

# SMRT410

## Megger Relay Test System



SMRT410 with 6 x 60 Amps

- **Small, rugged, lightweight and powerful**
- **Operate with or without a computer**
- **Intuitive manual operation with Smart Touch View Interface**
- **High current, high power output (60 Amps/300 VA rms) per phase**
- **Flexible output design provides up to four-phase voltage and up to ten-phase current**
- **Network interface provides IEC 61850 test capabilities**
- **Fully automated testing using AVTS Software**

### DESCRIPTION

The SMRT410 test system may be customized by adding the number of Voltage-Current, "VIGEN", modules needed for specific test applications. The SMRT410 has the "smart" combination of high compliance voltage and high current to test all electromechanical, solid-state and microprocessor-based overcurrent relays, including voltage controlled, voltage restraint and high impedance directional ground overcurrent.

The SMRT410 provides a complete multi-phase test system for commissioning of protection systems. With up to 4 voltage channels a 6 high currents, the SMRT410 meets every testing need. The SMRT410 VIGEN modules also provide high power in BOTH the voltage and current channels to test virtually all types of protective relays.

The SMRT410 test system has the ability to be manually controlled with Megger's new Smart Touch View Interface™ (STVI). The STVI, with its large, full color,

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 most popular relays.

The STVI eliminates the need for a computer when testing virtually all types of relays. Menu screens and touch screen function buttons are provided to quickly and easily select the desired test function. Tests results can be saved to the STVI for download to a memory stick to transfer or print test reports.

For full automatic testing the SMRT410 may be controlled by Megger Advanced Visual Test Software (AVTS). AVTS is a Microsoft® Windows® XP®/Vista™/7 compatible software program designed to manage all aspects of protective relay testing using the new Megger SMRT.

### APPLICATIONS

Each current channel is rated for 30 Amps @ 200 VA continuous, up to 60 Amps @ 300 VA for short durations. It has a unique flat power curve from 4 to 30 Amps that insures maximum compliance voltage to load at all times. With only 3 currents in parallel the unit provides up to 180 Amps @ 900 VA for instantaneous tests. With a maximum compliance voltage of 50 Volts per phase, with just two channels in series provides 100 Volts of compliance voltage to test high impedance relays.

Each voltage channel can provide variable outputs of 0- 30/150/ 300 Volts at 150 VA of output power, and has a unique flat power curve from 30 to 150 Volts insuring maximum output power to the load at all times. With the



STVI with SMRT410

voltage channels converted to current, a five channel unit can provide 10 currents.

Using the Ethernet ports, the SMRT410 is literally a “plug-and-play” unit, where voltage and current outputs can be seamlessly synchronized with other SMRT units outputs for testing more complex test applications such as back-to-back tests.

## FEATURES AND BENEFITS

**Constant Power Output** – New higher powered Voltage-Current amplifiers. The current amplifier delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically under load. This insures 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 or series current channels together to test high burden relays.

**High Output Current** – Provides up to 30 Amps at 200 VA per phase continuous, or up to 60 Amperes at 300 VA with a 1.5 second duty cycle. With only three current amplifiers in parallel the SMRT410 provides 180 Amperes at 900 VA, for testing all instantaneous overcurrent relays.

**New PowerV™ Voltage Amplifier High Power Output** – The SMRT provides a new higher VA power output on the voltage channel at the lower critical test voltages (from 30 to 150 Volts). Customers who want to test a panel of relays at one time find it impossible using lower VA rated voltage.

**Convertible Voltage Channels** – With a 5 channel SMRT410 unit, convertible channels in conjunction with the main current channels, provides 10 currents for testing multi-phase current differential relays.

**High resolution and accuracy** – Metered outputs provides extremely high accuracy needed for testing a wide variety of devices. With metered values, what you see is what you get.

**Steady-State and Dynamic testing capability** – The SMRT410 provides, 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.

**Output current and voltage sine waves are generated digitally** – Outputs do not vary with sudden changes in input voltage or frequency, which increases test accuracy and reduces testing time.

**Digital binary inputs and outputs** – The programmable binary inputs, and 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 normally closed and normally open contacts to simulate circuit breaker operation for testing reclosing relays. Sequence of operation, timing, and lockout are easily tested.

**Performs transient tests** – Perform acceptance or troubleshooting tests by replaying digitally recorded faults or EMTP/ATP simulations in the IEEE- C37.111, COMTRADE Standard format.

**Perform End-to-End tests** – Using AVTS software and a portable GPS satellite receiver, the SMRT performs satellite-synchronized end-to-end dynamic multi-state or playback transient COMTRADE files either for commissioning or troubleshooting tests.

**Wide-ranging output frequency** – The output frequency of the current and voltage channels can be set for any frequency from dc to 1 kHz. Popular test frequencies such as 16.66, 25, 33, 50, 60, 100, 120, 125, 150, 180, 250, 300 and 400 Hz are easily set and controlled. Multi-purpose test system saves time and money.

**USB 2.0 interface port** – The USB port provides a PC interface for automated control of the SMRT unit. Also provides secure isolation when testing IEC 61850 devices (for customers who require secure isolation from their IEC 61850 substation bus).

**Three Ethernet ports** – PC/OUT Ethernet Port is the primary PC connection port. The IN/IEC61850 Ethernet Port provides interface to multiple SMRT units, and may be used to connect to the IEC 61850 substation bus. The OUT Ethernet Port is primarily used to interconnect multiple SMRT units together for synchronous multi-unit operation. The STVI PoE (Power over Ethernet) port and is used to connect to the STVI.

**Bluetooth** – Optional Bluetooth provides more flexibility. A wireless interface between the PC and SMRT, in conjunction with the SMRT IEC 61850 Ethernet port, provides the isolation required for a secure substation access interface between the SMRT and the IEC 61850 substation network.

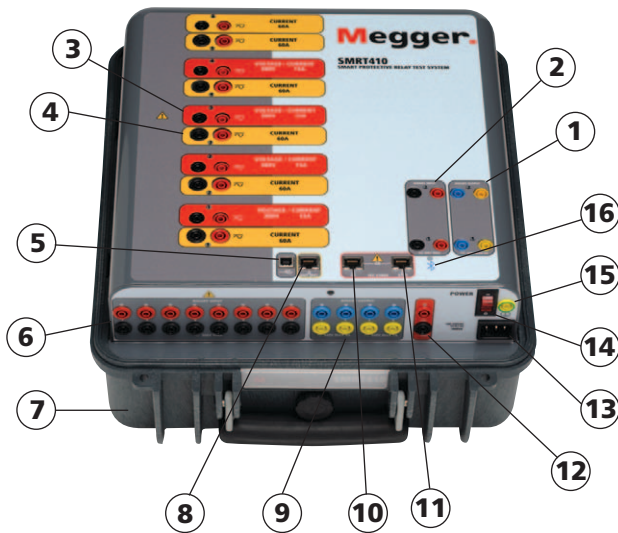
**Universal input voltage** – Operation from 90 to 264 Vac, 50/60 Hz, the SMRT can use virtually any standard source in the world.

**Immediate error indication** – Audible and visual alarms indicate when amplitude or waveforms of the outputs are in error.

**Modular design** – Output modules plug-in and out easily for system re-configuration and maintenance.

**IEC 61850** – Optional integrated interface provides testing using the IEC 61850 GOOSE protocol.

## SMRT410 RELAY TESTER



### APPLICATIONS SELECTION GUIDE

1. **Binary Outputs 1 and 2:** Rated for 300 V at 8 Amps.
2. **Binary Inputs 1 and 2:** Rated 5 to 300 V AC/DC
3. **Voltage Outputs:** Up to 4 channels 300 V at 150 VA, convertible to currents 15 A at 120 VA per phase.
4. **Current Outputs:** Up to 6 channels 60 Amps at 300 VA per phase.
5. **USB 2.0 Interface:** Communication and control port.
6. **Additional Binary Inputs:** Provides 8 additional monitor circuits.
7. **Rugged Case:** Fiberglass reinforced plastic.
8. **PC/OUT:** Ethernet Port is the primary PC connection port. Ethernet Port used to chain multiple SMRT units together for synchronous multi-unit operation.
9. **Additional Binary Outputs:** Adds 4 outputs. Binary Outputs 3 and 4 are rated for 300 V AC/DC, 8 amperes. Binary Outputs 5 and 6 are high speed and have an AC/DC voltage rating of 400 volts peak, 1 ampere.
10. **IN/61850:** This port may also be used for connecting to the IEC 61850 substation bus for testing IEC 61850 devices.
11. **STVI:** Ethernet Port is a PoE (Power over Ethernet) port and is used to connect to the STVI for manual control.
12. **Battery Simulator:** Variable 5 to 250 Volts DC output at 100 Watts (4 amperes maximum).
13. **Incoming Power/Line Cord Socket:** 100 to 240 V, 50/60 Hz.
14. **POWER ON/OFF Switch:** Illuminates when power is on.
15. **Protective Earth Ground Jack.**
16. **Bluetooth:** Bluetooth® provides wireless control.

### APPLICATIONS SELECTION GUIDE

Protective Relays by IEEE Device #		SMRT410 Three Channels	SMRT410 Four Channels
2	Time Delay	■	■
21	Distance Single Phase	■	■
21	Distance Three Phase Open Delta	■	■
21	Distance Three Phase wye	■	■
24	Volts/Hz	■	■
25	Synchronizing	■	■
27/59	Under/Over Voltage	■	■
32	Directional Power Single Phase	■	■
32	Directional Power Three Phase	■	■
37/76	DC Under/Over Voltage/Current	■	■
40	Loss of Field	■	■
46	Phase Balance Current	■	■
46N	Negative Sequence Overcurrent	■	■
47	Phase Sequence Voltage	■	■
50	Instantaneous Overcurrent	Up to 225 Amps	Up to 300 Amps
51	Time Delay Overcurrent	Up to 105 Amps	Up to 140 Amps
55	Power Factor	■	■
60	Voltage/Current Balance	■	■
67	Directional Overcurrent	■	■
67N	Ground Directional Overcurrent	■	■
78	Out of Step	■	■
79	Reclosing	■	■
81	Frequency	■	■
85	Carrier or Pilot Wire	■	■
87	Differential	■	■
91	Voltage Directional	■	■
92	Voltage and Power Directional	■	■
94	Tripping	■	■

**SPECIFICATIONS<sup>1</sup>****Input Power**

100 to 240 Volts ( $\pm 10\%$ ) AC, 1 $\emptyset$ , 50/60 Hz, 1800 VA

**Outputs<sup>2</sup>**

All outputs are independent from sudden changes in mains voltage and frequency, and are regulated so changes in load impedance do not affect the output. All amplifier outputs are isolated or floating. The SMRT units can be ordered with the amplifier common returns tied to chassis ground as an option.

**Output Current Sources**

The SMRT410 with five modules can provide up to ten current sources; six high current/high power<sup>3</sup>, and four convertible channels providing lower current/high power. The per channel output current and power ratings are specified in AC rms values and peak power ratings.

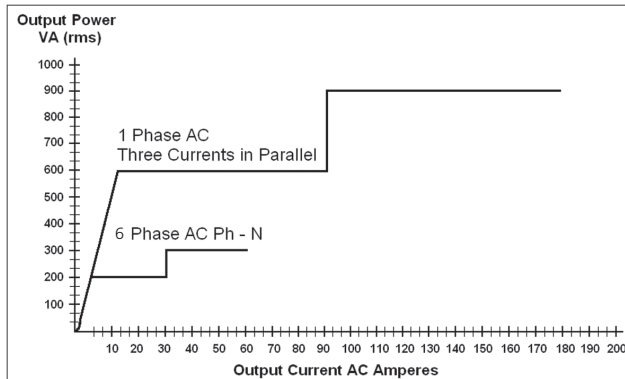
Output Current	Power	Max V/Duty Cycle
1 Ampere	15 VA	15.0 Vrms Continuous
4 Amperes	200 VA (282 peak)	50.0 Vrms Continuous
15 Amperes	200 VA (282 peak)	13.4 Vrms Continuous
30 Amperes	200 VA (282 peak)	6.67 Vrms Continuous
60 Amperes	300 VA (424 peak)	5.00 Vrms 90 Cycles
DC 200 Watts		

**With three currents in parallel:**

Output Current	Power	Max V/Duty Cycle
12 Amperes	600 VA (848 peak)	50.0 Vrms Continuous
45 Amperes	600 VA (848 peak)	13.4 Vrms Continuous
90 Amperes	600 VA (848 peak)	6.67 Vrms Continuous
180 Amperes	900 VA (1272 peak)	5.00 Vrms 90 Cycles

**With two currents in series:**

The compliance voltage doubles to provide 4.0 Amperes at 100 Volts rms.

**Current Amplifier Output Power Curve****Current Amplifier - Extended Power Range**

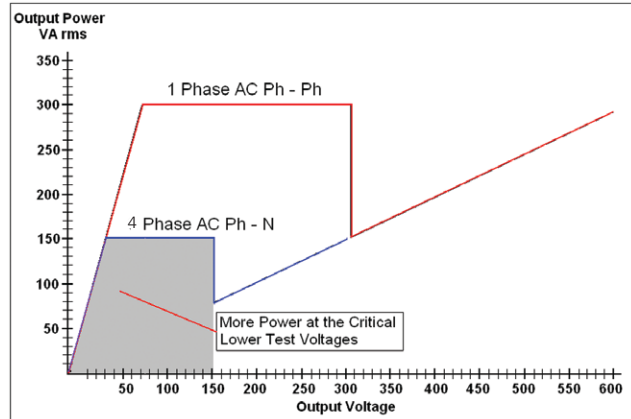
The SMRT current amplifier provides a unique flat power curve from 4 to 30 Amperes per phase to permit testing of electromechanical high impedance relays, and other high burden applications, with an extended operating range up to 60 Amperes at 300 VA rms.

**AC Voltage Output**

Outputs are rated with the following Ranges:

Output Volts	Power	Max I
30 Volts	150 VA	5 Amps
150 Volts	150 VA	Variable <sup>4</sup>
300 Volts	150 VA	0.5 Amps
DC 150 Watts		

**Duty Cycle:** Continuous

**"PowerV" Voltage Amplifier Output Power Curves****"PowerV"™ Voltage Amplifier - Extended Power Range**

The SMRT voltage amplifier provides a flat power curve from 30 to 150 Volts in the 150V range to permit testing of high current applications such as panel testing.

**Voltage Amplifier in Current Mode:**

The voltage amplifier is convertible to a current source with the following output capability. Output power ratings are specified in rms values and peak power ratings.

Output Current	Power	Max V	Duty Cycle
5 Amperes	150 VA (212 peak)	30.0 Vrms	Continuous
15 Amperes	120 VA	8.0 Vrms	90 Cycles

**Phase Angle**

**Ranges:** 0.00 to 359.99 degrees, Counter Clock Wise, or Clock Wise rotation, or 0.00 to  $\pm 180.00$  degrees

**Accuracy:**  $\pm 0.02^\circ$  typical,  $\pm 0.25^\circ$  max at 50/60 Hz

**Frequency**

The output modules provide a variable frequency output with the following ranges and accuracy.

**Ranges**

DC

0.001 to 1000.000 Hz

Output amplifiers can provide transient signals with a range of DC to 10 kHz for transient playback using COMTRADE files.

**Resolution\*:** .0001/.001 Hz

**Frequency Accuracy:**

2.5 ppm typical

25 ppm  $0^\circ$  to  $50^\circ$  C, at 50/60 Hz Maximum

**Total Harmonic Distortion**

Less than 0.1% typical, 2% maximum at 50/60 Hz

<sup>1</sup> Megger reserves the right to change product specifications at any time.

<sup>2</sup> For 4 or 5 channel units operating at input voltages below 220 VAC a derating of the simultaneously available total output power of the voltage/current amplifiers and battery simulator will occur. The maximum output power of a single amplifier is not affected.

<sup>3</sup> Six high current/high power channels require optional DIGEN, Double Current Generation, see Ordering Information for details.

<sup>4</sup> PowerV™ voltage amplifier output current varies depending on the voltage setting on the 150 Volt range, see curve.

**Timer**

The Timer-Monitor Input is designed to monitor and time-tag inputs, like a sequence of events recorder. In addition, the binary input controls enable the user to perform logic AND/OR functions, and conditionally control the binary output relay to simulate circuit breaker, trip, reclose and carrier control operation in real-time. The Timer function displays in Seconds or Cycles, with the following range and resolution:

**Seconds:** 0.0001 to 99999.9

**(Auto Ranging)**

**Cycles:** 0.01 to 99999.9

**(Auto Ranging)**

**Accuracy:**  $\pm 0.001\%$  of reading, typical.  $\pm 2$  least significant digit,  $\pm 0.005\%$  of reading from 0 to 50° C maximum

**Binary Input – Start/Stop/Monitor Gate**

To monitor operation of relay contacts or trip SCR, continuity light is provided for the input gate. Upon sensing continuity the lamp will glow. In addition to serving as wet/dry contacts the Binary Inputs may be programmed to trigger binary output sequence(s).

**Input Rating:** up to 300 V AC/DC

**Binary Output Relays**

SMRT410 has independent, galvanically isolated, output relay contacts to accurately simulate relay or power system inputs to completely test relays removed from the power system. The binary output simulates normally open / normally closed contacts for testing breaker failure schemes. The binary output can be configured to change state based on binary input logic.

**High Current Output Relays:** The first two VIGEN Modules have 1 each and the P option add 2 more.

**AC Rating:** 400 V max., I<sub>max</sub>: 8 amps, 2000 VA max.

**DC Rating:** 300 V max., I<sub>max</sub>: 8 amps, 80 W

**Response Time:** <10ms

**High Speed Output Relays:** SMRT410 P Option adds 2

**AC/DC Rating:** 400 V peak, I<sub>max</sub>: 1 amp

**Response Time:** <1ms typical

**Battery Simulator**

The SMRT410 with the P (Plus) option includes a battery simulator with a variable DC output voltage ranging from 5 to 250 Volts at 100 Watts, 4 Amps max, providing capability to power up relays with redundant power supplies. Voltage output is controlled via the Smart Touch-View Interface, or through AVTS software. The SMRT410 with the N option does not include a battery simulator.

**Waveform Generation**

Each output channel can generate a variety of output waveforms such as: DC; sine wave; sine wave with percent harmonics at various phase angles; half waves; square waves with variable duty cycles; exponential decays; periodic transient waveforms from digital fault recorders, relays with waveform recording capability or EMTP/ATP programs, which conform to the IEEE C37.111 COMTRADE standard format.

**Metering**

Measured output quantities such as AC Amperes, AC Volts, DC Volts or DC Amperes, and Time may be simultaneously displayed on the large, color TFT LCD touch screen. The AC and DC outputs display the approximate voltage/current output prior to initiation of the outputs. All accuracies stated are from 10 to 100% of the range at 50/60Hz.

**AC Voltage Amplitude**

**Accuracy:**  $\pm 0.05\%$  reading + 0.02 % range typical,  $\pm 0.15\%$  reading + 0.05 % range maximum

**Resolution:** .01

**Measurements:** AC RMS

**Ranges:** 30, 150, 300V

**AC Current Amplitude**

**Accuracy:**  $\pm 0.05\%$  reading + 0.02 % range typical,  $\pm 0.15\%$  reading + 0.05 % range maximum

**Resolution:** .001/.01

**Measurements:** AC RMS

**Ranges:** 30, 60A

**DC Voltage Amplitude**

**Accuracy:** 0.1% range typical, 0.25% range maximum

**Resolution:** .01

**Measurements:** RMS

**Ranges:** 30, 150, 300V

**DC Current Amplitude**

**Accuracy:**  $\pm 0.05\%$  reading + 0.02 % range typical,  $\pm 0.15\%$  reading + 0.05 % range maximum

**Resolution:** .001/.01

**Measurements:** RMS

**Ranges:** 30A

**Convertible Source in AC Current Mode**

**Accuracy:**  $\pm 0.05\%$  reading + 0.02 % range typical,  $\pm 0.15\%$  reading + 0.05 % range or  $\pm 12.5$  mA whichever is greater

**Resolution:** .001

**Measurements:** AC RMS

**Range:** 5, 15A

**Environmental**

**Operating Temperature:** 32 to 122° F (0 to 50° C)

**Storage Temperature:** -13 to 158° F (-25 to 70° C)

**Relative Humidity:** 5 - 90% RH, Non-condensing

**Unit Enclosure**

The SMRT unit comes housed in a rugged, virtually indestructible, lightweight and ergonomic enclosure. It features a large oversized rubber cushioned handle, and removable lid for use in tight spaces.

**Dimensions**

**With the lid on:**

14.2 W x 7.6 H x 16.25 D in.

(360 W x 194 H x 413 D mm)

**With the lid off:**

14.2 W x 7.2 H x 16.25 D in.

(360 W x 180 H x 413 D mm)

**IEC Enclosure Rating:** IP20

**Weight**

**With the transit lid on:** 39.5 lb. (17.76 kg)

**With the transit lid off:** 36.5 lb. (16.4 kg)

**Conformance Standards**

**Safety:** EN 61010-1

**Shock:** MIL-PRF-28800F (30g/11ms half-sine)

**Vibration:** MIL-RFP-28800F (5-500Hz, 2.05 g rms)

**Transit Drop:** MIL-RFP-28800F (10 drops, 46 cm)

**Protection**

Voltage outputs are protected from short circuits and thermally protected against prolonged overloads. Current outputs are protected against open circuits and thermally protected against prolonged overloads.

**Communication Interfaces**

Ethernet (2)

USB 2.0

Bluetooth (optional)

## SOFTWARE

### AVTS – STVI Basic

Every unit comes with **AVTS Basic** software and the PC version of the **STVI Basic** software packages. AVTS Basic version includes Online Vector control (for single and multi-state timing tests), Online Ramp control (for automatic ramping of voltage, current, phase angles or frequency) and Online Click-On-Fault (for dynamic tests of impedance relays). Test results may be exported directly to Microsoft Word. AVTS software includes a database for saving test results, which can also provide the necessary information needed for system reliability audits. See **AVTS** bulletin for more information.

The PC version of the STVI software includes the ability to bring all STVI test data (from other STVI units) into file folders for retrieval, review and printing whenever needed. See **STVI** bulletin for more information.

### AVTS Advanced

The AVTS Advanced version includes all the feature in AVTS Basic plus the powerful Test Editor, Dynamic Control (includes dynamic end-to-end testing capability, and waveform recording capability), ASPEN OneLiner™ or Electrocon CAPE™ SS1 File Converter for dynamic testing, and easy to use programming Tools for creating and editing test modules. See **AVTS** bulletin for more information.

### AVTS Professional

The AVTS Professional version includes all of the features of the Basic and Advanced versions plus some other powerful test tools and features. It includes the DFR Waveform Viewer, One-Touch™ Test for fully automatic tests, Modbus communication test capability, and Waveform Digitizer to digitize scanned waveforms of electromechanical over current time curves. See **AVTS** bulletin for more information.

### IEC 61850 GOOSE

The SMRT with the GOOSE enabled, in conjunction with the Megger GOOSE Configurator (MGC) software, can be used in the testing or commissioning of IEC 61850 compliant devices. See **AVTS** bulletin for more information.