MAGAZINE FOR ELECTRICAL SAFETY

# MONITOR

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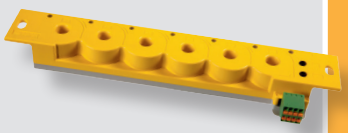
Versatile and functional:

**Glass – material of the future**

– also in the hospital

RCMS150 residual current monitoring system:

**The new generation of monitoring for modern loads**



## Always on and on

### Measuring without switch off



**Additional page "Practical Expertise" at the back of the booklet for collection!**

Insulation fault location – Planning and set-up

BENDER Group

# editorial

EDITORIAL

## Dear Readers,

With his patent in 1937, Walther Bender laid the foundations for the first insulation monitoring device (IMD) for insulation monitoring in unearthed systems. Since then, monitoring has been one of Bender's core competencies, which has been constantly developed to adapt to changing technical possibilities over the years. Today, our iso685 features a range of measurement and additional functions, protocols and interfaces. An internal web server enables direct connection to a computer or integration into a computer network via Ethernet. This means, the customer is now able to utilise the full functionality of the IMD, alone or in conjunction with other monitoring devices. Unlike in the past, the monitoring largely takes place on monitors. In order to provide customers with a perfect overview of their electrical systems Bender has pushed the development of system and communication technology in recent years.

Advice and training for our customers is more important than ever. One of the requirements for this is training and continuous professional development of our own employees and distributors. We have developed a special training system for sales and technology, that we have been held all over the world. This puts us in a position to assist you in optimising your systems and to stand by your side as a capable partner as you achieve your objectives.

Another innovation provides an additional page "Practical Expertise" for you to collect but you can see for yourself on the last page of this edition.

Yours

Dirk Pieler
*Managing Director*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Technologies from aerospace for road and rail. Mobility plays a crucial role in our economy and society. People wish to reach their destinations safely, conveniently and quickly. Goods have to be transported cost-effectively over short and long distances ...

FEATURE

# Always on and on

## Measuring without switch-off


The safe and reliable operation of electrical installations and equipment is only possible if their correct working condition is ensured over the long term. To this end the German ordinance on industrial health and safety (Betriebssicherheitsverordnung – BetrSichV) regulates the provision of equipment by the employer, the usage of equipment by the employees and the operation of installations* that require monitoring as per health and safety requirements. Here in particular there is the requirement to test prior to commissioning and to test regularly; the test intervals and types of tests for these regular tests are defined in the health and safety regulations (UVV) DGUV regulation 3 (formerly BGV A3).

**The German ordinance on industrial health and safety (BetrSichV) has been in existance since 2002** and has been under extensive revision since 2010 to take into account European law, as well as new findings and the resulting requirements. On 1 June 2015 the amended issue with the modified full (translated) title: ordinance on health and safety on the usage of equipment (Verordnung über Sicherheit und Gesundheitsschutz bei der Verwendung von Arbeitsmitteln (BetrSichV)) came into force. With this amendment, which is aimed at all employers, employees and operating organisations, lawmakers have established a completely new basis for the testing of installations requiring monitoring.

Along with the protection objectives as a requirement on the safe use of equipment, the hazard assessment has been specified in greater detail and the rules on existing equipment clearly defined. The employer is only allowed to deliver equipment if a hazard assessment is available prior to usage for the

*These include installations from which special hazards such as falling, explosion, fire or pressure emanate.

first time, and health and safety are ensured on the intended use of the equipment.

For safe and reliable plant operation, which is the most important goal for an operator, there are numerous laws, regulations and standards that define the framework for safe operation. For the specific and reliable operation of all electrical installations and equipment as well as the safeguarding of correct working conditions during operation over the long term various safety aspects, such as the insulation resistance, dielectric strength, leakage current etc. must be taken into account and checked. For this, BetrSichV and the UVV DGUV regulation 3 prescribes regular tests.

## Hazard assessment

Along with the requirement to undertake and document a hazard assessment prior to commissioning an item of equipment, the amended BetrSichV also prescribes regular hazard assessments. By undertaking a hazard assessment, the related state-of-the-art technology must be taken into account. The presence of a CE marking does not relieve the employer of the obligation to undertake a hazard assessment.

If the result of the hazard assessment is that hazards cannot be prevented or can only be inadequately prevented by technical protective measures using the state-of-the-art technology, corresponding organisational or personnel-related protective measures are to be taken. Technical protective measures always have priority.

If the technology is no longer state-of-the-art in relation to protective measures, this situation must be taken into account during the hazard assessment. In some circumstances this can mean that the protection concept used previously must be adapted to whatever is considered state-of-the-art.

How to undertake a hazard assessment is defined in the German technical rules on work safety (Technische Regeln zur Betriebssicherheit – TRBS).

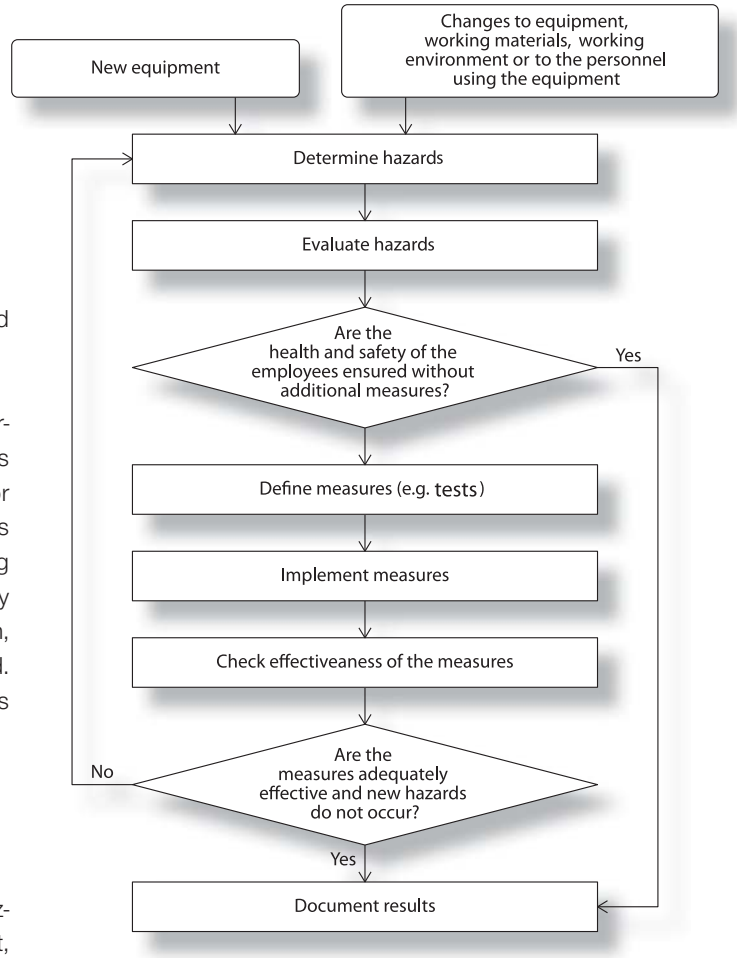



Fig. 1

**Basic process for determining and assessing hazards as well as for deriving of measures. (Fig. 1 in TRBS1111, [1.2])**

## Insulation resistance measurement

Regular testing of the electrical installation can mostly be performed while the installation is in operation (e.g. visual inspection) – with the exception of the insulation resistance (cf. DIN VDE 0100-600:2008-06[1)]) and the measurement of the earth resistance.

The insulation resistance measurement, as part of the regular test on electrical installations, is undertaken using insulation resistance test devices according to DIN EN 61557-2 (VDE 0413-2):2008-02. This measurement between active conductors and the protective earth conductor can, as described in "the

[1)] DIN VDE 0100-600:2008-06 Low-voltage electrical installations – Part 6 Verification: 61.3.3 Insulation resistance of the electrical installation

Scope 1" of this standard, only be undertaken if the installation is shut down. Equipment and/or protective devices must be disconnected prior to the insulation resistance measurement, as they may not be able to withstand the test voltage used for the insulation resistance measurement, depending on their dielectric strength. Often such additional effort and the shutdown of the power supply involve high downtime costs. In addition, restarting the installation is complex or not possible at all (e.g. in computer centres, production plants or intensive care stations).

## What the standard states

However, standards like DIN VDE 0105-100:2015-10 "Operation of electrical installations" and DGUV regulation 3 " Electrical installations and equipment " (formerly BGV A3) offer two alternatives for the safe monitoring of installations without shutdown, these alternatives must always be available:

- Continuous residual current measurement (earthed power supply)
- Continuous monitoring of the insulation resistance (unearthed power supply).

Continuous monitoring of insulation of the electrical installation permits the electrician to adapt the test intervals for the regular insulation measurements, if this procedure is approved by the insurer:

**DIN VDE 0105-100:2015-10 Operation of electrical installations 5.3.101.0.4**

In installations that, in normal operation, are subject to an effective management system for preventive maintenance and servicing, regular tests can be replaced with the appropriate implementation of continuous monitoring and servicing of the installation and all its equipment by electricians. Suitable documentation must be available.

DGUV regulation 3 also offers the possibility of adapting the tests for maintaining the correct working condition of the installation by means of continuous monitoring:

**Implementation instruction for DGUV regulation 3:**

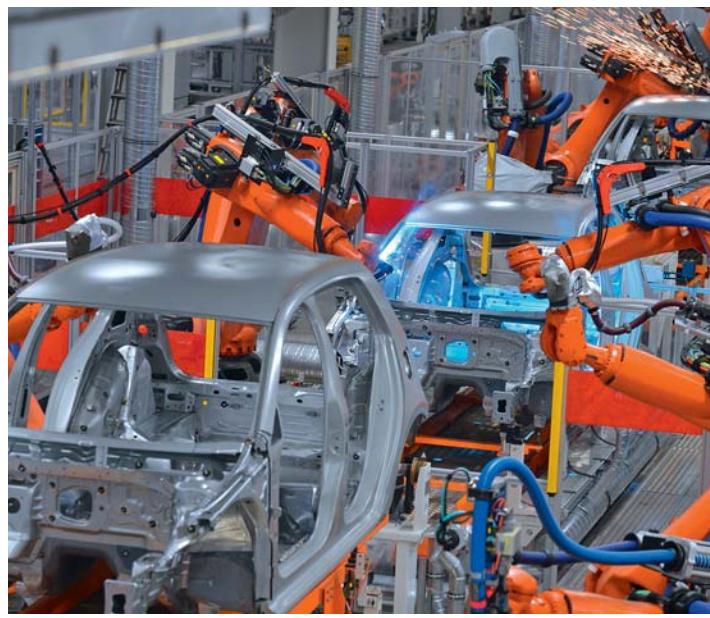
Fixed electrical installations and equipment are considered continuously monitored if they are continuously:

- Maintained by qualified electricians

**and**

- Tested by measurement methods during operation (e.g. monitoring the insulation resistance).

In the earthed power supply system (TN-S system) it is possible to continuously measure and evaluate the residual currents in the entire installation using residual current monitoring systems. During this process, degradations in the insulation resistance are detected and signalled. A further possibility is offered by the unearthed power supply (IT system) with an insulation monitoring device that continuously monitors the insu-



"**The availability** of an electrical installation is increased, interference currents are located during the early phase and the costs are minimised ..."

lation resistance of the installation. In neither case is it necessary to shut down the installation for the insulation resistance measurement during the regular test.

## Earthed power supply (TN-S system)

Accordingly, earthed installations (TN-S systems) can be equipped with a selective system for residual current monitoring (RCM).

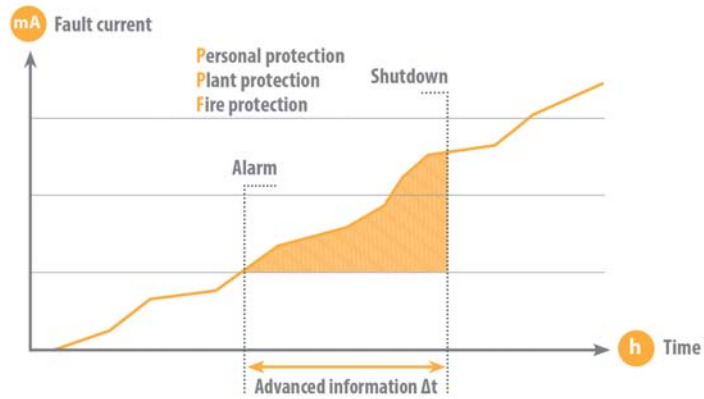
## Continuous monitoring

As the residual current is representative of the insulation resistance, residual current monitoring systems (RCMS) can continuously detect a degradation in the insulation in fixed electrical installations and equipment. This degradation will cause a measurable change in the residual current in the installation, and as a result critical changes may occur in the system. RCMS not only detect fault currents during their evolution phase, but overloads on N conductors are also indicated at an early stage. In this way the risk of fire is significantly reduced. The operator is informed via an alarm message, e.g. by e-mail.

The residual currents measured can be unambiguously traced to the related electrical circuits and individual loads. The electrician can then isolate the faulty circuit or equipment from the system, repair it and perform an insulation test prior to placing it back in operation. If certain equipment is switched on and off during normal usage, the total insulation resistance and the residual current change. These changes must be taken into account during the installation of the monitoring device so that a change due to operation that does not involve a fault is not electrically interpreted as a faulty state. If some equipment is only switched on infrequently and is not connected to the installation when switched off, this equipment is not monitored – the operator must then analyse whether additional monitoring is necessary in this case.

Fig. 2

Preventive maintenance by residual current monitoring




## Safety tests increase profitability

With residual current monitoring systems, it is also possible for the electrician to determine, specific test intervals and to define the intervals based on practice. The result can be a reduction or an extension of the test intervals for the insulation resistance measurement.

Depending on the utilisation of the equipment, it is possible to adapt the definition of the interval for the periodic testing involving insulation resistance measurements to suit safety and economic aspects.

Shutdowns for conventional insulation resistance measurements, even only for short times, are a thing of the past due to the specific usage of residual current monitoring systems (RCMS). The availability of an electrical installation is increased, interference currents are located during the early phase and the costs incurred for the insulation measurement during the periodic testing of electrical installations and equipment are minimised.

A vital point to consider during the safety tests according to BetrSichV are the maximum stipulated test intervals for instance for cranes, lifts or media equipment for event engineering.

## Unearthed power supply (IT-system)

For installations in which a shutdown or unplanned stoppage would involve high costs, the unearthed system (IT system) offers an ideal alternative with numerous advantages.

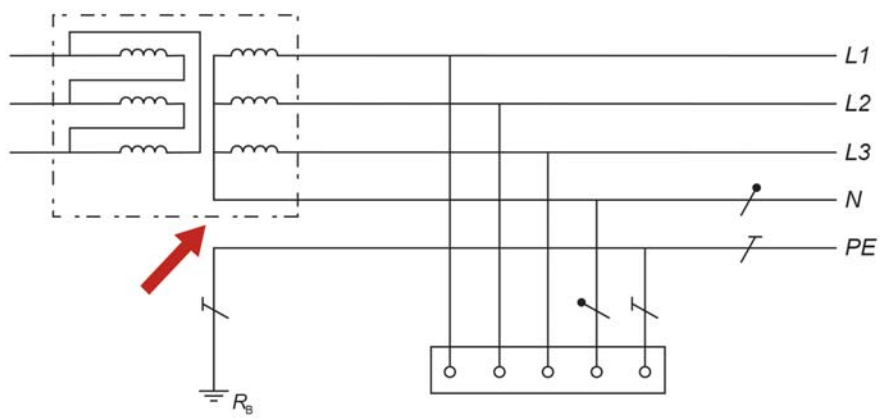
## IT system – the better type of system

Unlike an earthed TN-S system, in the IT system no active conductor is connected to earth. Due to this conscious lack of a low-impedance connection between the transformer's star point and PE (Protective Earth), a high fault current does not flow on the occurrence of a first insulation fault. As a consequence the EMC characteristics are very good, there are no shutdowns and single-fault safety is provided.

In addition, on the occurrence of a first fault in an IT system, hazardous fault currents cannot flow due to the conscious lack of a low-impedance connection between N and PE; therefore the risk of fire is significantly reduced.


Fig. 3

**In IT system, an active line has no conductive low-impedance connection to PE**



"**Due to the continuous monitoring of the insulation resistance,**
it is not necessary to install additional protection
according to DIN VDE 0100-410:2007-06 Low-voltage electrical installations:
Part 4-41 Protection for safety - Protection against electric shock."


While installing an IT system and the calculation of the possible fault currents, however, the system leakage capacitance present in the system must be taken into account.

In principle, the IT system offers the highest security of supply of all types of system.

Compared to residual current monitoring, insulation monitoring in the IT system has a few additional advantages:

- Detection of symmetrical insulation faults and as a consequence increased fire safety.
- Detection of low-impedance insulation faults.
  Typically the measuring sensitivity is at least a factor of 100 greater, which enables a significantly earlier warning.

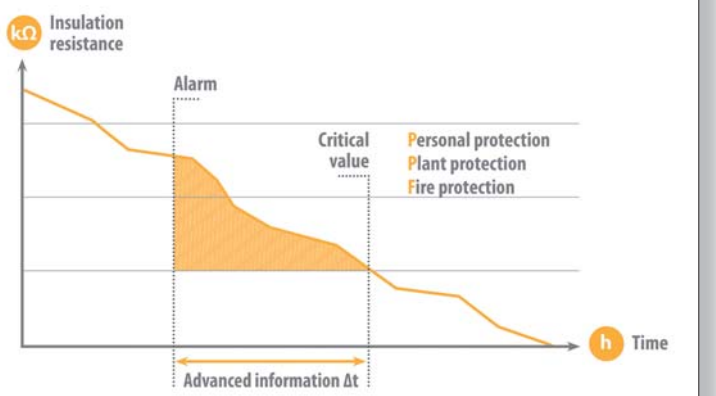
If a symmetrical insulation fault occurs in an IT system, each conductor has an identical lower insulation value in relation to earth. In this situation the fault current flows via earth between the faults and represents a load current for the power supply. If this fault current is significantly lower than the actual load current in the installation, it is not detected by the protection elements and can represent a fire risk.

As the product standard on insulation monitoring devices, IEC 61557-8:2014 stipulates that an insulation monitoring device must detect symmetrical and asymmetrical insulation faults. During the hazard assessment, it must be determining whether the insulation monitoring device used is state-of-the-art.

The significantly higher measuring sensitivity of insulation monitoring compared to residual current monitoring is achieved by determining the insulation values in the kOhm range. Here the operator of the installation receives information on the long-term evolution of the installation before the occurrence of a low-impedance state and can react to trends or intermittent degradations. By consistently monitoring a continuously reducing level of insulation, maintenance measures as well as their budget can be accurately planned.

Fig. 4

Preventive maintenance by insulation monitoring in the unearthed system




## Less test effort, increased safety

A further feature of the IT system is that, due to the continuous monitoring of the insulation resistance, it is not necessary to install additional protection according to DIN VDE 0100-410:2007-06[2]. Avoiding the usage of residual current devices (RCDs) significantly reduces the test effort for the installation. A saving of 100 RCDs, for example, in the installation also means that 100 RCDs do not need to be checked cyclically.

The insulation resistance in the IT system is measured continuously by an insulation monitoring device that generates an alarm in the event of critical changes. A first insulation fault does not result in the automatic shutdown of the installation like in an earthed system, instead the installation can continue to operate in the event of a fault. Due to this special feature, an IT system is always used in particularly critical applications that cannot shut down on the occurrence of a first fault and that must guarantee an increased level of reliability (e.g. in intensive care stations, operating theatres, chemical plants etc.)

An insulation monitoring device in the IT system therefore meets the requirements according to DIN VDE 0105-100:2015-10 "Operation of electrical installations" and DGUV regulation 3 for continuous monitoring such that regular insulation measurement and installation shutdown are not necessary.

For completeness it should be mentioned here that all other tests, e.g. visual inspection, loop resistance measurement, still need to be undertaken. However, these can be performed while the installation is in operation.

Bender is supporting the introduction of modern continuous monitoring both in earthed and in unearthed power supplies with its know-how and the necessary technologies. ■

*Dipl.-Wirt.-Ing. Michael Faust, T-MTS*
*Dipl.-Ing. Jörg Irzinger, T-MIS*
*B.Eng. Mario Lehr, T-MIS*

[2] DIN VDE 0100-410:2007-06 Low-voltage electrical installations: Part 4-41 Protection for safety - Protection against electric shock

MONITOR, the magazine for elekctrical safety turns 10 years old!

MONITOR
NEWSWORTHY

# A success story
## against the trend


This issue marks the tenth anniversary of the appearance of MONITOR. The first edition for the Hanover Fair 2006 had 5200 copies, while today's edition has a print run of around 10,000, of which 8500 copies are sent to subscribers. In times when the print media is complaining of drastically reduced print runs, this increase speaks for itself ...

But the idea of using the MONITOR as a communication tool for customers and interested decision-makers is considerably older. An attempt was made to establish a newsletter of this kind many years earlier. Hermann Mülot and Hans-Günter Ulmer, the previous advertising agency owners, who Bender had assigned, which played a role in the development of the brand, came across an old issue of MONITOR when going through some old PR materials and immediately recognised the value of this form of communication. They are responsible for the success story of MONITOR.

*"For many years, the Monitor magazine has been offering us a platform for information regarding changes to standards, innovations and the diverse application possibilities of Bender products.Individual articles have directly led to implementation in specific application cases. When it comes to detailed issues, the Bender Group is a helpful contact partner that provides solutions for every requirement."*

Birgit Schäfer, Technical Planning Steinsalz, Südwestdeutsche Salzwerke AG, Heilbronn

The principle of the magazine is and was sound expert and largely independent discussion of the various subjects related to the challenges of electrical safety and network and plant protection. As well as comprehensive lead articles on the current issues in electrical safety, it includes, for example, case studies, new product presentations, customer portraits and interviews with members of the company.

*"I like the very interesting combination of highlights from all application areas and suggestions on strategic issues. Congratulations on the anniversary!"*

Dipl.-Ing. Christoph Feldhaus
CEO, CoSolvia Krankenhaustechnik GmbH & Co. KG, Osnabrück

MONITOR is still not an advertising brochure. Instead, it provides information about current developments, trends, problems and solutions and provides a basis for more in-depth discussions. This is why it always appears to accompany the major specialist trade fairs, which are the most important comprehensive communication platforms, and, of course, it is also issued in English. The concept is strengthened by increasing print and subscription numbers and lots of positive customer feedback.

*"It is always exciting to receive information regarding your own or similar application areas in a clear and well-founded way. We wish you great success for the next 10 years and keep up the good work!"*

Dr. Michael Lehmann, Siemens AG - MO TI EH, Erlangen

Since its first edition, I have really enjoyed writing for MONITOR because the subject of electrical safety has so many different nuances, developments and surprises that it is always guaranteed to be interesting.

Finally, I would like to express my heartfelt congratulations on the anniversary and thank the Bender editorial team, Anne Katrin Römer and Marita Schwarz-Bierbach for their excellent cooperation. I would also like to thank Natascha Schäfer from S!Designment who has been responsible for the modern layout of the magazine from the very beginning. ■

*T. Hörl, DREIPASS*


Opening of Bender China

# New international expansion

On 05 November 2015, the new subsidiary of the Bender Group was opened in China.

**Business activities in China** started already in 1995 with a fair visit in Beijing. In 1999, the first representative office was opened in Shanghai. The first customers were from the shipbuilding sector. Later on, customers from various industrial branches followed, as for example from the area of hospital engineering. Over the years, business in China could be increased in a way that founding a subsidiary, a so-called "Wholly Foreign Owned Enterprise (WFOE)" became necessary. Jackio Pan was appointed managing director.

The size of the country with a population of over one billion, the rising standard of living and the immense investments makes China, along with the USA, the most relevant international market for Bender. In order to face future challenges and satisfy the needs of Chinese customers, a new building in the strategically well situated Guangling industrial park (GIP) near Yangzhou was occupied. It offers enough office and production space to combine sales activities with creating solutions for the customers and, if necessary, build and test them in situ. Furthermore, it is planned to hire more employees at strategically relevant places in China.


The mayor of Guangling, Wang Feng, and the director of the industrial park, Xia Yuanbiao, as well as the CEOs and CTOs of several partner companies of Bender China attended the opening ceremony. In particular, we were able to welcome many representants from hospitals, the shipbuilding industry, power plants and various other industrial branches. Following the opening ceremony, a training focused on insulation monitoring and residual current technology took place.

Thus a close network of national and international agencies and distributors makes us flexible to provide close and direct dialogue with our customers. That guarantees competent consultation, on-time delivery and perfect service – worldwide. Along with numerous subsidiaries and agencies in Europe, Asia, Africa, the Americas and Australia, Bender China is the 13th international subsidiary. ■

*Marita Schwarz-Bierbach*
*S-COM*

O. Weinert

Hohenloher Krankenhaus, Oehringen, operating

# Glass

## material of the future also in the hospital

**During the design of functional spaces** such as operating theatres, endoscopy, CT and MR rooms, architects and planners with insight have for some time relied on a material that is both versatile and functional: **glass**.

Extremely robust, resilient and functional, it also meets the highest hygiene requirements, is fire-resistant and environmentally friendly. Particularly in the medical area, architects and operating theatre planners need a material on which it is possible to rely 100 percent. "Glass is the first choice here", say Thomas Lütke-Kappenberg and Jean-Paul Isroe, the two directors at our partner MEDIK Hospital Design. "Along with excellent material properties, glass impresses above all because it is possible to create such unique, individual design solutions and it does not age."

Diakonieklinikum Hamburg, endoscopy

KFMC Riyadh, Saudi Arabia, operating theatre area

## Flexible solutions

Diakonie Markus Krankenhaus, Frankfurt, operating theatre

Chang-Hua Christian Hospital Taipei, Taiwan, Da Vinci operating theatre

MEDIK Hospital Design is one of the world's leading providers of glass operating theatres and has installed more than 200 theatres in the last three years. While initially customers were primarily from the German region, in the meantime hospital managers from Saudi Arabia, Kuwait, Oman, India, Brunei, Australia, China, Taiwan and Japan have had their operating theatres equipped to suit their specific needs. There are no limits to the processing of glass for this purpose. Accordingly, almost any customer requirement can be implemented. Whether walls, doors, cabinets or floors – MEDIK Hospital Design can use glass everywhere in every possible way. For this process the entire RAL palette of colours, patterns or images are available. MEDIK Hospital Design guarantees its clients that all the usual standards for fire, radiation and noise prevention are met by the designs.

EVK Düsseldorf, endoscopy

During the planning of operating theatres and examination rooms, the design of the lighting plays a major role. Various studies have shown that the ambient lighting has a significant effect on the concentration and satisfaction of the personnel, as well as on the condition of the patient. Bright light with a high indirect component, as is produced by a light band, reduces stress and increases concentration due to the suppression of the sleep hormone melatonin. With the "Daylight" option, MEDIK also offers a light spectrum very similar to the sun and in this way increases the feeling of well-being in closed rooms due to the sensation of daylight.


Bender panel

"**Together** with Bender, special housings have been developed for installation of Bender control panels in glass walls."

## Tradition meets innovation

Technology also plays a role in such rooms and supplements the room concept with interesting features. Together with Bender, special housings have been developed for the installation of Bender control panels in the glass walls. From the standard membrane panel to the capacitive touch-panel with glass finish, among other features it is now possible to implement in the panel the control of intelligent lighting concepts via the DMX, KNX and Dali bus. The state in the rooms is signalled via a BACnet interface to the Building Management System (BMS). As time plays a major role in the operating theatre and the timer and clock should always be easy to see, these functions have now both been integrated into the new panel with an intelligent, clear visual design. The new features from MEDIK Hospital Design and Bender were presented to interested visitors at MEDICA for the first time.

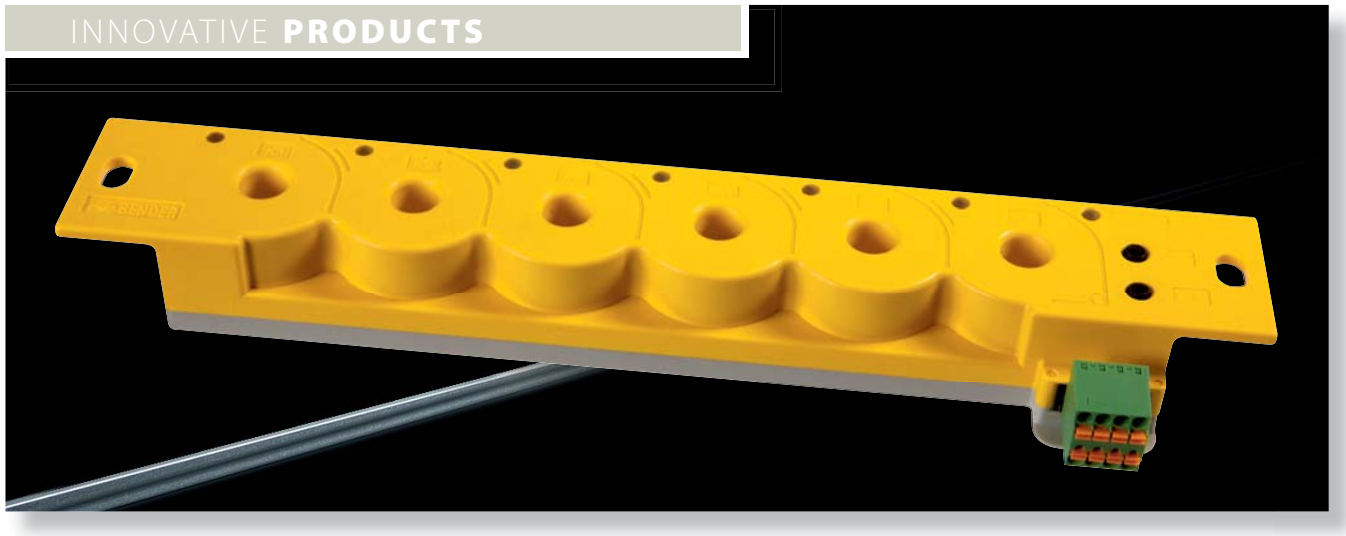
Bender panels

St. Andrews Hospital, Toowoomba, Australia, operating theatre

## Custom-manufacture without limits

Special designs are the norm at MEDIK Hospital Design. Every additional requirement is addressed. These can be, for instance, desks or drawers integrated directly into the wall, or even a custom-made washbasin. However, the two founders and their team also implement glazed floor motifs that provide a relaxing atmosphere in the waiting area for the delivery room, or individual motif walls. ■

*Thomas Lütke-Kappenberg, CEO*
*MEDIK Hospital Design GmbH*



RCMS150 residual current monitoring system

# The new generation of monitoring for modern loads

**The availability and reliability of power supplies** is a decisive factor for the efficiency and productivity of business processes. Unexpected operation interruptions and faults not only cost time and money, they also have a negative impact on production. This means that the early detection of looming interruptions and system

## Measurement technology for modern loads

Due to their non-linear power consumption, electrical loads such as PCs, electronic ballasts, copiers, etc. can generate a smooth fault current in modern electrical systems in the event of an error. This requires a complete rethink of protection and monitoring technology. The traditional fault current monitoring devices for alternating and pulsing direct fault currents (type A) used thus far have become unusable in these cases. For this reason, DIN VDE 0100-530:2011-06 has, for some years, required AC/DC sensitive residual current monitoring.

## AC/DC sensitive version (type B)

The reason for this is in the detail: A conventional type A RCM (Residual Current Monitor) would not trigger in the event of a smooth direct error current, as there is no change in magnetisation over time in summation current transformers, and this is required for inductive energy transfer to the RCM trigger relay. Depending on the level, the direct fault current effects an initial magnetisation of the transformer core, thus increasing the RCM trigger threshold for other alternating fault currents which may still be present to the point of not triggering.

This meant that the aims of the development of the RCMS150 six-channel residual current monitoring system were varied and ambitious. For good reasons, it needed to be sensitive to all currents for space-sensitive final circuit applications (type B).

## Multi-channel residual current measurement

With the new six-channel RCMS150 which is AC/DC sensitive and measures “true r.m.s.”, residual currents of 0 to 2000 Hz and 0 to 300 mA can be measured and evaluated during operation. The information exchange between the individual type RCMS150 and RCMS460 evaluation devices and a gateway happens via an RS-485 interface.

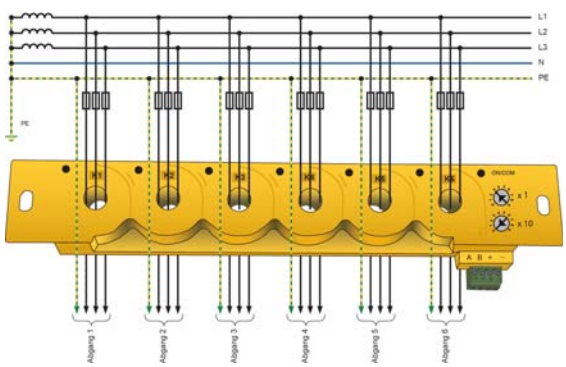
This means that a complete building or a complete supply section (with multiple measurement points and multiple devices) can be permanently monitored from a central point such as a control cabinet or a control room. The history memory and the data logger integrated into the gateway store up to 1000 messages with time stamp.

**Further benefits of the RCMS150 are:**

- adaptation of the internal diameter for residual current measurement in final circuits
- simple installation on and behind DIN rails in distribution cabinets
- cost-effective version without display, which can be configured via a gateway
- compatible with all RCMS460/490 units and gateways installed.

Fig. 1

**Circuit diagram of RCMS150**



## Monitoring the entire systemge

Unlike traditional insulation measurement, the RCMS150 offers permanent monitoring of the system and the option to monitor not only cables but also the “main culprits” in any electrical system - the loads.

It is important that a measurement set up in this way is refined enough to detect damage at an early stage. Monitoring the building feed is very rarely enough. The closer to the final circuit the RCMS technology is installed, the more accurately the fault location and fault currents can be recorded. If you think about this statement, it becomes clear that the six-channel RCMS150 was developed for exactly this measuring job.

At the same time, the RCMS150 fulfils all the requirements of the accident prevention regulation DGUV regulation 3.

## Use of RCMS technology in compliance with DGUV regulation 3

The role of a residual current monitoring device is to monitor an electrical installation or an electrical circuit for a residual current and trigger an alarm when it exceeds a set value.

The benefits of this measurement method are mainly in prevention. The measurements are carried out on a permanent basis and deliver the required measured values early to enable safety-related assessment of the electrical system. This property is also required for fulfilment of the accident prevention regulation DGUV regulation 3 (formerly BGV A3).

According to the German ordinance on industrial safety and health, the electrically skilled person in charge must carry out a risk assessment determining the nature, extent and period of the periodic test.

Permanent residual current monitoring allows the test interval for insulation measurement to be adapted based on the situation. The electrical system only needs to be shut down if there is a detectable and safety-critical deterioration of the insulation. What this means is: fault-free systems and equipment do not need to be shut down for an insulation test. The test interval for an insulation measurement is thereby defined by the notification from an RCMS. ■

*Marc Euker, T-MTS*

**A high level of safety and reliability** in information technology systems is the primary goal of all administrators in data centres and building services. Planning, implementation and operation of a reliable IT infrastructure in data centres represent a major challenge.


# High availability and safety

with BlueNet residual current monitoring (RCM)

Despite design according to the standards, modern loads increasingly cause interference in electrical installations. The consequences are undesirable interruptions in operation, damage, fire, EMC disturbances and also high costs.

By using residual current monitoring, changes in the insulation level of a power supply can be detected at an early stage before a high hazardous fault current with risk of fire causes protective devices to trip. This time saving makes it possible to plan corrective action and contributes to the high availability of the power supply and therefore, the installation.

With the Bachmann BlueNet PDU, these residual current measurements are not only made at central measuring points, but directly at the outlets for the loads. Along with high physical granularity, this standards-compliant residual current technology developed together with Bender offers a very high level of safety and high availability. All types of residual currents in modern power supplies are monitored using this AC/DC sensitive measuring technology. For this reason, the new BlueNet residual current PDU is particularly suitable for usage in the IT sector.

## Interference on the power supply

Undesirable interruptions in operation and malfunctions in power supplies always cause high costs – irrespective of whether the issue is the failure of a ventilation or air-conditioning system, or malfunctions in an extensive, networked IT system. The causes are, on the one hand, insulation faults, "stray currents", overloads on N conductors due to harmonics, open circuits in PE and N conductors and, last but not least, EMC effects. On the other hand, there are effects such as undesirable interruptions in operation, fire damage, triggering of protective devices, inexplicable malfunctions and damage, e.g. to telecommunications, fire alarm and IT systems, corrosion on pipework and lightning protection systems. Depending on the location of the damage, costs of more than € 100,000 can easily be caused.

## Insulation fault

An insulation fault is defined by the VDE as a defective state of the insulation. Insulation faults occur as a consequence of mechanical, thermal and/or chemical damage to electrical insulation. Soiling, moisture or damage due to flora and fauna can also degrade the insulation in such a way that an undesirable fault current flows through the insulation faults. The magnitude of this current is determined by the power from the voltage source, the earth resistance and the insulation fault $R_F$. This fault current can flow between active, current-carrying conductors or from active, current-carrying conductors via the insulation fault and/or conductive parts to earth. If the current is high enough (only in the event of a full short circuit or earth fault), the upstream protective device will be tripped and the defective load or the defective part of the installation will be isolated from the distribution network.

If the fault current is insufficient to trip the protective device (partial short circuit or earth fault), there is an acute risk of fire if the power at the fault exceeds a value of approx. 60 W (approx. 260 mA at 230 V). Safe and reliable protection against this problem is provided by residual current devices (RCDs) that, e.g. at a rated current below 300 mA, produce a safe shutdown in the event of a hazard. However, since a shutdown has wide-ranging consequences in information technology, RCDs are not used. In addition to the familiar protective devices, residual current monitors (RCM) according to DIN VDE 0663 are available. These devices make it possible to specifically monitor individual devices

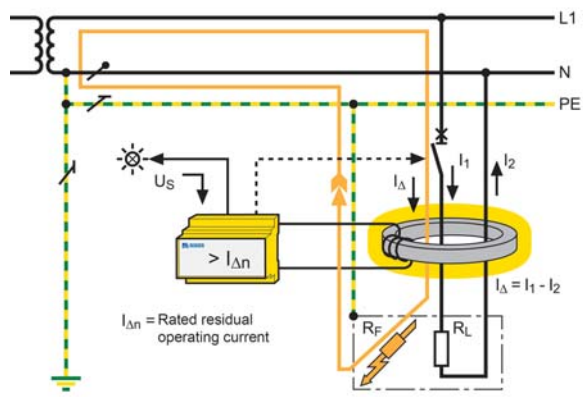

or parts of installations and, as an option, provide a signal before the actual value at which the protective device responds is reached.

## Stray currents

Even though the TN-S system has been a requirement for some time for EMC reasons (e.g. VDE 0800, VDE 0100-540:2012-06), the situation is often different in practice. Installations are primarily designed for safety and cost optimisation so that from a cross-section 10 mm² the N conductor may be combined with the PE as a PEN conductor. As a result, part of the return conductor current (N conductor) can be distributed over all earthing systems and equipotential bonding cables, since the N conductor is connected to the PE/equipotential bonding system in each floor distribution box. Consequently, high equalising currents flow through all the conductive (metal) circuits (e.g. water pipes, heating systems) in the entire building, in some cases these currents produce strong electromagnetic fields, cause undefined failures and are responsible for difficult-to-find faults in electronic systems. In principle – as documented in many VDE provisions – the TN-S system must be used in all power supplies in which the usage of IT components is expected. Return conductor currents from the single-phase loads are specifically fed back to the supplying source and cannot "stray" to the transformer star point via low-impedance earth con-

Fig. 1

**Functional principle residual current monitoring**



nections. The (PE)N conductor must only be connected to the PE/equipotential bonding system at the central earthing point (CEP) (preferably in the main low-voltage distribution).

This connection should be continuously monitored using a residual current monitoring system (RCM). The RCM detects the small equalising current that flows in a normal situation, triggers an alarm if a specific value is exceeded due to an additional N-PE connection or an insulation fault between phase N and earth. The PE system should also be monitored using an RCM to check if it is free of currents. In a TN-C system the N conductor current splits in the N-PE bridges. Part of it flows through the PEN conductor and an undesirable interference current flows through screen conductors and structural parts of the building back to the transformer.

In a TN-S system the N conductor currents flow directly back to the transformer star point. The protective earth conductor, the screen conductors and the building structure do not carry any interference current. Additional N-PE connections are immediately detected and located with an RCM system.

## What is a residual current monitoring system?

Residual current monitors (RCMs) are able to measure fault or residual currents and operating currents from 5 mA. For this purpose, the current or residual current measured using a measuring current transformer is recorded by electronics and evaluated. Visual and acoustic indicators are used to indicate whether the set response value and response time have been exceeded. They can be used for either signalling or switching, using the built-in signal contact.

A signal has the advantage that there is no unexpected shutdown if the availability of the installation has absolute priority. Gradual changes are also easy to detect with the measured value indication. RCMs comply with DIN EN 62020 (VDE 0663):2005-11. In complex electrical installations, multi-channel residual current evaluators (RCMS460) can be used to record and evaluate fault, residual and operating currents via the corresponding measuring current transformers. A central point, e.g. the control room, then continuously monitors a data centre or supply section. Faults are detected during operation, it is not necessary to shut down the installation. ■

*Patrick Zimmermann*
*Bachmann GmbH & Co. KG, Stuttgart*

### CONCLUSION

High requirements are placed on the power supply in information technology systems, as a failure involves considerable expenses and causes significant problems. The usage of a residual current monitoring system can contribute to reducing these costs significantly, increasing the availability, and to meeting safety and fire prevention requirements in the context of modern facility management.

The BlueNet residual current monitoring is able to measure residual currents from 5 mA. This statement applies to both DC and AC residual currents. Residual current response values can be set in the BlueNet software. The BlueNet software reliably signals if these values are exceeded. All measured values are transmitted via the Ethernet interface to higher-level monitoring systems. A local display on the PDU also provides information on all important measured values. In this way, it is always ensured that the availability of the power supply has absolute priority and there is no unexpected shutdown in the event of a fault.

INNOVATIVE **PRODUCTS**


The proven devices from the series VME420, VMD420 and VMD460 cover a broad performance spectrum with the following functions:

- Under and overfrequency monitoring
- Under and overvoltage monitoring
- Phase sequence
- Phase failure
- Asymmetry
- Vector shift
- ROCOF (Rate of change of frequency)

## Coupling device CD440

# Voltage and frequency monitoring devices for higher nominal system voltages

To ensure electrical safety for personnel and machinery, the operating states of electrical installations must be constantly monitored. The electrical parameters such as voltage and frequency are also not visible to personnel without additional aids – this requires the usage of suitable measuring instruments.

The portfolio of voltage and frequency monitoring devices from Bender is varied. It ranges from the single-phase voltage and frequency monitoring device for applications in main and auxiliary circuits, through special solutions such as analogue voltage monitoring devices for nuclear power station applications to three-phase network and system protection for decoupling in power generation systems in the renewable energy sector. They provide the necessary early warning so that faults and malfunctions can be detected at an early stage and so that it is possible to react before time-consuming, expensive interruptions to operation and installation damage occur.

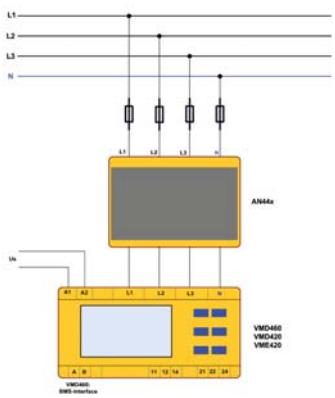
The devices can be used in numerous applications due to the comprehensive range of parameters for a nominal system voltage of 3(N)AC 400/230 V. The devices in the above series can also be used for nominal system voltages > 400 V using the new coupling device CD440.

In particular, the application range for the series VME420, VMD420 and VMD460 is extended to the following nominal system voltages:

- AC 1000 V
- DC 1000 V
- 3NAC 690 V
- 3 AC 1200 V ■

*Dipl.-Ing. Marc Euker*
*T-MTS*

Fig. 1
**Block diagram CD440**



The **offline monitoring function** of the insulation monitoring device **ISOMETER® isoNAV685-D-B** makes it possible to monitor the state of the insulation in drive systems, even in earthed systems

# Avoiding failure of drive systems


**Drive systems are important and widespread industrial applications.** One of the most critical elements and, at the same time, the main source of failures of drive systems is the electrical insulation. There are various studies on the insulation system for stator windings that report drive failures due to insulation faults in the order of 26 % [1] or even 36 % [2].

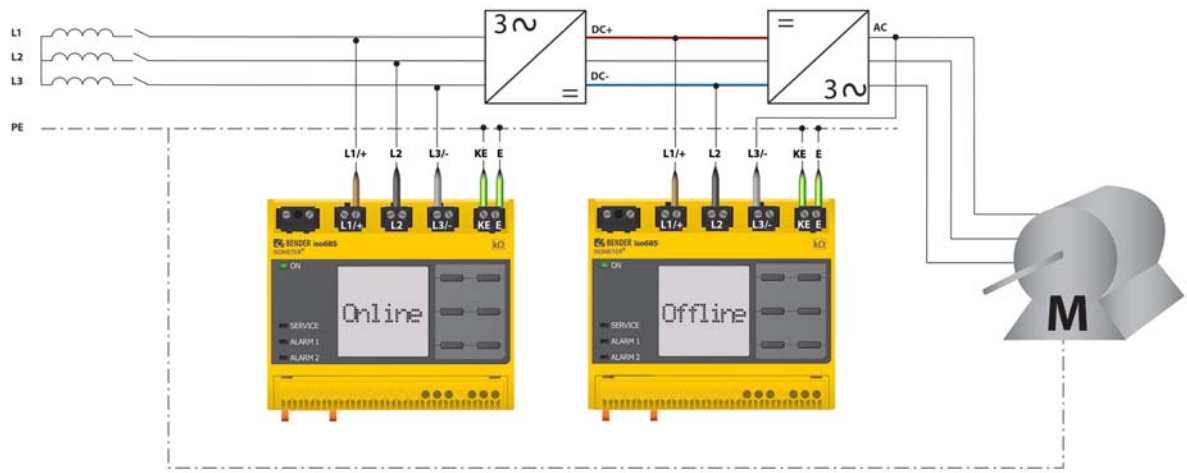
Insulation faults can be caused by, e.g., mechanical damage, dust, moisture, thermal ageing of the insulation or rodent damage. Independent of the cause, insulation faults represent a life-threatening hazard for personnel, the risk of damage to assets and a hazard for the availability of electrical power.

[1] MOTOR RELIABILITY WORKING GROUP, "Report of large motor reliability survey of industrial and commercial installations, Part I," IEEE Trans. Ind. Appl., vol. IA-21, no. 4, pp. 853–864, Jul. 1985"

[2] O. V. Thorsen and M. Dalva, "A survey of faults on induction motors in offshore oil industry, petrochemical industry, gas terminals, and oil refineries," IEEE Trans. Ind. Appl., vol. 31, no. 5, pp. 1186–1196, Sep./Oct. 1995."

Fig. 1

**Regulated drive with insulation monitoring in operation and offline mode with isoNAV685**




Unplanned failures due to faults in the electrical insulation cause to some extent very considerable costs in industrial processes. For this reason it is desirable that a weak spot in the insulation system is detected at an early stage so that planned maintenance or drive replacement can be undertaken in good time.

In the majority of cases the economic losses caused by an unexpected failure of the drive exceed the maintenance costs several times over. For example, the losses due to a stoppage on an offshore oil platform caused by drive failures are up to $ 25,000/h.[3]

It is known that drive systems operated in IT systems can be monitored using commonly available insulation monitoring devices while they are in operation. Drive systems that are operated in earthed systems (TN and TT system) can be monitored using commonly available residual current monitors . Proactive maintenance helps to avoid possible costs due to the unplanned failure of drive systems.

On the other hand, it is often not known that offline insulation monitoring devices can be used for unearthed and earthed drives outside the active operating state to detect a degradation in the level of insulation at an early stage.

"A degradation in the level of insulation is detected before parts of the installation or loads enter a critical state ..."

Parts of installations or loads that are de-energised, or that are only switched on briefly or in case of an emergency are continuously monitored by offline monitoring during the shutdown period. A degradation in the level of insulation is therefore detected before

[3] A Survey on Testing and Monitoring Methods for Stator Insulation Systems of Low-Voltage Induction Machines Focusing on Turn Insulation Problems, "IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 55, NO. 12, DECEMBER 2008"

parts of the installation or loads enter a critical state and important functions essential for operation fail.

This time saving can be used to plan a maintenance measure. Unplanned stoppages due to shutdown are reliably prevented and downtime reduced. In the past, solutions for offline monitoring were available above all for motors and heaters. On pure AC systems, e.g. the ISOMETER® IR420-D6 could be used together with a coupling device up to 7200 V, without having to use external medium voltage isolating relays.

"Unplanned stoppages due to shutdown are reliably prevented and downtime reduced."

The latest offline insulation monitoring device from Bender, the ISOMETER® isoNAV685-D-B, is available especially for large frequency converter drives up to AC 690 V and DC 1000 V (or higher voltages with an external coupling switch), on which both the intermediate circuit and the motor circuit must be monitored offline. ■

*Dieter Hackl, T-MIS*
*Harald Sellner, S-NOR*

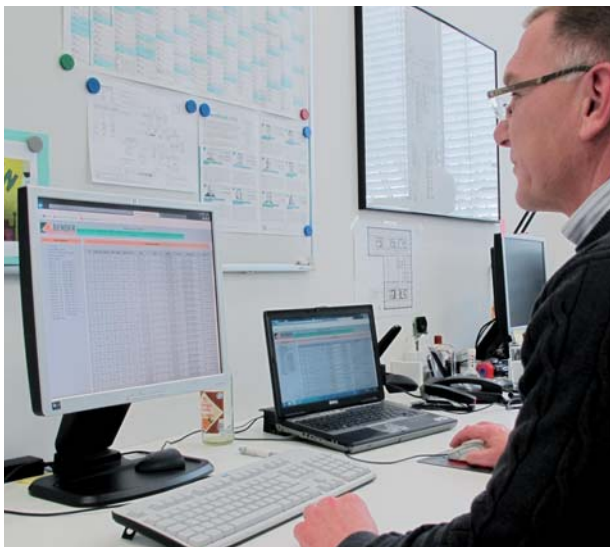

## THE ADVANTAGES

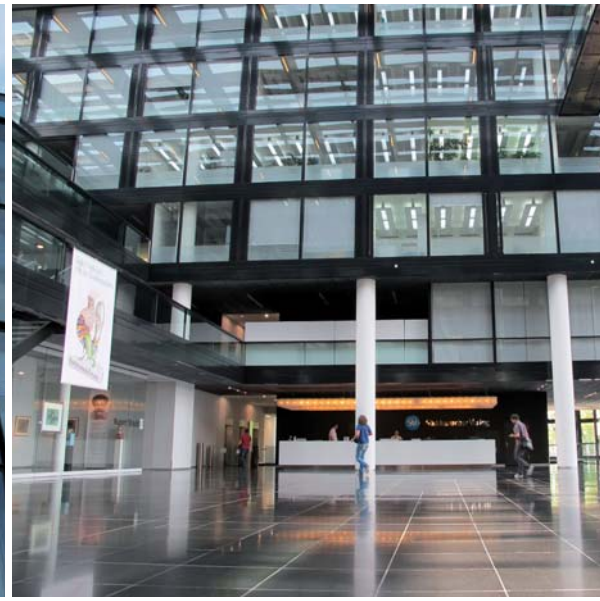
of continuous monitoring
by means of offline monitoring:

- Increase in the productivity of installations due to the prevention of expensive, unplanned installation stoppages, interruptions to operation or emergency situations
- Minimisation of the fire risk and risk of a hazard due to two-stage warning
- Reduction of damage due to faulty power modules and motors, as well as consequently longer service life of the parts of the installation
- Lower inventory costs for keeping spare parts for assemblies
- Optimized maintenance due to early warning that contributes to the reduction of the costs for operation and maintenance.

Süddeutsche Zeitung

TECHNICAL **APPLICATION**





# Eight years of Bender residual current technology in the publishing building for the Süddeutsche Zeitung in Munich

An **INTERVIEW** with Manfred Huber from technical building management at the Süddeutscher Verlag in Munich

**Herr Huber, I can still remember the first joint planning meeting at CBP (Cronauer Beratung Planung) Beratende Ingenieure GmbH in Munich. At that time we talked in great detail about the usage of Bender residual current technology and the continuous monitoring of the "central earthing point".**

**What was it that made you decide to use Bender residual current technology?**
Crucial for the installation of Bender residual current technology was the opinion of the expert assessors involved: "The operator of an electrical installation is obliged to have the installation tested for good condition at regular intervals. The relevant test requirements are defined in the related applicable standard, DIN VDE 0105-100, 'Operation of electrical installations'. Checks comprise inspections, tests and measurements. During the latter activities, among others, measurements of cable insulation resistances are stipulated.

Residual current measuring systems are integrated into the high-power electrical system in the Süddeutscher Verlag's building. Due to the usage of these measuring systems, the measurement of insulation resistances in the monitored system can be omitted."

After detailed consideration and consultation with expert assessors, VBG and Bender, we decided on continuous monitoring of the electrical circuits using residual current technology.

A key issue was also that we could set the test intervals for checking the portable electrical equipment according to BGV A3 (today DGUV Vorschrift 3) at two years. You can imagine the effort required to check the office equipment used by all employees, such as computers, monitors, printers, desk lamps etc.

**Herr Huber, you have now worked with our technology for eight years. What can you tell us about that?**
Our first task on every working day is to check and assess the alarms and status reports on the master computer.

Based on the error messages provided, including times when the electrical circuit had a residual current fault, we are able to locate and rectify sources of faults in a very short time.

Here an example from the last few days: it was possible to find a faulty blind motor very quickly. The fault only occurred on sunny days and at certain times (sunshine).

We have to deal with faults in the kitchenettes very frequently. Faulty electrical appliances are very often brought in from home. Here we talk of so-called "approx. 20-minute faults". We often have external organisations on our premises; any faulty electrical equipment they bring with them is immediately detected by the residual current measurement.

We have also seen a major benefit during the initial commissioning of electrical systems on our premises. Here, electrical loads were connected incorrectly; as a result, there were additional N-PE bridges. Due to the continuous monitoring of the CEP (Central Earthing Point) it was possible to locate them immediately.

Electrical equipment with incorrect insulation values is also detected during initial commissioning and replaced, e.g. electromagnets on the doors.

**Herr Huber, based on what you know now and your experience with Bender residual current technology, what would you do differently?**
Based on our current experience with Bender residual current technology, I would break down the loads tested into significantly smaller groups for some measurements.

For instance, the large loads in the kitchen such as ovens, dishwashers etc. should be monitored with separate residual current measurements.

I would also like to monitor the individual final circuits in the cafeteria and in our kitchenettes.

**How would you estimate the value of Bender technology overall in achieving your business objectives?**
The technology used protects our employees and other persons who move around in our buildings against electric shock. And it helps us to identify and rectify potential fire hazards. A fire would have immeasurable consequences for us. And finally, we have been able to rectify a large number of faults in the electrical installation and in loads that could have caused shutdowns as a minimum. As a publisher under constant time pressure and with copy deadlines, we cannot afford unplanned shutdowns. There is no doubt that the total costs for the Bender system have resulted in savings of several times that amount – to say nothing of the fact that we are able to serve our customers with our customary punctuality.

**Are there other areas where you see a use for our technology?**
We are planning to use this technology also in our external editorial offices with remote monitoring.

**Herr Huber, thank you for this interview!**

**We hope your experience and that of your colleagues with Bender residual current technology continues to be positive!**

Many thanks. ■

*Reinhard Piehl*
*Tech. Office Munich*

NOTE

Technical details on the usage of residual current technology in the Süddeutscher Zeitung were described in an article in MONITOR issue 2-2010 on pages 23-25.

LIEBHERR

TECHNIK **IM EINSATZ**

**The Liebherr group,** based in Bulle in Switzerland, is one of the leading manufacturers of construction machinery in the world and is recognised as a provider of technically demanding products and services. Liebherr relies on electric drives for its largest material handling machines, the LH 150 series. Liebherr has been one of Bender's biggest customers for many years. Bender safety technology has been fitted to ensure that the electricity can flow without maintenance. The unearthed networks in crane systems and utility vehicles are, in particular, monitored with ISOMETER® systems.

# Giant on the "line"

## Liebherr material handling machines under safe current

Liebherr offers a wide range of tailored machines and technologies for handling materials of different kinds. These include not only products for maritime materials handling but also various designs of caterpillar handling machines with service weights of between 20 and 220 tons. These machines are used to handle waste and goods, wood and recycling materials.

One of Liebherr's new products is a yellow giant named LH 150 C Gantry Litronic. Strictly speaking, it is not an excavator, even if it looks like a caterpillar excavator at first sight, albeit a bit taller. It is a materials handling machine with electric drive for use all over the world. On closer observation, you quickly realise that the driver of this massive machine could easily see over a normal terraced house. He could even dig up the garden over the roof of the house without having to touch the roof at all.

### Yellow giant with electric drive

When it comes to processing waste, wood or steel at coastal or inland ports, increasing importance is being placed on low noise and exhaust emissions, while at the same time the infrastructure for electric systems is already in place in many cases. This is why a platform for electric power was also developed for this machine, based on its predecessor model. Another benefit of the electric drive is the significantly reduced maintenance costs and thus increased productivity.

In order for the giant to output its massive 400 kW (536 PS) performance, it is connected via cable to up to 20,000 volts on a medium voltage system. The connected load can be absorbed by a spiral winding system. A transformer and a large frequency inverter ensure the correct voltages on board. Despite the cable connection, the unit can travel up to 400 m, depending on the device configuration. There are multiple feed-in points so the travel distance of the device can be expanded almost at will, although the device normally works on a static basis for materials handling.

## Safety through Bender technology

To ensure a trouble-free, reliable and, most importantly, safe current flow, an RCMS460D-2 residual current monitoring system from Bender and a specially shielded large WR115x305 SP right-angle converter permanently monitor all the loads on the vehicle connected after the right-angle converter. In the event of an error, for example, fault currents flowing as a result of the ingress of dirt or moisture, the system triggers an alarm. This is shown to the vehicle operator as a visual alarm message. The monitoring by the RCMS460D-2 is incorporated into an emergency-stop chain and can lead to the electric drive being shut down if triggered.

In order to reduce system-related network repercussions and increase machine availability, the drive system is fed by an IT system which is determined by a transformer without a neutral point and is therefore unearthed. For this reason, the secondary side of the transformer is monitored by a type IRDH275 ISOMETER® insulation monitoring device from Bender with an upstream AGH150W-H coupling device.

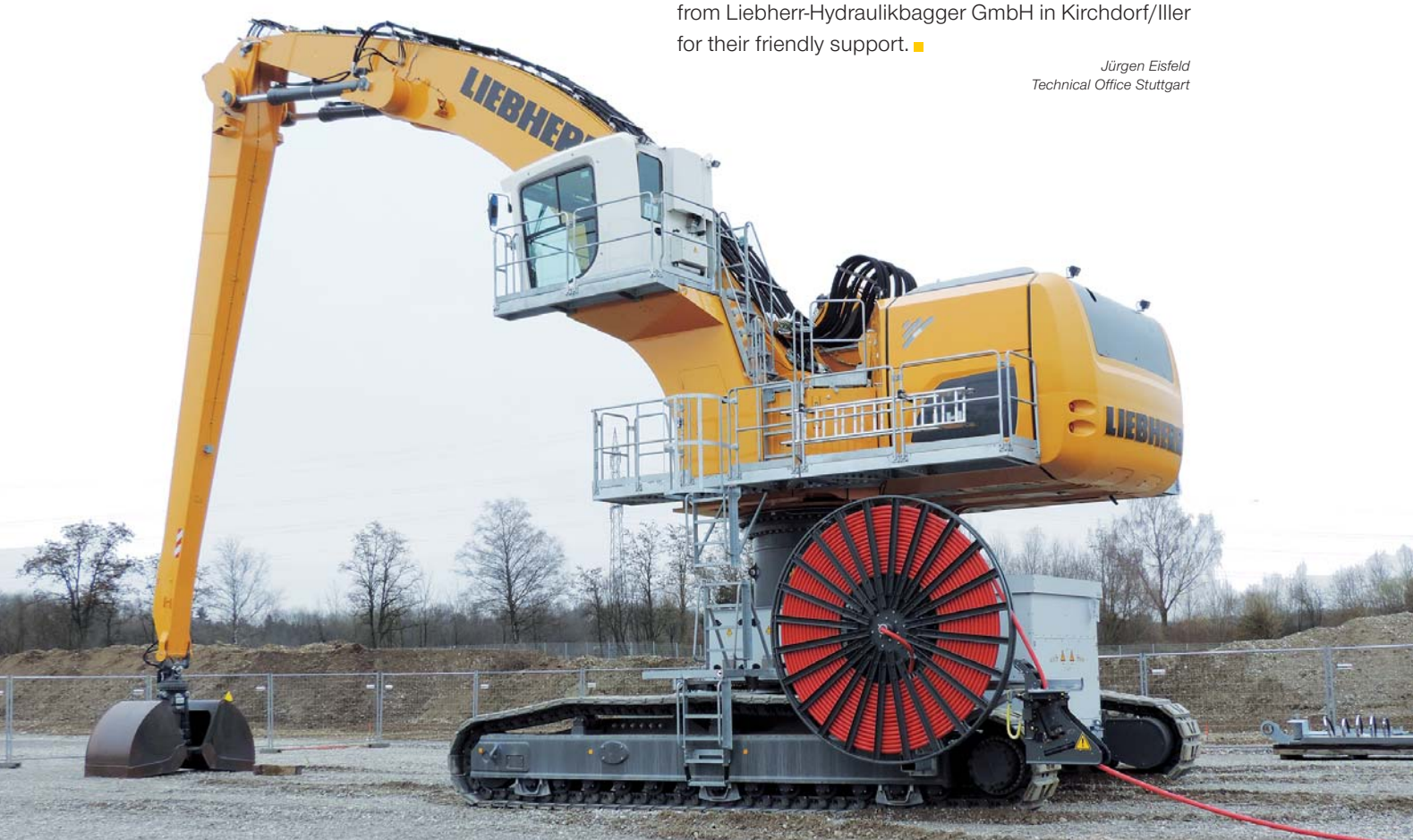
## Movement with future-oriented technology

The energy saved by the electrical system is around one third of what would otherwise be required. This means that the improvements made are both economical and ecological and makes the switch to electric power pioneering in every respect.

The safety solutions from Bender play a role in guaranteeing the priorities of availability and reliability which were set out during the development of the material handling machine, while at the same time operating costs are reduced.

**Thank you** to Daniel Bayer and Christian Abler from Liebherr-Hydraulikbagger GmbH in Kirchdorf/Iller for their friendly support. ■

*Jürgen Eisfeld*
*Technical Office Stuttgart*



# Quick and reliable


TECHNICAL **APPLICATION**

Chulapronkaroonyalak Building, PSU animal hospital, faculty for veterinary medicine

## Medical technical IT systems at the veterinary teaching hospital at Prince of Songkla University in Thailand

IT distributor

**As the IEC 60364-07-710:2002-11[1] standard has applied for many years in Thailand, the power supply in operating theatres must have an unearthed power supply (IT system) for safety reasons. This is why Bender installed an IT system at the animal hospital of the veterinary faculty on Hat Yai Campus of Prince Sonkla University in Thailand for the first time in December 2015.**

### History of the animal hospital

The Prince of Songkla University (PSU) was founded in 1967 and was the first university in Southern Thailand. It currently covers five locations. The PSU has 30 faculties, two hospitals and more than 40 research centres. One of them is the veterinary medicine faculty. It was founded in 2011 as part of the Hat Yai Campus and is 1000 km from Bangkok in the Province of Songkla. The animal hospital was planned in line with the guidelines from the veterinary committee. It now treats and cares for pets and working animals, water animals and wild animals. At the same time, the hospital also incorporates teaching facilities and a training centre for students and farmers from the region. The construction of the animal hospital was completed in late 2015.

### Medical technical IT systems for an animal hospital – why not?

Simplify Engineering has been working on the electrical safety aspects of planning and modernisation of medical facilities across Thailand for some time. Numerous leading regional and international hospitals rely on established Bender technology to secure power supplies to operating theatres and intensive care units.

So it is hardly surprising that the electrical engineer planning the veterinary teaching hospital at the PSU, who already had good experience using Bender technology at various international hospital projects in Thailand, decided to implement the power supply to the operating theatres in the animal hospital



[1] IEC 60364-07-710:2002-11 – Low-voltage electrical installations: Requirements for special installations or locations- Medical locations

as a medical technical IT system. Their aim was to protect the personnel, the systems, and, of course, the animals.

A total of eight medical technical IT systems were supplied by Simplify Engineering, each with an ISOMETER® isoMED427p insulation monitoring device, an MK2007 alarm indicator and test combination and a medical technical transformer, and installed by a local service provider on site.

The schedule for the project was very ambitious. An audit of the preparations by the veterinary council in early December ascertained that no medical technical IT systems had yet been fitted, although the hospital was due to open at the end of the month.

After a call to the service provider responsible, Simplify Engineering got going. Within a week, all the IT distributors, which were set up directly by Simplify Engineering in Thailand, had been delivered to the service provider and were on-site and ready to install. Only a specialist company with sufficient levels of stock could act at this kind of speed.

In order to check whether the installation had been correctly executed, Simplify Engineering Co. Ltd. carried out a visual and functionality test after the installation was completed by the local service provider before proceeding with the commissioning. This meant that the hospital could open in time with the requisite medical technical IT systems.

But the service from Simplify Engineering did not end there. As in human hospitals, all the employees affected, including doctors, nurses and technical personnel, were trained by Simplify Engineering. This is the only way for all operators to be familiar with all the functions and not only be able to operate and maintain the equipment but also know how to react in the event of an alarm.

Operating theatre

There are three possible alarms in a medical IT system with no insulation monitoring: over-temperature, overload and insulation fault. In the event of over-temperature or overload, unnecessary devices are shut down in order to reduce the load or the temperature. If an insulation fault occurs, it is often due to a faulty device being connected. Removing the device or replacing it with a fault-free one could be the solution, and this can be carried out by the operating personnel without technical intervention.

The medical personnel at the veterinary teaching hospital at the Prince of Songkla University are very pleased with the technology as it not only protects the lives of vets and nursing staff but also those of the animals undergoing surgery. However, the employees would like more animal hospitals to use this technology. ■

*Saprang Wisuthipanich*
*SPF Simplify Engineering Co. Ltd, Thailand*

**NOTE:** Although this article is about the veterinary teaching hospital at the Prince of Songkla University, it should be pointed out that the medical faculty also uses modern medical technical IT systems supplied by Simplify Engineering, including isoMED427P, EDS151, MK2430 and medical technical transformers.

Charge Controller CC612
from Bender

## Public charging in Switzerland

# Energie Service Biel relies on charging points "Made in Germany" also in 2016


**The customer base of the Bender partner eBee Smart Technologies GmbH** founded in 2011 is expanding significantly.

Along with organisations and utility companies in Germany, eBee from Berlin can also look beyond national borders to satisfied customers for instance in Austria, Hungary and Switzerland. These include the Swiss public utility company Energie Service Biel (ESB).

The Swiss energy service provider started installing charging infrastructure in 2013 and continued this process last year with eBee technology. EBee charging points can be connected quickly to lampposts, walls, free-standing pillars or other electrified public amenities.

For 2015, ESB relied on the three-phase 11 kW version of the eBee charging point "Berlin". Four charging points of this type were installed in the multi-storey car park at the convention centre in Biel and six in the car park at ESB's headquarters; these were mounted on walls as well as on free-standing pillars. Four of the charging points at the headquarters remain reserved for the organisation's own use; the other stations were installed with a public interface.

According to Andreas Hirt, head of the ESB business area Operations, "a key reason for the ESB decision for eBee technology was the central aim to make possible public charging in Biel". This aspect is ensured

Company parking spaces:
Charging points installed on crash barriers
(Assembly set "wall")


Multi-strorey car park:
Wall mounted charging points
(Assembley set "wall")

Visitors parking spaces:
Charging points installed on a free-standing pillar
(Assembly set "pillar". The pillar has been
adapted for the mounting of two charging points)


by the optimal compatibility of eBee charging points with Intercharge, the European roaming platform from Hubject. The Hubject interface makes it possible also for motorists from outside of Biel to be identified by the eBee charging points and authorised to charge via RFID card or smartphone app.

According to Hirt other reasons from the perspective of ESB for the decision for eBee charging infrastructure were its intelligent and at the same time lean usage of technology, the flexible in-stallation options, competent backend IT support, as well as dependable, quick advice during the entire installation process and operation. That eBee charging points are also significantly less ex-pensive to procure and operate is, according to Hirt, a further positive effect for ESB — although not the most important.

Reassured by its previous good experience with eBee, ESB is continuing the expansion of the charging infrastructure in Biel this year. Soon the existing 11 kW charging points will be supplemented with the 22 kW version. The Bender charging controller CC612 (see MONITOR issue 02/2015) integrated into the charging point from 2016 implements advanced standards such as the ISO/IEC standard 15118. This standard optimises the co-ordination between the vehicle and the charging point and, for instance, will make it possible to adapt the charging to the related availability of volatile regenerative power in future. This feature addresses the long-term goal of ESB to integrate electric mobility in Biel into a smart grid concept.

Along with expanded charging intelligence, the new DC 6 mA RCMB controller function developed by Bender optionally replaces the installation of a residual current circuit breaker of type B saving further costs and, in general, the need to switch back on the residual current circuit breaker manually on-site after it has tripped. Finally, the new charge controller provides advanced smart city functions such as WLAN hotspot, parking space management, traffic monitoring or lamplight management.

The future will show the extent to which ESB makes use of such functions — the decision to expand further the charging infrastructure in Biel has already been made. According to Hirt, the reasons for this decision, along with the positive corporate image, include compliance with the national programme for $CO_2$ reduction, electric mobility as an element of system load management and, last but not least, safeguarding the sustainable future of a region with a high quality of life. ■

*Dipl.-Pol. Peter Wilhelm*
*eBee Smart Technologies GmbH, Berlin*

eBee Smart Technologies GmbH has also learnt from the good experience with its customer ESB and started offering an "All-round carefree package for public utility companies" including a low-cost Hubject interface in 2016.



DLR Deutsches Zentrum für Luft- und Raumfahrt
Institut für Verkehrssystemtechnik

## Institute of Transportation Systems

# Technologies from aerospace for road and rail

**Mobility** plays a crucial role in our economy and society. People wish to reach their destinations safely, conveniently and quickly. Goods have to be transported cost-effectively over short and long distances. The consequences of mobility reveal themselves in pollution, accidents and traffic jams.

"Operational, technical and economical **optimisation is the aim**."

A contribution to increasing the safety and efficiency of road and rail transport is made by more than 170 researchers in various fields at the Institute of Transportation Systems (Institut für Verkehrssystemtechnik), which is part of Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR). Based at DLR's facilities in Brunswick and Berlin, they work on the research and development of automotive and rail systems, public passenger transport and traffic management. Engineers, psychologists and computer scientists work together in interdisciplinary teams on solutions for user-oriented driver assistance, traffic monitoring and influencing traffic operations, and automation and dispatching in rail transport. They consider all the demands and effects within the whole of the transportation system. Close cooperation between the various institutes and research organisations at the DLR allows synergies between aerospace and energy technologies to be exploited.

The Institute of Transportation Systems develops innovative technologies in the field of automation for railway systems, with the aim of making operational, technical and economic improvements. As part of their activities, researchers work on projects set up by the institute in connection with the Next Generation Railway System (NGRS). A significant component of NGRS is concerned with condition monitoring of railway infrastructure.

In the automotive field, the institute is researching driver behaviour, stress and accidents and seeks to derive the requirements for driver assistance from the results. Psychological and ergonomic findings flow from every technical field in which the DLR is involved into the development of driver assistance systems. To allow for drivers' capabilities and expectations, the ideas arising from the research are implemented and assessed by test drives – in simulators and in live traffic.

Deutsches Zentrum für Luft- und Raumfahrt

## CUSTOMER **PORTRAIT**

In the field of intermodality and public transport, the institute is pursuing innovative solutions to improve efficiency and customer convenience on journeys involving more than one mode of public transport.

> "**The institute's work** concentrates mainly on the management of large traffic systems."

As a result of funded research in the field of traffic systems technology, the Institute of Transportation Systems has come forward with new concepts for the organisation and operation of traffic to increase efficiency for all road users. In order to influence traffic operations by whatever means, an essential first step is to capture the relevant data on current traffic conditions. The researchers' task is divided into two areas: the development of innovative methods of traffic monitoring and the development of methods of intervening in the flow of traffic (influencing traffic operations). The institute's work concentrates mainly on the management of large traffic systems, such as road networks in conurbations, and in the event of catastrophes or major events.

The institute is accredited in accordance with ISO 9001:2008 and VDA 6.2. In addition, the institute has been approved as a subcontractor for its work in the rail systems field by Eisenbahn-Cert (EBC), an EC notified body for interoperability. Bahnlabor RailSiTe® is accredited as a testing laboratory for the conformity and interoperability of ETCS subsystems and components in accordance with ISO 17025. ■

*Dipl.-GeoInf. Christian Linder*
*Deutsches Zentrum für Luft- und Raumfahrt e.V.*
*Institut für Verkehrssystemtechnik*

# EXHIBITIONS 2016

## EXHIBITIONS INTERNATIONAL

**Data Centre World**
12. – 13.04.2016
London (Great Britain)

**Canadian Mining Expo 2016**
01. – 02.06.2016
Timmins, Ontario (Canada)

**ELEKTRO 2016**
06. – 09.06.2016
Moscow (Russia)

**29th International Electric Vehicle Symposium & Exhibition (EVS29)**
19. – 22.06.2016
Montreal, Quebec (Canada)

**Automation 2016**
22. – 25.08.2016
Mumbai (India)

**Canadian Healthcare Engineering Society 2016 National Conference & Exhibition (CHES 2016)**
11. – 13.09.2016
Vancouver, British Columbia (Canada)

**Canadian Airports National Electrical Workshop (CANEW 2016)**
25. – 30.09.2016
Moncton, New Brunswick (Canada)

**Healthcare Estates**
04. – 05.10.2016
Manchester (Great Britain)

**Intersolar 2016**
19. – 21.10.2016
Mumbai (India)

**MATELEC**
25. – 28.10.2016
Madrid (Spain)

**Electric Networks**
06. – 09.12.2016
Moscow (Russia)

DATES

## EXHIBITIONS NATIONAL

**Hagemeyer Leistungsschau 2016**
01. – 03.04.2016
Munich

**FKT Trade Fair Hospital Technology**
20. - 21.04.2016
Gelsenkirchen

**Hannover Messe**
25. – 29.04.2016
Hanover

**PowerBuilding & DATA CENTER Convention**
11. – 12.05.2016
Cologne

**Intersolar**
22. – 24.06.2016
Munich

**InnoTrans 2016**
20. – 23.09.2016
Berlin

**WindEnergy 2016**
27. - 30.09.2016
Hamburg

**belektro 2016**
11. – 13.10.2016
Berlin

**eCarTec 2016**
18. – 20.10.2016
Munich

**PowerBuilding & DATA CENTER Convention**
26. – 27.10.2016
Munich

**SPS IPC Drives 2016**
22. – 24.11.2016
Nuermberg

INTERVIEW

# Dr Dirk Pieler

## Managing Director Bender

### CAREER OUTLINE

Dr Dirk Pieler, born in 1969, was born, raised and did military service in North Hesse.

He studied industrial engineering (electrical engineering) at the University of Paderborn. Five years of management consultancy and teaching at the Fachhochschule der Wirtschaft (University of Applied Sciences). Doctorate while working. Ten years at Siemens. Married, three children, living in Grünberg since 2009.

**Dr Pieler, you have been the CEO of the Bender Group since January 2009. You came from Siemens AG, which is a considerably larger company with different structures. Back then, what were your reasons for making the move to Bender?**

That was exactly why I wanted to move. Siemens is an outstanding company with a varied portfolio and a unique global presence. I really enjoyed working for Siemens and being able to fulfil a wide range of roles, most recently the management of a turnaround program for a loss-making division with turnover into the billions. Once the restructuring work was complete and the division was back in profit, I felt it was time to switch to an innovative family-run company. I was familiar with this kind of company from when I started out my career as a management consultant and found them fascinating, I still do. The sheer size of a company like Siemens means that processes are different to a medium-sized company.

**Have you and your family settled well in Grünberg? Would you make the same decision again?**

Definitely. We have bought and renovated a house in Grünberg and it really feels like home now. We spend the majority of our leisure time here. Grünberg is a lovely little town and the countryside around it offers excellent quality of life. And the region of Middle Hesse also has plenty to offer. I have not regretted the decision for a single day. It was primarily a decision for Bender, and Bender is a company I get more excited about every day.

**What is it you find so fascinating about Bender?**

Firstly, what we do: we protect people, systems and processes. We have already saved many lives - nobody can say how many. And we do this in the background. It is never in the news that a power plant has worked perfectly for another day thanks to Bender technology or that surgery has been carried out successfully. Nobody notices us when everything works like it should. But we know what we do and we are proud of it. We have a special market position as the worldwide leader in terms of technology in our core segments. This is largely based on very innovative products. These don't just simply fall out of the sky, they are developed, produced and marketed, then trained and supported by our outstanding employees. I have often heard Mr Bender say that he was always lucky to have the right staff at the right time. And fortunately that is still the case.

**When you look back, what have you changed in your last seven years at Bender?**

First off, I'd like to say that I always find it very presumptuous when chairmen or managing directors claim they have increased turnover by whatever percentage or captured new markets or similar, as if they had done it single-handed. A managing director can change the strategy, he can make good or sometimes bad decisions, perhaps he can even acquire a new customer personally. But a company manager cannot achieve much alone. Whatever is achieved is generally a team success. And there is not enough space to

"I have often heard Mr Bender say that he was always lucky to have the right staff at the right time. And fortunately that is still the case."

list them all. Just a few key words: We have conquered other regions, founded new subsidiaries, developed business in new industries. We have restructured production in new buildings based on optimal processes. We have replaced existing products with higher-performance models and developed new products for futher-applications. We have opened a test centre where we can thoroughly test our products, including cross-generation system tests. We have massively expanded our patent portfolio, reoriented service, restructured purchasing, changed many processes and so on and so on.

**How can your customers benefit from all these changes?**

Our guiding principle is to orient everything we do towards the needs of our customers. We do not want to offer cheap products, because that is not in line with our claim to be the leader in terms of technology and quality. But we want to offer exactly the solutions from which our customers benefits most. The new production and testing processes have enabled us to offer extended guarantee services for most of our products. In recent years, development outgoings have largely gone towards new measurement processes which have pushed back the boundaries of what is possible for our customers. The new networking and visualisation technology considerably reduces system commissioning costs. At the same time, it has become much simpler and easier for users to use Bender systems on an everyday basis. Expanding our system portfolio to include Power Quality Analyzers, for example, gives customers a more comprehensive overview of the status of their systems. At the same time, we have developed new solutions for specialist requirements, such as fast shutdown insulation monitoring devices, ISOMETER® for electric vehicles, highly integrated charging technology for electric vehicles and insulation monitoring for data centres, to name just a few applications.

**The degree of electrification in the world is increasing - thanks to renewable energies, electrification, controllers, etc. This also makes systems more prone to failure. Would you agree that this means new opportunities for Bender in the future?**

Yes. The world is indeed getting more and more electric. Years ago, we started reinforcing development investment into renewable energies, electromobility and in control current circuits and now have unique products in these areas. Overall, the hazardous potential of electricity is still underestimated. For example, electric insulation faults are the most common cause of fires there is. But this knowledge alone often still does not lead to investment in insulation monitoring. The risk seems too improbable and they're insured anyway. But even if we make the optimistic assumption that no person would ever come to harm in a fire and that the insurance would pay up for the fire damage, fire prevention should still be a key issue for all companies. A fire can have devastating consequences for the company. Delivery relationships are now so carefully timed that customers cannot wait for suppliers to solve their problems. If a supplier drops out for a long period, they will probably lose their customers irretrievably. I know a company that lost three quarters of its turnover on a long term basis because of a fire and could only survive at all by making massive cuts. It is still not clear whether the insurance will pay for the actual fire damage, but it has become moot.

As well as fire prevention, protection against electric shock is also becoming more important, especially against the backdrop that there is an increasing number of applications where shutting down is not an option, such as in operating theatres and intensive care units, in the control current circuits in power stations, in data centres, in the process industry, etc. Electricity is dangerous, but so is no electricity. Where continuity plays a major role, we can generally provide custom-fit solutions.

**This edition marks the tenth anniversary of MONITOR. It costs a lot of money to produce a specialist magazine of this kind, is it worth it?**

If our customers think it is worth reading MONITOR, then it is worth the expense.

Dr Pieler, thank you for the informative interview. ■

*Timothy Hörl, Dreipass*

# Insulation fault location

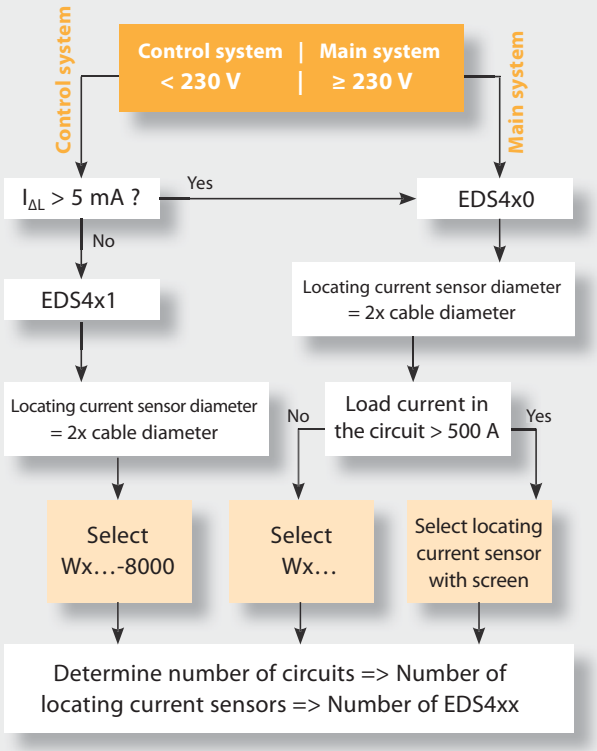
## Planning and set-up

**DIN VDE 0100-410 (VDE 0100-410):2007-06**
requires the rapid location and elimination of insulation faults.

Bender offers a modular solution to this requirement with an insulation fault location system (IFLS), comprising an insulation monitoring device ISOMETER® with integrated locating current injector, insulation fault locator and locating current sensors. IFLSs are used in, among other places, power stations, hospitals, in shipbuilding, in the paper industry, oil and gas installations, in the machine tool manufacture and in heavy engineering.
Insulation faults can be found quickly without shutting down the installation and the operation of the installation is therefore safeguarded. The defective circuit can be located simply and quickly and the location of the fault is indicated centrally. As a consequence, maintenance and service costs are reduced.

## Planning

Some knowledge of the installation to be monitored is required to plan an IFLS. For example, is the installation a small control system with small, simple loads and a voltage < 230 V, or a main circuit with voltages ≥ 230 V, converters and system interference due to non-linear loads? The answer to this question will allow the locating current to be determined for the insulation fault location.
In systems with sensitive loads, such as relays and PLCs, the insulation fault location is often only allowed to be undertaken using very low locating currents, while in systems with large loads, such as motors and converters, a higher locating current should be selected to be able to differentiate interference from the locating current. If a locating current > 5 mA is allowed to be used for insulation fault location in a control system, an EDS4x0 can be used in exactly the same way as in the main circuit. The diameter of the locating current sensors must be selected such that the inside diameter of the sensor is twice the outside diameter of the cable. However, it is required, a very sensitive insulation fault locator EDS4x1, locating current sensors of type Wx...-8000 are used. In this way it is also possible to detect smaller locating currents. If an EDS4x0 with lower sensitivity is used, it is possible to select screened or unscreened locating current sensors depending on the load current. The number of circuits monitored defines the number of locating current sensors required, and therefore also the number of EDS4xx required.



# Practical Expertise



## Set-up

To set up an IFLS, all the devices in the project must be switched off. The insulation fault locators are interconnected via the BS[1)] or BB[2)] bus and connected to the related insulation monitoring device with integrated locating current injector. Each insulation fault locator requires an individual address on the BS bus in the range 2...90. The BS bus can be used for communication with insulation fault locators at distances of up to 1200 m. The BB bus is a local device expansion on an insulation monitoring device for one to two insulation fault locators. After the locating current sensors have been connected to the related insulation fault locator the system can be switched on again.

The EDS mode is set either using the commissioning wizard or via the menu. In this way, you can define whether the insulation fault location should start automatically on the occurrence of an insulation fault (mode: Auto) or only when an electrician starts the search manually on the insulation monitoring device (mode: Manual). Afterwards, a channel scan is carried out. During this process all EDS channels detected on the permissible interfaces are indicated and their parameters can be configured. The channels to which locating current sensors are not connected can be deactivated such that all the channels no longer appear during subsequent group parameter configuration.

The upper limit for the locating current is defined by the maximum locating current used for the insulation fault location. For control systems combined with an EDS4x1, a locating current of 1...5 mA can be set, and for main systems combined with an EDS4x0, a locating current of 10...50 mA. The locating current defined in the insulation monitoring device (which has integrated locating current injector) must be greater than the corresponding response value in the insulation fault locators. The response values are specified in the factory settings such that they are below the minimum locating current values in the insulation monitoring device.

For insulation fault locators of type EDS46x, the locating current sensor type must also be set. Other possible settings are connection monitoring in the insulation fault locator, as well as the fault memory or the trigger mode, which is factory set to "com". This means that the insulation fault locator receives a trigger via interface and measures the locating current in the locating current sensors based on this trigger. If the trigger mode is set to "auto", the locating current in all circuits is measured continuously. In systems with heavy interference and high residual currents, the trigger mode should be set to "com" to obtain better measurement results. ■

*Dipl.-Ing. Jörg Irzinger, T-MIS*

**System commissioning of ISOMETER® with EDS4xx**

↓

Disconnect supply voltage of all devices

↓

Connect the EDS to the ISOMETER®
*EDS4xx-L: BS-bus
*EDS4xx-S: BB-bus

↓

Connect the supply voltage to all devices

↓

Set EDS mode in the ISOMETER® menu:
-> EDS -> General -> Mode

↓

Search for adjustable measuring channels in the ISOMETER® menu: EDS -> Scan for channels

↓

Activate measuring channels in ISOMETER® menu:
EDS -> Enable channel

↓

Set the maximum locating current in the ISOMETER® menu:
EDS -> General -> Current
*EDS4x1…: 1…5 mA
*EDS4x0…: 10…50 mA

↓

Make any other necessary settings for the EDS4xx in the ISOMETER® menu: EDS

↓

Function test with a suitable resistance between system and earth. Resistance value: 50 % of the response value Alarm 2

↓

Remove the resistance

↓

**The ISOMETER® and EDS4xx combination is properly connected and functions reliably**

[1)] BS: Bender sensor bus for communication with insulation fault locators. Partially compatible with BMS.
[2)] BB: BackBone bus for communication with insulation fault locators

# **BENDER** Group

The Bender Group with its main office in Gruenberg/Hesse has 70 representatives and 13 subsidiaries with nearly 700 employees worldwide.

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BENDER Group

**Power in Electrical Safety**