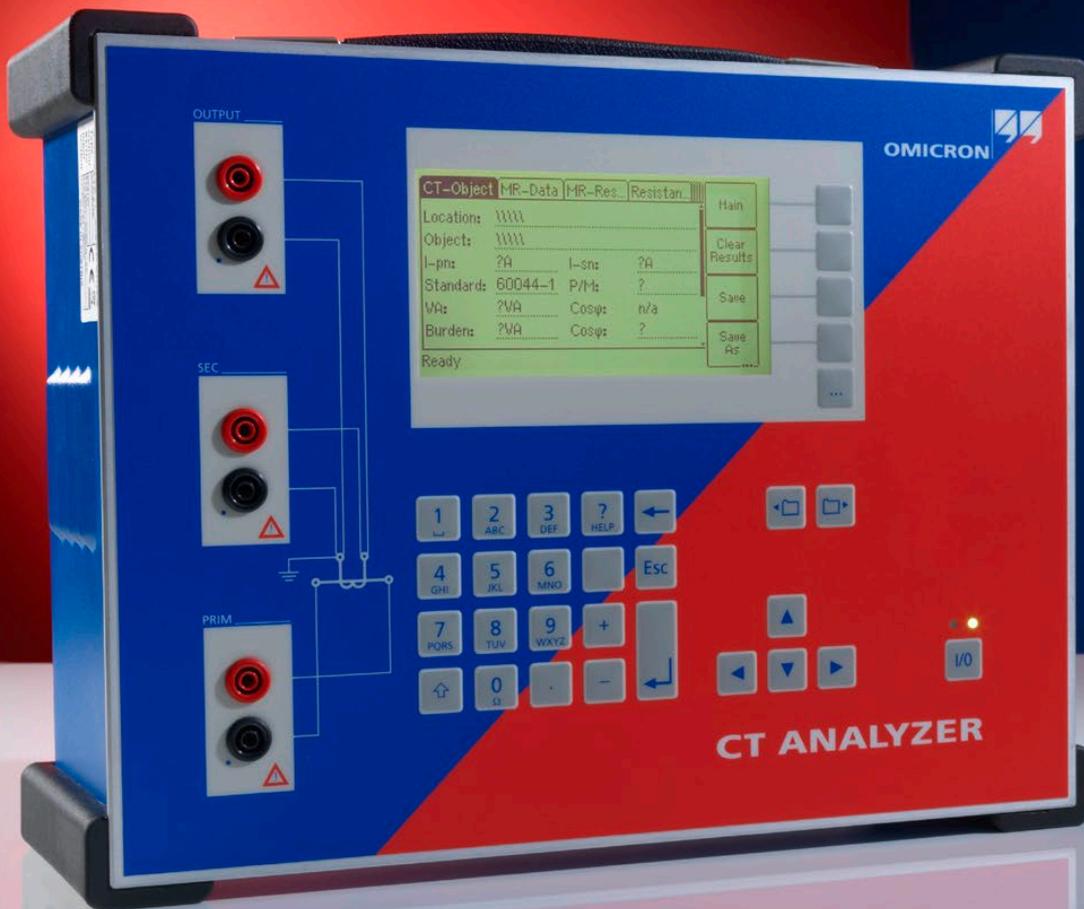


CT Analyzer

Revolution in current transformer testing and calibration



Revolutionary way of CT testing

Current transformers are used for relaying and metering purposes in electrical power systems. They connect the high power primary side to the protection and metering equipment on the secondary side. Depending on the application they are used for, current transformers are designed differently.

Protection current transformers

As it is used to feed protective relays, the CT must be accurate during normal and fault conditions. Failures in transformation could lead to misoperation of the relay along with unwanted and costly outages. To test CTs according to the requirements of modern protection systems, it is compulsory to consider the CT performance at rated frequency for normal and overcurrent operation. Also transient components and auto-reclosure systems must be considered.

Metering current transformers

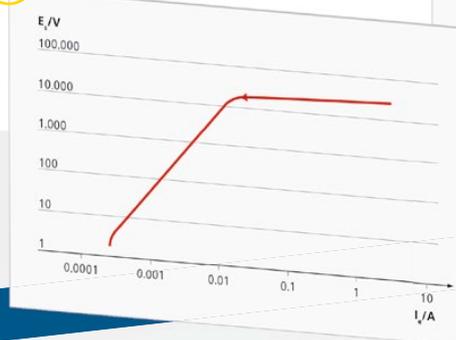
Metering CTs must provide high accuracy up to class 0.1 to guarantee correct metering and billing. It is therefore essential to test and calibrate the metering CT, as the accuracy of the metering chain depends on the accuracy of the CT feeding the meter.

In contrast to protection CTs, metering CTs should go into saturation beyond the nominal primary current level to protect the connected metering equipment.

Automated testing procedure

1 Measurement of parameters

Measurement of CT parameters like excitation curve, eddy current, ratio, etc.



2 Modeling

Definition of CT model elements and calculation of CT parameters through embedded mathematical functions

$$\psi(t) = \psi'_0 + \int_0^t (U_s(t) - R_{CT} I_{CT}(t)) dt - L_{CT} \frac{d}{dt} I_{CT}(t)$$

$$U_c(t) = U_s(t) - R_{CT} I_{CT}(t) - L_{CT} \frac{d}{dt} I_{CT}(t)$$

The CT Analyzer is designed to accurately measure all relevant CT parameters and compare them to the requirements of the defined IEEE or IEC standard. Due to this automated assessment, testing engineers receive the 'pass or fail' decision within seconds.

POWER	
cos φ	Data type
0.8	String value: -0.0
0.8	Float value: -0.0
0.8	String value: -0.0
0.8	Float value: -0.0
1	String value: 0.0
1	Float value: 0.0

CT Analyzer – a new way of testing CTs

The CT Analyzer is the most complete and easy-to-use testing system for protection and metering CTs according to IEEE and IEC standards. It allows all types of single and multi-ratio current transformers to be tested in labs and on site in power system grids. Manufacturers, utilities, service providers and other CT operators use the CT Analyzer in production, labs, test fields, and on site.

The CT Analyzer offers a wide range of measurements, such as:

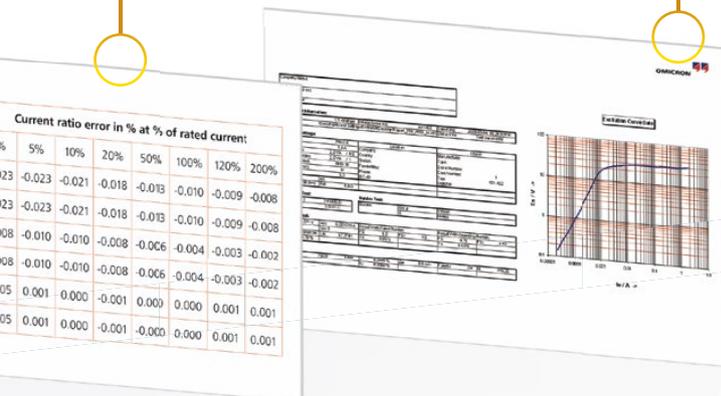
- > CT ratio and phase-angle accuracy
- > CT accuracy for different burdens
- > CT winding resistance
- > CT excitation characteristics
- > CT inductance (saturated and unsaturated)
- > ALF and FS (direct and indirect)
- > Burden impedance
- > CT residual magnetism

3 Assessment according to IEEE or IEC standard

Automated comparison of test results with the defined values / limits according to the selected IEEE or IEC standard

4 Reporting

All data is delivered in an XML file and can be displayed via the reporting tool



Your benefits

- > Field verification of CTs up to the 0.1 accuracy class due to extremely high accuracy (0.02 % typical)
- > Compact and lightweight (< 8 kg / 17.4 lbs)
- > Automatic assessment in accordance with IEEE and IEC standards
- > Reduced testing time (typically < 1 min)
- > High noise immunity for on-site testing

www.omicronenergy.com/CT-Analyzer

Highly accurate CT calibration and verification made mobile

The ideal way of testing a current transformer

Due to the continuous expansion of the power system grids the reliability of the installed equipment becomes more and more important. This makes the use of additional metering and protection CTs necessary. To test all of these CTs in a cost-effective and reliable way, the ideal CT test device fulfills the following requirements:

Mobility

Test engineers often have to maintain several CTs within one utility. The ideal CT test device would therefore be an all-in-one solution, light enough to be carried by one person. It should be able to measure all parameters without the need for any further equipment (such as burden boxes).

Accuracy

Correct billing is only possible if metering CTs work within their specifications, for all secondary burdens and levels of primary current that are defined in the standards. To test and calibrate these metering CTs, measurement equipment delivering reliable results up to class 0.1 CTs is needed.

Primary nominal current injection

Primary current injection

Mobility

- > Approx. 2 tons of equipment (high current source, huge cables, current booster, burden box etc.)

- > > 30 kg / 66.1 lbs (Not including additional equipment, e.g. external burden box)

Accuracy

- > High accuracy, but complicated wiring makes testing error-prone

- > Not sufficient for high accuracy metering CTs
- > Sensitive to transient distortion from life signals (due to the use of 50 Hz test signals)

Safety

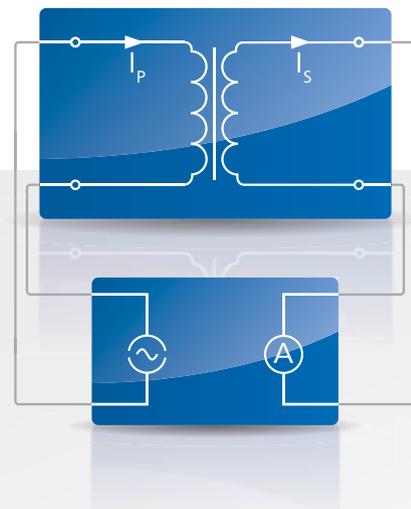
- > Uses dangerously high voltages and currents (primary nominal current injection)

- > Typical current levels of 500 A to 800 A are used

Handling

- > Requires several people to set-up and conduct the test

- > Re-wiring is required for each type of test (e.g. ratio, polarity, saturation, winding resistance)
- > Test results must be assessed manually



Safety

Equipment for testing CTs on-site must comply to applicable safety standards and regulations. However, the ideal test device should avoid the use of high test currents and voltages and conduct tests with as low test voltages as possible to reduce the operator's health and safety risks.

Handling

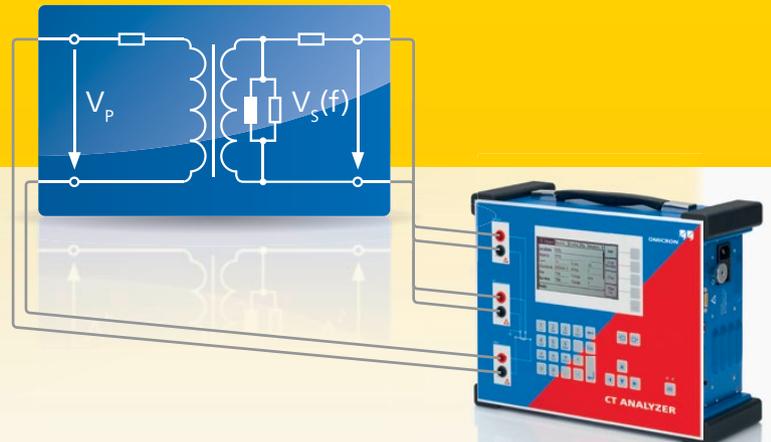
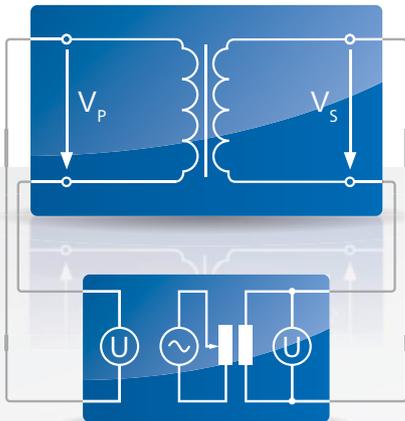
Short measurement times and an automated assessment to the respective IEC and IEEE standards characterize modern test equipment. All relevant parameters should be measured in one test cycle without the need for rewiring. Printable test reports, including all measured data and the assessment to the standard, are ideally created automatically by the test device.

Secondary voltage injection

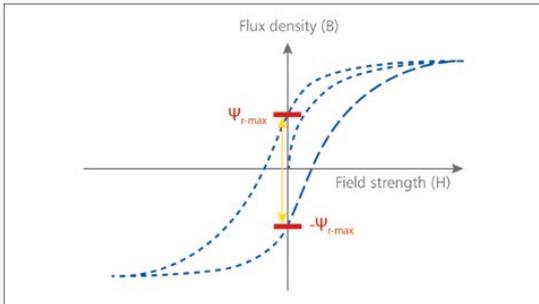
- > > 30 kg / 66.1 lbs (Not including additional equipment, e.g. external burden box)
- > Not sufficient for high accuracy metering CTs
Sensitive to transient distortion from life signals (due to the use of 50 Hz test signals)
- > Voltages for saturation tests can be 2,000 V or more
- > Re-wiring is required for each type of test (e.g. ratio, polarity, saturation, winding resistance)
- > Test results must be assessed manually

Model-based CT testing

- > < 8 kg / 17.4 lbs; ideal for handling on site
- > Measurement of class 0.1 metering CTs
- > Excellent noise suppression guaranteed
- > Highly accurate on-site testing even if active lines are close to the test object
- > Maximum output voltage of 120 V
- > One-step test determining all parameters (< 1 min)
- > Automated assessment to standard and integrated report functionality

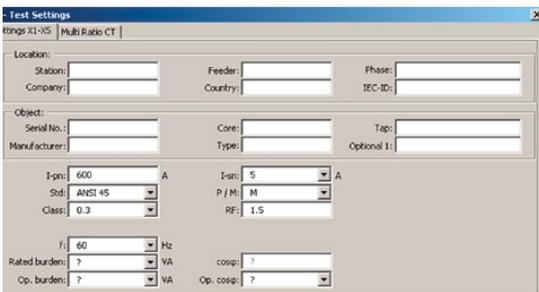


Extraordinary features



RemAlyzer

- > Software-based tool to determine the residual magnetism in current transformers
- > Analysis of the remanence condition before putting into operation the CT to assure proper function
- > Simplifies power grid failure analysis after unwanted operation of protective relays
- > Demagnetizes the CT core after measurement



Remote control

- > Full access to all functions of the CT Analyzer via a PC using the remote interface
- > Optimizes the integration into automated testing procedures in production lines
- > Data export into Excel™ and Word™
- > Customizable testing and reports

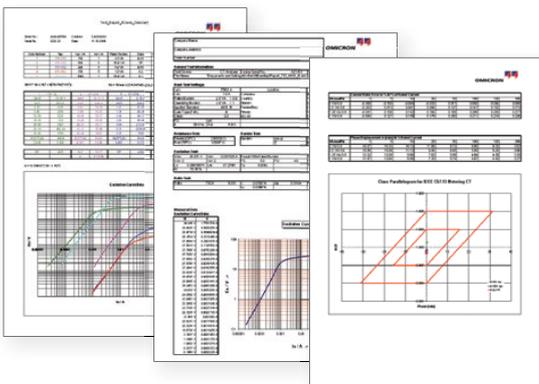


Network simulation and relay testing

- > Easy transfer of CT Analyzer measurement data to NetSim (Test Universe module) and RelaySimTest (stand-alone software) for network simulation and relay testing
- > Calculation of current and voltage signals based on accurate modelling of energy networks and the resulting time constants
- > Behavior analysis of protective system in case of CT saturation
- > Support of several simultaneous CT simulations e.g. for test on differential protection

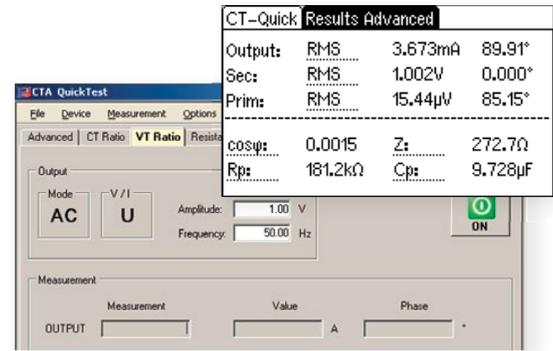
Data handling and reporting

- > Test reports can be saved on the Compact Flash Card and transferred to a PC
- > Data and protocols can be shown on a PC via the Excel™ file loader program
- > Customizable report templates are available, for example:
 - > Different standards, classes and applications
 - > Single, multi-core and multi-tap CTs
 - > Three-phase testing
 - > Core testing



Manual testing: QuickTest

- > Use of the CT Analyzer as a multimeter with an integrated current and voltage source (DC and AC)
- > Perform manual tests (L, Z, R, ratio, polarity, burden etc.) for trouble-shooting and quick verification on site
- > VT ratio check



CPOL2: Polarity checker using QuickTest

- > Check of correct polarity along the different connection points in CTs' secondary wiring
- > Analysis of sawtooth signal injected by the CT Analyzer



CT SB2 switch box

- > Automated testing of multi-tap CTs without the need for rewiring
- > Includes terminals for burden and primary resistance tests
- > CTs with up to six taps can be tested
- > Automatic wiring check before measuring
- > Use attached to the CT Analyzer or as a standalone unit



„Guessing“ nameplates

- > Determination of unknown CT data
- > Older CTs can be classified and put into service without contacting the manufacturer
- > Determinable parameters include:
 - > CT type
 - > Class
 - > Ratio
 - > Knee point
 - > Power Factor
 - > Nominal and operating burden
 - > Winding resistance (primary and secondary)

	CT-Object	Resistan...	Excitati...	Ratio
before test	Location:	XXXX		
	Object:	XXXX		
	I-pr:	?A	I-sn:	?A
	Standard:	ANSI 45	P/M:	?
	VA:	?VA	Cosφ:	n/a
	Burden:	?VA	Cosφ:	?
after test	Location:	XXXX		
	Object:	XXXX		
	I-pr:	2000.0A	I-sn:	5.0A
	Standard:	ANSI 45	P/M:	M
	Class:	0.3	RF:	2
	VA:	22.5VA	Cosφ:	0.9

Simulation and reuse of measurement results

- > Existing measurement data can be loaded to the CT Analyzer at any time
- > Recalculation of the CT parameters for different burdens and primary currents
- > No further on-site measurements are necessary to verify whether a change in the burden will influence the accuracy of a CT

VA	POWER		Current ratio error in % at % of rated current							
	cos Phi	Burden in %	1%	5%	10%	20%	50%	100%	120%	200%
15	0.8	100	-0.023	-0.023	-0.021	-0.018	-0.013	-0.010	-0.009	-0.008
		25	-0.023	-0.023	-0.021	-0.018	-0.013	-0.010	-0.009	-0.008
7.5	0.8	100	-0.008	-0.010	-0.010	-0.008	-0.006	-0.004	-0.003	-0.002
		25	-0.008	-0.010	-0.010	-0.008	-0.006	-0.004	-0.003	-0.002
3.75	1	100	0.005	0.001	0.000	-0.001	0.000	0.000	0.001	0.001
		25	0.005	0.001	0.000	-0.001	-0.000	0.000	0.001	0.001
0	1	100	0.007	0.005	0.004	0.003	0.003	0.003	0.004	0.004
		25	0.007	0.005	0.004	0.003	0.003	0.003	0.004	0.004

Technical data, Services

Technical data CT Analyzer

Current ratio accuracy

Ratio 1 ... 2000	0.02 % (typical) / 0.05 % (guaranteed)
Ratio 2000 ... 5000	0.03 % (typical) / 0.1 % (guaranteed)
Ratio 5000 ... 10000	0.05 % (typical) / 0.2 % (guaranteed)

Phase displacement

Resolution	0.1 min
Accuracy	1 min (typical) / 3 min (guaranteed)

Winding resistance

Resolution	1 m Ω
Accuracy	0.05 % (typical) / 0.1 % + 1 m Ω (guaranteed)

Power supply

Input voltage	100 V _{AC} ... 240 V _{AC}
Permissible input voltage	85 V _{AC} ... 264 V _{AC}
Frequency	50 / 60 Hz
Permissible frequency	45 Hz ... 65 Hz
Input power	500 VA
Connection	Standard AC Socket IEC 60320

Output

Output voltage	0 ... 120 V _{AC}
Output current	0 ... 5 A _{eff} (15 A _{peak})
Output power	0 ... 400 VA _{eff} (1500 VA _{peak})

Physical dimensions

Size (W x H x D)	360 x 285 x 145 mm / 9.2 x 7.2 x 3.7 in
Weight	8 kg / 17.4 lbs (without accessories)

Environment conditions

Operating temperature	-10 °C ... + 50 °C / 14 °F ... 122 °F
Storage temperature	-25 °C ... + 70 °C / -13 °F ... 158 °F
Humidity	Relative humidity 5% ... 95% not condensing

Certificates from independent test institutes

KEMA Test Report
PTB Test Report
Wuhan HV Research Test Report

Optional services

Calibration according to ISO / IEC 17025 for new CT Analyzers
Recalibration according to ISO / IEC 17025 for CT Analyzers



Technical data CT SB2

Input Current	0.2 A
Dimensions (W x H x D)	284 x 220 x 68 mm / 11.2 x 8.7 x 2.7 in
Weight	5.7 lbs / 2.6 kg



Technical data CPOL2

Measuring range	250 μ V _{RMS} ... 300 V _{RMS}
Evaluated signal form	Polarity test signal with slope ratio \geq 3:1
Nominal frequency	52.6 Hz
Power consumption	Measurement active: < 100 mW Standby: 50 μ W
Input impedance	> 300 k Ω

Batteries	Type and number: 2 x 1.5 V Mignon LR6 AA AM4 MN1500
Dimensions (W x H x D)	180 x 55 x 35 mm / 7.1 x 2.2 x 1.4 in
Weight	150 g / 0.33 lb



Features of CT Analyzer Packages

	Standard Package	Advanced Package	IEEE Metering Test Set	IEEE Protection Test Set
Automatic assessment according to				
> IEC 61869-2 / 60044-1, or IEEE C57.13 for CTs of accuracy classes ≥ 0.3	■	■	■	■
> IEC 61869-2 / 60044-1 / 60044-6 / IEEE C57.13 / C57.13.6 for CTs of accuracy classes ≥ 0.1	–	■	–	–
> IEEE C57.13 for CTs of all metering accuracy classes, incl. 0.15 and 0.15S	–	–	■	–
> IEEE C57.13 of protection class CTs	–	–	–	■
Determination of ALF/ALFi and FS/FSi, Ts, and composite error for nominal and connected burden	■	■	–	–
CT ratio and phase measurement with consideration of nominal and connected secondary burden	■	■	■	■
CT winding resistance measurement (primary and secondary)	■	■	■	■
CT excitation curve				
> Saturation characteristic measurement	■	■	■	■
> Comparison of excitation curve to a reference curve	■	■	■	■
CT phase and polarity check	■	■	■	■
Secondary burden measurement	■	■	■	■
Automatic demagnetization of the CT after the test	■	■	■	■
„Nameplate guesser“ function for CTs with unknown data	■	■	■	■
RemAlyzer tool which determines the residual magnetism in CTs	□	□	□	□
Remote control interface	■	■	■	■
QuickTest: Manual testing interface (L, Z, R, ratio, polarity, burden etc.)	■	■	■	■
Simulation of measured data with different burdens and currents	■	■	■	■
Knee-point voltage from 1 V up to 4 kV can be measured	■	■	■	■
Knee-point voltage from 1 V up to 30 kV can be measured	–	■	–	–
Measurement of transient behavior of TPS, TPX, TPY and TPZ type CTs	–	■	–	–
Determination of the transient dimensioning factor (Ktd)	–	■	–	–
Considering Duty Cycles C-O / C-O-C-O e.g. auto-reclosure system	–	■	–	–
Allows testing of CTs for power frequencies of 50 Hz	■	■	–	–
Allows testing of CTs for power frequencies of 60 Hz	■	■	■	■
CT SB2 (switch box) for measurements of CTs with up to 6 taps including accessories	–	–	–	■
CPOL2 checks the correct polarity along the different connection points in CTs' secondary wiring	□	□	□	□
Calibration according to ISO / IEC 17025 for new CT Analyzers	□	□	□	□
Recalibration according to ISO / IEC 17025 for CT Analyzers	□	□	□	□

■ included □ optional – not included

Ordering Information

CT Analyzer Packages

	Description	Ordering No.
Standard Package incl. accessories	For measurements and automatic assessment on CTs with accuracy classes ≥ 0.3 according to IEC and IEEE standards	VE000656
Advanced Package incl. accessories	Expanding standard package functionality to accuracy classes ≥ 0.1	VE000654
IEEE Metering Test Set	For metering CTs with accuracy classes ≥ 0.15 according to IEEE C57.13 (does not support protection CTs)	VE000658
IEEE Protection Test Set	For protection CTs according to IEEE C57.13 (does not support metering CTs)	VE000657

CT Analyzer Standard Package



Package Upgrades

	Description	Ordering No.
Upgrade Standard - Advanced	Upgrades Standard Package to Advanced Package	VESM0653
IEEE Metering - Advanced Upgrade	Upgrades IEEE Metering Test Set to Advanced Package	VESM0656
IEEE Protection - Advanced Upgrade	Upgrades IEEE Protection Test Set to Advanced Package	VESM0654

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

CT Analyzer Accessories

	Description	Ordering No.
CT SB2 incl. accessories	Switch box for measurements on CTs with up to 6 taps	VEHZ0696
		
Training CT	Class 0.5 CT for training purposes. FS 5, ratio = 300:5	VEHZ0643
		
Calibration CT	High-precision CT (class 0.02) for calibration purposes. Ratios = 2000:1 / 2000:5	VEHZ0649
		
CPOL2	Polarity checker for CTs' secondary wiring	VEHZ0702
		

Software Tool

	Description	Ordering No.
RemAlyzer	Determines the residual magnetism in CTs	VESM0657

Calibration Services

	Description	Ordering No.
Recalibration of high-precision CT	Recalibration of high-precision CT according to ISO / IEC 17025 (recommended every 1-2 years)	VEDK9055
Calibration of new CT Analyzers	Calibration of new CT Analyzer devices according to ISO / IEC17025 (certificates included)	VEDK9002
Recalibration of CT Analyzers in service	Recalibration of CT Analyzer devices according to ISO / IEC17025 (certificates included, recommended every 1-2 years)	VEDK9051

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 150 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.

The following publications provide further information on the solutions described in this brochure:



Datasheet CT SB2
Switch Box

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