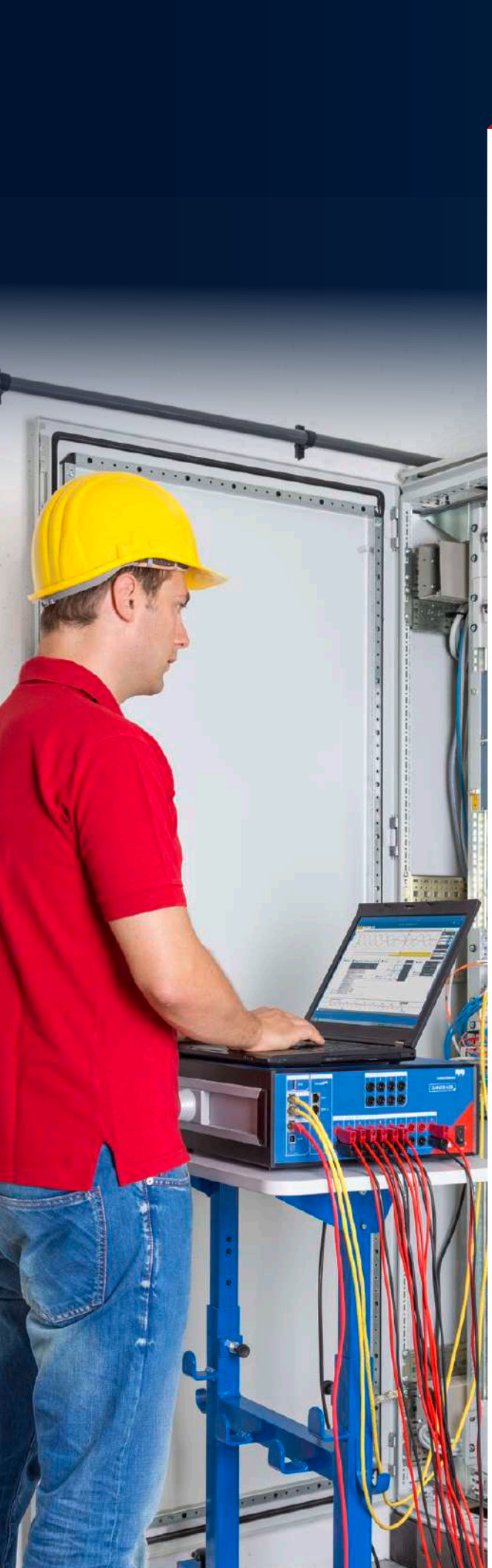
OMICRON

DANEO 400

Hybrid Signal and Network Analyzer for Substation Automation Systems



DANEO 400 – Advanced measureme

DANEO 400 is a hybrid measurement system that records and analyzes all conventional signals (voltages, currents, hard wired binary status signals) and messages on the substation communication network. It measures signals from both of these worlds and can provide information to assess their proper coordination. With this device, you can easily keep track of what is going on in the substation by obtaining information on the operational status and communication.

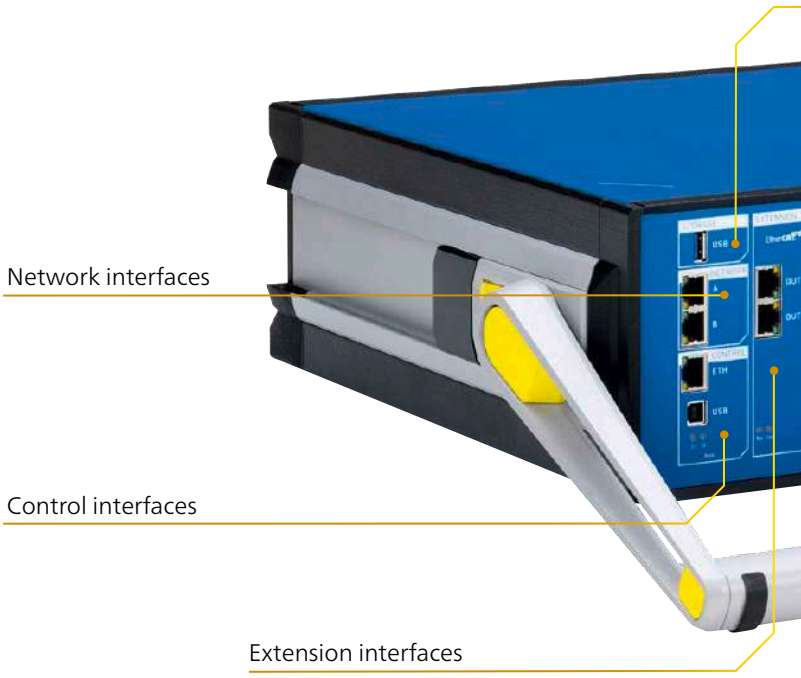
Its sophisticated network analyzer functions are essential for testing and troubleshooting substation communication networks and their performance.

Easy operation and documentation

Easily operate one or more DANEO 400 units with the PC software DANEO Control. There are various live observation options during measurements and in-depth analyzing of recordings with tailor-made visualization tools. Detailed reports are created for documentation of test results.

Distributed recording with multiple units

A measurement system with multiple DANEO 400 units obtains a time aligned view on signals covering the entire scope of a distributed substation automation system. All acquisition units are accurately time synchronized, using the precision time protocol (PTP) according to IEEE 1588.



nt and recording system

Main use cases

- Measurement and recording
- Verification of IEC 61850 communication and network redundancy
- Merging Unit testing
- Supervision of network traffic
- Assessment of network performance

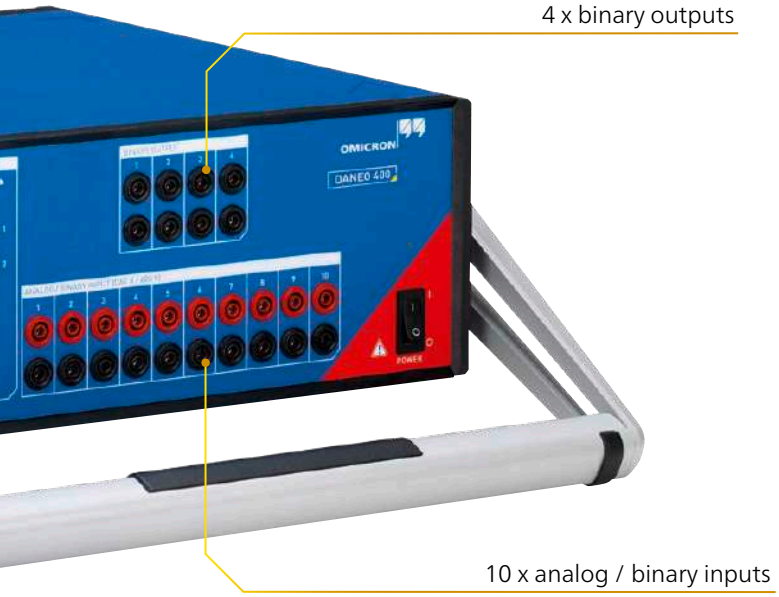
Fields of application

DANEO 400 is a useful tool that covers the whole life-cycle of a protection automation and control (PAC) system.

FAT → Commissioning → SAT → Maintenance/ Change → Troubleshooting

DANEO 400 can be used in all kinds of different PAC systems and network topologies:

- Hybrid substation with conventional signals and network communication
- Local area network (LAN) in local substations
- Wide area network (WAN) between substations
- Redundancy network topologies (e.g. HSR and PRP)



Your benefits

- Easy to operate with DANEO Control software
- Easy verification of IEC 61850 (GOOSE, R-GOOSE, Sampled Values)
- Simultaneous processing of analog/ binary signals and network traffic
- Analysis of distributed systems
- Automated checking of network redundancy
- Autonomous operation for troubleshooting of sporadic events

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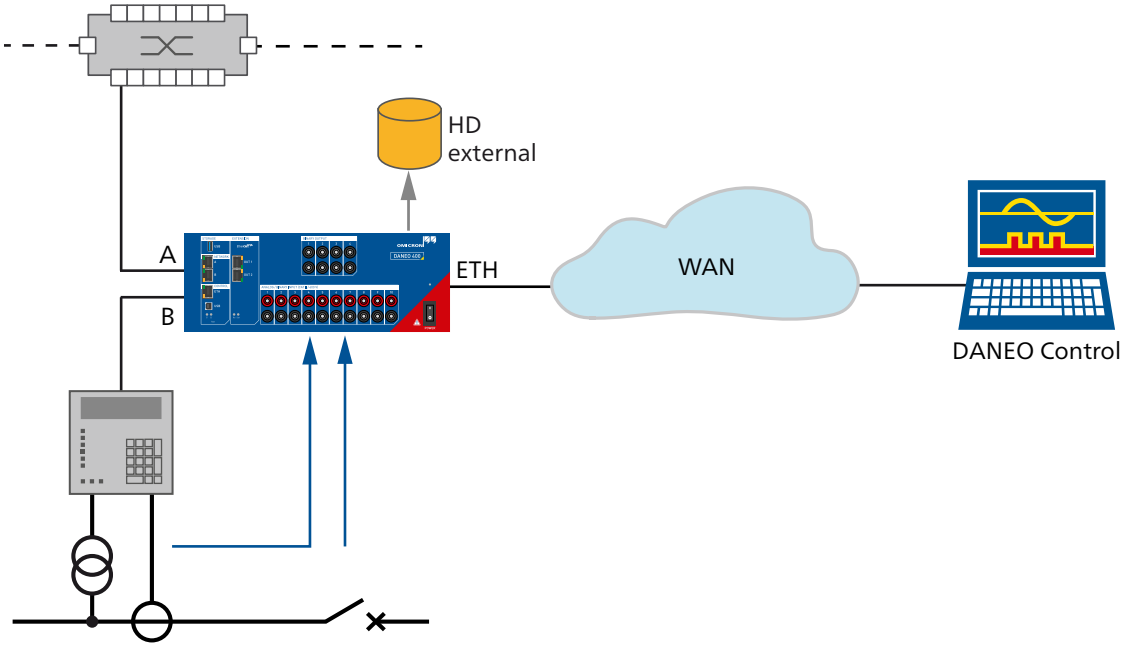
One device – multiple use cases

Measurement and recording

The DANEO 400 is able to simultaneously measure and record analog/binary signals and network traffic.

It can easily be used to observe all measurement values live or to create recordings for further analysis and documentation of test results.

For troubleshooting sporadic events or unpredictable malfunctions in PAC systems, sophisticated trigger conditions are available to collect the relevant data for solving issues.



Unattended operation

The device works unattended in permanent or semi-permanent test setups. The detection of predefined trigger conditions starts the recording of signals and network traffic. The device rearms itself to detect another occurrence of the fault and creates multiple recordings autonomously.

External storage option

If large amounts of data are expected, an external hard drive can be connected for storing the recordings.

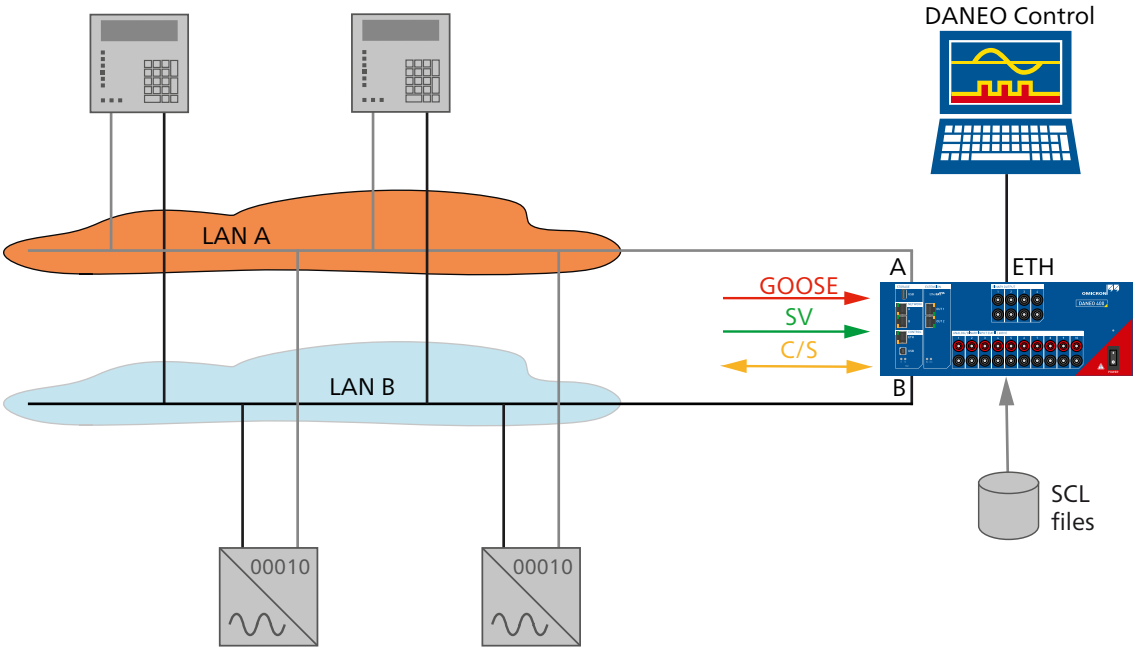
Remote control

With a remote connection to the DANEO 400 you can check the device status, live values, and download recordings for analysis.

Verification of IEC 61850 communication and network redundancy

IEC 61850 communication is a critical part of a PAC system, so it is common to implement redundant network topologies. DANEO 400 helps to easily verify, prove, and document that IEDs are communicating properly and that network redundancy is in place.

The description of the communication system in the standardized IEC 61850 substation configuration language (SCL) format serves as the basis for the verifications.



System verification

It is verified that the IEC 61850 server of IEDs are available and all GOOSE and Sampled Values are present on the communication network as defined.

If devices do not perform as desired, detailed information is provided for further investigation and debugging. The differences between the configuration and the traffic on the network is clearly visualized side by side.

All found GOOSE or Sampled Values which are not defined in the SCL files are listed as orphan elements.

Network redundancy check

DANEO 400 verifies and compares all GOOSE and Sampled Values in redundant network architectures such as PRP or HSR. It automatically checks that all messages are present in both PRP LANs or in both HSR ring directions.

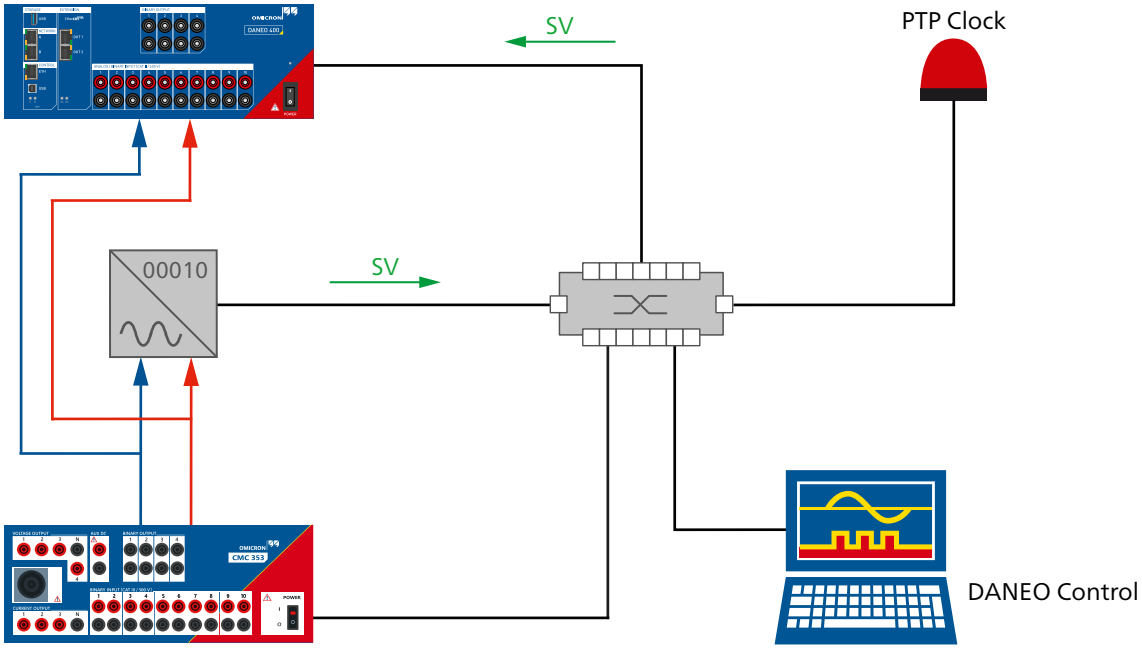
Redundancy issues such as missing PRP trailers and HSR headers, or incorrect cabling of IEDs are automatically detected and documented in the test report.

One device – multiple use cases

Merging Unit testing

The Merging Unit (MU) is a device which serves as an interface between the physical power system and the protection and control device in a digital substation. Testing MUs is essential for system integrity by ensuring accuracy, reliability and interoperability.

The DANEO 400 is the perfect tool for testing MUs. It supports real-time monitoring and sophisticated signal analysis. It verifies the Sampled Values stream parameters, compares the inputs with the output values, and checks the MU performance with detailed packet timing analysis.



Comparison of inputs with outputs

Comparing input with output values is the core task of MU testing. The DANEO 400 is the dedicated tool to compare the waveform, magnitude and phase of the input voltages/currents with the Sampled Values output of the MU.

Performance analysis

The performance of a MU is verified by analyzing Sampled Values packet intervals and packet delays. The results are shown as statistics in a histogram view and can be printed in as test report.

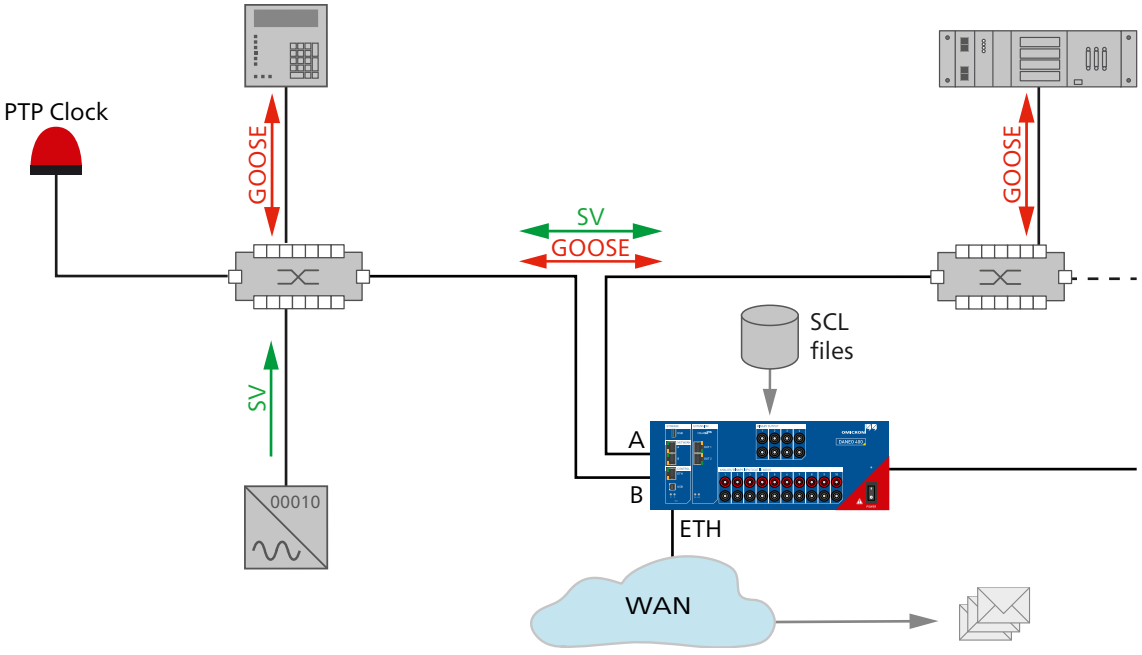
Troubleshooting

The DANEO 400 has the necessary functions to detect MU data anomalies, dropped packets and synchronization or quality problems. When such events occur, a recording can be triggered with all relevant data for troubleshooting.

Supervision of network traffic

During the normal operation of a PAC system, the IEC61850 network traffic is supervised so that any issues are detected immediately. The supervision is based on the SCL definition and constantly evaluates all network packets of GOOSE and Sampled Values.

The DANEO 400 detects abnormalities in the network traffic and automatically logs all events with the corresponding detailed information (e.g. lost samples, GOOSE timing problems, PTP time synchronization issues, et. al.). The event severity and category helps to filter and analyze the entries in the event log.



Actions

The occurrence of events can trigger recordings of the relevant data or send email notifications to inform the operating staff. Multiple actions with different event filters can be configured.

Network TAP mode

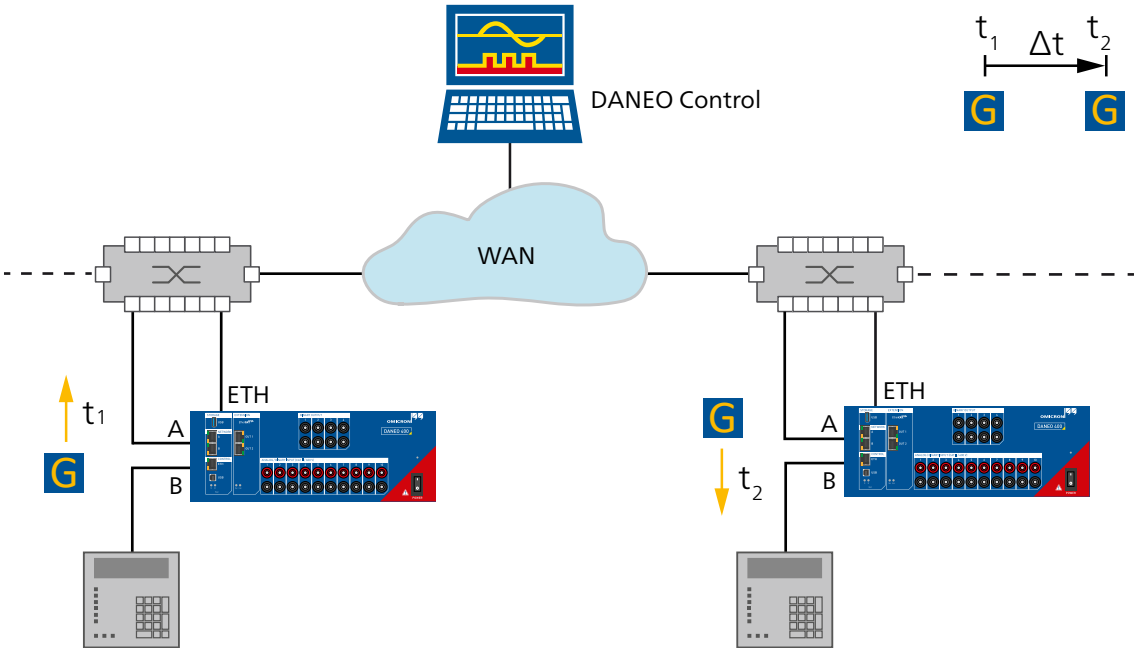
The DANEO 400 can be connected in passive TAP mode to the substation network. Thus, it can obtain all traffic on a link without the requirement to configure traffic monitoring in the Ethernet switches.

One device – multiple use cases

Network performance assessment

The correct functioning of the communication network is an essential precondition for the optimal performance of a PAC system. Consequently, the performance and load of the communication network needs to be measured and assessed on its own. Depending on the communication architecture and technologies deployed, different approaches are applicable.

DANEO 400 measures and assesses the transfer of status information (e.g. R-GOOSE messages) within a local substation network or between substations. All involved devices are configured and controlled with the DANEO Control software, even if they are connected over a wide area network (WAN).



Redundancy networks

There are often redundancy mechanisms (e.g. HSR and PRP) used in PAC systems. DANEO 400 can also measure packet timings in such network topologies.

DANEO Control – Data acquisition

The innovative DANEO Control is the PC software to easily operate your DANEO 400 measurement system and analyze your recordings. It is divided into an acquisition and analysis workspace. All configurations and results can be saved in files, printed or stored in PDF/RTF format.

Data acquisition

In the acquisition workspace, you configure your measurement devices and IEDs of the system under test. You can import IED configurations from SCL files and find GOOSE and Sampled Values orphans on the network. The whole test setup is visualized in a network diagram. The IEC 61850 communication can easily be verified and the supervisor detects abnormalities during the operation. All measurment signals can be observed live, recorded, and used in trigger conditions.

Acquisition tools

Observation

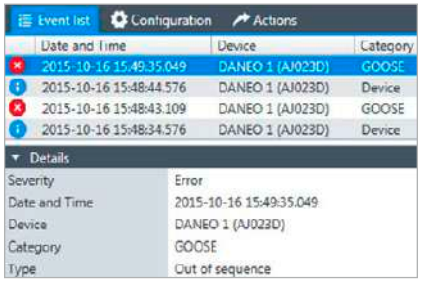
The actual values and the most recent history of signals are shown.

- Measurement values
- Instantaneous value observation
- Phasor diagrams
- Harmonics spectrum view

Recording

All signals and the network traffic are recorded. A recording is started manually or by trigger condition.

- Signals selection
- Traffic filters
- Trigger condition
- Post trigger action
- Storage location



Supervision

The network traffic is constantly supervised and the occurred events are logged in the devices.

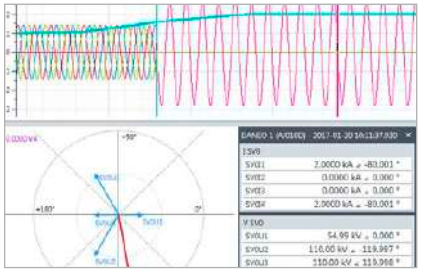
- Live event list
- Details for selected events
- Actions for specific events to trigger recordings or send email notifications

DANEO Control – Data analysis

Data analysis

In the analysis workspace, you can analyze your recordings and supervisor events. It is easy to find and select the data on the time line and collect it from your devices. If recordings are too large, just crop it for analyzing. Simply export your recordings into COMTADE and PCAP files for further processing with other tools.

Analysis tools



Time signal analysis

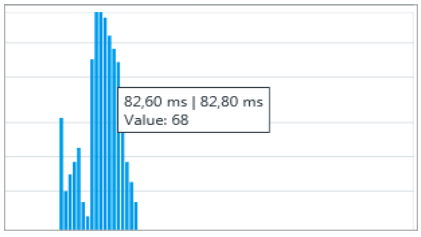
All recorded signals are available in an aggregated and time-aligned view for analysing the results.

- Time signals, phasors diagrams, and harmonic spectrums
- Cursor values and calculations
- GOOSE packet details for mapped binary signals
- Traffic signals

Sampled Values timing analysis

Calculation of Sampled Values statistics for packet intervals and packet delays. Printing test reports for MU performance tests.

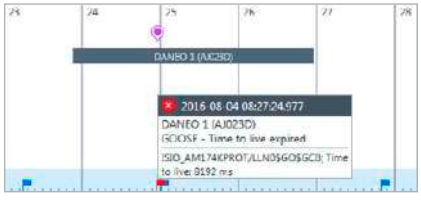
- Sampled Values timing statistics (min, max, average, standard deviation)
- Histogram of packet interval and delay values



Propagation delay analysis

Calculation of propagation delay statistics for any kind of packets between two different locations in the network.

- Selection of network packet and direction
- Propagation delay statistic values (min, max, average, standard deviation)
- Histogram of delay values



Supervisor event analysis

All events are shown on a time line together with the recordings. They can be analyzed, saved, and documented together.

- Events on time lines
- Selected events in list with all details

Operating options and accessories

Flexible housing

The housing of the DANEO 400 is very flexible. It can be configured for different working positions by rotating and moving the device handle.

For placing the DANEO 400 on the floor, the handle can be used as a stand. If the handle is not required (for example, when stacking multiple devices) you can easily move it to the rear of the DANEO 400.

EXB1 binary I/O extension unit

The EXB1 extends the I/O capabilities of the DANEO 400 with 8 binary inputs and 8 binary outputs. The EXB1 units are connected to the DANEO 400 main unit via the extension interfaces.

EMCON 200 ethernet media converter

The PTP transparent media converter EMCON 200 is used to connect the DANEO 400 to the optical fiber networks. It is powered over Ethernet (PoE) and SFP transceiver modules offer flexible configurations.

PTP grandmaster clock

In some cases a time synchronization of the involved DANEO devices is needed (e.g. distributed recording with multiple units). Dedicated PTP grandmaster clocks are required, if the PTP protocol is not available yet on the communication network. OMICRON offers the suitable accessories CMGPS 588 and OTMC 100p.

Technical specifications

DANEO 400

Network interfaces

Network ports (A,B)	2 Ethernet ports 10/100/1000 Base-TX (RJ45); configurable as network TAP

Control interfaces

Control port (ETH)	1 Ethernet port 10/100/1000 Base-TX (RJ45)
USB port	1 USB 2.0 device port; High-Speed (Type B)

Mass storage interface

USB port	1 USB 3.0 host port; SuperSpeed (Type A)

Extension interfaces

Extension ports (OUT 1,2)	2 EtherCAT ® ports (RJ45)

Analog inputs

Number	Max. 10 (shared with binary inputs)
Sampling frequency	10 kHz or 40 kHz
Nominal ranges	10 mV, 100 mV, 1 V, 10 V, 100 V, 600 V
Measurement category	CAT II / 600 V CAT III /300 V CAT IV / 150 V

Binary inputs

Number	Max. 10 (shared with analog inputs)
Level detection	Potential-free contacts or DC voltage compared to threshold voltage
Input ranges	10 V (-10 V ... 10 V); 100 V (-100 V ... 100 V); 600 V (-600 V ... 600 V) default: 600 V
Sampling frequency	10 kHz
Time resolution	100 µs

Binary ouputs

Number	4

Internal storage

Technology	Solid State Disc (SSD)
Capacity	Approx. 58 GB

Power supply

Voltage; nominal	100 – 240 VAC, 1-phase
Frequency; nominal	50/60 Hz
Power consumption	Max. 100 W

Environmental conditions

Operating temperature	0 °C ... +50 °C +32 °F ... +122 °F
Storage and transportation	-25 °C ... +70 °C -13 °F ... +158 °F

Mechanics

Dimensions (W x H x D, without handle)	345 mm x 140 mm x 390 mm 13.6 in x 5.7 in x 15.4 in
Weight	7.0 kg 15.4 lbs
Ingress protection	IP30 according to EN 60529

Ordering Options

	Description	Item no.
DANEO 400 Basic	Signal Analyzer for Substation Automation Systems. Measuring and recording conventional analog and binary signals	P0006500
DANEO 400 Standard	Hybrid Signal and Network Analyzer for Power Utility Automation Systems. Measuring and recording conventional signals and traffic from power utility communication networks (IEC 61850, GOOSE, R-GOOSE, and Sampled Values)	P0006501
Upgrade	From DANEO 400 Basic to DANEO 400 Standard	P0006503
EXB1	Binary I/O extension unit for DANEO 400 which offers an additional eight binary inputs and outputs	P0006502
EMCON 200	Ethernet media converter used for connecting optical fiber and twisted pair copper Ethernet networks	P0006504
CMGPS 588	Antenna-integrated IEEE 1588-2008/PTP grandmaster clock optimized for outdoor usage supporting the power profile according to IEEE C37.238-2011	P0006433
OTMC 100p portable	Antenna-integrated IEEE 1588-2008/PTP grandmaster clock and NTP time server for applications in the power industry supporting the power profile according to IEEE C37.238-2011	P0006508

We create customer value through ...

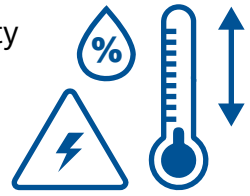
Quality

You can rely on the highest safety and security standards

Superior reliability with up to

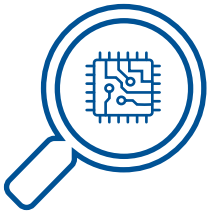
72

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

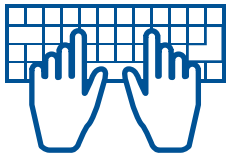
Innovation

... 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%

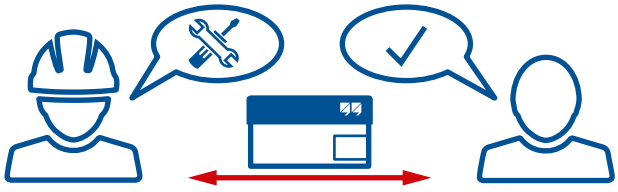
testing time through templates, and automation

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

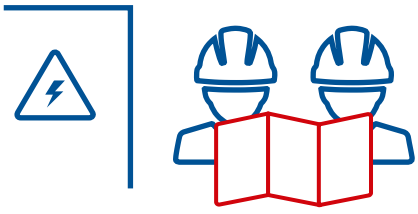
More than

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, secure, 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. Customers worldwide rely on the accuracy, speed, and quality of our reliable, user-friendly solutions for electrical testing of medium- and high-voltage equipment, protection systems, digital substations, and cybersecurity.

Founded in 1984, OMICRON draws on their decades of profound expertise in the field of electric power engineering. A dedicated team of more than 1.300 employees provides solutions with 24/7 support at 23 locations worldwide and serves customers in more than 170 countries.

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