



Connecting systems **Photovoltaics**



T. Fastabend

E. P. Benner

H. Spelsberg

Dear customers and friends,

Only when conditions deteriorate is it possible to recognise what is really important. We have never been in favour of continual growth at any price – we have always been more concerned with sensible management and responsible business dealings.

While the economy is booming, such a company philosophy is sometimes ridiculed: just think how much more you could earn if you didn't do so much research, didn't invest so much in improving your employees' qualifications, were happy to purchase cheap materials or outsourced your production to the Far East.

We didn't do any of those things, instead we steadfastly continued with our policy of innovation and quality, expanded our presence in Germany and invested in growth areas. We were the first manufacturers in our sector to offer innovative solutions for photovoltaics and this advantageous expertise is still paying off.

We offer top-quality up-to-the-minute products for a fair price. That is exactly our strength and our competitive advantage.

This is where many suppliers of super-cheap goods finally meet their match, because manufacturing such products calls for years of experience, technical competence and a functioning infrastructure, up to and including an efficient test laboratory. All of which are a matter of course for Spelsberg.

See for yourself what we have to offer: well-established products as well as innovations. Rest assured, you can continue to rely on our products and solutions:

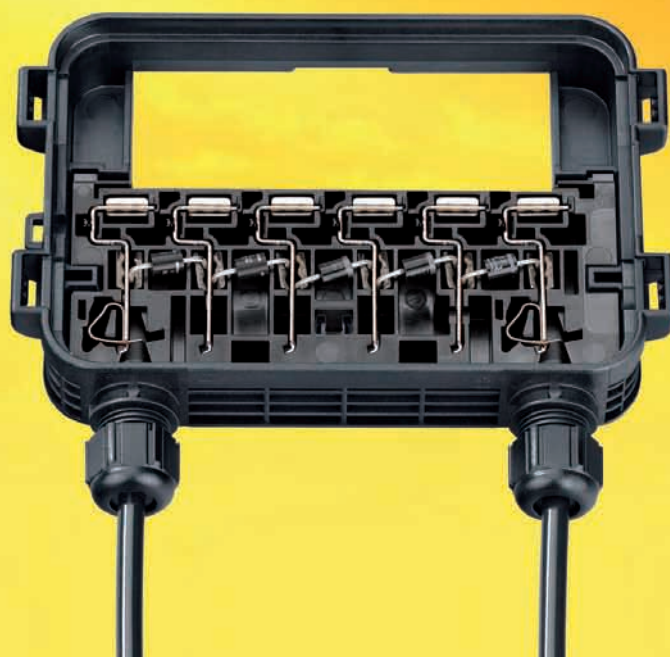
Quality Made in Germany – you can depend on it.

Your Spelsberg Management

Till Fastabend
Ernst Peter Benner
Holger Spelsberg



1987



2011

For over 100 years our company has been well known in the housing and electrical goods industry. Competent development, quality manufacturing and reliable service are the qualities that our clients have come to expect and appreciate from Spelsberg.

During the 80s, through several oil crises and steadily growing popular environmental consciousness, solar energy increasingly became a topic of discussion. As photovoltaic systems were introduced on the market, Spelsberg was among the first companies to become involved and was responsible for the development of specialised enclosures for modules.

At that time, we were unique pioneers – since then, solar modules have made their way onto many roofs; the boom appears to continue and silicon, the material from which the modules are produced, can hardly be produced rapidly enough to satisfy growing demand. Many companies are venturing into the PV market, however hardly any of them has as much experience as Spelsberg.

Over 20 years experience of PV Connecting systems



More than 100 years of installation and enclosure technology and over 20 years in photovoltaics have led to a wide, sophisticated product spectrum: "Made in Germany" brand quality – we develop and manufacture at both of our German locations. We are of course also a partner of numerous trade associations within the solar industry.



Since 1992, in addition to our main location in Schalksmühle, Spelsberg has operated a branch factory in Buttstädt, Thuringia, from which rapid delivery service to the eastern German states is guaranteed. This location was not chosen by chance: alongside our own interest in the region the Thuringian state government has been endeavouring to develop the Erfurt-Jena-Ilmenau technology triangle as a stronghold of solar energy. We have more than achieved this goal:

The region today boasts a broad and diverse spectrum of middle-sized solar companies and research institutions. For example, the SolarZentrum of the CiS Institute for Microsensor Technology has for over 10 years been synonymous with expertise in silicon technologies and is considered one of the industry's outstanding innovators.

Our partnership with "SolarInput" forges a link between industry and research and enables us to develop joint concepts for industrial research projects.

In Buttstädt we are thus in the best of company; in order to be familiar with the latest developments, we are always able to find expert partners with which to collaborate in the immediate area.

Solar energy heartland - Erfurt/Thuringia



els solar Member of

EnergieAgentur.NRW

EnergieAgentur.NRW provides information and support for companies in North Rhine-Westphalia, with the goal of helping them to improve their competitiveness by exploiting efficiency potential in energy applications. It encourages companies to participate in knowledge transfer and implement innovative energy technologies in marketable products and production methods.



The EPIA is the world's largest industry association for photovoltaics. Its goal is to advocate and promote photovoltaics at national, European and global levels.



The Bundesverband Solarwirtschaft e.V. is an association of around 800 solar technology companies, representing the interests of the German solar industry. It acts as an information provider, advisor, and intermediary between business and the political and public sectors, and provides for secure investment in the growth industry that is solar energy.



SolarInput e. V. is an association of solar energy companies, research and educational institutions, solar initiatives, tradespeople, municipalities and other public institutions in Thuringia. It serves as a partner in establishing ties between industry and research and jointly developing plans for industrially relevant research concepts, so with our facilities in Buttstädt (near Erfurt, Thuringia), we are in excellent company that helps us keep up with the latest developments and find competent partners in the vicinity.



What would our products be, without the people behind them? Without the qualified employees who develop our products, manufacture and test them, and ensure the logistics runs smoothly.

What would Spelsberg be without our sales and service team, who make direct contact with clients, and bring to life our philosophy of dialogue and partnership?

The people at Spelsberg influence the success of the whole company – but the really important thing is the success of the team.

Our Team

Without the ideas and the motivation of the Spelsberg employees, we would not be where we are today.

This teamwork has resulted in a high level of commitment and long retention of employees at all levels.





Over 200 000 enclosures leave the two manufacturing locations at Schalksmühle in North Rhine-Westphalia and Buttstädt in Thuringia daily, beginning their journey to clients. A consistent organisational structure and the most modern logistics systems ensure that our products arrive punctually on-site, both at home and abroad. Spelsberg is represented by partners or subsidiaries in over 50 countries.

We absorb impulses from other markets through this international network, and are inspired by new technologies and the demands of clients from all over the world. The results are continually improved brand products with certain extras – details that make their usage and maintenance particularly straightforward and safe.

Our clients demonstrate their appreciation of our power of innovation, top-quality products and an attractive cost-benefit analysis through unprecedented brand loyalty.

Over 100 years of Spelsberg international

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Why renewable energy?

Climate change demonstrates: Not only the limited availability of oil, natural gas and coal calls for a rethink, their environmental effects do so as well. One approach to a solution lies in increased reliance on emission-free renewable energy sources. Photovoltaics, the harnessing of electrical energy from sunlight, is assuming an increasingly important role. Exploit natural properties. Silicon, the element employed in solar cells, has four valence electrons orbiting the atomic nucleus. Photons that impact the silicon as sunlight impart energy to these valence electrons, causing an electron to dissociate from the silicon atom, leaving behind a positively charged atom.

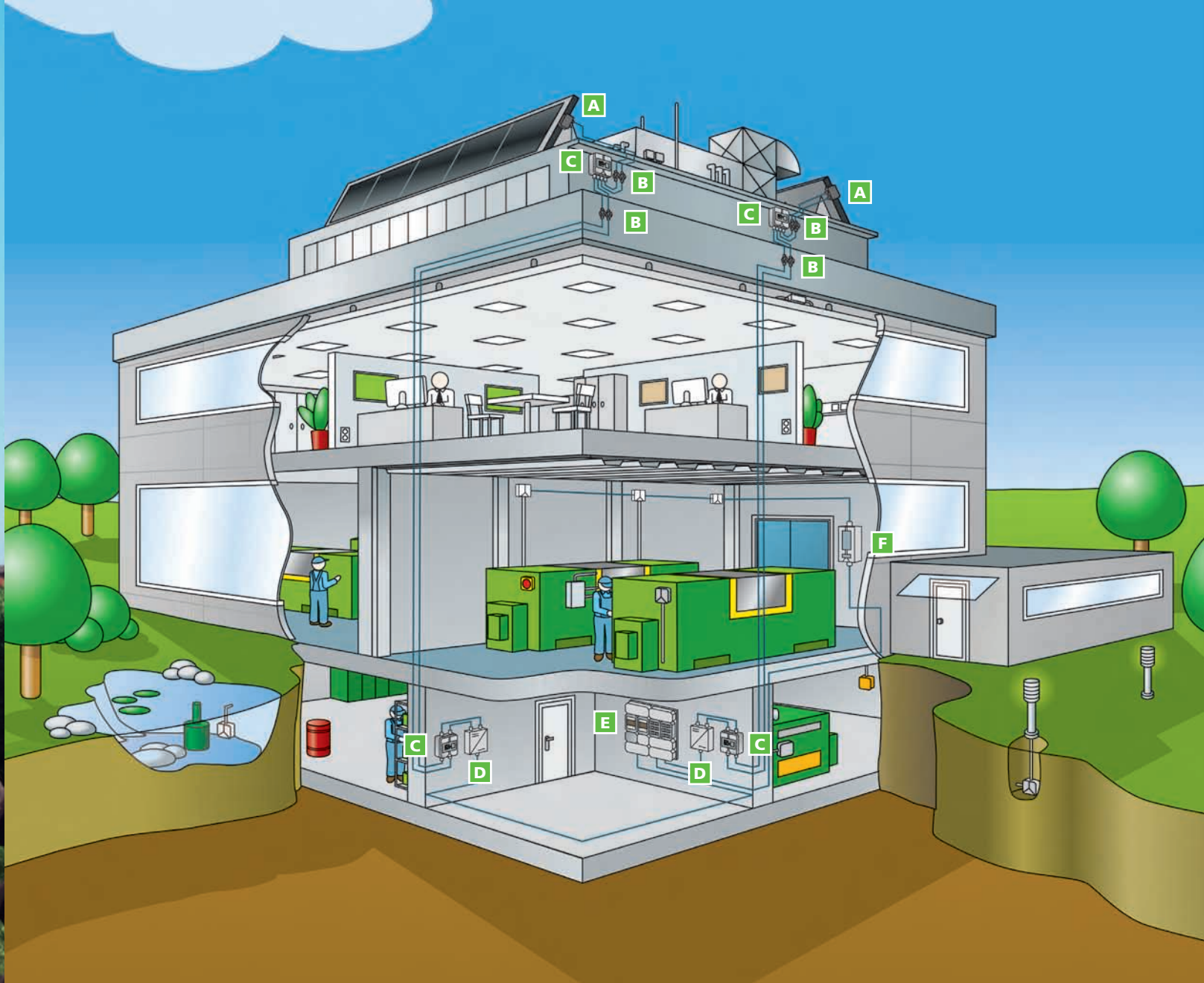
To ensure that the freed electrons all flow in the same direction and can be harnessed as an electric current, the front and rear faces of the solar cell must have different polarity.

The silicon atoms on the front face are doped with phosphorus atoms which possess an additional valence electron. The meter determines the supplied power and can therefore be used for settlement with the electricity supply company. The silicon atoms on the rear face are doped with boron atoms which possess only three valence electrons. The imbalance created between the positive and negative poles enables the electrons to flow – producing electricity.

Generator isolation housings

Photovoltaic systems involve more difficult disconnecting conditions than conventional installations because of the special characteristics of the current sources. The standard IEC 60364-7-712 (DIN VDE 0100 Part 712) provides for an easily accessible interrupter between the PV generator and PV inverter. This must be installed in close proximity to the inverter. In the absence of a lightning protector, the outer coaxial cables associated with the PV direct current cable should be protected against damage by surge protectors mounted close to the inverter. The standards VDE V 0185 Parts 2-4 and VDS 2010, as well as the locally applicable national building code should be respected.

Photovoltaics - The transformation of light into electrical energy



A Solar module junction boxes

Solar module junction boxes according to DIN V VDE V 0126-5 are used as an interface between the solar panels and the photovoltaic installation. In case of shading, they protect the PV modules with bypass diodes.

B PV junction boxes

We recommend the PV 48 for secure connection of solar cabling. They can be installed and secured flexibly.

C Generator isolation housing

A generator isolation housing or a photovoltaic terminal block box is used when several lines need to be combined in parallel. Generator isolation housings serve as separators required by standards for

safety in danger situations or servicing. They ensure that only minimal down time results when a PV installation needs maintenance or repairs, or that unaffected parts of the installation can continue to deliver power. For the safest possible installation, we recommend installing this device as closely as possible to the PV generator. If it is not needed at this position, the PV terminal block boxes are used instead.

D PV inverters

PV inverters convert direct current (DC) into alternating current (AC) and adjust the frequency and voltage to the electrical power network.

E Distributors (GTi / AKi)

With the distributors, the inverters can be protected and be gathered.

For further distribution, and to feed in the generated power, additional fuses, meters and other protective equipment can be used.

F Meters

The meters measure the power generated and used, so they support settlement of accounts with the electric utility (e.g. ZKi-ehZ or AKi-Z).



We develop customised solutions in close cooperation with our clients. All of the necessary specialised professionals and divisions work together at a single location, so little time is lost between the initial inquiry and the finished product.

We first create 3D drawings and construct an initial prototype. We remain in close contact with our clients throughout the entire development process and ensure that they approve each step. Once the best solution has been found, various different production methods can be considered, from completely new injection moulding tools to modifications of existing components in our modern CNC processing centres.

Naturally, we take it upon ourselves to deal with all the necessary certification and quality testing. Our superbly equipped testing laboratory offers all that is required.

We develop together with you

Fire protection according to UL 94 The FTT UL 94

evaluates the flammability of plastics and synthetics, which determines where the product can subsequently be employed. We use this test instrument to perform all five UL 94 fire protection tests plus the horizontal and vertical Bunsen burner tests and meet all international standards.

Climatic Exposure Test Cabinets

We test the functional safety of our products under various environmental conditions in our two climatic exposure test cabinets.

Our quality control team also performs VDE, UL waterproofing and contact protection tests:

IP Protection test in accordance with VDE

- IP 0X to 6X dust-proofing and contact protection
- IPX4 – X8 waterproofing

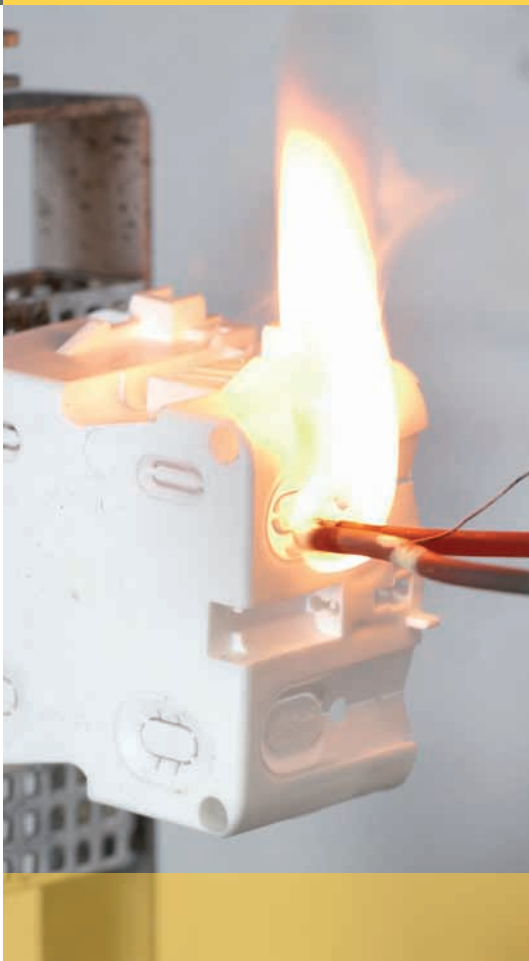
NEMA/UL Waterproofing tests in accordance with the US standard

Development and testing laboratory

- NEMA 4 x hose-down test
- atomized water test
- drip test

Data logger with LAB View workstation

All tests are performed using Lab View measurement data, such as dampness, temperature and current, which are collected locally via 60 distinct channels and displayed by an efficient data logger. The evaluation is performed using DIADEM Report software. For example, we perform the standardised warming test in accordance with EN 60439, and the bypass diode test in accordance with IEC 61215.





Trust is good – monitoring is better. Certification guarantees quality. Because we meet national and international standards, our clients are assured that they can rely on Spelsberg products.

But it is not only our enclosures and systems that are subjected to diverse testing and evaluation procedures in our own and other facilities.

Broadspectrum quality control informs the entire enterprise and ensures smooth processes, minimises possible sources of error and ensures absolute trackability of everything from the finished product to individual components, materials and suppliers.

Certifications



We also hold ourselves to high standards in the areas of work safety, environmental management and health protection. Our clients are thus absolutely guaranteed to enjoy the highest quality that Germany has to offer.

Developed by qualified specialised professionals, manufactured from the best materials using the most modern processes, under excellent employment conditions and meeting all relevant standards and regulations.

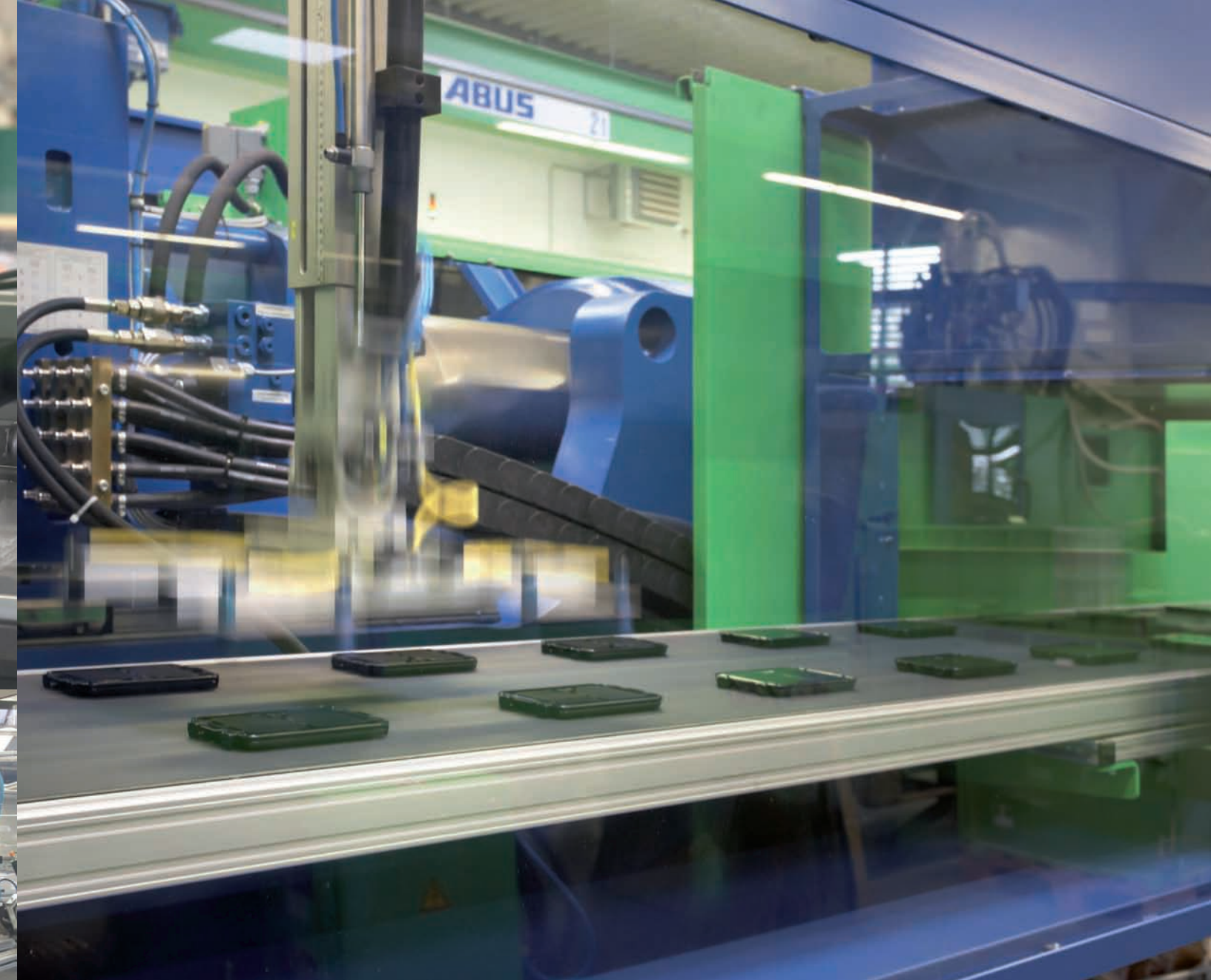


Because solar modules are installed outside, exposed to wind and weather, their connector socket systems have to fulfil particularly high quality standards. After the final installation, all products must pass the specially developed, fully automated battery of tests.

The individual systems are supported on component carriers that take them through the different stations, thus ensuring 100% testing. Each product is completely tested and the results of the test are documented in their entirety.

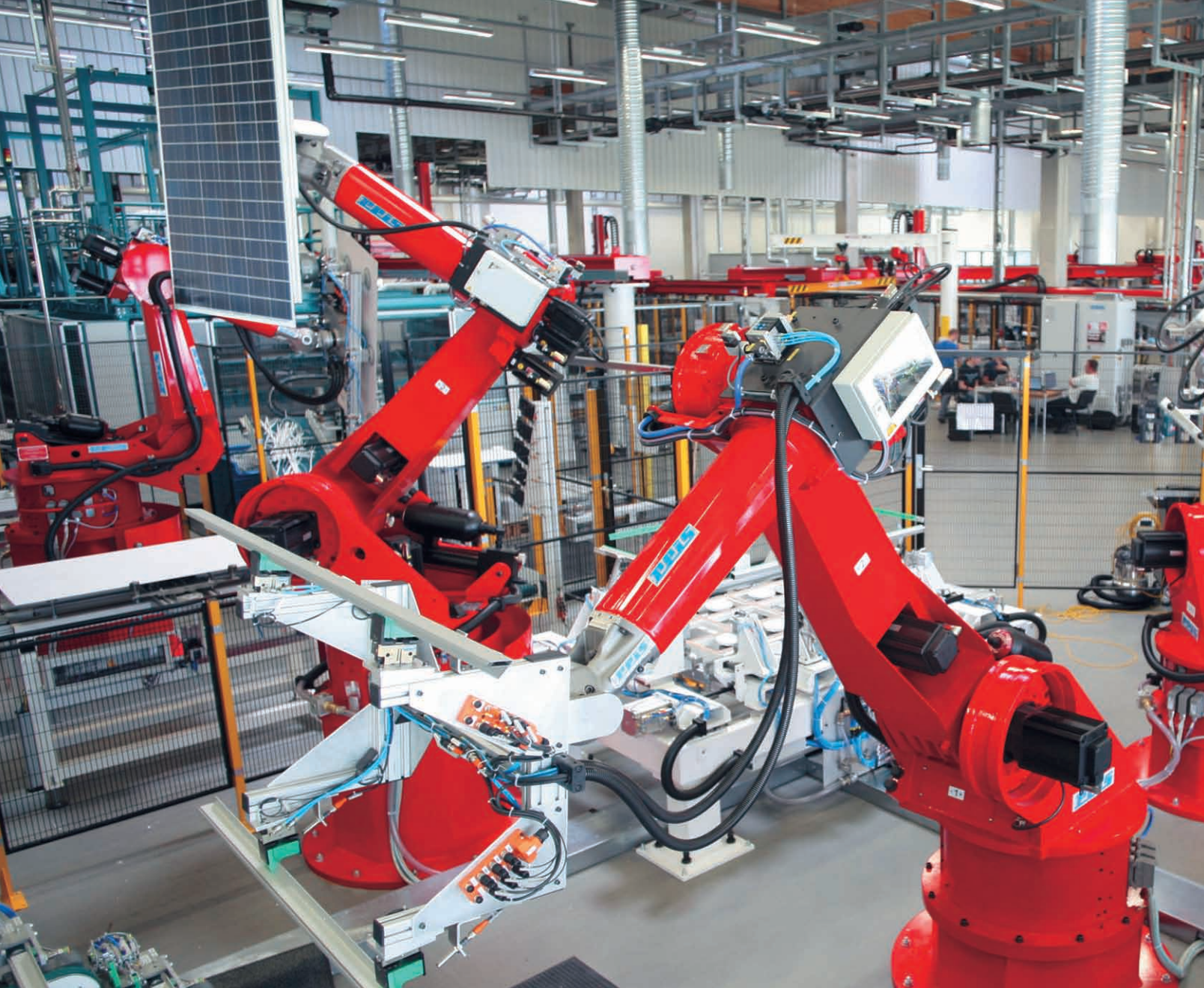
For example, the measuring station for electrical and electronic components assesses and evaluates the polarity and functioning of the complete circuit. A specially developed torque screwing station, along with the SPS controlled system, ensures the correct starting torque and conformity with the protection class and strain relief of the conduit entry points.

Quality control for connection systems for photovoltaic modules



The axial tensile test examines the retention force of the terminal enclosures and the visual inspection station evaluates the geometric characteristics and inspects the positions of the contacts and conduit entry points.

The battery of tests evaluates more than 20 quality-related parameters. All images and data are continuously recorded, evaluated and monitored.



Together we are stronger: We work with capable partners drawn from different areas of photovoltaics.

At regular meetings we exchange information, share our know-how and work on common solutions in order to always be a step ahead of new technological developments and changes in the market.

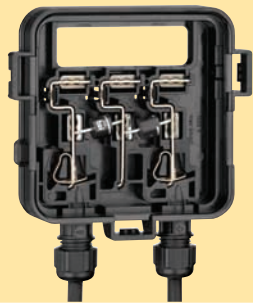

Each of our network partners is an experienced specialist and market leader in their particular area.

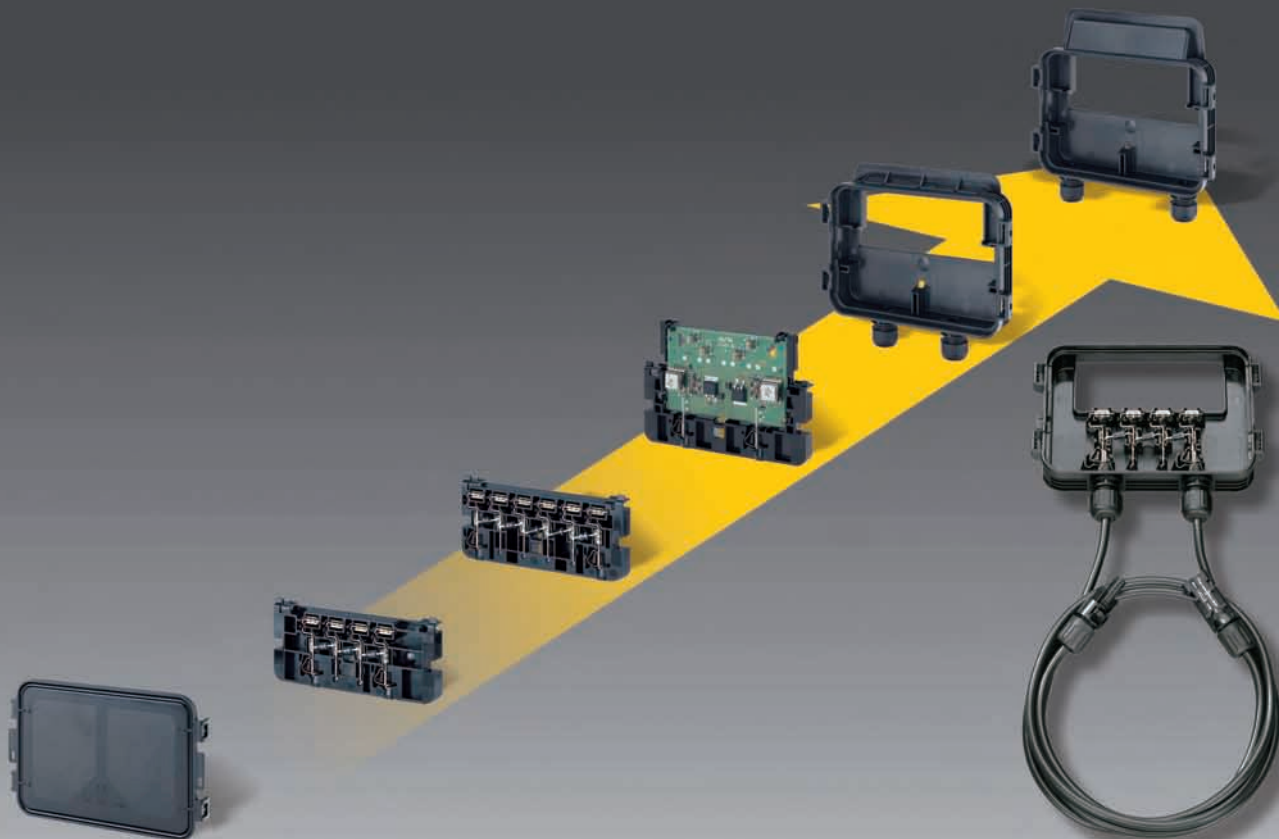
Our network



Clients that trust Spelsberg profit from the collected specialised professional knowledge of the top manufacturers in the industry.

		
Type:	PV 1410-2	PV 1410-2
Dimension:	141 x 101 x 28 mm	141 x 101 x 28 mm
Version:	4-poles 6-poles On request: 5-poles 7-poles	4-poles 6-poles On request: 5-poles 7-poles
Rated current:	9,5 A	10 A / 16 A
Rated voltage:	1000 V	1000 V
Can be automated	x	x

		
410-2 ISBT™	PV 88	VariBOX
101 x 28 mm	80 x 80 x 21,5 mm	141 x 101 x 28 mm
4-poles	2-poles 3-poles	4-poles 5-poles 7-poles
A / 20 A	9 A	9,5 A
1000 V	1000 V	1000 V
x	x	-



PV 1410-2
with cover



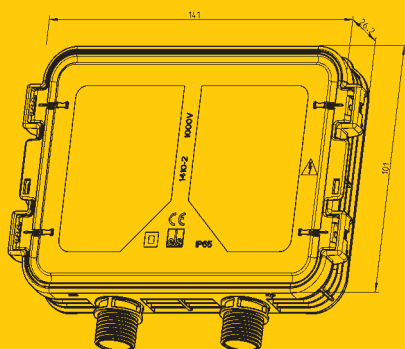
PV 1410-2
4 - 6-poles



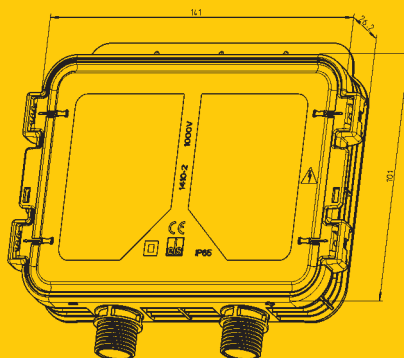
PV 1410-2
with fixing pad for applikation
in the modul assembly



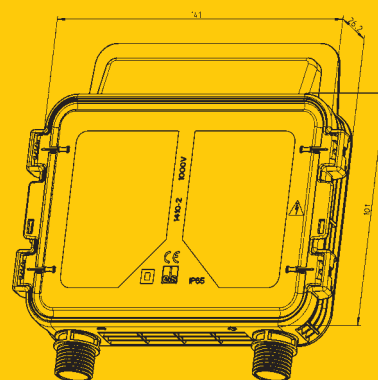
PV 1410-2 - The modular System



Version: 4-poles,
with small terminal space



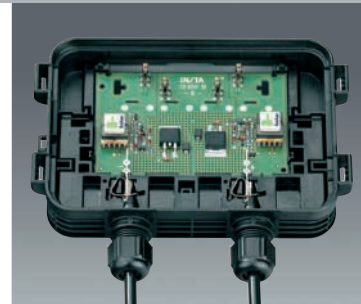
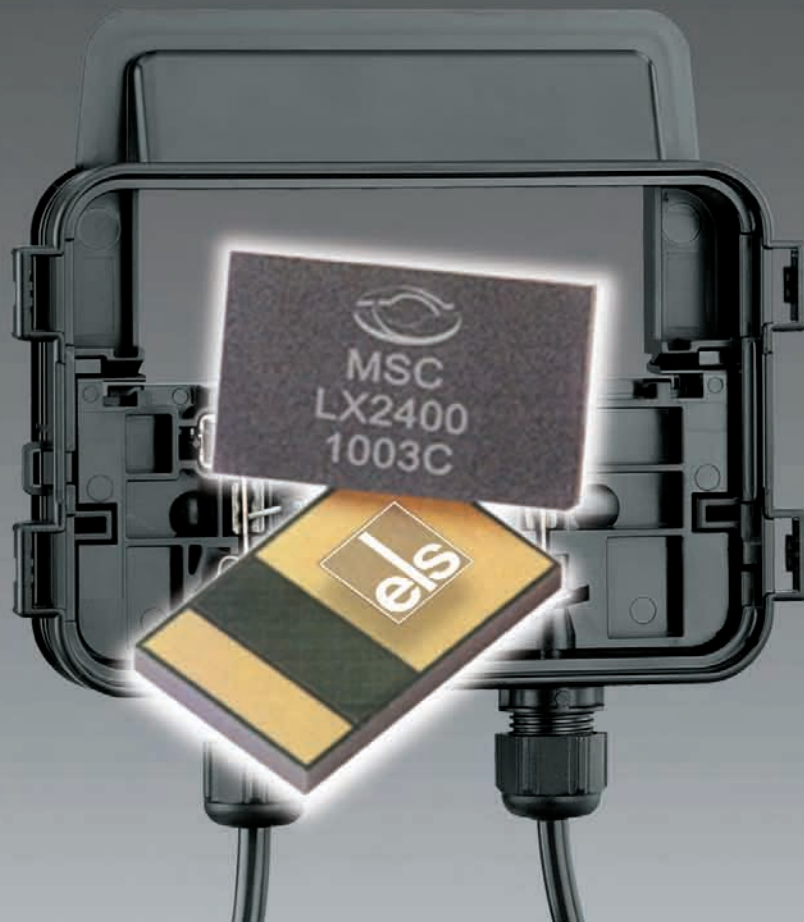
Version: 4-poles,
with standard terminal space



Version: 6-poles,
with enlarged terminal space

PV 1410-2		
Version	4-poles	6-poles
Rated current I_{SC}^*	5 up to 12,5 A	6 up to 11 A
Rated current I_N	max. 9,5 A	max. 9,5 A
Rated voltage V_{OC}	1000 V	1000 V
Rated isolation voltage according to EN 60439-1	1000 V	1000 V
Maximum working voltage	100 V	100 V
Number of bypass diodes	3	5
Type of connection solar cable	screwless	screwless
Connection cross-section	2,5 - 6 mm ² , AWG 10	2,5 - 6 mm ² , AWG 10
Connection for flat ribbon cables	max. 8 mm	max. 8 mm
Temperature range	- 40°C bis + 85°C	- 40°C bis + 85°C
Protection degree according to IEC 60529	IP 65	IP 65
Protection class according to DIN VDE 0106	II	II
Dimensions	141 x 101 x 28 mm	141 x 101 x 28 mm
IK	07	07
Flammability	in accordance with UL 94-5V	in accordance with UL 94-5V

* depending on type of diodes used, subject to bypass diode test according to IEC 61215

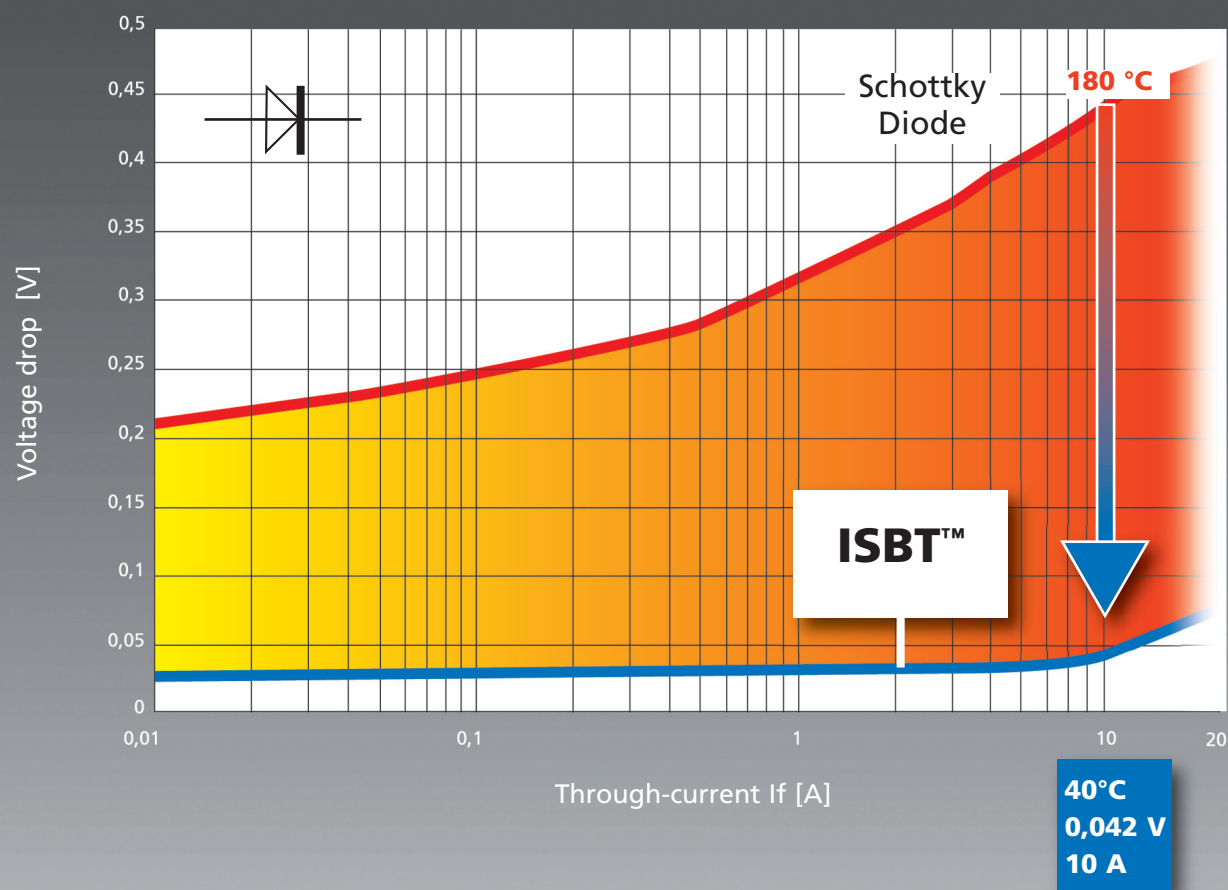


Modular integration of integrated circuits such as the ISBT;
customer-specified applications also possible.



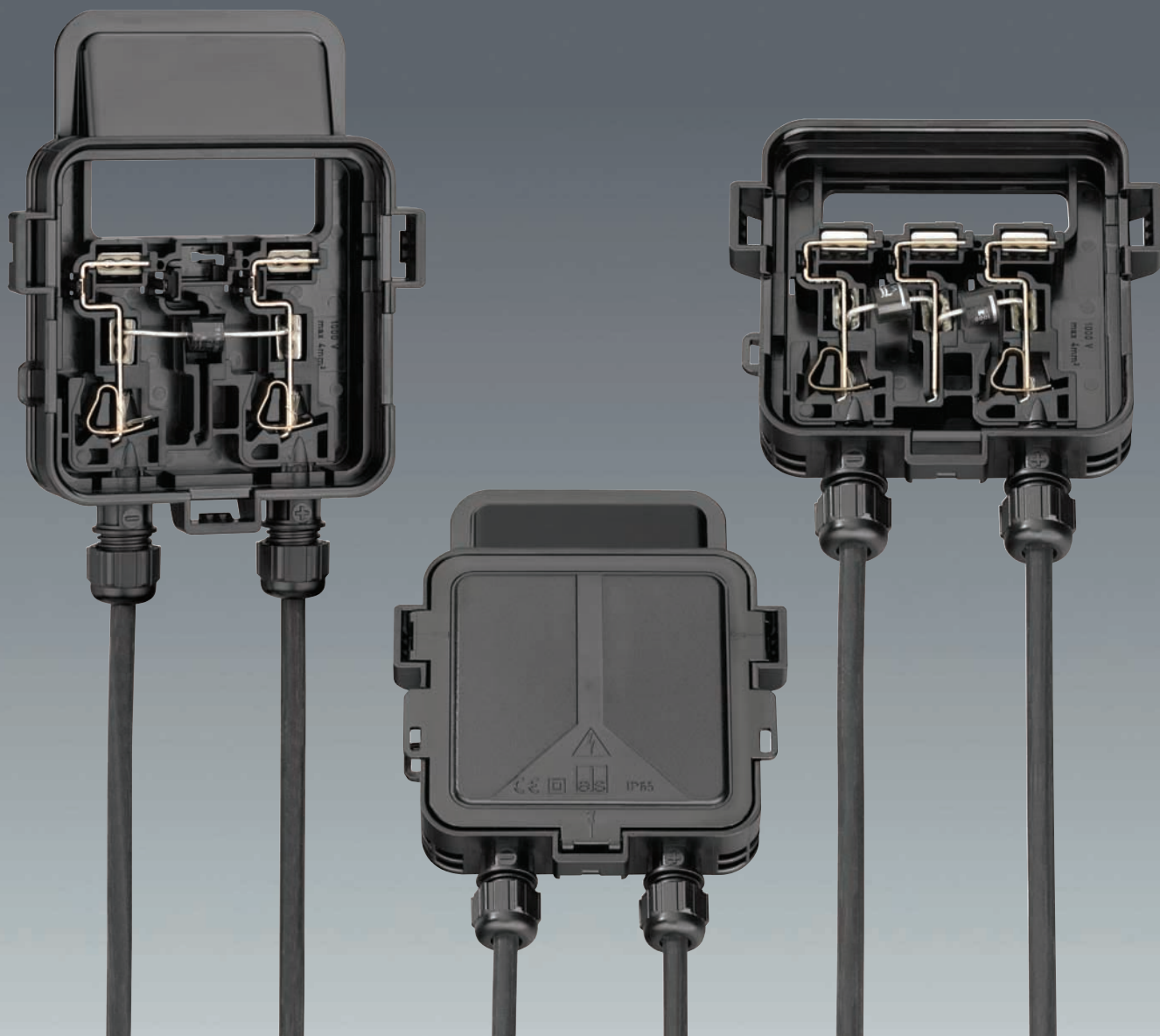
PV 1410-2 - The modular system

ISBT™ reduces power loss and temperature to a minimum in comparison with conventional Schottky diodes (in bypass mode).

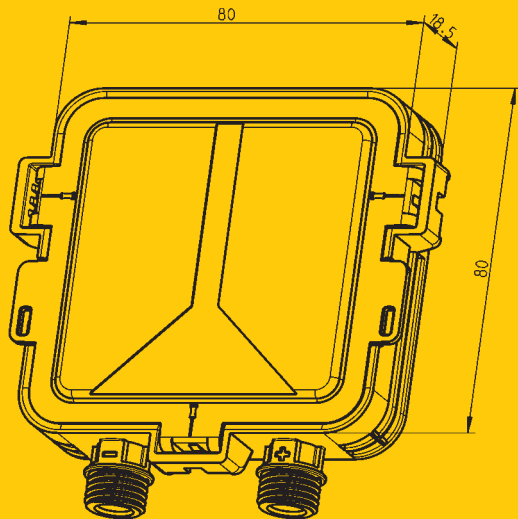


PV 1410-2 with ISBT*	
Rated current I_N	max. 9,5 A
Rated voltage V_{OC}	1000 V
Rated isolation voltage according to EN 60439-1	1000 V
Continuous bypass current (30 years)	10 A
Maximum bypass current	20 A
Power loss (10 A, $T_A=90^{\circ}C$)	0,5 W
From lightning-induced pulses up to	1,4 Joule
Induced current pulses in bypass mode up to	250 A
Induced current pulses in cutoff mode up to	150 A
Type of connection solar cable	screwless
Connection for flat ribbon cables	max. 8 mm
Temperature range	- 40°C bis + 85°C
Protection degree according to IEC 60529	IP 65
Protection class according to DIN VDE 0106	II
Dimensions	141 x 101 x 28 mm
IK	07
Flammability	in accordance with UL 94-5V

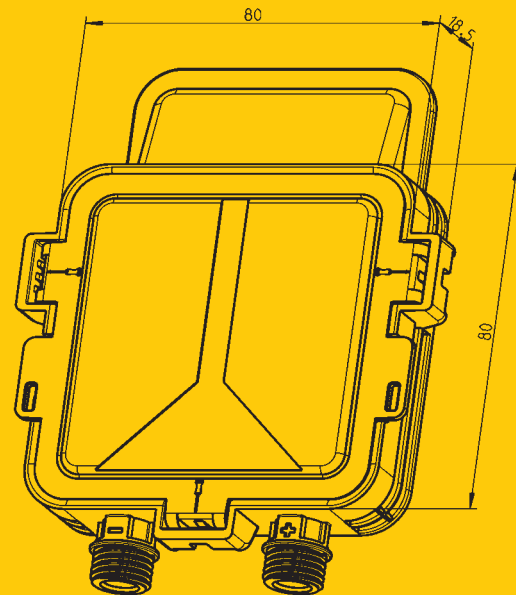
* ISBT™ = Ideal Solar Bypass-Technology



PV 88 - for Ongrid- and Offgrid-PV-Modules



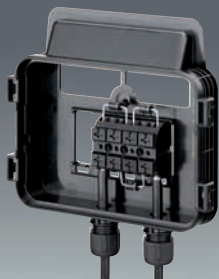
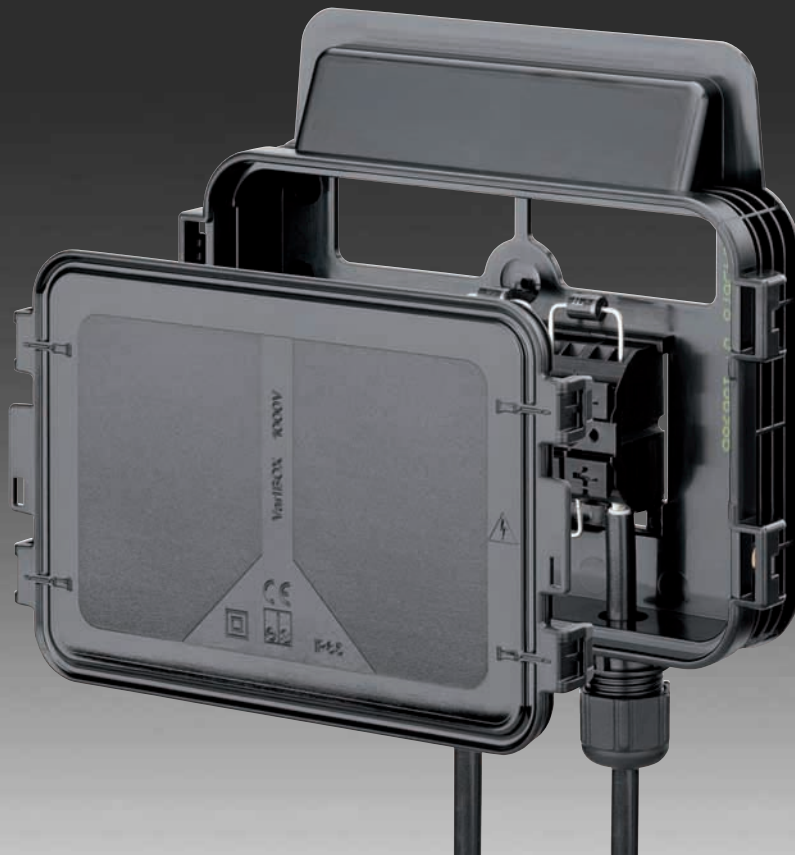
Version: 2-poles



Version: 2-poles,
with enlarged terminal space

PV 88	
Version	2/3-poles
Rated current I_{SC}^*	6-12 A
Rated current I_N	9,0 A
Rated voltage V_{OC}	1000 V
Rated isolation voltage according to EN 60439-1	1000 V
Maximum working voltage	100 V
Number of bypass diodes	1/2
Type of connection solar cable	screwless
Connection cross-section	2,5 - 4 mm ² , AWG 12
Connection for flat ribbon cables	max. 8 mm
Temperature range	- 40°C up to + 85°C
Protection degree according to IEC 60529	IP 65
Protection class according to DIN VDE 0106	II
Dimensions	80 x 80 x 21,5 mm
IK	in accordance with UL 94-5V

* depending on type of diodes used, subject to bypass diode test according to IEC 61215



VariBOX
with laterally offset
screwed cable glands



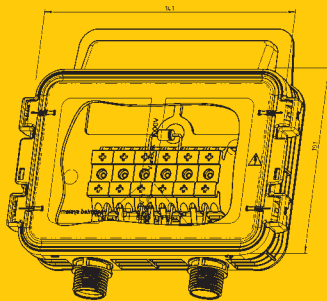
VariBOX
with closely spaced
screwed cable glands



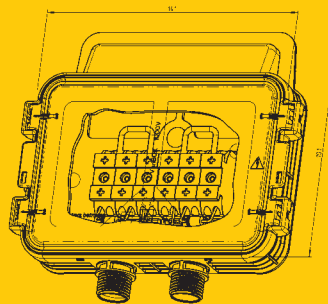
VariBOX
with widely spaced
screwed cable glands



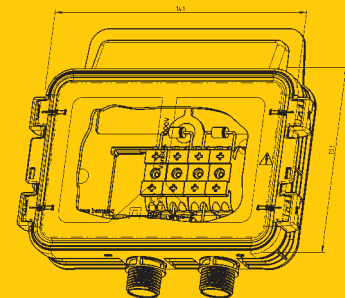
VariBOX - The established connection system



Version: 4 poles, with widely spaced screwed cable glands



Version: 4 poles, with closely spaced screwed cable glands



Version: 4 poles, with laterally offset screwed cable glands

VariBOX	
Version	4-poles
Rated current I_{SC}^*	9 A - 9,5 A
Rated current I_N	9,5 A
Rated voltage V_{OC}	1000 V
Rated isolation voltage according to EN 60439-1	1000 V
Maximum working voltage	100 V
Number of bypass diodes	3
Type of connection solar cable	screwless
Connection cross-section	2,5 - 4 mm ² , AWG 12
Connection for flat ribbon cables	Terminal block with cage clamp terminal, max. 5 mm,
Temperature range	- 40°C up to + 85°C
Protection degree according to IEC 60529	IP 65
Protection class according to DIN VDE 0106	II
Dimensions	141 x 101 x 28 mm
IK	in accordance with UL 94-5V

* depending on type of diodes used, subject to bypass diode test according to IEC 61215

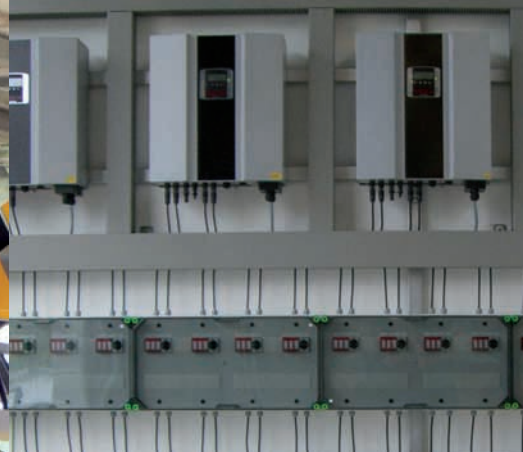


As a pioneer in the electronics business, we draw on over 100 years of knowledge and experience to develop innovative, high-quality products for safe and standard-compliant installation of PV systems. With over 20 years of experience in photovoltaics, we offer a comprehensive range of products and services oriented to the individual requirements of each project. For electrical installations in PV systems, we use our iQ products such as the modular GTi series of switchgear and the AKi and TK enclosure series. Our most important strengths include an attractive price-performance ratio, reliability and customer-oriented service. We can also provide the

right solution for special applications. On request, we can integrate individual components according to customer specifications to create a customised, integrated solution from a single source, and of course these customised products have fulfilled all necessary test and certification procedures and satisfy international standards. Our range of electrical products for photovoltaic systems includes PV generator junction boxes, string collectors and generator connection housings – each with and without overvoltage protection on the DC side – as well as solutions for efficient and safe distribution of the generated electricity on the AC side.

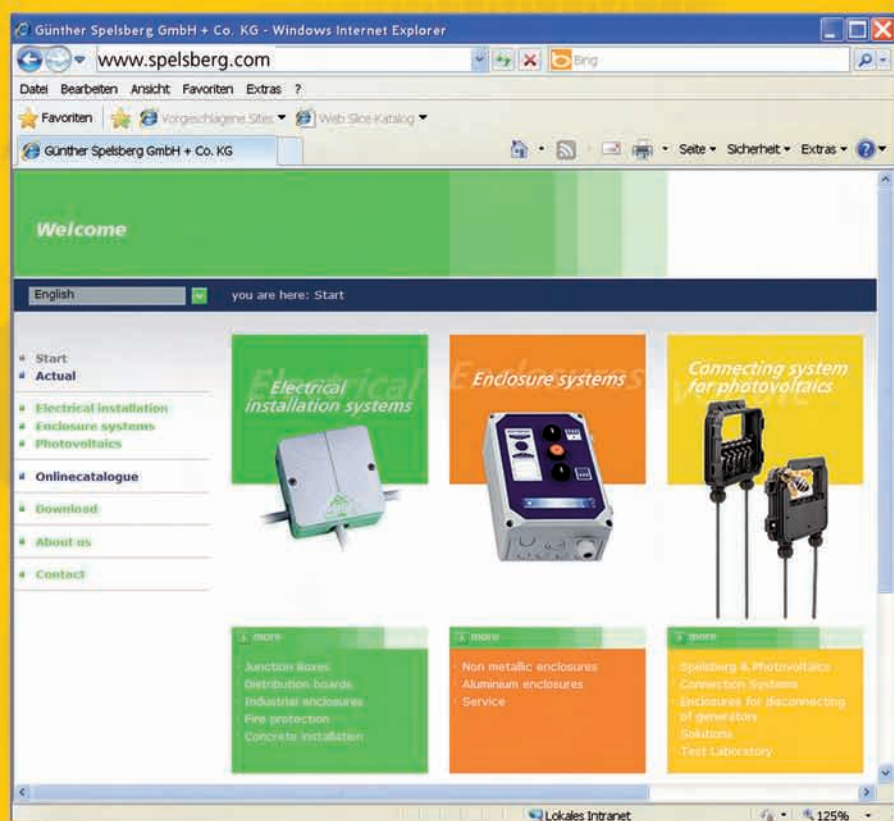
Integrated ventilation seals or pressure compensation devices in enclosures prevent a dangerous build-up of condensation resulting from temperature variations. To provide reliable protection against the effects of lightning and voltage spikes in different installed configurations, we integrate a variety of modular surge protection devices.

PV-Electrical installation - Individual. Flexibel. Innovative.



More Informations you can find in our catalogue!

Feel free to contact us!



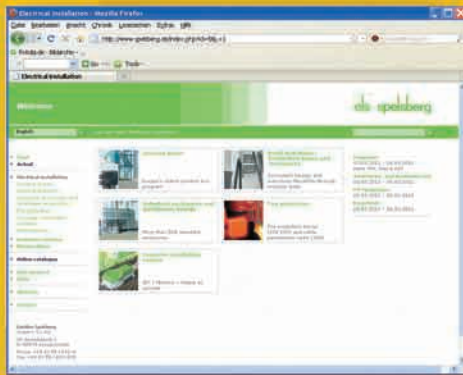
Comprehensive internet pages

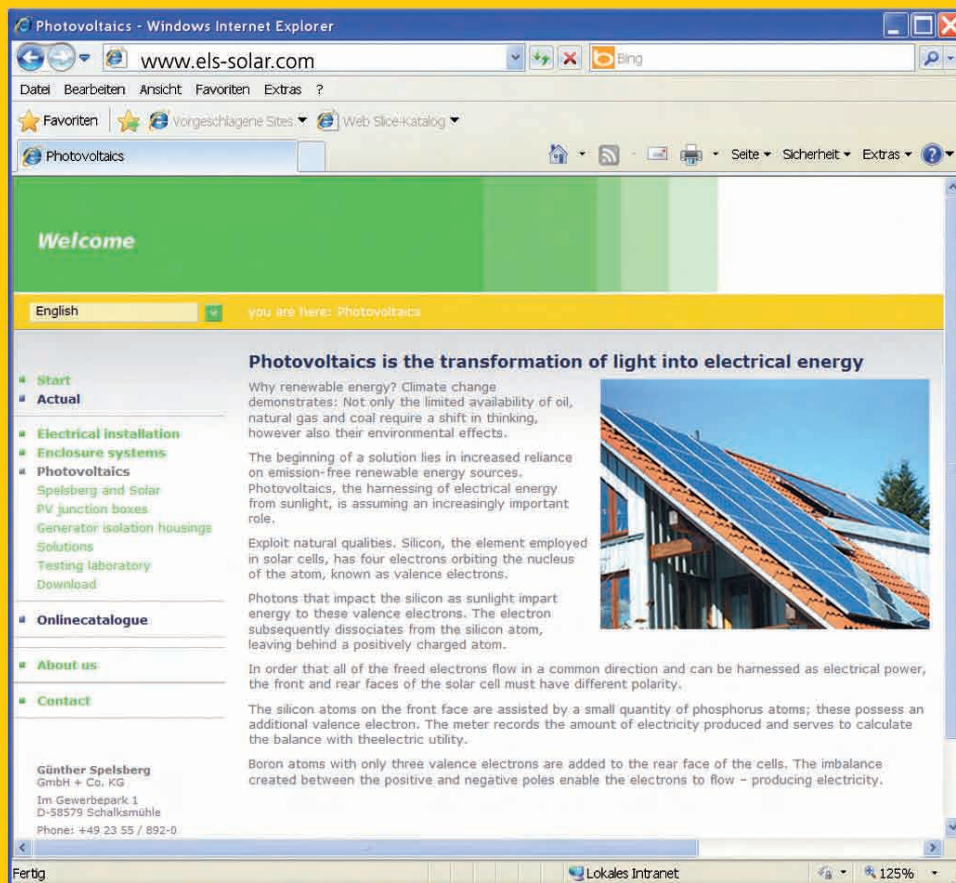
Quick and easy – these days, information can be obtained from the internet around the clock, seven days a week. We offer our customers several homepages with various main subjects:

www.spelsberg.com is our main page with price lists, tender document texts and up-to-date information about our products and our company.

The page www.els-solar.com deals with the subject of photovoltaics: There is a completely new page at www.box-finder.com where you can find the right box for your application with just a few mouse clicks.

Visit us in the internet





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BSW Bundesverband Solarwirtschaft

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The General Terms and Conditions you can find on our homepage: www.spelsberg.de



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Advice at a touch on a button - Thanks for calling



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