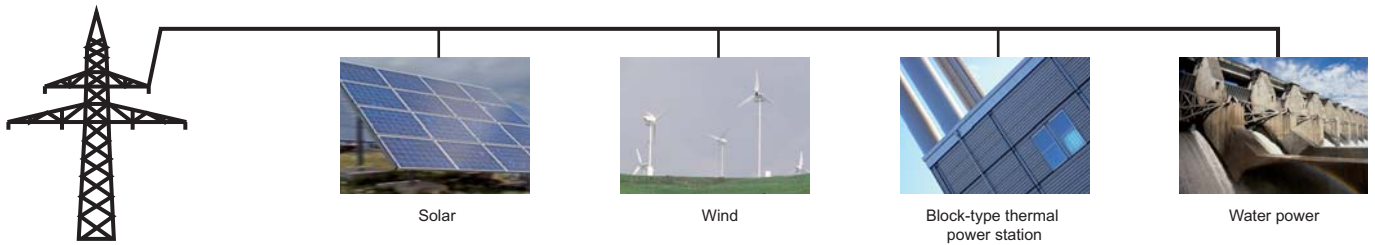


# Renewable energy

## Reliable and efficient use of the power of nature





## Electrical safety for efficient use of renewable energy

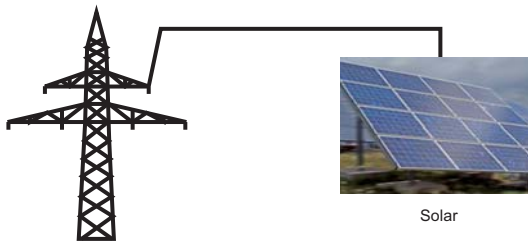
Making efficient and reliable use of natural energy resources, that is the system operator's aim, regardless of whether these are solar, wind, hydro or biogas systems.

Bender offers proven, tried-and-tested and reliable solutions for

- early detection of possible electrical hazards
- guaranteed safety of persons and plants
- immediate recognition of critical operating statuses of electrical installations
- minimisation of failure risks and operational interruptions
- guaranteed high system availability by means of preventive intervention
- efficient system data management.

We would be delighted to see your project through from initial planning and design to modernisation.

Planning & concept	Selection of devices & project scheduling	Commissioning	Operation & maintenance	Expansion & modernisation
<p><b>From support to customised solutions</b></p> <ul style="list-style-type: none"> <li>• Detailed as-is analysis</li> <li>• Technical support for products and systems</li> <li>• Application assistance</li> <li>• Seminars, training and presentations</li> </ul>	<p><b>From the selection of the device to project scheduling</b></p> <ul style="list-style-type: none"> <li>• Selection of the appropriate components and systems</li> <li>• Working out a detailed solution</li> <li>• Assistance in tender invitations and project awarding</li> </ul>	<p><b>From installation to final inspection</b></p> <ul style="list-style-type: none"> <li>• Installation check</li> <li>• Parameter settings and adjustments</li> <li>• Test run and final inspection</li> <li>• Operator instruction/training</li> </ul>	<p><b>From maintenance to repair</b></p> <ul style="list-style-type: none"> <li>• Repair/troubleshooting</li> <li>• Maintenance, repairs, spare parts</li> <li>• Maintenance/repair works</li> </ul>	<p><b>From expansion to modernisation</b></p> <ul style="list-style-type: none"> <li>• Technical advice on the improvement and modernisation</li> <li>• Planning and implementation of retrofitting</li> <li>• Optimisation of installations and installation sections</li> </ul>

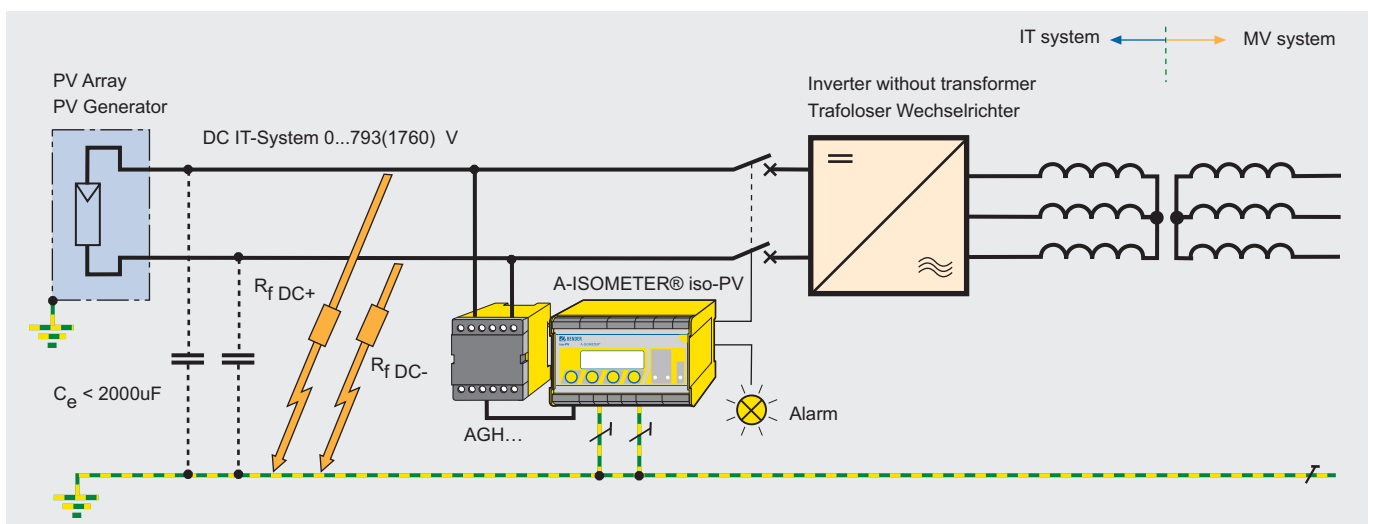


## Unearthed power supply with insulation monitoring for high availability of photovoltaic systems

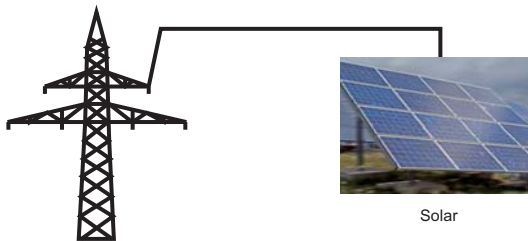
Making efficient use of the sun – that is the goal of each operator of a photovoltaic system. However, the high productivity of a photovoltaic system is always linked with the desire to avoid a shutdown at the first insulation fault while nevertheless guaranteeing the necessary safety. For this reason the IT system with insulation monitoring according to IEC 60364-4-41:2005-12 and IEC 60364-7-712:2002 is used. The required safety is provided by the series A-ISOMETER® iso-PV. This early warning system provides the necessary information well in advance before operational interruption occurs.

### Why unearthed photovoltaic systems?

- No operational interruption on the occurrence of a first insulation fault
- High standard of protection against fire
- Early detection and signalling of developing insulation faults
- Enhanced personal safety
- Only direct current at PV modules without an AC ripple
- The PV system is kept at a high level of availability
- Insulation fault location during operation of the photovoltaic system
- Costs for time and personnel can be drastically reduced
- Localisation of insulation faults toward the photovoltaic module



Principle of an unearthed photovoltaic system with insulation monitoring



## Early detection of insulation faults using an A-ISOMETER® iso-PV

### Photovoltaic systems with transformerless inverters

DIN V VDE V 0126-1-1:2006-01 specifies that in these plants the insulation resistance value  $R_{iso}$  must not be lower than  $\geq 1 \text{ k}\Omega/\text{V}$  (min. 500 k $\Omega$ ) **before** the system is connected to the mains. Therefore, the A-ISOMETER® measures the insulation resistance before the system is connected to the mains and provides a release signal.

### Photovoltaic systems with galvanic isolation

Photovoltaic systems galvanically isolated from the public grid resp. from earth are defined as an unearthed system (IT system) according to IEC 60364-4-41:2005-12 and IEC 60364-7-712:2002.

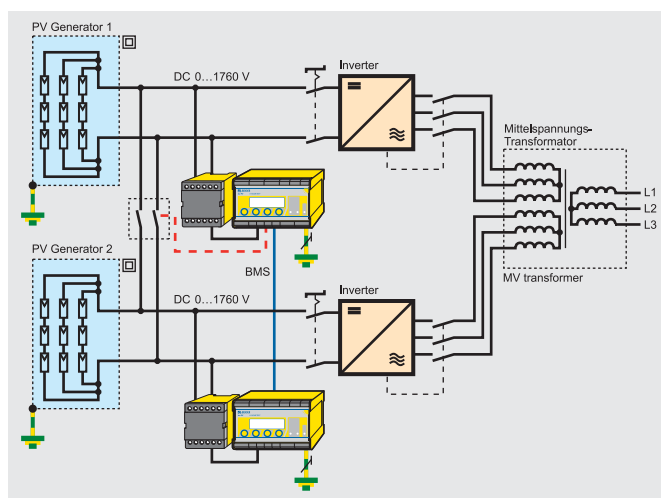
In contrast to the application above, the insulation resistance is continuously monitored during operation by an A-ISOMETER®.

### Your advantages

- High level of efficiency of the photovoltaic system through the whole service life
- Unexpected maintenance measures are avoided
- Optimised deployment of personnel and planning of time resources

### A-ISOMETER® iso-PV

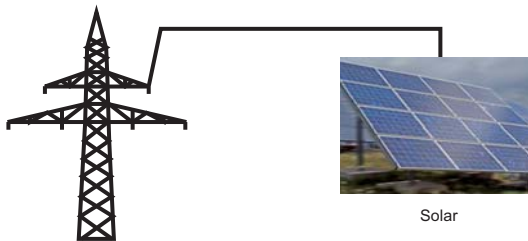
- Precise measurement of the insulation resistance by patented measuring procedure
- Optimum adaptation to modern photovoltaic systems (presetting for PV systems)
- Easy coupling of several IT systems in large-scale photovoltaic systems



Example of insulation monitoring of a photovoltaic system with two converters



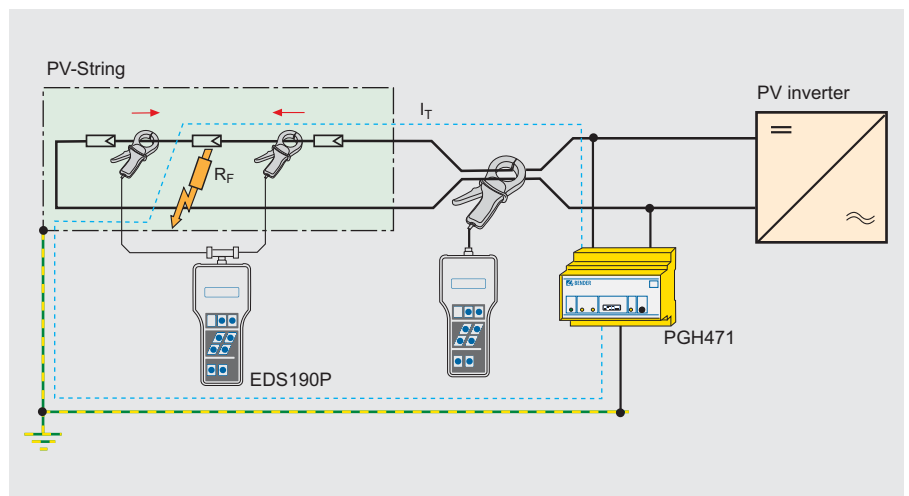
A-ISOMETER® iso-PV



## Increasing the productivity of photovoltaic systems by fast localisation of insulation faults

Insulation fault location in expanded photovoltaic systems is a time-consuming and costly affair. Insulation faults in unearthed power supplies can be localised reliably using the portable or permanently installed EDS insulation fault location system.

The EDS system will pay for itself within a relatively short period by drastically reduced maintenance costs and by avoiding unnecessary costs in case of operational interruptions.



Principle of manual insulation fault location in a photovoltaic string

### Your advantages

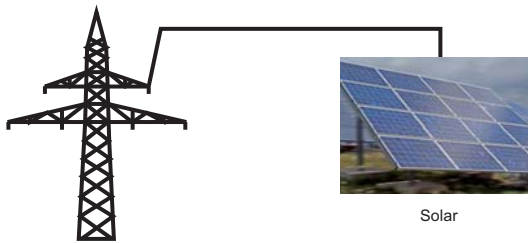
- Precise fault location within a relatively short period
- Significantly lower outlays in terms of personnel and time
- Modular system concept for optimal adaptation to the electrical installation
- Optional automatic or manual fault location



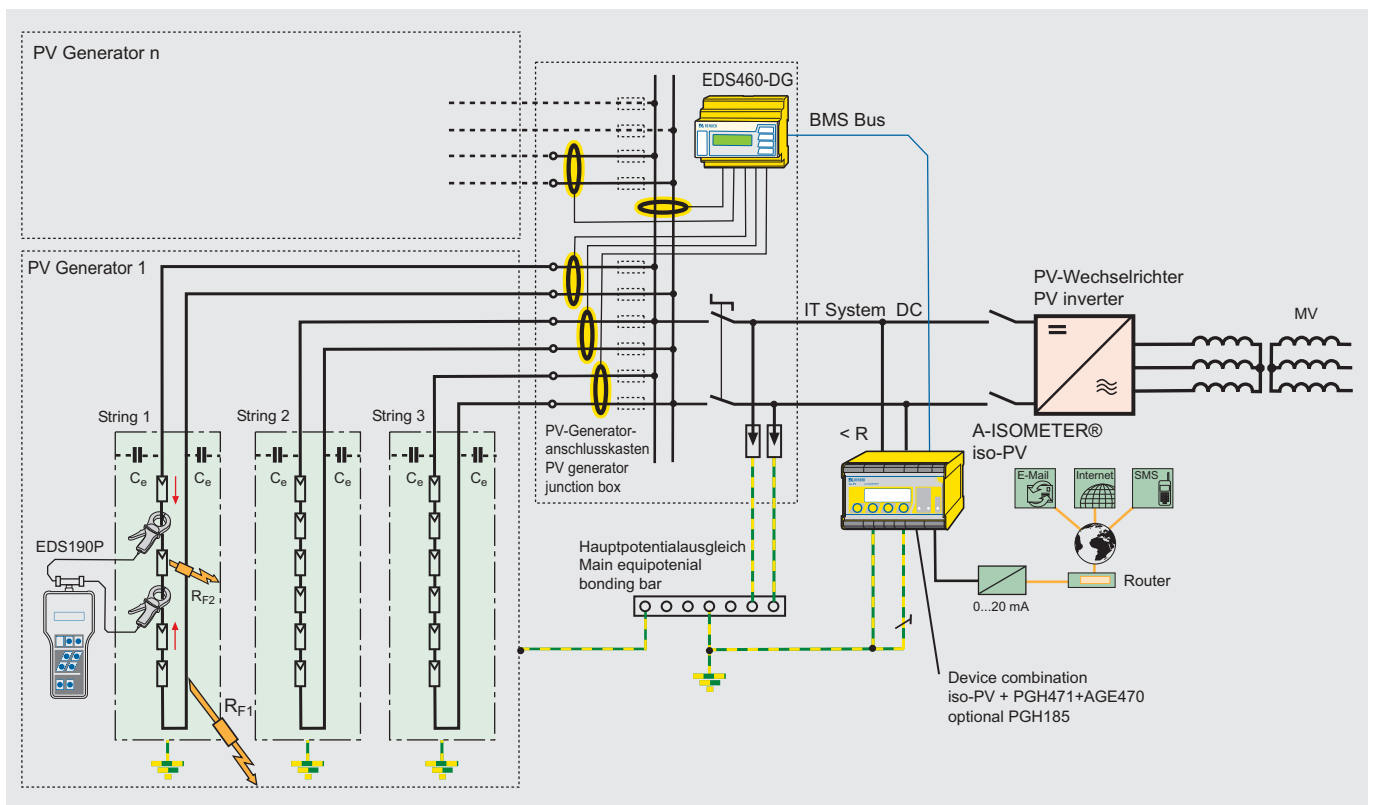
EDS460-DG Insulation fault evaluator for automatic insulation fault location



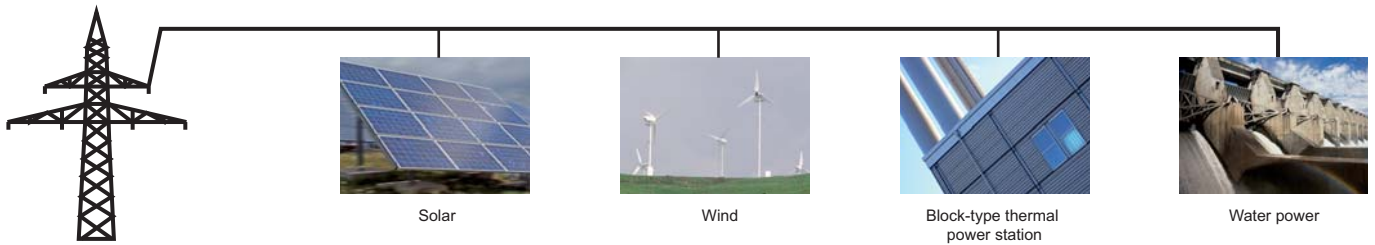
Portable insulation fault location system EDS3090PG



## Electrical safety in photovoltaic systems



Principle of a photovoltaic system with insulation monitoring and manual/automatic insulation fault location



## Safe connection to the distribution system – Monitoring relay VMD423

When a decentralised power station is connected to the public grid there is no room for compromise, since safe operation must be guaranteed at any time. Normally, the system's operator is not able to influence the control process of the decentralised power station. Therefore a monitoring system is required to guarantee reliable decoupling. If, for example, the public grid is disconnected for the purpose of maintenance works, the disconnecting point will prevent that the incoming supply represents a risk to the maintenance staff.

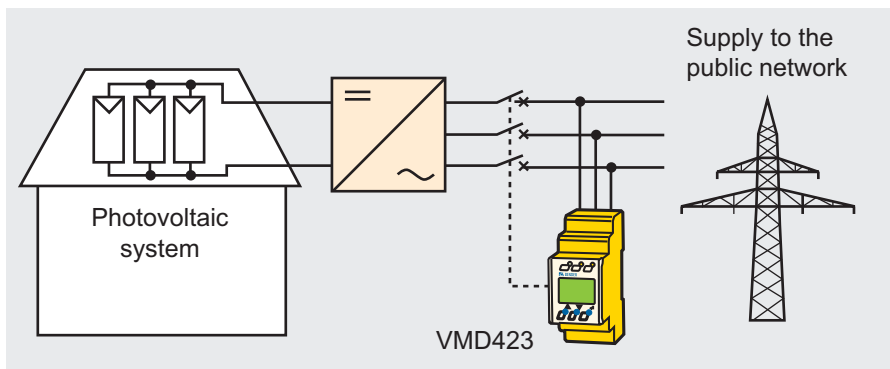
The appropriate monitoring are provided by VMD423 voltage and monitoring relays. In compliance with the requirements of DIN V VDE V 0126-1-1, the relays will activate the automatic disconnection device within  $\leq 80$  ms, if the voltage and frequency values are outside the permissible measuring range (according to VDEW). The alarm relay is also activated if, over a period of ten minutes, the average value measured is an overvoltage.



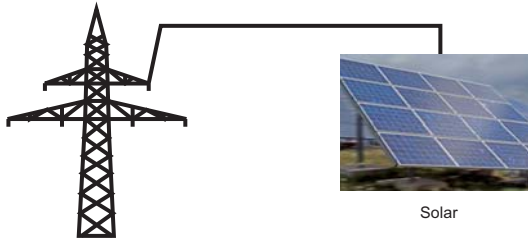
Monitoring relays VMD423

### Essential device features

- Certificate of non objection for Germany, France, Czech Republic and Belgium
- Preset response values allow fast commissioning
- Adaptable to meet all the requirements of utilities
- Continuous measured value display via large LCDs
- Continuous undervoltage, overvoltage, underfrequency and overfrequency monitoring
- Monitoring the overvoltage as an average value for each current ten minute sampling interval
- Measured value memory for operating value
- Cyclical self monitoring
- The VMD423 is also suited for medium voltage application



Block diagram for continuous voltage and frequency monitoring



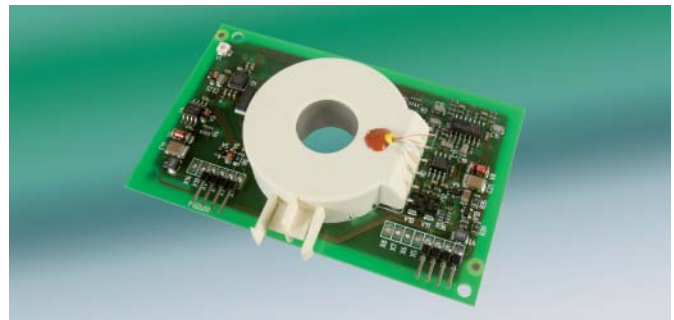
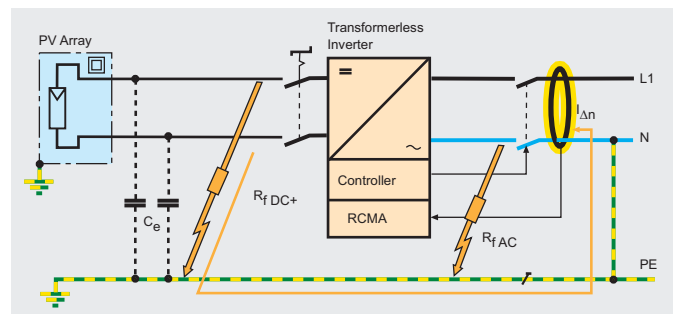
## Having fault currents under control at all times – Inverters used in earthed systems

DIN V VDE V 0126-1-1 (VDE 0126-1-1):2006-02 specifies that inverters without galvanical isolation used in photovoltaic systems are to be equipped with a fault current monitoring device (RCMA). The RCMA126 / RCMB100 residual current monitoring module fulfills the requirements with respect to the switching device integrated in the inverter, hence ensuring a safe and standard-compliant operation.

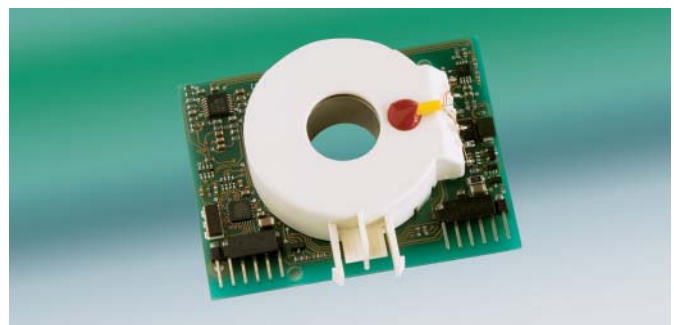
Residual current monitoring is carried out using an internal measuring current transformer. The r.m.s. value is calculated by summing up the DC components included in the residual current and the AC components that are below the cut-off frequency. A signal in proportion to the residual current is provided at the module output (X1). Then this output signal can be used to activate the switching device.

### Technical features

- AC/DC sensitive residual current measurement 0...100 mA
- Frequency range 0...500 Hz
- Monitoring of the connection to the measuring current transformer
- Various output options



Residual current monitoring module RCMB100



Residual current monitoring module RCMA126P1-S



**Dipl.-Ing. W. Bender GmbH & Co. KG**

P.O.Box 1161 • 35301 Grünberg • Germany

Londorfer Straße 65 • 35305 Grünberg • Germany

Tel.: +49 6401 807-0 • Fax: +49 6401 807-259

E-Mail: info@bender-de.com • www.bender-de.com

**BENDER Group**