OMICRON

CMC 500

Modular, multi-phase protection relay test set and commissioning tool



The new benchmark in protection testing

The CMC 500 gives you an efficient way of tackling current challenges in the field of protection technology that arise due to an aging infrastructure, the expansion of power grids, and an increasingly acute skills shortage.

This lightweight, robust test set delivers a consistently high level of testing quality in minimal time. The versatile solution is second to none when it comes to safety, cybersecurity, and being ready for the future.

HIGHLY EFFICIENT

- Standardized, contemporary testing approaches save a huge amount of time during test preparation and execution
- Fast and easy troubleshooting thanks to unparalleled software usability
- Complete and automatic documentation of test results



RELIABLE

- Lightweight, durable enclosure for use in the field
- Developed and tested in accordance with internationally recognized standards
- Multi-day endurance test of every device prior to delivery

READY FOR IEC 61850

- Integrated network interfaces for IEC 61850 IEDs
- Support of latest communication protocols (GOOSE, R-GOOSE, MMS, Sampled Values with configurable datasets as per IEC 61869)
- Easy to adjust existing test plans to suit digital installations



CYBERSECURE

- Comprehensive protection from cyber threats
- Secure Boot, encrypted communication, tamper-proof firmware, and much more

SAFE TO USE

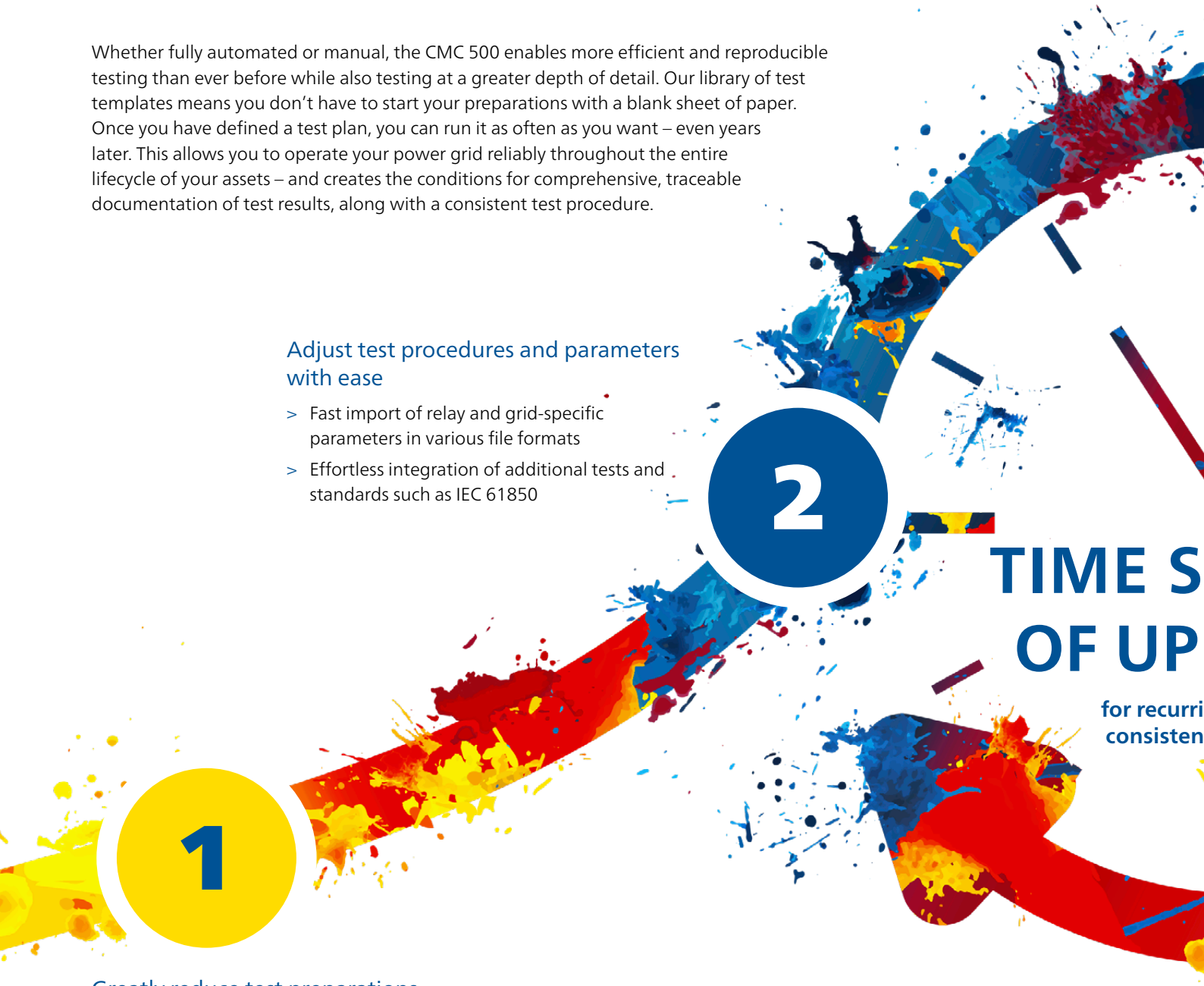
- Reduced risk of electrical hazards thanks to comprehensive safety features
- Organized test setup: all terminals on the same side

VERSATILE

- Testing of protection relays, current transformers, circuit breakers, and more
- Troubleshooting and analysis using hybrid signal recording
- Flexibly equipped with up to 7 voltage outputs and 10 current outputs

Unrivaled testing efficiency

Whether fully automated or manual, the CMC 500 enables more efficient and reproducible testing than ever before while also testing at a greater depth of detail. Our library of test templates means you don't have to start your preparations with a blank sheet of paper. Once you have defined a test plan, you can run it as often as you want – even years later. This allows you to operate your power grid reliably throughout the entire lifecycle of your assets – and creates the conditions for comprehensive, traceable documentation of test results, along with a consistent test procedure.



Adjust test procedures and parameters with ease

> Fast import of relay and grid-specific parameters in various file formats

> Effortless integration of additional tests and standards such as IEC 61850

Greatly reduce test preparations

> Perfectly organized test procedure at the touch of a button: Protection Testing Library (PTL) with templates for over 500 relay types

> Test templates for testing entire systems

GE VERNOVA SEL ...

Schneider Electric sprecher automation

Our expert know-how for relays from ABB to ZIV: The PTL contains recommended test procedures for relays from all current manufacturers.

3

Perform tests in no time – including the report

- Standardized and automated testing
- Intuitive to use
- Summarized and exportable test results for transparent reporting

AVINGS TO 80 %

ng tests with t test quality

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Use test plans again and again

- Easily reusable commissioning test plans for maintenance, after incidents, and during firmware upgrades
- Long-term comparisons between test results
- Consistently high testing quality for all test personnel thanks to standardization

FOR QUICK CHECKS: CMC SWIFT

- Quick manual tests using a smartphone or tablet
- Convenient and intuitive operation
- Ideal for polarity and wiring checks

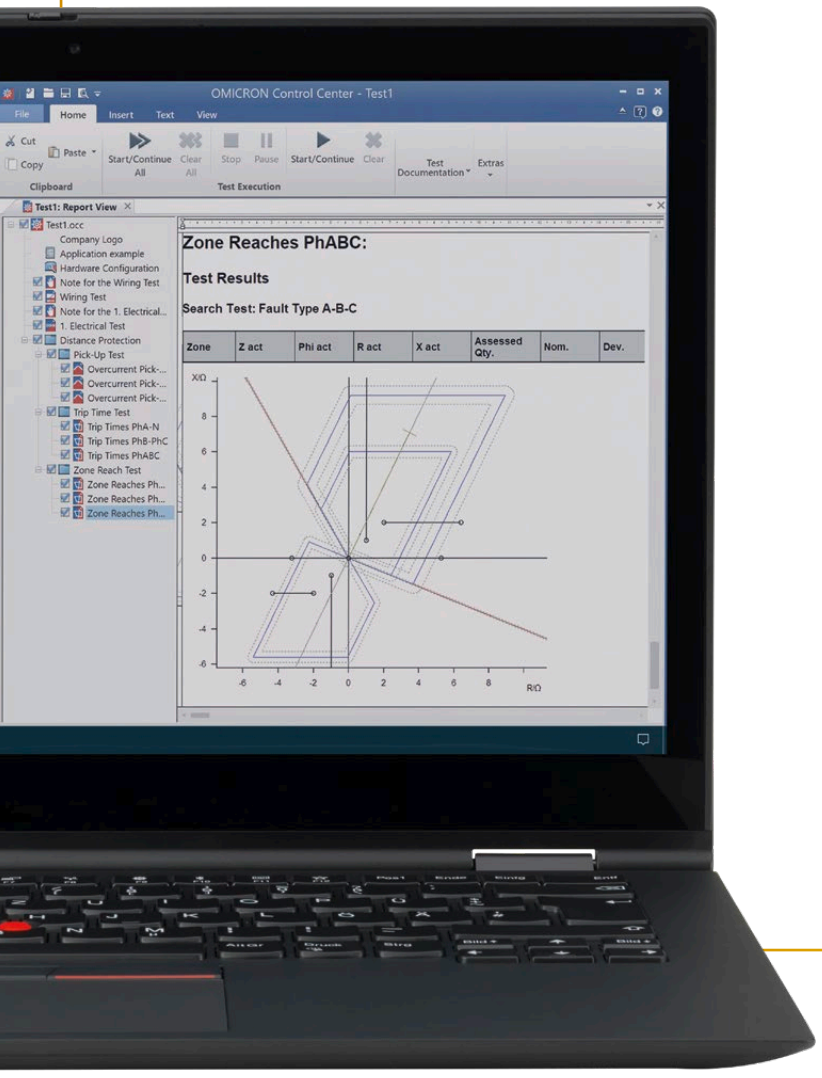


Full validation of your protection system

Two powerful testing paradigms allow you to examine your protection system from completely different angles. This enables the unveiling of issues that would otherwise remain undetected. Test each individual relay parameter in incredible detail with Test Universe and assess the behavior of your protection system in a realistic grid simulation with RelaySimTest.

PARAMETER-BASED TESTING

Use Test Universe to examine all the key parameters in your protection relay in detail. You can either create new test plans from scratch or conveniently import parameters for over 500 stored relay types including recommended test procedures from our PTL. Simply adjust the plans to suit your needs and create different versions – to accommodate similar relay models or different firmware versions, for example.



Test your protection relay down to the finest detail

- Measure reaction times, such as:
  - Pick up
  - Trip
- Verify your protection functions and their tolerances, such as:
  - Overcurrent
  - Distance protection
  - Differential protection
- Simply compare existing parameters in the relay with the expected values
- Get test parameters automatically adjusted to the respective relay settings – without having to manually calculate and input them for every test

PTL
PROTECTION TESTING LIBRARY

SYSTEM-BASED TESTING

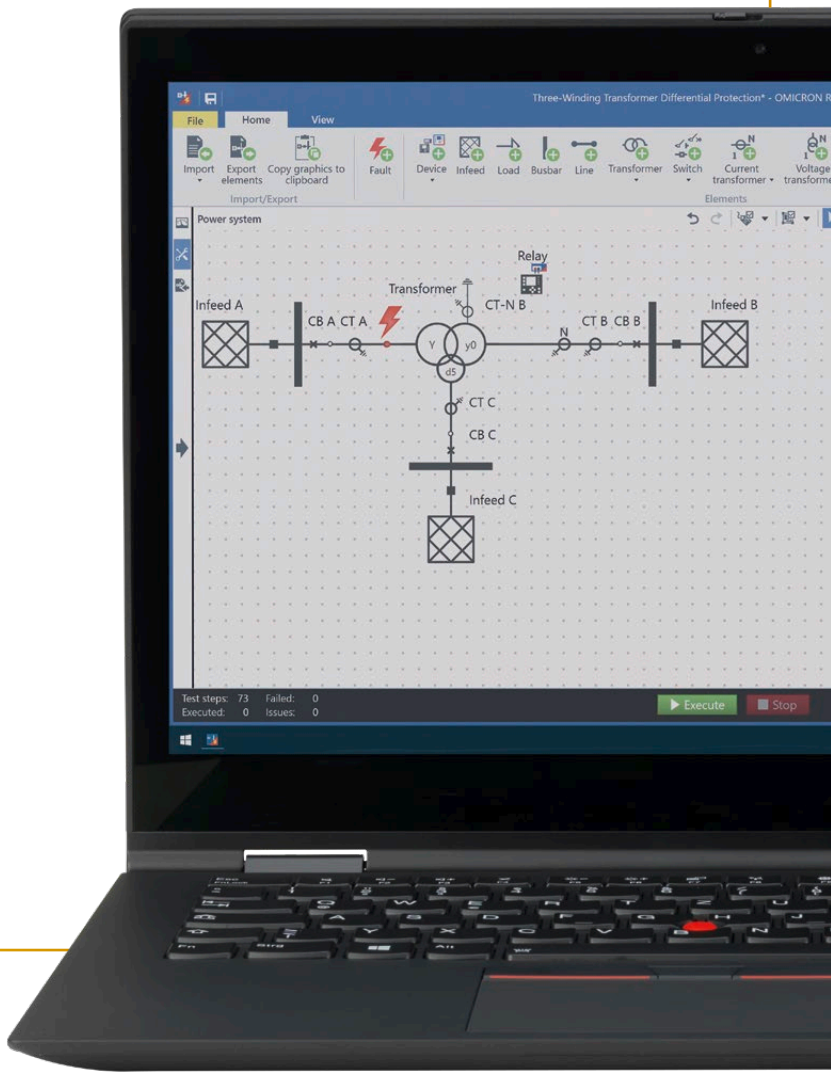
System-based testing with RelaySimTest enables full validation of your protection system and gives you an efficient way of pinpointing logic or design errors. No matter the complexity of your protection systems, whether they are located in one substation or distributed across several, whether they protect feeders, lines, power transformers, phase shifters, busbars, or motors – RelaySimTest gives you the confidence you need in your protection system.

Validate your protection system

- Simulate your system with realistic test scenarios
  - Variation of injection and load ratios
  - Switching operations
  - Breaker failures
  - Dynamic fault simulation
  - Test quantities adapted in response to the reaction of the protection system (Iterative Closed-Loop)

- Carry out distributed tests involving multiple CMCs from a single computer and visualize the results of the protection system in one test document

- Simulate transient processes, such as:
  - Transformer energization (inrush)
  - Automatic reclosures (ARC)
  - Current transformer saturation
  - Ground faults
  - Network oscillations
  - Motor start-ups
  - Traveling waves



Cybersecurity by design

It's crucial to ensure the test sets do not serve as a gateway for cyber attacks, thus guaranteeing the security of your critical infrastructure. This is particularly important if the testing solutions are connected to your substation network. The CMC 500 impedes cyber attacks on your installation based on a wide range of security measures that we have integrated in the development from the very start.

Continuous protection

The CMC 500 is the first protection test set that comes with a secure cryptoprocessor built in. We followed the principles of the secure software development life cycle (SSDLC) when developing the device, just as we do with every OMICRON test set. This process ensures that cybersecurity is maintained throughout the entire life cycle of the CMC 500. Our company-wide cybersecurity concept also sets out our approach when dealing with security gaps that have come to our attention.

Find out more at
omicronenergy.com/product-security

Broad package of measures

- Protection against man-in-the-middle and spoofing attacks: test set is securely identified as the CMC 500 via a digital certificate
- Protection against firmware tampering: Secure Boot and Measured Boot with ISO/IEC 11889-compliant Trusted Platform Module (TPM2.0)
- Protection against disclosure of sensitive information: encrypted communication during operation and firmware upgrades, encrypted configuration and customer data
- Protection against unauthorized use: password protected communication with the CMC 500



Maximum user safety

Protection testers working in substations are exposed to an increased risk of electrical threats. Don't leave your team's safety to chance. The CMC 500 represents a new industry standard in user safety. A multi-stage safety concept minimizes electrical hazards to the greatest possible extent. We developed the system in line with internationally established standards in the field of functional safety (ISO 13849-1).

Multi-staged safety

The CMC 500 outputs test signals only when the INTERLOCK key is plugged in and after pressing the operational mode button. This protects users against hazardous voltages occurring outside the defined test procedure. Signal lights on the device clearly indicate the state of the analog outputs. An interface for connecting an external emergency switching off button makes it easy to establish safe test setups in accordance with EN 50191.

Guided test execution

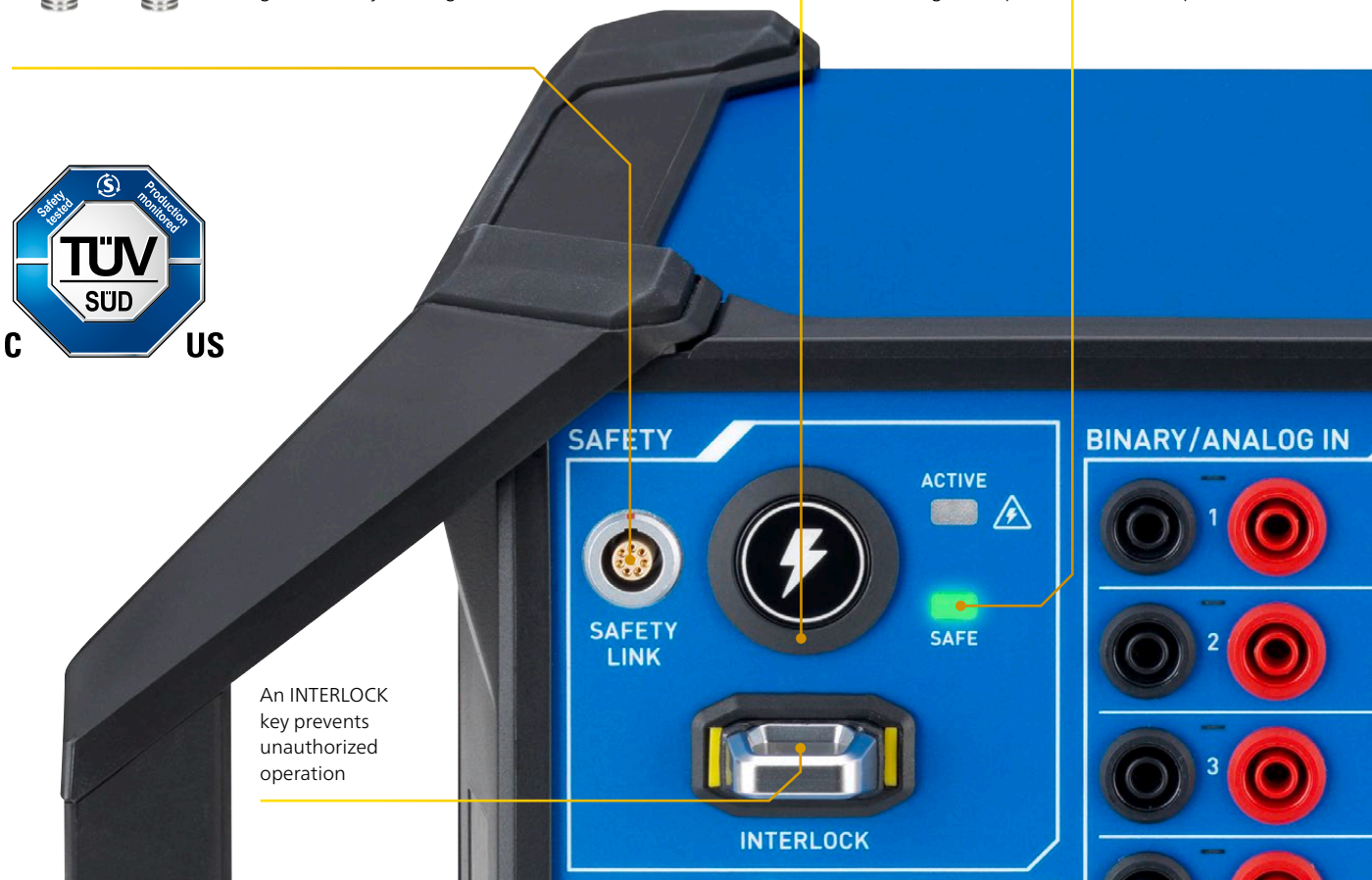
Safety and wiring instructions are built into your test sequences, alerting you to hazards when carrying out tests and reducing errors. Standardized test procedures prevent time pressure and careless mistakes. Thanks to the new safety functions, the CMC 500 also allows for risk-free rewiring while the device is switched on.



One or more external emergency switching off buttons provide for greater safety (coming soon)

An operational mode button prevents accidental signal output

Bright lights indicate the status of the outputs



An INTERLOCK key prevents unauthorized operation

Versatile solution

A reliably functioning protection system requires a proper interacting of all involved assets to clear a fault. The instrument transformers and circuit breakers also need to function properly and be correctly wired to the protection relay. In addition to protection testing, the versatile CMC 500 makes it easy to analyze these assets and provides comprehensive troubleshooting tools for initial commissioning and recommissioning. Thanks to current amplitudes of up to 450 A, the entire signal path can be verified using primary injection. The CMC 500 is also suitable for special tests due to an extensive range of accessories.



Protection relays

- All generations, from high-burden electromechanical relays through to fully digital IEDs as per IEC 61850
- GOOSE, R-GOOSE, MMS, Sampled Values with configurable datasets according to IEC 61869

Current transformers (coming soon)

- With CMC CT Check software
- Calculation of polarity, transfer ratio, phase, winding resistance, knee point, and burden
- Safe and simple test setup
- Automatic demagnetization

Transducers

Circuit breakers

- With EnerLyzer software
- Timing tests
- Analysis of the coil current

Wider range of applications thanks to accessories

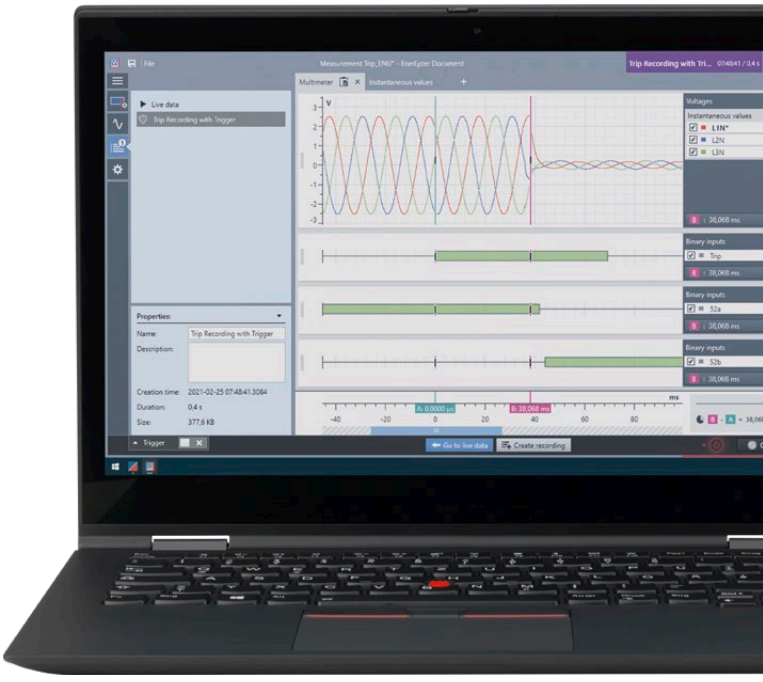
- Time synchronization
- Wiring and polarity tests
- Relays with input ports for sensors (LPITs)
- Traveling wave protection relays
- And much more...

Discover our range of accessories for the CMC 500:

omicron.energy/cmc500-links

ANALYSIS AND TROUBLESHOOTING WITH ENERLYZER

- Efficient troubleshooting during commissioning and after incidents
- Analysis of transformer inrush currents, circuit breaker switching operations, synchronization, rotating machine startups, and power quality
- Comprehensive real-time measurement and signal recording of Sampled Values, GOOSE, and conventional signals with 10 channels
- Immediate signal analysis with high sampling rate (40 kHz)



Open/close timing measurement of a circuit breaker with EnerLyzer

Full flexibility for your work

You can adjust the CMC 500 so it fits your needs and applications perfectly. The device is available in five different variants consisting of four powerful and precise generator modules. Plus, each variant can be optionally equipped with ten analog and one DC measuring input.

Use a parallel connection to test all current channel outputs with larger single or multi-phase amplitudes. Higher output powers, such as for testing relays with high burdens, can be achieved with current outputs of the same amplitude connected in series.

GENERATOR MODULES

Type U, type S, and type V

- Switchable between 300 V and 30 A (30 A for 2 seconds, 15 A continuously)
- Unmatched amplitude, frequency, and phase accuracy at high output powers per channel (> 150 W)
- Wide frequency range of up to 5 kHz
- Very high signal quality (THD)

Type H

- High current amplitudes of 60 A per channel (for 2 seconds, 30 A continuously)
- Very high output power per channel (> 350 W)
- Extended frequency range of up to 3 kHz

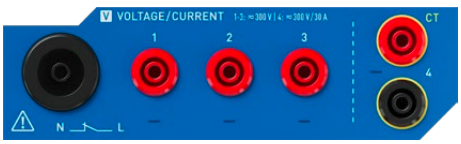
Type U
4-phase 300 V or 30 A



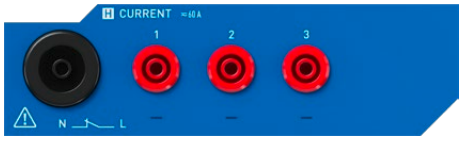
Type S
3-phase 300 V or 30 A



Type V
3-phase 300 V and single phase 300 V or 30 A



Type H
3-phase 60 A



CMC 500 Configurator

Find the perfect configuration for your application!

omicron.energy/cmc500-configurator

DEVICE VARIANTS

USH – the most versatile variant

- For applications with high accuracy and amplitude requirements
- Up to 10 currents and 7 voltages
- Three-winding transformer protection, sync check, energy meter, and much more

Weight	Multi-phase currents	Single-phase currents	Voltage
14.9 kg / 32.8 lbs	7 × 30 A + 3 × 60 A 6 × 60 A 3 × 120 A	1 × 360 A	7 × 300 V

UHH – the most powerful variant

- For applications with high output power and amplitude requirements
- Up to 10 currents and 4 voltages
- Three-winding transformer protection, high-burden relay, primary injection, and much more

Weight	Multi-phase currents	Single-phase currents	Voltage
15.6 kg / 34.4 lbs	4 × 30 A + 6 × 60 A 4 × 30 A + 3 × 120 A 3 × 150 A	1 × 450 A	4 × 300 V

USX – the lightweight, accurate variant

- For 1 A relay applications with high accuracy requirements
- Up to 7 currents and 7 voltages
- Two-winding transformer protection, sync check, energy meter, and much more

Weight	Multi-phase currents	Single-phase currents	Voltage
12.1 kg / 26.7 lbs	7 × 30 A 3 × 60 A	1 × 180 A	7 × 300 V

UHX – the lightweight, powerful variant

- For 5 A relay applications with higher amplitudes
- Up to 7 currents and 4 voltages
- Two-winding transformer protection, primary injection, and much more

Weight	Multi-phase currents	Single-phase currents	Voltage
12.9 kg / 28.4 lbs	4 × 30 A + 3 × 60 A, 3 × 90 A	1 × 270 A	4 × 300 V

VHX – the three-phase variant

- For applications in the distribution grid
- Up to 4 currents and 4 voltages
- Directional overcurrent protection, distance protection, and much more

Weight	Multi-phase currents	Single-phase currents	Voltage
12.4 kg / 27.3 lbs	3 × 60 A + 1 × 30 A	1 × 180 A	4 × 300 V

Technical data

Analog outputs

Configuration		VHX	UHX	USX	UHH	USH
Number		7	7	7	10	10
Current	Output A	1×30 A	4×30 A	4×30 A	4×30 A	4×30 A
	Output B	3×60 A	3×60 A	3×30 A	3×60 A	3×30 A
	Output C	–	–	–	3×60 A	3×60 A
Voltage	Output A	4×300 V	4×300 V	4×300 V	4×300 V	4×300 V
	Output B	–	–	3×300 V	–	3×300 V

Convertible analog output modules U, S, V

Module		U	S	V	
Current	Multi-phase (L-N)	4×	3×	1×	30 A
	Single-phase (LLL-N)	1×	1×	–	90 A
Voltage	Multi-phase (L-N)	4×	3×	4×	300 V
	Single-phase (L-L)	2×	–	2×	600 V

Output ranges		
Current	Range I	0 … 1.25 A
	Range II	0 … 6 A
	Range III	0 … 30 A
Voltage	Range I	0 … 75 V
	Range II	0 … 300 V

Frequency range
0 … 5 kHz

Output duration		
Current	0 … 15 A	Continuous
	30 A	2 s on, 10 s off
Voltage	0 … 600 V	Continuous

Output power (AC)		Typical	Guaranteed
Current	3-ph. symmetrical	250 W at 15 A	200 W at 15 A
	1-ph. high power	500 W at 15 A	400 W at 15 A
	1-ph. high amplitude	630 W at 39 A	510 W at 39 A
Voltage	3-ph. symmetrical	140 W at 300 V	115 W at 300 V
	1-ph. high power	405 W at 300 V	315 W at 300 V
	1-ph. high amplitude	280 W at 600 V	225 W at 600 V

Amplitude accuracy [1]		Typical	Guaranteed
Current	≤ 100 Hz	0.05 + 0.01	0.10 + 0.03
Voltage	≤ 100 Hz	0.03 + 0.005	0.07 + 0.01

Phase accuracy		Typical	Guaranteed
Current	50/60 Hz	0.03°	0.10°
Voltage	50/60 Hz	0.02°	0.05°

THD+N		Typical	Guaranteed
Current	30 A / 55 Hz	< 0.03 %	< 0.05 %
Voltage	300 V / 55 Hz	< 0.03 %	< 0.05 %

High current output module H

Module	H
Multi-phase (L-N)	3×60 A
Single-phase (L-L)	1×180 A

Output ranges	
Range I	0 … 1.25 A
Range II	0 … 60 A

Frequency range
0 … 3 kHz

Output duration	
0 … 30 A	continuous
60 A	2 s on, 10 s off

Output power (AC)	Typical	Guaranteed
3-phase symmetrical	450 W at 30 A	350 W at 30 A
1-phase high power	900 W at 30 A	700 W at 30 A
1-phase high amplitude	1 200 W at 75 A	1 000 W at 75 A

Amplitude accuracy [1]	Typical	Guaranteed
≤ 100 Hz	0.07 + 0.02	0.14 + 0.03

Phase accuracy	Typical	Guaranteed
50/60 Hz	0.1°	0.2°

THD+N	Typical	Guaranteed
60 A / 55 Hz	< 0.02 %	< 0.05 %

Auxiliary DC output

Voltage range	12 … 264 V_{DC}
Power	120 W / 2 A for 2 s 50 W / 0.8 A continuous

Binary outputs

Type	4 relay
Breaking capacity	I_{max}: 8 A / P_{max}: 2 000 VA at 300 V_{AC} I_{max}: 8 A / P_{max}: 50 W at 300 V_{DC}

DC measuring input (optional)

Measuring range voltage	± 10 mV, ± 100 mV, ± 1 V, ± 10 V
Measuring range current	± 1 mA, ± 20 mA

Binary inputs

Number	10 (each fully isolated)
Modes	Potential-free, potential-sensing
Trigger criteria	Toggling of potential-free contacts, input voltage against threshold
Sampling rate	10 kHz (resolution 100 µs)
Max. measuring time	Unlimited

Analog inputs (optional)

Number	10 (each fully isolated)
Measurement ranges (RMS)	10 mV / 100 mV / 1 V / 10 V / 100 V / 600 V
Sampling rate	10 kHz, 40 kHz (configurable)
Amplitude accuracy [1] (100 mV … 600 V, < 1 kHz)	0.09 + 0.03 (guaranteed)
Analog measurement quantities	I, V (AC/DC, RMS and instantaneous), ϕ, f, P, Q, S, harmonics (up to 100th), df/dt
Hybrid recording [2] while analog outputs are on	With software option EnerLyzer

IEC 61850

GOOSE/R-GOOSE

Standards	IEC 61850-8-1, IEC 61850-90-5
Publishing	360 virtual binary outputs, 128 (R-)GOOSE
Subscribing	360 virtual binary inputs, 128 (R-)GOOSE

Sampled Values

Standards	IEC 61850-9-2, IEC 61869-9
Publishing	4 streams [3] max. 32 attributes per dataset max. 24 mapped signals into dataset
Subscribing	2 streams

Time synchronization

Internal system clock

Frequency drift	< ± 0.37 ppm / 24 h < ± 4.6 ppm / 20 years

CMC 500 to external reference

Absolute timing accuracy (voltage/current)	< ± 1 µs
To external voltage	Reference signal on binary input 10: 10 … 600 V / 15 … 70 Hz
Precision Time Protocol (PTP)	IEEE 1588-2008 IEEE C37.238-2011 (Power Profile) IEC/PAS 61850-9-3 (Utility Profile)

Power supply

Nominal	100 … 240 V, 50/60 Hz, 10 … 15 A

Environmental conditions

Operation temperature	–25 … +50 °C / –13 … +122 °F
Storage temperature	–40 … +70 °C / –40 … +158 °F
Relative humidity	5 … 95 %, non-condensing

Equipment reliability

Electromagnetic interference (EMI)

International / Europe	IEC/EN 61326-1, IEC/EN 55032 (Class A), IEC/EN 61000-3-2/3
USA	FCC Subpart B of Part 15 (Class A)
Canada	CAN ICES-3 (A) / NMB-3 (A)

Electromagnetic susceptibility (EMS)

International / Europe	IEC/EN 61326-1 IEC/EN 61000-4-2/3/4/5/6/8/11

Safety

International / Europe	IEC/EN 61010-1, IEC/EN 61010-2-030
USA	UL 61010-1, UL 61010-2-030
Canada	CAN/CSA-C22.2 No. 61010-1 CAN/CSA-C22.2 No. 61010-2-030

Mechanical tests

Classification	IEC 60721-3-7
Vibration	IEC 60068-2-64
Shock	IEC 60068-2-27
Free fall	IEC 60068-2-31

Miscellaneous

Weight	12.1 kg (USX) … 15.6 kg (UHH) 26.7 lb (USX) … 34.4 lb (UHH)
Dimensions (W x H x D, without handle)	364 × 263 × 225 mm / 14.3 × 10.4 × 8.9 in
Interfaces	3 PoE ethernet ports 1 USB type-C port 1 USB type-A port 4 Expansion ports 1 Safety Link interface

Certifications

Developed and manufactured under an ISO 9001 registered system

[1] ± (% of set value + % of range) or better
[2] Analog, binary, SV and GOOSE
[3] RelaySimTest: 4, Test Universe: 3

All data specified are guaranteed with a confidence level of 99 % (k = 2.58), except where indicated otherwise. OMICRON guarantees the specified data for a defined period of time (1 or 2 years) when operated under the specification conditions mentioned in the manual.

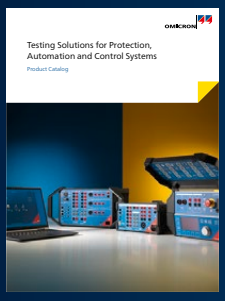
Detailed technical data and ordering information can be found here:
omicron.energy/cmc500-links

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.

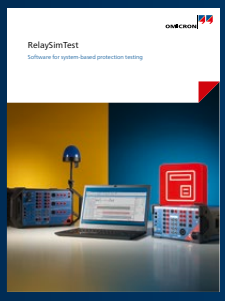
Within the OMICRON group, we research and develop innovative technologies for all fields in electric power systems. When it comes to electrical testing for medium- and high-voltage equipment, protection testing, digital substation testing solutions, and cybersecurity solutions, customers all over the 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 1 250 employees provides solutions with 24/7 support at 22 locations worldwide and serves customers in more than 170 countries.

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



Product catalog



RelaySimTest

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

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