OMICRON

Diagnostic testing for grounding systems

Know the condition of your grounding system

Why measure?

Grounding systems are essential for the safe and reliable operation of electrical power systems. In the event of a ground fault, improperly designed or deteriorated grounding systems can have a major impact on:

Safety

The ground potential rise due to the fault can cause hazardous step & touch voltages in and around the grounding system.

Primary assets

Derogated grounding systems may not be able to carry the full fault currents and thus may cause additional damage to primary assets like transformers.

Secondary assets

Resulting potential differences could also impair the function of electronic devices like protection relays and communication equipment or even destroy them.

When to measure?

During planning

Soil Resistivity measurements provide valuable data for designing a proper grounding system.

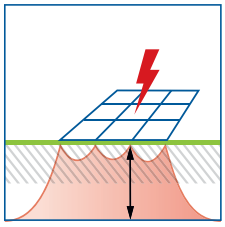
During commissioning

Measurements can be used to ensure that the grounding system fulfills all technical, legal, and normative requirements.

During maintenance

Grounding systems are subject to deterioration over time. Periodic measurements allow you to check if the grounding system is still in sound condition.

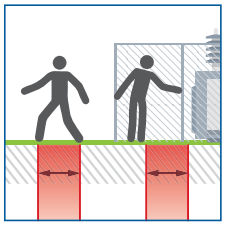
COMPANO 100 is ideally suited for such small medium voltage substations.



Ground impedance

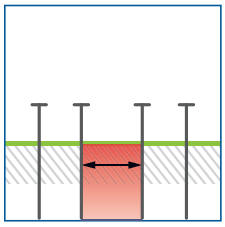
Ground impedance is the quality of the connection between the grounding system and its surrounding soil. An increased value is an indication of deterioration.

In the event of a fault, the fault current and the ground impedance lead to a so-called Ground or Earth Potential Rise (GPR, EPR).



Step- and touch voltage

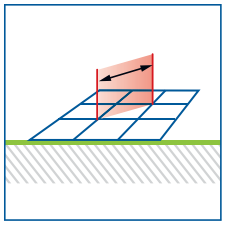
Step- and touch voltages are caused by potential differences in the substation or by being too close to the grounding system when a fault occurs on a power line or within the power system. The measurement verifies that no critical potential differences for the human body have occurred.



Soil resistivity

The electric soil resistivity test (SRT) is performed before the construction of a grounding system. The soil's electric resistivity is required for designing a grounding grid that meets all safety and functional criteria.

The Werner or Schlumberger method are most often used.



Ground grid integrity

The ground grid needs to be able to reliably conduct the full fault current. A resistance measurement with high current can be used to check the ampacity between different parts of the systems, like raisers, grounding points, etc.

Improper construction work and deterioration can be detected with this method.

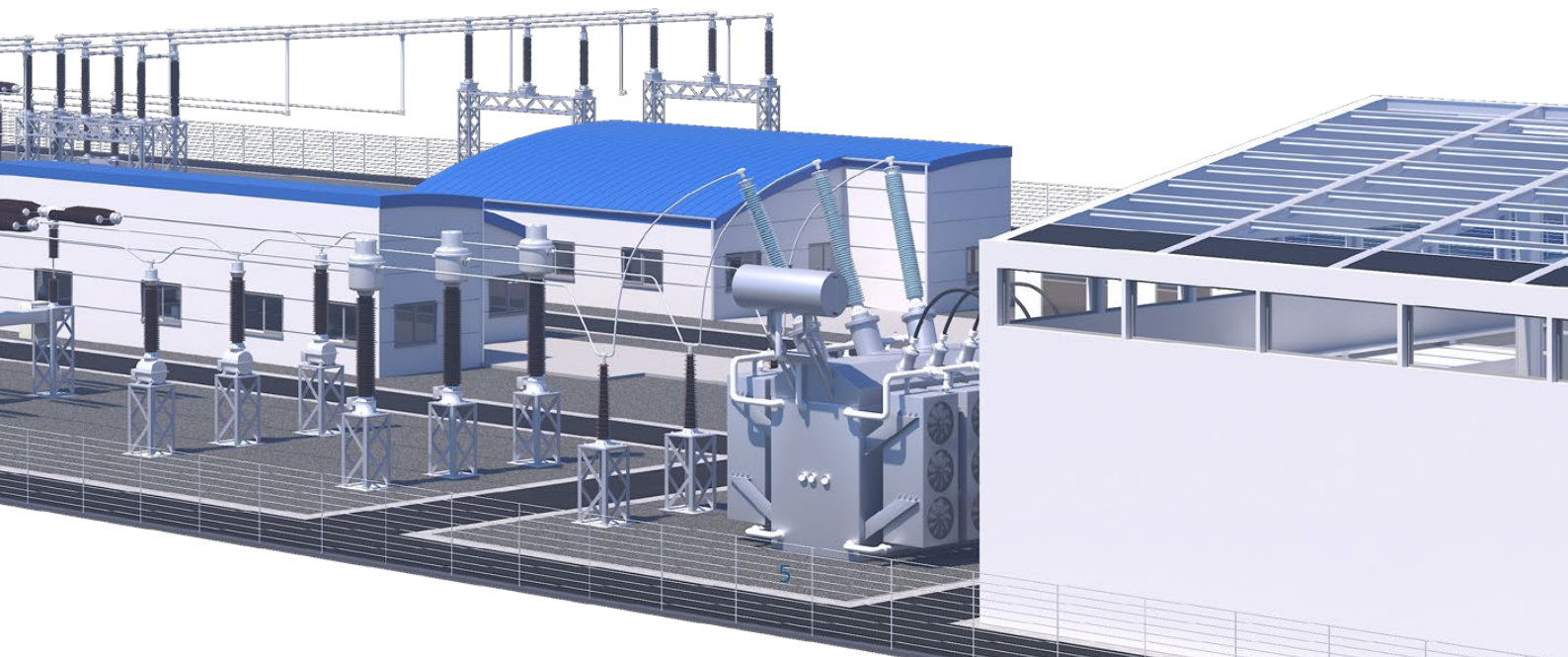
The ideal solution for your grounding systems

		CPC 100 + CP CU1 + HGT1
	Recommended grounding system size	All
	Supported injection method	Via power line
Possible measurements methods	Ground impedance measurement	CPC 100 + HGT1 + PTM
	Step & touch voltage measurement	
	Soil resistivity test	
	Ground grid continuity test	

Multifunctional test set for impedance and step & touch voltages measurement s for large grounding grids via power line injection.

CPC 100 is ideally suited for large substations

CPC 100 + HGT1	CPC 100	COMPANO 100 + HGT1	COMPANO 100
Grounding systems smaller than 30 m x 30 m (100 ft x 100 ft)			
Via current probe			
(PTM for HGT1 + Sequencer test card)	CPC 100 (RGround test card)	COMPANO 100 + HGT1 (Grounding system application modules) (optinal PTM for HGT1)	COMPANO 100 (Grounding system application modules)
	-		-
CPC 100 (RGround test card (On-Device) or PTM Quick)		COMPANO 100 (Grounding system application moduls)	
CPC 100 (Resistance test card)		COMPANO 100 (Micro-Ohm application module)	
Multifunctional test set for condition diagnosis of ground systems via current probe injection. Supports additional step & touch voltage measurements.	Multifunctional test set for a comprehensive condition diagnosis and condition assessment of multiple high-voltage assets including grounding systems.	Portable battery-operated primary and secondary injection and basic protection test set. Supports additional step & touch voltage measurements.	Portable battery-operated primary and secondary injection and basic protection test set. Supports Ground Impedance, Soil Resistivity and Continuity measurements.
			



Test current injection for ground impedance and step- and touch vol

What can be tested?

- ✓ Ground impedance
- ✓ Step- an touch voltages
- Soil resistivity
- Ground grid continuity

How does it work?

The CPC 100 and COMPANO 100 use the so-called Frequency Selective Method (FSM) to inject a test current into the grounding system. Frequency selective measurements are carried out on the resulting voltages and currents to reliably suppress interferences and disturbance voltages. This provides very reliable results, even when it comes to small test currents.

The test current can be injected in two different ways:

Power line injection

Uses a disconnected power line to inject the test current via a remote grounding system.

- > Makes test setup easier for large grounding systems, like transmission substations.
- > No long injection lead or current probe required. No interference with public.
- > Reflects real-world current distribution and therefore provides very accurate results.
- > Makes line impedance measurement with the same setup possible.

Current probe injection

Uses an auxiliary current probe to inject the test current.

- > Makes test setup easier for small grounding systems, like transmission towers or small distribution substations.
- > No power line required

CPC 100 & COMPANO 100 comparison

	CPC 100	**COMPANO 100**
Signal strength	CP CU1 Power line injection 100A @ max. 50V 10A @ max. 500V CPC 100 Current probe injection 3A @ max. 150V	Current probe injection 200 mA @ max. 150V
Battery operated	No	Yes: Ideal for testing at locations without mains power or generator.
Weight	29 kg/ 64 lbs	9.9 kg/ 22 lbs

Good to know ...

Results from the frequency-selective measurements with CPC 100 and COMPANO 100 are automatically interpolated to the mains frequency.

Ground grids are often larger than assumed. Especially in urban environments, interconnected elements like grounding systems in buildings, fences, water pipes, etc., can form a so-called global grounding system. Such systems can be tested using power line injection.

Depending on the standard being used, the test current injection should be at a distance of approx. 5 times the grounding grid's diameter or more.

Ground wires from overhead lines or cable sheaths can take over part of the earth current if a fault occurs. The extend is described by so-called reduction factor. This must also be considered for the test current injection, depending on the concrete measurement task.

Why use CPC 100 + CP CU1 + HGT1?

- Optimal for large grounding systems
- Makes very accurate measurements possible when using power line injection
- Reflects real fault conditions
- Frequency selective method has lightweight design compared with conventional methods

Why use CPC 100 + HGT1?

- Optimal if no power line is available
- Optimal for small grounding systems

Why use COMPANO 100?

- Optimal for small grounding systems
- Lightweight and battery-powered
- On-device visualization of test results

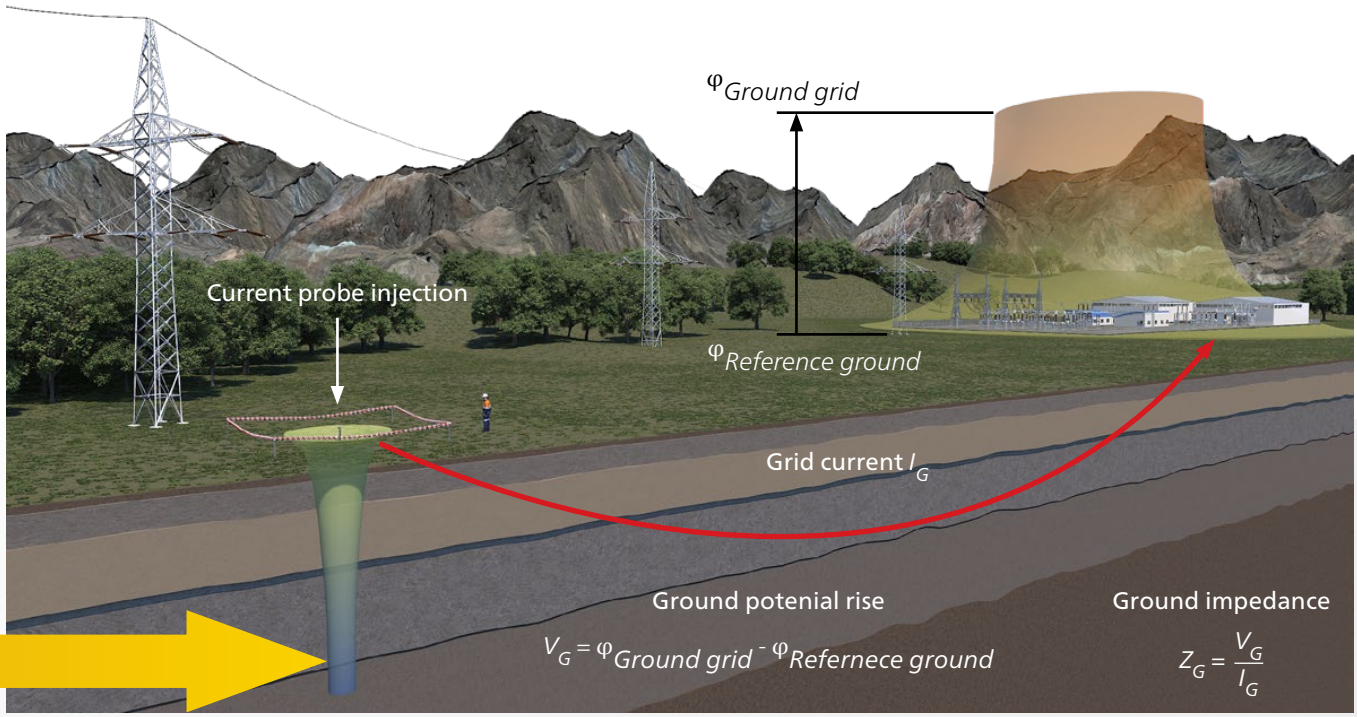


Illustration of current probe injection and ground potential rise

Ground impedance

Our solutions ...

CPC 100 and COMPANO 100 provide a lightweight and modular solution for obtaining accurate ground impedance measurements in medium and high voltage systems.

Our support of power line injection and current probes offers users a flexible way of adapting to on-site testing conditions.

With CPC 100, users can choose between on-device operation or testing via the Primary Test Manager™ (PTM).

With CPC 100, direct voltage measurements on the device are possible, whereas with PTM, the voltage pickup is performed with our mobile handheld meter HGT1.

COMPANO 100 grounding measurements follow a guided workflow. The clear instructions and the graphical representation are unique in this field, making these measurements easier than ever before.

As a battery-operated device, COMPANO 100 is ideal for determining ground impedance in remote areas, where the availability of mains power is a concern. An integrated reduction factor calculation makes a direct on-device evaluation of measurement results possible.

How does it work?

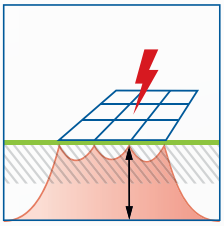
For the ground impedance measurement according to EN 50522 and IEEE 80/81 the voltage between the ground system and the and reference ground needs to be measured.

This can be done with a single measurement at a sufficient distance, as e.g. described in IEEE 80/81, or by a series of measurements at different distances until the reference ground is reached.

This method is called the Fall-of-potential method (FOP), described in EN 50522 and IEEE 80/81 and provides more reliable results.

On GPS enabled devices, our companion app PTMate allows users to share the GPS coordinates with PTM for directly documenting the position of the measurement locations.

With PTM, maps can be retrieved directly from online map services or individual pictures can be uploaded to create comprehensive documentation.



Good to know ...

With variable frequency injection, avoiding and suppressing interferences at mains frequency, CPC 100 and COMPANO 100 provide a small, lightweight and transportable solution for current injection.

With the integrated FFT-view, direct feedback about the measurement is provided.

Currents measured during the reduction factor measurement, should be similar in all phases. Deviations in the results might indicate contact problems (e.g. aged grounding switch).

For power line injection, the CP GB1 grounding box protects users in case of unexpected events in the power line via diverging fault currents up to 30kA against earth potential.

CPC 100 & COMPANO 100 can be extended with the SAA2 safety accessory. It supports users with visual and acoustic signaling during ongoing testing activities and improves their ability to mark the work- and high-voltage area.

Why use CPC 100 + CP CU1?

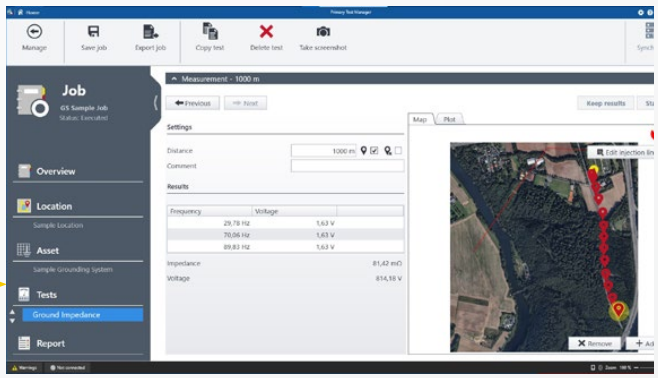
- Covers multifunctional testing requirements
- High power injection for long lines & cables
- Operates with CP GB1 & SAA2 safely
- Measurements include phase-angles

Why use COMPANO 100 ?

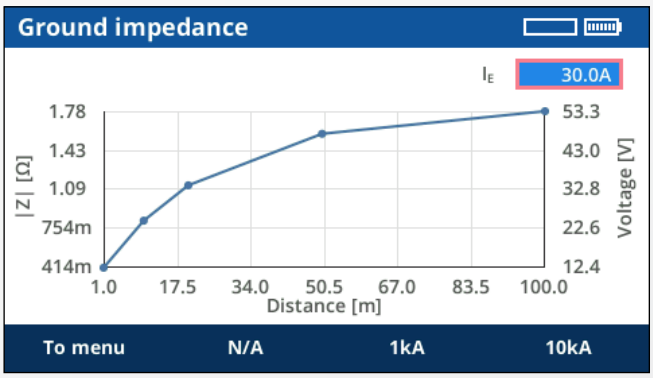
- Ideally suited for remote environments
- Integrated calculation for the reduction factor
- Lightweight & mobile solution for transmission towers and small medium voltage substations

Why use PTM + HGT1 ?

- High sensitivity down to µV-range
- Automatically records measured values
- Automatically detects injection for faster test workflow in the field



CPC 100: Ground impedance measurement with PTM



COMPANO 100: Measurement result

Step- and touch voltage

Our solution ...

The HGT1 is a handheld, battery-powered voltmeter with an integrated FFT-based spectrum analyzer.

Electronically configurable integrated resistors allow users to simulate the human body's impedance.

It provides a wide dynamic range combined with high sensitivity, which even allows users to measure very small voltages and distinguish them from interferences and disturbances with reliability.

How does it work?

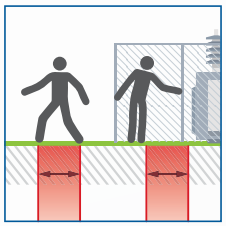
The HGT1 acts as voltage meter by picking up resulting voltages from the current injection.

The injection path is the same as it is for the ground impedance measurement.

Measurements for potential critical points are performed within the grounding grid of a substation to ensure that the grounding system is still in sound condition.

Additionally, when it comes to measurements near the substation, it's necessary to check if transferred potentials pose any danger.

All measurements can be assessed according to the limits allowed by EN 50522 and IEEE 80/81.



Good to know:

Usually, step and touch voltages are measured at a distance of 1 m. If hand-to-hand contact is likely or persons are lying on the grass, like they are leisure zones, a distance of 2 m is used for the measurements.

The highest touch potentials usually occur on the outside of fences without proper potential grounding or on nearby metallic structures like streetlights or traffic signs due to transferred potentials.

Whereas the grounding system under test is often well maintained, nearby connected grounding systems may deteriorate and can have a significant impact on the ground impedance and step & touch voltages.

Measurements should be repeated in case of structural changes. Such changes in the vicinity of the grounding system often happen without the knowledge of the operator. Periodic measurements can help detect such changes.

Why use HGT1?

- Frequency selective measurement (FSM)
- Shows relevant frequency spectrum, including interferences and disturbances.
- Switchable input impedances conforming EN and IEEE requirements.
- Can be used with PTM or without as results can be saved internally.

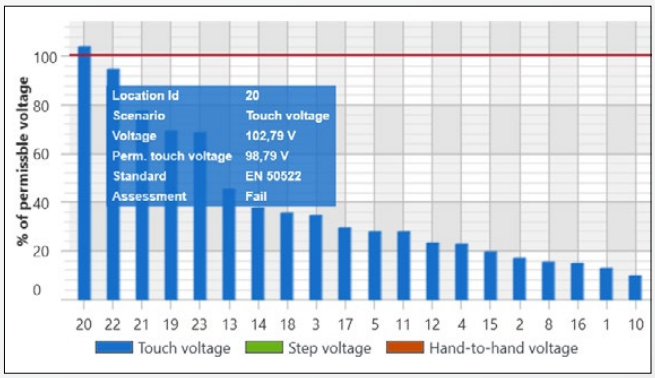
Why use PTM?

- Convenient measurement preparation at the office
- Integrated assessment according to EN 50522 and IEEE 80/81 based on fault clearance times and fault currents
- Integrated database for preparing & storing measurements
- Supports PTMate on iOS and Android
- One-click reports

Why use PTMate

- Photo documentation by sending images directly to PTM
- Allows you to use integrated GPS for entering the direct data of measurement points

Step- and touch voltage measurement with the handheld meter HGT1



PTM step- and touch voltage table with assessment

Soil resistivity & Ground grid continuity

What can be tested?

- Ground impedance
- Step- and touch voltages
- ✓ Soil resistivity
- ✓ Ground grid continuity

Our Solutions ...

Depending on the testing situation, the high-powered CPC 100 or the mobile COMPANO 100 will meet your requirements.

How does it work? - Soil resistivity

Soil resistivity data is essential for dimensioning a grounding system correctly before construction. It will usually be measured by injecting current between two current probes to measure the generated potential difference using two voltage probes. Multiple measurements with probes at unequal distances make measuring the soil resistivity at different depths possible.

Supported methods:

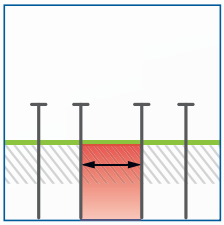
> Wenner Method – Equal probe distances

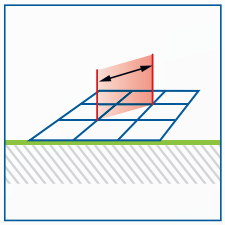
> Schlumberger Method - Unequal probe distances

Good to know ...

With the Schlumberger method, it's easier to measure the soil resistivity at different depths, as only two probes must be relocated for each measurement.

As a rule of thumb, a measurement has the highest sensitivity at a depth of about half the distance between the two inner probes.





How does it work? - Ground grid continuity

A sufficiently large cross-section of a grounding system's components must be able to handle very high currents that occur during a fault or lightning strike.

The high electromagnetic forces that result from them can cause mechanical damage in the components and the joints between them.

Testing the resistance between different parts of the grounding system allows users to detect such damage and deterioration effects.

Good to know ...

High test currents of 50 A and above help to identify even small changes in the resistance between the different parts of the grounding systems. Thus, damage can be detected, which would not be noticeable with small test currents produced by regular low voltage grounding test sets.

Why use CPC 100 ?

- Continuity checks for high currents up to 400 A DC.
- High currents and long output durations allow users to also test thermal effects.
- Very high output power makes tests with high currents possible, even when long cables are needed.

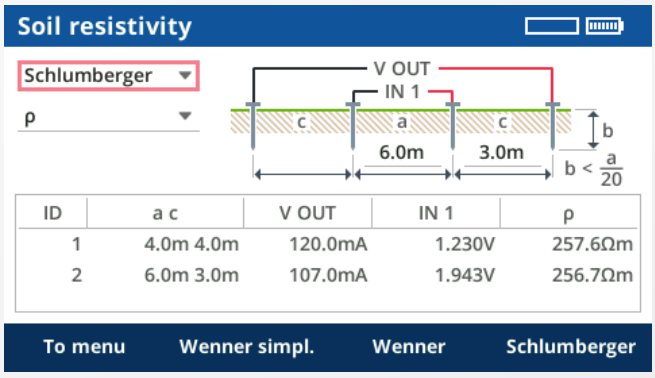
Why use COMPANO 100 ?

- Lightweight, battery-powered, yet power-full solution.
- Soil resistivity application module with graphical representation.
- Continuity checks for high currents up to 100 A DC.
- High output power makes continuity tests with high current and long cables possible, e.g. for railway or wind turbine applications.

	CPC 100	COMPANO 100
Current	up to 400 A DC	up to 100 A DC
Output power	2600 W (< 2min, 400 A), 1300 VA (> 2h, 200 A)	600 W
Output duration	2 min (400 A), >2h (200 A)	Single measurement (<2.2s)
Accuracy (typ.)*	< 0.5% rd. + 0.5 µΩ	

* see datasheet for detailed specification.

Soil resistivity measurement



COMPANO 100: Direct calculation of the soil resistivity using the Wenner or Schlumberger method.

We create customer value through ...

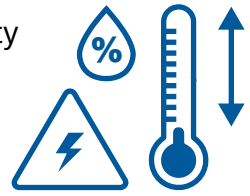
Quality

You can rely on the highest safety and security standards

Superior reliability with up to

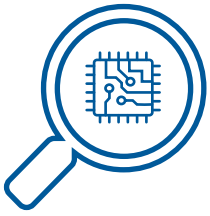
72

hours burn-in tests before delivery



100%

routine testing for all test set components



ISO 9001
TÜV & EMAS
ISO 14001
OHSAS 18001

Compliance with international standards

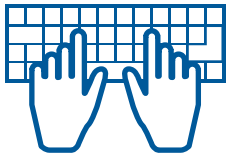
Innovation

... a product portfolio tailored to my needs

More than

200

developers keep our solutions up-to-date



More than

15%

of our annual sales is reinvested in research and development

Save up to

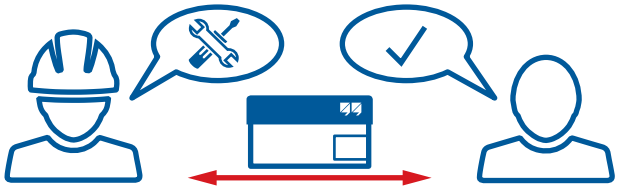
70%

testing time through templates, and automation

Support

Professional technical support at any time

Loaner devices help to reduce downtime



Cost-effective and straight-forward repair and calibration

offices worldwide for local contact and support

Knowledge

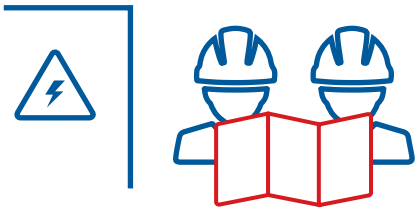
More than

300

Academy and numerous hands-on trainings per year

Frequently OMICRON hosted user meetings, seminars and conferences

to thousands of technical papers and application notes



Extensive expertise in consulting, testing and diagnostics

OMICRON is an international company that works passionately on ideas for making electric power systems safe and reliable. Our pioneering solutions are designed to meet our industry's current and future challenges. We always go the extra mile to empower our customers: we react to their needs, provide extraordinary local support, and share our expertise.

Within the OMICRON group, we research and develop innovative technologies for all fields in electric power systems. When it comes to electrical testing for medium- and high-voltage equipment, protection testing, digital substation testing solutions, and cybersecurity solutions, customers all over the world trust in the accuracy, speed, and quality of our user-friendly solutions.

Founded in 1984, OMICRON draws on their decades of profound expertise in the field of electric power engineering. A dedicated team of more than 900 employees provides solutions with 24/7 support at 25 locations worldwide and serves customers in more than 160 countries.

For more information, additional literature, and detailed contact information of our worldwide offices please visit our website.

www.omicronenergy.com

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