

# 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.

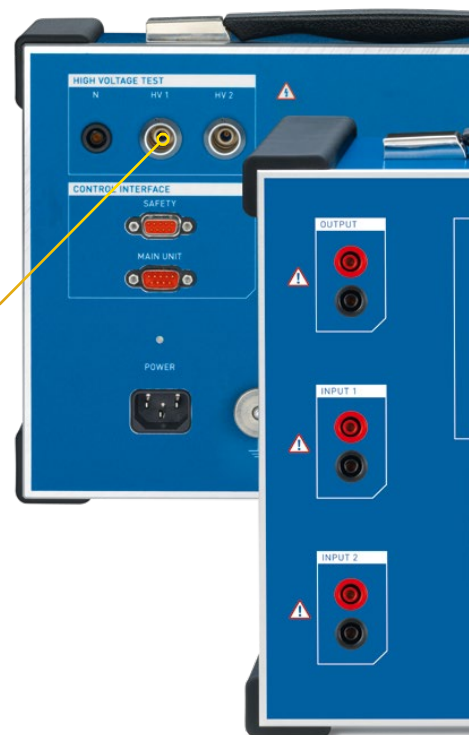
VOTANO 100 is supplied with the separate voltage booster VBO2. This 4 kV amplifier provides the necessary test voltage during the ratio measurement. Its integrated switchbox automatically switches between the necessary test sequences.

## 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 reproducibility



\* 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.)

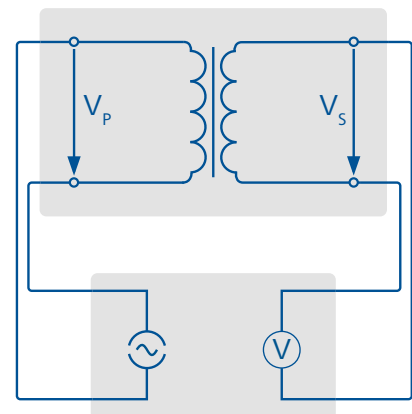
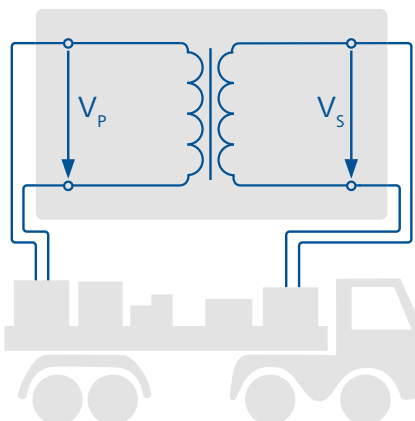
- > More than 30 kg / 66 lbs (not including additional equipment, e.g. external burden box)

#### 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



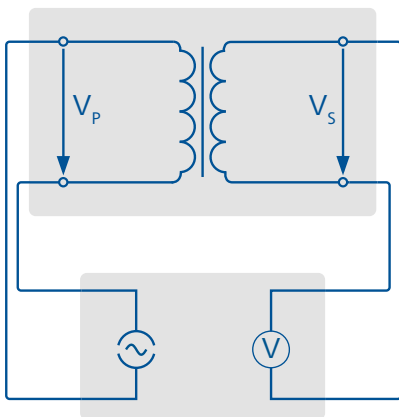
### Primary voltage injection

> Typically voltage levels of up to 100V are used

> Not suitable for calibration  
> Only sufficient for an estimation of the ratio

> Typically less than 10 kg / 22 lbs  
> Ideal for handling on site

> Class compliance of the voltage transformer can only be roughly estimated  
> Comparatively simple and easy test setup



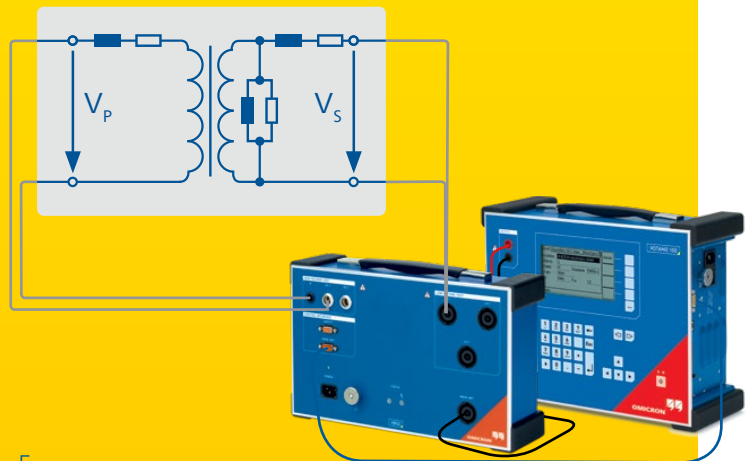
### Model-based VT/CVT testing

> Measuring voltages of up to 4kV are used  
> Local isolation between high voltage and measuring equipment

> Sufficient for measurement and calibration of class 0.1 metering VTs/CVTs  
> Measuring signals away from the mains frequency guarantees excellent noise suppression

> 15 kg / 33 lbs  
> Ideal for handling on site

> 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

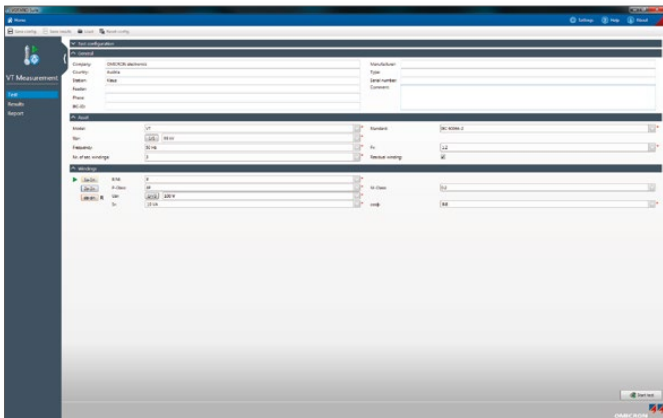


# VOTANO 100's features

		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)



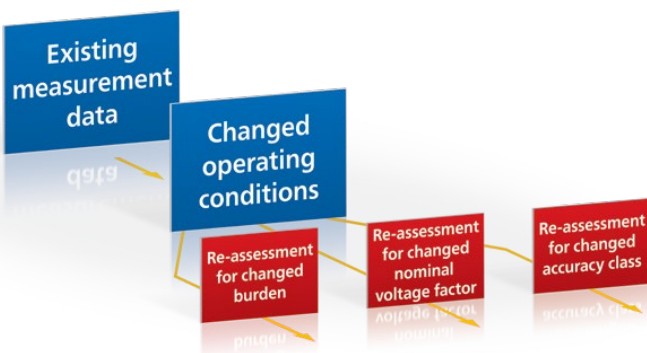
## Remote control

- > 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

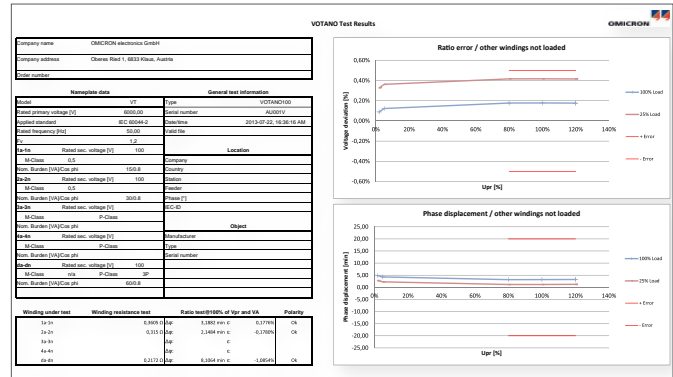
Using the measured data of previous tests you can save time and money by;

- > 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



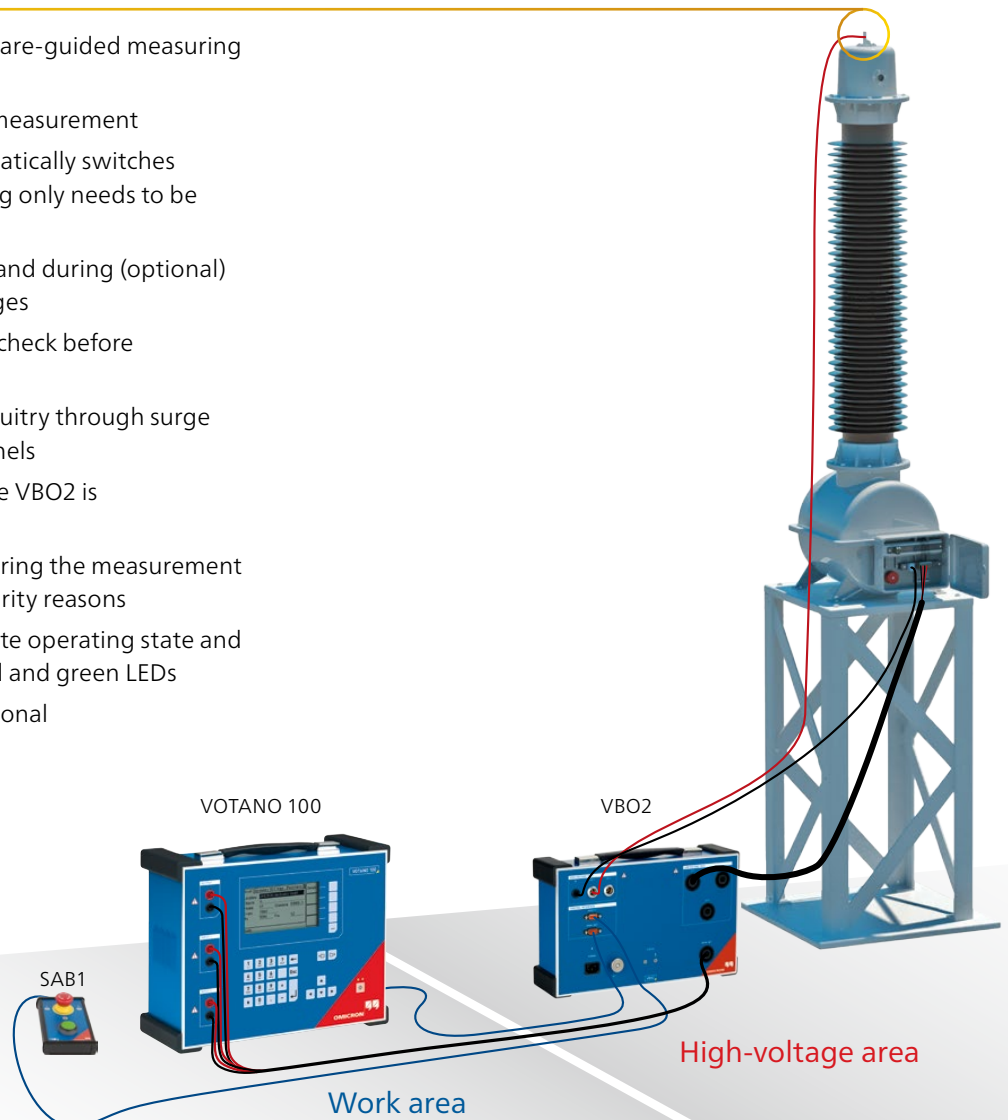
## Data processing and test reports

- > 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 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 the test setup via red and green LEDs
- > Emergency stop button for additional safety interruptions





# 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* <sup>1</sup>
0.6 kV ... 35 kV	≤ 0.03 %
> 35 kV ... 123 kV	≤ 0.05 %
> 123 kV	≤ 0.08 %

### Phase displacement measurement

Voltage level*	Typical accuracy* <sup>1</sup>
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* <sup>1</sup>
> 30 kV ... 100 kV	0.05 %
> 100 kV ... 500 kV	0.07 %
> 500 kV	0.09 %

### Phase displacement measurement

Voltage level*	Typical accuracy* <sup>1</sup>
> 30 kV ... 100 kV	2 min
> 100 kV ... 500 kV	3 min
> 500 kV	4 min

## 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)

### Power supply

Input voltage	100 V <sub>AC</sub> ... 240 V <sub>AC</sub>
Permissible input voltage	85 V <sub>AC</sub> ... 264 V <sub>AC</sub>
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 <sub>DC</sub> , 0 ... 40 V <sub>AC</sub>
Output current	0 ... 5 A <sub>eff</sub> (15 A <sub>peak</sub> )
Output power	0 ... 400 VA <sub>eff</sub> (1500 VA <sub>peak</sub> )

### 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 8.1™ 64 bit Windows 8™ 64 bit Windows 7™ 32 bit and 64 bit Windows Vista™ with SP 1 32 bit
Microsoft Office® versions	365, 2016, 2013, 2010, 2007 SP2, 2003 SP3



### Environmental conditions

Please see VOTANO 100 parameters.
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\* network voltage level (line-to-line voltage)

\*<sup>1</sup> accuracy valid for nominal voltages



## Features of VOTANO 100 software packages

	VT	VT	CVT	CVT	VT/CVT
	Standard	Advanced	Standard	Advanced	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 (0VA, 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 $\geq 0.1$					
> 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	■	■	■	■	■

■ 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	VE000804
Available software packages		
VOTANO 100 VT Standard Software Package	Software package for common load and no-load ratio and phase measurements on VTs	VESM0803
VOTANO 100 CVT Standard Software Package	Software package for common load and no-load ratio and phase measurements on CVTs	VESM0804
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	VESM0805
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	VESM0806
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	VESM0807

## VOTANO 100 Package



## Software Upgrade Options, Licenses and Tools

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	<b>Description</b>	<b>Ordering No.</b>
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	VESM0808
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	VESM0809
Manufacturer Application Programming Interface License	Software license for usage of the VOTANO 100 Application Programming Interface (API)	VESM0811

## Accessories and Cables

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	<b>Description</b>	<b>Ordering No.</b>
Calibration VT	High-precision calibration IVT (0.05% accuracy) for calibration of VOTANO 100 and VBO2 (calibration certificate ISO / IEC 17025 included)	VEHZ0801
VOTANO 100 Cable Package	Additionally available cables / adapters for the connection of several secondary windings and burdens	VEHK0804

## Services

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	<b>Description</b>	<b>Ordering No.</b>
Recalibration of Calibration VT	Recommended recalibration of calibration VT every 1-2 years (return shipment included)	VEDK9057
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	VEDK0017
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)	VEDK9058

# A strong and safe connection

## Welcome to the team

At OMICRON you can always depend on an experienced team that actively supports you and an infrastructure that you can rely on. We always listen attentively in order to understand your needs so that we can offer you the best possible solutions. We strive for lasting partnerships and ensure that you can continue to rely on your product long after you've purchased it. In order to do this, we focus on quality, the transfer of knowledge and unique customer support.

Tony, Wenyu and Thomas are able to tell you about the services we have available for you and why it pays to be part of the team.



Tony Porrelli  
Application Specialist

## Solutions you can rely on...

... developed with experience, passion and an innovative approach that we use to continually set groundbreaking standards in our industry sector.

We invest more than 15 % of the total turnover in research and development so that we can even guarantee the reliable use of the latest technology and methods in the future.

Our comprehensive product care concept also guarantees that your investment in our solutions – like free software updates – pays off in the long term.





Wenyu Guo  
OMICRON Academy



### We share our knowledge...

... by maintaining a constant dialogue with users and experts. Some examples of this are our customer events and conferences that take place all over the world and our collaboration with numerous standardization committees.

We also make our knowledge available to you in the customer section of our website in the form of application reports, specialized articles and articles in the discussion forum. With the OMICRON Academy, we also provide a wide spectrum of training possibilities and assist you with Start-up training and free webinars.



Thomas Bischof  
Technical Support

### 24/7 support

#### When rapid assistance is required...

... our excellent level of support is always appreciated. You can reach the highly-qualified and committed technicians in our customer support department 24 hours a day, seven days a week – and it's completely free. We deal with repair services and service features in a fair and non-bureaucratic manner.

We can help minimize your downtime by lending you equipment from a readily available plant at one of our service centers in your area. A comprehensive offer of services for consulting, testing and diagnostics completes our range of services.



# OMICRON – Who we are

## Reliable. Passionate. Different.

For over 30 years we have been developing innovative, top-quality testing and monitoring solutions for electrical power systems.

Customers in more than 150 countries rely on OMICRON's testing technology. In addition, we offer a wide array of services in the fields of consulting, testing and training.

We aim to inspire our customers with exceptional products, an interactive exchange of knowledge and extraordinary customer support. Our curiosity and passion give us the courage to approach things from different angles.

Together with our partners and customers, we are striving towards a safe and reliable energy supply.

*„Create an environment with no artificial limits where a team of excellent members can reach an excellent performance and enjoy working together at the same time.“*

(Rainer Aberer, company founder)

## Our values

We acknowledge our social, ecological and corporate responsibility, and are committed to ensuring sustainable development and business practices. The majority of development and production work takes place at our premises in Austria. Highly specialized suppliers from the region and first-class components guarantee the reliability and durability of every OMICRON device.

Over 750 employees from 45 different countries shape our extremely diverse corporate culture today. Flat hierarchies and a high degree of individual responsibility create a motivational work environment in which our employees can realize their full potential. Actively practiced corporate values such as respect and trust lead to our unique company spirit.

Founding of  
OMICRON in Austria

1984

Entering the fields of protection  
and measurement technology

1990

First major OMICRON  
protection testing conference

1993

OMICRON has  
over 100 employees

2000

Entering the field of  
primary equipment  
testing

2001





The world of OMICRON

OMICRON has established a global presence, providing customers with the highest quality of electrical testing and protection equipment, including protection systems and power analyzers.

By combining innovation, broad application knowledge and unparalleled customer support, OMICRON is a leader in its sector. With more than 200 worldwide offices in Europe, the Americas, Asia and Australasia, and a network of distributors and representatives, OMICRON has established a reputation for the highest quality.

Customers in over 100 countries worldwide



Entering the field of online monitoring

Over 700 employees across 22 offices worldwide



2003

2009

2015



OMICRON is an international company serving the electrical power industry with innovative testing and diagnostic solutions. The application of OMICRON products allows users to assess the condition of the primary and secondary equipment on their systems with complete confidence. Services offered in the area of consulting, commissioning, testing, diagnosis and training make the product range complete.

Customers in more than 160 countries rely on the company's ability to supply leading-edge technology of excellent quality. Service centers on all continents provide a broad base of knowledge and extraordinary customer support. All of this together with our strong network of sales partners is what has made our company a market leader in the electrical power industry.

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