Photo: TÜV Rheinland

This time a monocrystalline and a polycrystalline module from JS Solar faced the test.

Doubling down on quality

PV+Test: Four more modules made by Chinese manufacturers have undergone the Solarpraxis/TÜV Rheinland module test. The manufacturer JS Solar has proven that China is capable of producing high quality modules. The other two manufacturers, however, underscore the fact that this is not always the case.

A drop in output following the thermal cycling test, faulty soldered connections on cells, and significant disparities between measured and reported performance data are just a few examples of reasons why some Chinese manufacturers have chosen to keep mum about their PV+Test results. JS Solar (also known as Jiashengsolar) based in China's Jiangsu Province is a company with nothing to hide. This manufacturer sent two types of modules in for testing, the JS190D monocrystalline module and the JS230P polycrystalline model. Both panels performed very well and had similar test results; both received the mark of "Good+" with their scores placing them squarely among the best modules tested.

Both JS Solar modules tested had better nominal capacities than the figures on their nameplates. The output of the five JS190D monocrystalline modules tested was an average of four watts higher than the capacity specified on the nameplate, and the polycrystalline JS230P modules exceeded the nameplate capacity by a full 12 W on average. "That is curious," says Andreas Cox, who is responsible for qualifying modules and for PV+Test at TÜV Rheinland. "JS Solar could just as easily have labelled the polycrystalline module 240 W rather than 230 W and would still be within the specified positive output tolerance." That may even have allowed the manufacturer to charge a bit more money for the modules. The company gets high marks for the fact that the measurement values for its modules are so much greater than the manufacturer's specifications. The slightly higher output of these modules poses no risk of damage to photovoltaic systems, however.

The temperature coefficient as measured by TÜV Rheinland was also better than the data provided by JS Solar. The data sheets for the modules specify a coefficient of -0.45% per degree of temperature increase. The actual temperature coefficient was measured at -0.436% for the monocrystalline and -0.431% for the polycrystalline module. This measured value of the JS Solar modules is in line with the average values for all of the modules tested so far in accordance with PV+Test. The modules provided by JS Solar also performed well in the other tests and had no notable problems. The modules lost a few points for documentation. The data sheet lacks information about certification as required by the EN50380 data sheet standard, for instance. Cox says that the necessary certificates are all available, however. Another positive feature worth mentioning, according to Cox, is that all of the connection components – plug connectors, cables, and sockets – are certified as well. "That's not always the case. But the components from Renhesolar (ZJRH) used in these panels are certified."

The modules were also docked a few points because at the time the tests were performed, neither the data sheets, nor the installation instructions, nor the guarantee conditions were available in German. "Not every worker or installer speaks English. English installation instructions might not help them much," says Cox. He said that all of the documentation should therefore be available in the official language spoken in each market. JS Solar says that all of its documentation will soon be available in German.

A glance at the module nameplates reveals a further issue. A note on the nameplate reads, "protection class A." Cox says that this is a bit confusing. The modules actually conform to protection class 2 – that is, they have extra thick double insulation. "That is signified here correctly by this double-square on the nameplate," Cox explains. In addition to the protection class, there is the so-called 'applica-

Photo: TÜV Rheinland

The bonding is not all that clean, but the quality is not affected.

tion class A.'" "That is probably what JS Solar meant," says Cox. Application class A means that from a safety standpoint, module installers can install the panels just about anywhere – either on the roof of a house or in a ground-mounted array. Modules can also be certified as application class B or C in accordance with IEC 61730. Class B modules must be installed in inaccessible locations, surrounded by a safety fence and may only be handled by trained personnel during and after installation. The application class B allows manufacturers to skip certain IEC electrical safety tests when certifying modules. Application class C modules may only be installed in arrays with a system voltage of less than 50 volts and less than 240 W, such as domestic PV systems. "Just about every manufacturer has its modules certified as application class A so that they won't be subject to restrictions," says Cox.

Although the two JS modules perform similarly in nearly every test, the mechanical loading test with a load of 2,400 pascals revealed a significant difference. While the output of the JS230P polycrystalline module only dropped by about one percent after the test, the monocrystalline module degraded by nearly four percent. The explanation for the disparity, Cox says, is probably the very different construction of the two modules. The JS190D monocrystalline module with its 72 five inch cells, measuring 1,580 by 808 millimeters is noticeably smaller than the JS230P polycrystalline module with 60 six inch cells measuring 1,650 by 992 millimeters. The polycrystalline module's larger size meant that it was fitted with a heavier 50 millimeter frame to ensure the necessary stiffness. The more robust frame also paid off when

PV+TEST: THE BEST OF TESTED MODULES

Rank	Points	Note	Manufacturer	Module type
1	94.3	very good	Solon	Solon Blue 230/07-235W
2	91.3	very good (-)	Schott Solar	Schott Poly 290
3	90.7	very good (-)	Sharp	NU-180E1
4	89.8	good (+)	IBC Solar	IBC Monosol 240 ET
5	89.6	good (+)	JS Solar	JS230P
6	89	good (+)	Mitsubishi Electric	PV-TD185MF5
7	88.5	good (+)	Jetion Solar	JT235PCe
8	88.4	good (+)	JS Solar	JS190D
9	88.1	good (+)	Conergy	PowerPlus 225P
10	84.3	good	Sovello	SV-X-195-fa1
11	80	good (-)	Perfect Solar	PS230-6P-TOP

PV+Test results

Results	JS Solar JS190D	JS Solar JS230P
Made in	China	China
Size (millimeters)	1,580 x 808 x 35	1,650 x 992 x 50
Weight (kilograms)	16.5	20.0
Cell type	Monocrystalline 5" cells	Polycrystalline 6" cells
Module type	Glass/EVA/Cells/EVA/Foil	Glas/EVA/Cells/EVA/Foil
Performance parameters		
Specific power	190	230
Output tolerance (negative, positive, in percent)	0/+3	0/+3
Deviation of measured performance from specified performance (watts)	**+4.02**	**+11.75**
Measured performance within the specified performance tolerance	**yes**	**Performance 5.1% over given information**
Efficiency under STC (1000 watts of solar radiation per m², 25°C, measured)	15.19%	14.77%
Efficiency reduction at low light levels (200 watts of solar radiation per m²)	-3.01%	-3.30%
Temperature coefficient	-0.436%	-0.431%
Efficiency reduction at 50 degrees (temperature coefficient measured)	-10.90%	-10.78%
Fill factor	75.8%	74.5%
Evaluation of performance variance	+++	+++
Evaluation of low-light behavior	o	o
Evaluation of temperature behavior	+	+
Evaluation (20%)	+++	+++
Aging behavior		
Thermal cycling test (power degradation in percent)	1.83%	-0.68%
Damp heat test, 1000h (power degradation in percent)	1.86%	-0.46%
Damp heat test, 1500h (power degradation in percent)	-3.12%	-2.81%
Mechanical load test, 2400 pascals (power degradation in percent)	-3.94%	-1.15%
Mechanical load test, 5400 pascals (power degradation in percent)	0.01%	-1.20%
Evaluation of the thermal cycling test	+++	++
Evaluation of the damp heat test, 1000h	+	+
Evaluation of the damp heat test, 1500h	+	++
Evaluation of the mechanical load test (2400 pascals)	++	+++
Evaluation of the mechanical load test, very high load (5400 pascals)	+++	+++
Irregularities	none	none
Evaluation (25%)	+	+
Documentation		
IEC 61215/IEC 61730/CE label	+/+/+	+/+/+
Irregularities	At time of test, not in German. Missing: Information on certification, NOCT values, protection class	At time of test, not in German. Missing: Information on certification, NOCT values, protection class
Evaluation (15%)	+++	+++
Electrical safety		
Results meet requirements of safety standard IEC 61730	yes	yes
Irregularities	none	none
Evaluation (25%)	++	+++
Processing		
Sharp corners (tested according to UL)	no	no
Visible irregularities	Sealing/bonding partially unclean, but have no negative impact on functionality	Sealing/bonding partially unclean, but have no negative impact on functionality
Electroluminescence	-	-
Evaluation (10%)	+	++
Warranty and ease of installation		
Product warranty	10 years	10 years
Performance guarantee 90% / 80%	12 years / 25 years	12 years / 25 years
Irregularities	Module assembly, disassembly and transport cost not included	Module assembly, disassembly and transport cost not included
Comments		quite heavy (20 kg)
Evaluation (5%)	+++	+++
Overall evaluation		
Results within requirements of IEC 61215 and IEC 61730	yes	yes
Overall evaluation (maximum 100 points)	88.42	89.56
SCORE	good (+)	good (+)

OVERVIEW

The overall score is based on a large number of measurements conducted by TÜV Rheinland, not all of which are included in the table.

Each item receives a score from 0 to 10, and each of these scores is weighted as part of the total score. The total scores are ranked as follows:

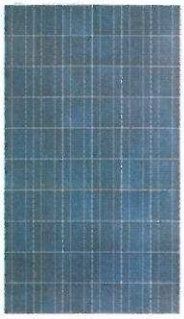
≥ 90 % of the maximum number of points -> excellent
| ≥ 80 % -> good
| ≥ 70 % -> satisfactory
| ≥ 50 % -> poor
| < 50 % -> very poor
The subitems are assessed as one of: +++ | ++ | + | o | -

The industry council came up with the weighting for the subitems towards the overall score. The output parameters make up 20%, the accelerated aging parameters make up 25%, documentation comprises 15%, electrical safety makes up 25%, workmanship makes up 10%, and warranty terms and ease of installation comprise 5%. The scores of the modules tested so far can be found on page 83.

Tested: JS Solar JS190D und JS230P

Photos: JS Solar

According to JS Solar, the JS190D and JS230P modules which underwent testing were among the manufacturer's least expensive and most sought after modules in Europe, which was why JS Solar selected these two models for the PV+Test. The panels were manufactured on a fully automated line and all of the raw materials and components that went into them were thoroughly inspected for quality. These modules are frequently used in roof and ground-mounted systems, but they are also suitable for domestic-scale roof projects.



The JS190D has 72 five inch monocrystalline cells and has been on the market since 2009. The module is offered in various performance classes, ranging from 185 to 205 watts peak. By June 2012, JS Solar had sold a total of 1.1 gigawatts of this type of module, of which 400 megawatts were sold under its own brand and 700 megawatts were sold as OEM products to other module providers and distributed under other brand names.

JS Solar also offers the JS230P polycrystalline module containing 60 six inch solar cells, which has been in production since 2007. Since then, JS Solar has manufactured some 800 megawatts of this type of module. The company has sold 300 megawatts of the polycrystalline model under its own name and a further 500 megawatts as OEM products. JS Solar says that the JS230P displays very stable performance. The robust 50 millimeter frame offers extra stability in areas subject to high winds.

it came to the mechanical loading tests. While the polycrystalline module seemed relatively unaffected by the load, the drop in output of the monocrystalline module indicated damage to the contacts on the surface of the cells. This was later confirmed by an inspection of the cells using electroluminescence imaging.

Sloppy but sealed

One issue, which has no bearing on the performance or service life of the modules but nevertheless resulted in a lower score for both types, was the sloppy bonding of the junction box and the laminates into their frames. "The bonds are not especially nice to look at because a lot of silicon sealant was used and it is smeared in places," says Cox. "That's a pity, of course, because the modules are actually quite good." On the other hand, he says that a bit too much silicon is better than not enough and that the slight imperfection has no negative impact on the quality of the modules. Ultimately, both of the JS Solar modules cut a very good figure coming out of the tests. Soon the PV+Test program will enter a second iteration. Some of the tests will be adjusted for PV+Test 2.0 and others will become much more strict. New tests will be added, such as a test for potential-induced degradation (PID), which can occur in modules subject to excessive system voltage. The tests for temperature coefficients and low-light performance will be expanded. Measurements will be performed at a more extensive range of different irradiation levels and temperature combinations. This will enable more precise information about the behavior of modules under different conditions and enable better conclusions with regard to energy yield. Four manufacturers have already signed up for PV+Test 2.0, among them are two very well-known firms. The first modules are already undergoing testing. Interested readers can find out the results of the tests, which will appear on a regular basis in **pv magazine**. ◆

Mirco Sieg

ACTUAL TESTS AND CONTACT

PV+Test test results are documented on the **pv magazine** website:

www.pv-magazine.com/pv-test

and on the PV+Test homepage:

www.pvtest.de/index_en.html

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