Megger

SPI2000

Smart Primary Injection Test System

User Guide

IMPORTANT

This user guide, as well as the hardware and software described in it, is furnished under license and may be used or copied only in accordance with the terms of such license. The content of this user guide is furnished for informational use only, and is subject to change without notice. Megger assumes no responsibility or liability for any errors or inaccuracies that may appear in this user guide.

The information and data in this user guide are proprietary. The equipment described herein may be protected by U.S. patents. Megger specifically reserves all rights to such proprietary information as well as rights under any patent, none of which is waived by the submission of this user guide.

Except as permitted by such license, no part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, recording, or otherwise, without the prior written permission of Megger.

Megger, the Megger logo are trademarks of Megger. All other trademarks are the property of their respective owners.

Notice to U.S. government end users. The hardware, software and documentation are “commercial items”, as that term is defined at 48 C.F.R. §2.101, consisting of “commercial computer software” and “commercial computer software documentation,” as such terms are used in 48 C.F.R. §12.212 or 48 C.F.R. §227.7202, as applicable. Consistent with 48 C.F.R. §12.212 or 48 C.F.R. §§227.7202-1 through 227.7202-4, as applicable, the commercial computer software and commercial computer software documentation are being licensed to U.S. government end users (1) only as commercial items and (2) with only those rights as are granted to all other end users pursuant to the terms and conditions set forth in the Megger standard commercial agreement for this software and hardware. Unpublished rights reserved under the copyright laws of the United States. The recipient, if a government agency, acknowledges that this user guide and the equipment described were procured with "Limited Rights" to technical data as described in ASPR 9-203 (b).

The Smart Touch View Interface includes an RTOS-resident computer program. This program belongs to Megger and contains trade secret ideas and information of Megger, written and designed at Megger, 4545 W. Davis, Dallas, Texas 75211-3422 USA

This document is the copyright of:
Megger Limited, 4545 W Davis Street
Dallas, Texas 75211-3422 USA
PHONE: (800) 723-2861
FAX: (214) 331-7399
www.megger.com

WEEE

Waste Electrical and Electronic Equipment - 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. Please utilize your Local WEEE collection facilities or observe all applicable Local requirements.
Megger is registered in the UK as a Producer of Electrical and Electronic Equipment. The Registration No is WEE/ DJ2235XR.s
Printed in the USA.

Megger reserves the right to alter the specification of its products from time to time without notice. Although every effort is made to ensure the accuracy of the information contained within this document it is not warranted or represented by Megger Limited to be a complete and up-to-date description.

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

Revision History

Revision	ECN #	Date
1	Initial Release	11/5/2025

Declaration of Conformity

Hereby, Megger Instruments Limited declares that the SPI2000, 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

Table of Contents

Section **Page**

1.0 **Introduction**

This user guide contains information regarding the correct use and safe handling of the SPI2000. This user guide is on-board the 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, Warnings and Standards**'. This section contains information regarding your personal safety when using the SPI2000.

1.1 **Product description**

The Model SPI2000 is a high current primary injection test system with the flexibility to test a wide variety of devices such as low-voltage power circuit breakers, molded-case circuit breakers equipped with thermal magnetic or electronic trip devices, switchgear CT's, overcurrent relays, and thermal relays via primary injection. The SPI2000 is designed to test a wide range of circuit breakers, with ratings up to 2000 Amps frame size. The unit is fully compliant with NEMA AB-4 test guidelines.

The SPI2000 is a stackable unit designed to be able to break down into smaller sections for improved portability. The main unit with no booster can test up to a 600-amp breaker. Adding boosters will get the output up to 20,000 amps and allow the user to be able to test up to a 2,000 amp breaker.

	Max Current	Output through Breaker
Main Unit	14kA	6kA
With 2X booster	20kA	9kA
With two 2X booster	20kA	12kA
With 3X booster*	20kA	12kA
With two 3X booster*	20kA	20kA

*3X not released, check data sheet for release updates

The SPI system is the FIRST high current test system that allows a user to type in a predetermined current amplitude and the SPI system will generate and regulate the requested high current without preheating the test sample by pulsing the output current at high amplitudes. The SPI system also has the unique ability to turn on at the current zero crossing every time for any load by automatically adjusting the output firing angle. This eliminates DC offset for every circuit breaker type and the need for the user to determine and manually adjust the firing angle for different loads and circuit breakers.

The SPI system can be operated in a fully automated or manual mode via a full color, high resolution, TFT LCD touch screen controller (STVI). The optional controller provides the overall system operations and data storage functions. The unit comes with a USB memory stick which includes the PowerDB SPI2000 software to load onto a PC.

The touch-screen controller allows the use of Megger's PowerDB software, which gives the user the ability to download a TCC (Time Current Curve) into the SPI test system. By using a downloaded curve, the user will be provided with Pass/Fail results directly on the SPI test report. This provides the user with an immediate answer to whether the test sample is working correctly or requires maintenance.

1.2 **Terminology**

The acronyms, terms, and definitions used throughout this manual are described below:

1.2.1 **Glossary of Terms for Circuit Breaker Testing**

The SPI2000 software screens prompt the user to select, or set, various values. The values vary depending on the protective device under test. Many of the terms used are similar in nature and

mean virtually the same thing regardless of the type of breaker. For example, the term Time Dial is commonly used to define the time dial setting on the device under test. Unfortunately, some of the terms described here may apply to different types of devices under test in different ways and thus may not cover every possible device made. However, it is hoped that this glossary will help the user to understand every setting value on every device under test.

1.2.2.1 **Pickup** (Tap / Sensitivity Rating)

A numerical value associated with a tap or sensitivity rating setting on the device under test. It is used to define a setting value, pick up value, or minimum operating point, of the device under test.

1.2.2.2 **Time Delay**

It is a numerical value of time, normally associated with the minimum operating time of the device under test. Low Voltage Power Circuit Breakers are available with three types of tripping characteristics: Long-Time, Short-Time, and Instantaneous.

1.2.2.2.1 **Long-Time Delay**

The long-time delay characteristic is normally associated with direct acting low voltage power circuit breakers providing overload protection with typical time delays of approximately 10 -60 seconds at 300% of pickup.

1.2.2.2.2 **Short-Time Delay**

The short-time delay characteristic is normally associated with direct acting low voltage power circuit breakers providing protection for short circuit or fault conditions. It is used whenever a small delay is necessary for coordination or selectivity with other protective devices. Typical delays of this type of characteristic are approximately 6-30 cycles.

1.2.2.3 **Instantaneous**

A numerical value associated with a tap setting of the instantaneous element of the device under test. It is used to define a pickup value, or minimum operating point, of the instantaneous element of the device under test. The instantaneous trip characteristic is used for short circuit or fault protection and has no intentional time delay.

1.2.2.4 Test **Multiple**

A numerical value normally associated with conducting timing tests. Multiples are normally expressed in terms of whole numbers like 2, 3, 4, etc., times the Device under test Pickup, or Tap, value of the device under test. Fractions of test multiples may also be entered, and the appropriate test values and theoretical trip times will automatically be calculated.

1.2.2.5 **Frame Size**

The frame rating is the maximum continuous current rating in amperes of all parts except the overcurrent device. All current-carrying parts, contacts, and pivot points are designed to carry the amperes up to the frame size rating without exceeding heating limits.

1.2.2.6 **Continuous Current Rating**

The continuous current rating is a current value equal to or less than the frame rating. This value of current is printed or stamped on the overcurrent device. It is possible to have a 600-ampere frame rating, with a continuous current rating of only 100 amperes (due to the size of the overcurrent trip device).

1.2.2.7 **Expected Trip Time**

A numerical value which expresses the operating time of the device under test.

1.2.2.8 **Interrupting Rating**

A numerical value associated with the highest current at rated voltage that the device can interrupt without external damage.

1.3 **Applications**

SPI2000
Universal in application, the SPI2000 is a high current primary injection test unit with the ability to perform high current commissioning tests as well as the testing of virtually all low-voltage molded-case and metal-clad direct-acting ac circuit breakers produced by General Electric, Westinghouse, Eaton, Federal Pacific Electric, Square D, Gould, ABB, ITE, Siemens, Merlin Gerin and other manufacturers. Rugged and reliable, this low voltage Circuit Breaker Test set is designed to provide years of trouble-free field operation. The test set also may be used for other high-current applications such as performing ratio tests on current transformers, heat runs or primary injection testing on high-voltage breakers and their associated protective relays.

PowerDB Software
PowerDB software is the premier software for automated testing, report generation and maintenance record keeping of all low voltage circuit breakers. The SPI software works with PowerDB and test results can be pushed directly into any PowerDB form. PowerDB also uses the test results to provide the operator with Pass/Fail evaluations. These results are then recorded in the PowerDB database for report generation and archive. PowerDB can also accept other test data such as contact resistance and insulation resistance measurements, so a complete circuit breaker report can be maintained in one database location.

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 SPI2000.

www.megger.com

The rest of this page is intentionally left blank

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 test equipment 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!**

2.2 Additional Safety Warnings

The following are some additional safety related items associated with the SPI2000.

- The test system must only be used by suitably trained and competent persons.
- Read and understand all safety precautions and operation instructions before attempting to use this test system.
- 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 test system can be **extremely dangerous.**
- Always start with the power **OFF**, before connecting the power cables. 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.
- Always use properly insulated test leads. **DO NOT** use cracked or broken test leads.
- Always turn the test system off before disconnecting the power cables.
- **DO NOT** use the SPI2000 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 test system chassis area with the instrument connected to a power source. Lethal voltages are present and may cause serious injury or death!

3.0 Instrument Overview

This section of the user guide contains the information that you will need to set up and use the SPI2000 with the optional Smart Touch View Interface (STVI).

⚠ NOTE: If you use a PC loaded with the PowerDB software to control the SPI2000, the same connection port is used as the STVI.

3.1 Smart Touch View Interface

The optional STVI is a user-friendly interface to control the Megger SPI test equipment. This user guide contains the information that you will need in order to set up and use your STVI with the SPI Device. How the unit operates, some of the different types of testing you can do, and how to save and view your test results with the Smart Touch View Interface software is described. It also covers running the SPI2000 using the PowerDB software on your PC.

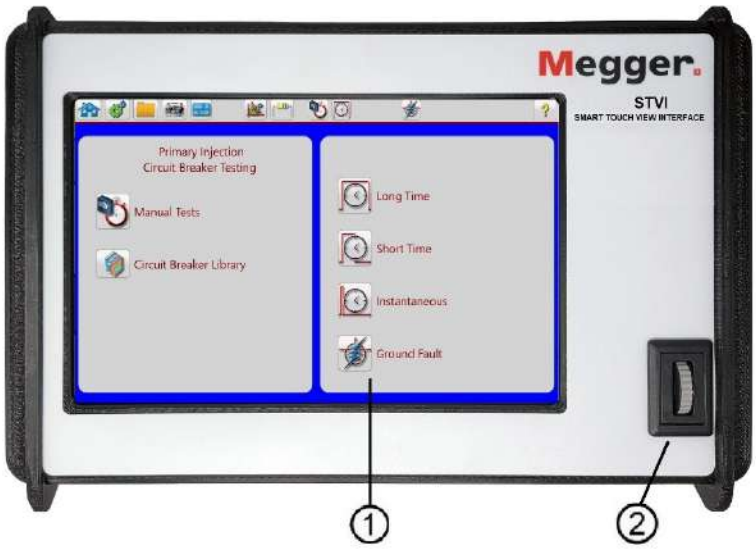

Figure 1 STVI-10 Front Panel

1. **LCD Color Display** ① – this 10.1-inch (25.65 cm) touch panel display provides high resolution, and features Wide Viewing Angle Technology with high luminance. The Display is a user-friendly interface to control the SPI2000.
2. **Control Wheel** ② – the Control Wheel provides the ability to manually adjust values.

Figure 2 STVI Ethernet and USB Ports

3. **Ethernet Port** ③ is a 10/100BaseTX port. It 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 files, and updating the unit’s firmware as required. The STVI comes standard with a crossover cable.

⚠ **NOTE:** The STVI gets Power Over Ethernet (PoE) of 48 Volts DC at 0.5 A from the SPI2000 Ethernet Port.

4. **USB Interface Terminals** ④ - there are two Type A USB terminals available. The USB 2.0 Interface requires a Type B “downstream” connector and is primarily used as a communication and control port when used with Megger PowerDB software. A USB cable is not provided with the test set or in the accessories. For computer control, an Ethernet cable is provided with the STVI. However, should the user desire to use the USB port any standard USB Type A cable will work with the unit. This port may also be used to update the STVI software and/or the SPI2000 firmware.

3.2 Descriptions of Inputs and Outputs

The following are descriptions of the SPI2000 inputs and output connections.

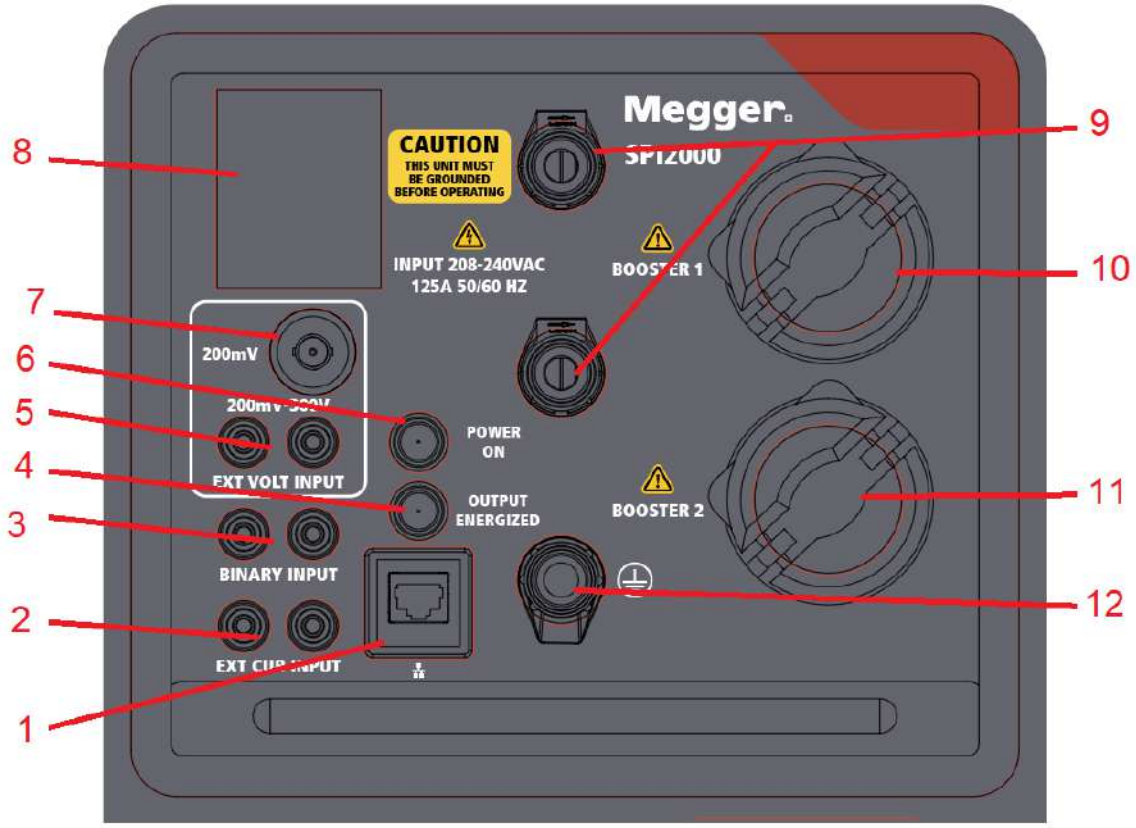

Figure 3 SPI2000 Power Input connections and controls

1. **Ethernet Port**: Connection for control of the instrument. Contains Power Over Ethernet (PoE) for STVI operation.
2. **EXT. Current Input** – An input to measure external current. 0-10 amps.
3. **EXT. BIN** Terminal – An external contact can be plugged into these terminals to provide a remote stop.
4. **Green Light Indicator:** Provides indication that the unit is powered on
5. **EXT. VOLTAGE** – External voltage (0-300V) can be measured on these inputs.
6. **Red Light Indicator:** Provides indication that the unit is outputting current.
7. **EXT. VOLTAGE** – External voltage (0-200mV) can be measured on these inputs. (Future features, not released in current model)
8. **Circuit Breaker:** Functions as the input Power ON/OFF switch and also provides short-circuit and overload protection.
9. **Power Input Receptacles**: Receptacles for power input connection.
10. **Booster Output:** Port to connect booster 1
11. **Booster Output:** Port to connect booster 2

12. **Equipment Earth Ground Connection**: Test set chassis ground. For safety purposes, this should be connected to a power system ground.

3.2.1 Input Voltage

The SPI2000 Circuit Breaker Test Set is designed to operate on a single-phase voltage source. See nameplate for input Voltage rating.

3.2.2 Input Cables

The power source must have sufficient capacity to maintain RATED input voltage at the INPUT terminals of the test set. All units are supplied with 15-foot (4.6 m) #4 AWG (5.19 mm) input cables with locking connectors on one end. This is done to provide a locking input connector, for safety purposes, along with input cables that are appropriate for a minimal amount of voltage drop from the input source to the input terminals of the test set. Although the test set is designed to operate satisfactorily at 80-105% of rated voltage, any drop in voltage below RATED at the input terminals will result in a proportional decrease in the maximum available output.

NOTE: To achieve published output currents, the rated input voltage must be maintained at the test set input terminals during the test.

3.2.3 Grounding

For safety, ground wires must be connected to the test set chassis to energize the test set. One ground lead must be connected to the ground terminal located just below the input plug to system ground. The size of the conductor should be rated per code for the size of the breaker supplying the test set. A 6 AWG (16 mm^2) is supplied with the unit. The test set will alarm and not operate if the unit is not grounded.

WARNING

For safety of the operator, it is essential that the test set be properly and effectively grounded.

The rest of this page is intentionally left blank

3.2.4 **Output Section**

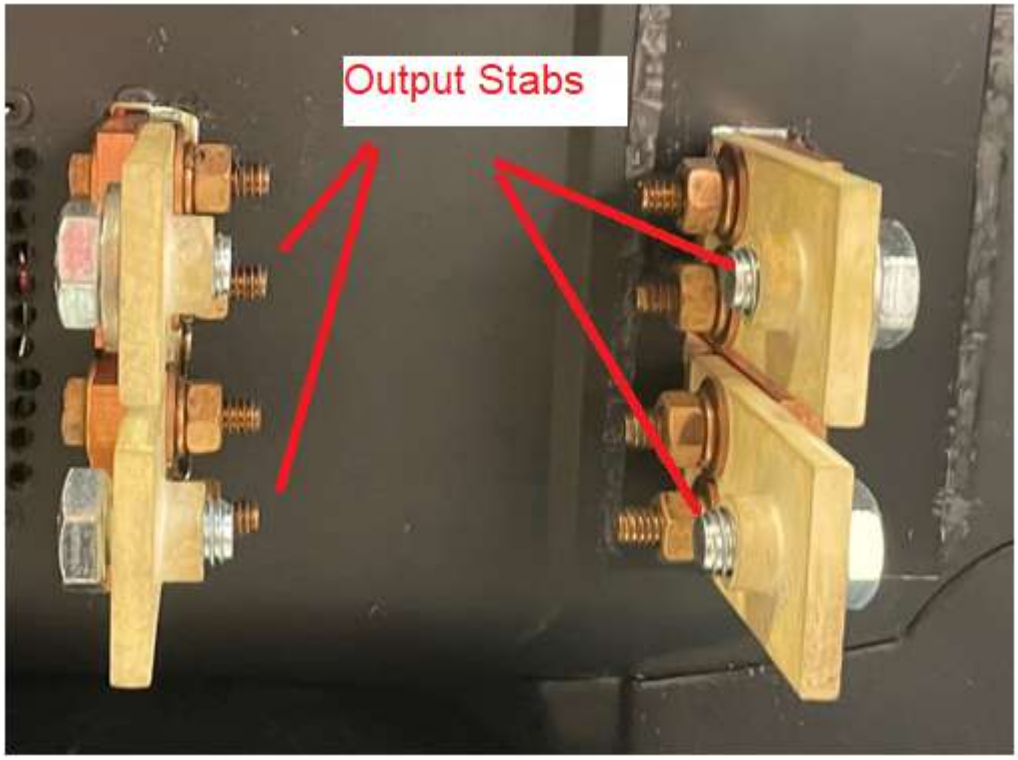

Figure 4 Output Connections

3.2.5 **Output**

The following describes the possible output connections, the duty ratings and overload capabilities of the unit.

3.2.5.1 **Selection of Output Connections**

Two output connections, parallel and series, provide various voltage and current ratings to adapt the SPI2000 Circuit Breaker Test Set to a wide variety of test circuit impedances.

The test set can be operated most efficiently by utilizing the parallel connection, which provides the HIGHEST CURRENT rating consistent with being able to obtain the desired test current. In this way, finer adjustment can be obtained by making maximum use of the variable autotransformer range. Even the smallest currents can be obtained from the parallel connection. The series connection should be used only when testing high impedance devices, where the parallel connection does not produce enough voltage to “push” the desired test current through the device. The operator should start with the parallel connection and move to series connection only when necessary. To operate the test set in parallel connection requires the operator to install the Parallel Adapter plates to the output stabs, see the following figure.

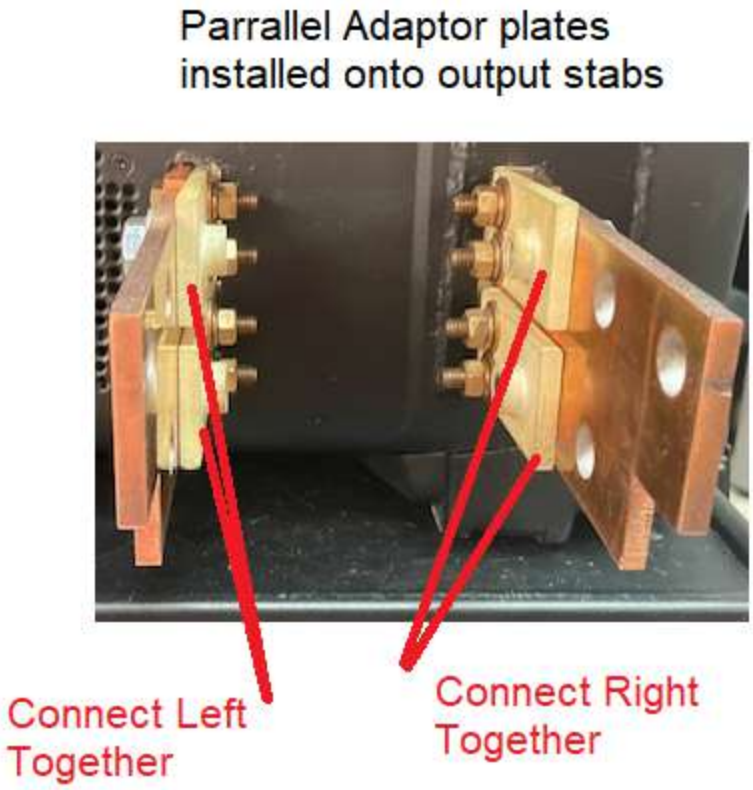

Figure 5 Installing Parallel Adapters

To operate the test set in series connection requires the operator to install the Series Adapter plate to the output stabs, see the following figure. Note the paralleling plates can be used to create a larger landing pad for output cables.

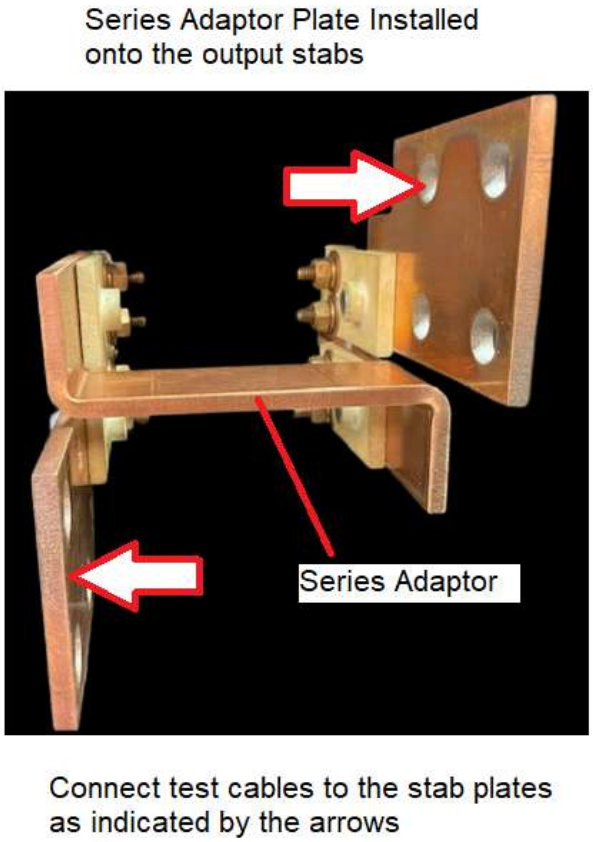

Figure 6 Series Connections with Adapter plate

With the test set in series requires that test cables be connected to the output stab to complete the series connection, as shown in the figure above.

⚠**APPLICATION NOTE**: When the output of the test set is in series configuration, cabling must be used to connect the output of the test set to the test specimen, and the setting under the **System** Tab must have **Series Mode** turned **ON**, see **sections 3.4.1.2 System Configuration Options**, and **3.4.1.2.1.5 Series Mode**.

Parallel Output Connections: This connector allows higher output current, but lower compliance voltage.

Series Output Connections: As previously noted, when operating in the series mode test leads must be connected to the two output stabs that are not connected to the Series Adapter bar. To obtain the highest level of current it is worthwhile to sacrifice cross section of the output test leads for the sake of reducing length. Every inch of lead that can be eliminated provides a worthwhile increase in available test current. Heating is not a significant problem in testing, even though the leads become hot. The use of 4/0 AWG (11.7 mm) welding or motion picture cable is convenient for constructing test leads. Paralleling of sufficient cables provides higher test currents. Each cable can be fitted with a compression lug on each end, then bolted to the output stabs of the test set and the breaker.

The two cables between the test set and the breaker should be twisted together or bundled with tape or cord to maintain the close proximity which minimizes inductive reactance.

It is sometimes necessary to use bus bar in order to obtain the desired maximum current. When using bus bar, the buses should be run parallel and kept as close to one another as possible, without touching each other.

3.2.5.2 **Connection of Boosters**

The SPI2000 can have up to 2 boosters connected to the output. Boosters can be 2X (double VA out) ,3X (3 times VA out).

	Max Current	Output through Breaker
Main Unit	14kA	6kA
With 2X booster	20kA	9kA
With two 2X booster	20kA	12kA
With 3X booster*	20kA	12kA
With two 3X booster*	20kA	20kA

*3X not released, check data sheet for release updates

To connect a booster the main unit should be stacked on top of the booster(s) and connect the output as follows:

Figure 7

When connecting 2 boosters the units should be stacked and connected as follows:

Figure 8

3.2.5.3 **Duty Ratings and Overload Capacities**

The SPI2000 is rated on a continuous duty basis as described by NEMA for test equipment in intermittent service; that is, 30 minutes ON followed by 30 minutes OFF. This means that the equipment can supply rated output current for a maximum period of 30 minutes ON provided a 30-minute cooling OFF period follows. This is a satisfactory basis of rating for testing of circuit breakers and primary injection testing of relays. When the equipment is being used for heat runs on cables, bus bars, terminations, etc., the 30 minutes ON time may be exceeded. In such cases the output current should be limited to 2000 amps.

In addition to the continuous duty rating defined above, all units have considerable short-time overload capability. Duration of the overload is governed by ambient temperature and thermal considerations within the test set. The maximum current available is determined essentially by the impedance of the load. The duty cycles of the SPI2000 are listed on the data sheet.

3.3 Graphical User Interface

The SPI2000 is controlled by a computer software interface and can be run from a laptop or the Smart Touch View Interface (STVI). See the following descriptions of the startup screen.

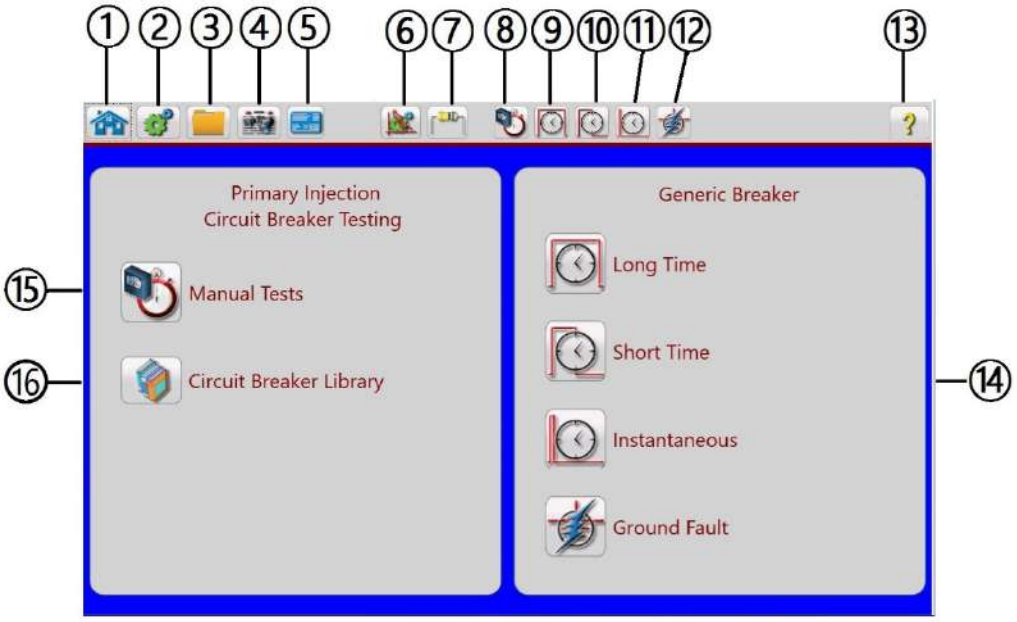

Figure 9 Main Startup Screen Identifications

3.3.1 ① Home button

Pressing the Home button from any screen will return the user to the Main Startup Screen

3.3.2 ② The Configuration button 

Press this button to go to the SPI2000 software Configuration Screen. See Section 3.4.1 Configuration for more information on the Configuration Screen.

3.3.3 ③ File Folder button 

To access the File Management system, touch the File Folder top tool bar. It provides the user with the ability to save tests in different formats, or open saved tests or new files.

3.3.4 ④ View Report options button 

To view a test result, press the View Report button. The report may be saved and exported to the PowerDB database for record keeping. Pressing on the View Report button will provide the following figure.

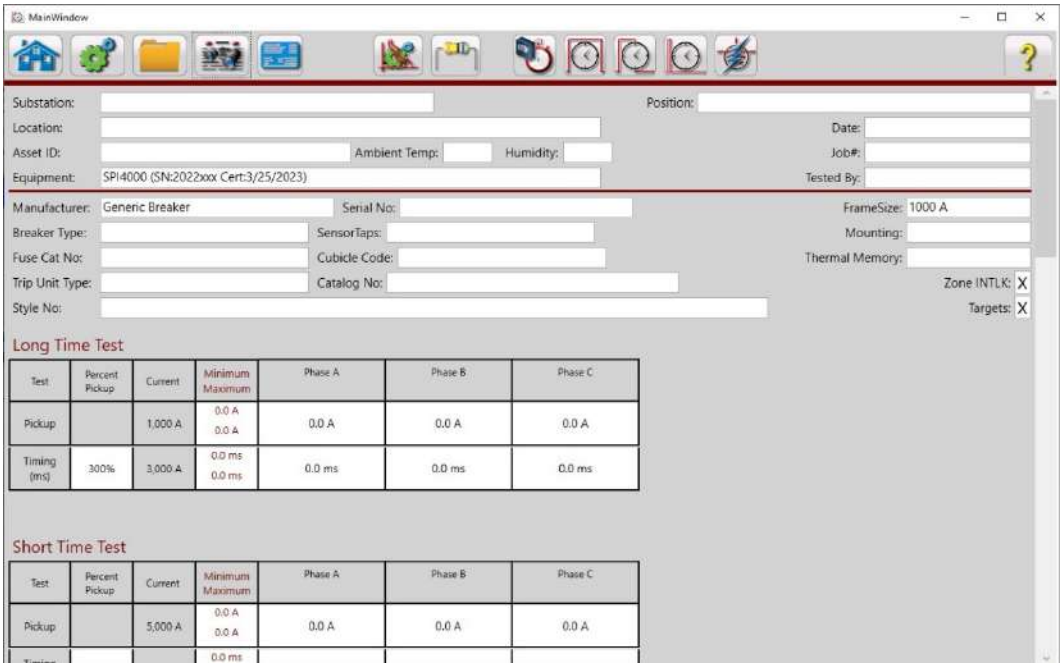

Figure 10 Sample Test Report

When a test is completed the test results will be displayed in the above report.

3.3.5 ⑤ Nameplate Data button 

Press this button to go to the Nameplate Data entry screen. Here the user can input all the related data associated with the device under test. This information will appear in the Test Result Header, see Figure 5 above.

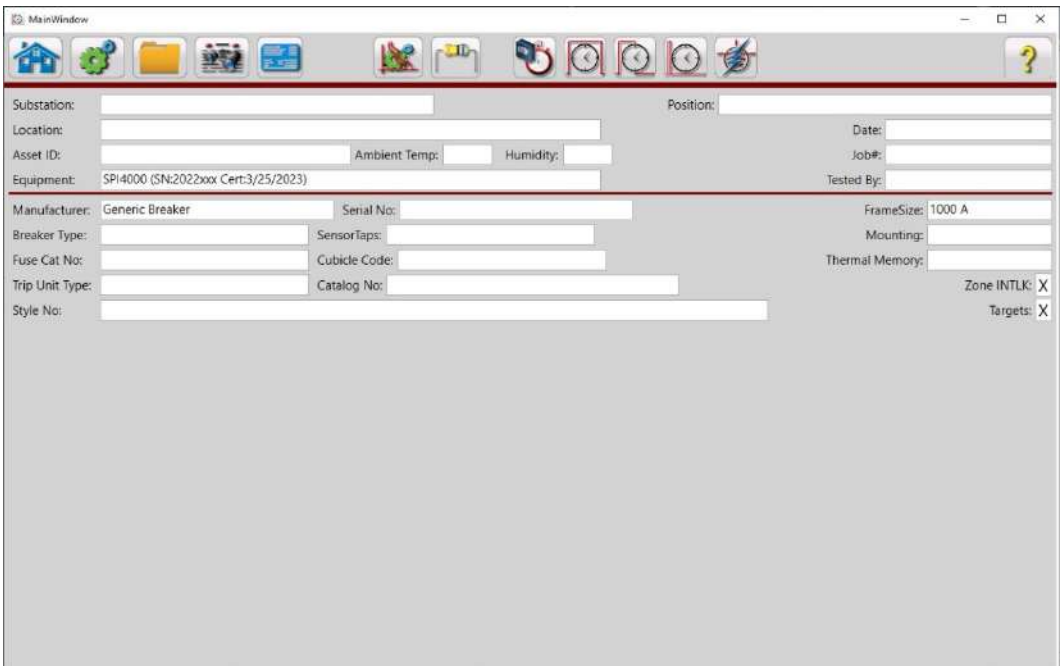

Figure 11 Nameplate Data Screen

3.3.6 ⑥ **Breaker Settings button** 

To access the Breaker Settings data window, press this button. Here the user can enter information relative to the device under test such as Pickup and Delay Settings. If the Generic Breaker is selected, only the settings windows will appear. If a specific breaker was selected, then the TCC for that breaker will be included, see the following figure for an example.

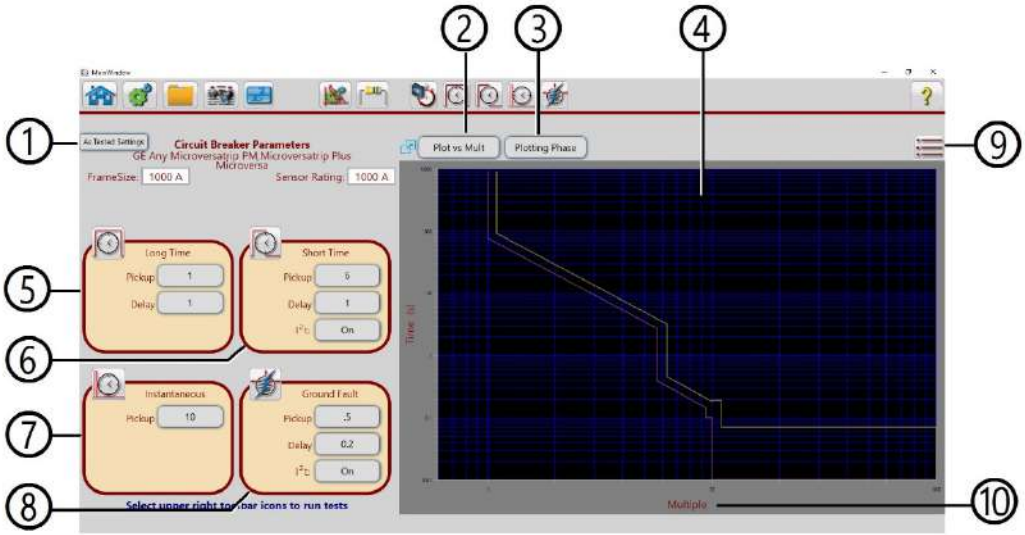

Figure 12 Example Breaker Settings with TCC

3.3.6.1 ① **As Tested Settings button**

Pressing this button will provide the user with a selection of options regarding how the document will display the settings along with the results, see the following figure.

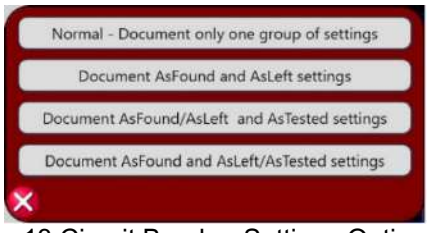

Figure 13 Circuit Breaker Settings Options

3.3.6.1.1 **Normal - Document only one group of settings button**

Default setting. Only one group of settings will be displayed.

3.3.6.1.2 **Document As Found and As Left settings** button

Pressing the button will provide two additional buttons; **AsFound** and **AsLeft** just under the Frame Size window. The option is used when changing settings on an in-service breaker. Pressing these buttons, the user can enter the As Found settings and then change to the As Left settings. The Test Document will include the As Found Settings and the As Left Settings.

3.3.6.1.3 **Document As Found / As Left and As Tested settings button**

Pressing the button will provide two additional buttons; **AsFound/AsLeft** and **AsTested** just under the Frame Size window. The option is used when changing settings on an in-service breaker. Pressing these buttons, the user can enter the **As Found/As Left** settings and the **AsTested** settings. The Test Document will include the As Found/As Left Settings as well as the As Tested settings.

3.3.6.1.4 **Document As Found and As Left/AsTested settings** button
Pressing the button will provide two additional buttons: **AsFound** and **AsLeft/AsTested** just under the Frame Size window. The option is used when changing settings on an in-service breaker. Pressing these buttons, the user can enter the **As Found** and **As Left / AsTested** settings. The Test Document will include the As Found and As Left / As Tested settings.

3.3.6.2 ② **Plot vs Current button**
Pressing this button will toggle between **Plot vs Current** and **Plot vs Multiple**, which will change the X-axis label from **Current (A)** to **Multiple**. Some TCC are plotted in Amperes and some are plotted in Multiples of rating.

3.3.6.3 ③ **Plotting Phase button**
Pressing this button will toggle between **Plotting Phase** and **Plotting Ground**, which will change the displayed Phase TCC to displaying the Ground TCC.

3.3.6.4 ④ Graphical Display
If using the Manual Control, or the Generic Breaker test functions, a Time Current Curve Characteristic will not be provided. The Graphical display will only appear for selected circuit breakers which have a time curve characteristic in the SPI2000 Library.

3.3.6.5 ⑤ **Long Time settings** 
There are two values to enter, **Pickup** and **Delay**. Pressing the **Pickup** button will provide a listing of typical pickup % values, and Off. Press Off if there is no Long-Time delay setting. If none of the typical values apply, the user can manually enter the pickup value in the **Enter Value** window. Press the green check button when finished. Pressing the **Delay** button will provide three possible Band delay options, **Max, Int**, **Min**. Press the appropriate Delay Band option associated with the device under test.

3.3.6.6 ⑥ **Short Time settings** 
There are two values to enter, **Pickup** and **Delay**. Pressing the **Pickup** button will provide a listing of typical pickup % values, and Off. Press Off if there is no Short-Time delay setting. If none of the typical values apply, the user can manually enter the pickup value in the **Enter Value** window. Press the green check button when finished. Pressing the **Delay** button will provide three possible Band delay options, **Max, Int**, M**in**. Press the appropriate Delay Band option associated with the device under test.

3.3.6.7 ⑦ **Instantaneous setting** 
Pressing the Pickup button will display a list of typical Instantaneous multiples, and Off. Press Off if there is no Instantaneous setting. If none of the typical values apply, the user can manually enter the pickup value in the **Enter Value** window. Press the green check button when finished.

3.3.6.8 ⑧ **Ground Fault settings** 
There are two values to enter, **Pickup** and **Delay**. Pressing the **Pickup** button will provide a listing of typical pickup % values, and Off. Press Off if there are no Ground Fault settings. If none of the typical values apply, the user can manually enter the pickup value in the **Enter Value** window. Press the green check button when finished. Pressing the **Delay** button will provide three possible delay Band options, **max, int**, **min**. Press the appropriate Delay Band option associated with the device under test.

3.3.6.9 ⑨ **Special Functions button** 
Pressing this button provides the following options list.

Figure 14 Special Functions Options List

3.3.6.9.1 **Edit Curve file button**
This is for more advanced users/programmers to edit existing curve data. This button will open a visual basic program window where the curve script file may be edited for the circuit breaker that has been selected. Press the **Help on Curve Scripting** button to view the help file associated with defining curves using vbscript.

3.3.6.9.2 **Load Different Curve File button**
This button will open the File Explorer, where the user may select a different curve that has been stored in memory.

3.3.6.9.3 **Turn On Logging of Curve Points button**
The default position is On. Pressing this button will produce a message window stating that the curve data points will not be written to the SPI log file. If there is an issue regarding the data points that needs to be discussed with Megger, this information will be helpful in troubleshooting the issue. Turning the logging of the data points Off will save a little space in memory in your STVI, or PC.

3.3.6.9.4 **View Log File button**
Select this button to view logged commands sent to the SPI2000 unit from the SPI software. This information can be useful to the Megger Technical Support Group when troubleshooting.

3.3.6.9.5 **Clear Log File button**
Select this button to clear the logged commands sent to the SPI2000 unit from the SPI software. When troubleshooting it may be necessary to clear the logged commands.

3.3.6.9.6 **Easy Load TCC File button**
There are two options presented when pressing this button, see the following figure.

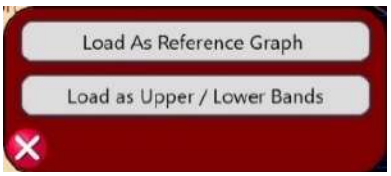

Figure 15 Easy Load TCC Options List

The following are descriptions of each option.

Load As Reference Graph: Using a 3rd party software program, advanced users can generate Time Curve Characteristics and save to the PC as a graphic file. Pressing this button will provide access to

the saved file to load and use as a reference when conducting pickup and timing tests. Contact Megger Technical Support for more information.

Load as Upper / Lower Bands: Using a 3rd party software program to generate Time Curve Characteristics, advanced users can overlay those characteristics into the graphic window provided for conducting pickup and timing tests. Contact Megger Technical Support for more information.

3.3.6.9.7 **Help on Curve Scripting** button
This is for more advanced users/programmers. Press this button to review the Curve Scripting Help file.

3.3.6.9.8 **Display Large Graph** button
Pressing this button will enlarge the displayed TCC to full screen. To go back to a normal screen, press the **Special Functions** button and press the **Display Small Graph** button.

3.3.6.10 ⑩ **X-Axis Display Nomenclature**
There are two nomenclatures, **Current** and **Multiple** associated with the TCC. The nomenclature will change with the pressing of the **Plot vs Curre**nt see section 3.3.7.2.

3.3.**7** ⑦ **Insulation Contact Resistance** button 
Pressing this button will open the Insulation and Contact Resistance input screen, see the following.

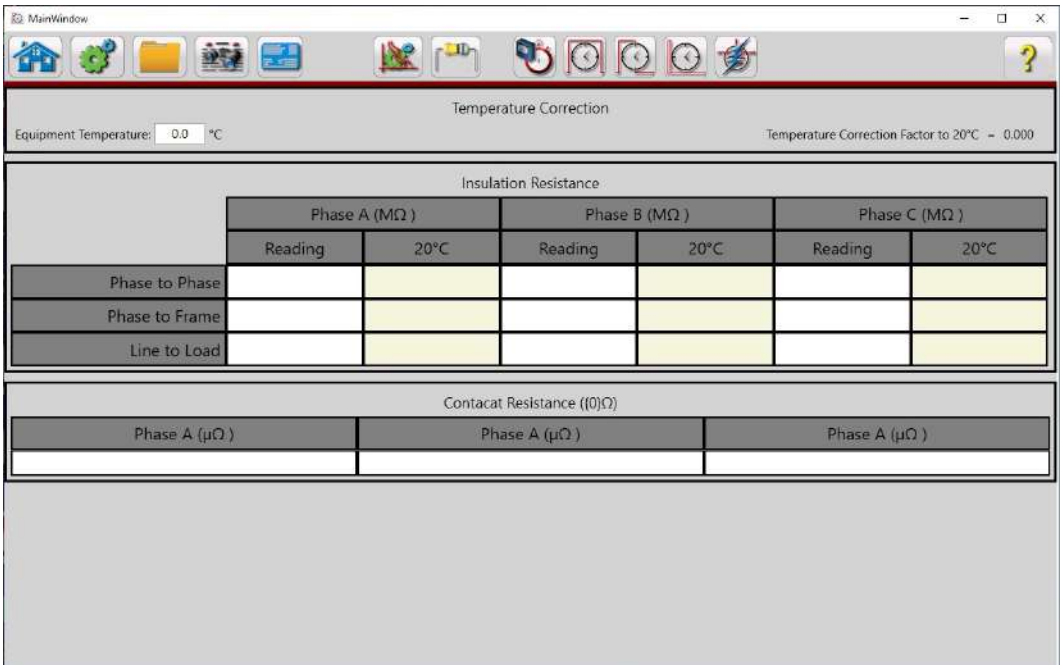

Figure 16 Insulation and Contact Resistance screen

The user can perform insulation and contact resistance tests on the circuit breaker and enter the test data here. This will become part of the test report.

3.3.**8** ⑧ **Manual Test button** 
Press this button to perform a manual test.

3.3.**9** ⑨ **Long Time Test button** 
Press this button to perform a Long Time Delay test.

3.3.**10** ⑩**Short Time Test button** 
Press this button to perform a Short Time Delay test.

3.3.**11** ⑪ **Instantaneous Time Test button** 
Press this button to perform an Instantaneous test.

3.3.**12** ⑫ **Ground Fault Test button** 
Press this button to perform a Ground Fault test.

3.3.**13** ⑬ **Help button** 
Press this button to access the User Guide.

3.3.**14** ⑭ **Test buttons**
Press this button to perform a selected test.

3.3.**15** ⑮ **Manual Test button**
Press this button to access the Manual Test Screen.

3.3.**16** ⑯ **Circuit Breaker Library button**
Press this button to access the time curve database, which includes a library of manufacturers TCC, see the following figure for library options.

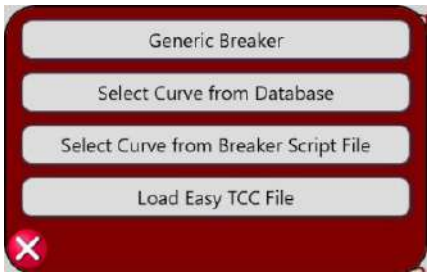

Figure 17 Library Options screen

3.4 **Configuration of SPI2000 software**
This section of the manual includes configuration of the SPI2000 software. The SPI2000 software is the manual control and user interface for the unit. All manual entries will be made through the touch screen of the SPI2000 STVI or through a PC. If using the STVI, to follow along with your unit will require that the unit be powered up, and the Ethernet cable connected to the STVI (the STVI uses Power Over Ethernet, see Section 3.1). Before connecting power to the unit, make sure the Unit POWER ON/OFF Switch is in the OFF position. Connect the unit to an appropriate power source, **connect the safety ground terminal to an appropriate earth ground**, and turn the POWER ON/OFF Switch to ON. The SPI2000 unit will go through its power up sequence, and in less than a minute the main startup screen will appear on the STVI.

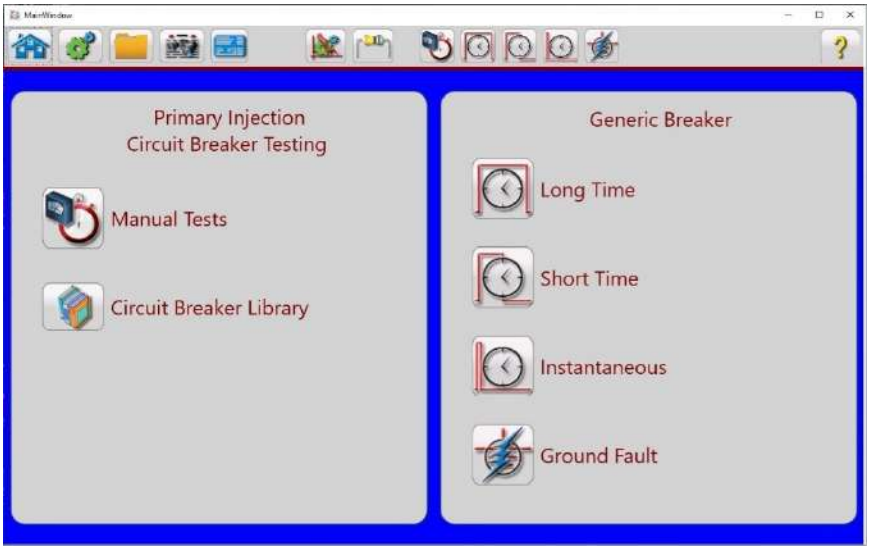

Figure 18 Main startup screen

3.4.1 Configuration

Pressing the Configuration button  will allow the user to configure the SPI2000 hardware and SPI2000 software by displaying tabs for **General** and **System**.

3.4.1.1 General Configuration Options

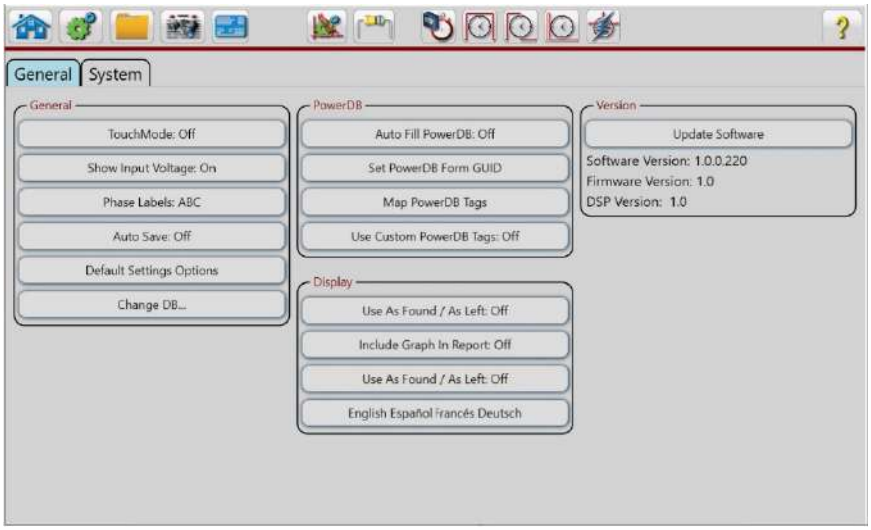

Figure 19 General Configuration Options screen

3.4.1.1.1 General Options Group

3.4.1.1.1.1 TouchMode On/Off

With TouchMode On, the user can either use the touch screen of the STVI or use a mouse. When in the Off mode, the software will only respond to a mouse click, such as using a PC.

3.4.1.1.1.2 Show Input Voltage On/Off

The user can decide if they want to display the input voltage or not by turning this feature On or Off.

3.4.1.1.1.3 **Phase Labels**
Found in the System Config General settings section; this button allows the user to set labels for each phase; ABC, RST or 123. Press the default ABC button and two other options appear to select from.

3.4.1.1.1.4 **Auto Save**
The Auto Save may be turned On or Off. Works similar to auto save features in other software applications, where work will be automatically saved.

3.4.1.1.1.5 **Default Settings Options**
Press this button to get access to the settings options of Save as Default, Restore Default, and Restore Factory default settings.

Figure 20 Default Settings Options List

1. **Save As Default**:
   Press this button and all the changes made to the Configuration Screen and most of the default values for all screens are now saved as the power up defaults.
2. **Restore Default**:
   Pressing this button provides the ability to restore the original system power up defaults.
3. **Restore Factory:**
   Pressing this button provides the ability to restore the original system factory power up defaults.

3.4.1.1.1.6 **Change DB**
Users can change their database if they have PowerDB version 11.2 or higher.

3.4.1.1.2 **PowerDB Options Group**

3.4.1.1.2.1 **Auto Fill PowerDB**
This is used to populate an open PowerDB test form, while the unit is operating.

3.4.1.1.2.2 **Set PowerDB Form GUID**
Allows the user to specify the GUID (Global Unique Identifier) of the test form to be used. Normally used by advanced PowerDB users.

3.4.1.1.2.3 **Map PowerDB Tags**
Allows users to map tests to custom forms. Normally used by advanced PowerDB users.

3.4.1.1.2.4 **Use Custom PowerDB Tags**
This feature allows the user to use standard tags to map data to a form or to use the custom tag map. Normally used by advanced PowerDB users.

3.4.1.1.3 **Display Options Group**

3.4.1.1.3.1 **Use As Found / As Left**
Found in the Display Options section, under the General tab in the System Configuration Screen, the button defaults to Off. The user will need to select On if they want As Found/As Left results displayed in the test report.

3.4.1.1.3.2 **Include Graph In Report**
The user can choose to include the TCC, Time Curve Characteristic, in the test report by clicking on this button changing from the default Off position to On.

3.4.1.1.3.3 **English, Español, Francés, Deutsh**
Found in General settings; this button allows the user to select the desired displayed language. The factory default is English. Future releases will include Spanish, French and German.

3.4.1.1.4 **Version**
The version of software, firmware and DSP version are shown in the window. To Update the Software, press the **Update Software** button. When the button is pressed it will look for new versions of software. If one is found it will step you through the process of updating the STVI and the firmware in the unit. See section 6.3 **Updating SPI2000 firmware and software** for more instructions.

3.4.1.2 **System Configuration Options**
This section of the manual will describe the System Group, Timer Group, and Ethernet configurations in the SPI2000 software.

3.4.1.2.1 **System Group**
The System Group includes information related to the test system inputs and output, including internal temperature.

3.4.1.2.1.1 **Line Frequency**
The test system measures and displays the input line frequency and displays it in the Configuration / System Group window.

3.4.1.2.1.2 **Internal Temperature**
The test system constantly measures the internal temperature in order to protect the unit against thermal damage. The internal temperature can be viewed in the SPI2000 Configuration / System Group window.

3.4.1.2.1.3 **Running on 480 (or 240) VAC Input**
Refer to nameplate for input voltage options. If the unit has the option for 480 or 240V the unit will automatically detect and run on the proper transformer tap.

3.4.1.2.1.4 **Adjust Current During Timing**
By default, the SPI2000 will automatically adjust current to maintain the setpoint during timing test. Turning this function Off the unit will not automatically adjust the output current for the duration of the test.

APPLICATION NOTE: Normally, as the breaker heats up the output must be raised to keep the same current due to heat and resistance increasing. It is recommended to leave this feature On. However, for special cases the user can turn off the auto adjustment by pressing this button.

3.4.1.2.1.5 **Series Mode**
When connecting the output terminals into series mode, the System Series Mode configuration must be placed in the On Mode to properly measure the output current.

APPLICATION NOTE: See section 3.2.5.1 Selection of Output Connections regarding operation of the SPI2000 using Series Connections.

3.4.1.2.1.6 **Calibrate Unit**

NOTE: Only qualified personnel should calibrate the unit. Contact Megger Dallas or your local Megger representative for more information.

3.4.1.2.2 **Timer Group**

3.4.1.2.2.1 **Timer Unit**

The user can select to display trip time either in seconds or cycles by pressing this button. The default position is seconds. Cycles are based on 50 or 60 hertz depending on the frequency of the input voltage.

3.4.1.2.2.2 **Stop On Options**

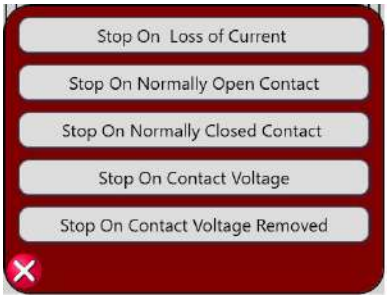

Figure 21 Timer Stop Options List

1. **Stop On Loss of Current**
   Timer will initiate only when the output circuit is completed, and a threshold current of approximately 10% of the selected test current is exceeded. Timer will continue to run until output circuit opens, and the current drops below threshold level, or output is de-energized by the user.

2. **Stop On Normally Open Contacts (closing)**
   With the BINARY INPUT terminals connected to normally open external contacts, output circuit will remain energized and timer will continue to run until contacts close.

3. **Stop On Normally Closed Contacts (opening)**
   With the BINARY INPUT terminals connected to normally closed external contacts, output circuit will remain energized and timer will continue to run until contacts open.

4. **Stop On Contact Voltage (applied)**
   With the BINARY INPUT terminals connected to an external monitoring circuit, output circuit will remain energized and timer will continue to run until an AC or DC Voltage is applied.

5. **Stop On Contact Voltage Removed**
   With the BINARY INPUT terminals connected to an external monitoring circuit, output circuit will remain energized and timer will continue to run until an AC or DC Voltage is removed.

3.4.1.2.2.3 **Firing Angle**

The firing angle will limit inrush current and DC offset on the output. The default is 70 degrees and this angle can be adjusted if different types of loads are tested with the unit. If large DC components are measured on the output this angle can be changed to get the best results. For normal breaker testing this setting should not be adjusted. Any changes to this value will be erased and default back to 70 on a power cycle of the unit.

3.4.1.2.3 **Ethernet**

The STVI or PC will auto-detect the SPI2000 unit (the DHCP mode does not require the user to input an IP address). If the unit is on a network with a DHCP server, the user must enter an IP address. Using the STVI or PC, pressing the DHCP button will highlight the Static IP Address Dialog box where the user can enter the IP address.

NOTE: On the PC version, the PC might not auto detect due to firewall or VPN settings. In this case the firewall can be temporarily turned off.

4.0 Operating Instructions

The **Manual Test** section is designed for general purpose high current test applications or primary current tests such as motor overload relays etc. This section describes basic operating procedures for using the SPI software and hardware for such applications as basic pickup and timing tests. The **Advanced Test** section is designed for automated testing of devices using the built-in tests associated with low voltage circuit breakers using manufacturers Time Current Curves.

4.1 Safety Considerations

DANGER: Professional organizations using this unit will normally have safety procedures covering such installations and users will be trained to follow them. Not withstanding these conditions, certain precautions should be followed when using this unit.

1. The chassis ground connection should **always** be firmly attached to the system ground bus.

2. Connections should be established to the current terminals before the unit is energized.

4.2 Set up of SPI2000

4.2.1 Unpack System

Unpack the unit and check the instrument and accessories 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. If no damage, **save the shipping box and packing material for reuse**; such as returning the unit for calibration certification. If being returned for calibration or service, see section10.2 Return Procedure.

4.2.2 Initial startup

DANGER: ALL SAFETY PROCEDURES AND PRECAUTIONS MUST BE FOLLOWED WHEN OPERATING THIS UNIT!

1. Before connecting power to the unit, make sure the Unit POWER ON/OFF Circuit Breaker is in the OFF position.
2. Connect the power cables into an appropriate power source, connect the safety ground to an appropriate earth ground, and turn the POWER ON/OFF Circuit Breaker to ON. The SPI2000 unit will go through its power up sequence. If using the optional STVI, in less than a minute the main startup screen will appear, see section 4.3.

4.3 Main Startup Screen

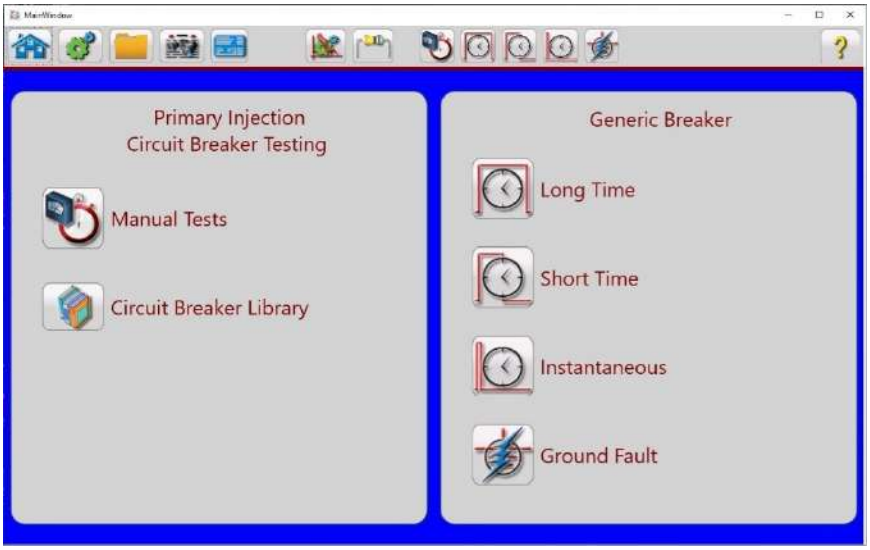

Figure 22 Main Startup Screen

4.3.1 **Manual Test**

To perform a manual test, in the Main Startup screen press on the Manual Test button  . The following screen will appear.

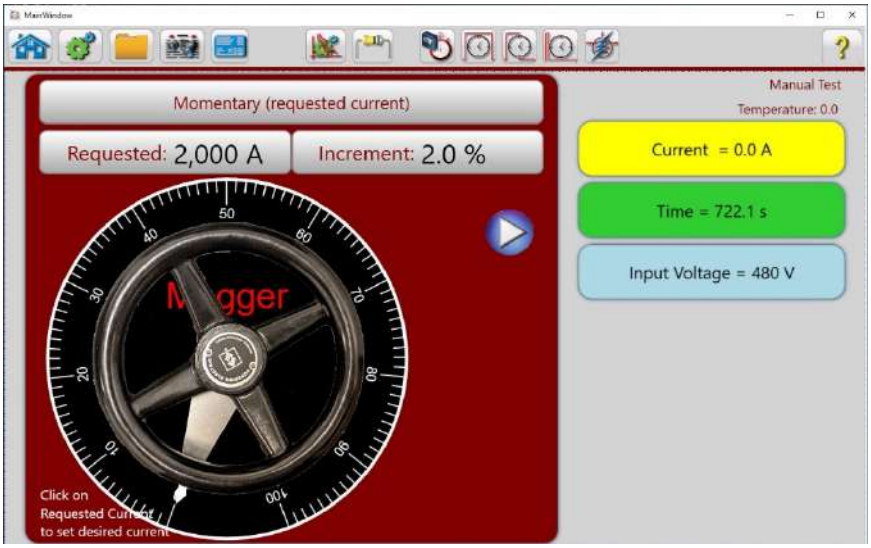

Figure 23 Manual Test Screen, Momentary requested current

4.3.2 **Manual Modes of Operation**

There are five options available. Pressing the Momentary (requested current) button will display the following figure.

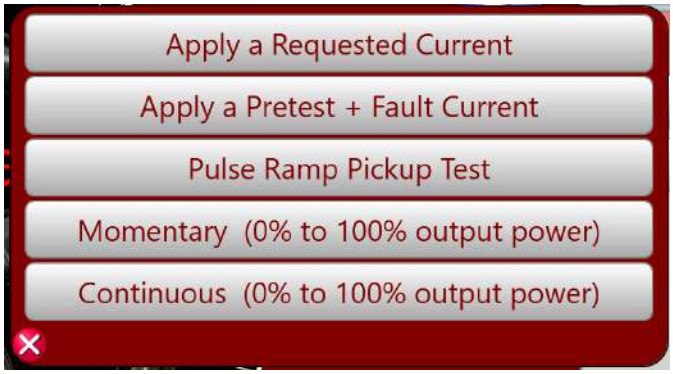

Figure 24 Manual Modes of Operation

4.3.2.1 **Momentary (0% to 100% output power)**

Clicking on the Momentary (0% to 100% output power) button will present the following screen.

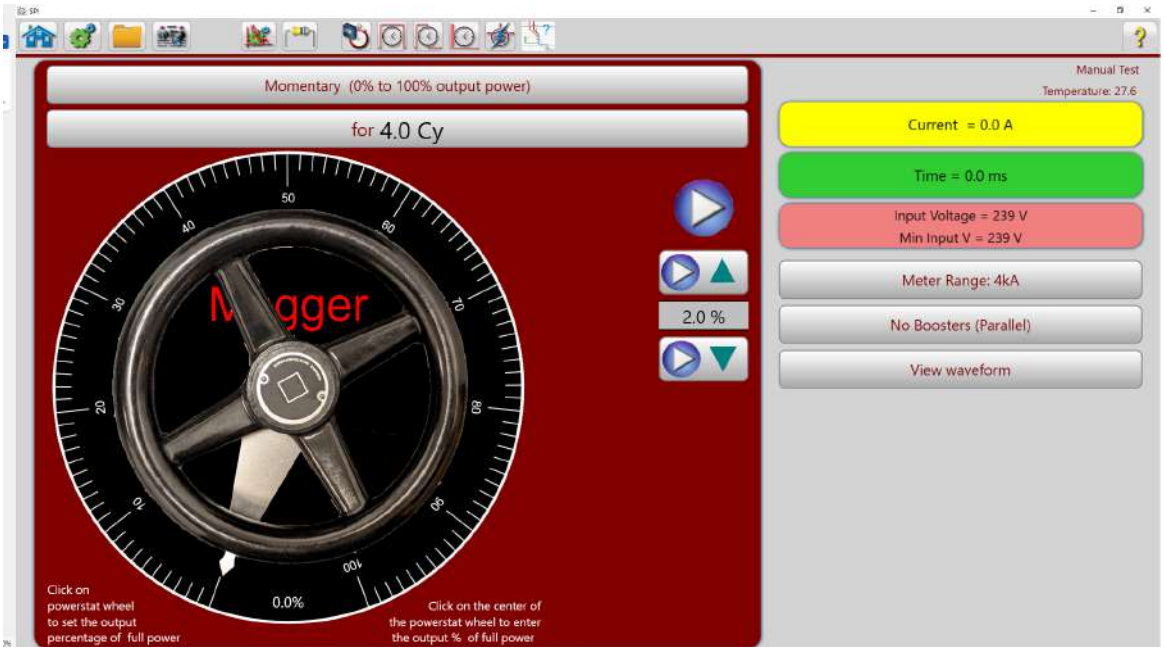

Figure 25 Manual Momentary 0 to 100% output power Test Screen

In this mode the unit will perform a momentary bump of current when the blue play button is pressed. Output of the unit will be based on the wheel setting, which is 0 to 100% of full output power. Click on the Powerstat™[1] wheel to set an output level, then press the blue play button. The unit will output selected percent out selected for the time selected.

Pressing the blue play button will produce the 4 cycles of test current. The output current will be displayed in the **Current** window. Once current is produced the user can use the up/down ▲▼arrows to bump the current up or down until the desired current is found. Note that the default adjustment of the current using the up/down arrows is 2.0%. Press the **Increment Percent** button and a numerical keypad will appear to enter a higher or lower % value for finer adjustment.

4.3.2.2 **Continuous (0% to 100% output power)**

In this mode the unit will perform a continuous output until the breaker trips (or preset **Max Time** limit is reached). Typically, a user will use Momentary (0% to 100% output power) to find the proper test

[1] Powerstat is a registered Trade Mark by Superior Electric

current, then switch to Continuous mode to run a test. Pressing the Momentary (requested current) will produce the **Manual Modes Options** screen, see figure 23. Select the Continuous (0% to 100% output power) option, the following figure will appear.

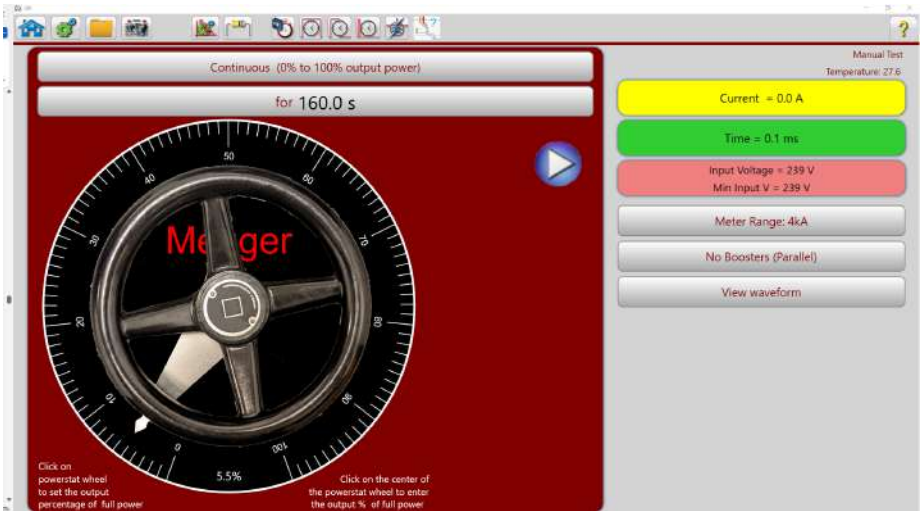

Figure 7 Manual Test Continuous 0 to 100% output power

Pressing the blue play button will provide the **% of Output** based upon the position of the wheel. A **Max Time** duration that the current will be applied defaults to 160s (seconds), but can be changed by the user, by clicking on the time button and entering a new time.

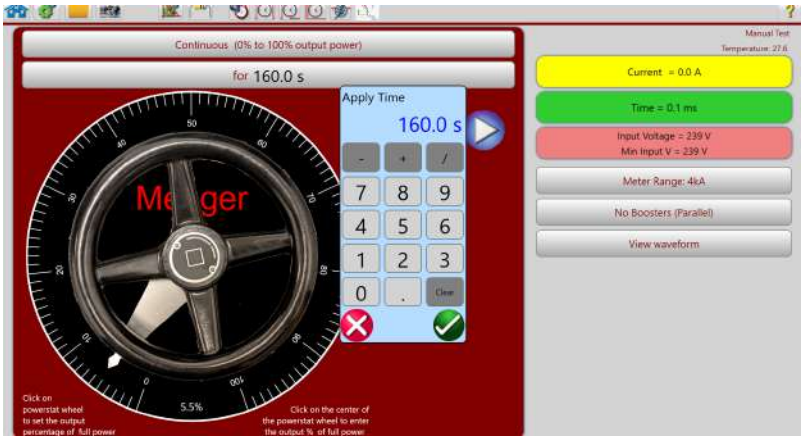

Figure 8 Continuous Mode Input Screen

Pressing the blue play button will produce 160 seconds of test current. The output current will be displayed in the **Current** window. Up/Down arrows will appear when the test is running that will allow the user to change output during the test.

4.3.2.3 Apply a Requested Current

Clicking on the **Apply a Requested Current** button will present the following screen.

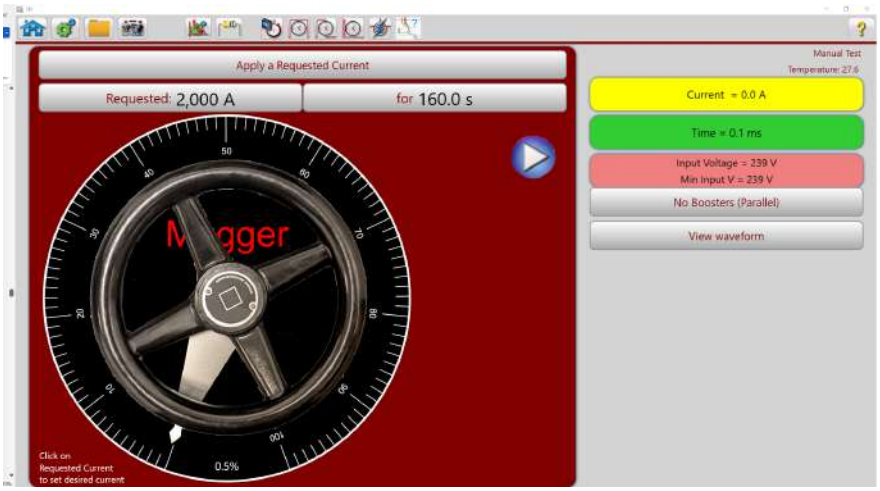

Figure 9 Apply a Requested Current test screen

This mode allows the user to set the desired test current. Press the blue play button and the test will start. Note up/down arrows will also appear.

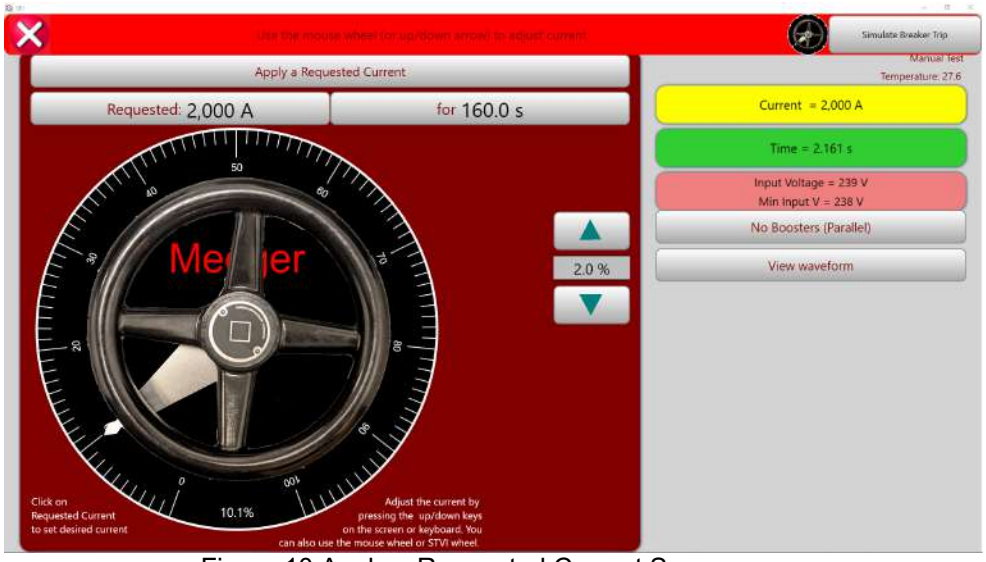

Figure 10 Apply a Requested Current Screen

The arrows can be used to adjust the current.

4.3.2.4 **Apply a Pretest + Fault Current**

Clicking on the **Apply a Pretest + Fault Current** button will present the following screen.

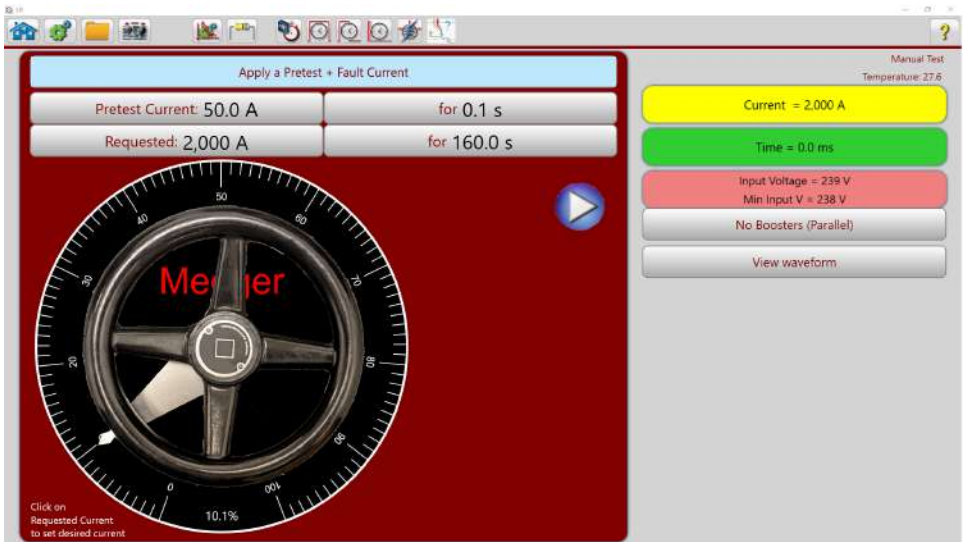

Figure 11 Apply a Pretest + Fault Current test screen

This mode allows the user to set a requested smaller pretest current followed by a fault current. Press the blue play button and the following figure will appear.

4.3.2.5 Pulse Ramp Pickup Test

Clicking on the Pulse Ramp Pickup Test button will present the following screen.

Enter the requested current and press play. The test wet will apply small pulses to find 80% of the requested value, then start putting out 100ms pluses. After each pulse the unit will rest for 8 cycles then apply another pulse 2% higher. This will continue until the breaker trips. Pulse ramp and other settings can be changed as required.

Figure 31 Pulse Ramp Pickup Test

4.3.3 Advanced Automated Test

4.3.3.1 Selecting a Curve

To perform an advanced automated test, in the Main Startup screen press on the **Circuit Breaker Library** button  The following screen will appear.

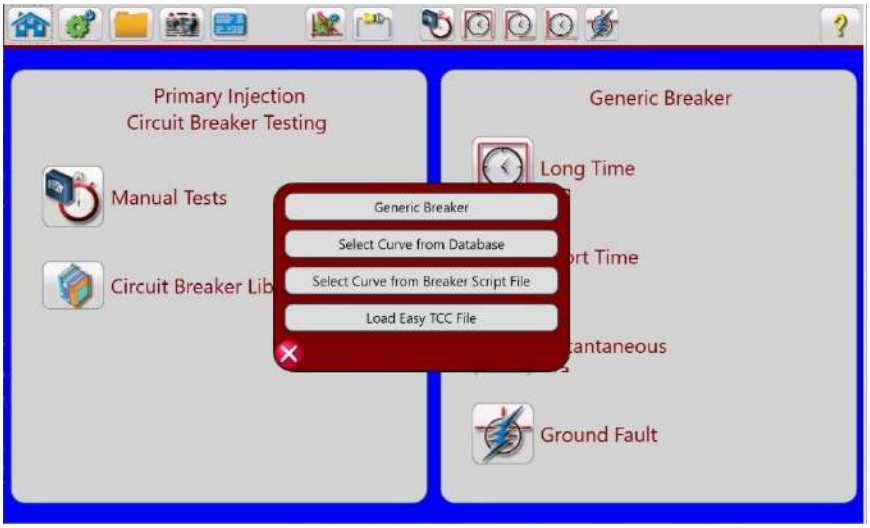

Figure 12 Circuit Breaker Library Option Selected

4.3.3.2 Selecting Generic Breaker

Click on Generic Breaker and the following screen will appear.

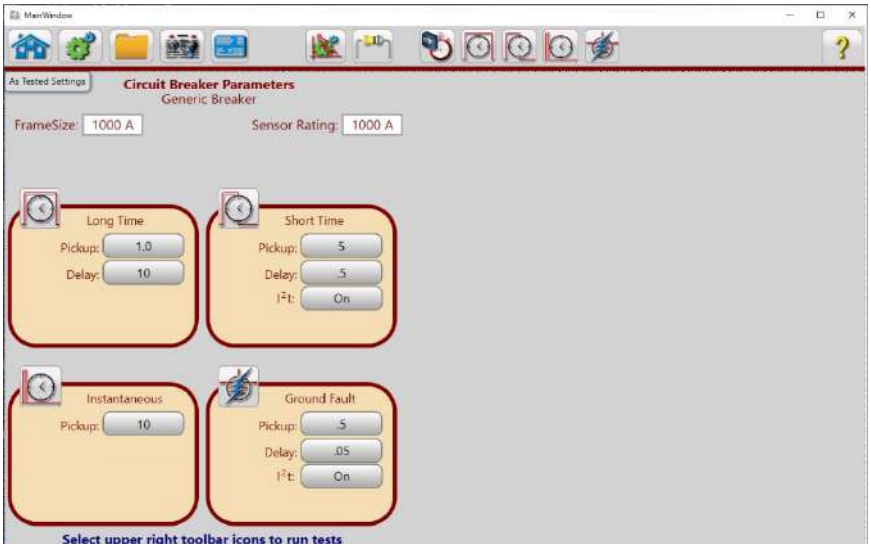

Figure 13 Generic Breaker Setting Screen

Enter the **Frame Size** and **Sensor Rating** in the windows provided. Enter the appropriate breaker setting values for **Long Time**, **Short Time**, **Instantaneous**, and **Ground Fault**. To execute the individual tests, click on the appropriate test icon in the tool bar. For example, pressing the **Long Time Test**  icon for the above setting values will result in the following figure.

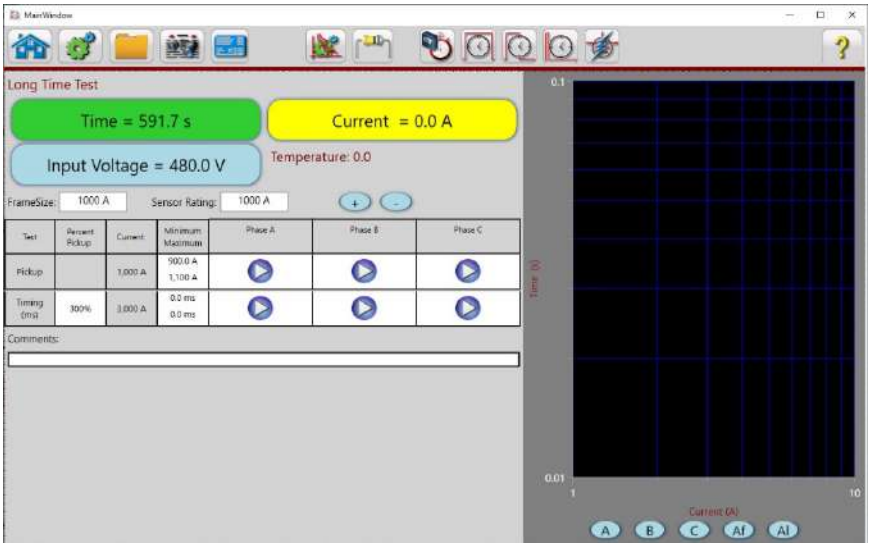

Figure 14 Example Generic Long Time Test Screen

To perform a Generic **Long Time Pickup** test, click on the blue play button for Phase A Pickup test and the test will start.


Figure 15 Example Generic Long Time Pickup Test Description

To run the test, press the blue play button and the unit will find the start current and then ramp the current up, per the settings. Use the mouse wheel or up/down arrow keys to adjust current. Once the **Pickup Light** on the breaker lights up, press the **Simulate Breaker Trip** button to record the value. Also, note that the Minimum and Maximum pickup values are pulled from the Test Screen. If higher or lower values are desired, click in the Minimum and Maximum values in the window and a numeric keyboard will appear.

To perform a Generic **Long Time Timing Test**, press the blue Play button in the **Timing** row under the **Phase** that is desired to be tested. The unit will find the requested current and start the test. A red bar will appear at the top of the screen to let the user know the test is running.

Figure 16 Example Generic Long Time Timing Test Description

The test set will apply the desired current until the breaker trips, or the **Max Time** limit is reached. It will record the trip time. Note that the Minimum and Maximum delay times default to 0.0 ms. Click on the Minimum and Maximum values in the window and a numeric keyboard will appear. Enter the appropriate minimum and maximum times for the breaker being tested. Normally, Long Time Delay values are measured in seconds. Click on the milliseconds, **ms**, in the numeric keypad window and three selections will be provided, **s** (seconds), **ms** (milliseconds), and **cy** (cycles). Select and enter the appropriate values.

4.3.3.3 Selecting a Curve from Database

Click on **Select a Curve from Database** to view all available manufacturers curves. There are two types of breakers with manufacturers curves that are available, Air Frame and Molded Case. The **Breaker Type** defaults the **Air Frame**. If the breaker to be tested is a Molded Case breaker click on the **Breaker Type Air Frame** button, and the following list will be provided.

Figure 17 Breaker Type Options

Click on **Molded Case** and the following Manufacturers Options window will appear.

Figure 18 Molded Case Breaker Manufacturers List

Select from the available manufacturers. If the manufacturer for your breaker does not exist go back and use the **Generic Breaker**. New manufacturers TCC's will be added to the software from time to time. Check with your Megger sales representative regarding additional breaker TCC's, or check the Megger website to see if a new version of software is available to download, see section 5.3 for more information.

To access manufacturers time curves for **Air Frame** breakers, click on the **Curve Manufacturer Generic Breaker** button and the following Manufacturers Options window will appear.

Figure 39

For this example, Air Frame, Square D breaker was selected, see the following figure.

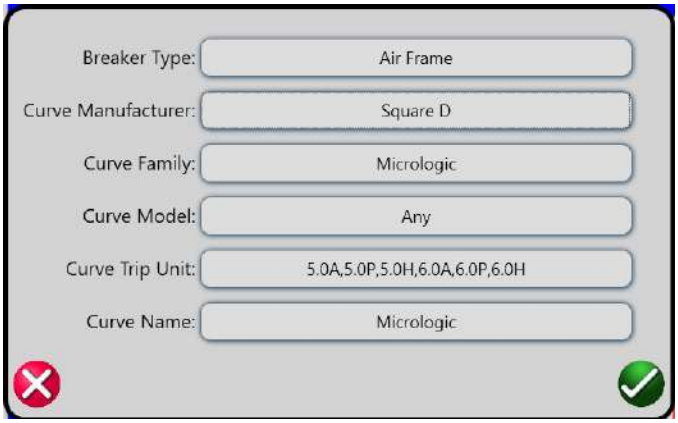

Figure 40 Example Square D Air Frame Breaker

Click on the green check button and the following breaker setting screen will appear.

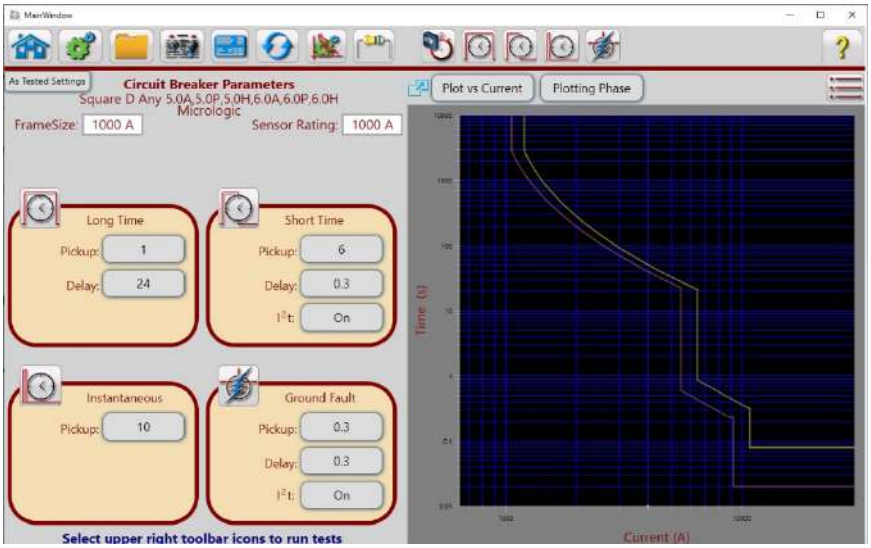

Figure 41 Example Square D Breaker Settings Screen

4.3.3.4 **Selecting Tests**
In the above example, the breaker has Long Time delay settings, Short Time delay settings, an Instantaneous setting, and Ground Fault settings. The top tool bar allows you to go to several different element testing modes. These include Long Time Pickup and Timing  , Short Time Pickup and Timing  , Instantaneous Pickup and time  , and Ground Fault Pickup and Time  . Review section 3.3.7 for details regarding Breaker Settings and Tests descriptions.

4.3.3.4.1 **Long Time Tests**
There are two types of tests for Longtime. **LT Pickup** and **LT Timing**. The software defaults to timing at 300% of LT Pickup, but this can be modified to any value desired by the user. Also, additional timing tests can be added by click the "+" button next to the sensor rating. See figure below.

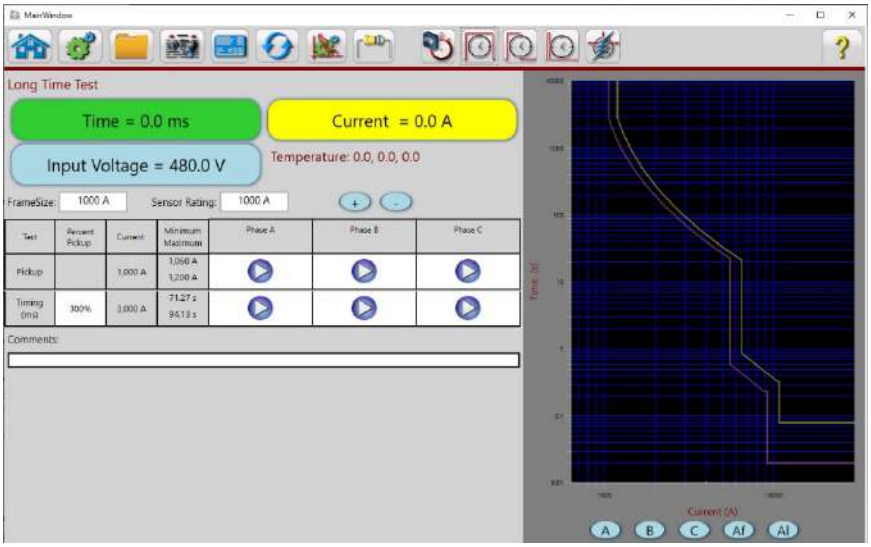

Figure 42 Example Long Time Test Screen

To perform a **LT Pickup** the same sequence as outlined in Generic LT tests are used.

4.3.3.4.2 **Short Time Tests**

There are two types of tests for Short Time: **ST Pickup** and **ST Timing**. The software defaults to timing at 133% of Pickup, but this can be modified to any value desired by the user. Also, additional timing tests can be added by click the "+" button next to the sensor rating. See figure below.

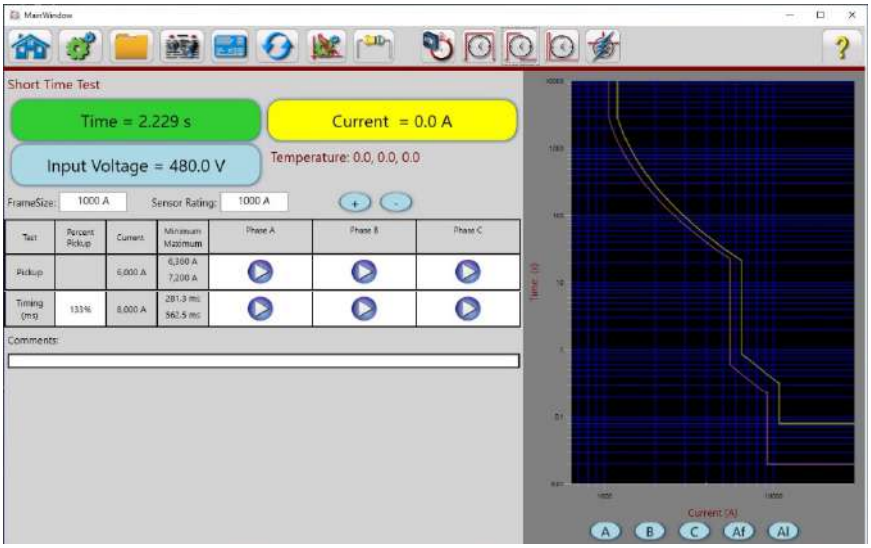

Figure 43 Example Short Time Test Screen

To perform a **ST Pickup**, press the play button in the **Pickup** row under the **Phase** desired to be tested. Then a screen will appear showing the details of the test. See figure below.

Figure 44 Example Short Time Pickup Test Description

Any of the white boxes can have the values changed by pressing the Advanced button, but in most cases the defaults are sufficient. These include:

- **Start% of Output** – This is the level of output (in % of transformer) that the test will start at. The unit pules current (based on Pulse Time) and measures the amount of current applied to the output. The unit uses this feedback to approximate the desired current and applies another pulse. It will do this several times until the desired start current is reached.
- **Rest Time** – This is the rest time between search pulse.
- **Stop Precent** – This is the percent of LT Pickup that you want to start the test at. Typically, 80% is an acceptable level to start looking for LT Pickup. The unit will do several search pulses until this level is found. Then it will start the test.
- **Percent Increment** – This is the amount of current the unit will increment as the current ramps up looking for Pickup.
- **Ramp Pulse Time** – This is the amount of time the pulse will be applied. Note that the unit looks at the max time in the Short Time curve and applies pulses for 135% of the max time. This ensures the pulses are long enough to trip Short Time.

To run the test, press the Blue Play button and the unit will find the start current and then ramp the current up, per the settings. The unit will apply pulses long enough to trip the ST element and keep increasing current until the breaker trips. The unit will record the trip current when the breaker trips.

To perform a **ST Time Delay test**, press the blue play button in the **Timing** row under the **Phase** that is desired to be tested. To change the pulse time, change the maximum trip time shown below. The test set will apply 35% more time than this setting.

Test	Percent Pickup	Current	Minimum Maximum
Pickup		500.0 A	450.0 A 550.0 A
Timing (ms)	150%	750.0 A	500.0 ms 550.0 ms

Figure 45 Example ST Plus Length Description

4.3.3.4.3 **Instantaneous Tests**

There are two types of tests for Instantaneous, **Inst Pickup** and **Inst Timing**. The software defaults to timing at 110% of Pickup, but this can be modified to any value desired by the user. Also, additional timing tests can be added by click the "+" button next to the sensor rating. See figure below.

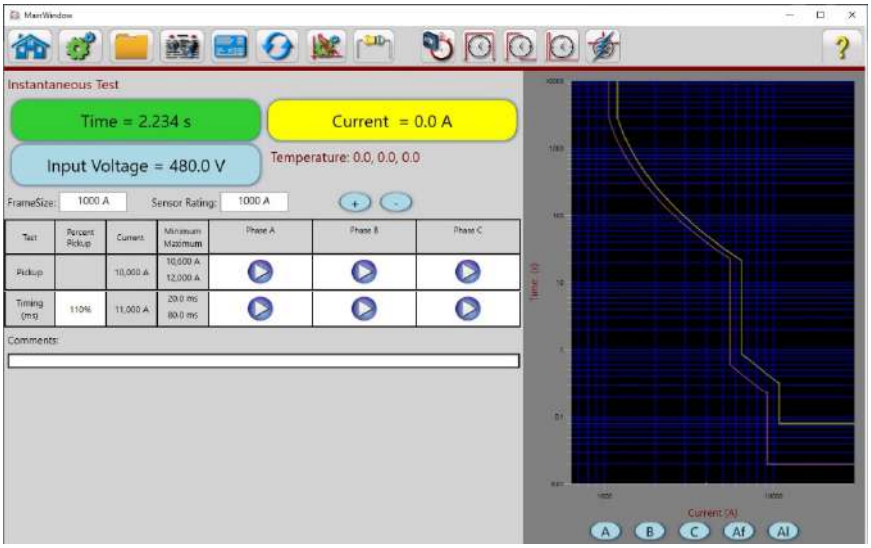

Figure 46 Instantaneous Test Screen

To perform an **Inst pickup**, press the blue play button in the **Pickup** row under the **Phase** desired to be tested. A screen will appear showing the details of the test. See figure below.

Figure 47 Instantaneous Pickup Test Description

Any of the white boxes can have the values changed by pressing the Advanced button, but in most cases the defaults are sufficient. These include:

- **Maximum Current** – Limits the test set to how high current can go during the test. This is a safety feature if desired.
- **Start% of Output** – This is the level of output (in % of transformer) that the test will start at. The unit pules current (based on Pulse Time) and measures the amount of current applied to the output. The unit uses this feedback to approximate the desired current and applies another pulse. It will do this several times until the desired start current is reached.
- **Rest Time** – This is the rest time between search pulse.
- **Pulse Time** – This is how long the search pulse last.
- **Start Precent** – This is the percent of LT Pickup that you want to start the test at. Typically, 80% is an acceptable level to start looking for LT Pickup. The unit will do several search pulses until this level is found. Then it will start the test.

- **Acceptable Current Band** – This is the amount of error accepted when finding the starting current for the test.
- **Percent Increment** – This is the amount of current the unit will increment as the current ramps up looking for Pickup.
- **Ramp Pulse Time** – This is the amount of time the pulse will be applied. Typically, breakers trip in 3-5 cycles for Inst and the default setting is 106ms (6 cycles)

To run the test, press the blue play button and the unit will find the start current and then ramp the current up, per the settings. The unit will apply pulses long enough to trip the Inst element and keep increasing current until the breaker trips. The unit will record the trip current when the breaker trips.

To perform an **Inst Timing** test, press the blue play button in the timing row under the **Phase** that is desired to be tested. The setting screen shown in the figure below will appear.

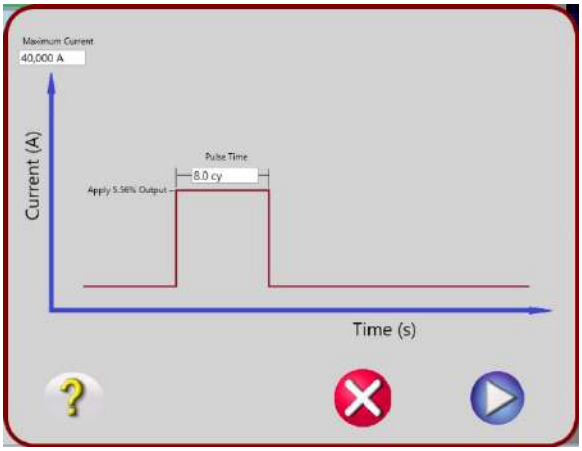

Figure 48 Instantaneous Timing Test Description

The default values in this screen will work for most tests, but any value in the white boxes can be changed. These include:

- **Maximum Current** – Limits the test set to how high current can go during the test. This can be a safety feature if desired.
- **Pulse Time** – This is how long the pulse will last. The pulse time will default to 8 cycles.

Once the settings are ready press the blue play button. The software will calculate the current needed based on the **Inst Pickup** test that was done. The test set will apply to the test current. The test set will record the time it takes to trip the Inst element.

4.3.3.4.4 **Ground Fault Tests**

There are two types of tests for Ground Fault, **Pickup** and **Timing**. The software defaults to timing at 150% of Pickup, but this can be modified to any value desired by the user. Also, additional timing tests can be added by click the "+" button next to the sensor rating. See figure below.

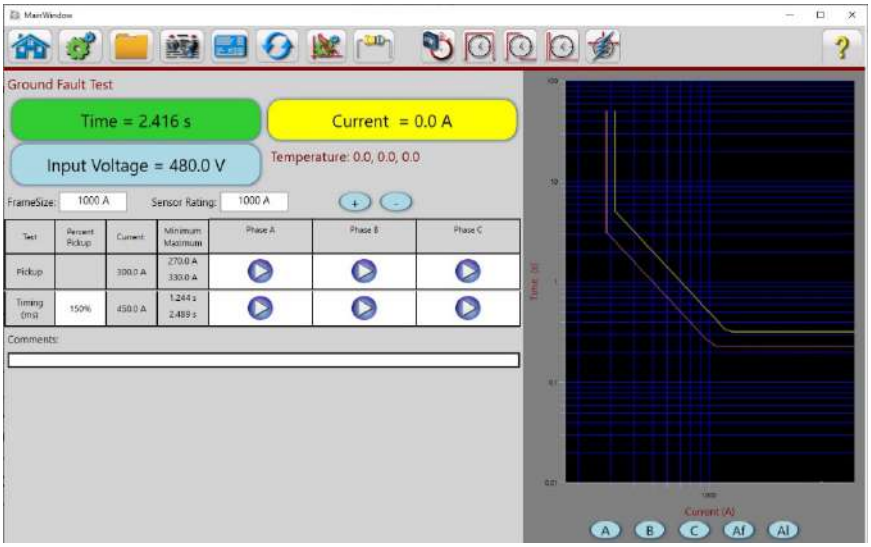

Figure 49 Ground Fault Test Screen

To perform a **Ground Fault Pickup**, press the blue play button in the **Pickup** row under the **Phase** desired to be tested. Then a screen will appear showing the details of the test. See figure below.

Figure 50 Ground Fault Pickup Test Description

Any of the white boxes can have the values changed by pressing the Advanced button, but in most cases the defaults are sufficient. These include:

- **Maximum Current** – Limits the test set to how high current can go during the test. This is a safety feature if desired.
- **Start% of Output** – This is the level of output (in % of transformer) that the test will start at. The unit pules current (based on Pulse Time) and measures the amount of current applied to the output. The unit uses this feedback to approximate the desired current and applies another pulse. It will do this several times until the desired start current is reached.
- **Rest Time** – This is the rest time between search pulse.
- **Pulse Time** – This is how long the search pulse last.
- **Start Precent** – This is the percent of LT Pickup that you want to start the test at. Typically, 80% is an acceptable level to start looking for LT Pickup. The unit will do several search pulses until this level is found. Then it will start the test.
- **Acceptable Current Band** – This is the amount of error accepted when finding the starting current for the test.
- **Percent Increment** – This is the amount of current the unit will increment as the current ramps up looking for Pickup.

- **Ramp Pulse Time** – This is the amount of time the pulse will be applied. Typically, breakers trip instantaneous to 300 ms for Ground Fault.

To run the test, press the blue play button and the unit will find the start current and then ramp the current up, per the settings. The unit will apply pulses long enough to trip the Ground Fault element and keep increasing current until the breaker trips. The unit will record the trip current when the breaker trips.

To perform a **Ground Fault Timing** test, press the blue play button in the timing row under the **Phase** that is desired to be tested. The setting screen shown in the figure below will appear.

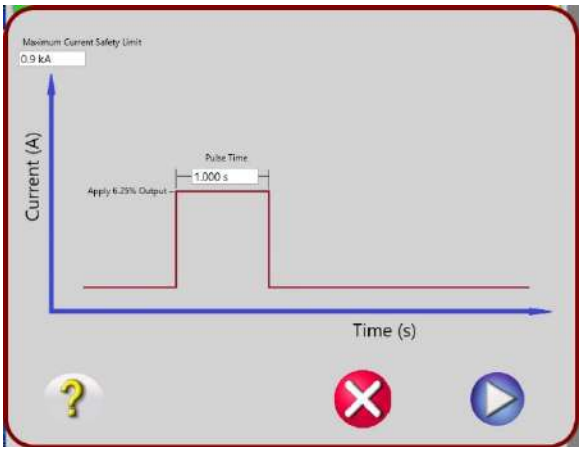

Figure 51 Ground Fault Timing Test Description

The default values in this screen will provide work for most testing, but any value in the white boxes can be changed by clicking in the window. These include:

- **Maximum Current** – Limits the test set to how high current can go during the test. This is a safety feature if desired.
- **Pulse Time** – This is how long the pulse will last. The pulse time will default to 8 cycles.

Once the settings are ready press the blue play button. The software will calculate the current needed based on the **Ground Fault Pickup** test that was done. The test set will apply the test current. The test set will record the time it takes to trip the Inst element.

If the breaker to be tested is a Molded Case breaker press the **Breaker Type Air Frame** button, and the following list will be provided.

Figure 52 Breaker Type Options

Click on **Molded Case** and the **Manufacturers Curve**, and the following Options window will appear.

Figure 53 Breaker Manufacturers List

Select from the available manufacturers. If the manufacturer for your breaker does not exist go back and use the **Generic Breaker**. NOTE: New manufacturers TCC's will be added to the software from time to time. Check with your Megger sales representative regarding additional breaker TCC's, or check the Megger website to see if a new version of software is available to download, see section 5.3 for more information.

Tests are similar to those described for the air frame breakers.

5.0 Maintenance

NOTE: There are no user replaceable parts within this product.

5.1 General Maintenance

Ensure the unit is kept clean and dry after use. Test cables and adaptors should be checked before use for damage and continuity.

The unit utilizes surface mount technology (SMT) and other components which require little or no service. The unit should be serviced in a clean atmosphere away from energized electrical circuits.

5.2 Cleaning

Never use spray liquids or industrial cleaners. Some cleaning solvents can damage electrical components and should never be used. Remove dust with dry, low pressure, compressed air. Use a lightly damp cloth (not dripping wet) to wipe off the outer surface of the unit.

5.3 Updating SPI2000 Software and Firmware

Download Firmware Upgrade via Megger Website

Updating Firmware via Megger Website
To download the latest SPI software from the Megger website. The software contains both the GUI and the firmware for the unit.

1. Go to WWW.Megger.com
2. **Log In**. If you have not registered before, you will need to do so first.

3. Go to **Products** / **Circuit Breaker test equipment** / **Primary Injection test systems** and click on the picture of the SPI2000 unit.
4. Click on the **Software** tab
5. Click on the **SPI ↓Download** button
6. Install the software on the STVI or a PC
7. Connect to the SPI2000 and if the firmware needs to be updated it will prompt the user and step through the installation of the firmware. The firmware is part of the software downloaded and will be updated.

USB Memory Stick: With the SPI2000 powered up, insert the USB memory stick into the USB type A port on top of the STVI or your PC. Press the **Configuration** Screen button, with the **General** tab highlighted press **Update System** button. At that point the user will be presented with a window that shows the Current Software version. The software will try to find the software on the USB stick. If it cannot find the software use the Browse button to search for the USB stick. When discovered the software upgrade process will automatically start. Observe the touch screen display, and the unit. At the completion of the download there will be an instruction to reboot (turn off and back on) the test system.

The rest of this page is intentionally left blank

6.0 Specifications[2]

See datasheet for specifications.

7.0 Accessories

See data sheet for list of included and optional accessories.

7.2 Optional accessories

Additional Optional Test Leads and Accessories can be ordered individually, see data sheet for list of optional accessories.

8.0 Calibration, Repair and Warranty

Megger operates fully traceable calibration and repair facilities to make sure your instrument continues to provide the high standard of performance and workmanship that is expected. These facilities are complemented by a worldwide network of approved repair and calibration companies, which offer excellent in-service care for your Megger products.

Since the SPI2000 uses Surface Mount Technology, repairs are beyond the basic capabilities of the majority of customers, and should be referred to the Service Department at Megger or handled through the Megger Representative.

For calibration and service requirements for Megger SPI2000 instruments contact:

Megger
4545 W Davis Street
Dallas, Texas 75211-3422 USA.
PHONE: 1-214-330-3519
FAX: 1-214-331-7399

[!] 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.**

8.1 Warranty

Megger warrants the equipment sold by Megger, or our authorized agents, to be free from defects in material and workmanship, reasonable wear and tear excluded, for a period of 12 months from date of shipment. Since Megger has no control over conditions of use, no warranty is made or implied as to suitability for customer's intended use beyond the units normal performance specifications. No other warranty is either expressed or implied. Megger shall not be liable for consequential damages.

Warranty service will be performed on the equipment at the Megger factory. The customer shall prepay shipping charges for units returned to Megger. Megger shall pay for the return of the repaired or replaced unit to the customer (repair or replace at Megger's option), provided that the Instrument has not been altered, modified or repaired by unauthorized personnel, and that our examination discloses to our satisfaction that any improper operation or failure was not the result of improper use, negligence or accident, exceeding environmental limits, or connecting the Instrument to incompatible equipment. The customer is asked to obtain a return authorization number from Megger PRIOR TO returning a unit for service, see Return Procedure.

---

[2] Megger reserves the right to change product specifications at any time without notice.

[2] Accuracies specified within 23° ± 5° C (73° ± 9° F) in the frequency range of 45 to 65 Hz, and after warm-up of 20 min.

[3] Accuracies specified within 23° ± 5° C (73° ± 9° F), and after warm-up of 20 min.

8.2 Return Procedure

1. When an instrument requires recalibration, calibration certification, or in the event of a repair being necessary, a Return Authorization (RA) number must first be obtained from the address shown above. The following information is to be provided to enable the Service Department to prepare in advance for receipt of your instrument and to provide the best possible service to you:
   - Model number, SPI2000.
   - Serial number (found on the display under Configuration, System tab, or on the unit enclosure, or on the calibration certificate).
   - Reason for return (for example, calibration required, or repair).
   - Details of the problem if the instrument is to be repaired.
   - Provide a return address, your name, and how to contact you should the factory need to discuss the service request.

2. Make a note of the RA number. A return label can be emailed or faxed to you if required.

   ! 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.

3. 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.

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

4. Before the instrument is sent to Megger, freight prepaid, make sure that the return label is attached or that the RA number is clearly marked on the outside of the package, and on any correspondence. Copies of the original purchase invoice and packing note should be sent simultaneously by airmail to expedite clearance through customs. In the case of instruments which require repair outside the warranty period, an immediate quotation can be provided when obtaining the RA number.
5. Track the progress on line at www.megger.com

8.3 Lifting and Transporting

Lifting and transporting the unit is necessary to move the unit to and from the job site. The following are brief descriptions and recommendations for moving the unit.

8.3.1 Lifting

The weight of the SPI2000, *without accessories*, is 116 lbs. or 52.6 kg. The cube measurement of the unit is 2.8 ft^3 or 0.079 m^3. Lifting the unit will require appropriate lifting techniques. Two-person lift is recommended.

8.3.2 Transporting

The unit should be strapped to a pallet when shipping, use the optional shipping case, or use the original box supplied with the unit

9.0 Decommissioning

9.1 **WEEE Directive**

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. Please utilize your local WEEE collection facilities, or observe all applicable local requirements.

Megger is registered in the UK as a Producer of Electrical and Electronic Equipment. The Registration No is WEE/HE0146QT.

For further information about disposal of the product consult your local Megger company representative or distributor or visit your local Megger website.