SPI2000
Smart Primary Injection test system

- **Up to 20,000 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 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, 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 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 SPI2000 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 the user 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 Thumb drive to transfer or print test reports.

Megger's PowerDB software 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. Every SPI2000 unit is supplied with the PowerDB software for installing on a PC.

APPLICATION

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.

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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.

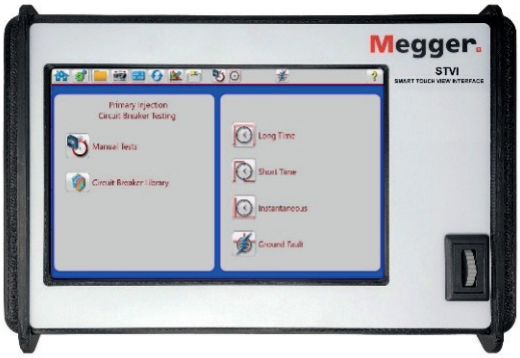

Figure 1: Smart Touch View Interface for SPI2000

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.

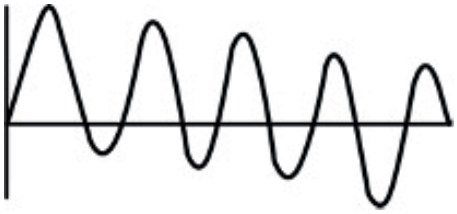

Figure 2: DC offset in test current

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 breaker with test cables, require a firing angle between 10 and 30 degrees while air frame breaker connected with buss bar 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 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.

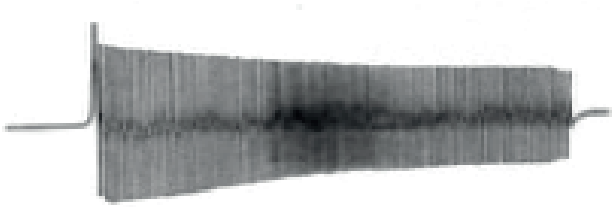

Figure 3: Current decay

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.

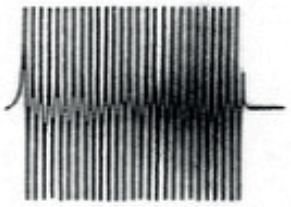

Figure 4: Constant current amplitude

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 SPI2000 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.

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Protection
Circuit breaker and overload protective devices are incorporated. Temperature sensors provide protection from overheating. An Emergency stop pushbutton 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.

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 SPI2000 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 a user 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) means that users can easily learn to use the instrument.

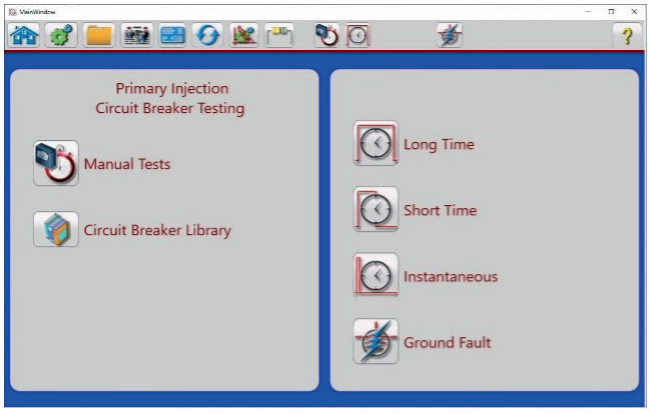

Figure 5: SPI User Interface

Manual control
Manual control of the SPI system may sometimes be the desired test method. Primary injection testing is simplified by permitting the user 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.

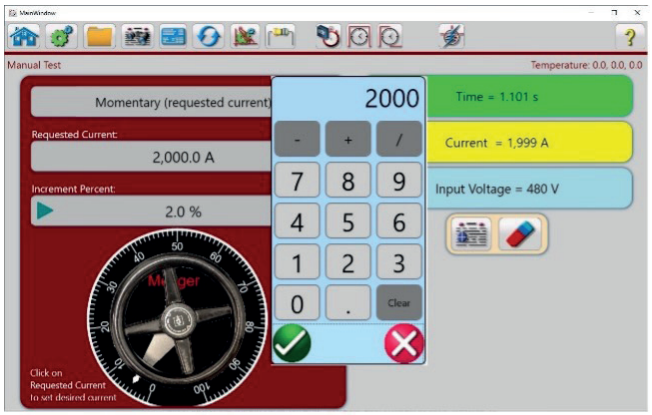

Figure 6: Manual entry of required test current

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 test 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

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Automatic Control

In order to simplify testing the SPI software is pre-loaded with a library of manufacturers circuit breaker time-curves (Figure 7). The user 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

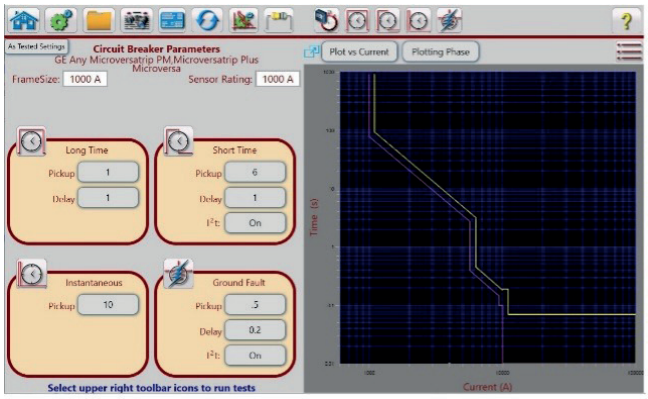

Figure 7: GE Microversatrip curves

When a breaker curve is selected from the application's library, the software can provide the user with immediate pass/fail test results, and the user can see the test points plotted directly on the breaker's trip curve. The application will also generate a test report for the user. This eliminates the need for the user 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).

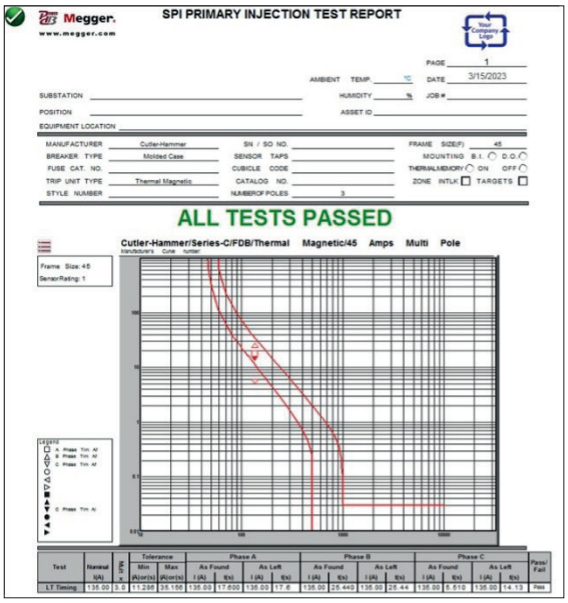

Figure 8: SPI test report

SPECIFICATIONS[1]

Input

Model	Input Voltage	Input Breaker Required	Input Frequency
SPI2000-240	240V +5/-20%	30-125 A*	60 Hz
SPI2000-480 (future release)	480V +5/-20%	30-125 A*	60 Hz

***Breaker Size depends on application**

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 190 volts, with possible limitations.

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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 SPI2000 will produce the following outputs at 100% of nameplate input voltage. 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 booster will get the output up to 20,000 amps and allow the user to be able to test up to a 2000 amp breaker.

Duty cycles for SPI2000 circuit breaker test set

(Current Rating through a Circuit Breaker)

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

*3X boosters will be released first quarter of 2026.

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.

Parallel Connection with 1 booster

Parallel Connection with 2 boosters

Series Connections

The SPI2000 can be operated in series mode to increase output voltage. This helps produce current with longer cables on the output. Up to two boosters can be used. See table below for max series voltage at full nameplate input voltage.

	Open Circuit Voltage
Main Unit	6.4V
With 2X booster	12.8V
With two 2X boosters	19.2V
With 3X booster*	19.2V
With two 3X boosters*	32V

Series Connection with 2 boosters

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INSTRUMENTATION[2]

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 ±2mS

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 I Port 10/100Mbit PC or STVI.POE Connection

Dimensions
23 H X 19 W X 12 D (in.)
58.4 H X 48.3 W X 30.5 D (cm)
Main unit and boosters dimensions are identical

Weight
Main Unit: 116lbs/52.6 kg
2X Booster: 92lbs/41.7kg
3X Booster: 145lbs/67.8kg

Environmental
Operating Temperature: 0 °C to 50 °C
Storage Temperature: -30 °C to 70 °C
Humidity: IEC 60068-2-30, 0 to 90 % non-condensing

Conformance standards Safety: EN 61010-1
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

[1] Megger reserves the right to change product specifications at any time.
[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.

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ORDERING INFORMATION

DESCRIPTION	PART NUMBER
SPI2000 Smart Primary Injection Test System, 240V 60 HZ	**SPI2000-240**
SPI2000 Smart Primary Injection Test System, 480V 60 HZ	**SPI2000-480**
SPI2000 2X Booster, 240V 60 HZ	**SPI2000B2X-240**
SPI2000 2X Booster, 480V 60 HZ	**SPI2000B2X-480**
SPI2000 3X Booster, 240V 60 HZ	**SPI2000B3X-240**
SPI2000 3X Booster, 480V 60 HZ	**SPI2000B3X-480**

INCLUDED STANDARD ACCESSORIES

Included standard accessories	Part number
Input Leads, 15 ft. (4.5m), #4 cable, 2 ea.	**17156**
GND Lead, 15ft. (4.5m), #4 cable, 1 ea.	**1017-154**
Parallel Stab Bar, 0.5" (12.7mm), 2 ea.	**2018-017**
Series Stab Bar, 0.5", used to connect the output stabs in series, 1ea.	**2018-019**
Accessory carry case: Used to carry power cord, ethernet cable, optional STVI, test leads and accessories	**90001-165**
Accessory carry case: Used to carry bolts and nets.	**2006-528**
Ethernet cable: for interconnection to PC 210 cm (7 ft.) long	**90038-983**

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 Additional Optional Test Leads and Accessories	Part number
	**Output Leads:** 2ft. (0.6m), Double 4/0 AWG Cables	**1017-413**
	Output Leads: 5ft. (1.52m), Double 4/0 AWG Cables	**1017-407**
	**Output Leads:** 2ft. (0.6m), Quadruple 4/0 AWG Cables	**1017-414**
	Output Leads: 5ft. (1.52m), Quadruple 4/0 AWG Cables	**1017-408**
	**Ext Voltage Cable:** 5ft. (1.52m), BNC to Banana	**90047-695**

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	Descriptions of Additional Optional Test Leads and Accessories	Part number
	**Transport case for SPI2000:** Hard-sided transit case for SPI2000. Transit case includes retractable handle, polyurethane wheels with stainless steel bearings, double-throw latches, fold down handles, and stainless steel hardware and padlock protection with O-ring seal, making the case watertight with an IP67 rating.	**1017-336**
	**Smart Touch View Interface:** Handheld Controller for SPI2000.	**STVI-10R**
	**Sleeved pair of test leads:** Red and black sleeved leads with retractable safety shrouds, use with timer, or binary I/O, 200 cm long (78.7”) 600 V/ 32 Amps CAT II, RoHS compliant.	**2008-539-2**
	**Alligator/Crocodile Clip:** Excellent for test connections to terminal screws and pins where spade lugs cannot be used.	
	Alligator clip, **red**, use with test leads up to 1000 V CAT III /32 Amps.	**684006**
	Alligator clip, **black**, use with test leads up to 1000 V CAT III /32 Amps.	**684007**

SALES OFFICE
Megger Limited
Archcliffe Road Dover
CT17 9EN England
T. +44 (0) 1304 502101
E. UKsales@megger.com

UNITED STATES
4545 West Davis Street
Dallas, TX 75211-3422
T 800.723.2861
T +1 214.333.3201
F +1 214.331.7399
E usasales@megger.com

SPI2000_DS_EN_V03
www.megger.com
ISO 9001