and code-compliant package for installations where more power is needed. The FLEXware 1000 accommodates up to four inverter/chargers and four charge controllers. Multiple power panels can be used for systems up to 36 kW. Both the FLEXware 500 and 1000 systems provide ample locations for AC and DC breakers, DC-current shunts, an autotransformer and other items required in higher kW systems. The FLEXware MP mounting plate is used with with both FLEXware 500 and FLEXware 1000 enclosures. Use two mounting plates for the FW1000. The picture here shows the FLEXware 1000 AC and DC boxers with 4 inverters and 4 MX60 charge controllers.

OutBack model	FLEXware 500 and 1000	Inverters	Item code
FLEXware Mounting Plate			
FW-MP	FLEXware Mounting plate for FLEXware 500 and 1000 enclosures (2 required for FW-1000 systems)	2	**030-04260**
FLEXware 500 Power System Box and IOB Kits			
FW500-AC	FLEXware 500 enclosure with TBB-ground, DIN rail for AC breakers	1-2	**030-04215**
FW500-DC	FLEXware 500 enclosure with DC breaker bracket, TBB, BBUS, 500A shunt		**030-04212**
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04237**
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04240**
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and breaker bypass slide plate, TBB, wire - export		**030-04243**
FLEXware 1000 Power System Box and IOB Kits			
FW1000-AC	FLEXware 1000 Enclosure with TBB-ground, DIN Rail for AC breakers	up to 4	**030-04223**
FW1000-DC	FLEXware 1000 Enclosure with DC Breaker bracket, TBB, 2 SBUS, BBUS, 500A Shunt	up to 4	**030-04221**
FW-IOB-D-120/240VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	2	**030-04237**
FW-IOB-D-120VAC	IOB kit includes six 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04240**
FW-IOB-D-230VAC	IOB kit includes six 30A 230VAC breakers and bypass slide plate, TBB, wire - EXPORT ONLY		**030-04243**
FW-IOB-T-120/208VAC	IOB kit includes nine 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	3	**030-04253**
FW-IOB-T-230/400VAC	IOB kit includes nine 30A 230VAC breakers and bypass slide plate, TBB, wire - EXPORT ONLY		**030-04255**
FW-IOB-Q-120VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire	4	**030-04249**
FW-IOB-Q-120/240VAC	IOB kit includes twelve 60A 120VAC breakers and AC breaker bypass slide plate, busbars, wire		**030-04247**
FW-IOB-Q-230/AC	IOB kit includes twelve 30A 230VAC breakers and bypass slide plate, TBB, wire EXPORT		**030-04251**

FLEXware Components

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

Model	FLEXware options	Item code
FW-X240*	4kVA 120/240VAC autotransformer -w/ 25A 2-pole breaker for mounting inside FLEXware 500 and 1000 AC enclosures	**030-04270**
TBB-GROUND	Ground/neutral terminal busbar with mounting screws (no insulators).	**030-04356**
OBDC-GFP	Ground Fault Protection, 2 pole, 80A	**030-04323**
TBB-black	Bus bar with black insulators	**030-04353**
TBB-BLUE	Bus bar with blue insulators (for 3-phase and export versions)	**030-04359**
TBB-RED	Bus bar with red insulators	**030-04355**
TBB-WHITE	Bus bar with white insulators	**030-04354**
TBB-BROWN	Bus bar with brown insulators (for export versions)	**030-04352**
FW-BBUS	FLEXware Breaker Bus connector two 175-250A, three 100-125A, four 1-80A DC breakers or three 500 amp DC shunts	**030-04280**
FW-CBUS	Combiner Bus connects up to eight DIN mount breakers or four DIN mount fuse holders – includes one 1/0 screw lug	**030-04361**
FW-SBUS	FLEXware shunt bus connector allows up to four high current cable connections on same side of DC shunt	**030-04284**
FW-CCB	FM charge controller mounting bracket for one side mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04263**
FW-CCB2	FM charge controller mounting bracket for two side mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04265**
FW-CCB2T	FM charge controller mounting bracket for two top mounted on FW500 or FW1000 DC enclosures – with hardware	**030-04267**

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

OutBack

OutBack Accessories

Conduit Adapters

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

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

MATE Remote Monitors and Hubs

The OutBack MATE is a complete system controller and display for both the OutBack inverter/charger and OutBack MPPT PV charge controller. It provides a display of the operation and allows control and adjustment of the setpoints. The OutBack MATE also coordinates the operation of the entire system to maximize performance and to prevent multiple products from conflicting. A single OutBack MATE is able to connect to multiple inverter/chargers, OutBack MPPT PV charge controllers and any other OutBack power conversion and control products offered in the future. A maximum of ten OutBack products will be able to be connected to a single MATE via Cat 5 Ethernet type cabling with 8-wire RJ45 modular connectors and the OutBack HUB-10 communication manager. The OutBack MATE also includes an optoisolated RS-232 port with a DB9 jack for connection to the serial port of a PC computer. The MATE2 has a flush-mount black face for panel or in-wall mounting.

OutBack MATE3

The MATE3 system display and controller is the next generation of 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 allows easy adjustment of system setpoints. Expandable SD card memory allows you to increase data logging capacity, as well as upgrade units in the field. Built-in clock and calendar enables timer-based programming, permitting the user to set the system up to work with time-of-day utility rates, or set up a generator to only run at certain times of the day or week. The MATE3 has permanent memory, and is internet enabled to allow full remote monitoring.

The FLEXnet DC System Monitor

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

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

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

OutBack model	OutBack MATE system monitor and control	Item code
MATE	System control – shipped with a 50 ft Cat 5 cable	030-04180
MATEB	Black version of MATE	030-04180-B
MATE2	Flush-mount version of MATE	030-04181
MATE3	System Control w/ full graphical display and 50 ft CAT 5 cable	030-04178
FLEXNet DC	Advanced DC System Monitor - requires a MATE	030-04187
HUB-4	Stacking kit for up to 4 inverters and/or charge controllers	030-04185
HUB-10	Stacking kit for up to 10 inverters and/or charge controllers	030-04188
RTS	Remote temperature sensor with 20' cable	030-04190

Power Where You Need It.
Monitor and Control Wherever You Are.

The new MATE3 Advanced System Display and Controller provides easy, yet powerful command of your complete OutBack Power system. An intuitive user interface and integrated setup wizard makes programming quick and seamless. Improved tactile buttons and a programmable "favorite" key offers immediate access to the features you want, while a scroll wheel interface supports easy adjustments.

- Program, monitor and manage entire system
- User friendly interface
- Intuitive menu structure
- Easy-to-read graphical display

- SD card included for increased data logging capacity
- Field upgradable
- Internet enabled
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Schneider Electric

Xantrex XW Sine Wave Battery-Based Inverter/Charger System

The Schneider Electric Xantrex 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 120/240VAC output from a single inverter. Up to 4 inverters can be paralleled for up to 24kW of total output in a 120/240V split-phase system, or operate in a 208VAC 3-phase configuration with up to 2 inverters per phase (6 inverters total) for up to 36kW of power. Models are also available for 230V or 400VAC three-phase at 50Hz for overseas operation. Charge controllers, such as the Schneider XW60-150 or the XW80-600, are required for use with any PV array (see the Charge Controller section in page 122 for more information on these controllers).

High surge capacity is achieved by using digital control to regulate the output voltage from dropping during surge. Efficient, power-factor-corrected, high-current multi-stage battery charging minimizes recharge time and electricity/fuel costs. Dual AC inputs (grid and generator). Full control of generator with optional automatic generator start (AGS) unit. Configurable auxiliary relay output of 250mA at 12VDC included in each inverter.

The inverter display panel shows status at a glance. LEDs indicate AC-in status, faults/warnings, equalize mode, and battery state of charge. Three-character LED indicates output power or charge current. A battery temperature sensor is included with each inverter, but only one is needed per system.

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

The **XW Connection Kit** contains everything needed to add a second inverter. For a third inverter, use one Connection Kit plus a pair of 5-foot 4/0 inverter cables, with lugs on each end. An external transfer switch will be required if the inverter bypass function is desired. For four inverters, use two Power Distribution Panels and two Connection Kits.

Use the **XW conduit box** to retrofit XW inverters into existing systems which already have AC/DC disconnects.

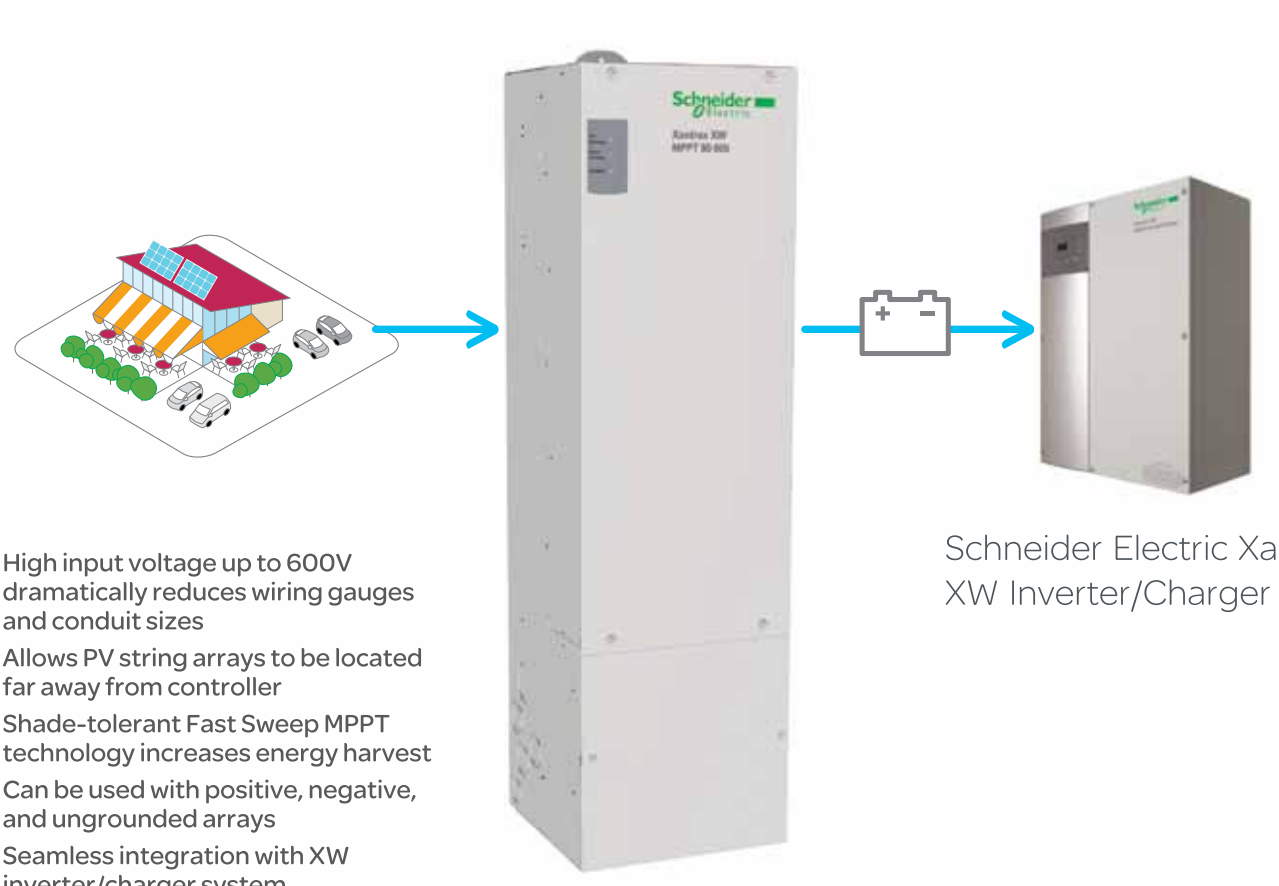
The **XW System Control Panel** plugs into the Xanbus network and provides a central user interface to configure and monitor all components in the system. One is required per XW system to change inverter programming. The Communications Gateway on page 122 can be used to connect the XW to a PC.

5-year warranty. CSA Listed to UL 1741 for the U.S. and Canada. Dimensions of the inverter are 16 x 23 x 9 inches. The inverter is field-serviceable without needing to remove it from the wall.

Schneider Electric model	Continuous watts	Battery voltage	AC out volts/ hertz	No load draw	Charger amps	Peak AC surge	Inverter Weight (lbs)	Shipping Weight (lbs)	Item code
XW4024-120/240-60	4000	24 VDC	120/240V/60Hz	24W	150	8000W	116	163	**030-01166**
XW4548-120/240-60	4500	48VDC	120/240V/60Hz	26W	85	9000W	118	165	**030-01163**
XW6048-120/240-60	6000	48VDC	120/240V/60Hz	28W	100	12000W	122	169	**030-01160**
XW4024-230-50	4000	24 VDC	230V-50	24W	150	8000W	116	163	**030-01178**
XW4548-230-50	4500	48VDC	230V-50	26W	85	9000W	118	165	**030-01177**
XW6048-230-50	6000	48VDC	230V-50	28W	100	12000W	122	169	**030-01176**
XW Power Distribution Panel	XW Power Distribution Panel w/ conduit box for 1 XW inverter								**030-01169**
XW Connection Kit	XW Connection Kit is needed for each additional inverter, includes breakers and conduit box*								**030-01172**
XW Conduit Box	XW empty conduit box raceway								**030-01175**
XW-MPPT60-150	XW 60A MPPT charge controller with built-in ground fault protection - 150VDC max input voltage								**020-08040**
865-1070	Input circuit breaker for MPPT60-150 charge controller; 60 A 160 VDC								**030-01192**
865-1075	Output circuit breaker for MPPT60-150 charge controller; 80 A 125 VDC								**030-01189**
XW-MPPT80-600	XW 80A MPPT charge controller with built-in ground fault protection - 600VDC max input voltage								**020-08048**
E-Series 100A/125VDC	Output circuit breaker for MPPT80-600 charge controller; 100 A 125 VDC								**053-01051**
XW Auto Generator Start	Automatic generator start module for the XW system								**030-01183**
XW System Control Panel	Plugs into Xanbus network and provides a central user interface								**030-01181**

The first high voltage solar charge controller on the market!

> Introducing the Xantrex™ XW MPPT 80 600 high voltage charge controller.



- High input voltage up to 600V dramatically reduces wiring gauges and conduit sizes
- Allows PV string arrays to be located far away from controller
- Shade-tolerant Fast Sweep MPPT technology increases energy harvest
- Can be used with positive, negative, and ungrounded arrays
- Seamless integration with XW inverter/charger system

Schneider Electric Xantrex XW Inverter/Charger system

Schneider Electric Xantrex MPPT 80 600

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Magnum Energy

MMS1012 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 ME and MS models. The MMS charger has a PFC (power factor corrected) charger, which is 85% efficient. The **MMS1012G** model comes with a flexible cord on the AC input and a GFCI outlet for easy connection to AC appliances. Great for mobile or emergency applications. Just connect to a 12VDC battery, and you have clean sine wave power anywhere. Optional MMS-RC-25 remote control available. The MMS Series is ETL Listed to the stringent requirements of UL/cUL 458, CSA C22.2 #107.1-01 and meets the KKK-A-822E standard. Made in USA.

MS-Series 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 MS Series inverters are powerful, easy to use, and are available in 12-, 24- and 48-volt versions. The MS4024 can be series stacked, using the ME-SSI, for 120/240 VAC operations, and 8kW total output. The MS2012-20B has two 20-amp AC breakers built in. The M4024-PAE and MS4448-PAE have 120/240VAC split-phase output, eliminating the need to stack two units or buy a transformer to run 240-volt loads. As many as four MS-PAE inverters can be paralleled for larger systems up to 17.6kW with 120/240VAC split-phase output (ME-RTR router required).

Mount the MS Series on a shelf or bulkhead, even upside down, or use Magnum's integration hardware on page 116. The aluminum base and cover provide noise reduction and corrosion resistance. The MS Series has an RS-485 communication port and a remote control port. The MS Series front panel has an on/off switch with an LED indicator. All models have a 50-amp transfer relay. The ME-RC50 controller is required for inverter programming.

The MS Series is ETL Listed to UL/cUL 458 for mobile use and UL 1741 for off-grid installations. Dimensions: 13.75 x 12.65 x 8 inches. 3-year warranty, except MS4024-PAE and MS4448-PAE which have a 2-year warranty. Made in USA. See page 116 for Magnum's integration hardware for MS and MS-PAE inverters.

Magnum model	Continuous output watts	Battery voltage	AC output volts/hertz	No-load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code
MMS1012	1000	12VDC	120V/60Hz	18W	50	1750W	20	**030-02320**
MMS1012G								**030-02321**
MS2012	2000	12VDC		25W	100	3300W	43	**030-02332**
MS2012-20B				25W	100	3300W	44	**030-02334**
MS2024		24VDC		25W	50	3900W	60	**030-02335**
MS2812	2800	12VDC		30W	125	3900W	53	**030-02336**
MS4024	4000	24VDC		25W	105	5800W	58	**030-02338**
MS4024-PAE	4000	24 VDC	120/240V/60Hz	27W	105	5800W	58	**030-02342**
MS4448-PAE	4400	48VDC		25W	60	8500W	58	**030-02341**
Accessories and Options								
ME-RC50	Remote control for all Magnum inverters with 50-foot cable for ME, MS, MS-PAE, RD						2	**030-02351**
ME-ARC50	Advanced Remote for all Magnum inverters with 50-foot cable						2	**030-02352**
ME-RTR	Magnum Router required for parallel stacking of MS-PAE inverters. Stacking cables included						2	**030-02350**
ME-SSI	Series stacking cable for MS-4024 ONLY						10	**030-02362**
ME-AGS-N	Automatic generator start – network version for use with Magnum inverters and ME-RC50						4	**020-06377**
ME-AGS-S	Automatic generator start – standalone version						4	**020-06375**
ME-BMK	Battery monitor kit - ME-ARC50 required with this item						4	**020-06379**
ME-CB	Conduit Box for ME, MS, ME-AE, and RD inverters						4	**030-02360**
MM-RC25	Remote control for MM, MM-AE, and MMS inverters						4	**030-02355**

Modified-Sine Wave Inverter/Chargers

MM-AE Series 12V Inverters

The MM-AE Series 12VDC 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-AE models use an 85% efficient PFC (power-factor-corrected) charger, and the same charger topology as all Magnum models. The 600- and 1200-watt models have a 12VDC input;1500-watt models have 24VDC input. The MM Series are powerful, easy-to-use and cost-effective. 2-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches.

ME-Series 12V Inverters

Designed for RV use the ME Series 12VDC inverter/charger charges batteries efficiently even at low AC voltage from low-cost generators. The modified sine wave inverter keeps the cost down and a battery temperature sensor optimizes charging. ME inverters have 3 power levels and built-in ground switching required for mobile inverters that may connect to utility power. ETL Listed to UL/cUL 458 for RV, marine and mobile use. 3-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches.

RD-Series 12V and 24V Inverters

The RD Series inverter/charger is designed specifically for off-grid use with the same chassis as the MS sine wave inverters. Includes power-factor-corrected charger, modified sine wave inverter and battery temperature sensor. The RD inverters are ETL Listed to UL 1741. 2-year warranty. Dimensions: 16.6 x 8.4 x 4.7 inches.

Magnum model	Continuous watts	Battery voltage	AC out volts/ hertz	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code
MM612-AE	600	12VDC	120V/60Hz	10W	30	1100W	14	**030-02302**
MM1512-AE	1500			16W	70	2100W	20	**030-02306**
MM1524-AE	1500	24VDC		16W	35	2650W	20	**030-02303**
ME2012	2000	12VDC	120V/60Hz	12W	100	3700W	38	**030-02305**
ME2512	2500			13W	120	5000W	42	**030-02311**
ME3112	3100			13W	160	6000W	45	**030-02315**
RD2212	2200	12 VDC	120V/60Hz	12W	110	3200W	38	**030-02326**
RD1824	1800	24 VDC		13W	50	4000W	38	**030-02322**
RD2824	2800			15W	80	6000W	42	**030-02324**
RD3924	3900			15W	105	9000W	45	**030-02328**

Accessories and Options

The optional ME-RC remote control is simple to use, yet allows all the set-up features of the ME, MS, MS-ME, and RD Series inverters. The ME-RC controls the ME-AGS automatic generator start using a network connection to the inverter. This remote has convenient finger-tip operation, including one-knob programming. The new ME-ARC advanced remote offers even more control of the setup.

The optional Auto Generator Start (AGS) module automatically starts and stops most major generator brands. 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-settable level. The **ME-AGS-S** is the 'standalone' version of Magnum Energy's Automatic Generator Start (AGS) 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 (AGS) controllers and is setup and operated via a Magnum Energy Inverter and ME-RC or ME-ARC remote panel. When using the ME-RC Remote, the ME-AGS-N has basic adjustments starting on battery voltage or temperature. When using the ME-ARC 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. Also includes the ability to manually turn the generator ON and off, generator exercise, warm-up and cool-down. The optional ME-SSI allows series connection of two MS4024 inverters for 120/240VAc split-phase output at 8kW total power output.

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-RC or ME-ARC remotes. Kit includes a sense module, shunt and wiring. The MM-RC provides on/off control and a quick indication of inverter and charger operation. (Table on opposite page.)

Magnum MMP Mini Magnum Panel

The MMP - Mini Magnum Panel - is an inclusive, easy-to-install panel designed to work with one Magnum MS-AE, MS, RD or other non-Magnum inverter/charger. The MMP features a small footprint and comes prewired for fast installation. Circuit breakers and the optional remote control mount on the front of the cabinet. Dimensions are 12.5" wide x 18" tall x 8" deep. They are ETL listed to UL 1741 and CSA C22.2 107-01. Each MMP includes one DC breaker – 175A or 250A, One AC bypass breaker – 30A dual pole or 60A single pole, one AC input breaker – 30A dual pole or 60A single pole, a 500A/50mv shunt, DIN rail provided for up to eight DC mini breakers (see page 119). Panels are available for inverters with 120 VAC output and 120/240 VAC output.

Magnum model	DC main breaker	AC output breaker	Use with	Item code
MMP250-30D	250	30A @120/240VAC	MS4024-PAE	**030-02380**
MMP250-60S	250	60A @ 120VAC	All ME models, MS4024, MS2812, MS2012, RD3924	**030-02381**
MMP175-30D	175	30A @120/240VAC	MS4448-PAE	**030-02382**
MMP175-60S	175	60A @ 120VAC	RD2824 or RD1824	**030-02383**

MP Magnum Panels

The **MP** Magnum Panels are available in three sizes, each with either a 30-amp two-pole 120/240 VAC output breaker or a 60-amp 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 up to 2 inverters with the use of an MPX Extenssion Box. Includes a 250A DC breaker, a 125A AC bypass breaker, a 500A/50mv DC shunt and inverter AC input protection, and all AC/DC wiring for dual inverters (source/ load wiring not included).

The **MPSH** (magnum panel, single enclosure, high capacity) 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 250A DC breaker, a 125A AC bypass breaker, a 1000A/100mv DC shunt and inverter AC input protection, and all AC/DC wiring for dual inverters (source/load wiring not included).

The **MPHD** (magnum panel, dual enclosure, high capacity – accommodates as many as 4 inverters with 2 enclosures – one for AC and one for DC connections. Two inverters can be connected to the MPHD. The third and fourth inverters require one MPX for each. The MPHD includes two 250A DC breakers, a 125A AC bypass breaker, a 1000A/100mv DC shunt and inverter AC input protection, and all AC/DC wiring for dual inverters (source/load wiring not included)

Mount and connect additional inverters to MP Series Systems Panels using **MPX Series** Extension Boxes. They mate perfectly to the bottom of Magnum MS4024 or the MS-PAE inverters. Includes 250A DC breaker and all AC and DC inverter wiring for adding another 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 from six extension box models depending on the type MP enclosure to be installed and which side of the MP enclosure it will be installed on.

Magnum model	DC main breaker quantity	Main breaker spaces	AC bypass breaker	Item code
MPSL-30D	1	1	60 A	**030-02384**
MPSL-60S	1	2	60 A	**030-02385**
MPSH-30D	1	3	125 A	**030-02388**
MPHD-30D	2	4	125 A	**030-02389**
MPXS-30D-L	Extension Box for MPSL-30D or MPSH-30D panels		LEFT-side mounting	**030-02399**
MPXS-30D-R			RIGHT-side mounting	**030-02400**
MPXS-60S-L	Extension Box - for MPSL-60S, with SERIES cabling		LEFT-side mounting	**030-02401**
MPXS-60S-R			RIGHT-side mounting	**030-02402**
MPXD-30D-L	Extension Box - for MPHD-30D, with PARALLEL cabling		LEFT-side mounting	**030-02403**
MPXD-30D-R			RIGHT-side mounting	**030-02404**
BP-S	Back Plate Single (fits 1 - MMP, MPSL, MPSH, MPX)			**030-02394**
BP-D	Back Plate Double (fits 1 - MPDH)			**030-02395**
BP-MMP	Back Plate MMP (fits 1 - MMP)			**030-02396**
MP-CCB	Bracket for mounting charge 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-HOOD	Panel Hood (included in MMP, MPSL, MPSH, MPDH)			**030-02398**

Apollo Solar

TSW TrueSineWave Inverter/Chargers

The Apollo Solar TSW inverter/chargers include a true sine wave inverter, a battery charger, and AC transfer switch in a compact modular housing. These inverters provide field-selectable 120/240VAC split-phase AC power at 60Hz or 230VAC at 50Hz. Multiple TSW inverters can be stacked for increased power output for larger systems, and 3 inverters can be stacked for three-phase power. Apollo's integration hardware can be used to provide a clean, compact, NEC compliant power system. The inverters have on-board system monitoring, and when coupled with Apollo's MPPT charge controllers, the system provides PV array control and battery state of charge metering.

The TSW series inverters provide a 120/240 volt AC split-phase input and output. The output provides 240 volts for well pumps, appliances, or shop tools while providing 120 volts for standard circuits. The input can accept the utility line or 240-volt AC generators. The output can be wired for single 230/240VAC output or for single 120VAC output at twice the current. Internal switches allow the option to select 230VAC or 240VAC and 50Hz or 60Hz. In 120/240VAC split-phase configuration, either side of the output line can supply up to 75% of the total load. Over 200% of the rated TSW power is available to allow for surges for short periods, such as starting a 3-HP motor, without interrupting sensitive computer loads. At the same time, the TSW inverters can be wired in parallel to provide additional output current for larger systems up to 32kW of power output at 120/240VAC split-phase.

The high-current battery-charging circuit is power-factor corrected and optimizes the efficient use of energy from generator or utility line input. The 4-stage charging algorithm — Bulk, Absorb, Float, Equalize — maximizes both battery life and storage capacity.

Monitoring of energy used, battery state-of-charge, and system performance is included in the Apollo TSW inverters. The two-line LCD shows all major parameters and adjusts to allow horizontal and vertical inverter installation. The TSW's ASNET port allows networking capability between multiple units as well as access to the T80/T80HV MPPT Turbocharger PV controllers. Remote system monitoring on a local Ethernet and/or on the internet is provided via the Apollo Solar Communications Gateway via the Apollo Solar GSM Modem even when telephone land line is unavailable. See page 122 for more info on the Apollo communications equipment.

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

Apollo model	Continuous watts	Battery voltage	No load draw	Charger amps	Peak AC surge	Weight (lbs)	Item code
TSW3224	3200	24 VDC	29 W	100	6400W	49	**030-02615**
TSW4048	3600	48 VDC	35 W	70	8000W	49	**030-02620**

ISM 120/240 Inverter Switchgear Module

The Apollo Solar ISM 120/240 comes factory assembled with the inverter breakers for DC input and AC input/output/bypass breakers, and slots for 18 DIN rail half-inch wide breakers, and fits all Apollo TSW inverters. Apollo Solar Breaker Pacs are available for the T80 or T80HV MPPT Charge Controller, ground fault protection, and generator/grid selector. With the AC and DC disconnects, busbars, shunt and connectors in a single enclosure, installers need only connect the PV Input, battery cables, AC load, and optional AC line/generator input from the outside, providing a complete solar power switchgear package for quick, fail-safe installation. One ISM needed per TSW inverter, and multiple inverters and ISM units can be stacked together to create larger systems.

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

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

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

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

Morningstar

SureSine 300W Inverters

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

The SureSine uses epoxy encapsulation, conformal coating, stainless steel hardware, and an anodized aluminum enclosure to protect against harsh tropical and marine environments. AC output connection does not have an AC receptacle so it needs to be hardwired. 2-year warranty.

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

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

Exeltech

XP Series Sine Wave Inverters

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


XP 125


XP 250


XP 600


XP 1100

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

MAGNUM ENERGY

Inverter/Chargers ▪ Interconnection System Equipment ▪ Accessories ▪ Web-based Monitoring

Inverter/Chargers
600 to 4400 watt models available
- MM-AE Series
- MS Series
- MS-PAE Series
- RD Series

Interconnection System Equipment
Designed to make installations even easier, the Magnum Panel systems integrate multiple components into a simple number system to make ordering your MP a breeze.
- MMP – Mini-Magnum Panel
- MP – Magnum Panel – three models available

AGS

Battery Monitor Kit

Accessories
- AGS – Automatic Generator Start Module
- BMK – Battery Monitor Kit
- Fuse Blocks
- LCD Remote Displays
- ME-SBC – Smart Battery Combiner

New! Web-based System Monitoring from Magnum now available

Call and ask for our full catalog for complete product information.
Phone: 425-353-8833 **Web: www.magnumenergy.com** **The Powerful Difference**

Samlex

Sine Wave Inverters

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

Samlex model	Battery voltage	Continuous watts	Surge watts	Dimensions (inches)	Weight (lbs)	Item code
PST-15S-12A	12V	150	250	2.4 x 4.7 x 7.4	2.6	**030-07123**
PST-30S-12A	12V	300	500	4.7 x 11.22 x 2.4	3.9	**030-07126**
PST-60S-12A	12V	600	1000	9.3 x 13.2 x 3.3	6.6	**030-07129**
PST-100S-12A	12V	1000	1500	9.3 x 15.5 x 3.3	8.8	**030-07130**
S-1500-112B2	12V	1500	2000	15.4 X 10.8 X 4.1	15.4	**030-07131**
PST-60S-24A	24V	600	1000	9.3 x 13.2 x 3.3	6.6	**030-07132**
PST-100S-24A	24V	1000	1500	9.3 x 15.5 x 3.3	8.8	**030-07134**
S1500-124B2	24V	1500	2000	15.4 X 10.8 X 4.1	15.4	**030-07135**
S1500-148B2	48V	1500	2000	15.4 X 10.8 X 4.1	15.4	**030-07148**

OutBack

SmartRE Grid-Tie Inverter with Battery Backup

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

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

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

A matching battery enclosure holds four 31-series sealed batteries, including the new "tall" 31 series batteries. This enclosure weighs 44 lbs (19.9 kg) not including batteries. For more battery capacity, extra enclosures are available, or some other battery bank housing can be used. All SmartRE systems use a 48 volt nominal battery bank.

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

OutBack model	Continuous watts	AC current max (RMS) 120 VAC / 240 VAC		AC output volts	Item code
SRE2500-120-NA	2500	50	n/a	120	**030-04040**
SRE2500-120/240-NA	2500	50	25	120/240	**030-04042**
SRE3000-120-NA	3000	50	n/a	120	**030-04041**
SRE3000-120/240-NA	3000	50	25	120/240	**030-04043**
SRE-BE1	SmartRE Outdoor Battery Enclosure - for additional battery capacity - holds 4 type 31 batteries				**030-04049**

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 directly from you.

FLEXpower ONE Pre-Wired Power System

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

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

Model	FLEXpower ONE - System Description	Inverter	Item code
FP1-1	Prewired inverter system, 3.5kW 120VAC, 24VDC, 80A PV control	VFX3524	**033-04100**
FP1-2	Prewired inverter system, 3.6kW 120VAC, 48VDC, 80A PV control	VFX3648	**033-04101**
FP1-3	Grid tie prewired inverter system, 3.5kW 120VAC, 24VDC, 80A PV control	GVFX3524	**033-04102**
FP1-4	Grid tie prewired inverter system, 3.6kW 120VAC, 48VDC, 80A PV control	GVFX3648	**033-04103**
FP1-5	EXPORT prewired inverter system, 3.0kW 230VAC 50Hz, 24VDC, 80A PV control	VFX3024E	**033-04104**
FP1-6	EXPORT prewired inverter system, 3.0kW 230VAC 50Hz, 48VDC, 80A PV control	VFX3048E	**033-04105**

NEW! FLEXpower TWO Pre-Wired Power System

The new FLEXpower TWO System accommodates all of the essential protective devices in an easy-to-install, fully pre-wired and factory tested dual inverter system. The FLEXpower TWO is applicable for either grid-tie or off-grid applications with medium sized power requirements such as homes, light commercial or larger back-up power systems. Utilizing a compact design and an easy-to-install mounting plate, the FLEXpower TWO System can be mounted in either a horizontal or vertical orientation to allow installation in more space-limited locations.

FLEXpower TWO includes two inverter/chargers, AC and DC wiring boxes, a MATE2, HUB, and Surge Protector with optional kits for charge controllers and DC system monitoring. The FLEXpower TWO System is also equipped with battery and PV array breakers, an AC Input-Output-Bypass Assembly, mounting locations for AC GFCI Type B style outlets and additional AC breakers. FLEXpower TWO components carry all of the necessary ETL Certifications allowing for a code compliant installation.

Dimensions are 46.5 x 20.25 x 13 inches. Weight is 232 lbs.

FLEXpower TWO Pre-Wired			
Model	**FLEXpower TWO - system description**	**Inverter**	**Item code**
FP2-32	Prewired dual inverter system, 5.0kW 120/240VAC, 24VDC	FX2524T	**033-04131**
FP2-12	Prewired dual inverter system, 7.0kW 120/240VAC, 24VDC	VFX3524	**033-04133**
FP2-31	Prewired dual inverter system, 6.0kW 120/240VAC, 48VDC	FX3048T	**033-04135**
FP2-10	Prewired dual inverter system, 7.2kW 120/240VAC, 48VDC	VFX3648	**033-04137**
FP2-28	Grid tied prewired dual inverter system, 7.0kW 120/240VAC, 24VDC	GVFX3524	**033-04151**
FP2-29	Grid tied prewired dual inverter system, 7.2kW 120/240VAC, 48VDC	GVFX3648	**033-04153**
FP2-24	EXPORT prewired dual inverter system, 6kW 230VAC 50Hz, 24VDC	VFX3024E	**033-04181**
FP2-22	EXPORT prewired dual inverter system, 6kW 230VAC 50Hz, 48VDC	VFX3048E	**033-04183**
Option for single FLEXMax60 charge controller			**033-04203**
Option for TWO FLEXMax60 charge controls			**033-04204**
Option for single FLEXMax80 charge controller			**033-04205**
Option for TWO FLEXMax80 charge controls			**033-04206**
Option for GFP-2 Ground fault protection			**033-04221**
Option for FLEXNetDC monitoring			**033-04219**

AEE Solar

OutBack FLEXware Complete Power Systems

Fully Assembled and Tested

NEC-compliant pre-assembled power systems include inverter(s), AC enclosure with inverter bypass, DC enclosure, inverter disconnect breaker and shunt, all mounted to a back plate and prewired. Charge controllers, battery cables, and displays are not included. Charge controllers, additional AC and DC input and load breakers can be added at the time of pre-assembly, or in the field. Some options are listed on the page 114. Many other options are available. Please contact us for more information. Power systems ship by truck freight. ETL Listed to UL standards.

Grid-Tie FLEXware 500 Systems

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

AEE Grid-tie OutBack FLEXware 500 Systems

Model	FLEXware type	Inverter(s) qty – model	Rated power kW - AC output	DC voltage	Battery charger	Item code
OBFW5-GTFX2524/S	500	1 – GTFX2524	2.5kW 120V	24 VDC	55 amp	**033-00201**
OBFW5-GTFX2524/D	500	2 – GTFX2524	5kW 120/240V	24 VDC	110 amp	**033-00203**
OBFW5-GTFX3048/S	500	1 – GTFX3048	3.0kW 120V	48 VDC	35 amp	**033-00209**
OBFW5-GTFX3048/D	500	2 – GTFX3048	6.0kW 120/240V	48 VDC	70 amp	**033-00211**
OBFW5-GVFX3524/S	500	1 – GVFX3524	3.5kW 120V	24 VDC	85 amp	**033-00205**
OBFW5-GVFX3524/D	500	2 – GVFX3524	7kW 120/240V	24 VDC	170 amp	**033-00207**
OBFW5-GVFX3648/S	500	1 – GVFX3648	3.6kW 120V	48 VDC	45 amp	**033-00213**
OBFW5-GVFX3648/D	500	2 – GVFX3648	7.2kW 120/240V	48 VDC	90 amp	**033-00215**

Unsurpassed Tech Support and Customer Service

AEE Solar has the in-house expertise to help you do it right. And our personal, friendly, responsive customer service is second to none. Our three decades of solar experience support you at every step! **Call us at 800-777-6609.**

Off-Grid FLEXware 500 Systems

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

Off-Grid FLEXware 1000 Systems

A FLEXware 1000-based system is best utilized in applications with greater power requirements like large residential, commercial or mini-grid projects. FLEXware 1000 system architecture is capable of supporting up to four FX Series inverter/chargers, four FM charge controllers, and all the required AC and DC components and wiring. FLEXware 1000 is easily expandable for systems as large and complex as your imagination allows. FLEXware 1000 AC and DC enclosures accommodate all essential protective devices while still providing lots of room for additional breakers and large cable connections. With mounting provisions for three DC shunts, there is now space for enough to max out the inputs of multi-channel amp-hour meters. For added versatility a FLEXware 1000-based system can be mounted horizontally or vertically. FLEXware 1000 systems come with one RTS, IOB-Q-120/240VAC, HUB10 and X-240. Both the FLEXware 500 and 1000 systems come with the MATE remote monitors (page 100).

AEE Solar Off-Grid OutBack FLEXware 500 and 1000 Power Systems						
Model	FLEXware type	Inverter(s) qty - model	Rated power kW - AC output	DC voltage	Battery charger	Item code
OBFW5-FX2012T/S	500	1 – FX2012T	2.0kW 120V	12 VDC	80 amp	**033-00321**
OBFW5-FX2012T/D	500	2 – FX2012T	4.0kW 120/240V	12 VDC	160 amp	**033-00323**
OBFW5-VFX2812/S	500	1 – VFX2812	2.8kW 120V	12 VDC	125 amp	**033-00325**
OBFW5-VFX2812/D	500	2 – VFX2812	5.6kW 120/240V	12 VDC	250 amp	**033-00327**
OBFW5-FX2524T/S	500	1 – FX2524T	2.5kW 120V	24 VDC	55 amp	**033-00329**
OBFW5-FX2524T/D	500	2 – FX2524T	5.0kW 120/240V	24 VDC	110 amp	**033-00331**
OBFW5-VFX3524/S	500	1 – VFX3524	3.5kW 120V	24 VDC	85 amp	**033-00333**
OBFW5-VFX3524/D	500	2 – VFX3524	7.0kW 120/240V	24 VDC	170 amp	**033-00335**
OBFW5-FX3048T/S	500	1 – FX3048T	3.0kW 120V	48 VDC	35 amp	**033-00337**
OBFW5-FX3048T/D	500	2 – FX3048T	6.0kW 120/240V	48 VDC	70 amp	**033-00339**
OBFW5-VFX3648/S	500	1 – VFX3648	3.6kW 120V	48 VDC	45 amp	**033-00341**
OBFW5-VFX3648/D	500	2 – VFX3648	7.2kW 120/240V	48 VDC	90 amp	**033-00343**
OBFW10-FX2524T/D	1000	2 – FX2524T	5.0kW 120/240V	24 VDC	110 amp	**033-00365**
OBFW10-FX2524T/Q	1000	4 – FX2524T	10.0kW 120/240V	24 VDC	220 amp	**033-00367**
OBFW10-VFX3524/D	1000	2 – VFX3524	7.0kW 120/240V	24 VDC	170 amp	**033-00369**
OBFW10-VFX3524/Q	1000	4 – VFX3524	14.0kW 120/240V	24 VDC	340 amp	**033-00371**
OBFW10-FX3048T/D	1000	2 – FX3048T	6.0kW 120/240V	48 VDC	70 amp	**033-00373**
OBFW10-FX3048T/Q	1000	4 – FX3048T	12.0kW 120/240V	48 VDC	140 amp	**033-00375**
OBFW10-VFX3648/D	1000	2 – VFX3648	7.2kW 120/240V	48 VDC	90 amp	**033-00377**
OBFW10-VFX3648/Q	1000	4 – VFX3648	14.4kW 120/240V	48 VDC	180 amp	**033-00379**

Options for AEE FLEXware Systems		
Model	Description	Item code
OBFW-O-FM60	OutBack FM60 charge controller with breaker, installed in power system	**033-01513**
OBFW-O-FM60/D	Two OutBack FM60 charge controllers with breaker, installed in power system	**033-01515**
OBFW-O-FM60/D-top	Two OutBack FM60 60-amp charge controller mounted on top with breakers	**033-01517**
OBFW-O-FM80	OutBack FM80 charge controller with breaker, installed in power system	**033-01521**
OBFW-O-FM80/D	Two OutBack FM80 charge controllers with breaker, installed in power system	**033-01522**
OBDC-GFP2	Ground fault interrupter for PV array installed in DC system box 80A 2-pole	**033-01221**
FLEXnet DC	FLEXnet metering installed with 2 additional shunts (3 total)	**033-01291**
TriMetric meter	Amp-hour meter – connection block installed in system	**033-01215**
Aux Relay	Aux relay installed (specify inverter or MX60)	**033-01287**
SP-ACA	Surge protector ACA installed (one per inverter)(std. on grid-tie units)	**033-01285**
LA-302DC	DC Delta lightning arrestor installed	**033-01281**
LA-302R	AC Delta lightning arrestor installed	**033-01283**
OBFW-O-X240	X-240 transformer installed in single inverter systems for 240 VAC input or output (specify in or out)	**033-01254**
OBDC-100	100-amp DC load breaker installed in system	**033-01227**
OBDC-80	80-amp DC load breaker installed in system	**033-01228**
OBDC-60	60-amp DC load breaker installed in system	**033-01229**
OBDC-40	40-amp DC load breaker installed in system	**033-01231**
OBDC-30	30-amp DC load breaker installed in system	**033-01233**
OBDC-15	15-amp DC load breaker installed in system	**033-01235**
OBDC-10	10-amp DC load breaker installed in system	**033-01237**
OBDC-1	1-amp DC load breaker installed in system	**033-01239**

MidNite Solar

Pre-Wired Power Systems

MidNite Solar is now offering pre-assembled and tested systems using OutBack and Magnum inverters. Magnum inverters are installed on the MNE250STM-L gray steel E-Panel with the inverter listed and a ME-RC50 remote display, MEBMK-NS, 1 MNEPV2 breaker for BMK, an FM60 charge controller with two MNEPV63 charge control breakers, one AC lightning arrestor, one DC lightning arrestor and two battery temperature sensors. All assemblies are thoroughly tested and crating is included. OutBack inverters are installed on the MNE250AL-Plus white alum E-Panel, or a MNE250STS-L gray steel E-Panel (see model number)and include the listed inverter/charger, a MATE-B black remote display, an FM60 charge controller, two MNEPV63 charge control breakers, one AC lightning arrestor, one DC lightning arrestor and two battery temperature sensors. All assemblies are thoroughly tested and crating is included. Options include and FM80 charge controller in place of the FM60 and a DC-GFP to meet 2008 NEC.

MidNite Pre-Wired Power Systems				
Model	**MidNite pre-wired E-Panel system description**	**Inverter**	**Weight**	**Item code**
MNEMS4024FM60	Magnum 120VAC off-grid 4000 watt 24VDC inverter	MS4024	190	**033-04301**
MNEMS4024AEFM60	Magnum 120/240VAC off-grid 4000 watt 24VDC inverter	MS4024PAE	190	**033-04303**
MNEMS4448AEFM60	Magnum 120/240VAC off-grid 4400 watt 48VDC inverter	MS4448PAE	190	**033-04305**
MNEPLUSGVFX3524FM60	OutBack Plus 120VAC battery backup Grid-Tie 3500 W 24V inverter	GVFX3524	190	**033-04307**
MNEPLUSGVFX3648FM60	OutBack Plus 120VAC battery backup Grid-Tie 3600 W 48V inverter	GVFX3648	190	**033-04309**
MNEPLUSVFX3524FM60	OutBack Plus 120VAC off-grid 3500 watt 24VDC inverter	VFX3524	190	**033-04311**
MNEPLUSVFX3648FM60	OutBack Plus 120VAC off-grid 3600 watt/48VDC inverter	VFX3648	190	**033-04313**
FM80 Option	Change FM60 charge controller to FM80			**033-04325**
DC-GFP Option	Add ground fault protection to systems above			**033-04329**
FLEXnet DC Option	Add FLEXnet DC to systems above (not with both FM80 & GFP)			**033-04331**

Apollo Solar

Pre-Wired Power Systems

Apollo finalized its pre-wired, assembled, and factory-tested power panels just as we went to press with this catalog. Here is the basic information:

One panel has 4kW output at 120/240VAC split-phase, using a single Apollo Solar TSW4048 inverter. Two or three panels can be paralleled for 8kW or 12kW respectively. When the 8kW or 12kW system is ordered, only a single Apollo Communications Gateway for remote system diagnostics and performance monitoring will be supplied, however the 4-inch by 4-inch gutter and the extra wiring (cut and stripped) will be included.

24VDC models will also be available, in 3.2kW, 6.4kW, and 9.6kW. Please call for additional details on this new product.

Model	Description	Item code
PWP4kW	Single Panel with one TSW4048 inverter and one T80HV controller	**call**
PWP8kW	Dual Panel with two TSW4048 inverters and two T80HV controllers	**call**
PWP12kW	Triple Panel with three TSW4048 inverters and three T80HV controllers	**call**

MidNite Solar

E-Panel

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

E-Panels for OutBack Inverters

OutBack inverters mount on a unique hinged door to keep the footprint of the system as small as possible. They come standard with left-hand hinge, allowing the charge controller to mount on the right. The STS version leaves room for the OutBack AC box with a surge arrestor for grid-tie applications and the AL-PLUS version has room to mount an inverter and MX60 on the door. Right hand doors are available. Mounting brackets are included to aid in one-person installations. Main breaker, inverters cables, a 500-amp/50mv shunt for battery monitoring systems, 175-amp AC-power distribution block, 50-amp AC-input disconnect for generator or utility, 50-amp AC bypass switch are included and pre-wired. They come with a mounting bracket for an OutBack FM controller. Cutouts for mounting up to six additional 13mm-wide DIN rail mount breakers are provided, as are cutouts for GFCI-style AC outlets and 3-panel mount DC breaker slots. Circuit breakers and DC GFP are located on page 119.

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

E-Panels for Magnum Inverters

Magnum inverters mount on a unique hinged door to keep the footprint of the system as small as possible. Mounting brackets are included to aid in one-person installations. They come with a main breaker, 2/0 inverters cables, a 500-amp/50mv shunt for battery monitoring systems, an AC input and bypass, PV input busbars, DIN rails, 3-panel mount breaker knockouts, ground bus, remote display mounting brackets, charge controller bracket, wall mount bracket and lots of hardware. 120/240 models are for Magnum MS-AE inverters.

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

E-Panel for Schneider Electric Xantrex XW

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

E-Panels for Xantrex TR and Samlex SL Inverters

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

E-Panels for Apollo Solar TSW Inverters

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

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

More E-Panels

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

MidNite model	Description	Item code
MNE125LT	Gray steel chassis with 125-amp inverter breaker (Lite)	**030-05105**
MNE175LT	Gray steel chassis with 175-amp inverter breaker (Lite)	**030-05109**
MNE250LT	Gray steel chassis with 250-amp inverter breaker (Lite)	**030-05113**
MNE125ALT	White alum chassis with 125-amp inverter breaker (Lite)	**030-05101**
MNE175ALT	White alum chassis with 175-amp inverter breaker (Lite)	**030-05102**
MNE250ALT	White alum chassis with 250-amp inverter breaker (Lite)	**030-05103**

MidNite Solar

Mini-DC Disconnect Power Center (MNDC)

Use this small DC disconnect, which includes the inverter breaker, to provide overcurrent protection for any single inverter. The MNDC comes with a DIN rail for 5 additional DC breakers for DC loads, charge controller disconnect, battery status monitor feed etc. included is a ground bus, 5/16"bonding battery minus stud. Mounting holes for a 500 amp shunt are built in.. The white powder-coated aluminum chassis measures 10" X 5" X 18" and weighs 7 pounds. Three main breakers sizes are available. Left side main breaker placement is available on special order. The MNDC Plus version of the popular MNDC adds another DIN rail allowing up to ten DIN rail mount breakers. Two DIN rail cover plates and two panel mount plates are included. The panel mount plates allow for mounting the ¾" 125VDC breakers that range from 60 amps to 100 amps. You can also fit the MNDC-GFP80 plus four more panel mount breakers in the enclosure. Another configuration would be one MNDC-GFP, one ¾" panel mount breaker and five DIN rail breakers as well as the large 125-250A inverter breaker. Mounting is provided for a 500 amp shunt and a MNTBB-R terminal busbar. Battery negative stud is included as well as a ground busbar.

Model	Description	Item code
MNDC125	125A mini-DC disconnect	**053-00091**
MNDC175	175A mini-DC disconnect	**053-00092**
MNDC250	250A mini-DC disconnect	**053-00093**
MNDC125 Plus	125A mini-DC disconnect	**053-00096**
MNDC175 Plus	175A mini-DC disconnect	**053-00097**
MNDC250 Plus	250A mini-DC disconnect	**053-00098**

Baby Boxes and Wiring Accessories

The Baby Box encloses up to four MNEPV or MNEAC DIN rail breakers. It is a general-use enclosure for retrofits, a small inverter disconnect, a PV disconnect or a small AC or DC distribution center. It has concentric ¾" and 1" knockouts at each end. Breakers are not included. Boxed: 3" x 3" x 7" and weighs 2 pounds. The Big Baby overcomes the Baby Box smallness. This box is at least one inch larger in all dimensions. It also includes a ground box lug and mounting provisions for our short insulated busbar. It holds up to 4 of the 13mm wide DINrail breakers from 1-63 amps. Box Size is 9" x 5" x 4" and weighs 3 pounds. MNEDC Quad is the same size as the Big Baby but holds up to four MNEDC-type panel-mount DC breakers available on page 119 or the panel-mount high amperage (70-100A) breakers on page 120.

Accessories

These UL Recognized busbars can be use in the Mini-DC Disconnect and Baby Box above. Busbars with colored insulators. Each MNT bar has four 1/0 and eleven #6 usable wire slots, with two sizes of 10-32 screws. 4.63" long. MNS is a shorter version, useful for PV+ input on the narrow OB E-Panel and for a separate PV- busbar for charge controllers. Four #6 and two 1/0 wire slots. Ground busbar, 3.45" long with green screws has two 1/0 and seven #6 wire slots with mounting screws. 2.3" long bar has two 1/0 & four #6 wire slots. Both come with mounting screw and nut #10-32 x 7/8". Big Busbar is a pair for plus and minus with 5 battery connections and six small wires.

Model	Description	Item code
Big Baby Box	Big Baby box breaker center holds 4 DIN DC breakers	**053-00088**
MNEDC QUAD	Quad breaker center holds 4 MNEDC 3/4" DC breakers	**053-00087**
Baby Box	Baby box breaker center	**053-00089**
MNTBB-R	Red terminal busbar	**053-00105**
MNTBB-B	Black terminal busbar	**053-00106**
MNTBB-W	White terminal busbar	**053-00107**
MNGBB	Ground busbar - 3.45" long	**053-00100**
MNSBB-R	Red terminal short busbar	**053-00108**
MNSBB-B	Black terminal short busbar	**053-00109**
MNSBB-W	White terminal short busbar	**053-00110**
Big Busbar	Big Bus Bar 5 hole 280A w/ aux busbar	**053-00115**
Shunt Busbar	Shunt busbar with 4 studs and short aux busbar	**053-00117**

DC Ground Fault Protection Circuit Breakers

These breakers use a trip mechanism to connect battery negative and earth ground to open the larger breaker in case of a ground fault. The 2008 NEC requires DC ground fault protection on all solar installations. The DIN rail mount and single pole panel mount GFPs will mount in MidNite E-panels. The panel mount GFP's will mount in the OutBack FLEXware enclosures.

Amps	Poles	Mount type	Volts	Width (inch)	OutBack number	MidNite number	Item code
80	1	Panel w/ 1/4" studs	150	1.5	OBB-GFDI-80-150VDC-PNL		030-04324
80	2	Panel w/ 1/4" studs	150	2.25	OBB-GFDI-80D-150VDC-PNL		030-04323
80	4	Panel w/ 1/4" studs	150	3.75	OBB-GFDI-80Q-150VDC-PNL		030-04325
63	1	DIN rail w/ screw lugs	150	1		MNDC-GFP63	030-05249
80	1	Panel w/ 1/4" studs	125	1.5		MNDC-GFP80	030-05250
50	1	DIN rail w/ screw lugs	300	2		MNDC-GFP-300	030-05248

DIN Mount AC Circuit Breakers

DIN mount AC breakers with set-screw compression terminals for 14 to #2AWG wire. Use these for AC in OutBack FLEXware, MidNite E-panels, and Magnum panels.

Breaker amps	Poles	Voltage rating	Frequency rating	Width (inches)	OutBack number	MidNite Solar #	Item code
10	1	120	50/60HZ AC	0.5	OBB-10-277VAC-DIN	MNEAC10	030-04439
15	1	120	50/60HZ AC	0.5	OBB-15-120VAC-DIN	MNEAC15	030-04415
15	2	120/240	50/60HZ AC	1	OBB-15D-240VAC-DIN	MNEAC15-2P	030-04416
20	1	120	50/60HZ AC	0.5	OBB-20-120VAC-DIN	MNEAC20	030-04418
20	2	120/240	50/60HZ AC	1	OBB-20D-240VAC-DIN	MNEAC20-2P	030-04419
25	2	120/240	50/60HZ AC	1	OBB-25D-240VAC-DIN		030-04421
15	1	277	50/60HZ AC	0.5	OBB-15-277VAC-DIN	MNEAC15QZD	030-04440
30	1	277	50/60HZ AC	0.5	OBB-30-277VAC-DIN	MNEAC30QZD	030-04437
30	2	277	50/60HZ AC	1	OBB-30D-480VAC-DIN	MNEAC30QZD2P	030-04414
30	3	277/480	50/60HZ AC	1.5	OBB-30T-480VAC-DIN	MNEAC30QZD3P	030-04435
50	1	277	50/60HZ AC	0.5	OBB-50-277VAC-DIN	MNEAC50QZD	030-04422
50	2	277	50/60HZ AC	1	OBB-50D-480VAC-DIN	MNEAC50QZD2P	030-04423
50	3	277/480	50/60HZ AC	1.5	OBB-50T-480VAC-DIN	MNEAC50QZD3P	030-04432
60	1	277	50/60HZ AC	0.5	OBB-60-277VAC-DIN		030-04431
60	2	277	50/60HZ AC	1	OBB-60D-480VAC-DIN	MNEAC60QZD2P	053-03036

DIN Mount DC Circuit Breakers

DIN rail mount breakers fit MidNite and Apollo enclosures, and MNPV and OutBack PV array combiners. The more positive line should be connected to the + pole of the breaker. Breakers for arrays with maximum voltage of 150 V and arrays with voltage up to 300 V are listed below.

DIN Rail Mounted 300 VDC Circuit Breakers			
Amps	Voltage	MidNite Solar #	Item code
7	300 VDC	MNEPV7-300	053-03107
10	300 VDC	MNEPV10-300	053-03110
12	300 VDC	MNEPV12-300	053-03112
15	300 VDC	MNEPV15-300	053-03115
20	300 VDC	MNEPV20-300	053-03120
30	300 VDC	MNEPV30-300	053-03125
50	300 VDC	MNEPV50-300	053-03130

Amps	OutBack number	MidNite Solar #	Item code
1	OBB-1-150VDC-DIN	MNEPV1	053-03033
2	OBB-2-150VDC-DIN	MNEPV2	053-03034
3	OBB-3-150VDC-DIN	MNEPV3	053-03024
4	OBB-4-150VDC-DIN	MNEPV4	053-03020
5	OBB-5-150VDC-DIN	MNEPV5	053-03025
6	OBB-6-150VDC-DIN	MNEPV6	053-03021
8	OBB-8-150VDC-DIN	MNEPV8	053-03022
9	OBB-9-150VDC-DIN	MNEPV9	053-03023
10	OBB-10-150VDC-DIN	MNEPV10	053-03026
12	OBB-12-150VDC-DIN	MNEPV12	053-03027
15	OBB-15-150VDC-DIN	MNEPV15	053-03029
20	OBB-20-150VDC-DIN	MNEPV20	053-03030
30	OBB-30-150VDC-DIN	MNEPV30	053-03032
40	OBB-40-150VDC-DIN	MNEPV40	053-03039
50	OBB-50-150VDC-DIN	MNEPV50	053-03035
60	OBB-60-150VDC-DIN	MNEPV60	053-03037
63	OBB-63-150VDC-DIN	MNEPV63	053-03038

Panel Mount AC/DC Circuit Breakers

Single pole 3/4-inch wide breakers with 1/4-inch stud connections. Ring terminals on wire are required on these panel mount breakers with stud terminals. Use these breakers for DC protection in OutBack FLEXware enclosures, and MidNite E-panels (three spaces). Breakers are rated for 150VDC/120VAC.

Breaker amps	Voltage rating	Width (inches)	MidNite Solar #	OutBack number	Generic number	Item code
1	150	0.75	MNEDC-1	OBB-1-150VDC120VAC-PNL	LELK1-1	**030-04350**
5	150	0.75	MNEDC-5	OBB-5-150VDC120VAC-PNL	LELK1-5	**030-04349**
10	150	0.75	MNEDC-10	OBB-10-150VDC120VAC-PNL	LELK1-10	**030-04348**
15	150	0.75	MNEDC-15	OBB-15-150VDC120VAC-PNL	LELK1-15	**030-04344**
20	150	0.75	MNEDC-20	OBB-20-150VDC120VAC-PNL	LELK1-20	**030-04347**
30	150	0.75	MNEDC-30	OBB-30-150VDC120VAC-PNL	LELK1-30	**030-04341**
40	150	0.75	MNEDC-40	OBB-40-150VDC120VAC-PNL	LELK1-40	**030-04338**
50	150	0.75	MNEDC-50	OBB-50-150VDC120VAC-PNL	LELK1-50	**030-04337**
60	150	0.75	MNEDC-60	OBB-60-150VDC120VAC-PNL	LELK1-60	**030-04335**
70	150	0.75	MNEDC-70	OBB-70-150VDC-PNL		**030-04334**
80	150	0.75	MNEDC-80	OBB-80-150VDC-PNL		**030-04333**
100	150	0.75	MNEDC-100			**030-04310**

Surface (Back) Mount DC Circuit Breakers

Surface mount single-pole breakers with screw lug wire terminals.

The 10-110A sizes are 1 inch wide and have mounting feet used to attach them to the back panel in an enclosure. Use these breakers in the Xantrex XW distribution panel, the Magnum MP and MMP panels, and for custom DC control panels.

175A and 250A sizes are 1.5 inches wide, require one rear mount kit each. They fit the large-breaker space in the front of the older Xantrex/Trace DC disconnect, or can be used for custom DC panels.

Surface-Mount DC Breakers (large frame)				
Breaker amps	**DC voltage rating**	**Lug size**	**Part #**	**Item code**
10	125	#1 AWG	CF-10	**053-01011**
15			CF-15	**053-01016**
20			CF-20	**053-01021**
30			CF-30	**053-01026**
50			CF-50	**053-01031**
60			CF-60	**053-01036**
60	160		865-1070	**030-01192**
75	125		CF-75	**053-01041**
80			865-1075	**030-01189**
100			CF-100	**053-01051**
110			CF-110	**053-01055**
175		4/0 AWG	GJ1-175-SM	**053-01056**
250			GJ1-250-SM	**053-01061**
Mount kit for GJ1 breakers above				**053-01066**

Panel (Front) Mount DC Circuit Breakers

Panel mount single-pole breakers with stud terminals on the back. Ring terminals on the wire are required. Breakers mount from the front with two small screws. 10A- 125A breakers are 1 inch wide. 175A and 250A breakers are 1.5 inches wide

Use these breakers in the side knockouts of the old Xantrex/Trace DC disconnect, and in the large breaker spaces in the OutBack FLEXware 500/1000 enclosures.

The panel-mount 175A/250A breakers are also used in the Xantrex XW distribution panel.

Panel-Mount DC Breakers (large frame)				
Breaker amps	**DC voltage rating**	**Stud size**	**Part #**	**Item code**
10	125	1/4"	CD10-PM	**053-01010**
15			CD15-PM	**053-01015**
20			CD20-PM	**053-01020**
30			CD30-PM	**053-01025**
50			CD50-PM	**053-01030**
60			CD60-PM	**053-01035**
75	125		CD75-PM	**053-01040**
80			CD80-PM	**053-01045**
100		5/16"	CD100-PM	**053-01050**
125			CD125-PM	**030-04331**
175		3/8"	MNEDC175	**030-04329**
250			MNEDC250	**030-04326**

AEE Solar

Toroid Autotransformers

These AC step-up and step-down transformers are greater than 98% efficient and cause less than 0.2% idle loss at no load. Nearly silent when operating. Use an autotransformer as a step-down to connect the 240V output of a generator to the 120V input on an inverter. This allows full output power of a 240V generator to be used for battery charging. Autotransformers can step-up voltage to operate 240V appliances and motors from the 120V output of an inverter. NEMA 3R enclosure with knockouts for conduit. 2-year warranty.

Description	Dimensions (inches)	Item code
2.5 kW autotransformer	8 x 8 x 4	**038-09437**
4 kW autotransformer	10 x 10 x 4	**038-09440**
8 kW autotransformer	12 x 10 x 6	**038-09445**

OutBack

PSX-240 Autotransformer

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

OutBack model	Description	Item code
PSX-240	4 kW autotransformer	**030-04429**

Samlex

DC Step-Down Power Converters

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

Samlex model	Output max amps	Item code
SDC-15	12	**030-08720**
SDC-23	20	**030-08725**

Samlex

Isolated DC-DC Converters

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

Samlex model	Input voltage	Output voltage	Output amps	Item code
IDC-100B-12	20-35	12.5	8	**030-08741**
IDC-100C-12	30-60	12.5	8	**030-08742**
IDC-100A-24	9-18	24	4	**030-08744**
IDC-100C-24	30-60	24	4	**030-08746**
IDC-200B-12	20-35	12.5	16	**030-08748**
IDC-200C-12	30-60	12.5	16	**030-08749**
IDC-200A-24	9-18	24	8	**030-08751**
IDC-200C-24	30-60	24	8	**030-08753**
IDC-360A-12	9-18	12.5	30	**030-08755**
IDC-360B-12	20-35	12.5	30	**030-08756**
IDC-360C-12	30-60	12.5	30	**030-08757**
IDC-360A-24	9-18	24	15	**030-08758**
IDC-360C-24	30-60	24	15	**030-08760**

Solar Converters DC Autotransformers

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

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

Charge Controllers – PWM and MPPT

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

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

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

Apollo Solar

T80 and T80HV PV MPPT Battery Charge Management Systems

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

The T80 and T80HV produce full-rated power without de-rating up to 45 degrees C/113 degrees F ambient temperature. Above that, the output current is reduced gradually to protect the life of the T80, and then automatically ramped up as the temperature decreases. High efficiency power circuits and robust thermal design minimize heat generation. The internal temperature-controlled variable speed fan runs just fast enough to maintain optimum reliability. UL Listed. Dimensions are 15.2" x 8.5" x 4.4" and weight is 22 lbs.

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

Controllers do not include shunts. Order a 500A/50mV shunt if your system doesn't have one. Both the T80 and T80HV support flooded lead acid (FLA), GEL and absorbed glass mat (AGM) batteries. Two independently programmable SPST relays can be used to control external devices based on battery voltage, charge or discharge current or battery state of charge. Contact rating is ½ amp at up to 50 VDC.

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

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

Model	Description	Item code
T80	Apollo T80 charge controller	**020-07080**
T80HV	Apollo T80 charge controller	**020-07081**
RD-WIRED	Wired remote display	**020-07085**
ASNET	Network option card	**020-07091**
ACG-1	Communications Gateway	**020-07093**
AMS-1	Apollo Monitoring Service / year	**020-07094**
ACM-1	Apollo Cellular Modem	**020-07092**

OutBack

FM60 and FM80 MPPT Charge Controllers

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

With active cooling and intelligent thermal management, both FLEXmax charge controllers can operate at their full maximum current rating, 60 amps or 80 amps respectively, in ambient temperatures as high as 104°F (40°C). Both controllers can be used with battery systems from 12 to 60 VDC with PV open-circuit voltage as high as 150 VDC. The controller's set points are fully adjustable to allow use with virtually any battery type, chemistry and charging profile. The OutBack FLEXmax controllers allow you to use a higher output voltage PV array with a lower voltage battery – such as charging a 12 or 24VDC battery with a 48VDC PV array. This reduces wire size and power loss from the PV array to the battery/inverter location and can maximize the performance of your PV system.

The FLEXmax 60 can be used with PV arrays up to 750 watts when charging a 12-volt battery, 1,500 watts when charging at 24 volts, and 3,000 watts when charging at 48 volts.

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

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

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

OutBack model	Description	Item code
FM80	OutBack 80A MPPT charge controller	**020-02020**
FM60	OutBack 60A MPPT charge controller	**020-02017**
MATE	System controller – shipped with 50' cable	**030-04180**
MATEB	Black version of the MATE	**030-04180-B**
MATE2	Flush mount version of the MATE	**030-04181**
RTS	Remote temperature sensor with 20' cable	**030-04190**

It's your best source for timely, comprehensive information on federal, state, local and utility incentives: **www.dsireusa.org**

MidNite Solar

Classic MPPT Charge Controller

The MidNite Classic charge controller maximizes the flexibility and features available in a charge controller. At this time, the Classic the only MPPT charge controller that offers arc fault detection. This will soon be required by the NEC. These charge controllers also include ground fault protection so that a separate GFP breaker assembly is not necessary and leaves those breaker spaces free for other uses. Three models accommodate solar arrays with up to 150, 200, or 250 VDC of operating voltage. Open circuit voltage (Voc) is based on operating voltage plus the battery voltage. This is called the HyperVOC zone. They have MPPT modes for solar, wind or hydro with user adjustable power curves, and a learning mode for self optimization. No hub is required for stacking Classics to act as one large controller. They have two auxiliary outputs, a dry contact relay and a 12V output. Each unit includes snap-on covers and hole plugs for sealing openings in dusty or salt-air environments, but about 20% reduction in output will result when used in sealed mode. The Classic has built-in Ethernet, USB and RS-232 ports for two-way communications. An internal IP address allows the Classic to be a mini web server when hooked up to broadband. It has 32 MB of memory for data storage. A wizard driven setup covers battery bank size, string voltage, wind turbine selection, power and wire loss chart, PV breaker sizing and more. Firmware is user upgradable by downloading files. Works with the MidNite Clipper for wind and hydro applications to protect turbine and Classic from excessive voltage. The MidNite clipper will load the turbine based on one of five parameters: 1-max current; 2-max voltage; 3-max RPM's; 4-max wind speed; 5-as commanded by the Classic. In addition the Clipper can be programmed to automatically shut the turbine down during high wind conditions and will float the batteries when they are fully charged. Floating the batteries results in much reduced turbine speed. ETL listed and made in the U.S. 5-year warranty.

Model	Output amps maximum	Array open circuit volts at battery volts			Item code
		12V battery	24V battery	48V battery	
Classic 150	76-96	162	175	200	**020-02405**
Classic 200	63-79	212	225	250	**020-02407**
Classic 250	53-62	262	275	300	**020-02409**
Classic 250KS	40	Used for charging a 120V Battery			**020-02411**
Clipper	Expected availability late 2011				**020-02421**

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.**

The CLASSIC

Most Powerful MPPT Controller in North America

With Arc Fault Detection

The **Classic MPPT Charge Controller** will soon stand the renewable energy industry on it's ear. The Classic will substantially increase the flexibility, features and range currently found on MPPT controllers. The Classic is the only MPPT controller that has Arc Fault Detection, making this controller the safest controller available. With the Classic 150 ranging up to 96 amps, the Classic 200, 79 amps and the Classic 250, 63 amps, why would you need any other controller.

MidNite has doubled its factory floor space for production of the Classic, which means the Classic will be the only real "Made in America" charge controller.

- *150, 200 and 250V operating voltages.*
- *12-72V battery charging standard with models up to 120V battery bank*
- *Built in DC-GFP and **Arc Fault Detector***
- *Solar, wind and hydro MPPT modes*
- *Set up Wizard with voice help screens coming soon.*
- *Wizard walks you through:*
  - *Battery hook up*
  - *PV array sizing and hook up*
  - *Wind turbine program selection*
  - *Wire sizing*
  - *Breaker selection*
  - *PV combiner selection*
  - *Sunrise and sunset program set up*
  - *Voltage drop calculations*
- *Ethernet, USB and RS232*
- *Remote and local displays possible*
- *20 megs of data logging*

MIDNITE SOLAR, INC

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Schneider Electric

Xantrex XW-MPPT60-150 Charge Controller

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

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

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

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

The XW-MPPT60-150 is able to communicate its settings and activity to other Xanbus-enabled devices, such as the XW Series inverter/charger, the System Control Panel II (SCP), XW Automatic Generator Start (XW-AGS), and other Xantrex XW-MPPT-60-150 solar charge controllers through the Xanbus network.

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

5-year warranty. 10-year warranty optional.

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

Model	Description	Item code
XW-MPPT60-150	60-amp MPPT charge controller	**020-08040**

NEW! Available in Q2 2011

Xantrex XW-MPPT80-600 Charge Controller

The XW-MPPT 80-600 is the first PV battery charge controller to use DC input voltages up to 600v. This breakthrough charge controller significantly decreases the current needed in the array to reduce wiring gauges and costs, increase string sizing, and gives the ability to easily place the array farther from the battery bank. A PV array combiner box isn't required for many installations. It can be used with PV arrays with voltages ranging from 195 to 550 VDC and can support an output of up to 80 amps into the battery for battery voltages of 24 or 48 VDC (nominal). The PV open circuit voltage must not exceed 600 VDC.

The Xantrex XW MPPT 80 600 tracks the maximum power point of a PV array to deliver the maximum available current for charging batteries. When charging, the XW MPPT 80 600 regulates the battery voltage and output current based on the amount of energy available from the PV array and the present state-of-charge of the battery. Standby and night time power draw is less than one watt.

The charge controller has a configurable auxiliary output to drive a relay for load control or to turn on devices such as vent fans or indicator alarms. The auxiliary output can be configured to perform only one function at a time. Full output power of 4800W up to 45ºC is available without de-rating. There is over-temperature protection and power derating when ambient temperatures are high, as well as input over-voltage and under-voltage protection, output over current protection, and back-feed (reverse current) protection. Built-in PV ground fault protection allows code-compliant installation without the need for additional ground fault protection. It is configurable for positive, negative, and ungrounded PV systems.

The XW MPPT 80-600 can be used with the XW inverters and power distribution panel, or used by itself in other PV systems. A battery temperature sensor is included with the controller. The XW MPPT 80-600 is able to communicate its settings and activity to other Xanbus-enabled devices, such as the XW Series inverter/charger, the System Control Panel (SCP), XW Automatic Generator Start (XW-AGS), and other Schneider Electric Xantrex XW solar charge controllers through the Xanbus network. It can also be installed in a stand-alone mode with XW System Control Panel XW SCP.

See the Xantrex array sizing tool at www.se-renbu.com/support/xwsizing/Default_SE.aspx. Dimensions are 30”H x 8.63”W x 8.63"D and weight is 29.8 lbs. 5-year warranty. 10-year warranty optional. Listed to UL 1741 for the U.S. and Canada.

Model	Description	Item code
XW-MPPT 80-600	80-amp MPPT charge controller	**020-08048**

Blue Sky Energy

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

Solar Boost 50L

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

Solar Boost 3048

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

Solar Boost 2000E

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

Model	Description	System voltage	Charge amps	Item code
SB50L	Charge controller	12 or 24	50	**020-03140**
SB50DL	Controller w/ digital display	12 or 24	50	**020-03137**
SB50PDL	Front cover w/ digital display for SB50L			**020-03134**
SB3048L	Charge controller	24 or 48	30	**020-03128**
SB3048DL	Controller w/ digital display	24 or 48	30	**020-03125**
SB3048PDL	Front cover w/ digital display for SB3038L			**020-03131**
SB50RD25	Remote digital display w/ 25' cable			**020-03152**
930-0022-20	Battery temperature sensor			**020-03149**
SB2000E	Charge controller	12	25	**020-03122**
720-0011-01	Wall mount box for SB2000			**020-03119**

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Blue Sky Energy

IPN Controllers

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

Solar Boost 2512i , 2512iX, and 2524iX

The Solar Boost 2512i provides a fully automatic 3-stage charge controller system. A partial IPN network interface is included to allow use of the IPN-Remote or IPN Pro-Remote displays. Additional features provided in the Solar Boost 2512iX and 2524iX include automatic or manual equalization, battery temperature sensor input, full IPN network compatibility, and an auxiliary output. The user-configurable auxiliary output can serve as either a 25-amp (15/20 in 2524iX) load controller or a 2-amp auxiliary battery charger. The auxiliary battery charge feature is ideal for charging a separate battery such as the engine battery in an RV.

Solar Boost 3024iL

SB3024iL is designed to charge 12- and 24-volt battery systems from a 24-volt array (maximum open circuit voltage is 57). Maximum charge current is 40 amps output at 12 and 30 amps at 24 VDC. The new IPN network interface coordinates multiple controllers and shares temperature sensors and display. ETL/cETL Listed.

Optional Equipment

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

IPN-Remote

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

IPN Pro-Remote

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

Model	Description	System voltage	Charge amps	Item code
SB2512i	Charge controller	12	25	**020-03123**
SB2512iX	Charge controller	12	25	**020-03124**
SB2524iX	Charge controller	12 or 24	20/15	**020-03118**
SB3024iL	Charge controller	12 or 24	40/30	**020-03158**
SB3024DiL	Controller w/ digital display	12 or 24	40/30	**020-03159**
SB3024PDiL	Front cover w/ digital display for SB3024i			**020-03157**
IPNPRO-S	IPN Pro-Remote display w/ 500 amp shunt			**020-03161**
IPNPRO	IPN Pro-Remote display			**020-03162**
IPNREM	IPN-Remote			**020-03163**
930-0022-20	Battery temperature sensor			**020-03149**
CS-100	Remote shunt 100A/100mV			**028-09245**
CS-500	Remote shunt 500A/50mV			**028-09253**

Blue Sky ENERGY

Industry Leaders In MPPT Solar Charge Controllers

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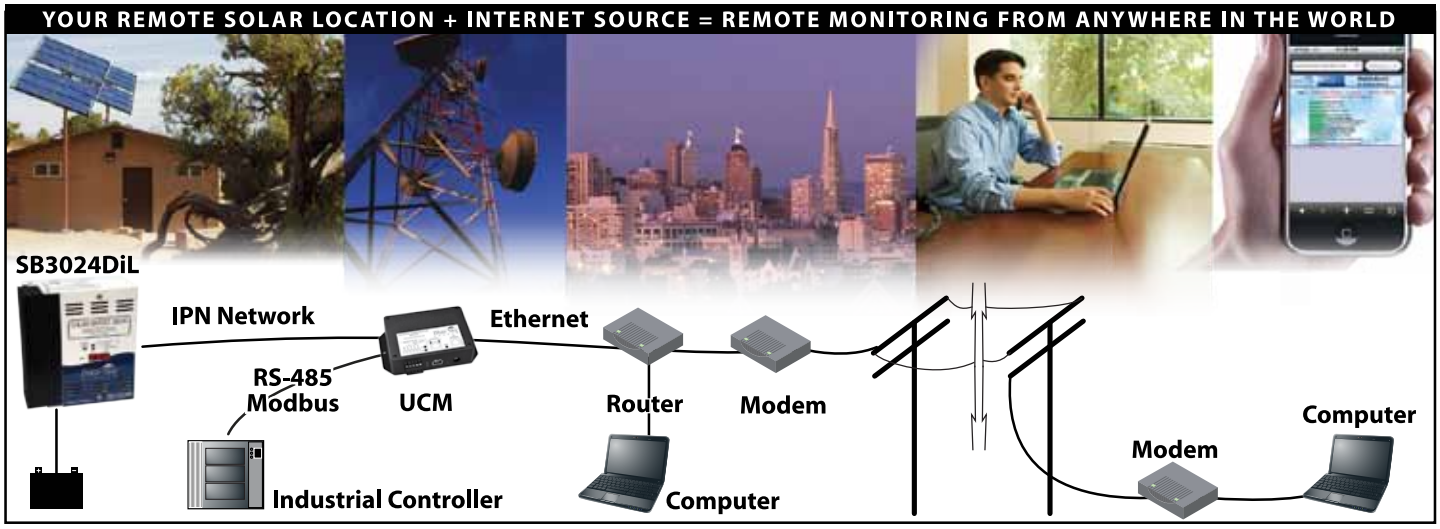

UCM Typical Application

Connect to your IPN based Solar Boost controller remotely

- Allows Access to Charge Controller & Display Via Multiple Standard Communication Interfaces
- Provides Periodic FTP Data Upload to a Remote Server
- Provides 128 Days Data Logging
- NO Subscription Required

2010 - Introduced SB1524iX 12V/24V small MPPT solar lighting controller.

2009 - First ever solar/wind/hydro controller for both solar charging and diversion control in the same unit at the same time introduced as our SB3024iL DUO-Option.

1998 - Solar Boost MPPT controllers revolutionize solar charging for the commercial and consumer market

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Morningstar

TriStar MPPT Charge Controller

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

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

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

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

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

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

SunSaver MPPT Charge Controller

The SunSaver MPPT charge controller is designed for 12V and 24V battery charging from PV modules with a maximum open circuit voltage of 75V. Use up to three 36-cell modules in series. It can be used with 200 watts of PV when charging a 12-volt battery and up to 400 watts when charging a 24-volt battery.

Provides an estimated 5-25% boost of amps from the PV array into the battery. Actual boost depends on PV cell temperature and battery state of charge. Enables the use of high-voltage PV modules (designed for grid-tie applications) for off-grid 12V or 24V battery charging. Provides a means to use a 24V PV array to charge a 12V battery, reducing power losses in systems with a long cable run between the PV array and the battery. The controller has electronic protection from short circuit, overcurrent, reverse polarity, high temp, high voltage, lightning and transient surges. An adjustable low battery voltage load disconnect protects the battery from over-discharge. LED indicators indicate charging, low battery and faults. Dimensions are 6.6 x 2.75 x 2.2 inches. DIN rail clips on page 133. Weight is 1.65 lbs. 5-year warranty.

Model	Description	System voltage	Charge amps	Item code
SS-15MPPT	SunSaver MPPT charge controller	12 or 24	15	**020-01261**
RMI	SunSaver MPPT remote meter	12	15	**020-01258**
RTS	Battery temperature sensor			**020-01141**
MSC	Meterbus adapter			**020-01257**

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Morningstar

TriStar Charge Controllers

The TriStar pulse width modulated (PWM) controller can operate as a solar charge controller, a load controller, or a diversion regulator in 12-, 24- or 48-volt systems. It can operate in only one of these modes at a time, but two or more controllers can be used to provide multiple functions. PWM operation may be changed to on/off operation to prevent telecom noise.

Two models are available with UL current ratings of 45 and 60 amps. A choice of 7 different set points are easily selectable with DIP switches. An RS-232 communications enables PC connection to adjust control set points and data logging. An optional digital display may be mounted on the front of the controller or up to 100 feet away using 4-conductor phone cable with RJ11 jacks.

Battery temperature compensation may be added with the optional temperature sensor. Knock-outs on the bottom of the charge controller match knock-out spacing on MPPT controllers, allowing easy mounting to available power system components.

Dimensions: 10.25" H x 5" W x 2.8" D; weight is 3.5 lbs. 5-year warranty. UL Listed for U.S. and Canada.

Model	Description	System voltage	Charge amps	Item code
TS-45	TriStar 45 charge controller	12, 24 or 48	45	**020-01105**
TS-60	TriStar 60 charge controller	12, 24 or 48	60	**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-ft. cable			**020-01112**

ProStar Charge Controllers

This sophisticated line of PV charge trollers incorporates constant voltage PWM to make maximum use of valuable PV power. They have automatic equalization, temperature compensation and very high efficiency. They can be used on 12-, 24- and 48-volt systems with sealed, gel and wet-cell lead-acid batteries. Front panel LEDs indicate when the batteries are being charged and relative battery state of charge. Reverse polarity protection on input and output. In the event of a load short circuit, the load is automatically disconnected. M models include LCD meter of battery voltage, PV charging current, and load current. Low voltage LVD is current-compensated to prevent false disconnect when the battery is heavily loaded. Units are conformal coated to guard against corrosion. Dimensions: 6.01" x 4.14" x 2.2". 5-year warranty.

Model	Description	System voltage	Charge amps	Item code
PS-15	ProStar 15	12 or 24	15	**020-01120**
PS-15M	ProStar 15 w/ digital display	12 or 24	15	**020-01123**
PS-15M-48V	ProStar 15 48V w/ display	48	15	**020-01126**
PS-15M-48-PG	48V w/ display & positive ground	48	15	**020-01129**
PS-30	ProStar 30	12 or 24	30	**020-01132**
PS-30M	ProStar 30 w/ digital display	12 or 24	30	**020-01135**
PS-30M-PG	30 w/ digital display & positive ground	12 or 24	30	**020-01138**
RTS	Battery temperature sensor			**020-01141**

SunGuard Charge Controller

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

Model	Description	System voltage	Charge amps	LVD amps	Item code
SG-4	SunGuard	12	4.5	No	**020-01215**

SunKeeper Charge Controller

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

5-year warranty. ETL/cETL Listed to UL 1604. CSA 22.2 Listed.

Model	Description	System voltage	Charge amps	Item code
SK-6	SunKeeper6	12	6	**020-01252**
SK-12	SunKeeper12	12	12	**020-01253**

SunSaver Duo RV Charge Controller

The SunSaver Duo 2-battery controller for RVs, caravans, boats and cottages is rated for 25 amps at 12 volts DC. This product will charge two separate and isolated batteries at the same time, such as a house and an engine battery, based on user selectable priorities. The SunSaver Duo employs Morningstar's SunSaver controller technology, whose long-term track record for high reliability and improved battery charging is well-recognized in the solar industry.

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

Model	Description	System voltage	Charge amps	Item code
SK-6	SunSaver Duo	12	25	**020-01250**
RTS	Battery temperature sensor			**020-01141**
DIN 1	DIN rail clip - each			**020-01259**

Need assistance?
Call you AEE Solar rep, or Sales Support, at **800-777-6609.**

SunSaver Charge Controllers

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

Dimensions: 6" x 2.2" x 1.3".

MET Listed for the U.S. and Canada.

Model	Description	System voltage	Charge amps	LVD amps	Item code
SS-6-12V	SunSaver	12	6	No	**020-01245**
SS-6L-12V	SunSaver w/ LVD	12	6	6	**020-01248**
SS-10-12V	SunSaver	12	10	No	**020-01230**
SS-10L-12V	SunSaver w/ LVD	12	10	10	**020-01233**
SS-10L-24V	SunSaver w/ LVD	24	10	10	**020-01236**
SS-20L-12V	SunSaver w/ LVD	12	20	20	**020-01239**
SS-20L-24V	SunSaver w/ LVD	24	20	20	**020-01242**

SunLight Charge Controller with Lighting Control

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

Model	Description	System voltage	Charge amps	LVD amps	Item code
SL-10L-12V	SunLight w/ LVD	12	10	10	**020-01218**
SL-10L-24V	SunLight w/ LVD	24	10	10	**020-01221**
SL-20L-12V	SunLight w/ LVD	12	20	20	**020-01224**

Schneider Electric

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

The Xantrex C-35, C-40, and C-60 PWM (pulse width modulator) controllers can be used as PV charge controllers, DC load controllers or DC diversion regulators in 12-, 24- and 48-volt systems (only the C-40 can be used in 48-volt systems). They operate in only one mode at a time, so two controllers must be used to provide both PV charge controller and low battery load disconnect. As DC load controllers they disconnect the load at a user-settable low voltage and reconnect at a higher voltage reconnect point. As diversion controllers they send excess power to a "dummy load" (such as a water or space heater) to regulate hydroelectric or wind generators. When used in diversion mode, derate the amperage by 25%. All Xantrex controllers, when used as a charge controller, have field-adjustable bulk and float set points and perform automatic equalization every 30 days or whenever LVD is reached. Equalization can be manually initiated with automatic shut-off. Order the optional temperature sensor for a more accurate battery charge controller. The optional LCD digital display shows battery voltage, array amps and watts, cumulative amp-hours and a separately resettable "trip" amp-hour measurement. The digital display is available for mounting on the front of the charge controller, or with a 50- or 100-foot cable for remote mounting in a double-gang electrical box. UL Listed. 2-year warranty.

Model	Description	System voltage	Max PV amps	Item code
C-35	Charge controller	12 or 24	35	**020-08004**
C-40	Charge controller	12, 24 or 48	40	**020-08005**
C-60	Charge controller	12 or 24	60	**020-08009**
BTS/15	Battery temperature sensor with 15-foot cable			**020-08025**
BTS/35	Battery temperature sensor with 35-foot cable			**020-08029**
CM	Digital display mounts on front of charge controller			**020-08016**
CM/R50	Remote display with 50-foot cable			**020-08019**
CM/R100	Remote display with 100-foot cable			**020-08017**

Xantrex C-12 Charge & Lighting Controller

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

Model	Description	System voltage	Max PV load amps	Item code
C-12	Charge controller / lighting controller	12	12 / 12	**020-08002**

Atkinson

Lighting Controllers

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

Model	System voltage	PV amps	Load amps	Dimensions L" x W" x D"	Item code
PVLC-15	12 or 24	15	15	2 x 3 x 1.25	**020-05425**
PVLC-40	12 or 24	40	40	3.3 x 5.5 x 1.7	**020-05427**

Lighting Controllers with Motion Sensor

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

Model	System voltage	PV amps	Load amps	Dimensions L" x W" x D"	Item code
PVLC-15MD	12 or 24	15	15	2 x 3 x 1.25	**020-05432**
PVLC-40MD	12 or 24	40	40	3.3 x 5.5 x 1.7	**020-05435**

Magnum

AGS - RV Auto Generator Start

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

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

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

Model	Description	Item code
AGS-S	Automatic generator start standalone	**020-06375**
AGS-N	Automatic generator start – Magnum network version – 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 the 12-volt output from an OutBack FX inverter auxiliary relay, a user-supplied switch, an auxiliary relay in an inverter, a voltage controlled relay, a timer or any user-supplied contact closure. It automatically controls a gas/propane or diesel powered generator or pump, and is totally sealed for harsh environment operation.

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

GSCM-mini

This generator start controller is optimized for use with OutBack inverters. It supports three types of 3-wire gas-generator control: momentary, maintained or ignition. It has a fixed crank time and over and under frequency shutdown.

Model	Description	Item code
GSCM	Generator start controller module	**020-06341**
GSCM-mini	Generator start controller module	**020-06343**

Morningstar

Relay Driver

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

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

Description	Item code
Morningstar Relay Driver RD-1	**020-01255**

Voltage-Controlled Switches

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

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

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

Model	Mode of operation	Enclosure	Item code
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 12V 40A relay

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

SPST N.O. 12V 75A relay

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

DPDT 30A Relays

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

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

Diversion Load Information

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

The typical way to regulate battery charging voltage with this type of generating system is to use a "load diversion" type charge controller. The Morningstar TS45 and TS60, the Phocos PL60, and the Xantrex C-35, C-40 and C-60 can be configured for this mode of charge controller. A diversion-type charge controller also may be used in a PV system. If the array is much larger than necessary to charge the battery, excess power can be used to heat water by using a water heating diversion load.

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

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

Low-Voltage Water Heating Element

These low-voltage water heating elements are for use as diversion loads for wind or hydroelectric systems. Use one or more of these heating elements with a charge controller designed for load diversion, such as the Xantrex C-40 or C-60, or the Morningstar TS-45 or TS-60 to turn your excess power into hot water. They fit most electric water heaters with screw-in elements. We have one model for 12- and 24-volt systems and another for higher power 24- and 48-volt systems. Each unit has two elements that can be wired in series or parallel or used individually, depending on voltage and desired amp draw. See table to determine what each element will draw at various charging voltages.

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

Regulation voltage:			14		28		56		
Model	Wiring	ohms	amps	watts	amps	watts	amps	watts	Item code
12v / 24v	Series	0.96	14.6	204	29.2	817			021-09275
	Single	0.48	29.2	408					
	Parallel	0.24	58.3	817					
24v / 48v (12v also)	Series	2.48	5.6	79	11.3	316	22.6	1265	021-09279
	Single	1.24	11.3	158	22.6	632			
	Parallel	0.62	22.6	316	45.2	1265			
Square flange element adapter									021-09285

Air Heating Diversion Loads

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

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

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

Model	Resistance setting	Diversion load amps at these voltages:						Item code
		14V	15V	28V	30V	56V	60V	
HL-100	0.25	56	60					021-09330
	0.50	28	30					
	1 ohm	14	15	28	30			
	4 ohms	3.5	3.8	7	7.5	14	15	
HL-75	0.75 ohms	19	20	38	40			021-09335
	3 ohms	4.7	5	9.3	10	19	20	

AEE Solar

Digital DC Volt & Amp Meters

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

Amp meters are available with a 100A/100mV shunt for measuring up to 100 amps with 0.1 amp resolution, and a 500A/50mV shunt to measure up to 500 amps with 1 amp resolution. The meters are also available without a shunt for installations with a shunt already in place. Current draw is only 20mA. Amp meters are bi-directional, so they can be used to read loads, showing negative numbers, or to read charging sources, displaying positive numbers.

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

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

Analog Amp Meters

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

Description	Item code
Analog meter 0-30A DC	028-07332
Analog meter 0-60A DC	028-07362
Mounting plate for 2-gang wiremold box	028-09015

MidNite Solar

NEW! Battery Capacity Meter

Designed to simplify battery management, this new meter can be used on 12, 24, 36 and 48 volt battery systems using flooded, AGM and GEL chemestry.

LEDs on the upper dial show present battery capacity. Three lower LEDs show the recency of the last full charge: 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" x 4".

Description	Item code
MidNite Battery Capacity meter	028-02260

Schnieder/Xantrex

TM-500A Amp-Hour Meter

The TM-500A is similar to the TriMetric meter in a special package with fuse and fuse holder. An improved display shows volts, amps, amp-hours and percent, without changing mode. It is very easy to install and use. Installation is simplified with a special shunt that includes a phone-type jack. Install the shunt, plug the special six-conductor cable into the shunt and meter and all the connections are made! Meter shows days since fully charged, cumulative amp-hours, recharge indicator, low-voltage indicator, and full-charge indicator. Comes with a 50' six-conductor cable with jacks, fuse, and a special 500A/50mV shunt. 2550 amp-hours is the maximum battery size it can keep track of. Use the 48-volt adapter for 48-volt systems.

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

Xantrex model	Description	Item code
TM-500A	Amp-hour meter w/shunt	028-01405
TM-500NS	Amp-hour meter w/o shunt	028-01403
TM48	48-volt adapter	028-01413
TC50	50-foot cable	028-01422-A

Bogart Engineering

TriMetric 2025 and 2025-RV

This updated version of the 2020 amp-hour meter operates on 12, 24 or 48 volts. LEDs show volts, amps and amp-hours on. Displays amp-hours directly or as "% full". An LED indicates charging and fully charged states. Another LED indicates when charging or equalization are needed, and during low battery voltage events. Meter also records minimum and maximum voltage, number of days since last charge, days since last equalized, and total lifetime amp-hours withdrawn. The TriMetric can be located hundreds of feet away from batteries using inexpensive 4-conductor twisted-pair meter wire. A shunt is required for operation. Use the 500-amp shunt on a 12V inverter larger than 800 watts, or a 24V inverter larger than 1600 watts. Use a 1000-amp 100mV shunt for systems with stacked XW inverters or where continuous current is over 300 amps. The 1000A/100mV shunt has the same resistance as the 500A/50mV shunt and may be used interchangeably. Order the shunt separately. Allows for a maximum battery bank size of 2500 amp-hours. The positive lead to the TriMetric should be fused with a 1-amp fuse. Flush mount or use wiremold box to mount. Made in USA. Dimensions: 4.5" x 4.75". 2-year warranty.

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

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

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

Pentametric Battery Monitor

The Pentametric monitor measures up to 2 separate battery systems with a common negative. With one battery system, meter monitors battery current plus two charging sources/loads.

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

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

Basic measurements:

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

Secondary measurements:

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

Data logging functions

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

1. In Periodically Logged Data mode you can record any or all of the following at regular intervals ranging from once per day to once per minute: amp-hours (3 channels), watt hours (2 channels), Temperature max/min (1 channel), volts (1 channel), amps (1 channel)
2. The Battery Discharge Voltage Profile logs volts and amps every time the charge level changes by 5% (or 10%) for 1 or 2 battery systems.
3. Battery Cycle Efficiency documents system efficiency for up to 2 battery systems.

AC Kilowatt-Hour Meter

If you are selling power back to the utility grid these reconditioned and certified utility-grade meters are an economical means for keeping track of how much power your system is generating. For use on 120 or 120/240 VAC systems. Maximum current 200 amps.

The ITRON LCD meter is the standard utility-grade meter seen on most homes. The 028-03042, five-terminal meter (Form 12S) is used for tracking the power fed back to the grid from an OutBack 120 VAC grid-tie system. Often used for Green Tag sales.

Description	Item code
Kilowatt hour meter ITRON LCD Digital 240V CL200	028-03012
Kilowatt hour meter 12S LCD 120V for OutBack grid-tie	028-03042

Kilowatt-Hour Meter Sockets

We stock two types of kilowatt-hour meter bases.

The Milbank brand sheet metal base is 8" W x 11.5" H. Both are for single phase 2- or 3-wire 100-amp service and both come with sealing ring. Raintight, NEMA 3R rated for outdoor use and UL Listed.

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

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

Description	Item code
Kilowatt hour meter socket 2S 120/240VAC - round	028-03025
Kilowatt hour meter socket 2S 120/240VAC NEMA 3R	028-03031
Kilowatt hour meter socket 12S 120 V 5 terminal	028-03047

NEW! 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.

The Vision meters with wireless communication utilizes robust 900 MHz radio communication between the Vision Meter and Vision Gate Collector to provide real-time data. The Collecotor connects to a LAN. A PC must be running on the network to receive data from the collector. One Gate Collector can read multiple meters in a 1000-yard line-of-site radius. A Collector can be configured as relay to increase range or go around corners.

Description	Item code
Vision kilowatt-hour meter form 2S	028-03061
Vision kilowatt-hour meter form 12S	028-03062
Vision kilowatt-hour meter 3-phase form 14/15/16S	028-03063
Vision kilowatt-hour meter form 2S with wireless comm	028-03064
Vision kilowatt-hour meter form 12S with wireless comm	028-03065
Vision kilowatt-hour meter 3-phase form 14/15/16S with wireless	028-03066
Vision wireless collector	028-03075

NEW! Solar-Log

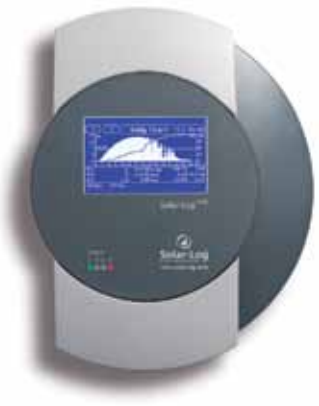
Solar-Log is a cost-effective, multi-vendor monitoring system for photovoltaic systems - supporting over 40 brands of inverter manufacturers. Three models provide accurate and economical equipment for monitoring any size installation, from smaller residential systems to large-scale commercial systems with central inverters. **Solar-Log WEB** adds on-line monitoring and is available in three functional levels: The basic free version has the key functions that suits the private plant owner; the **Solar-Log WEB Commercial and Solar-Log WEB Server** editions, specifically designed for installation engineers and resellers, provide a practical billing feature as well as an extensive project management system.

Features and Configurations

All three Solar-Log models have an RS-422/RS-485 input for wired connection to the inverter of the system being monitored. BT models are equipped with Bluetooth communications for connection to SMA inverters that are so-equipped.

Solar-Log^{200} supports one inverter and is configured via built-in web server. The PV system output data can be monitored by logging into the Solar-Log web site or by connecting to the Solar-Log with a web browser on a PC that is on the same LAN.

Solar-Log^{500} supports up to 10 inverters and is monitored via two-line display and/or via the built-in web server as on the Solar-Log200. In addition to all of the connections on the Solar-Log200 it has a S0 Pulse in/out for connecting building load meters and displays.



Solar-Log^{1000} supports up to 100 inverters and features a 3.5" x 2" touch screen display that allows configuration without a computer. It also acts as a public display for daily, monthly, yearly and total yields in a graphical output. The Solar-Log1000 offers an additional RS-485 port along with USB, relay and alarm ports, and RS-232 port for GPRS and analog modems.

Accessories

Accessories compatible with all Solar-Log models include the free iPhone app, RS-485 wireless radio set, Solar-Log WEB online monitoring and pre-fabricated installation cables. The S0 pulsing meter is compatible only with the 500 and 1000 models. The GSM/GPRS and analog modems, weather station capability, and 3-phase current meter are compatible only with the Solar-Log1000.

Inverter compatibility

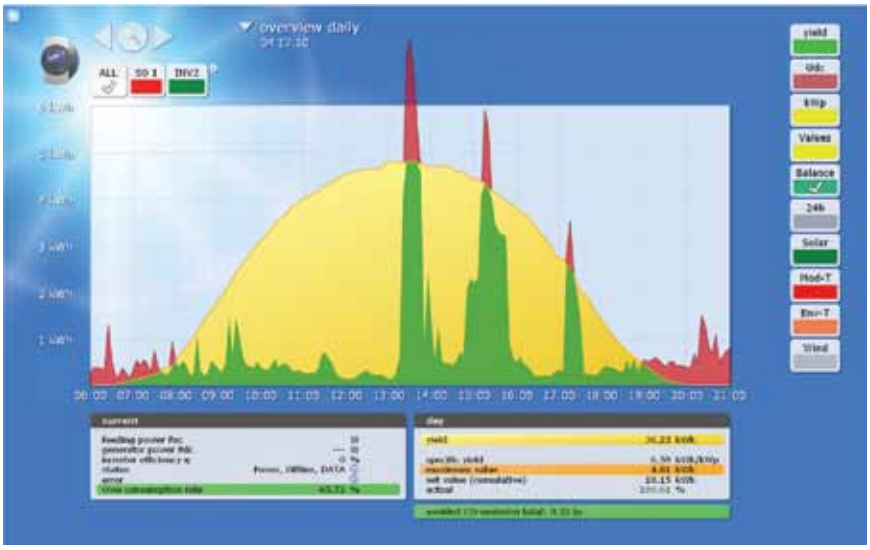
Solar-Log is unique because of its ability to analyze true inverter data including status and error codes. Solar-Log works with more than 40 inverter manufacturers, including SMA, Fronius, PVPowered, KACO and PowerOne. Satcon, Solectria, Schneider/Xantrex and Advanced Energy will be added by June 2011.

Solar-Log part #	Description	Item code
210220	Solar-Log200 (all brands, 1 inverter)	**029-06020**
210221	Solar-Log200 BT (all brands, 1 inverter, Bluetooth)	**029-06022**
210501	Solar-Log500 (all brands, 1-10 inverters)	**029-06050**
210502	Solar-Log500 BT (all brands, 1-10 inverters, Bluetooth)	**029-06052**
211001	Solar-Log1000 (all brands, 1-100 inverters)	**029-06100**
211002	Solar-Log1000 BT (all brands, 1-100 inverters, Bluetooth)	**029-06102**

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 directly from you.

NEW! Solar-Log WEB



Solar-Log WEB is a web-based monitoring application that allows installers and their customers to monitor installed systems. Accessible from either PC or Mac, the centralized control center provides easy management of an entire installed base of systems. Save time and money with precautionary monitoring to identify faults quickly and easily. Fast response time, maximum uptime and minimal loss of yield allows an integrator to increase customer loyalty and generate extra revenue from service contracts. Damage scope analysis helps document insurance claims against loss of revenue due to system failure. Product offerings range from the free **Solar-Log WEB Classic 2nd Edition** for up to 30kWp, to the integrator friendly **Solar-Log WEB Commercial** which adds features that make monitoring multiple plants easy. You also gain billing features and other tools to use your installed base as a customer portfolio.

Solar-Log WEB Server Edition is a complete server solution for large integrators who will install and monitor more than 500 PV plants. Operators of the "Server Edition" can create, manage and bill clients individually. The operator is given a private domain name, which allows customization of the Content Management System with an in-house CI. This solution offers wholesalers, investors and system integrators a professional, cost-effective platform for promoting their own products.

Solar-Log iPhone App

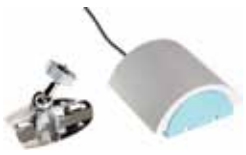
This iPhone app, included with all paid Solar-Log Web services, displays data from up to 10 solar installations, including daily, monthly, annual and overall views, plant informational views including a customizable plant photo and CO2 avoidance information.

The app is handy during sales discussions for showing customers everything that Solar-Log can do without bringing along a PC.

Solar-Log WEB Monitoring Options	
Solar-Log Web Classic 2nd Edition for 1 Year	**Item code**
1 - 30 kWp (small residential plant)	**029-06200**
31 - 50 kWp (large residential plant)	**029-06201**
51 - 200 kWp (small commercial plant)	**029-06202**
201 - 1499 kWp (medium commercial plant)	**029-06203**
from 1500 kWp (large commercial plant)	**029-06204**
Solar-Log WEB Commercial Edition for 1 Year	
1 - 10 kWp (small residential plant)	**029-06220**
11 - 20 kWp (medium residential plant)	**029-06221**
21 - 50 kWp (large residential plant)	**029-06222**
51 - 200 kWp (small commercial plant)	**029-06223**
201 - 1499 kWp (medium commercial plant)	**029-06224**
from 1500 kWp (large commercial plant)	**029-06225**

Irradiation/wind/temperature sensor

Wireless RS-485 transceivers



Wireless RS-485 antenna extension

GSM/GPRS modem

Solar-Log model #	Accessory application	Solar-Log accessories	Item code
220020	SMA RS-485 Adapters	Special Piggy Back (RS-485) for SMA inv. (not usable for Transformerless inverters)	029-06301
220053		SMA Data Module RS-485 1 inv. works for SB3000/SB4000/5000TL-20 (Next Generation)	029-06302
220060	Weather Monitoring	Weather monitoring kit, including irradiation and module temperature sensor	029-06309
220061		Wind sensor - connects to irradiation sensor	029-06310
220062		Ambient temperature sensor - connects to irradiation sensor	029-06311
220058	Wireless RS-485	Wireless RS-485 radio set - specify inverter when ordering - not compatible w/ Fronius	029-06321
220059		Wireless RS-485 radio directional antenna. 3m cable included. outdoor use	029-06322
220067		Directional antenna extension cable, indoor/outdoor 3M	029-06326
220066		Directional antenna extension cable, indoor/outdoor 6M	029-06327
220065		Directional antenna extension cable, indoor/outdoor 9M	029-06328
220063	Outdoor Mounting	Solar-Log Installation Box IP65 for outdoor use, incl. 3m power cord and installation plate	029-06323
220037	Inverter Connection Cables	Cable set for SMA (3m)	029-06331
220038		Cable set for KACO (3m)	029-06332
220041		Cable set for Fronius (3m)	029-06333
220043		Cable set for Power-One (3m)	029-06334
		Cable set for PVPowered (3m)	029-06335
		Cable set for Schneider/Xantrex (3m) (available by June 2011)	029-06336
		Cable set for Solectria (3m) (available by June 2011)	029-06337
		Cable set for AE (3m) (available by June 2011)	029-06338
		Cable set for Satcon(3m) (available by June 2011)	029-06339
	Miscella-neous	Public Display - SolarFox 200 47" (24/7 Display)	029-06350
220047		GSM/GPRS Mobile Radio Set (Modem + Antenna) Siemens CT63	029-06323
255168		3-Phase Energy Meter (40A-300A CTs) 480V	029-06355

DECK Monitoring

Solar Monitoring Solution

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

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

Manage and view solar energy system or whole-building energy usage in a single view. View your system anytime, anywhere using a web browser or any internet-connected device. Residential and commercial installers can assure customers that their renewable energy system is operating properly. DECK provides views for post-installation support, alerting you to failure issues and providing tools for remote troubleshooting. The DECK service also generates the regular reports required for performance-based financial incentives available under programs such as California's CSI.

Residential Monitoring Service

DECK's Residential Monitoring Service uses monitoring and visualization tools to help the residential end user understand their solar energy system. The residential solution allows improvement of net metering results and reduction of electricity bills by managing energy use.

The image at right is a typical simple view showing real-time and historical data about energy generation, the building's energy usage, and environmental information. Energy information can be selected to show daily, weekly, monthly and yearly comparisons. A simple Flash application shows consumers "How Solar Works," as well.

DECK offers inverter-direct monitoring for many grid-tie inverters as well as revenue-grade, inverter-independent monitoring that can be used for power purchase agreements, performance incentives and renewable energy credit trading. Residential monitoring systems are for home users only; they are single phase, and measure only kWh, not volts and amps.

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

DECK part #	DECK Residential Monitoring w/ 5 years monitoring included	Item code
RM5YP001	Residential solar monitoring equipment and service package	029-04019
RM5YSWB1	Residential SMA WebBox software only	029-04022
RM5YE001	Residential solar monitoring 5-year extension	029-04030
RI5YE001	Residential inverter monitoring 5-year extension	029-04031
INVDIR002	System Config. per Residential inverter w/5yr monitoring	029-04032
WSMA001	Weather Station Residential - SMA	029-04034

Commercial Monitoring Service

DECK's Commercial Monitoring Service provides an accurate, real-time view of savings and production whenever and wherever needed. View the whole-building energy picture by monitoring one or many building systems in a single view. Pricing is based on the actual monitoring services delivered, not on the kW-size of the job.

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

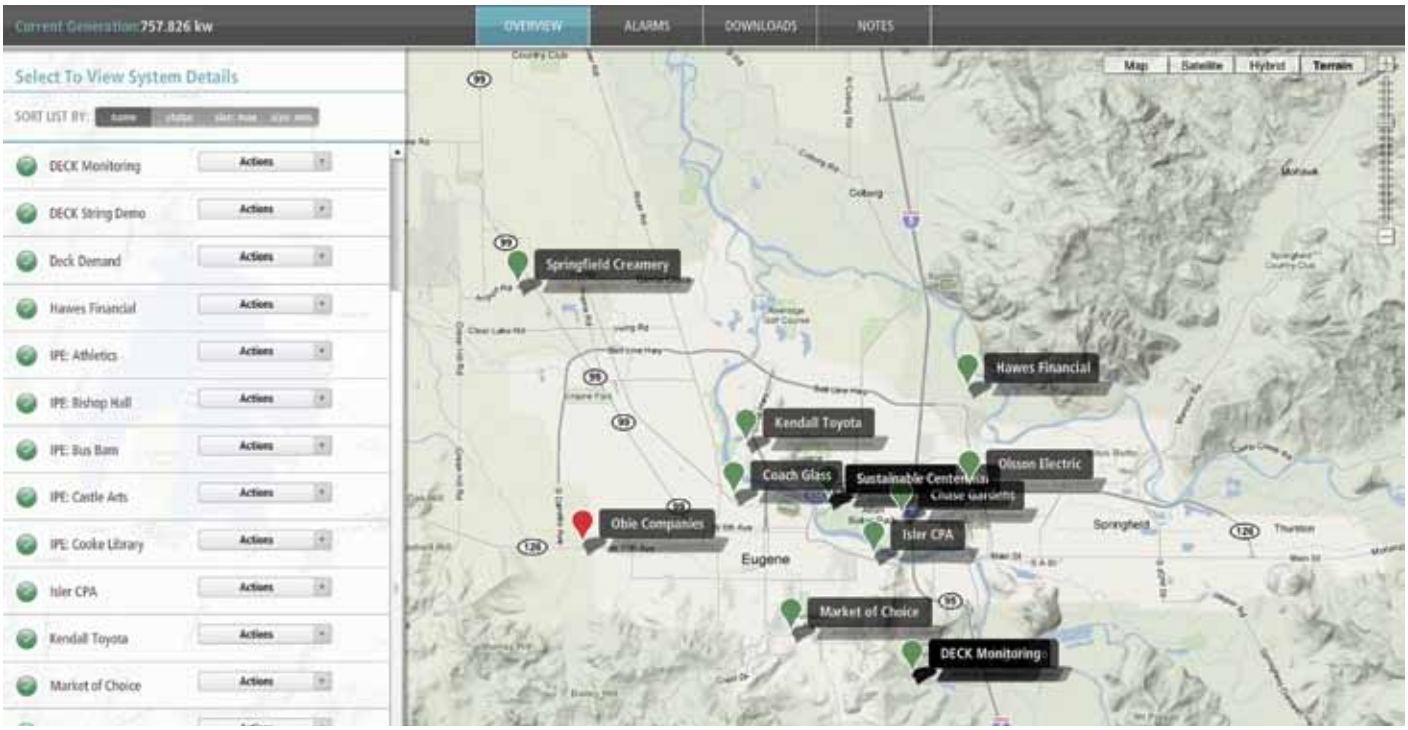
For large projects, DECK also provides string monitoring on the DC side, which allows integrators, owners and PPAs to ensure their system is operating at peak efficiency. DECK's advanced string outlier graph shows at a glance if any strings are underperforming, while giving the integrator the ability to adjust the

tolerance level to prevent false alarms due to shading or other factors. String monitoring can easily pay for itself in a large system by alerting to under-performing strings that might otherwise pass unnoticed.

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

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

DECK part #	DECK Commercial Monitoring w/ 5 years monitoring	Item code
CM5YP001	Commercial solar monitoring equipment and service package	029-04000
CMAMS001	Add-on energy meter w/CTs (100A-2400A) unidirectional	029-04002
CMAMS002	Add-on energy meter w/CTs (100A- 1600A) bidirectional	029-04004
WS5YP001	Weather station standard w/5 yrs. Monitoring included	029-04005
WS5YP002	Weather station with wind speed & direction	029-04006
WP2PP001	Wireless outdoor send/receive connection (1500 ft.) - 2 units	029-04009
WP2PP002	Wireless outdoor send or receive connection (1500 ft.) - 1 unit	029-04015
CB08S00	String monitoring and UL combiner for up to 8 strings	029-04010
CB16S001	String monitoring and UL combiner up to 16 strings	029-04011
CMG00001	Cellular modem for gateway (no internet service)	029-04012
	DIGI Connnect WAN 3G Cellular Router with antenna	029-04043
	DIGI Power Cord for Cellular Router	029-04042
EDI5YA001	PDP reporting	029-04013
N4REO001	NEMA 4 outdoor enclosure	029-04016
INVDIR001	System config. per commercial inverter (allows subarray monitoring)	029-04017
CS5YP001	Current Sensor 200ADC max; reading w/ 5-yr. monitoring	029-04029
Display Options		
KTSIP001	Kiosk preconfigured indoor	029-04007
KTSOP001	Kiosk preconfigured outdoor	029-04008
LCD50001	50" monitoring LCD display with preconfigured PC	029-04023
HPTSP001	Touchscreen flat panel PC/display preconfigured	029-04024
STORB001	How Solar Works (story board) 4' x 3'	029-04025
Monitoring Extension Options		
CM5YE001	Commercial solar monitoring 5-year extension	029-04001
CI5YE001	Commercial inverter monitoring 5-year extension	029-04028
CM5YM001	Add-on meter 5-year monitoring extension	029-04003
WS5YE001	Weather station 5-year extension	029-04026
ST5YE001	String monitoring 5-year extension (per string)	029-04027



Battery Information and Sizing

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

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

Battery Size

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

Lead-Acid Batteries

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

Caring for Lead-Acid Batteries

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

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

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

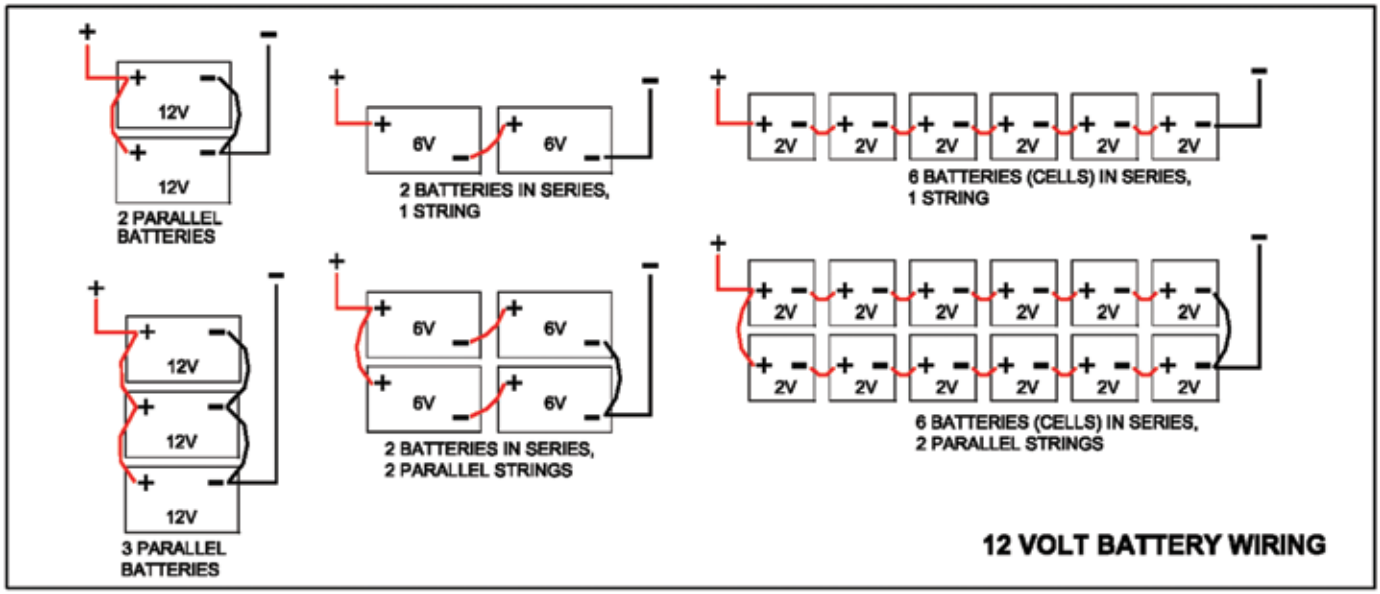
With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. With poor treatment lead-acid battery life will be very short.

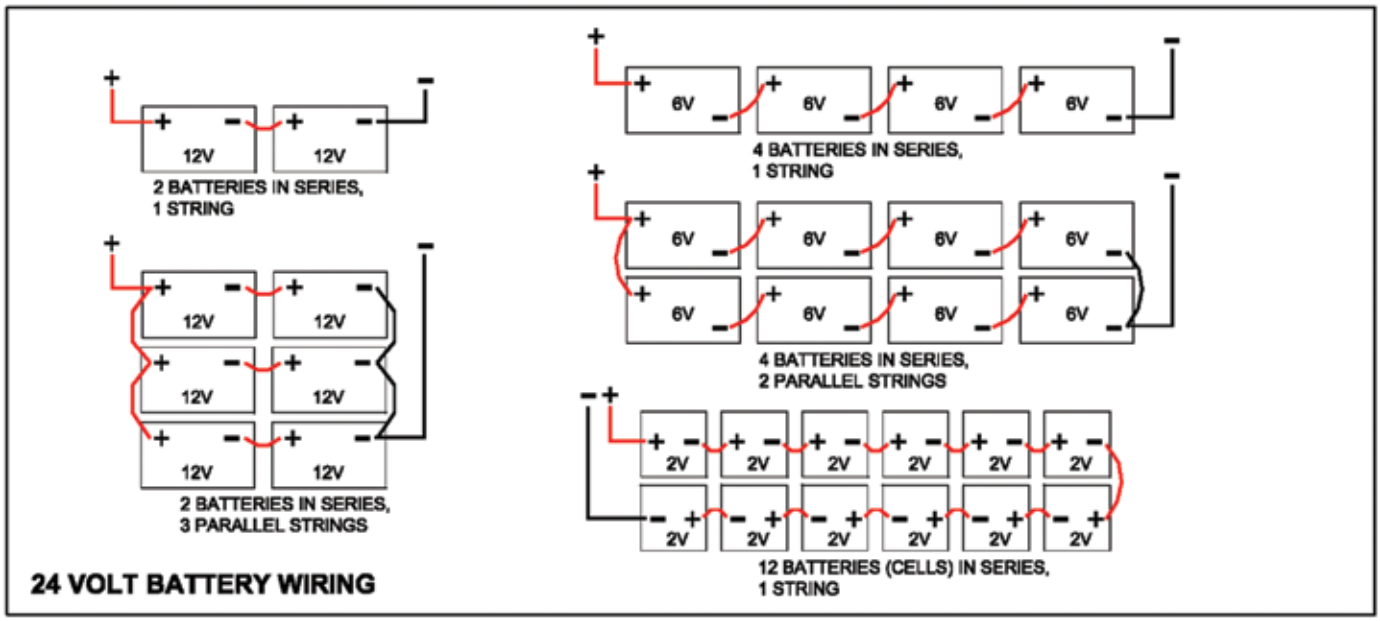
We strongly recommend the use of an amp-hour meter with all battery systems. See pages 138-139.

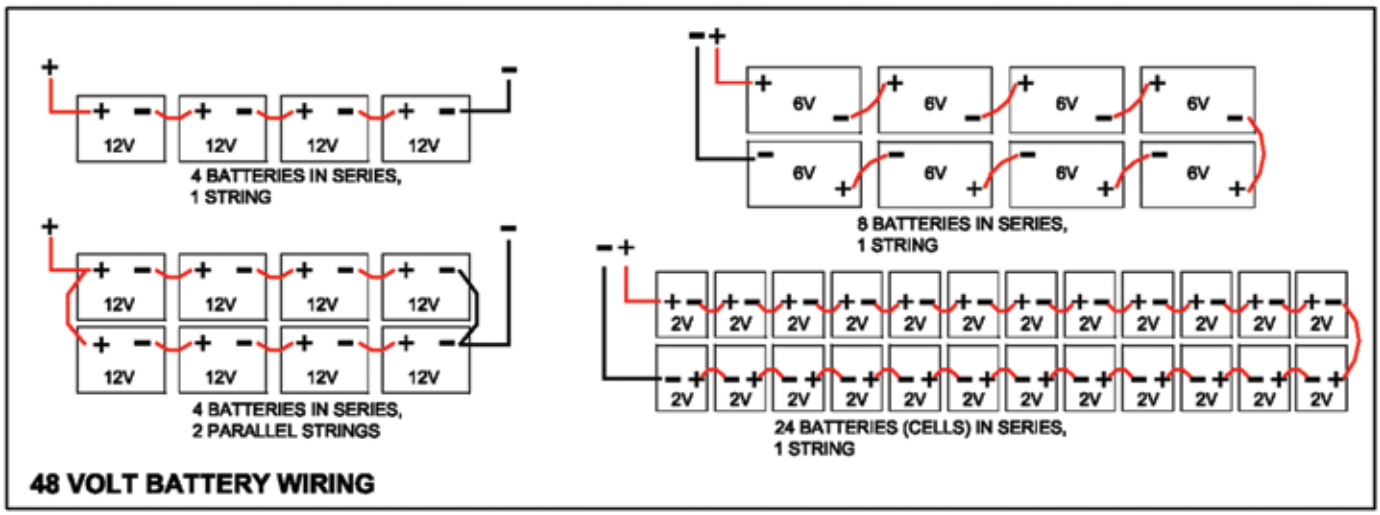
Battery warranties do NOT cover damage due to poor maintenance or loss of capacity from sulfation.

Battery Wiring Diagrams

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







Battery State-of-Charge

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

Amp-Hour Meters

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

Measuring Battery State-of-Charge

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

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

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

Hydrometers

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

Hydrometer Readings

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

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

Battery Sizing Worksheet

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

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

Step 1 Total average amp-hours per day required (line 10 from the Off-Grid Load Worksheet on page 13): _____

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

Step 3 Multiply line 1 by line 2: _____

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

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

Special Condition #1: Heavy Electrical Load

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

Step 6 Multiply line 5 by line 10: _____

Special Condition #2: High-Charge Current

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

Step 8 Multiply line 7 by 10: _____

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

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

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

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

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

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

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

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

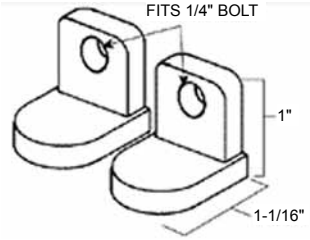
East Penn/MK Battery

MK Sealed PV/Solar Batteries

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

MK Sealed Gel Batteries

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



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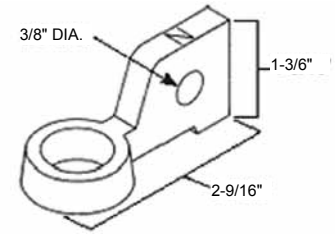

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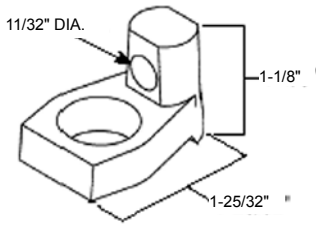

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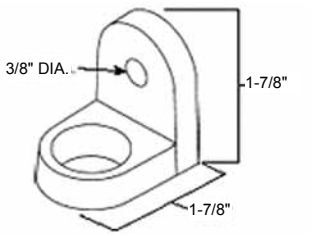

T975

Battery type	Model number	Volts	Terminals	Capacity (Ah)		Dimensions (in) L" x W" x H"	Weight (lbs)	Item code
				20-hr rate	100-hr rate			
Sealed gel solar batteries	8GU1	12	T874	31.2	36.1	7.8 x 5.2 x 7.3	24	**040-03015**
	8G22NF	12	T881	50	57	9.38 x 5.5 x 9.25	38	**040-03018**
	8G24UT	12	T881	73.6	84	10.9 x 6.8 x 9.9	53.6	**040-03022**
	8G27	12	T876	86.4	99	12.75 x 6.75 x 9.75	63.2	**040-03024**
	8G31	12	T876	97.6	108	12.94 x 6.75 x 9.75	71.7	**040-03027**
	8G4DLTP	12	T975	183	210	20.8 x 8.5 x 10	130	**040-03030**
	8G8DLTP	12	T975	225	265	20.8 x 11 x 10	161	**040-03033**
	8GGC2	6	T881	180	198	10.3 x 7.2 x 10.9	69	**040-03036**

MK Sealed AGM Batteries

These are completely sealed, absorbed glass mat, valve-regulated batteries with efficient recombination. UL Recognized components to UL MH17218. AGM batteries are recommended for battery backup standby power systems where batteries are in float service with occasional deep discharges. They can operate at temperatures from -40 to 140 F. Delivered from one of 20 MK warehouses across the U.S. NOTE: The 3 asterisked models in the table can NOT be shipped by air or UPS, only by truck freight.

Battery type	Model number	Volts	Terminals	Capacity (Ah)		Dimensions (in) L" x W" x H"	Weight (lbs)	Item code
				20-hr rate	100-hr rate			
Sealed AGM solar batteries	8AU1H	12	T874	32.5	37	7.8 x 5.2 x 7.3	24	**040-03117**
	8A22NF	12	T881	55	63	9.38 x 5.5 x 9.25	38	**040-03120**
	8A24DT	12	T881	79	91	10.9 x 6.8 x 9.9	53.6	**040-03123**
	8A27	12	T876	92	106	12.75 x 6.75 x 9.75	63.2	**040-03126**
	8A31DT*	12	DUAL	105	116.2	12.94 x 6.75 x 9.75	71.7	**040-03129**
	8A4DLTP*	12	T975	200	216	20.8 x 8.5 x 10	130	**040-03132**
	8A8DLTP*	12	T975	245	257	20.8 x 11 x 10	161	**040-03135**
	8AGC2	6	T881	200	220	10.3 x 7.2 x 10.9	69	**040-03137**

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

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

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

Manufactured in one of the cleanest, most advanced plants in the world.

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

Trojan

Commercial Deep Cycle Lead Acid Batteries

These batteries have been used in off-grid power systems in remote cabins for the past 25 years with great success. Because of their low initial cost, they are the most affordable true, deep cycle batteries. The T105 golf cart battery is designed to be used in small electric vehicles where they are cycled heavily and last about 2 years. In a remote home system where they are cycled down 20% every day they can last 3 to 6 years. The L-16 battery is a heavy-duty cousin of the golf cart battery with much thicker lead plates and nearly twice the capacity. Trojan's Renewable Energy (RE) Series (L16RE-2V, L16RE-A, L16RE-B and T105-RE) is a line of technologically advanced lead-acid deep cycle batteries, optimized for renewable energy applications such as solar PV, small wind, and micro hydro. They have heavier duty separators and plates designed for longer life and their warranty has been extended to two years free replacement and 60 months additional pro-rated on the L16s and 36 months pro-rated on the T-105.

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

HuP Solar-One

2100 Cycle Industrial Batteries

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

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

With Trojan Battery, you just may forget you're off-the-grid.

With over 85 years of experience, Trojan Battery offers a complete line of deep cycle flooded, AGM and gel batteries for reliable power and long life in the toughest off-grid locations.

Trojan Battery is the most trusted name in deep cycle technology:

- **Even longer life**
- **Superior charge performance**
- **7 year limited warranty: Best-in-class for Renewable Energy applications**

Trojan batteries are available through Trojan's Worldwide Master Distributor Network and Renewable Energy Wholesalers. Visit www.trojanbattery.com to see our selection of Renewable Energy batteries or call 800-423-6569 for the nearest Trojan Battery partners near you.

Trojan®
BATTERY COMPANY
Clean energy for life™

Rolls/Surrette

S-series Batteries

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

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

Deep Cycle Industrial Flooded Batteries

These are the new generation, dual container, deep cycle Rolls batteries from Surrette. They are high-capacity batteries with a heavy-duty plate grid to resist positive plate breakdown. The plates are double insulated with glass mat and a polyethylene envelope, eliminating the possibility of separator misalignment, cracked separators, treeing or shorting at the bottoms or sides. Rolls batteries are rated at 3200 cycles at 50% depth of discharge. Each 2-volt cell is built into its own lightweight container made of durable polypropylene with the cover heat bonded to the container, thus acid leakage is eliminated. The cells are then assembled into a tough, lightweight polyethylene outer container with a removable lid. Even if the outer case is broken the battery remains operable and spill-free. The individual cells of the CS and KS series are bolted together allowing the battery to be disassembled. The cells can be independently removed. This facilitates easy on-site installation, disassembly, assembly, or replacements of individual cells without special skills or tools. All 5000 Series Rolls Batteries, including the CS & KS models, come with a 10-year warranty, 3-year full warranty, and 7-year prorated warranty.

Surrette model	Battery voltage	Capacity (Ah)		Rated cycles (50% DOD)	Warranty (years)	Dimensions (inches)			Weight wet / dry	Item code
		20-hr rate	100-hr rate			L"	W"	H"		
2-KS-33PS	2	1766	2491	3300	10	15.44	8.31	24.81	208/145	**040-02220**
2-YS-31PS	2	2430	3435	3300	10	15.50	9	31.63	285/200	**040-02221**
4-CS-17PS	4	546	770	3200	10	14.38	8.25	18.25	128 / 98	**040-02223**
4-KS-21PS	4	1104	1557	3200	10	15.75	9.38	24.75	267 / 186	**040-02226**
4-KS-25PS	4	1350	1900	3200	10	15.75	10.63	24.75	315 / 220	**040-02229**
6-CS-17PS	6	546	770	3200	10	22	8.25	18.25	221 / 178	**040-02232**
6-CS-21PS	6	683	963	3200	10	22	9.75	18.25	271 / 217	**040-02235**
6-CS-25PS	6	820	1156	3200	10	22	11.25	18.25	318 / 254	**040-02238**
8-CS-17PS	8	546	770	3200	10	28.25	8.25	18.25	294 / 238	**040-02247**
8-CS-25PS	8	820	1156	3200	10	28.25	11.25	18.25	424 / 342	**040-02250**
12-CS-11PS	12	357	503	3200	10	22	11.25	18.25	272 / 220	**040-02259**

RED IS THE NEW GREEN.

Available in 20 countries on 6 continents worldwide,

Rolls offers the broadest product line of deep cycle, low maintenance and maintenance free batteries for the Renewable Energy market. From large-scale storage to small village electrification, our flooded or AGM storage batteries deliver the power you need every time. Each is backed by our industry leading warranty, solid reputation and 97% recyclable at end of life. Green just got a whole lot meaner.

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Largest Liquid Reserves | Easiest to Install | Longest Life Span | Premium Warranties

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ReStore Energy Systems/GNB

Absolyte GP Industrial Sealed Batteries

ReStore Energy Systems, a division of Exide Technologies, specializes in renewable energy sources. ReStore's Absolyte GP Industrial Sealed Battery was developed by GNB (also a division of Exide) in conjunction with Sandia National Laboratories. Together they created the first VRLA large capacity, deep cycle battery for PV applications, designed for deep discharge recovery. Life expectancy: in float conditions, 20 years @ 25°C (77°F) with proper charging; in cycling conditions, 1200 cycles to 80% DOD with proper charging. Sealed cells with absorbed glass mat (AGM) separators eliminate the need for periodic water additions as found in flooded cells. Periodic visual inspections, voltage readings, and connection retorquing required.

Protective steel tray housings offer maximum installation flexibility and the Absolute GP is normally stacked horizontally up to eight high for use in 1997 UBC/2001 CBC Seismic Zone IV (at or below grade). 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.

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

When ordering you must specify the positive and negative terminal locations and stacking configuration. Protective steel tray housings offer maximum installation flexibility and the Absolute GP is normally stacked flat up to eight high vertically for use in 1997 UBC/2001 CBC Seismic Zone IV (at or below grade). All cell connections are included for each battery system that consists of one series string. Connections for parallel strings are not included.

Applications

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

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

GNB part #	Volts	Capacity (Ah)		Dimensions (inches)			Weight (lbs)	Item code
		20-hr rate	100-hr rate	L"	W"	H"		
6-cell 12-volt batteries								
6-50G05	12	120	140	17.19	8.53	16.22	157	**040-04409**
6-50G07	12	182	210	21.69	8.53	16.22	209	**040-04412**
6-50G09	12	240	290	26.19	8.53	16.22	252	**040-04415**
6-50G13	12	360	430	35.19	8.53	16.22	356	**040-04421**
6-90G07	12	300	360	21.69	8.53	23.56	316	**040-04430**
6-90G09	12	400	480	26.19	8.53	23.56	396	**040-04433**
6-90G11	12	500	600	30.69	8.53	23.56	477	**040-04436**
6-90G13	12	600	720	35.19	8.53	23.56	557	**040-04439**
6-90G15	12	700	840	39.69	8.59	23.56	637	**040-04442**
3-cell 6-volt batteries								
3-100G13	6	680	790	19.93	8.53	26.38	328	**040-04313**
3-100G15	6	800	920	22.18	8.59	26.38	374	**040-04316**
3-100G17	6	900	1,000	24.50	8.59	26.38	424	**040-04319**
3-100G19	6	1,020	1,100	26.75	8.59	26.38	470	**040-04322**
3-100G21	6	1,140	1,300	29	8.59	26.38	515	**040-04325**
3-100G23	6	1,260	1,400	31.25	8.59	26.38	561	**040-04328**
3-100G25	6	1,360	1,500	33.50	8.59	26.38	608	**040-04331**
3-100G27	6	1,460	1,700	35.75	8.59	26.38	653	**040-04334**
3-100G29	6	1,580	1,800	38	8.59	26.38	704	**040-04337**
3-100G31	6	1,700	1,900	40.25	8.59	26.38	750	**040-04340**
3-100G33	6	1,820	2,100	42.50	8.59	26.38	795	**040-04343**
2-volt cells								
1-100G39	2	2,040	2,370	19.93	8.53	26.38	328	**040-04225**
1-100G45	2	2,340	2,760	22.18	8.59	26.38	374	**040-04228**
1-100G51	2	2,700	3,000	24.50	8.59	26.38	424	**040-04231**
1-100G57	2	3,060	3,300	26.75	8.59	26.38	470	**040-04234**
1-100G63	2	3,420	3,900	29	8.59	26.38	515	**040-04237**
1-100G69	2	3,780	4,200	31.25	8.59	26.38	561	**040-04240**
1-100G75	2	4,080	4,500	33.50	8.59	26.38	608	**040-04243**
1-100G81	2	4,440	5,100	35.75	8.59	26.38	653	**040-04246**
1-100G87	2	4,800	5,400	38	8.59	26.38	704	**040-04249**
1-100G93	2	5,100	5,700	40.25	8.59	26.38	750	**040-04252**
1-100G99	2	5,460	6,300	42.50	8.59	26.38	795	**040-04255**

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A DIVISION OF EXIDE TECHNOLOGIES

East Penn

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 ideal for float applications with an occasional deep discharge, such as battery-backup for grid-connected systems. The front safety shield design easily clips on and off without tools for quicker assembly. The modules are coated with acid resistant epoxy powder paint and each module has mounting holes for grounding option. They come with flame retardant polyethylene cases.

These batteries are available with interlocked frames for locations with tough seismic requirement 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 enables it to be used as an anchoring template. Anchors can be drilled and installed with the base in place. They are certified to UBC 97 Zone 4 Top of Building up to 8 modules high. The non-interlock modules require front and rear access bolts for mounting, providing easy and safe installation. The standard two-piece base enables anchors to be drilled and installed with base in place. The non-interlock version is certified to UBC 97 Zone 2B Top of Building up to 8 modules high.

				Non-Interlock SpaceSaver	Interlock SpaceSaver
				Flame retardant poly case	Flame retardant poly case
Deka model	Amp hours		*Suffix>*	-NL	-IL
	20 hour rate	100 hour rate	Module volts	Item code prefix	
6AVR75-5	180	210	12	040-06011	
6AVR75-7	280	310	12	040-06012	
6AVR75-9	380	420	12	040-06013	
6AVR75-11	460	520	12	040-06014	
6AVR75-13	540	630	12	040-06015	
6AVR75-15	640	730	12	040-06016	
3AVR75-17	720	840	6	040-06017	
3AVR75-19	820	940	6	040-06018	
3AVR75-21	920	1050	6	040-06019	
3AVR75-23	1000	1150	6	040-06022	
3AVR75-25	1100	1250	6	040-06023	
3AVR75-27	1200	1360	6	040-06024	
3AVR75-29	1280	1460	6	040-06025	
3AVR75-31	1380	1570	6	040-06026	
3AVR75-33	1460	1670	6	040-06027	
6AVR95-15	790.6	941.2	12	040-06028	
3AVR95-17	903.5	1075.7	6	040-06029	
3AVR95-19	1016.4	1210.1	6	040-06030	
3AVR95-21	1129.4	1344.6	6	040-06031	
3AVR95-23	1242.3	1479	6	040-06032	
3AVR95-25	1355.3	1613.5	6	040-06033	
3AVR95-27	1468.2	1747.9	6	040-06034	
3AVR95-29	1581.1	1882.4	6	040-06035	
3AVR95-31	1694.1	2016.9	6	040-06036	
3AVR95-33	1807	2151.3	6	040-06037	
2AVR125-33	2367	2930	4	040-06038	

MidNite Solar

Battery Enclosures

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

MNBE-B

MNBE-A

MNBE-D

MNBE-C

MidNite model	Battery size	Battery capacity	Shelves included	Dimensions (inches) H" x W" x D"	Shipping dimensions	Weight (lbs)	Item code
MNBE-A	27 or 31 8D	6 2	2	27 X 29 x 14.5	30" X 32" x 7.5"	71	**048-05501**
MNBE-B	27 or 31 or GC2	8	2	34 X 34 X 15.25	49" X 19" x 8" & 50" X 19" x 9"	107	**048-05503**
MNBE-C	27 or 31 or GC2 8D	12 3 (4 w/ extra shelf)	3	58 X 34 X 15.25	Ships by truck on a 42" x 42" x 60" pallet	190	**048-05505**
MNBE-D	27, 31, GC2	8	2	41 X 34 X 15.25	49" X 19" x 8" & 50" X 19" x 9"	113	**048-05506**
MNBE-D3R	27, 31, GC2	8	2	41 X 34 X 15.25	49" X 19" x 8" & 50" X 19" x 9"	113	**048-05507**
MNBE-E	27, 31, GC2, or L16	8	2	47 X 34 X 15.25	49" X 19" x 8" & 50" X 19" x 9"	128	**048-05508**
Extra Shelf for MNBE-C, MNBE-D or MNBE-D3R							**048-05520**

Heavy Duty Plastic Battery Box

These battery enclosures are made from HDPE plastic, the same material used to manufacture the outside cases of batteries. A removable lid with handles allows easy access to the batteries for service. Enclosures for L-16s are made with a removable middle section that minimizes lifting when installing the batteries. The plastic is acid resistant and very strong, but easy to drill with a hole saw for adding conduit fittings or battery filling tubes. The hydrogen vent fitting on the lid should be extended to the exterior of the building.

Each of the boxes can be ordered with, or without a drain fitting. The drain allows the batteries to be washed and hosed off. The drain option includes a 3" rigid foam base with HDPE trim ring and 3/4" pipe that extends horizontally out of the trim ring. Dimensions listed are inside of the battery compartment. Shipping size is slightly larger.

Battery type	Battery quantity	With drain	Dimensions W" x L" x H"	Item code
L16	4	No	33 x 14 x 22.5	**048-04014**
L16	4	Yes	33 x 14 x 22.5	**048-04015**
L16	8	No	33 x 27 x 22.5	**048-04016**
L16	8	Yes	33 x 27 x 22.5	**048-04017**
T105	4	No	32.5 x 12.5 x 17	**048-04018**
T105	4	Yes	32.5 x 12.5 x 17	**048-04019**
T105	8	No	32.5 x 23.5 x 17	**048-04020**
T105	8	Yes	32.5 x 23.5 x 17	**048-04021**

DPW Solar

POWER-FAB Pole-Mount Aluminum Battery Boxes

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

Battery size	Part number	Batteries spaces	Dimensions (inches) D" x W" x H"	Item code
27/30	BB1-8G30H-HC	1	9 X 16 x 20	048-04179
	BB2-8G30H-HC	2	16 X 16 x 20	048-04188
	BB4-8G30H-HC	4	16 X 16 x 20	048-04200
	BB6-8G30H-HC	6	16 X 25 x 34	048-04201
Golf cart GC2	BB2-6V/220AH-HC	2	14 X 18 x 22	048-04197
4D	BB1-8G4D-HC	1	12 X 24 x 22	048-04282
	BB2-8G4D-HC	2	12 X 24 x 36	048-04291
8D	BB1-8G8D-HC	1	15 X 24 x 22	048-04285
	BB2-8G8D-HC	2	15 X 24 x 36	048-04294

POWER-FAB Chest-Style Battery Enclosures

Pad mount, chest style enclosures are manufactured with 0.125" 5052-H32 aluminum. All die marks and welds are sanded smooth and the boxes are finished with a reflective bright white polyester powder coat to minimize internal heat gain. All enclosures are provided with integrated louvers located to promote convective air flow through the enclosure to reduce internal temperatures and remove gasses. Filters are located over the louvers to keep out dust and insects. The filters are removable for cleaning or replacement. All standard enclosures are built to meet NEMA 3R specifications.

Other sizes are available. Contact us for sizes not listed here.

Battery size	Part number	Batteries spaces	Layout	Dimensions (in) (non-insulated)	Weight (lbs) (non-insulated)	Non-insulated	Insulated
						Item code	Item code
27/30	BB2-GRP30	2	2x1	16x16x16	26	048-04030	048-04033
	BB4-GRP30	4	2x2	18x30x16	39	048-04031	048-04034
	BB4-GRP30-1X4	4	1x4	16x34x16	37	048-04032	048-04035
	BB6-GRP30	6	2x3	25x30x16	50	048-04140	048-04143
	BB8-GRP30	8	2x4	30x33x16	60	048-04036	048-04043
	BB12-GRP30-4X3	12	4X3	33x44x16	79	048-04038	048-04039
8d	BB2-8G8D	2	2x1	24x26x16	44	048-04057	048-04065
	BB4-8G8D	4	2x2	26x46x16	68	048-04116	048-04119
	BB4-8G8D-1X4	4	1x4	24x50x16	65	048-04066	048-04067
	BB6-8G8D	6	2x3	38x46x16	90	048-04128	048-04131
	BB8-8G8D	8	2x4	46x50x16	111	048-04068	048-04069
	BB12-8G8D-4X3	12	4x3	50x68x16	150	048-04071	048-04078
Golf cart GC2	BB2-6V200	2	2x1	13x18x17	25	048-04074	048-04079
	BB4-6V200-1X4	4	1x4	14x35x17	36	048-04076	048-04081
	BB8-6V200	8	2x4	25x32x17	56	048-04152	048-04155
	BB12-6V200-4x3	12	4x3	34x35x17	74	048-04084	048-04091
	BB16-6V200-4X4	16	4x4	35x47x17	89	048-04040	048-04041
L-16, S460, S530	BB2-SS530	2	2x1	16x19x24	31	048-04088	048-04095
	BB4-SS530-1X4	4	2x2	16x36x24	46	048-04122	048-04125
	BB8-SS530	8	2x4	29x36x24	70	048-04158	048-04161
	BB12-SS530-4X3	12	4x3	36x43x24	91	048-04171	048-04172
	BB16-SS530-2X8	16	2x8	29x70x24	114	048-04176	048-04177
	BB16-SS530-4X4	16	4x4	36x56x24	111	048-04187	048-04181

Schneider Electric

Xantrex Truecharge2 12V Battery Charger

Truecharge2 is available as a 20- or 40-amp electronic battery charger for deep cycle batteries. Switch settings give correct charge for wet, gel cell, or absorbed glass mat (AGM) batteries. Selectable 2- or 3-stage charging; 3-stage includes float charge. Manual equalize charge button. Manual or automatic temperature compensation. The optional temperature sensing probe corrects charge voltage for actual battery temperature. These chargers have full output even with low-cost generators, which is important when using the charger with a 1000- to 3000-watt generator. Dimensions: 2.75" x 6.7" x 9.8". 1-year warranty.

Description	Item code
Truecharge 2 40 amp charger	**045-02896**
Truecharge 2 20 amp charger	**045-02895**
Temperature sensor	**045-02898**
Remote control panel	**045-02897**

IOTA

DLS Converter/Chargers

The DLS series converter/power supply output is so clean and ripple-free, it can be used with or without a battery. The DLS series converter/charger quickly and efficiently charges batteries from the full rated output of the DLS. The DLS then maintains the batteries, only putting into the battery what is required by load or self discharge, cutting back to milliamps as the battery requires. Low and transient AC line voltage can be a major cause of converter/power supply failure. The DLS series converter/power supply is protected against low line voltage, spikes from the AC power source, or from improperly adjusted generators. When used as a power supply, the DLS model will only supply what is required by the load. When not in use it is essentially off, reducing electricity usage. External fuses can be quickly and easily replaced. There is a socket and jumper that can be used to change the charge voltage limit to either 13.6 or 14.2 volts (multiply by 2 for 24v and 4 for 48v batteries).

Chargers have 120 VAC input. 75-amp and larger chargers have 120V 20-amp plugs. 2-year warranty

IOTA IQ-4 Smart Controller

The IQ-4 makes the DLS charger into a 3-stage charger with bulk, absorption and float charging. It will bulk charge to 14.8v for 15 minutes after it has reached the set-point, or for 3.75 hours. It will then absorb charge at 14.2v for 8 hours, then drop to float charge at 13.6v (multiply by 2 for 24v and 4 for 48v batteries). If the battery remains in float stage for 7 days, it delivers a bulk charge. The IQ-4 is not recommended for generator-powered battery charging if generator is only run for short periods of time.

IOTA model	Battery volts	Charge amps	Dimensions (inches)	Weight (lbs)	Item code
DLS-15	12	15	9.7 x 6.7 x 3.4	5.0	**045-02112**
DLS-30	12	30	9.7 x 6.7 x 3.4	5.0	**045-02115**
DLS-45	12	45	9.7 x 6.7 x 3.4	5.0	**045-02118**
DLS-55	12	55	9.7 x 6.7 x 3.4	5.0	**045-02121**
DLS-75	12	75	13 x 6.7 x 3.4	7.8	**045-02124**
DLS-90	12	90	13 x 6.7 x 3.4	7.8	**045-02127**
DLS-27/15	24	15	9.7 x 6.7 x 3.4	5.0	**045-02130**
DLS27/25	24	25	9.7 x 6.7 x 3.4	5.0	**045-02133**
DLS-27/40	24	40	13 x 6.7 x 3.4	7.8	**045-02136**
DLS-54/13	48	13	9.7 x 6.7 x 3.4	5.0	**045-02147**
IQ-4	12-24	Smart controller for 12 to 24V chargers			**045-02103**
IQ-4-54V	48	Smart controller for 48V charger			**045-02104**

Zephyr

Power Vent Battery Box Vent

Lead-acid batteries produce hydrogen gas when charging. But if the battery box is left open to vent gas in cold climates, the batteries get too cold and battery capacity is significantly reduced. A vent that solves this problem is especially important when battery boxes are placed in basements, garages and sheds. When heat rises in the structure, a low pressure area forms around the box, cool air flows into the box and gases vent into the structure. The Power Vent controls battery box venting, removing hydrogen gas while reducing cold air infiltration into the box. The Power Vent contains a gravity-operated damper that normally stays closed. When connected to a voltage-controlled relay, the fan operates only when the batteries are being charged and blows gas vapors out. Designed for battery banks under 2200 Ah and charge rates under 125 amps. Fan can be operated from the auxiliary relay on a Xantrex XW inverter, from the auxiliary relay of an OutBack FX inverter (use 12 volt-fan for all OutBack inverter voltages) or by a voltage controlled switch (sold separately). The 12/24-volt unit uses 3 watts and pushes air at 6 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 7.25" with a 2" PVC pipe socket on the inlet and outlet. The 48-volt unit uses 6 watts and pushes 8 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 10" long, with a 3" PVC pipe socket on the inlet and outlet.

Description	Item code
Power vent 12V	085-08205
Power vent 24V	085-08207
Power vent 48V	085-08209

QuickCote

Anti-Corrosion Protectant

QuickCote offers a complete acid neutralizing coating, formulated especially for battery terminals and exposed electrical connections. The 8-ounce can has a brush-on applicator that will give years of use and cannot clog like aerosol coatings.

Description	Item code
QuickCote	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, corrosion, and keeps the battery tops much cleaner and dryer. Excess water is dropped back into the battery cell. Water loss is reduced, which extends time between watering. These caps fit all batteries with standard bayonet caps.

Description	Item code
Water Miser battery cap	040-09913

Unsurpassed Tech Support and Customer Service

AEE Solar has the in-house expertise to help you do it right. And our personal, friendly, responsive customer service is second to none. Our three decades of solar experience support you at every step! Call us at **800-777-6609.**

Why Have Surge Protection?

Photovoltaic, wind and hydroelectric systems usually have long runs of exposed wire that can pick up surges from lightning, even if the lightning strike is not nearby. These power surges can damage sensitive electronic components in meters, charge controllers and inverters. Surges can also damage telephone, audio and video equipment connected to the power system. It is a good idea to install surge protection on all incoming wires in the system, including incoming PV, wind or hydroelectric power lines, AC generator lines, telephone and antenna leads. Proper grounding is absolutely necessary for lightning protection to be effective. In the event of a direct strike, damage may occur, even with surge protectors installed. Type 1 heavy duty surge protectors are recommended when a direct lightning strike is possible on the installation.

Delta

Lightning Arrestors

Delta lightning arrestors have a maximum current rating of 60,000 amps and 2,000 joules per line. Response time is 25 ns to clamp 50,000 amps. Mounts easily in a 1/2" knockout. All units are waterproof.

Delta model	Description	Item code
LA302DC	Arrestor for up to 300 VDC	**053-04115**
LA602DC	Arrestor for up to 600 VDC	**053-04109**
LA302R	Arrestor for up to 300 VAC	**053-04112**
LA303R	Arrestor for up to 300 VAC 3-Phase	**053-04118**
LA603R	Arrestor for up to 600 VAC 3-Phase	**053-04120**
Mounting bracket for surge arrestors		**053-04138**

MidNite Solar

NEW! Lightning Arrestors

The MidNite Solar Surge Protector (MNSPD) is a Type 2 device. It is 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 three different voltages 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 any electronics in the system. The MidNite Solar SPD voltage rating should be chosen according to the nominal voltage of the system. Response time is 8/20µs to clamp 128,000 amps. There are two LED's in each unit that will indicate when the unit is functioning correctly and there is voltage to it.

Install the 150V DC version for surge protection on wires coming from a 12, 24, or 48v PV array, DC wind generator or DC hydroelectric turbine, the 300VDC unit for DC sources up to 300v, and the 600VDC unit for high-voltage grid-tie PV arrays. Lightning protection can be installed in a combiner box, DC load center or grid-tie inverter. They 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, pumps or outbuildings. Mounts easily in a 1/2" knockout. Material and workmanship warranty for 5 years.

Model	Description	Nominal DC voltage	Nominal AC voltage	Item code
MNSPD115	Surge Protection Device	0-150	N/A	**053-04141**
MNSPD300	Surge Protection Device	0-300	120/240	**053-04143**
MNSPD600	Surge Protection Device	0-600	480	**053-04146**

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.**

Citel

Surge Protection Products

Citel PV surge protectors are DIN mount and are ideal for placement inside combiner boxes.

DS210DC off-grid surge arrestor

The Citel DS210DC series is designed to protect 12V, 24V, 48V and 150V DC power lines for an off-grid PV system. The maximum voltage should not be exceeded in any conditions. Use the next higher rated unit if necessary. The surge protectors protect the charge controller and other system electronics. DS210DC automatically reset after each lightning surge or electrical transient. These surge arrestors clamp at much lower voltage than Delta surge arrestors at left so they offer much better protection for charge controllers and inverters in low-voltage DC systems.

DS50PV grid-tie surge arrestor

The DS50PV is designed to protect the solar array at the solar PV array combiner box for a utility-interactive PV system. The DS50PV is designed to withstand 40kA (8/20us) induced transient surges and is designed with replaceable modules. Use the DS50PV-600 for systems with inverters that have an upper limit of up to 600 volts.

DS60PV grid-tie surge arrestor

DS60PV are Type 1 heavy duty surge protectors, recommended when a direct lightning strike is possible on the installation. They are available in 500- and 1000-VDC operating voltages. The use of Type 1 surge protector is recommended at both ends of the DC power supply line (solar array side and inverter/converter side). The DS60PV is made with a monoblock enclosure and mounts on DIN rail.

Citel model	Maximum volts	Discharge current	Width (mm)	Item code
DS210-12DC	15 VDC	1 kA	0.7 (18)	**053-04201**
DS210-24DC	30 VDC	1 kA	0.7 (18)	**053-04203**
DS210-48DC	56 VDC	1 kA	0.7 (18)	**053-04205**
DS210-75DC	85 VDC	2 kA	0.7 (18)	**053-04206**
DS210-95DC	100 VDC	2 kA	0.7 (18)	**053-04207**
DS210-130DC	150 VDC	2 kA	0.7 (18)	**053-04209**
DS50PVS-600	690 VDC	20 kA	1.4 (36)	**053-04219**
DS60PVS-1000	1000 VDC	40 kA	2.8 (72)	**053-04226**

Lay-in Lugs for Module Grounding

These 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 kep-nut. Pick the type that meets the module manufacturers requirements. . They meet NEC requirements for connecting a continuous ground wire to all modules. Sold in packages of 10. UL Listed.

Description	Item code
Bag of 10 lay-in lugs w/ screws	**051-03414**
Bag of 10 lay-in lugs w/ 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 and comes with a star washer captive on the nut. It takes #6 or #8 solid copper ground wire. Use this grounding lug where corrosion is a consideration. UL listed to UL 467.

Description	Item code
Tyco Grounding Connector	**051-03420**

Wiley Electronics

WEEB Grounding Products

WEEB stands for "washer, electrical equipment bonding." WEEB products are used to bond solar modules to aluminum solar mounting rails. The mounts are then grounded, grounding the entire assembly. This eliminates the need to use a lay-in lug and thread-forming screw on each module and it eliminates the need to run a continuous wire to each module.

This saves time and money and it meets the requirements of UL 467. Wire is only needed to connect a lay-in lug on each module rail to an equipment grounding terminal in the inverter or disconnect. ETL listed to UL standards.

WEEB-9.5

The WEEB-9.5 is used for bonding modules to mounting structures when the modules are directly bolted to the rails using 1/4" bolts through the mounting holes on the rear of the module frames. This type of mounting is typical on DPW ground (page 39) and pole mount systems (pages 40-44) and on Wattsun and Zomeworks trackers (page 47-49). The WEEB-9.5NL is used for bonding strong-back structure and legs to the rail where 3/8" bolts are used. Sold in packs of 10.

WEEB-UMC

WEEB-UMC grounding clips are used between modules and Unirac SolarMount Standard Rails when front mount clips are used to hold the module to the rails. One clip grounds the frame of 2 adjoining modules to one of the mounting rails. Two clips are required for each pair of modules so that the modules will be bonded to both rails. Sold in packs of 10.

WEEB-PMC

WEEB-PMC grounding clips are used between modules and SnapNrack or ProSolar rails when front mount clips are used to hold the module to the rails. One clip grounds the frame of two adjoining modules to one of the mounting rails. Two clips are required for each pair of modules so that the modules will be bonded to both rails. Sold in packs of 10.

WEEB Lug-6.7

The WEEB Lug-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 can be used to connect across a rail splice, or a WEEB bonding jumper can be used.

WEEB Bonding Jumper

WEEB Bonding Jumper is used to electrically bond mounting rails together at a splice. Use one at every splice.

We advise speaking to your building inspector before installing these products to see if they are acceptable in your area.

Wiley part #	Description	Item code
WEEB-9.5	Bonding washer for 1/4" bolted connections - order in multiples of 10	**051-04007**
WEEB-9.5NL	Bonding washer for 3/8" bolted connections - order in multiples of 10	**051-04008**
WEEB-UMC	Clip for use with Unirac SolarMount Standard Rail - order in multiples of 10	**051-04003**
WEEB-DMC	Clip for use with DPW Power Rail – order in multiples of 10	**051-04004**
WEEB-PMC	Clip for use with SnapNrack and ProSolar rails - order in multiples of 10	**051-04001**
WEEB-6.7	Lay-in lug with mounting hardware and WEEB washer	**051-04015**
Bonding Jumper	Splice kit for rails	**051-04019**

Unirac

Grounding Clip 1 (UGC-1)

For use with Unirac SolarMount mount rails. Slot allows the insertion of a T-bolt after the modules are in place. Order one grounding clip for each module plus one more for racks with an odd number of modules. ETL listed to UL standards.

Unirac #	Item code
980000	**051-04055**

MidNite Solar

MNPV Combiners

These powder-coated aluminum, rainproof array combiners will accept DIN-rail mounted 150v circuit breakers, MidNite 300VDC breakers, or 600VDC 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 busbar and ground bar are included. The aluminum NEMA 3R enclosures are approved to be mounted at angles from 90 to 14 degrees (14 degrees = 3/12 slope). ETL Listed to UL 1741 for the U.S. and Canada. Breakers and fuse holders are not included. See page 171 for breakers, fuses and fuse holders.

	PV source circuit options						Output circuits							
	Max 150 VDC with breakers		Max 300 VDC with breakers		Max 600 VDC with fuses			Max continuous output amps						
MidNite model	# of input circuits	Max circuit amps	# of input circuits	Max circuit amps	# of input circuits	Max circuit amps	Max output circuits	150 VDC	300 VDC	600 VDC	Output wire size	MNPV combiner dimensions (inches)	Weight (lbs)	Item code
MNPV3	3	20			2	20	1	60		60	#14-1/0	10.5 x 4.9 x 3.4	2	**053-03017**
MNPV6	6	20			4	20	2	120		80	#14-1/0	12.7 x 7.9 x 3.4	4	**053-03018**
MNPV6-250			3	20					120		#14-1/0	12.7 x 7.9 x 3.4	4	**053-03081**
MNPV12	12	20			10	20	2	200		200	#14-2/0	14.7 x 12.2 x 3.5	6	**053-03015**
MNPV12-250			6	20					168		#14-2/0	14.7 x 12.2 x 3.5	6	**053-03082**
MNPV16					16	20	1			240	#14-250mcm	20.7 x 16.2 x 3.5	12	**053-03016**
MNPV16-24	24	20					1	240			#14-250mcm	20.7 x 16.2 x 3.5	12	**053-03087**
MNPV16-250			12	20			1		240		#14-2/0	20.7 x 16.2 x 3.5	12	**053-03083**

OutBack

FLEXware PV Combiners

The FLEXware PV8 and PV12 accommodate overcurrent protection requirements for off-grid and grid-connected applications. The DIN rail can be fitted with 150VDC circuit breakers for low-voltage PV arrays or 600VDC fuse holders for grid-tie arrays. These combiners replace the PSPV. Rated for NEMA 3R rainproof, the powder-coated aluminum chassis can be mounted on a wall, a sloped roof, or a pole. Dual output lugs allow connection for up to 2/0 AWG wire. An easily removable flame-retardant polycarbonate deadfront panel prevents accidental contact with live terminals. FWPV8 has one circuit and FWPV12 can be configured to have one or two circuits. Negative and ground terminal busbars are included. The two output circuits can be used for fuses in both the negative and positive legs for up to 4 strings into a transformerless inverter. Limited to 15A breakers or fuses. ETL listed to UL STD1741.

OutBack model	# of breakers	# of fuse holders	Dimensions (inches)	Weight (lbs)	Item code
FWPV8	8	6	15.2 x 12.7 x 3.9	4.4	**053-03012**
FWPV12	12	8	15.2 x 9.2 x 3.9	5.9	**053-03014**

SolarBOS

Combiners

SolarBOS 600 VDC combiners are ETL listed to UL 1741 for 600-volt DC PV systems. Designed to minimize costs by giving the system designer max flexibility, SolarBOS uses high quality components to ensure long-term field reliability. Products are assembled in an ETL certified facility in Livermore, CA. Specify the combiner with 4 to 24 input circuits, single or dual 90C output terminals, and NEMA 3, 3R, 4 or 4X steel or fiberglass enclosures. Enclosures are gasketed for protection from the elements. Lots of room for easy wiring. Fuses not included. All combiners listed below have single outputs.

	# of input circuits	# of output circuits	Dimensions (inches)	Item code
NEMA 3R Steel	4	1	16 x 12 x 6	**140-02004**
	6	1	16 x 12 x 6	**140-02006**
	8	1	16 x 12 x 6	**140-02008**
	10	1	16 x 12 x 6	**140-02010**
	12	1	16 x 12 x 6	**140-02012**
	14	1	16 x 16 x 6	**140-02014**
	16	1	16 x 16 x 6	**140-02016**
	18	1	16 x 16 x 6	**140-02018**
	20	1	20 x 20 x 6	**140-02020**
	22	1	20 x 20 x 6	**140-02022**
	24	1	20 x 20 x 6	**140-02024**
NEMA 4 Steel	4	1	16 x 12 x 6	**140-02107**
	6	1	16 x 12 x 6	**140-02108**
	8	1	16 x 12 x 6	**140-02109**
	10	1	16 x 12 x 6	**140-02110**
	12	1	16 x 12 x 6	**140-02112**
	14	1	16 x 16 x 6	**140-02114**
	16	1	16 x 16 x 6	**140-02116**
	18	1	16 x 16 x 6	**140-02118**
	20	1	20 x 20 x 6	**140-02120**
	22	1	20 x 20 x 6	**140-02122**
	24	1	20 x 20 x 6	**140-02124**
NEMA 4X Fiberglass	4	1	16 x 14x 6	**140-04604**
	6	1	16 x 14 x 6	**140-04606**
	8	1	16 x 14 x 6	**140-04608**
	10	1	16 x 14 x 6	**140-04610**
	12	1	16 x 14 x 6	**140-04612**
	14	1	16 x 18 x 6	**140-04614**
	16	1	16 x 18 x 6	**140-04616**
	18	1	20 x 18 x 6	**140-04618**
	20	1	26 x 22 x 10	**140-04620**
	22	1	26 x 22 x 10	**140-04622**
	24	1	26 x 22 x 10	**140-04624**

Disconnect Combiners

SolarBOS now offers disconnect combiners that merge the combiner box and the disconnect switch into one product with integrated load-break 600 VDC disconnects. This helps further reduce costs where a rooftop disconnect is required. Available with 55, 100, 150, 200, and 245 amp disconnects. Combiners are ETL listed to UL 1741 for 600 volt DC photovoltaic systems. Contains one output circuit; NEMA 4 steel enclosures. Fuses not included.

Input Circuits	Disconnect amps	Dimensions (in)	Item code
4	55	16x12x6	**140-05041**
6	55	16x12x6	**140-05061**
6	100	16x12x6	**140-05064**
6	150	20x20x6	**140-05063**
8	100	20x20x6	**140-05085**
8	150	20x20x6	**140-05083**
8	200	20x20x6	**140-05086**
8	245	24x24x6	**140-05084**
10	100	20x20x6	**140-05105**
10	150	20x20x6	**140-05103**
10	200	20x20x6	**140-05106**
10	245	24x24x6	**140-05104**
12	100	20x20x6	**140-05125**
12	150	20x20x6	**140-05123**
12	200	20x20x6	**140-05126**
12	245	24x24x6	**140-05124**
16	100	20x20x6	**140-05166**
16	150	20x20x6	**140-05163**
16	200	20x20x6	**140-05165**
16	245	24x24x6	**140-05164**
20	150	24x24x6	**140-05203**
20	200	24x24x6	**140-05205**
20	245	24x24x6	**140-05204**
24	150	24x24x6	**140-05243**
24	200	24x24x6	**140-05241**
24	245	24x24x6	**140-05244**

Advanced Energy

NEW! IntelliString Smart Combiner Box

Advanced Energy's IntelliString line of string combiners have touch-safe fuse holders, solid busbar and bridge punched back panels to help this smart string combiner box install quickly and last the life of the PV system. String current monitoring is enabled by the integrated DC Solar Current Monitor from Obvius, selected for its robust and easy to use design, modbus output, and built-in user adjustable alarming functions which simplify data collection and reporting. String-level performance data is a valuable tool for PV system owners because it enables fast diagnosis of PV system underperformance due to failed modules, shading or soiling. Monitoring at the string level has been primarily used on large expensive systems due to the high cost. Now, the IntelliString line of smart string combiner boxes offers a solution that is practical and affordable enough to use on most commercial installations. Useable with any third-party monitoring system that uses RS-485 communications. NEMA 4X fiberglass lockable boxes. 20A max fuse size. The 8-string model has single 350mcm output lugs, and the 16 has dual 350mcm lugs. ETL Listed to UL 1741.

Model	Description	Weight (lbs)	Item code
IntelliString 8	Array combiner - 8-string 160 A with Modbus over RS-485 NEMA 4x fiberglass, 24" x 20" x 8"	27	**053-02750**
IntelliString 16	Array combiner - 16-string 320 A with Modbus over RS-485 NEMA 4x fiberglass, 24" x 24" x 8"	48	**053-02751**

Insulated Cable Connector Blocks

This insulated connector is molded for precise fit and supplied with removable access plugs over the hex screws. Available with 2- to 4-wire entry ports on one side for 4 to 14 AWG wire. This can be used to transition from Multi-Contact cables to conduit wiring on roof to PV arrays or for any parallel wiring connection. UL Listed for 600 volts.

Number of poles	Wire range AWG	Item code
2	4 -14	**054-01142**
3	4 - 14	**054-01143**
4	4 - 14	**054-01144**

Waterproof Strain Reliefs

Use the 1/2" NPT threaded connectors to provide a waterproof entrance or exit for wiring on PV module junction boxes and outdoor combiner boxes. Use the 3/4" NPT connector for cables up to 5/8" dia. Made of Nylon with Buna-N seals. Resistant to salt water, weak acids, weak alkalis, alcohol, ether, esters, ketones, and mineral, animal and vegetable oils. Non-corrosive, suitable for direct burial installations. The oval-hole 1/2" strain relief works for 2-conductor TC cable used for module interconnects, PV outputs or UF cable. The 2-hole 1/2" connector is designed for use with two #10 or #12 type USE conductors. UL Listed. Suitable for use in NEMA 4, 6 and 12 applications.

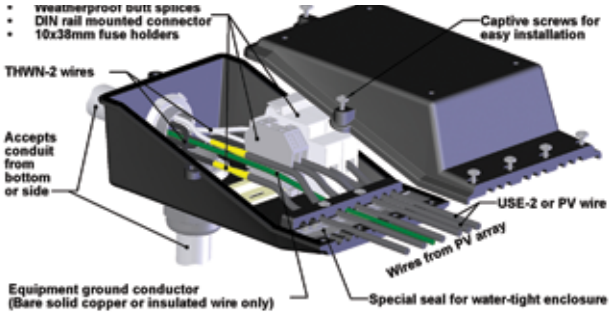
Strain relief description	Fits cable size	Item code
1/2" thread w/ 1 round hole	USE #12 & #10	**054-03243**
1/2" thread w/ 2 round holes	USE #12 & #10	**054-03252**
1/2" thread w/ 1 round hole	0.25" to 0.5" dia. wire	**054-03241**
1/2" thread w/ 1 oval hole	14/2,12/2,10/2 TC	**054-03257**
3/4" thread w/ 1 round hole	0.4" to 0.7" dia. cable	**054-03246**
Steel lock nut 1/2"		**054-03238**
Steel lock nut 3/4"		**054-03244**

Wiley Electronics

Acme Conduit Entry

This transition box to go from MC cables to conduit is made from corrosion resistant anodized aluminum. It accepts conduit from the bottom or side and has a seal for entry of USE-2 or PV wire. The optional mounting bracket makes it easy to mount on any module mounting structure. ACE -PT is for pass-through and has no terminals or DIN rail. ACE-xP have two terminal blocks for each string. The ACE-2C combines two strings into one + and - out without fuses. The Ace-3C and -4C have 3 and 4 fuse holders respectively. Fuses are not included.

Model	Description	Item code
ACE-PT	Pass through - MC cables to conduit	**053-00305**
ACE-1P	Pass through - MC cables to conduit - 1 string	**053-00308**
ACE-2P	Pass through - MC cables to conduit - 2 string	**053-00309**
ACE-3P	Pass through - MC cables to conduit - 3 string	**053-00310**
ACE-4P	Pass through - MC cables to conduit - 4 string	**053-00311**
ACE-2C	Combiner - MC cables to conduit - 2 string	**053-00312**
ACE-3C	Combiner - MC cables to conduit - 3 string	**053-00313**
ACE-3C-1	Combiner - MC cables to conduit - 3 string w/o ground	**053-00315**
ACE-4C	Combiner - MC cables to conduit - 4 string	**053-00314**
ACE-4C-1	Combiner - MC cables to conduit - 4 string w/o ground	**053-00316**



SolaDeck

PV Roof-Mount Enclosure/Combiner

This NEMA 3R enclosure is made from 18 gauge galvanized steel with a powder coated finish provides a professional look. It has a dual ground lug, a 6 inch (150mm) universal DIN rail to mount fuse holders or terminal blocks. There are three roof deck knockouts 1/2", 3/4" and 1", and dimples to center a punch or drill for entry conduit or fittings. It has built-in flashing to seal to roof. It is only 2.5" deep and can fit under the array. To make pass-through connections inside the SolaDeck use one or more 2-String Pass-Thru Kits. This kit has 4 DIN mount terminals that can be used with AWG 6-16 wire, and hardware to hold them in place. Each terminal is 10mm wide.

For combining circuits use up to four DIN mount fuse holders, each 18mm wide, a positive and negative busbar and a 2-string pass thru kit to combine up to 4 module strings. Or use the two position positive and negative busbars for combining two strings, with or without fuses. Fuses are not included so order the appropriate fuses. It is ETL listed to UL STD1741 for photovoltaic combiner enclosures.

Model	Description	Item code
SD-786-41	SolaDeck enclosure combiner	**053-00226**
PASS-THRU	2-string pass-thru terminal kit	**053-00231**
SD-784BB	Positive busbar for 4 fuse holders	**053-00227**
SD-784FBB 2	Positive busbar for 2 fuse holders	**053-00229**
SD-785BB	Negative busbar for 4 terminals	**053-00228**
SD-785TBB 2	Negative busbar for 2 terminals	**053-00230**
Fuse Holder	Fuse holder for DIN mount 600v	**053-00240**

Pass-Thru Wiring Box

These ETL listed Pass-Thru Wiring Box are intended to provided a robust, secure, and code compliant method of transferring the Multi-Contact USE-2 type conductor coming from the PV array to THHN/THWN-2 type conductor. The PTWB also provides a convenient location to begin the necessary conduit run from the PV array to the power conditioning equipment. The NEMA 4 enclosure dimensions are 8" x 6" x 4". It has two cord grips for array wire entry and a hole on the opposite side for a 1/2" conduit fitting. There are two terminal blocks for positive and negative conductors and one for ground. It is designed to be mounted directly on the side of the module mounting rail.

Description	Item code
Pass Thru Wiring Box	**053-00271**

DIN Rail Mount Fuses and Fuse Holders

Fuse holder and fuses below and breakers at right fit MidNite MNPV and OutBack FlexPV and other combiners. Use the fuses and fuse holder below for 600VDC array combiners. Fuses are KLKD for 600 VDC.

Amps	Description	Item code
USM1 Fuse Holder - 600V 30A Max - DIN mount		**053-03040**
1	1-amp 600 VDC KLKD fuse	**053-03155**
2	2-amp 600 VDC KLKD fuse	**053-03052**
4	4-amp 600 VDC KLKD fuse	**053-03051**
6	6-amp 600 VDC KLKD fuse	**053-03050**
8	8-amp 600 VDC KLKD fuse	**053-03048**
10	10-amp 600 VDC KLKD fuse	**053-03046**
12	12-amp 600 VDC KLKD fuse	**053-03044**
15	15-amp 600 VDC KLKD fuse	**053-03043**
20	20-amp 600 VDC KLKD fuse	**053-03042**
30	30-amp 600 VDC KLKD fuse	**053-03041**

DIN Rail Mount Combiner Breakers

These breakers fit MidNite MNPV and OutBack combiners. Use breakers for arrays with maximum voltage of 150 or less. Use 300 VDC breakers for 200 - 250 VDC charge controllers.

Amps	OutBack number	MidNite Solar #	Item code
1	OBB-1-150VDC-DIN	MNEPV1	**053-03033**
2	OBB-2-150VDC-DIN	MNEPV2	**053-03034**
3	OBB-3-150VDC-DIN	MNEPV3	**053-03024**
4	OBB-4-150VDC-DIN	MNEPV4	**053-03020**
5	OBB-5-150VDC-DIN	MNEPV5	**053-03025**
6	OBB-6-150VDC-DIN	MNEPV6	**053-03021**
8	OBB-8-150VDC-DIN	MNEPV8	**053-03022**
9	OBB-9-150VDC-DIN	MNEPV9	**053-03023**
10	OBB-10-150VDC-DIN	MNEPV10	**053-03026**
12	OBB-12-150VDC-DIN	MNEPV12	**053-03027**
15	OBB-15-150VDC-DIN	MNEPV15	**053-03029**
20	OBB-20-150VDC-DIN	MNEPV20	**053-03030**
30	OBB-30-150VDC-DIN	MNEPV30	**053-03032**
50	OBB-50-150VDC-DIN	MNEPV50	**053-03035**
60	OBB-60-150VDC-DIN	MNEPV60	**053-03037**
63	OBB-63-150VDC-DIN	MNEPV63	**053-03038**

1" Wide DIN Rail Mounted 300 VDC Circuit Breakes			
Amps	**Voltage**	**MidNite Solar #**	**Item code**
7	300 VDC	MNEPV7-300	**053-03107**
10	300 VDC	MNEPV10-300	**053-03110**
12	300 VDC	MNEPV12-300	**053-03112**
15	300 VDC	MNEPV15-300	**053-03115**
20	300 VDC	MNEPV20-300	**053-03120**
30	300 VDC	MNEPV30-300	**053-03125**
50	300 VDC	MNEPV50-300	**053-03130**

Square-D

240V and 600V NEMA 3R Safety Switch Disconnects

The NEC, sect. 690.15, requires that PV arrays have a means for disconnecting and isolating the inverter from the PV power source. Grid-tie inverters with arrays of voltages above 250VDC need a disconnect rated for 600VDC. These can be used with inverters that do not include a DC disconnect. Square-D 600VDC 30, 60, and 100 amp 3-pole safety switches are rated by the factory to handle one 600VDC circuit per pole. The 30A switch is rated for 16A Isc for non-fused and 12.8A Isc for fused. The 60A switch is rated for 48A Isc for non-fused and 38A Isc for fused. The 100A switch is rated for 80A Isc for non-fused and 64A Isc for fused. Disconnects up to 3 PV arrays for 3 grid-tie inverters. The larger Square-D 600VDC disconnects are rated for disconnecting one circuit at full rated power using 2 poles in series.

Many utilities require an AC disconnect between a grid-tie inverter and the AC load center, close to the AC service entrance, with a visible and lockable handle. A 30A 240V disconnect is good for up to 5kW at 240 VAC and the 60A disconnect for up to 11kW. For multiple inverters, use an AC load center with a circuit breaker acting as an AC combiner box between each inverter and the disconnect switch. Back feed the breakers with the inverter outputs, and the load center main lugs will handle the combined outputs to the AC disconnect.

Use Class R fuses of the proper voltage and amperage for fused disconnects. 600V fuses will not fit into 240V disconnects, and 250VAC/125VDC fuses will not fit into 600V disconnects. See next page for Class R fuses.

Amps	AC /DC	Fused	Poles	Neutral kit	Ground kit	Dimensions (in) H x W x D	Weight (lbs)	Square-D model	Item code
600-volt AC or DC 3-Pole NEMA 3R heavy duty switches									
30	Yes	No	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.3	HU361RB	**053-02312**
30	Yes	Yes	3*	SN03	GTK03	14.88 x 6.63 x 4.88	9.8	H361RB	**053-02313**
60	Yes	No	3*	SN0610	GTK0610	17.50 x 9 x 6.38	16	HU362RB	**053-02339**
60	Yes	Yes	3*	SN0610	GTK0610	17.50 x 9 x 6.38	16	H362RB	**053-02341**
100	Yes	No	3*	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	HU363RB	**053-02357**
100	Yes	Yes	3*	SN0610	GTK0610	21.25 x 8.50 x 6.38	24	H363RB	**053-02355**
200	Yes	No	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50	44	HU364RB	**053-02364**
200	Yes	Yes	3**	SN20A	PKOGTA2	29.25 x 17.25 x 8.50		H364NRB	**053-02366**
400	Yes	Yes	3**	Included	PKOGTA2	50.31 x 27.88 x 10.13		H365NR	**053-02407**
800	Yes	Yes	3**	Included	PKOGTA7	69.13 x 36.62 x 17.75		H367NR	**053-02408**
1200	Yes	Yes	3**	Included	PKOGTA8	69.13 x 36.62 x 17.75		H368NR	**053-02409**
* Uses 2 poles in series for 600VDC, except as a PV disconnect, where all 3 poles may be used for 600VDC . ** Uses 2 poles (and 2 fuses) in series for 600VDC.									
240-volt AC / 125-volt DC* NEMA 3R heavy duty switches**									
30	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	H321NRB	**053-02315**
60	Yes	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	10	H322NRB	**053-02336**
100	Yes	Yes	3	included	GTK0610	21.25 x 8.50 x 6.38	19	H323NRB	**053-02351**
200	Yes	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.50	43	H324NRB	**053-02363**
*** Switches are rated for 250VDC but available fuses are only rated for 125VDC.									
240-olt AC Only NEMA 3R general duty switches									
30	AC only	No	2	N/A	PK3GTA1	9.63 x 7.25 x 3.75	4.4	DU221RB	**053-02318**
30	AC only	Yes	2	included	PK3GTA1	9.63 x 7.25 x 3.75	4.5	D221NRB	**053-02326**
30	AC only	No	3	N/A	PK3GTA1	9.63 x 7.25 x 3.75	4.7	DU321RB	**053-02319**
30	AC only	Yes	3	included	PK3GTA1	9.63 x 7.25 x 3.75	5.1	D321NRB	**053-02329**
60	AC only	Yes	2	included	GTK03	14.88 x 6.63 x 4.88	9.7	D222NRB	**053-02334**
60	AC only	No	3	N/A	PK3GTA1	9.63 x 7.25 x 3.75	5	DU322RB	**053-02342**
60	AC only	Yes	3	included	GTK03	14.88 x 6.63 x 4.88	9.8	D322NRB	**053-02343**
100	AC only	Yes	2	included	GTK0610	17.50 x 8.50 x 6.50	16	D223NRB	**053-02358**
100	AC only	No	3	SN0610	GTK0610	17.50 x 8.50 x 6.50	15	DU323RB	**053-02359**
100	AC only	Yes	3	included	GTK0610	17.50 x 8.50 x 6.50	16	D323NRB	**053-02361**
200	AC only	Yes	2	included	PKOGTA2	29.25 x 17.25 x 8.25	29	D224NRB	**053-02371**
200	AC only	Yes	3	included	PKOGTA2	29.25 x 17.25 x 8.25	30	D324NRB	**053-02372**

Square-D Disconnect Accessories

Use the hubs listed in the ordering table at the below to connect conduit or a kWh meter socket to the top of the disconnect. Disconnects are raintight (NEMA 3R) for outdoor use. Order a neutral busbar and ground busbar if you need to land these conductors in the disconnect switch box. See table on the previous page to determine which neutral and ground to use.

Neutral and ground accessories	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**
Conduit hubs	**Item code**
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**

Class R Fuses

These Class R fuses can be used in AC circuits up to 250V or DC circuits up to 125V. They have the high amp interrupting capacity (AIC) required for fusing circuits powered by batteries and for protecting Square-D brand circuit breakers. They can be used to protect wiring to small inverters (100-700 watts) and wiring from charging sources. Use these fuses in fused safety disconnect switches. UL Listed.

Amps	250VAC/125VDC Item code	600VAC/VDC Item code
10	**053-02441**	**053-02442**
15	**053-02444**	**053-02447**
20	**053-02450**	**053-02453**
30	**053-02456**	**053-02459**
40	**053-02462**	**053-02463**
50	**053-02465**	**053-02466**
60	**053-02468**	**053-02471**
70	**053-02469**	**053-02470**
80	**053-02475**	**053-02472**
90	**053-02476**	**053-02473**
100	**053-02474**	**053-02477**
125	**053-02478**	**053-02481**
150	**053-02479**	**053-02482**
200	**053-02480**	**053-02483**




Class R Fuse Blocks

Use these fuse blocks with the Class R 250-volt fuses. Bare wire ends fit into the screw terminals on each end of the fuse block. The small fuse block holds 10-30A fuses and accepts up to #2 wire. The medium size block holds 40-60A fuses and accepts up to #2 wire also. The large size block holds a 100A fuse and accepts up to #1/0 wire. Small and medium size blocks are available in one-pole and two-pole versions.

Description	Item code
Class R fuse block 0.1-30A, 1-pole	**053-02423**
Class R fuse block 0.1-30A, 2-pole	**053-02426**
Class R fuse block 31-60A, 1-pole	**053-02429**
Class R fuse block 31-60A, 2-pole	**053-02432**
Class R fuse block 61-100A, 1-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-amp interrupting capacity (AIC) required to protect Square-D brand circuit breakers in DC load centers. They are UL Listed for up to 160VDC and NEC approved for inverter use. A fuse comes installed in the block. Order spare fuses separately.

Xantrex model	Description	Item code
TFB200	200A fuse and holder w/studs	**053-02526**
TFB300	300A fuse and holder w/studs	**053-02544**
TFB400	400A fuse and holder w/studs	**053-02559**

Class T Fuses - JJN Series

These Class T fuses are rated for These Class T fuses are rated for 160 VDC and 300 VAC as protection for circuit breakers, load centers and inverters where high available short circuit currents are possible. These fuses fit the fuse blocks described above and the inline holder shown here.

Model	Description	Item code
TF110	110A replacement fuse	**053-02509**
TF200	200A replacement fuse	**053-02520**
TF300	300A replacement fuse	**053-02538**
TF400	400A replacement fuse	**053-02556**

Square-D

QO Load Centers

Square-D brand load centers can be used for multiple purposes, for wiring that meets the National Electric Code (NEC). All of these can be used as AC load centers or subpanels. Panels using QO plug in breakers are rated up to 50 VDC for use as 12V or 24V DC load centers. They can also be used to combine the AC output from multiple inverters feeding the grid. When used as DC load centers they should be protected by a high interrupt capacity fuse or circuit breaker between the load center and the battery. Use one of the Class T or Class R fuses, or the DC breakers used in the OutBack and Xantrex DC power centers.

When used to combine the AC output of multiple grid-tie inverters, and meet the requirements of NEC 690.64(B)(2) the bus amp rating for the load center must be larger than the sum of all of the overcurrent devices feeding it, from both the utility and all inverters.

Load centers are not supplied with any breakers – order conduit hubs for outdoor load centers, and breakers, separately.

Spaces (single)	Bus amp rating	Outdoor	Cover	Max wire in main lug	Ground kit for this unit	Dimensions (inches) H" x W" x D"	Weight (lbs)	Square-D model	Item code
120/240-volt AC Single-Phase Main Lug Load Centers									
2	70	yes	incl.	# 4	PK4GTA	9.38 x 4.88 x 4	5.0	QO24L70RB	**053-02141**
2	70	no	incl.	# 4	PK4GTA	9.30 x 4.81 x 3.19	3.8	QO24L70S	**053-02144**
6	100	yes	incl.	# 1	PK7GTA	12.62 x 8.88 x 4.27	9.7	QO612L100RB	**053-02147**
6	100	no	incl.	# 1	PK7GTA	12.57 x 8.88 x 3.8	8.3	QO612L100DS	**053-02153**
12	125	yes	incl.	# 2/0	incl.	19 x 14.25 x 4.5	23	QO112L125GRB	**053-02163**
12	125	no	add	# 2/0	incl.	18 x 14.25 x 3.75	15	QO112L125G	**053-02162**
12	200	yes	incl.	250 kcmil	incl.	26.25 x 14.25 x 4.5	27	QO112L200GRB	**053-02165**
12	200	no	add	250 kcmil	PK15GTA	29.86 X 14.25 X 3.75	18	QO112L200G	**053-02164**

Uses QO plug-in breakers

120/208-volt AC Three-Phase Main Lug Load Centers									
12	125	yes	incl.	# 2/0	incl.	19 x 14.25 x 4.52	22	QO312L125GRB	**053-02181**
12	125	no	add	# 2/0	incl.	19 x 14.25 x 3.75	11	QO312L125G	**053-02183**
18	200	yes	incl.	250 kcmil	incl.	30 x 14.25 x 4.52	31	QO318L200GRB	**053-02185**
18	200	no	add	250 kcmil	incl.	30 x 14.25 x 3.75	17	QO318L200G	**053-02187**

Uses QO plug-in breakers

Square-D Load Center Covers and Ground Bus Bars for QO Load Centers			
Description	**Weight**	**Square-D model**	**Item code**
Surface cover for 12-space 125A load centers 053-02162 & 053-02183	6.0	GOC16US	**053-02159**
Flush cover for 12-space 125A load centers 053-02162 & 053-02183	7.0	GOC16UF	**053-02156**
Surface cover for all 200A load centers 053-02164 & 053-02187	9.2	GOC30US	**053-02169**
Flush cover for all 200A load centers 053-02164 & 053-02187	11.0	GOC30UF	**053-02170**
Ground Bus Bar for 2-Space Load Centers		PK4GTA	**053-02390**
Ground Bus Bar for 6-Space Load Centers		PK7GTA	**053-02391**
Ground Bus Bar for 12-Space Load Centers		PK9GTA	**053-02392**
Ground Bus Bar for 12-Space 200A Load Centers		PK15GTA	**053-02393**
Ground Bus Bar for 30-Space Load Centers		PK18GTA	**053-02394**

QO Circuit Breakers

QO circuit breakers snap into QO load centers. They are UL Listed for DC branch circuits up to 48VDC (not for use in 48V systems). They can also be used for 120VAC (1-pole) or 120/240VAC (2-pole) circuits. Circuit breakers in 10A to 30A sizes can handle one or two #14 to #10 wires or one #8 wire. Circuit breakers 40A to 70A will handle #8 to #2 wire sizes.

	QO breakers	
Description	Part #	Item code
10-amp 1 pole	QO110	**053-02063**
15-amp 1 pole	QO115	**053-02065**
20-amp 1 pole	QO120	**053-02071**
30-amp 1 pole	QO130	**053-02075**
40-amp 1 pole	QO140	**053-02080**
50-amp 1 pole	QO150	**053-02083**
60-amp 1 pole	QO160	**053-02086**
70-amp 1 pole	QO170	**053-02090**
15-amp 2 pole	QO215	**053-02067**
20-amp 2 pole	QO220	**053-02073**
25-amp 2 pole	QO225	**053-02076**
30-amp 2 pole	QO230	**053-02077**
40-amp 2 pole	QO240	**053-02081**
50-amp 2 pole	QO250	**053-02084**
60-amp 2 pole	QO260	**053-02088**

Barrel Connectors

These UL Listed connectors are tin-plated high strength aluminum alloy. They can be used with copper or aluminum wire. Set screw holds wire in terminal. Single-and double-barrel connectors. These are not approved for use with very fine stranded wire.

Type	Wire size (AWG)	Hole size	Item code
Single	14 to 2	1/4"	**051-03319**
Single	14 to 2/0	1/4"	**051-03327**
Double	14 to 2/0	1/4"	**051-03324**
Single	6 to 4/0	3/8"	**051-03334**
Double	6 to 4/0	3/8"	**051-03330**

Square D QOU Circuit Breakers

QOU circuit breakers are designed for surface or DIN rail mounting. They are UL Listed for DC branch circuits up to 48VDC (not for use in 48V systems). They can also be used for 120VAC (1-pole) or 120/240VAC (2-pole) circuits. Circuit breakers in 10A to 30A sizes can handle one or two #14 to #10 wires or one #8 wire. Circuit breakers 40A to 70A will handle #8 to #2 wire sizes.

Description	Part #	Item code
10-amp 1 pole	QOU110	**053-02006**
15-amp 1 pole	QOU115	**053-02009**
20-amp 1 pole	QOU120	**053-02015**
30-amp 1 pole	QOU130	**053-02024**
40-amp 1 pole	QOU140	**053-02030**
50-amp 1 pole	QOU150	**053-02036**
60-amp 1 pole	QOU160	**053-02042**
70-amp 1 pole	QOU170	**053-02048**
15-amp 2 pole	QOU215	**053-02012**
20-amp 2 pole	QOU220	**053-02018**
25-amp 2 pole	QOU225	**053-02021**
30-amp 2 pole	QOU230	**053-02027**
40-amp 2 pole	QOU240	**053-02033**
50-amp 2 pole	QOU250	**053-02039**
60-amp 2 pole	QOU260	**053-02045**

Safety Labels for PV Installations

These labels are manufactured using ultraviolet (UV) resistant ink, permanent acrylic adhesive and base material designed to withstand environmental elements. A laminate is added to further add protection against prolonged UV exposure. They are recommended for use in identification of DC disconnects and inverters. For use on both painted smooth metal and textured metal surfaces. All labels are 4.12" wide. Labels are sold in packs of 10 labels.

Label description	Item code
DC Disconnect warning 2-piece label - 10 pack	**053-00013**
Solar Disconnect warning 2-piece label - 10 pack	**053-00015**
Warning - Dual Power Sources - 10 pack	**053-00017**
Warning - Electric Shock Hazard - 10 pack	**053-00019**

MidNite Solar

Manual Transfer Switch

120/240 VAC manual transfer switches have a neutral busbar and ground box lug terminal. Dimensions are 9 x 5 x 4 inches. Can be used with up to 6AWG wire. These can be used to connect utility power and a generator to inverters with one AC input.

Description	Weight (lbs)	Item code
30 amp, 240 VAC transfer switch	4	**053-07851**
60 amp, 240 VAC transfer switch	4	**053-07853**

Inverter Bypass Switch

Wired between any 120VAC inverter/charger, generator and load center, this unit allows you to bypass the inverter in the event of an inverter failure. After the bypass switch is thrown, the generator is connected directly to the load center. The inverter can than be removed for repair. This is designed for inverters with built-in transfer switches. Maximum current is 60 amps. Dimensions: 13.5" x 6.25" x 3.5"

Description	Weight (lbs)	Item code
Inverter bypass switch	7	**053-07819**

Power Distribution Blocks

Use these blocks to split primary power into secondary circuits, or join cables from a solar array to a power lead-in cable. Install cables and tighten set screws. Terminal blocks are made of zinc-plated aluminum for use with aluminum or copper conductors. 2 poles. Primary side accepts one large cable; secondary side accepts 6 smaller cables. UL Recognized for up to 600 volts.

Primary		Secondary		Amp rating	Item code
Wire size	Taps	Wire size	Taps		
2/0 - 8	1	#14 to #6	6	175	**054-01024**
6/0 - 6	1	#14 to #4	6	350	**054-01027**
500mcm - 4	1	2/0 - 14	4	380	**054-01025**
350mcm - 8	1	4 - 14	12	310	**054-01023**

Splicer Blocks

Use these blocks to splice wires of up to #2/0 gauge. They are UL Recognized and CSA certified for up to 600 volts. The terminal blocks are made of zinc-plated aluminum, for use with aluminum or copper conductors. 2 pole and 3-pole blocks. One connection on each side.

Wire size (AWG)	Poles	Amp rating	Item code
#8 to 2/0	2	175	**054-01030**
#8 to 2/0	3	175	**054-01033**

Why Use Larger Cable?

Low-voltage power systems with inverters can have very high current flows in the cables that connect the inverter to the batteries. Large AC loads like microwave ovens, toasters, irons and washers can cause an inverter operating on a 12-volt battery to draw over 100 amps. Large motors may draw 300 to 500 amps at startup. Using cables that are too small between batteries, and from batteries to the inverter, will limit the current available to the inverter and may prevent a large load from operating properly.

Plated Copper Lugs

These UL- listed lugs are made from tin-plated copper tubing with 3/8" holes. Solder or crimp to stranded cable.

Description	Item code
Copper lug 3/8" ring #6	051-03240
Copper lug 3/8" ring #4	051-03237
Copper lug 3/8" ring #2	051-03234
Copper lug 3/8" ring #2/0	051-03231
Copper lug 3/8" ring #4/0	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.

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 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 1" x 6" black	3/8"	051-01137-B
Heat shrink tubing 1" x 6" red	3/8"	051-01137-R

UL Listed Battery Cable

This fine-stranded, very flexible cable is UL Listed for use as battery cable. It is rated MTW or THW or AWM, 600-volt, sunlight resistant, direct burial, 105 degrees C. Available with red or black insulation.

Description	Item code
X-Flex battery cable 4/0 black	050-01470
X-Flex battery cable 4/0 red	050-01472
X-Flex battery cable 2/0 black	050-01476
X-Flex battery cable 2/0 red	050-01478
X-Flex battery cable 2 AWG black	050-01487
X-Flex battery cable 2 AWG red	050-01488

Battery Cables

Use these cables between a battery bank and an inverter, fuse or power center. They have flexible stranded UL Listed copper wire and 3/8" diameter lugs. Lug barrels are covered with glue-filled heat-shrink tubing. Cables are marked in red heat-shrink tubing for positive and white heat-shrink on black wire for negative.

Cable AWG	Length (ft.)	Cable color	End color	Item code
Cables with 2 Lugs				
4/0	5	Red	Red	052-04005-R
	5	Black	Black	052-04005-B
	5	Black	White	052-04005-W
	10	Red	Red	052-04010-R
	10	Black	Black	052-04010-B
	10	Black	White	052-04010-W
2/0	5	Red	Red	052-02005-R
	5	Black	Black	052-02005-B
	5	Black	White	052-02005-W
	10	Red	Red	052-02010-R
	10	Black	Black	052-02010-B
	10	Black	White	052-02010-W
2	3	Red	Red	052-01003-R
	3	Black	Black	052-01003-W
	3	Black	White	052-01003-W
	5	Red	Red	052-01005-R
	5	Black	Black	052-01005-W
	5	Black	White	052-01005-W

Battery Interconnects

Use these cables between individual battery cells or between battery banks. Circuits protected by 250-amp breakers or 400-amp fuses should use 4/0 cables. Use 2/0 cables for 175-amp breakers and 200-amp fuses. Use #2 cables for 110-amp or smaller fuses or breakers. Cables with 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, replace "-C" with "-R" for red, "-B" for black, "-W" for white or "-BR" for one end red and one end black.

Wire size (AWG)	Length of cable	Item code
2/0	9"	052-05122-C
2/0	12"	052-05121-C
2/0	20"	052-05124-C
4/0	12"	052-05142-C
4/0	20"	052-05145-C

PV Wire Sunlight Resistant Cable

This single conductor wire is double insulated with heat and moisture resistant, cross-linked polyethylene insulation, and thermoplastic jacket (Type PV wire, USE-2, RHH, RHW, RHW-2). Rated for direct burial or in conduit and is sunlight resistant flame retardant, and rated for temperatures from -40 to 90C. It meets the 2008 NEC code for use with transformerless inverters. Listed as Type PV Wire, USE-2 600V per UL 854.

USE by the foot	Item code
#10 AWG, PV wire, USE-2, 600V, double insulated, black - 500ft roll	050-01147

Tray Cable (TC)

This 2-conductor flexible wire is excellent for outdoor applications like PV array lead-in and subarray wiring. It may be buried directly in the ground or exposed to direct sunlight. 10- and 12-gauge are good for array interconnects. UL Listed, stranded type THHN/THWN conductors. Conductor insulation is red and black.

Description	Item code
8 AWG 2-conductor TC cable - 100ft	050-01157
10 AWG 2-conductor TC cable - 100ft	050-01163
12 AWG 2-conductor TC cable - 100ft	050-01175
16 AWG 2-conductor TC cable - 100ft	050-01178
18 AWG 2-conductor TC cable - 100ft	050-01181

Pump Cable

10/2 without ground pump cable is for the SHURflo 9300 submersible pump. 2-conductor with ground pump cable is required for Grundfos SQFlex and SQ AC pumps.

Sensor Wire

This 3-conductor, 22-gauge direct-burial wire can be used between water level sensors and pump controls in pumping applications where you must sense the water level in a remote tank or in a well.

Description	Item code
10/2 without ground	050-01637
12/2 with ground	050-01635
10/2 with ground	050-01638
8/2 with ground	050-01643
Sensor wire 22/3	050-01273
Splice kit	075-00130

Array Cables and Connectors

Module manufacturers supply their grid-tie modules with pre-assembled cables, listed to UL with the module and ready for connection. This saves considerable time during an installation and greatly increases reliability over wiring with the old style junction boxes. These cable connectors are fully waterproof when connected, touch-protected and designed for up to 600 volts and 30 amps. They are not approved for disconnection under load.

For the past few years, modules have mostly come with Multi-Contact MC3 or MC4 connectors. Recently PV manufacturers began using different makes of locking connectors on their modules to meet supply demands. We sell cable assemblies with the most commonly used connectors. All of our array output cables are now made with PV Wire rated wire which meets the 2008 NEC code requirements for use with transformerless inverters. This single conductor wire is double insulated with heat and moisture resistant, cross-linked polyethylene insulation, and thermoplastic jacket (Type PV wire, USE-2, RHH, RHW, RHW-2). Rated for direct burial or in conduit and is sunlight resistant flame retardant, and rated for temperatures from -40 to 90C. Listed as Type PV Wire, USE-2 600V per UL 854.

We also carry a variety of cable adapters from one type of connector to another for those times when a device uses a different connector than the module.

For those who want to assemble their own cables, we stock many styles of connectors for use with #10 AWG PV Wire USE-2 stranded wire. Proper crimping to the wire and insulator assembly requires special tools. We stock the tools required for shop or on-site assembly of cables (see page 188).

MC4 (Solarline 2) PV-Wire Array Cables

These cables have the newer, snap-together Multi-Contact hard plastic connectors on each end. Use these output cables with many modules brands between module wires and 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 double insulated black #10 AWG, PV WIRE, USE-2 sunlight-resistant cable. Use the locking sleeve where a tool is required to disconnect.

Cable length (ft)	Item code
6	052-09451
15	052-09453
30	052-09455
50	052-09457
100	052-09458
Locking sleeve 25 pck	097-01419

Amphenol Helios 4 PV-Wire Array Cables

These cables have the Amphenol Helios 4 connectors on each end. These connectors are rated as compatible with MC4 connections. 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. Made with double insulated black #10 AWG, PV WIRE, USE-2 sunlight-resistant cable. The male connector has a built-in locking sleeve. The unlocking tool is needed to disconnect these.

Cable length (ft)	Item code
6	052-09720
15	052-09722
30	052-09724
50	052-09725
100	052-09727
Unlocking tool	094-00010

Radox PV Wire Array Cables

These cables have the Huber+Suhner Radox twist-lock connectors on each end. Use these output cables with REC modules between module wires and 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. Made with double insulated black #10 AWG, PV WIRE, USE-2 sunlight- resistant cable. Use the locking sleeve where a tool is required to disconnect.

Cable length (ft)	Item code
6	052-09807
15	052-09807
30	052-09815
50	052-09816
70	052-09817
100	052-09818
Locking sleeve	099-01254

Tyco SolarLok PV Wire Array Cables

These cables have Tyco SolarLok connectors to match the connectors on some SCHOTT, Day4Energy, GE and CSI Solar modules. These cables have a neutral male at one end and a negative female at the other so they can be used to extend the cables on the modules or be cut in half and used to connect to a roof-top j-box or combiner. This polarity works for most connections but is not guaranteed for all modules. Made with double insulated black #10 AWG, PV WIRE, USE-2 sunlight-resistant cable. Use the locking sleeve where a tool is required to disconnect.

Length (ft)	Item code
6	052-09607
15	052-09611
30	052-09615
50	052-09616
70	052-09617
100	052-09618
Locking sleeve	052-09435

H+S Radox to Helios 4 (or MC4) Adaptors

Use these adapters to connect modules with Radox twist lock connectors to MC4 devices like Enphase inverters, or anywhere a transition is needed between Radox and MC4 or H4 cables. This polarity works for most connections.

Description	Item code
Radox male to H4 or MC4 male adapter	052-09838
Radox female to H4 or MC4 female adapter	052-09839

MC4 to Tyco SolarLok Adaptors

Use these adapters to connect solar modules with Tyco connectors to MC4 cables.

Description	Item code
Tyco female negative to MC4 female adapter	052-09471
Tyco male neutral to MC4 male adapter	052-09473

MC4-Solarline 2 Branch Connectors

These waterproof Y-connectors make it possible to parallel wire PV modules with Multi-Contact output cables. Maximum current rating allowed through connectors is 30 amps.

Description	Item code
Solarline 2 branch cable coupler female - 2 male	052-09403
Solarline 2 branch cable coupler male - 2 female	052-09404

Cable Clip

Use these stainless steel clips to keep module interconnect cables neatly secured to module frames so they do not drop below the array. Order in batches of 10.

Description	Item code
Clips for 10-12 AWG wires - stainless	052-09100
Clips for larger wires - stainless	052-09102

Connectors

MC4-Solarline 2 Connectors

The connector can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool and wrench set are required to assemble the connector. We have connectors for 10 AWG USE-2 wire and for larger diameter 10AWG PV wire. Sold in Packs of 25 connectors.

Connector description	Item code
Male MC4 locking connector for USE-2 wire	097-01407
Female MC4 locking connector for USE-2 wire	097-01409
Male MC4 locking connector for PV wire	097-01411
Female MC4 locking connector for PV wire	097-01413
MC safety locking sleeve PV-SSH4 – pack of 25	097-01419

H+S Radox Connectors

These connectors can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool is required to assemble the connector. For use with 10AWG "PV Wire" rated double insulated wire. Sold in packs of 25.

Connector description	Item code
Radox male connector 10 AWG PV Wire - 25 pack	097-01528
Radox female connector 10 AWG PV wire - 25 pack	097-01529
Radox male connector 12 AWG PV Wire - 25 pack	097-01525
Radox female connector 12 AWG PV wire- 25 pack	097-01526
Locking sleeve, ea	099-01254

Tyco SolarLok Connectors

These connectors can be assembled quickly on site by a contractor allowing assembly of custom cables at the job site. A special crimping tool and wrench set are required to assemble the connector. For use with 10AWG "PV Wire" rated double insulated wire. Sold in packs of 25.

Connector description	Item code
SolarLok male neutral connector - 25 pack	097-01361
SolarLok female negative connector - 25 pack	097-01366

Solar Water Pumping

The sun is the natural source of energy for an independent water supply. Solar pumps operate anywhere that the sun shines, and the longer it shines, the more water they pump. When it's cloudy, they pump less water, but often you need less water when it is cloudy.

Photovoltaic modules, the power source for solar pumping, have no moving parts, require no maintenance and last for decades. A properly designed solar pumping system will be efficient, simple and reliable.

Solar water pumping systems operate on direct current. The output of the solar power system varies throughout the day and with changes in weather conditions. The nature of variable electricity in the form of direct current (DC) is quite different from conventional, steady alternating (AC) current from the utility grid or a generator.

To use solar energy economically, the pumping system must utilize the entire solar day, while drawing a minimum of power. This means pumping more slowly than conventional pumps. Many solar pumps are designed to produce less than 6 gpm. To obtain the most output from the least amount of solar electricity, these small pumps generally use motors and pumping mechanisms that are more efficient than conventional AC powered centrifugal pumps.

The most efficient pumps are "positive displacement" pumps. They pump a certain amount of water with each rotation. If it is cloudy or early morning, the pump will receive less energy and run more slowly. A positive displacement pump will pump approximately half as much water with half as much energy.

Conventional AC pumps are usually centrifugal pumps that spin at a high speed to pump as many gallons per minute as possible. They also consume a large amount of power. If you run a centrifugal pump at half speed, it pumps one quarter the pressure. Their efficiency is very low at low speeds and when pumping against high pressure.

If your water sources are remote from power lines, add up your long-term costs of fuel and repairs on generators, or the cost of utility line extensions. Compare that with the cost of a solar pumping system that needs attention only once every 2 to 20 years depending on the model.

Solar powered pumps can provide an equal volume of water per day without the high and inefficient energy demands of a large capacity AC pump. Instead of pumping a large volume of water in a short time and turning off, the solar pump works slowly and efficiently all day. Often a solar pump will work fine in a well with a recovery rate too slow for a conventional AC pump.

Submersible Pumps

If you are pumping from a well, we have solar pumps that can deliver from 1 gallon per minute to over 75 gpm. The smallest pumps, the low-power diaphragm pumps from SHURflo can be powered by two 50- to 100-watt solar modules, depending on the head (vertical distance) they are pumping. They can pump 500 to 1000 gallons per day and lift water 200 feet. These pumps require service every 2 to 4 years.

If you have a higher lift, need more water or want a pump that does not require service for 10 to 20 years, the Grundfos SQFlex pump is a good choice. The SQFlex can lift water over 800 feet and can pump over 20,000 gallons per day at lower lifts. The SQFlex pump can be powered by solar modules, a wind generator, a fuel powered generator, an inverter, the utility grid, or a combination of several of these.

Surface Pumps

Surface pumps are less expensive than DC submersibles, where applicable. A surface pump is not submersible. It can draw water from a spring, pond, river, or tank, and push it far uphill and through a long pipeline to fill a storage tank or to pressurize it for home use or for irrigation, livestock, etc. The pump may be placed at ground level, or suspended in a well in some cases.

All pumps are better at pushing than pulling. Surface pumps must be placed no higher than 10 or 20 feet above the surface of the water source at sea level (subtract one foot per 1000 feet elevation).

Suction piping must be oversized a bit and not allow air entrapment (much like a drain line) and should be as short as possible. Pumps can push very long distances. The vertical lift and flow rates are the primary factors that determine power requirements.

Pressurization

Many conventional AC powered water systems pump from a well or other water source into a pressure tank that stores water and stabilizes the pressure for household use. When you turn on water in the house, an air-filled bladder in the tank forces the water into the pipes. When the pressure drops, a pressure switch turns on the pump, refilling and repressurizing the tank. This works fine because of the ability of the AC pump to deliver a volume of water larger than what is required for household use.

An AC pressure pump can work in systems with an inverter large enough to run a standard AC pump. However, this will not work with pumps operating directly from PV modules because the sun may not be shining when you need pressure and thus the pump may not keep up with household use.

There are two ways to solve this problem. A non-pressurized water tank can be located high enough above the house for gravity to supply the water pressure. This can be on a hill or a tower. Water pressure in psi = head (in feet) times 0.433. For reasonable pressure the tank needs to be at least 40 feet above the house. If this is not possible, a battery operated pressure booster pump can fill a pressure tank as needed from a storage tank that is filled by a solar pump during the day. You must use a pump that can deliver the maximum gpm required by the house, or have a pressure tank that is large enough to make up the difference between what the pressure pump can deliver and what is required, for the amount of time it is required. This is called the "draw down volume" of the tank.

Calculation of Solar Power Needs

If you are using a pump driven directly by solar modules, the array watts should be at least 20% higher than the power required by the pump in your situation. If you use a larger array or a tracking array, the pump will operate at its maximum output for more hours of the day, delivering more gallons per day.

Grundfos

SQFlex Submersible Pumps

This is the ultimate submersible pump for water lifts of up to 650 feet. They can be directly powered by solar or wind power or can be run on an inverter, a generator, a battery or the utility grid, or any combination of these sources. Virtually any source of power, 30-300 VDC and 90-240 VAC, can be used to run the pump. They can operate on a series string of PV modules with a total peak power voltage of at least 30 volts, but their efficiency will be much higher at voltages over 100 VDC. The motor is designed to draw a maximum of 8.4 amps, which means that many types of PV modules can be used efficiently, including 60 cell modules with outputs up to 260 nameplate watts. SQFlex 3SQF through 11SQF pumps will fit into a 3" well.

Eleven pump models can deliver from 82 gpm at 6 feet of head to 4 gpm at 800 feet with a 1.6 kilowatt solar array or less. Helical rotor pumps (models 3, 6 and 11) for high head applications and centrifugal pumps (models 16, 25, 40, and 60) for low head applications assure a pump that is efficient for any use. The SQFlex has built-in protection from dry-running, overloading, and overheating.

SQFlex pumps have a 2 year warranty from the date of purchase. A 5 year extended warranty is available separately and highly recommended.

The Whisper 200-120 V wind generator can be connected directly to an SQFlex pump. Please contact us for information.

Grundfos SQFlex pumps and accessories	Item code
SQFlex 3 SQF-2 pump - 3"	075-01012
SQFlex 3 SQF-3 pump - 3"	075-01013
SQFlex 6 SQF-2 pump - 3"	075-01015
SQFlex 6 SQF-3 pump - 3"	075-01016
SQFlex 11 SQF-2 pump - 3"	075-01018
SQFlex 16 SQF-10 pump - 4"	075-01020
SQFlex 25 SQF-3 pump - 4"	075-01021
SQFlex 25 SQF-7 pump - 4"	075-01025
SQFlex 40 SQF-3 pump - 4"	075-01027
SQFlex 40 SQF-5 pump - 4"	075-01028
SQFlex 60 SQF-3 pump - 4"	075-01029
SQFlex extended 5-year warranty	075-01001
IO50 On/Off switch	075-01038
IO101 interface box (115V)	075-01036
CU200 interface for multiple sources	075-01033
Level switch (use with CU200 only)	075-01042
Pressure switch (use with CU200 only)	075-01044

Optional Controls

The CU200 interface box communicates with the pump and monitors operating conditions. Built-in diagnostics indicate faults and dry-running, display operating status, power consumption and water level switch input. The water level switch interfaces with the CU200 control to turn off the pump when a tank is full. Since the CU200 control circuit uses only 15 milliamps, the water level switch can be located in a tank that is as far away as 1,640 feet from the pump, using a minimum 18ga two conductor wire. Two year warranty.

The IO50 is a simple control box with cable terminations and a manual on/off switch. It is a great interface between a solar array and the pump to allow you to turn off the high voltage array when working on the pump.

The IO101 is an interface for using AC backup on a solar pump. An automatic transfer switch disconnects the solar array when AC power from a generator (120V only), utility connection or inverter is present. When AC power stops, it automatically reconnects the array to let the sun continue pumping.

The IO102 interface unit is used for systems powered exclusively by a wind turbine or by a combination of wind and PV. You can use several controls if you need more features than one control can provide. The SQFlex pumps will not function with a GFCI in the supply circuit, and should not be used where a GFCI is required.

Use the table on the next page to choose a pump. The left column shows total head in feet and meters. The top row shows array wattage/number and suggested type of modules. Boxes show seasonal pump performance and maximum flow.

Select the row with the head (total lift) that most closely matches your application. Move across the row to the column that contains the desired daily volume or peak flow rate. Note the pump model in that block and wattage of the PV array in that column.

60 SQF-3	= Pump model
24,885	= Estimated daily summer volume (GPD)
19,944	= Estimated daily winter volume (GPD)
44	= Peak flow rate (gpm)

NOTE: Daily volume and flow calculations are calculated with Fresno, CA data at a 36° tilt in July, at 7.8 kWH/m2. Winter calculations are calculated with Fresno, CA data at a 36° tilt in February, at 4.7 kWH/m2. Most solar pumping systems will give significantly more output in the summer than in the winter. Also, up to 40% more water can be pumped in the summer if the array is on a tracking mount (these estimates are for non-tracking array mounting). The output can vary with different locations and years, and is not guaranteed. Contact an AEE technical person for sizing your specific system.

Estimated Water Production from SQFlex Pumps (Summer and winter volumes and peak flow rates based on solar array wattage)							
Head	(Module watts)	230	230	230	230	230	230
feet	X (# of modules)	2	3	4	5	6	7
(m)	= (Array watts)	460	690	920	1150	1380	1610
6 (2)	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	31,609	37,627	42,809	46,335	49,272
	4.7 kWh/m2	19,944	26,177	31,410	35,264	38,204	40,675
	Max flow	44	55	64	73	78	82
25 (8)	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	20,089	26,345	31,950	35,680	38,605
	4.7 kWh/m2	9,539	15,049	19,889	24,146	27,295	30,149
	Max flow	27	40	52	61	67	70
50 (15)	Model	11 SQF-2	25 SQF-7	40 SQF-5	40 SQF-5	40 SQF-5	40 SQF-5
	7.8 kWh/m2	5,582	9,725	14,817	19,166	22,462	25,183
	4.7 kWh/m2	4,287	7,100	10,684	13,909	16,552	18,838
	Max flow	11	20	32	40	45	49
75 (23)	Model	11 SQF-2	11 SQF-2	25 SQF-7	25 SQF-7	25 SQF-7	40 SQF-5
	7.8 kWh/m2	4,580	6,300	9,221	11,832	13,742	17,381
	4.7 kWh/m2	3,410	5,067	6,691	8,624	10,157	12,345
	Max flow	9	12	20	24	27	37
100 (30)	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	5,617	6,695	7,303	10,833	12,536
	4.7 kWh/m2	2,639	4,182	5,439	6,021	7,662	9,065
	Max flow	7	12	12	12	23	26
125 (38)	Model	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	25 SQF-7
	7.8 kWh/m2	2,897	4,769	6,145	6,915	7,286	10,006
	4.7 kWh/m2	2,085	3,435	4,807	5,536	5,974	7,055
	Max flow	6	9	12	12	12	21
150 (46)	Model	6 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	11 SQF-2	25 SQF-7
	7.8 kWh/m2	2,454	4,041	5,675	6,565	6,952	7,844
	4.7 kWh/m2	1,851	2,903	4,198	5,114	5,543	5,397
	Max flow	5	9	12	12	12	18
175 (53)	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	3,450	5,024	6,114	6,633	6,926
	4.7 kWh/m2	1,672	2,442	3,594	4,682	5,233	5,531
	Max flow	5	8	11	12	12	12
200 (61)	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	2,885	4,237	5,593	6,199	6,586
	4.7 kWh/m2	1,480	2,288	3,015	4,036	4,777	5,207
	Max flow	4	5	9	12	12	12
250 (76)	Model	6 SQF-2	6 SQF-2	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m2	1,584	2,585	3,556	4,509	5,440	6,477
	4.7 kWh/m2	1,097	1,970	2,632	3,315	3,969	4,656
	Max flow	4	5	7	9	11	13
300 (91)	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	2,516	3,058	3,379	3,556	3,628
	4.7 kWh/m2	1,091	1,835	2,439	2,752	2,957	3,058
	Max flow	3	5	6	6	6	6
400 (122)	Model	3 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m2	974	1,859	2,613	3,025	3,216	3,365
	4.7 kWh/m2	719	1,315	1,942	2,360	2,564	2,737
	Max flow	2	4	6	6	6	6
500 (152)	Model	3 SQF-3	3 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m2	814	1,287	2,000	2,593	2,857	3,025
	4.7 kWh/m2	585	987	1,402	1,902	2,212	2,398
	Max flow	2	3	5	6	6	6
650 (198)	Model	3 SQF-3	3 SQF-3	3 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m2	498	990	1,298	1702	2149	2415
	4.7 kWh/m2	316	692	1,015	1107	1473	1819
	Max flow	1	2	3	4	5	5
800 (244)	Model			6 SQF-3	6 SQF-3	6 SQF-3	6 SQF-3
	7.8 kWh/m2			421	871	1325	1741
	4.7 kWh/m2			179	470	796	1111
	Max flow			1	3	4	4

SHURflo

9300 Submersible Pump

Use this lightweight submersible pump for livestock, irrigation or remote home applications with low water requirements. The 9300 is a positive displacement diaphragm type pump with very high efficiency, but a much shorter life than centrifugal or helical rotor pumps. The 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-volt battery, or, with the use of one of the SHURflo Pump Controls, directly on a PV array. The pump can lift 1.3 gpm to 230 feet and can pump nearly 2 gpm from very shallow wells. It measures only 3.75" diameter x 12" long. Performance on a 12-volt battery will be less than half the flow on the accompanying table. One year warranty.

The 902-200 controller comes in an outdoor enclosure with water level sensors and sensor wire. It can be operated from a 12V or 24V array. Water sensors hang in the well and are used to prevent dry running in very low yield wells. The 902-100 control must be mounted in a dry location and used with a 24V array. One year warranty.

It is recommended that the pump be pulled up out of the well every few 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.

To reduce current loss and plug corrosion in SHURflo 9300 installations, always use 10 gauge, 2 conductor, no ground, solid core submersible pump cable.

Description	Voltage/wattage	Item code
SHURflo 9300 submersible pump	12 - 24 VDC	**075-05817**
SHURflo 902-100 pump controller	24 VDC	**075-05823**
SHURflo 902-200 pump controller	12-24 VDC	**075-05820**
SHURflo 9300 end bell brush kit	24VDC	**075-05742**
SHURflo 9300 diaphragm kit		**075-05838**
SHURflo 9300 valve kit		**075-05832**
SHURflo 9300 cable plug kit		**075-05826**
Sub pump cable 10-2C no ground		**050-01637**

Array Direct Performance (24V array)			
Vertical lift	Minimum solar array size	Flow rate (gpm)	Amps @ 30V
20	2 x 32 watts	1.95	1.5
40	2 x 32 watts	1.90	1.7
60	2 x 50 watts	1.81	2.1
80	2 x 50 watts	1.76	2.4
100	2 x 50 watts	1.71	2.6
120	2 x 50 watts	1.68	2.8
140	2 x 80 watts	1.65	3.1
160	2 x 80 watts	1.63	3.3
180	2 x 80 watts	1.55	3.6
200	2 x 80 watts	1.52	3.8
230	2 x 80 watts	1.36	4.1

Solar Converters

Linear Current Boosters for DC pumps

Linear current boosters from Solar Converters are used in solar direct pumping applications. They can achieve a 30-90 percent increase in water pumped over connecting the pump directly to the solar modules. We can special order 90V units that can operate 12-, 24-, 36- and 48-volt pumps from several modules in series. This will be useful where the panels must be a long distance from the motor, allowing wiring with a smaller wire size as the current is reduced. The wire savings alone can easily pay for the controller. Call for details.

One year warranty.

Solar converters model	Array volts nominal	Current max amps	Item code
PPT 12/24-7	12 or 24	7	**075-00124**
PPT 12/24-15	12 or 24	15	**075-00126**
PPT 12/24-30	12 or 24	30	**075-00128**
PPT 48-10	48	10	**075-00136**
PPT 48-20	48	20	**075-00137**
PPT 90-12	90	12	**075-00141**

Aquatec

550 Series Pressure Pumps

These Aquatec booster pumps provide "town pressure" for remote home water supplies where 12-volt or 24-volt power is available. They have a longer life and greater flow rate than other diaphragm booster pumps and they use less than half the energy consumed by an AC jet pump running on an inverter. The 120-volt version can be used on remote power systems with inverters.

Aquatec's 550 pressure pumps delivers powerful flow rates at pressures up to 60 PSI. Their patented 5-chamber diaphragm and piston design allows these pumps to operate at very low noise levels and with minimal pulsations. These pumps are designed for intermittent duty, though most models can be run continuously for hours at a time. They are commonly used to pressurize water from an atmospheric tank, to deliver purified water to a specific point of use, or simply to increase pressure when required.

The built-in pressure switch is set for 60 psi off and 40 psi on. The pumps come with straight threaded male half-inch fittings that snap into the quick disconnect ports. The optional strainer is highly recommended to keep debris out of the pump, insuring long diaphragm life.

All Aquatec 550 Pressure Pumps weigh 8 pounds each.

One-year warranty.

Aquatec model	Voltage	Max. gpm	Pressure (psi)	Current draw (amps)	Item code
5503-AEE-B636	12 VDC	4.10	30	11.0	**075-04805**
		3.80	40	13.0	
		3.55	50	14.6	
5503-AEE-B736	24 VDC	4.10	30	5.5	**075-04809**
		3.80	40	6.5	
		3.55	50	7.3	
5503-AEE-B656	120 VAC	4.10	30	1.42	**075-04813**
		3.80	40	1.60	
		3.55	50	1.80	
Strainer	High flow 50 mesh in-line strainer				**075-04821**

HighLifter

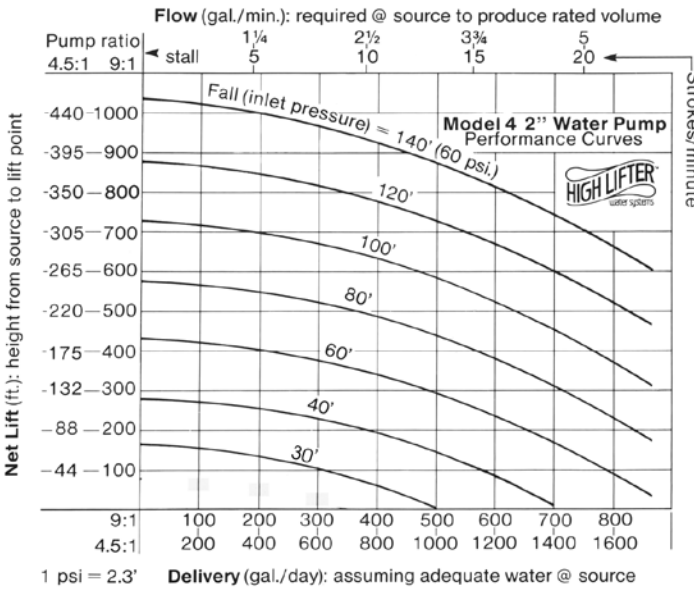
Water Powered Water Pumps

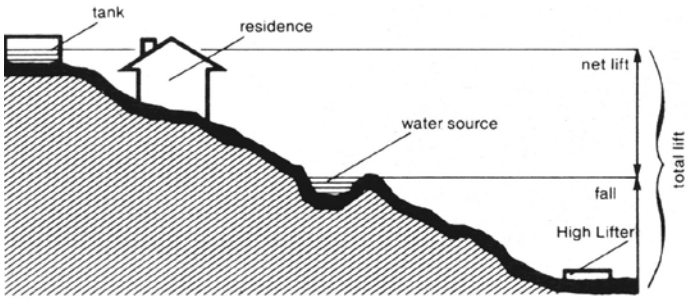
The High Lifter is a powerful water pump designed to move water uphill without using gasoline or electricity. By harnessing the energy of piped water pressure from an uphill source, the High Lifter pump can drive a portion of this water through another pipe to a tank higher than the water source. Pistons provide the pumping action and water is the only lubricant used. With adequate water and pressure it can pump up to 1500 gallons of water per day as high as 300 feet, or it can pump 200 gallons per day as high as 1000 feet. It can also pump smaller amounts on as little as one quart per minute of source water, and can pump to lower elevations with as little as a 30-foot drop from the water source.

It is self-starting and requires no lubrication, priming, or tuning, and is quiet compared to gas engine pumps. Due to its light weight, ease of installation, and lack of fuel requirements, it is ideally suited for hilly or remote terrain. Simply run a pipe downhill to your High Lifter from a pond, stream, or spring, lay out a pipe to your high tank, and start pumping. Designed to be installed and maintained by the user with basic hand tools, the High Lifter requires little attention other than filter cleaning for years of hardworking service. Depending on how clean the water source is, a High Lifter can operate continuously for 1-3 years between piston replacement service, or even longer if the inlet water is processed through a settling tank to remove grit. The High Lifter is an efficient, economical, and reliable way to handle many water pumping requirements. It can be effectively used for domestic water pumping, garden water supply, irrigation, range cattle, etc. All High Lifter parts are made of stainless steel, Teflon, and polyethylene, so they are safe for drinking water. Pump is 26" long. 1-year warranty on materials and workmanship.

As illustrated in the graph, the High Lifter responds to both inlet and output pressure. Because the High Lifter utilizes inlet water pressure to pump water, locating the pump farther down from the water source will yield greater delivery or higher pumping elevations. The higher the upper tank is located, the slower the pump will work. If the upper tank is placed too high, the pump will stall (with no damage to the pump) and no water will be pumped.

To determine how much water will be pumped, find the net lift for either the 4.5:1 or 9:1 pump on the left side of the graph. Move across the graph horizontally to the right until you cross the curve for the fall (inlet pressure). From the point where lift and fall cross, move vertically down to the bottom of the graph and read the "Delivery (gal/day)" for the type of pump being used. To get this delivery amount, the input flow to the pump must be equal to or greater than the "Flow (gal/min)" at the top of the graph in line with the point where the lift and fall lines cross. If the input flow is less than this number, the output will be correspondingly lower.





The picture above shows a typical installation using the High Lifter to fill a tank. Note that "net lift" is the vertical distance from the water source to the tank.

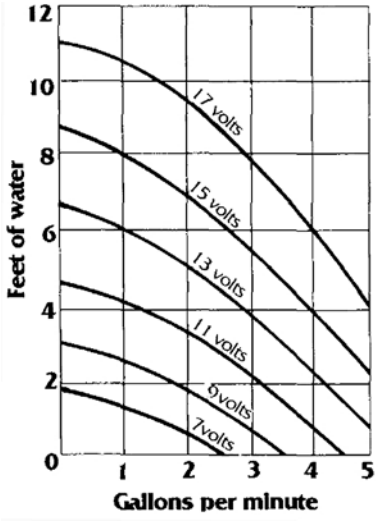
Model	Pump ratio	Max output/day	Max net lift	Max total lift	Item code
H44	4.5:1	1500 gal	440 ft.	580 ft.	**076-09002**
H49	9.1:1	750 gal	1000 ft.	1140 ft.	**076-09005**

Repair kits	Item code
Rebuild kit for 4.5:1 High Lifter	**076-01118**
Rebuild kit for 9:1 High Lifter	**076-01124**

Hartell

MD10HEH Circulator

This pump has an electronically commutated, high efficiency brushless motor with a 30,000-hour life expectancy. It may be operated from an 20- to 22-watt solar module or directly from a 12-volt battery system. They work great for closed-loop solar water heating systems and radiant floor heating. The graph shows this pump's performance at various heads and flows, at different input voltages.



One year warranty.

Model	Operating voltage	Pipe connections	Dimensions (inches)	Item code
MD-10-HEH	6-16 VDC	1/2" MNPT	5.25" x 9"	**075-07237**

EL-SID

Brushless Water Circulators

These tiny brushless, magnetic-drive circulators can be driven by PV modules or 12-volt batteries for closed-loop circulation in solar water heating systems and individual loops of radiant floor heating systems. Use of several small pumps in a radiant floor system allows each loop to be controlled by a different thermostat. Model 10PV-12 is designed to be powered by a 10- to 20-watt PV module in an open loop system and can pump 3.3 gallons per minute at no head, and 1/2 gpm at 2.5 feet of head, at 17 volts input. A 20-watt module should be used for glycol systems. It can circulate water in a well designed solar water heating system with two 4 x 10 collectors. Model 10B-12 is designed to be battery powered and has the same specifications at 12 volts. 10B-24 is designed to operate on a 24 volt battery system. 20B-12 uses more power to provide more flow and more head. 20PV-12 requires 40 watts of PV and is ideal for pumping glycol through 3 or more collectors. It is a good idea to face the module to the east to help this pump start in the morning. Dimensions: 4" x 4" x 5". 30,000-hour life expectancy.

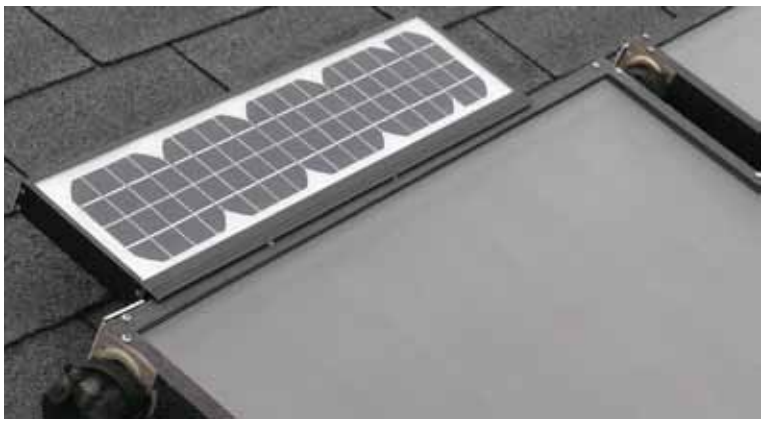
One year warranty.

El-Sid model	Flow (gpm) maximum	Volts (max)	Amps	Weight (lbs)	Item code
10PV-12	3.3	20	0.9	2	**075-07218**
10B-12	3.3	16	0.45	2	**075-07219**
10B-24	3.3	32	0.25	2	**075-07222**
20B-12	5	16	1.5	2	**075-07224**

NEW! 10W Module for Circulator Pumps

This black anodized module is designed to mount on the top or side of a solar water heating panel. It can be attached with sheet metal screws and does not require an additional mounting structure. Use one module for the ElSid PV10-12 and use 2 modules for Hartel 20-watt pumps. Six-foot output cable.

10W Circulator Module		
Power STC (peak)	watts	10
Peak power voltage	volts	17.9
Peak power current	amps	0.56
Open circuit voltage	volts	21.8
Short circuit current	amps	0.61
Length	inch (mm)	(649.5)
Width	inch (mm)	(182.5)
Depth	inch (mm)	(76)
Item code		**011-08213**



PV Cable Assembly Tools

We have tools from Multi-Contact and Tyco for crimping the pins on their connectors. There is a tool for each type of connector. We also have a high quality tool from Rennsteig that has a set of dies and positioners for MC Solarline 2; and for Tyco connectors, 10, 12 and 14 AWG wire.

MC4 Solarline 2 Crimping Tool

Crimping tool to assemble MC Solarline 2 locking connectors. Crimping tool is for 10 or 12 AWG stranded wire.

Description	Item code
MC Solarline 2 MC4 pin crimper for 10/12 AWG wire	094-00104

Tyco SolarLok Crimping Tool

Crimping tool to assemble SolarLok locking connectors. Crimping tool is for 10 or 12 AWG stranded wire.

Description	Item code
Tyco crimper for 10/12 AWG wire	094-00114

MC4 Solarline 2 Open-End Spanner Set

This set of 2 plastic wrenches is used to tighten the sealing nut in the connectors and to unlock the male and female connector. Sold in pack of 2 wrenches.

Description	Item code
MC Solarline 2 open-end spanner set	094-00112

Helios H4 Assembly Tools

The H4 wrench is used for assembling and disconnecting the connectors. The ring tool is for disconnecting the connectors only.

Description	Item code
Helios wrench/disconnect/assembly tool	094-00008
Helios H4 Ring Tool	094-00010

Rennsteig

Crimping Tool Sets and Accessories

There are 2 sets available: The MC3/MC4/Tyco set comes with 3 die-sets and 3 pin locators for crimping MC Solarline 1 (MC3) and Solarline 2 (MC4) pins and Tyco Solarlok pins on 14, 12, and 10 AWG stranded wire. The MC4/H4/H&S set comes with die-sets and pin locators for Solarline 2 (MC4) and Helios (H4), as well as a die-set for crimping H&S (Radox) pins on 14, 12, 10 AWG stranded wire. Comes with a molded plastic carrying case.

Individual die-sets and pin locators are also available.

Description	Item code
Rennsteig crimper set for MC3, MC4, Tyco	094-00123
Rennsteig crimper set for MC4, H4, H&S	094-00125
Rennsteig die only - MC4	094-00126
Rennsteig die only -Tyco	094-00127
Rennsteig die only- Helios H4	094-00130
Rennsteig die only – H&S (Radox)	094-00134
Rennsteig pin locator only - MC4	094-00132
Rennsteig pin locator only - Tyco	094-00133
Rennsteig pin locator only – Helios H4	094-00131
Rennsteig stripper for 14, 12, 10 AWG	094-00128
Rennsteig cutter for 14, 12, 10 AWG	094-00129

Hammer Crimp Tool

This simple, inexpensive crimping tool can be used to crimp connectors on 8 through 4/0 AWG wire. Spring-loaded pin locks in "up" position for loading connector and cable. When released, the pin holds the connector securely during crimping. Use with a hammer or vice.

Description	Item code
Hammer crimp tool	094-00013

Cable Crimper

Use crimper to crimp battery terminals, copper lugs and splices on wire from 8 gauge to 4/0. Adjustable crimp dies are clearly marked and easy to rotate into position. This 26-inch tool gives you plenty of leverage for quality crimping. Made in USA. UL Listed.

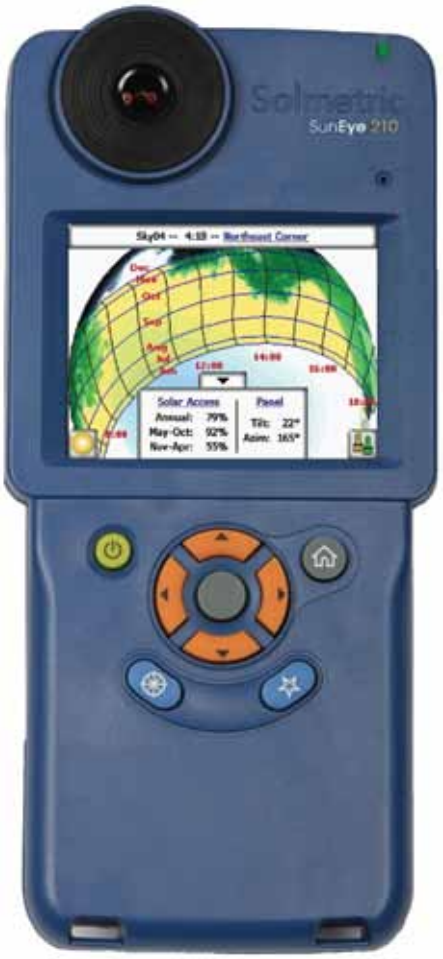
Cable Cutter

Cut cable up to 6/0 AWG with this 22-inch long handheld or bench-mount cutter with removable carbon steel blades. Use this tool for cutting large cable to make inverter cables and battery interconnects. Made in U.S.A.

Description	Item code
Cable cutter 22-inch bench mount	**094-00003**
Cable cutter with 22-inch handles	**094-00004**
Cable crimper with 26-inch handles	**094-00011**

Solmetric

SunEye 210 Site Analysis Tool



The Solmetric SunEye 210 is a hand held electronic device that allows users to assess total potential solar energy given the shading of a particular site. Identifying the shading pattern early in the process reduces the expense of system and home design and improves the efficiency of the final system or house.

The Solmetric SunEye 210 is an important tool for the professional solar installer, saving time and money and helping to design high performance systems. It's equally useful for PV, passive hot water, roof mount or ground mount systems. Optimize new systems for maximum production. Analyze existing installations to solve problems of under production. Identify specific shade-causing obstructions such as trees or structures and know instantly how much additional energy would be produced if the obstruction were removed.

The SunEye 210 comes with a fish-eye lens digital camera and sophisticated measurement software that simulates removal or addition of shading objects or structures, and measures roof tilt and azimuth. It works in the northern and southern hemispheres and provides easy measurements and instant feedback allowing you to make quick estimates and accurate system designs and stores data for later review. The SunEye interfaces to the USB port of your PC, and data is transferred from the device to the SunEye Desktop software. A Solar Access and Shading Report summarizes the data from each session. The SunEye also outputs various data files for use in simulation and design programs.

The GPS version permits automatic readings of latitude and longitude for sun path calculations and displays. Each Skyline reading can be automatically tagged with the latitude and longitude coordinates. Recommended for large sites where many skylines will be recorded, or when exact latitude/longitude coordinates are desired. Accuracy is +/-3 meters. When data is taken using the GPS option, all Skylines are geo-tagged, and the locations and data can be output to Google Earth.

It works on PCs with Windows Vista (all editions), Windows XP SP2 (Professional, Home, or Media Center), or Windows 2000 SP4. Currently, the SunEye software does not run natively on Mac OS. It is possible, however, to run the SunEye software on a Mac using a Windows emulator, such as Parallels Desktop for Mac.

Description	Item code
Solmetric SunEye 210 Tool w/ worldwide operation	**094-00200**
Solmetric SunEye 210 Tool w/ worldwide operation and GPS	**094-00201**

Solmetric

NEW! PVA-600 PV Analyzer

The Solmetric PV Analyzer is a complete electrical test solution for verifying photovoltaic array performance. For each string, the analyzer measures current and power as a function of voltage. Measured results are compared to the performance predicted by advanced built-in models.

- I-V and P-V graphs
- Wireless convenience
- Advanced predictive PV models built-in
- "Array-as-sensor" mode derives irradiance and cell temperature
- Wireless sensor kit for irradiance and temperature (optional)
- Inverter voltage range highlighted on I-V graphs
- Maximum input: 600V, 20A

The PVA-600 comes standard with:

- I-V measurement unit with soft carrying case
- PVA software for Windows
- Wireless USB interface (for Windows laptop or UMPC)
- Connector saver jumper set (two 12-inch m-f MC-4 jumpers)
- MC-4 to MC-3 adaptor cable set
- Battery charger (AC adapter)

Optional Wireless PVA Sensor Kit includes:

- Irradiance sensor and wireless transmitter
- Thermocouples (5) and wireless transmitter
- Wireless USB Interface (connects to Windows PC)
- Rechargeable transmitter batteries and charger
- Hard plastic carrying case

Other optional accessories include:

- PV Analyzer Test Leads (MC-4 to alligator clips, 5 ft)
- I-V Data Analysis Tool for Microsoft Excel

Computer requirements:

- Windows 7 (all editions), Windows Vista (32 bit only), Windows XP SP3
- 700 MHz
- 500 MB RAM
- 100 MB hard drive space
- Minimum resolution: 1024 by 600
- 2 USB ports

Description	Item code
PV-600 Analyzer	**094-00220**
Wireless Sensor Kit	**094-00221**
PVA Test Leads	**094-00222**
I-V Data Analysis Tool	**094-00223**

Daystar

Digital Solar Meter

Daystar's DS-05A solar meter brings "point and read" simplicity to the measurement of solar irradiance. Just turn the meter on, point the sensor at the sun, and obtain a reading in watts/square meter.

Each meter is hand calibrated so you can rely on the accuracy.

Description	Item code
Daystar Solar Meter	**094-00271**

They See a Roof.
You See an Obstacle Course.

Measure

Solmetric
SunEye®

Quick, accurate shade measurements with the touch of a button.

The new SunEye 210 incorporates one-handed operation, live preview mode, target mode for dealing with compass interference from metal roofs, integrated pitch measurements, and optional integrated GPS.

Design

Solmetric
PV Designer™

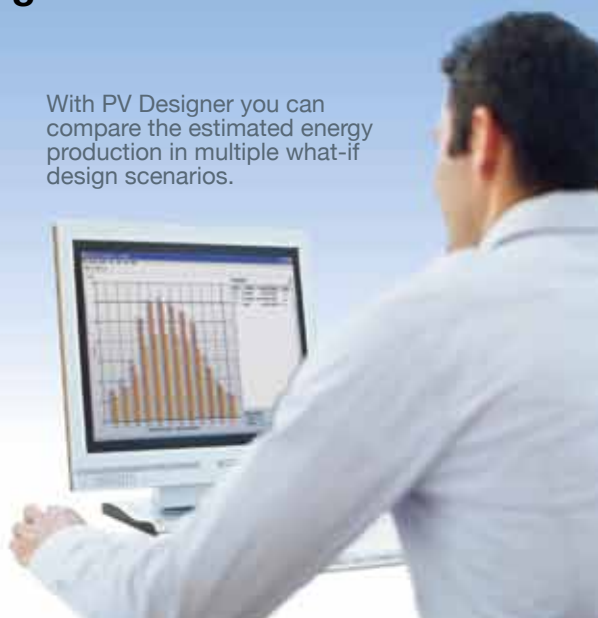
Transfer the data to your PC and use Solmetric PV Designer to design the most effective solar array. Draw the roof, identify locations of SunEye readings, lay out modules, and perform string sizing.

Solar Made Simple

With Solmetric® solutions you get maximum sun with minimum headache. Expert tools let you measure the site, design the system, and get the job done right.

Generate winning quotes and designs that take you from rooftop to desktop and back again.

With PV Designer you can compare the estimated energy production in multiple what-if design scenarios.



Expert Tools. Better Solar.

Solmetric SunEye 210 and PV Designer are available now at **www.solmetric.com**

Solmetric

NEW! Electric Vehicle Charging Stations

Experts say that by the end of 2015 there will 500,000 to one million battery-electric vehicles (BEVs) and plug-in hybrid-electric vehicles (PHEV) in the United States. Most electric vehicle owners will charge their cars at home, creating a large market for home chargers. In addition, many municipalities and businesses are planning to install commercial charging stations. We believe this burgeoning industry is both a can't-miss winner in the years and decades ahead, but also a natural complement to solar PV electricity generation.

Nissan requires that buyers of their all-electric Leaf certify they have a charging station before they will sell them an electric car.

A charging station is a great companion to a grid-tied PV system, and the people who own one are likely candidates for solar power systems. It makes sense to make your own electricity in the daytime to charge your electric vehicle at night.

There are three categories of EV charging stations:

Level 1 chargers are simple 120 VAC 20 amp outlets. They look like conventional AC outlets but with one blade turned 90 degrees. Level 1 chargers are limited to a maximum of 2,000 watts and take 10 to 20 hours to fully charge an all-electric car. This type of charger is great in an emergency when the driver is running low on charge and needs to plug into a readily available outlet.

Level 2 charging stations like the ones featured on the next two pages range from 6,000 to 12,000 watts and can fully charge a plug-in electric vehicle in 3 to 8 hours. They feed 240 VAC power to the vehicle's built-in charger through a power cord with a J1772 plug at the end that looks like the nozzle of a gas pump. These chargers must be installed by a qualified electrician on a dedicated circuit. Many of these chargers communicate via Wi-Fi and can be set to charge when electricity cost is the lowest, usually at night. They may be controlled by the "smart grid" in the future.

Level 3 charging stations are high powered chargers that deliver 20,000 watts or more of 300+ volts DC power directly to the EV battery. These chargers will require three-phase power and be served by a large commercial service panel. When these chargers are available they will be in business locations and are more likely to be used for busses and commercial vehicles. Level 3 connectors are an option on the Nissan Leaf and other electric vehicles, even though the infrastructure to use them robustly is years away.

Federal tax credits and state tax credits in California, Hawaii, Illinois, Louisiana, Oklahoma, Oregon and Washington lower the cost of equipment and installation of charging stations.

We expect our product offering of electric vehicle charging stations to grow and change through the months and years ahead. Please check our website for changes and new product offerings in his exciting new market.

NEW! GoSmart Technologies

ChargeSPOT RF Series

The ChargeSPOT RF Series is an intelligent charging station usable in any environment where fee collection is not needed. Private fleets for business, residential (both suburban and urban), and even retail outlets can use ChargeSPOT stations to provide complimentary charging for their customers.

With multiple power levels available, a robust user interface, and "smart grid" capabilities, the RF Series will support the current and future demands of any community or business.

ChargeSPOT RF30A is capable of providing up to 7.2 kW of power which is enough to fully charge most PHEV in 2 to 4 hours.

ChargeSPOT RF50A is capable of providing up to 12 kW of power which is enough to fully charge most PHEV in 1 to 2 hours.

Both units are configurable with a variety of networking options, including Wi-Fi, Ethernet and cellular modem. Electrical power usage data is securely uploaded to the GoSmart servers to provide energy statistics to registered users. They can operate on 208 VAC or 240 VAC.

Description	Item code
GoSmart RF30A charging station	089-01030
GoSmart RF50A charging station	089-01050
Private label option	089-01089

ChargeSPOT PS-50A

The ChargeSPOT PS-50A is a public charging station that allows station owners to determine the fee collected for vehicle charging at commercial and public sites. The consumer is also provided with charging options that vary with the length of time they charge their vehicle.

With these options, site owners and consumers can make better choices for energy usage, affecting smart grid initiatives and the environment.

ChargeSPOT PS50A provides up to 12 kW of power, enough to fully charge most PHEV in 1-2 hours. It is configurable with a variety of networking options, including Wi-Fi, Ethernet and cellular modem. Electrical power usage data is securely uploaded to the GoSmart servers to provide energy statistics to registered users. It can operate on 208 VAC or 240 VAC on a 50 amp 4-wire circuit. The housing is rated NEMA 3R.

Description	Item code
GoSmart PS50A charging station	089-01150
Private label option	089-01089

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 directly from you.

NEW! Shorepower Technologies

ePump Commercial EV Charging Stations

Shorepower's ePump stations combine the latest electric vehicle charging technology with customization options for municipalities, private employers, retail environments, and fleet locations.

The freestanding tower is designed for street or curb mounting with maximum visibility while the cube has a slim profile designed for a garage wall or a pole. Both are made of high quality stainless steel for years of flawless performance and good looks. An optional illuminated globe gives the station a retro fuel pump look, blending the past with the future.

Shorepower's open source charging stations can be customized to meet any technology requirements including custom payment/access options. Virtually any card swipe (Visa/MC/AMEX/gift/debit) or RFID technology including employee or student IDs, multiple charging types – Levels 1 and 2 in various combinations within the same station – offer user flexibility.

Description	Item code
Tower charging station	089-02015
Cube charging station	089-02020
Illuminated globe with photoswitch	089-02050
Monitoring and reporting system	089-02053
Payment, monitoring and reporting system w/ touchscreen	089-02056
Web portal fee per year (required with Payment System above)	089-02059
Card reader	089-02062
Thermal receipt printer	089-02065
Custom graphics	089-02068
Additional Level 1 outlets	089-02071
Additional Level 2 cable and connector	089-02074

NEW! Leviton

Evr-Green Residential Charging Stations

Leviton's Evr-Green Home Charging Stations enable quick charging of any SAE J1772 compatible plug-in electric vehicle. The intuitive user interface and automatic features make the charging process extremely simple. Their small footprint takes a minimum amount of wall space for mounting. Their mounting system allows do-it-yourself installation when using cord-connected stations in conjunction with the Evr-Green pre-wire kit. Built-in communication verifies proper connection before charging can commence. All units are NEMA 4 outdoor/indoor. The Evr-Green 160 Level 2 Charging Station provides 3.8kW output (16A @ 240V). The charger plugs into dedicated 20A circuit. The Evr-Green 320 Level 2 charging station provides 7.2kW output (30A @240V); the charger plugs into a dedicated 40A circuit.

Description	Item code
Leviton Evr-Green 160 charging station	089-03160
Installation Kit for 160 charging station	089-03164
Leviton Evr-Green 320 charging station	089-03320
Installation Kit for 320 charging station	089-03324

Reference Section

Maximum Ampacities for Wire

The table to the right shows allowable ampacities of conductors (wires) in conduit, raceway, cable or directly buried, based on ambient temperature of 30°C (86°F). National Electrical Code (NEC) allows rounding up cable ampacity to next size standard fuse or breaker.

For ambient temperatures above 30°C (86°F), multiply the allowable ampacities shown at right by the correction factor listed under the insulation temperature rating below.

Temperature Range		75°F insulation	90°F insulation
31-35°C	87-95F	0.94	0.96
36-40°C	96-104F	0.88	0.91
41-45°C	105-113F	0.82	0.87
46-50°C	114-122F	0.75	0.82
51-55°C	123-131F	0.67	0.76
56-60°C	132-140F	0.58	0.71

Wire Size	Copper conductor temp. rating		Aluminum cond. temp. rating	
	75°C (167°F)	90°C (194°F)	75°C (167°F)	90°C (194°F)
*14	20	25		
*12	25	30	20	25
*10	35	40	30	35
8	50	55	40	45
6	65	75	50	60
4	85	95	65	75
2	115	130	90	100
1	130	150	100	115
1/0	150	170	120	135
2/0	175	195	135	150
3/0	200	225	155	175
4/0	230	260	180	205

NEC specifies that the overcurrent protection device not exceed 30A for 10 AWG wire, 20A for 12 AWG wire and 15A for 14 AWG wire.

Recommended Inverter Cable and Overcurrent Protection

Use this table to decide cable size and fuse or breaker size for common inverter models. Smaller cable sizes can be used if fuse or breaker size is reduced but this can cause problems if the inverter is run near its maximum output wattage. Larger cables may be necessary if the distance from the inverter to the battery is greater than 10 feet.

We stock battery-to-inverter cables in #2, 2/0 and 4/0 AWG.

Inverter voltage	Continuous watts	Maximum inverter input amps	Fuse size (amps)	Circuit breaker (amps)	Wire size AWG
12-volt	600	80	80	80	2
	800	107	110	110	2
	1000	134	200	175	2/0
	1500	200	300	250	4/0
	2000	265	400	250	4/0
	2400	320	400	250	4/0
	2500	334	400	250	4/0
	2800	382	400	250	4/0
	3000	400	400	250	4/0
24-volt	600	40	50	50	8
	800	54	75	75	4
	1000	67	80	100	2
	1500	100	110	110	2/0
	2400	160	200	175	2/0
	2500	167	200	175	2/0
	3000	200	300	250	4/0
	3500	230	300	250	4/0
	4000	265	300	250	4/0
48-volt	3000	100	110	110	2/0
	3600	120	200	125	2/0
	4000	135	200	175	2/0
	4500	155	200	175	2/0
	5000	167	200	175	2/0
	6000	200	400	250	4/0

Wire Loss Tables - 12V and 24V

Use these tables to determine the maximum distance one-way in feet of various gauges of two-conductor copper wire from power source to load for 2% voltage drop in 12-volt and 24-volt system wiring. You can go twice the distance where a 4% loss is acceptable. Do not exceed the 2% drop for wire between PV modules and batteries. A 4% to 5% loss is acceptable between batteries and lighting circuits in most cases. Note that if you change an array from 12 volts to 24 volts and the wattage remains the same, then the current is cut in half. This allows you to go 4 times as far with the same wire gauge with the 24-volt array as you could with the 12-volt array.

AMPS	#14	#12	#10	#8	#6	#4	#2	1/0	2/0	4/0
12-volt system – 2% voltage drop										
1	45	70	115	180	290	456	720			
2	22.5	35	57.5	90	145	228	360	580	720	1060
4	10	17.5	27.5	45	72.5	114	180	290	360	580
6	7.5	12	17.5	30	47.5	75	120	193	243	380
8	5.5	8.5	15	22.5	35.5	57	90	145	180	290
10	4.5	7	12	18	28.5	45.5	72.5	115	145	230
15	3	4.5	7	12	19	30	48	76.5	96	150
20	2	3.5	5.5	9	14.5	22.5	36	57.5	72.5	116
25	1.8	2.8	4.5	7	11.5	18	29	46	58	92
30	1.5	2.4	3.5	6	9.5	15	24	38.5	48.5	77
40			2.8	4.5	7	11.5	18	29	36	56
50			2.3	3.6	5.5	9	14.5	23	29	46
100					2.9	4.6	7.2	11.5	14.5	23
150							4.8	7.7	9.7	15
200							3.6	5.8	7.3	11
24-volt system – 2% voltage drop										
1	90	140	230	360	580	912	1440			
2	45	70	115	180	290	456	720	1160	1440	2120
4	20	35	55	90	145	228	360	580	720	1160
6	15	24	35	60	95	150	240	386	486	760
8	11	17	30	45	71	114	180	290	360	580
10	9	14	24	36	57	91	145	230	290	460
15	6	9	14	24	38	60	96	153	192	300
20	4	7	11	18	29	45	72	115	145	232
25	3.6	5.6	9	14	23	36	58	92	116	184
30	3	4.8	7	12	19	30	48	77	97	154
40			5.6	9	14	23	36	58	72	112
50			4.6	7.2	11	18	29	46	58	92
100					5.8	9.2	14.4	23	29	46
150							9.6	15.4	19.4	30
200							7.2	11.6	14.6	22

Wire Loss Tables - 48V and 120V

Use these tables to determine the maximum distance one-way in feet of various gauge two-conductor copper wire from power source to load for 2% voltage drop in 48-volt and 120-volt system wiring. You can go twice the distance where a 4% loss is acceptable. Do not exceed the 2% drop for wire between PV modules and batteries. A 4 to 5% loss is acceptable between batteries and lighting circuits in most cases.

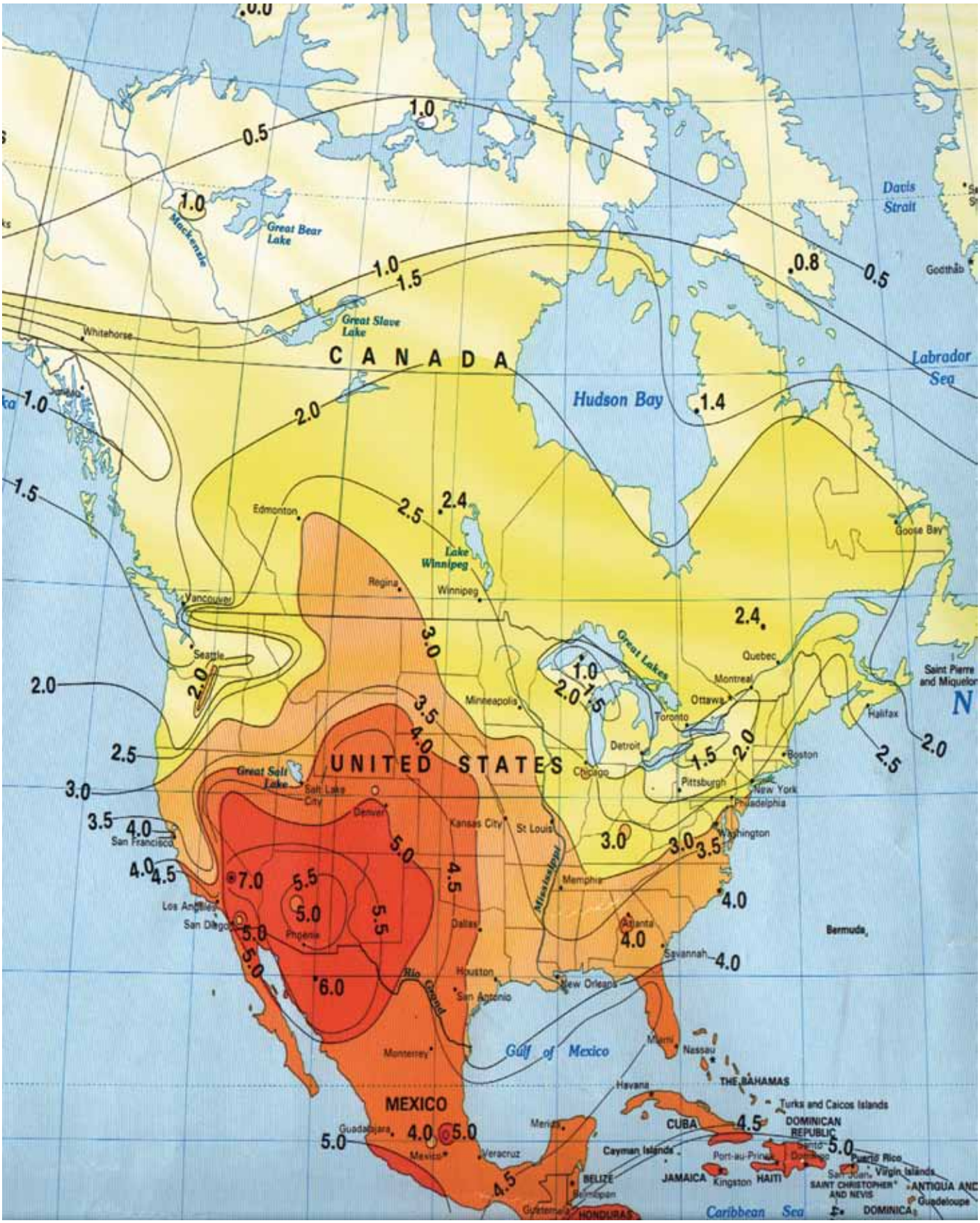
AMPS	#14	#12	#10	#8	#6	#4	#2	1/0	2/0	4/0
48-volt System – 2% Voltage Drop										
1	180	280	460	720	1160	1824	2880			
2	90	140	230	360	580	912	1440	2320	2880	4240
4	40	70	110	180	290	456	720	1160	1440	2320
6	30	48	70	120	190	300	480	772	972	1520
8	22	34	60	90	142	228	360	580	720	1160
10	18	28	48	72	114	182	290	460	580	920
15	12	18	28	48	76	120	192	306	384	600
20	8	14	22	36	58	90	144	230	290	464
25	7.2	11.2	18	28	46	72	116	184	232	368
30	6	9.6	14	24	38	60	96	154	194	308
40			11.2	18	28	46	72	116	144	224
50			9.2	14.4	22	36	58	92	116	184
100					11.6	18.4	28.8	46	58	92
150							19.2	30.8	38.8	60
200							14.4	23.2	29.2	44
120-volt System – 2% Voltage Drop										
1	450	700	1150	1800	2900	4560	7200	0	0	0
2	225	350	575	900	1450	2280	3600	5800	7200	10600
4	100	175	275	450	725	1140	1800	2900	3600	5800
6	75	120	175	300	475	750	1200	1930	2430	3800
8	55	85	150	225	355	570	900	1450	1800	2900
10	45	70	120	180	285	455	725	1150	1450	2300
15	30	45	70	120	190	300	480	765	960	1500
20	20	35	55	90	145	225	360	575	725	1160
25	18	28	45	70	115	180	290	460	580	920
30	15	24	35	60	95	150	240	385	485	770
40			28	45	70	115	180	290	360	560
50			23	36	55	90	145	230	290	460
100				18	29	46	72	115	145	230
150							48	77	97	150
200							36	58	73	110

Solar Insolation

This table shows solar insolation in kilowatt hours per square meter per day in many U.S. locations. For simplicity, we call this figure "sun-hours per day." To find average sun-hours per day in your area, check local weather data, look at the maps on the following pages, or find a city in the table below that has similar weather to your location. If you want year-round autonomy, use the low figure. If you want only 100% autonomy in summer, use the high number. If you want a utility grid-tie system, and you have net metering available in your state, use the average figures. For off-grid systems, see U.S. insolation map on the next page.

State	City	High	Low	Avg
AK	Fairbanks	5.87	2.12	3.99
AK	Matanuska	5.24	1.74	3.55
AL	Montgomery	4.69	3.37	4.23
AR	Bethel	6.29	2.37	3.81
AR	Little Rock	5.29	3.88	4.69
AZ	Tucson	7.42	6.01	6.57
AZ	Page	7.30	5.65	6.36
AZ	Phoenix	7.13	5.78	6.58
CA	Santa Maria	6.52	5.42	5.94
CA	Riverside	6.35	5.35	5.87
CA	Davis	6.09	3.31	5.10
CA	Fresno	6.19	3.42	5.38
CA	Los Angeles	6.14	5.03	5.62
CA	Soda Springs	6.47	4.40	5.60
CA	La Jolla	5.24	4.29	4.77
CA	Inyokern	8.70	6.87	7.66
CO	Grandby	7.47	5.15	5.69
CO	Grand Lake	5.86	3.56	5.08
CO	Grand Junction	6.34	5.23	5.85
CO	Boulder	5.72	4.44	4.87
DC	Washington	4.69	3.37	4.23
FL	Apalachicola	5.98	4.92	5.49
FL	Belie Is.	5.31	4.58	4.99
FL	Miami	6.26	5.05	5.62
FL	Gainsville	5.81	4.71	5.27
FL	Tampa	6.16	5.26	5.67
GA	Atlanta	5.16	4.09	4.74
GA	Griffin	5.41	4.26	4.99
HI	Honolulu	6.71	5.59	6.02
IA	Ames	4.80	3.73	4.40
ID	Boise	5.83	3.33	4.92
ID	Twin Falls	5.42	3.42	4.70
IL	Chicago	4.08	1.47	3.14
IN	Indianapolis	5.02	2.55	4.21
KS	Manhattan	5.08	3.62	4.57
KS	Dodge City	6.50	4.20	5.60
KY	Lexington	5.97	3.60	4.94
LA	Lake Charles	5.73	4.29	4.93
LA	New Orleans	5.71	3.63	4.92
LA	Shreveport	4.99	3.87	4.63
MA	E. Wareham	4.48	3.06	3.99
MA	Boston	4.27	2.99	3.84
MA	Blue Hill	4.38	3.33	4.05
MA	Natick	4.62	3.09	4.10
MA	Lynn	4.60	2.33	3.79
MD	Silver Hill	4.71	3.84	4.47
ME	Caribou	5.62	2.57	4.19
ME	Portland	5.23	3.56	4.51
MI	Sault Ste. Marie	4.83	2.33	4.20
MI	E. Lansing	4.71	2.70	4
MN	St. Cloud	5.43	3.53	4.53
MO	Columbia	5.50	3.97	4.73
MO	St. Louis	4.87	3.24	4.38
MS	Meridian	4.86	3.64	4.43
MT	Glasgow	5.97	4.09	5.15
MT	Great Falls	5.70	3.66	4.93
MT	Summit	5.17	2.36	3.99
NM	Albuquerque	7.16	6.21	6.77
NB	Lincoln	5.40	4.38	4.79
NB	N. Omaha	5.28	4.26	4.90
NC	Cape Hatteras	5.81	4.69	5.31
NC	Greensboro	5.05	4	4.71
ND	Bismarck	5.48	3.97	5.01
NJ	Sea Brook	4.76	3.20	4.21
NV	Las Vegas	7.13	5.84	6.41
NV	Ely	6.48	5.49	5.98
NY	Binghampton	3.93	1.62	3.16
NY	Ithaca	4.57	2.29	3.79
NY	Schenectady	3.92	2.53	3.55
NY	Rochester	4.22	1.58	3.31
NY	New York City	4.97	3.03	4.08
OH	Columbus	5.26	2.66	4.15
OH	Cleveland	4.79	2.69	3.94
OK	Stillwater	5.52	4.22	4.99
OK	Oklahoma City	6.26	4.98	5.59
OR	Astoria	4.76	1.99	3.72
OR	Corvallis	5.71	1.90	4.03
OR	Medford	5.84	2.02	4.51
PA	Pittsburgh	4.19	1.45	3.28
PA	State College	4.44	2.79	3.91
RI	Newport	4.69	3.58	4.23
SC	Charleston	5.72	4.23	5.06
SD	Rapid City	5.91	4.56	5.23
TN	Nashville	5.20	3.14	4.45
TN	Oak Ridge	5.06	3.22	4.37
TX	San Antonio	5.88	4.65	5.30
TX	Brownsville	5.49	4.42	4.92
TX	El Paso	7.42	5.87	6.72
TX	Midland	6.33	5.23	5.83
TX	Fort Worth	6	4.80	5.43
UT	Salt Lake City	6.09	3.78	5.26
UT	Flaming Gorge	6.63	5.48	5.83
VA	Richmond	4.50	3.37	4.13
WA	Seattle	4.83	1.60	3.57
WA	Richland	6.13	2.01	4.44
WA	Pullman	6.07	2.90	4.73
WA	Spokane	5.53	1.16	4.48
WA	Prosser	6.21	3.06	5.03
WI	Madison	4.85	3.28	4.29
WV	Charleston	4.12	2.47	3.65
WY	Lander	6.81	5.50	6.06

This map shows the average value of total solar energy received in peak sun hours per day on an optimally tilted surface during the month with the lowest solar radiation. This is the best number to use in off-grid system design where the electrical demand is continuous or is not expected to vary seasonally and the system must be designed to operate year around. (Use this number for line 3 in the Off-Grid Solar Array Sizing Worksheet on page 12.)

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Martinique
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Montevideo
ARGENTINA
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Bahía Blanca
CHILE
SOUTH
Stanley
Falkland Islands (Islas Malvinas)
South Georgia
Scotia Sea
CAPE VERDE
Praia


North Sea
Baltic Sea
Black Sea
Caspian Sea
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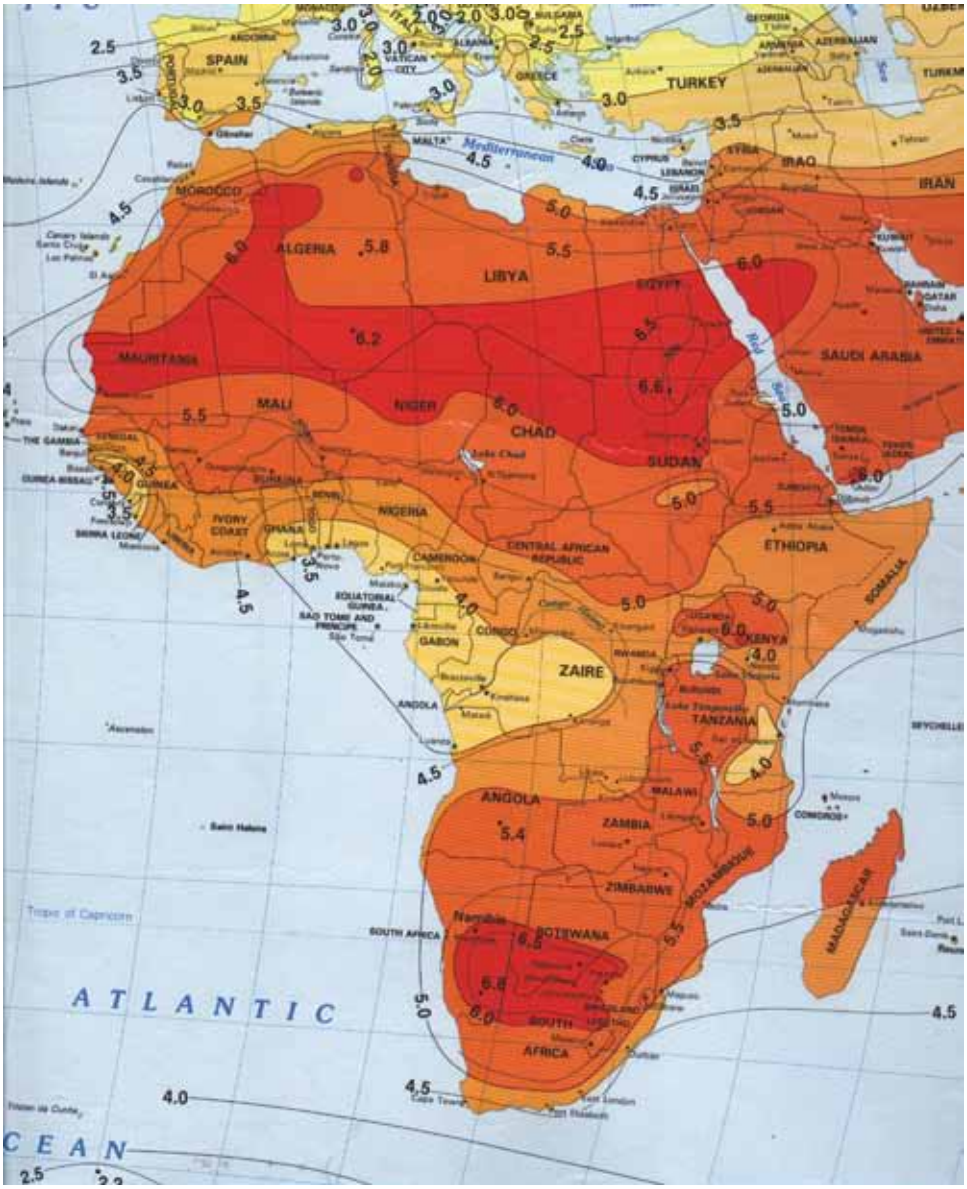
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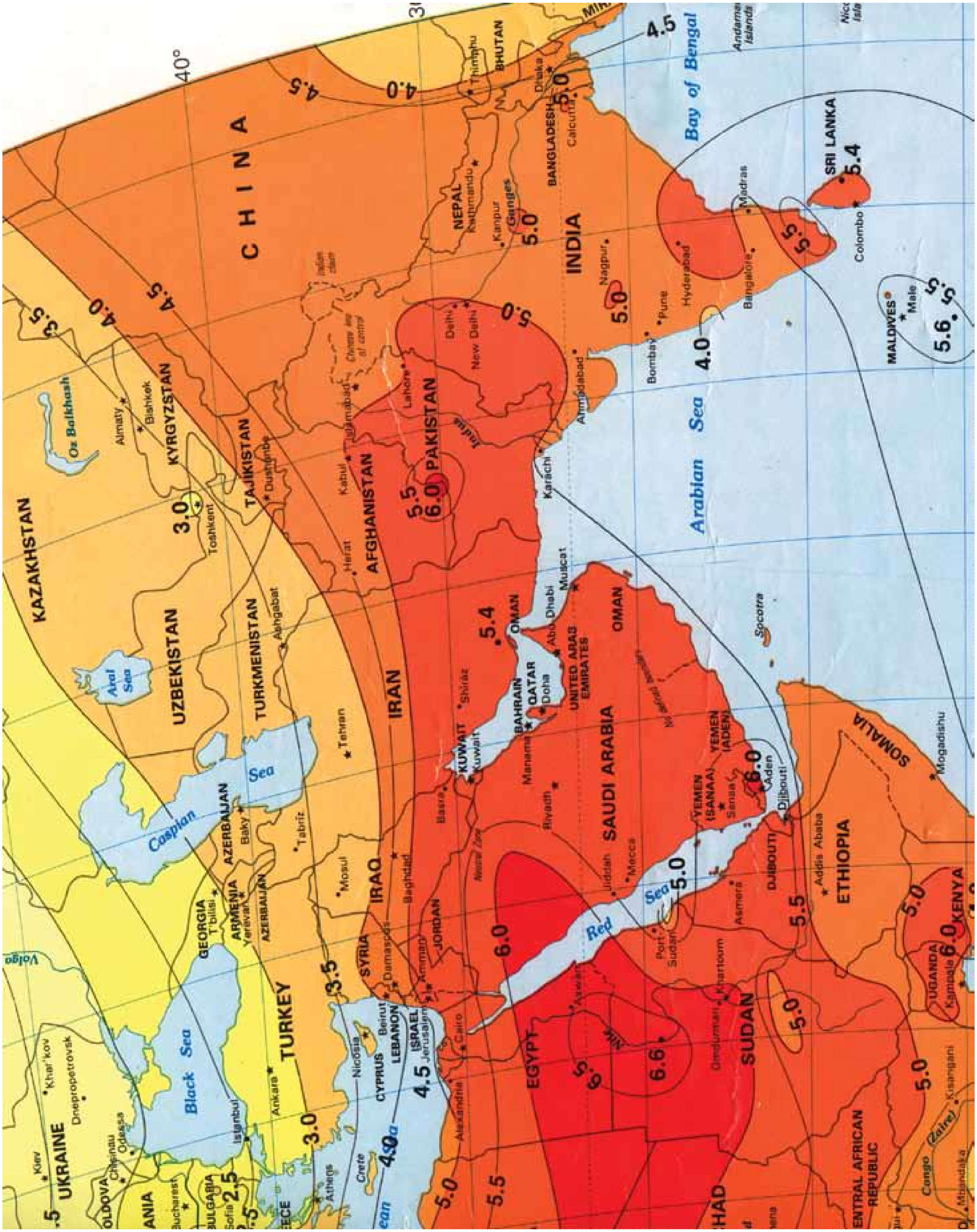
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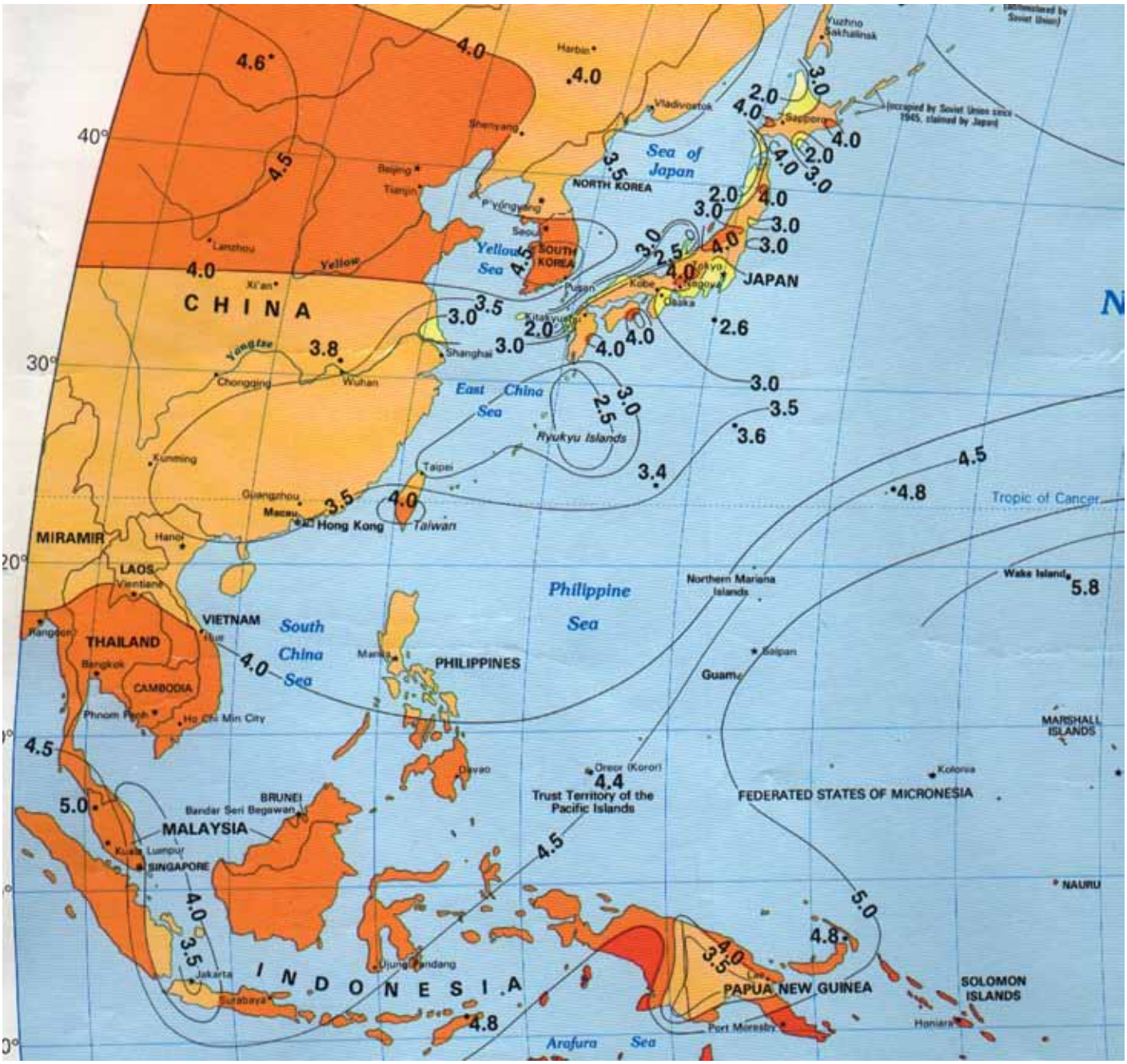
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East China Sea
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Taiwan
Hong Kong
MIRAMIR
LAOS
VIETNAM
THAILAND
CAMBODIA
PHILIPPINES
BRUNEI
MALAYSIA
SINGAPORE
INDONESIA
Trust Territory of the Pacific Islands
FEDERATED STATES OF MICRONESIA
Northern Mariana Islands
Guam
Wake Island
MARSHALL ISLANDS
NAURU
PAPUA NEW GUINEA
SOLOMON ISLANDS
Arafura Sea
Tropic of Cancer
Harbin
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Davao
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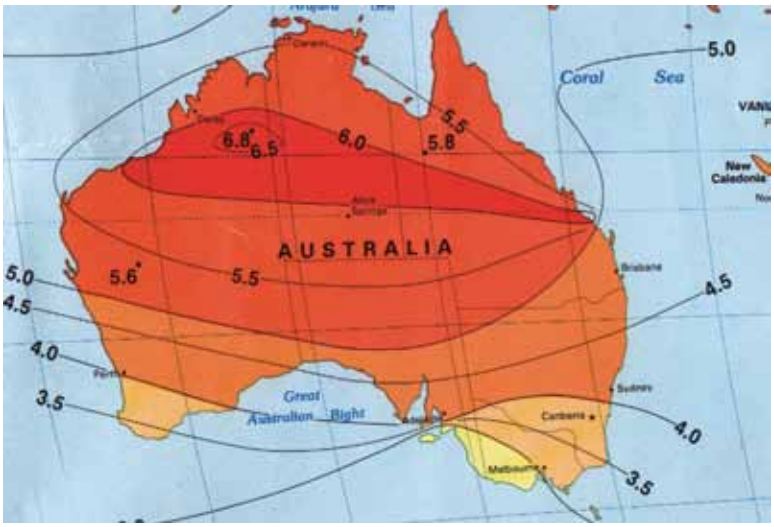
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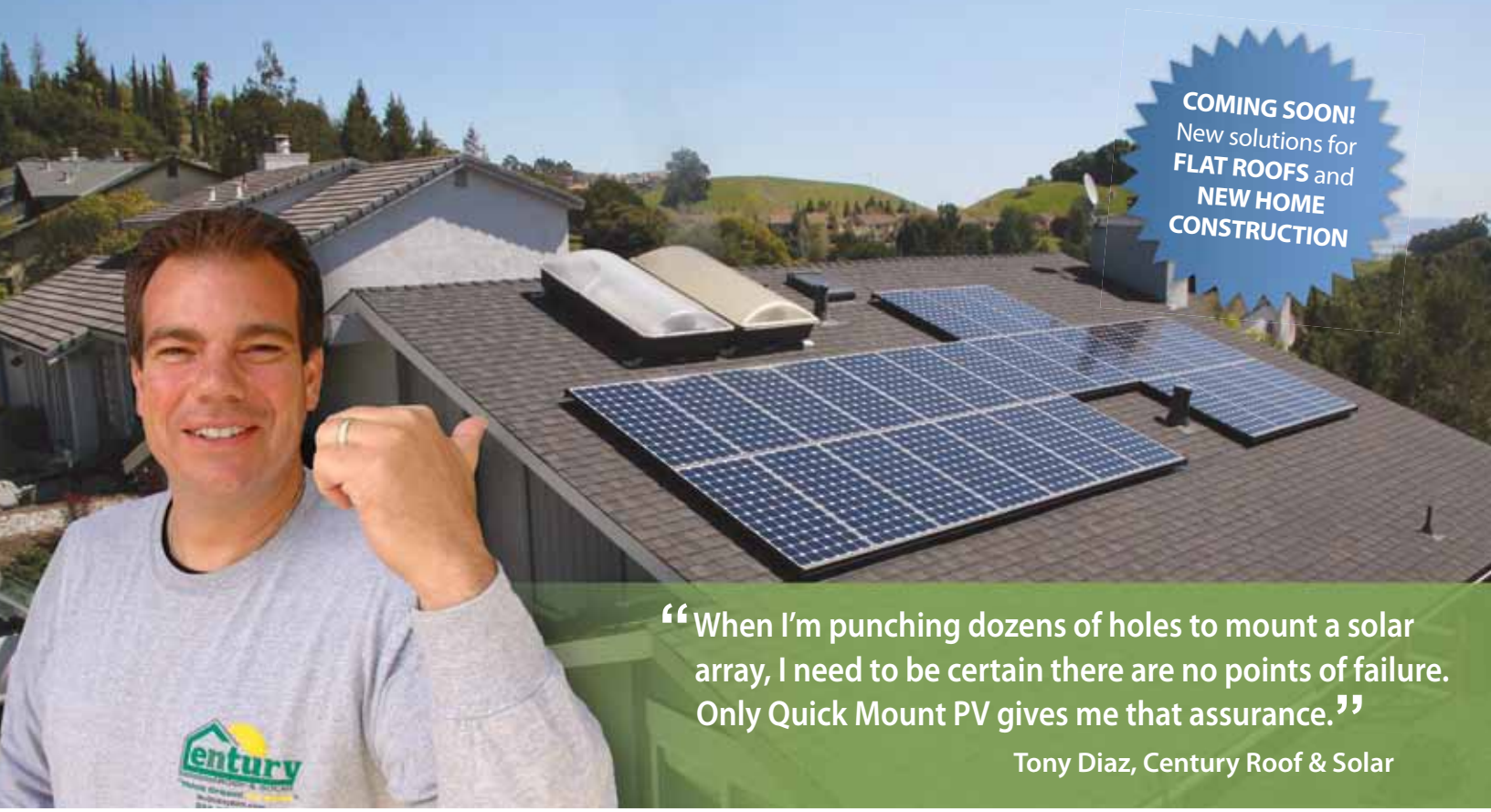

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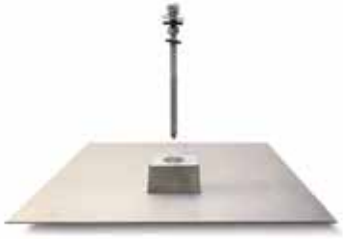

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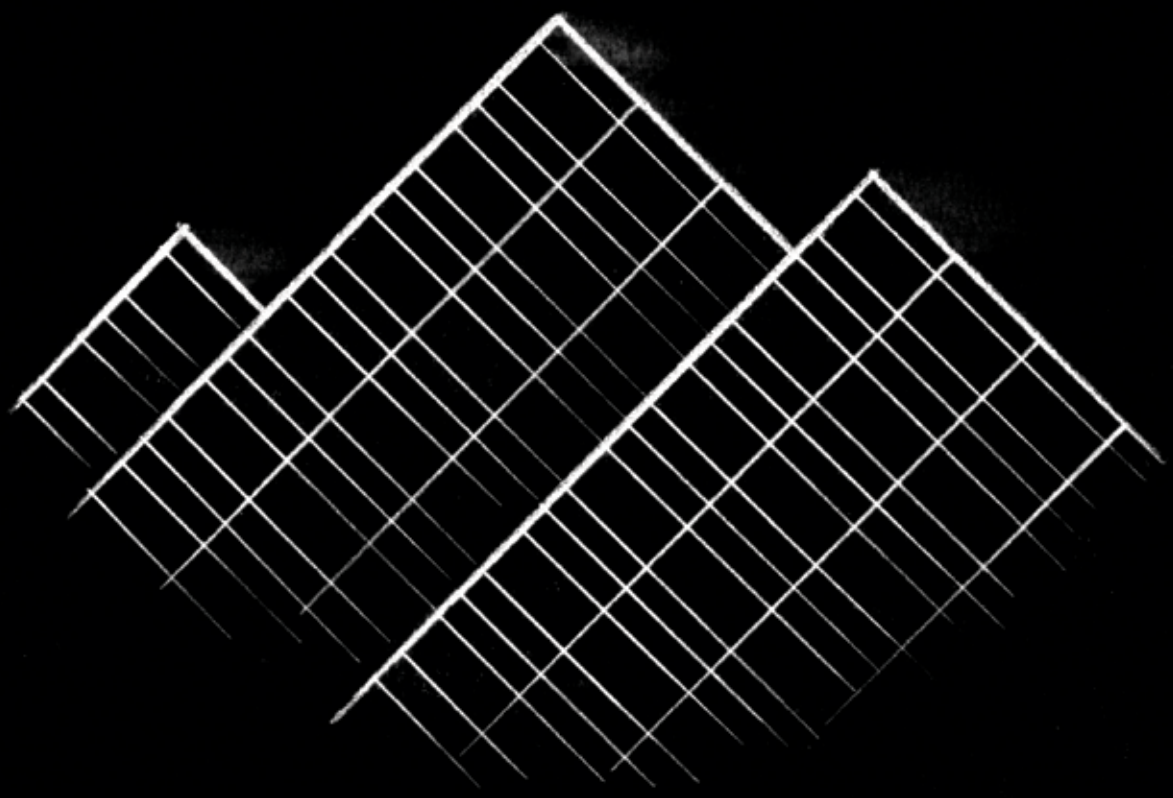

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