SPI500
Smart Primary Injection test system

Megger



- **2500 A output with main unit**
- **Up to 6500 A output with 2 boosters**
- **Add boosters for output capacity**
- **120 or 240 V input (auto detects input voltage)**
- **Designed for self-powered recloser, high-speed fuse, circuit breaker, or ground fault relay testing**
- **Software includes hundreds of circuit breaker TCC curves**

DESCRIPTION

The SPI500 is a high current primary injection test system for all forms of high current testing required in a substation, including testing electronic reclosers, circuit breakers, high speed fuses, and ground fault relays.

One SPI500 can control up to two SPI500B boosters (depending on the model) increasing its capability by three times. The SPI500 has a unique control system that allows a dynamic change of output to keep current at a constant level, even if the load is changing impedance during the test.

All SPI systems are fully automated and/or manually controlled. The Smart Touch View Interface (STVI) allows users to manually control the unit and perform automated testing. The SPI500 unit can be controlled by a PC for fully automatic testing and report generation.

APPLICATION

Universal in application, the SPI500 is a high current primary injection test unit with the ability to perform high current commissioning tests as well as test on low-voltage molded-case circuit breakers. A single SPI500 is designed to supply up to 2500 A. Adding one booster will produce up to 5000 A and a second booster up to 6,500 A.

The SPI500 is unique in that it can change output levels sub-cycle to test devices that have changing impedance such as self-powered reclosers. Self-powered reclosers have a large impedance when charging or drawing power for the electronics, and a very small impedance when fully charged. This creates dramatic changes in impedance that require continuous feedback to the controller to properly regulate the output current.

FEATURES AND BENEFITS

Smart Touch View Interface (STVI) is a simplified input and control touch screen

A key feature of the SPI system is the simplified touch screen input. The STVI touch screen input eliminates the confusing menu system of other primary injection and circuit breaker test systems. The touch screen makes the STVI simple for any technician to use even if the technician does not use the STVI on a consistent basis.

Automatic control

- The SPI system has many unique abilities to assist in testing.
- The user can type a high current setting then the SPI system will generate the requested output without additional user intervention.
- Automatically regulate the system's output to the pre-programmed setting.
- Automatically regulate the systems output current to compensate for test sample heating or changing impedance of the load.
- Deliver the requested current without user intervention.

Most primary injection systems require the user to turn on the system's high current output, 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 to maintain the desired test current. The SPI500 system eliminates both requirements.

Manual control

The STVI manual controller of the SPI system is sometimes the desired test method. The SPI system permits the operator to run any of the standard tests required for primary injection, as well as low voltage circuit breakers, without the need for a laptop computer.

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 therefore providing incorrect results. This conforms to ANSI/NEMA AB 4-2023 standard.

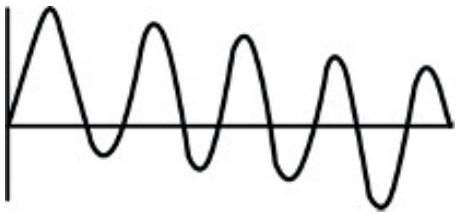


Figure 1: DC current with offset

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 unless the operator manually intervenes. This manual intervention can cause inconsistent test results that misinform the decisions made by the individual operator.

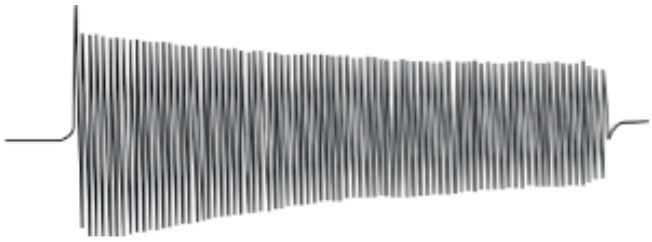


Figure 2: Current decay

The SPI systems eliminate all these problems by providing a constant current output from the beginning of the waveform until test completion.

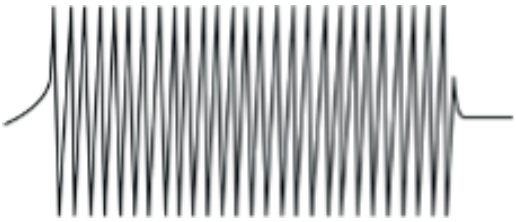


Figure 3: Current decay eliminated

Construction

This test set is built for years of trouble-free, reliable operation. SPI systems feature rugged instrumentation and controls designed to withstand the vibration and shock of frequent transportation.

Protection

Fuse, circuit breaker, and overload protective devices are incorporated into the SPI systems. Temperature sensors provide protection from overheating.

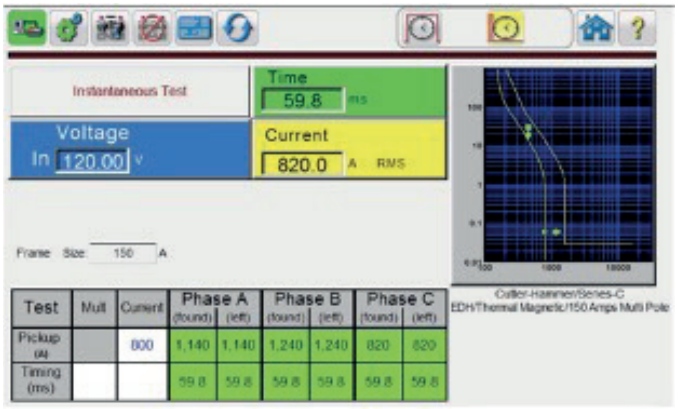


Figure 4: Manufacturer specific test screen

SPI software

SPI software is the premier software for automated testing, report generation, and maintenance record keeping of all primary injection and low voltage circuit breaker tests. These results are then recorded in the PowerDB database for archival or report generation.

The SPI software is specifically designed for primary injection testing of circuit breakers, self-powered reclosers, and other substation equipment. In order to simplify testing the SPI software is pre-loaded with circuit breaker curves in order to permit the user to verify that the circuit breaker under test is operating correctly. Since the SPI software has the curves pre-loaded 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

Included complex breaker curves

The SPI software includes report generation for all testing. Thus, the user can not only perform all the primary injection testing required and generate a report for an end customer or for historical purposes.

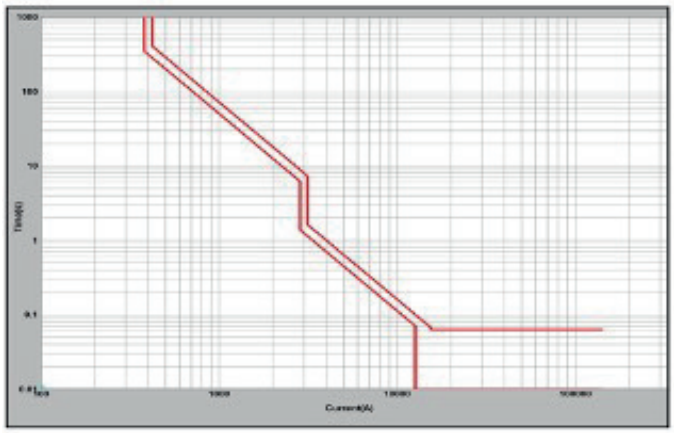


Figure 5: Complex breaker curves in the SPI500 software

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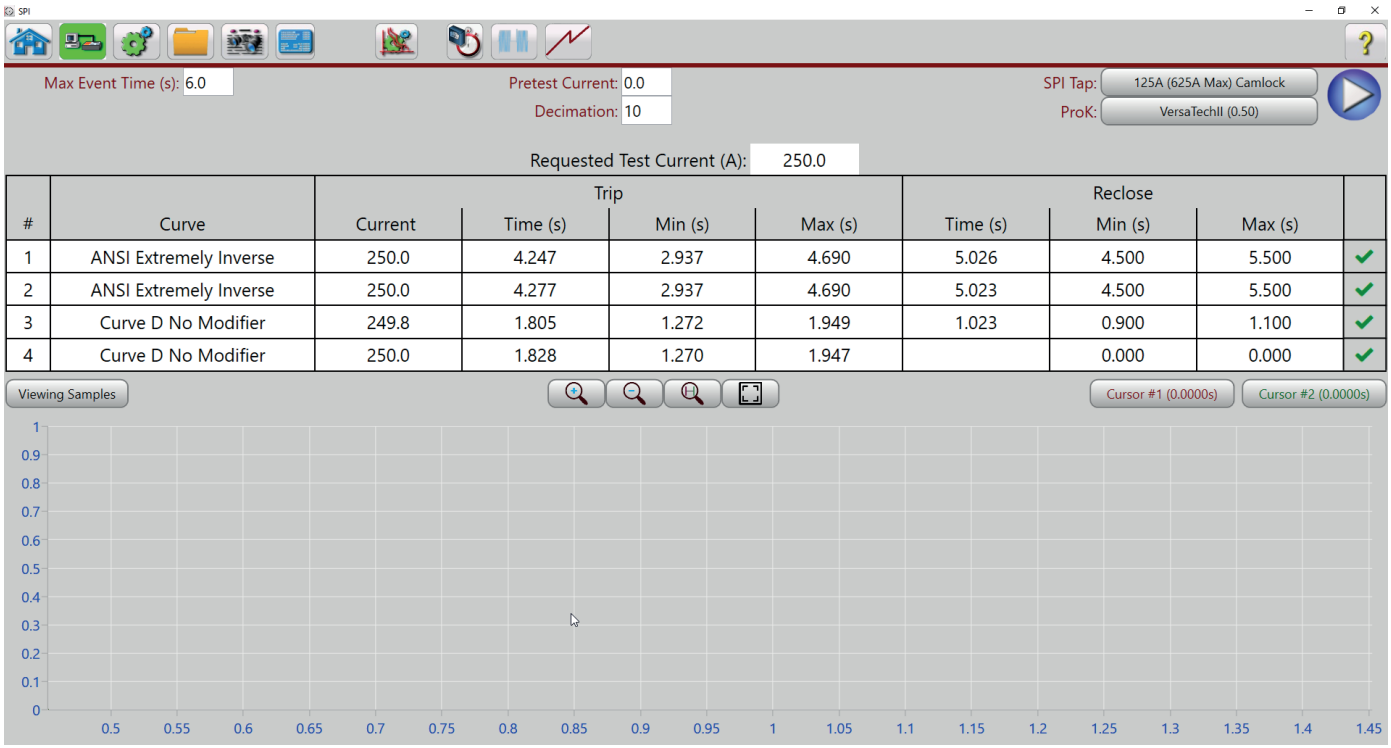
Self-Powered Recloser Testing

Self-powered reclosers present a unique challenge to test with primary injection. These recloser draws power from the current flowing through the line to power up the electronics in the recloser. Often, they draw power to charge capacitors or batteries to that store power for the electronics to ride through events. Therefore, sometimes the recloser is drawing high power from the current in the line to charge or power up, and sometimes it is drawing minimal power. This changing power demand causes a changing impedance seen by the primary injection test set and to keep constant current the test set must dynamically change output voltage to keep current steady. The SPI technology is the only test set on the market capable of changing output sub-cycle to keep a constant current.

The SPI500 can test electronic reclosers including:

- S&C TripSaver II
- Siemens Fusesaver
- Hubbell VersaTech II
- NOJA EcoLink
- ABB Eagle
- Any electronic recloser on the market

Below is an example of the test screen of the SPI500 testing shots to lockout. Note the Trip times and recloser times are recorded and can be compared to min and max trip times of the unit. I complete library of curves is provided and the user can select the proper curve to compare times with. The test is as simple as select the recloser type, input the settings to test, and push play to see the results.



#	Curve	Trip Current	Trip Time (s)	Trip Min (s)	Trip Max (s)	Reclose Time (s)	Reclose Min (s)	Reclose Max (s)	
1	ANSI Extremely Inverse	250.0	4.247	2.937	4.690	5.026	4.500	5.500	✓
2	ANSI Extremely Inverse	250.0	4.277	2.937	4.690	5.023	4.500	5.500	✓
3	Curve D No Modifier	249.8	1.805	1.272	1.949	1.023	0.900	1.100	✓
4	Curve D No Modifier	250.0	1.828	1.270	1.947		0.000	0.000	✓

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Booster Enabled

The SPI500 can control the output of the SPI500 and up to two SPI500B boosters. This dramatically increases the output power of the unit with lower cost boosters. The boosters are supplied with an umbilical cord that can be plugged into the main unit. The boosters can be placed in Parallel or Series to achieve higher output current or higher compliance voltage.



Booster Ports



SPI500 and SPI500B Connected in Parallel

Parallel/Series Operation

Up to two SPI500B units may be operated in a parallel or series configuration with a SPI500. This allows for higher current (up to 6500 A) or a higher compliance voltage. SPI500B units are powered by the main SPI500 unit therefore only one power cord is required.

Parallel Current

500 A Tap						
	30 Min	10 Min	3 Min	30 Sec	7 Sec	2 Sec
SPI500	500 A	600 A	1000 A	1500 A	2000 A	2500 A
SPI500 + Booster		1000 A	2000 A	3000 A	4000 A	5000 A
SPI500 + 2 Boosters		1500 A	3000 A	4500 A	6000 A	6500 A
Max voltage is 3.5V for parallel operations of 500 amp tap						

125 A Tap						
	30 Min	10 Min	3 Min	30 Sec	7 Sec	2 Sec
SPI500	125 A	150 A	250 A	375 A	500 A	525 A
SPI500 + Booster		250 A	500 A	750 A	1000 A	1050 A
SPI500 + 2 Boosters		375 A	750 A	1125 A	1500 A	1575 A
Max voltage is 14V for parallel operations of 125 amp tap						

-Ratings above are with unit powered by 240V.

-Ratings will be lower at 120V. Max continuous VA at 120V is 1800VA.

-Ratings are shown using 500 and 125 A taps (25 A taps are not published and measurement is estimated if 25 A tap is used in parallel)

Series Voltage

The SPI500 can be operated in series to increase output voltage. This helps produce current with longer cables on the output. Up to two boosters can be used. It is recommended to use 240V power with the boosters in this mode to achieve desired voltage. Results at 120 V will vary based on the strength of the input. See table below for max series voltage at 240 V input.

	500 A Tap	125 A Tap	25 A Tap
SPI500	3.5 V	14 V	70 V
SPI500 + Booster	6.3 V	25 V	130 V
SPI500 + 2 Boosters	9 V	30 V	180 V

Test Report

Megger
www.megger.com

SPI PRIMARY INJECTION TEST REPORT

Your Company Logo

PAGE 1

AMBIENT TEMP. 20 °C DATE 11/18/2014

SUBSTATION Electric Utility HUMIDITY 50 % JOB #

POSITION Cubical A ASSET ID 1245

EQUIPMENT LOCATION Toronto

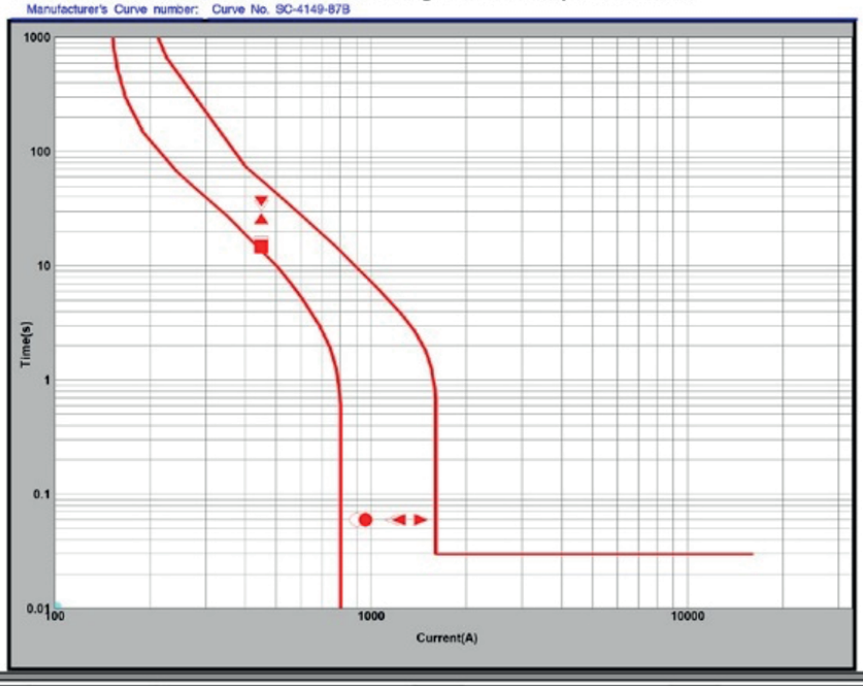
MANUFACTURER	Cutler-Hammer	SN / SO NO.		FRAME SIZE(F)	150
BREAKER TYPE	Molded Case	SENSOR TAPS		MOUNTING B.I. ○ D.O. ○	
FUSE CAT. NO.		CUBICLE CODE		THERMAL MEMORY ○ ON OFF ○	
TRIP UNIT TYPE	Thermal Magnetic	CATALOG NO.		ZONE INTLK ☐ TARGETS ☐	
STYLE NUMBER		NUMBER OF POLES	3		

ALL TESTS PASSED

Cutler-Hammer/Series-C/EDH/Thermal Magnetic/150 Amps Multi Pole

Manufacturer's Curve number: Curve No. SC-4149-87B

Frame Size: 150
Sensor Rating: 1



Legend
A Phase Tim Af
B Phase Tim Af
C Phase Tim Af
A Phase Pkup Af
B Phase Pkup Af
C Phase Pkup Af
A Phase Tim Al
B Phase Tim Al
C Phase Tim Al
A Phase Pkup Al
B Phase Pkup Al
C Phase Pkup Al

Test	Nominal	Mult	Tolerance		Phase A				Phase B				Phase C				Pass/ Fail
			Min	Max	As Found		As Left		As Found		As Left		As Found		As Left		
	I(A)	x	(A) or (s)	(A) or (s)	I (A)	t(s)	I (A)	t(s)	I (A)	t(s)	I (A)	t(s)	I (A)	t(s)	I (A)	t(s)	
LT Timing	450.00	3.0	13.623	56.012	450.00	15.690	450.00	14.7	450.00	25.820	450.00	25.93	450.00	33.560	450.00	36.78	Pass
Inst Pickup	800.00		800.00	1,600.00	900.00	0.060	960	0.060	1,160.00	0.060	1220	0.060	1,420.00	0.060	1440	0.060	Pass

TEST EQUIPMENT USED: SPI 225(SIM09876451) TESTED BY: Joe

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SPECIFICATIONS[1]

Input	Input voltage	Input current	Frequency
Standard (N)	115/230 V ± 15 %	15/8 A	60/50 Hz
CE compliant (C)	230 V ± 15 %	8 A	60/50 Hz

Output Taps (30 minute rating)

500 A at 3.5 V max
125 A at 14 V max
25 A at 70 V max

The output ranges will provide several times their current rating, provided the output/compliance voltage is sufficient to push the desired current through the impedance of the test circuit.

Ammeter

Operating mode: Memory, continuous
Accuracy between 10-100% of range:
- Continuous ± 1 % of reading
- RMS pulse ± 1.5 % of reading

Ranges:
- 500 A Tap – 7 kA, 70 0A, 70 A
- 125 A Tap – 1500 A, 150 A, 15 A
- 25 A Tap – 110 A, 11 A

Accuracy with boosters:
- Additional 1% decrease in accuracy when using boosters on 125- or 500-amp tap.
- Additional 1% decrease in accuracy when using 25 amp tap in parallel and accuracy not stated for 25-amp tap in parallel.

Timer range

Ranges: 0.001 to 99999 seconds
0.01 to 99999 cycles
Accuracy: ± 1 % of reading

Communications port

Ethernet (2)

Input Voltmeter**

Range:
AC: 1V–100V
DC: 5V–180V
AC Accuracy: 0.5% of readings ± 0.3% of range
DC Accuracy: 0.2% of readings ± 0.3% of range

**Input voltage specifications only valid on units with manufacturing date after 4/20/25. Previous models are binary inputs only.

Dimensions

(N): 14.2 W x 7.6 H x 12.0 D in.
(360 W x 194 H x 305 D mm)

(C): 14.2 W x 7.6 H x 17.0 D in.
(360 W x 194 H x 432 D mm)

Weight

Standard system (N):
47.5 lb. (21.5 kg)

CE compliant system (C):
50.7 lb. (23 kg)

Operating temperature range and humidity

Operating: 0 °C to 50 °C
Storage: -30 °C to 70 °C
Humidity: 0 to 90 % non-condensing

Conformance standards Safety: EN 61010-1

Shock: EN/IEC 60068-2-27
Vibration: EN/IEC 60068-2-6
Transit drop: ISTA 1A
Free fall: EN/IEC 60068-2-32
Drop/topple: EN/IEC 60068-2-31
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

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INCLUDED ACCESSORY DESCRIPTIONS

	Description	Part No.
	**Accessory carry case:** Used to carry power cord, Ethernet cable, optional STVI and test leads.	2003-725

Alligator clip: 4.1 mm, use with test leads up to 1000 V/32 A CAT III. Excellent for test connections to terminal screws and pins where spade lugs cannot be used.		
	Alligator clip, **red**, 4.1 mm	684006
	Alligator clip, **black**, 4.1 mm	684007

Sleeved pair of test leads with retractable shroud: Sleeved test leads, one **red**, one black, 200 cm (78.7 in) long, 600 V, 32 A CAT II		
	Sleeved test leads in pairs will reduce tangling. These leads and alligator clips are used when the 25 A, 70V output tap is used. This lead set allows the user to utilize themaximum output compliance voltage.	2008-539-2

The 4/0 high **current leads** allow the SPI500 to generate the maximum current specified. These leads also include Megger's unique adapters to allow connection to multiple breaker styles. The AWG #6 high current lead is used with the SPI500's 125 A 14 V output tap. This lead is used when 14 V output compliance voltage is required.		
	**Current lead for 125A Tap:** AWG#6 61 cm (2 ft) long	1017-003
	**Current lead:** AWG 4/0 61 cm (2 ft) long, red	1017-002
	Current lead: AWG 4/0 61 cm (2 ft) long, black	1017-001

	Description	Part No.
Power cord: Depending on the style number, the unit will come with one of the following:		
	Line cord, North American	620000
	Line cord, Continental Europe with CEE 7/7 Schuko Plug	50425
	Line cord, international color-coded wire	15065
	Line cord, United Kingdom	90002-989

Ethernet cable: for interconnection to PC 210 cm (7 ft.) long	90038-983

	**CE Bus Bar Extender** (Supplied with CE model Only)	2018-025

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OPTIONAL ACCESSORY DESCRIPTIONS

	Description	Part No.
	**SPI500B Booster:** Booster to extend the output range of the SPI500	SPI500B
	SPI 6' lead set consists of: **SPI 6' red 4/0 SPI 6' black 4/0 SPI 6' red 14V** Note: Reduces max current capability. 2 current leads, AWG 4/0, 183 cm (6 ft) long one red, one black	1008-284
	SPI 10' lead set consists of: **SPI 10' red SPI 10' black** Note: Reduces max current capability. 2 current leads, AWG 4/0, 305 cm (10 ft) long one red, one black	1008-747
	**High current test probe:** Current lead AWG 4/0, 305 cm (10 ft) Probe dimensions: 61 cm (2 ft), 15 cm (6 in) in diameter supplied with 2 high current tips. Return Lead AWG 4/0 122 cm (4 ft)	1007-833
	**Current lead for 125A Tap:** AWG#6 305 cm (10 ft) long	1016-196
	**Smart Touch Screen Interface:** Handheld controller for SPI500	STVI-10

	Description	Part No.
	**Current leads:** with 400 A clip, AWG 4/0,400 cm (10 ft) long, one red and one black with 400 amp clip on each	1014-475
	Line Cord: North America 250 V NEMA L6-20P	90038-265
	Power Cord Splitter: C14-2X C13 300 V	90038-266
	**Recloser Accessory Kit:** Contains lead bag, 2 -10 ft 6 AWG cables for 125 amp tap, and 2-10 ft 6AWG lead for return	1016-354
	**Bus Bar for Paralleling 2 Boosters**	1017-421
	**Transport case for SPI500 + Booster Insert:** Hard-sided transit case for SPI500 (Standard Version) and up to two SPI500B. This case is not for the SPI500 CE model. 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	1016-822

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ORDERING INFORMATION

STYLE NUMBER IDENTIFICATION

Model SPI500- ☐☐☐

Regulatory
N = Standard System 115/230 VAC
C = CE Compliant System 230 VAC*

Bluetooth option
0 = Without Bluetooth

Power cord option
A = North American power cord
I = International power cord
E = Continental Europe power cord
U = United Kingdom power cord

NOTE:
*CE Marked units operating at 230V will have reduced outputs.

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

CANADA
550 Alden Road, Unit 106
Markham, Ontario L3R 6A8
T (800) 567-0286
F (416) 298-7214
E casales@megger.com

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