OMICRON

RelaySimTest

Software for validating protection systems

For full validation of your protection

As the energy transition continues apace, power systems are being expanded and renewable energies are seeing increasing use. New assets and technologies require adjustments to tried-and-tested protection concepts, or the development of entirely new ones. Given these conditions, protection testing is also facing increased demands. Whether you're working with conventional substations or in an IEC 61850 environment, it's becoming increasingly challenging to reliably validate the correct function of protection systems.

State-of-the-art protection testing

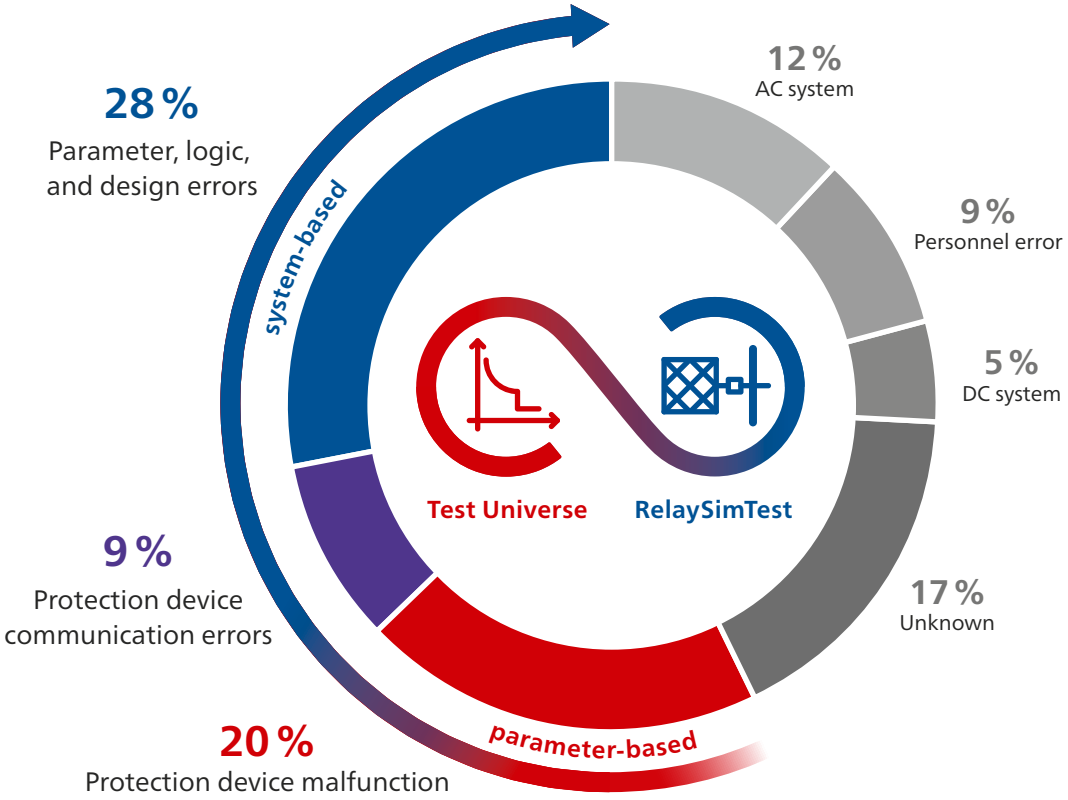
Studies show that in many cases, malfunctions in protection systems are due to setting incorrect parameters as well as logic, design, and communication errors. In other words, it takes more than parameter-based testing on individual protection components to assess whether a protection system is working as it should.

System-based protection testing with RelaySimTest enhances parameter-based testing by increasing the testing depth and offering a reliable way to identify even those errors that are hard to find. This intuitive software solution uses transient signals to create a realistic simulation of operational statuses and fault cases in the electric network, which are then injected into the protection system by an OMICRON test set.

Flexible test software for any test setup

You need to be able to trust your relay systems, and RelaySimTest helps you do just that – no matter which asset is protected by them, and whether they are located in a single substation or distributed across several substations. Testing can be performed with absolutely any type of protection device from any manufacturer, and regardless of the individual parameters. The only key factor is whether the protection system is working correctly.

system



Conventional testing based on individual parameters is no longer a reliable way of identifying many malfunctions that occur in protection systems.
(Source: ERO study on malfunctions, 2019)

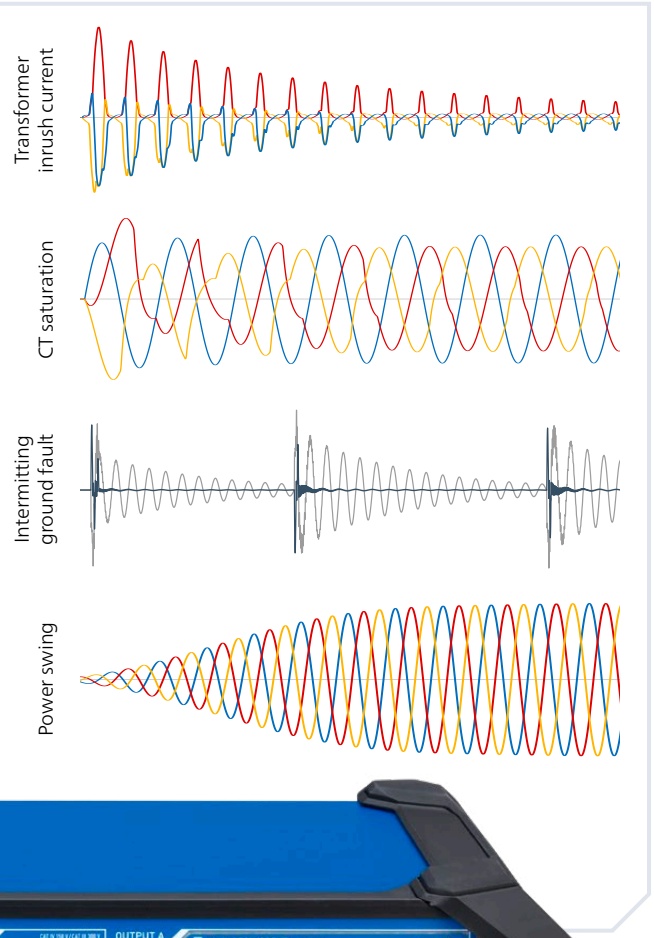
Your Advantages

- Efficient way to test complex and distributed protection systems – including IEC 61850 and hybrid installations
- Extensive testing depth, regardless of the protection device type and manufacturer
- Validates extended protection functions such as power swings and ground faults
- Automatically adjusts test signals to the behavior of the protection system
- Virtual closed-loop protection testing without physical IEDs and test hardware

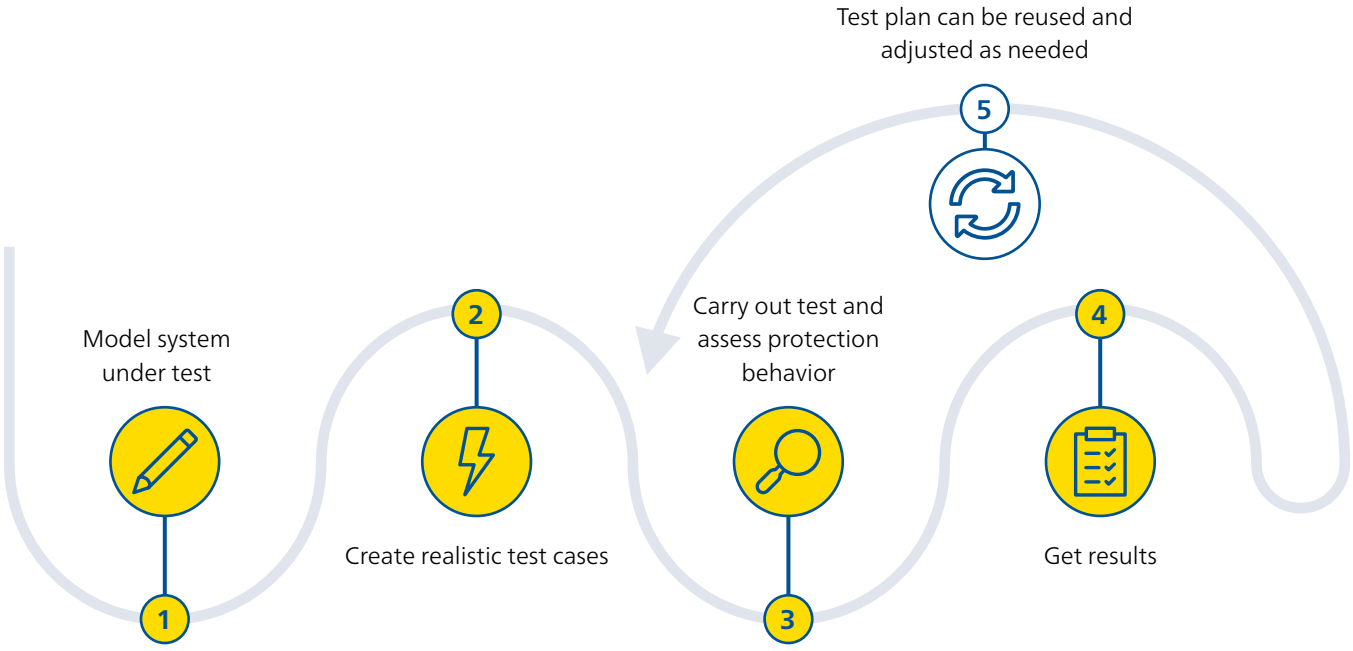
omicronenergy.com/RelaySimTest

Efficient testing with transient signals

RelaySimTest lets you analyze your protection system under transient conditions including CT saturation, power swings, reclosures, or switching on conditions of transformers – so you can ensure maximum security of supply, right from the start. What's more, the transient simulation supports you with the proper engineering of the protection system – without any test hardware.



As part of a powerful team in the field or the lab, RelaySimTest gives you an intuitive way of simulating fault events and power system statuses. The compact, portable test sets in the CMC family inject the calculated transient test signals with precision.



Save time during modeling

Modeling your power grid is an intuitive process with the flexible grid editor, and you'll be able to create realistic load and fault events in a matter of seconds. Many power system modeling parameters can be varied on an automated basis in order to simulate variations in fault locations or changing fault types. The individual test shots are summarized in test cases. And you'll save valuable time thanks to a wide range of templates for selected test situations.

RelaySimTest doesn't require any expert knowledge on power system modeling and simulation. Data that is generally available, such as the asset's nameplate data, is all you need to reliably validate your protection system.

Check out the video to see how simple protection testing can be with state-of-the-art software!

Getting Started with RelaySimTest

Automated testing and documentation

RelaySimTest uses a transient simulation to calculate the test signals, which are then injected into the protection system on a time-synchronized basis using one or more CMC test sets. Based on the system's response, RelaySimTest automatically adapts the test values during testing (see page 8 for further details). Plus, you can use digital twins to analyze your protection system without any test hardware (details on page 11).

Once testing is complete, you'll automatically receive an adjustable test report with an accurate assessment of your protection system's behavior. This report contains the results of all the test cases you have run, as well as topologies, binary contact statuses, and test hardware configurations if desired.

High-quality testing, guaranteed

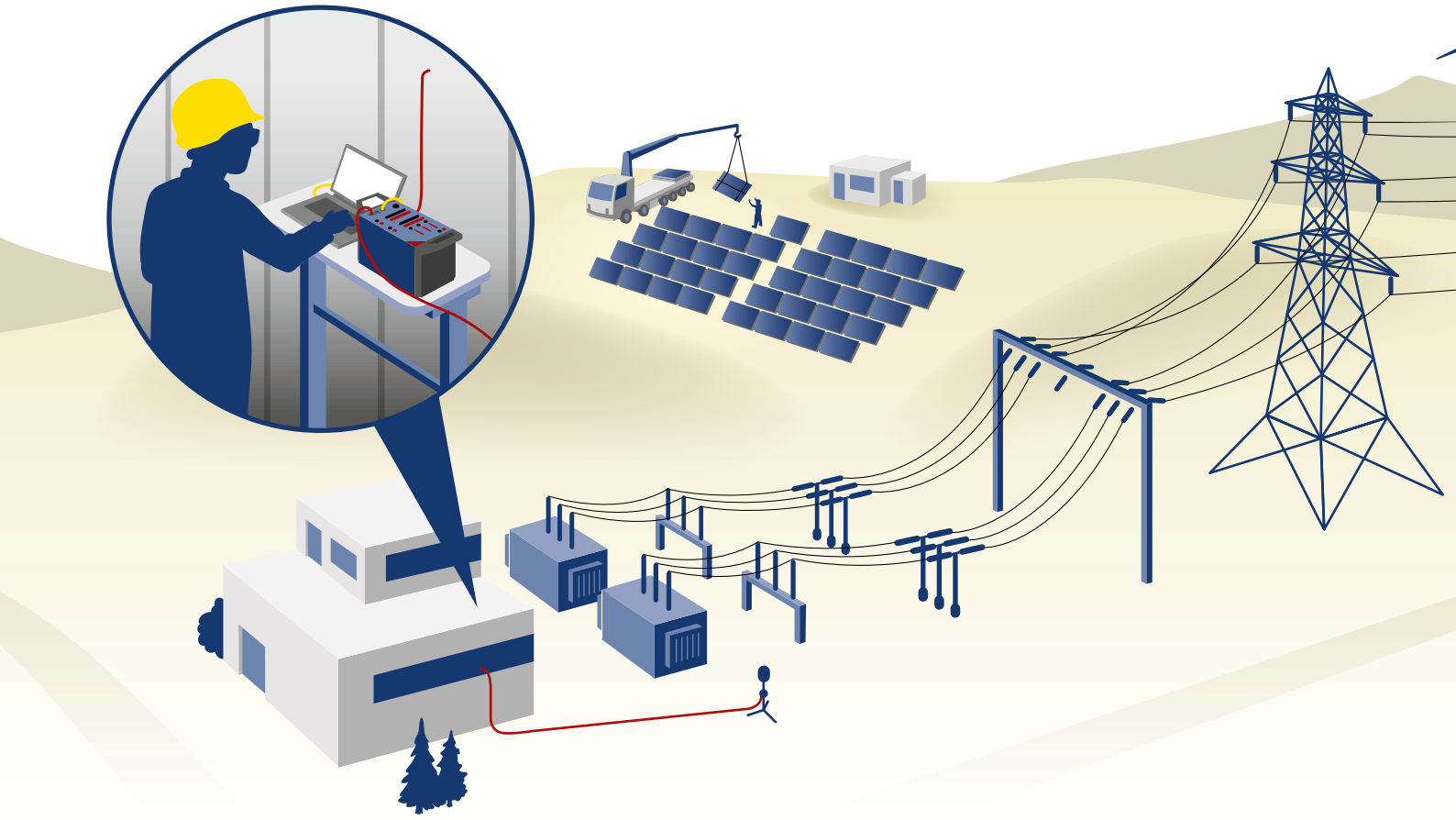
Once test plans have been created, you can run them again anytime or adjust them beforehand as needed. This saves valuable time when carrying out maintenance later on. And the standardized RelaySimTest test procedure ensures high-quality testing every time. Thanks to the modeled test cases, your company has a reliable way of documenting its test knowledge.

Everything under control – now and in the future

Distributed testing, the convenient way

RelaySimTest lets you test multiple protection devices at once. Thanks to the software's intuitive approach, even team members without in-depth technical training can configure distributed tests in no time – whether typical end-to-end tests or more complex configurations involving more than two injection points.

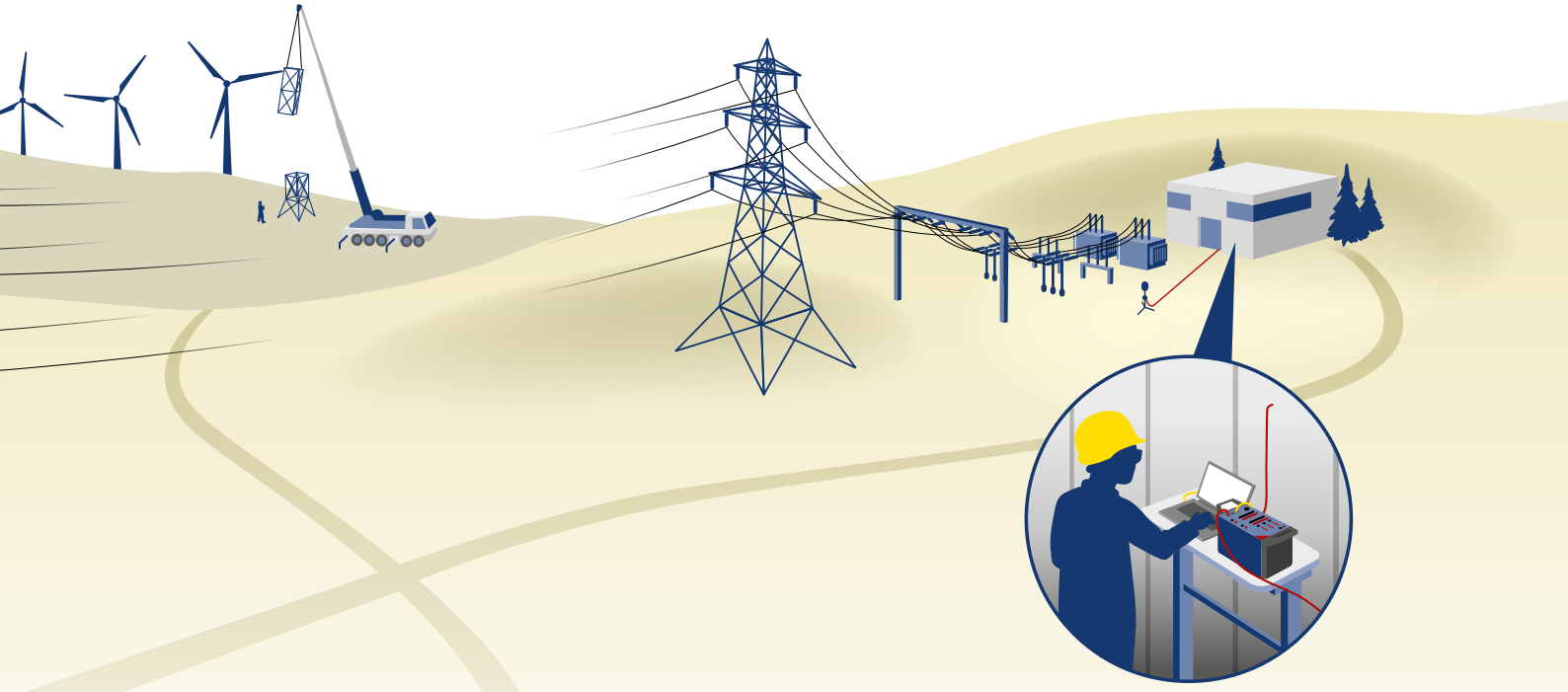
Once all test set configurations are ready, the test can be run conveniently from one central PC – without having to coordinate the process by phone. The CMC test sets inject signals simultaneously, with nanosecond precision. A PTP Grandmaster Clock such as the CMGPS 588 is used to synchronize the CMCs. Despite being located far away from each other, the test sets can be reliably controlled via an Internet connection. You can of course synchronize a number of CMC test sets locally as well in cases where you need a large number of test signals – such as testing in lab environments.



Flexibility to work with confidence

RelaySimTest offers a wide range of options for cascading and controlling test sets and boosters – so you'll be ready for future developments in your power systems as well. This might include additional injection points due to renewable energy sources, or the use of central protection systems that process measured values from distributed measurement points at the same location. Thanks to the hybrid test hardware in the CMC family, it doesn't matter whether the measured values are passed to the central system in the form of analog values or whether they are already fully digital Sampled Values.

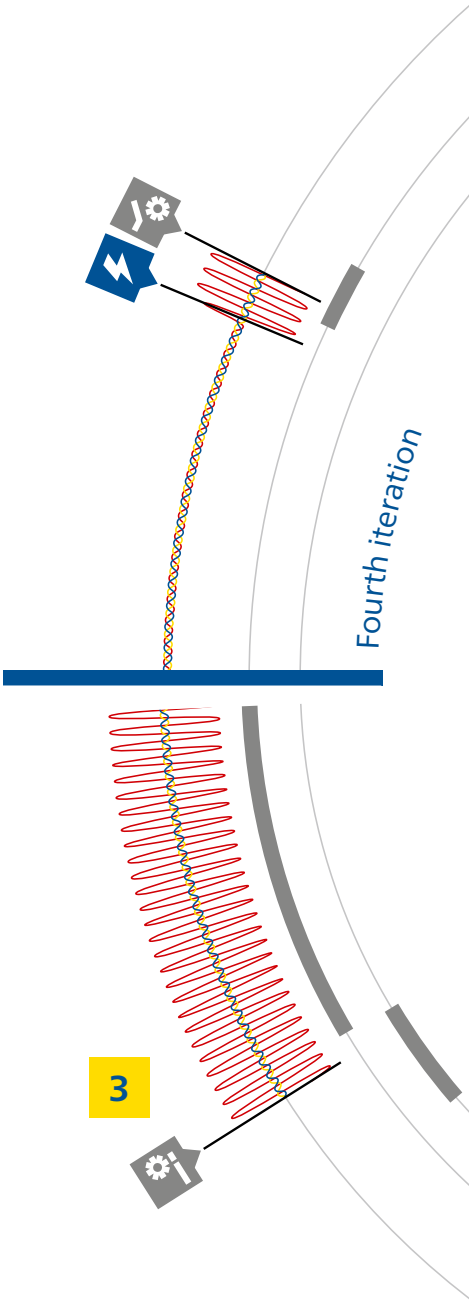
A single test document is all you need to conveniently evaluate main and backup protection concepts as well. And with the right accessory, you can even test the latest traveling wave protection relays with three-phase voltage and current traveling wave impulses.



Self-learning State Sequencer

In most cases, logic functions in protection systems are checked by specifying sequences of states, such as prefaults, faults, and postfaults. The transition to the subsequent state is initiated either because a specified period of time has elapsed or the protection device being tested issues a trip or close command. In order for this procedure to work, the test sequence has to be prepared precisely ahead of time – and is therefore prone to errors.

Thanks to its patented Iterative Closed-Loop method, RelaySimTest automatically adjusts the test signals according to the trip and close commands from the protection system. This means you don't need to go to the effort of running through and defining specific sequences of states and their transitions – no matter how complex the logic is, and regardless of whether you're running a distributed or virtual test (see page 11).



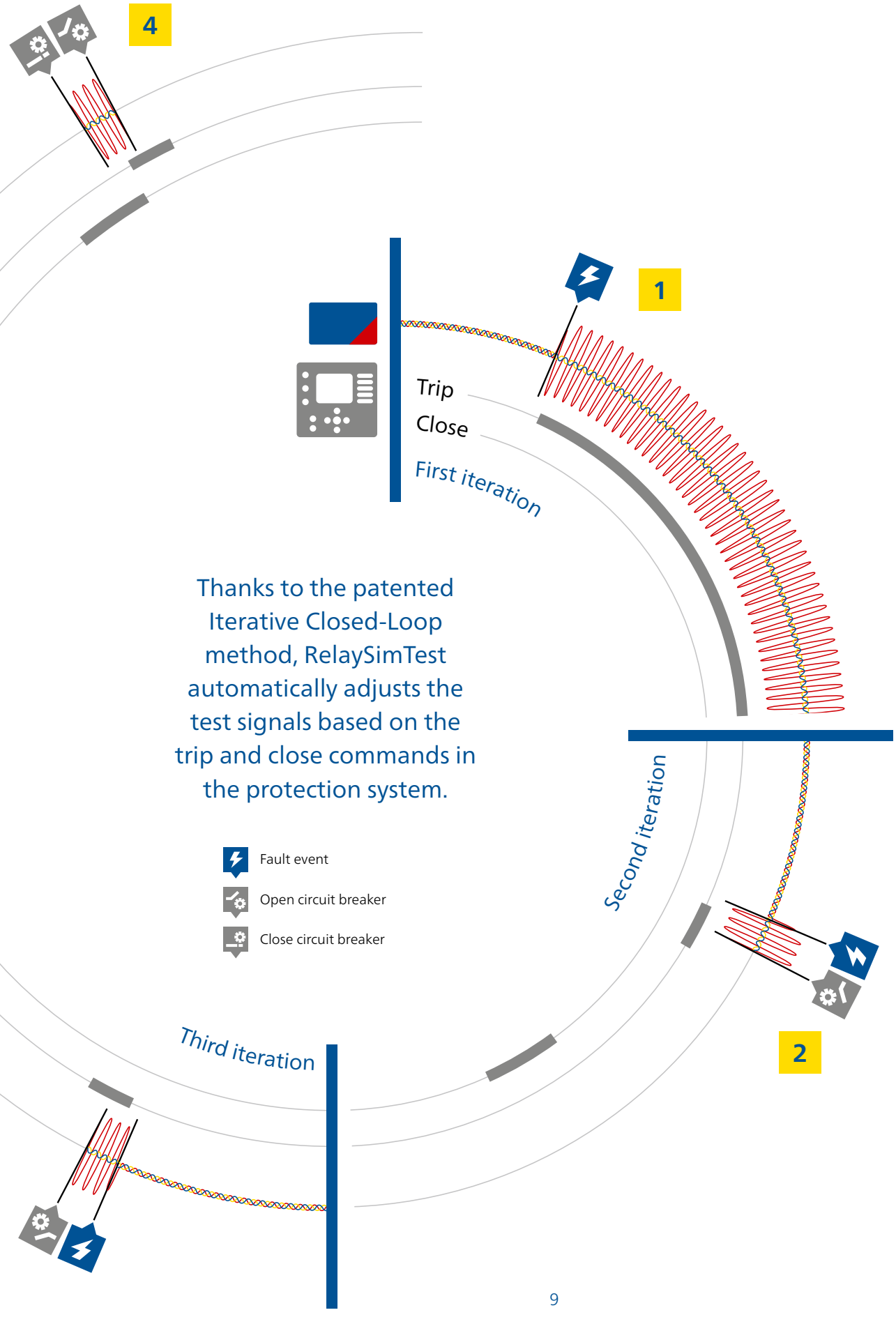
1 The test set outputs the test sequence calculated by RelaySimTest. The protection device responds during the injection of the signal with a trip command. The simulation is then interrupted. A breaker event (open) is added to the next iteration step.

2 RelaySimTest simulates correct opening of the circuit breaker with a recalculated test signal. The protection device behaves as it did during the first iteration and also causes the circuit breaker to close a short time later.

RelaySimTest interrupts the simulation again and adds a further breaker event (close) to the following test sequence.

3 Short-circuit current flows again when the circuit breaker closes, prompting the protection device to inject another trip command, which is taken into consideration in the fourth iteration.

4 The final test sequence contains all of the breaker events that were previously learned, as well as signal curves that have been adjusted accordingly. The iterations are finished once the protection device does not issue any more trip or close commands within the set simulation duration.



Thanks to the patented Iterative Closed-Loop method, RelaySimTest automatically adjusts the test signals based on the trip and close commands in the protection system.

Fault event

Open circuit breaker

Close circuit breaker

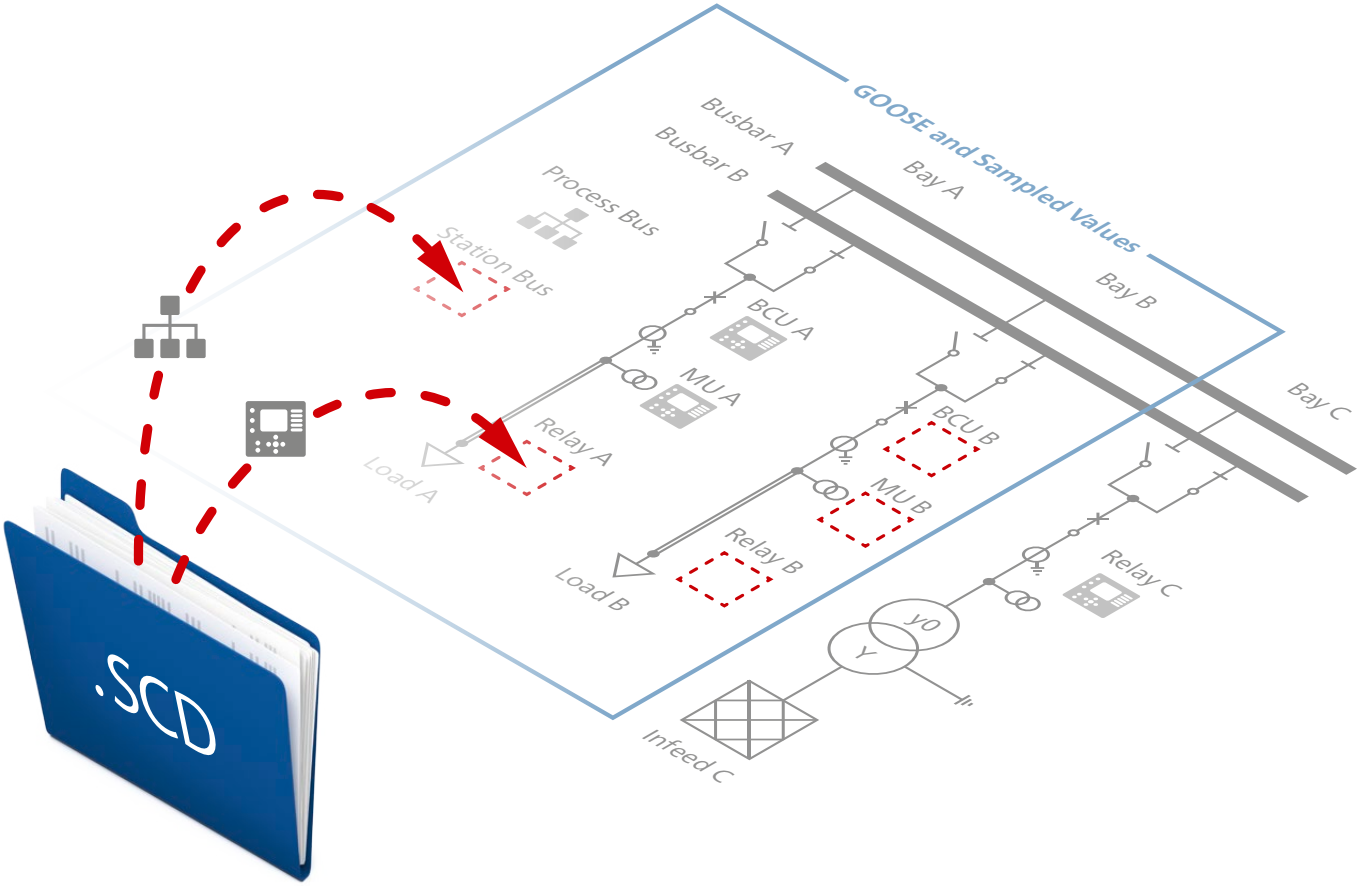
Perfect for IEC 61850 environments

Protection-, automation-, and control devices (intelligent electronic devices, IEDs) exchange information via GOOSE messages and Sampled Values (SV) in digital substations using IEC 61850 communication. The IEDs need to be considered and tested jointly in order to ensure that they are interacting with each other as they should. RelaySimTest uses a system-based testing approach that is perfect for these conditions because it includes all IEDs that are part of the protection concept.

The substation configuration file (SCD file) created in the IEC 61850 engineering process contains descriptions of all the IEDs and forms the basis for an efficient configuration using RelaySimTest. Once it has been imported, the test software automatically adds all of the required IEDs to the single line diagram that was previously created. This clear visualization helps you carry out the GOOSE and Sampled Values mapping process even when working with complex systems consisting of merging units, bay control units, and protection devices. And you won't need any in-depth knowledge of IEC 61850 data modeling or the communication structure.

Unique functional range

- Supports configurable Sampled Values datasets in accordance with IEC 61869-9
- Unlimited simulation of Sampled Values by cascading multiple test sets
- Testing of hybrid substation configurations (conventional and IEC 61850)
- Simulation of GOOSE failures
- Simulation flag clearly distinguishes test signals and real signals
- Intelligent sniffing identifies configuration errors prior to testing
- Duplicate GOOSE or Sampled Values are prevented



Virtual Closed Loop: the next dimension in protection testing

Virtual protection testing with digital twins

Physical protection devices and test hardware used to be a must for protection testing, but all you need these days is a computer and RelaySimTest to perform testing in the virtual space. Virtual protection testing can be performed regardless of time and location, offering incredible potential for savings.

Digital twins replicate your protection devices down to the detail, so you can validate entire protection concepts in a virtual environment – even if real IEDs aren't available yet or protection concepts are still being developed. You can also use virtual replicas of your protection devices to identify errors in the test plan at an early stage. This allows you to correct measurements or assessments that have been incorrectly defined in the test plan ahead of time and reuse the plan to test the physical protection system at the touch of a button. This boosts test quality and saves you the effort of adjusting the test plan on-site at the substation.

Speed up commissioning and troubleshooting

Testing your protection systems ahead of time in the virtual space reduces the time required for commissioning and testing in the field. But virtual testing is also helpful in other phases of the IED lifecycle. Because digital twins with different firmware versions are evaluated using identical test sequences, RelaySimTest pinpoints deviations in the behavior of IEDs with new firmware versions. If a protection system malfunctions or fails, virtual protection devices make it easy to simulate the events and see exactly how the system is behaving.

Unlimited freedom

The virtual world of protection testing offers almost endless possibilities, because there's no limit on the test set's output power or the number of test signals. There's no load on the real IEDs even during intensive testing, and spare IEDs are not required for the test.

Wide range of applications

Transmission network

Line protection

End-to-end testing of the line protection incl. communication (distance protection with teleprotection/differential protection). Test setup is controlled from one end without coordinating every test step by phone.

Autoreclosure

Simple testing of autoreclosure sequences independent of the number of cycles and single- or three-pole tripping. Simultaneous coordination testing for autoreclosure cycles of multiple protection devices.

Three-terminal lines

Control each test set in multiple substations from one end without having to coordinate every test step by phone.

Traveling wave

Simulation with automatic calculation of the transient signal and traveling wave impulses for the TWX1 accessory.

Power swing blocking and out-of-step protection

Test tripping and blocking of the protection if the power system is out-of-step or experiences power swings. You can also simulate combinations of power swings and fault or breaker events.

Parallel lines with mutual coupling

Simulate mutual coupling between line segments as they occur in your actual setup. Test for over- and underreach on parallel lines that are in operation or grounded.

Series-compensated lines

Test complex zone coordination on series-compensated lines, including time grading.

Phase shifter

Simulation of phase shifting transformers in accordance with IEC/IEEE 60076-57-1202 – all models, one or two cores, symmetric or asymmetric. Test transient protection system behavior in accordance with IEEE C37.245™-2018.

Combined applications

Examples showing how RelaySimTest can be flexibly adjusted to practically any application

Teleprotection with ARC

Simultaneous coordination testing for the autoreclosure cycles of multiple distributed protection devices. Test for weak infeed scenarios and current reversal.

Teleprotection with a transformer in the protected zone

Test distributed line protection containing a transformer inside the protected zone. Transformer model automatically adjusts test values to the vector group and transformation ratio.

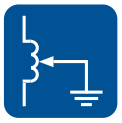
Substation

Busbar protection

Models any type of busbar topology. Simultaneous injection to any number of field units. Simulates disconnector and breaker positions and faults at every node, including dead zone fields in the coupling field.

Breaker-and-a-half

Test 1 ½ breaker setups with all current and voltage inputs. No need to rewire during the test. Check coordination of both protection devices, e.g., for breaker failure protection.



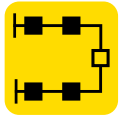
Insulated and compensated power systems

Simulate networks with all types of neutral point treatments (insulated, compensated, grounded via a low-impedance path). Test behavior of the protection system for ground faults, intermitting faults, and resulting two-pole short circuit faults.

Transformer differential protection

Model two- or three-winding transformers, autotransformers, and phase shifters and simulate tap changers, internal winding faults, and transformer inrush currents.

Distribution network



Distributed recloser testing

Simultaneous injection of test signals to multiple recloser units or sectioning points in a distribution network. Test the full operating sequence from fault isolation until service restoration.

Industry

Motor protection

Simulate the behavior of induction motors (motor startup, load jump, asymmetric load) for testing motor protection systems and motor bus transfer schemes.

Ordering information

Software packages	Item no.
RelaySimTest Standard: Single license for RelaySimTest	P0000367
Package for distributed testing: Includes two standard licenses for RelaySimTest plus two CMGPS 588 units	P0006621
RelaySimTest license for ARCO 400: Enables synchronized distributed scheme testing for recloser controls	P0008699
Transformer license: Extends transformer simulation capabilities like internal faults, inrush, and overexcitation	P0006853
Motor license: Simulates induction motors	P0008107
Annual license for virtual protection testing (Digital Twin)	P0008810

RelaySimTest is included in the CMC software packages **Enhanced** and **Complete**, as well as in the ARCO 400 package **Advanced**.

We create customer value through ...

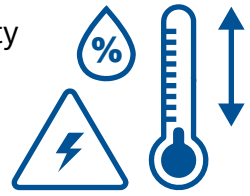
Quality

You can rely on the highest safety and security standards

Superior reliability with up to

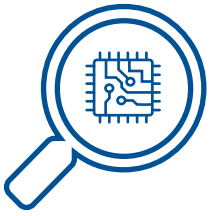
72

hours burn-in tests before delivery



100%

routine testing for all test set components



ISO 9001
TÜV & EMAS
ISO 14001
OHSAS 18001

Compliance with international standards

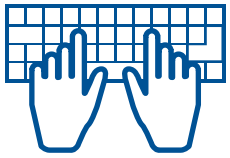
Innovation

... a product portfolio tailored to my needs

More than

200

developers keep our solutions up-to-date



More than

15%

of our annual sales is reinvested in research and development

Save up to

80%

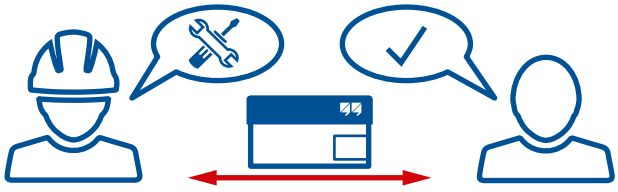
testing time through templates, and automation

Support

24/7

Professional technical support at any time

Loaner devices help to reduce downtime



Cost-effective and straight-forward repair and calibration

offices worldwide for local contact and support

Knowledge

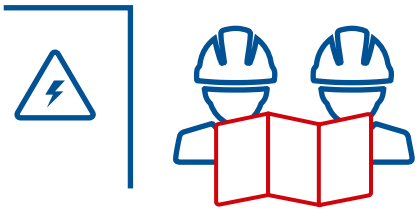
More than

300

Academy and numerous hands-on trainings per year

Frequently OMICRON hosted user meetings, seminars and conferences

to thousands of technical papers and application notes



Extensive expertise in consulting, testing and diagnostics

OMICRON is an international company that works passionately on ideas for making electric power systems safe and reliable. Our pioneering solutions are designed to meet our industry's current and future challenges. We always go the extra mile to empower our customers: we react to their needs, provide extraordinary local support, and share our expertise.

Within the OMICRON group, we research and develop innovative technologies for all fields in electric power systems. When it comes to electrical testing for medium- and high-voltage equipment, protection testing, digital substation testing solutions, and cybersecurity solutions, customers all over the world trust in the accuracy, speed, and quality of our user-friendly solutions.

Founded in 1984, OMICRON draws on their decades of profound expertise in the field of electric power engineering. A dedicated team of more than 1300 employees provides solutions with 24/7 support at 23 locations worldwide and serves customers in more than 170 countries.

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

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