CP CU1

Coupling unit for line and ground testing

Line and ground test system - CPC 100

The CPC 100 is a multifunctional test set for primary assets. When combined with the CP CU1 it covers the following tests:

- Line impedances of overhead lines and power cables for distance relay parameterization
- Mutual coupling impedances between parallel lines
- Ground impedances of large substations (fall-of-potential or 3-point test)
- Step and touch voltages
- Reduction factor
- Coupling of power lines into signal cables

CPC 100

HGT1 - Handheld grounding tester

CP GB1 - Grounding box

+ CP CU1

Safe testing

Measurements on power lines require special safety precautions. The CP CU1 ensures the galvanic isolation of the user from the line under test for enhanced protection.

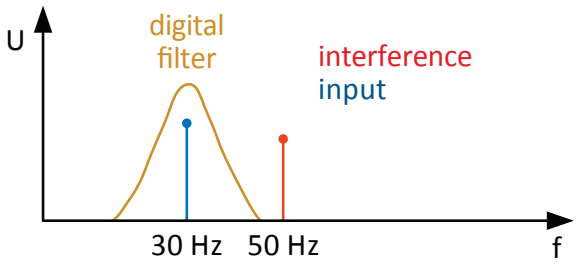
In addition the CP GB1 features high current surge arrestors to protect the CP CU1 and the CPC 100 from unexpected overvoltages on the line under test. Up to 30 kA can be safely diverted to ground.

Accurate and light-weight

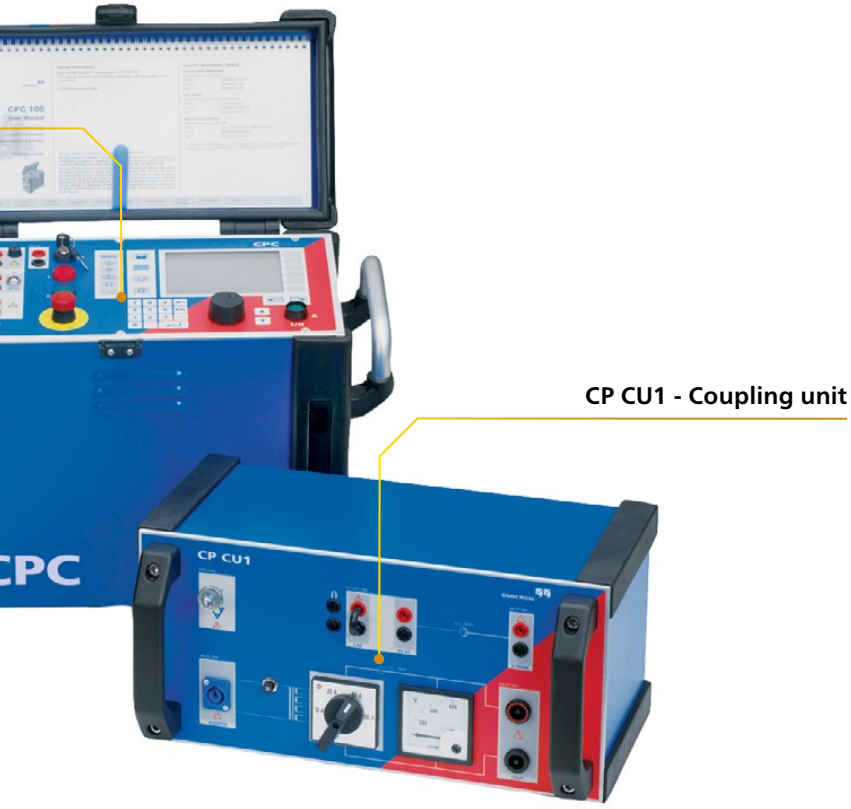
Overhead lines can be subjected to high interference. Accurate line impedance measurements therefore require effective noise suppression.

For this reason the CPC 100 employs frequency selective measurement. This means that a test current with a frequency different from power frequency is injected into the line.

Using a digital filter for the current and voltage measurements allows power frequency interference to be suppressed effectively and the test parameters to be determined accurately.



Conventional testing equipment uses noise suppression methods which require much higher test currents.
Thus the equipment is much larger and heavier. The heaviest component of our test solution is 29 kg - perfect for easy handling and for being shipped around the world!



CP CU1 - Coupling unit

Your benefits

- High Accuracy: Frequency selective measurement and digital filtering
- Safety: Galvanic isolation and protection from overvoltages
- Light-weight and easy to handle
- Intuitive reporting and assessment with dedicated templates
- One unit for line and ground testing

www.omicronenergy.com/CPCU1

Line impedance measurement

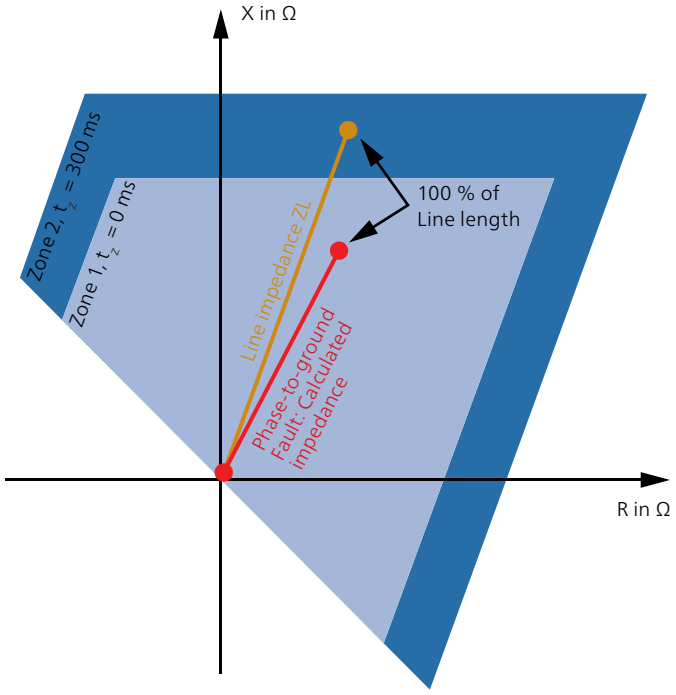
Line parameters for distance protection

Correct line parameters are crucial for reliable and selective distance protection. The set of parameters contains the positive and the zero sequence impedance (Z_1, Z_0) as well as the k-factor (k_L, R_E/R_L and X_E/X_L, k_0).

These parameters are often calculated from software tools, which do not provide actual line parameters due to unknown soil properties, such as different soil resistivities, pipelines or other unknown conductors. This leads to under- or overreach of your distance protection relay resulting in outage and loss of grid stability.

Zone under- and overreach

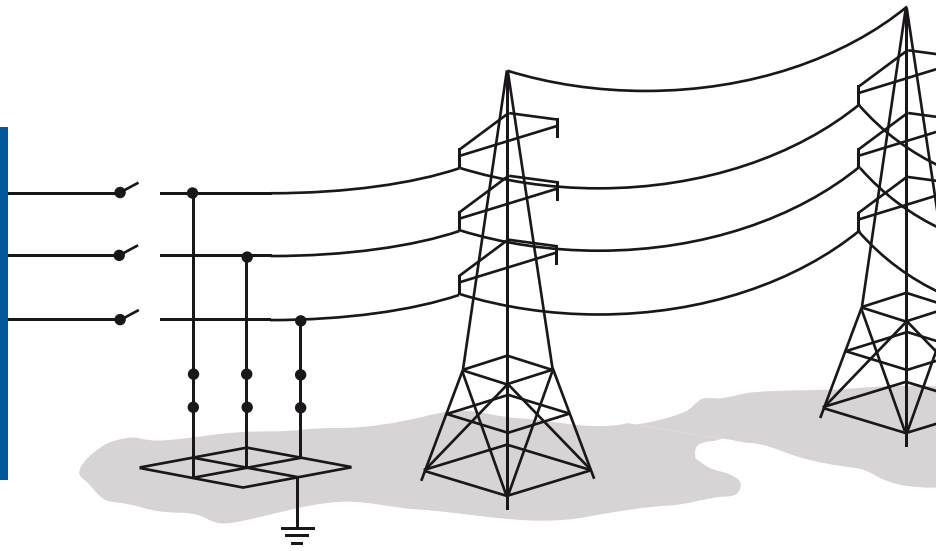
The most frequent faults on power lines are ground faults. In particular, inaccuracies from software calculation effect this kind of fault. The example on the right shows a zone overreach for a ground fault due to an incorrect k-factor setting. In this case the assumed k-factor is higher than the actual one. Therefore, a ground fault at the remote end of the line is seen incorrectly in the first zone.



Incorrect k-factor (tendancy to overreach)

Measurement advantages:

- Tune your distance relay by performing a line impedance measurement
- Safe and quick determination of Z_1, Z_0 and k-factors.
- Mutual coupling Impedance measurement between parallel lines



Test set-up

The test set-up for a line impedance measurement is shown below. The loops A-B, B-C and A-C are measured to determine Z_1. The loop ABC-G is measured to determine Z_0. K-factor formats commonly used in distance relays are then calculated from these two values.

Testing with the CPC 100

The main unit CPC 100 unit generates the frequency variable test current and measures current and voltage by applying digital filtering for high accuracy. The complex loop impedance is then calculated accordingly.

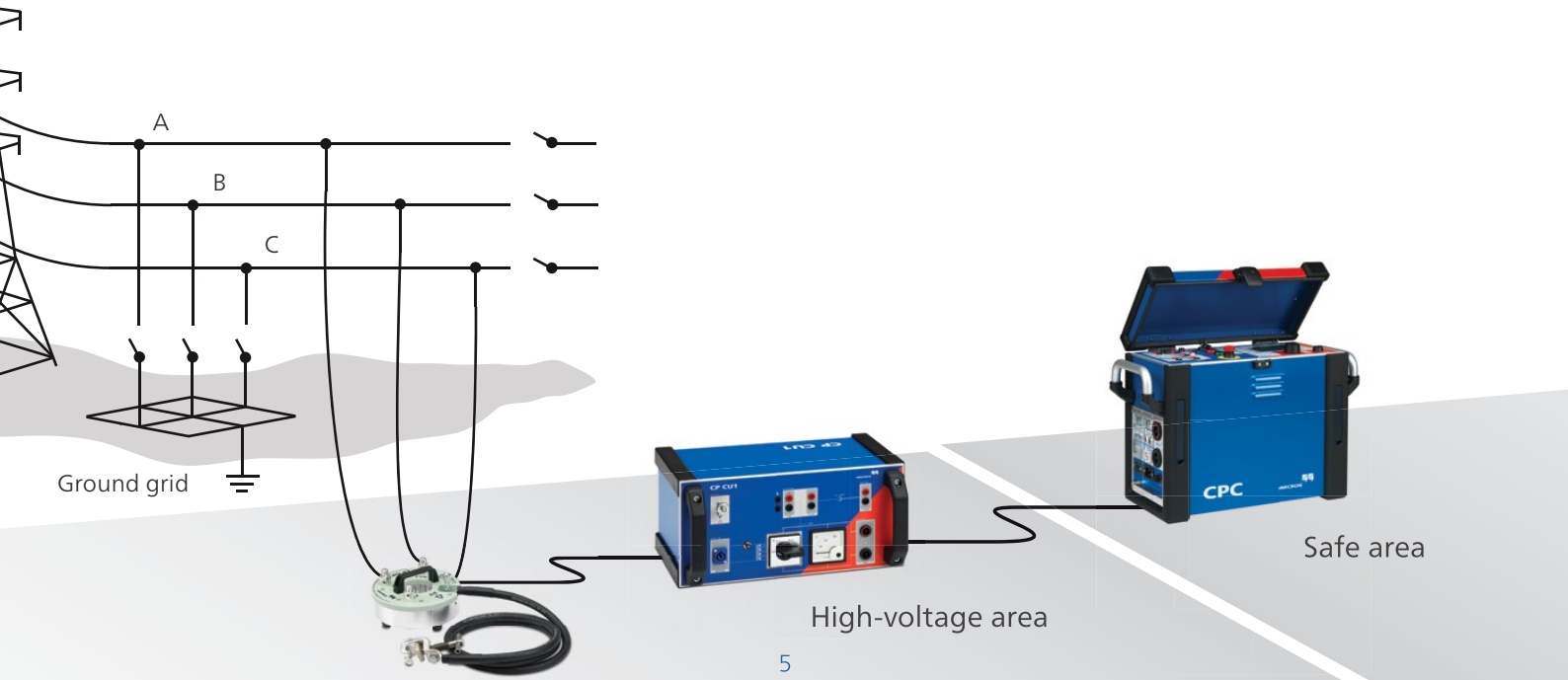
The CP CU1 provides galvanic isolation between the line under test and the CPC 100 as well as impedance matching for short and long lines.

The CP GB1 protects the test equipment and the user from any unexpected overvoltage on the line under test. Furthermore it allows a direct connection to the power line for a convenient execution of the test.

A dedicated test template provides the positive and the zero sequence impedance as well as the k-factor in commonly used formats. Furthermore it shows the actual zone reach for each fault type based on the measured values and relay parameters that are currently being used.

Mutual coupling

With this unique testing equipment, the mutual coupling impedance between parallel lines can also be determined to consider coupling effects for correct parameterization.



Grounding system testing

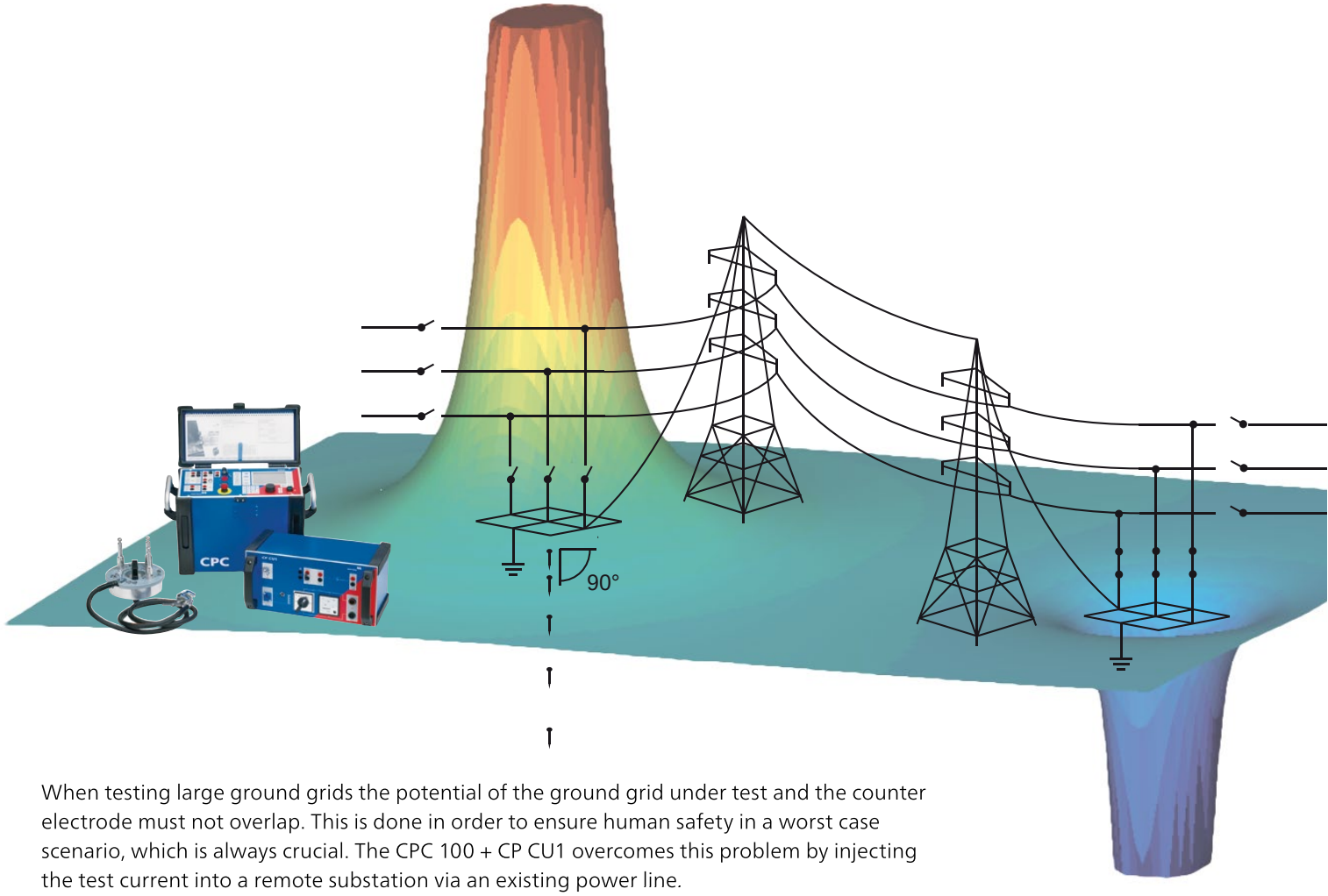
Personnel safety

In the event of a ground fault hazardous step and touch voltage can occur inside and outside of a substation. Ground tests prove the effectiveness of grounding systems and guarantee safety of people inside and outside the substation.

A fall-of-potential measurement is usually performed to determine the condition of the entire ground grid. On top of that, step and touch voltages are measured at exposed locations in order to ensure human safety in select areas.

Fall-of-potential measurement (3-point test)

The fall-of-potential measurement with the CPC 100 is performed according to EN 50522 or IEEE 81. For the fall-of-potential measurement the voltage between the ground grid and ground electrodes in different distances to the ground grid is measured until reference ground is reached. Dedicated software transforms the test results into a voltage and impedance chart which allows the ground potential rise and the ground impedance to be determined.



When testing large ground grids the potential of the ground grid under test and the counter electrode must not overlap. This is done in order to ensure human safety in a worst case scenario, which is always crucial. The CPC 100 + CP CU1 overcomes this problem by injecting the test current into a remote substation via an existing power line.

Step and touch voltage measurement

Step and touch voltage measurements according to EN 50522 and IEEE 81 are performed with the HGT1. This handheld device employs frequency selective measurements for effective noise suppression.

Furthermore, tests can be executed quickly and easily since long test cables for connecting to the main device are no longer necessary.

Dedicated test templates assess measured step and touch voltages according to EN 50522 and IEEE 80 automatically.

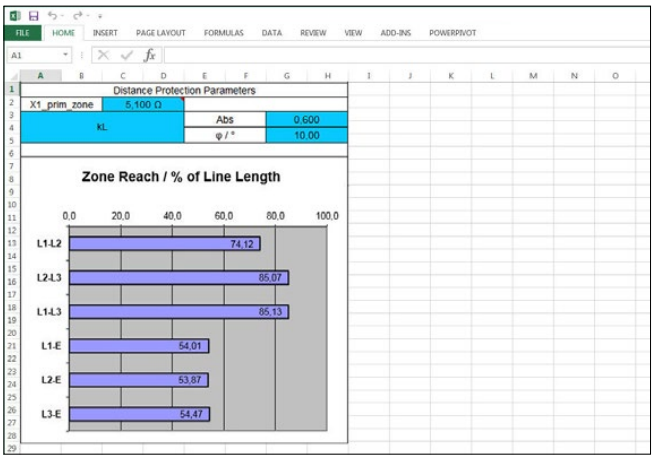
Measurement advantages:

- > Determine true test values by power line injection
- > Simple and accurate step and touch voltage measurements with handheld device HGT1
- > Reduction factor measurement on ground wires and cable shields

The HGT1 employs frequency selective measurements for effective noise suppression.
You can easily access different measurement locations, eliminating the need for a separate set of long measurement cables.

A 20 cm x 20 cm metal plate is used for touch voltage measurements according to EN 50522.
A rod is used for measurements according to IEEE 81.

Software supported testing

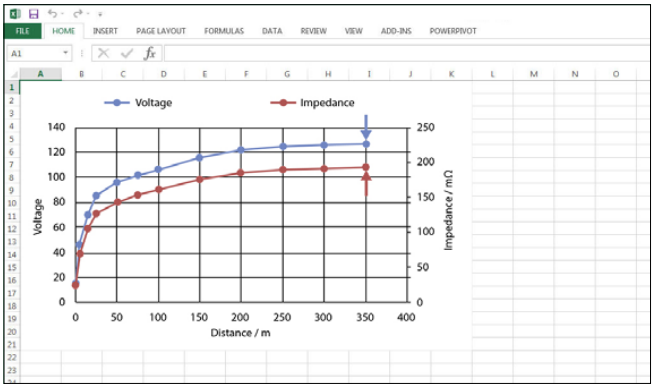


Test templates

We provides dedicated Microsoft Excel™ test templates for line and ground testing. This allows reporting and test data assessments to be performed quickly and easily.

Line impedance

The line impedance test template shows the actual zone reach of an arbitrary parameter set (X-value of the zone and k-factor) based on the measured impedances. The example on the left refers to the settings of the first zone (usually 80 % zone reach) which reveals a zone underreach for ground faults.



Ground testing

The ground impedance test template creates impedance and voltage charts for the determination of ground impedance and ground potential rise.

Furthermore the step and touch voltage test template allows automated assessment according to EN 50522 and IEEE 80.

System-based protection testing with RelaySimTest

RelaySimTest is our easy-to-use software for system-based protection testing with CMC test sets. It applies power system simulations based on the measured line, ground and mutual coupling impedances and calculates realistic voltages and currents for multiple fault scenarios automatically. This unique approach reveals failures created during calculations used for the parameterization of protection relays as well as during the setup of a relay or a complete protection scheme.

CPC 100: the all-in-one system

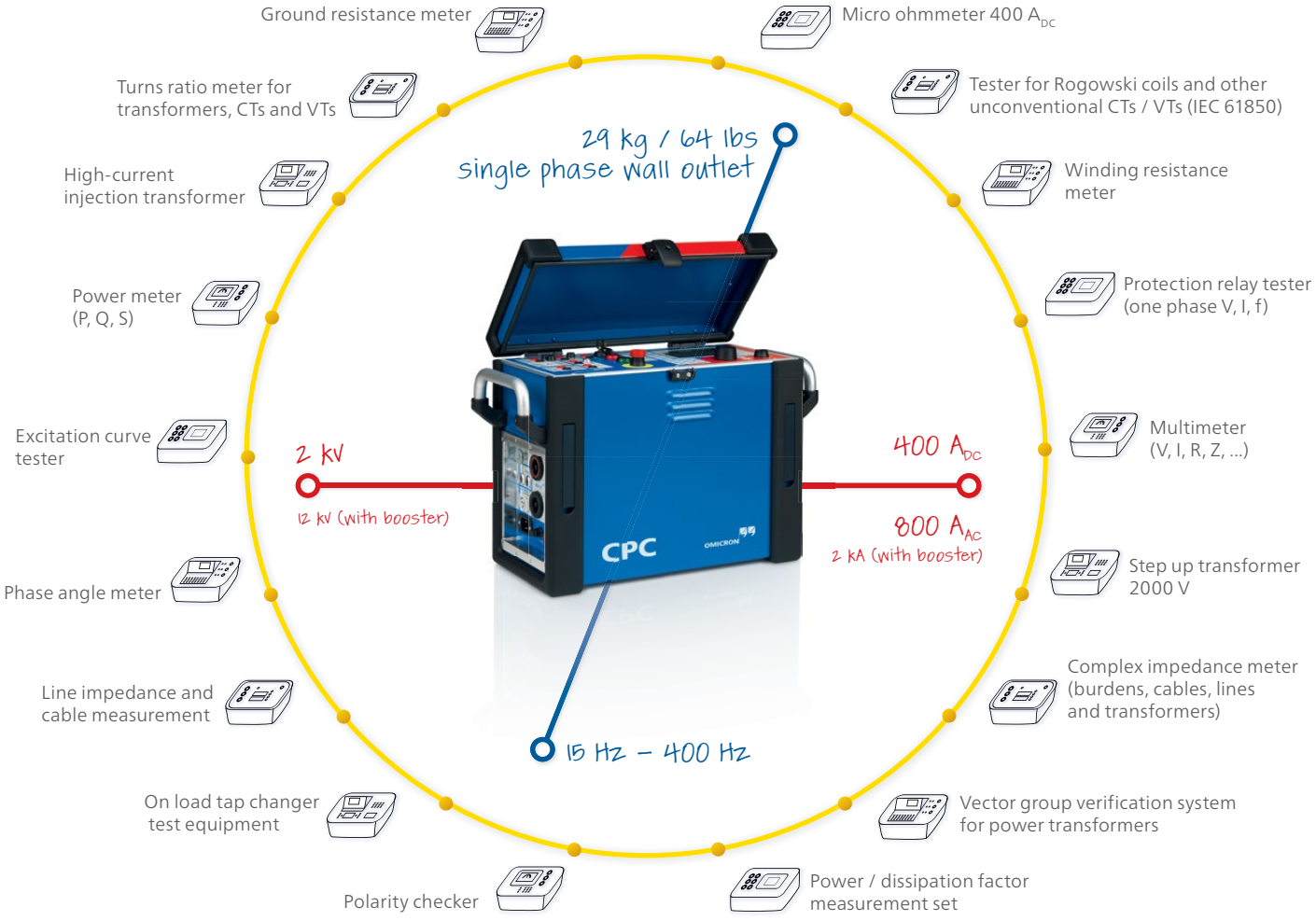
The CPC 100 covers a lot of other applications in and around substations as well as at the manufacturer's production site. This powerful device provides up to 800 A or 2 kV with up to 5 kVA over a frequency range of 15 Hz to 400 Hz or 400 A_{DC}.

It can test various substation assets, thereby replacing several individual testing devices. This makes testing with the CPC 100 a time-saving and cost-effective alternative, especially as the application range of the CPC 100 is further expanded by a high number of valuable accessories. Despite its expansive capabilities, the CPC 100 is very simple to use.

Thus it is the ideal instrument for all major applications in the area of substation asset testing.

Featured assets

- Current transformers
- Voltage transformers
- Power transformers
- Power lines
- High-voltage cables
- Grounding systems
- Rotating machines
- Switchgear and circuit breakers
- IEC 61850 installations
- Protection relays



Technical data

CPC 100*

Power specifications

Single-phase, nominal[1]	100 V_{AC} ... 240 V_{AC} , 16 A
Single-phase, permissible	85 V_{AC} ... 264 V_{AC} (L-N or L-L)
Frequency, nominal	50 Hz / 60 Hz

Mechanical data

Dimensions (W × H × D) (cover without handles)	468 × 394 × 233 mm / 18.4 × 15.5 × 9.2 in
Weight (case without protection cover)	29 kg / 64 lbs

CP GB1

Nominal ac spark-over voltage	< 1 000 V_{rms}
Impulse spark-over voltage	< 2 000 V_{peak}

Short circuit proof with:

16 mm cylindrical or 20 mm ball studs	26.5 kA (< 100 ms) / 67 kA_{peak}
25 mm ball studs	30 kA (< 100 ms) / 75 kA_{peak}
Torsional moment for changing arrestors	> 15 Nm
Dimensions (Ø × H)	200 × 190 mm / 7.9 × 7.5 in
Weight	6.8 kg / 13.2 lbs (including grounding cable)

HGT1

Voltage input	Max. 25 V_{rms}
Power supply	1 × 3.7 V lithium polymer (Li-Po) battery
Dimensions (W × H × D)	90 × 180 × 45 mm / 3.5 × 7.1 × 1.8 in
Weight (including battery)	0.48 kg / 1 lb

* Additional information can be found in the CPC 100 brochure.

CP CU1

Output ranges

Range	Current	Compliance voltage at > 45 Hz
10 A	0 ... 10 A_{rms}	500 V_{rms}
20 A	0 ... 20 A_{rms}	250 V_{rms}
50 A	0 ... 50 A_{rms}	100 V_{rms}
100 A	0 ... 100 A_{rms}	50 V_{rms}

Measuring transformers

Transformer	Ratio	Accuracy at 50 Hz / 60 Hz
VT	600 V : 30 V	Class 0.1
CT	100 A : 2.5 A	Class 0.1

Inputs

	Characteristic	Rating
V SENSE	Overvoltage category	CAT III (IEC 61010-1)
	Voltage range	0 ... 600 V_{rms}
BOOSTER	Overvoltage category	CAT I
	Voltage range	0 ... 200 V_{rms}
	Current range	0 ... 30 A_{rms}
	Frequency range	15 Hz ... 400 Hz
	Fuse	30 A fast acting, automatic circuit breaker

Output power

Characteristic	Rating
Maximum power	5 000 VA (45 Hz ... 70 Hz), cos ϕ < 1.0 for 8 s at 230 V_{AC} 5 000 VA (45 Hz ... 70 Hz), cos ϕ < 0.4 for 8 s at 115 V_{AC}
Continuous power	0 ... 1 600 VA

Accuracy

Range	Accuracy of absolute value	Accuracy of phase angle	V SENSE voltage	I OUT current	Current range
0.05 ... 0.2 Ω	1.0 ... 0.5 %	1.5 ... 0.8°	5 ... 20 V	100 A	100 A
0.2 ... 2 Ω	0.5 ... 0.3 %	0.8 ... 0.5°	20 ... 50 V	100 ... 25 A	100 A
2.0 ... 5 Ω	0.3 %	0.5°	100 V	50 ... 20 A	50 A
5.0 ... 25 Ω	0.3 %	0.5°	100 ... 250 V	20 ... 10 A	20 A
25 ... 300 Ω	0.3 ... 1.0 %	0.5 ... 1.5°	250 ... 500 V	10 ... 1,5 A	10 A

Mechanical data

Dimensions (W × H × D)	450 × 220 × 220 mm / 17.7 × 8.7 × 8.7 in
Weight	28.5 kg / 62.78 lbs

Ordering information

CP CU1 Packages

Package	Description	Ordering No.
CP CU1 and CP GB1 Upgrade Option	Upgrade opiton to expand your existing CPC 100 to a line impedance measurent test system. Note: CP sequencer test card has to be ordered separately (order no. VESM0635)	VEHZ0671
CPC 100 Line Impedance Test System	Package including CPC 100, CP CU1, CP GB1 and all accessories to perform impedance measurements for determination of distance protection relay settings.	VE000602
Step & Touch Voltage Set for CP CU1	Package to measure step and touch voltages within HV stations and surrounding areas. Including handheld grounding tester HGT1 and accessories.	VEHZ0625
Ground Impedance Set for CP CU1	Upgrade option for ground impedance measurements. It comes with Rogowski coil and a handheld eTrex 10 GPS navigation device including accessories.	VEHZ0622

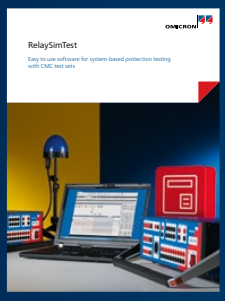
CPC 100 Line impedance test system (order no. VE000602)

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.

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

CPC 100 Brochure



RelaySimTest Brochure

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

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