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The Solar Power Magazine

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OFFPRINT:
Huawei

Quasi-mono hype over?

Equipment makers offer products for mono-like ingots but demand is slow

Previewed: Intersolar Munich
Many new products presented at Europe's largest PV show

Punished: Chinese PV makers
Europe puts import tariffs on wafers, cells and modules

Surveyed: Sun simulators
Overview on IV-measurement equipment for modules

Terminated: Italian PV program
Successful feed-in tariff program reaches funding limit

Watch out, SMA

Huawei is a player in the global telecommunication market that decided to dabble in inverters. On its first try, its device makes it into the top three of PHOTON's ranking – even without SiC transistors

When a company like Chinese-based Huawei Technologies Co. Ltd. decides to start a new venture, one can be sure it doesn't aim to just sell a few thousand devices. With revenue of $35.4 billion in 2012, a profit of about $2.48 billion, and more than 150,000 employees, Huawei is a new player in the inverter market that has the potential to give market leader SMA Solar Technology AG a run for its money, if not outright scare it. Not surprisingly, the PHOTON engineers were very eager to get their hands on one of the first devices from Huawei's new inverter series, which was tested under the usual agreement.

And they were not disappointed. Not only the high efficiency – achieved without using silicon carbide (SiC) transistors, no less – caught the engineer's attention, but also the overall impression of the inverter. Many inverters coming out of China show poor workmanship and use a large amount of glue to attach electrical components. Getting these devices to work is usually complicated and often success is only achieved on a second try. There is no way to objectively factor these things into a rating, so the PHOTON grade does not reflect them. When an inverter doesn't show any of these flaws, like the one from Huawei, its »A+« grade is all the more valuable.

Construction

The Huawei Sun2000-20KTL is part of a series of six transformerless inverters with nominal AC powers from 8 to 20 kW. Of those, the three least powerful models feature two MPP trackers, while the most powerful ones have three. The Sun2000-20KTL is designed with six circuit boards on two different levels. All the power elements are on the lower level connected to one big circuit board. Through an opening in the housing, warm air can escape and is guided through a cooling element, which is screwed onto the back of the housing. The filters on the DC as well as on the AC side are mounted on the circuit board on the upper part of the housing, where one can also find part of the control circuit board and a power supply unit. Additional parts of the control unit are mounted on a small circuit board that is attached to the lower board through spacers. An aluminum sheet attached directly to the housing hosts another circuit board. The sheet can be disassembled without having to move any other circuit board. Six chokes are molded directly into the upper part of the housing.

On the lower left side of the housing, there is an internal DC disconnect as well as the connectors and a DC fan. Alongside the connectors you will also find some small circuit boards with capacitors. Close to the AC connectors, there is a gas discharge tube as well. Finally there are three small chokes hidden under a piece of sheet metal.

The aluminum housing consists of four parts including the cooling body and has an IP 65 protection type. Since the Sun2000-20KTL does not use any extra fans for cooling, the inverter can be mounted outdoors without hesitation. Overall the device appears to be sorted out very well. The electrolytic capacitors in the power element and in the control electronics have a 105 °C temperature rating and are well suited for outdoor temperatures. Both the connectors for the solar generator as well as for the grid enter the housing through its underside. On the DC side there are two Amphenol connector pairs for each tracker – the AC side uses Amphenol connectors as well. The inverter features a USB port and two RS486 ports.

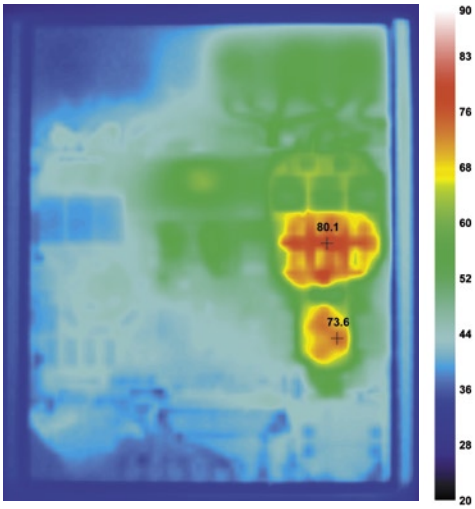
Operation

The Sun2000-20KTL is delivered well packaged and includes a wall-mounting bracket. At

Highlights

- The Sun2000-20KTL, with 22.5 kW nominal DC power, is the most powerful inverter of the first series of devices produced by Chinese company Huawei
- The inverter has three MPP trackers and no transformer, and it feeds on three phases into the grid
- The PHOTON efficiency for medium irradiation is 98.0 percent and for high irradiation 98.1 percent, which makes the Sun2000-20KTL one of only four inverters ever to receive an »A+«; and the device ranks third in the list overall
- As both of the higher ranked inverters – from SMA and the other from Refusol – use silicon carbide transistors, Huawei could easily kick the SMA Sunny Tripower STP 2000TLHE-10 off the throne, if it did the same with its device

Romana Brentgens / photon-pictures.com (2)



▲ Convincing appearance: From the inside as well as from the outside, the Sun2000-20KTL gives the impression of a high quality device. The thermographic camera doesn't reveal any problems either; the temperature of the film capacitors remains in the non-critical range.

48 kg, the inverter is lightweight given its nominal power. Once the solar generator is properly configured and the internal DC disconnect is activated, the device begins to operate. At the lab, the candidate took 63 seconds to run a series of tests before connecting to the grid.

The graphics-capable display has white backlighting, which insures good readability. In addition to the display, there are four LED that show the current state of the device. With the help of buttons, the user can choose between English, Chinese, French, German, Italian and Spanish, even though the test device only corresponded in either English or Chinese. The user can check and adjust a wide range of current values and error messages with the help of four buttons. DC voltages, DC current, AC voltages and AC power are readily available as well as yield and temperature. The yield can be shown as a daily or monthly value. Error messages as well as an error history are found in the alert section.

Instruction manual

The Huawei Sun2000-20KTL comes with a thorough installation manual in English. In addition to general explanations about PV systems and design, the manual includes information on connecting and installing the inverter as well as information on its operating behavior, display and alerts. According to the manufacturer, there will be manuals in German, Italian and Chinese in the future.

Circuit design

The Sun2000-20KTL is a three-phase transformerless inverter with three MPP trackers in the input. The power from the solar generator reaches the power stage via an EMI filter. The incoming voltage is adjusted by three symmetrical boost converters with »soft switching« technology. This means they only switch if the voltage or the current equals zero, thus, switching losses are reduced. In the beginning the inverter decides by itself if the MPP tracker will work independently or if all strings will be put in parallel. Through an intermediate circuit consisting of a mix of electrolytic capacitors and thin-film capacitors, the energy flows into an »3 level T-type« output bridge, which Huawei developed and patented. »3 level T-type« describes a three point half bridge with one arm from the midpoint of the transistor half bridge to the midpoint of the capacitor half bridge of the intermediate voltage circuit. The voltage circuit features two anti-parallel transistor diodes that are connected in series. The transistors and the diodes of the power stage are designed as six integrated modules. The following chokes smooth the voltages blocks into sinusoidal waves with a grid frequency of 50 Hz.

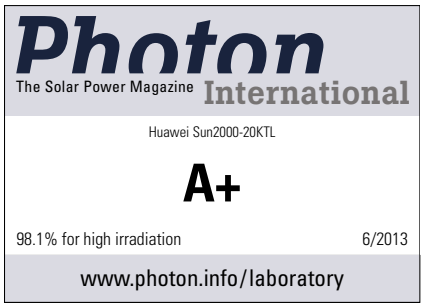
A subsequent automatic disconnect separates the inverter from the grid if it detects that grid voltage or frequency deviate from predetermined values. Additionally, the unit monitors for grid-side leakage current and excessive insulation resistance on the DC side. An output filter, installed directly in front of the grid terminal, filters out radio interference.

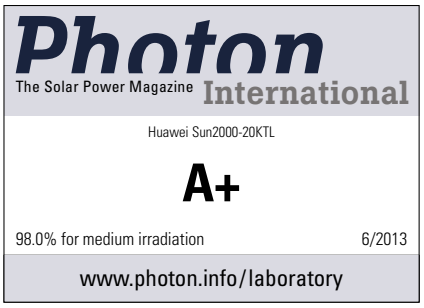
Measurements

All of the following measurements are based on a grid voltage of 230 V. The Sun2000-20KTL's maximum DC voltage is 1,000 V, and its DC nominal power is 20,600 W, a solar system of no more than 22,500 W can be connected to this inverter.

Due to the inverter's multitracker design, the MPP voltage range can be defined in several ways:

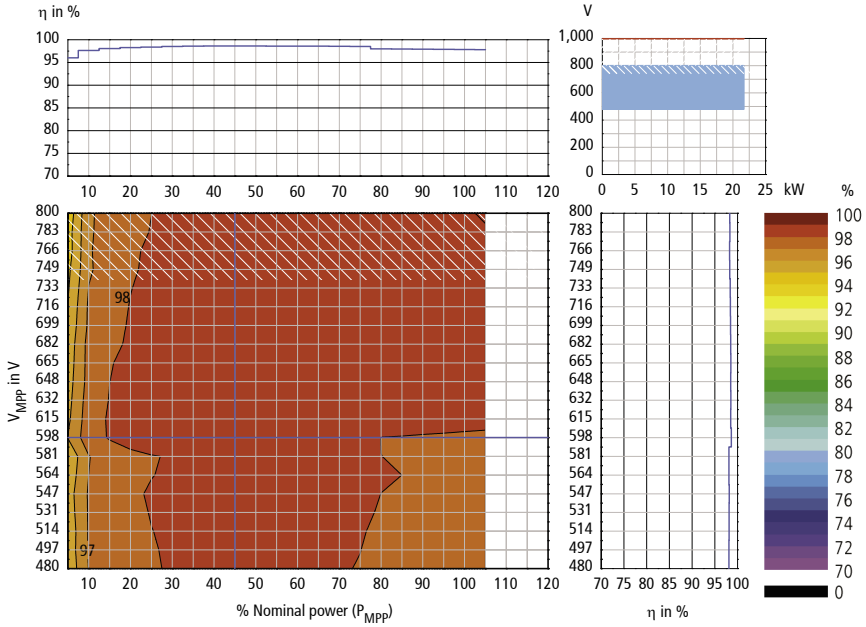
Case 1: If the DC power is distributed symmetrically to the MPP trackers and is given as the sum of DC nominal power, then the MPP voltage range can be defined in the same way as for single-tracker inverters. That is, the inverter can process 100 percent of its DC nominal power at any voltage level within this range.





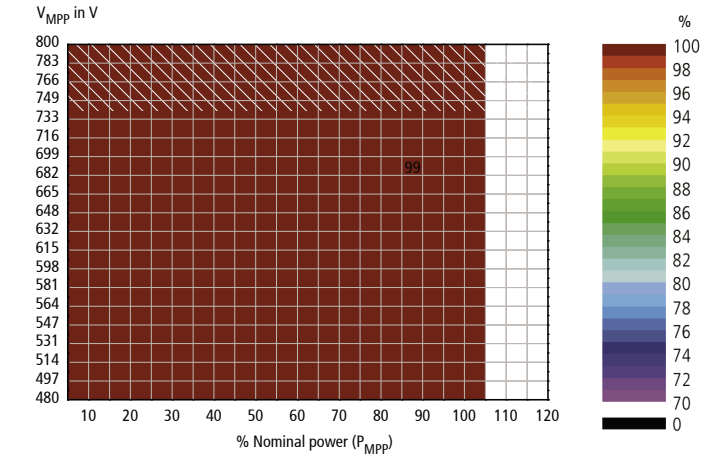
Conversion efficiency (symmetrical)

In symmetrical mode, the conversion efficiency reaches more than 98 percent almost over the entire working range. The maximum conversion efficiency is found at 45 percent of nominal power and 598 V MPP voltage, which is identical with the manufacturer's specs.



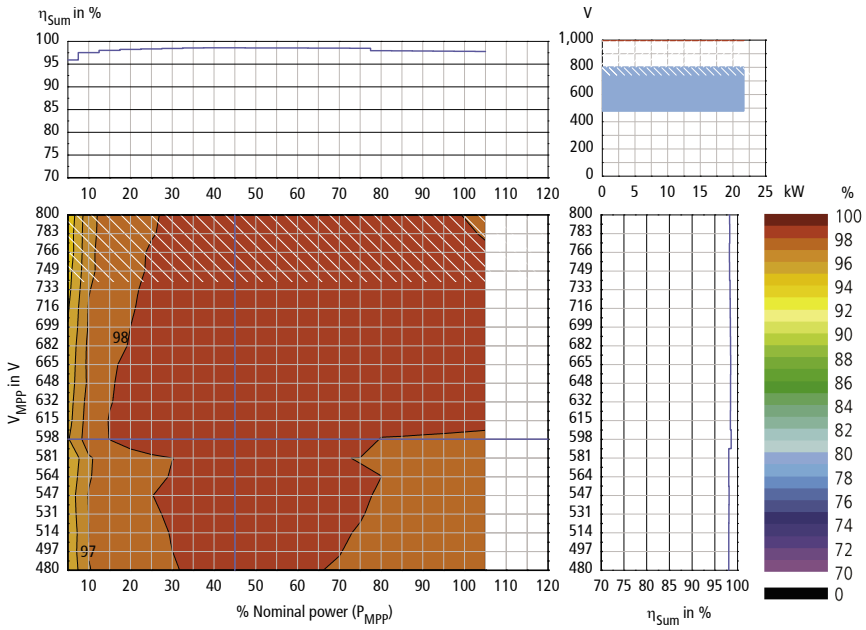
× MPPT adjustment efficiency (symmetrical)

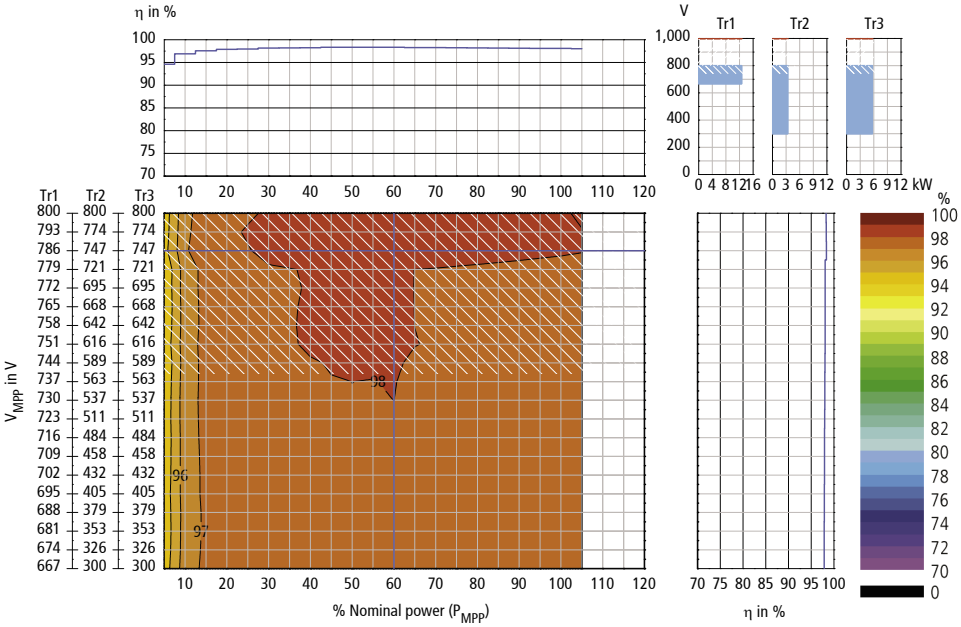
The MPPT adjustment efficiency in symmetrical mode appears to be more than 99.8 percent for all three trackers over the entire working range.



= Overall efficiency (symmetrical)

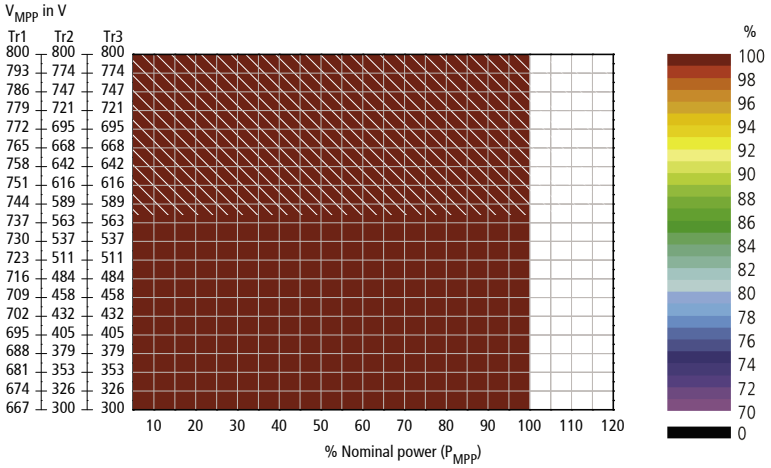
Due to the high MPP adjustment efficiency, there is almost no difference between the conversion efficiency and the overall efficiency, which tops out at 98.6 percent.





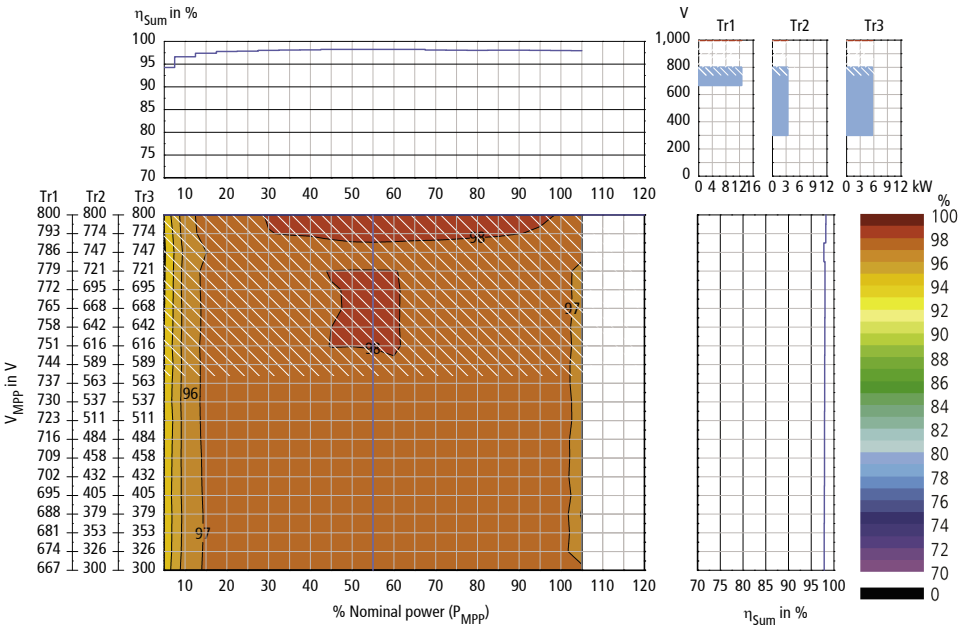
Conversion efficiency (asymmetrical)

In asymmetrical mode, the conversion efficiency resembles that of the conversion efficiency in symmetrical mode. However, the range depicting values above 98 percent is significantly smaller and shifted toward higher MPP voltages. The maximum is found at 60 percent nominal power and an MPP voltage of 786 V (Tracker 1) and 747 V (Tracker 2 and 3), respectively.



× MPPT adjustment efficiency (asymmetrical)

In asymmetrical mode, the MPP adjustment efficiency for all three trackers comes out at more than 99 percent over the entire working range. Only tracker 2 and 3 show a few points where the efficiency falls under 99 percent.

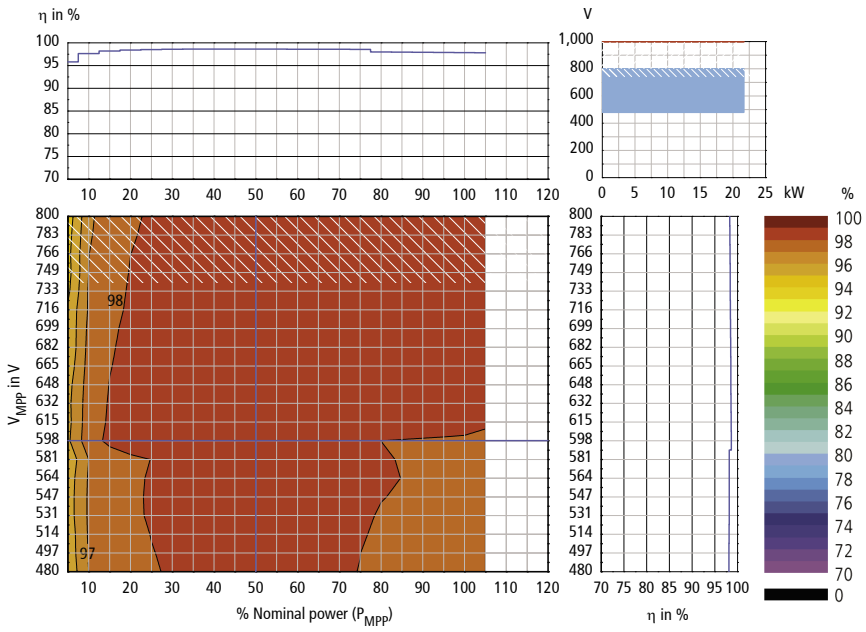


= Overall efficiency (asymmetrical)

Compared to symmetrical mode, the overall range of efficiencies over 98 percent is significantly smaller. The overall efficiency maxes out at 98.2 percent at 55 percent nominal power and 800 V.

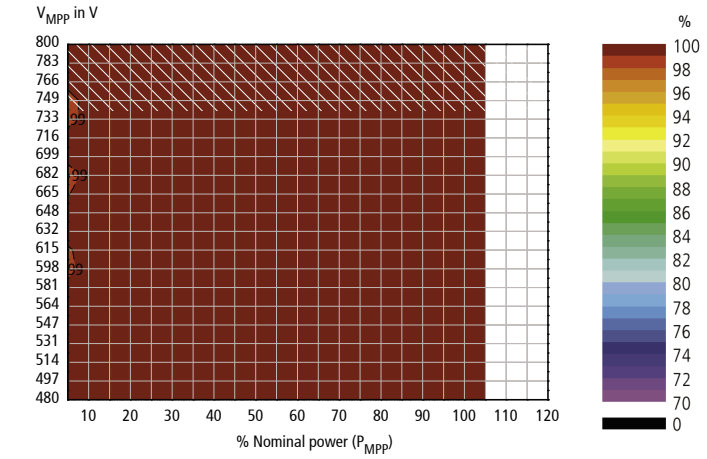
Conversion efficiency (parallel)

If the trackers are in parallel mode, the inverter basically functions as a one-tracker device. In this case, the conversion efficiencies are almost identical to those in symmetrical mode. The maximum conversion efficiency of 98.6 percent is found at 50 percent nominal power and 598 V MPP voltage.



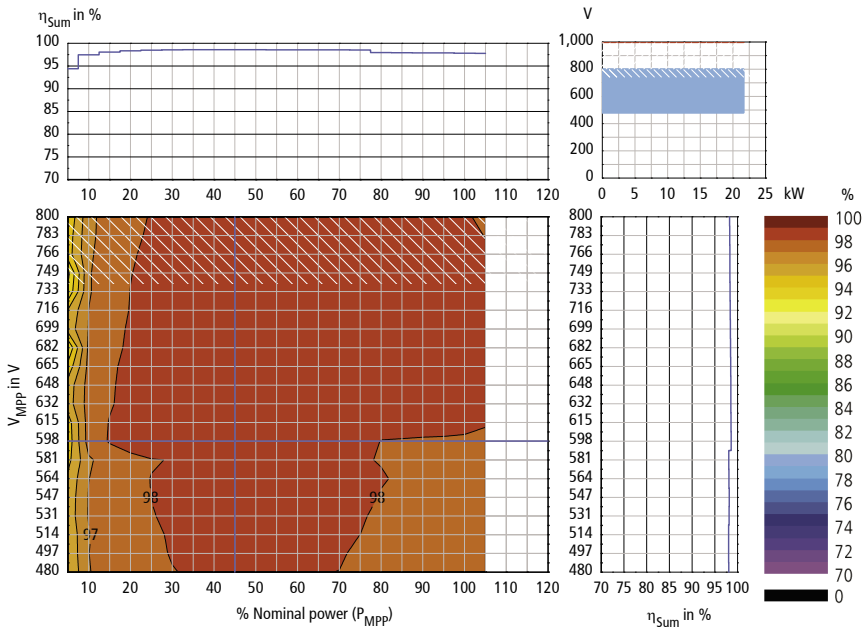
× MPPT adjustment efficiency (parallel)

The MPP adjustment efficiency is almost always over 99 percent, with the only exception at 5 percent load.



= Overall efficiency (parallel)

In parallel mode, the vertical line at 45 percent nominal power and the horizontal line at 598 V MPP voltage mark the maximum of 98.6 percent – which is identical to that achieved under symmetrical mode.



Case 2: If the DC power distribution can be divided asymmetrically among the number of tracker inputs, the product's datasheet must specify the DC system nominal power and the maximum power of each individual tracker. Consequently, there are two complementary definitions for the MPP voltage range: a range for the tracker or trackers operating at maximum DC power and for the other tracker or trackers operating at reduced power.

Case 3: Another option is to connect the trackers in parallel.

To allow for easy comparison, the PHOTON efficiency is calculated based only on the device's performance while the MPP trackers are operating under a symmetrical load (scenario one).

Locating the MPP: At the start of testing, the DC and AC sides were shut off. At a predetermined IV curve with nominal power and an MPP voltage of 632 V, the inverter needs 1 minute to connect to the grid and another 57 seconds until all three trackers reach their MPP. When switching from 632 V to 615 V, the inverter takes 22 seconds. While switching to 648 V, it takes 26 seconds.

MPP range: The Sun2000-20KTL's MPP range stretches from 480 to 800 V, which makes it a wide-range inverter. For silicon crystalline modules, the maximum MPP voltage is sufficiently separated from the maximum input voltage of 1,000 V. For thin-film modules, the distance is a little too narrow. Given the three ways the MPP trackers can work under load, there are different MPP ranges as well.

1) All three trackers face a load of one third of the DC nominal power, respectively. In this case the MPP range spans from 480 to 800 V and equals that of a wide-range inverter.
2) Tracker 1 faces a load of 12,000 W in the range of 677 to 800 V, while tracker 2 works in the range of 300 to 800 V with a load of up to 3,200 W. Tracker 3 works within the same voltage range as tracker 2 and faces the remaining load of 5,400 W.
3) All three trackers work in parallel mode within a voltage range of 480 to 800 V facing the DC nominal power of 20,600 W. The Sun2000-20KTL is able to adjust to this mode automatically.

Conversion efficiency: The inverter can process 105 percent of its nominal power in an MPP voltage range of 480 to 800 V. Hence, efficiencies could be calculated for this range.

At the top of the diagram, the hatching in the small area around 1,000 V represents limitations when the inverter is used with thin-film modules. These limitations are due to the insufficient distance between the maximum MPP and maximum DC voltages.

1) In symmetrical mode, the range for the maximum conversion efficiency starts at 25 percent of the nominal power and stretches over the whole MPP range from 480 to 800 V. If the current is above 80 percent of the nominal power, the inverter can't keep its efficiency above 98 percent if the voltage falls below 615 V. The maximum conversion efficiency of 98.6 percent is reached at 45 percent of nominal power and a MPP voltage of 598 V, which equals the value the manufacturer claims. The conversion efficiency loses about 0.5 percentage points toward smaller MPP voltages and up to 0.4 percentage points toward high voltages. At power levels below 15 percent of the nominal power, the conversion efficiency is reduced by up to 4.3 percentage points. At nominal power, the power factor cos φ was about one.
2) In asymmetrical mode, the large plateau that marks the area of maximum conversion efficiency is pretty close to the one in symmetrical mode except that it is significantly smaller and has moved toward higher MPP voltages. The asymmetric is very pronounced, and it is remarkable that the inverter dials all the trackers in at the same voltage when the highest MPP voltage is used. The reason for this is that the device chooses its operation mode by itself and if the open circuit voltages are very close to each other it changes the tracker to parallel mode. As a result, the difference between the defined MPP voltages is much smaller in the upper voltage range than in the lower voltage range. We find the maximum conversion efficiency of 98.3 percent at 60 percent nominal power and MPP voltages of 786 V (tracker 1) and 747 V (tracker 2 and 3). The hatching reflects the limit of tracker 1.
3) In parallel mode, the efficiency curve turns out to be almost identical to the one in symmetrical mode. The maximum conversion efficiency of 98.6 percent is reached at 50 percent nominal power and 598 V.

Weighed conversion efficiency: The Sun2000-20KTL's European efficiency reaches its peak of 98.3 percent at a MPP voltage range of 598 to 648 V, which is identical to the manufacturer's statement. The difference between the inverter's maximum conversion efficiency and its maximum European efficiency is 0.3 percentage points. The device's maximum Californian efficiency is 0.2 percentage points higher at 98.5 percent, occurring in the MPP range of 598 V.

MPPT adjustment efficiency:

1) In symmetrical mode, the Sun2000-20KTL's MPPT adjustment efficiency for all three trackers remains consistently above 99.8 percent.
2) In asymmetrical mode, the picture is pretty much the same. Over the whole range, the MPP adjustment efficiency for all three trackers is above 99 percent. There are only a few single points where tracker 2 and tracker 3 show values lower than 99 percent.
3) In parallel mode, the MPPT adjustment efficiency is again higher than 99 percent with a few exceptions at 5 percent of the nominal power.

Overall efficiency: The overall efficiency is calculated by multiplying the conversion efficiency and the MPPT adjustment efficiency.

1) In symmetrical mode, the overall efficiency shows no noticeable differences to the conversion efficiency, which was to be expected because of the high MPPT adjustment efficiency. The overall efficiency maximum is 98.6 percent.
2) In asymmetrical mode the overall efficiency is 0.4 percentage points lower (98.2 percent) at 800 V and 55 percent of nominal power.
3) In parallel mode, the inverter functions like a one tracker device. The vertical line at 45 percent nominal power and the horizontal line at 598 V MPP voltage mark the maximum overall efficiency at 98.6 percent, which is identical to the results in symmetrical mode.

Course of overall efficiencies, average overall efficiency and PHOTON efficiency: The overall efficiency curves for the symmetrical mode at different MPP voltages all start at high levels and fall ever so slightly after peaking. The PHOTON efficiency at medium irradiation is 98.0 percent, while the PHOTON efficiency at high irradiation is 98.1 percent, which translates into an »A+« in both cases.

Feed-in at nominal power: The inverter feeds in 100 percent of its nominal power over an input voltage range of 480 to 800 V at an ambient temperature of 25 °C.

Displayed output power: The Sun2000-20KTL was fed output power varying from 5 to 100 percent of its nominal power at a constant MPP voltage of 632 V (that is, in the medium range). The output values displayed by the inverter were compared with those recorded by a power analyzer. This revealed deviations of up to + 0.39 percent. Beyond 20 percent of nominal power, the error level was about +/- 0.1 percent. This rises slightly once the inverter works in the overload range. This means that the accuracy of the display corresponds to a class B meter (similar to precision class 1).

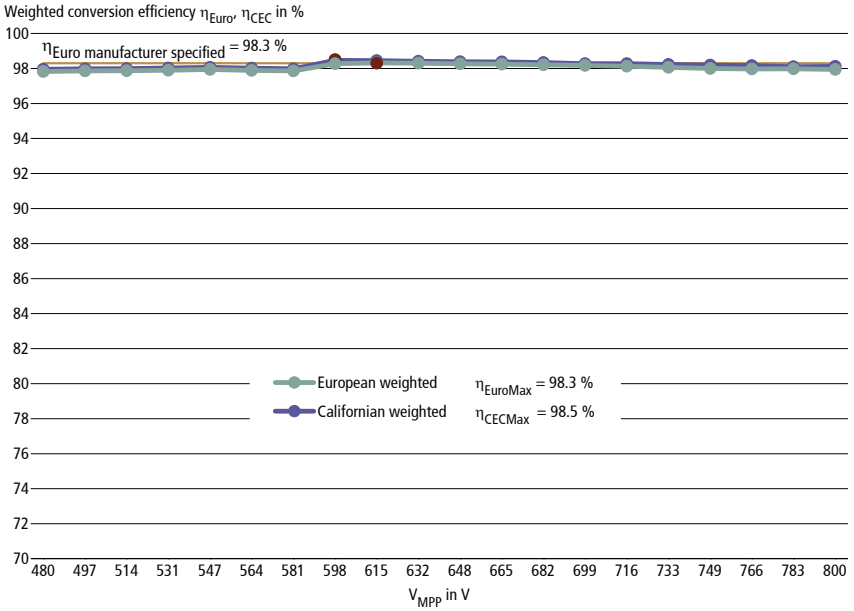
Operation at high temperatures: As ambient temperature increases, the Sun2000-20KTL feeds 100 percent of its nominal power into the grid up to around 59.2 °C (at 632 V MPP voltage). After that it reduces its power. The efficiency fell in this case by 0.18 percentage points.

Overload behavior: If the Sun2000-20KTL is fed an overload of 1.3 times its nominal input power – 23,780 W – at an ambient temperature of 25 °C, the inverter limits DC output to 22,406 W. This corresponds to a load of 108.8 percent, which means the device has a small overload range. When power limitations take effect, the inverter pushes the operating point on the IV curve in the direction of higher input voltage. The DC voltage then adjusts to 698 V.

Own consumption and night consumption: In the version tested, the Sun2000-20KTL's own consumption was around 0.8 W on the AC side and 21.9 W on the DC side. The manufacturer doesn't specify these values. At night, the inverter consumes around 0.9 W of real power from the grid.

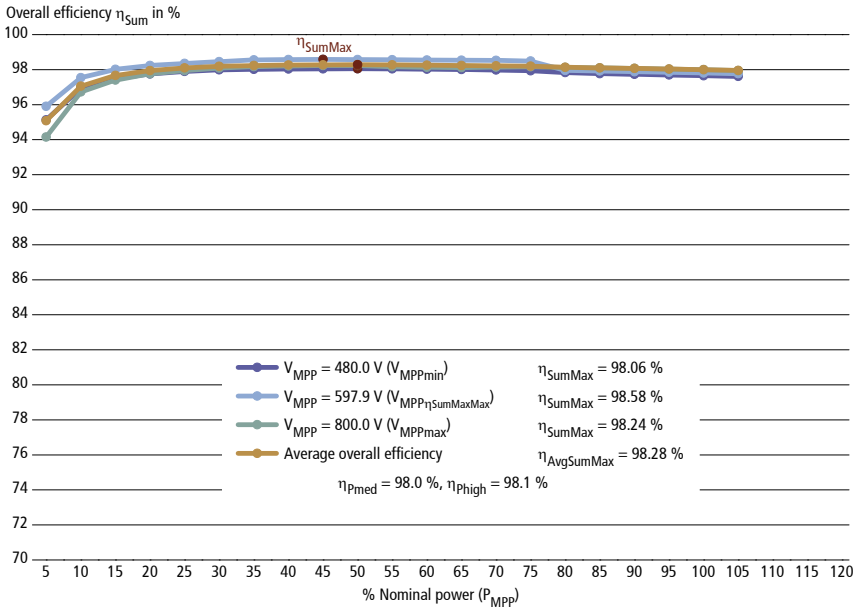
Weighted conversion efficiency

The European efficiency tops out in the range of 598 to 648 V MPP voltages and meets the manufacturer's spec of 98.3 percent. The maximum California efficiency is 98.5.



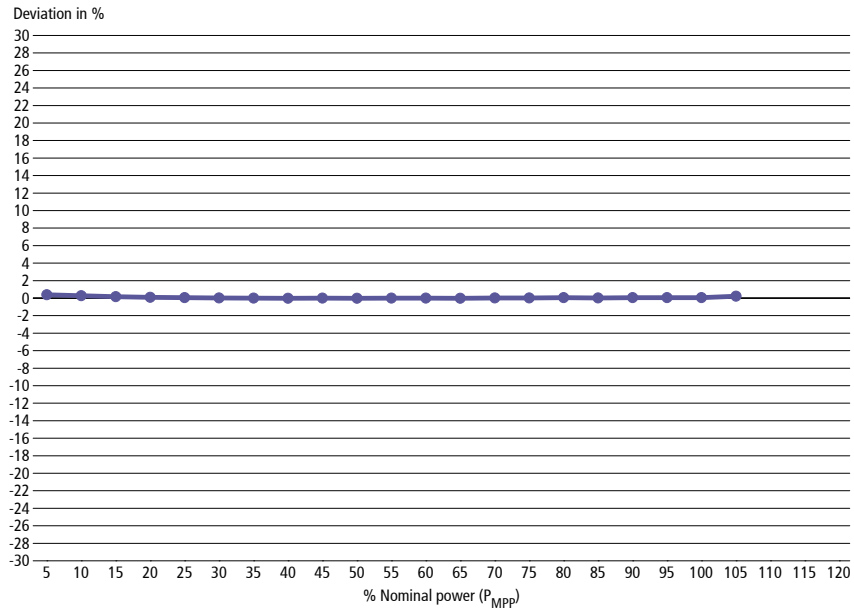
Overall efficiencies at different voltages

The overall efficiencies at different MPP voltages (in symmetrical mode) are very close together.



Accuracy of inverter display

The accuracy of the inverter display leaves very little room for improvement.



The manufacturer specifies less than 1W here.

Thermography: Thermographic imaging shows the inverter from above while operating at nominal power and an ambient temperature of 25 °C. Due to the device's many-layered design, it was impossible to capture all components with thermographic imaging. Some of the components on the visible circuit boards showed component temperatures of up to 80.1 °C in the area of the output relays. The output chokes warmed up to 73.6 °C. It is obvious that the visible DC area is cooler than the visible AC area. The thin-film capacitors in the area of the filter were in green respective to the blue range of the temperature scale.

Summary

Overall the Sun2000-20KTL presented itself as an outstanding inverter. Even though it is designed with two levels of circuit boards, it remains well sorted. Since it does not need active cooling, the inverter can be mounted indoors as well as outdoors. Only if the temperature rises above about 60 °C does the inverter start to reduce its output, which does not pose a problem in real life. The overload capacity, 8.8 percent, turns out to be on the smaller side.

There are no limitations when designing PV systems with crystalline silicon modules: the maximum MPP voltage of 800 V keeps a healthy distance from the maximum DC input voltage of 1,000 V. Only for thin-film modules does the difference turn out to be a little too small. But according to the manufacturer, thin-film modules can only be used if the module outs do not have any connection to the ground or if there is to be an electrical isolation installed on the inverter output side.

The inverter display only shows a small margin of error and can be used to track the yield without hesitation. When it comes to the efficiencies, it turns out that they are almost identical in all three different modes (symmetrical, asymmetrical and parallel) with the asymmetrical mode being the least efficient. The maximum conversion efficiency, 98.6 percent, offers exactly what the manufacturer promised. The MPPT adjustment efficiency in all three modes is equally as high over the whole working range and never falls below 99.8 percent for any of the trackers. The European efficiency reaches its maximum in the range of 598 to 648 V MPP voltages and confirms the manufacturer's specs with 98.3 percent yet again. The overall efficiency is 98.6 percent.

To determine the PHOTON efficiency, only the symmetrical mode is used. For medium irradiation the PHOTON efficiency is 98.0 percent, for high irradiation it is 98.1 percent. That makes the Sun2000-20KTL the fourth inverter ever tested to achieve an »A+« for medium irradiation. In the overall test ranking, the inverter comes in third, surpassed only by two inverters that both use silicon carbide transistors. Huawei does not build these transistors into their devices yet. In the end this is the first inverter from China that has the chance to give SMA a run for its money. ●

Manufacturer's response

The efficiency measured in this test corresponds to our own results, if one takes into consideration the degree of accuracy possible in such measurements. The result proves that inverters relying on standard silicon components, which were developed for multiple uses, still can achieve an »A+« rating for both medium and high irradiation.

Text Heinz Neuenstein, Anne Kreutzmann

Inverter test results

Inverter	Observed voltage range*1	Medium irradiation				High irradiation				PI issue
		eta_{Pmed}	Grade as of 2011	Grade before 2011	Position	eta_{Phigh}	Grade as of 2011	Grade before 2011	Position	
SMA's STP 20000TLHE-10*3	580 - 800 V	98.5 %	A+	–	1	98.6 %	A+	–	1	12/2011
Refusol's 020k SCI	490 - 800 V	98.2 %	A+	–	2	98.3 %	A+	–	2	7/2012
Huawei Technologies Co. Ltd.´s Sun2000-20KTL	480 - 800 V	98.0 %	A+	–	3	98.1 %	A+	–	3	6/2013
Diehl AKO's Platinum 16000 R3	350 - 720 V	98.0 %	A+	–	3	98.0 %	A+	–	4	3/2013
Donauer Solartechnik's High Efficiency 3.6	350 - 650 V	97.8 %	A	–	5	97.9 %	A	–	5	12/2012
Steca's StecaGrid 3600	350 - 600 V	97.7 %	A	–	6	97.8 %	A	–	6	12/2011
Steca's Stecagrid 3000	350 - 700 V	97.5 %	A	–	7	97.8 %	A	–	6	9/2012
Siemens' Sinvert PVM20	480 - 850 V	97.5 %	A	–	7	97.7 %	A	–	8	4/2011
Sungrow's SG30KTL	480 - 800 V	97.5 %	A	–	7	97.7 %	A	–	8	2/2013
Siemens' Sinvert PVM17	460 - 850 V	97.4 %	A	–	10	97.7 %	A	–	8	4/2011
Refusol's 017K	460 - 850 V	97.4 %	A	A+	10	97.6 %	A	A+	11	12/2010
Global Mainstream Dynamic´s Soldate 318KTLE	490 - 800 V	97.3 %	A	–	12	97.6 %	A	–	11	–*9
Refusol's 013K	420 - 850 V	97.3 %	A	A+	12	97.6 %	A	A+	11	12/2010
Siemens' Sinvert PVM13	420 - 850 V	97.3 %	A	–	12	97.6 %	A	–	11	4/2011
Refusol's 020K	480 - 850 V	97.3 %	A	–	12	97.5 %	A	–	15	3/2012
SMA's STP 17000TL	400 - 800 V	97.3 %	A	A+	12	97.5 %	A	A+	15	12/2010
SMA's STP 10000TL-10	320 - 800 V	97.1 %	A	–	17	97.5 %	A	–	15	10/2011
Chint Power's CPS SC20KTL-O	500 - 800 V	97.1 %	A	–	17	97.4 %	A	–	18	11/2011
Siemens' Sinvert PVM10	380 - 850 V	97.0 %	A	–	19	97.4 %	A	–	18	1/2011
Delta Energy Systems' Solivia 20 EU G3 TL	350 - 800 V	97.0 %	A	–	19	97.2 %	A	–	22	3/2012
Zeversolar New Energy's Eversol-TLC 17k*2	550 - 720 V	96.9 %	A	–	21	97.3 %	A	–	20	4/2011
Mastervolt's Sunmaster CS20TL	350 - 800 V	96.9 %	A	–	21	97.2 %	A	–	22	5/2011
Power-One's Trio-27.6-TL-OUTD-S2-400	500 - 800 V	96.9 %	A	–	21	97.2 %	A	–	22	2/2013
Refusol's 011K*3	380 - 800 V	96.9 %	A	A+	21	97.2 %	A	A+	22	9/2008
Goodwe Power Supply Technology's GW4000-SS	280 - 500 V	96.9 %	A	–	21	97.1 %	A	–	26	12/2012
SMA's SMC 8000 TL*3	335 - 487 V	96.9 %	A	A+	21	97.0 %	A	A+	30	10/2007
SMA's SMC 11000TL*3	333 - 500 V	96.9 %	A	A+	21	96.8 %	A	A+	43	7/2010
B&B Power´s SF 4600TL	250 - 500 V	96.8 %	A	–	28	97.3 %	A	–	20	–*9

*1 range at which the model was tested and to which the grade applies, *2 Eversolar New Energy Co. Ltd. and Zof New Energy Co. Ltd. merged at the end of 2011 and altered their name to Zeversolar New Energy Co. Ltd.; Zeversolar now calls the device the Eversol TL 17k; however, the power data differs from the tested Eversol-T, *3 device no longer being produced, *4 renamed Solarmax 13MT3 since April 2012, *5 name changed from Eltek Valere to Eltek, *6 now Schneider Electric Industries SA, *7 prototype; device no longer being produced, *8 the identical solar inverter brands Helios Power (Riello UPS) and Sirio (AROS) are now marketed under a single brand, AROS Solar Technology GmbH, and distributed by AROS Neufahrn, *9 inverters that have been already tested by PHOTON Lab, but results are not yet published in the magazine

High-tech at Chinese prices

How leading ICT solutions supplier Huawei hopes to conquer the global PV inverter market

Despite its quickly growing international business, leading Chinese information and communication technology supplier Huawei is still a rather unknown brand beyond ICT circles. Now, Huawei – which recently recently caught up with the sales volume of global market leader Ericsson – wants to play in the premier division of solar inverters as well. Huawei targets to become, at a minimum, the world's number three in the PV grid-connection segment. PHOTON International spoke with Roland Hümpfner, head of Huawei's Research Center in Nuremberg, Germany. Hümpfner, who has been with Huawei since 2011, is also vice president of its uninterruptible power supply.

Huawei is planning on getting into the solar power business. Why solar?

There is a lot of overlap between PV and Huawei's strong suit of telecommunications. For example, cell phone towers must be supplied with power, including those in relatively remote locations. Huawei has a history of providing turn-key solutions for powering, inter alia, diesel generators and batteries – including PV and wind power plants.

And why now?

Over the past 5 years, Huawei has become accustomed to annual earnings growth just over 30 percent. Growth is one of Huawei's goals, so we asked ourselves: How can we continue to grow? This is what is driving Huawei to develop its portfolio in other related energy sectors full steam ahead. Photovoltaic inverters and uninterruptible power supply are the two new product areas we now want to bring to market. This decision was actually made 3 years ago.

And why specifically inverters?

Inverters are a good match for Huawei since cutting-edge power electronics are used in the telecom business in the form of 48 V rectifiers. Our power electronics business also provides us with a solid foundation on which to build. Huawei is committed to becoming a technology leader, which is why we have invested in the European Research Center Energy in Nuremberg, Germany. The Nuremberg area offers good infrastructure and a large number of suppliers, semiconductor manufacturers for the power electronics spectrum, and other resources.

So can we infer that this inverter technology was developed in Nuremberg?

With regard to development, we in Nuremberg work in close collaboration with our colleagues in China. We took the lead in the conceptual development of the SUN2000 series. We then worked jointly with our Chinese engineers to perfect its design and ready it for production.

This, of course, is not the first Chinese inverter we have tested at PHOTON Lab. And many of them have had very high efficiencies. Huawei, too, wants to compete in the highest efficiency class.

People expect a lot from Huawei. Our products have come to enjoy »world class« status. With such a reputation to uphold, we cannot afford to enter the market with a mediocre, made-in-China inverter. That just doesn't cut it. Huawei places a lot of emphasis on innovation: a very large proportion of our 140,000-strong global workforce – a whopping 44 percent – is employed in research and development. Huawei, moreover, invests 12 percent of its sales earnings in R&D. The goal is to enter the market at the top by offering customers real value: technologically top-drawer inverters that are also attractively priced.

You say your devices will be »attractively priced«. So what do you expect them to cost per watt, say for a 20 kW inverter?

Huawei will adjust its pricing to align with market averages. The cost of an inverter usually represents 10 to 15 percent of the cost of an entire system, depending on how big the installation is. This cost share will not change much in the future, either. When the end customer can purchase an entire system for €1,000 ($1,360) per kW, the cost of the inverter will also be priced accordingly, in proportion to the whole system. Based on this, 10 euro cents (14¢) per W is in the ballpark.

I assume that is the price for installers, right?

It is difficult for us to predict what the prices for installers will be since we will be selling our products through distributors. But I think we should keep our sights on the mid to long-term goal of 10 euro cents (14¢) per W for installers.

The Huawei inverter that we have in our lab still uses the classic IGBT (insulated-gate bipolar transistor) rather than silicon carbide transistors. Is there a special reason for this?

We researched this matter thoroughly. We do not feel that silicon carbide switches are ready yet for series production on a large scale. Moreover, without using silicon carbide, we are playing in the same league in terms of efficiency as devices that do use it. So we currently see no need to use that technology.

Are you also concerned about there being too few supply sources?

Exactly. If all inverter manufacturers were to convert to silicon carbide today, the silicon carbide industry would not be able to cope with the demand. Also, silicon carbide transistors are more expensive because it is technologically quite difficult to produce good ones. If and when silicon carbide transistors become cheap and readily available from many suppliers, we will again consider using them.

What we have observed is that silicon carbide switches are definitely already being used here and there, but so far mostly as a relatively simple substitute for the IGBT. Manufacturers use their existing IGBT topology with the same switching frequencies but then use the silicon carbide transistors to achieve half a percentage point more efficiency. But they don't exploit the ability afforded by silicon carbide transistors to raise pulse frequency in order to save on component costs.

This technology will certainly continue to develop, and then we will have to see what the market demands – more efficiency or more price concessions.

Regardless, you will no doubt be able to produce your inverters very inexpensively since you can buy the components at lower costs.

Of course, with our many suppliers, Huawei can negotiate high volume discounts. But this is also why we decided to stick with standard components – to ensure we can continue to deliver our products to customers.

So how much market share are you aiming for?

We want to become one of the top-tier suppliers. Long term, we want to be in the top three. It remains to be seen how long it will take us to achieve this and whether we can do so quickly with our first generation products.

Have you set specific sales volume goals for this or next year?

Yes, but we can't discuss that here.

So what is your inverter production capacity, then?

We want to expand into the multi-hundred megawatt range. Production will take place at facilities in the Song Shan Lake Science and Technology Industrial Park in Dongguan, about 30 km north of Shenzhen.

What, then, is your expectation as to how inverter prices will develop?

Some manufacturers are already feeling some price pressure today, which means their profit margins will be subject to a little more pressure. There is a lot of competition in the PV sector and this will give rise to a technology race as well. In the final analysis, we can simply state that inverter production costs are very closely related to weight and volume. With higher power densities, prices in the future could go down more.

How will you make your inverters appeal to installers, especially when it comes to things like service and support?

We will have the standard service strategy and policies which are demanded by the market and fulfilled by the installer, distributor and manufacturer working in close coordination with each other. Huawei has a worldwide service network. We have very good coverage in Germany, for example. In addition, we are making an effort to simplify the knowledge needed by the user in such a way that it can be communicated very quickly. And when there is a problem, we will provide a substitute device with no hassles. We will not be able to succeed unless we strive to make things as easy as possible for the end user and installer. We are aware of this.

Do you use your own service personnel?

Service is provided partly by our own employees and partly outsourced. In Germany, for example, Huawei has its own service company. They have really great infrastructure there and relatively short response times, so they can provide assistance locally very quickly – in fact, quicker than is typical for solar technology today. In the telecommunications field, you have to be able to provide assistance within hours. So you have about 2 to 4 hours to get from your central office out to wherever.

Inverter manufacturers are increasingly offering devices that include a built-in battery or that can be retrofitted with one.

That is an interesting idea. I like it very much. We have a lot of experience with our battery systems in setting up cell towers in areas without or with only poor access to the grid. We have set up about 180,000 battery-based power supply systems, some of which are already equipped with solar generators. These systems are extremely accessible and, in the future, we will be offering them outside of the telecom field as well.

Let's talk about grid stability: How important is this topic to Huawei and how will your inverters be able to make a positive contribution in this area?

Huawei is on board with the smart grid idea. We are examining the question of additional uses for inverters. Inverters are capable, without much extra investment, of maintaining grid stability. There are quite a few possibilities in this area. For example, you can limit peak output under certain circumstances. If you hold back a certain reserve capacity – for example, not feed all available energy into the grid but rather, say, 10 percent less than the maximum – then in effect you have created a virtual 10 percent reserve. This can be used to stabilize the grid and very profitably at that.

Let's say I am an installer in Germany who has been using SMA inverters for 20 years.

Huawei Technologies Düsseldorf GmbH

▲ Roland Hümpfner is the head of Huawei's European Research Center Energy in Nuremberg, Germany. He is also VP of its UPS and Inverter Product Line.

How will you persuade me to try out a Huawei inverter?

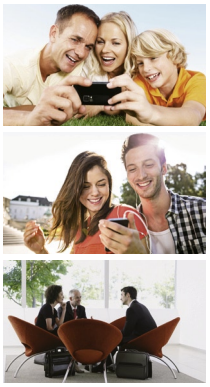
We have spoken with a number of installers. They are very open about trying something new. Many of them really like to experiment. And with the Huawei name, we find ourselves very well received. When we say, »We are from Huawei,« people want to talk to us. They say, »Yeah, okay. Sounds good.« There is a general climate in which Chinese manufacturers, too, are now being considered by many, many installers. On the other hand, people expect Huawei to deliver world-class products with cutting-edge technology at Chinese prices. I am convinced that we will be able to meet these expectations. ●

Thank you for the interview.

Interview Anne Kreutzmann

Unit: USD Million (Sales Revenue in 2012)

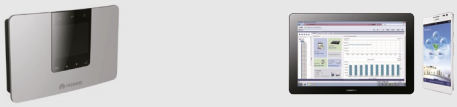
35,353



As a leading global ICT solutions provider, Huawei continually works toward realizing its vision: Enriching life and improving efficiency through a better connected world

And the vision has been powered by Huawei Energy. 1.2 Million equipments deployed in 150+ countries which are serving 1/3 global population

Site Power | Hybrid Power | UPS | Data Center Facility

SUN2000	 8KTL, 10KTL, 12KTL, 15KTL, 17KTL, 20KTL
SUN8000	 SUN8000-500KTL; 1MW Container
iManager Smart Management	 Smart Logger; iManager NetEco 1000S

Including Solar Inverters for powering further future

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