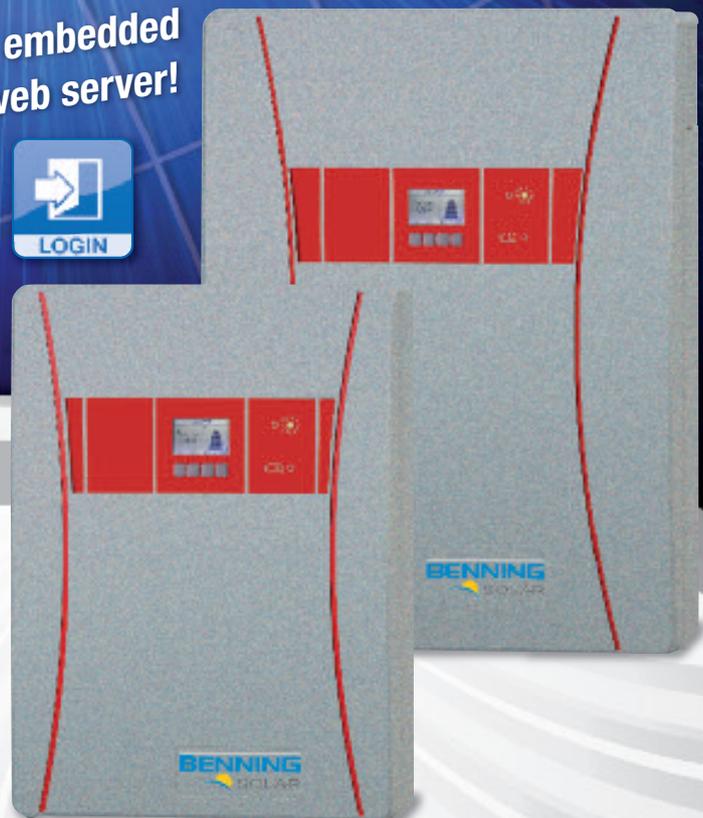


Secure • Powerful • User friendly

Sustainability and Profitability for the renewable energy age

embedded
web server!



Photovoltaic inverter

TLS Series
4,600W - 17,000W

"Our vision of sustainability is the efficient storage of renewable energy for flexible use day and night"



Safety through experience – economy through innovation

For more than half a century BENNING products have improved the safe and efficient utilisation of energy resources. Smart solutions for the conversion of energy in multi-purpose or storable energy draw the company.

BENNING is known worldwide as a "quality leader" for reliable and efficient power supplies for the telecommunications, medical and IT industries.

For example the network infrastructure of many telecommunications companies rely on BENNING rectifiers and inverters to avoid downtime and the associated revenue losses, whilst highly efficient conversion technology helps reduce their energy demand.

Even life-support systems in hospitals are connected to BENNING power supplies to minimise the risk of power outages.

BENNING engineers have now applied this reliable and efficient technology to the design of inverters for the Solar market.

Our experience in the field of energy conversion and storage forms the basis of the BENNING SOLAR PV inverter design

Look into the Future - ideas for the more efficient handling of renewable energy

BENNING Li-ion batteries and BELATRON Li-ion battery chargers are already pioneers in the motive power market for use with electric-powered vehicles. In this application, the use of a high-performance BENNING Li-ion battery provides cost savings of approximately 25% when compared to energy storage using lead acid batteries.

Powerful BENNING Li-ion battery systems for use with standby power supplies and UPS systems are already under long term test.

Efficient energy storage, combined with time of day independent power consumption provides the plant operator with extraordinary money saving potential. Sustainability pays off, because the money savings grow with each electricity price increase.

Currently BENNING SOLAR are developing concepts that make BENNING Li-ion battery and charging technology available for renewable energy storage.



Opt for "sustainable economy" with future-oriented products and a loyal partner

The BENNING SOLAR philosophy is to ensure maximum profitability through sustainable solutions that are environmentally friendly, simple to use and reliable in operation.

The sound and rigorous stewardship of our natural resources, together with the return on investment, stands at the center of our focus.

This not only affects our products but the entire supply chain, from production via the online shop to installation.

We offer our installation partners exclusive products at an attractive price-performance ratio with secure market opportunities.

Plant operators will benefit from the excellent economic performance and high reliability of our products.

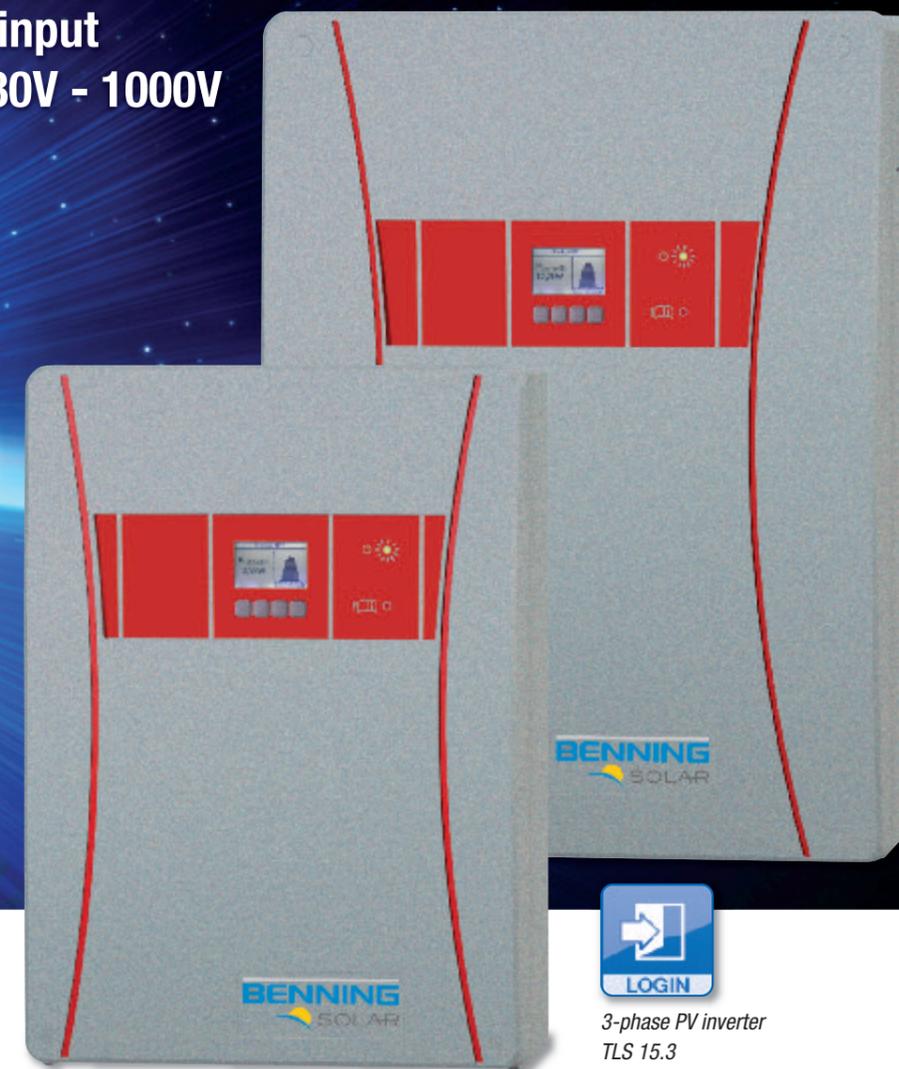


Rely on BENNING SOLAR for:

- Reliable inverter with integrated data-logger and web server for online monitoring
- High efficiency for maximum power yield
- "Plug & Play" installation
- "Made in Germany" quality
- After sales support through more than 20 international subsidiaries
- Guarantee from a German manufacturer
- An intelligent value concept
- On-line shopping with first class logistics and short delivery times



Flexible design, input voltage range 280V - 1000V



1-phase PV inverter
TLS 5.1



3-phase PV inverter
TLS 15.3

Simple and flexible – we focus on the essentials!

The range of plant design possibilities is endless. Different types of modules, inverters, locations, roof pitches and much more must be aligned and merged to optimise the overall system.

The wide input voltage range of BENNING Solar Inverters (280V - 1000V) provides flexibility of use at various power levels and in a variety of applications e.g. :

- Private homes
- Agriculture
- Industrial and commercial roof tops
- Open spaces

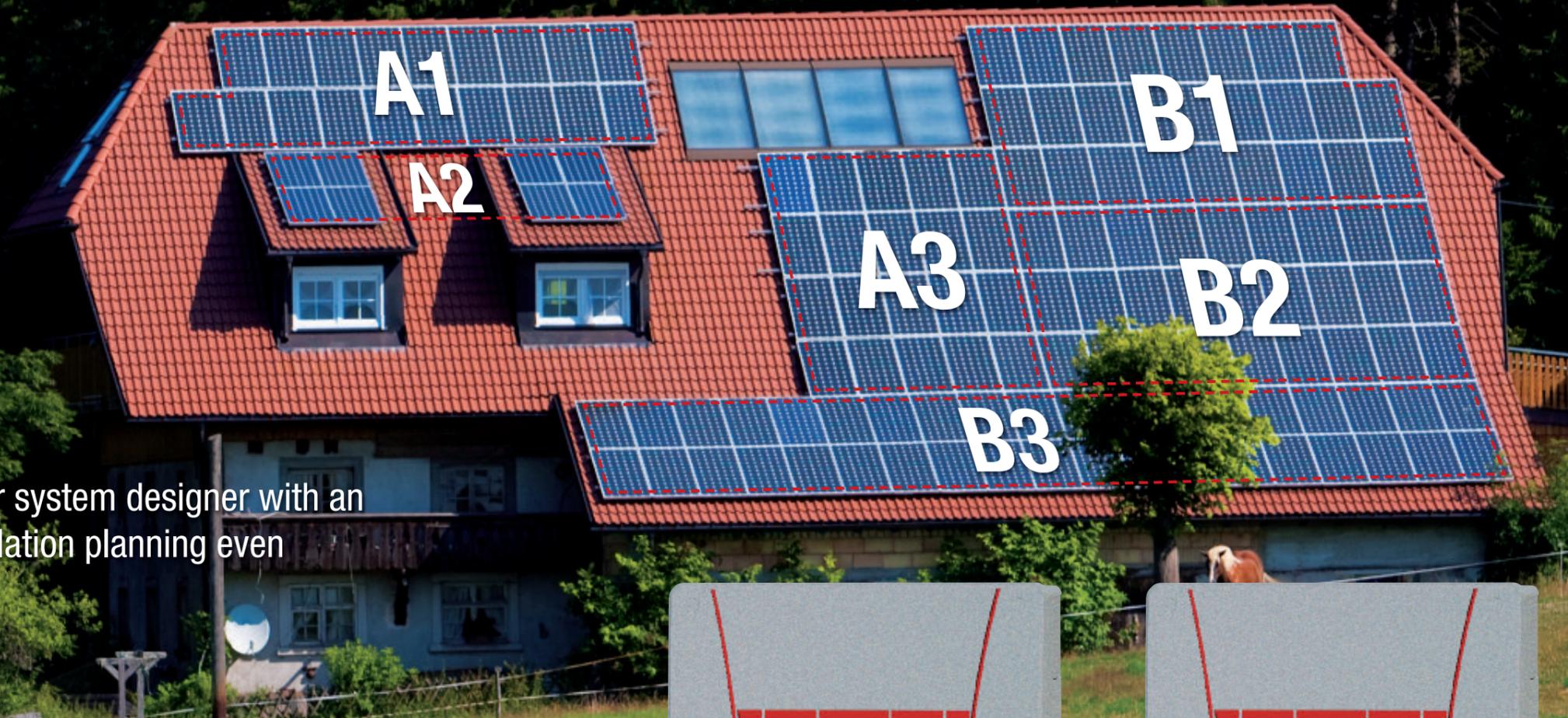
Benefit from:

- Reduced storage costs
- Increased liquidity
- Greater flexibility
- Simple planning
- Faster installation

Advantages that pay off!

**High system efficiency
by 3 MPP tracker**

"The TLS series provides the solar system designer with an inverter which simplifies PV installation planning even with complex roof structures."



**MPP tracking: fast, flexible & efficient
– Tripled**

The maximum power point (MPP) of the PV system is directly dependent on the temperature and solar radiation. These conditions vary constantly throughout the day. The MPP must be identified as quickly and accurately as possible, thereby ensuring that the Solar system always achieves optimum revenue.

Every inverter has up to 3 separate MPP trackers to meet this requirement.

The wide MPP input voltage range (300V - 800V) increases the flexibility of the Solar system design.

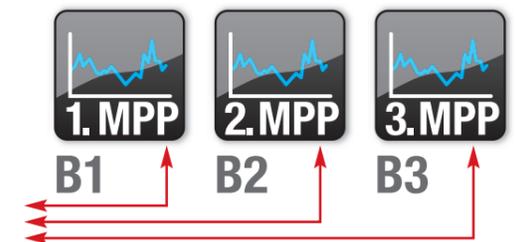
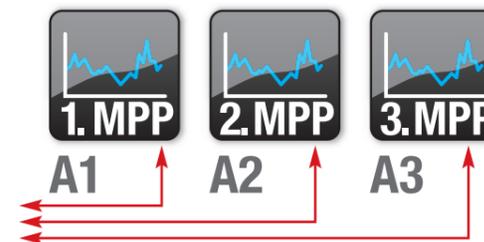
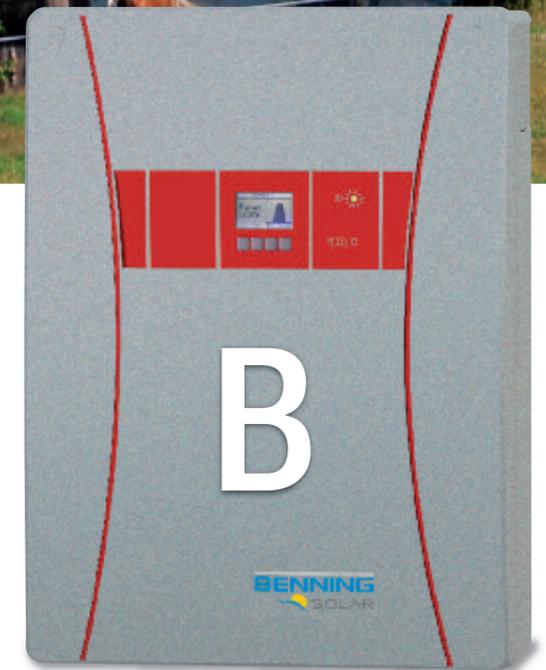
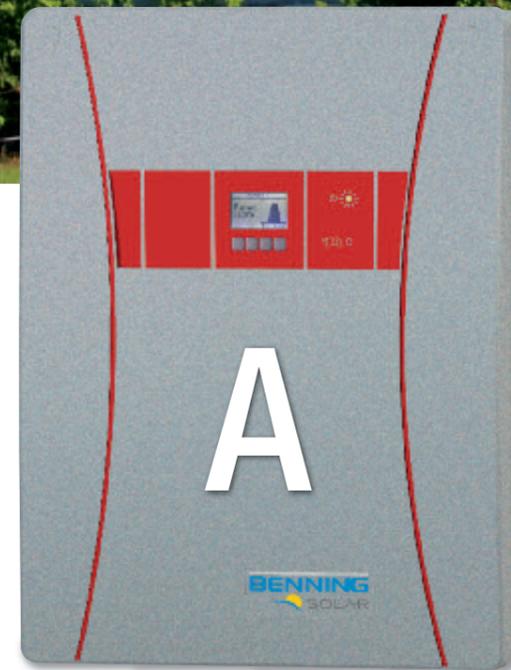
Different roof pitches? No problem!

To maximise total investment return, the 3 MPP trackers regulate different strings, to take account, for example, of different roof pitches and partial shading.

This can **increase system efficiency by 2-3%**, significantly increasing energy generation and consequently, profitability.



Multiple MPP tracking takes maximum advantage of the solar radiation, even in small scale applications such as the home. All it takes is a single TLS inverter.



*BENNING SOLAR PV-inverter TLS 15.3
The maximum power point of each roof pitch is separately identified.*

*BENNING SOLAR PV-inverter TLS 15.3
Individual string control maximises revenue despite varying roof pitches and partial shading*



**Integrated data-logger
and web server,
On-line-portal inclusive**

The perfect monitoring of your Solar installation –
Convenient and reliable



Example screen shots from the BENNING SOLAR portal



On-line monitoring without any additional hardware

With increasing plant size, the requirement for reliable monitoring also grows. A system fault can mean a loss of energy and a reduction in revenue for the plant operator.

Embedded data logger and web server

All BENNING Solar inverters are equipped with an intelligent "onboard data logger" and an embedded web server. This allows each inverter to communicate with the BENNING SOLAR Internet portal **without the need for additional communication hardware.**

In multiple inverter systems a communication connection is made to only one device with fast and secure communication between devices handled by a standard serial bus interface.

Income security through on-line system monitoring via the BENNING SOLAR portal

Online portal for secure access worldwide

The monitoring and analysis platform within the BENNING SOLAR portal can be conveniently operated via a PC or an Android OS based device.

As well as the evaluation of revenue, other individual comparisons or analyses are possible:

- Comparison of individual inverters in multi inverter systems
- Period comparisons
- Analysis of operating conditions
- Comparison with public systems

BENNING SOLAR Portal

- Worldwide access via the Internet
- Centralized log of the PV system
- Comprehensive Reporting
- E-mail notification of faults
- Data Export feature



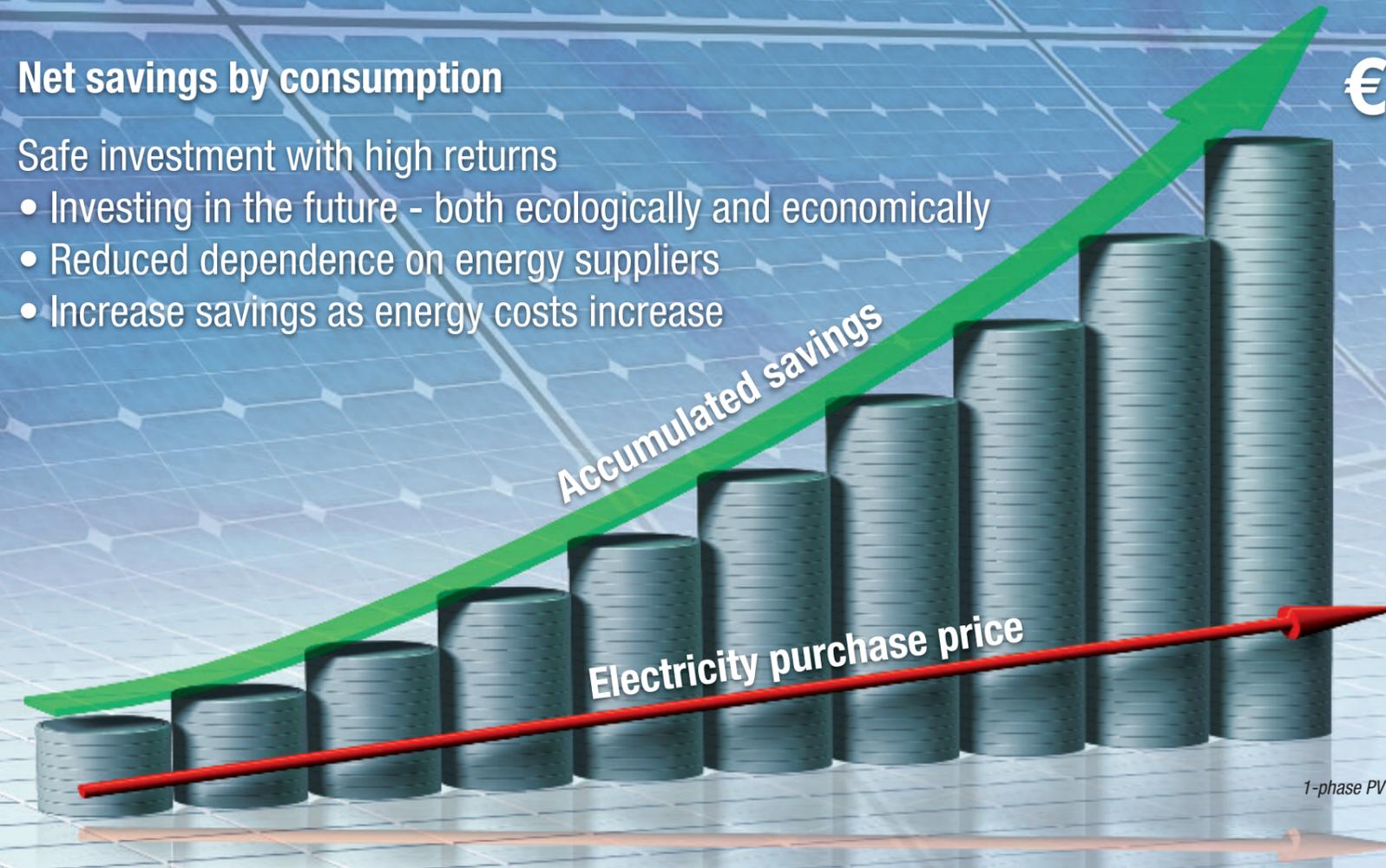
System monitoring communication possibilities



Net savings by consumption

Safe investment with high returns

- Investing in the future - both ecologically and economically
- Reduced dependence on energy suppliers
- Increase savings as energy costs increase



1-phase PV inverter
TLS 5.1



3-phase PV inverter
TLS 15.3



A price-performance ratio for smart calculators

The **competitive price-performance** ratio of the BENNING SOLAR inverter contributes to the efficient operation of the overall PV system.

Efficiency of 98% – Peak efficiency you can rely on

First class inverter efficiency of 98% is enabled by the use of the highest quality components, intelligently laid out and efficiently cooled.

The efficiency curve rises sharply, even with low sunlight and then remains nearly constant. Therefore, good revenues are available even with low solar radiation.

Made in Germany quality

BENNING SOLAR inverters are designed and built to German Quality standards. Use of the latest test methods at all stages of production provides quality assurance.

Prior to despatch all inverters are subjected to automated functional and performance tests.

This ensures that BENNING SOLAR inverters don't cause delays in the PV system installation or commissioning.

Excellent profitability combined with a long operational life

Powerful, cool and highly reliable

- Made in Germany
- Advanced testing methods for quality assurance at all production stages
- Use of high-quality components for long life
- Optimised cooling system to protect the power electronics
- Guaranteed by a German manufacturer



Automatic test facility at the production site in Bocholt, Germany

Practical solutions based on decades of partnership with electricians



"Plug & Play" significantly reduces installation time

BENNING SOLAR inverters can be manually activated or "plug and play" commissioned. All parameters can be set via either the graphical display, a laptop (RJ 45 Ethernet connection) or USB stick.

BENNING - the installers partner

BENNING has been providing electricians with innovative products that help them work more efficiently for more than 60 years. The DUSPOL® tester for example, is considered by the electrical industry to be a synonym for reliability and quality. The BENNING PV 1-1 installation tester has simplified the testing and commissioning of PV systems.

The BENNING SOLAR "Plug & Play" inverter continues this product philosophy.



BENNING PV 1-1 - multiple test and measurement procedures for commissioning and maintenance (in accordance with VDE 0126-23 (DIN EN 62446)), combined in an intuitive and easy to use instrument

Ideas into practice, together ...
... guaranteed customer satisfaction



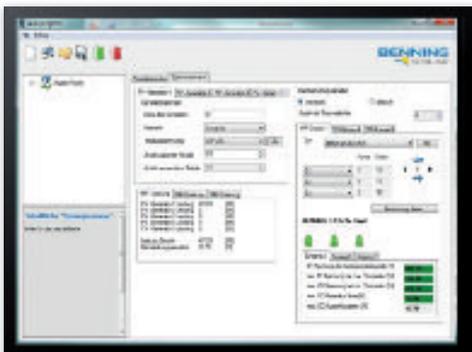
An intuitive planning tool minimises the scheduling risk and saves valuable time

Whether at the bidding or detailed design stage, by using the **intuitive BENNING SOLAR designer**, installers can quickly and easily perform all the necessary calculations to define the requirements for BENNING SOLAR inverters.

This easy to use tool avoids mistakes, increases planning security and speeds up the work.

The open structure of the planning tool database allows the manual addition of individual PV modules and third party inverters.

This reduces the future work load by enabling the user to take advantage of this "manually inserted" data in the planning process.



System design using the BENNING SOLAR designer

Service and partner programs – so that together we satisfy your customers

The most common reasons for low performance of solar systems are poor system design, low quality installation or badly commissioned PV inverters.

Benning addresses these issues by a Service & Partner program that provides the following:

- **International Service and Support**
- **24/7 hotline**
- **Technical on-site service**
- **Competent contacts in both the BENNING Headquarters and in more than 20 international branches**
- **Maintenance training on BENNING SOLAR inverters**
- **Provision of planning know-how for fast and profitable plant design**

Suitable for use in residential areas
... according to EMC regulations



Electromagnetic compatibility

According to the law, a PV inverter must not cause electrical interference to other equipment such as the Telephone, TV, Wi-Fi etc.. Additionally, external disturbances must not affect the performance or operation - particularly for safety features - of the inverter.

BENNING SOLAR places particular emphasis on the correct application of these standards. For this reason, BENNING SOLAR has its own modern EMC laboratory.

BENNING SOLAR TLS inverters meet all EMC requirements for operation in:

- Industrial areas
- Residential and commercial areas, where much stricter EMC limits apply



Type table

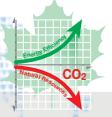
PV Inverter	TLS 5.1	TLS 8.3	TLS 10.3	TLS 13.3	TLS 15.3	TLS 17.3
DC Input						
Recommended maximum DC power	5700 W	10000 W	12000 W	15000 W	17000 W	20000 W
Maximum input voltage	850 V	1000 V	1000 V	1000 V	1000 V	1000 V
Input voltage range	180 V / 200 V	250 V / 280 V	250 V / 280 V	250 V / 280 V	250 V / 280 V	250 V / 280 V
MPP voltage range	250 – 720 V	300 – 800 V	350 – 800 V	320 – 800 V	360 – 800 V	400 – 800 V
Rated input voltage	680 V	690 V	690 V	690 V	690 V	690 V
Maximum current per input*	12 A	16 A	16 A	16 A	16 A	16 A
Maximum short circuit current per input	16 A	20 A	20 A	20 A	20 A	20 A
Start feeding-in at	20 W	30 W	30 W	30 W	30 W	30 W
Number of independent MPP inputs	2	2	2	3	3	3
Strings per MPP input	2	2	2	2	2	2
DC terminal type	SUNCLIX	SUNCLIX	SUNCLIX	SUNCLIX	SUNCLIX	SUNCLIX
AC Output						
Rated output power at (230 V/50 Hz, cos(φ)=1)	4600 W	8000 W	10000 W	13000 W	15000 W	17000 W
Maximum apparent AC power	4600 VA	8000 VA	10000 VA	13000 VA	15000 VA	17000 VA
AC connection	L / N / PE	3 / N / PE				
AC nominal output voltage range	230 V +/-20 %	3 x 400 V/3 x 230 V +/-20 %				
Power factor range, adjustable	0.9 ind. ... 1 ... 0.9 cap.					
Operating range at nominal frequency 50 Hz	50 Hz/47.5 Hz – 51.5 Hz					
Maximum output current	22 A	3 x 16 A	3 x 20 A	3 x 22 A	3 x 22 A	3 x 25 A
Distortion factor	< 3 %	< 3 %	< 3 %	< 3 %	< 3 %	< 3 %
Self consumption (Stand-by)	2 W					
Efficiency						
Maximum efficiency	97.8 %	98 %	98 %	98 %	98 %	98 %
European weighted efficiency	97.2 %	97.5 %	97.5 %	97.5 %	97.5 %	97.5 %
Protection and protective devices						
Ingress protection	IP 65	IP 65 / connection area IP 54				
Protection class	I					
Earth fault monitoring	integrated					
Residual current monitoring	integrated, sensitive to universal current					
Overload and overtemperature behaviour	operating point adjustment					
Input isolator	integrated					
Overvoltage protection-input	integrated, Type 3 as per EN 61643-11					
Overvoltage protection-output	integrated, Type 3 as per EN 61643-11					
Automatic disconnection device	as per VDE 0126-1-1					
General Data						
Topology	transformerless					
Cooling concept	convection	variable speed, temperature-controlled fan				
Operating temperature range	-20°C – 60°C					
Climatic category	4K4H according to IEC 721-3-4**					
Maximum operating altitude above sea level	2000 m					
Standards and approvals						
EMC emissions	EN 61000-6-3: 2007					
EMC immunity	EN 61000-6-2: 2005					
Equipment safety	EN 62109-1, EN 62109-2					
Certificates and approvals	VDE-AR-N 4105	VDE-AR-N 4105, EN 50438, AS 4777, AS 3100				
Dimensions and weight						
Dimensions in mm (width x height x depth)	360 x 506 x 190	455 x 612 x 213 mm				
Weight (approx.)	26 kg	43 kg	43 kg	45 kg	45 kg	45 kg
Features						
Display	liquid crystal display					
Communication interfaces	RS 485, USB, Ethernet, S0 according to DIN EN 62053-31 class B					
Data storage	24h: 5-minutes resolution / 30days: 1h resolution / 20years: 1day resolution					

* It is permitted to break this limit, if the maximum short circuit current will not be exceeded.

**The inverters are qualified for the outdoor use. Direct solar radiation and precipitation (rain, snow, hail) have to be avoided.
A necessary protection has to be provided by the customer.

technical changes reserved

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