

Design the future of energy

Edition 2024

# MONITOR

 BENDER

Mobility of the future:  
Hydrogen-driven mobility

Networked and future-proof:  
state-of-the-art eye clinic

Practical Knowledge:  
Battery energy storage systems



**BENDER**

# Dear readers,



Heinz Nowicki (CSO), Dr. Sven Hartung (CFO)

Designing the future of energy is certainly an ambitious goal, but it is actually what we have already been doing for more than 80 years, ever since we first patented our ISOMETER®. We design the future of energy by helping to make it electrically safe and by making intelligent use of energy.

With our new claim, **Design the future of energy**, we perfectly sum up this approach and make a statement both within our Group and around the world. With our claim, we consolidate the many aspects of our global company in a large common denominator and signal to both our customers and partners that we are ready and willing to work with them to shape the future of energy.

In doing so, we are well aware that the solutions required may vary strongly from application to application and from region to region. This MONITOR provides you with an insight into the wide range of possibilities available with Bender.

Discover how our ideas are helping to advance hydrogen mobility and help electric flight take off. See how we made an eye clinic and electrical shore connections for ships fit for the future and find out all about our idea for revolutionising the charging of electric vehicles with PV electricity.

You can also read about the tasks facing Bender according to our Managing Director Sven Hartung (CFO) and learn about our sustainable efforts to future-proof the site of our company headquarters. Last but not least, this MONITOR issue tells you all about the applications in which we help make electrical installations intelligent and fit for the future – and the new products we use to achieve this! **Let's work together to design the future of energy. We're ready!**

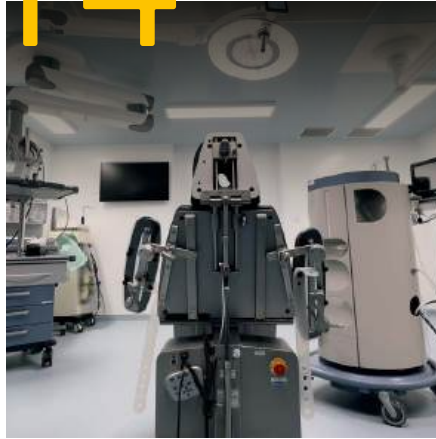
PS: And while we're on the topic of 80 years, we would like to take this opportunity to wish the son of our founder, Dirk Christian Bender, who expanded our company on a global scale, a very happy 80th birthday.

6



**Mobility of the future**  
Hydrogen-driven mobility

14



**State-of-the-art eye clinic**  
Networked and future-proof

26



**Making electricity**  
future-proof worldwide

10

**Safety on the train**  
Insulation monitoring

18

**Excess PV charging**  
Getting more from the sun

29

**Seminars and exhibitions**  
Exchange with experts

13

**Flying high**  
with electrical safety

22

**Regular servicing keeps**  
systems running smoothly

30

**New products**

25

**Awards**  
National and international

33

**Bender makes work easier**  
on board the Mercy Ships

34

**Sustainably future-proof**  
Bender's commitment

36

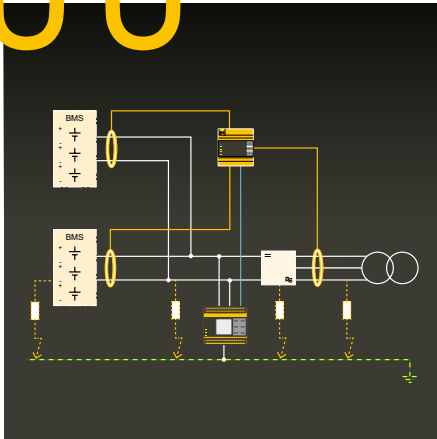
**Bender@SELAM**  
Social-electrical aid project

37

**Designing**  
wind energy plants

# Content

38



**Practical knowledge**  
**Battery energy storage systems (BESS)**

---

**40** **Design the future of energy**  
The new Bender claim

---

46



**APAC Sales Meeting 2023**  
**Productive discussions in Manila**

---

**47** **ODCA (Open DC Alliance)**  
For the future of energy

---

**48** **Interview**  
CFO Dr Sven Hartung

---

50 **Outlook Dorothea Bender Fernández**  
51 **Imprint**



# Hydrogen-driven mobility

When it comes to the mobility of the future, hydrogen is playing an increasingly prominent role – and with good reason. Nevertheless, there are still a number of open questions to answer and technical challenges to overcome. Such obstacles often concern electrical safety.

## **The current situation**

The decision has been made: From 2035, combustion engines will be phased out throughout the EU. However, it is still unclear which drive concept will end up replacing them in the long term. Battery electric vehicles (BEVs) are an attractive alternative but have limited acceptance due to their long charging times and the slow expansion of the charging infrastructure. Hydrogen may represent a sensible alternative or an additional solution. Given the development cycles in

the automotive industry, developers, manufacturers, suppliers, service stations and H<sub>2</sub> producers are now working at full steam to explore this option.

## **Sustainably powering vehicles with hydrogen**

The prospects of success of fuel cell vehicles depend on a multitude of factors. In the case of the tank-to-wheel approach, for example, questions such as how the hydrogen is used in the vehicle and how a sufficient amount of green hydrogen can be generated need to

be considered. One thing, however, is certain: without intelligent solutions for electrical safety, no H<sub>2</sub> concept will establish itself successfully. A number of highly promising tests are currently being conducted on hydrogen-powered heavy goods vehicles, special-purpose vehicles and even passenger vehicles.

**For which vehicles is H<sub>2</sub> suitable?**

Each test kilometre driven makes two aspects increasingly clear: the huge potential that hydrogen can offer for the energy transition and decarbonisation and the many major obstacles and smaller stumbling blocks that still need to be overcome along the way. The tests have provided sufficient evidence that the cost-effectiveness of fuel cell electric vehicles (FCEVs) increases alongside the intensity of use. In other words, the larger the vehicle is and the further it travels, the better. At present, there are therefore strong indications that hydrogen will initially establish itself as the ideal solution for buses, special-purpose vehicles and heavy goods vehicles on the road and vehicles travelling via rail and water. The first test projects involving aircraft are also currently underway.

**Decarbonisation refers to the process of reducing sales of carbon obtained from fossil fuels in order to lower emissions that intensify the greenhouse effect and thus accelerate global warming.**

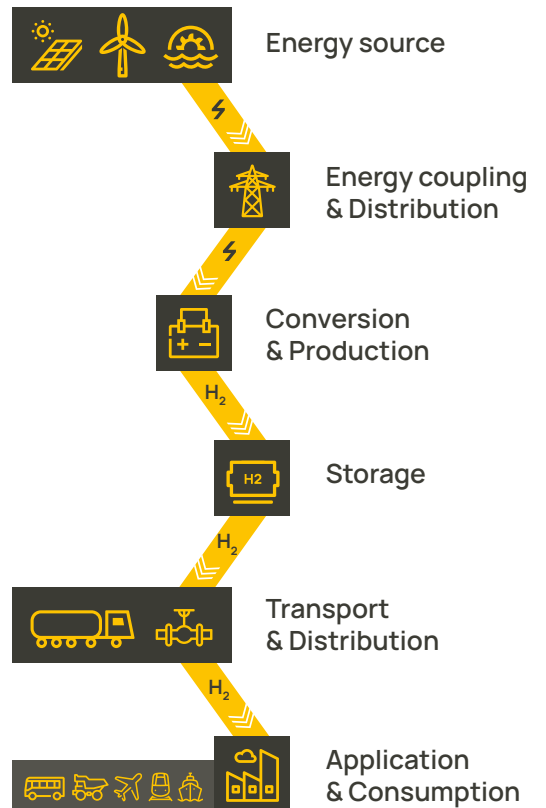
**H<sub>2</sub> vehicles in use**

At present, a variety of approaches are used to power vehicles with hydrogen. When used as range extenders, fuel cells are added to battery electric vehicles (BEVs) to increase their range. The fuel cells then cover the base load while the batteries satisfy peak power requirements. As a result, vehicles can be powered and rapidly 'refuelled' without carbon dioxide. In fuel cell electric vehicles (FCEVs), hydrogen is used to provide the primary power. Here, a reverse electrolysis process takes place in a fuel cell. The electrical energy generated during this process is fed into a battery and used to power the vehicle. Current test vehicles have a power range of 150 kW to 500 kW and are usually designed as unearthed high-voltage systems.



**A challenge for safety**

When converting from combustion vehicles to electric vehicles, safety experts had to find a way to deal with the high energy density of the batteries. This challenge is much greater in the case of H<sub>2</sub> vehicles. After all, hydrogen must be safely transported and stored under high pressure or at extremely low temperatures. A solution for dealing with the high voltage also needs to be found. All of these questions require electrically and technically safe answers that must be anchored in generally applicable standards.



### Electrical safety in vehicles

When it comes to the electrical safety of H<sub>2</sub> vehicles, the challenge lies in measuring the insulation resistance in a dynamically loaded system both flexibly and robustly. This in turn requires factors such as the safe detection of disturbances in the case of strongly variable voltages and insulation values lower than those of batteries. Electrical solutions for such factors need to be highly available for a long period of time and need standardised communications interfaces. Insulation monitoring devices also need to be able to be disconnected during charging.

### Service stations and infrastructure

At present, the network of H<sub>2</sub> service stations is only rudimentary, and its expansion is slow. This is partly due to the fact that H<sub>2</sub> vehicles are still expensive compared to other alternatives. What's more, there are uncertainties among service station operations regarding the generation, transport, storage and filling of hydrogen. After all, hydrogen is much more volatile than diesel or petrol and has different refuelling requirements than, for example, the now-established liquefied petroleum gas (LPG).

### The bottleneck of sustainable H<sub>2</sub> production

The potential of green hydrogen as a future energy source is supported by its ability to be produced wherever there is sufficient sustainably generated electricity. This is, of course, always the case in close proximity to PV installations, but wind power installations and hydroelectric power stations can also help to cover the huge current demand for green hydrogen. The fact that this may put producers in competition with industrial companies, municipalities and private households, which also require sustainably generated electricity or hydrogen, is a problem that has yet to be solved.

### Electrolysers as a source of hope

The production of hydrogen requires electricity, water and an electrolyser. At present, three procedures are mainly used: Solid oxide electrolysis (SOE) takes place at temperatures of 600 to 900 °C and is therefore a high-temperature process that achieves an impressive efficiency of around 80 %. The widespread proton exchange membrane electrolysis (PEM) method is also suitable for variable requirements and partial load operation and achieves an efficiency of up to 63 %. Alkaline electrolysis, which has an efficiency of approximately 65 %, is a particularly flexible option.



The hydrogen-experts of Bender (f.l.t.r.): Roman Schmittloch, Daniel Wölfel, Roman Ludwig



## Developing standards for H<sub>2</sub> usage

**Water electrolysis was discovered more than 200 years ago.** To provide as many people as possible with safe access to this method, it is important that the technical framework conditions are determined and anchored in standards. This is why Bender is actively involved in two areas: firstly, as part of the higher-level joint research project “Normungsroadmap Wasserstofftechnologien” (Standardisation Roadmap for Hydrogen Technologies), which is accelerating the H<sub>2</sub> run-up, and secondly, as an active member of the standards committee behind the development of the “Elektrische Schutzmaßnahmen in Wasserelektrolyseuren” (Electrical Protective Measures in Water Electrolysers) with aim of establishing the required framework conditions.

### Electrical safety for electrolysis

Regardless of the electrolysis technology used, process-related challenges arise in the area of electrical safety. The high energy densities, operating voltages and operational currents pose a hazard to humans, technology and operational safety. This challenge needs to be fully identified, evaluated within the context of the system and countered with project-specific technical and organisational solutions in the earliest possible stage of planning. Within this context, thinking in terms of devices and smaller functional units is not enough. Instead, entire concepts need to be considered; concepts that meet the requirements and offer both operators and users precisely what they need: electrical safety.

### No H<sub>2</sub> transition without storage

Efficient storage solutions with sufficient dimensions can secure the availability of green H<sub>2</sub> around the clock. The most common method of H<sub>2</sub> storage is at a temperature of -253 °C in compressed gas cylinders or cryogenic storage tanks. Hydrogen can also be stored in caverns or in solid matter such as metal hydrides. When evaluating the efficiency of such storage options, aspects such as the energy required for compression or cooling also need to be factored into the overall equation. Furthermore, checks are currently being performed to determine whether the existing natural gas grid is suitable for the transport and storage of a proportion of hydrogen in the case of decentralised H<sub>2</sub> production.

If you would like to find out more, please feel free to contact us directly:

**Roman Schmattloch**  
Head of Corporate Development,  
Hydrogen Innovations

**Daniel Wölfel**  
Field Application eMobility

**Roman Ludwig**  
International Standards

### Hydrogen is teamwork

To achieve a successful conversion to H<sub>2</sub> mobility, all stakeholders – developers, vehicle manufacturers, energy suppliers, regulatory authorities and other interest groups – need to work together in close cooperation and as well as possible. With this in mind, Bender views itself as an adviser and partner for technology and development that can contribute its expertise in many areas and offer, adapt or develop fitting solutions for electrical safety. Bender’s long-standing experience with IT systems in both large industrial facilities and mobile applications provides an outstanding technical basis for this role. Against this background, Bender is actively involved in a variety of organisations and initiatives and is happy to engage in open technological dialogue with all interested parties.

# Safety on the train

**Preventing failures thanks to insulation monitoring in the traction circuit** – For several years, Turkey has been expanding its rail network and entire railway industry. Many of the components required for these expansions are developed and produced by companies based in Turkey. In addition, external providers are contacted for support where needed, for example in the case of traction current inverters for traction vehicles and locomotives.

## Expanding rail transport in Turkey

With a total area of nearly 800,000 km<sup>2</sup>, Turkey has a population of more than 85 million. Despite these figures, its rail network, which currently covers a good 11,000 km, is still rather limited. Although rail remained the most important mode of transport in Turkey up until the 1950s, it has since been overtaken by road transport, which is much more prominent in the present day. Turkey has now decided to return to promoting and advancing rail transport and is even developing its own rail vehicles to this end.

## Unearthed systems in trains

To guarantee reliable and safe operations in rail transport, the high availability of technical systems is a central prerequisite. This is why different IT systems are often used in parallel in locomotives and multiple units – as is the case in the newly developed rail cars in Turkey. The Turkish research and development institute set the task of designing the new traction current inverters contacted Bender at an early stage of development. With its many years of experience in

the electrical safety of rail vehicles, Bender was the ideal partner for fundamentally redesigning the power supply of the upcoming vehicle generation.

### Demands for robust insulation

When it comes to operating locomotives and multiple units, unearthed traction motors are an essential component. They provide the necessary drive and need to be constantly available to ensure the mobility of trains. Given the challenging conditions in which they are required to perform, they also have to withstand a great deal, with strong temperature fluctuations, humidity, vibrations and flying gravel all placing a strain on electrical systems and above all their insulation. As a result, insulation faults may lead to failures, downtime and, in the worst-case scenario, fires.

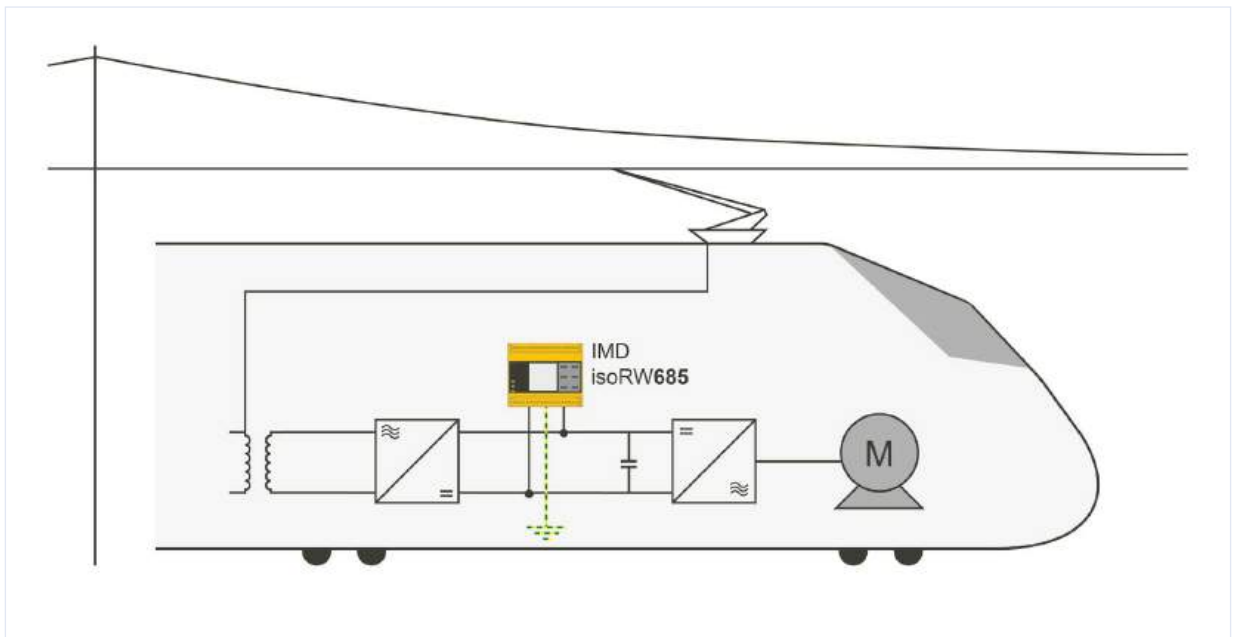
### Monitoring for early fault recognition

To prevent such consequences of insulation faults, it is a good idea to fit traction current inverters with an insulation monitoring device, which keeps a close eye on the system status at all times. With this solution, damages can be detected at an early stage, and failures can be prevented, thus ensuring reliable protection for both passengers and railway staff. Insulation monitoring devices from Bender offer relay contacts and communications interfaces, which transmit alarms to the vehicle management system. This train can then use wireless communication to warn the



The isoRW685 isometer was designed especially to fulfil the robust demands involved in rail transport and meet the requirements of the relevant standards.

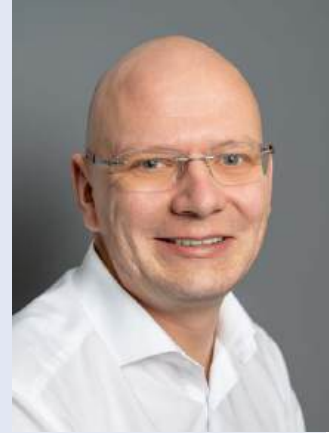
workshop systems about the reported defects. With this intelligent solution, the workshop systems are always informed about the status of the electrical systems without maintenance staff having to check the devices manually. Furthermore, the monitoring devices enable the systems to track the development of the measured values over longer periods. By doing so, they can identify tendencies and use preventive maintenance of ageing components to prevent failures and optimise workshop times.



The IMD monitors the entire system from the inverters and thus provides the transparency required for high availability.

**Matthias Rohner**, Market Segment Manager Railway at Bender, has positive memories of the project:

*“New developments are always particularly exciting for us. They allow us to contribute our abundance of experience in working with unearthed systems and in the field of railway applications. When working on this project, it soon became clear to us that a standard insulation monitoring device commonly used in the market would not be able to cope with such high voltages.”*



### Rail expertise comes out on top

After conducting a competitive analysis, the Turkish project team ultimately opted for Bender's expertise and technology to solve this problem. When developing the solution that ultimately proved to be successful, representatives from Bender's Export department, the Market Segment Management team in Germany and the Turkish sales partner accompanied the project over several years.

### Developing a customised combined solution

The Bender experts in Turkey and at the Bender headquarters in Germany discussed a multitude of different options with the Turkish partners. The ideal solution needed to meet the demands of typical railway standards, for example with regard to electromagnetic compatibility, environmental conditions and fire protection. It was also required to cover a maximum voltage of up to 1,800 V DC. Bender's tried-and-tested high-performance isoRW685-D railway insulation monitoring device alone was not able to meet these requirements, but when combined with the AGH150W-4 coupling device, it ticked all the boxes with its expanded permissible voltage range.

### An established solution for Turkish rail transport

Intensive tests in the R&D department in Turkey confirmed that the developed solution fulfilled all requirements and was compatible with the planned application. These tests examined the actuating time of the solution both with different voltages and in different positions in the system, not only coupled with the AC circuit but also in an intermediate DC circuit. Given

these positive test results, the developed solution has now established itself for insulation monitoring both now and in future rail vehicle projects in Turkey. Bender has already supplied the Turkish rail industry with the first 48 units of the combined solution, and further deliveries have also been planned.

### Expanding a successful partnership

Bender's excellent cooperation when developing the monitoring system for traction inverters also enabled the company to attract attention as a partner for other projects. Its Turkish partners, for example, additionally ordered a smaller insulation monitoring device. The isoRW425-D is used to monitor 400 V circuits, for example those used in the on-board network for lighting and other electrical components. It is suitable for applications involving less demanding electrical specifications, complies with the relevant railway standards and has already proven its worth in a variety of comparable applications worldwide. With this solution, Bender helps to ensure that Turkish trains are both reliable and failure-free and provide passengers and staff with a safe and comfortable travel experience.

**The railway specialist Matthias Rohner is delighted with the excellent cooperation of all parties involved and the positive feedback received:**

*“When it came to meeting these complex demands, Bender impressed us with its competent contacts, well-engineered products and personal commitment. The solution developed by Bender combines transparency in the electrical system with the high availability of the overall system.”*



## Flying high with electrical safety

### On board in electric aircraft

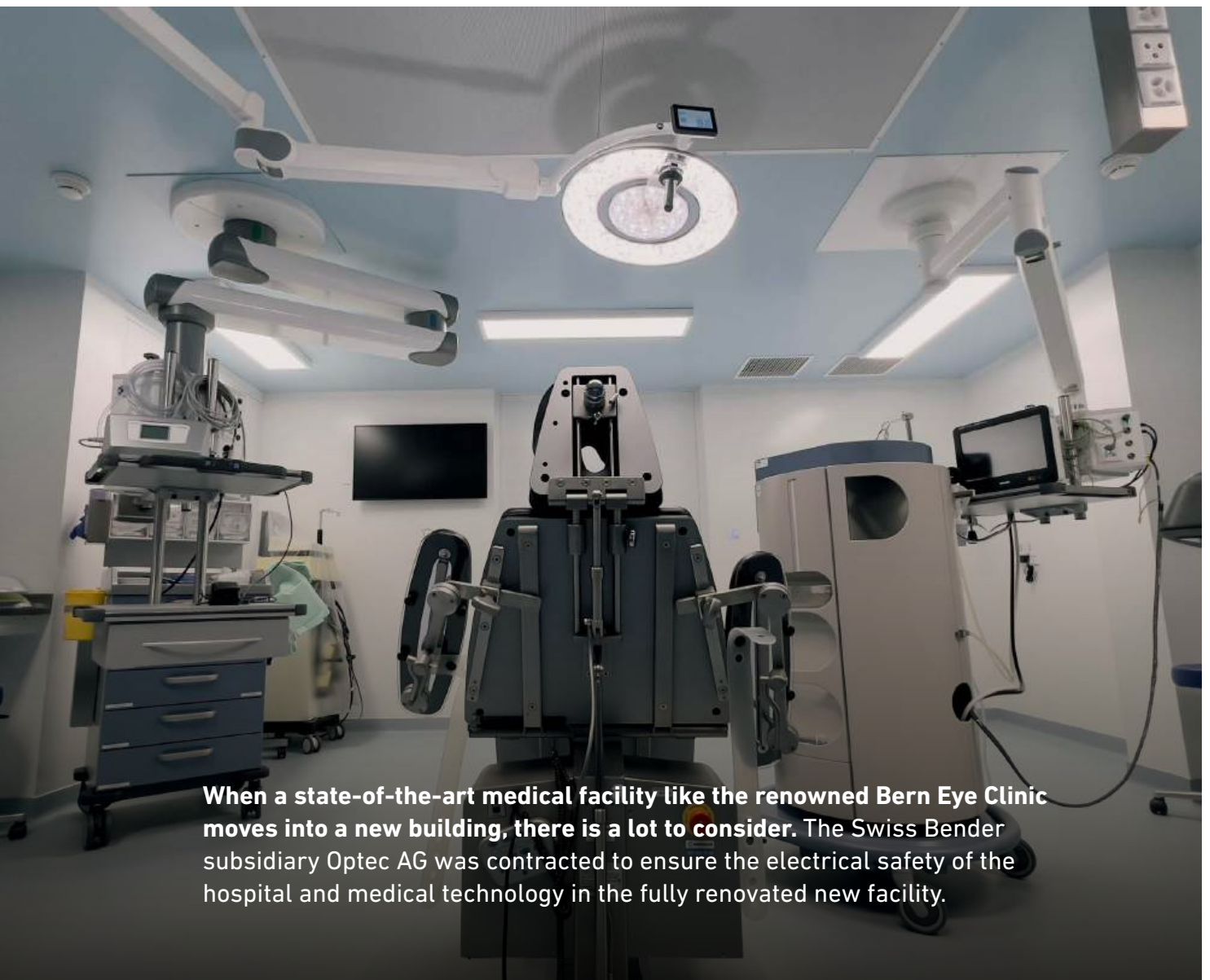
The “Energy and Mobility” in Cleveland, USA, is one of the leading conferences for the forward-looking implementation of modern energy and mobility concepts. Specialists from a multitude of companies and organisations all gather at the event, which was initiated by NASA, SAE and INCOSE. At last year’s event, Bender was invited to give a presentation on the topic of electrical safety in aviation. The physician Florian Bruder-Mandler made the most of the opportunity to present the status quo from Bender’s perspective and attracted a great deal of interest with his talk.

### IMDs in multi-channel operation in aviation

The market for electric flight is currently experiencing extremely dynamic development, especially when it comes to evTOLs (electric Vertical Take-Off and Landing aircraft) flying at low altitude and with a limited range. The physical and technical demands of higher-altitude aircraft are also becoming an increasingly common topic of discussion. Alongside battery weight, electrical safety is one of the biggest challenges faced in this regard. Thanks to his many years of experience in the fields of mobility and avionics and his work in standards committees, Bruder-Mandler was able to provide plenty of ideas and inspiration for the future.

# Networked and future-proof

Hospital and medical technology for a state-of-the-art eye clinic in Bern



**When a state-of-the-art medical facility like the renowned Bern Eye Clinic moves into a new building, there is a lot to consider.** The Swiss Bender subsidiary Optec AG was contracted to ensure the electrical safety of the hospital and medical technology in the fully renovated new facility.

### The renowned Bern Eye Clinic

The Bern Eye Clinic specialises in the diagnosis and treatment of complex eye diseases. Its main areas of expertise lie in treating retinal diseases / cataracts and general age-related clinical pictures (for example wet or dry macular degeneration). The clinic uses state-of-the-art technologies and participates in Swiss and international further education courses and studies to provide its patients with access to the latest diagnoses and therapies. With its more than 50-strong team, including 13 doctors, the clinic also performs complex operations in its three in-house operating theatres. To provide its patients with even better care, the clinic recently moved to a new facility. Its new premises are spread out over two floors and had to be gutted, renovated and fitted with a new electrical system before the big move.

### Planning in accordance with the requirements of applicable standards

At the start of the renovation, a detailed inventory, including a risk assessment, was required. This revealed that the power supply in the three operating theatres needed to be designed in accordance with the requirements of applicable standards, namely CH NIN 2020, Chapter 7.10. One of the requirements stipulated by this standard is that the safety of patients and medical staff must take top priority in all medical areas. Given that even a short interruption of the power supply could endanger the diagnosis, treatment or operation of patients, a safe and reliable power supply is absolutely essential. Optec AG was already able to provide its expertise and experience in the planning phase of the project.

### Additional services

When consulted regarding the construction of the new premises for the eye clinic, Optec AG was able to offer its services in not one but two different areas.

*“We had initially only been recommended for the hospital technology. When discussing the project with the building owner and the planning specialists, however, we were also able to provide our expertise on fittings and fixtures for the operating theatres and were therefore also contracted to implement these plans,”* reports **Benjamin Bühler, Head of Hospital and Medical Technology / Key Account Manager for Hospital and Medical Technology at Optec AG.**



The detached control unit forms the basis for electrical safety.

### A central power supply

The basis for electrical safety, the control cabinet, was installed on the ground floor of the clinic. This contains automatic changeover modules from the ATICS® series, insulation monitoring and isolating transformers, all networked with the building technology. The specialists from Optec AG then worked together with the specialist planning team to develop a concept for the three operating theatres as Group 2 medical locations with an uninterrupted power supply. Three distribution boards now ensure a safe electrical power supply for the operating theatres, each of which also has its own newly established IT system.

### The CP915 control and operator unit

Three detached CP915 control and operator units were installed for central control in the operating theatre. These units ensure that alarms and signals are triggered in the case of faults by supporting the medical staff with understandable operating and handling instructions. As an interface between humans and machines, the remote alarm indicator and operator panels therefore play an essential role, especially when there is a risk of critical operating situations,

namely disturbances to the electrical power supply. As central monitoring and control systems suitable for a wide variety of applications, the CP915 control and operator units also network third-party systems from other manufacturers reliably and with a future-proof approach, for example ventilation technology, lighting and medical gas supplies. Additional systems can be easily integrated at a later point in time. In addition to the CP915 control and operator units, three detached control units were also installed to integrate and control the third-party systems.



The CP915 control and operator units control all systems in the operating theatre and provide staff in the operating theatre with clear information on any disturbances that occur.

### Merivaara operating theatre lights

How an operating theatre is lit also plays an important role in ensuring the best possible treatment success. It is particularly essential that the light is always in the right place and no shadows occur. Nowadays, high-quality lighting precisely where it is needed is a standard requirement in hospitals and medical practices. Optec AG was able to meet this requirement by offering a tried-and-tested and suitable solution: efficient, high-performance operating theatre lights by Merivaara. The Q-Flow™ 4i operating theatre lights stand out due to their modern design optimised for air flow circulation and their easy operation. They instantly provide perfect vision and make operations easier to perform.

## An experienced specialist in hospital technology

The Swiss company Optec AG has been a reliable partner for innovative and sustainable electrical safety solutions since 2000. It has been part of the Bender Group since 2017 and caters to the needs of customers in Switzerland with its team of around 40 specialists. Hospitals and medical locations are one of the company's focus areas.



In addition to its comprehensive product portfolio, Optec AG also offers all services from a single source, **from consulting to project planning and commissioning and right through to after-sales service.**



*"The relocation of our eye clinic posed a number of challenges for us with regard to hospital and medical technology. With Optec, we found a partner that supported us throughout the entire project planning, implementation and commissioning processes. We trust the products and solutions from Optec AG used in our new premises, for example the CP915 operating theatre control system and the new Q-Flow™ operating theatre lights. We can wholeheartedly recommend Optec AG to anyone looking for an ideal partner for hospital or medical technology."*

**Robert Brauer, Operating Theatre Coordinator, Bern Eye Clinic**



### All from a single source

With its construction period of around eight months, the project was indeed a significant challenge for Optec. The company not only had to consider different systems but also needed to mediate between the interests of the different stakeholders involved.

Optec's Managing Director, **Omar Seijo**, was extremely pleased with the result:

*"We are delighted that we were able to contribute our entire spectrum of expertise, from project planning to producing diagrams and putting systems into operation on site and right through to service. The Bern Eye Clinic now has a future-proof electrical power supply that is designed in accordance with the requirements of applicable standards and can always be extended without any problems at a later point in time."*



The high-quality Merivaara Q-Flow™ 4i operating theatre lights ensure excellent visibility at all times and therefore provide the ideal conditions for successful operations.

# Getting more from the sun

Efficiently charging electric vehicles thanks to phase switch-off in the case of a reduced PV output



The sun is always shining. Nonetheless, depending on the time of day and year, weather and clouds and other factors, the amount of sunlight that actually reaches roofs with PV installations varies. Until now, technical limitations have meant that the amount of sun exposure was not always enough to produce enough electricity to charge electric vehicles.

With their new function, however, Bender charge controllers now enable electric vehicles to be charged using PV electricity even when solar radiation is low. The charging station achieves this by automatically switching between three-phase and single-phase charging and thus significantly improving the efficiency of the system.

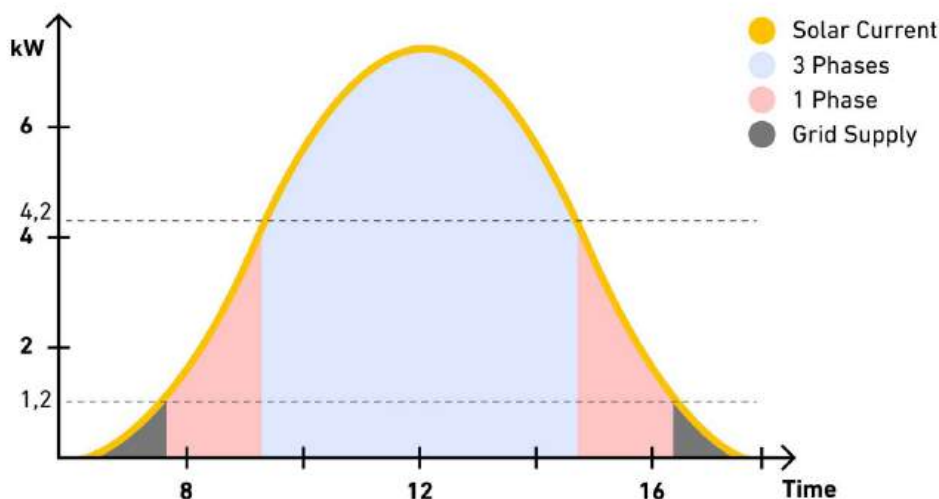
### Excess charging without wasting any sunlight

Electric vehicles play an important role in helping to reduce CO<sub>2</sub> emissions in road traffic. To make them an even more sustainable solution, they should ideally be charged using electricity generated by PV installations. Excess PV charging supports this by solely using PV electricity to charge electric vehicles. There is, however, a limitation to this application: If the amount of electricity generated by the PV installation falls below a certain value, the charging process stops. For example, at dusk, in the winter months or on cloudy days. The electricity produced is then fed into the grid, earning users a small feed-in bonus, and is no longer used for charging.

### The challenge of excess PV charging

The technical background to this problem can be explained in just a few words: Most vehicle charging stations use three-phase charging, ideally with 16 A per phase. This enables them to achieve a charging capacity of 3 x 3.7 kW, equalling a total of approx. 11 kW. If solar radiation weakens so much that the PV output falls below 4.2 kW and less than 6 A is therefore available per phase, three-phase charging is no longer possible for technical reasons, despite the fact that solar power is still being generated to a relevant extent. This is because electric vehicles require at least 6 A per phase to charge. To enable excess PV charging to continue despite these circumstances and without using additional electricity from the grid, there is a simple solution close at hand, namely switching off, or 'shedding', two phases and switching to single-phase charging in periods of low solar radiation. With a reduced PV output, for example just 3.2 kW, such charging is possible with 14 A.

### PV excess charging flexibly adapts the charging process to the available solar energy



Excess PV charging enables charging stations to switch flexibly between single-phase and three-phase charging and therefore to make optimal use of the solar energy available.

The control system for PV charging can be programmed to ensure that electricity from the grid is used additionally where needed to facilitate a charging process.

## EN ISO 15118 expands communication

### Improved communication between vehicles and charging stations in the medium term

According to standard IEC 61851-1, AC charging stations can only notify vehicles of the maximum amount of electricity they are permitted to use. This one-sided communication via the charging plug does not differentiate between individual phases, and the vehicle itself cannot communicate with the charging station. The standard ISO 15118-20 can help to resolve this issue. It describes expanded communication between a charging station and a vehicle and enables a bidirectional data exchange. The power line communication (PLC) used for this exchange has already been available in Bender charge controllers for more than eight years.

In the medium term, it will be used to realise further functions that are essential for efficient energy management.

**Although many of these functions have not yet been implemented in vehicles, they demonstrate the opportunities awaiting us in the future:**

- Reporting the current charging status and requirements of vehicles to the charging station
- Sending information on the grid capacity and possible limitations from the charging station to the vehicle
- Efficient and grid-friendly charging thanks to charging time planning that factors in both the charging requirements and the grid capacity
- Use of the energy stored in the vehicle within the scope of vehicle-to-grid functions

#### Charge controllers for intelligent charging stations

Although this solution sounds simple, its technical implementation is slightly more complicated because the charging station needs to be able to independently switch phases on and off. To identify the correct operating point for making the switch, the station also needs to know how much PV energy is currently being generated and how much is available for charging purposes once all loads in the home grid have taken what they need. Charging products from Bender meet the necessary technical requirements thanks to their charge controllers, which determine the amount of power currently available by communicating with the PV installation and requesting the required data via SEMP or the SunSpec protocol. They achieve this by communicating with the inverter, the energy manager or an additional energy meter that is installed behind the house connection and integrated via Modbus TCP. This energy meter is connected to the Bender charge controller via Ethernet to record the net PV output available.

#### The benefits for charging station manufacturers

In terms of both hardware and software, many of Bender's charge controllers support several relays or contactors to switch phases on and off when managing the power supply between the charging station and the vehicle. Charging station manufacturers can choose to implement this function either discretely via contactors or using an integrated solution with a so-called power board. Manufacturers that already use Bender charge controllers can integrate PV charging via a software update and offer excess PV charging without phase shedding as a new function for existing products and charging stations. Furthermore, system and solution providers can expand their PV installations and energy solutions by exploring charging infrastructure options. They can use protocols such as EEBus, SEMP, OCPP and Modbus TCP to integrate the PV charging functions of charge controllers from Bender into their products. As a result, their solution will be simultaneously compatible with many charging stations produced by different manufacturers.

### A modular solution with the ICC1324 charge controller

The charge controllers in the ICC1324 range enable manufacturers of charging stations to use Bender's IPM14x1 power boards to easily integrate phase shedding. Bender supplies the circuit logic for the power path. These additional boards known as power boards, for example the IPM1404, can be mounted directly below the controller and also offer a number of other sensible functions such as overvoltage protection, DC residual current monitoring and weld check. Alternatively, customers can also implement phase shedding with their own switch relay solutions or discretely via contractors. In this case, a switching output of the charge controller is used to control the process.

### Comfortable control with the Bender app

Be it in a Bender charging station or a solution from another manufacturer, the PV charging function can be easily and conveniently controlled via the Smart Energy Control App. Manufacturers can simply use the Bender app, which is available for Apple and Android devices, as provided or adapt it to meet their own requirements. They can alternatively integrate their own app via a REST interface.



The Smart Energy Control App enables users to conveniently select their chosen charging mode via smartphone.

### Three charging modes available

The Bender app enables manufacturers to choose between the charging modes of manual charging, PV charging and excess PV charging depending on their needs.

**01** In manual charging mode, the vehicle is charged with the selected output or predefined amount of energy regardless of the PV output available. This is a sensible option when a vehicle needs to be charged as quickly as possible but an insufficient amount of solar energy is available.

**02** The PV charging mode always favours the use of electricity from the PV installation. If the amount of electricity available falls below 4.2 kW, the system switches from three-phase to single-phase charging. If the charging capacity continues to decrease, for example to below 1.4 kW, the system can be programmed to automatically use electricity from the grid so that the charging process can continue and, where possible, no electricity is fed into the grid.

**03** Last but not least, excess PV charging only uses electricity from the PV installation and pauses the charging process if the capacity falls below the set limit. Without phase shedding, this usually occurs when the charging capacity decreases to less than 4.2 kW.

**All in all, the PV charging function plays an important role in helping to make the future of energy efficient and sustainable and to further reduce the carbon footprint of electric vehicles.**

# Regular servicing keeps systems running smoothly

## Maintenance protects patients

A safe and uninterrupted power supply is essential for ensuring excellent care for hospital patients. Special warning systems help to detect faults at an early stage. Nevertheless, these warning systems themselves can also be technically outdated and therefore need to be checked on a regular basis.

### Alarms as a stress factor

Loud beeping and flashing alarm lights are the constant companions of staff working in intensive care units, operating theatres and other medical areas. If alarms are triggered for no reason, staff may tune them out subconsciously or simply ignore them, which may lead to life-threatening situations. A hospital in California faced a similar problem when the insulation monitoring devices of its medical IT system sounded an alarm for no explicable reason.

### IT systems in the medical sector

In hospitals, medical IT systems are usually the best option for a safe, uninterrupted power supply. Their main advantage is the fact that they continue to operate without disconnecting in the event of an initial insulation fault. As a result, operations or treatments do not need to be interrupted, and there is time for the fault to be corrected. Insulation monitoring devices (line insulation monitors – LIM) play an important role in medical IT systems by monitoring the IT system and emitting acoustic and visual signals to warn hospital



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Regularly checking electrical safety in operating theatres and intensive care units helps to protect patients and operating theatre staff.

staff in the event of an earth fault. To guarantee their operational safety, these insulation monitoring devices also need to be checked and serviced on a regular basis.

### **Hospital technology put to the ultimate test**

To avoid all risks, the hospital in California wanted to get to the bottom of the matter and contacted the specialists at Bender Inc. When carrying out their annual checks and re-certifying alarm indicator and test combinations for Bender IT systems, the Bender specialists also tested the function of the insulation monitoring devices. The Bender Service Team examined a total of 13 medical IT systems for operating theatres at the hospital. The IT systems tested included both outdated analogue insulation monitoring devices and newer digital devices from the early 2000s. Although most of the digital insulation monitoring devices passed the functional and standard tests, all of the analogue devices failed them. This was mainly due to their insufficient response value of 2 mA, which was far below the current value of 5 mA required by the relevant standard.

### **Outdated technology as a source of faults**

Conversations with the hospital staff soon revealed that in many of the rooms containing outdated insulation monitoring devices, the insufficient response value frequently triggered disturbing alarms. Furthermore, some of the existing analogue devices not only failed the standard test but were also unsuccessful in the functional test. In some cases, this was due to defective indicator lights, while other devices displayed a fault current that was much too high. In these questionable cases, the insulation monitoring devices displayed a value that was nearly 2 mA above the actual fault current (total hazard current according to NFPA99) when tested using a simulated system disturbance with a current over the response value of 5 mA. Such a large difference between the internal calculations of the insulation monitoring device and the known system status indicated that there was a fault in the software of the monitors, which therefore needed to be replaced as quickly as possible.



The specialists from Bender Inc. put the hospital's medical IT system through its paces.

### **New safety thanks to a retrofit plan**

Upon completion of the checks, it was clear that a total of seven of the thirteen medical IT systems tested did not comply with the current standards or were not in working order. As a result, the operational safety of the hospital was seriously at risk, and a solution needed to be developed as a matter of urgency. In consultation with the hospital technicians, the experts at Bender Inc. came up with a retrofit plan. This plan was designed to ensure that the faults could be corrected while keeping downtimes for hospital operations to an absolute minimum.



For the re-certification of the systems in accordance with the requirements of applicable standards, faults are simulated, and the triggered alarms are checked.

### Implementing the retrofit

Special retrofit kits and corresponding alarm indicator and operator combinations were planned for the retrofit measures. These ensure that the new insulation monitoring devices are compatible with the distribution boards of the existing IT systems and will work smoothly in the future. Even following this extremely comprehensive retrofit, the Bender Inc. service team will continue to check the alarm indicator and operator

combinations of the medical IT systems on an annual basis and to re-certify them. With this support, the hospital can ensure that its new insulation monitoring devices are fully functional, and its medical IT system is correctly monitored. As a result, the new technology makes life easier for the hospital staff plagued by alarms and ensures that the hospital's power supply will remain future-proof for many years to come.

## Dave Bradley, a Service Technician at Bender Inc., has been helping to ensure electrical safety in hospitals for more than 30 years. In our interview, he shares his experiences.



### What does servicing mean for companies?

*"We carry out more than 200 servicing checks every year. In most cases, we discover at least one faulty device in each check. In one hospital, I even found 15 LIMs that were all more than 30 years old.*

*I recently performed tests in an operating theatre and immediately noticed that the display had completely frozen and was therefore unable to*

*relay alarm messages. The hospital hadn't noticed it and would never have realised that there was a problem with the power supply of its medical IT system. I was able to restart the device quickly and will replace it soon. This replacement is affordable compared to the potential negative impacts of continuing to use a faulty device."*

### What problems do you discover when performing checks?

*"We most frequently find faults in outdated components such as analogue insulation monitoring devices. These are often still programmed to a response value of 2 mA and therefore trigger countless annoying false alarms. As a result, staff ignore alarms, which can lead to distractions during an operation and cause electrical faults to be overseen at the same time. Some hospitals even press the mute button, which causes all alarms to be switched off immediately, even the critical ones."*

### What are the possible consequences of such actions?

*"If the first fault is overseen or ignored and therefore not corrected, a second fault may trigger the fuse, thus causing the power supply to be cut off. This is an absolute no-go when a patient is on the operating table. Many people don't realise that we protect not only the staff but also the patients who are lying on the operating table, ventilated and helpless. We are here to protect them."*



# National and international



## 01 EV Awards India Technology Excellence Awards: Passenger Safety Solutions of the Year & EV Component Innovation of the Year

At the first EV Manufacturing Show in India in 2023, Bender India Pvt Lt. won not one but two awards for its expertise in e-mobility. The company received the Technology Excellence Award in the category of Passenger Safety Solutions for its pioneering work in sensor technology, which has improved electrical safety and reduced the fire risk of electric vehicles.

The second award was presented to Bender India in the category of EV Component Innovation for its innovative insulation monitoring devices, which monitor the entire electrical drive system in electric and hybrid vehicles and thus provide effective protection against electric shocks.

## 02 Kununu Top Company Award 2024

This year, Bender has yet again received the Top Company Award from the employer rating platform Kununu. The platform presents this seal of approval to the best-rated employers. Overall, only around five percent of the companies listed on Kununu receive the award. Bender has been part of this top-rated group every year since the award was launched in 2022, winning it for the third time in a row this year.



# Making electricity future-proof worldwide

From H<sub>2</sub> to the OR and from trains to data centres, wherever electrical safety and the future-proof use of energy play a role in locations all over the globe, Bender is sure to be close at hand. In countless applications, Bender's standard products and individually developed solutions help to make electricity safe and protect people, systems and processes. When doing so, they meet all general specifications, special regional requirements and customer and application-specific special requests.

## 01

### The CP907 touch control panel: for monitoring operations

More and more hospitals are now transforming their classic operating theatres into hybrid operating theatres using modern imaging devices. As a result, their power requirements are increasing hugely, and their power supply systems therefore need to be modernised.

A cancer centre in the USA recently contracted Bender to support it in this process. A total of 32 operating theatres required new control cabinets with real-time monitoring of essential electrical systems. The centre also required all monitoring data from the various insulation monitoring devices, remote displays and insulation fault locators to be consolidated in a central location. With its CP907 touch control panel, Bender provided a modern, cost-effective solution that can be easily integrated into existing applications and is also suitable for complex systems.

You can read more about this project here:



## 02

## The DGUV V3 inspection: a challenge for hospitals

In many countries, the regular inspection of electrical installations and equipment is legally stipulated. This is also the case in Germany, where hospitals must get their systems inspected every three years in accordance with Regulation 3 of the German Social Accident Insurance (DGUV). For many hospitals, this inspection is so complex in terms of time and organisation that it is extremely difficult to perform.



In the Bender blog, you can read about how the installation of residual current measurement technology from Bender has made the DGUV V3 inspection much easier for a hospital in the German state of Brandenburg.



## 03

## Reliably supplying ships in harbour with electricity: PE monitoring of shore connections with the GM401

To efficiently reduce noise and particulate emissions, an increasing number of ships in harbour are now being supplied with electricity via shore connections. With such supplies, it is important to ensure electrical safety. To achieve this, Bender offers a patented solution for permanently monitoring the grounding conductor of the shore connection in order to avoid faulty releases via the sea water or gangway.

**The current GM401 device combination enables particularly rapid and simple installation without even requiring the involvement of service technicians on-site. You can read more about this solution on [page 30](#).**



# 04

## Protecting critical infrastructures

Be it railway connections, petrol stations, data centres, water lines, heating or hospitals, virtually nothing in our critical infrastructure functions without electricity. A fail-safe power supply is therefore the top priority when it comes to protecting this infrastructure.



**In the Bender blog, you can read all about the ideas and solutions that Bender offers for perfectly securing our critical infrastructure with a safe power supply as an electrical safety specialist.**



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# 05

## Hospitals: an upgrade for the power supply

When caring for patients, doctors and carers are now supported by an increasing amount of technology. Against this background, most hospitals primarily invest in new medical technology, while the modernisation of the power supply is often left unconsidered. It is, however, important that the two go hand in hand to ensure a fail-safe power supply for medical departments.



**In the Bender blog, you can read about how hospitals can meet the requirements for a safe power supply and what solutions Bender offers for upgrading hospital power supplies, for example the CP305 alarm indicator and operator combination.**

## 06

## CCV payment: EV charging via credit card

Find out more  
about this  
exciting project.



To make charging electric cars easy, fast and safe throughout Europe, Bender has launched a project with the internationally successful payment provider CCV Payment. With their project, the two partners aim to install 300,000 charging stations offering simple and contactless credit card (PIN on Glass) payments in locations all over Europe.



All of the charging stations will be equipped with Bender's CC613 charge controllers and will support functions such as Dynamic Load Management (DLM), Power Line Communication in accordance with ISO 15118 and providing electronic receipts. The charging station will also, of course, be updatable and therefore fit for the future.

## Seminars and exhibitions

At seminars and the following trade fairs, you are invited to exchange ideas with the electrical safety experts in person. Find out about the current events in the respective regions online:

**Exhibitions, trade fairs and events:**



**America Web-Seminars:**



**Europa Web-Seminars (in English):**



**Seminars and Web-Seminars (in Spanish):**



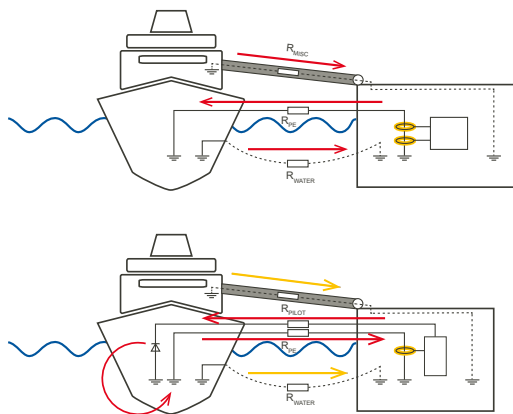
# New Products

## PE monitoring of shore connections with the GM401

Providing electrically safe power supplies for ships in harbour is becoming increasingly important. Shore connection systems have to cope with a variety of challenges in the form of ship movements, tides and rough working conditions. The new GM401 device combination ensures that passengers and crew are protected against faulty onshore power systems at all times and that it is particularly quick and easy to install.

### Electrical risks in harbour

Various influencing factors can all lead to damage to shore connection lines over time. In the event of a fault, the PE acts as a return conductor, causing the medium voltage to be disconnected. If this process were interrupted and this were to go unnoticed, the short-circuit current would flow through the gangway or the ship's hull and the water surrounding the ship to the shore, thus posing a severe risk for passengers and the crew. Safe, robust and reliable monitoring of the PE therefore prevents damage. Bender already presented a patented solution for this issue in the form of its GM400 back in 2016. The successors to this model have been significantly improved, especially in terms of usability.



### PE monitoring of shore connections with the GM401

The IEC 80005-1 (medium voltage) requires the connection between the ship's hull and the shore to be permanently monitored in the case of electrical shore connections. This guarantees that the equipotential



Slim device on the left: LPR measurement (Low Parallel Resistance) Two devices on the right: HPR measurement (High Parallel Resistance)

bonding between the ship and the shore is ensured. The PE monitoring of shore connections with the GM401 achieves this by combining two measuring methods that measure directly via the PE and thus avoid faulty OK measurements via the gangway or sea water. The HPR (high parallel resistance) measurement reliably measures the connection between the ship and the shore, even in the case of high parallel resistance. The LPR (low parallel resistance) measurement reliably detects and reports the difference between the PE connection and the water in the case of low resistance between the ship and the shore, for example with the brackish water in Hamburg Altona (approximately 1  $\Omega$ ). The onshore power supply is only enabled when one of the measurements detects the PE connection.

Bender already provided the first electrical shore connections in Hamburg Altona, Germany, back in 2017. Looking back at this period, Uwe Radke, GVEFK Head of department electrical engineering / Hamburg Port Authority, reports that it was a success:

*“We tested the new measuring method back then and have been extremely satisfied ever since. The direct measurement of the PE conductor was important so that we could eliminate the risk of a faulty release measurement of the PE via the tide-dependent brackish water in the Port of Hamburg. There were no problems, and the new version is much easier to handle.”*



© HPA/Schmidt Wiehoff

### Simplified Plug & Play installation

Up until now, Bender manufactured its PE monitoring devices for shore connections with an extra enclosure. The current generation of GM401 models, however, enables electrically skilled individuals to easily integrate and mount the devices on the DIN rail in the switchboard of the shore connection. This saves both time and money and makes the installation much easier. The GM401 can then be easily configured without any complex programming. The GM401 is suitable for use in both medium-voltage and low-voltage applications (IEC80005-3).

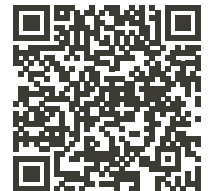
### Holistic Bender safety on board

If necessary, the GM401 can also be expanded by adding an NGRM700 neutral grounding resistor monitor on shore. This monitor detects damage to the earthing resistance and the connection, as well as earthing faults. On the ship, a Bender CME420 current relay can be installed to additionally monitor the current over the PE and disconnect the system on the ship to avoid further damage if the threshold value is exceeded. As a result, port operators and shipping companies can also fully benefit from Bender safety for their electrical shore connections.

### Empirical values based on years of experience

Both the GM401 and its predecessor model, the GM400, have successfully proven their worth in a variety of applications. The Hamburg Cruise Center Altona, for example, has already been monitoring its electrical shore connection with Bender devices for many years. The Norwegian shipping company Color Line and another major ferry operator also use the patented technology in their Baltic Sea terminals. Another example can be found in Rotterdam, where the GM401 and NGRM700 monitor the electrical safety of the shore connections of large suction and rinse excavators.

For more information, please download:  
[https://www.bender.de/file-admin/content/Products/a/d/GM401\\_D00252\\_N\\_DEEN.pdf](https://www.bender.de/file-admin/content/Products/a/d/GM401_D00252_N_DEEN.pdf)





### The iONiX 25kW wallbox A stylish mode-4 charging station for private and public spaces

As a specialist in electromobility, Bender offers innovative products and technical services for the charging infrastructure of both electric and hybrid vehicle technology. A further example of such innovations is the iONiX Medium 25 wallbox for the DC charging of electric vehicles in charging mode 4 in accordance with IEC 61851-1 and IEC 61851-23.

The wallbox is designed for use outdoors and in enclosed spaces. Given that it is intended for continuous operation and offers conformity with the German calibration law as an option, the charging station can be used in both private and public spaces. A payment terminal can also be integrated as an additional option. The iONiX Medium 25 wallbox was developed as a reference design for Bender's DC charging components (DCC613 – DC-Charge Controller; SU612 – Safety unit for DC wallboxes; HMI180 – Communication module – circuit board for controlling the display, lighting and antennas; ALM113 – Ambient Light Module; and RFID105 – Radio-Frequency Identification). —

### Making e-mobility safer The ISOMETER® iso175 for hybrid and electric vehicles

The ISOMETER® iso175 is a new insulation monitoring device for unearthed drive systems in hybrid and electric vehicles. It uses an active, patented measuring principle to continuously monitor the insulation resistance in high-voltage systems. In doing so, it reliably detects symmetrical and asymmetrical faults and thus contributes towards safety in e-mobility.

The ISOMETER® iso175 is available in different designs and, depending on the variant, uses different CAN protocols (Standard Bender, SAEJ1939) to communicate with the system environment. It ensures insulation monitoring of AC and DC insulation faults for unearthed DC systems from 0 to 1000 V. The device also offers automatic adaptation to the system leakage capacitance (up to 10 µF depending on the profile) and integrated self-diagnosis. —





# Continued commitment

## ISOMETER® devices will make work easier on board the Mercy Ships

**Electrical systems must offer guaranteed safety on Mercy Ships hospital ships.** To achieve this, a current over 300 motors need to be disconnected, measured, reconnected, and inspected every 5 years. The insulation and overvoltage tests are challenging in terms of both staff and material. Bender makes this critical task much easier by providing suitable offline ISOMETER® IR420-D6 devices.

*"The new ISOMETER® devices enable automated testing and will make work much easier when it comes to the regular testing and maintenance of the electrical machines. As a result, my team will be able to focus more on other important tasks."*

**Renier Marx, Chief Electrician, Global Mercy®, Mercy Ships**



Renier Marx, Chief Electrician, Global Mercy®, Mercy Ships and Alistair Macdonald, Electrical and Control Technician, are delighted about the automatic fault location in the main and emergency switchboard.



# Sustainably future-proof

**Bender's commitment to the environment** – At industrial companies in particular, the topic of sustainability is often only considered in terms of energy requirements, the use of raw materials and compliance with environmental protection regulations. Sustainability can, however, involve so much more, as is demonstrated by the activities at and around the Bender headquarters in Grünberg, Germany.



*“Our commitment to a multitude of environmental activities at our company locations allows us to cover important sustainability aspects. We are also involved in a large number of smaller individual projects focusing on protecting flora and fauna,”*

explains **Benjamin Höchst**, Group Leader for Site Maintenance at BISG and a pioneer for sustainability in Grünberg.

### **A green roof and green surroundings**

Given that the German word for green is *grün*, the town of *Grünberg* goes perfectly with its natural surroundings. To ensure that this remains the case, Bender has transformed its roof into a garden full of fruit trees and berry bushes and launched a multitude of sustainable activities. Its lawns, for example, are maintained based on a sustainable mowing concept in which grassy areas are mown and left to grow in alternation. Sheep always lend a helping hand in the autumn. Behind its building, Bender has planted eight fruit trees with varieties such as quince, cherry and mirabelle plum, with employees free to help themselves to whatever grows. A raised bed has also been built to grow vegetables for the company restaurant KostBar.

### **Birds, fish and fire salamanders**

As you would expect, Bender is also actively committed to the animal world. The blinds on its main building, for example, are regularly moved based on a plan developed by Giessen University. This helps birds to learn that there is an obstacle and in turn prevents nasty collisions. 100 crayfish at risk of extinction have been released into the pond in front of the main entrance, with plans in place to relocate their offspring to local rivers at a later point in time. The pond also contains swan mussels, which use their impressive cleaning performance of up to 40 litres per day to keep the pond clear and eliminate the need for chemical cleaning agents. What’s more, the area surrounding the building now contains a number of nest boxes, the company’s own hedgehog house and bird feeders that are filled on a regular basis.



At the Family Day in the Brunntal valley, around 250 employees and their family members discovered how nature conservation and fun can be perfectly combined.

# Bender@SELAM

## Exciting news from the relief project in Ethiopia

**Our vocational training project at the Technical Vocational College (SDR-TVC) at the SELAM site in Addis Ababa is still going strong. In April 2023, 14 trainees signed up to complete a long-term apprenticeship in Building Electrical Installations (BEI) and 12 enrolled in training in Industrial Electrical Engineering and Control Technology (IEECT).**

Unfortunately, seven of these trainees have since decided to end their apprenticeships. As a result, a total of ten trainees are currently completing vocational training at Level 2 in BEI, and nine are working on Level 3 in IEECT. All of these trainees have passed their institutional examinations for their respective training levels and moved up to the next level. During their apprenticeships, the trainees in the Bender@SELAM class complete practical training that takes up 70 % of

their training hours and also learn a great deal from in-person visits to companies all over Addis Ababa. SELAM offers both regular apprenticeships lasting one to four years and various short courses lasting only six months. In 2023, 86 % of the 175 students at SELAM passed their final examination and were all then able to find employment or set up their own business.

### **About the social electrical project Bender@SELAM**

Homing – Educating – Providing a future. The child welfare organisation SELAM has been working from these principles since 1986, striving to fight poverty through training and support. Bender launched the project Bender@SELAM in cooperation with the Swiss aid organisation SELAM in 2021.



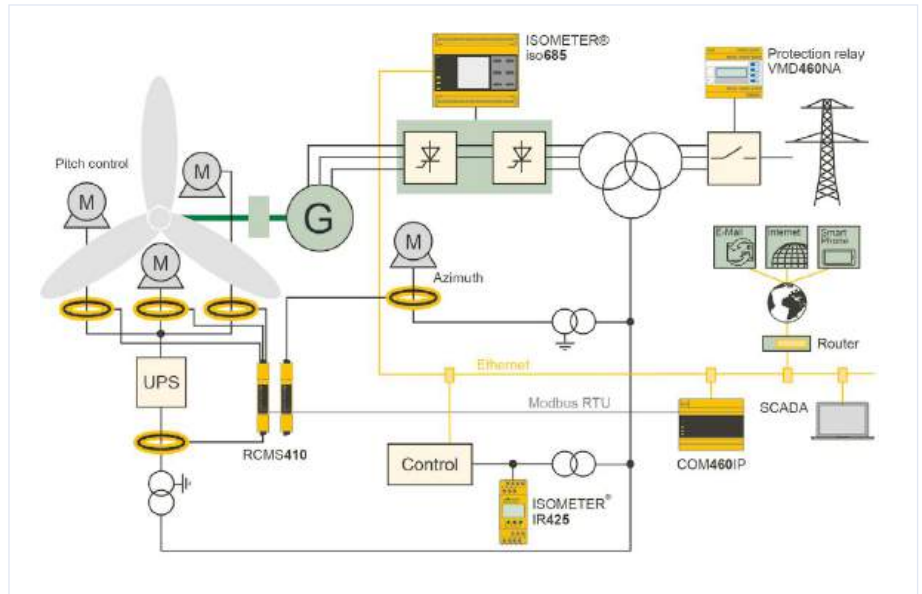
Our photos provide an insight into the field of electronics at the Technical Vocational College.

# Designing wind energy plants

## Specialist expertise in detecting and localising insulation faults at an early stage



Tilo Püschel is a specialist in electrical safety in renewable energy plants.



ISOMETER® devices enable the early detection and localisation of insulation faults in wind energy plants.

The second edition of the reference book **“Wind Turbine System Design: Electrical Systems, Grid Integration, Control and Monitoring”**, published by Jan Wenske, was released this year. Tilo Püschel, Market Segment Manager at Bender, made an important contribution to the book.

In his article, he reveals how environmental influences (onshore and offshore), the vibration of the rotor blades and the rotation of the nacelle affect the safety of the electrical systems of wind energy plants. He also explains how detecting and localising insulation faults at an early stage can help minimise the risks resulting from such effects, prevent system downtimes, reduce costs and ensure high availability.

ISBN-13: 978-1-78561-858-1  
<https://shop.theiet.org/wind-turbine-system-design-2>



# Battery energy storage systems (BESS)

## Ensuring high availability and improving fire protection

Battery energy storage systems (BESS) are highly versatile and play an important role in the energy transition. It is therefore essential that they always function reliably and guarantee electrical safety. Given their high performance and storage capacity, a number of factors need to be considered in this regard.

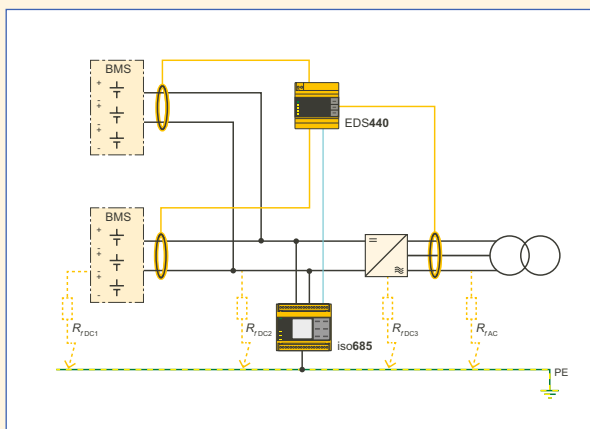
### Designs and application focuses

Two types of BESS are currently used in the industrial sector: fully or partly freely planned BESS in buildings or halls and turnkey container solutions. Depending on the application, such BESS are designed to have a high energy storage capacity extending to the MWh range and more. BESS form part of the critical infrastructure and help to secure the future-proof reliability of electric energy supplies. In the future, they can also

play a significant role in peak load management and system regulation. Furthermore, BESS enable the use of sustainably generated energy even when there is no sun or wind. Ensuring that they are highly available is therefore absolutely essential for both industrial companies and system operators, and as a result, risks of failure such as fire must be minimised.

### Fire protection provisions with an IT system

When planning and implementing fire protection measures for all kinds of batteries, it is important to remember that the fire load is directly related to the amount of energy stored. This means that the higher a battery's energy content, the larger a potential fire will be and the longer it will burn. Such fires are usually also difficult to extinguish because a sufficient amount of stored energy must be consumed or released before they can be effectively tackled. BESS fires can be caused by electrical, mechanical or thermal faults. To prevent such incidents, BESS manufacturers provide comprehensive precautions for fire protection and are constantly looking for new ways to optimise them further. Establishing an unearthed IT system can be helpful and should already be planned into the system design.



**Figure 1: Schematic structure of a battery energy storage system**  
In complex applications, integrating automated fault location by an EDS (earth fault detection) system can save a lot of time.

### The IT system and transformer

The use of a transformer is recommended in the case of industrial BESS or connection to a higher voltage level. The transformer galvanically insulates the BESS from the connected mains. In the overall system, the (unearthed) IT system has established itself as a system type. One of its main characteristics is that the active AC and DC conductors are not connected to earth (PE). Only the enclosures are connected to earth. The fact that the active conductors do not have an earth connection provides huge advantages: In the initial case of a fault, no short-circuit currents regarded as fire hazards occur because the system design means that the fault loop is not closed. Figure 1 shows the schematic structure of a typical BESS consisting of batteries, a battery management system (BMS), an inverter and a transformer. The BMS monitors and controls the individual battery cells to already exclude points of fault at cell level or to detect them at an early stage. The Bender system shown contains an ISOMETER® with earth fault detection (EDS) and monitors the insulation level.

### Insulation coordination with sector coupling of PV and BESS

Solar parks are a typical area of application for BESS. In such cases, each individual application – PV and BESS – places its own high demands on the measurement technology used. One of the stand-out electrical characteristics of large solar parks is their relatively low insulation value (R), not only in newly installed parks but also, and in particular, in older installations. In damp conditions, the leakage capacitance can

reach around  $C \geq 2000 \mu$ . The situation is reversed in the case of battery storage systems (BESS), which usually have high insulation values (R) reaching megaohm ranges and very low leakage capacitances (C). These circumstances make the demands placed on measurement technology even tougher because the electrical coupling of the two systems (PV and BESS) can result in a misinterpretation of measured values in the simplest case or lead to the safety shutdown of the overall system in an extreme case when the insulation level values fall below the defined threshold values.

### Insulation monitoring in coupled systems

With its ISOMETER® range of devices, Bender offers an option that reliably prevents such problems from occurring. Both the isoPV1685DP devices for solar parks and solutions suitable for BESS, for example the iso685-D-B, feature the “coupled systems” function. This enables operators to coordinate the insulation monitoring based on the use of PV or BESS. As a result, they cannot only achieve precise measurement results but also identify points of fault in the overall system more rapidly. Figure 2 demonstrates the potential complexity of coupling PV and BESS. The first applications to additionally contain wind energy generation plants as an option are now also available. Further additions are conceivable and technically feasible using the solution described above. In all cases, the observation and analysis of the overall system play an essential role, followed by the selective status definition of the interconnected elements and the corresponding selection of devices.

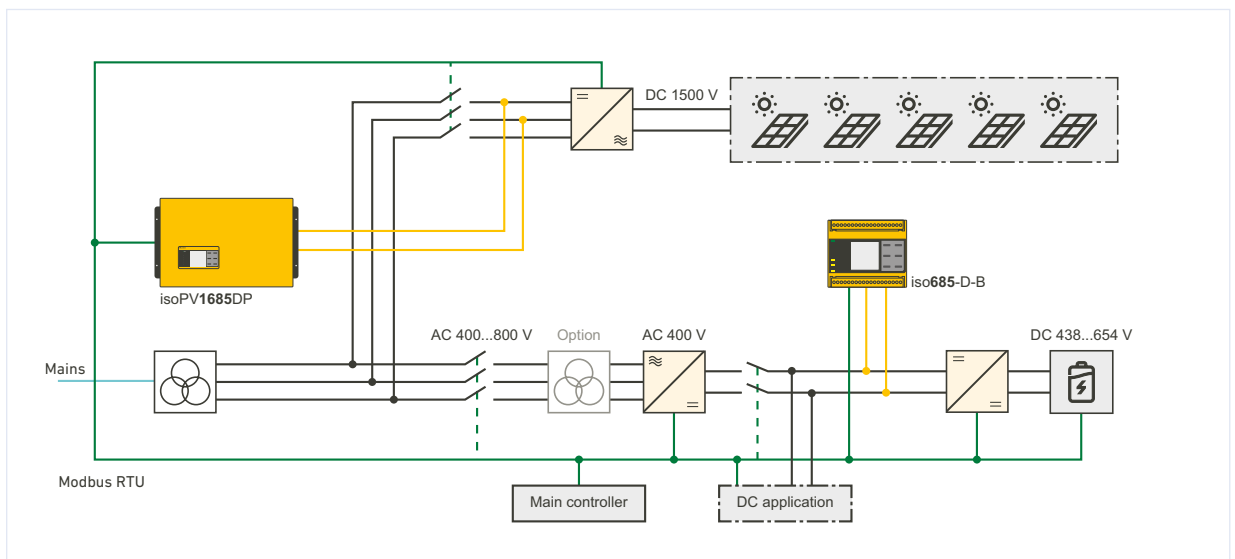
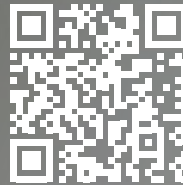


Figure 2: An overall system comprising PV and BESS with a Bender ISOMETER®

# “How we design the future of energy”

Bender has developed at a rapid pace in recent years, welcoming new people, new companies, new business divisions and new regions. The new claim unites all of these developments and focuses on what has always made Bender special and will continue to do so in the future.



A number of statements that reveal the meaning of this claim for various members of the Bender Group have been collected. You can find the full interviews and other responses at [www.bender.de/en/future-of-energy](http://www.bender.de/en/future-of-energy)

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**“Our solutions have always been much more than just electrical components hidden away in control cabinets. With our products, we have already been enabling and shaping the future of energy for quite some time.”**

**Dorothea Bender Fernandéz,  
Chair of the Advisory Board of the Bender Group**







**"For me, designing the future of energy at Bender means developing into a system partner for safety technology and energy, and shifting our focus from managing energy to shaping it. This is a huge task that we are already successfully tackling in a variety of applications."**

**Heinz Nowicki**  
Chief Sales Officer / GM Bender Group

"The focus on awareness of the present dangers of electricity and the risk that comes with the absence of electricity is still central to the philosophy of Bender, but we are now centring that safety commitment around developing intelligent solutions to make electricity both safer and smarter."

**David Knecht**  
Joint Managing Director Bender Inc.



"The future of energy is increasingly becoming decentralised, digital, and green. Digital connectivity is a key part of decentralisation and a hot topic in Canada. Canada is a vast country, and many of our customers operate in remote areas where they need connected monitoring solutions and remote access."

**Amir Mojtahed**  
Managing Director at Bender Canada Inc.

**"Energy is one of the big challenges for the future, and the focus of Bender is shifting in line with a change in the way our customers and key markets now look at electrical power. Bender has a vital role to play in that energy-driven future."**

**Gareth Brunton**  
Managing Director, Bender UK



"Bender is starting to employ the latest technology including AI and machine learning to push the boundaries of holistic intelligent power management, combining the generated data with human expertise and experience of customer business sectors to deliver the solutions they need now and in the future. That is how we are helping to design that future."

**Mumtaz Farooqi**  
Technical Director, Bender UK



"Our claim is a promise that we will take care of the future and use our unique knowledge to develop new solutions. Electrical safety is our core competence and will therefore remain a strong focus. It is where we are from, what we specialise in and what we will continue to use as a foundation for our future development."

**Michael Breuer**  
Vice President APAC

# APAC Sales Meeting 2023

**Teamwork, input and productive discussions in Manila**  
As a networking platform full of enthusiasm, experience and a shared desire to grow, the APAC Sales Meeting in Manila (Philippines) was a complete success for all participants from the local region and the company headquarters.

One of the highlights of the event was the new business unit workshops, in which the members of small groups combined their expertise and worked together with corresponding specialists to master practical challenges. The APAC Sales Meeting also provided participants with the latest news from the sales regions and the company headquarters.

Michael Breuer, Vice President APAC and Managing Director of Eetarp, additionally presented the strategy for further establishing the region. In his speech, he underlined the three pillars involved: intensifying sales, building a foundation for future growth and developing a competitive local portfolio.



The APAC Sales Meeting helped a strong region to grow closer together.

The programme of accompanying events gave attendees the opportunity to experience the importance of teamwork live and in person as they attempted to complete an exciting escape room game. Last but not least, the evening was brought to a close with a performance by the live band “Atoms Reborn”, featuring the lead singer Mr Penalosa, also known as the owner of the Bender partner office in Manila, and great conversations in a casual setting.



Teamwork formed the focus of the tasks tackled by participants.

## ODCA (Open DC Alliance)

### The work of the ODCA is gaining momentum

#### Interest in Germany and worldwide

Ever since the Open Direct Current Alliance (ODCA) was founded in 2022, its German and international members, a current total of more than 60 companies, have been actively committed to promoting DC systems in industrial areas. One of these companies is Bender, a founding member of the alliance. The “NExT Factory”, a pilot project with a DC system implemented by the company Schaltbau in the German town of Velden, represents one of the alliance’s first achievements.

#### Five working groups established

To advance the activities of the ODCA with a targeted approach, five working groups focusing on Technology, Research, Use Cases, Partner Management, and Communication have been established. A sixth working group that will focus on transferring results is currently in the planning stages. Bender contributes its expertise to four of these working groups and thus plays a significant role in further developing DC technology. This development in turn forms a basis for advancing the global establishment of an energy-efficient and resource-conserving direct current ecosystem and thus shaping the future of energy.

© ODCA, Hannover Messe 2023



Dieter Hackl is actively involved in the ODCA on behalf of Bender, for example at the alliance’s stand at the Hannover Messe trade fair.



You can find out more about the ODCA here at <https://odca.zvei.org/>

# Dr. Sven Hartung

## Managing Director/CFO

### **My electrical safety experience**

*As a child, I loved to tinker with my model railway and even digitised it. When doing so, I caused a short circuit every now and again, but thanks to the low voltage, both me and my belongings remained unscathed.*

### **You have been at Bender since October 2023. How was your onboarding process?**

*Very good and very friendly and welcoming. It was also very challenging considering that I had already been working on individual topics since the summer and was at the heart of things after just a week.*

### **What exactly do you do at the company?**

*I am responsible for two main areas. As a modern CFO and Managing Director, these include classic topics such as Controlling, Accounting, Financial Affairs and Taxes as well as the supporting areas of Human Resources, IT, Legal & Compliance, Process Excellence, Marketing, Purchasing and Customer Service.*

### **How do you understand your role in the Bender team?**

*As a team player, I work with my team to free up other colleagues. We do so by creating and securing a business framework in which teams such as Sales, Production and Development are free to focus on their individual topics.*

### **Where and how do you go about this?**

*Bender has experienced extremely strong growth in recent years. As a result, it needs to also adapt its structures and processes to integrate new employees, secure high standards in all areas and stabilise the company at this new level.*

### **And how do you want to achieve this in concrete terms?**

*In a nutshell, by creating structures, optimising processes and steering things in the right direction to complement the growth. We are doing so by establishing a scalable platform that will also reliably support future growth without requiring too much bureaucracy. At the same time, we are also focusing on ensuring that despite all these changes, our employees still enjoy their work and their time at our company.*

### **Will Bender continue to grow so rapidly?**

*It has grown at a rapid speed, but now the situation has changed in terms of economics and global politics, and the markets are unsettled. This is putting the brakes on the course of growth. We therefore need to break new ground and further improve our participation in the international markets to achieve constant and healthy growth.*

## Professional background

After taking on roles in the German cities of Lüneburg, Hamburg, Essen, Düsseldorf, Bielefeld and Bad Oeynhausen, Sven Hartung, a Frankfurt native with a PhD in Economics, has returned to the German state of Hesse – bringing with him plenty of experience in management positions at companies such as KPMG, E.ON, the industrial service provider ERIKS and the wheelchair manufacturer Meyra.



For me, Bender is ...

**"a committed family company, with opportunities to develop new, cost effective, future-proof solutions and a good reason to stay."**



**What direction could that take?**

*We need to see how we can establish ourselves in new markets and countries with our existing products and solutions. On this basis, we can then derive new products and solutions with which we can secure and expand our position in the international competitive environment. After all, this is where safety made in Germany is in demand.*

**Where do you currently see the biggest challenges?**

*Following our growth spurt, I consider 2024 to be a year of consolidation. We need to use this phase to put ourselves in the ideal position to hit the ground running the moment the next upswing comes along. In addition to the consolidation, I also, and above all, view the major topics that many companies are currently facing as a challenge for Bender, too – for example supply chains, decarbonisation, digitalisation and the transformation of the automotive industry.*

**How are you tackling these challenges?**

*Bender is a committed family company. It is therefore in an excellent position with its environmental standards, social activities and governance approach. We need to build on this and use it as a foundation for developing new, cost-effective and future-proof solutions.*

**What do you do when you're not working?**

*As you can imagine, I'm currently putting a lot of energy into many areas. I recharge my batteries at home with my wife and my three children, and if I have any energy left, I like to play tennis.*



# Design the future of energy

**I am delighted that with our new claim, “Design the future of energy”, we now have a bright light to guide our way. I consider our claim to be a demand to put our unique knowledge of electrical safety to good use while considering the big picture. Our radiant claim brings together the many different aspects of our company and lets it shine in a new light.**

## **More than electrical safety**

I have grown up with Bender and experienced how the company has developed over the years. Our team has grown, subsidiaries have been founded and companies have been acquired. Each of these steps has also provided new ideas and incentives for our world, helping it to become bigger and even more diverse. The business that my grandfather started and my father continued has long become far more than just supplying devices for electrical safety, and this also represents an important aspect of our new claim.

## **Personal perspective**

Our claim also has a very personal meaning for me. As the energy transition progresses, fossil fuels will become less important, while electric energy will remain and grow in importance. With our committed approach to actively supporting and shaping the future of this electric energy, we are helping to ensure that my children and all future generations will be able to use energy both intelligently and safely. For me, this is motivation at its best.

**Dorothea Bender Fernández,  
Chair of the Advisory Board of the Bender Group**



## Imprint

**Publisher:**  
Bender GmbH & Co. KG  
Londorfer Straße 65  
35305 Grünberg / Germany  
Fon: +49 6401 807 - 0  
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**Editors:** Susanne Tröller  
**Copy-editing/text:** Marco Michels and Stefanie Rieck  
(txtconcept.de), editorial team Bender Group  
**Graphics/Layout:** ONEDOT GmbH, Michelstadt  
**Photos, unless otherwise stated:** Customer photos  
and Archiv Bender Group  
**Print:** JD Druck GmbH, Lauterbach



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