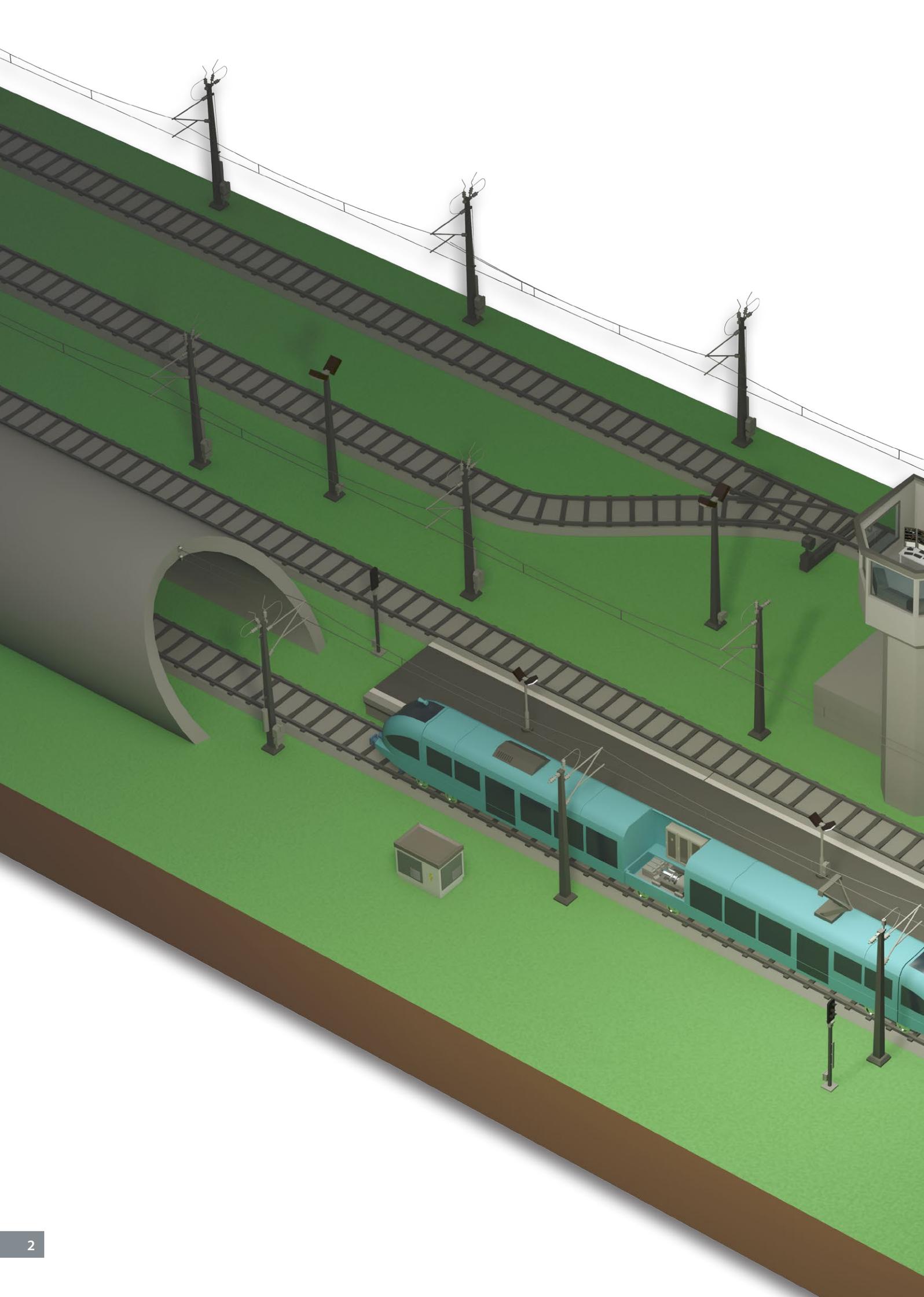


# Electrical safety in railway technology





# Electrical safety has the right of way

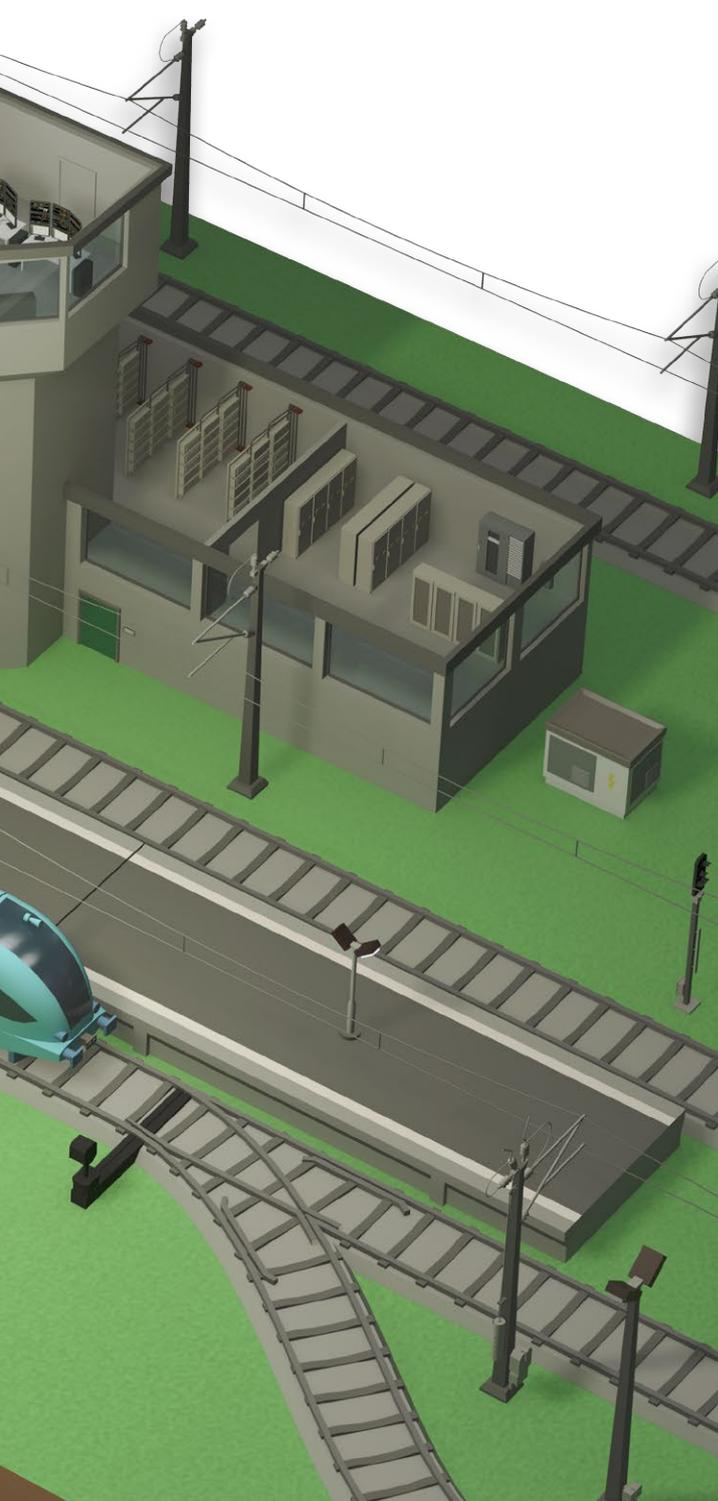
The railway industry deals with extremely demanding tasks on a daily basis. This includes monitoring high-speed routes, railway track construction or power supply in addition to the transport of hazardous goods. Regardless of the pressure to be punctual, however, passenger safety remains the overriding priority.

Guaranteeing electrical safety is an essential component of smooth railway operation. This applies equally to signal boxes, signal systems, operational buildings, tunnels and bridges as well as to rolling stock, such as locomotives and railcars.

**Bender system solutions monitor electrical systems and equipment on the railways and ensure the necessary edge in terms of information before critical operating conditions arise.**

## Solutions for railway technology

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# Safe railway technology: high availability and cost effectiveness

## Standard-compliant solutions from Bender experts

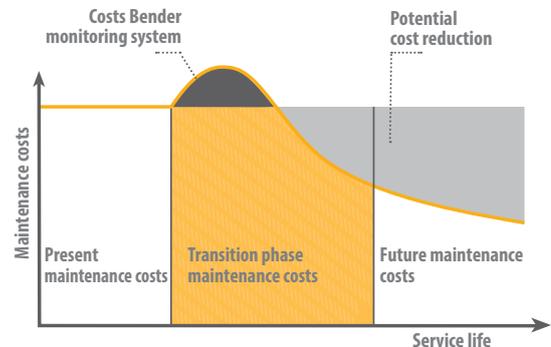
### Safe operation and reduced costs

Bender monitoring systems ensure fault-free power supply, help you to quickly locate insulation faults and enable you to prevent downtimes of important system parts.

What is the cost of unscheduled maintenance, unavailability of route sections, insulation fault searches that last for hours or even days? Investing in modern monitoring technology from Bender quickly pays for itself.

### Standard-compliant solutions

Electrical railway technology is subject to extremely stringent safety standards and must therefore comply with national and international standards, see below. Bender system solutions monitor electrical installations and equipment on the railways in an innovative and standard-compliant manner and ensure that you have the necessary edge in terms of information.



## Bender system solutions support you in complying with the following standards, for example:

- **DIN VDE 0100-...**  
Protection against electric shock
- **DIN EN 50122-... (VDE 0115-...)**  
Railway applications – Fixed installations – Electrical safety, earthing and the return circuit
- **DIN EN 50123... (VDE 0115...):**  
Railway applications – Fixed installations; D.C. switchgear
- **DIN EN 50153... (VDE 0115...)**  
Railway applications – Rolling stock – Protective provisions relating to electrical hazards
- **DIN 5510...**  
Preventive fire protection in railway vehicles
- **IEC 61373**  
Railway applications – Rolling stock equipment
- **EN 45545...**  
Railway applications – Fire protection on railway vehicles
- **NF F 16-10...**  
Railway Rolling stock. Fire behaviour
- **DIN EN 50155...**  
Railway applications – Electronic equipment used on rolling stock
- **DIN EN 50121...**  
Railway applications – Electromagnetic compatibility
- **DIN EN 50553... (VDE 0115-...)**  
Railway applications – Requirements for running capability in case of fire on board of rolling stock
- **DIN EN 50502... (VDE 0115-...)**  
Railway applications – Rolling stock – Electric equipment in trolley buses



# Proactive instead of reactive: predictive maintenance

## Determination of the ideal point in time for maintenance

### Reducing risks of failure

Whether it is gradually developing insulation faults, stray currents, or malfunctions due to material fatigue of the electrical systems, often accelerated by weather conditions: The impact of these problems, which can be detected at an early stage, are often underestimated and range from triggering protective devices and the sudden appearance of arcs to fire damage or even personal injuries. Those who only react once a fault has occurred are forced to accept regular downtimes with all the associated financial and image-damaging consequences.

Many installation operators test their systems at regular intervals and renew technical components as a precautionary measure. This simple model of preventive maintenance may impede many avoidable downtimes, but is personnel and cost-intensive due to manual inspections and wasted residual quality of the components. Furthermore, intermittent assessments of the condition are very unreliable.

### What if downtimes could be predicted and therefore prevented? What if maintenance could be cost-optimised?

This can be achieved with Bender monitoring systems as they enable monitoring that provides analysis capabilities and can thus determine the ideal point in time for maintenance. This predictive maintenance saves valuable resources: Maintenance measures can be planned, and devices and components can be used until the end of their service life. Moreover, the targeted and fast localisation of problem areas is achieved by Bender insulation fault location systems.

## Maintenance strategies

### Corrective

#### Downtime-oriented

- Reaction after direct damaging event
- Unscheduled downtime

### Preventive

#### Time-dependent

- Established deadlines
- Frequent exchange of intact components

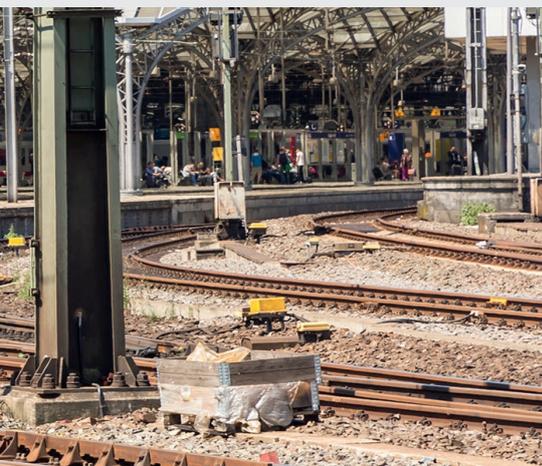
#### Condition-oriented

- Reaction to warning thresholds concerning the system condition, still prior to downtime
- Optimum use of service life (wear margin)

### Predictive

#### Analysis-supported monitoring

- Prognosis of the ideal point in time for maintenance
- Maintenance measures that can be planned



**Predictive maintenance** allows you to achieve maximum cost effectiveness. Bender monitoring systems help you to

- improve the management of your assets (CAPEX)
- optimise maintenance efficiency (OPEX)

# Information for planners

## Only forward-looking planning enables foresighted maintenance

Electrical devices are subject to normal wear and may be susceptible to faults during their service life. The portable insulation fault location systems from Bender can be a valuable tool in the search for insulation faults as it allows easy determination of the fault location.

For correct functionality, the transformer and measuring clamps for insulation fault location must be placed/installed correspondingly. Ideally, this has already been considered during planning.

## Always ready, always reliable

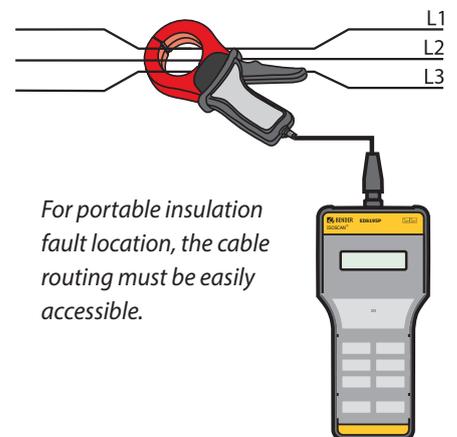
The search for insulation faults in order to determine the fault location is not possible on all conductors of the signal box, as several voltage levels can be connected via the common negative potential. In this case, a current clamp can display high residual currents without the existence of an insulation fault. To be considered during planning: Outward and return line conductors of a system component, which should be able to be monitored for faults by means of insulation fault detection equipment, must be fully enclosable with the current clamp.

## Recommendation: adjust system size

The larger the system, the longer the measuring time. It is possible that very short-time insulation faults cannot be detected or localised. It is therefore recommended to adjust the system size to the maintenance objectives.

## Easy planning with macros

Bender devices are available in the library for EPLAN macros. Additional formats, such as WSCAD, DWG and DXF are available upon request.



# Why the IT system is the better choice



## The aim: reliable power supply – high availability

Due to increasing complexity and automation technical installations depend more and more on reliable power supply. At the same time, the follow-up costs of unexpected downtimes increase. The selection of the power supply system already determines how well a reliable power supply can be implemented and how high availability can be achieved.

## TN system, TT system or IT system?

In principle, planners can choose between different system types, which differ in structure with regard to earthing relations of power supply source and equipment, as well as in the type of neutral conductor and protective conductor. After considering all options, the result is often that the IT system is the best choice as system type in most cases.



An additional plus: Operators are able to evaluate installation information according to their personal requirements and use it for installation improvement as well as comparing the measurement data with other events in the signal box. This is a valuable tool to also find the causes of short-time insulation faults.

Often, maintenance teams do not stand a chance to react to fault messages within a few hours, locate and eliminate them. Stationary equipment for insulation fault location offers a crucial advantage for these cases.

## The five most important advantages of an IT system:

### Advantage 1: Continued operation after the first insulation fault

One of the crucial advantages of the unearthed system (IT system) is that the system can still be operated after the appearance of a low-impedance insulation fault.

### Advantage 2: Fire protection

Insulation faults are the most common cause of fire. IT systems reduce the fire risk due to insulation faults to a minimum, which will also be rewarded with lower insurance premiums by insurance companies.

### Advantage 3: Locating the fault during ongoing operation

Faster insulation fault location without operational interruption is possible with insulation fault location systems.

### Advantage 4: Reduced test effort

Costs and time are reduced since  $R_{iso}$  measurement for periodic verification is not required with insulation monitoring devices. Therefore, operational interruptions are not necessary.

### Advantage 5: Increased personal safety

System operators that use IT systems offer their employees, visitors, customers the highest possible level of protection.

Due to the various economic and technical advantages, an unearthed system with high-performance insulation monitoring is almost always profitable in rather complex installations.

# Signal box, control and safety technology



## Monitoring safe railway operation

The smooth operation of the whole railway network is the predominant focus of the signal box and the control and safety technology.



A voltage swell in the event of a fault is a particular hazard. The insulation monitoring devices from Bender comply with IEC 61557-8 and measure voltages from system to system and system to earth in addition to gauging insulation. This allows early detection of these hazards.

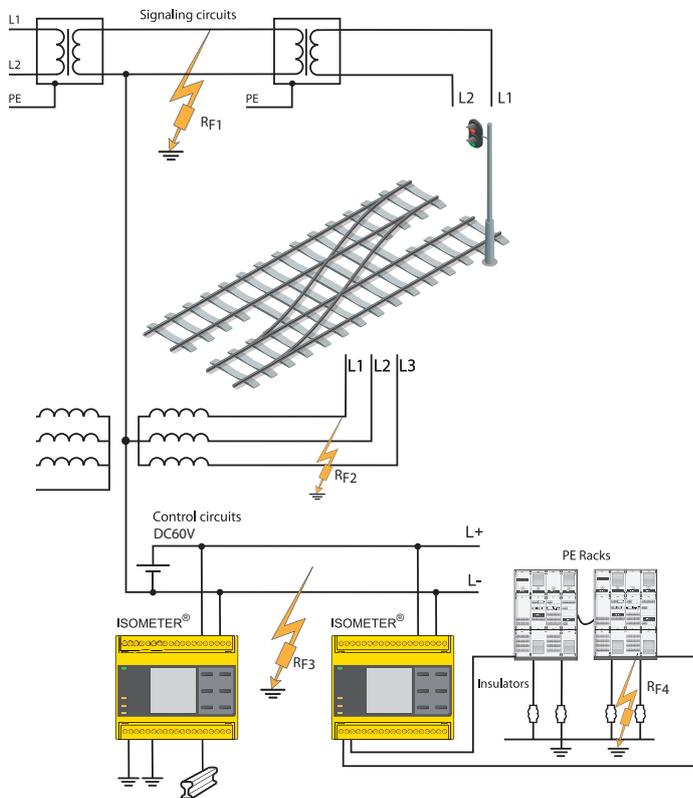
## Fault search? Made easy!

To prevent interruptions to operation even in the event of a fault, Bender insulation fault location systems enable a fault search – also in system (areas) that are switched off.

Even large systems can be reliably monitored by means of Bender insulation monitoring devices. The leakage capacitance value may increase with the size of the system, but Bender insulation monitoring devices identify and adjust to the leakage capacitance value.

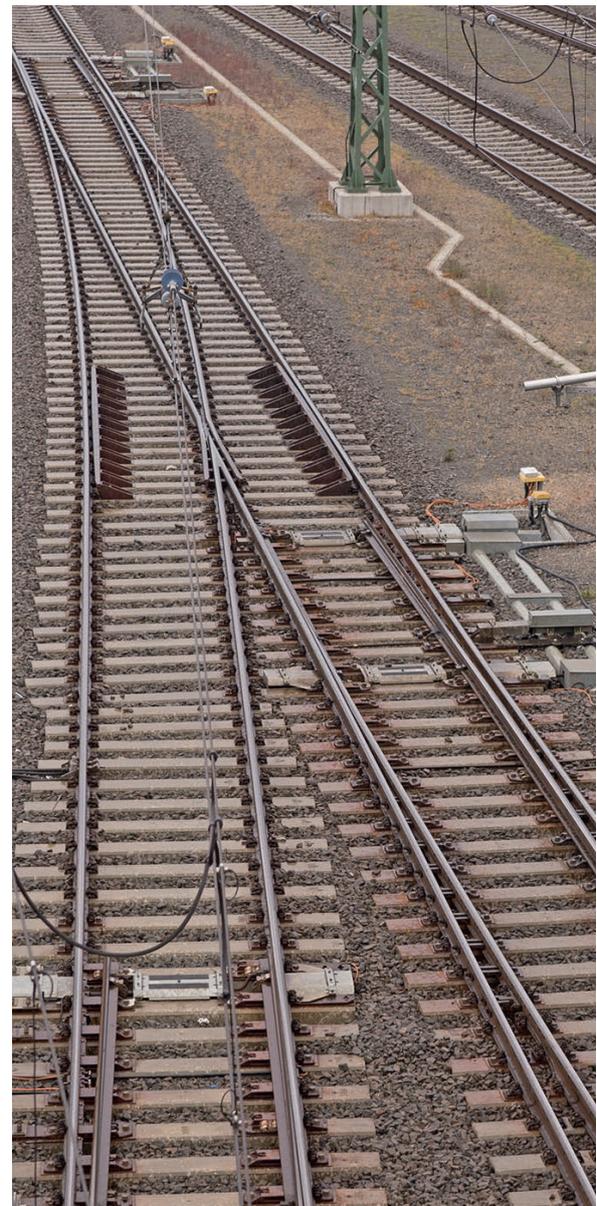
## Insulation monitoring during an earth to rack short circuit

Bender insulation monitoring devices also enable the monitoring of ohmic-coupled systems.



**Guideline stipulation acc. to RIL892, example Germany: insulation fault below 30 kΩ within 10 working days**

In practice, traditional technology often only detects faults from 0 kΩ to approx. 7 kΩ. Bender offers solutions that can detect faults in a range from 0 kΩ (dead circuit to rack or earth) to 100 kΩ. These solutions can be implemented in a stationary and/or portable manner without shutting down the system. Good to know: Even retrofitting stationary solutions for insulation fault location is possible without shutting down the system.



# Track field illumination and safety lighting

## Shunting – better with lighting!

According to Ril 954.9103, the power supply of track field illumination must be designed as an IT system. Bender offers insulation monitoring devices that comply with IEC 61557-8. These also adjust to larger systems with several lighting masts, parameterisation of the system size is not required.

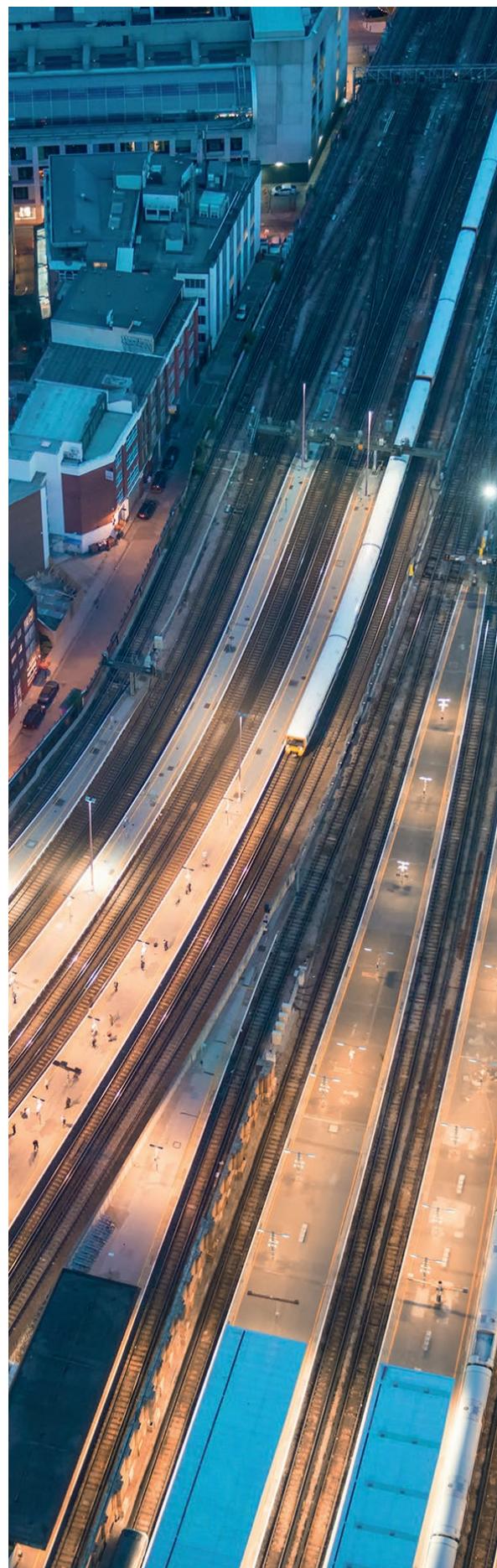
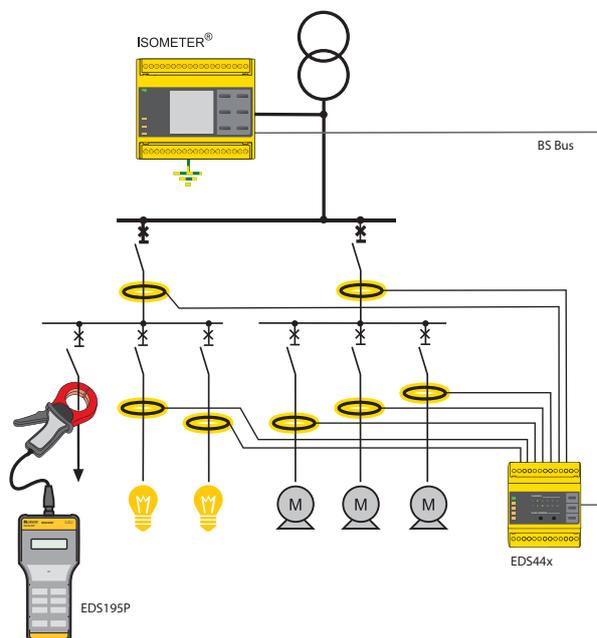
### Ril 954.9103 guideline

According to the most recent guideline, the lamps must be illuminated by means of LED. This means that rectifiers and mains filters are in the system, which, in the event of a fault, represent a symmetrical fault. Bender insulation monitoring devices also determine insulation faults in systems with mixed current types (AC/DC).

AC/DC

Insulation monitoring devices from Bender measure voltages from system to system and system to earth in addition to gauging insulation. This permits the early detection of voltage swells in the event of a fault.

In systems consisting of several poles including mast switches, insulation faults can also quickly be found. Insulation faults can be allocated to the individual illumination elements when using insulation fault location systems.



# Locomotives, full trains (passenger transport)



## Safe power supply for drives and auxiliary units

**IT systems** with different voltage levels are implemented in locomotives and full trains. Bender provides solutions for these differing voltage levels. Insulation monitoring devices measure the insulation resistance, voltages and the leakage capacitance to earth/chassis.



Voltage relays monitor the different voltage levels as well as the phase sequences.



## Challenge: Insulation fault location with changes in railcar sequence

Device addressing must be taken into account when using communication interfaces within insulation fault location systems. The fault location sensors may be evaluated locally with frequent changes to railcar sequences.

There are also good solutions for the electrical safety of **TN systems** with different voltage levels: By means of residual current monitoring, different system components are continuously monitored and faulty system components identified. Bender voltage and current relays reliably monitor the different voltage levels and phase sequences even at 16 <sup>2</sup>/<sub>3</sub> Hz.



## Remember:

### Measuring current at the central earthing point

Bender provides equipment for measuring current at the central earthing point.

## EN 50155 – higher vibration level and increased environmental influences

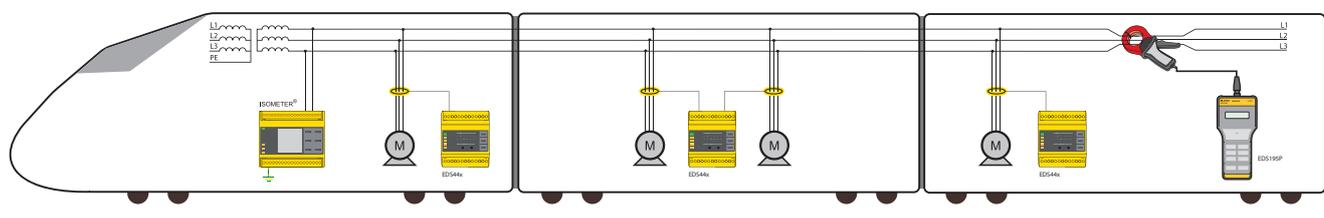
The RW version of the Bender devices are tested according to EN 50155

## Minimising delays – adhering to scheduled timeframes and deadlines for maintenance

Bender insulation fault location systems enable expeditious fault detection when installed in a stationary manner – ready to be implemented at any time. Alternatively, mobile equipment may also be used in the fault search.

## Facilitating standardised work

Bender portable insulation fault location systems enable standardised working methods. In this way, quality levels and timing goals for maintenance can be achieved even via subcontractors (e.g. ECM).



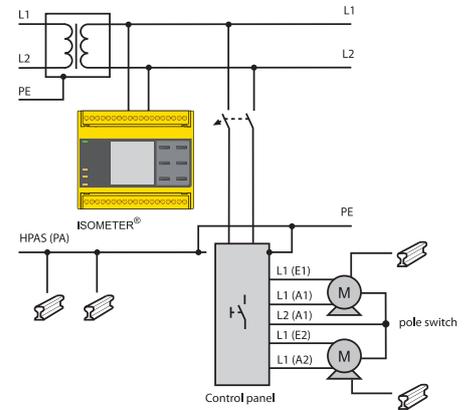
Portable insulation fault location systems use current clamps, which must be positioned around the cables. Ideally, cable input and cover design have already been considered during the engineering planning phase.

# Mast switch actuators

## Monitoring safe railway operation

Mast switch actuators are switching devices that, during regular operation, during construction work, after lightning strikes or after accidents must switch the overhead line in a reliable manner. Their functionality in the event of implementation can be guaranteed via continued monitoring of the power supply system with insulation monitoring devices. They automatically adapt to the installation size and report critical conditions to the supervising system.

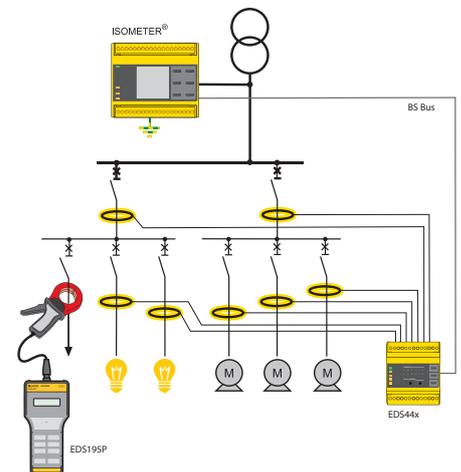
The chronological tendency of slowly decreasing insulation values can be made visible via Bender technology. The use of communication interfaces enables predictive maintenance and analysis.



## Finding insulation faults easily and without disconnecting

Insulation faults can quickly be found in systems consisting of several poles including mast switches by using insulation fault location systems. In this way, they can be allocated to the individual mast switches. Insulation faults are located during ongoing operations, without cable disconnection.

Insulation monitoring devices from Bender measure voltages from system to system and system to earth in addition to gauging insulation. This permits the early detection of voltage swells in the event of a fault.



# Points drives, points heating

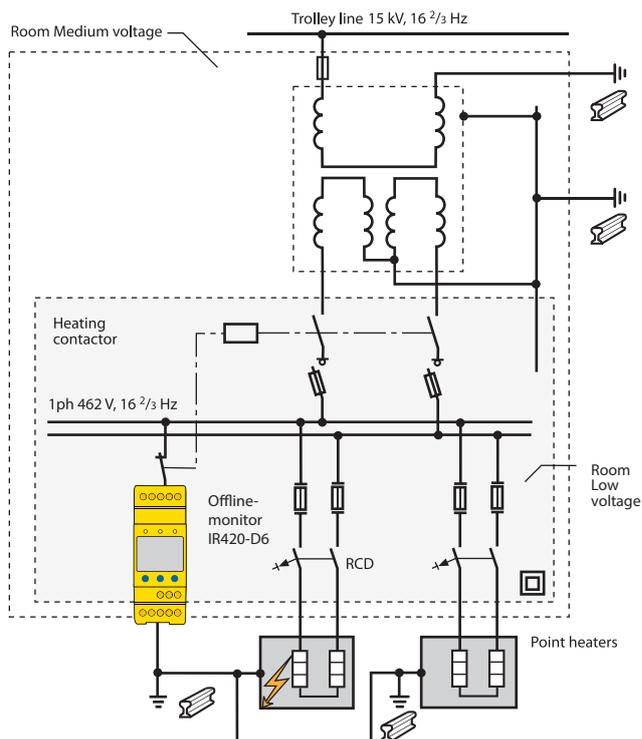
## Setting the right course for electrical safety

Points drives are only used when resetting points. To assure that they function reliably when implemented, it is recommended to continuously monitor the power supply system with insulation monitoring devices. They report critical conditions to the supervising system.

The use of modern communication interfaces enables an analysis of measured data and correlation to additional events in the signal box. This is a valuable tool to also find the causes of short-time insulation faults.

## Heating points safely in the winter

Frozen points present a safety problem and are the main cause of delays. Their functionality in the event of implementation can be guaranteed via continuous offline monitoring of the power supply system, as offline insulation monitoring devices report critical conditions to the supervising system also when switched off.



For predictive maintenance and analysis, Bender technology visualises the progress of insulation values over time.

## The risk of downtimes

During downtime, insulation faults may occur due to moisture or other factors on the supply line or the load which are not noticed. When connecting the installation, the protective device trips or engine fires occur and operation is not possible.

This can be remedied by continuous insulation monitoring that informs about insulations faults at an early stage.

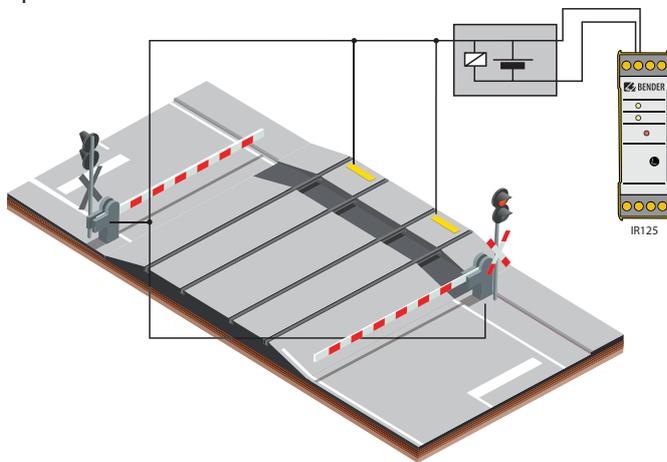


# Railway crossing/Safety installations

## Electrical safety has the right of way

Reliably functioning railway crossings and safety installations are of vital importance for transport users. The train triggers the opening and closing of the gates when driving over sensors. Failure of these safety installations would bring the train to stop or block cross traffic.

Danger arises when insulation faults cause malfunctions. These can be prevented with Bender technology as it enables continuous monitoring of insulation values over time. Slowly decreasing insulation values are visualised via the communication interfaces, predictive maintenance and analysis become possible.



## Problem case: short-time insulation

Short-time insulation faults are difficult to interpret. Frequently they no longer exist when the service staff arrives on site. In this case, the analysis of measured data and correlation to additional events in the signal box helps establish the cause.



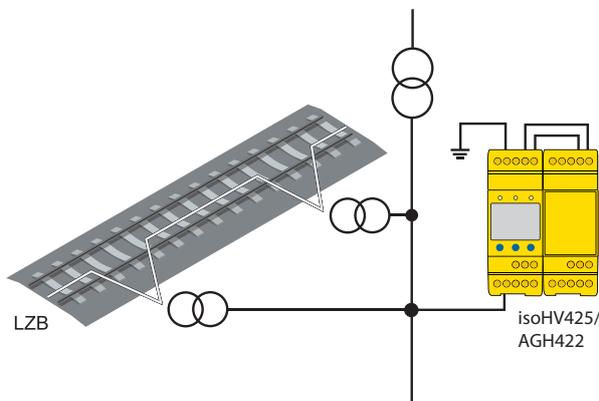
# Punctiform continuous train control and ETCS

## Safe control of trains in international railway operation

Securing railway traffic by means of punctiform train/continuous train control/ ETCS encompasses the entire railway network. Insulation monitoring systems and insulation fault location systems are implemented in order to find insulation faults also in the case of extensive routes. They are able to allocate insulation faults to individual route sections.

**A further advantage is:** Bender fault location systems find insulation faults during ongoing operations, without cable disconnection.

The following image shows the use of an insulation monitoring system for continuous train control.



The use of modern communication interfaces enables an analysis of measured data and correlation to additional events along the route. This way, even short-time insulation faults become easily interpretable.

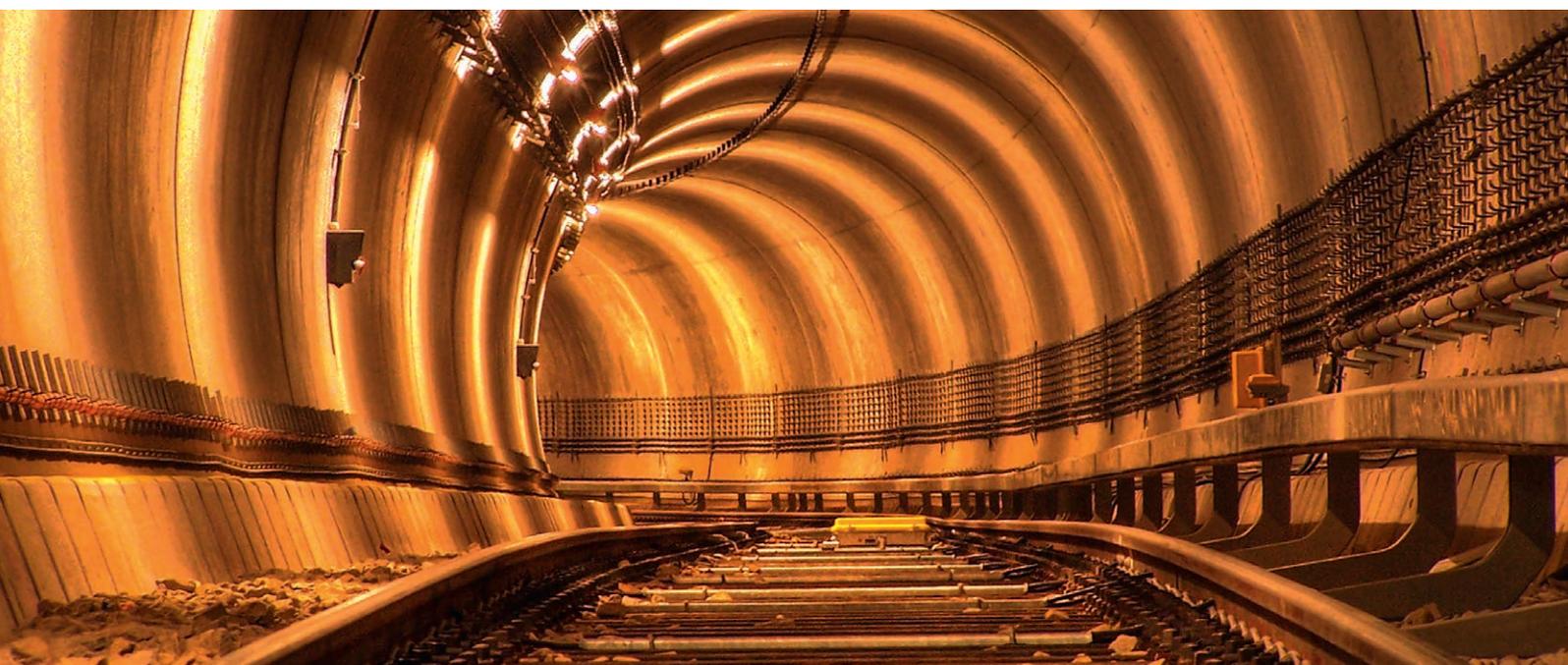
## Punctiform train control

A symmetrical fault to earth can disable the functionality of the current-free punctiform train control. The suitable monitoring option is continuous insulation monitoring of the current-free track magnets. Insulation monitoring devices report critical conditions to the supervising system.

## Insulation monitoring isoHV425 + AGH422



- acc. to IEC 61557-8
- with coupling device
- up to AC 1000 V
- Modbus RTU



# Electrical safety in tunnels, in case of catastrophe

## Safe power supply even in case of catastrophe

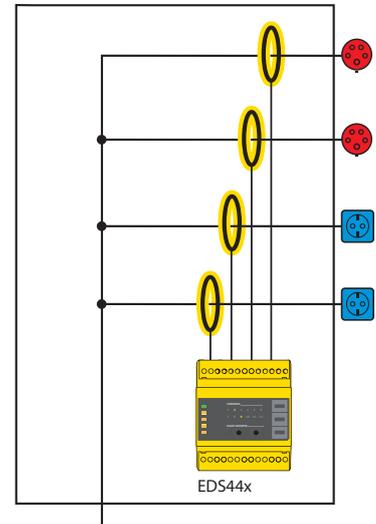
Train routes in mountainous landscapes lead across a sequence of tunnels and bridges. The route operator must be prepared for a train accident in a tunnel. Along the route, fire brigades and Technical Relief Services (THW) are equipped for assistance in case of catastrophe. To support the rescue concept, hydrants and emergency power supply points are installed in the tunnels. Rescue teams thus have quicker access to water and electrical energy in sufficient quantities. According to the guideline 95401, in Germany the power supply has to be designed as an IT system.

## Securing a functioning power supply for rescue teams even in case of catastrophe

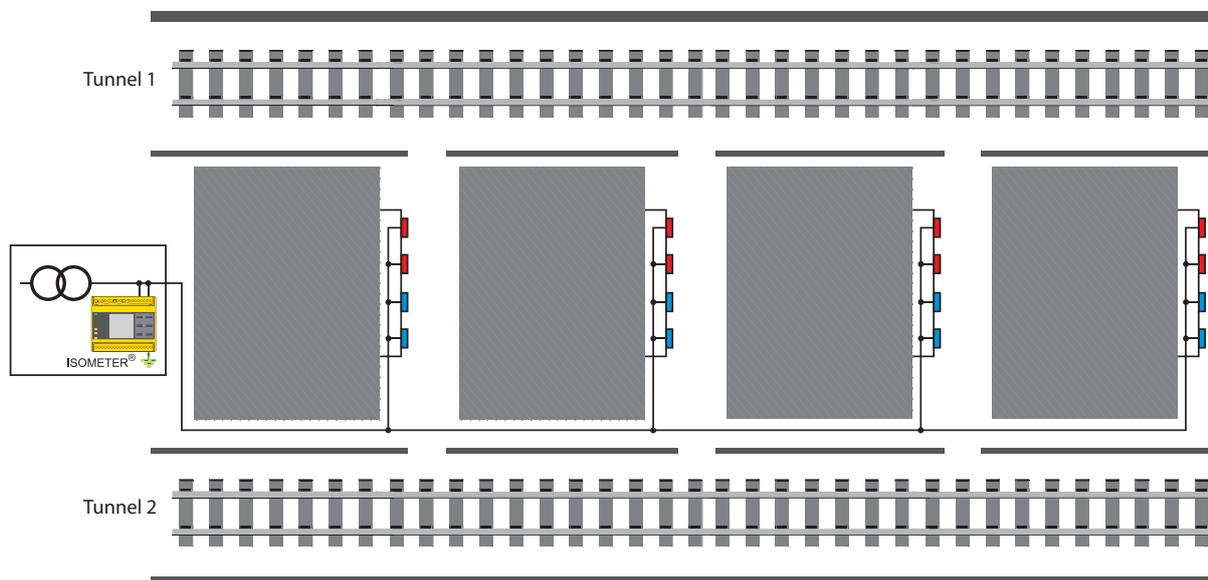
So that rescue teams can rely on a functioning power supply in the event of a catastrophe, continuous insulation monitoring is required. Critical installation conditions are reported to the supervising system in a timely manner.

## Fast localisation of insulation faults

Even in the case of extensive routes, insulation faults can be allocated to the individual tunnel sections when using Bender insulation fault location systems. A further advantage is: They find insulation faults during ongoing operations, without cable disconnection.



*Emergency power supply points for rescue teams*



# Portable generators

## Electrical safety when using portable generators

Portable generators are implemented in maintenance measures and in cases of catastrophe. They have to function quickly and reliably. The amendment of DIN VDE 0100-551 clearly specifies that periodic verification is no longer required if insulation monitoring according to DIN EN 61557-8 has been implemented.

Furthermore, it is no longer required to set an earth spike if the protection concept consists of protective separation with insulation monitoring. Bender offers solutions for insulation monitoring of the system to secure electrical safety of portable generators and connected operating resources.



# Building technology: railway station, depot

## Safer building technology for satisfied customers

Modern railway stations are service centres that depend on a safe power supply. The service centre should also be able to function if an electrical fault occurs in a minor part of the system. By means of the RCMS residual current measuring system, faults are detected long before a normal residual current circuit breaker would shut down. Therefore, availability for the total system is increased.

**Technology that quickly pays for itself:** The RCMS improves and simplifies maintenance and fault location.

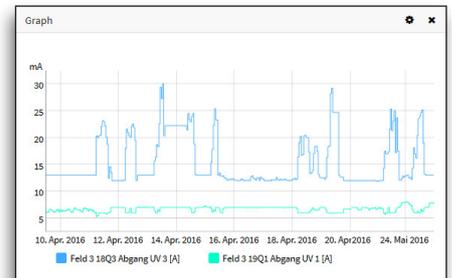
So that even the slowly decreasing insulation values are detected, Bender technology uses modern communication interfaces for visualisation and thus enables predictive maintenance and analysis.

## Transparency for electrical installations

Power quality problems generate costs. Overloaded operating materials, overheating and disruptions do not have to be a given. These occurrences can be prevented by means of targeted energy management with PQ devices from Bender. Documentation of adherence to the standard-defined power quality is easy. With Bender Class A power quality analysers, you can perform measurements according to IEC 61000-4-30 Class A and receive a legally incontestable report.

## Energy management

All Bender measuring devices from the PEM range also capture energy and performance data. Therefore, setting up measuring points for the purpose of invoicing becomes uncomplicated. Bender energy meters with MID compliance labelling are suitable for this, as they meet official measurement requirements.



Monitoring and analysis made easy with the browser-based **POWERSCOUT®** software



# POWERSCOUT®

## Find out today what won't happen tomorrow

Moisture, deterioration, dirt, mechanical damage or faults due to the impact of current, voltage and temperature cause malfunctions in every electrical installation. The web-based software solution POWERSCOUT® helps you detect malfunctions at an early stage and eliminate the causes in an economically reasonable way. This guarantees high installation and operational safety and reduces costs.

### **Analysis – as individual as your system– as simple as possible**

Predictive maintenance prevents downtimes, reduces costs and staff deployment. POWERSCOUT® informs you about the condition of your electrical installation at all times, since the meaningful visualisations with flexible dashboards can be retrieved via any display device: smartphone, laptop, computer. On request, POWERSCOUT® sends you graphically processed reports at specified intervals.

### **Continuous monitoring instead of random tests**

Manual data acquisition is time consuming, error prone and only provides random sampling results. POWERSCOUT® gives you an insight into the entire data of your installation at any time, since all measured values are automatically and continuously saved. Your data is stored reliably and remains available for years.

### **Basis for periodic verification**

The automated POWERSCOUT® report on residual currents forms the basis for measuring without switch-off by means of periodic verification. In order to maintain the correct status for electrical installations and stationary electrical equipment, periodic verification must be carried out.

This can be ensured, for example, by means of continuous monitoring of the installation carried out by qualified personnel. In this case, it would be smart to rely on continuous monitoring with multi-channel residual current monitoring systems (RCMS) and an evaluation (CP700) adapted to the system. The automatic POWERSCOUT® reports based on this monitoring enable the qualified person in charge to adjust the time limits for the insulation test within the context of periodic verification.

#### **Analysis**

- Continuously recording insulation values
- Recognising connections and optimising maintenance
- Cross-system evaluation possibilities
- Access from any place
- Supporting investment decisions

#### **Predictive maintenance**

- Higher availability
- Continuous monitoring
- Early detection of gradually developing insulation faults
- Early detection and reporting of short-time insulation degradation
- Less costs incurred due to unexpected malfunctions and shut-downs

#### **Reports**

- Historical comparisons
- Safe storage of measured values
- Event and alarm statistics

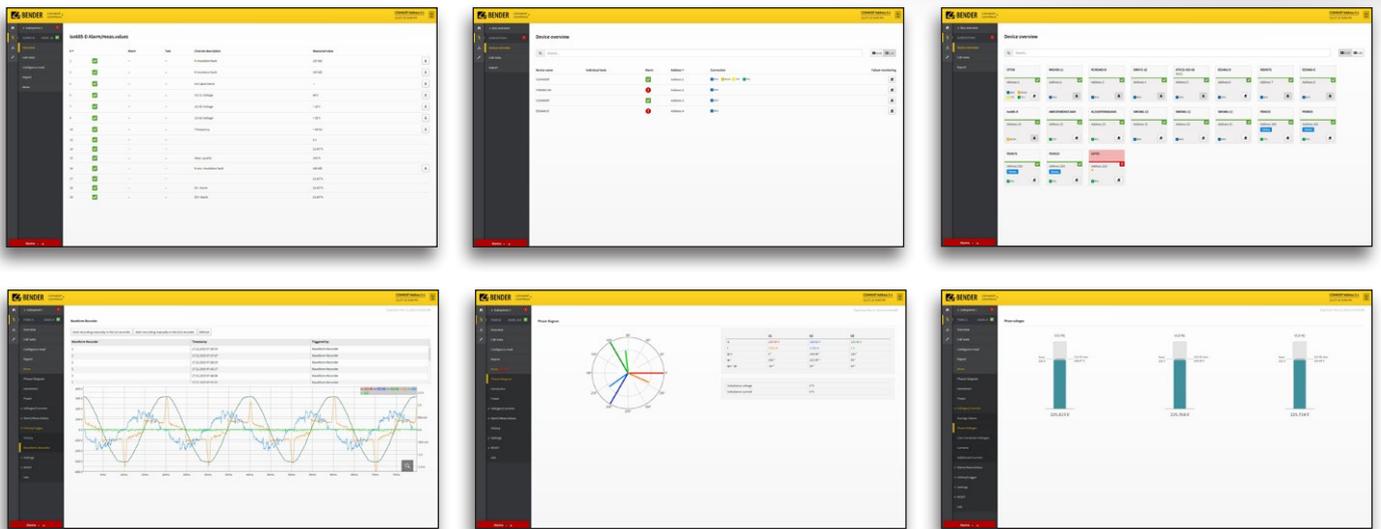
# Visualisation and gateways

## Interconnection and visualisation made easy

The COMTRAXX® monitoring systems are used in a wide range of applications. However, what they have in common is that the user can obtain relevant information in a fast and easy way. In the event of an alarm, the system informs actively via e-mail, switching contacts or by forwarding information to higher-level control systems. To carry out an analysis or create a report, the user accesses data points that were captured previously. The Bender system control centre allows both in one system. Data is collected from all connected measuring devices, evaluated and processed according to the respective application. In doing so, the browser-based concept offers many advantages:

- Remote access to the current measured values, status/alarm messages and parameters via LAN/WAN Internet
- All users work live in a browser-based system
- 10/100 MBit Ethernet gateway for Modbus TCP, Modbus RTU and Profibus DP and support for third-party devices
- Central management
- The system is safe and geared toward the future with expansions

From the entire system overview with integrated visualisation tool to detailed power quality evaluations, the Bender system control centre accompanies the user with intuitive operation and guided support during fault analysis.

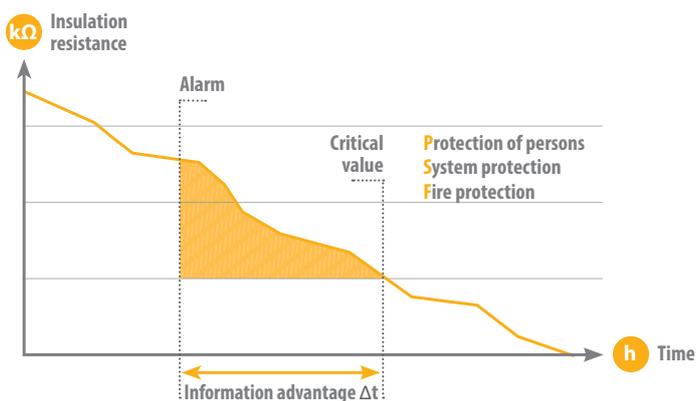


Indication of device data on the web user interface (COM465IP)

# Maintenance

## Data basis for maintenance

Maintenance is one of the focal points in daily railway operations. This encompasses maintenance of railway vehicles, tunnels, signalling equipment and buildings. Bender monitoring devices provide assistance in the monitoring of the electrical power supply. They continuously furnish data about the condition of the installations and are therefore indispensable for preventive and predictive maintenance.



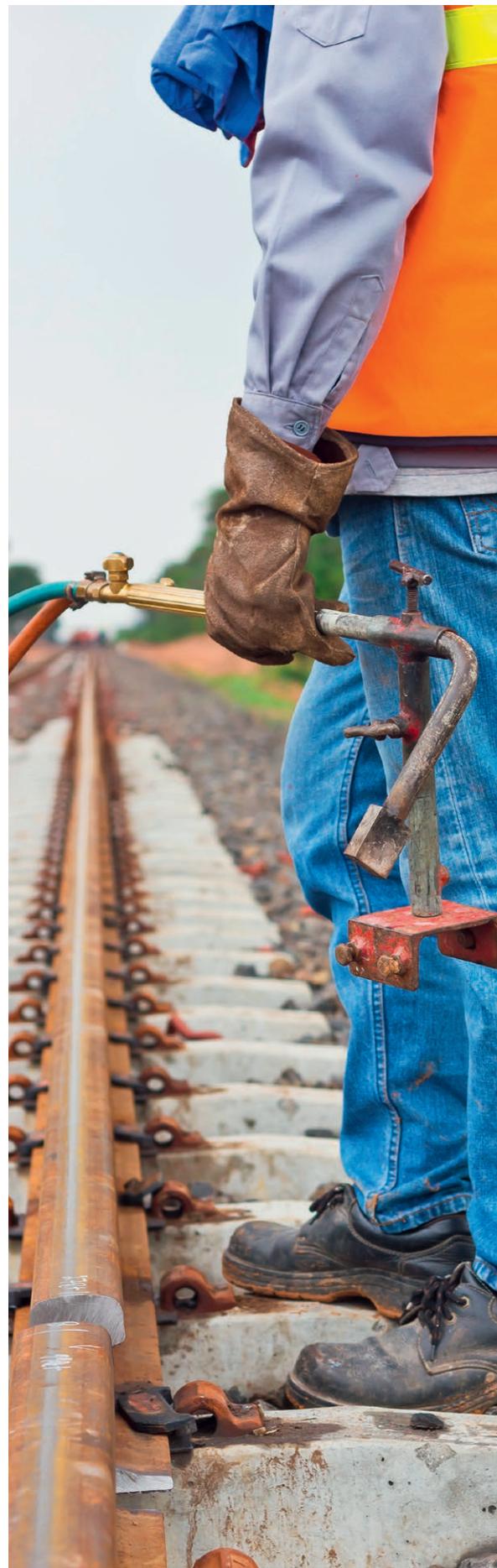
## The aim: reduce costs – increase availability

The aim of every plant operator should be to detect malfunctions at an early stage and eliminate the causes economically in order to achieve optimal system and operational safety and ultimately reduce costs significantly. Only those who are aware of the condition of their system can fulfil the prescribed targets concerning personal, system and fire protection. With Bender monitoring devices, installation operators stay on top of things.

## Avoiding delays

One of the main causes for delays in railway traffic are insulation faults in the cable installation. Bender insulation monitoring devices and insulation fault location systems provide support in the demanding task of maintaining functionality of the cable installation that often spans many kilometres along the railway lines.

In practice, the progress of insulation values over time is often not captured. Bender technology detects slowly decreasing insulation values and uses communication interfaces to enable predictive maintenance and analysis.

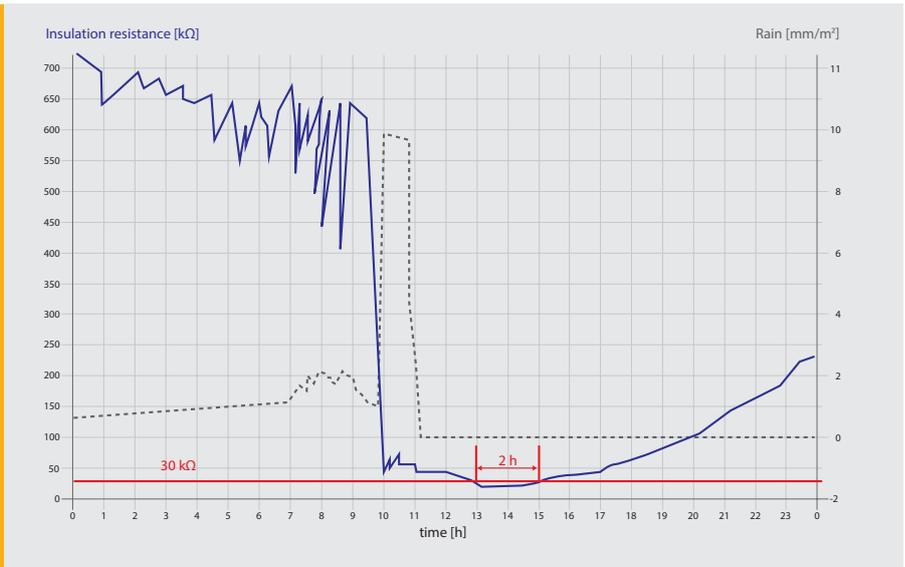


### Interpreting short-time insulation fault messages correctly

Short-time insulation faults are difficult to interpret. If, for example, the insulation value falls below the alarm notification threshold value for only two hours and then rises again to a normal level, the on-site service technicians often do not stand a chance in finding the cause of the fault. Maintenance must then be terminated without fault elimination, and the faulty insulation remains a hazard for the system.

#### The solution:

Via modern communication interfaces and the browser-based POWERSCOUT® software, all measured data is captured to allow correlation to additional events in the system. As an example: comparison of insulation values with weather data. In many cases, rain showers significantly reduce the insulation value of damaged cable installations. Stationary insulation fault location systems are able to identify the affected route section or damaged component already during the impacts of a rain shower.



### Fault location in cable installations made easy

In order to rapidly find insulation faults also in the case of systems with extensive routes, the implementation of stationary insulation fault location systems is preferred. They are able to allocate insulation faults to individual route sections. A further advantage is: Bender fault location systems find insulation faults during ongoing operations, without cable disconnection.

### Insulation fault location in switched-off system areas

It is possible to conduct insulation fault searches in switched-off system areas as well. Current-free but galvanically connected cables, as well as single feeder cables with low currents can be directly enclosed with current clamps or transformers. Bender insulation fault locators generate the measurement signals themselves.

### Proactive fault search

In practice, traditional technology often only detects faults from 0 kΩ to approx. 7 kΩ. Bender offers solutions that can detect faults in a range from 0 kΩ (short circuit to rack or earth) to 100 kΩ. These insulation fault location systems can be implemented in a stationary and/or portable manner and permit proactive fault location by supplying the most important data concerning the condition of the system.

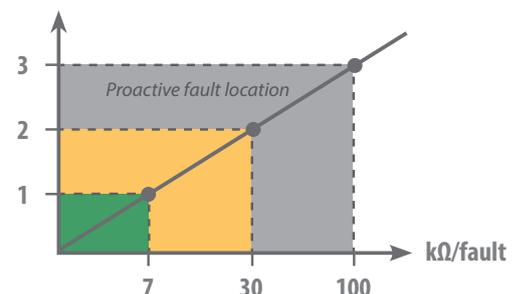
**Good to know:** Stationary solutions for insulation fault location can also be retrofitted. Portable and stationary solutions from Bender comply with IEC 61557-9

### Insulation fault location during ongoing operations

Like stationary equipment, the portable insulation fault location system EDS309x also enables the detection of insulation faults without cable disconnection.



### Complexity in fault location



# Retrofit

## Is your system still state of the art?

Even the most modern electrical systems cannot escape the marks of time. Whether diminishing operational reliability, changed legal stipulations or increasing energy costs: Upgrading to the respective current state of the art is indispensable. Products for monitoring energy quality and fault search are typically retrofitted.

## Risk assessment according to operating safety regulations: Does your presently installed monitoring equipment recognise symmetrical and asymmetrical insulation faults?

Symmetrical and asymmetrical insulation faults present a high risk potential. Bender insulation monitoring devices continuously monitor your systems, insulation faults are captured and reported. Bender insulation monitoring devices comply with IEC 61557-8.

**We will check your electrical installations and provide you with recommendations on how to proceed further.**

## Bender delivers flexible solutions for retrofit projects

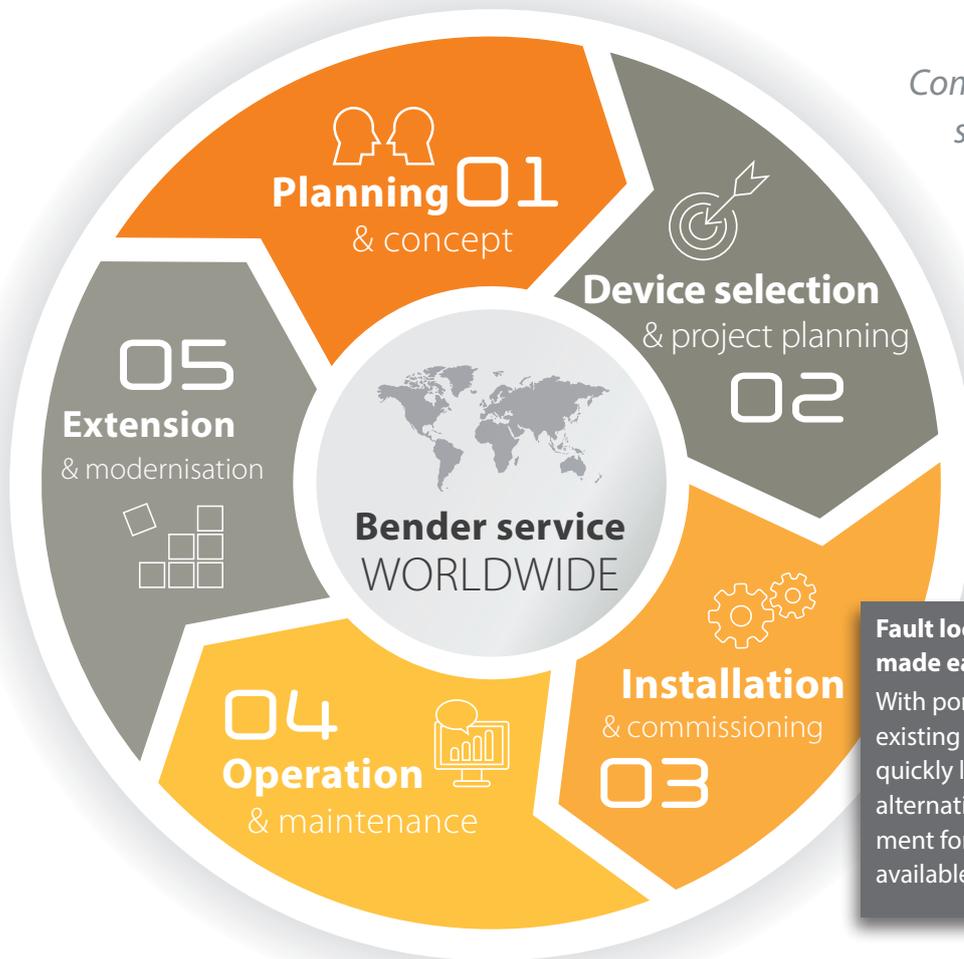
Modern monitoring methods can be integrated in older installations as well – also during ongoing operations. Retrofitting is possible via devices such as divisible transformers, whereby the transformers are not even required to be shut down nor must cable installations be disconnected.

**Successor devices from Bender can conveniently replace older installations. Long-term availability is thus guaranteed.**



# Support during all stages

Comprehensive service for your installation: remote, by phone, on site



*Competent service for maximum safety and high availability of your installation*



### **Fault location – made easy**

With portable fault location systems, existing insulation faults can be quickly located. They are the best alternative if no stationary equipment for insulation fault location is available.

**From planning to modernisation** – Our extensive know-how is at your disposal during all project phases.

**Furthermore, with our first-class service we guarantee maximum safety for your electrical installations.**

We offer services ranging from support over telephone to repairs and on-site service – with modern measuring devices and competent employees.

### **Secure yourself:**

- High availability of your installation thanks to fast reaction to fault messages
- Increased profitability of your capital expenditure (CapEx) via optimised maintenance processes
- Targeted operating expenditure (OpEx) due to less downtimes and shorter service visits
- Support for your prospective system monitoring and regular tests of your system/power quality/monitoring devices
- Automatic control, analysis, correction, new settings/updates
- Competent assistance with setting changes and updates

### **Bender Remote Assist**

Bender Remote Assist offers you support via remote access, high-quality service and advice for your challenging task consisting in ensuring consistent high safety in your systems.

Many service visits, fault clearance but also analyses and controls can be carried out remotely – without the expenses of time and money that an on-site visit of a technician implies.

This fast, efficient help and advice by our expert network allows the highest possible availability of your system.



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