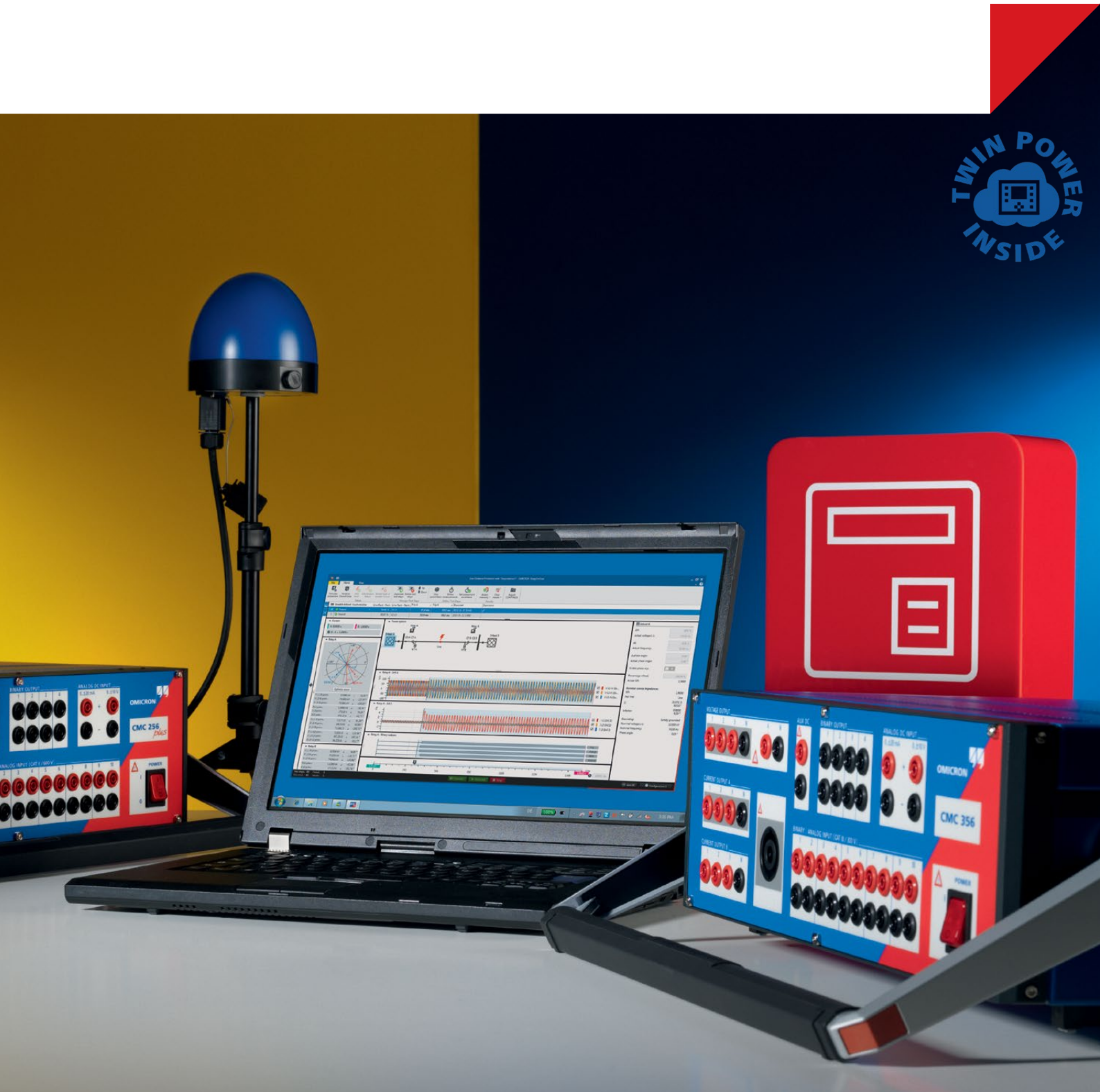
RelaySimTest

Software for system-based protection testing



RelaySimTest – Test the whole system

System-based testing

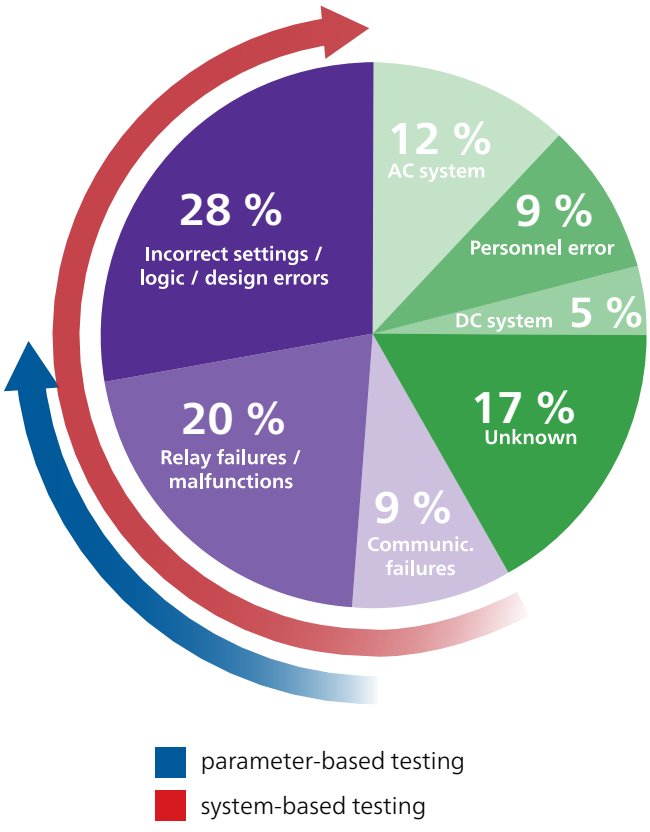
RelaySimTest is a software solution for OMICRON test sets that simplifies complex protection scheme testing.

Its innovative approach validates the correct operation of the entire protection system by simulating realistic power system events. In addition to common tests, RelaySimTest also reveals settings, logic and design errors in the scheme, which increases the confidence in the correct operation of your protection system. This paves the way for improved testing quality and time saving testing procedures.

Modern protective relays use adaptive algorithms. Simple steady-state tests are often not sufficient for testing such relays. RelaySimTest covers these new demands with a transient simulation of the primary power system.

System-based tests are independent from relay type, manufacturer and detailed parameters, which reduces the preperation effort. The correct protection system behavior is the only thing that counts.

ERO Misoperation Study 2019



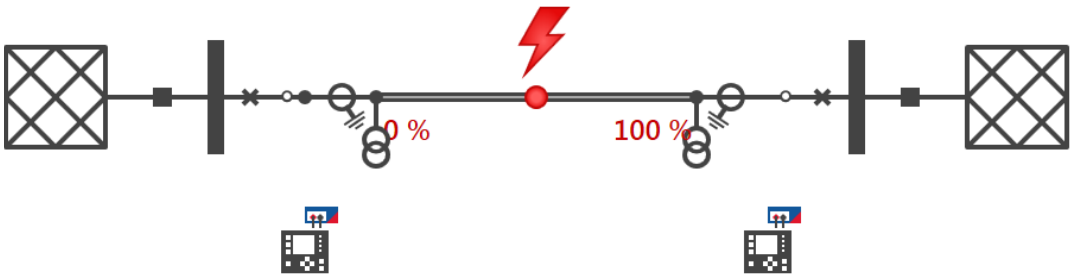
Get the highest level of system reliability

Compared with conventional testing methods (such as settings-based testing with Test Universe), RelaySimTest can detect errors in the settings, logic, and design of the protection system much more efficiently. This allows testers to verify their protection system's correct behavior faster and with a higher level of testing quality than ever before. Complementary to testing with Test Universe, RelaySimTest contributes to a more reliable power system.

Increasing complexity? – Keep testing simple!

Predefined templates get you started quickly and easily for the most common testing applications. With the flexible grid editor, you can adjust the power system and fault scenarios to your needs.

To test the relay, you can create a test case with multiple variations (for example, fault type, fault location, etc.). Afterwards, test results are automatically assessed according to the pre-defined time frame.



RelaySimTest is based on an intuitive and flexible grid editor

Your benefits

- System-based testing for a higher level of testing quality
- Independent of relay type and manufacturer
- Distributed testing made easy by controlling multiple CMCs from one PC – direct or via Internet
- Testing of advanced relay functions such as power swings, transient ground faults, and capacitive line phenomena

www.omicronenergy.com/relaysimtest

Typical applications

Transmission

Teleprotection and line differential
Test the protection including its communication channels. Control the test setup from one end without coordinating each test by phone. Independent of the teleprotection scheme being used.

Auto-reclosing
Simple testing of auto-reclosing sequences independent of the amount of cycles, single or three pole tripping. Simultaneous coordination testing for the reclosing cycles of multiple relays.

Three-terminal lines
Control all test sets at each terminal from one end without having to coordinate each test on the phone.

Traveling Wave
The simulation automatically calculates the transient signal and the travelling wave pulses for the TWX1 accessory.

Power-swing & out-of-step
Test the tripping & blocking for out-of-step and power-swing conditions. Combine power-swings with fault and breaker events.

Series-compensated lines
Test complex zone coordination on series compensated lines including the effects on time grading.

Parallel lines with mutual coupling
Simulate mutual coupling between line segments as they occur in your real world topology. Test for over- and underreach when parallel lines are in operation or grounded.

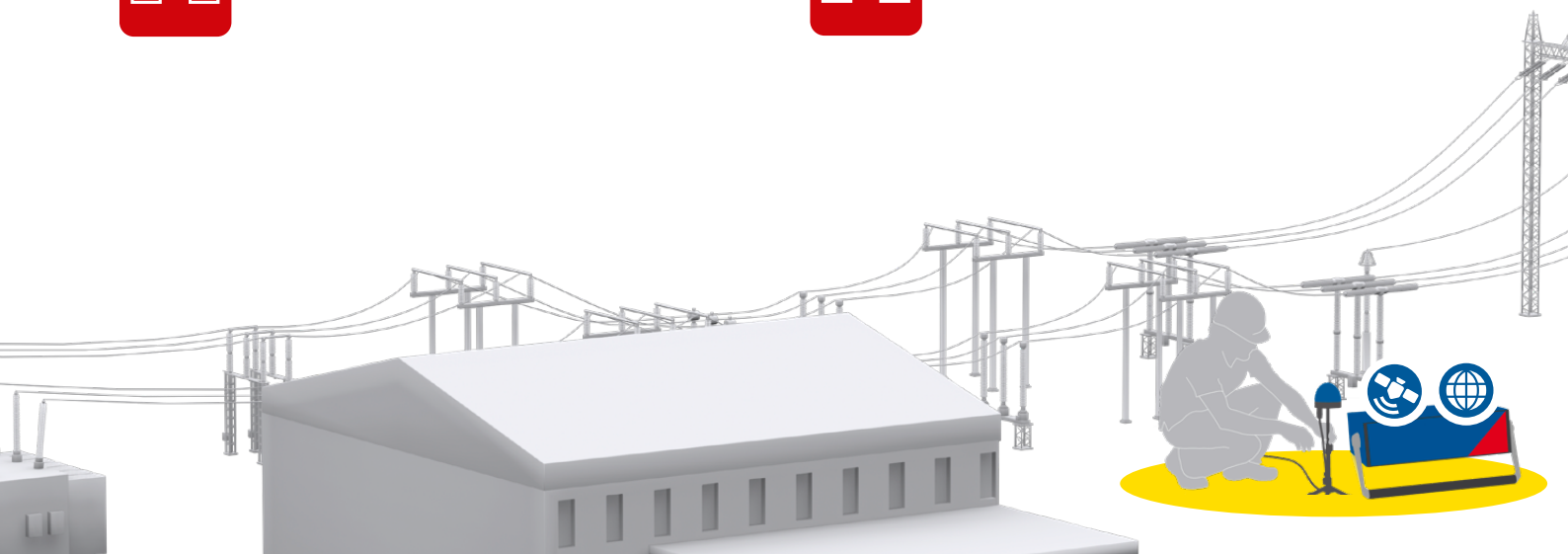
Phase shifter
Simulate phase shifting transformers according to IEC/IEEE 60076-57-1202 with all types of construction, such as single and dual core, symmetrical and asymmetrical. Use the dual-core simulation for transient protection system studies according to IEEE C37.245™-2018.

Combined applications

Examples of how RelaySimTest can be adapted flexibly for almost every application

Teleprotection with auto-reclosing
Simultaneous coordination testing for the reclosing cycles of multiple distributed relays. Testing for weak infeed scenarios and current reversal.

Teleprotection with transformer
Testing distributed line protection containing a transformer inside its protected zone. Transformer model takes care of vector group and transformer ratio automatically.



Substation

Busbar protection
Model any type of busbar topology. Simultaneous injection to any number of field units. Simulation of disconnector and breaker position. Faults on every node including dead-zone faults in the coupling field.

Breaker-and-a-half
Test 1 ½ breaker relays with all current and voltage inputs. No need to re-wire during the test. Check coordination of both relays e.g. for breaker-failure protection.

Insulated and compensated networks
Simulate networks with insulated and compensated star-point grounding. Test behavior of the protection system for earth faults, intermitting faults and resulting two phase faults.

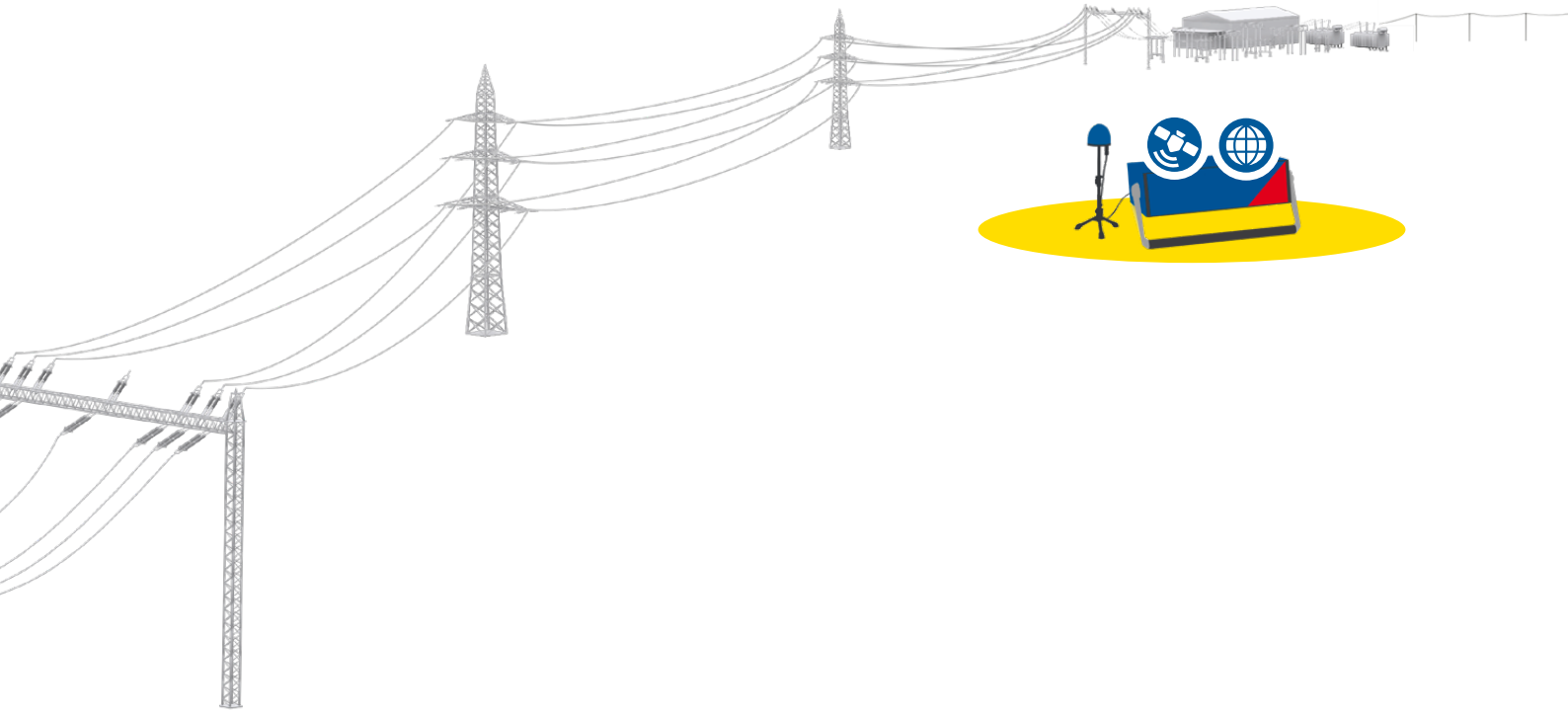
Transformer differential protection
Model two- and three-winding transformers, autotransformers, and phase shifting transformers and simulate tap changers, internal winding faults and inrush currents.

Distribution

Distribution loop scheme
Inject to every single recloser unit in the loop scheme simultaneously. Tests the full operation sequence from fault isolation to service restoration.

Industry

Motor Protection
Simulate the behavior of asynchronous motors in order to test motor bus transfer schemes and motor protection systems.



Testing in IEC 61850 environments

In substations utilizing IEC 61850, real-time information between the protection, automation, and control devices is exchanged via GOOSE messages and Sampled Values. A system-based test is highly recommended for ensuring that the whole protection system is operating as expected. RelaySimTest offers a unique feature set for performing system-based tests in substations utilizing IEC 61850.

Simplified & comprehensible test setup

By simply importing the IED descriptions (e.g. for protection IEDs, merging units, bay units etc.) from the substation configuration file (in SCL format), RelaySimTest visualizes the whole system under test in the single line diagram. GOOSE and Sampled Values can be mapped with one click. The hardware configuration will be reduced to a simple mapping of the test set's Ethernet ports to the substation network.

Secure testing

To ensure a secure and reliable operation, RelaySimTest runs an automatic validation process before every execution. The software will sniff the network to avoid misoperations caused by simulating duplicate GOOSE and Sampled Value messages. Additionally, the software automatically checks if the subscribed GOOSEs are present. All binary outputs, circuit breaker and switch positions can be latched according to the single-line-diagram or verifying the correct set-up.

Unique IEC 61850 features

- Flexible Sampled Value data sets according to IEC 61869-9
- Simulation of missing GOOSE messages
- 4 Sampled Value streams per test set. Extendable by adding further test sets
- Connection to multiple virtual or physically separated networks – no need to bridge networks

Interface for testing in IEC 61850 environments

Transient simulation

To ensure your protection system is working as expected, RelaySimTest calculates its test signals via a transient power system simulation. This enables users to investigate their protection system under challenging conditions like CT saturation, power swings, weak infeed conditions, inrush and many more. As the test signals are like real world system events, even adaptive or time domain protection functions can be tested.

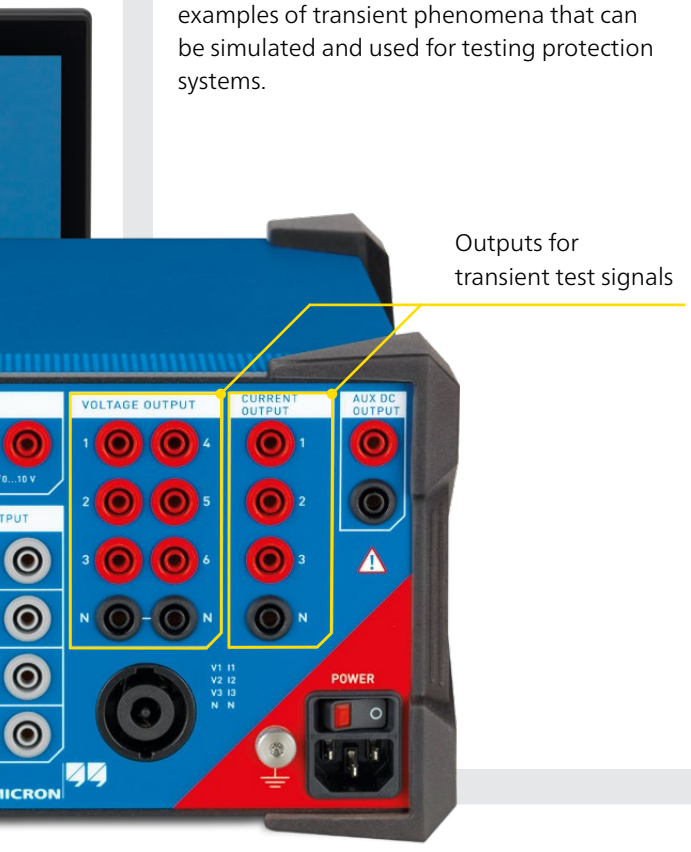
Simple test setup and high testing depth

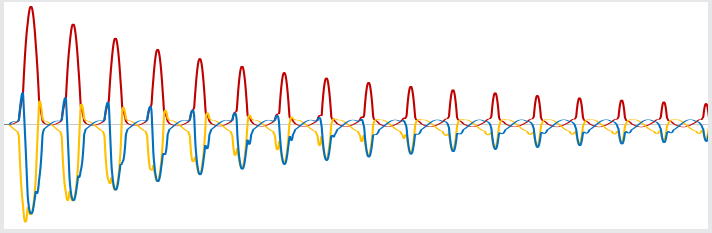
To set up a test, you can either use a predefined template or draw your power system with the intuitive editor. RelaySimTest only requires readily available data like nameplate data to yield a stable transient simulation – no expert knowledge in simulations is required. Each test case can be defined in seconds by simply adding faults or operating breakers. The simulation takes care of all calculations. This allows you to test your protection system in depth. The system-based testing approach enables you to set up tests with multiple relays. For example, you can set up an end-to-end configuration test in no time.

The ideal combination

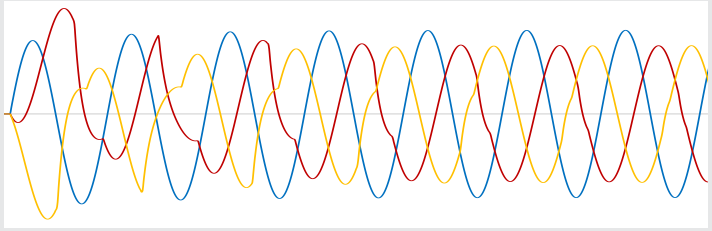
The ability to output high-precision signals makes CMC test sets[1] the ideal signal generators for transient signals.

The power system simulation in RelaySimTest is constantly being extended. Here are some examples of transient phenomena that can be simulated and used for testing protection systems.

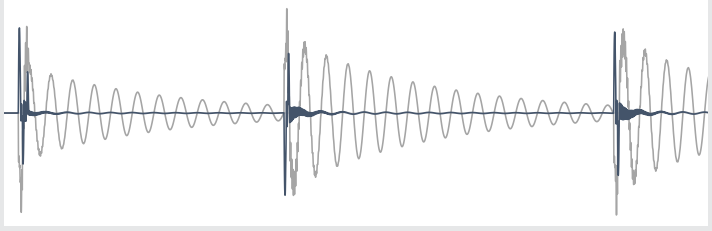




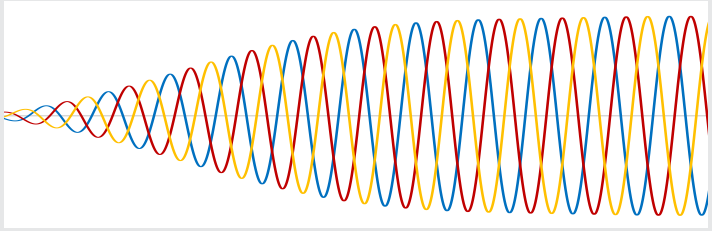
Transformer inrush current



CT saturation



Intermittent ground fault



Power swing

[1] Works with: CMC 356, CMC 256plus, CMC 430, CMC 353 and CMC 850

Distributed testing

With RelaySimTest you can control all connected CMCs from one PC using several options. This allows you to execute distributed tests across substations as easily as single substation tests, regardless of how many CMC test sets you use. By pressing execute, RelaySimTest calculates the required signals and sends them to the test sets; the following test execution is simultaneous with nanosecond precision.

- No coordination via phone required
- Troubleshooting from one PC
- Iterative Closed-Loop for automatic response to trip and close commands (e.g. for testing auto-recloser functions in end-to-end line protection)
- One summarized report

Remote control

- WAN
- Direct Fiber Connection
- Device Remote Agent (Cloud)

Remote CMC

Control PC with RelaySimTest

Remote CMC

Local control

- LAN
- USB
- WIFI

Remote CMC

Local CMC

Time synchronization

- CMC Local sync
- CMGPS 588
- IRIG-B
- IEEE 1588 / PTP network

Logic testing with physical IEDs or Digital Twin and test reports

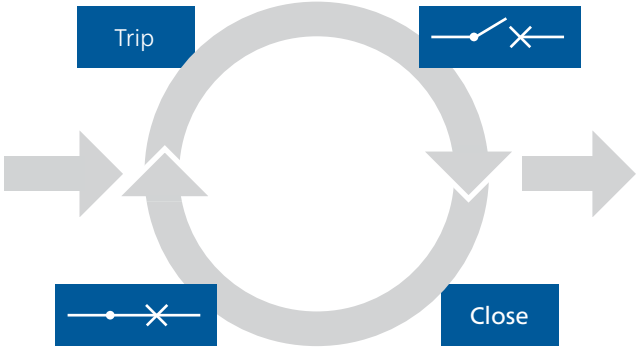
Testing with Digital Twin

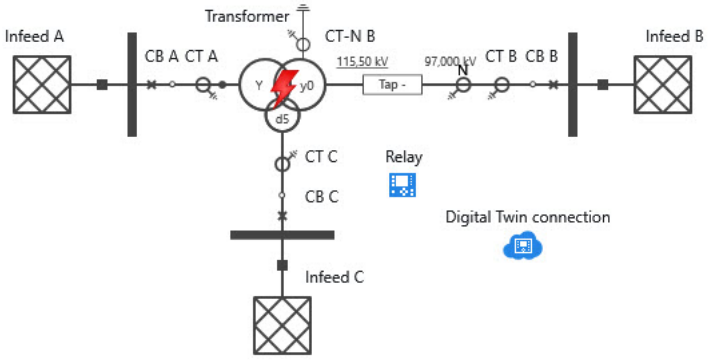
All essential functions of RelaySimTest can also be used with Digital Twins. Simply add a Digital Twin connection to your topology, connect to your digital twin and start testing as with physical IEDs.

- removes need for spare IEDs for testing
- no test set output power limitations
- unlimited number of test signals
- speeds up troubleshooting
- increases test quality
- helps find design errors during engineering
- lets you create fault scenarios and replay on DT
- helps to find errors in protection system test plan
- lets you test intensively without stressing your IEDs
- lets you later use same test plan for physical IED testing

Iterative Closed Loop

With the patented "Iterative Closed-Loop" method, RelaySimTest can automatically adjust test signals according to the trip and close commands.



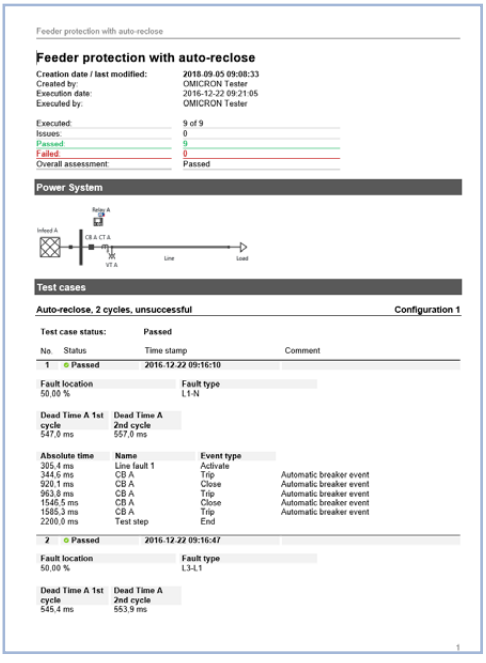


Topology with Digital Twin connection

Test reports

RelaySimTest automatically generates a report for all the performed test cases and summarizes all results in one document. The report can be customized to contain test case results, single line diagrams, status of binary contacts and test set configurations. RelaySimTest exports the report in the .docx format for easy further processing.

- .docx format
- Automatically generated
- One report per protection system
- Customizable


Feeder protection with auto-reclose

Feeder protection with auto-reclose

Creation date / last modified:	2018.09.05 09:08:33
Created by:	OMICRON Tester
Execution date:	2016-12-22 09:21:05
Executed by:	OMICRON Tester
Executed:	9 of 9
Issues:	0
Passed:	9
Failed:	0
Overall assessment:	Passed

Power System

Test cases

Auto-reclose, 2 cycles, unsuccessful — **Configuration 1**

Test case status: Passed

No.	Status	Time stamp	Comment
1	Passed	2016.12.22 09:16:10	

Fault location	Fault type
50,00 %	L1-N

Dead Time A 1st cycle	Dead Time A 2nd cycle
547,0 ms	557,0 ms

Absolute time	Name	Event type	
305,4 ms	Line fault 1	Activate	
344,6 ms	CB A	Trip	Automatic breaker event
920,1 ms	CB A	Close	Automatic breaker event
963,8 ms	CB A	Trip	Automatic breaker event
1546,5 ms	CB A	Close	Automatic breaker event
1585,3 ms	CB A	Trip	Automatic breaker event
2200,0 ms	Test step	End	

No.	Status	Time stamp
2	Passed	2016.12.22 09:16:47

Fault location	Fault type
50,00 %	L3-L1

Dead Time A 1st cycle	Dead Time A 2nd cycle
545,4 ms	553,9 ms

Embedded in OMICRON's world of testing

Advanced Protection Testing

RelaySimTest is OMICRON's system-based testing solution. OMICRON also offers a parameter-based testing solution, called Test Universe (TU). Using test plans of these two software solutions together is what OMICRON calls Advanced Protection Testing, offering a range of benefits, including the highest testing depth, testing knowledge transfer and safeguarding, faster testing, and cost savings.

Ordering information

Supported test devices & accessories
CMC 356, CMC 353, CMC 256plus, CMC 430, CMC 850, ARCO 400
CMGPS 588 and CMIRIG-B for time synchronized testing
ISIO 200 binary input/output terminal
TWX1 traveling wave testing accessory

A CMC with NET-2 board is required for the full application range.

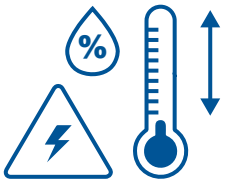
Software packages	Item number
One license for RelaySimTest	P0000367
Package for distributed testing, including two licenses for RelaySimTest plus two CMGPS 588	P0006621
RelaySimTest license for ARCO 400, enables synchronized distributed scheme testing for recloser controls	P0008699
Trafo license	P0006853
Motor license	P0008107
Digital Twin subscription	P0008810

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

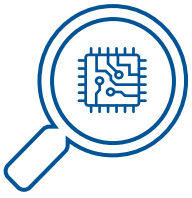
We create customer value through ...

Quality

Highest safety and security standards

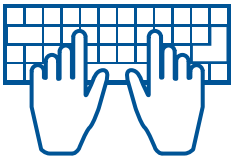


Up to 72 hours burn-in tests



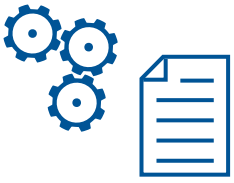
100% routine testing for all components

Innovation



>200 developers keep our solutions up-to-date

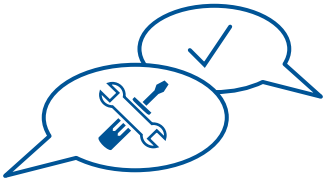
Reinvestment >15% in R&D



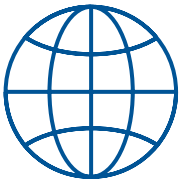
Up to 70% time saving through automation

Support

Professional technical support

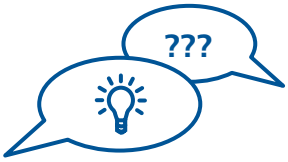


Cost-effective repair & calibration



25 offices worldwide

Knowledge



>300 Academy trainings per year

OMICRON hosted training & events

Free papers & application notes

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 900 employees provides solutions with 24/7 support at 25 locations worldwide and serves customers in more than 160 countries.

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

www.omicronenergy.com

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