VOTANO 100

Voltage transformer testing, calibration and assessment

Sophisticated testing of inductive and capacitive voltage transformers

VOTANO 100 at a glance:

VOTANO 100 is the first portable device (15 kg/33 lbs) which offers highly accurate voltage transformer tests. This allows to use VOTANO 100 not only for electrical performance checks, but also for class verification and calibration.

It performs quick tests of all kinds of inductive voltage* transformers (VTs) and capacitive voltage transformers (CVTs) for both protection and metering purposes.

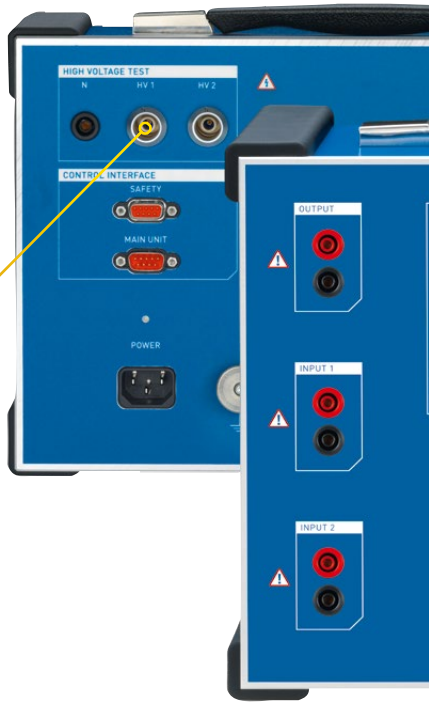
Its lightweight design makes it ideal for on-site tests and calibration tasks in power system grids. As a manufacturer or testing lab you can use VOTANO 100 in your production facilities and test/development labs.

VOTANO 100 is supplied with the separate voltage booster VBO2. This 4 kV amplifier provides the necessary test voltage during the ratio measurement. Its integrated switchbox automatically switches between the necessary test sequences.

How VOTANO 100 works

- Uses a well-established, model-based testing method
- The method can be compared to that used by OMICRON's CT Analyzer
- Injects low test signals into the secondary side of a VT/CVT
- Determines a VT's/CVT's equivalent circuit parameters
- Identifies all relevant VT/CVT performance parameters
- Displays all relevant VT/CVT parameters and its accuracy at different currents and burdens and with loaded and unloaded secondary windings
- Evaluates the VT/CVT according to the selected standard

RELIABLE
high accuracy
and reproducability



* In some countries, inductive voltage transformers (VTs) may also be referred to as potential transformers (PTs). This document will use the term voltage transformer.

Features for voltage transformer testing (VT/CVT)

- Check the electrical performance of VTs and CVTs
- Check the condition of VTs and CVTs
- Basic condition assessment for CVTs
- Tests such as ratio, phase, polarity, capacitive ratio

Features for voltage transformer accuracy verification and calibration (VT/CVT)

- Check the electrical performance of VTs and CVTs
- Check the condition of VTs and CVTs
- Basic condition assessment for CVTs
- Tests such as ratio, phase, polarity, capacitive ratio
- Verify accuracy class according to IEC, IEEE
- Test of VTs/CVTs up to rated voltages and voltage factors up to 1.9
- Automatic class assessment
- Accuracy classes up to 0.1 for VTs and 0.2 for CVTs

FAST
short test duration

PORTABLE
low weight
small size

Accuracy and mobility for on-site VT/CVT testing

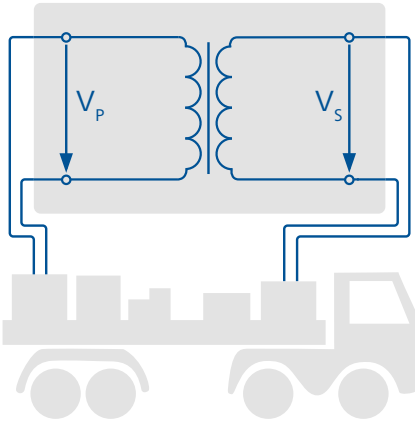
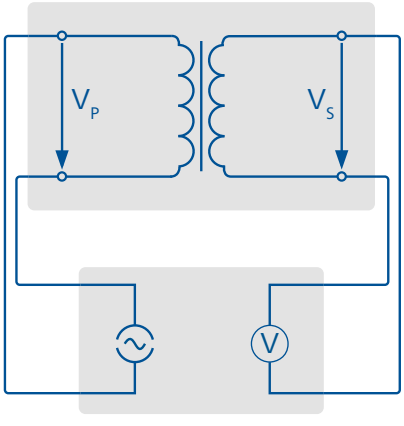
Characteristics for the ideal on-site VT/CVT testing device

> Safety: The dangerous part of the test taking place under high voltages should be kept as short as possible.

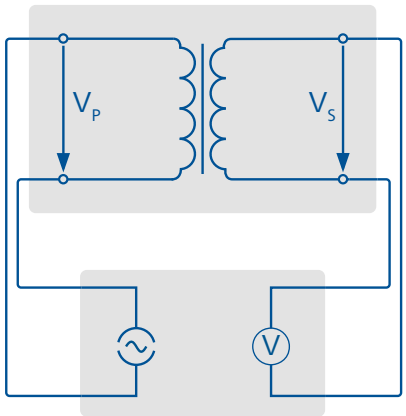
> Accuracy: Accuracy level should allow a calibration of metering VTs/CVTs with up to class 0.1.

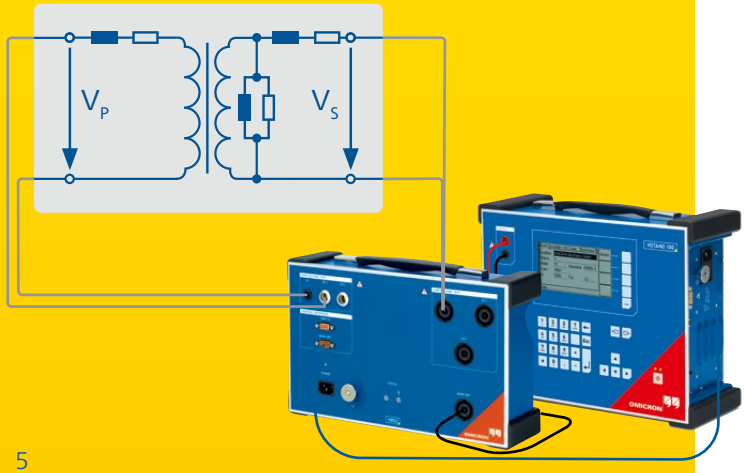
> Mobility: It should be compact and lightweight enough to be carried by one person.

> Handling: It should offer fast and automated tests and assessment to the respective IEC and IEEE standards. The setup and testing effort should be kept at a minimum in order to reduce time and costs. All relevant parameters should be measured in one test cycle and without the need for any further equipment (such as a burden box) and for rewiring.

	Primary nominal-voltage injection	Primary high-voltage injection
Safety	> Very high voltages of up to 1.9 times nominal voltage	> Typically voltage levels of up to 10 kV are used
Accuracy	> Very high accuracy > Many testing components resulting in a lot of calibration work and wiring	> Not sufficient for calibration > Sensitive to coupling from nearby live cables (typical measurement at mains frequency)
Mobility	> Approximately half a ton of equipment (controlled voltage transformer, high-voltage transformer, heavy cables, booster, burden box, etc.)	> More than 30 kg / 66 lbs (not including additional equipment, e.g. external burden box)
Handling	> A manual assessment of the results as per applicable standards is possible > Complex test setup: setup and testing requires several people	> Class compliance of the voltage transformers with higher rating can only be estimated > For the single ratio test only a simplified test set-up and process is necessary
Principle		

Primary voltage injection	Model-based VT/CVT testing
> Typically voltage levels of up to 100 V are used	> Measuring voltages of up to 4 kV are used > Local isolation between high voltage and measuring equipment
> Not suitable for calibration > Only sufficient for an estimation of the ratio	> Sufficient for measurement and calibration of class 0.1 metering VTs/CVTs > Measuring signals away from the mains frequency guarantees excellent noise suppression
> Typically less than 10 kg / 22 lbs > Ideal for handling on site	> 15 kg / 33 lbs > Ideal for handling on site
> Class compliance of the voltage transformer can only be roughly estimated > Comparatively simple and easy test setup	> Software-guided and automated test procedure (< 15 min) > Automated assessment (as per applicable standards) and reporting function > Enhanced simulation function eliminates the necessity to double-check measurements



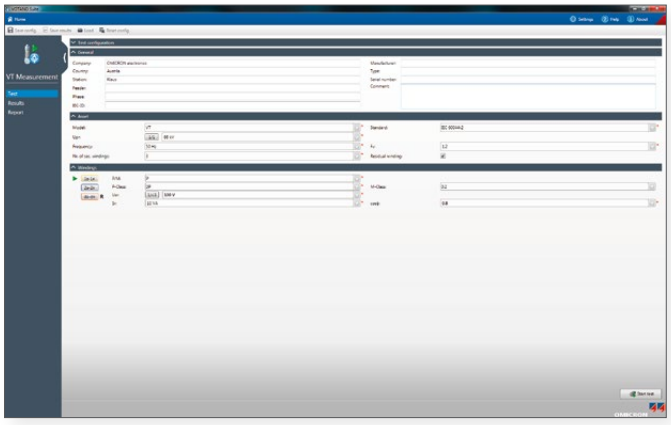


VOTANO 100's features

	Power			Voltage ratio error in % at % of rated voltage				
	VA	cos Phi	Burden in %	2%	5%	80%	100%	120%
Ratio unloaded	15	0.8	100	0.088%	0.123%	0.177%	0.177%	0.176%
	3.75		25	0.033%	0.362%	0.415%	0.417%	0.415%
Ph. angle unloaded	15	0.8	100	4.825 min.	4.287 min.	3.180 min.	3.186 min.	3.245 min.
	3.75		25	2.802 min.	2.263 min.	1.155 min.	1.161 min.	1.220 min.
Ratio loaded	15	0.8	100	-0.57%	-0.54%	-0.482%	-0.481%	-0.483%
	3.75		25	-0.33%	-0.30%	-0.246%	-0.245%	-0.246%
Ph. angle loaded	15	0.8	100	2.320 min.	1.783 min.	0.678 min.	0.683 min.	0.737 min.
	3.75		25	0.302 min.	-0.235 min.	-1.340 min.	-1.335 min.	-1.300 min.

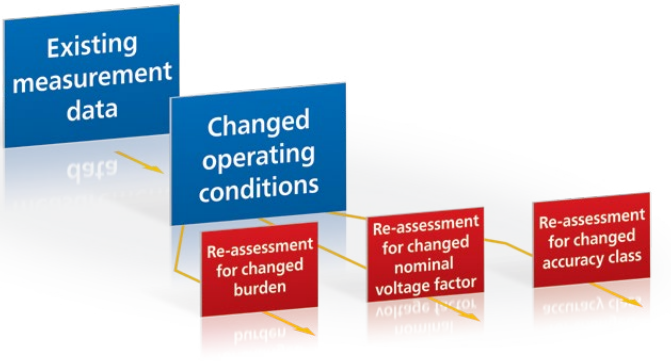
Automated assessment of measurement results in compliance with the standards

- Limit values for automated assessment are set in compliance with the applicable standards (IEC or IEEE)
- Automatic assessment is completed within seconds after the measurement
- Complete transformer assessment considering;
  - different burdens of secondary windings under test
  - different primary voltage values
  - each secondary winding under load and no-load conditions (while the others are either under load or without load)



Remote control

- With the PC software you can easily control the whole measuring procedure
- Allows the integration of VOTANO 100 into the automated testing procedures of a production line
- You can export data into Excel™ or XML format



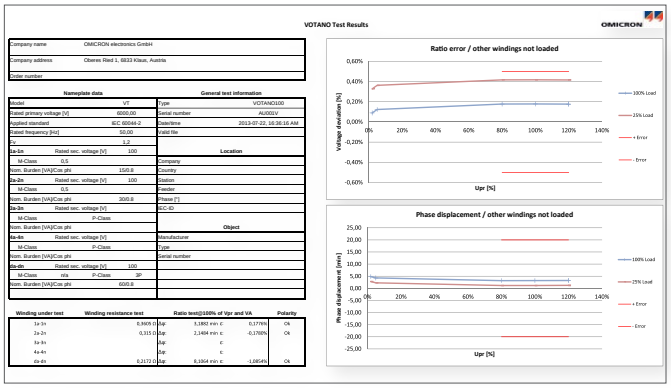
Simulation and re-assessment

Using the measured data of previous tests you can save time and money by;

- reloading existing measurement data into VOTANO 100 at any time for simulation
- doing later simulations and re-assessment of transformers when the following parameters have changed:
  - Burdens (individually for each winding)
  - Nominal voltage factor
  - Accuracy class of transformer
  - Primary voltage
- avoiding further on-site measurements to verify whether a change in the burden will influence the transformers' accuracy

Data processing and test reports

- You can save the test results directly on the Compact Flash Card
- With your PC you can easily generate reports using the Report Function
- The content and layout of reports can be customized in Excel™



Safe VT and CVT testing

- Enhanced security through software-guided measuring procedure via GUI or PC software
- Wiring diagrams for each single measurement
- The voltage booster VBO2 automatically switches through all tests. HV and LV wiring only needs to be done once
- Acoustic warnings sound before and during (optional) measurements with higher voltages
- Automatic plausibility and wiring check before critical measurements
- VBO2 offers additional safety circuitry through surge arrestors for the measuring channels
- Integrated system check to ensure VBO2 is correctly grounded
- If reconnections are necessary during the measurement the system can be locked for security reasons
- Safety box SAB1 and VBO2 indicate operating state and safe state of test setup via red and green LEDs
- Emergency stop button for additional safety interruptions

Additional C-Divider test option (for CVTs)

- For a detailed test of your CVTs' capacitor stack
- Smart method for accurate determination of individual C_1 and C_2 values, the overall capacitance C_r, and the capacitive ratio K_c.
- Combines two different primary short-circuit tests on the capacitor stack in a new measurement method
- Stack values can be determined for all CVT designs, even when no ground switch is available.

Specifications and software packages

Technical specifications of VOTANO 100

Inductive and capacitive coupled voltage transformers

Ratio test (basic testing)	
Typical accuracy for	
Ratio measurements	Phase measurements
0.02 %	0.7 min

Winding resistance measurement		
Resolution	Guaranteed accuracy	Typical accuracy
1 mΩ	0.1 % + 1 mΩ	0.05 %

Inductive voltage transformers

Ratio measurement	
Voltage level*	Typical accuracy*[1]
0.6 kV ... 35 kV	≦ 0.03 %
> 35 kV ... 123 kV	≦ 0.05 %
> 123 kV	≦ 0.08 %

Phase displacement measurement	
Voltage level*	Typical accuracy*[1]
0.6 kV ... 35 kV	2 min
> 35 kV ... 123 kV	3 min
> 123 kV	4 min

Capacitive coupled voltage transformers

Ratio measurement	
Voltage level*	Typical accuracy*[1]
> 30 kV ... 100 kV	0.05 %
> 100 kV ... 500 kV	0.07 %
> 500 kV	0.09 %

Phase displacement measurement	
Voltage level*	Typical accuracy*[1]
> 30 kV ... 100 kV	2 min
> 100 kV ... 500 kV	3 min
> 500 kV	4 min

Power supply

Input voltage	100 V_{AC} ... 240 V_{AC}
Permissible input voltage	85 V_{AC} ... 264 V_{AC}
Frequency	50 Hz / 60 Hz
Permissible frequency	45 Hz ... 65 Hz
Input power	500 VA
Connection	Standard AC socket as per IEC 60320

Output

Output voltage	0 ... 120 V_{DC} , 0 ... 40 V_{AC}
Output current	0 ... 5 A_{eff} (15 A_{peak})
Output power	0 ... 400 VA_{eff} (1 500 VA_{peak})

Physical dimensions

Size (W × H × D)	360 × 285 × 145 mm 9.2 × 7.2 × 3.7 in
Weight	< 8 kg / 17.1 lbs (without accessories)

Environmental conditions

Operating temperature	-10 °C ... +50 °C / +14 °F ... +122 °F
Storage temperature	-25 °C ... +70 °C / -13 °F ... +158 °F
Relative humidity	5 % ... 95 %, non-condensing

PC Requirements

Operating system	Windows 10™ 32 bit and 64 bit Windows 7™ 32 bit and 64 bit
Microsoft Office® versions	2019, 365, 2016, 2013, 2010, 2007 SP2

Technical specifications of VBO2 voltage booster

Physical dimensions

Size (W × H × D)	358 × 230 × 114 mm / 14.1 × 9.1 × 4.4 in
Weight	7.5 kg / 16.5 lbs (without accessories)

Environmental conditions

Please see VOTANO 100 parameters.

* network voltage level (line-to-line voltage)
*[1] accuracy valid for nominal voltages

Features of VOTANO 100 software packages

	VT Standard	VT Advanced	CVT Standard	CVT Advanced	VT/CVT Universal
PC software remote interface	■	■	■	■	■
Simple VT/CVT ratio check	■	■	■	■	■
VT/CVT polarity check	■	■	■	■	■
Measurements for inductive VTs with up to 5 secondary windings	■	■	–	–	■
Measurements for capacitive VTs with up to 5 secondary windings	–	–	■	■	■
Measurements for VTs as part of combined VT/CT units with up to 5 secondary windings	■	■	–	–	■
VT/CVT ratio and phase measurements under load and no-load condition	■	■	■	■	■
VT/CVT ratio error and phase displacement measurement in accordance with the standard	–	■	–	■	■
> Primary voltage levels between 5 % and 190 % of the nominal primary voltage					
> Nominal burden and burden values below (0 VA, 25 % and 100 % burden)					
> Other windings under load and no-load condition					
> Customized burden and Total Simultaneous Burden (TSB)					
Automatic assessment as per applicable standards up to accuracy class ≥ 0.1					
> IEC 60044-2 for inductive VTs	–	■	–	–	■
> IEC 60044-5 for capacitive VTs	–	–	–	■	■
> IEC 61869-3 for inductive VTs	–	■	–	–	■
> IEC 61869-5 for capacitive VTs	–	–	–	■	■
> IEEE C57.13 for instrument transformers	–	■	–	–	■
> ANSI C93.1 for capacitive VTs	–	–	–	■	■
Automatic test and assessment of ground fault winding (open delta)	–	■	–	■	■
Equivalent circuit parameter determination	–	■	–	■	■
> VT/CVT excitation curve measurements					
> Winding resistances					
> Leakage reactances					
Subsequent simulation and re-assessment of the VTs/CVTs after modification of	–	■	–	■	■
> Burden, nominal/rated voltage factor, accuracy class of VT/CVT, primary voltage					
Reloading of saved measuring data into VOTANO 100 for simulation at any time	–	■	–	■	■
Short-circuit impedance measurements	■	■	■	■	■
Burden measurement	■	■	■	■	■
C-divider test module for a detailed test of your CVTs' capacitor stack	–	–	–	■	■

■ included – not included

Ordering information VOTANO 100

Packages

	Description	Ordering No.
VOTANO 100 Package incl. all cables and accessories	VOTANO 100 device including simple VT/CVT ratio check	P0000747

Available software packages

VOTANO 100 VT Standard Software Package	Software package for common load and no-load ratio and phase measurements on VTs	P0006578
VOTANO 100 CVT Standard Software Package	Software package for common load and no-load ratio and phase measurements on CVTs	P0006579
VOTANO 100 VT Advanced Software Package	Software package for complete measurements and simulation of VTs up to accuracy class 0.1 with automatic IEC/IEEE class assessment	P0006580
VOTANO 100 CVT Advanced Software Package	Software package for complete measurements and simulation of CVTs up to accuracy class 0.1 with automatic IEC/IEEE class assessment	P0006581
VOTANO 100 VT/CVT Universal Software Package	Software package for complete measurements and simulation of VTs and CVTs up to accuracy class 0.1 with automatic IEC/IEEE class assessment	P0006582

VOTANO 100 Package

Software Upgrade Options, Licenses and Tools

	Description	Ordering No.
VOTANO 100 VT Standard to Advanced Upgrade Option	Upgrade option for complete measurements and simulation of VTs up to accuracy class 0.1 with automatic IEC/IEEE class assessment	P0006583
VOTANO 100 CVT Standard to Advanced Upgrade Option	Upgrade option for complete measurements and simulation of CVTs up to accuracy class 0.1 with automatic IEC/IEEE class assessment	P0006584
Manufacturer Application Programming Interface License (API; only VT testing functions supported)	Software license for usage of the VOTANO 100 Application Programming Interface (API)	P0006802
VOTANO 100 Calibration Suite (requires VT or CVT Advanced Software Package)	Device-specific license for usage of VOTANO 100 and VBO2 calibration tool	P0006801
VOTANO 100 16.7 Hz Measurement License	Software license for measurement of 16.7 Hz VTs (Central and Northern European railway grids)	P0006803
C-Divider Test	Test module for a detailed test of your CVTs' capacitor stack	P0007483

Accessories and Cables

	Description	Ordering No.
Calibration VT	High-precision calibration IVT (0.05% accuracy) for calibration of VOTANO 100 and VBO2 (calibration certificate ISO / IEC 17025 included)	P0005500
VOTANO 100 Cable Package	Additionally available cables / adapters for the connection of several secondary windings and burdens	P0006208

Services

	Description	Ordering No.
Recalibration of Calibration VT	Recommended recalibration of calibration VT every 1-2 years (return shipment included)	P0006037
Calibration of new VOTANO 100 devices	Optional calibration of new VOTANO 100 devices according to IEC17025. Certifies accuracy for VT accuracy class determination and verifies accuracy of low- and high-voltage in- and outputs	P0005953
Recalibration of VOTANO 100 devices in service	Recommended annual recalibration of VOTANO 100 devices in service according to IEC17025. Certifies accuracy for VT accuracy class determination and verifies accuracy of low- and high-voltage in- and outputs (return shipment included)	P0006038

Find detailed ordering information and package descriptions on www.omicronenergy.com

We create customer value through ...

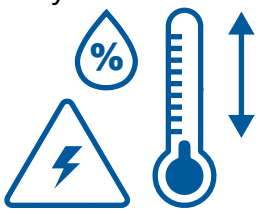
Quality

We always want you to be able to rely on our testing solutions. This is why our products have been developed with experience, passion and care and are continually setting ground-breaking standards in our industry sector.

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

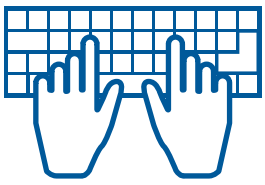
Innovation

Thinking and acting innovatively is something that's deeply rooted in our genes. Our comprehensive product care concept also guarantees that your investment will pay off in the long run – e.g. with free software updates.

... 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%

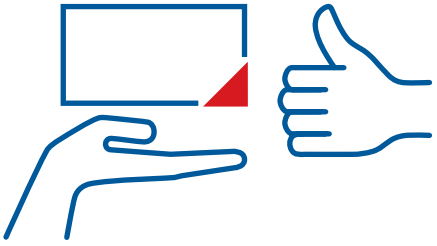
testing time through templates, and automation

We create customer value through ...

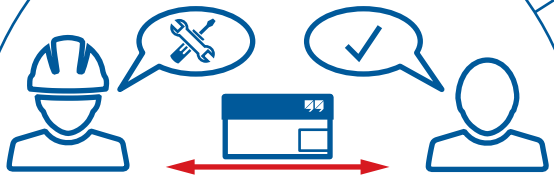
Support

When rapid assistance is required, we're always right at your side. Our highly-qualified technicians are always reachable. Furthermore, we help you minimize downtimes by lending you testing equipment from one of our service centers.

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

We maintain a continuous dialogue with users and experts. Customers can benefit from our expertise with free access to application notes and professional articles. Additionally, the OMICRON Academy offers a wide spectrum of training courses and webinars.

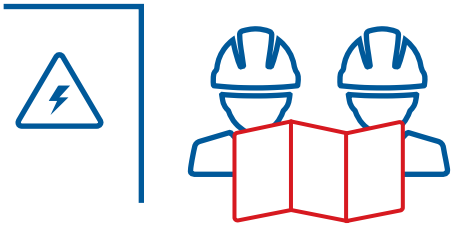
More than

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.

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