

# PI-2500 Portable Circuit Breaker Test Set

- Input: 208-240 / 480 VAC +/- 10% Switch Selectable
- 15 KVA Continuous (Test up to 2000 Amp Circuit Breakers)
- Digital Memory Ammeter Controller MAC-21
- Rugged enclosure with pneumatic wheels for ease mobility
- Selectable Output Connections for all types impedance loads
- Variable pulse times for convenient preset output current
- Ground Safety Interlock



## DESCRIPTION

The PI-2500 is a versatile and technologically advanced primary injection test set capable of testing circuit breakers up to 2000 amperes frame size. It incorporates an improved low impedance output transformer with dual secondaries to provide optimal impedance matching to a wide range of breaker sizes. High capacity internal fan cooling allows maximum utilization of the output transformer and faster recovery after overload conditions. It is housed in a rugged aluminum frame enclosure with removable sides allowing easy access to all internal components to facilitate ease of service and maintenance. The sides are clear of protruding components, as well as locking pneumatic swivel castors on one end provide ease of mobility, and allow the test set to be moved on rough surfaces. A flat area on the top surface can be used for convenient placement of manuals, breaker curve books, and auxiliary instruments. The auxiliary 120 VAC GFI protected outlet is conveniently located on the rear of the unit, and protected by a 4 ampere circuit breaker. The output stab connectors are slotted to accommodate special breaker stab adaptor plates as well as being able to connect to the optional AUX-5000 unit for increased output capacity. A series adaptor bar allows the output to be configured for 1000 amps at 15 VAC for testing breakers that require connection via cables. The test set may be plugged into any 60 Hz AC voltage source of 200-250 VAC or 400-500 VAC. The line voltage is displayed on the indicator control panel digital meter. An input selector switch can be set for 208, 240, or 480 VAC inputs. An internal voltage sensor automatically ensures that the switch is set correctly before AC control power can be turned on. The vernier adjust the output manually as well as motorized control actuated by means of a smart control switch. When the switch is pressed briefly, the vernier moves in a very small increment for fine control. When the switch is held, the vernier moves very quickly, so that the entire span may be traversed in less than five seconds. The approximate vernier position is displayed on an LED indicator bar graph. The electronically controlled tap selection uses power contactors to set the coarse tap. The unit powers up in the lowest tap position. Tap change is not allowed when output is on. The indicator/control panel features two temperature indicators: one for the output bus temperature, and the other for the overall system temperature. If either temperature exceeds a safe operating level, the interlock is asserted and the output section is de-energized. Additional thermostatic sensors in the output transformer windings will also assert the interlock if unsafe temperature levels are detected. Primary catastrophic overload protection for the test set is accomplished with input fuses having high interrupting current capacity. Overload of the output system is sensed by means of the programmed overload device on the vernier autotransformer, and thermal sensors in the transformer winding. The combination of these devices allows full utilization of the overload capability of the test set, and eliminates costly and cumbersome fuse replacement required in other test sets. The output of the test set is controlled by means of a proven SCR controller. This provides precise initial phase angle control to reduce DC offset for inductive loads and more consistent pulse currents.

The phase angle is internally adjustable, and is preset for optimal waveforms with most breakers. The measurement of output current and time is accomplished by means of the proven MAC-21, which uses highly accurate A/D circuitry and intelligent firmware to resolve true-RMS values of distorted waveforms. The entire test set has been designed for reliability, ruggedness, and ease of use. Sophisticated electronics in the indicator/control panel and the MAC-21 provide state of the art accuracy and convenience, while simple connections allow for easy removal and replacement for transportation or service. A large bottom-mounted fan provides airflow to the transformer and output bus. The input jacks and voltage switch are protected by being mounted on a recessed rear panel.

## APPLICATIONS

This test set will test low-voltage, molded-case and metal-clad, direct acting AC circuit breaker from various manufactures. The test set can also be used on high current applications like ratio transformers, and heat runs. Using SCR's the **PI-2500** eliminates closing time errors. Initiation at the zero crossover point eliminates DC offset in the current waveform and results in accurate, repeatable test results even with short-duration currents for high speed solid state or electromechanical trip devices. The reduced length and width of the test set allows it to be maneuvered in tight spaces and it can be lowered into a shaft 26" x 30", or a manhole 40" diameter. Provisions have been made on the bottom of the frame for a lifting sling to be attached without slipping from the corners. The rugged silver plated copper stab adaptors supplied with the test set are designed to be used for both vertical and horizontal stabs, and have both ½" and ¾" output plates.

## ADVANCED FEATURES

**Initiating Control:** The advance initiate circuitry provides both pulse preset modes for cycles or seconds for output duration. The pulse mode automatically pulses the output to any preset programmed duration. This provides additional testing capabilities for electromechanical and solid state trip devices. A short preset pulse duration also allows for instantaneous tripping without preheating the breaker under test. A long preset time can be used for heat runs on cables or other devices up to maximum 9999 seconds.

**Zero DC Offset:** Use of digitally controlled SCR's instead of a contactor to initiate the output of the test set eliminates closing time error and thereby ensures precise initiation at the zero crossover point of the output current waveform every time. Initiation at the zero crossover point ensures symmetrical output current by eliminating DC offset in the current waveform. Therefore accurate, repeatable test results are assured even with currents of very short duration, as when conducting tests of instantaneous or short delay trips.

**Ground Safety Interlock:** Circuit ensures that the test set chassis is connected to system ground before the output of the test set can be energized.

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**INITIATE key:** This key is used to turn ON the output of the test set. The LED in the key indicates that the MAC-21 is attempting to turn the output ON. In MOMENTARY mode, the key must be held to keep output current on. In MAINTAIN mode, once current is detected, the output will stay on until the breaker trips, or the STOP or RESET button are pressed.

**STOP key:** This key is used to turn the output of the test set OFF. Use of this key is usually necessary only when in MAINTAIN mode, and it is necessary to abort the test before the breaker trips. The STOP key is also used to access peak RMS and last average RMS values. See description of CURRENT DISPLAY for details.

**RESET key:** This key resets the displays on the MAC-21, and arms the pulse reading system. The LED on the key indicates that the system is reset and armed. RESET also takes the unit out of PRESET ADJUST mode.

**DOWNLOAD key combination:** On models equipped with a printer option, the STOP and RESET keys may be pressed simultaneously to send the time and current readings in ASCII format to a printer or computer, via the serial port.

**MAINTAIN key:** This key toggles the MAINTAIN or MOMENTARY mode for initiation; its LED indicates that this mode is enabled. When in MAINTAIN mode, the INITIATE key need only be pressed briefly to turn output on. For test sets with motorized vernier, the MAINTAIN key may be pressed while output is ON to provide automatic current hold feature. The LED in the MAINTAIN key will blink while this mode is set, and the vernier motor will be activated whenever the current varies more than 5 amperes from the value displayed when the key was pressed. The key may be pressed again to return to normal mode. STOP or RESET will also discontinue current hold.

**NORMALLY OPEN key:** This key is used to set the Normally Open contacts mode when testing a device with an normally open auxiliary contacts. In N.O. mode, the timer starts as soon as current (about 3% of range) is detected after the INITIATE key is pressed, and stops when the STOP key is pressed or a break in continuity is sensed at the CONTACTS binding posts. Timing accuracy in this mode is typically +/- 0.01 seconds.

**NORMALLY CLOSED key:** This key is used to set the Normally Closed contacts mode when testing a device with an normally closed auxiliary contacts. In N.C. mode, the timer starts as soon as current (about 3% of range) is detected after the INITIATE key is pressed, and stops when the STOP key is pressed or a break in continuity is sensed at the CONTACTS binding posts. Timing accuracy in this mode is typically +/- 0.01 seconds.

**Current Latch key combination:** When the N.O. and N.C. keys are pressed simultaneously, both LEDs light, indicating C.L. mode (Current Latch). This is the normal power-up default mode for the test set, and is recommended for all tests. In this mode, current is continuously sampled, and when it exceeds approximately 10% of the current range value, the timer starts, and calculation of pulse current begins. When current stops the timer stops and the final value for pulse current is calculated and displayed as well as the time.

**PRESET key:** This key toggles the PRESET ADJUST mode, indicated by illumination of its LED. This feature is used to set current test durations for short times (jog or instantaneous) using the cycles or long times (heat runs) using the seconds modes. When not in PRESET mode, the LED will flash if the displayed time exceeds the preset limit.

**TIME DISPLAY:** This 4 digit LED display indicates the elapsed time of a current pulse. In SECONDS mode, it displays time up to 9.999 seconds, then autoranges to 99.99 seconds, 999.9 seconds, and 9999 seconds. In CYCLES mode, it reads time (based on 60 Hz), up to 999.9 cycles, then autoranges to 9999 cycles

**SECONDS key:** This key normally selects the SECONDS timebase. SECONDS or CYCLES timebase may be selected at any time before, during, or after a test.

**CYCLES key:** This key normally selects the CYCLES timebase. SECONDS or CYCLES timebase may be selected at any time before, during, or after a test.

**CURRENT DISPLAY:** This 4 digit LED display indicates the output current. In CONTINUOUS mode, as well as in MEMORY mode before and during a test, the display indicates true-RMS output current in real time. This display can also indicate peak RMS and last average current. This feature allows the test set to be used to test various solid state trip devices used on circuit breakers. It may not be accurate for times less than half a cycle.

**MEMORY key:** This key toggles the MEMORY mode, indicated by illumination of its LED. In MEMORY mode (LED on), the current display will read the continuous output current until the test is complete. At this time, the LED will flash, and the display will read the computed true-RMS value of the entire current pulse for the duration indicated on the TIME display. This key may be pressed at any time before, during, or after the test, to toggle between the two modes.

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### Current Ranges:

- 0-1000 Amps
- 5 Kilo-Amps
- 25 Kilo-Amps
- 100 Kilo-Amps

### Current Accuracy:

- Continuous
- +/- 0.5% of reading + .5% Full Scale
- Pulse
- +/- 1% of reading + 1% Full Scale Pulse

### Timer Ranges:

- 0-9999.999 Seconds
- 0-9999.9 Cycles

### Timer Accuracy:

- +/- 0.005% of reading +/- 1 count

### Dimensions and Weight

- Height: 8.5 in. (216 mm)
- Width: 19.5 in. (495 mm)
- Depth: 13.0 in. (330 mm)
- Weight: 15 lb. (6.8 kg)

### Digital Voltmeter: Input

- Range: 0-600 Volts AC
- Accuracy 1% of FS

### Included Accessories:

- Input Power Connectors 2 each
- Ground Connector 1 each
- Series Output Bus Set 1 set
- Stab Adaptor Set 1 set
- 1/2 inch Universal Stabs 1 each
- Contacts leads 1 pair
- Remote Cable 1 each
- Technical manual 1 copy

## SPECIFICATIONS

PI-2500 Output Current & Overload Capabilities

7.6 V (Par)	15.2 V (Series/Par)	30.4 V Series	Over-load	Duty	Max ON Time	Min OFF Time	Max Input Curr 480V	Max Input Curr 240V
2000 A	1000 A	500 A	1X	100%	Continuous	N/A	32 A	64 A
2800 A	1400 A	700 A	1.4 X	50%	15 Min	15 Min	45 A	90 A
4000 A	2000 A	1000 A	2 X	25%	5 Min	15 Min	64 A	128 A
8000 A	4000 A	2000 A	4 X	6%	1 Min	15 Min	128 A	256 A
12000 A	6000 A	3000 A	6 X	2%	6 Sec	2 Min	192 A	384 A
16000 A	8000 A	4000 A	8 X	1.6%	1 Sec	1 Min	256 A	512 A
20000 A*	10000 A*	5000 A*	10 X	1%	0.5 Sec	1 Min	320 A*	(640 A*)
25000 A*	12500 A*	6250 A*	MAX	.1%	0.03 Sec	1 Min	400 A*	(800 A*)

\* Max ON Times will be less at 208 or 240 VAC; Best results at 480VAC input

### Input Supply:

- 208/240/480 VAC + 10%, -15% (Switch Selectable), Single Phase
- 60 Hz (50 Hz at 10% lower maximum line voltages)

### Dimensions and Weight:

- Height: 41 in. (1041 mm)
- Width: 29 in. (737 mm)
- Depth: 25 in. (635 mm)
- Weight: 515 lb. (192 kg)