OMICRON

VOTANO 100

Accurate and mobile voltage transformer testing and calibration system

Sophisticated voltage transformer testing

VOTANO 100: accuracy and mobility

At only 15 kg/33 lbs and compact in size VOTANO 100 is the first mobile device to also offer high accuracy. It can be used for testing protection and metering voltage/potential* transformers (VTs) quickly. The measured results are automatically assessed in accordance with IEEE and IEC standards.

VOTANO 100 uses an electrical modeling method which is already well-established and proven in OMICRON's CT Analyzer.

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

VOTANO 100 and VBO1: a safe combination

VOTANO 100 is supplied with the separate voltage booster VBO1. This 4 kV amplifier provides the necessary test voltage during the ratio measurement.

VBO1 is positioned close to the transformer under test while VOTANO 100 is operated in the safe area outside of the high-voltage environment.

Software-guided workflow

1 Measurement of parameters

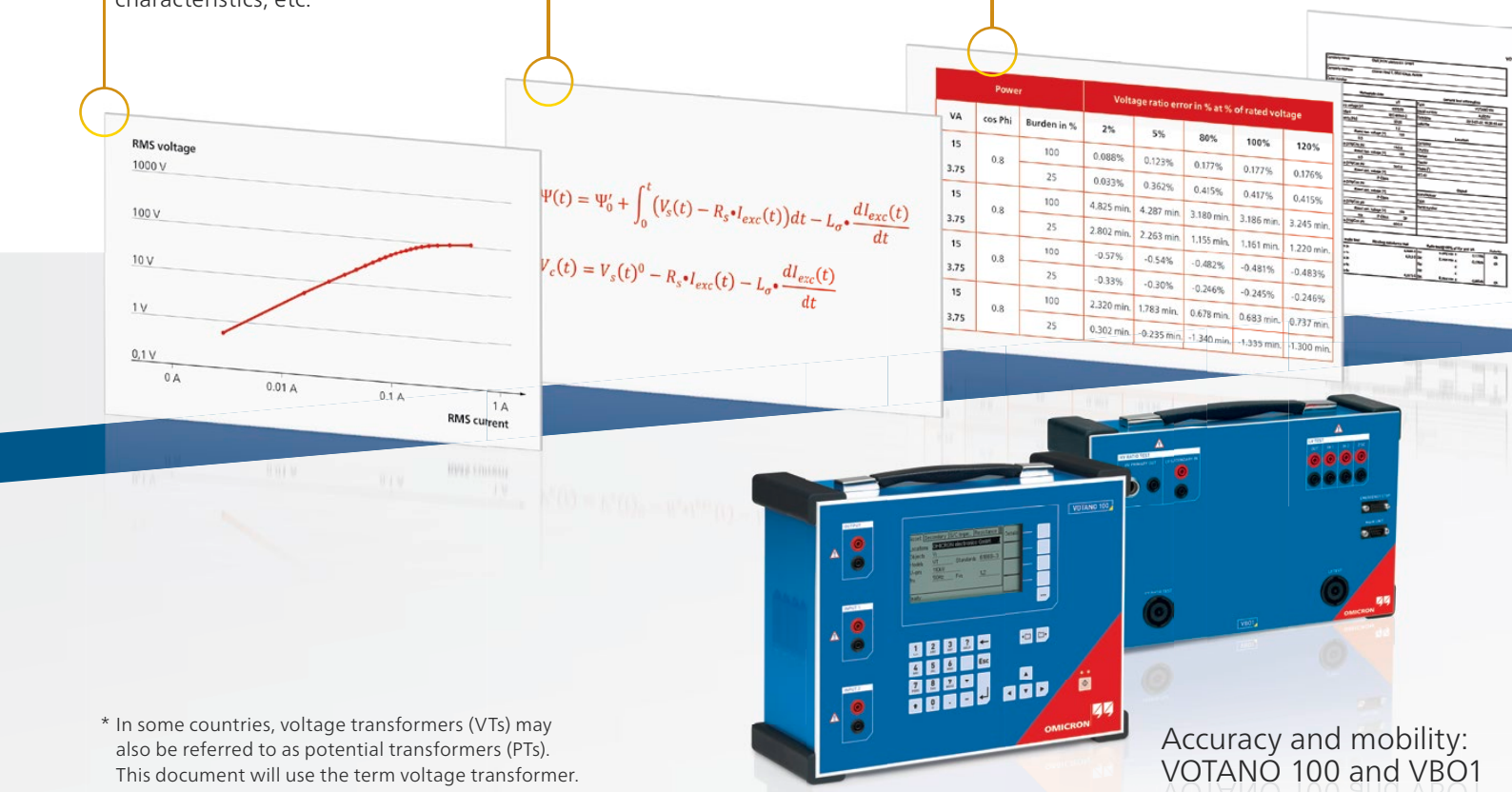
Software-guided measurement of different VT parameters such as winding resistance, magnetization characteristics, etc.

2 Modeling

Determination of VT model elements and calculation of VT accuracy through embedded mathematical functions.

3 IEEE/IEC assessment

Automated comparison of test results with the defined values in accordance with the selected IEEE or IEC standard.



Accuracy and mobility: VOTANO 100 and VBO1

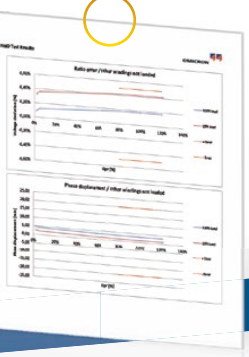
* In some countries, voltage transformers (VTs) may also be referred to as potential transformers (PTs). This document will use the term voltage transformer.

What VOTANO 100 can do for you

- Determination of VT ratio and phase angle accuracy for all specified ratio values, considering the nominal burden under and without load and for different voltage values
- VT winding resistance measurement of secondary windings
- Determination of magnetization characteristics
- Leakage reactance measurement of VTs under test
- Automatic assessment of results regarding class accuracy in compliance with pre-defined standards
- Class verification of VTs with up to 5 secondary windings can be done within one measurement cycle (with ground fault winding / open delta included)

4 Reporting

All data can be saved in Excel™ and XML format or can be printed as a test report.



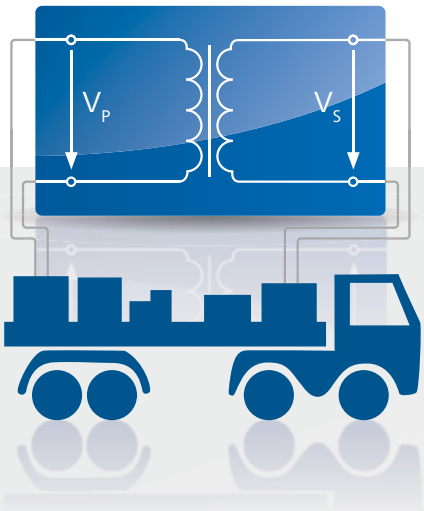
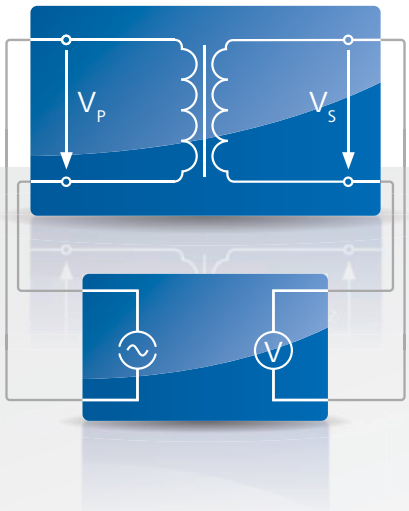
Your benefits

- Very high accuracy allows field calibration of VTs up to the 0.1 accuracy class
- Excellent mobility through compact size and low weight (< 15 kg / 33 lbs)
- Automatic result assessment as per IEEE and IEC standards directly after the test
- Short testing time compared to conventional methods (< 20 min)

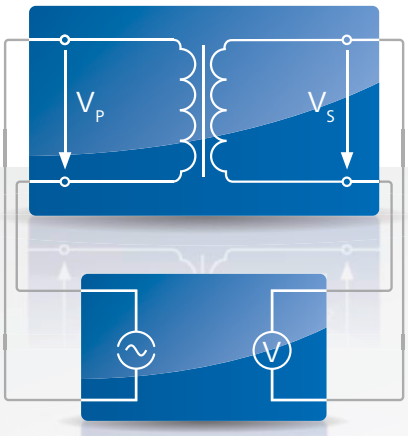
Accuracy and mobility for on-site VT testing

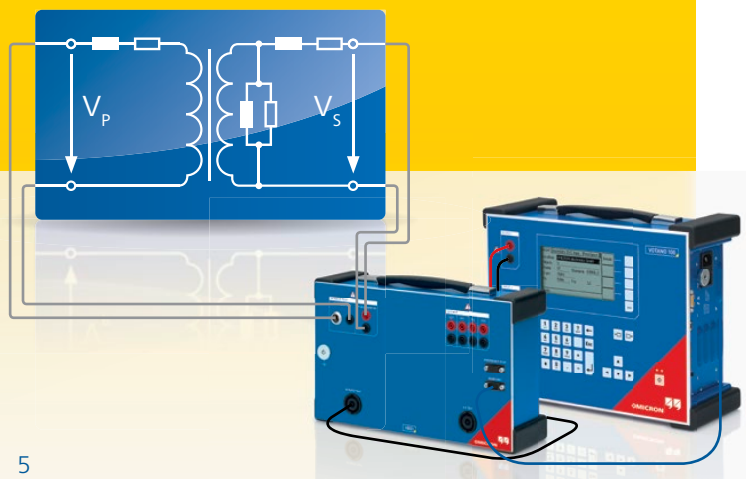
Requirements for the ideal VT testing device

- > Mobility: It should be compact and lightweight enough to be carried by one person.
- > Accuracy: It ought to be accurate enough to calibrate metering VTs with up to class 0.1.
- > Safety: The part of the test taking place under high voltages must be as short as possible.
- > Handling: It should offer fast and automated assessment to the respective IEC and IEEE standards. One person must be able to complete the setup and testing. All relevant parameters should be measured in one test cycle and without the need for any further equipment (such as a burden box).

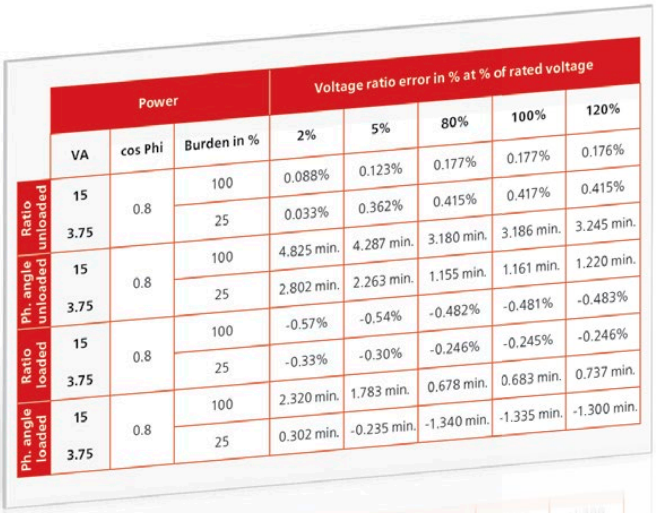
	Primary nominal-voltage injection	Primary high-voltage injection
Mobility	> Approximately half a ton of equipment (controlled voltage transformer, high-voltage transformer, heavy cables, booster, burden box, etc.)	> More than 30 kg / 66 lbs (not including additional equipment, e.g. external burden box)
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)
Safety	> Very high voltages of up to 1.9 times nominal voltage	> Typically voltage levels of up to 10 kV are used
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 transformers can only be estimated > For the single ratio test only a simplified test set-up and process is necessary
Electrical model		

Primary voltage injection	VT as an electrical model
> Typically less than 10 kg / 22 lbs > Ideal for handling on site	> 15 kg / 33 lbs > Ideal for handling on site
> Not suitable for calibration > Only sufficient for an estimation of the ratio	> Sufficient for measurement and calibration of class 0.1 metering VTs > Measuring signals away from the mains frequency guarantees excellent noise suppression
> 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
> Class compliance of the transformer can only be roughly estimated > Comparatively simple and easy test setup	> Software-guided test procedure (< 20 min) > Automated assessment (as per applicable standards) and reporting function > Enhanced simulation function eliminates the necessity to double-check measurements > Different tests require different test setups





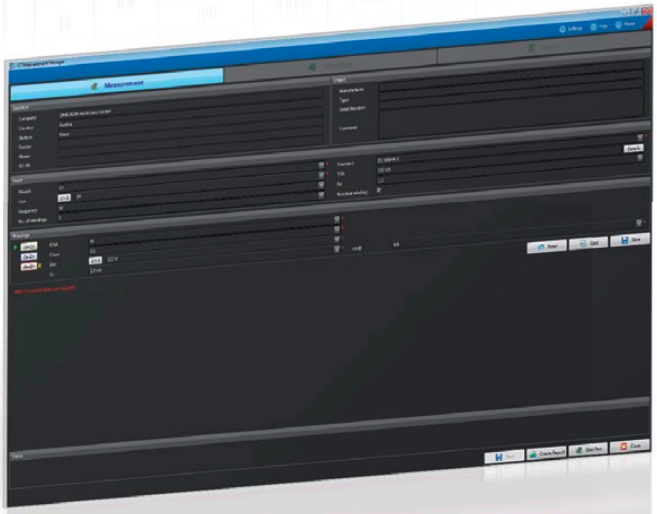
VOTANO 100's features



	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.

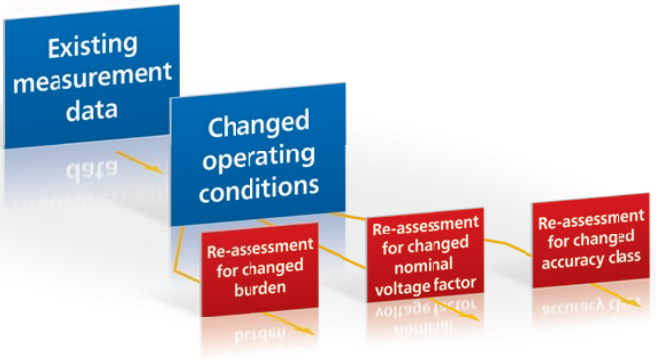
Automated assessment of measurement results in compliance with the standards

- 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;

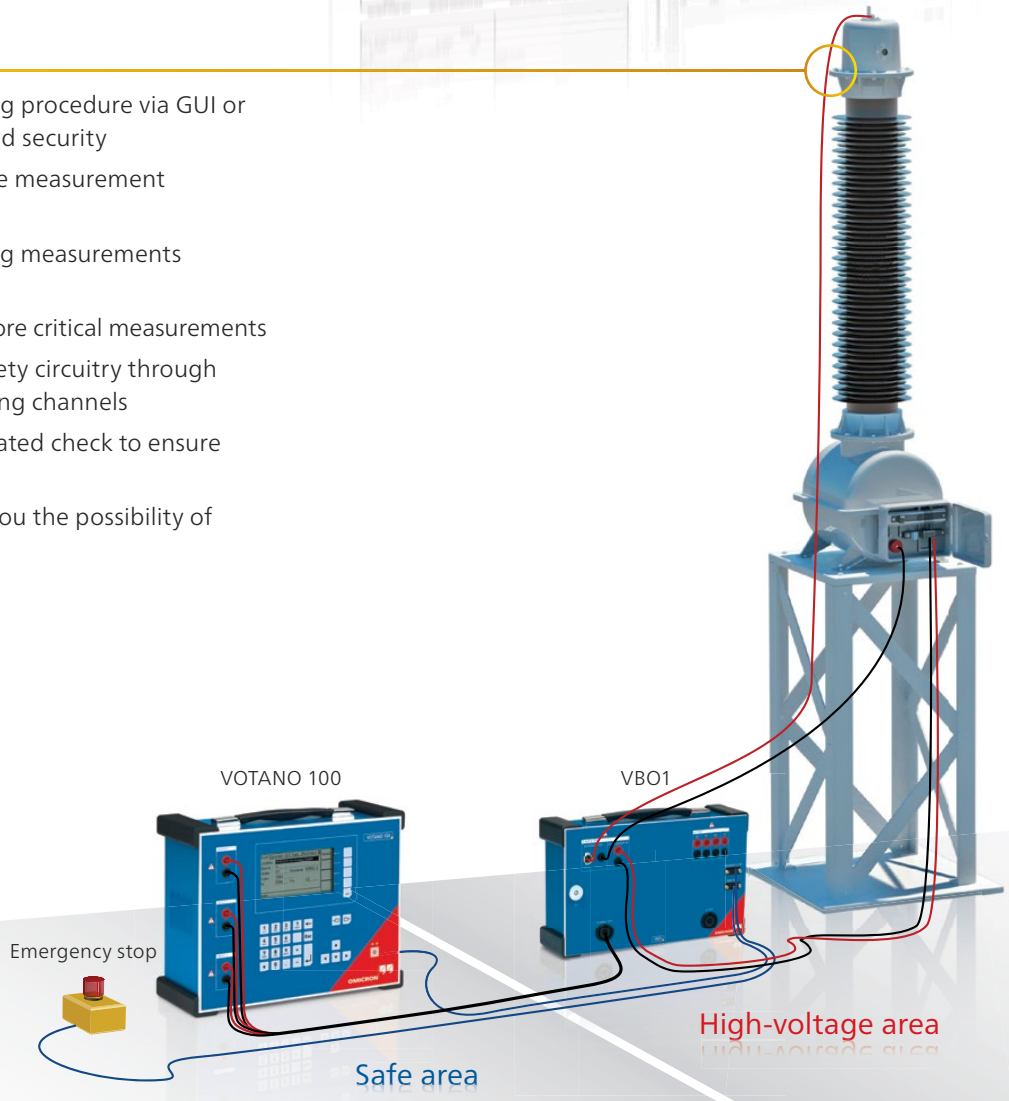
- reloading existing measurement data into VOTANO 100 at any time for simulation
- doing later simulations and re-assessment of transformers when the following parameters have changed:
  - Burdens (individually for each winding)
  - Nominal voltage factor
  - Accuracy class of transformer
- avoiding 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

- The software-guided measuring procedure via GUI or PC software gives you enhanced security
- Wiring diagrams for each single measurement are provided to support you
- Acoustic warnings sound during measurements with higher voltages
- There is a plausibility check before critical measurements
- VBO1 offers you additional safety circuitry through surge arrestors for the measuring channels
- The system performs an integrated check to ensure VBO1 is correctly grounded
- Emergency stop buttons give you the possibility of additional safety interruptions



Specifications and software packages

Technical specifications of VOTANO 100

Inductive voltage transformers

Ratio measurement

Voltage ratio	Voltage level	Typical accuracy
1 ... 350	0.6 kV ... 35 kV	0.05 %
> 350 ... 1 100	> 35 kV ... 110 kV	0.07 %
> 1 100 ... 2 450	> 110 kV ... 245 kV	0.07 %

Phase displacement measurement

Voltage ratio	Voltage level	Typical accuracy
1 ... 350	0.6 kV ... 35 kV	1 min
> 350 ... 1 100	> 35 kV ... 110 kV	2 min
> 1 100 ... 2 450	> 110 kV ... 245 kV	2 min

Winding resistance measurement

Resolution	Guaranteed accuracy	Typical accuracy
1 mΩ	0.1 % + 1 mΩ	0.05 %

Capacitive coupled voltage transformers

Ratio measurement

Voltage ratio	Voltage level	Typical accuracy
300 ... 8 000	> 30 kV ... 800 kV	0.07 %

Phase displacement measurement

Voltage ratio	Voltage level	Typical accuracy
300 ... 8 000	> 30 kV ... 800 kV	2 min

Winding resistance measurement

Resolution	Guaranteed accuracy	Typical accuracy
1 mΩ	0.1 % + 1 mΩ	0.05 %

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_{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	7.8 kg / 17.2 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

CE conformity

(EMC) Directive 2004/108/EC and low-voltage Directive 2006/95/EC

EMC	EN 61326-1 Class A, IEC 61326-1 Class A, FCC Subpart B of Part 15 Class A
Safety	EN 61010-1 / EN 61010-2-30 IEC 61010-1 / IEC 61010-2-30 UL 61010-1 / UL 61010-2-30

Technical specifications of VBO1 voltage booster

Physical dimensions

Size (W × H × D)	357 × 235 × 111 mm 14.1 × 9.2 × 4.4 in
Weight	6.8 kg / 15 lbs (without accessories)

Environmental conditions

Please see VOTANO 100 parameters.

CE conformity

Please see VOTANO 100 parameters.

Features of VOTANO 100 software packages

	Standard Package	Advanced Package	Capacitive VT Upgrade
Complete measurements for inductive VTs with up to 5 secondary windings	■	■	
Complete measurements for capacitive VTs with up to 5 secondary windings	–	–	■
Automatic assessment as per applicable standards up to accuracy class > 0.3			
> IEC 60044-2 for inductive VTs	■	■	
> IEC 60044-5 for capacitive VTs	–	–	■
> IEC 61869-3 additional requirements for inductive VTs	■	■	
> IEC 61869-5 additional requirements for capacitive VTs	–	–	■
> IEEE C57.13 standard requirements for conventional transformers	■	■	
> ANSI C93.1 requirements for capacitive VTs	–	–	■
Automatic assessment as per applicable standards up to accuracy class ≥ 0.1	–	■	
Ground fault winding (open delta) definition is included in the test specifications e.g. $V_{sr}/3$	■	■	
VT ratio and phase error 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 without load			
Ratio and phase error measurements considering the Total Simultaneous Burden (TSB)	■	■	
VT polarity check	■	■	
Direct comparison of VT excitation curve to a reference curve	■	■	
Secondary winding resistance	■	■	
Short-circuit impedance	■	■	
Remote interface	■	■	
Easy generation of customizable reports	■	■	
Subsequent simulation and re-assessment of the VTs after modification of parameters	–	■	
> Burden (individually for every winding)			
> Nominal voltage factor / rated voltage factor			
> Accuracy class of VT			
Saved measuring data can be reloaded into VOTANO 100 for simulation at any time	–	■	

■ included – not included

Ordering information

VOTANO 100 Standard Package incl. accessories (order no. VE000800)

Hardware

1 × VOTANO 100

1 × VBO1

Cables and accessories

1 × Connection cable (6 poles) VOTANO – VBO1 (6 m / 19.7 ft)

1 × Emergency stop button with cable (6 m / 19.7 ft)

2 × Grounding cable (6 m, 6 mm² / 19.7 ft, 0.01 sq in) with connection clamp

1 × Set consisting of two screened VBO1 high-voltage cables (6 m / 19.7 ft)

3 × 2-pole coax measuring cable (3 m / 9.8 ft)

1 × Set consisting of two Kelvin clamp adapters

2 × Set consisting of two crocodile clamps with 4 mm / 0.2 in banana sockets

1 × Set consisting of two Kelvin battery clamps with 4 mm / 0.2 in banana sockets

1 × USB 3.0 Compact Flash card reader

1 × Compact Flash card (512 MB)

1 × Power cable

1 × User manual

1 × Calibration confirmation

1 × VOTANO 100 PC Toolset CD

1 × Transport case VOTANO 100 + VBO1

VOTANO 100 Advanced Package incl. accessories (order no. VE000801)

Hardware, cables and accessories

Hardware, cables and accessories from VOTANO 100 Standard Package plus the following additional features:

- Automatic VT assessment as per applicable standards up to accuracy class ≥ 0.1
- Subsequent simulation and re-assessment of the VTs after modification of the parameters
  - Burden (individually for every winding)
  - Nominal voltage factor / rated voltage factor
  - Accuracy class of VT
- Reload saved measuring data into VOTANO 100 for simulation at any time

VOTANO 100 Capacitive VT Upgrade Option (order no. VESM0801)

Software upgrade for Standard and Advanced Package

Adds automatic VT assessment as per the following standards to both packages:

- IEC 60044-5 for capacitive VTs
- IEC 61869-5 additional requirements for capacitive VTs
- ANSI C93.1 requirements for capacitive VTs

VOTANO 100 Standard to Advanced Upgrade Option (order no. VESM0802)

Software upgrade from Standard to Advanced Package

Adds to the Standard Package the additional features described under Advanced Package (see above).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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 140 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.

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