

# Protective relay and instrument transformer testing equipment

**Megger**<sup>®</sup>



# Simplicity.

## **Megger makes the complex task of protective relay testing simpler.**

Our robust, reliable solutions and our advanced integrated software have been designed to make the art of testing relay protection schemes simpler and more intuitive.

By simplifying testing, we speed up the process, reducing costs by freeing up skilled man hours that become available for other tasks.

Megger test solutions give you the tools you need to perform your tasks swiftly and accurately.

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# Protective relay testing

## SMRT and FREJA series

### Automated single-phase, multi-phase, and relay commissioning test sets

Megger's FREJA and SMRT series of relay test sets has been engineered to offer a full range of testing solutions built around flexibility and customisation to meet needs for single-phase or three-phase testing. These test sets combine high compliance voltage with high current, enabling you to test all electromechanical, solid-state, and microprocessor-based relays. These features, combined with the ability to daisy-chain multiple SMRT units, provide game-changing flexibility and testing options to ensure your testing needs are met and exceeded.

The versatility of this series makes it ideal for performing commissioning and periodic maintenance testing. Designed for accuracy, reliability, and power, the FREJA and SMRT series delivers a level of assurance unmatched in the relay testing industry.

### Features

- High output current
- High resolution and accuracy through metered outputs
- Convertible voltage channels for enhanced testing options
- Steady-state, dynamic, and transient testing capabilities, programmable waveforms with harmonics and DFR playback
- Digital binary input and output for testing reclosing relays
- Boolean logic programmable for complex power system simulations
- Audible and visual error indications
- Dynamic, transient and GPS satellite synchronised end-to-end testing capability with built-in IRIG-B
- IEC 61850 GOOSE testing capability and IEC 61850 9-2 LE sampled values compliant
- Small, rugged, and portable



# SMRT and FREJA series Multi-phase test set

The SMRT and FREJA family of units are multipurpose, lightweight, field-portable test sets capable of testing a wide variety of electro-mechanical, solid-state, and microprocessor-based protective relays, motor overload relays, and similar protective devices. They have a “smart” combination of features, being both small and light while also having high power.

The SMRT test systems can be manually controlled with Megger’s stand-alone Smart Touch View Interface™ (STVI) or the integrated onboard display on the SMRT D and FREJA units running RTMS, Relay Testing Management Software. The STVI, with its large, full colour, high resolution, TFT LCD touch screen eliminates the need for a computer when testing virtually all types of relays. The STVI menu screens and touch screen function buttons are provided to select the desired test function quickly and easily. It allows the user to perform manual, steady state, and dynamic testing using the touch screen, as well as using built-in preset test routines for most popular relays. Tests results can be saved to the STVI’s internal memory for later download to a USB Thumb drive to transfer or print test reports.

## STVI Handheld Controller



The STVI can be purchased as an optional handheld controller, or as a built-in feature, see the ordering information.



## SMRT46D With built-in STVI

### Large colour TFT touch screen display

Easy to use and read, even in direct sunlight, the TFT display provides manual control of the test set. Colour contrasts accentuate vital information, reducing human error and time spent testing relays.

### Constant power output

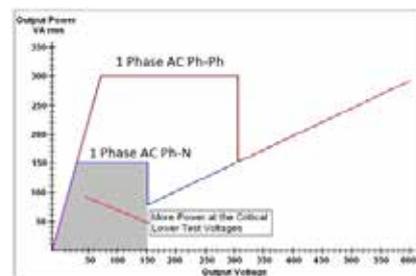
The current amplifier delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically under load. This ensures better test results and saves time by not having to turn the outputs off to change ranges. Constant power output, in many cases, eliminates the need to parallel and/or series current channels together to test high burden relays, which also saves time.

### Higher output current

The current generators provides up to 32 A at 200 VA per phase continuous, or up to 60 A at 319 VA with a 1.5 second duty cycle. In the three-phase units, the three current amplifiers can be paralleled to provide a maximum of 180 A at 957 VA for testing all instantaneous overcurrent relays.

### PowerV™ voltage amplifier high power output

The voltage generators provides a higher VA output on the voltage channel at the lower critical test voltages, from 30 to 150 V. Users who want to test a panel of relays at one time, or certain older electromechanical impedance relays, find it impossible using lower VA rated voltage amplifiers.



# SMRT and FREJA series Multi-phase test set

## High resolution and accuracy

Metered outputs, and a timer, provide extremely high accuracy. With metered outputs, what you see is what you get.

## STVI internal memory

The STVI provides storage of test setup screens and test reports, which reduces testing time and paper work.

## Steady-state and dynamic test capability

The SMRT and FREJA provide, either through manual control or computer control, both steady-state and dynamic testing of protective relays. This includes programmable waveforms with DC offset and harmonics.

## Digital inputs and outputs

Up to 10 programmable inputs, with the three phase models and, six programmable outputs, provide timing and logic operations in real time with the output voltage and currents. Binary inputs can be programmed, using Boolean logic, for more complex power system simulations. This provides a low cost, closed loop, power system simulator.

## Circuit breaker Simulator

Binary outputs provide programmable contacts that are usually open or closed, to simulate circuit breaker operation for testing reclosing relays. Sequence of operation, timing, and lockout are easily tested.

## Performs transient tests

The units can perform acceptance or troubleshooting tests by replaying digitally recorded faults, or EMTP/ATP simulations, in the IEEE- C37.111 / IEC 60255-24, COMTRADE Standard format.

## Perform end-to-end tests

Using the RTMS sequencer test with a Megger MGTR GPS satellite receiver (or suitable IRIG-B time code source input into Binary Input #1), the SMRT and FREJA units perform satellite synchronised end-to-end dynamic or transient tests. This provides precise synchronised testing for remote complex protection schemes.

## Perform multi-phase tests

The SMRT46 can be interconnected with the SMRT1 single phase unit (or other SMRT units) to increase the total number of test currents for testing multi-phase bus differential protection schemes. For example, a three-channel SMRT46 may be interconnected with four more SMRT46 units, providing up to a maximum of 30 current channels.

## IEC 61850

Optional integrated interface provides real-time testing using the IEC 61850 GOOSE and Sampled Values (IEC 61850 9-2 LE) protocols.

## Low-level output capability

The current generators can provide very low current outputs ranging from 0 to 50 mA full scale or be enabled to provide a voltage output simulating a Rogowski output. In Rogowski mode, the current channel will change from a current source to a voltage source. This will allow the current channel to simulate a low-level voltage source from a Rogowski coil, with three ranges: 2, 10, and 40 V.

## Variable voltage threshold

Variable voltage threshold – The variable voltage threshold from 5 -150 V AC/DC will either start or stop the timer. The continuity indicator will glow (application) or not glow (removal) upon the application or removal of either an AC or DC voltage.

## Open communication architecture

Use with third party software for more flexible automated control.



# SMRT and FREJA selection guide



		SMRT1/1D	SMRT33N	SMRT43/43D	SMRT46/46D	SMRT410/410D	FREJA543	FREJA546	FREJA549
Outputs	Instantaneous current per channel	60 A @ 300 VA <sub>RMS</sub>	45 A @ 300 VA <sub>RMS</sub>	45 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>
	Continuous current per channel	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>	32 A @ 200 VA <sub>RMS</sub>
	Max voltage per channel	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	3 X 300 V @ 150 VA <sub>RMS</sub> 1 X 150 V @ 100 VA <sub>RMS</sub>	3 X 300 V @ 150 VA <sub>RMS</sub> 1 X 150 V @ 100 VA <sub>RMS</sub>	4 X 300 V @ 150 VA <sub>RMS</sub>	3 X 300 V @ 150 VA <sub>RMS</sub> 1 X 150 V @ 100 VA <sub>RMS</sub>	3 X 300 V @ 150 VA <sub>RMS</sub> 1 X 150 V @ 100 VA <sub>RMS</sub>	4 X 300 V @ 150 VA <sub>RMS</sub>
	Number of current channels	1/2*	3	3	3/6*	6/10*	3	3/6*	6/10*
	Number of voltage channels	1	3	4	4	4	4	4	4
Control	On-board touch screen display	D model only		D model only	D model only	D model only			
	STVI option	■	■	■	■	■	■	■	■
	PC software	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB	RTMS/ PowerDB
Communications	Bluetooth (optional)	■	■	■	■	■	■	■	■
	USB	SMRT1D	■	■	■	■	■	■	■
	Ethernet	■	■	■	■	■	■	■	■
	Transducer (optional)		■	■	■	■	■	■	■
	Battery simulator (optional)			■	■	■	■	■	■
	Weight	4 kg	11.4 kg	12.55 kg D Model (13.2 kg)	12.55 kg D Model (13.2 kg)	17.76 kg D Model (19.2 kg)	13.2 kg	13.2 kg	19.2 kg
	Rack mountable	SMRT1							
IEC 61850 (optional)	■	■	■	■	■	■	■	■	

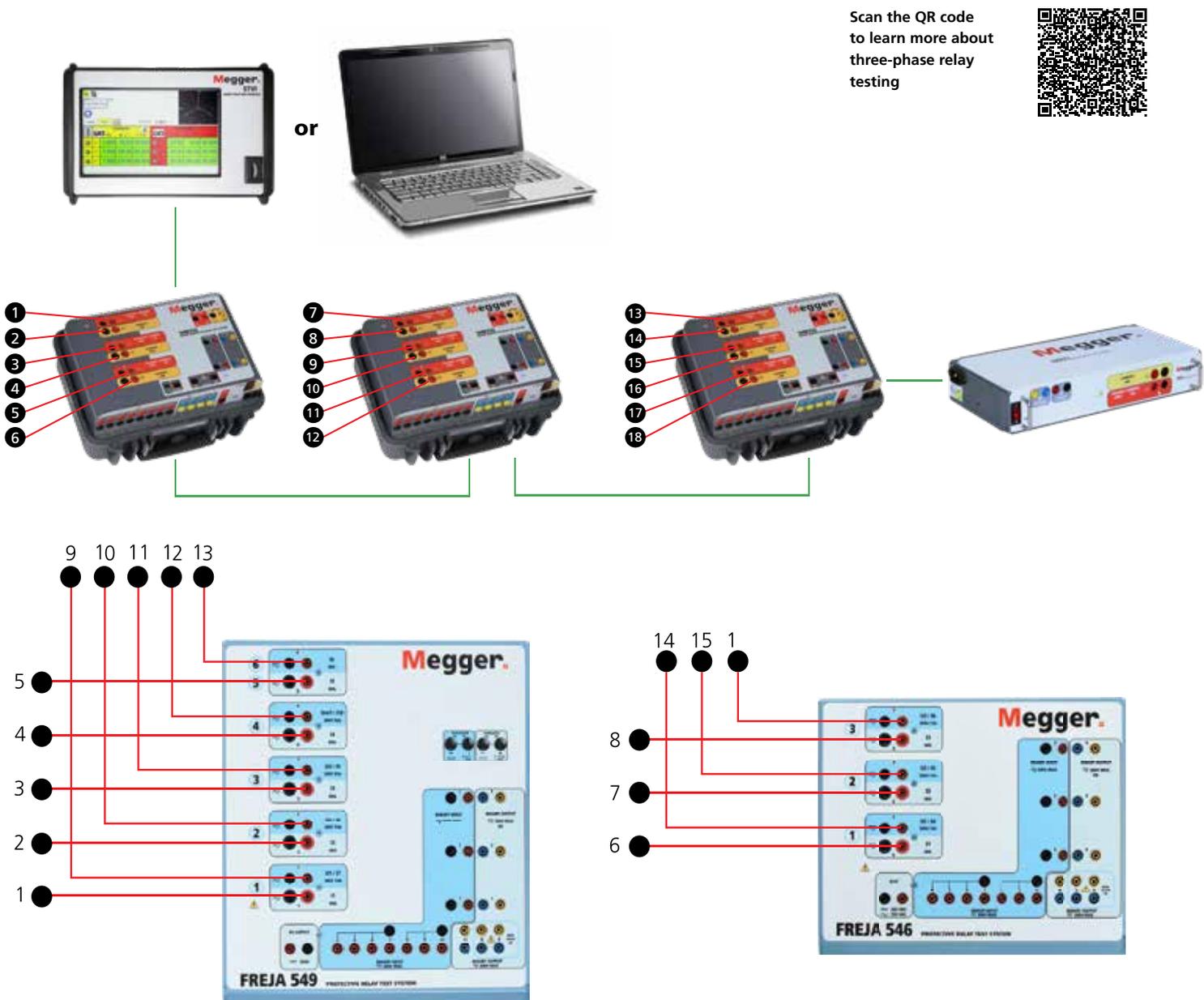
\*/X Represents the number of channels when convertible voltage channels are in current mode.

\*\* D Model Battery Simulator is a standard feature. SMRT410 and SMRT410D have a dedicated battery simulator, all other units share the battery simulator and V4.

# Expand your testing Daisy-chaining SMRT and FREJA units

The SMRT family of relay testing products is the only solution on the market that allows multiple test sets to be interconnected, controlled, and viewed as a single entity to increase testing capabilities when you need it.

The SMRT test sets can be connected to one another using standard off-the-shelf Ethernet cables. The connected units are then synchronised and controlled as a single test system using RTMS, Megger's Relay Testing Management Software. This allows you to test even the most complicated protection schemes that require more than 6 current channels, avoiding the need to divide testing into different zones. This reduces your testing time from days to hours.



The SMRT test sets shown are connected via standard RJ45 Ethernet cables and controlled from a single STVI interface or PC. This example presents a 32-channel testing environment.

# SMRT1 and SMRT1D

## Single-phase test set

As a stand-alone unit, the SMRT1 has the 'smart' combination of high compliance voltage and high current to test electromechanical, solid-state, and microprocessor-based overcurrent relays, including voltage controlled, voltage restraint, and directional overcurrent; test under/over voltage, single-phase impedance, single-phase power, directional, synchronizing, auto-synchronising, negative sequence under/over voltage, current balance, frequency, volts/hertz, reclosing, thermal, and various other relays, see the Applications Guide for more.

The SMRT1 test system has the ability to be manually controlled with Megger's new Smart Touch View Interface (STVI). The STVI, with its large, full colour, high resolution, TFT LCD touch screen, allows the user to perform manual, steady-state, and dynamic testing quickly and easily using the manual test screen, as well as using built-in preset test routines for the most popular relays.

The STVI eliminates the need for a computer when testing nearly all types of relays. Menu screens and touch screen function buttons are provided to quickly and easily select the desired test function. Test results can be saved to the PowerDB on-board for download to a memory stick to transfer or print test reports. For full automatic testing the SMRT1 may be controlled using Relay Test Management Software (RTMS). RTMS is a Microsoft® Windows® XP® Service Pack 3/Vista 7/8/10 compatible software program designed to manage all aspects of protective relay testing using the new Megger SMRT.



SMRT1



SMRT1D

- Small, rugged, lightweight, and powerful
- Operate with or without a computer
- Intuitive manual operation with Smart Touch View Interface STVI
- High current, high power (75 A/400 VA rms)
- IEC 61850 GOOSE testing capability and IEC 61850 9-2 LE sampled values compliant
- Fully automated testing using RTMS software



You can connect three SMRT1 units for three-phase testing (3 x 300 V at 150 VA plus 3 x 60 A at 300 VA) and they still weigh less than 30 lbs!

# MLLA ROGOWSKI

## Megger low level adapters

In Rogowski mode, the current channels will convert from a current source to a millivolt source. This will allow the current channel to simulate a low-level voltage source from a Rogowski coil. The MLLA will provide filtering of the low-level outputs from the latest version of voltage/current generators in the Megger SMRT series and FREJA 500 series test sets. The MLLA provides the interface from the low-level outputs to the device under test using appropriate interface cables.

There are three ranges for the Rogowski outputs, 2, 10 and 40 V, with high resolution and accuracy. When in the low voltage mode, the voltage channel provides 0 to 2 V with high resolution and accuracy. Use the low-level outputs available on the latest versions of SMRT and FREJA relay test sets for testing relays, which use low voltage signals from non-conventional CT's and VT's such as Rogowski coils and CVT's. The current and voltage channels can be configured to simulate low-level outputs using RTMS (Relay Testing Management Software) on a SMRT or FREJA on a FREJA 500 series unit. Low-level outputs are available from the voltage and current channel output terminals through the individual MLLA low-level filters. For testing relays like the ABB REF615 and Siemens 7SJ81, the low-level filters provide the interface between the SMRT/FREJA relay test set's converted low-level output terminals and the low-level signal interface cables to the relay under test.

- **Simulate a low-level voltage source from a Rogowski coil**
- **MLLA provides filtering of the low-level outputs**
- **Can be used with any SMRT or FREJA 500 series unit\***
- **Three Rogowski output voltage ranges available, 2, 10 and 40 V**
- **Millivolt output in low voltage range, with high resolution and accuracy**



Scan the QR code to learn more about the Megger low level adapter.

## Popular accessories



The STVI controller is both the most comprehensive relay test set controller on the market and the easiest to use.

The Smart Touch View Interface (STVI) is a substation hardened controller for the SMRT series relay test sets, custom built to be adapted for field use. As a dedicated unit, it offers true plug-and-play capability with test sets, eliminating the need to deal with constant Windows® updates, viruses, communication issues due to firewalls or anti-virus software, and other annoyances that comes with using a laptop or PC. Its anti-glare LCD screen is easily readable in direct sunlight and the resistive touch screen allows operation even when wearing protective gloves.



Soft carrying case for SMRT1 and STVI Smart Touch View Interface



MGTR-II  
GPS timing reference



Relay lead connector



Megger transit case



Test paddle 10 pole



Megger

SMRT46D  
PROTECTIVE RELAY TEST SYSTEM

PROTECTIVE RELAY TEST SYSTEM  
60A 1A 1A 1A

CURRENT  
60A

VOLTAGE  
200V

CURRENT  
60A

CURRENT  
60A

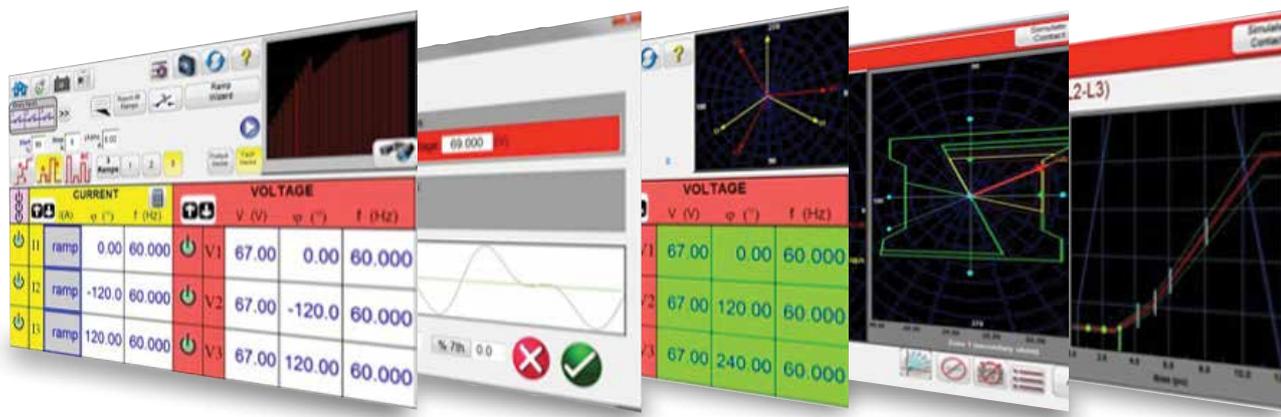
CURRENT  
60A

Megger

# Relay Testing Management Software (RTMS)

Megger's **Relay Testing Management Software (RTMS)** combines our easy-to-use Smart Touch View Interface (STVI) to give you increased testing abilities that are easier than ever to perform. RTMS is the go-to software platform for all relay testing requirements and is compatible across the entire Megger SMRT and FREJA family. This powerful software runs on SMRT and FREJA units with built-in displays, the STVI hand-held controller, or a personal computer.

Every SMRT and FREJA units comes with RTMS Standard for installing on a PC. It does not require a security dongle or license to operate, and can be loaded on as many customer-owned computers as required.



## RTMS Standard and Enhanced

There are two different levels of RTMS: Standard, and Enhanced.

The Standard level includes:

- The Standard level includes:
- The manual test screen
- Simple and advanced ramping
- Pickup and timing of over-current
- Under and over-voltage relays
- Directional over-current
- Sequence tests for reclosing and transient earth fault simulation
- Impedance (both generic and relay specific from various manufacturers)
- Three-phase and single-phase transformer differential
- And other special test applications such as the fault calculator, harmonics generator, symmetrical components, simplified power swing and more!

The Enhanced level includes:

- Tests for synchroniser
- Under/over and  $df/dt$  (ROCOF) Frequency relay pick-up and timing tests
- IEEE/IEC COMTRADE transient waveform playback
- Enhanced power swing/out of step simulator
- SSI file converter and playback



Learn more about RTMS features, scanning this QR code

## RTMS distinctive features

- Manual test screen includes a harmonic generator capable of summing up to four harmonics per phase
- Automatic configuration of up to 30 currents for multi-phase tests, such as bus differentials
- Ramping includes step, pulse-ramp, pulse-ramp binary search, and smooth ramp (x/s)
- Timing tests for overcurrent and under/over voltage relays includes hundreds of manufacturers' time curves
- Sequencer (dynamic) testing capability includes IRIG-B time synchronisation for end-to-end tests
- Transient earth fault simulator
- Click-on-fault impedance relay test includes generic and relay specific operating characteristics
- Impedance relay includes relay test plan library with over 60 specific relays
- Impedance relay setting import files supported
- are RIO, XRIO, TEAX, SEL RDB, and RTMS CSV files
- Three-phase and single phase transformer, motor, and generator differential testing capability
- Synchroniser relay characteristic test
- Frequency relay test, including ROCOF df/dt relays
- Power swing and out-of-step test capability
- IEEE C37.111/IEC 60255-24 COMTRADE transient playback
- Playback SS1 files generated using power system simulation software programs by Electrocon®, CAPE™, or Aspen One-liner®
- Relay library with more than 220 relay templates
- Relay template manager for uploading and updating relay templates

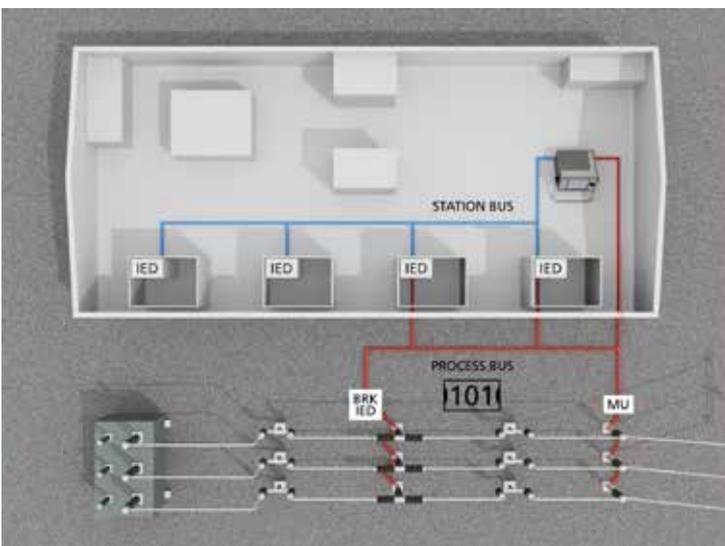
## IEC 61850



Scan the QR code to learn more about IEC 61850 and digital substations

### The core of digital substation

Megger has developed practical tools for quality assurance and troubleshooting of IEC 61850 networks. MGC (Megger GOOSE Configurator) used with either FREJA or SMRT will seamlessly test relay protection with IEC 61850 and identify differences between the actual data traffic and the SCD file.



### IEC 61850 Solutions

- Megger GOOSE Configurator
- Sampled Values Analyser
- IEC 61850 hardware solutions (SMRT and FREJA)



Learn more the smart test solutions for digital substations scanning this QR code

## **SVERKER series**

# **Relay and substation toolboxes**

Megger's SVERKER series offer single and three-phase test solutions combined with traditional substation testing applications. This combination makes them an engineer's toolbox built for testing efficiency. Tests include plotting excitation curves, current and voltage transformer ratio tests, burden measurement for protective relay test equipment, impedance measurement, efficiency tests, and polarity (direction) tests. Their designs incorporate benefits gleaned from years of experience in relay testing in the field, and have a well-earned reputation for reliability, and convenience. The SVERKER series has sold more than 25 000 units globally, making it the most sold relay tester in the world.

SVERKER is synonymous with the very best in relay and substation testing. New SVERKER 900 now lifts this success to a higher level. Megger's skilled designers and testers have taken the best of the previous generation's features and added modern, state-of-the-art functions (plus a simple stroke of genius) to meet today's increasing need for accurate three-phase protection testing in electrical distribution substations, renewable power generation stations, and industrial applications. Intuitive to use and packed in an easy-to-transport box, SVERKER900 is ready for your next test assignment.



BINARY INPUTS

BINARY OUTPUTS

CURRENT GENERATORS

EXTRA TIMER

VOLTAGE GENERATORS

U4/DC out

**Megger**  
SVERKER 900  
Three phase test unit

CE



USB

SERVICE

100-240V  
100-240V ~ 10A  
50/60Hz



er

R

Megger

# For substation engineers everywhere, this is your ultimate toolbox

The need to test modern relays using three-phase voltage and current sources is clear to all involved with today's MV substations. From commissioning engineers needing to ensure compliance to dedicated relay engineers requiring greater power and amplitude to handle a wide spectrum of test situations, SVERKER900 is the ultimate universal toolbox – complete, reliable, accurate, and very easy-to-use.

Electrical contractors and service companies, especially those working in deregulated markets, will also find SVERKER 900 perfect for the many different assets they need to test. Similarly, sectors like heavy industry, marine and oil and gas will also enjoy the ergonomic connector panel and intuitive user-interface, not only in the substation environment but also in motor and generator protection testing.

## BINARY INPUTS

Independently programmable and galvanically separated. Measure both energised and floating contacts.

## BINARY OUTPUTS

One change-over contact. Simplifies testing relay re-close function or simulating breaker status contact.

## EXTERNAL TIMER

Universal timer. Can be used independently of voltage or current outputs, or be used with internal start and stop conditions.

## USB OUTPUT

Primarily for report data upload/download, or if you would like to control the screen from keyboard and mouse.

## ANALOG MEASURING INPUTS

Ampmeter: 0–10 A

Voltmeter: 0–900 V

Measurements available: (P, Q, S, power factor), impedance (resistance, reactance), frequency, and phase angle.



# For substation engineers everywhere, this is your ultimate toolbox

Scan the QR code  
for more information and  
technical documents.



All current and voltage generators are galvanically separated. Can be controlled independently with respect to:

- AC or DC
- Frequency
- Amplitude
- Phase angle



## CURRENT GENERATORS

High-current terminals secure high-power connections during single-phase testing of over-current relays and low-voltage breakers.

3 power generators, fully isolated.  
Connect in series or parallel. Jumpers help avoid wrong connections.

## VOLTAGE GENERATORS

4 voltage generators. Fully-isolated.  
Connect in series or parallel. Also protected against incorrect wiring. 900 V is sufficient to record CT saturation curves in most MV substations.

## LCD TOUCH SCREEN

LCD touch screen with full control of instruments and test types.

Fields for test condition inputs and measurements.

## DIAL

Dial sets generator output. Also for ramping or searching for function values during testing.

# SVERKER900 – a true hybrid

## Now with full three-phase testing capability

The strict demarcation between single and three-phase testing no longer exists. Modern microprocessor-based relay protection platforms demand to be tested with three-phase voltage and current sources. Yet the need to quickly switch back to single-phase testing of older electromechanical and solid-state relays still remains. SVERKER900 Relay and Substation Test System handles both with finesse. It's a true hybrid.

## Cleverly-designed jumpers ensure safe and simple switching between test modes

Three current and four voltage generators make SVERKER900 a complete three-phase test system. Furthermore, since all voltage and current sources have floating ungrounded neutral, primary switchgear testing is also possible. All sources can be used; separate, in parallel or in series. Quick and reliable transfer between test modes is taken care of by a series of jumpers. Their patented design, in combination with the new panel layout, ensures that you do not accidentally short circuit generator and also they drastically reduce cabling.



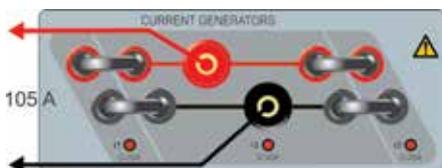
SVERKER 900 jumpers – the safe and simple way reset phase status.

## Intuitive user-interface adds clarity and flexibility

For times when most of your tests are single-phase, SVERKER900's user-interface also simplifies resetting by minimizing the number of button-pushing adjustments needed for each new test. Clear coupling graphics shown on the 5.7" LCD touch-screen also help you make the right connections.

In addition, operating SVERKER 900 via the touch screen eliminates the need for a PC in the field.

Test files and results are simply transferred between the instrument and a PC via a USB port on the front panel. Performed relay tests can be saved and used as 'test plans' for repeated test or as a template. This greatly speeds up testing in the field.



All three current generators in parallel.



Easy-to-follow coupling instructions are shown on the graphic display.



Stand-alone functionality in the field. With its built-in LCD touch-screen and USB port, SVERKER900 needs no PC.

# Wide range of test functions plus simple, efficient working

Using SVERKER900 is simplicity itself. It takes the obvious, logical ergonomics of previous generations and adds new, highly-intuitive panel and screen layouts. Setting the correct voltage and current generator output couldn't be easier. Plus you have all the instruments you need to generate accurate test measurements without fuss or bother. The result is simpler and more efficient working. Here are some examples:

## Flexible and powerful

Test engineers performing servicing jobs in power stations or substations can take great comfort in the knowledge that SVERKER900 handles both simple over-current protection and maintenance tests on generator protection. The power it generates is sufficient for heavy-powered older generations of back-up relay protections as well as checking the knee-point voltage of connected transformers.

## Pre-fault – fault instrument

A timing test used mainly to test relays that require simulation of a pre-fault state before the fault simulation. Both pre-fault and fault states can be configured individually (including time duration). SVERKER900 will then measure the test object's trip time from when the fault state was initiated. The Multiple Timing Test (MTT) feature, with reference curve Inverse Definite Minimum Time (IDMT) according to IEC60255-151:2009, simplifies test and verification of the tripping times for the different current amplitudes.

## Ramp instrument

The ramp test is very similar to pre-fault – fault. Set a ramp rate between the states (individually for each generator if you wish) as well as the threshold and time measurement. SVERKER900 automatically determines the pick-up or drop-off values.

This instrument is particularly well suited for generator protection applications, such as ROCOF, frequency, under/over voltage functionality, etc., where the need for flexible control of rate-of-change for any set parameter is paramount.



The accurate CT testing information provided by SVERKER900 helps manage power grid protection systems.

## Sequence instrument

You can define up to 16 different sequence states, freely setting values for generator voltage, current, phase angle, and frequency in each one. Similarly, the binary inputs can be used to set stop conditions dependent on or independent of each other. This operating mode is most often used to simulate and test auto reclosers, motor starts, and re-striking earth faults.

## CT magnetization instrument

In relay testing, this function is mostly used to determine the different knee-point voltages of respective current transformers characterised by having at least two separate cores with different saturation curves. Commissioning engineers thus need to ensure that these are correctly connected. If not, correct relay functionality at high fault currents may be compromised.

## Advanced mode – enables harmonics generation

In this mode, each individual generator can be set to generate a harmonic waveform. A second and third layer of harmonics can be super-imposed over the fundamental frequency with a user-selectable portion of the fundamental frequency and selectable harmonics frequency.

In addition, the fundamental frequency can be set to any value between 10 Hz and 600 Hz, allowing for DC to cater for high-current DC applications.

## Impedance instrument

To test distance protection effectively, this instrument allows users to test relays directly from the so-called impedance plane, where the conversion from the impedance into voltages and currents is automatically done by SVERKER900. Pre-fault fault, ramp, click-on-fault tests etc. can be performed.

## Continuous software development

Continuous development of SVERKER900 software will make additional measurement instruments available on a regular basis. This ensures that users always have the most up-to-date means of performing relay and substation testing at their disposal.

# Wide range of test functions plus simple, efficient working



By helping detect and counteract islanding in distributed power generators, SVERKER900's ramp instrument is useful to test frequency protection.



SVERKER900 eliminates concerns about test equipment power capacity and facilitates setting up the test sequence.

## Testing distributed generation plants

In the strive to become climate neutral, electricity and renewable energy sources, such as wind and solar, play a key role. The significant increase of distributed power generation puts new demands on grid safety and regulation. With this in mind, IEC in 2019 released a new standard, IEC 60255-181:2019, specifying relay performances and test methodologies of frequency relays including ROCOF protection.

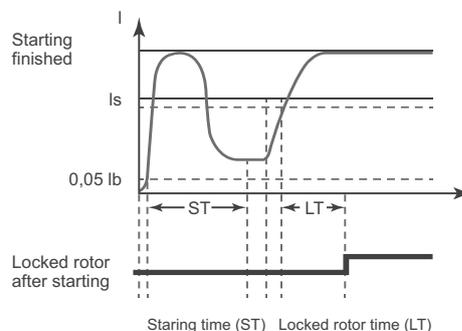
ROCOF's role is to detect power supply failures and isolate the generator in the event of loss of supply. If the power flow from the utility supply prior to an islanding generator is not zero, the frequency changes to the islanded system's natural resonance frequency. Islanding can be dangerous to utility workers, who may not realise that a circuit is still powered, and it may prevent automatic re-connection of devices.

It is therefore essential that distributed generators both detect islanding and immediately stop producing power. The ramp instrument is compliant with the IEC 60255-181:2019 standard and SVERKER900 offers quick, safe, and convenient testing of the vital ROCOF function.

## Motor protection testing

Motor protection is a very common feature in most industrial facilities, including power generation. It also requires a great deal of power; extended loading time at high power is needed for the actual relay testing, for example. Furthermore, the set-up curve is quite complex.

It's a big advantage for users if they can test this protection to the full without worrying about test equipment capacity. A simple and intuitive user interface for setting up the test sequence demanded by the relay also makes their work much easier. SVERKER900 delivers on both counts.



Case of locked rotor after starting.

## CT-testing

All decision-making depends on accurate information and managing a power grid protection system is no different. That both current and voltage transformers are properly connected to their protection and give correct values is fundamental to this task. Since the very beginning, the SVERKER family of relay and substation testing equipment has always helped simplify CT testing and verification. SVERKER900 is no exception. This new full three-phase testing model has now been developed to encompass:

- Excitation curves
- Polarity
- Ratio
- Burden

# SVERKER780 / SVERKER750

## Premier manual single-phase relay and substation toolbox



The **SVERKER750** and **SVERKER780** are manual, single-phase relay test sets designed to be used in high voltage substation and industrial environments. Testing can be performed using the on-board controls, or be managed using a PC running the optional SVERKER Win. Both models facilitate convenient relay testing with an easy-to-read display that shows time, voltage, current, Z, R, X, S, P, Q, phase angle, and cos phi. Directional relays and autoreclosers are easily tested.

KEY FEATURES	SVERKER780	SVERKER750
Current outputs AC	30 A cont., 250 A for 1 sec.	30 A cont., 250 A for 1 sec.
Main voltage outputs AC/DC	0 - 250 V AC, 0 - 300 V DC	0 - 250 V AC, 0 - 300 V DC
AUX voltage output	Range: 5 - 220 V AC Frequency generator Frequency range: 15 - 550 Hz Phase angle: 0 - 360 deg.	0 - 120 V AC
Timing range	Seconds or cycles 0.000 - 999.9s	Seconds or cycles 0.000 - 999.9s
Binary inputs	2 (start and stop)	2 (start and stop)
Binary outputs	1 output Max. current - 1 A Max. voltage - 250 V AC / 120 V DC	1 output Max. current - 1 A Max. voltage - 250 V AC / 120 V DC
DC supply output voltage	20 - 220 V DC	20 - 220 V DC
Internal ammeter (high current)	0 - 250 A AC	0 - 250 A AC
External ammeter	0 - 6 A AC / DC	0 - 6A AC / DC
External V-meter	0 - 600 V AC / DC	0 - 600 V AC / DC
Measurements	Z ( $\Omega$ and $^\circ$ ), Z ( $\Omega$ ), R and X ( $\Omega$ and $\Omega$ ), P (W), S (VA), Q (VAR)	Z ( $\Omega$ and $^\circ$ ), Z ( $\Omega$ ), R and X ( $\Omega$ and $\Omega$ ), P (W), S (VA), Q (VAR)
Reclosing test	■	■
Local software	■	■
Optional PC software	■	■
USB Comm. port	■	■
Resistor set	■	■
Mains voltage	115 / 230 V AC, 50 / 60 Hz	115 / 230 V AC, 50 / 60 Hz
Weight	39.9 lbs. / 18.1 kg. (without accessories)	17.3 kg / 38.1 lbs. (without accessories)
Dimensions	350 mm X 270 mm X 220 mm / 13.8 in. X 10.6 in. X 8.7 in.	350 mm X 270 mm X 220 mm / 13.8 in. X 10.6 in. X 8.7 in.

# Instrument transformer testing

## MRCT

### Megger relay and current transformer tester

The Megger MRCT is a light weight, robust, portable unit used to perform demagnetization, ratio, saturation, winding resistance, polarity, phase deviation, and insulation tests on current transformers. The MRCT automatically calculates ratio errors, saturation curves, and knee points. The MRCT provides a microprocessor-controlled variable voltage and current output and precision instrumentation for automatically testing single and multi-ratio CT, reducing testing time and increasing productivity. The MRCT will directly connect to multi ratio CT, and perform all tests – saturation, ratio and polarity, winding resistance, and insulation – on all taps with the push of a button and without changing leads.



- Industry leading test duration using patented simultaneous multi-tap measurements reduces testing time by 20 % on multi-tap CT's
- Increased measurement accuracy to support metering class CT testing
- Smallest and lightest 2 kV secondary voltage injection unit on the market
- Integrated single-phase relay test system
- General purpose substation secondary circuit testing with 300 V and 60 A generators
- Grouped testing: demagnetization, knee points, ratios, saturation curves, and more
- Measure all ratios and saturation curves on multi-tap CTs with one lead connection
- Built-in insulation resistance testing
- Relay option adds all features of the SMRT Series to the MRCT
- Optional DC excitation technique for testing CTs with kneepoints up to 40 kV
- VT testing
- CVT testing up to 256 kV



Learn more about Primary Injection systems, scanning this QR code

# MVCT

## Megger VT and CT analyser

The Megger MVCT test set is a lightweight, robust, portable unit capable of testing both current and voltage transformers. At less than 20 lb (10Kg) the MVCT is a highly portable unit that also offers accuracy in testing. Capable of performing saturation, ratio, polarity, winding resistance, and insulation tests on current transformers, the MVCT can also be used for testing metering and protection class voltage/potential transformers. The MVCT provides a microprocessor controlled variable voltage and current output along with precision instrumentation for automatically testing single and multi-ratio CTs and VTs. The MVCT makes testing CTs easy. It will directly connect to multi-ratio CTs and perform all tests – saturation, ratio and polarity, winding resistance, and insulation – on all taps with the push of a button and without changing leads. This greatly reduces testing time. The MVCT can be controlled via its large, full colour, high resolution, sunlight readable TFT LCD touch screen display. This interface allows the user to perform manual and automatic testing quickly and easily using the manual test screen, or by using pre-constructed test routines. The large colour display also permits the user to easily read all pertinent data while the test is being performed and provides the ability to view the results when the test is complete. The unit can also be configured to come without a display and thus be controlled via a laptop using PowerDB or with Megger's existing Smart Touch View Interface (STVI).



- Ability to test both VT and CT
- Easy to use one-button automated test plans
- Industry leading test duration using patented simultaneous tap measurements
- Smallest and lightest unit on the market
- CT Kneepoints up to 40 kV
- CT grouped testing includes demagnetization, knee points, ratios, saturation curves, winding resistances, polarities and phase deviation (on all taps of multi-ratio CTs)
- VT testing including demagnetization, ratio, winding resistance, polarity and phase deviation
- Performs secondary burden tests
- Integrated 1 kV DC insulation test system

# Primary injection testing

## Megger relay and current transformer tester

Primary injection testing required the system to be taken out of service and consequently is usually conducted during commissioning . it does however test the complete system, the current transformer, conductors,connection points, relay protection, and circuit breakers.

### INGVAR

- Most advanced primary current injection test system to simplify all types of switchgear, and CT commissioning, ground grid, circuit breaker testing and more
- Up to 5000 A output current
- Two units, each of about 20 kg, makes it easier to carry
- Unique I/30 function allows the current to be pre-set using low current to prevent test sample heating, thus eliminating corruption of test result

This powerful test system is designed for primary injection testing of protective relay equipment and circuit breakers. It is also used to test the turns ratio of current transformers and for other applications that require high variable currents.

The system consists of a control unit and a current unit. The two parts are portable, and INGVAR can be quickly assembled and connected.

### ODEN AT

- Most advanced primary current injection test system to simplify all types of switchgear and CT commissioning, ground grid, circuit breaker testing and more
- Modular design to permit optimal user configuration of output current vs. unit size
- Compact transport cart facilitates portability into switchgear rooms with limited space
- Unique I/30 function allows the current to be pre-set using low current to prevent test sample heating, thus eliminating corruption of test result

This powerful test system is designed for primary injection testing of protective relay equipment and circuit breakers. It is also used to test the turns ratio of current transformers and for other applications that require high variable currents.



### Current transformer switchbox

For use with ODEN AT, the switchbox facilitates CT testing. The secondary windings of the CT are connected to the switchbox inputs and the outputs are connected to the ammeter 2 of the ODEN AT. It can handle up to 5 secondary windings.



# Primary injection testing

## Megger relay and current transformer tester

### Current supply units CSU600A and CSU600AT

These high-current supply units have two main fields of application. The first is to conduct primary tests on protective relays, and the second involves conducting current tests on low-voltage circuit breakers and overcurrent devices.

Both outputting 600 A, the CSU60A required the use of an external timer and ammeter, while the CSU600AT comes with built-in timer and analogue ammeter that provides rough current settings quickly and easily, reducing connection time to a minimum.



### BALTO SYSTEMS

The BALTO Compact system was developed to generate, and inject into the circuit, very high and precise DC test currents in order to carry out functional tests on high-speed DC circuit breakers. The problems that arise during the testing of high-speed DC circuit breakers frequently worry service and maintenance personnel, especially when it comes down to checking and adjusting the thresholds.

The BALTO system comes in two models: the BALTO Compact and the BALTO Modular.

The BALTO Compact system, has been developed specifically for testing DC high-speed circuit breakers at rolling stock, tramways, and primary infrastructure. It is also suitable for on-board maintenance in marine applications. Special attention was given to the weight and size of this compact version resulting in an ergonomic design that permits usage in small spaces.

The BALTO Compact system, can generate a maximum current of 4000 A and, the BALTO Modular system, can generate a maximum of 20.000A on a single trolley using five current generators of 4000 A. In a master-slave configuration, the maximum current can be doubled to 40000 A.

- Ergonomic design
- Energy sources: batteries and ultra-caps
- Power units: DC/DC current converters internationally patented
- Current rate of rise can be adjusted
- Control unit with user-friendly operator terminal
- Power unit(s): 4000 A each
- Cart supporting batteries, ultra-caps, and battery chargers
- Connection with the high-speed DC circuit breaker by specific high current flex-cables



**BALTO Compact system**



**BALTO Modular system**

# Primary injection test system

## SPI225

The SPI225 is high current primary injection test unit with the ability to perform high current commissioning tests as well as test low voltage moulded-case circuit breakers.

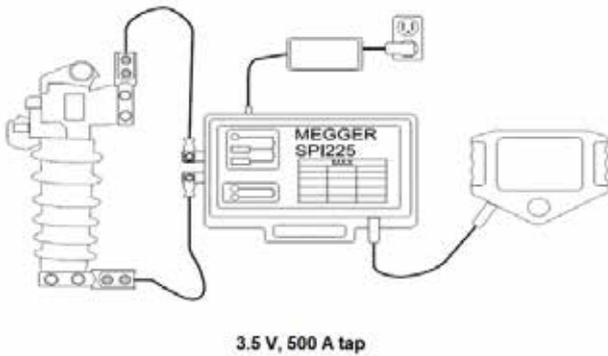
A single SPI225 is designed to test low voltage moulded-case circuit breakers up to a rating of 225 A.

The Smart Touch View Interface, STVI, permits users to manually control the SPI and to perform automated testing. The SPI unit can also be controlled by a PC to generate tests and reports.



## Recloser testing

The SPI225 can test small reclosers that are 400 A or below. It can apply pre-fault and fault current at different levels. The ability to



have a pre-fault setting is often required when testing small self-powered reclosers for proper operation. The SPI225 can operate on 120 V or 240 V and is the most compact test set for testing self-powered reclosers on the market.

Up to ten trip/reclose operations can be recorded. Each trip current, trip time, and reclose time is recorded and can be displayed in a report format.

**Recloser Timing Tests**

Mode **Test** ▶

Pre-Fault % Output	10.00
Pre-Fault Time (S)	80
Fault % Output	28.00
Total Time for Trips and Reclose (S)	30

Current **367.6** A

Pre-Fault Time **972.2** ms

	Current (A)	Time (Sec)
Prefault	84.726	80
Trip 1	360.671	3.0179
Reclose 1	-	10.0115
Trip 2	366.309	3.0026
Reclose 2	-	Locked Out



Learn more about Primary Injection systems, scanning this QR code

## Power multifunction measurement instrument

The PMM2 is an ideal instrument for use in general electrical systems maintenance, electrical machine repairs, protective relay testing or in monitoring power at the electrical service entrance. Motor starting currents, voltages, and power can be captured for analysis.

The PMM2 is designed to perform fast, accurate checking and testing of protective relay and meter installations during their commissioning and in routine maintenance.

For meter installations, the unit can be configured to measure phase-to-phase voltage and single-phase current amplitudes and phase angles.

Combined with a voltage or current source, the PMM2 also becomes an excellent tool for testing and calibrating virtually any type of protective relay.



- **Simultaneous measurement and display of all three-phase system parameters**
- **Accurate phase angle measurement at low current levels**
- **Versatile, menu-driven instrument with a built-in timer and data-logging**

The power multi-meter PMM2 is a next generation multifunction instrument for measuring AC or DC voltage and current, primary, and secondary voltage and current, power, reactive power, power factor, phase angle and frequency of a single-phase or three-phase electrical system.

In the single-phase mode, the PMM2 is easily configured to measure the amplitude and phase angle between any two voltage and current inputs. These measured quantities are then displayed in an enlarged font size for easier reading on a graphic display. In three-phase mode, all measured quantities are displayed simultaneously on a large, easy-to-read graphic display.

The unique software in the PMM2, combined with a built-in, microprocessor-based timer, is specifically designed to make testing and commissioning protective relay systems easier, including induction unit pickup and timing tests.

The internal timer responds to a variety of start and stop gates, including the application of AC or DC voltage, and opening or closing of dry contacts.

The PMM2 is a menu-driven instrument equipped with data-retention capabilities. It can be used to automatically store measured data using a user-defined trigger. With a sampling rate of 28.8 k samples/second, and with 64 GB of memory, over 60 minutes of data can be stored on-board in non-volatile memory. The date and time can also be set, which can be used to start and stop data logging.

Accurate phase angle measurement at very low current levels, which can be displayed either as lagging or leading angles, is another feature of the PMM2. The user can choose for phase angle readings to be displayed as 0-360 degrees (leading or lagging) or  $\pm 180$  degrees.

Any current or voltage transformer ratio up to a ratio of 9999:1 or 9999:5 can be input into the instrument. The displayed value on the PMM2 is the primary line value of the circuit under test. The values measured will be displayed as primary values, eliminating the need for making conversions.

## SUPPORTING PRODUCTS

### MGTR-II

The MGTR-II is a timing reference for the SMRT and FREJA series relay test sets for time synchronisation for IEC 61850 9-2 LE testing and synchronise end-to-end testing of line protection schemes. It has a 12-channel Global Positioning System (GPS) receiver to simultaneously track all available GPS satellites and derive highly accurate timing information from the satellites' cesium atomic clocks. The MGTR-II can generate a precise Programmed Output Pulse (POP) with 100 ns resolution, allowing it to synchronise multiple test systems, miles apart, to within 1  $\mu$ s of Universal Time Coordinated (UTC). The Intelligent Holdover feature provides near rubidium standard accuracy in the absence or loss of GPS signals so you can test even in urban canyon environments or government and military facilities where GPS signals may be temporarily blocked.



### PAM410 and PAM420

The PAM410 and PAM420 are digital multifunction meters designed for use in high voltage substations and industrial environments (CAT III 500 V safety rating). They can measure phase angle between current and voltage in any combinations of the two signals. The PAM420 has additional timing channels and can also measure voltage, current, frequency, and timing.



### TM200

The TM200 is a digital timer designed for use in medium voltage substation and industrial environments. Its 1 ms resolution makes it suitable for a broad range of timing and triggering applications from circuit breaker testing to relay testing.



## SUPPORTING PRODUCTS

### SST-9203

The SST-9203 is a digital timer designed for use in high noise utility environments such as extra high voltage substations and switchyards. Its shielding and noise-suppression circuitry ensures reliable readings when measuring the operating time of switching devices such as relays, circuit breakers, or contactors. Using a crystal-controlled oscillator, it can achieve 100  $\mu$ s accuracy, independent of power line frequency.



### NTS-300A

The NTS-300A is self-contained test set specifically designed for field testing of secondary network protectors. Network protectors are typically installed in underground vaults contained within a submersible enclosure and the NTS-300A's two-piece design makes it easy to maneuver and operate in tight spaces. The NTS-300A is able to perform all tests as specified in the IEEE C57.12.44-2014 standard.



### ERTS

The Megger model ERTS, electronic recloser test simulator unit, is designed to interconnect to Megger SMRT and FREJA 500 series relay test systems, for easy field testing of electronically controlled reclosers.



### AFS (Arc Flash Simulator)

The Arc Flash Simulator interfaces with Megger's relay test sets to test arc flash protection systems. It provides a high intensity white light to simulate an arc flash without the need for a direct connection to the arc flash sensor. The flexible arm and magnetic base allows for easy mounting and positioning on switchgear and other metal surfaces.





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