ETI PRECISION

PORTABLE CURRENT SOURCE FOR CIRCUIT BREAKER AND MOTOR OVERLOAD TESTING

INSTRUCTION MANUAL

PI-250B

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GENERAL INFORMATION

WARNING

WARNING - READ THIS ENTIRE MANUAL AND THOROUGHLY FAMILIARIZE YOURSELF WITH THE UNIT OPERATION PRIOR TO CONNECTING THE UNIT TO A SOURCE OF POWER. HIGH CURRENT TEST SETS ARE NORMALLY POWERED FROM HIGH CAPACITY MAINS, AND IMPROPER CONNECTION OR OPERATION COULD CAUSE DAMAGE TO THE TEST SET AND EQUIPMENT UNDER TEST, AS WELL AS CREATE AN UNSAFE CONDITION FOR PERSONS OPERATING THE SET.

ABOUT THIS MANUAL

This manual consists of completely new descriptive, operational, and technical information, based on many years of experience in the design, manufacturing, and operation of electrical protective device test equipment. It is intended to provide useful, up-to-date and complete information for safe and efficient operation of the test set.

INTRODUCTION

A high current test set is designed with high current, low voltage outputs used for many purposes, including primary injection testing of direct acting low voltage circuit breakers, motor overload relays, current transformers. It also can be used as a general purpose adjustable voltage or current source. The front panel displays provide simple indication of output current, time, and system status. The keyboard provides easy control of output.

GENERAL DESCRIPTION

The PI-250B features digital readout of current and time enhanced by digital signal processing. Automatic pulse (memory) mode provides fast and accurate evaluation of output current pulses as short as one half cycle.

The PI-250B incorporates a PIC microcontroller with a precision A/D converter and special firmware for true-RMS continuous and pulse current reading with high accuracy. It also utilizes a sophisticated current sensing system for more reliable current latch mode operation and better timing accuracy. An LED 4 digit readout for current in eight ranges from 5.000 A to 1000 A full scale with automatic overrange detection reduces the chance of operator error. An integral auto ranging timer with LED readout provides four digits in seconds or cycles mode, with a resolution of 0.001 second or 0.1 cycle. The entire metering and control package is combined on a single PCB which can be removed and replaced very easily, for efficient maintenance and repair.

The PI-250B provides four output taps which range from 0-3 volts at 250 amps to 0-120 volts at 5 amps, continuous, and pulse output up to 5x. The high current outputs use bus bar and convenient thumb screws for connection of heavy cables, and the lower current outputs use heavy duty binding posts which accommodate banana plugs and smaller wires.

The unit is housed in a rugged, lightweight aluminum case with a water-resistant seal, and a removable lid which has room for storage of power cord and output leads. The front panel is a durable plastic overlay which can be wiped clean easily and safely, and the tactile keypad provides long-lasting and reliable operation with positive operator feedback.

SPECIFICATIONS for PI-250B

Input: 120 VAC +/- 10%, 50/60 Hz
600 VA Continuous, 3 kVA Peak

Output:

0-3 VAC	250 A	30 min on	30 min off
	500 A	3 min on	8 min off
	750 A	30 sec on	4 min off
	1000 A	1 sec on	1 min off
0-6 VAC	125 A	30 min on	30 min off
	250 A	3 min on	8 min off
	375 A	30 sec on	4 min off
	500 A	1 sec on	1 min off
0-24 VAC	25 A	30 min on	30 min off
	50 A	3 min on	8 min off
	75 A	30 sec on	4 min off
	125 A	1 sec on	1 min off
0-120 VAC	5 A	30 min on	30 min off
	10 A	3 min on	8 min off
	15 A	30 sec on	4 min off
	25 A	1 sec on	1 min off

CURRENT RANGES:
10.00 / 25.00 / 50.00 / 100.0 / 250.0 / 500.0 / 1000 Amperes

CURRENT ACCURACY:
+/- 0.5% Reading + 0.5% Range + 1 Digit (Continuous)
+/- 1.0% Reading + 1.0% Range + 1 Digit (Pulse > 0.01 sec)

TIMER RANGES:
0-9.999 / 99.99 / 999.9 / 9999 Seconds
0-999.9 / 9999 Cycles

TIMER ACCURACY:
+/- 0.005 sec +/- 0.005% of reading +/- 1 count

DIMENSIONS AND NET WEIGHT
Height: 12.0 in. (178 mm)
Width: 13.0 in. (483 mm)
Depth: 9.0 in. (152 mm)
Weight: 35 lb. (4.55 kg)

STANDARD ACCESSORIES

Cable Lug Adapter	2 pcs
Contact Leads	1 pair
High current leads	1 pair

SECTION II

DETAILED DESCRIPTION

SECTION II
DETAILED DESCRIPTION

High Current Test Sets

High current test sets generally consist of the following:

1) A continuous (Vernier) or step-adjustable AC voltage.
2) An output transformer with one or more isolated low voltage, high current secondaries.
3) Power control circuitry consisting of switches, relays, SCRs, protective devices, etc.
4) Current measurement circuitry consisting of sensors, current meter, and timer.

In general, a primary voltage is selected by means of a combination of coarse tap and Vernier adjustment. This voltage is applied to the output transformer and stepped down to provide the desired current into the load impedance.

Since the load is usually inductive, the output initiation should correspond to a phase delay of up to 90 degrees (voltage peak). This tends to minimize the DC offset which results when an inductive load is energized at or near the voltage zero-crossing.

Many modern test sets use solid-state SCR controllers, with electronic circuitry to provide precise phase control of initial firing angle.

PI-250B Circuitry

The PI-250B uses a 120 VAC supply for main power, using a standard IEC input connector and a rocker switch. A 12 VDC switching supply provides control voltage for the instrumentation, which also has a 5 VDC supply for logic circuitry, and +/- 12 VDC for analog circuitry.

There is a solid-state SCR controller which provides power to the variable autotransformer, which is may be set to 0-100%. This variable output voltage is connected to the primary of the output transformer through a circuit breaker. The four output taps are provided for connection to the device under test.

The common lead of the output transformer is wired through a PCB mounted current transformer. The PC board provides signal conditioning and measurement by means of a microcontroller (PIC), which has a 10 bit A/D converter. The firmware responds to operator keypad input to perform control and measurement functions. An RS-232 connection is used to provide current

and time measurements on two 4-digit seven segment LED displays. There is also a continuity sensor which can monitor contact state or be used as a remote initiate.

Major Parts Identification and Operation

Power Inlet: This is a standard IEC power inlet jack which accepts removable line cords. A right-angle cord is provided which routes the input power cord toward the rear of the unit.

On/Off Switch: This rocker switch controls the input power to the PI-250B.

Vernier: This is a variable autotransformer which can be adjusted from 0 to 100% of line voltage, corresponding to a range of output current.

Circuit Breaker: This 10-amp circuit breaker protects the output of the Vernier. It will pop out under an extended or extreme overload, and must be pushed to reset (after a short period of time).

Current Display: This 4 digit 7 segment red LED display shows the current being produced from the output terminals of the test set. It can be selected in 8 ranges to read full scale currents from 5.000 amps full scale to 1000 amps full scale, and can give readings up to 50% higher before indicating an overrange condition.

Time Display: This 4 digit 7 segment red LED display shows the time that output current has been flowing. It is auto ranging from 0.001 to 9999 seconds, or 000.1 to 9999 cycles.

Output Terminal Board: This is where the output current from the test set may be connected to cables and the device under test. The 3V 250A and 6V 100A connections, and the associated common terminal, are bus bars with ¼”-20 thumb screws for convenient connection to heavy cables. The 24V 25A and 120V 5A connections, and their common terminal, are heavy duty binding posts for banana jacks or smaller wires.

Power ON Indicator: This green LED indicates that power is turned on and the control circuitry is operating properly.

Output ON Indicator: This yellow LED indicates that power is being supplied to the output terminals.

Continuity Indicator: This green LED indicates that continuity is present at the contacts jacks.

Contacts Jacks: These banana jacks provide a small AC signal which determines if there is continuity. They may be used to monitor auxiliary contacts on a protective device, or as a remote initiate in Current Latch mode.

Initiate Key: This button initiates the output of the test set. It will also reset the current and time displays.

Stop Key: This button turns off the output of the test set. It may also be held for two seconds to reset the displays.

MOM Key: This button puts the controls in momentary mode, where output will stay on only while the initiate key (or remote switch) is held.

MAINT Key: This button activates the maintained, or latch function, where the output will remain on until the Stop key is pressed. MAINT function is disabled for remote initiate.

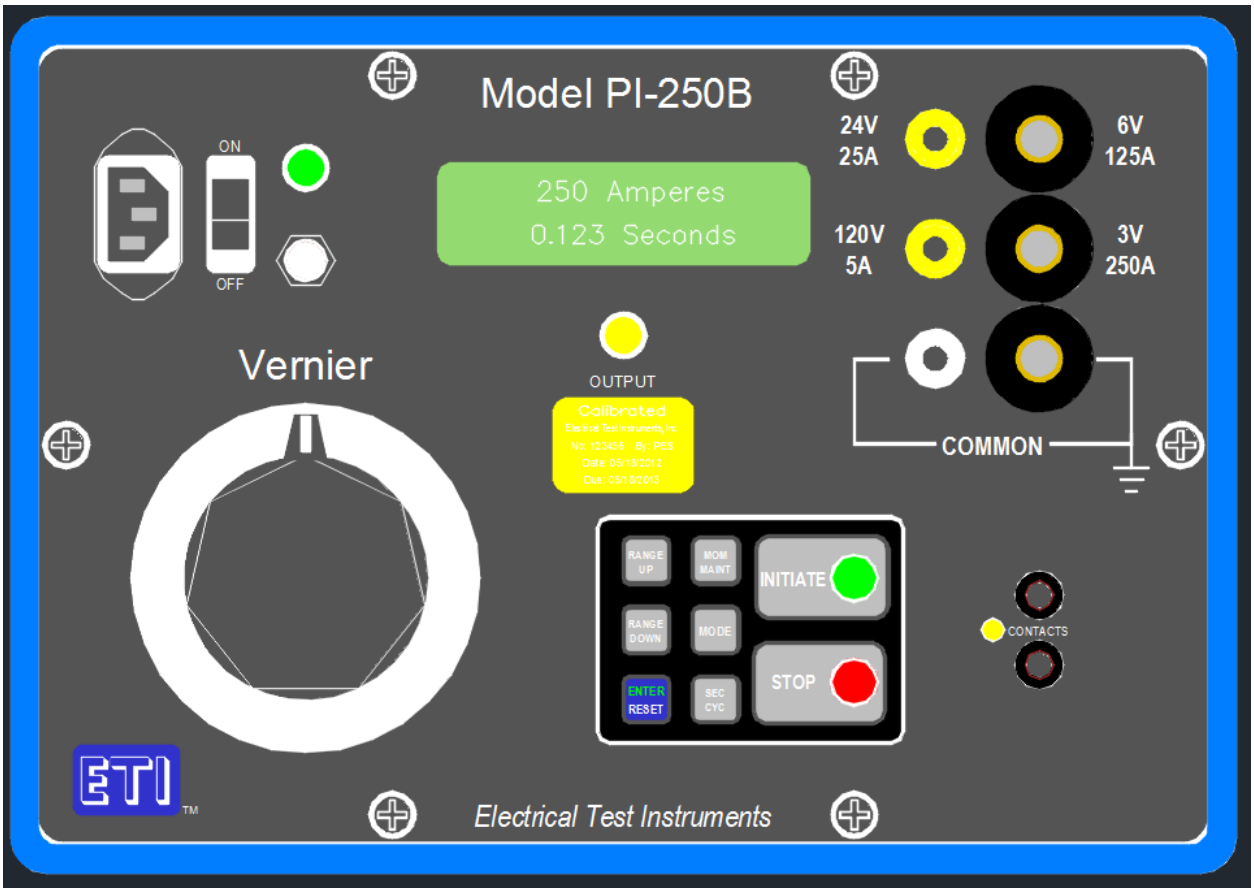
SEC Key: This button selects time reading in seconds.

CYC Key: This button selects time reading in cycles, based on 60 Hz line frequency.

RANGE Key: This button shows the current display range, which may be 5.000 to 1000 amps full scale. Holding this button for more than one second will cycle the ranges through all eight selections.

MODE Key: This button shows the operational mode of the test set. Default is C.L., or current latch, which performs timing while current is present and shuts off the test when current stops. If this key is held more than one second, the display will cycle through N.O. and N.C. modes, for Normally Open and Normally Closed contacts. The contacts must be in their normal state to initiate output, and current must be detected to latch on in MAINT mode. Output is turned off when contacts change state.

Figure II-1 – PI-250B Front Panel



SECTION III

OPERATING INSTRUCTIONS

SECTION III

OPERATING INSTRUCTIONS

PRE-TEST INSTALLATION AND SET-UP

1. The following components of the test set should be available and in good condition:
    a. PI-250B Test Set
    b. Cables and adapters to match device to be tested
    c. Input power cord
    d. Contact lead set (If applicable)
    e. Remote initiate cable (optional)
2. Additional requirements for testing are as follows:
    a. Devices to be tested
    b. Manufacturers' curve data
    c. Test log and/or report forms
    d. Basic hand tools (wrench, screwdriver, etc.)
    e. Safety equipment (safety glasses, gloves, etc.)
    f. Reliable and sufficient power source
    g. Clean, spacious, and well-lit work area.
3. Make sure that the controls on the test set are adjusted as follows:
    a. Main Power Switch OFF
    b. Output Control Vernier: 0 (minimum position)
4. Connect the line cord to the IEC power inlet, and plug into a properly grounded 120 VAC receptacle
5. Turn on power switch. Power On lamp should light, and displays and keypad lights should go through a test sequence.
6. Connect device under test to appropriate output tap, using properly sized cables as required.
7. Follow Step-by-Step procedures below, as required, for testing.

8. When tests are completed, turn VERNIER to 0, and MAIN POWER switch OFF.
9. Disconnect input power cord. Store cables in lid and close securely.

BASIC GUIDELINES AND SUGGESTIONS

1. Best timing and current accuracy will be obtained with the MAC-20 in current latch (C.L.) mode.
2. Current Latch modes are preferred for most testing purposes. Exceptions are:
    a. Non-series-connected devices such as motor overload relays or shunt-trip breakers.
    b. Ratioing of current transformers.
    c. Heat runs of cables, bus work, etc. (Connect contacts to thermostat).
3. If Contacts Mode is selected, use caution when connecting continuity sensing cables. Although the voltage and current are minimal, under some conditions it could cause electrical shock. ALWAYS connect one clip at a time, and NEVER rest the other hand on any current-carrying parts of the breaker while the test set is powered up.
4. Always choose an ammeter range that allows the test current to be read in the area from 20% to 80% of the maximum. This provides greatest accuracy of readings, least chance of overrange, and optimum current latch operation.
5. To obtain maximum output current from the test set, especially when using output cables, it is important to minimize both input and output impedance. This can be accomplished by using the largest cable size possible, or using multiple cables in parallel, to reduce resistance, and by keeping cables close together by tying or twisting, to reduce inductance.
6. For all high current test sets, much better output current waveform and stability can be achieved when the controls of the test set are in their higher positions. To test smaller devices at lower currents, it is helpful to introduce additional output impedance, by using some length of adequate, but lighter gauge, wire to connect the device to the output connections. The Vernier control should always be at least at 10% to produce desired test current.

SINGLE POLE MOLDED CASE CIRCUIT BREAKERS

Timing Test

1. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results. A test current of three times the rating of the breaker should be used for this test.

2. Follow steps in pre-test installation and setup, as required, to set up the test set.
3. Set for C.L. MOM.
4. Set RANGE to lowest range that is greater than desired test current.
5. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the desired test current is read on the ammeter.
6. Press RESET button.
7. Select MAINT mode.
8. Press and release INITIATE key; OUTPUT ON light should glow, timer should run, and current display should read desired output current.
9. While test is running, observe current reading. If necessary, adjust to correct value by using Vernier control.
10. When breaker trips, the test set output should de-energize, timer should stop, and OUTPUT ON light should turn off.
11. Read and record trip current and trip time. Compare to manufacturer's time/current curve.
12. If test is to be repeated, make sure that breaker cools completely.
13. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Pick-Up of Instantaneous Element

1. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results. Check the breaker's instantaneous setting. Pickup should occur at about that current.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Setup for C.L. MAINTAIN
4. Set RANGE to lowest range that is greater than desired test current.
5. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the circuit breaker trips instantaneously. This is the approximate pickup point.
6. Close breaker under test.
7. By repeating the test, determine the MINIMUM SETTING of the OUTPUT CONTROL, at which the breaker under test opens immediately, whenever the INITIATE button is depressed.
8. Read and record ammeter reading as instantaneous pick-up of the breaker.
9. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Instantaneous Trip Time Test

1. Perform Instantaneous Pickup Test as outlined above.
2. Adjust controls to obtain current above pickup, at approximate desired multiple of rating.
3. Close breaker under test.
4. Press the INITIATE button. Breaker should trip instantaneously.
5. Read and record timer and ammeter readings as instantaneous trip time and current.
6. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

MULTI-POLE MOLDED CASE CIRCUIT BREAKERS

Timing Test

1. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results. A test current of three times the rating of the breaker should be used for this test.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Connect appropriate output tap to one pole of breaker under test.
4. Setup for C.L. MOM
5. Set RANGE to lowest range that is greater than desired test current.
6. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the desired test current is read on the ammeter.
7. Select MAINTAIN mode.
8. If desired, N.C. mode may be used; connect contacts leads to an unused pole of the breaker.
9. Press and release INITIATE key; OUTPUT ON light should glow, timer should run, and current display should read desired output current.
10. While test is running, observe current reading. If necessary, adjust to correct value by using Vernier control.
11. When breaker trips, the test set output should de-energize, timer should stop, and OUTPUT ON light should turn off.
12. Read and record trip current and trip time. Compare to manufacturer's time/current curve.
13. Repeat above tests for other poles of the breaker. Allow time for breaker to cool. Note: it is acceptable if all poles of the breaker trip within +/- 15% of the manufacturer's time range for the value of test current chosen. All poles of the breaker need not trip in exactly the same amount of time.
14. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Pick-Up of Instantaneous Element

1. Consult manufacturer's literature to determine any necessary precautions and expected test results. Check the breaker's instantaneous setting. Pickup should occur at about that current.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Setup for C.L. MOM
4. Set RANGE to lowest range that is greater than desired test current.
5. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the circuit breaker trips instantaneously. This is the approximate pickup point.
6. Close breaker under test.
7. By repeating the test, determine the MINIMUM SETTING of the OUTPUT CONTROL, at which the breaker under test opens immediately, whenever the INITIATE button is depressed.
8. Read and record ammeter reading as instantaneous pick-up of the breaker.
9. Repeat the above test for the other poles of the circuit breaker.
10. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Instantaneous Trip Time Test

1. Perform Instantaneous Pickup Test as outlined above.
2. Adjust controls to obtain current above pickup, at approximate desired multiple of rating.
3. Close breaker under test.
4. Press the INITIATE button. Breaker should trip instantaneously.
5. Read and record timer and ammeter readings as instantaneous trip time and current.
6. Repeat the above test for the other poles of the circuit breaker.
7. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

LOW VOLTAGE POWER CIRCUIT BREAKERS

Nearly all low voltage power circuit breakers are multi-pole devices. The trip units may be either magnetic with a dash pot or solid state electronic devices. Test procedures would be the same for either type. However, electronic trip types may incorporate ground fault protection. If so, it is necessary to either block or by-pass ground fault protection when tests are being conducted on phase fault characteristics. This is because the tests are being conducted on one pole at a time, and the ground fault protection would consider this operation to be a ground fault.

Most low voltage power circuit breakers have either Long Time Delay, and Short Time Delay, and/or instantaneous tripping characteristics. In this case, for test purposes, it is recommended that the instantaneous unit be set in its maximum calibration. This is to prevent an instantaneous trip while trying to set the current for the Short Time Delay characteristic.

Electrical tests to be conducted on low voltage power circuit breakers include timing test on L.T.D.; timing test on S.T.D.; and instantaneous pick-up. It is recommended that the magnitude of test current for the L.T.D. timing test be 3 times coil rating or transformer tap. For timing test on S.T.D. the test current should be about 1.5 times the S.T.D. setting. In both cases, tripping time should be within the manufacturer's published time range. Pick-up of the instantaneous unit should be +/- 10% of the setting for the electronic device and +/- 20% of the setting for the magnetic device.

Testing the instantaneous trip on very large circuit breakers set at or near maximum calibration may sometimes exceed the capacity of the test set. In most cases, the instantaneous element has several calibration marks between "LO" and "HI". In such cases, it may be necessary to perform the test at one of the lower calibration marks. Always be sure to record the "AS FOUND" settings, and return the adjustments to these settings after testing. To perform testing, adjust the screw to a lower setting that allows the test set to verify that the unit will pick up. If the instantaneous unit picks up at the proper current at a lower calibration point, it may be assumed that the unit will operate properly at higher calibration points. This has been verified by manufacturers and by means of field tests.

Specific test procedures for all electrical tests are outlined on the following pages.

Timing Test, Long Time Delay

1. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results. A test current of three times the rating of the breaker should be used for this test.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Connect appropriate output tap to one pole of breaker under test.
4. Setup for C.L. MOM
5. Set RANGE to lowest range that is greater than desired test current.
6. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the desired test current is read on the ammeter.
7. Select MAINTAIN mode.
8. If desired, N.C. mode may be used; connect contacts leads to an unused pole of the breaker.
9. Press and release INITIATE key; OUTPUT ON light should glow, timer should run, and current display should read desired output current.
10. While test is running, observe current reading. If necessary, adjust to correct value by using Vernier control.
11. When breaker trips, the test set output should de-energize, timer should stop, and OUTPUT ON light should turn off.
12. Read and record trip current and trip time. Compare to manufacturer's time/current curve. If necessary, adjust the trip unit and repeat the test.
13. Repeat the above tests for the other poles of the breaker, allowing time for breaker to cool. Note: Results are acceptable if all poles of the breaker trip within the manufacturer's time range for the value of test current chosen. All poles of the breaker need not trip in exactly the same amount of time.
14. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Timing Test, Short Time Delay

Note: The breaker's trip time for short time delay will always be less than 30 cycles and may be as low as 4-5 cycles. Therefore, setting test current will require some practice. However, the magnitude of the test current is not critical; for instance, if the S.T.D. is set for 1000 amperes, there will be little or no difference in timing if a test current of 1500, 2000 or 2500 amperes is used.

Set up of controls is the same as for timing test L.T.D. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results.

1. Follow steps 1 through 5 under Timing Test Long Time Delay.
2. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the desired test current is read on the ammeter.
3. Select MAINTAIN mode.
4. If desired, N.C. mode may be used; connect contacts leads to an unused pole of the breaker.
5. Press and release INITIATE key; OUTPUT ON light should glow, timer should run, and current display should read desired output current.
6. Breaker should trip within 30 cycles (0.5 seconds). When breaker trips, the test set output should de-energize, timer should stop, and OUTPUT ON light should turn off.
7. Read and record trip current and trip time. Compare to manufacturer's time/current curve. If necessary, adjust the trip unit and repeat the test.
8. Repeat the above tests for the other poles of the breaker, allowing time for breaker to cool. Note: Results are acceptable if all poles of the breaker trip within the manufacturer's time range for the value of test current chosen. All poles of the breaker need not trip in exactly the same amount of time.
9. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Pick-Up of the Instantaneous Unit

1. Consult breaker manufacturer's literature to determine any necessary precautions and expected test results. Note: If the instantaneous setting is such that the expected test result is above that which may be easily produced by the test set, a valid test may be performed by adjusting the setting to its minimum value. At the end of the test, restore the instantaneous setting to its specified value.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Setup for C.L. MOM
4. Set RANGE to lowest range that is greater than desired test current.

5. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until circuit breaker trips instantaneously. This is the approximate pickup point.
6. Close breaker under test.
7. By repeating the test, determine the MINIMUM SETTING of the OUTPUT CONTROL, at which the breaker under test opens immediately, whenever the INITIATE button is depressed.
8. Read and record ammeter reading as instantaneous pick-up of the breaker.
9. Repeat the above test for the other poles of the circuit breaker.
10. If trip settings were modified for test purposes, restore them to their original values.
11. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

Instantaneous Trip Time Test

1. Perform Instantaneous Pickup Test as outlined above.
2. Adjust controls to obtain current above pickup, at approximate desired multiple of rating.
3. Close breaker under test.
4. Press the INITIATE button. Breaker should trip instantaneously.
5. Read and record timer and ammeter readings as instantaneous trip time and current.
6. Repeat the above test for the other poles of the circuit breaker.
7. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

MOTOR OVERLOAD RELAYS

The motor overload relay is designed to provide overload protection for a motor; therefore, it offers only one time/current characteristic, which is essentially a long time delay. It may be multi-pole, however, most relays are single pole. In the case of a multi-pole device each pole is tested individually as in the case of a multi-pole direct acting circuit breaker.

The motor overload relay contains two separate circuits. The current carrying circuit which contains the relay's operating coil or heater. The control circuit which contains a set of contacts; these contacts open when the relay "operates". It is the opening of these control circuit contacts that deenergizes the motor starter holding coils, thus allowing the starter contactors to open, shutting down the motor.

Timing Tests

1. Consult the relay manufacturer's literature to determine any necessary precautions and the expected timing test results. The test current should be 3 to 4 times the rating of the relay operating coil or heater.
2. Follow steps in pre-test installation and setup, as required, to set up the breaker test set.
3. Setup for C.L. MOM
4. Set RANGE to lowest range that is greater than desired test current.
5. Connect the relay operating coil or heater circuit terminals to the breaker test set common terminal and the proper output tap terminal.
6. Repeatedly jog the INITIATE button, while adjusting the OUTPUT CONTROL higher, until the desired test current is read on the ammeter.
7. Setup for N.C. MAINTAIN.
8. Connect the relay control circuit contacts to the CONTACTS binding posts, and determine that they are closed by observing the CONTINUITY lamp.
9. Press and release INITIATE button; OUTPUT ON light should glow, timer should operate, and current should indicate on display.
10. When the relay control circuit contacts open, the test set output should deenergize and the timer should stop.
11. Read and record the test value of current and the time of the test. Compare the results to the manufacturer's specifications. If possible, adjust the relay. Usually, if the relay time of operation is incorrect, it is necessary to replace the relay heater with one of the recommended size

for the motor being protected. If a check test is desired, the relay must be allowed to cool for a period of time (approximately 15 to 30 minutes).

12. For a multi-pole relay, repeat the above tests for the other relay poles.
13. Shut down test set, disconnect breaker, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

RATIOING CURRENT TRANSFORMERS

To conduct a ratio test on a current transformer, a good multi-range bench ammeter is required in addition to the breaker test set. The breaker test set supplies primary current to the transformer and the bench ammeter is used to read the transformer secondary current. It is suggested that a graph of the test results be plotted. Primary current should be the abscissa and corresponding secondary current the ordinate of the graph.

WARNING: It is extremely important that the secondary circuit of the current transformer never be broken or opened while the primary circuit is energized. Should the secondary circuit of an energized current transformer be opened, the collapsing magnetic field generates an extremely high voltage across the open ends of the circuit until the resultant arc is extinguished. Under these conditions, personal injury and/or damage to the current transformer under test are probable.

1. Follow pre-test installation and setup, as required, to set up the breaker test set.
2. Connect the current transformer primary terminals to the breaker test set common terminal and the proper output tap terminal.
3. Connect the current transformer secondary terminals to the bench ammeter.
4. Set the PI-250B to N.O. mode. Set MAINTAIN on.
5. Press and release INITIATE button; OUTPUT ON light should glow, timer should operate, and current should indicate on display.
6. Adjust OUTPUT CONTROL higher until the desired current transformer primary current is read on the current display.
7. Read and record the readings on both the PI-250B and the bench ammeter.
8. Repeat steps 6 and 7 until the desired number of test points have been obtained. Note: It is suggested that test points be obtained in multiples of the current transformer rating. For instance, for a 200/5 current transformer, test points would be obtained at primary currents of 200, 400, 600, 800 amperes, etc.
9. Shut down test set, disconnect CT, and prepare for subsequent testing or relocation according to pre-test installation and setup outlined above.

SECTION IV
SERVICE INFORMATION AND DOCUMENTATION

SECTION IV

SERVICE INFORMATION AND DOCUMENTATION

BASIC MAINTENANCE AND CALIBRATION

Circuit breaker test sets are often subject to conditions in use, storage, and transportation that may affect reliability, safety, and accuracy. Basic preventive maintenance should be performed on a regular basis and as needed due to abnormal conditions. Procedures should include general cleaning, tightening of electrical connections, replacement of worn or damaged components, and a complete functional check. Calibration by certified instruments and personnel should be performed at least annually, or whenever erroneous readings are suspected.

PARTS LIST:

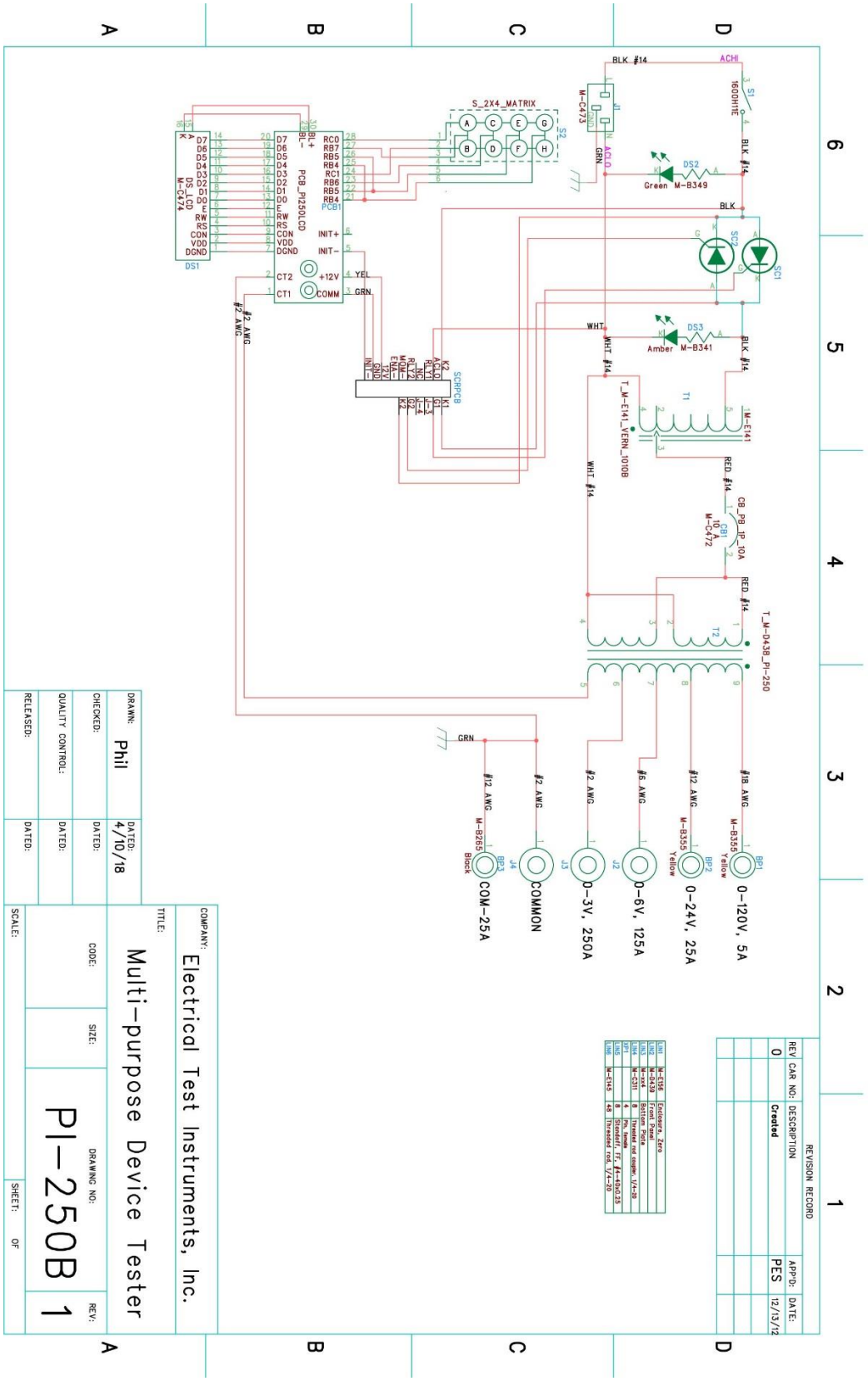
The overall schematic is at the end of this manual. The parts list for the main assembly and other parts is provided below. Please refer to both when ordering replacement parts.

ITEM	QTY	DESCRIPTION	REF DES	ETI Number
1	1	Front Panel, 12.5" x 8.5"		M-D439
2	2	Binding Post, Yellow	BP1-2	M-B355
3	1	Binding Post, Black	BP6	M-B265
4	1	Circuit Breaker, 10A	CB1	M-C472
5	1	Power inlet, 15A	J1	M-C473
6	1	Line cord	P1	M-C491
7	1	PCB, PI-250B	PCB1	S-B344
8	1	PCB, SCR Trigger, 12 VDC	PCB2	S-B393
9	1	SCR Assembly, 600V, 90A	SC1-2	M-C202
10	1	Switch, SPST, Rocker, 16A	S1	M-C479
11	1	Transformer, variable, 10A	T1	M-E141
12	1	Transformer, output	T2	M-D438
13	1	Base plate		M-D441
14	4	Standoff, 8.25"		M-D448
15	1	Enclosure		M-D156

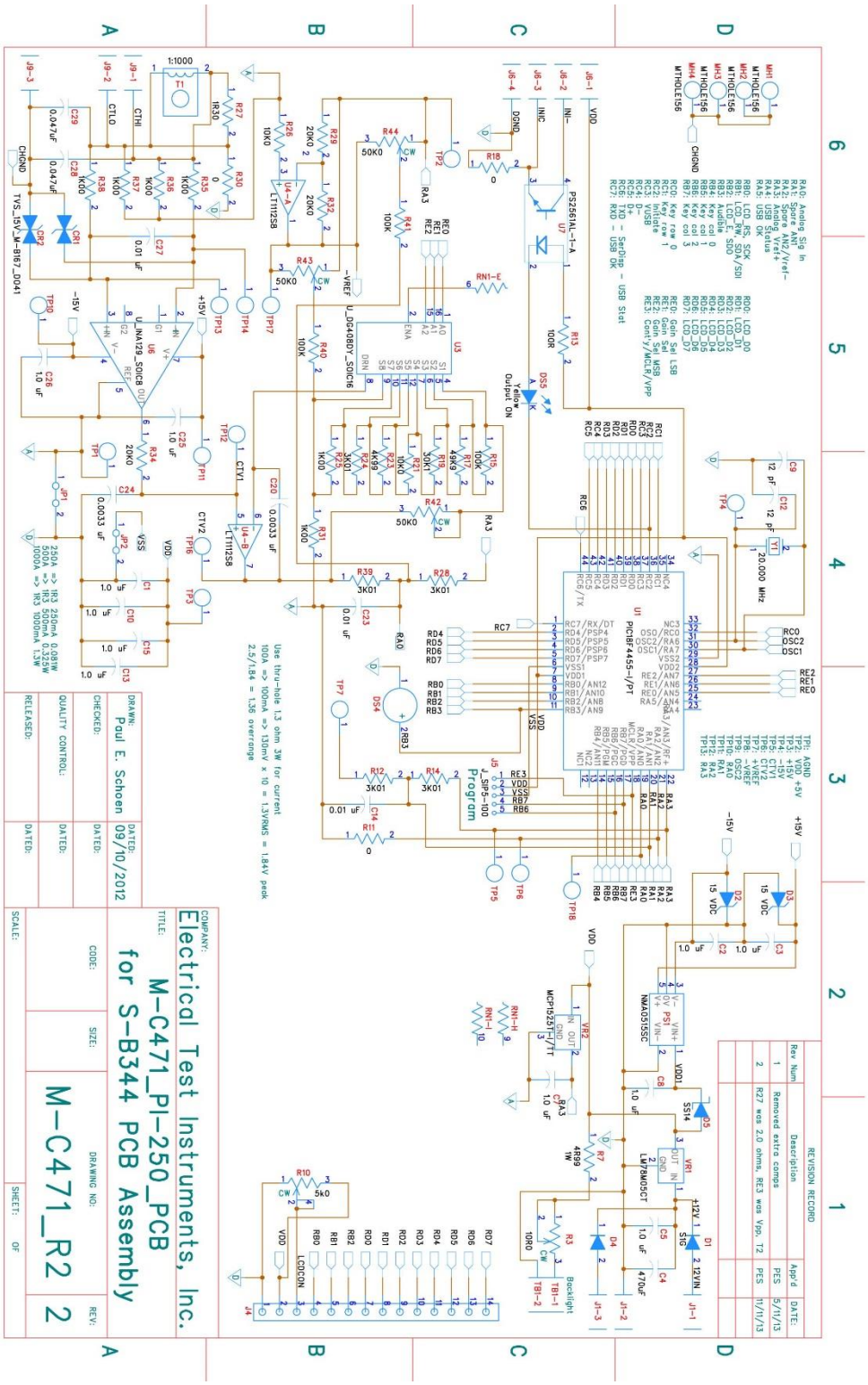
WARRANTY

Electrical Test Instruments, LLC, will correct any defect in workmanship or material for two years after date of purchase of any Electrical Test Instruments product. Such corrective measures will be limited to repairing or replacing the unit, at Electrical Test Instruments' option. This limited warranty shall not apply to equipment which has been subjected to negligence, accident or damage by operation, maintenance or storage, or to non-normal use or service. This limited warranty does not cover reimbursements for transportation, removal, installation, repair or replacement, except as may otherwise be specifically agreed to in writing by Electrical Test Instruments. The foregoing is in lieu of all other warranties expressed or implied, and all other obligations or liabilities whether arising under contract, negligence or otherwise, on the part of Electrical Test Instruments. In no event shall Electrical Test Instruments be liable for consequential or special damages, including but not limited to loss of use, loss of income, loss of profit or cost of replacement.

Schematic



PCB Schematic



PCB Schematic – Page 2