

USER GUIDE

SMRT1B

Single phase relay tester

with STVI and battery power options installed

Megger[®]



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For Patent information about this instrument refer to the following web site: megger.com/patent

Revision History

<u>Revision</u>	<u>ECN #</u>	<u>Date</u>
1	34635	9/10/2025

Declaration of Conformity

Hereby, Megger Instruments Limited declares that the SMRT1B, manufactured by Megger Instruments Limited described in this user guide, is in compliance with Directive 2014/53/EU. The full text of Megger Instruments EU declarations of conformity is available at the following internet address:

[Megger.com/Company/About-Us/Legal/EU declarations of conformity](http://Megger.com/Company/About-Us/Legal/EU%20declarations%20of%20conformity)

Table of Contents

Section	Page
© 2025.....	2
Revision History	3
1.0 Introduction	5
1.1 Product description	5
1.2 Features	5
1.3 Applications	6
1.4 Megger web site	6
2.0 Safety Warnings and Standards	7
2.1 Warnings, Cautions and Notes	7
2.2 Additional Safety Warnings	8
1.0 Operation	9
1.1 General Description	9
1.1.1 Top Panel.....	9
1.2 Input Power	10
1.2.1. Input Power Cord	10
1.2.2. Battery Power	11
1.2.3. Installing Batteries.....	11
1.3 Voltage Current Generator (VIGEN) Module	12
1.3.1. Convertible Voltage/Current Amplifier.....	12
1.3.2. Current Amplifier	12
1.4 Binary Input and Output	13
1.4.1 Binary Input.....	13
1.4.1.1 Start, Stop, and Monitor Gates.....	13
1.4.1.1.1 Dry Contacts Open	13
1.4.1.1.2 Dry Contacts Close.....	13
1.4.1.1.3 Application or Removal of AC or DC voltage.....	14
1.4.2 Binary Output.....	14
2.0 SETUP	14
2.1 Unpack System	14
2.2 Communication Ports	14
2.2.1 USB 3.0 Interface.....	15
2.2.2 PC IN Ethernet Port	15
2.2.2.1 Setting SMRT IP Address for Operation with a PC	15
2.2.3 Ethernet PC OUT Port	16
2.2.4 IEC61850 /PC OUT Ethernet Port	16
2.2.4.1 Setting SMRT IP Address for Networks or IEC 61850 Operations	17
3.0 Current Sources	17
3.1 Currents in Parallel Operation	17
3.1.1 Manual Test Screen - Single Phase Up To180 Ampere	18
3.2 Currents in Series Operation	18
4.0 Voltage Sources	19
4.1 Outputs Summed Together	19
4.2 3Ø, 3-Wire, Open-Delta	20
4.2.1 Balanced Open Delta.....	20
5.0 Warranty Statement	21
5.1 Preventive Maintenance	21
5.1.1 Examine the Unit.....	21
5.1.2 Updating SMRT1D Firmware	21
5.2 Service and Repair Instructions	22
5.2.1 Basic Troubleshooting	22
5.2.1.1 Power Input	22
5.2.1.2 VIGEN Input Power, Communication and Control	23
6.0 Preparation for Reshipment	24

1.0 Introduction

This user guide contains information regarding the correct use and safe handling of the SMRT1B. This user guide is on-board the STVI (Smart Touch View Interface), and can be quickly referred to by pressing the “?” Help button located on the main screen. Please read the section ‘Safety Precautions’. This section contains information regarding your personal safety when using the SMRT1B.

1.1 Product description

The Megger Model SMRT1B is a next generation, state-of-the-art, portable battery/line operated multifunction instrument, with the “smart” combination of high compliance voltage and high current to test both electromechanical and microprocessor based relays. This includes voltage controlled, voltage restraint and directional overcurrent, under/over voltage, single-phase impedance, single-phase power, directional, synchronising, auto-synchronising, negative sequence under/overvoltage, current balance, frequency, volts/hertz, reclosing, thermal, and various other relays.

The SMRT1B test system can be manually controlled with Megger’s Smart Touch View Interface™ (STVI), or as an option with the Integrated on-board STVI display. 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 pre-set test routines for most popular relays. The standalone STVI and the optional on-board display eliminates the need for a computer when testing almost any type of relay. Menu screens and touch screen function buttons are provided to select the desired test function quickly and easily. Tests results can be saved to the STVI’s, or on-board display’s, internal memory for later download to a USB Thumb drive to transfer or print test reports. For fully automatic testing every SMRT unit is supplied with Relay Testing Management Software (RTMS) for installing on a PC.

1.2 Features

- Battery or line operated.
- Rugged, ergonomic and light plastic enclosure.
- **Constant power output** – The current amplifier delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically under load. This ensures better test results and saves time by not having to turn the outputs off to change ranges. Constant power output in many cases, eliminates the need to parallel or series current channels together to test high burden relays.
- **High output current** – Provides up to 32 A at 200 VA per phase continuous for timing tests and can provide up to 60 A at 300 VA for testing instantaneous overcurrent relays.
- **PowerV™ voltage amplifier high power output** – The SMRT1B voltage amplifier provides high VA output on the voltage channel at low critical test voltages (from 30 to 150 V). Users who want to test a panel of relays at the same time, or certain older electromechanical impedance relays, find it impossible using lower VA rated voltage amplifiers. The high burden voltage option in the SMRT, when enabled allows the unit to output up to 1 A at 300 V.
- **Convertible voltage channel** – Provides a second current source for testing single phase current differential relays, including harmonic restraint transformer differential relays. Paralleled with the main current channel to increase output current to 37 A continuous, and up to 75 A for a short time.
- **Simultaneously High resolution and accuracy** – Metered outputs provides 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.

- **Steady-state and dynamic testing capability** – The SMRT1B provides, either through manual control or computer control, both steady-state and dynamic testing of protective relays. This includes programmable waveforms with 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 input and output** – The programmable binary input, and programmable output provide timing and logic operations in real-time with the output voltage and currents. The binary input can be programmed, using Boolean logic, for more complex power system simulations.
- **Circuit breaker simulator** – Binary output provide programmable normally closed or 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/IEC 60255-24, COMTRADE Standard format.
- **Perform end-to-end tests** – Using the RTMS Sequencer test; with a Megger MGTR GPS satellite receiver (or suitable IRIG-B time code source input into Binary Input #1), the SMRT1B performs satellitesynchronised end-to-end tests.
- **Wide-ranging output frequency** – The output frequency of the current and voltage outputs can be set for any frequency from DC to 1kHz. 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.

1.3 Applications

The current channel is rated for 32 A at 200 VA continuous and up to 60 A at 300 VA for short durations. It has a unique flat power curve from 4 to 32 A that always ensure maximum compliance voltage to the load. With a high compliance voltage of 50 V, the SMRT1/1D has the capability to test high impedance overcurrent relays.

The voltage channel can provide a variable output of 0 - 30/150/300 V at 150 VA of output power and has a unique flat power curve from 30 to 150 V, always ensuring maximum output power to the load. With the voltage channel converted to current, it can perform minimum operating point, slope, and timing on current differential relays, including harmonic restraint transformer differential relays (which can be tested one phase at a time).

It is also designed to operate in conjunction with other SMRT family units. Using the Ethernet ports, SMRT1/1D is literally a “plug-and-play” unit, where voltage and current outputs can be seamlessly synchronized with other SMRT unit’s voltage and current outputs for testing more complex relays such as three-phase directional power, distance, and loss of excitation, with up to 30 phase currents for testing bus differential schemes.

1.4 Megger web site

Occasionally an information bulletin may be issued via the Megger web site. This may concern new accessories, new usage instructions or a software/firmware update. Please occasionally check on the Megger web site for anything applicable to your SMRT1B.

www.megger.com









2.0 **Safety Warnings and Standards**

This instrument has been designed for operator safety; however, no design can completely protect against incorrect use. This instrument must be operated, used and serviced **ONLY** by trained, qualified personnel. Misuse of electrical instruments can result in personal injury and damage to the apparatus under test. **Obey all applicable safety rules and regulations at all times.** Electrical circuits are dangerous and **can be lethal** when lack of caution and poor safety practices are used. There are several standard safety precautions that should be taken by the operator.

2.1 **Warnings, Cautions and Notes**

Where applicable, internationally recognized defined IEC safety markings have been placed in the user guide, and on the instrument, to notify the operator to refer for instructions on correct use or safety related topics. Refer to the following descriptions and table of symbols.

Descriptions
DANGER: Indicates a dangerous situation, which could cause serious injury or death
WARNING: Indicates a potentially dangerous situation, which could cause serious injury or death
CAUTION: Indicates a situation which could lead to damage of the equipment or environment
NOTE: Indicates important instructions to perform the relevant process safely and efficiently
APPLICATION NOTE: Indicates a possible application of the instrument

Symbol	Description
	Direct Current
	Alternating Current
	Both direct and alternating current
	Earth (Safety Ground) Terminal. This terminal must be connected to an earth ground before making other connections to the instrument and prior to operating it.
	EU conformity. Equipment complies with current EU directives.
	The crossed out wheeled waste bin placed on Megger products is a reminder not to dispose of the product at the end of its life with general waste.
	Warning/Caution, risk of electric shock. Indicates that high voltage is present on the terminal. Use extreme caution.
	Warning/Caution, this symbol indicates that the operator of the instrument must refer to the user guide for further explanation and clarification.



WARNING: Under no circumstances should the operator or technician attempt to open or service any Megger instrument while connected to a power source. Lethal voltages are present and may cause serious injury or death!



Additional Safety Warnings

The following are some additional safety related items associated with the SMRT1B.

- The instrument must only be used by suitably trained and competent persons.
- Read and understand all safety precautions and operation instructions before attempting to use this instrument.
- The purpose of this equipment is limited to use as described in this user guide. Should a situation arise that is not covered in the general or specific safety precautions please contact Megger regional representative or Megger, Dallas Texas.
- Safety is the responsibility of the user. Misuse of this equipment can be extremely dangerous.
- Always start with the power OFF, before connecting the power cord or inserting the batteries. Make sure to connect the earth ground terminal to a suitable earth ground before attempting to make test connections.
- **DO NOT** attempt to use the unit without a safety ground connected.
- If using the power cord, **DO NOT** attempt to use the unit if the power cord ground prong is broken or missing.
- Always use properly insulated test leads. **DO NOT** use cracked or broken test leads.
- Always turn the test system off before disconnecting the power cord, or disconnecting the batteries.
- **DO NOT** use the SMRT1B in an explosive atmosphere.
- Observe all safety warnings marked on the equipment and in the user guide.
- For safety related or other important topics in this user guide, like the statement below, will be notated with the adjoined symbol. Read the topic carefully as it may relate either to the safe operation of the instrument or the safety of the operator.



Under no circumstances should the operator put their hand or tools inside the instrument chassis area with the instrument connected to a power source. Lethal voltages are present and may cause serious injury or death!

1.0 Operation

The unit's design is a "modular" concept. All inputs and outputs are clearly marked and logically grouped so continual reference to the user guide should not be necessary once the operator is acquainted with the test system.

1.1 General Description

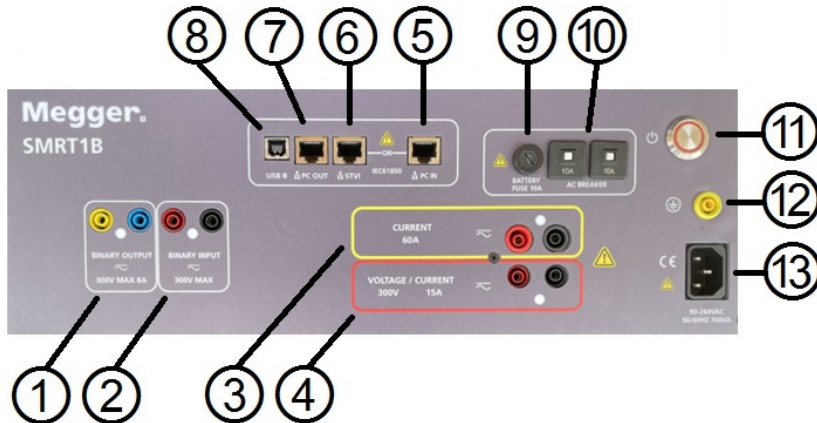



Figure 1 SMRT1B Top Panel

1.1.1 Top Panel

1. **Binary Output** ① – the Binary Output can be configured as Normally Open or Normally Closed contacts providing logic to the device under test. The Binary Output can switch up to 300 VAC or 250 VDC with 8 Ampere continuous. The programmable wait duration is from 1 millisecond to 10,000 milliseconds.
2. **Binary Input** ② –The Binary Input will accept a voltage range of 5 to 300 VAC, or 5 to 250 VDC, or dry Normally Open / Normally Closed contacts. The binary input voltage threshold is programmable from 2 to 150 volts AC/DC. For **GPS End-to-End synchronized relay testing** the **Binary Input** may be connected with a remote trigger pulse from a GPS satellite receiver for external initiation, or the input of an **IRIG-B** signal (see use of **Wait IRIG-B** input using the RTMS Sequencer test). The Binary Inputs will accept a voltage range of 5 to 300 VAC, or 5 to 250 VDC, or dry Normally Open / Normally Closed contacts.
3. **Current Channel Output** ③ – For more details on the VIGEN output capabilities see section 1.3.
4. **Voltage Channel Output** ④ – For more details on the VIGEN output capabilities see section 1.3.
5. ⑤ **PC IN** Ethernet Port is a 10/100BaseTX port, and is the primary PC connection port. This port supports MDI/MDI-X auto cross over configuration, which means both standard and “crossover” Ethernet cables may be used. This port provides the optimal method for downloading EMTP files, DFR streaming, and updating the unit’s firmware as required. This port may also be used for connecting to the IEC 61850 substation bus for use in testing IEC 61850 devices. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”.
6. ⑥ **STVI** Interface – This Ethernet port is used to connect to the optional STVI (Smart Touch View Interface) controller, when installed in the enclosure lid. It can also be used to connect the STVI-10 hand held controller. The STVI interface port is a POE (Power Over Ethernet)

port, which provides power to the STVI. The STVI includes two USB Type A ports to update the firmware in the SMRT as well as update the RTMS software using a USB memory stick. It may also be used to download test results from the SMRT for download into another PC with Power DB software for storage or printing. See the datasheet for the STVI for more information.

7. ⑦ **PC OUT** Ethernet Port is a 10/100BaseTX port, and is primarily used to interconnect multiple SMRT units together for synchronous multi-unit operation. It is also be used to provide access to the substation IEC 61850 network. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”. With the PC connected to the PC Port, the SMRT and the PC share the same Ethernet network connection, and thus will not have a secure isolation from each other. When testing IEC 61850 devices connect the PC to the ISOLATED Ethernet port to isolate the PC from the IEC 61850 substation bus.
8. ⑧ **USB** Interface - USB Interface requires a Type B “downstream” connector, and is primarily used as a communication and control port when used with a PC and Megger software for automated relay testing.
9. ⑨ **BATTERY FUSE 10A**- Used to protect the unit when using battery power.
10. ⑩ **AC BREAKER**- Resettable breakers used when powering the unit from a standard AC power source.
11. ⑪ **POWER ON/OFF Switch** – used to switch unit on and off. The red ring will glow when the unit is on.
12. ⑫ **Earth Ground Jack**– use this terminal to connect chassis ground to earth ground.
 A chassis ground (earth) point on the front panel is provided as an additional safety ground.
13. ⑬ **Incoming Power / Line Cord** – the input line cord, ground terminal, are mounted on the top panel of the test set.

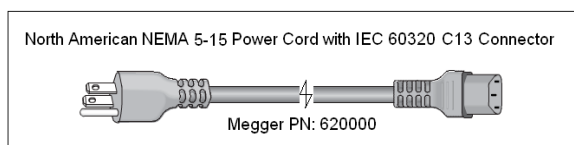
1.2 Input Power

The SMRT1B can be powered from a standard AC voltage source, or from the optional DC battery source. The input voltage rating is from 90 - 264 VAC, 50/60 Hertz. The maximum input power is 700VA. The input is protected by a resettable circuit breaker. The battery source is protected using fuses.

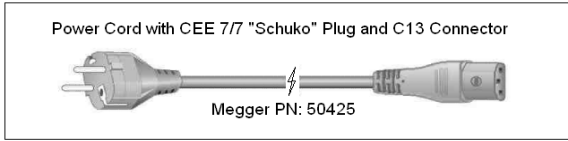
1.2.1. Input Power Cord

Depending on the country, the power cord can come with a NEMA 5-15 male connector, a CEE 7/7 Schuko two prong connector, with International Color-Coded pig-tail wires (light blue, brown and green with yellow stripe) with the insulation jacket stripped ready for installation of the appropriate male connector, or with UK power cord.

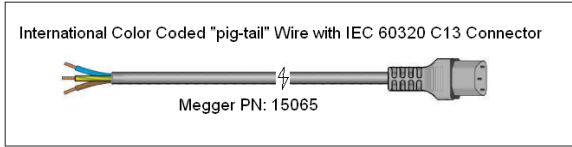
Model SMRT1 XXXAXBX comes with a North American power cord (part number 620000).



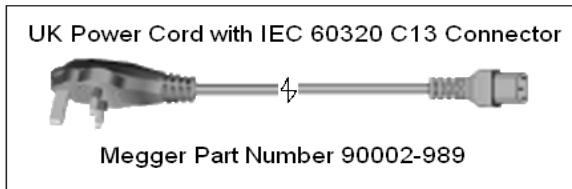
Model SMRT1 XXXEXBX comes with a Continental Europe power cord (part number 50425).



Model SMRT1 XXXIXBX comes with an International Color Code power cord. The cord, part number 15065, is ready for wiring to the appropriate plug (depending on country). The following colors apply, Brown = Line, Blue = Neutral and Green/Yellow = Ground.



Model SMRT1 XXXUXBX comes with a UK power cord (part number 90002-989).



1.2.2. Battery Power

The SMRT1B can be powered using two DeWALT **Flexvolt® 20/60V Lithium 9.0Ah**, or equivalent, batteries, Dewalt part number DCB609. Batteries, and battery charger, are not included with the SMRT1B and must be purchased separately.



Always ensure that the battery is properly and fully charged before using the instrument in the battery operation mode. The DeWALT 8 Amp fast charger is recommended for charging the batteries, part number DCB118. Recharge only with the chargers specified by DeWALT.



Note and follow all DeWALT battery safety, use and care instructions.

1.2.3. Installing Batteries

The batteries are installed in the SMRT1B compartment shown below. Simply slide each battery into the appropriate fixture until its "locked" into position. The battery's state of charge is indicated by the LED indicators. To remove the battery, insure the unit is powered off, press the battery release button, and slide the battery out.

Slide the batteries into the connectors shown below



Batteries properly installed into connectors

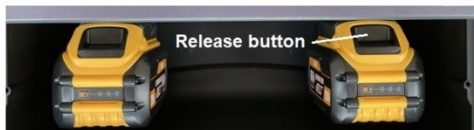


Figure 2 Battery Compartment

1.3 Voltage - Current Generator (VIGEN) Module

Voltages and Currents are noted by the red and yellow boxes surrounding each output channel. The voltage channel is denoted by the red color box. The current channel is denoted by the yellow color box. 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. Standard amplifier outputs are isolated or floating.

1.3.1. Convertible Voltage/Current Amplifier

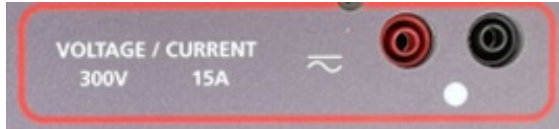


Figure 3 SMRT1B Voltage Channel

The SMRT PowerV™ 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 Range	Power / Current (Max)
30.00V	150VA @ 5.0A
150.00V	150VA Constant Output Power from 30 to 150 Volts
300.00V	150VA @ 0.5A

Voltage Amplifier in Current Mode:

The SMRT1B 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	1.5 sec.

When the voltage generators are converted to current generators, they will change on the STVI display as current phases 4 and 5.

! The voltage amplifier output is protected from short circuits and thermally protected against prolonged overloads. In case of a short circuit or a thermal overload, the amplifier will automatically turn off, and a message to the user will be displayed indicating which condition exists.

1.3.2. Current Amplifier

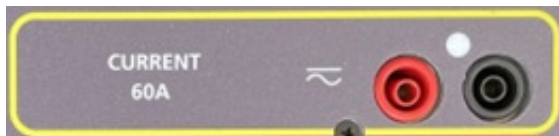


Figure 4 SMRT1B Current Channel

The SMRT current amplifier Constant Power Output feature delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically, on-the-fly, under load. This ensures better test results, saves time by not having to turn the outputs off to change output taps or ranges, and unlike single range current amplifiers ensures a higher compliance voltage at lower test currents. Constant Power Output in many cases eliminates the need to parallel or series current channels together to test high burden relays.

The following are typical output current and associated available compliance voltage values for the SMRT1B Current channel. The per channel output current and power ratings are specified in AC rms values and peak power ratings. Specified duty cycles are based upon typical room ambient temperature.

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
32 Amperes	200 VA (282 peak)	6.25 Vrms 15 minutes
60 Amperes	300 VA (424 peak)	5.00 Vrms 1.5 sec
DC 200 Watts		

! The current amplifier output is protected from open circuits and thermally protected against prolonged overloads. In case of an open circuit or a thermal overload, the amplifier will automatically turn off, and a message to the user will be displayed indicating which condition exists.

1.4 Binary Input and Output



Figure 5 Binary Input and Output terminals

The Binary Input and Output terminals are clearly marked and logically grouped. The Binary Input is used to monitor relay trip contacts for performing pickup and dropout tests as well as for performing timing functions. The Binary Output contacts are used to simulate normally open / normally closed contacts for testing breaker failure schemes, or similar power system operations. In addition, they may also be used to switch AC/DC voltages and currents.

1.4.1 Binary Input

The binary input is specifically designed to measure high speed operation of electro-mechanical, solid-state and microprocessor-based protection relays. The binary Input defaults to Monitor Mode, Contact change of state, latched OFF.

If using the STVI or RTMS software to change a binary input from Contact change of state to Voltage Applied / Removed click on or touch the Input Type window and a sine wave will appear where the Contact icon was indicating. The input is now set for voltage sensing.

To change the binary input from Monitor mode to Timer Mode, click on or touch the Use as Monitor button and the display window will change to show Use as Trip, Latched, meaning the binary input is now set to stop the timer upon sensing the first contact closure (if the Input Type is set for contact) or upon sensing voltage if the Input Type is set to Voltage Sensing.

1.4.1.1 Start, Stop, and Monitor Gates

In the SMRT1B there is an independent, programmable gate circuit that permits simple selection of the desired mode for timing or contact monitoring operation.

To monitor operation of the contacts or trip SCR in the device under test, a light is provided for the gate. The gate circuit is isolated for voltage-sensing and can monitor solid-state logic signals. The light will illuminate once contacts close or voltage is applied to the gate.

1.4.1.1.1 Dry Contacts Open

Timer stops or a continuity indicator goes out at the opening of normally closed contacts, or when conduction through a semiconductor device, such as a triac or a transistor, is interrupted.

1.4.1.1.2 Dry Contacts Close

Timer stops or a continuity indicator glows at the closing of the normally open contacts, or upon conduction through a semiconductor device such as a triac or a transistor.

1.4.1.1.3 Application or Removal of AC or DC voltage

This will either start the Timer or stop the Timer. The continuity indicator will glow (application) or darkens (removal) upon the application or removal of either an AC or DC voltage. For typical test applications binary input 1 has a programmable voltage threshold from 2 to 150 volts. The allowable voltage applied is 5 to 300 Volts AC or 5 to 300 Volts DC, current limiting resistor provide protection.

1.4.1.1.4 The Timer can be started when turning on any selected generators.

1.4.1.1.5 The Timer can be started simultaneously with a change in Frequency, Phase Angle, or Amplitude. Also, it can be started simultaneously with a Voltage or Current waveform step.

1.4.2 Binary Output

Binary Output 1 is located on the top panel, rated for 300 V at 8 Amperes. The Binary Output can be configured as normally open or normally closed contacts providing logic to the device under test. Binary Output 1 has a rating of 300 V AC/DC, 8 amperes and a maximum of 2000 VA breaking capacity (80 watts DC), with a response time of less than 10ms.

The contacts may be programmed to open or close, thus simulating circuit breaker operation. The programmable wait duration is from 1 millisecond to 10,000 milliseconds.

2.0 SETUP

2.1 Unpack System

Unpack the unit and check for evidence of any shipping damage. If there is any visual damage, immediately notify the freight carrier to make a damage claim, and notify Megger of the damage.



CAUTION:

Potentially lethal voltages may be present on the output terminals. It is highly recommended the operator read the user manual thoroughly and have an understanding of the test set operation prior to turning power on.

2.1.1 Initial Start Up

1. With the Ethernet cable supplied with the unit connect the **IN** Ethernet Port on the SMRT unit to the Ethernet port on the PC Ethernet port. If using the optional STVI mounted in the lid, connect the short Ethernet cable provided from the STVI port to the Ethernet port on the STVI.
2. Plug the unit line cord into an appropriate power source, or insert batteries, and turn the POWER ON/OFF Switch to ON (I). As the SMRT unit goes through its power up sequence, in about a minute the optional STVI power up screen will appear, then the manual start-up screen will appear.

2.2 Communication Ports

There are several communication ports. These ports are: three Ethernet, and one USB. The optional STVI has one Ethernet port, and two USB Type A ports.

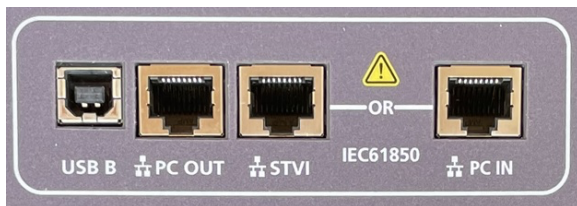

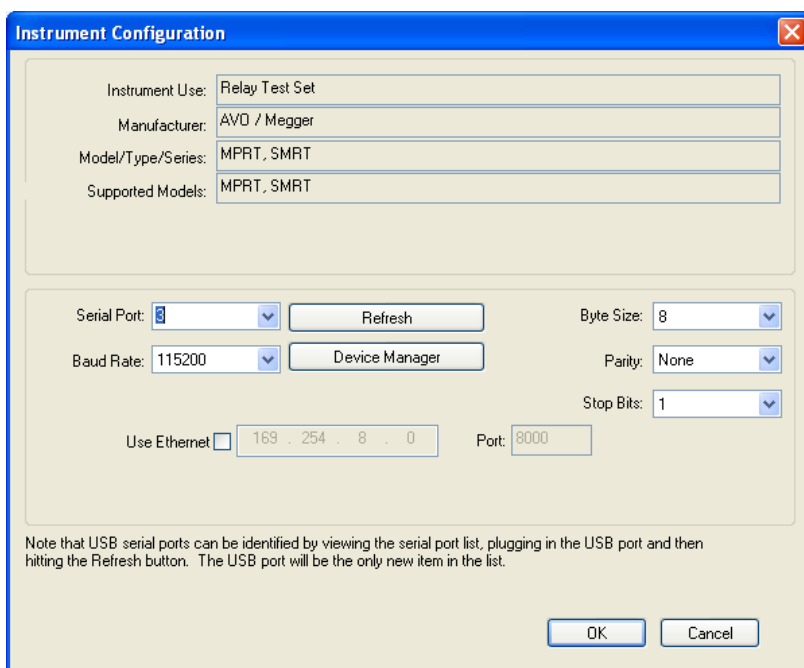


Figure 7 SMRT1B Communication Ports

2.2.1 USB 3.0 Interface

The optional STVI USB Type A port is intended for use with downloading new RTMS Software, SMRT firmware, or stored PowerDB test results. A USB keyboard or mouse can also be used with the STVI. The SMRT1B Type B USB Interface requires a Type B “downstream” connector, and is primarily used as a communication and control port when used with a PC and Megger RTMS PC version software for automated relay testing. It is recommended that you use the Ethernet port for high-speed communication and control of the SMRT unit. To use the USB port will require the user to configure the PC com port for

USB operation. Clicking on the Instrument Setup icon on the PowerDB tool bar , the Instrument Configuration Screen (shown in the following figure)




provides the user with access to the PC Device Manager screen. Click on the Device Manager button and navigate to the USB Ports file directory. Since the SMRT1B **defaults to a baud rate of 115,200**, the user will need to configure their USB output com port to match. Returning to the Instrument Configuration screen the user will need to check off the Use Ethernet check box, and set the Baud rate, Byte Size and Stop Bits as shown.

2.2.2 PC IN Ethernet Port

The **PC IN** Ethernet Port is the primary PC connection port for automated relay testing. This port supports MDI/MDI-X auto cross over configuration, which means both standard and “crossover” Ethernet cables may be used. Use this port for standard automated relay testing. This port provides the optimal method for downloading COMTRADE files, DFR streaming, and updating the unit’s firmware as required. For multiple unit operation, the unit providing the PC OUT link is providing the master phase reference to all units “downstream”. For multiple unit operation connect the PC OUT port to the downstream SMRT unit IN port. The RTMS software will automatically configure when the units are powered up.

2.2.2.1 Setting SMRT IP Address for Operation with a PC

With the Ethernet cable supplied with the unit, connect the **PC IN** Ethernet Port on the SMRT unit to the PC Ethernet port. Turn the test set on. As the SMRT unit goes through its power up sequence, in less than a minute the optional STVI power up screen will appear. If using the PC version of the RTMS Software it will auto-detect the SMRT unit connected to the PC. Once it auto-detects the unit, and determines the configuration of the SMRT unit connected, the Manual screen will appear. The unit might not auto detect due to firewall settings. In this case the firewall can be turned off or you can enter the IP address directly using the PowerDB instrument configuration screen by clicking on the Instrument Setup icon on the PowerDB tool bar . From the Instrument Configuration Screen, shown in the following figure, click off the check mark in the Auto Discover Unit box.

From the Instrument Configuration Screen, shown in the following figure, click off the check mark in the Auto Discover Unit box.

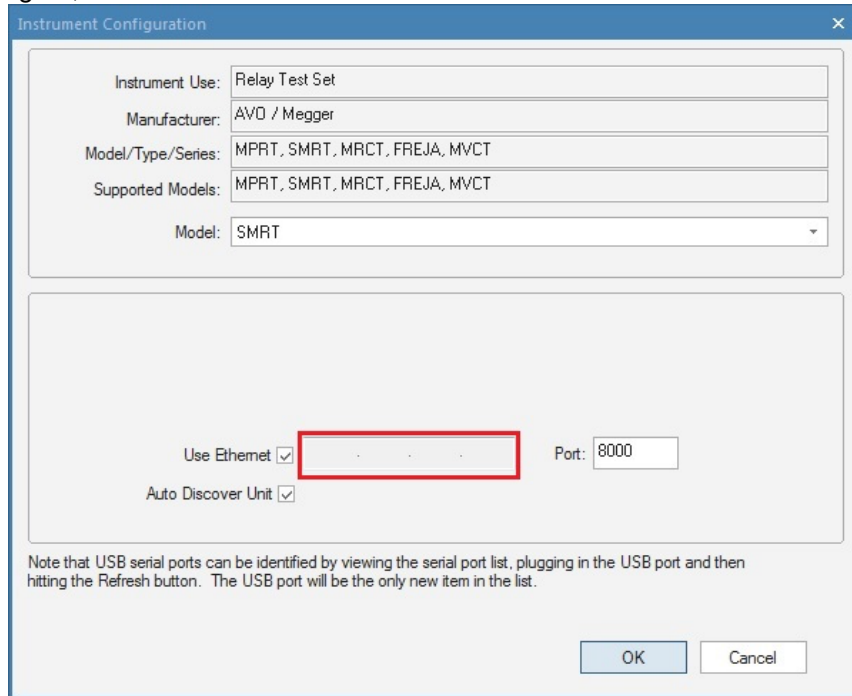


Figure 8 PowerDB Instrument Setup Screen

With the Auto Discover Unit box checked the RTMS software should find the unit. If not, the IP address can be entered in the box highlighted in the figure above. Also note that the IP address is also printed on the unit nameplate sticker. If the unit is on a network with a DHCP server, the user must use the Auto Discovery mode.

2.2.3 PC OUT Ethernet Port


For IEC 61850 testing connect Ethernet OUT port to the substation bus or to the relay under test to receive and send GOOSE messages. Connect the Ethernet IN port to the PC. When used with the Megger GOOSE Configurator software, the SMRT can provide high speed testing of IEC 61850 relays and substations by subscribing to GOOSE messages and mapping to the binary inputs. In addition, it can simulate system conditions such as circuit breaker operation by publishing GOOSE messages mapped to the SMRT binary outputs. With the PC running Megger GOOSE Configurator and connected to the Ethernet IN port, the operator can “sniff” the substation network from the Ethernet OUT port through the IN port with the SMRT serving as the firewall. With this design the operator cannot accidentally trip off the substation or inflect a PC virus into the substation LAN.

2.2.4 IEC61850 / PC OUT Ethernet Port

The IEC 61850 / OUT Ethernet Port is a 10/100BaseTX port, and is primarily used to interconnect multiple SMRT units together for synchronous multi-unit operation. It is also be used to provide access to the substation IEC 61850 network (when enabled). The SMRT1B with the IEC 61850 option enabled provides selectable priority, VLAN-ID, and meets the IEC 61850-5 standard Type 1A, Class P 2/3, for high-speed trip and reclose simulations. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”. With the PC connected to the PC IN Port, the SMRT and the PC share the same Ethernet network connection, and thus will not have a secure

isolation from each other. When testing IEC 61850 devices connect the PC to the IN Ethernet port to isolate the PC from the IEC 61850 substation bus.

2.2.4.1 Setting SMRT IP Address for Networks or IEC 61850 Operations

 The SMRT1B may be controlled over a network. This provides remote control of the SMRT1B virtually over any distance allowing one PC to control at least two units simultaneously, such as in end-to-end testing. *Connecting the SMRT1B to a Local Area Network or a Wide Area Network could permit unauthorized operation of the unit.*

Through the IN Ethernet port, the SMRT1B integrates into a network just like a PC or server. To use this feature requires the user to setup the IP configuration of the SMRT1B for their LAN. Note that the SMRT1B when turned on will automatically search for and acquire a network address if connected to a network. If it fails to automatically acquire an address check to make sure you are properly connected using a standard Ethernet cable. **Do not** use a “cross-over” Ethernet cable (a cross over cable is designed for use from your PC to the test set, not to a network). If the unit still fails to acquire an address, then there may be other issues. This will probably require assistance from your company’s information management department.


3.0 Current Sources

3.1 Currents in Parallel Operation

Each SMRT1B current amplifier is capable of providing 32 Amperes for 15 minutes, and up to 60 amperes for 1.5 seconds for testing instantaneous trip elements. When more than 32 Amperes single phase is required for long durations, or 60 Amperes for testing instantaneous elements, two current channels can be connected in parallel to provide 64 Amperes for up to 15 minutes. For higher output currents, two SMRT1B channels can provide up to 120 Amperes.

To parallel the current channels of the unit, perform the following:

If using the current test leads connect each current channel to the relay under test (both red and black terminals to the load). Each Megger test lead is rated for 32 Amperes continuous. If using test leads other than those supplied by Megger insure that the wire has sufficient size to carry the test current.

 All of the return leads will need to be common together **at the load** as shown in the following figure.

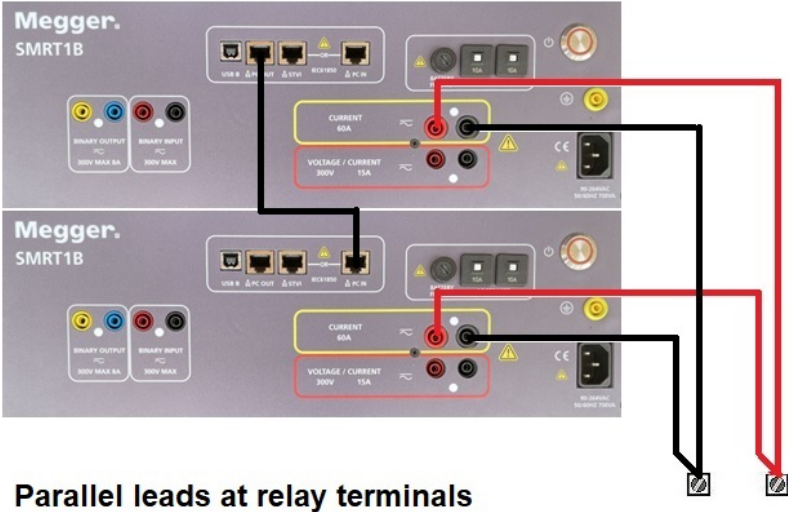


Figure 9 Parallel of Current Outputs 1 & 2

3.1.1 Manual Test Screen - Single Phase Up To 120 Ampere

For ease of use and operator convenience, go to the Configuration screen and select the Operating Mode of **2 Voltages – 1 Current @ 120A**. When you return to the manual test screen there will be one current channel displayed, as shown in the following figure.

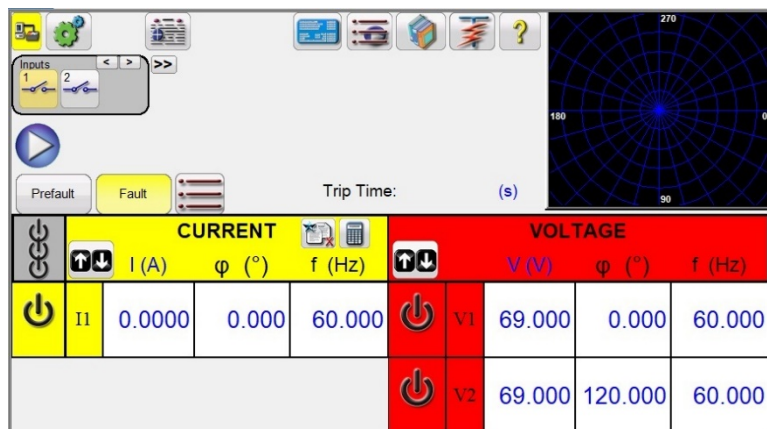





Figure 10 Manual Test Screen – Two SMRT1B Single Phase High Current Operation

The STVI will automatically set the two currents in phase with each other and divide the current equally between the two current amplifiers. When setting an output, simply enter the value of the desired output current. For example, for an output of 75 Amperes, enter 75, while each current amplifier will be providing 37.5 Amperes. The current can also be phase shifted. Simply enter the desired phase angle and all currents will be phase shifted together.

Always use the ALL ON/OFF  button to turn both current channels on and off together. For manually ramping outputs, if using the PC version of the RTMS software the  buttons will be displayed. If using an STVI controller the Control Knob icon  will be displayed. Pressing either of these two will present the user with a window to select the desired level of increment for manually ramping the outputs, the desired channel(s) to be ramped, and what is to be adjusted (amplitude, phase angle or frequency).

3.2 Currents in Series Operation

Two current channels may be connected in series in order to double the available compliance voltage. High impedance electromechanical ground (earth) overcurrent relays have always been difficult to test at high multiples of tap due to the winding impedance and saturation characteristics. The peak voltage required can exceed the maximum output voltage of one SMRT1B current output channel, depending on the required test current. By connecting two current outputs in series, the compliance voltage is doubled, providing higher test currents through the load. Connect the two current amplifiers in a “push-push” configuration as shown in the following figure.

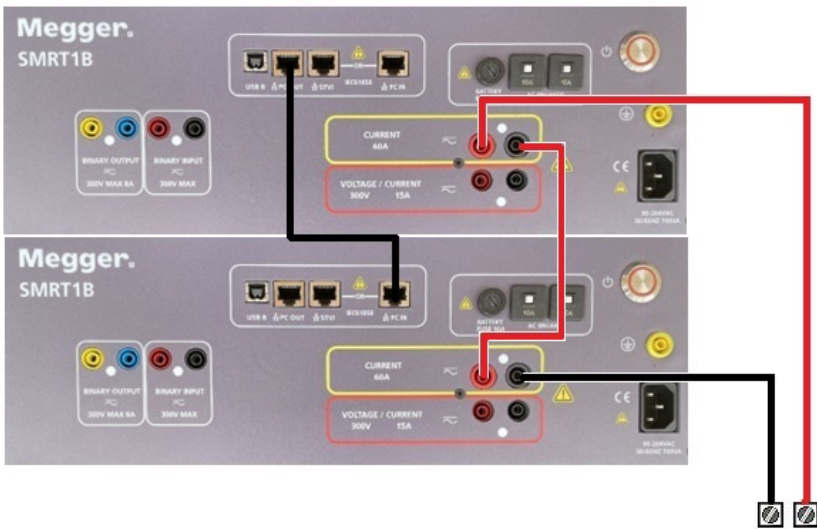



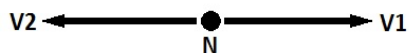
Figure 11 Series Two Currents


The two current channels that are to be used in series set each to the same test current magnitude, and phase angle. Select both current channels and turn output on by pressing or clicking on the ALL ON/OFF button. Always use the ALL ON/OFF button to turn both current channels on and off together. For manually ramping outputs, if using the PC version of the RTMS software the $\uparrow\downarrow$ buttons will be displayed. If using an STVI controller the Control Knob icon  will be displayed. Pressing either of these two will present the user with a window to select the desired level of increment for manually ramping the outputs, the desired channel(s) to be ramped, and what is to be adjusted (amplitude, phase angle or frequency).

4.0 Voltage Sources

4.1 Outputs Summed Together

Two voltage channels may be used to sum the voltage outputs to obtain higher than rated voltage provided the load is ungrounded. Connect the load between the voltage channel posts, set V_1 Phase to 0° and set V_2 Phase to 180° . The voltage outputs will add so the total voltage is the sum of the two voltage amplitudes, V_1 and V_2 as can be seen in the following figures.



 Note: If an **F** or **C** appears in the 5th digit of the style identification number (i.e. xxxx**F**xxxx) the voltage returns are floating (isolated from each other and ground).

For the floating commons the user must connect the associated voltage channels black common returns together, when series operation is required (see the following figure). Remove external commons when testing is completed.

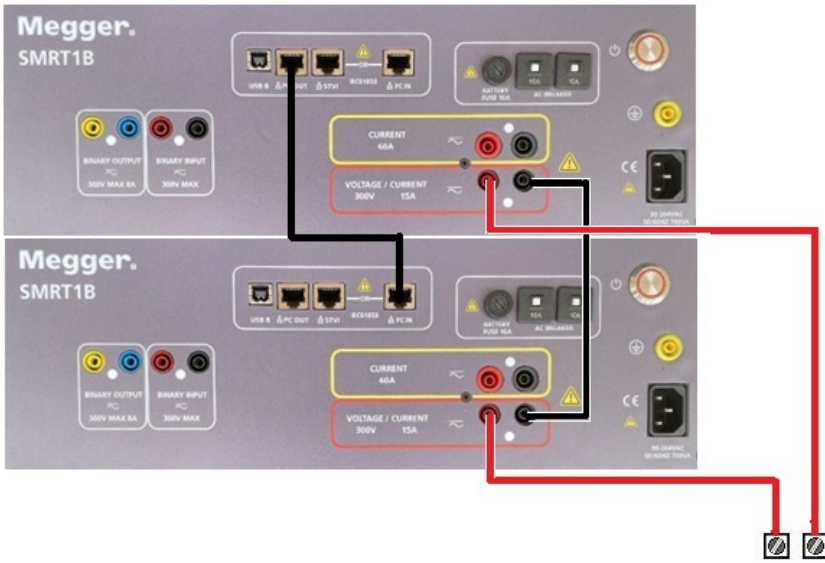


Figure12 Series of Voltage Channels for **Floating Ungrounded Common Returns**

4.2 3Ø, 3-Wire, Open-Delta

See section 3.4.2 in the RTMS software for detailed descriptions and use of the Open-Delta.

4.2.1 Balanced Open Delta

The Open-Delta configuration is the easy to use when a balanced three-phase source is required because the amplitude and phase relationship can be set directly. No calculations are necessary. When using the Open-Delta configuration, it is suggested to use voltage channel #1, designated V_1 , and voltage channel #2, designated V_2 , while the COMMON binding post is designated V_g . With this arrangement, the magnitude and phase angle of the potentials can be easily calculated and set. For the balanced three-phase condition V_{1g} and V_{2g} are equal in magnitude and separated by an angle of 60° . This is done by setting the V_1 and V_2 potentials equal in magnitude, setting 0° on V_1 and 300° (60 degrees leading assuming that the default phase rotation is set to 360 Lag) on V_2 , see the following figure.

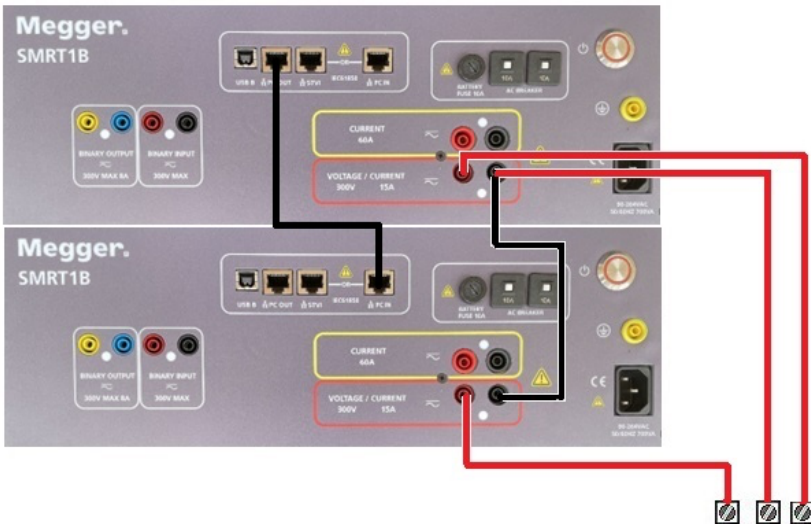


Figure 13 Three Phase Open Delta Connections

5.0 Warranty Statement

Megger warrants the product is free of defects in material and workmanship for a period of one (1) year from date of shipment. This warranty is non-transferable. This warranty is limited and shall not apply to equipment that has damage, or cause of defect, due to accident, negligence, and improper operation, faulty installation by the purchaser, or improper service or repair by any person, company or corporation not authorized by Megger. Megger will, at its' option, either repair or replace those parts and/or materials it deems to be defective.

The warranty is in lieu of all other warranties, either expressed or implied on the part of Megger and in no event shall Megger be liable for the consequential damages due to the breach thereof.

For warranty of the batteries, consult the battery manufacture's operator's manual.

5.1 Preventive Maintenance

This section discusses the maintenance of the SMRT1B. For maintenance of the battery consult the battery manufacture's operator's manual. The SMRT1B utilizes surface mount technology (SMT) and other components which require little or no service except for routine cleaning, etc. The unit should be serviced in a clean atmosphere away from energized electrical circuits.

5.1.1 Examine the unit every six months for:


Dust and Dirt	To clean the unit, disconnect the power cord from the unit. Never use spray liquids or industrial cleaners. Some cleaning solvents can damage electrical components, and should never be used. Water and a mild soap may be used. Use a lightly damp cloth (not dripping wet) to wipe off the unit. A dirty heat sink can cause thermal overloads. Remove dust with dry, low pressure, compressed air. Either remove the module from the chassis or simply apply air forcing the dust away from the heat sink through the sides of the unit.
Moisture	Remove moisture as much as possible by putting the test set in a warm, dry environment.

5.1.2 Updating SMRT1B Firmware

Download Firmware Upgrade via Megger Website

Updating Firmware via Megger Website

To download the latest SMRT firmware from the Megger website,

1. Go to WWW.Megger.com
2. Go to **Products / Relay and protection testing / Single-phase relay testing solutions** and click on the picture of your SMRT1 unit.
3. Click on the **Product support** tab, and click on the Software and firmware updates.
4. Click on the SMRT Firmware 50 Hz or 60 Hz Download  button
5. You will see a pdf document with detailed instructions on how to update the firmware on the SMRT unit. Download the **SMRT_Firmware** and install per the instructions.

USB Memory Stick: With the SMRT and STVI powered up, insert the USB memory stick into the USB port on the STVI. Press the **Configuration** Screen button, and then press the **Update Firmware** button in the Configuration Screen. At that point the user will be presented with the IP Address selection screen, with the serial number of the unit. Select the unit by Pressing or clicking the serial number and the upgrade process will automatically start. Observe the STVI display screen, and the unit. At the completion


of the download, the user will note the fans spin-up, and the LED's will be flashing rapidly on the SMRT unit. There will be an instruction to reboot (turn off and back on) the test system.

PC and RTMS Software: If using the PC version of the RTMS Software, it is very similar to the STVI. Upon clicking on the Update Firmware button, the familiar Windows *Open File* browser dialog box will appear. Using the *Look In* pull-down menu, navigate to where the new firmware was downloaded onto the PC, click on and open the file folder SMRT_LDR (SMRT Loader). There you will find the new firmware file. Click on the file, and click on Open. You will be requested to select a unit from the IP Address screen. Select the unit by clicking on the serial number and the upgrade process will automatically start. At the completion of the download, the user will note the fans spin-up, and the LED's will be flashing rapidly on the SMRT unit. There will be an instruction to reboot (turn off and back on) the test system. Note that after rebooting the SMRT unit, if using the PC version of the RTMS Software you will have to restart the RTMS Software on your PC in order to regain control of the SMRT unit

5.2 Service and Repair Instructions

The following basic troubleshooting information is provided to guide the technician to the possible source of a problem.

Since the SMRT unit uses Surface Mount Technology, repairs of the individual modules are beyond the scope of the basic troubleshooting guide, and should be referred to the Service Department at Megger or handled through the Megger Representative.

 If the unit is still within the original warranty period, or limited warranty period following factory servicing, **the factory must be contacted before attempting any repairs or the warranty will be void.**

5.2.1 Basic Troubleshooting

The troubleshooting information relies on the technician to have a good understanding of the operation of the unit. The technician should contact the factory before attempting repairs. Provide the Megger serial number of the SMRT unit when making inquiries.



WARNING It is necessary to energize the SMRT unit to properly troubleshoot some of the modules. The technician must take all applicable safety precautions for working near energized circuits.

NOTES

Before suspecting a failure in the SMRT unit, review the General Description and Operation sections to ensure that the problem is not a result of operating error.

Preliminary testing of the SMRT unit within its specified limits can help determine if a malfunction actually exists, identify the type of malfunction and define the general area of the failure.

Common causes of malfunctions, other than improper operation, are incorrect power input (voltage above or below specified limits), incorrect test signal voltages applied to the Binary Input gates (outside of the specified AC/DC Applied/Removed limits), and contact or circuit resistance too great for the Dry Contact gates to operate properly on the Monitor/Start/Stop gates. Typical malfunctions for the VI-Gen amplifiers are external short circuits on the voltage output and open circuits on the current output. The VI-Gen voltage and current outputs can be easily checked using a voltmeter and ammeter.

5.2.1.1 Power Input

Input voltage affects the whole unit and may or may not cause permanent damage if voltage is incorrect. These problems can often be corrected by simply using a better source of input power.

Some symptoms are as follows:

Low voltage: Erratic operation, no output, input power circuit breaker operation. If batteries are low, the unit will not energize.

High voltage: Circuit breaker operation, power supply failure.

For the battery, consult the battery manufacturer's operator manual for troubleshooting.

5.2.1.2 VIGEN Input Power, Communication and Control

Basic troubleshooting is as follows.

1. No power: Check the resettable circuit breaker. Does the ON/OFF switch light up? If it does not light up, then power is not getting to the unit. Check power source and line cord. If it lights up then the power is getting to the unit. Contact the factory or Megger representative for further instructions.
2. Erratic Manual Control: Individual Output Module communication cable is not properly connected thus cannot receive proper commands. Contact the factory or Megger representative for further instructions.

2.1.3 Binary Inputs, and Binary Outputs

If all the items external of the Timer assembly are in proper order, then the problem may exist within the Binary Input / Output assembly itself.

Some basic troubleshooting can pinpoint problems to the approximate cause.

Binary Inputs - Basic troubleshooting is as follows:

1. Timer does not stop: Jumper the appropriate Binary Input terminals manually. If LED for the selected input lights, check the Binary Input setup screen to verify that the selected binary input is properly setup as a Timer stop post. Check Timer stop settings as N.O. (Normally Open) to close, and Latch On. If LED does not light up, the Binary Input will need to be repaired or replaced. Contact the factory or Megger representative for further instructions.
2. Counting errors: AC applied or removed Stop signals can create, what appears to be poor repeatability, an inaccuracy or a malfunction in the Timer. The lower the voltage level, the more serious the "error" will be. What appears to be an error, however, is actually a variation in the point on the sine wave at which the voltage is great enough to cause the gate circuit to operate. If the circuit used for the timing test has a low AC voltage and the point at which the contact in the test circuit opens or closes, is at or close to zero on the sine wave, the period of time before the voltage level will be high enough to trigger the gate circuit can be as much as 4 milliseconds. The total timing variation can be as much as 8 milliseconds. The shorter the duration of the timing test, the more significant the variation becomes. Therefore, if small timing variations would present a problem, it is recommended that an AC voltage of 115 volts or above or a DC voltage be used for voltage applied/removed test selections.


When the SMRT Timer calibration is being tested, the AC voltage variable is often overlooked. This is particularly true when the Timer is compared to a counter and the two are triggered simultaneously with an electronic switch. For best results, a DC voltage should be used to eliminate the variable. If testing the AC voltage Timer Stop characteristics is desired, then the Stop signal must be triggered at the same point on the sine wave to assure that the gate signal will be repeatable. Ideally, the signal should be at a point near peak in the positive direction. In addition, the specified rms AC voltage values for the various Stop control selections must be adhered to.

Another source of apparent "error" can be the programmable de-bounce feature. If using electro-mechanical contacts for stopping the Timer, and if those contacts have a tendency to bounce, there could be a difference between an external standard timer and the SMRT unit Timer, depending on the programmed de-bounce period set in the SMRT unit. To determine the programmed value, look at the

Binary Input Setup Screen and see what the De-bounce setting value is. If a timing error or variation persists after all the suspected causes of error have been eliminated, then it is possible that the Binary Input circuit is malfunctioning. Contact factory for return instructions.

Binary Outputs - Basic troubleshooting is as follows:


Binary Output LED is ON but output contacts **not closed**: Using a continuity tester check to see if output circuit is open circuited. If circuit is open then it is possible that the internal surface mounted fuse element has been blown. Note: an optional in-line fused test lead Part Number: 568026 are available to provide protection from switching too high current, see SMRT Ordering Information under Optional Additional Accessories. The unit will need to be returned to the factory for further inspection and repair.

 Contact the factory for a Repair Authorization Number and return instructions if service is required. A Repair Authorization (RA) number will be assigned for proper handling of the unit when it arrives at the factory. Any non-warranty repair cost incurred for the repair or replacement of parts and/or materials shall be the responsibility of the purchaser.

Provide the factory with model number, Unit serial number, nature of the problem or service, return address, your name, and how to contact you should the factory need to discuss the service request.


You may need to provide a purchase order number, cost limit, billing, and return shipping instructions. If an estimate is requested, provide the name and contact information.

6.0 Preparation for Reshipment

 Save the original shipping container for future use. The shipping container is designed to withstand the rigors of shipping via a common commercial carrier. For example, you may wish to reship your unit to Megger for an annual calibration recertification.

Pack the equipment appropriately to prevent damage during shipment. If a reusable container is utilized, the unit will be returned in the same shipping container if it is in suitable condition.

Add the Return Authorization Number to the address label of the shipping container for proper identification and quicker handling.

 **NOTE:** Ship the equipment without nonessential items such as test leads, etc. These items are not needed by the factory to perform service.