

# PHOTON Lab's outdoor module tests – October results

The overview tables document the current status of solar module yield measurements conducted by PHOTON Laboratory. Since 2005, the lab has been measuring solar module yields

under real-world conditions: three modules of each model are installed on an open field, facing south, at a 30° incline. PHOTON Lab's proprietary measurement devices take second-by-

second measurements of the IV curve for each module. The test also captures other important values such as global irradiation, as well as module and air temperature.

## PHOTON Lab's outdoor module tests: Results for January to October 2010

Manufacturer	Model	Cell type	Origin	STC power in W	Yield in kWh/kW		Deviation from test winner (%)	Installed in
					October	January - October		
Siliken	SLK60P6L 230Wp	Multi	Spain	229.7	82.3	1,008.5	0.0	2009
Winergy	Winaico WSP-230P6	Multi	Taiwan	234.4	80.1	990.1	1.8	2009
Trina Solar	TSM-DC01 (180)	Mono	China	176.2	80.8	985.5	2.3	2009
Mage Solar	225/6PJ	Multi	China	232.0	80.3	982.9	2.5	2009
S-Energy	SM-220PA8	Multi	South Korea	224.4	80.5	982.6	2.6	2009
PV Power Technologies	PVQ3220	Multi	India	223.6	78.7	982.5	2.6	2007
Frankfurt CS Solar	FS215W-Poly	Multi	China	221.3	79.6	981.7	2.7	2009
First Solar	FS-265	CdTe	USA	65.4	77.7	979.9	2.8	2009
SolarWorld	Sunmodule Plus SW 210 poly*3	Multi	Germany	212.2	80.0	971.9	3.6	2006
Sunrise Solartech	SRM-180D-72	Mono	China	181.5	78.2	969.4	3.9	2009
Photowatt	PW 1650-175W	Multi	France	171.4	79.3	968.4	4.0	2006
Shell Solar (now SolarWorld)	SQ 150-C*1	Mono	Portugal	155.8	79.4	961.0	4.7	2006
Shell Solar (now SolarWorld)	Powermax Eclipse 80-C*1	CIS	USA	90.8	77.2	955.9	5.2	2007
Evergreen	EC-120*1	Ribbon	USA	121.0	79.4	950.9	5.7	2006
Canadian Solar	CS6A-170P	Multi	China	174.4	75.4	929.2	7.9	2007
Solarfun	SF160 M5-24 (175 W)	Mono	China	174.6	75.1	925.7	8.2	2007
Evergreen	ES-180-RL*1	Ribbon	Germany	185.4	75.5	924.4	8.3	2007
Isototon	IS-170/24	Mono	Spain	172.8	73.5	918.5	8.9	2009
Isototon	I-110/24*1	Mono	Spain	102.5	75.0	917.4	9.0	2006
BP Solar	BP 7185 S*1	Mono	Spain, India	185.1	74.1	914.0	9.4	2005
Kyocera	KC170GT-2*1	Multi	Japan	178.4	75.5	910.7	9.7	2006
Solar-Fabrik	SF 145A*1	Ribbon	Germany	145.8	74.1	906.6	10.1	2005
Schott Solar	ASE-300-DG-FT (300 W)*1	Ribbon	USA	308.1	74.6	905.6	10.2	2007
Sunways	MHH plus 190 (190 Wp)*1	Multi	Germany	199.5	73.9	902.8	10.5	2005
Sharp	NT-R5E3E*1	Mono	Japan	187.9	72.4	884.3	12.3	2005
Kioto Photovoltaics	KPV 210 PE*1	Multi	Austria	206.6	67.5	876.0	13.1	2009

## Models installed after January 2010

Aleo Solar	Aleo S_18 225	Multi	Germany, Spain	230.5	81.0	-	-	4/2010
Bisol	BMU-215-2/221	Multi	Slovenia	229.1	81.6	-	-	2/2010
CH Solar	CH Solar 180 mono	Mono	China	184.4	82.0	-	-	4/2010
CNPV Solar	CNPV-185M	Mono	China	193.8	81.6	-	-	3/2010
Conergy	Conergy Powerplus 220P	Multi	Germany	224.2	81.3	-	-	3/2010
CSG PVTech	CSG180S1-35/1589x807	Mono	China	184.1	81.8	-	-	6/2010
CSG PVTech	CSG230M2-30/1640x992	Multi	China	228.3	81.1	-	-	6/2010
Emmvee Solar	ES-200-P60(230)	Multi	India	234.0	80.8	-	-	3/2010
Perfectenergy	PEM-180/185-72M-SSC	Mono	China	191.3	79.2	-	-	6/2010
REC Scanmodule	REC230AE	Multi	Sweden	228.6	83.7	-	-	2/2010
Solar-Fabrik	SF 130/4-130	Mono	Germany	130.7	76.7	-	-	3/2010
Solarfun	SF160-24-1M175	Mono	China	183.0	80.1	-	-	2/2010
SolarWorld	Sunmodule Plus SW 225 mono	Mono	USA	233.4	81.5	-	-	3/2010
Sonalis*2	SL 180 CE-36M	Mono	China	185.1	80.1	-	-	3/2010
Sun Peak	ALP235W	Mono	India	233.0	80.7	-	-	3/2010
Trina Solar	TSM-PC05 (225)	Multi	China	233.0	80.8	-	-	2/2010
Upsolar	UP-M180M	Mono	China	181.5	80.8	-	-	3/2010
Winergy	Winaico WSP-235P6	Multi	Taiwan	240.1	82.1	-	-	5/2010

Please note: Yield data can only be fully assessed once a year of testing has been completed; the data provided here only allows for preliminary assessments; all yield data is standardized to STC; the average values displayed by each module model are listed. \*1 not manufactured anymore. \*2 for manufacturer Ningbo Qixin Solar Electrical Appliance Co. Ltd.. \*3 former model name: SW 210 poly

For testing purposes, it's important that modules actually feed in their electricity, as they would heat up in open-circuit mode. It's also important to measure yield before it hits the inverter. One common mistake made in yield comparisons, apart from using generally imprecise measurements, is capturing data at the electricity meter – after the output has passed through the inverter. Inverter efficiency impacts yield measurements. Moreover, different combinations of modules and inverters result in better or worse performances, which makes it impossible to compare results.

Another factor that poses challenges for module yield comparisons is standardization according to the manufacturer's specified nominal power. These specifications can deviate considerably from actual power – power under standard test conditions (STC). For instance, if a manufacturer with a 105 W module specifies that the module's nominal power is 100 W and the module produces an annual yield of 100,000 Wh, then standardizing to nominal power would result in a value of 1,000 Wh per

W. Another 105 W module with a specified nominal power of 110 W, producing 100,000 Wh annually, would have a value of 909 Wh per W. But in both cases, the actual yield is 952 Wh per W. That's why PHOTON Lab's yield tests always standardize to STC power.

The table regarding annual yield measurements from 2009 presents results for all modules installed on the test field for the entire year (see table below). The table on monthly yield (see table below) shows results for just 1 month. The module types in the two tables are not identical, since PHOTON Lab receives new modules constantly. Hence there are several modules that have monthly yield measurements, but no annual values yet. But there are other reasons why the values in the tables are not directly comparable: the results from just a single month say relatively little about how the modules function over the course of a full year. For instance, modules that perform well under direct solar irradiation, delivering high yield in the summer months, have considerable reductions in performance during fall and winter –

when the share of diffuse irradiation is higher. The opposite scenario is also possible. Naturally, the summer months play a disproportionately large role for annual yield calculations.

Winter can also impact results, albeit differently: modules on the test field are not cleaned during the year and PHOTON Lab does not remove snow. Frameless modules therefore have an advantage, as snow tends to slide off these models faster. This explains the disproportionate yield advantages enjoyed by First Solar thin-film modules in the winter – although these modules also performed well during the rest of the year.

The age of the modules should also be taken into account when analyzing yield information: a module installed in 2005 cannot be compared directly with a module just recently installed on the test field. ●

#### Further information

To get details about PHOTON Lab's module tests, please go to: [www.photon-laboratory.com](http://www.photon-laboratory.com).

## PHOTON Lab's outdoor module tests: Results of 2009 yield measurements

Manufacturer	Model	Cell type	Origin	Yield in kWh/kW*1	Deviation from test winner (%)	Installed in
SolarWorld	Sunmodule Plus SW 210 poly*2	Multi	Germany	1,084	0.0	2006
First Solar	FS-265	CdTe	USA	1,079	0.4	2007
Photowatt	PW 1650-175W	Multi	France	1,038	4.2	2006
Shell	PowerMax Eclipse 80-C*3	CIS	USA	1,037	4.3	2007
Evergreen	EC-120*3	Ribbon	USA	1,037	4.3	2006
Evergreen	ES-180-SL*3	Ribbon	Germany	1,036	4.4	2007
Shell	SQ 150-C*3	Mono	Portugal	1,033	4.7	2006
CSI	CS6A-170	Multi	China	1,009	6.9	2007
Kyocera	KC170GT-2	Multi	Japan	1,005	7.3	2006
Solar-Fabrik	SF 145A*3	EFG	Germany	1,000	7.7	2005
Isofoton	I1110/24*3	Mono	Spain	1,000	7.7	2006
BP	BP7185S*3	Mono	Spain, India	999	7.9	2005
Solarfun	SF160 M5-24 (175 W)	Mono	China	998	7.9	2007
Sunways	MHH plus 190 (190 Wp)*3	Multi	Germany	993	8.3	2005
Schott Solar	ASE 300 DG FT (300 W)*3	EFG	Germany	993	8.4	2007
Sharp	NT-R5E3E	Mono	Japan	953	12.0	2005

\*1 all standardized to STC power, \*2 former model name: SW 210 poly, \*3 not manufactured anymore

## PHOTON Lab's outdoor module tests: New entries

Manufacturer	Model	Cell type	Origin	Installed in*1
CEEG	SST 240-60M	Mono	China	–
CEEG	SST 265-72P	Multi	China	–
E-Ging PV	EGM-185	Mono	China	–
Day4 Energy	Day4 48MC 185	Multi	Canada	–
Jetion Solar	JT230 P156*2	Multi	China*2	–
Kinmac Solar	KSS-6P6A (230)	Multi	Taiwan	–
Nelumbo	NEI 230-3VA	Multi	Czech Republic	–
Solaria Energía	S6P220	Multi	Spain	–
Solibro	SL1-85	CIGS	Germany	–
Sovello	Pure Power SV-X-200 (LV)	Ribbon	Germany	–
Sunerg Solar	XP 60/156-230	Multi	Italy	–
Sunlink	SL220-20(230)	Mono	China	–
Sunways	—*2	—*2	—*2	–
Sun Well Solar	WD-A-CC-087*2	A-Si	Taiwan	–
Upsolar	UP-M180M	Mono	China	–

\*1 planned installation, changes possible; entries with no date means the test agreement is set up but modules are not yet in PHOTON Lab; after starting measurements, results are usually available the following month, \*2 commissioned test, exact model is unclear