

Megger.

STVI

Smart Touch View Interface

New! MPRT8445 Megger Protective Relay Test System



- **New Smart Touch View Interface™ (STVI)**
 - **New multi-colored graphics with intuitive navigation**
 - **New enhanced dynamic test capabilities**
 - **New built-in test report generator**
- **New high current output - 45 Amps at 300 VA per phase**
- **Improved low current accuracy - currents below 100 mA**
- **New convertible voltage channels - 15 Amps at 120 VA**
- **New lighter weight unit - up to 25% weight reduction**
- **Open communication architecture for use with third-party software programs**

DESCRIPTION

The MPRT8445 is a multipurpose, light-weight, field portable test set. The unit is capable of testing a wide variety of electro-mechanical, solid-state and microprocessor-based protective relays, small molded case circuit breakers, motor overload relays and similar protective devices.

With over 60 years of relay testing experience, the Megger MPRT8445 incorporates the latest in Digital Signal Processor (DSP) and microprocessor-based technology, to provide a powerful, easy to use relay test set. The unit can be operated either manually via hand held controller or placed under full computer control via the AVTS, Advanced Visual Testing Software. The hand held controller, called the Smart Touch-View Interface™ (STVI), is Megger's second generation of handheld controllers. It incorporates a large, easy to read Full Color high resolution, high definition, TFT LCD touch-screen display, which displays metered values such as AC and DC Amperes, AC and DC Volts, and Time in both seconds and cycles. Depending on the type of test selected, other values may be displayed, such as Ohms, Watts, Phase Angle, or Frequency.

APPLICATIONS

The test system may be customized by adding the number of Voltage-Current, "VIGEN", modules needed for specific test applications. For electric utility use, the MPRT8445 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 wye connected source.

Each current channel is rated for 30 Amps @ 200 VA continuous, up to 45 Amps @ 300 VA for short durations. For testing relay panels or electromechanical relays, it has a unique flat power curve from 4 to 30 Amps that insures maximum compliance voltage to the load at all times.

With a maximum compliance voltage of 50 Volts per phase, two channels in series provide 100 Volts of compliance voltage to test high impedance relays. Four currents in parallel provides test currents up to 16 Amperes (800 VA) for testing ground overcurrent relays at high multiples of tap rating.

With four currents in parallel it can provide up to 180 Amps at 1200 VA for testing all instantaneous overcurrent relays.

Each voltage channel can provide variable outputs of 0- 30/150/300 Volts at 150 VA of output power. For testing a panel of relays or older electromechanical impedance relays, it has a unique flat power curve from 30 to 150 Volts insuring maximum output power to the load at all times. With the voltage channel converted to current, a three channel unit can provide 6 currents for testing three phase current differential relays, including harmonic restraint transformer differential relays.

MANUAL or COMPUTERIZED CONTROL

The MPRT8445 can be operated manually via the STVI Interface controller, or automatically with the AVTS software package (see AVTS section for description of the software capabilities).

MANUAL OPERATION

The Smart Touch View Interface™ (STVI) touch screen allows the user to perform manual, steady-state and dynamic testing quickly and easily using the Manual or Sequencer test screens, as well as using built-in preset test routines for most popular relays. Ergonomically designed for either right or left hand operation using the rubber cushion grips, the centrally located control knob, and the touch screen, the STVI is extremely easy to use. Use the new built-in stand for single-handed operation. The STVI uses a standard Ethernet cable, and Power Over Ethernet (POE) operation. The STVI includes non-volatile built-in data storage for saving tests and test results. A USB port is provided for transferring test results to your PC.



Figure 1. Smart Touch View Interface

Description

The most significant feature of the STVI is its ability to provide the user with a very simple way to manually test, for both commissioning and maintenance, from the simple overcurrent relay to the most complex relays manufactured today. Manual operation is simplified through the use of a built-in computer operating system and the touch screen. The STVI eliminates the need for a computer when testing virtually all types of relays. Enhanced graphics, intuitive menu screens, and touch screen buttons are provided to quickly and easily select the desired test function.

Manual Test Screen

In the following Manual Test screen the pre-selected outputs are set using the touch screen. Power-up preset default values maybe automatically set from the user defined configuration screen. The user can select from a variety of test options including manual control using the control knob, a dynamic sequence of tests to include trip and reclose operations, an automatic ramp, pulse ramp, or pulse ramp binary search to determine pickup or drop out of relay contacts, or perform relay specific timing tests. By pressing the on button, the selected output indicators will change color indicating which outputs are energized.

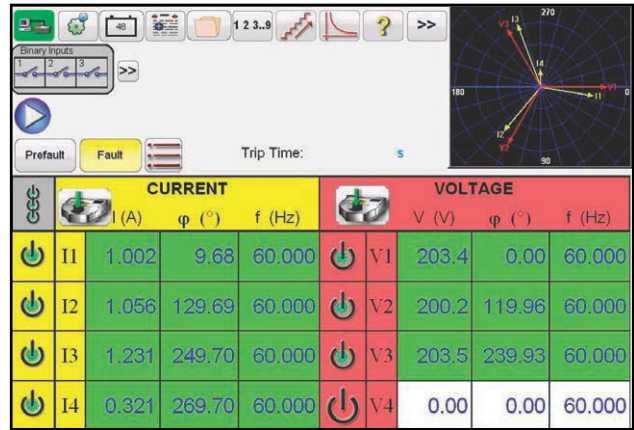


Figure 2. Manual Test Screen – 4 Channel Unit

A vector graph indicates the relative phase angles of all the outputs. The user may select to have all output amplitudes metered to provide real time verification of all of the selected outputs, or have setting values displayed. In the Manual Test Screen the user can set Prefault and Fault values. The user can toggle back and forth between the two values to monitor contact activity. To do a simple timing test the user can set Prefault time duration in seconds, and then press the Blue Play button. The Prefault values will be applied for the Prefault time, then change to the Fault values and start the Timer running. When the relay trips, it will stop the timer, and may turn selected outputs off depending on the user defined Auto-Off configuration.

Auto Ramp, Pulse Ramp and Binary Search Features

The STVI may be used to automatically determine pickup or dropout of various types of relays. Pressing the Auto Ramp button presents three choices; Step Ramp, Pulse Ramp, and Pulse Ramp Binary Search.

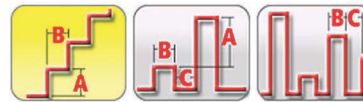


Figure 3. Step Ramp, Pulse Ramp and Pulse Ramp Binary Search Selection Bar

The first selection, Step Ramp, will ramp the output by applying a value and then waiting a specific amount of time before incrementing. For example, to automatically ramp output current the user will select the channel to be ramped, input Start and Stop Amplitudes, an Increment (A), and a Delay time in Cycles (B).

Pulse Ramp will start at user defined prefault condition, increment up or down returning to the prefault condition between each increment. Instead of Delay time the user sets the Pulse Cycles time, which applies the fault value to the relay for the specified time.

The user can select a 2nd, 3rd and 4th ramp if desired, changing the size of the increment with each ramp. This feature is most used when doing instantaneous pickup tests. The output current, or voltage, can be incremented in large steps getting to the pickup point quickly, and then reduce the size of the increment to zero-in

on the pickup value. This reduces the test time, heating of the relay under test, and provides a very accurate test result. This feature is also used when testing multi zone distance relays using three phase voltage and currents. Set the Pulse Cycles duration just long enough for the intended zone to operate. If you are not sure exactly where the pickup value of the relay is, you can use the Pulse Ramp Binary Search feature.

Timing Test Feature

Pressing the Time test button on the top menu bar, the user is presented a menu of relays to test. Built-in timing tests are provided for a wide variety of protective relays, including Overcurrent, Voltage, and Frequency relays. To make it even easier and faster, the STVI has ANSI, IEC, and IEEE Standards time curve algorithms built-in. The STVI also includes time curves and time curve algorithms for hundreds of specific relays. The user can select from a pull-down list of 18 different manufacturers, then select the relay model number, and/or curve shape (inverse, very inverse, definite time etc.). The list includes relay manufacturer’s digitized log-log, and semi-log, electromechanical relay time curves. Therefore, tests are conducted using the manufacturer’s actual time curve. In the following example, the G.E. IAC-51B relay with a 2 Amp Tap and a number 5 Time Dial was selected.

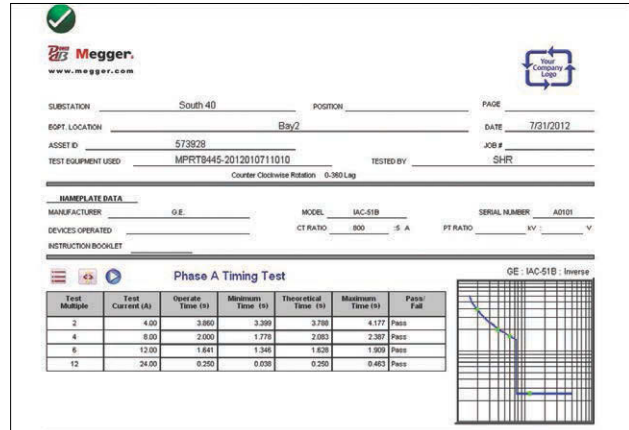


Figure 5. Test Report G.E. IACSIB Timing Test

Note that the software automatically compared the Operating Time to the theoretical and made a Pass/Fail determination based upon the manufacturer’s time curve characteristic. If the recorded test point(s) is out of specification it appears red in color. If it is within specification it will be green in color. This provides excellent visual As Found reporting. If the data is imported into PowerDB reports can be generated that summarize the comments and failures of every test you perform for future NERC requirements.

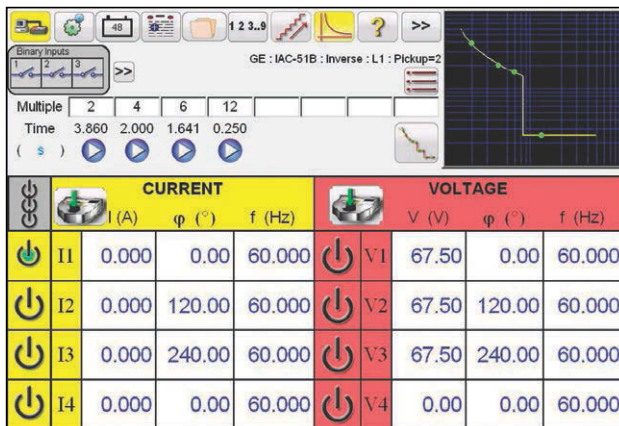


Figure 4. Timing G.E. IACS1B Overcurrent Relay

By entering the appropriate values in the setting screen, when the timing test is conducted, the test results will automatically be plotted and compared to the theoretical values from the relay specific time curve that was selected. Up to eight test points may be selected. If the test Multiple is changed, the appropriate theoretical trip time will change automatically.

View Test Reports

To View the test result, press the Add to Reports button. The user can now enter appropriate information relative to the test in the Test Report header. See the following example report.

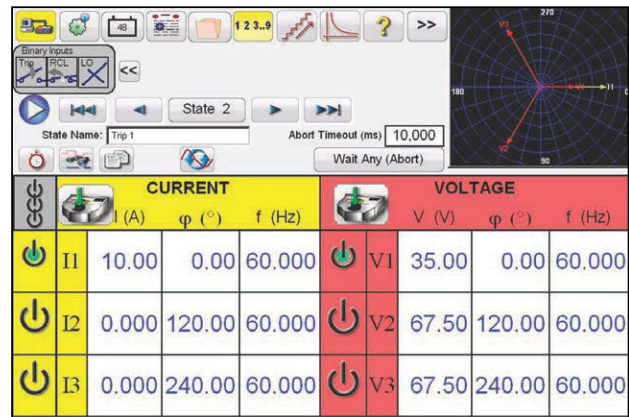


Figure 6. Sequence Test Screen

By default, there are 9 states already labeled as Prefault, Trip1, Reclose 1, etc. up to Lockout in step 9. Therefore, it is initially setup for a four shot trip, reclose to lockout scenario. The user is free to change the labels, or use the default labels. With each state the user may input values of voltage, current, phase angle, frequency and set the Binary Input sensing for each state. Both single pole and three pole trip can be simulated. There are default values and binary settings for a single phase trip and reclose scenario already

programmed in. The user can either use the defaults or change them to suit the application. The Total Time to Lockout is also included in the setting and indicates where the total timer starts and stops. This allows for 1, 2, 3, or 4 shots to lockout including trip and reclose times. The user can set conditional settings such as wait milliseconds, wait cycles, wait any contact (OR), and wait all contacts (AND). The user can set the Binary Outputs to simulate the 52a and/or 52b contacts.

Once all of the Binary Inputs, Outputs, Prefault, Fault and Reclose settings are completed, the user can then press the Preview button to get a visual representation of the voltage and current outputs, as well as a visual of the binary inputs and outputs for each stage of the simulation. The following figure illustrates a sample sequence.

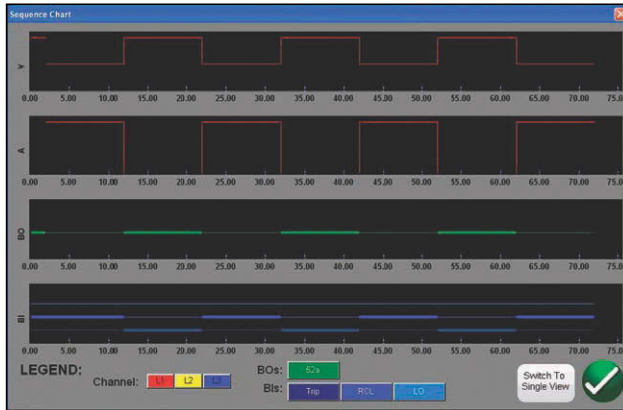


Figure 7. Sample Sequence Voltage, Current, Binary Inputs and Outputs

New Impedance Relay Click-On-Fault

The all new Click-On-Fault (COF) is located as one of the choices under the large More >> button located next to the Help ? button. The new COF provides automatic tests of Impedance (distance) relays. It includes Ramp, Pulse Ramp, Pulse Ramp Binary Search, and Shot test capabilities.

Selection of Relay Operating Characteristics

Select from one the predefined generic relay characteristics of MHO, Half MHO or QUAD (Quadrilateral), or select from the relay specific Library files. The current library includes distance relays from SEL, GE, AREVA, and ABB. There are numerous other library test files which are still being tested and field evaluated. Therefore, as new relay library files become available a new version of the software will be posted to the website for download.

Definition of Operating Characteristic and Tests

There are several new innovations in the new COF that make testing distance relays easier and faster. For example, selecting the Generic MHO characteristic provides the following user input screen.

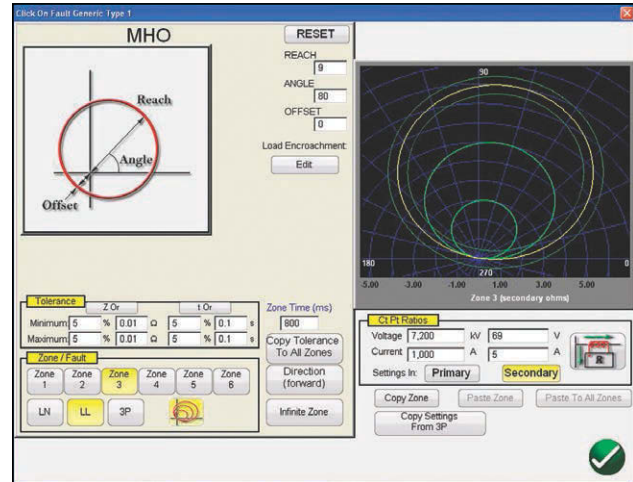


Figure 8. Generic MHO Setting Screen

Here the user selects which Zone (up to 6 zones may be defined), type of fault, direction, tolerance values, inputs the reach, max torque (line) angle, any offset, or load encroachment settings. The software draws the operating characteristic(s) of the relay defined by the user settings. The user may select to view single zone or multiple zones. Pressing the green check button takes the user to the COF test configuration screen, as shown in the following figure.

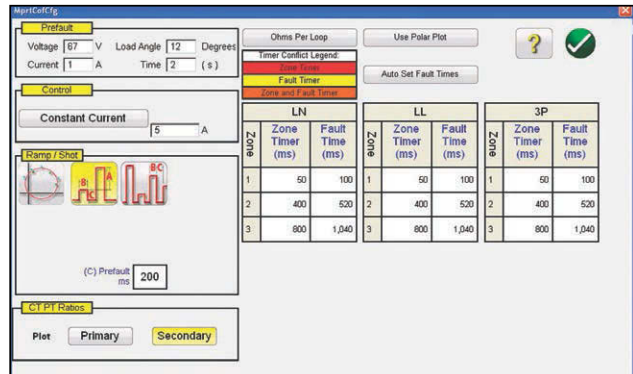


Figure 9. Generic MHO Test Configuration Screen

From this screen the user can select:

Test Method

- Linear Ramp
- Pulse Ramp
- Pulse Ramp Binary Search
- Shot

Test Source Models

- Constant Voltage
- Constant Current
- Constant Source Impedance

Displayed Values

- Primary Values
- Secondary Values

Prefault

- Voltage
- Current
- Load Angle
- Duration Time

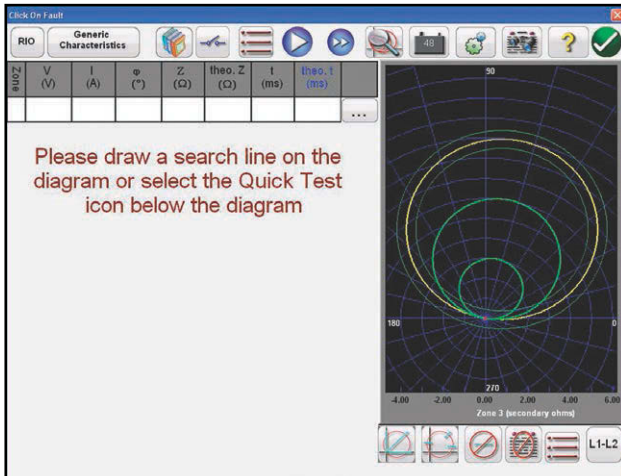


Figure 10. Click on Fault Test Definition Screen

Creating Search Lines or Shot Test Points

The user can define up to 10 search lines or test points per fault type, per zone. Test options include;

The *Independence Test* option provides maximum freedom to the user to select any test line, at any angle, around the operating characteristic to define the desired test line.

The *Origin Test* option the user clicks a point outside the operating characteristic, and the test line will be drawn to the origin or the intercept of the R and X axis.

The *Shots Test Points* option is used to create one or more test points, each to replicate a fault at a particular magnitude and angle. This type of test provides a quick GO, NO/GO test of the relay after a settings change.

The user does not even have to draw the test lines. There are two Quick Test Options the user may select. The first option draws three test lines for any of the selected Quick Test solutions. The second Quick Test the user may select the desired number of test points by pressing the Test Points button and select from the list. If none of the standard phase rotations meets the user’s needs, they can enter the desired phase rotation in the window provided.

IEC 60255 Test Option

To comply with regulations which require testing to the IEC 60255 standard, the IEC 60255 option is also provided. All defined test lines will automatically be drawn perpendicular to the relay operating characteristic.

Prefault Settings

For testing relays which require a prefault load condition, the user can set the prefault load voltages and currents. This is normally used when testing accelerated tripping or dynamic over-reach characteristics.

Performing Tests

The user then simply presses the blue Play button and the test begins. To save even more time the user can select the Play All button and the software will automatically test all define zones and faults in sequence. Based upon the user input the software will calculate all of the fault values and angles for each defined test point, and then make PASS/FAIL determination of the test results.

A real-time test screen will display the relay operating characteristic with the defined test lines in the right half of the screen with the

test vector moving in the impedance plane, and in the left half it will display either the test vectors of voltage and currents being applied in real-time, or it will display the Negative, Positive and Zero Sequence vectors being applied, see the following example.

The above figure is three zone, Pulse Ramp, Phase L1-L2 fault tests being performed. Note the test amplitudes and angles are displayed in the left half, with the test results displayed in the right half.

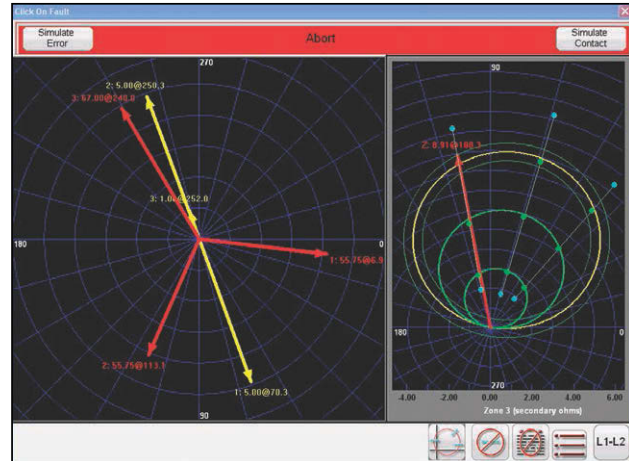


Figure 11. Generic MHO Real-Time Test Screen

FEATURES AND BENEFITS

Large Color TFT LCD touch-screen display - Easy to use and read (even in direct sunlight) display provides manual control of the test set. Color contrasts accentuate vital information. This reduces human error and time in 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 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.

New Higher Output Current – The MPRT8445 provides up to 30 Amps at 200 VA per phase continuous, or up to 45 Amperes at 300 VA with a 1.5 second duty cycle. Four current amplifiers can be paralleled to provide a maximum of 180 Amperes at 1,200 VA for testing all instantaneous overcurrent relays.

New PowerV™ Voltage Amplifier High Power Output – The MPRT8445 provides a new higher VA output on the voltage channel at the lower critical test voltages (from 30 to 150 Volts). Users, who want to test a panel of relays at once, or who have certain older electromechanical impedance relays, find it impossible using lower VA rated voltage.

STVI high resolution and accuracy – Metered outputs and timer provides extremely high accuracy. With metered outputs, what you see is what you get.

Internal memory – This feature provides storage of test set-up screens and test reports, which reduces testing time and paper work.

Steady-State and Dynamic test capability – The MPRT8445 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.

New STVI graphics and intuitive navigation – New test graphics and easier screen navigation saves test time and reduces human error.

Display screen provides four different languages – The display screen prompts the user in English, Spanish, French, or German.

Digital inputs and outputs – 10 programmable inputs, and 6 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 to test reclosing relays.

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 – The MPRT8445 can 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 MPRT8445 performs satellite-synchronized end-to-end dynamic or transient tests. This provides precisely synchronized testing of remotely located complex protection schemes.

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; 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.

Two Ethernet ports – The Ethernet port provides a high-speed computer interface, IEC-61850 test capability, as well as the STVI Power Over Ethernet interface.

USB 2.0 interface port – The USB port provides a PC interface for automated control of the MPRT8445 unit. Also provides secure isolation when testing IEC 61850 devices (for customers who require secure isolation from their IEC 61850 substation bus).

Battery simulator – The battery simulator includes 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 control knob, or through AVTS software.

Immediate 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.

Open communication architecture – Use with third party software for automated control, i.e. National Instruments® LabView™ software.

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

Optional Transducer Testing Capability – This optional hardware feature (see Ordering Information) provides transducer DC Inputs to test transducers easily and effectively. The STVI software is designed to automatically recognize the Transducer DC Inputs, and thus provide the Transducer Test Screen when selected. AVTS software comes standard with Transducer Test Modules, which will provide automatic transducer test capability in conjunction with the optional hardware.

SPECIFICATIONS

Input Power

90 to 264 Volts AC, 1ø, 50/60 Hz, 1800 VA.

Outputs

All outputs are independent from sudden changes in line voltage and frequency. This provides stable outputs not affected by sudden changes in the source. All outputs are regulated so changes in load impedance do not affect the output. Each output (VIGEN) module consists of one voltage amplifier, and a current amplifier. The voltage amplifier may be converted to a current source. Therefore, one amplifier module may be used to test current differential relays, including harmonic restraint.

Output Current Sources

The MPRT8445 with four VIGEN modules can provide up to eight current sources; four high current/high power, 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.

Per Channel Output

Output Current	Power	Max V
1 Ampere	15 VA	15.0 Vrms
4 Amperes	200 VA (282 peak)	50.0 Vrms
15 Amperes	200 VA (282 peak)	13.4 Vrms
30 Amperes	200 VA (282 peak)	6.67 Vrms
45 Amperes	300 VA (424 peak)	6.67 Vrms
DC 200 Watts		

Duty Cycle: 30 Amps Continuous, 45 Amps 1.5 seconds

Three Currents in Parallel:

Output Current	Power	Max V
12 Amperes	600 VA (848 peak)	50.0 Vrms
45 Amperes	600 VA (848 peak)	13.4 Vrms
90 Amperes	600 VA (848 peak)	6.67 Vrms
135 Amperes	900 VA (1272 peak)	6.67 Vrms

Four Currents in Parallel:

Output Current	Power	Max V
16 Amperes	800 VA (1132 peak)	50.0 Vrms
60 Amperes	800 VA (1132 peak)	13.4 Vrms
120 Amperes	800 VA (1132 peak)	6.67 Vrms
180 Amperes	1200 VA (1697 peak)	6.67 Vrms

Two Currents in Series

With two currents in series, the compliance voltage doubles to provide 4.0 Amperes at 100 Volts.

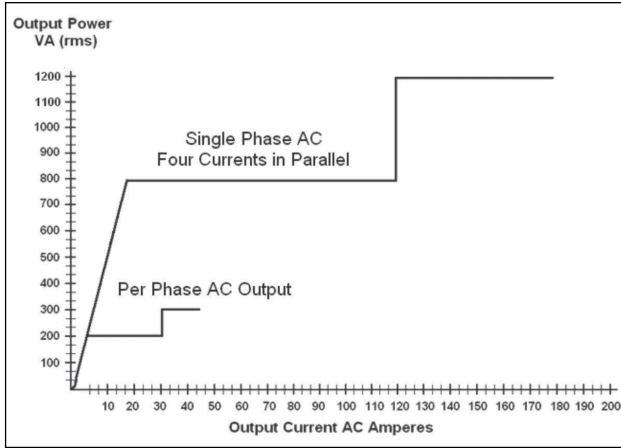


Figure 11 Current Output Power Curve

Current Amplifier - Extended Power Range

The MPRT8445 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 45 Amperes at 300 VA rms for short durations.

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 ²
300 Volts	150 VA	0.5 Amps

DC 150 Watts

Duty Cycle: Continuous

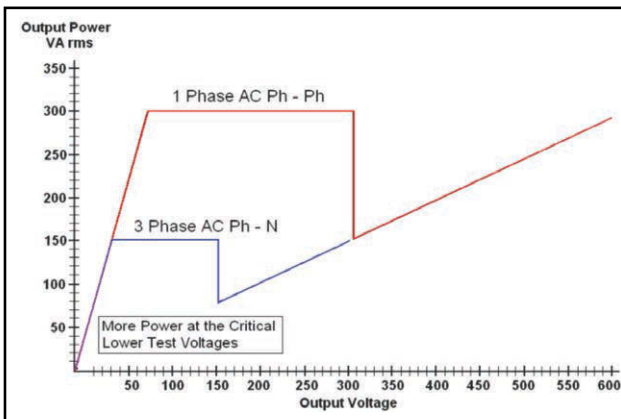


Figure 12 Voltage Output Power Curve

“PowerV™” Voltage Amplifier-Extended Power Range

The MPRT8445 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 AC rms values and peak power ratings.

Output Current	Power	Max V
5 Amperes	150 VA (212 peak)	30.0 Vrms
15 Amperes	120 VA	8.0 Vrms

Duty Cycle: 5 Amps Continuous, 15 Amps 1.5 seconds

Battery Simulator

The battery simulator provides a continuously 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 STVI control knob, or through AVTS software.

Metering

Measured output quantities such as AC Amperes, AC Volts, DC Volts or DC Amperes, and Time may be simultaneously displayed on the STVI. The AC and DC outputs display the approximate voltage/current output prior to initiation. This provides a fast, easy method for preset of outputs. Other values that may be displayed, depending on which test screen is in view, are phase angle, frequency, and Ohms. All accuracies stated are from 10 to 100% of the range at 50/60 Hz.

AC Voltage Amplitude

Accuracy: ±0.05 % reading + 0.02 % range typical, ±0.15 % reading + 0.05 % range maximum

Resolution: .01

Measurements: AC RMS

Ranges: 30, 150, 300V

AC Current Amplitude

Accuracy: ±0.05 % reading + 0.02 % range typical, ±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: ±0.05 % reading + 0.02 % range typical, ±0.15 % reading + 0.05 % range maximum

Resolution: .001/.01

Measurements: RMS

Ranges: 30A

Convertible Source in AC Current Mode

Accuracy: ±0.05 % reading + 0.02 % range typical, ±0.15 % reading + 0.05 % range or ±12.5 mA whichever is greater

Resolution: .001

Measurements: AC RMS

Ranges: 5, 15A

¹ Megger reserves the right to change product specifications at anytime.

² PowerV™ voltage amplifier output current varies depending on the voltage setting on the 150 Volt range, see curve.

DC IN Inputs (optional transducer feature)**DC IN Volts****Range:** 0 to ± 10 V DC**Accuracy:** $\pm 0.001\%$ reading + 0.005% range Typical
 $\pm 0.003\%$ reading + 0.02% range Max**Resolution:** .001**Measurements:** Average**DC IN Amperes****Range:** 0 to ± 1 mA DC4 to ± 20 mA DC**Accuracy:** $\pm 0.001\%$ reading + 0.005% range Typical
 $\pm 0.003\%$ reading + 0.02% range Max**Resolution:** .001**Measurements:** Average**Total Harmonic Distortion**

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

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. ± 2 least significant digit, $\pm 0.005\%$ of reading from 0 to 50° C maximum**Binary Input****Start/Stop/Monitor Gate**

10 inputs 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**

MPRT8445 has 6 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 1 to 4:**AC Rating:** 400 V max., I_{max}: 8 amps, 2000 VA max.**DC Rating:** 300 V max., I_{max}: 8 amps, 80 W**Response Time:** <10ms**High Speed Output Relays 5 and 6:****AC/DC Rating:** 400 V peak, I_{max}: 1 amp**Response Time:** <1ms typical**Waveform Storage**

Each output channel can store waveforms for playback on command. End-to-end playback of stored waveforms is possible, when triggered externally by a GPS receiver. Each channel can store up to 256,000 samples.

Protection

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

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**Dimensions**

17.2 W x 8.75 H x 15.75 D in.

430 W x 218 H x 400 D mm

Weight

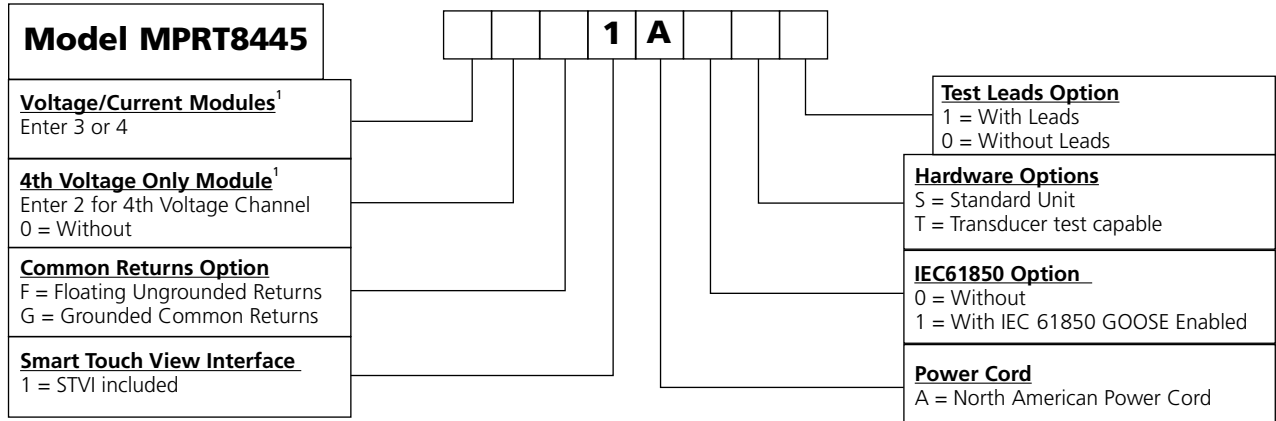
Weight varies depending on the number of output modules in the system. The weight below is for a complete three-phase test system. 31.1 lb. (14 kg) approximate

Conformance Standards**Safety:** EN 61010-1**Shock:** MIL-PRF-28800F (30g/11ms half-sine)**Vibration:** MIL-PRF-28800F (5-500Hz, 2.05 g rms)**Transit Drop:** MIL-PRF-28800F (10 drops, 46 cm)**MPRT8445 in Optional Soft-sided Carry Case****Enclosure and Transit Cases**

The unit comes mounted in a rugged enclosure for field portability. The optional soft-sided carry case protects the unit from light rain and dust. The padded sides provide moderate protection while in transit. An optional hard-sided transit case is also available. The robust design of the optional hard-sided transit case provides protection when transporting the unit over rugged terrain and long distances.

ORDERING INFORMATION

STYLE NUMBER IDENTIFICATION



DESCRIPTION OF SOFTWARE OPTIONS

Included Software	Part Number
AVTS Basic with STVI Application CD	81302
Software Options	
AVTS Basic with IEC 61850 Megger GOOSE Configurator, and STVI Application CD	1002-103
AVTS Advanced with STVI Application CD	81570
AVTS Advanced Test with IEC 61850 Megger GOOSE Configurator, and STVI Application CD	1002-106
AVTS Professional with STVI Application CD	81571
AVTS Professional Test with IEC 61850 Megger GOOSE Configurator, and STVI Application CD	1002-102

Descriptions of Hardware Options

This modular system lets you select the testing capabilities you need now and expand as testing requirements change. Customize the system by adding the number of Voltage-Current amplifier (VIGEN) modules (3 or 4), with optional Voltage-Only (VGEN) module. For example, start with the base unit of 3 VIGEN modules. For more demanding tests, add a VGEN to provide 4 Voltages, 3 Currents simultaneously.

Voltage/Current Module: The MPRT unit can have either 3 or 4 voltage/current modules. Enter the number of desired modules **3**, or **4**.

4th Voltage Only Module¹: The MPRT8445 last slot can host a single Voltage Only Channel for those who need a 4th voltage channel in addition to 3 Voltage/Current modules. Enter the number **2** for this option.

Common Returns Option: Enter **F** for floating returns and **G** for grounded common returns. The floating returns option provides independent, isolated return terminals for each output channel. The G option provides grounded common returns, where return terminals are connected internally to chassis ground.

Smart Touch View Interface: The unit comes with the STVI.

Power Cord Option: The unit comes with a NEMA 5-15 male to female IEC60320 C13 connector, UL & CSA approved.

IEC 61850 Option: The MPRT8445 in conjunction with the Megger GOOSE Configurator (MGC) software can be used in the testing or commissioning of IEC 61850 compliant devices. In order for the MPRT8445 to be able to subscribe as well as publish GOOSE messages, the IEC 61850 feature needs to be enabled. Enter the number **1** for the unit to come with the IEC 61850 option enabled. Enter **0** for the unit without IEC 61850 enabled.








Hardware Options: **S** = Standard unit. **T** = With Transducer test capability enabled.

Test Leads Option: Enter the number **1** for the unit to come with Test Leads. Enter **0** for the unit without Test Leads.

Test Leads and Accessories

All units come with a power cord, an Ethernet communication cable, and instruction manual CD. All other accessories varies depending on the options selected, see the following Table of Accessories.

¹If a 4th Voltage only channel is selected you are limited to a total of 3 VIGENS (Voltage Current Generators)

	Optional Accessories Descriptions	STVI, or Test Leads Options	Three (3) Voltage Current Modules	Four (4) Voltage Current Modules	With VGEN Module
	Accessory Carry Case: Use to carry power cord, Ethernet cable, Optional STVI and test leads.	Qty. 1 ea. Part No. 2001-487			
	Sleeved Pair of Test Leads: Sleeved Test Leads, one red, one black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II		Qty. 2 pr. Part No. 2001-394	Qty. 4 pr. Part No. 2001-394	Qty. 1 pr. Part No. 2001-394
	Cable/Spade Lug Adapter (Small): Small lug fit most new relay small terminal blocks. Lug adapter, red , 4.1 mm, use with test leads up to 1000 V/20 Amps CAT II.		Qty. 14 ea. Part No. 684004	Qty. 18 ea. Part No. 684004	Qty. 1 ea. Part No. 684004
	Lug adapter, black , 4.1 mm, use with test leads up to 1000 V/ 20 Amps CAT II.		Qty. 14 ea. Part No. 684005	Qty. 18 ea. Part No. 684005	Qty. 1 ea. Part No. 684005
	Jumper Lead: Jumper lead, black, 12.5 cm (5") long, use with voltage / current outputs, 600 V, 32 Amps CAT II		Qty. 4 ea. Part No. 2001-573	Qty. 6 ea. Part No. 2001-573	
	Sleeved Combination Voltage Test Leads: Three common leads connect to the test set, which are interconnected to one black common to connect to the relay. Sleeved, three red and black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II		Qty. 1 ea. Part No. 2001-395	Qty. 1 ea. Part No. 2001-395	
	Sleeved Combination Current Test Leads: Three pairs of leads connect to the test set, and to the relay under test. Sleeved, three red and black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II		Qty. 1 ea. Part No. 2001-396	Qty. 1 ea. Part No. 2001-396	

Descriptions of Software

Included Software – Every unit comes with **AVTS Basic**, and the PC version of the **STVI Basic** test software packages

AVTS Basic with STVI Application Software (PC Version) Part Number: 81302

AVTS Basic includes Online Vector, Online Ramp and Online AVTS Basic includes Online Vector, Online Ramp and Online Click-On-Fault controls, with the ability to import, save and execute relay specific test modules. The online tools of Vector and Ramp provide automatic pickup, or dropout tests as well as timing and multi-state dynamic tests. The Online Click-On-Fault tool is used to automatically determine the reach characteristics of single or multi-zone Distance relays using shot for single point tests, or Ramp, Pulse Ramp, or Binary Search tools along user defined search lines. Includes enhanced Relay Test Wizards for; Overcurrent, Differential, Voltage, Frequency and Distance relays.

The powerful STVI screens can be run directly from a PC providing both manual and automatic test capabilities. Intuitive menu screens and buttons are provided to quickly and easily select the desired test function. The Manual Test Screen power-up preset default values maybe automatically set from the user defined configuration screen.

The user can select from a variety of test options including manual control using the cursor up down arrows or use the mouse control wheel to vary outputs. In addition a dynamic sequence test includes trip and reclose up to 9 operations. An automatic ramp, pulse ramp, binary search or pulse ramp binary search is built in to determine pickup or drop out of relay contacts, or perform relay specific timing tests using the Timing Test Screen. A vector graph indicates the relative phase angles of all of the outputs. The user may select to have all output amplitudes metered to provide real time verification of all of the selected outputs, or have setting values displayed. 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 and review whenever needed. Each copy of the PC version of the STVI software is licensed for loading onto one PC.

Additional Optional Software

AVTS Advanced with STVI Application Part Number: 81570

AVTS Advanced includes all of the features of AVTS Basic in addition to the powerful Test Editor and test editor tools, which includes the Dynamic Control (with dynamic end-to-end test capability, and Recorder features) for developing sequential tests for virtually any function or measuring element within digital relays. In addition, it also includes Modbus communications for automatic download of

settings, SS1 File Converter for ASPEN and CAPE dynamic test files, End-to-End DFR Playback test macros and basic programming Tools for creating and editing test modules. Test files created in Advanced Test can be used with AVTS Basic.

AVTS Professional with STVI Application Part Number: 81571

Professional Test includes all of the features of AVTS Advanced Test version plus the following additional specialized test tools. The DFR Waveform Viewer and Playback tools are used for viewing and analyzing IEEE C37.111 COMTRADE Standard files from digital fault recorders and microprocessor based relays. The DFR Waveform Viewer includes tools to recreate the analog and digital channels for playback into protective relays for troubleshooting or evaluation. It includes the capability to extend the pre-fault data as well as start the timer associated with the event to time relay operation. These playback test files can also be used in end-to-end tests to recreate the transient event and evaluate the protection scheme. Test files created in Professional can be used with Advanced Test and Basic. Also included is the One-Touch Test Editor Control Tool for fully automatic testing of microprocessor based relays using VB script files to automatically download relay settings, and automatically test all the measuring elements within the relay based upon those settings. The Waveform Digitizer feature is also included in the Professional Test version of AVTS. It provides tools to create digital time curves for virtually any electromechanical relay time curve (that do not fit a time curve algorithm). It can even be used for digitizing scanned waveforms from a light-beam chart recorder.

IEC 61850 Megger GOOSE Configurator Software (See Table for Part Numbers)

The Megger GOOSE Configurator (MGC) provides easy to use tools for testing relays and substations using the IEC 61850 protocol. It is an optional software tool available with Basic, Advanced or Professional versions of AVTS Software; see Descriptions of Software Options above. The configurator provides relay test engineers and technicians the capability to import parameters from configuration files in the Substation Configuration Language (SCL) format, and/or capture GOOSE messages directly from the substation bus. All imported GOOSE messages will be unconfirmed messages. Only captured messages are confirmed messages due to the Capture feature of the MGC. Use the MGC Merge feature to compare imported SCL and captured GOOSE messages to verify all GOOSE messages needed to perform tests. Use them to configure the MPRT to subscribe to preselected GOOSE messages by assigning the data attributes to the appropriate binary inputs of the MPRT. Use the configurator to assign the appropriate binary outputs of the MPRT to publish GOOSE messages simulating circuit breaker status. After the appropriate assignments of binary inputs and outputs have been made, the test file can be saved for reuse. This provides both manual and automatic testing of the relay using either the STVI or AVTS software. Use standard test modules in AVTS to perform automatic tests. Use the Dynamic Control in AVTS Advanced or Professional to perform high speed trip and reclose tests, or use to perform interoperability high-speed shared I/O tests between multiple IED's. The MGC provides mappings of Boolean and Bit Strings and/or simulation of STRuct, Integer/Unsigned, Float and UTC datasets.

Included Standard Accessories

Description	Part Number
Line cord, North American Power Cord	620000
Rugged Ethernet cable for interconnection to PC, 210cm (7 ft.) long (Qty. 1 ea)	90003-684
Instruction manual CD	82178



Deluxe Test Leads and Accessories Kit

Deluxe Test Leads and Accessories Kit	1001-619
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The Test Leads and Test Lead Accessories are an option. Test leads and accessories can be ordered with the unit, or later as a kit. The Deluxe Test Leads and Accessories Kit includes sleeved pairs of leads for use with the extra binary inputs/outputs/battery simulator option, as well as the three phase sleeved combination leads for voltage and current channels. The following test leads and test lead accessories are included in the Deluxe Test Leads and Accessories Kit in quantities shown.

Description	Part No.
Sleeved Combination Voltage Test Leads: Keeps the test leads from getting entangled. Sleeved Three Phase Test Leads, three red and black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II (Qty. 1 ea)	2001-395
Sleeved Combination Current Test Leads: Keeps the test leads from getting entangled. Sleeved Three Phase Test Leads, three red and black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II (Qty. 1 ea)	2001-396
Sleeved Pair Test Leads, one red, one black, 200 cm (78.7") long, 600 V, 32 Amperes CAT II, (Qty. 5 pair)	2001-394
Jumper lead, black, 12.5 cm (5") long, use with voltage / current outputs, 600 V, 32 Amps CAT II (Qty. 4 ea.)	2001-573
Cable/Spade Lug Adapter (Small): Small lug fits most new relay small terminal blocks. Lug adapter, red, 4.1 mm, use with test leads up to 1000 V/ 20 Amps CAT II (Qty. 15 ea.)	684004
Lug adapter, black, 4.1 mm, use with test leads up to 1000 V / 20 Amps CAT II (Qty. 15 ea.)	684005
Accessory Case, black, used to carry test leads and/or STVI (Qty. 1 ea.)	2001-487

Additional Accessories (Not Included in the MPRT8445 Test Leads Option or Deluxe Lead Kit)

Individual (non-sleeved) Test Leads: Excellent for widely separated individual terminal test connections.	
	
Test lead, red, use with voltage/current output, or binary I/O, 200 cm long (78.7") 600 V/32 Amps CAT II.	620143
Test lead, black, use with voltage/current output, or binary I/O, 200 cm long (78.7") 600 V/32 Amps CAT II.	620144
Individual (non-sleeved) Extra Long Test Leads: Excellent for widely separated individual terminal test connections.	
	
Extra long test lead, black, use with voltage/current output, or binary I/O, 360 cm long (12 ft) 600 V/32 Amps CAT II.	2003-172
Extra long test lead, red, use with voltage/current output, or binary I/O, 360 cm long (12 ft) 600 V/32 Amps CAT II.	2003-173

Description	Part No.
Cable/Spade Lug Adapter (Large): Large spade lug fits older relay terminal blocks, or STATES® Company FTP10 or FTP14 Test paddles, ABB or General Electric test plugs with screw down terminals.	
Lug adapter, red , 6.2 mm, use with test leads up to 1000 V/20 Amps CAT II.	684002
Lug adapter, black , 6.2 mm, use with test leads up to 1000 V/20 Amps CAT II.	684003
Alligator/Crocodile Clip: Excellent for test connections to terminal screws and pins where spade lugs cannot be used.	
Alligator clip, red , use with test leads up to 1000 V/32 Amps CAT III.	684006
Alligator clip, black , use with test leads up to 1000 V/32 Amps CAT III.	684007
Flexible Test Lead Adapter: Use with rail-mounted terminals or screw clamp connections where spade lugs and crocodile/alligator clips cannot be used.	
Flexible test lead adapter, black , 1.8 mm male pin, use with test leads up to 1000 V/32 Amps CAT III.	90001-845
Flexible Test Lead Adapter with Retractable Insulated Sleeve: Use for connection to old style non-safety sockets with retractable protective sleeve on one end.	
Retractable sleeve test lead, red , 50 cm (20") long, use with test leads up to 600 V, 32 Amperes CAT II.	90001-843
Retractable sleeve test lead, black , 50 cm (20") long, use with test leads up to 600 V, 32 Amperes CAT II.	90001-844
In-Line Fused Test Lead: Use with high speed binary outputs 5 or 6 ("P" Option) to protect for accidental switching of currents higher than 1 Amp.	
Test lead, blue , in-line 500 mA fuse protection, 200 cm long (78.7").	568026
In-Line Fused Test Lead: Use with ("P" Option) Battery Simulator output to protect for accidental connection to substation battery.	
Test lead, black , in-line 3.15 A fuse protection, 200 cm long (78.7").	568025

Description	Part No.
In-Line Resistor Test Lead: Use with old solid state relays with "leaky" SCR trip gates.	
Test lead, red , in-line 100 k Ohm resistor, use with test leads up to 1000 V/32 Amps CAT III.	500395
STATES 10 Pole Test Paddle: Use with STATES FMS 10 Pole Test Switch or ABB FT-1 10 Pole Test Switch.	
Test paddle features knobs which also serve as insulated Ø 4 mm rigid socket accepting spring loaded Ø 4 mm plugs with rigged insulating sleeve, or retractable sleeve. Use with test leads up to 600 V, 32 Amperes CATII.	V1TP10
STATES 10 Pole Test Paddle Attachment: Use with STATES V1TP10 Test Paddle.	
Test paddle attachment provides an additional 10 insulated connection points for front connection, as well as the standard top connections for test leads. Adapter can provide convenient parallel test connections of test currents to two terminals at one time. Use with test leads up to 600 V, 32 Amperes CAT II.	TPA10
Transit Cases	
Soft-Sided Transit Case: The soft-sided carry case protects the unit from light rain and dust. The padded sides provide moderate protection while in transit. Includes custom designed foam inserts for the MPRT8445 unit, STVI and accessories. Padded soft-sided transit case (1ea).	90003-837
Hard-Sided Transit Case: Includes custom designed foam insert for the MPRT8445, the STVI, and accessories. Transit case includes retractable handle, polyurethane wheels, double-throw latches, fold-down handles, with O-ring seal making the case water-tight, with an IP 67 rating. With a three channel MPRT8445 it is small and light enough to check as luggage on commercial airliners.	1002-855