CPC 100

Multi-functional primary test system for substation commissioning and maintenance

CPC 100 – The revolutionary all-in-one test system

The patented test system replaces numerous individual testing devices and offers new, innovative testing methods. This makes testing with the CPC 100 a time-saving and cost-effective alternative for conventional testing methods. Despite its expansive capabilities, the CPC 100 is very simple to use.

The powerful testing device provides up to 800 A or 2 kV (2 kA or 12 kV with accessories) with up to 5 kVA over a frequency range of 15 Hz to 400 Hz or 400 A_{DC}.

Its compact design (29 kg / 64 lbs) makes it easy to transport and ideal for on-site testing.

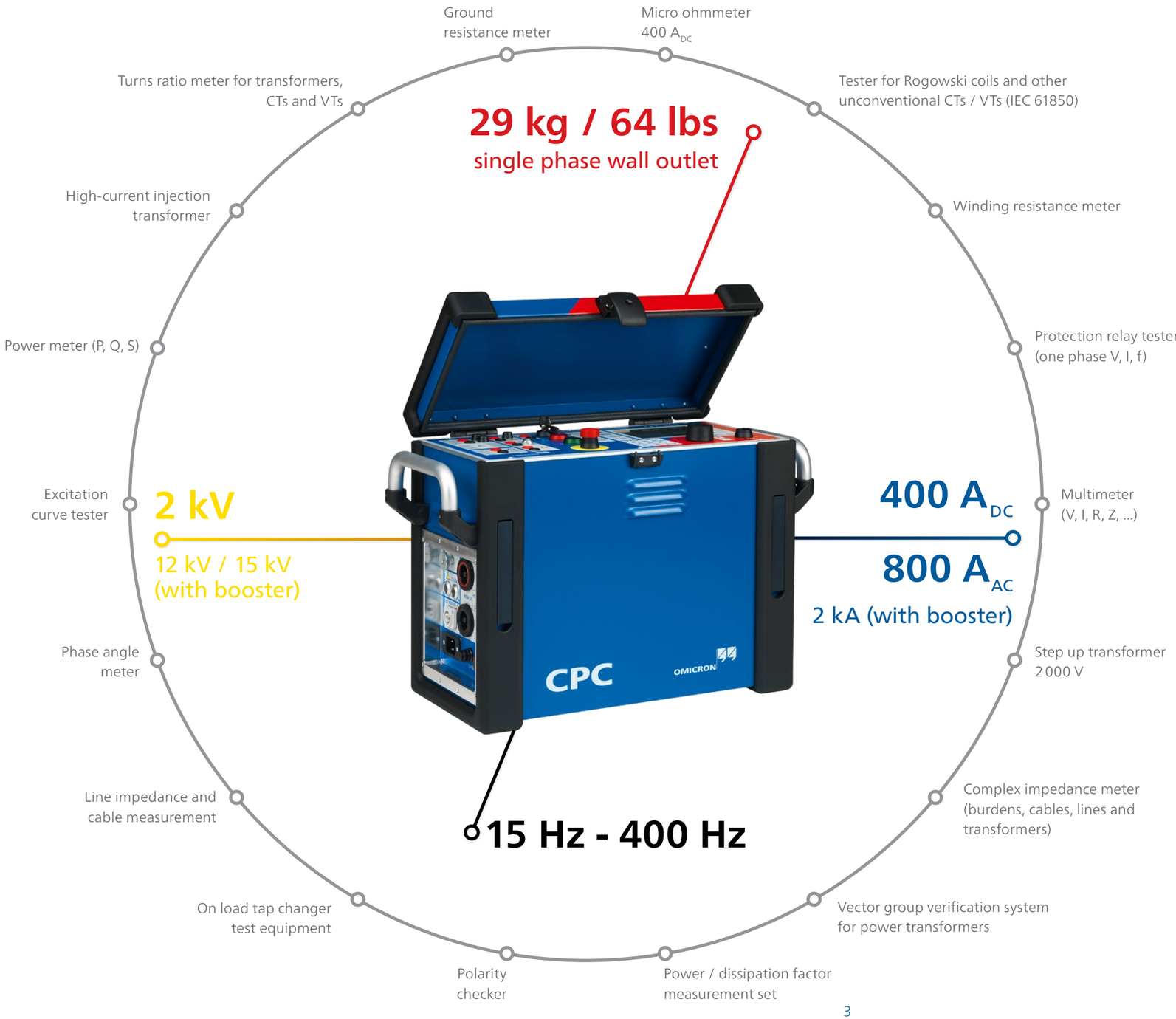
Using the CPC 100, electrical tests on various assets can be performed:

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

Quality & Experience

The usage of high-quality components & intensive routine testing in our factory have made the CPC 100 a reliable companion for for our customers worldwide.

The CPC 100 is being improved continuously in close cooperation with our customers. Its new accessories and continuous updates guarantee a future proof concept.



MULTI FUNCTIONAL

- Test several assets (e.g. CT, VT, CB, power transformer)
- Test different parts of an asset (e.g. core, windings, bushing, insulation)
- Perform numerous tests (e.g. ratio, polarity, burden, excitation current)

VARIABLE **FREQUENCY**

- Voltage and current injection with variable frequency
- Suppression of mains-related interference and disturbances
- Test results at different frequencies provide more detailed information about an asset
- Variable frequency testing is necessary for some standardized and advanced diagnostic tests

TESTING **AND** REPORTING

- Offline test preparation possibilities (time-saving and less error-prone)
- CPC 100 software automatically guides the user through the test
- Automated report generation
- Customizable test reports (e.g. different languages, customer logo)

CONFORMITY **TO STANDARDS**

- CPC 100 fulfills highest safety requirements
- CPC 100 is CE & TÜV tested
- CPC 100 tests according to IEEE and IEC standards
- Measurements with the CPC 100 deliver reliable and repeatable results due to high signal and measurement accuracy

EXPAND ABILITY

- Further applications can be covered by adding additional hardware accessories
- By upgrading the software:
  - Additional tests can be performed
  - Additional assets can be tested

WEIGHT **AND SIZE**

- Light-weight (29 kg / 64 lbs)
- Compact design
- Save costs on:
  - Transport
  - Handling
  - Storage

PRODUCTQUALITY

- Durable case design for rough environments with test field accuracy
- Long lifetime due to high quality components
- Premium quality cables and clamps
- Comprehensive documentation (e.g. user manual with connection diagrams, software help function, videos, application notes)

SAFETY FIRST

- Emergency switch-off button
- Protective Earth conductor connection check
- Overload detection
- Multiple isolated outputs
- Safety key lock
- Discharge circuit to de-energize DC test objects
- SAA1 - audible beeper dongle
- SAA2 - Warning Lamp Set
- SAA3 - 3-position remote safety switch
- Grounding box
- Rapid fault sense (RFS)

PREPARED FOR THE **FUTURE**

- Unconventional assets can be tested (e.g. Rogowski coils, low power CTs)
- Testing according to IEC 61850-9-2 (e.g. Sample Values, Merging Unit testing)
- Future applications areas will be covered by newly developed accessories and software

CPC 100 product family – Extended range of applications

The CPC 100 covers a lot of different applications in and around substations as well as at the manufacturer's production site.

Extended by a high number of valuable accessories the application range of the CPC 100 is further expanded.
Thus it is the ideal instrument for all major applications in the area of primary testing.

CPC 100
Applications

- Current transformer testing (page 8 – 9)
- Voltage transformer testing (page 10 – 11)
- Power and distribution transformer diagnosis (page 12 – 13)
- Grounding system analysis (page 16 – 17)
- Switchgear / circuit breaker testing (page 22 – 23)
- Commissioning protection systems (page 24 – 25)
- Sampled Values testing (page 26 – 27)

Primary test system

Extended range
with accessories

Coupling unit

Grounding box

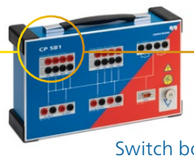
HV cable and power line analysis (page 14 – 15)

Handheld grounding tester

Grounding system analysis (page 16 – 17)

HV-source

Remote control



Switch box

Power and distribution transformer diagnosis (page 12 – 13)

Switchgear / circuit breaker testing (page 22 – 23)

Tan Delta test set (power factor)

Compensation reactor

Rotating machine diagnosis (page 18 – 19)

Voltage transformer testing (page 10 – 11)

Current booster

Current transformer testing (page 8 – 9)

Sampled Values testing (page 26 – 27)

Resonance circuit

Gas Insulated Switchgear testing (page 20 – 21)

Current transformer (CT) testing

Why testing CTs?

Testing current transformers helps to detect installation related and in-service related problems, such as:

Installation related

- Transportation damages
- Wiring errors
- Manufacturing defects

In-service related

- Degradation of accuracy class
- Shorted turns
- Magnetized core
- Burden failures in secondary circuit
- Insulation material failures

With the CPC 100 many standard electrical tests for CTs can be performed with one single device saving testing time and labor costs. Additionally, unconventional CTs, like Rogowski coils and IEC 61850 integrated systems, can also be tested.

CT testing with the CPC 100

Supplied from a single phase wall outlet, the CPC 100 can generate up to 800 A_{AC} (2 000 A with CP CB2 current booster) for injecting into the CT's primary side and testing its ratio, polarity and burden.

Excitation curve measurement

For excitation curve measurement, the CPC 100's output is connected to the secondary terminals of the core. Within an automatic test run, the CPC 100 measures the excitation curve and displays the knee point voltage and knee point current at rated frequency (according to the relevant IEC or IEEE / ANSI standard). The CPC 100 also automatically demagnetizes the CT core after the test.

Winding resistance measurment

Using the winding resistance measurement function also allows the user to calculate the accuracy limiting factor (ALF) for protection circuits and the instrument security factor (FS) for metering circuits.

Power/dissipation factor (PF/DF) measurement

When combined with the CP TD12/15, the CPC 100 is also capable of performing PF/DF measurements. This helps to assess the insulation condition of the CT.

Current transformer testing

- CT ratio (with burden)
  up to 800 A or 2 000 A with CP CB2, 5 kVA output power
- CT burden
  up to 6 A_{AC} | secondary
- CT excitation curve
  (knee point) up to 2 kV_{AC}
- Polarity check with CPOL3
  up to 800 A or up to 2 000 A with CP CB2
- Accuracy limiting factor (ALF) test
- CT ratio with voltage
  up to 130 V_{AC} | bushing CTs
- CT winding resistance
  up to 6 A_{DC}
- CT demagnetisation and remanence
- CT voltage withstand test
  up to 2 kV_{AC}
- CT ratio Rogowski and CT ratio low power
  up to 800 A or up to 2 000 A with CP CB2, 5 kVA output power
- Power/dissipation factor test
  up to 12kV/15 kV, 300 mA | with CP TD12/15
- IEC 61850 Sampled Values testing

+ CPOL3

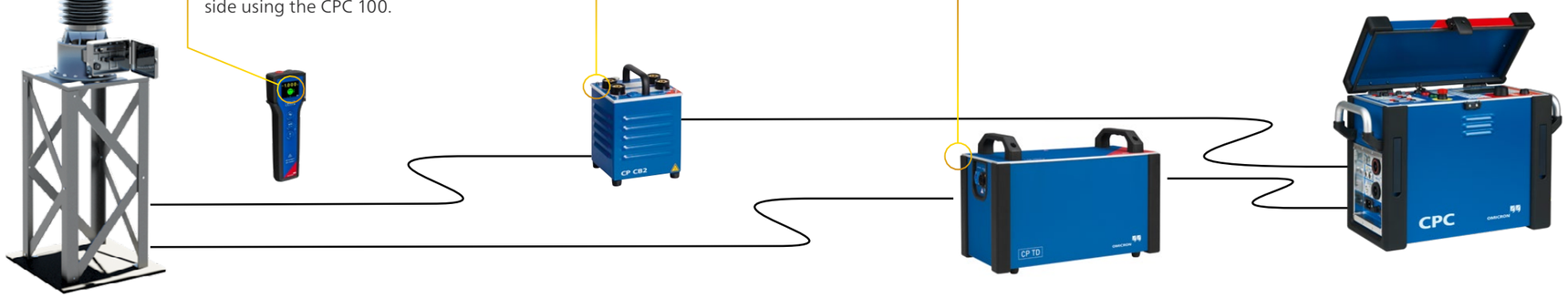
The CPOL3 can check the correct polarity along the different connection points in the secondary wiring by analyzing the sawtooth signal injected into the CT's primary side using the CPC 100.

+ CP CB2

With the CP CB2 primary injection of current up to 2 kA can be realized for CT testing.

+ CP TD12/15

For high-voltage CTs, insulation material tests are very important and can be easily done with the CP TD12/15 accessory.



Your benefits

- Mulifunctional CT tests
- Primary injection up to 2 kA
- Simple wiring test with handheld polarity checker (CPOL3)
- Voltage withstand test up to 2 kV

Voltage transformer (VT) / potential transformer testing

Why testing VTs?

The majority of VT failures occur due to electrical stresses or manufacturing and installation errors. Typically electrical stresses are caused by:

- Thunderstorms
- Ferro-resonances effects
- Over-voltages

Especially in high-voltage and extra high-voltage installations supervision of the VT insulation system is important to ensure that its dielectric characteristics have not degraded over time.

In case of (re-)commissioning of substations VT circuits should also be checked. Verifying the VT´s nameplate data helps to identify damages of the VT or wrong connections.

VT testing with the CPC 100

With a voltage output of up to 2000 V_{AC} the CPC 100 can be used to test VT ratio, polarity and burden.

By injecting voltage into the primary side, ratio can be measured. Thereby the phase angles of high-voltage output and voltage measurement input are also measured. Thus the correct VT polarity can be verified.

Applying voltage to the secondary VT circuits and measuring the load current in amplitude and phase allows the actual burden to be measured, ensuring that it is within the VT´s specification data.

Disturbance-free measurement

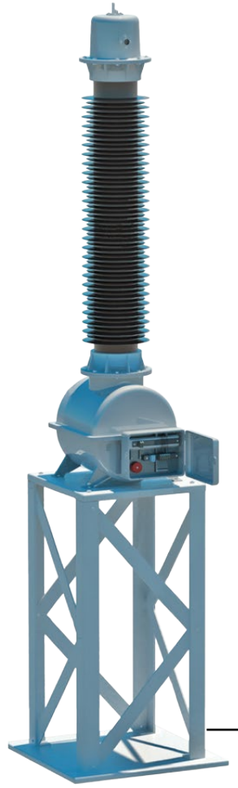
The VT's secondary signal may be difficult to measure if it is small in amplitude – especially if neighboring parts of the substation are in operation. In case of strong disturbances, the user can select a frequency different to that of the power system and utilizes the "frequency selective measurement" function. Thus only the VT's output signal with this particular frequency is measured while all other signals are filtered out.

Voltage/potential transformer testing

- VT ratio
  up to 2 kV_{AC} | polarity and burden
- VT burden
  up to 130 V_{AC} | secondary
- VT secondary voltage withstand test
  up to 2 kV_{AC}
- Polarity check with CPOL3
  up to 2 kV_{AC}
- VT electronics
  up to 2 kV_{AC}
- VT voltage withstand test
  up to 2 kV_{AC}
- IEC 61850 Sampled Values testing
- Power/dissipation factor test
  up to 12 kV/15kV, 300 mA | with CP TD12/15

Your benefits

- Ratio testing from 15 Hz – 400 Hz
- Multi-functional VT testing
- Simple wiring check with handheld polarity checker (CPOL3)



+ CPOL3

The CPOL3 can check the correct polarity along the different connection points in the secondary wiring by analyzing the sawtooth signal injected into the VT's primary side using the CPC 100.

+ CP TD12/15

For high-voltage VTs, insulation material tests are very important and can be easily done with the CP TD12/15 accessory.

Power transformer testing

Testing power transformers – Most common electrical tests with one device

Testing to assess the health of power transformers and to diagnose problems is of utmost importance to ensure the long-term and safe operation of these very expensive power assets.

With the CPC 100 power transformers and their ancillary components can be tested:

- Windings
- Tap changer
- Bushings
- Insulation
- Core
- Connection leads
- Surge arrestors

Winding resistance measurement

The CPC 100 provides an easy and accurate (4-wire connection) winding resistance measurement. Automatic measurement for tapped windings (by using CP SB1 with the on load tap changer) speeds up the measurement. The CPC 100 automatically discharges the inductive energy, which makes the measurement safe.

Demagnetisation

After switching off a transformer or after applying DC signals to a transformer, the core remains magnetized. This can cause problems for further diagnostic measurements or can lead to higher inrush currents. By using the CP SB1 switch box the integrated algorithm in the CPC 100 completely demagnetizes the transformer core.

Ratio & excitation current measurement

For measuring ratio and excitation current, the CPC 100 provides a 2 kV output, delivering 2500 VA. The test voltage is generated digitally and the current is automatically measured within the CPC 100. This makes the measurement highly accurate, easy to set up, fast and safe.

Power/dissipation factor (PF/DF) measurement

For PF/DF measurement on power transformers and bushings, the CPC 100 is combined with the CP TD12/15. Measuring this factor over a broad frequency range – in addition to mains frequency – helps to better assess the insulation condition, for example detect whether the cellulose or the oil is contaminated by moisture.

Dynamic resistance measurement (DRM)

The DRM can be performed as a supplementary measurement in order to analyze the OLTC's switching process. The CPC 100 + CP SB1 injects a DC current in the same way that it does for static winding resistance measurements with the the addition of recording the dynamic behaviour of the diverter switch. Based on this non-invasive testing method, failures can be detected without opening the OLTC compartment.

Power transformer testing

- DC winding resistance up to 100 A_{DC}
- Transformer demagnetization with CP SB1
- Dynamic load tap changer diagnostics (on load tap changer test) up to 100 A_{DC} | optionally with CP SB1
- Transformer turns ratio (TTR) per tap
  up to 2 kV_{AC} | including polarity and excitation current | IEC 61387-1 support for transformer with unconventional vector groups
- Automatically determination of the transformer's vector group with CP SB1
- Leakage reactance / short circuit impedance up to 6 A_{AC}
- Transformer, bushing: power/dissipation factor + insulation capacitance
  up to 12 kV/15kV, 300 mA | frequency from 15 Hz to 400 Hz | with CP TD12/15
- Insulating fluids: power/dissipation factor
  up to 12 kV/15kV, 300 mA | with CP TD12/15 and CP TC12
- Excitation current per tap up to 12 kV/15kV, 300 mA | with CP TD12/15
- Frequency response of stray losses (FRSL)
- Surge arrestors: leakage current and watt losses
  up to 12 kV/15kV, 300 mA | with CP TD12/15
- HV source for voltage withstand test
  up to 15 kVA | with 3 CPCs + TRC1
- HV source for PD measurements
  up to 15 kVA | with 3 CPCs + TRC1

Your benefits

- Most common power transformer tests with one device
- Fully automated testing with switchbox CP SB1
- Advanced tap changer diagnostics using OLTC scan (DRM)
- Effective core demagnetization

+ CP SB1

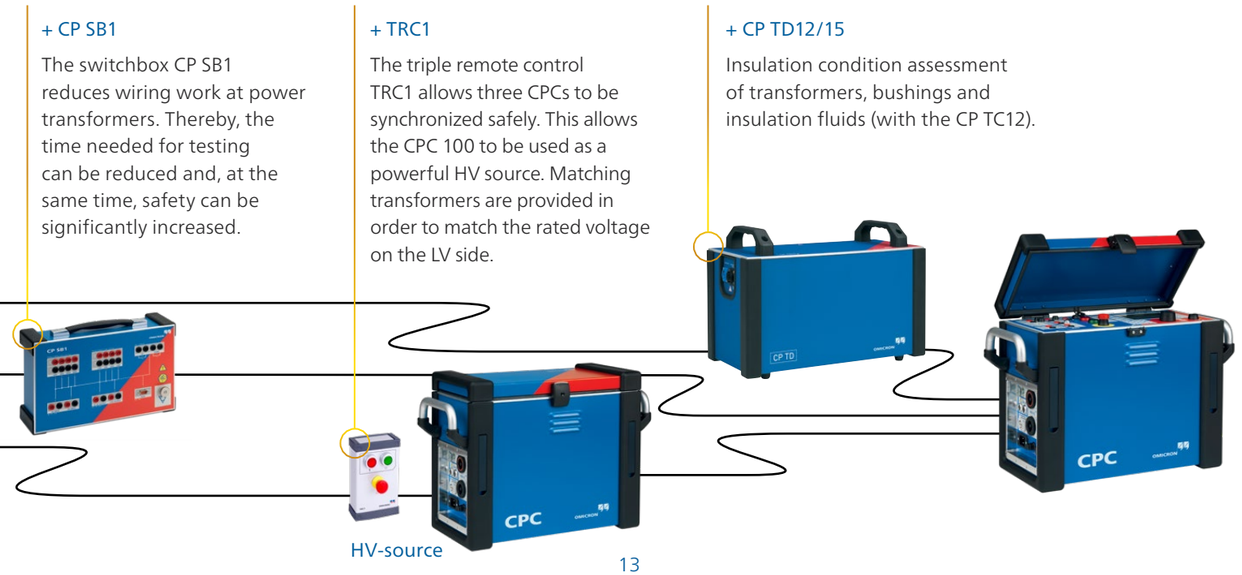
The switchbox CP SB1 reduces wiring work at power transformers. Thereby, the time needed for testing can be reduced and, at the same time, safety can be significantly increased.

+ TRC1

The triple remote control TRC1 allows three CPCs to be synchronized safely. This allows the CPC 100 to be used as a powerful HV source. Matching transformers are provided in order to match the rated voltage on the LV side.

+ CP TD12/15

Insulation condition assessment of transformers, bushings and insulation fluids (with the CP TC12).



HV-source

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).

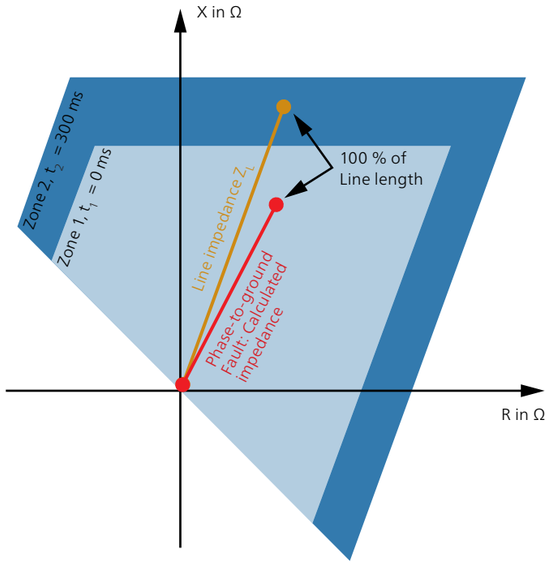
These parameters are often calculated from software tools, which do not provide actual line parameters due to unknown soil properties, such as different soil resistivities, pipelines or other unknown conductors. This leads to under- or overreach of your distance protection relay resulting in outage and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

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.



Incorrect k-factor (tendancy to overreach)

Testing with the CPC 100

The main unit CPC 100 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.

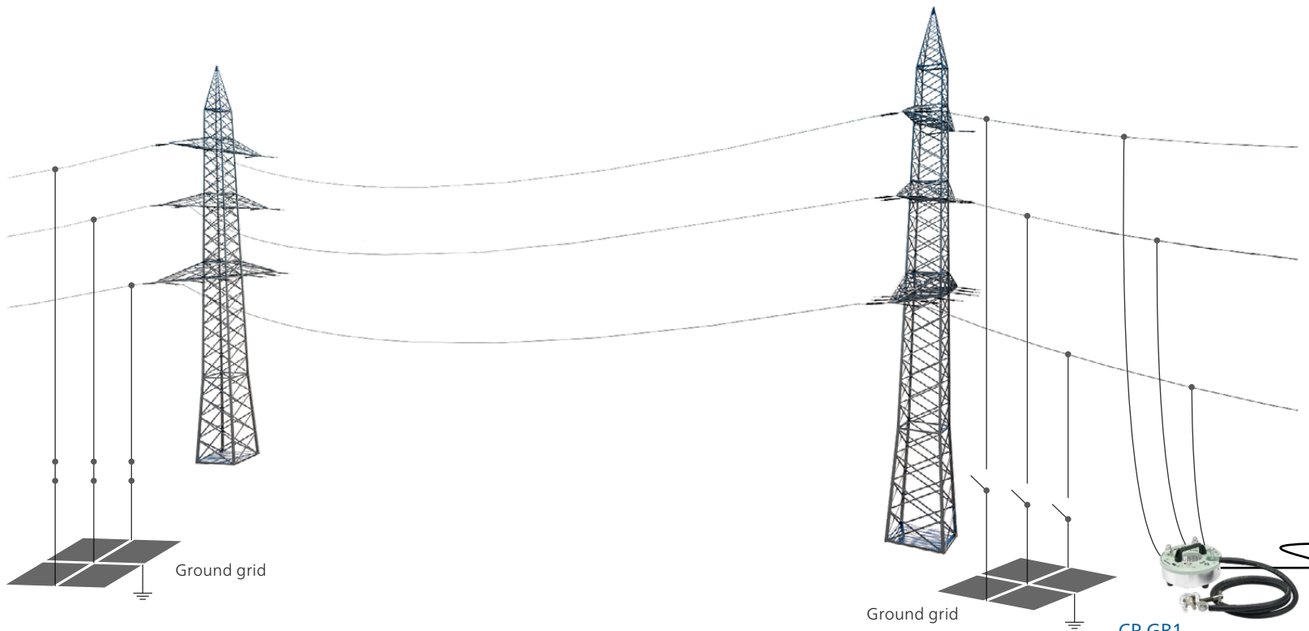
A dedicated test template provides the positive and the zero sequence impedance as well as the k-factor in commonly used formats. Furthermore it shows the actual zone reach for each fault type based on the measured values and relay parameters that are currently being used.

Cable and transmission line diagnosis

- Line impedance and k-factor
  up to 100 A | with CP CU1
- Mutual coupling
  up to 100 A | with CP CU1
- Positive or zero sequence impedance

Your benefits

- Accurate distance protection relay settings 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



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.

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.

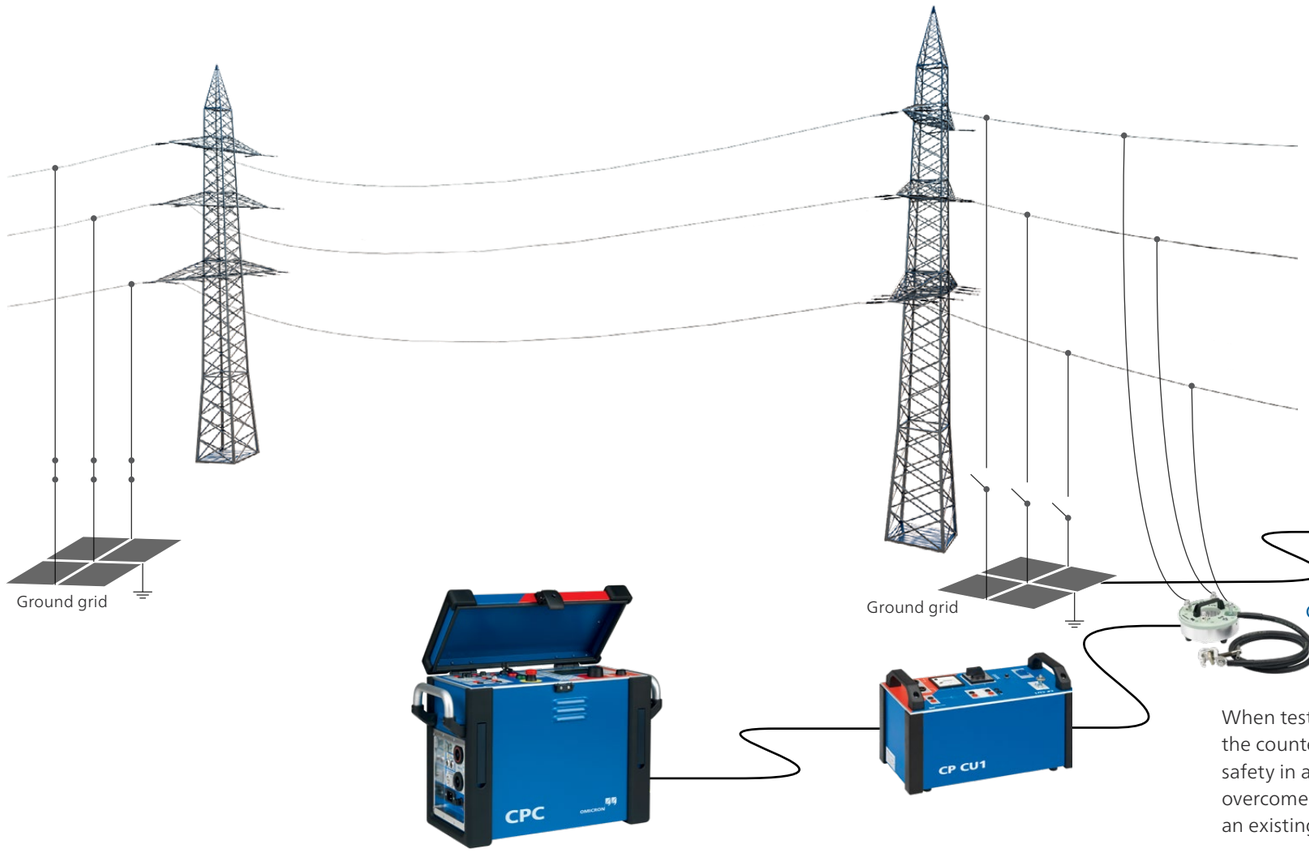
Dedicated test templates assess measured step and touch voltages according to EN 50522 and IEEE 80 automatically.

Ground system analysis

- Ground grid impedance for large systems
  up to 100 A | with CP CU1
- Step and touch voltage
  up to 100 A | with CP CU1 and HGT1
- Ground grid impedance for small systems
  up to 6 A_{AC}
- Soil resistivity
  up to 6 A_{AC}
- Integrity check of grounding connection
  up to 400 A_{DC}
- Reduction factor / current split factor
- Measure multiple current paths with Rogowski coil

Your benefits

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



+ HGT1

Primary Test Manager (PTM) and HGT1 enable you to quickly, simply and conveniently measure ground impedance as well as step and touch voltage. Due to a new approach there is no operational personal required at the CPC 100 anymore. Together, the test director and assistants perform all measurements out in the field in order to avoid miscommunication and selection of inadequate test points.

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.

Rotating machines diagnosis

Why test rotating machines?

Rotating machines, such as motors and generators, are highly important components in power generation and industrial applications. Therefore machine reliability and availability are in high demand. Motors and generators are exposed to high thermal, mechanical and electrical stress that influences their reliability and life expectancy.

Premature failure may lead to significant economical losses, due to unexpected outages and possible damage to the asset itself. In order to plan maintenance effectively, it is essential to have accurate condition information about when components need to be repaired or replaced.

A variety of electrical tests can be performed with the CPC 100 over the complete life cycle of machines to increase their reliability, prevent premature failures and to extend reliable service life.

PF/DF measurement and PF/DF tip-up test

The PF/DF measurement is used as a maintenance tool for entire windings. The portable solution CPC 100 + CP TD15 + CP CR600 allows PF/DF measurements to be carried out at nominal frequency.

The measurement results can be compared with previous measurements, factory acceptance tests or a phase-to-phase comparison can be made. An acceptable PF/DF offers assurance that the insulation condition allows reliable operation.

Furthermore, a parallel partial discharge measurement allows for a more detailed diagnosis of the type of fault. The CPC 100 + CP TD15 can be used as HV source for the partial discharge measurement.

The measurement complies with international standards such as IEC 60894 and IEEE 286.

DC winding resistance measurement

A DC resistance measurement is performed to detect possible contact problems in the stator and rotor winding of a machine.

The CPC 100 offers an integrated micro ohmmeter with a maximum output of 400 A. The 4-wire method is used to detect connection problems in the stator winding (bad soldering contacts) as well as contact problems on the pole connectors of the rotor winding.
Both failures can be the root cause of a local hotspot and potentially damage the machine.

Pole drop test

Mechanical stress in rotor windings cause inter turn faults (short circuits), which can lead to a magnetic imbalance. This causes higher shaft vibrations which puts more stress on the bearings and can potentially damage them. The CPC 100 provides the AC source and the accurate voltage inputs nedded to perform the pole drop test.

Electromagnetic imperfection testing

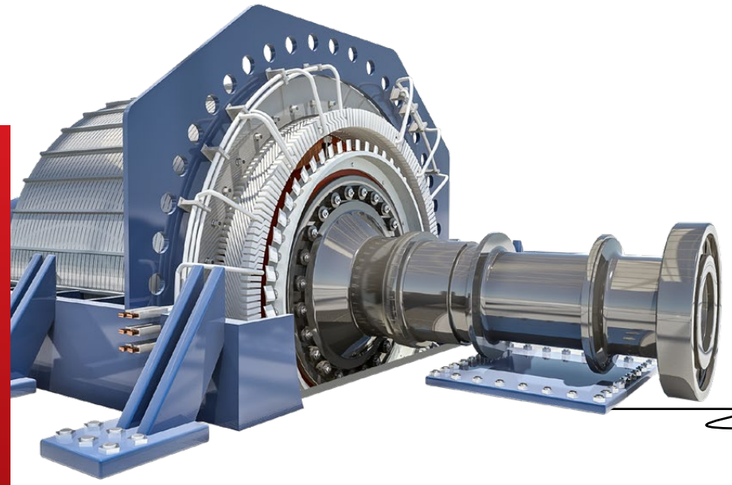
This test (also known as stray flux measurement) is performed to detect stator core interlamination faults that can cause overheating and damage during machine operation. The stator core is energized with a small percentage of nominal flux and the stray flux on the surface is measured along the slots. Faults are indicated by an increase of stray flux in amplitude and/or a change in the phase.

Rotating machines diagnosis

- Power/dissipation factor tip-up test at 50 Hz / 60 Hz
  up to 15 kV | 5 A| with CP TD15 and CP CR600
- Power/dissipation factor test with variable frequency
  up to 15 kV | frequency from 15 Hz to 400 Hz | with CP TD15
- HV source for testing rotating machines
  up to 15 kV | max. 2 µF | with CP TD15 and CP CR600
- DC winding resistance measurement
  up to 400 A DC and 5 kVA down to the microohm range.
- Pole drop test
- Electromagnetic imperfection testing
- Stator core measurement
  Semi-automatic scanning of the stator core, measurement and excitation in one solution

Your benefits

- Portable HV source
- High accurate PF/DF measurement with reference capacitance for maximum usability
- Defined voltage steps for a combined partial discharge and PF/DF measurement enable reproducible test conditions

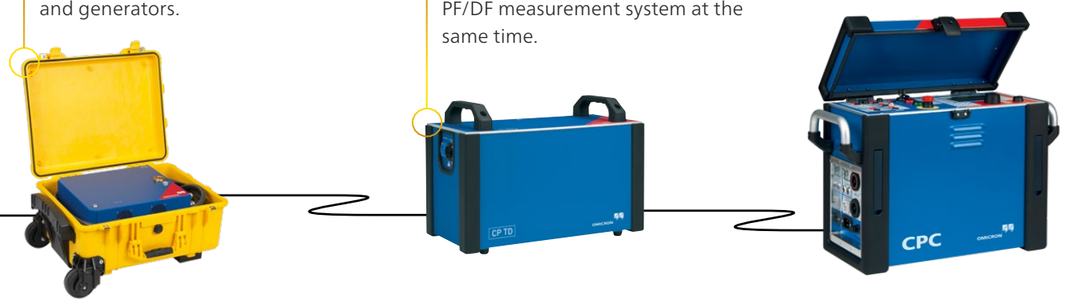


+ CP CR600

The CP CR600 compensator reactor enables the CP TD15 to be used with test objects with large capacitance such as large motors and generators.

+ CP TD15

Insulation condition assessment of motors and generators. The CPC 100 + CP TD15 can provide up to 15 kV. It can be be used as HV source and PF/DF measurement system at the same time.



Gas-insulated switchgear testing

Testing gas-insulated switchgear to date

Gas-insulated switchgears (GIS) are compact and are, therefore, used in applications where space is limited. For commissioning of GIS a high-voltage (HV) withstand test is required in accordance with standards (IEC 62271-203).

To date the test voltage needed for a withstand test has been produced by a resonance circuit. This test system consists of an HV test transformer, a coupling capacitor and a power control unit. The HV test transformer and the coupling capacitor have to be connected directly to the GIS.

Weak points of this testing principle:

- The complete test system is difficult to transport, because it consists of very heavy and large components.
- It is difficult to use it at test sites with limited space, such as wind turbines.
- The HV test lead must be connected to, and disconnected from, the GIS system for testing. This normally includes a time-consuming venting and refilling process of the SF_6 gas.

Innovative GIS testing

With the CPC 100 + CP RC it is possible to perform GIS tests without the need of a big HV transformer. This is possible because the system directly makes use of a specially designed “Power VT” for testing.

This Power VT is an integral part of the GIS and generates the required test voltage. CPC 100 injects power at the LV side of the VT, producing the necessary voltage on the HV side. A direct connection of the measuring system to the integrated VT of the GIS system eliminates the need for draining and refilling any SF_6 gas.

The CPC 100 + CP RC system comprises several small and light-weight components (< 21 kg / 46 lbs) which can be transported by one person. With its modular design GIS tests can even be accomplished at test sites with limited space.

Powerful voltage withstand testing

When combined with the CP RC1, the CPC 100 allows withstand tests with a maximum test voltage of 200 kV to be carried out on GIS systems up to a rated voltage of 123 kV. The CPC 100 + CP RC2 is appropriate for testing GIS systems with a rated voltage of up to 145 kV and a maximum test voltage of 235 kV. This package is supplied with the additional CP AT1 auto-transformer to guarantee the necessary output power of the CPC 100 for higher loads.

HV source for partial discharge measurements

During production or maintenance, impurities can occur in GIS. These can cause major problems in operation. Therefore, it is recommended to perform a partial discharge measurement during commissioning (acceptance tests). While performing these measurements with our MPD series the CPC 100 + CP RC can be used as the HV source.

GIS testing

- Withstand test
  up to 235 kV | max 1.6 nF | with CP RC2
- HV source for partial discharge measurements
  up to 235 kV | max 1.6 nF | with CP RC2

Your benefits

- Small and light-weight test system with high output power
- Testing without gas venting and refilling procedure
- Automatic frequency tuning for ideal load compensation

+ CP CR

With the compensating reactor 4 mH CP CR4 or 6 mH CP CR6 the CP CR compensates the capacitance in a modular fashion.

+ CP TR

The isolation transformer CP TR provides a potential-free output signal and compensates the capacitive load.

+ CP AT1

The auto-transformer CP AT1 allows to connect the mains supply of the CPC 100 to a three-phase 16 A power outlet, and delivers the required power for the test setup.

Switchgear and circuit breaker testing

Why test switchgear and circuit breaker?

Switchgear consists of busbars, circuit breakers (CB), disconnectors and earthing switches. There are various connections and contacts within the switchgear. Poorly maintained or damaged contacts can cause arcing, single phasing or even fire which can lead to the total loss of the asset.

Therefore, it is common practice to conduct contact resistance measurements to ensure that the connections have been made with the appropriate contact pressure.

Additionally, the insulation of CBs within the switchgear has to be tested. These assets are frequently exposed to HV stresses, switching currents and very high fault currents, which heat up the circuit breakers and impact on the insulation material.

Contact resistance measurement

The CPC 100 can measure contact resistance by injecting a current of up to 400 A_{DC} into the contacts and measuring the voltage drop (using the 4-wire method). The resistance value can be compared to the value given by the manufacturer as well as to previous records.

Insulation testing of circuit breakers

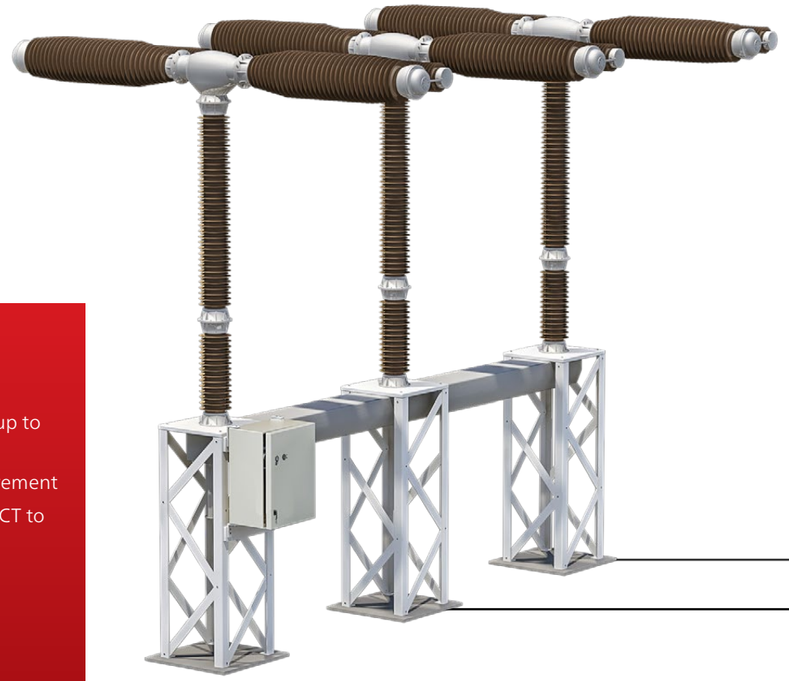
For power/dissipation factor measurements on CBs, the CPC 100 is combined with the CP TD12/15. Measuring this factor over a wide frequency range – in addition to mains frequency – helps to better assess the insulation condition.

Switchgear / circuit breaker testing

- Contact resistance
  up to 400 A_{DC}
- Bushing: power/dissipation factor (tan δ) + insulation capacitance
  12 kV/15kV, 300 mA | frequency from 15 Hz to 400 Hz | with CP TD12/15
- Circuit breaker: power/dissipation factor (tan δ)
  up to 12 kV/15kV, 300 mA | frequency from 15 Hz to 400 Hz | with CP TD12/15
- Insulating fluids: power/dissipation factor (tan δ)
  up to 12 kV, 300 mA | with CP TD12/15 and CP TC12

Your benefits

- Contact resistance testing with up to 400 A DC
- Power/dissipation factor measurement
- Testing of entire chain from the CT to the CB's main contacts

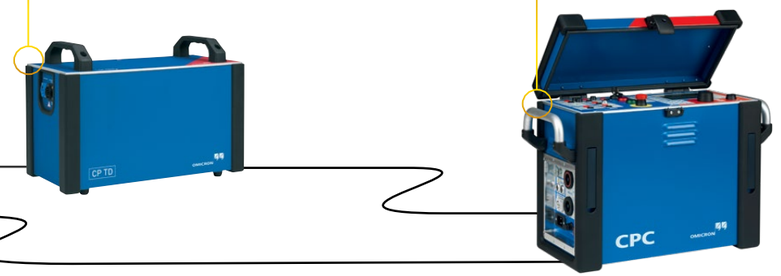


+ CP TD12/15

Insulation condition assessment of circuit breakers and insulation fluids (with CP TC12).

CPC 100

µΩ measurement with the CPC 100's 400 A_{DC} capabilities enables accurate contact resistance measurements on circuit breakers.



Commissioning and trouble shooting of protection systems

Commissioning protection systems

In order to work properly, protection and control systems have to be correctly integrated into the substation or power plant. Quantities from the primary system are transformed at the VTs and CTs – using their different cores – and so the voltage and current signals must be correctly connected to the protection relays, automation units and meters.

From these protection and control units, the trip signals are routed back to the primary apparatus, for example, the circuit breakers. A fault in any part of this system may result in a system failure – false tripping or a failure to trip.

To prevent such a failure, the system's functionality can be verified by injecting into the primary side of the CT or VT and checking the measured values at the relay or automation unit. Finally, injecting current at the magnitude of a fault should result in the tripping of the circuit breaker, which allows the verification of the complete chain.

CT & VT performance check

The CPC 100 allows the verification of the ratio and polarity of CTs and VTs – preventing wrong connections, especially in the case of tapped CTs. Injecting current or voltage into individual CTs / VTs and checking the reading at the relay ensures that phases are not mixed up and that the CT and VT ratio setting in the relay is correct.

The CPC 100 can also measure the burden on the CTs and VTs and, by determining the CT's excitation curve, it ensures that the protection circuits are connected to the appropriate CT cores.

Wiring check

The CPC 100 can help to verify that the secondary wiring is correct. By injecting a sawtooth signal into the CT or VT, the operator verifies with a handheld device that the signal has the correct polarity at the connection points of the secondary systems.

Timing of CBs with overcurrent elements

For testing of CBs or load breaker switches with integrated overcurrent elements, the CPC 100 can inject AC primary currents up to 800 A (or 2000 A together with the current booster CP CB2), and measure the time from the start of the injection to the interruption of the current.

Primary injection

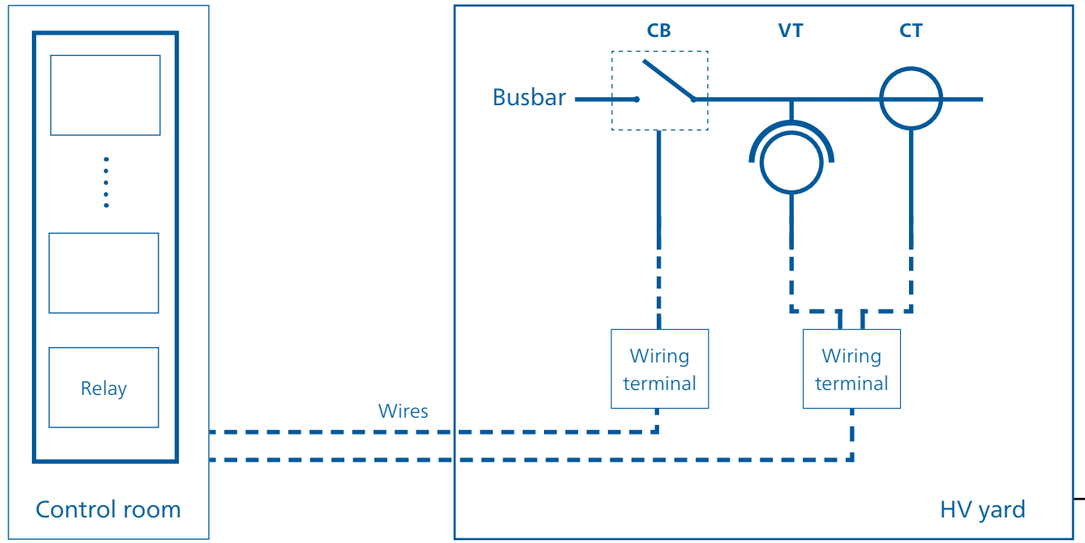
With the CPC 100 primary faults can be simulated to check if overcurrent, differential or distance relays operate correctly. The total trip time including the CB operating time can also be measured in this test.

Protection installation testing

- CT ratio (with burden)
  up to 800 A or 2000 A with the CP CB2, 5 kVA output power
- CT burden
  up to 6 A_{AC} | secondary
- CT excitation curve (knee point)
  up to 2 kV_{AC}
- VT ratio
  up to 2 kV_{AC} | polarity and burden
- VT burden
  up to 130 V_{AC} | secondary
- Overcurrent relays with primary injection (MV)
  up to 800 A or 2000 A with the CP CB2, 5 kVA output power
- Polarity check with CPOL3
  up to 800 A or 2 kV_{AC} , 5 kVA output power
- Testing of the entire protection chain
  by primary fault current injection and live CB tripping

Your benefits

- Testing of entire chain from the CT to the CB's main contacts
- Versatile due to high-current and high-voltage outputs
- Wide range of applications covered

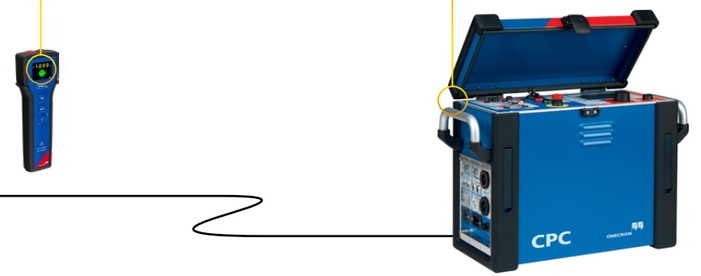


+ CPOL3

The CPOL3 can check the correct polarity along the different connection points in the secondary wiring by analyzing the sawtooth signal injected into the VT's and CT´s primary side using the CPC 100.

CPC 100

The CPC 100 can inject up to 800 A (2000 A with the CP CB2) or up to 2 kV as well as a sawtooth polarity check signal into CTs or VTs in the HV yard, hence performing testing on the whole system.



IEC 61850-9-2 Sampled Values testing

IEC 61850

The standard for “Communication Networks and Systems for Power Utility Automation”, IEC 61850, utilizes network technologies for all types of information exchange.

Within IEC 61850, protocols for the transmission of instantaneous voltage and current values are specified. The sensors used in the transmission process can be conventional CTs and VTs as well as unconventional current and voltage sensors.

Sampled Values

A merging unit (MU) collects the measured current and voltage values from the current and voltage sensors. Then it merges the digitized values, which are called “Sampled Values” (SV), into a data stream published to the substation network.

Using this method, measured values (for example, the bus voltage for a busbar protection scheme) can easily be distributed to multiple bay devices.

Sampled Values testing with the CPC 100

The CPC 100 test system performs closed-loop testing whereby a test signal is injected on the primary side of the current / voltage sensors. The MU converts the sensor output into a SV stream which is published to the substation network. The CPC 100 then reads the data back from the network in order to perform a variety of different tests.

Automatic MU and channel detection is achieved by injecting a test signal with a specific wave form. An optimized and time-effective algorithm searches for the unique test pattern within all the available MUs on the network to identify the correct channel for testing.

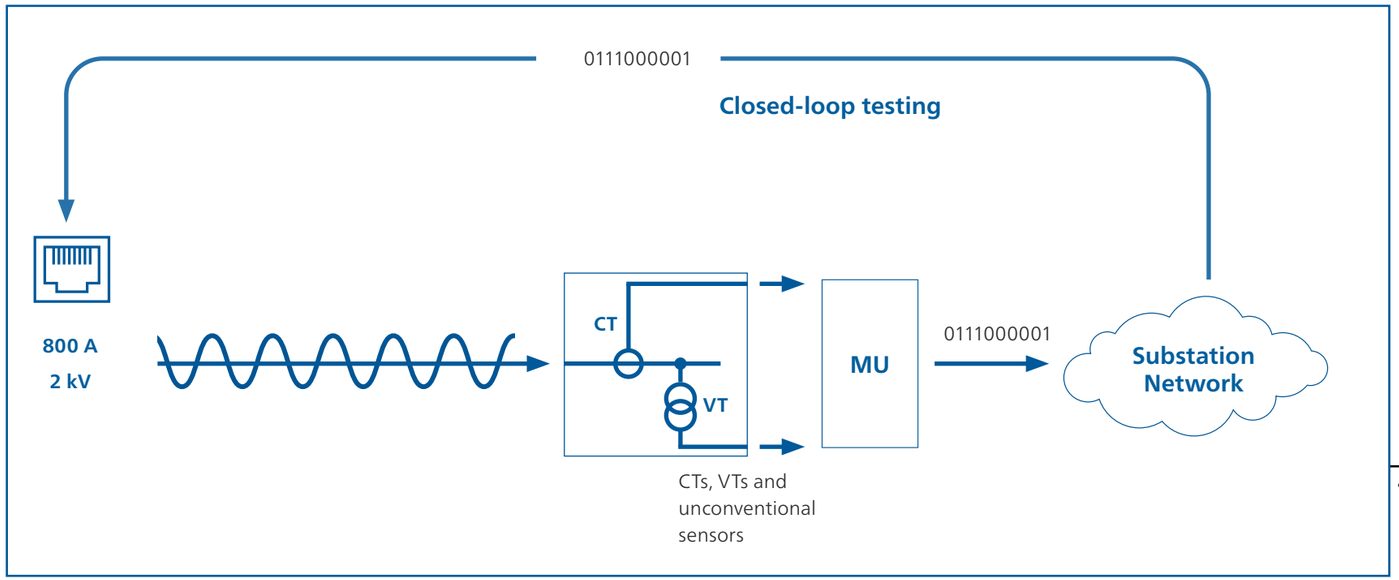
The CPC 100’s SV test card operates according to the “Implementation Guideline for Digital Interface to Instrumental Transformers using IEC 61850-9-2” published by the UCA International User Group.

Sampled Values testing

- SV CT ratio test and polarity check
  up to 800 A or up to 2000 A , 5 kVA output power | with the CP CB2
- SV VT ratio test and polarity check
  up to 2 kV_{AC}
- Automatic MU detection
- Automatic voltage / current channel detection
- Frequency selective voltage / current meter
- Noise level measurement
- Amplitude response of the signal processing chain
  up to 800 A or up to 2 kV_{AC} | frequency from 15 Hz to 400 Hz

Your benefits

- Ready for applications in digital substations
- Closed loop testing of merging units
- Primary injection works independently of the sensor technology used



CPC 100

The CPC 100 injects a sinusoidal test signal to perform tests such as the ratio test. Additionally, the CPC 100 generates specific periodic wave shapes to identify the correct MU and corresponding test channel.

Operation of CPC 100: front panel

Operating from the front panel

Selecting test cards directly

Operating the CPC 100 manually provides the quickest results with minimal training and preparation – perfect for users who only operate the device occasionally. The user just selects the test card to be used, connects the CPC 100 to the asset and performs the test by pressing the start button.

Using pre-defined test templates

Additionally, pre-defined test templates help the user to perform frequently used tests conveniently and efficiently. A number of test cards (for example, power/dissipation factor, winding resistance, ratio measurement, etc.) are combined into one test template. An example is the template containing all the recommended measurements for testing a current transformer.

The test template can be seen as a test plan. It tells the user which measurements to make and provides the basis for the overall test report.

Test templates can be prepared in advance in the office on the PC – without the CPC 100 connected – and can then be executed on site, step by step. Users can also create their own test templates and define, which test cards they want to include.

The settings and results of all manual tests can be stored on a flash memory and transfered to a PC using a USB memory stick or ethernet connection.

Customized reporting: Microsoft Excel™

After transferring the test results to a PC, report templates in numerical and graphical form are available.

The measurement data – including settings and results as well as administrative information such as date and time, filename, etc. – can also be imported to these templates for customized reporting, graphical result evaluation and further analyses.

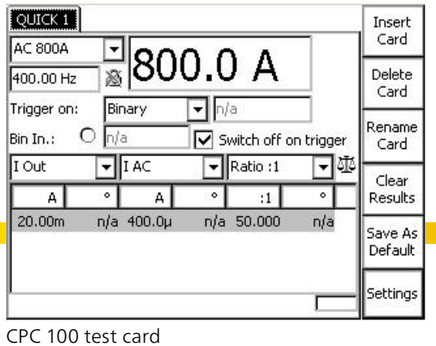
Microsoft Excel™ reports provide the basis for client-specific reporting and allow test reports to be adapted to utility or manufacturer specific formats. Further content, such as company logos, can also be added.

Test reports can then be printed in a variety of languages.

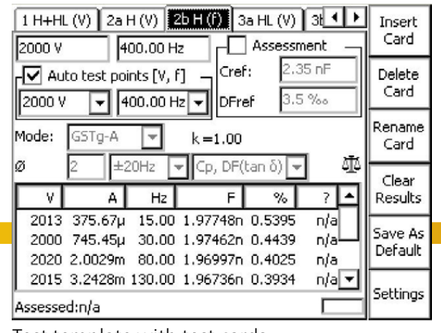
Different ways to operate

The CPC 100 offers different operating modes, to meet the personal preferences of the user:

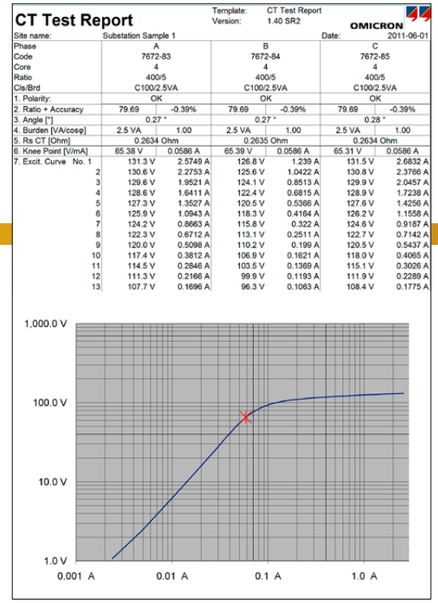
- From the front panel:
  Selecting test cards directly
- From the front panel:
  Using pre-defined test templates
- Fully automated:
  Using Primary Test Manager™ (see next page)



CPC 100 test card



Test template with test cards

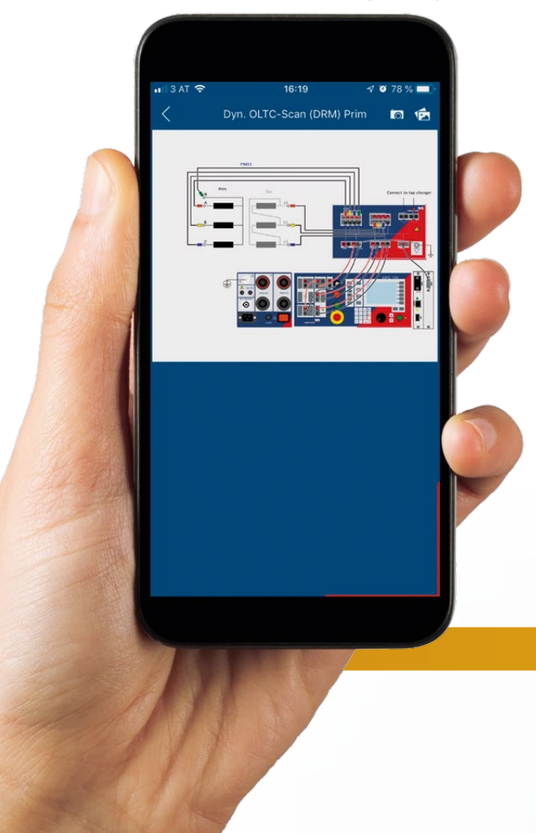


Test report

Step by step through the test procedure with Primary Test Manager™

The Primary Test Manager™ (PTM) software solution makes it possible to perform a multitude of tests on power transformers, circuit breakers, and current transformers. It provides active guidance for the user during the process of testing with the CPC 100, making tests faster, easier, and safer.

Get the PTMate app free of charge in the App Store and Google Play Store!



Managing location, asset and test data

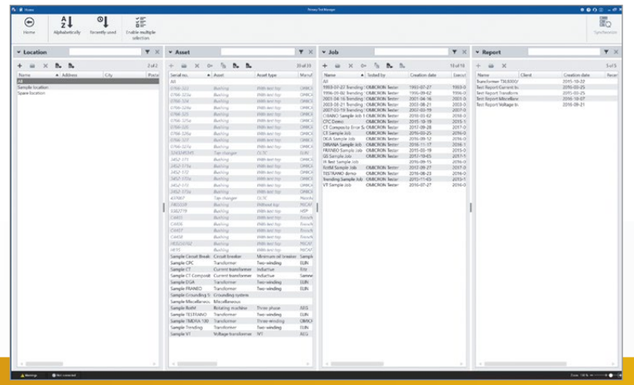
PTM provides a well-structured database for managing test results and getting a comprehensive overview of the asset's condition. Locations, assets, jobs and reports can be defined and managed quickly and easily.

Import and export functionality

PTM supports data exchange between different test systems. Data can be imported easily in the PTM database. In addition, they can be filtered or exported in common formats such as XML, PDF, Microsoft Word™, Microsoft Excel™.

Data synchronization and back-up

During on-site testing, data is often generated by multiple testing teams. With the 'PTM DataSync' module all data can be synchronized to a central database hosted on premises or in the cloud. In doing so, data synchronization and storage becomes safer and more convenient. The relevant locations can be selected in order to keep the local database small.



Easy management of location, asset and test data due to a structured database, implemented search and filter functions and automatic data synchronization.

Executing diagnostic tests

PTM helps to define the test asset with specific nameplate views. It indicates mandatory and recommended parameters, making data entry fast and easy.

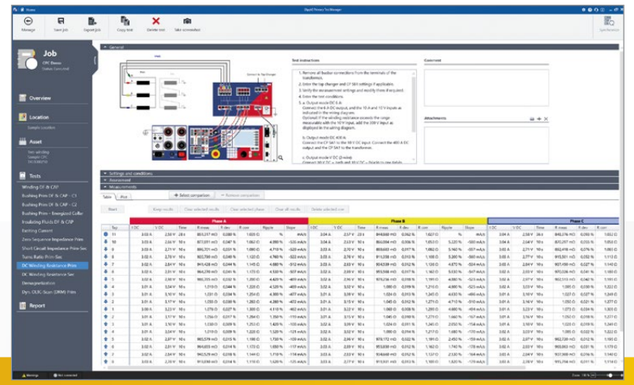
Based on the nameplate values, PTM generates a customized test plan according to current standards and guidelines for each asset. This way PTM is able to provide you with a comprehensive test plan for assessing the condition of your asset thoroughly.

Easy connection due to wiring diagrams

Pre-configured wiring diagrams based on selected assets help to set up the CPC 100 correctly. This minimizes the likelihood of measurement errors and speeds up the testing process.

PTMate app – your mobile companion

PTMate is our mobile companion for PTM. The app supports you on site and extends the PTM feature set to your smartphone, such as easy data entering, fast and safe wiring for tests as well as a stop button for ongoing measurements.



PTM supports you in the best possible way during execution of diagnostic tests via wiring diagrams and asset-specific test plans according to international standards.

Result analysis and reporting

A real-time overview of the test results is given during the measurement and an instant "pass/fail" assessment of the test results is displayed based on specified limit values.

PTM automatically generates reports including all asset-related information and the tests that have been performed. This gives a comprehensive overview of the test object, test results and assessment.

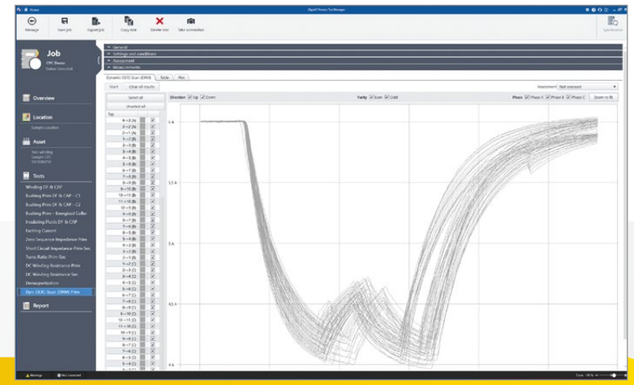
Comparison tools for detailed analysis

For a detailed analysis, different test results can be compared side-by-side or trended over time. Users can choose between a time- and type-based comparison as well as a phase-based comparison.

Customized, individual reports

User can adapt reports to their needs in PTM. Reports can be generated in Microsoft Word™, Microsoft Excel™ and as a PDF file.

They can be further adapted by e.g. compiling the included parts, providing comments or incorporating a company logo.



For a comprehensive analysis, PTM offers automatic result assessment and comparison as well as customized reporting.

Safety features

CPC 100 built-in safety functions

I/O status lights

The I/O status lights of the CPC 100 inform operators if the CPC output is switched ON or OFF.

These status lights provide a quick and easy way to monitor the device's operational state. Always pay attention to these lights when using the CPC 100 to ensure safe and effective testing.

Emergency stop button

The emergency stop button provides operators with the ability to immediately shut off the CPC 100 output in the event of an emergency.

The capability of rapid response can prevent accidents, protect expensive equipment, and most importantly, save lives.

Key lock

The key plays a crucial role in ensuring the safe operation of the CPC 100. The key provides a physical means of control, allowing operators to secure the CPC 100 against unauthorized operation.

Removing the key in locked position prevents the software from accepting any more commands and the test cannot be started by pushing the I/O button.

Protective earth verification

Before a measurement is started, the CPC 100 automatically verifies the PE connection. This is particularly important in high-voltage environments, where a faulty or non-existing earth connection can lead to serious consequences, including electrical shock or equipment damage.

Rapid Fault Sense (RFS)

Rapid Fault Sense (RFS) is an innovative feature of the CPC 100 that serves as an additional safety measure. It is an output supervisor that can detect output changes and initiate an immediate switch-off in selected test cards.

RFS works by performing a statistical analysis of the output signals. After a brief activation time of a few seconds, it continuously monitors these signals for unexpected, rapid changes that could be caused by factors such as contact with conductive parts, falling clamps, or insulation failures.

RFS complements the existing safety features of the CPC 100 and if triggered, will significantly limit exposure to dangerous current and voltage.

CPC 100 optional safety functions

SAA1

The SAA1 is an audible beeper dongle that is included with each CPC 100.

It generates an acoustic signal when the test systems outputs are activated. SAA1 alerts operators and others nearby of the ongoing operation, helping to raise awareness during a potentially hazardous measurement.

SAA2

SAA2 is a small, lightweight, and scalable safety accessory that helps you to mark your testing area and warn people that the prohibition zone around the test setup must not be entered. Depending on the status of the test device the SAA2 shows either a green or red signal light.

In addition, the SAA2 can also generate an audible signal if a measurement is ongoing. It also offers an emergency button to stop the measurement immediately, if needed.

SAA3

The SAA3 is a 3-position remote safety switch for use with the CPC 100. The three positions ensure that both the release and fully pressed position of the SAA3 result in an immediate trigger of the CPC 100 emergency stop.

Front panel and connection possibilities

1. Grounding terminal
2. High AC voltage output 2 kV AC
3. External booster output
4. High DC current output 400 A DC
5. High AC current output 800 A AC
6. Mains power supply
7. Overcurrent protection
8. Power switch

9. 6 A or 130 V output
10. Current output 6 A DC
11. Current measuring input 10 A AC or DC
12. Voltage measuring input 300 V AC
13. Low level voltage measuring input 3 V AC
14. Voltage measuring input 10 V DC
15. Binary input for potential-free contacts or voltages up to 300 V DC
16. Safety key lock
17. Signal lights
18. Emergency stop button

19. Keys for the quick selection of applications
20. Keys for the quick selection of the desired view
21. LCD monitor
22. Soft-touch keys which change their function according to the selected application
23. Keys for selecting stacked test cards
24. Numerical keyboard
25. Advanced jog-dial hand wheel with “click” (Enter) function
26. Up / down keys for navigation and entering values
27. Test start / stop button
28. User manual

29. Serial interface for devices such as CP TD12/15
30. Plug to connect external safety functions (SAA1, SAA2, SAA3)
31. Socket for the connection of the CPC 100 to a network or direct connection to a PC’s network connector
32. USB 2.0 port for memory stick connection
33. CPCsync network ports

Technical data CPC 100

CPC 100

Generator / Outputs

Current outputs

Range	Amplitude	t_{max}[1]	V_{max}[2]	$Power_{max}$[2]	f
800 A AC[3]	0 ... 800 A	25 s	6.0 V	4800 VA	15 Hz ... 400 Hz
	0 ... 400 A	8 min.	6.4 V	2560 VA	15 Hz ... 400 Hz
	0 ... 200 A	> 2 h	6.5 V	1300 VA	15 Hz ... 400 Hz
6 A AC[10]	0 ... 6 A	> 2 h	55 V	330 VA	15 Hz ... 400 Hz
3 A AC[10]	0 ... 3 A	> 2 h	110 V	330 VA	15 Hz ... 400 Hz
400 A DC	0 ... 400 A	2 min.	6.5 V	2600 VA	DC
	0 ... 300 A	3 min.	6.5 V	1950 VA	DC
	0 ... 200 A	> 2 h	6.5 V	1300 VA	DC
6 A DC[4, 10]	0 ... 6 A	> 2 h	60 V	360 VA	DC

2000 A AC[3] with an optional current booster (CP CB2)

Voltage outputs

Range	Amplitude[5]	t_{max}	I_{max}	$Power_{max}$[5]	f
2 kV AC[3]	0 ... 2 kV	1 min.	1.25 A	2500 VA	15 Hz ... 400 Hz
	0 ... 2 kV	> 2 h	0.5 A	1000 VA	15 Hz ... 400 Hz
1 kV AC[3]	0 ... 1 kV	1 min.	2.5 A	2500 VA	15 Hz ... 400 Hz
	0 ... 1 kV	> 2 h	1.0 A	1000 VA	15 Hz ... 400 Hz
500 V AC[3]	0 ... 500 V	1 min.	5.0 A	2500 VA	15 Hz ... 400 Hz
	0 ... 500 V	> 2 h	2.0 A	1000 VA	15 Hz ... 400 Hz
130 V AC[10]	0 ... 130 V	> 2 h	3.0 A	390 VA	15 Hz ... 400 Hz

Internal measurement of outputs (Accuracy[6])

Output	Range	Amplitude Reading Error	Amplitude Full scale Error	Phase Full scale Error
800 A AC	–	< 0.10 %	< 0.10 %	< 0.10°
400 A DC	–	< 0.20 %	< 0.05 %	–
2 kV AC	2000 V	< 0.05 %	< 0.05 %	< 0.10°
	1000 V	< 0.05 %	< 0.05 %	< 0.15°
	500 V	< 0.05 %	< 0.05 %	< 0.20°
	5 A	< 0.20 %	< 0.05 %	< 0.10°
	500 mA	< 0.05 %	< 0.05 %	< 0.10°

Inputs

Measuring inputs (Accuracy[6])

Input	Imped.	Range	Amplitude Reading Error	Amplitude Full scale Error	Phase Full scale Error
I AC / DC[4, 7]	< 0.1 Ω	10 A AC	< 0.05 %	< 0.05 %	< 0.10°
		1 A AC	< 0.05 %	< 0.05 %	< 0.15°
		10 A DC	< 0.03 %	< 0.08 %	–
		1 A DC	< 0.03 %	< 0.08 %	–
V1 AC[8]	500 kΩ	300 V	< 0.05 %	< 0.05 %	< 0.10°
		30 V	< 0.05 %	< 0.05 %	< 0.10°
		3 V	< 0.10 %	< 0.05 %	< 0.10°
		300 mV	< 0.15 %	< 0.05 %	< 0.10°
V2 AC[8, 11]	10 MΩ	3 V	< 0.03 %	< 0.08 %	< 0.10°
		300 mV	< 0.08 %	< 0.08 %	< 0.10°
		30 mV	< 0.10 %	< 0.25 %	< 0.15°
V DC[4, 7]		10 V	< 0.03 %	< 0.08 %	–
		1 V	< 0.03 %	< 0.08 %	–
		100 mV	< 0.05 %	< 0.10 %	–
		10 mV	< 0.05 %	< 0.15 %	–

Additional features of the measuring inputs

Automatic range switching (except Amplifier test card)
Galvanically separated potential groups: I AC/DC ; V1 & V2 ; V DC
AC frequency range: 15 Hz to 400 Hz (except Amplifier test card)
Protection of I AC/DC input: 10 A very fast acting (FF) fuse[4]

Binary input for dry contacts or voltages up to 300 V DC[7]

Trigger criteria: Toggling with potential-free contacts or voltages of up to 300 V
Input impedance: > 100 kΩ
Response time: 1 ms

Output to input synchronization

	Test cards Quick, Sequencer, Ramping	Amplifier test card
Frequency range	48 Hz ... 62 Hz	48 Hz ... 62 Hz
Synchronization inputs	V1 AC (automatic range switch)	V1 AC, V2 AC, I AC (fixed to maximum range)
Input magnitude	10 % of input range full scale	
Output magnitude	5 % of output range full scale	
Settling time	100 ms after 5 % of output range full scale is reached	1000 ms after 5 % of output range full scale is reached
Signal changes	All quantities must be ramped within 20 signal periods	No changes of frequency and phase. Magnitude changes without limitation. Output follows within 250 ms
Phase tolerance	0.5 ° within the limits as specified above	

Resistance measurement

4-wire measurement with 400 A DC output and 10 V DC input

Current	Resistance	Voltage	Accuracy (full scale)
400 A	10 µΩ	4 mV	Error < 0.70 %
400 A	100 µΩ	40 mV	Error < 0.55 %
400 A	1 mΩ	400 mV	Error < 0.50 %
400 A	10 mΩ	4 V	Error < 0.50 %

4-wire measurement with 6 A DC output and 10 V VDC input

Current	Resistance	Voltage	Accuracy (full scale)
6 A	100 mΩ	0.6 V	Error < 0.35 %
6 A	1 Ω	6 V	Error < 0.35 %
1 A	10 Ω	10 V	Error < 0.25 %

2-wire measurement with 10 V VDC input

Current	Resistance	Voltage	Accuracy (full scale)
> 5 mA	100 Ω		Error < 0.60 %
> 5 mA	1 kΩ		Error < 0.51 %
> 5 mA	10 kΩ		Error < 0.50 %

Power supply and mechanical data

Single-phase, nominal[9]	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
Power consumption	< 3500 VA (< 7000 VA for a time < 10 s)
Connection	IEC 320 / C20
Weight	29 kg / 64 lbs (case without protection cover)
Dimensions (W × H × D)	468 × 394 × 233 mm (18.4 × 15.5 × 9.2 in), cover, without handles.

Equipment reliability

Shock	IEC / EN 60068-2-27, 15 g / 11 ms, half-sinusoid, each axis
Vibration	IEC / EN 60068-2-6, frequency range from 10 Hz to 150 Hz, continuous acceleration 2 g (20 $^{m}/_{s^2}$ / 65 $^{ft}/_{s^2}$), 10 cycles per axis
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30,

Environmental conditions for CPC 100 and CPC 100 accessories

Operating temperature	-10 °C ... +55 °C /+14 °F ... +131 °F
Storage temperature	-20 °C ... +70 °C / -4 °F ... +158 °F
Humidity range	5 % ... 95 % relative humidity, no condensation
Protection class	IP22 (IEC/EN 60529)
EMC	IEC/EN 61326-1, FCC subpart B of part 15, class A

All input / output values are guaranteed for one year within an ambient temperature of 23 °C ± 5 °C / 73 °F ± 10 °F, a warm-up time longer than 25 min. and in a frequency range of 45 Hz to 60 Hz or DC. Accuracy values indicate that the error is smaller than ± (value read x reading error + full scale of the range x full scale error).

1. With a mains voltage of 230 V using a 2 × 6 m high-current cable at an ambient temperature of 23 °C ± 5 °C / 73 °F ± 10 °F.
2. The power and maximum voltage may be reduced above 60 Hz or below 50 Hz.
3. Output can be synchronized with V1 AC in Quick, Sequencer, Ramping and Amplifier test cards.
4. The inputs and outputs are protected with lightning arrestors between the connector and against the protective earth. In the event of application of energy exceeding a few hundred Joule the lightning arrestors apply a permanent short-circuit to the input / output.
5. The power and amplitude may be reduced above 200 Hz or below 50 Hz.
6. 98 % of all units have an accuracy better than specified as “typical”.
7. This input is galvanically separated from all other inputs.
8. V1 and V2 are galvanically coupled but separated from all other inputs.
9. There are power restrictions for mains voltages below 190 V_{AC}.
10. Fuse-protected.
11. When using the CTRogowski test card, the 3 V V2 AC input uses an additional software based integration method. In the range of 50 Hz < f < 60 Hz, this results in a phase shift of 90 ° as well as an additional phase error of ± 0.1 ° and an additional amplitude error of ± 0.01 %. For frequencies in the range of 15 Hz < f < 400 Hz, the phase error is not specified, and the amplitude error can be up to ± 0.50 % higher.

Technical data CPC 100 accessories

CP TD12/15 – Tan-delta unit

Combined with the CPC 100, the CP TD12/15 measures the capacitance and dissipation/power factor with laboratory precision.

High-voltage output

U/f	THD	I	Smax	tmax
0 ... 12 kV AC	< 2 %	300 mA	3600 VA	> 2 min
		100 mA	1200 VA	> 60 min
0 ... 15 kV AC	< 2 %	300 mA	4500 VA [1]	> 2 min
		100 mA	1500 VA	> 60 min

Capacitance Cp (equivalent parallel circuit)

Range	Typical accuracy [2]	Conditions
1 pF ... 3 µF	Error < 0.05 % of reading + 0.1 pF	I_x < 8 mA, V_{test} = 2 kV ... 10 kV
1 pF ... 3 µF	Error < 0.2 % of reading	I_x > 8 mA, V_{test} = 2 kV ... 10 kV

Power factor (cos φ) / Dissipation factor (tan δ)

Range	Typical accuracy [2]	Conditions
0 ... 10 % (capacitive)	Error < 0.1 % of reading + 0.005 %	f = 45 Hz ... 70 Hz I < 8 mA V_{test} = 2 kV ... 10 kV
0 ... 100 % (cos φ)	Error < 0.5 % of reading + 0.02 %	V_{test} = 2 kV... 10 kV
0 ... 10000 % (tan δ)	Error < 0.5 % of reading + 0.02 %	V_{test} = 2 kV... 10 kV

Mechanical data

Dimensions (W x H x D)	460 x 317 x 223 mm / 18.1 x 12.5 x 8.8 in
Weight CP TD12	23 kg / 51 lbs
Weight CP TD15	24 kg / 53 lbs

[1] Depending on control device and power supply
[2] Means "typical accuracy"; at typical temperatures of 23 °C ± 5 K; 98 % of all units have an accuracy which is better than specified

CP SB1 – Switch box

The CP SB1 switch box enables fully automatic testing of three-phase power transformers.

AC input / V1 AC output	Max. 300 V_{rms}
DC input	Max. 6 A_{DC}
Transformer high and low voltage connections	Max. 300 V_{rms} between all connectors and ground
Supply	Via serial interface from CPC 100 (+15 V)
Dimensions (W × H × D)	357 × 235 × 111 mm / 14.1 × 9.2 × 4.4 in
Weight	3.5 kg / 7.7 lbs

CP TC12 – 12 kV oil test cell

The CP TC12 oil test cell precisely determines the dielectric constant, the dissipation factor (tan delta) and the power factor of insulating liquids such as transformer oil.

Cell type	Three-electrode design with guard
Test gap	11 mm / 0.43 in
Capacitance of empty cell (air)	Approx. 65 pF ± 10 %
Sample volume	1.2 liters ... 2 liters / 41 ... 68 fl.oz.
Max. RMS test voltage	12 kV
Inner dimensions (diameter × height)	172 mm × 180.8 mm / 6.8 × 7.1 in
Outer dimensions (W × H × D)	220 × 235.5 × 220 mm / 8.7 × 9.3 × 8.7 in
Weight	Approx. 9.2 kg / 20 lbs

CP DB1 – Discharge box

The CP DB1 transformer discharge box facilitates fast discharging of power transformers during the test process.

6 A path

Switch closed	6 A continuous
Switch open	The discharge process is faster by a factor of 4 compared to the CPC 100, 6 A_{peak} Overtemperature protection: 85 °C / 185 °F Overvoltage protection: 150 V / 5 kA between connectors

100 A path

Switch closed	100 A continuous
Switch open	The discharge process is faster by a factor of 10 compared to the CPC 100, 100 A_{peak}, 2 500 J_{max} Overvoltage protection: 200 V / 30 kA between connectors

Mechanical data

Dimensions (W × H × D)	357 × 235 × 147 mm / 14.0 × 9.2 × 5.8 in
Weight	4 kg / 8.8 lbs

CP CU1 – Coupling unit

In combination with the CPC 100 the CP CU1 is used for line parameter measurements and ground testing.

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}

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

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

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 ... 5 Ω	0.3 %	0.5°	100 V	50 ... 20 A	50 A
5 ... 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

CP GB1 – Grounding box

The CP GB1 grounding box features high current surge arrestors to protect the CP CU1 and the CPC 100 from unexpected overvoltages on the line under test.

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 – Handheld grounding tester

The HGT1 handheld grounding tester can be combined with the CPC 100 and CP CU1 to measure step and touch voltages.

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

Technical data CPC 100 accessories

CP CR600 – Compensation reactor

The CP CR600 compensating reactor allows to test the insulation quality of generators, motors and other systems with large capacitance up to 1 µF.

Maximum test voltage	15 kV_{rms} (≥ 50 Hz)
Inductors	100 H ... 105 H ± 5% 50 H ... 52.5 H ± 5% 20 H ... 26.3 H -2% + 7%

Capacitance compensation (possible combination)

50 Hz / 15 kV	100 H	50 H	25 H
60 nF … 160 nF	■		
130 nF … 260 nF		■	
230 nF … 350 nF	■	■	
330 nF … 450 nF			■
420 nF … 550 nF	■		■
520 nF … 640 nF		■	■
620 nF … 740 nF	■	■	■

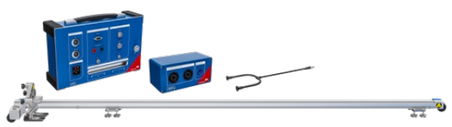
60 Hz / 15 kV	100 H	50 H	25 H
50 nF … 120 nF	■		
85 nF … 190 nF		■	
150 nF … 250 nF	■	■	
220 nF … 320 nF			■
290 nF … 390 nF	■		■
350 nF … 460 nF		■	■
420 nF … 520 nF	■	■	■

Mechanical data

Dimensions (W x H x D)	455 × 275 × 220 mm / 17.9 × 10.8 × 8.7 in
Weight	48 kg / 105.8 lbs

Stator Core Measurement Upgrade Option

The Stator Core Measurement Upgrade Option reliably detects inter-lamination imperfections in the stator core of rotating electrical machines.



	SCU1	WMP1	RAA1
Weight	4 kg / 9 lbs	846 g / 1.87 lbs	5.2 kg / 11.46 lbs
Dimensions (W × H × D)	375×235×111 mm 14.1×9.25×4.37 in	160×75×75 mm 6.29×2.95×2.95 in	1945×166×60 mm 76.6×6.54×2.36 in

CP CB2 – Current booster

The CP CB2 is an current booster for applications requiring currents up to 2000 A.

Output current	up to 2000 A
Output power at 2000 A	5 kVA
Accuracy of current at 50 Hz / 60 Hz	Error < ± 0.13 % (rd) ± 0.13 % (fs)
Phase tolerance at full scale	Error < ± 0.25 %
Dimensions (W × H × D)	186 × 166 × 220 mm 7.3 × 6.5 × 8.7 in
Weight	16.0 kg / 35.3 lbs

CP RC – Compensating reactor

The CP RC resonance circuit units in combination with the CPC 100 can be used for voltage withstand testing of gas-insulated switchgears (GIS).

	CP TR7 / CP TR8	CP CR4 /CP CR6	CP AT1
Voltage output	180 V[1]/ 220 V	220 V	254 V - 278 V
Current output	60 A	150 A	16 A
Apparent power on secondary side	13.2 kVA_r	33 kVA_r	4.4 kVA_r
Frequency	80 Hz ... 120 Hz	80 Hz ... 120 Hz	50 Hz / 60 Hz
Insulation class	F	F	F
Weight	19 kg / 42 lbs	20.5 kg / 45 lbs	15.5 kg / 34 lbs
Dimensions (W × H × D)	262 × 277.5 × 222 mm / 10.31 × 10.9 × 8.74 in		

CPOL3 – Polarity checker

The CPOL3 can check the correct polarity along the different connection points in an instrument transformer's secondary wiring.

Measuring range	1 mV_{rms}/mV_{DC} ... 1000 V_{rms}/V_{DC}
Evaluated signal form	Polarity test signal with slope ratio ≥ 3:1
Nominal frequency	52.6 Hz
Operation time	< 10 h
Input impedance	3 kΩ & 1.8 MΩ switchable
Batteries	Type and number: 2 × 1,5 V Mignon LR6 AA AM4 MN1500
Dimensions (W × H × D)	68 × 33 × 206 mm / 2.7 × 1.3 × 8.2 in
Weight	245 g / 0.54 lbs

SAA1

The SAA1 is an audible beeper dongle that is included with each CPC 100. It generates an acoustic signal when the test systems outputs are activated.

Dimensions (W × H × D)	49 × 37 × 20 mm 1.93 × 1.46 × 0.79 in
Weight	49 g / 0.11 lbs

SAA2

The SAA2 is a scalable safety accessory to mark your testing area. The SAA2 multifunctional Safety Accessory consists of a control unit and up to six signal lamps. The SAA2 control unit has its own power supply and the SAA2 control unit serves as a power supply for all connected SAA2 signal lamps.

Control unit

Dimensions (W x H x D)	180 × 111 × 44 mm / 7.1 × 4.4 × 1.74 in
Weight	620 g / 1.6 lbs (without cable)

Signal lamps

Diameter / Signal effekt	38 mm / LED (red, green)
Protection rating	IP52
Mounting	Magnet, 1/4" tripod screw, mounting ring and four M4 x 6 mm nuts for fixed mounting
Lenght	8 m
Dimensions (W x H x D)	180 × 111 × 44 mm / 7.1 × 4.4 × 1.74 in
Weight	620 g / 1.6 lbs (without cable)

SAA3

The SAA3 is a 3-position remote safety switch. It triggers the emergency stop of the connected test system.

Cable lenght	15 m / 49.4 ft
Dimensions (W × H × D)	174 × 61 × 44 mm 6.9 × 2.4 × 1.7 in
Weight	1,38 kg / 3.0 lbs with cable

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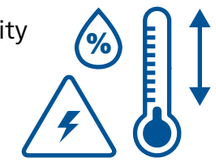
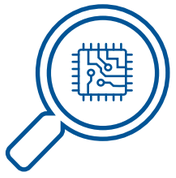


100%

routine testing for all test set components



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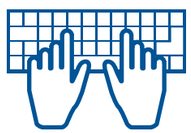

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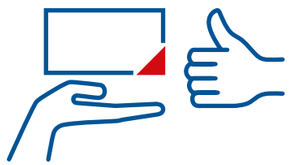
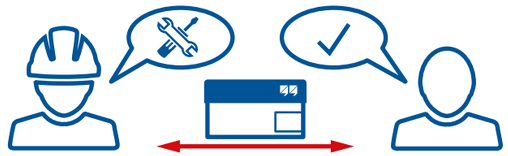


Loaner devices help to reduce downtime



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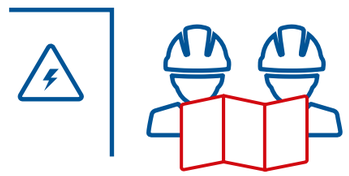

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