

A dramatic photograph of a power substation at night. A bright lightning bolt strikes a tower, illuminating the scene. The sky is dark blue, and the towers are silhouetted against the light. The overall mood is powerful and intense.

SMRT Series

Relay Test Sets

POWERFUL • ACCURATE • RELIABLE

Megger[®]

THE **SMRT** Solution

SMRT Relay Test Sets, because one size does NOT fit all.

Whether you are an Electric Utility (Generation, Transmission and/or Distribution), Relay Manufacturer or Service Provider, Megger has a **SMRT Solution** for you. We have taken a customized approach to design that ensures our new and existing relay test sets will meet your every need, regardless of the application.

We deliver solutions that help you work smarter.

Assurance

- Megger stands behind its relay products with a warranty that is twice the industry standard – that's reassurance you can trust
- Quality from product design concept to production
- Power where you (still) need it most

Ease of Use

- Intuitive yet powerful software is simple enough for the new technician yet comprehensive enough for the most experienced tester
- Error indication and connection diagrams provide audible and visual indicators for improved accuracy

Convenience

- Portability – Easy to lift and carry, even to the most remote corner on the highest floor in your generating plant or on that flight with you to your next customer site
- Flexibility – Combine multiple test sets to increase total number of channels, while controlling from a tablet, STVI or PC



NEW! SMRT36D



SMRT1



SMRT33



SMRT36



SMRT410



NEW! SMRT410D

Powerful

PowerV™ technology guarantees a flat power curve from 30 to 150 V. This gives you high current output at the low end of the voltage spectrum.

Constant Power Output (200 VA) of the current amplifiers from 4 A to 30 A providing a high compliance voltage of up to 50 V_{RMS}.

High Output Current which provides upwards of 300 VA for testing instantaneous elements.

Accurate

Metered outputs provide extremely high accuracy needed for testing a wide variety of devices.

All outputs are isolated to provide protection from sudden changes in line voltage, frequency and load impedance.

Reliable

Voltage outputs are **protected** from short circuits, current outputs are protected against open circuits and both are thermally protected against prolonged overloads.

Wide operating temperature range from 32 to 122° F (0 to 50° C) and fully functional after storage temperature from -40 to 158° F (-40 to 70° C).

SMRT: Core Features

■ High Resolution and Accuracy

- Metered outputs provide extremely high accuracy needed for testing a wide variety of devices
- Eliminates uncertainty with setting values - with metered values, what you see is what you get

■ High Output Current

- Upwards of 30 Amps at 200 VA per phase continuous for timing tests
- Upwards of 60 Amps at 300 VA for testing instantaneous overcurrent relays

■ Convertible Voltage Channel

- A main current channel provides the second current source for testing single phase current differential relays, including harmonic restraint for transformer differential relays (Excludes SMRT33)
- Parallel with main current channel to increase output current to 35 Amps continuous, and up to 75 Amps instantaneous per phase
- Convertible voltage channels for applications that require more current channels

■ Steady-State, Dynamic and transient testing capability

- Programmable waveforms with harmonics
- DFR playback

■ Digital binary input and output

- Boolean logic programmable for complex power system simulations
- Binary outputs provide programmable normally closed or normally open contacts to simulate circuit breaker operation for testing reclosing relays

■ Error indication

- Audible and visual alarms indicate when amplitude or waveforms of the outputs are in error due to short circuit, open circuit or thermal overload

■ Communication

- Network interface for IEC 61850 test capabilities (KEMA certified to publish and subscribe to GOOSE messages)
- Interconnectivity of STVI with all of the SMRT test sets and capability of connecting multiple units together (daisy chaining) to increase total available channels and output

Software

Megger is proud to introduce the **NEW RTMS - Relay Test & Management Software**.

This powerful and easy to use protective relay testing software combines our STVI software and AVTS software into one comprehensive testing solution.

For more details about this dynamic tool, please see our full description in this brochure, or online at megger.com/us



Megger

For more information: megger.com/us



Quality is in the DNA of the SMRT Family

Megger uses internationally recognized quality design practices for every single component that goes into a SMRT unit. Our stringent circuit board design practices ensure all proper trace clearances are maintained for both voltage and noise reduction. Each individual component is painstakingly selected to ensure that their tolerances will result in the complete system's desired accuracy and repeatability.

Assurance by Design

A design that is hard to build will lead to inconsistent quality. Everything in our SMRT Units - from the internal PCB to the individual modules - is designed with manufacturability in mind. The units are designed to keep up with you in the field and can withstand mechanical stress in accordance with international standards for vibration, transit drop, free fall and topple shocks. Internal sensors allow autonomous temperature monitoring and control, ensuring worry-free operation in all climates and conditions.



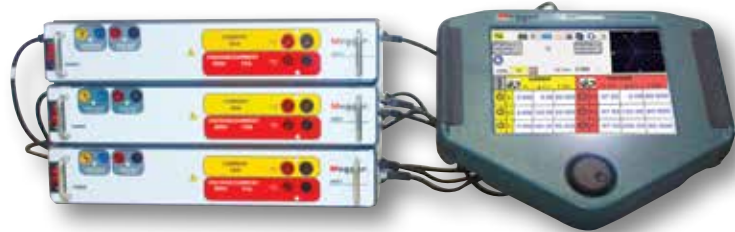
SMRT1

Single-Phase Test Set



For your single-phase testing applications, the **Megger SMRT1 Relay Test Set** is the best and most powerful testing device on the market. It is designed to operate in the field, yet with its high power output and accuracy it is an excellent tool for lab use as well. The SMRT1 can test all single-phase relays, and for applications that require three-phase capabilities simply parallel it with multiple SMRT1 test sets. This versatile feature gives you the ability to use the SMRT1 by itself or in conjunction with other Megger SMRT relay test sets to test more complex relay schemes like three-phase directional power, distance, loss of excitation, and/or multiple current channel applications.

The SMRT1 is our ultraportable, single-phase relay testing solution. Weighing just under 9 lbs, it is the smallest and lightest unit in the SMRT Family and in the market. It is highly versatile and ruggedly built for field testing and rack mountable for lab tests. Pound for pound, the SMRT1 provides the highest regulated test current on the market.



Connect 3 SMRT1 units for 3-phase testing: 3 x 300 V @ 150 VA plus 3 x 60 A @ 300 VA, yet they still weigh less than 30 pounds

SMRT33

Basic Three-Phase Test Set



The **SMRT33** is our entry-level, three-phase relay test set. It is designed for users that require three-phase capability but with lower instantaneous current output and fixed voltage channels. It is the most compact in its class while still providing very high output for its size and weight.

The SMRT33 provides high power in both the voltage and current channels to test virtually any type of protective relay used in heavy industrial, distributed generation and low to medium voltage distribution substations. With its high compliance voltage and current, the SMRT33 can test electromechanical, solid-state and microprocessor-based overcurrent relays, including high impedance directional ground overcurrent. In addition to this functionality, the unit includes the capability to test IEC 61850 devices.



Soft Case



Engineering intelligence and innovative technology allows us to increase the power output of our VI amplifiers while significantly reducing their size



Optional Bluetooth™ enabled for wireless control



Fully automated and manual testing with the dedicated SmartTouch View Interface, or with any Microsoft Windows™ PC



Soft Case for STVI & leads



ISO Certified Manufacturing

All SMRT units are manufactured in-house to our exacting quality standards. Megger is ISO9001 certified, with strict supply chain standards that include annual on-site inspections and audits of our key suppliers.



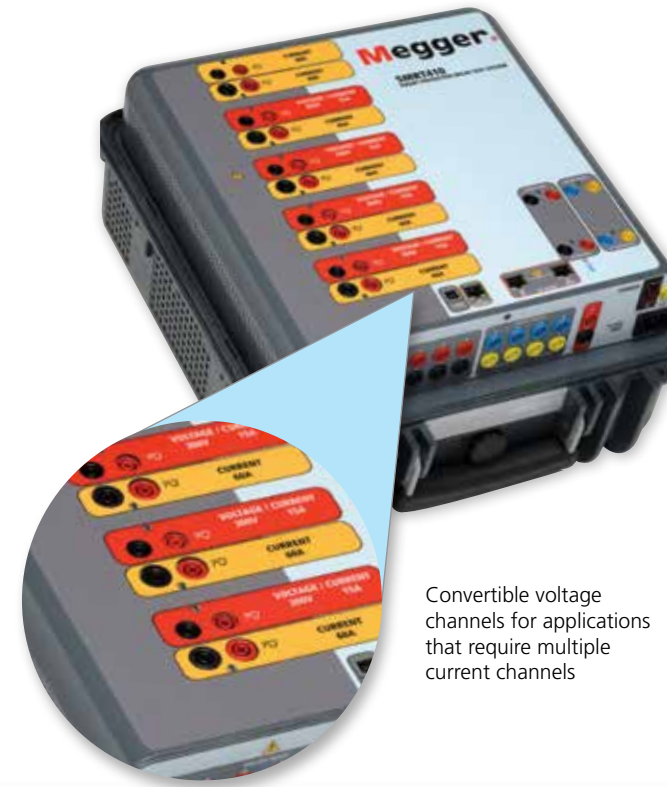
PCB and Component Testing

While most manufacturers outsource PCB production, we start from raw PCBs. The PCBs pass through a state-of-the-art Automatic Optical Inspection (AOI) to detect any missing or incorrect components. Electrical and functional tests are then performed to ensure all components are free from defects.

SMRT36 Advanced Three-Phase Test Set

The **SMRT36** is our best-selling three-phase relay test set. It can be configured with up to 3 Voltage-Current modules to test virtually all types of protective relays used in heavy industrial, distribution and transmission substations as well as generation facilities.

The SMRT36 is the smallest, most powerful three-phase relay test set on the market. This versatile test set may be customized by adding any number of Voltage-Current, or "VIGEN", modules needed for specific test applications. For electric utility use, the SMRT36 with three VIGEN Modules provides complete three-phase testing of three-phase impedance, directional power, negative sequence overcurrent and other devices that require a three-phase four-wire connected source. With three modules, output current and VA is tripled for high instantaneous or high burden overcurrent relays. The voltage channels are convertible to provide up to 6 current channels.



Convertible voltage channels for applications that require multiple current channels

SMRT410 Advanced Multi-Phase Test Set

The **SMRT410** is our premier relay test set. The SMRT410 test set has high compliance voltage and current to test all electromechanical, solid-state and microprocessor-based overcurrent relays, including voltage controlled, voltage restraint and high impedance directional ground overcurrent.

With 4 voltage channels and 6 high current channels, the SMRT410 meets every testing need. It can be configured with up to 4 Voltage-Current modules, with a 5th slot to accommodate a double-current module or a single-voltage channel - the convertible voltage channels provide up to 9 currents to handle the most difficult of testing needs.



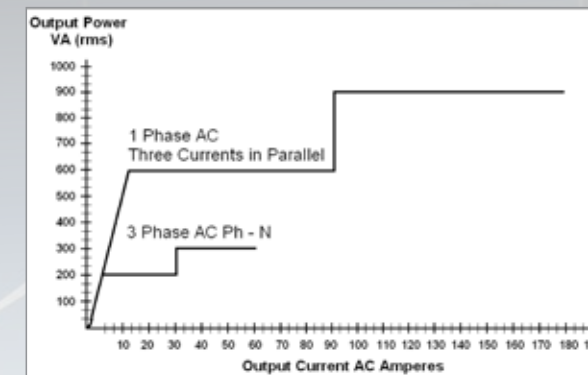
Daisy chain multiple units for even more testing capability



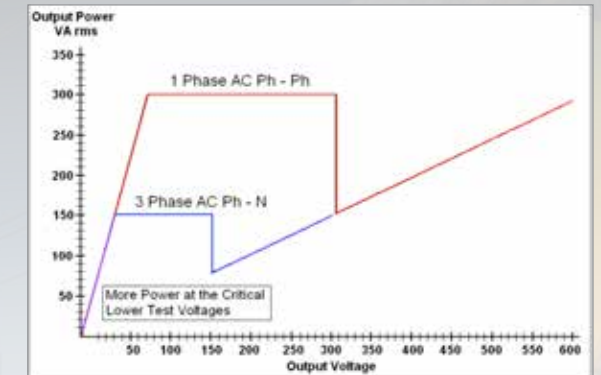
Transit case & soft case for STVI leads



Binary Input/Output



High compliance voltage of 50 V @ 4 A provide a constant power output of up to 30 A @ 200 VA RMS



PowerV™ technology guarantees a flat curve from 30 to 150 V, eliminating range switching



Individual Module Testing

Each completed PCB is placed into its respective module – power supply, voltage/current generators, etc., and each module is then individually tested and verified to work prior to installation into a SMRT unit.

Full System Testing

Each completed SMRT unit undergoes a full systems test, with every input and output tested to their full operating range and limits. The unit is then stress tested in a thermal chamber, where the temperature is cycled to thermal extremes. Next, we conduct safety, shock, vibration, transit drop, free fall and topple tests to both IEC and ISTA standards.



Introducing the New

SMRT36D & SMRT410D

Powerful • Accurate • Reliable • Powerful • Accurate • Reliable • Powerful • Accurate • Reliable • Powerful • Accurate • Reliable

SMRT36D Three Phase Test Set



The "D" in SMRT36D and SMRT410D indicates these units include an integrated Smart Touch View Interface (STVI) providing stand-alone testing capabilities (no PC required)

The easy to use touchscreen provides varying levels of manual to completely automatic control of the test sets

The USB port provides easy and safe access to test results for data retention and reporting

Megger's new **SMRT36D** and **SMRT410D** protective relay test sets are ideally suited for testing today's modern relays and legacy electromechanical relays, yet designed to meet the future challenges associated with testing the new generation multi-phase smart grid relays. With powerful testing capabilities and comprehensive relay management that facilitates compliance reporting, the "D" series offers the complete package for your testing needs.

SMRT410D Multi-Phase Test Set



Many test sets are designed to be controlled by a PC; however, with more stringent security regulations from a compliance and IT perspective, having a built-in screen is not just a convenience anymore. It is becoming essential in some sectors for the test set to operate as a self-contained unit which removes the need to obtain rights and permissions from your IT department. The SMRT "D" Series solves this issue.

Improved low current accuracy at currents below 100 mA

New convertible voltage channels (15 Amps at 120 VA)

Battery Simulator comes standard

Maximum power output of 100 W (for those relays with dual power supplies)

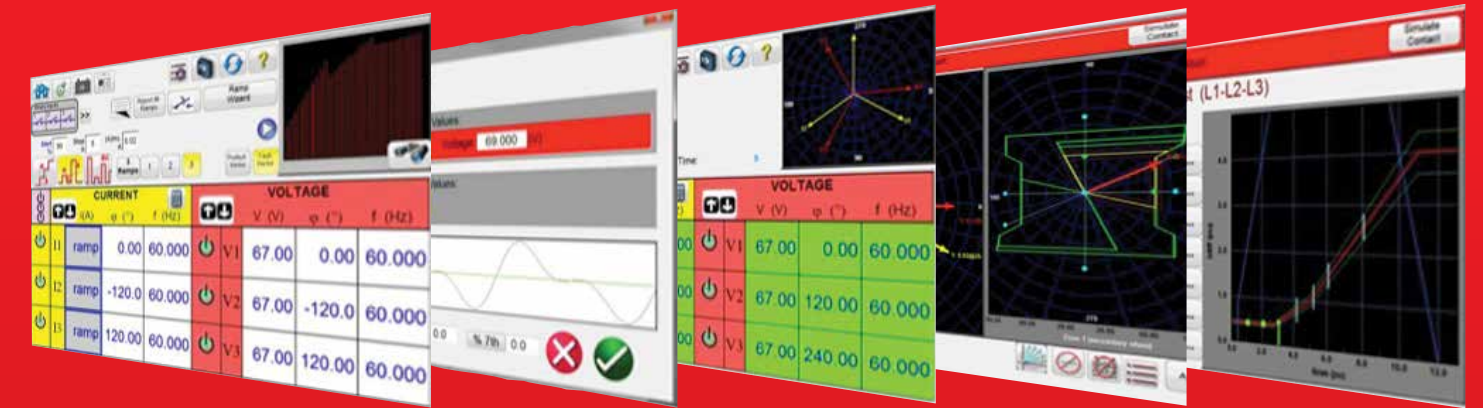
NEW RTMS - Relay Test & Management Software

Megger's new RTMS software combines our easy to use Smart Touch View Interface (STVI) Software with our Advanced Visual Test Software to give you increased testing abilities that are easier than ever to perform. The new RTMS is not only the go-to software platform for all relay testing requirements, but is compatible across the entire Megger SMRT Family of relay test systems. This powerful software runs on the Smart Touch View Interface hand-held controller, as well as the built-in Smart Touch View Interface in the SMRT36D and SMRT410D units, and also runs on your PC.

Together, the new RTMS and our existing PowerDB Software are the keys to complete and comprehensive relay testing. Whether you are testing simple or complex protection relays and protection schemes, or providing asset management and compliance reporting, the new RTMS is your relay testing and management solution.



RTMS Distinctive Features



Default Start-up Vector Screen

- General purpose test screen for setting voltage and current sources
- Built-in Fault Calculator for fast and easy settings of output values
- Color indicates which outputs are selected and on

Automatic Ramping Modes

- Step Ramp, Pulse Ramp, and Pulse Ramp Binary Search Capabilities to Automatically Determine Pickup and Dropout of relays
- Ramp Wizard available to perform various types of tests
- Pulse Ramp Binary Search define unknown operating characteristics

Fault Calculator

- Select Type of Fault (Phase to Ground, Phase to Phase, etc.)
- Select the Fault Mode (Overcurrent, Voltage, Impedance Symmetrical)
- Create and view harmonic waveforms
- Impedance and Symmetrical Modes will automatically calculate all phase amplitudes and phase angles, and enter them into the manual test screen

Automatic Timing Tests on Overcurrent, Voltage and Frequency Relays

- Hundreds of built-in Time Curves and time curve algorithms from 21 different relay manufactures, as well as ANSI, IEC, and IEEE Standards
- Graphical display draws actual time curves (electromechanical) or time curve algorithms (microprocessor based relays, or Standards)
- RMS Software automatically evaluates test results to the manufacturers time curve and user defined Pass/Fail tolerance
- Perform up to 8 test points on the curve

Creates Test Reports

- Save/View/Print test results from Power DB Database
- Software automatically compares the Operating Time to the theoretical and make a Pass/Fail determination based upon the manufacturers time curve characteristic
 - Pass shows a green dot
 - Fail shows a red dot

Click-On-Fault Impedance Relay Test Screen Provides Dual Graphics

- Right side graphic window displays relay operating characteristic
- Moving Vector shows impedance and angle as it moves in real time down the user defined ramp line
- Left side graphic displays actual test vector values of voltage and current
- Phase values of amplitudes and angles are displayed in real time
- User may select to view positive, negative and zero sequence components in real time

Sequencer (Dynamic) Testing Capability

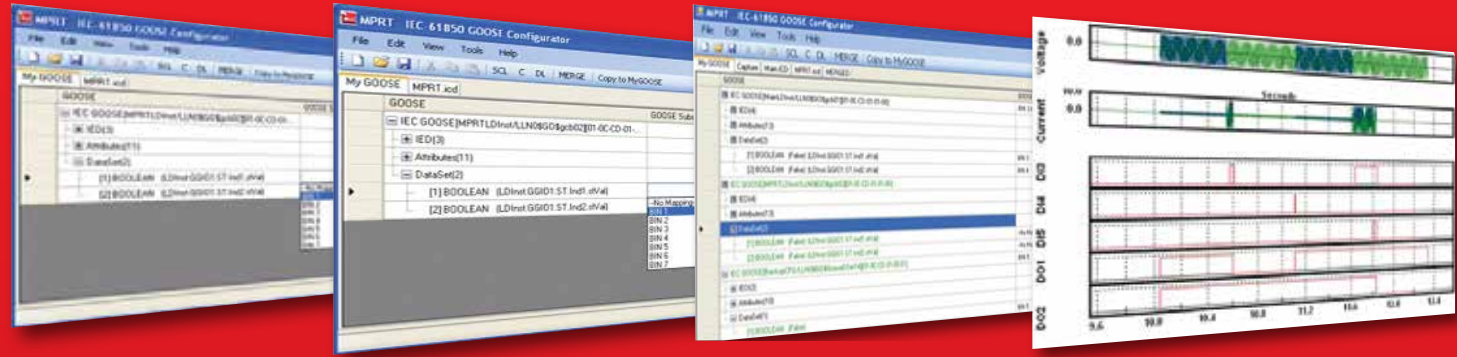
- Provides automatic multi-state dynamic testing, up to 15 states including lockout
- Can perform End-to-End Tests using IRIG-B input
- Graphical binary input and output setup

Differential Relay Test Includes:

- (4) Four Slope Characteristic Models to choose from
 - Line Segments (Example: G.E. SR745)
 - Slope Through Origin (Examples: SEL387, SEL587)
 - Slope From X Axis (Example: Siemens 7UT613)
 - Slope From Base Point (Examples: ABB RET 670 and Areva/Schneider P63X)
- (7) Seven IBias Equations to choose from
- Touchscreen to input test points
- Real-time test displays test results including Pass/Fail evaluation

Megger GOOSE Configurator with Integrated IEC61850 Testing

The Megger GOOSE Configurator provides easy to use tools for testing relays and substations using the IEC 61850 protocol. The configurator allows relay test engineers and technicians to import parameters from configuration files in the SCL format and use them to configure the SMART test sets to subscribe to preselected GOOSE messages by assigning the data attributes from received GOOSE messages to the appropriate binary inputs. This provides both manual and automatic testing of the relay using RTMS.



- Use the "C" Capture tab to "sniff" the network and capture GOOSE messages from IEDs
- Use MERGE Feature to compare captured GOOSE messages with the SCL file
- Captured and verified GOOSE messages can then be copied to "My GOOSE"

- GOOSE "Subscriptions" are assigned to Binary Inputs using the pull-down window
- GOOSE "Publications" are assigned to Binary Outputs using the pull-down window

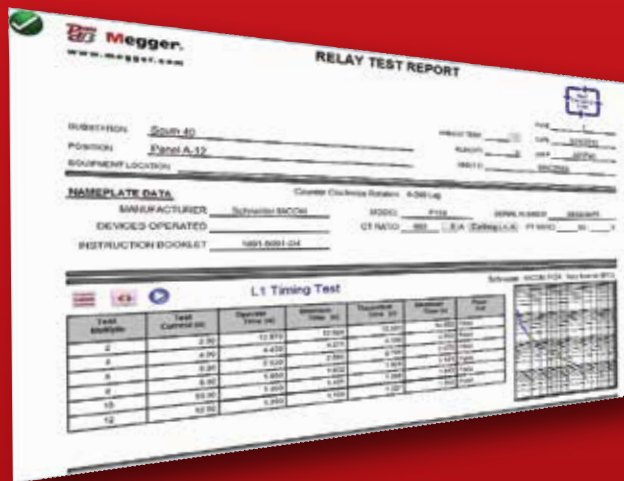
Once all the selected IEDs are in My GOOSE the appropriate GOOSE message indicators are assigned to Binary Inputs for monitoring by the test set unit. The Subscriptions and Publications are then downloaded into the test set ready to test.

Tests were conducted using GE UR D60 and SEL 421 relays to simulate a breaker failure scenario, where the Megger test set provides the trip currents to both relays and simulates the circuit breakers associated with each relay.

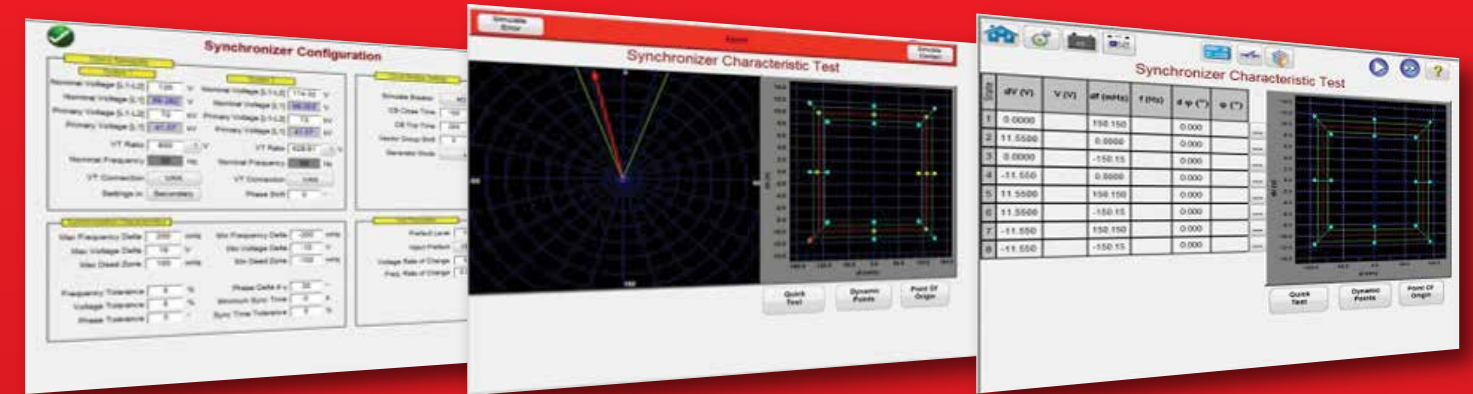
Reporting

PowerDB Software provides powerful reporting capabilities which gives you clearer visibility for relay management and provides a customizable relay test report which can be saved for internal use and compliance reporting or used to execute repeated testing. In addition to showing the location of the relays in the system, the user can also look at the historical test records of all relays. This includes relay settings and recorded test results.

The test report is fully customizable – add your logo to our default template, or completely change it to match your company's existing reporting standard and format. This makes it easy to generate your custom reports to comply with all current and future reporting requirements as specified by the NERC PRC-005-2 standard. The report can be printed immediately or exported to other common digital file formats such as Microsoft™ Word or Adobe™ PDF.



RTMS Enhanced Features



Synchronizing Relay Test Feature

- Synchronizer Configuration Screen
 - Inputs for System 1 and 2
 - Inputs for Voltage and Frequency Deltas
 - Closing and Trip times of the Circuit Breaker for breaker simulation
 - Inputs for Rate of Change of the Voltage and Frequency changes

Synchronizer Relay Quick Test Screen

- Software will automatically draw 4 test lines with two Delta Voltage lines and two Delta Frequency lines
- Provides quick and easy testing of synchronizer relays

Synchronizer Relay Characteristic Test Options

- Provides quick and easy testing of synchronizer relays
- Four test options available;
 - Quick Test, where the software draws 4 test lines with two Delta Voltage, two Delta Frequency
 - Dynamic Test, where software will automatically draw eight test lines, with two Delta Voltage, two Delta Frequency, and four Dynamic test lines where both Frequency and Voltage are run in Delta
 - Point of Origin Test, similar to the Dynamic but includes origin as a test point
 - Users draws their own test lines

Synchronizer Relay Real-Time Test Screen Provides Dual Graphics

- Right side graphic window displays relay operating characteristic
 - Test point moves in real time down the defined ramp line
 - Successful test results are shown with a green dot inside the user defined tolerance band
 - Failed test points show as red X outside of tolerance band
- Left side graphic the user can observe the synchro scope as the test voltage rotates

Application Note

16 Current Bus Zone Protection Testing

The Problem

Eskom, a Megger customer in South Africa, needed a way to efficiently test their bus differential protection scheme in one of their 400 kV substations. This required injecting current into all relays simultaneously, but no test set on the market at that time provided 16 current channels. The customer called Megger for technical guidance on how they could possibly test this bus without sectionalizing the bus into sub zones, which means it would require multiple days of testing.

Test Solution

The jointly agreed on solution was to use multiple test sets in parallel to achieve the required number of currents. Not all test sets support this mode of operation unless they have been specifically designed to do so. The Megger SMRT line of relay test sets have the ability to communicate with each other, and allow centralized control of multiple units working in unison. Eskom had two 3 phase SMRT36 and two single phase SMRT1 units. The SMRT36 provided six currents each and the SMRT1 two currents - a unique feature of the SMRT series is that the voltage channels can be converted to current channels -giving a total of 16 currents.

The four test sets were interconnected via standard RJ45 Ethernet cables (Fig. 1). This allowed them to be operated as a single test set, which was then controlled by the STVI (they could just as easily be controlled using a laptop running RTMS).

Test Results

The setup simulated the whole bus perfectly. In the pre-fault stage, a stable bus zone condition was simulated as shown in Figure 2. After the pre-determined time period, a fault was injected and the time taken to clear the fault was measured. Figure 2 shows a Zone 1 fault that tripped in 12.5 ms. After the zone timing tests were completed, breaker fail testing was performed using seven stages and the equipment executed this without a hitch.

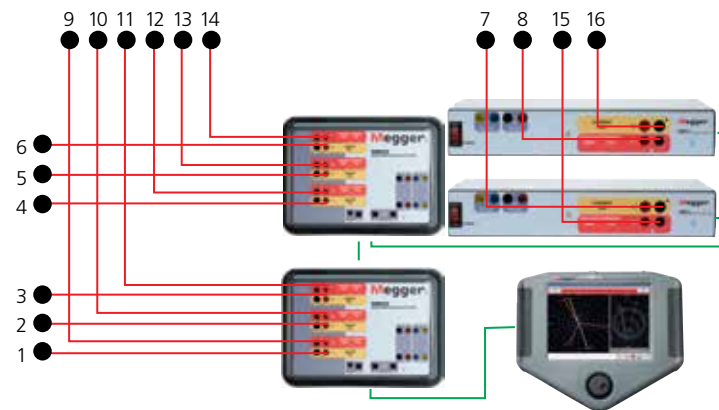


Fig. 1
The only solution on the market that allows multiple test sets to be interconnected, controlled and viewed as a single entity. The 4 SMRT test sets shown here are connected via standard RJ45 Ethernet cables and controlled from a single STVI interface.

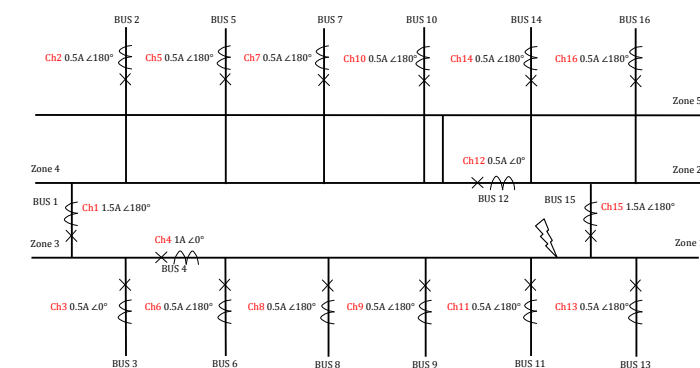


Fig. 2
Eskom's 400 kV substation with 16 bus zone protection. A Zone 1 fault that tripped in 12.5 ms is shown.

Conclusion

This novel testing approach allowed testing to be completed in less than a day when traditional testing methods would have typically taken three days to complete. The ability to simultaneously inject 16 currents allowed us to avoid the prolonged process of sectionalizing the bus zone and injecting three to six currents at a time to simulate all possible faults. This solution can be easily extended to 24 or even 30 current channels using the right combination of the Megger SMRT relay test sets.

APPLICATIONS SELECTION GUIDE

SMRT1

Dim: 13.5 W x 2.4 H x 6.75 D
Weight: 8.9 lbs.



SMRT33

Dim: 14.2 W x 7.6 H x 12 D
Weight: 25.4 lbs.



SMRT36

Dim: 14.2 W x 7.6 H x 12 D
Weight: 27.9 lbs.



SMRT36D

Dim: 13.25 W x 6.75 H x 10.75 D
Weight: 29.35 lbs.

SMRT410

Dim: 14.2 W x 7.6 H x 16.25 D
Weight: 39.5 lbs.



SMRT410D

Dim: 13.25 W x 6.75 H x 15 D
Weight: 42.65 lbs.

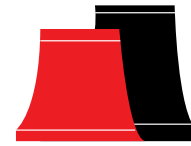
Protective Relays by IEEE Device #		SMRT1	SMRT33	SMRT36/SMRT36D	SMRT410/SMRT410D
2	Time Delay	■	■	■	■
21	Distance	Single Phase	■	■	■
24	Volts/Hz	■	■	■	■
25	Synchronizing (Single-Phase to Single-phase)		■	■	■
25	Synchronizing (Three-Phase to Single-phase)				■
27/59	Under/Over Voltage	■	■	■	■
32	Directional Power	Single Phase	■	■	■
37/76	DC Under/Overcurrent	■	■	■	■
40	Loss of Field		■	■	■
46	Phase Balance Current	■	■	■	■
46N	Negative Sequence Overcurrent	Single Phase	■	■	■
47	Phase Sequence Voltage		Open Delta	■	■
50	Instantaneous Overcurrent	Up to 75 Amps	Up to 180 Amps	Up to 225 Amps	Up to 360 Amps
51	Time Delay Overcurrent	Up to 35 Amps	Up to 75 Amps	Up to 105 Amps	Up to 200 Amps
55	Power Factor	Single Phase	■	■	■
60	Voltage/Current Balance		■	■	■
67/67N	Directional/Ground Overcurrent	■	■	■	■
78	Out of Step		■	■	■
79	Reclosing	Single Phase	■	■	■
81	Frequency	■	■	■	■
85	Carrier or Pilot Wire	■	■	■	■
87	Differential (Three-Phase - 6 Currents)			■	■
87	Differential (Three-Phase - 9 Currents)				■
91	Voltage Directional		Open Delta	■	■
92	Voltage and Power Directional		Open Delta	■	■
94	Tripping	■	■	■	■



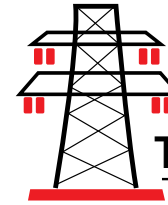
INDUSTRIAL



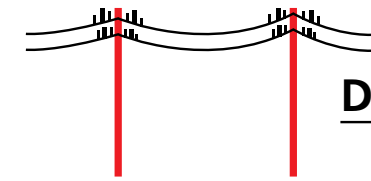
SERVICE CO.



GENERATION



TRANSMISSION



DISTRIBUTION

Single Phase Testing

Relay Testing & Management

Recloser Testing

Arc Flash Testing

Differential Testing

Sync Check Testing

End-to-End Testing

Specialized Applications Requiring Multiple Channels

Compliance Reporting & Results Database

HARDWARE

SMRT1



SMRT33



SMRT36

SMRT36D



SMRT410

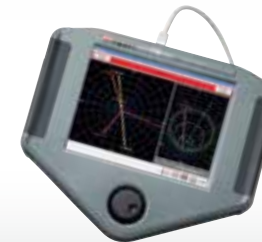
SMRT410D



SOFTWARE

RTMS
Relay Test & Management Software

STVI



24 Months Extended Warranty

Megger offers the industry leading extended warranty for the SMRT Series. Megger warrants to the original purchaser that the product is free from defects in material and workmanship for a period of twenty-four (24) months from the date of shipment (industry standard is 1 year).

How do we know what products to design?

We listen to our customers! Through an interactive process of customer and market surveys, we evaluate every customer request and concern. We then challenge our Engineers to make the best test sets that work in the most challenging environment so that when the final report is generated, you are assured your protection scheme will operate as designed.

Technical Support

With the purchase of select relay test sets, Megger offers commissioning training and ongoing technical support. Megger hires only the best Engineers to provide application support. Relay Application Engineers provide phone, email and in-person support for SMRT Relay Test Sets. They use their expertise in relay protection and comprehensive knowledge of our SMRT Relay Test Sets to provide superb customer support for your products.



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