

# SPI4000

## Smart Primary Injection test system

# Megger<sup>®</sup>



- Up to 40000 A output
- Smallest primary injection test system in class
- Regulated output current
- Designed for switchgear commissioning, circuit breaker, ground grid and relay testing
- Software includes hundreds of circuit breaker TCC curves

### DESCRIPTION

The SPI4000 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, overcurrent relays, and thermal relays via primary injection. The SPI4000 is designed to test a wide range of circuit breakers, with ratings up to 4000 Amps frame size. The unit is fully compliant with NEMA AB-4 test guidelines.

The SPI system is the FIRST high current test system that allows you to type in a predetermined current amplitude and 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 you to determine and manually adjust the firing angle for different loads and circuit breakers.

The SPI4000 test system has the ability to be manually controlled with Megger's Smart Touch View Interface™ (STVI) handheld controller running Megger's PowerDB software. The STVI, with its large, full color, high resolution, TFT LCD touch screen allows you to perform manual, or fully automated testing quickly and easily.

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

Megger's PowerDB software gives you the ability to download a TCC (Time Current Curve) into the SPI test system. By using a downloaded curve, you will be provided with 'Pass/Fail' results directly on the SPI test report. This gives you an immediate answer to whether the test sample is working correctly or requires maintenance. Every SPI4000 unit is supplied with the PowerDB software for installing on a PC.

### APPLICATIONS

Universal in application, the SPI4000 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.

### FEATURES AND BENEFITS

**Optional STVI large color TFT touch screen interface** - Easy to use and read (even in direct sunlight) display provides control of the test set. Color contrasts accentuate vital information. This reduces human error and time in testing. The SPI touch screen input eliminates the confusing menu system of other primary injection and circuit breaker test systems. This makes the SPI simple for any technician to operate - even if the technician does not use the SPI on a consistent basis.

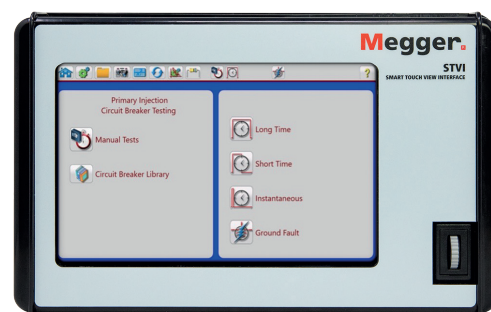


Figure 1: Smart Touch View Interface for SPI4000

**DC offset elimination** - DC offset is a common problem when testing instantaneous trips on low voltage circuit breakers. A standard high current test system will commonly cause DC offset in the initial 2 to 4 cycles of an output waveform. This DC offset will cause circuit breakers to trip at incorrect current amplitudes and therefore provide incorrect results.

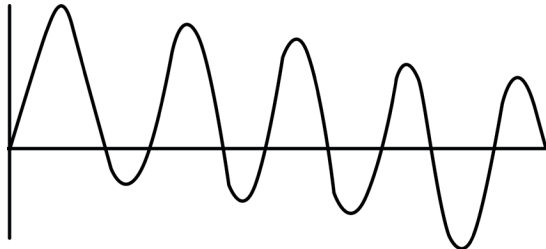


Figure 2: DC offset in test current

Firing angle control is a common method of reducing DC offset (Figure 2). Controlling the firing angle of a high current test system does eliminate the DC offset of the current waveform, but the common problem is determining where to set the firing angle. Some highly resistive test samples, such as molded case circuit breakers with test cables, require a firing angle between 10 and 30 degrees, while air frame breakers connected with a busbar require firing angles between 50 and 85 degrees. The SPI system not only has the ability to change the firing angle for different loads, but it also has the unique ability to automatically adjust the firing angle. This reduces testing time and provides a consistent test result.

**Current decay** - When performing primary injection testing, the test leads, or test sample, will heat up due to the high currents applied. This will result in current decay (Figure 3) unless the operator manually intervenes. This manual intervention can cause inconsistent test results due to the decisions made by the individual operator.

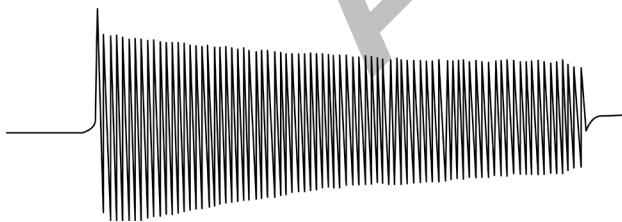


Figure 3: Current decay

The SPI system eliminates all of these problems by providing a constant current output (Figure 4) from the beginning of the waveform until test completion.

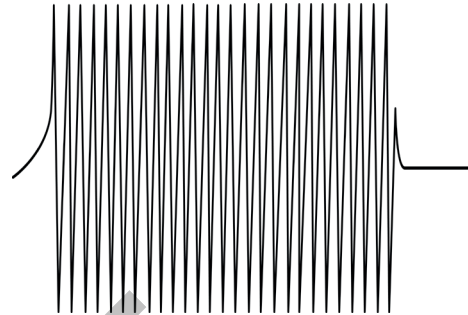


Figure 4: Constant current amplitude

**Construction** - The test set is built for years of trouble-free, reliable operation. It features rugged instrumentation and controls designed to withstand the vibration and shock of frequent transportation.

**Output stabs** - The SPI4000 stab sets permit direct connection of draw-out type breakers. Their long length allows easy connection without any interference between the test set enclosure and the breaker.

**Protection** - Circuit breaker and overload protective devices are incorporated. Temperature sensors provide protection from overheating. An emergency stop push button is provided to de-energize all input power to the test set.

**Ground safety interlock** - An interlock circuit ensures that the test set chassis is connected to system ground.

**Accessory outlet** - A ground-fault protected, 120-volt accessory outlet with a capacity of 0.4 kVA is provided for convenient connection of accessory equipment.

**Ethernet port** - The Ethernet port is the primary PC connection port. It also serves as the PoE (Power over Ethernet) port when used to connect to the STVI.

### PowerDB SOFTWARE

The SPI4000 utilizes Megger's premier PowerDB instrument control software using either a PC or Megger's optional STVI touch screen controller. The SPI application software allows you to perform primary injection testing on a multitude of test objects:

- Low voltage circuit breaker
- Substation switchgear
- Current transformers

The SPI application's simplified main screen user interface (Figure 5) makes it easy for users to learn to use the instrument.

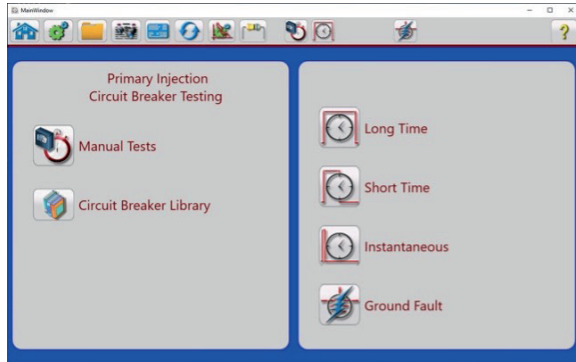


Figure 5: SPI user interface

**Manual control** - Manual control of the SPI system may sometimes be the desired test method. Primary injection testing is simplified by permitting you to simply type in the test current required (Figure 6). No need for hunting around and manually adjusting the test current amplitude. The SPI system will automatically set the current.

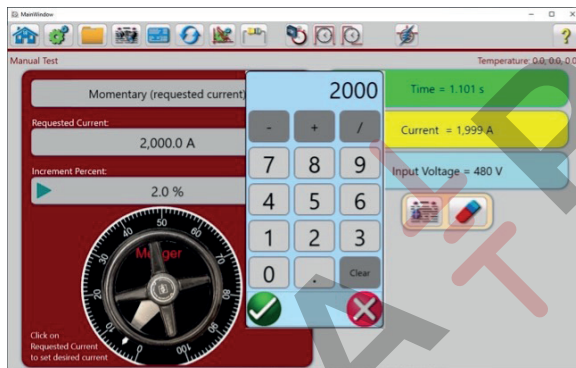


Figure 6: Manual entry of required test current

Even after the current output is initiated, the SPI system automatically regulates the output to ensure that the test current is maintained, even if test sample heating changes the load resistance.

Most primary injection systems require the user to turn on the system high current, and then manually adjust the output until the desired test current is set. Once the output is set, the user must still manually adjust the output in order to maintain the desired current during the test. The SPI system eliminates both of these issues.

Using the optional STVI permits an operator to run any of the standard tests required for primary injection as well as low voltage circuit breakers without the need for a computer. Some of the most common tests that can be performed without a computer are:

- Pickup test
- Long time trip test
- Short time trip test
- Instantaneous trip test
- Ground fault trip test

**Automatic control** - In order to simplify testing, the SPI software is pre-loaded with a library of manufacturers circuit breaker time-curves (Figure 7). You can test all breaker parameters including:

- Long time pick up
- Long time timing
- Short time pick up
- Short time timing
- Instantaneous pick up
- Ground fault pick up
- Ground fault timing

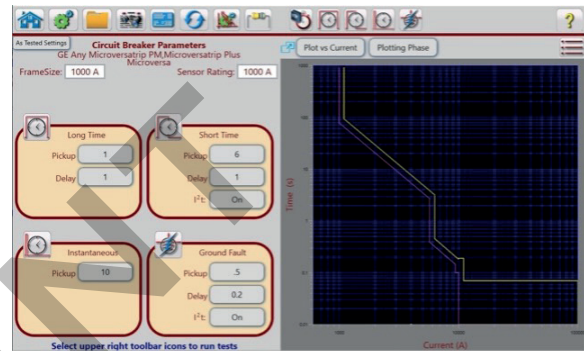


Figure 7: GE microstrip curves

When a breaker curve is selected from the application's library, the software can provide you with immediate pass/fail test results, and you can see the test points plotted directly on the breaker's trip curve. The application will also generate a test report for you. This eliminates the need for you to write down results, check the results against the curve, and validate whether the circuit breaker passed. If a breaker curve from the library was selected, the test report will also include the manufacturer's time current curve (Figure 8).

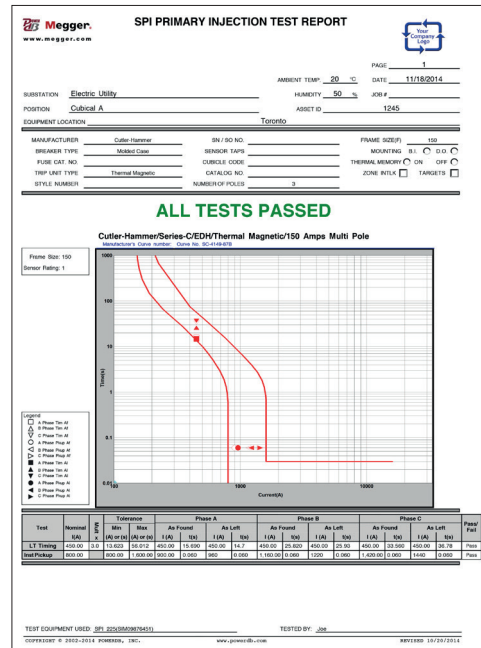


Figure 8: SPI test report

# SPI4000

## Smart Primary Injection test system



### SPECIFICATIONS<sup>1</sup>

#### Input

Model	Input Voltage	Input Current	Input Frequency
SPI4000	480 V +/-5%	225 A	60 Hz

The unit will produce maximum rated output when the input is as specified in the above table. The unit auto-senses the input voltage and can run on any input voltage down to 260 volts, with possible limitations. The unit can run with a 240-volt input, with the 240-volt mode selected, and will produce ½ of rated output.

#### Output

**Output circuit:** The output of the test set is easily adjustable from zero to the maximum current available through the impedance of the device under test. Multiple output ranges are provided to accommodate a variety of load circuit impedances. For high impedance devices, the output can be connected in series to increase the output voltage at a reduced maximum current. The maximum current available from the test set is determined primarily by the impedance of the load circuit, and the input voltage. The duration of the available current is determined primarily by thermal conditions within the test set.

**Maximum output current:** The SPI4000 will produce the following outputs at 480 V input voltage:

DUTY CYCLES FOR SPI4000 CIRCUIT BREAKER TEST SET (Current Rating through a Circuit Breaker)		
Current	Time On	Time Off
4,000 A	Continuous	N/A
4,500 A	30 Min	30 Min
6,000 A	15 Min	45 Min
15,000 A	2 Min	60 Min
40,000 A	2.5 Sec	12 Min

**Output connections:** To provide maximum utilization of the output available from the test set, each set is equipped with a Megger stab adapter board and stab sets Model CBS-1 and Model CBS-2 for use with draw-out style, metal-clad breakers. The stabs eliminate the significant losses that occur if leads are used to connect the breaker under test to the test set. Cables must be used when testing molded-case breakers or other devices which will not connect directly to the stabs.

### INSTRUMENTATION<sup>2</sup>

#### Digital ammeter

##### Operating mode

Memory  
Continuous

**Digital display:** Auto-ranging display with large numerals

**Ranges:** 400/4,000/40,000 A

##### Overall ammeter system accuracy

###### 400 amp scale:

Continuous ±1% of reading ± 1% of range  
RMS pulse ±1.5% of range  
Peak pulse ±2.0% of range

###### 4,000/40,000 amp scale:

Continuous ±1% of reading ± 0.1% of range  
RMS pulse ±1.5% of reading ± 0.1% of range  
Peak pulse ±2.0% of reading ± 0.1% of range

#### Digital timer

**Digital display:** Auto-ranging display with large numerals

##### Ranges

0.1-999.9 mS  
1.00 to 99999 seconds  
0.1 to 99999 cycles

**Accuracy:** ±1% of reading ±2 mS

#### Digital voltmeter

##### Operating mode

Input voltage  
External voltage (future)

**Ranges:** 0.0010 to 600.0 V

**Accuracy:** ±1% of reading ±1 LSD

#### Data input/output

**Ethernet:** 1 Port 10/100Mbit PC or STVI/POE connection

#### Dimensions

31 H X 34 W X 21 D (in) | 78.8 H X 86.4 W X 53.5 D (cm)

#### Weight

514 lbs. | 233 kg

#### Environmental

##### Operating temperature

0 ° to 50 °C

##### Storage Temperature

-30 ° to 70 °C

##### Humidity

IEC 60068-2-30  
0 to 90% non-condensing

#### Conformance standards

**Safety:** EN 61010-1, CSA

**Shock:** ISTA 1H Sequence #3

**Vibration:** ISTA 1H Sequence #2

**Electromagnetic compatibility**

**Emissions:** EN 61326-2-1, EN 61000-3-2/3,

FCC Subpart B of Part 15 Class A

**Immunity:** EN 61000-4-2/3/4/5/6/8/11

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

<sup>2</sup> 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.

# SPI4000

## Smart Primary Injection test system

### ORDERING INFORMATION









Description	Part Number
SPI4000 Smart Primary Injection Test System, 480 V 60 HZ - Solid Wheels	SPI-4000S
SPI4000 Smart Primary Injection Test System, 480 V 60 HZ - Pneumatic Wheels	SPI-4000P

### INCLUDED STANDARD ACCESSORIES

Description	Part Number
Stab Adapter Set (allows for use of standard stab sets)	V1015-563 & V1015-564
Input Leads, 15 ft. (4.5m) 4/0 cable, 2 each	2016-714
Series Stab Bar, used to connect the output stabs in series	2016-672

### ADDITIONAL OPTIONAL ACCESSORIES

Additional optional test leads and accessories can be ordered individually, see description and part numbers below. **The following accessories and part numbers are in quantities of 1 each. Order the appropriate number required.**

Descriptions of optional test leads and accessories		Part number
	<b>Ground Cam-Lock Adapter:</b> 15 ft. (4.5 m) #2 AWG cable	1015-592
	<b>CBS-FLEX Adapter:</b> Used to connect the output stabs to virtually any air frame breaker	CBS-FLEX Kit
	<b>CBS-3 Circuit Breaker Stab Sets:</b> Breakers that require a set of stabs designed specifically for that breaker can be accommodated by Model CBS-3 stab sets. The most common breakers requiring Model CBS-3 stabs are listed in the CBS-1, CBS-2 and CBS-3 data sheet ordering information.	See CBS-1, CBS-2 and CBS-3 Data Sheet
	<b>Smart Touch View Interface</b> Handheld Controller for SPI4000	STVI-10
	<b>Sleeved pair of test leads:</b> Red and black sleeved leads with retractable safety shrouds, use with timer, or binary I/O, 200 cm long (78.7 in) 600 V/ 32 Amps CAT II, RoHS compliant	2008-539-2
	<b>Alligator clip, red</b> Use with test leads up to 1000 V/32 A CAT III	684006
	<b>Alligator clip, black</b> Use with test leads up to 1000 V/32 A CAT III	684007
	<b>4 X 0.5 inch Stab Set</b> (Copper)	CBS-1
	<b>4 X 0.5 inch Stab Set</b> (Aluminum)	CBS-1A
	<b>4 X 0.75 inch Stab Set</b> (Copper)	CBS-2
	<b>4 X 0.75 inch Stab Set</b> (Aluminum)	CBS-2A

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