INSTRUCTION MANUAL

For

CIRCUIT BREAKER TEST SET

MODEL CB-845X

It is essential that this instruction book be read thoroughly before putting the equipment in service.

Part _ S/O 81892
Rev. 0

IMPORTANT

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GENERAL DESCRIPTION

The Multi-Amp Model CB-845X Circuit Breaker Test Set is a self-contained unit which provides a continuously adjustable high current output and incorporates a digital ammeter, digital timer and control circuitry. The test set consists of two units housed in interlocking, stackable, rugged, metal enclosures. Each unit has convenient carrying handles for easy portability.

COMMON TEST APPLICATIONS

Multi-Amp Model CB-845X is specially designed to provide high current at sufficiently high voltage for testing ground grids or high impedance circuit breakers.

The Model CB-845X is suitable for a wide variety of testing requirements including molded case circuit breakers, thermal, magnetic or solid-state motor overload relays and other overcurrent protective devices. Additional applications include ratioing recurrent transformers and testing ground fault trip devices.

SPECIFICATIONS

Input (switch-selected):	208 and 240 volts, single-phase, 60 hz. ± 5%
Output Range:	The output is continuously adjustable through 7 ranges to meet a wide variety of test circuit impedances. 0-5.5 volts at 1000 amperes 0-11 volts at 500 amperes 0-22 volts at 250 amperes 0-44 volts at 125 amperes 0-88 volts at 62 amperes 0-176 volts at 31 amperes 0-350 volts at 15 amperes
Ammeter:	A solid-state digital instrument with a 0.3" (7.62 mm) LED 3 1/2 digit display.
Ranges (switch selected):	0-19.99/199.9/1999 amperes/10.00 kiloamperes
Accuracy (overall ammeter system):	± 1% of reading ± 1 digit for 0-199.9/1999 amperes/10.00 kiloamperes ranges. ± 1% of range ± 1 digit for 0-19.99 amperes range
Modes (switch-selected):	
Memory:	Read-and-hold memory feature retains current reading after one complete cycle.
Normal:	Continually updates ammeter reading as current changes.

Timer: A solid-state crystal controlled digital timer with 0.3" (7.62 mm) LED 5 digit display.

Seconds Mode:

Ranges: 0-99.999 seconds
0-999.99 seconds

Accuracy: ± .005% of reading ± 1 digit

Cycles Mode:

Range: 0-99999 cycles

Accuracy: ± .005% of reading ± 1 cycle

Output Capacity: Where the output voltage is sufficient to "push" higher than rated current through the impedance of the load circuit, the test set may be overload for short durations as shown below.

PERCENT RATED CURRENT	MAXIMUM TIME ON	MINIMUM TIME OFF
100%	30 minutes	30 minutes
200%	75 seconds	6 minutes
300%	25 seconds	4 minutes

Protection: Overload and short circuit protection is incorporated.

Housing: High strength, metal enclosures with easy-to-carry handles.

Dimensions:

Control Unit - Height: 11 1/4 inches
Width: 21 inches
Depth: 17 1/2 inches

Output Unit - Height: 11 1/4 inches
Width: 21 inches
Depth: 19 1/2 inches

Weight:

Control Unit:	89 1/4 pounds
Output Unit:	205 pounds
Complete Unit:	294 pounds

Test Leads:	Two No.22 timer leads each 5 feet (1.5 m) long. These leads are used to connect the binding posts on the CB-845X labeled CONTACTS to the contacts of the device under test which will open or close when the device operates. Two No. 4 high current leads, each 5 feet (1.5 m) long and two No. 4/0 high current leads, each 4 feet (1.2 m) long.
Interconnect Cable:	Standard cable supplied to interconnect the control and output units is 4 feet (1.2 m) long. An optional cable 10 feet (3m) in length is also available.

DESCRIPTION OF FEATURES

NOTE: For greatest accuracy, allow 15 minutes for instrumentation warm-up.

POWER ON/OFF SWITCH:	Molded case circuit breaker resets after an overload when placed in the OFF position. Displays will light up when the switch is turned on.
INPUT VOLTAGE SELECTOR SWITCH:	Selects voltage setting to match voltage source.

WARNING: SELECT PROPER VOLTAGE BEFORE TURNING POWER SWITCH ON.

MAIN FUSE:	Protects power output circuit of unit against overloads.
CONTROL FUSE:	Protects instrumentation and control circuitry against overloads.

NOTE: Replace fuses with the same size and type as those supplied with test set.

OUTPUT CONTROL:	Variable autotransformer provides continuous non-stepped output from a variety of current terminals. Output system is controlled by a combination of timer STOP MODE and OUTPUT MODE Switch positions.
AMMETER:	LED display shows the numeral one in the left-most digit when the meter is over-ranged.

RANGE SWITCH:	Decimal of display shifts one digit to the right for each increase in range selection. Decimal moves to two digits from right on highest range.
DISPLAY MODES:	Switch selectable for NORMAL or MEMORY.
MEMORY:	Retains highest reading attained during current output operation above 8% of full scale of range selected. Reading is retained until the unit is reintiated or RANGE Switch position is changed.
NORMAL:	Updates readings continually as long as output is energized. Reading is lost when output is de-energized.
TIMER:	Automatically resets each time the unit is initiated.
DISPLAY MODES:	Switch selectable for cycles or seconds.
CYCLES:	Reads in whole cycles.
SECONDS:	Two switch selectable scales of either two or three decimal places.

NOTE: Changing display mode or scale during operation will produce erroneous readings.

STOP MODES:	Switch selected for external contact position or current actuate.
NORM. OPEN:	With CONTACTS binding posts connected to normally open external contacts, output will remain energized and timer will continue to run until contacts close.
NORM. CLOSED:	With CONTACTS binding posts connected to normally closed external contacts, output will remain energized and timer will continue to run until contacts open.
CURRENT:	Timer will initiate only when output circuit is completed and threshold current of approximately 8% of full scale of ammeter range selected is exceeded. Timer will continue to run until output circuit opens, drops below threshold level, or is de-energized.

NOTE: Current must be maintained above threshold level or timer error will result.

CONTACT BINDING POSTS:	Circuit controls output and timer in the normally open/closed stop modes when connected to external contacts.

WARNING: DO NOT CONNECT CONTACTS BINDING POSTS TO AN ENERGIZED CIRCUIT.

OUTPUT MODE SWITCH:	Initiates output circuit in conjunction with appropriate timer STOP MODE position.
OFF:	Unit remains powered up but the output is de-energized and the timer will not run.
MOMENTARY:	Momentary "ON" position with spring return to center OFF. Output will remain energized as long as the switch is held in MOM. position and is de-energized when released. Timer starts and stops in the same manner.. Used for "jogging" output the circuit.
MAINTAIN:	Switch energized output circuit when moved to MAIN. position. Output will remain energized until appropriate STOP MODE function occurs, switch is moved to OFF or current drops below threshold requirement of control circuitry.
OUTPUT INDICATING LAMP:	Lights up whenever output circuit is energized.

OPERATIONAL SAFETY

Every consideration has been given to the design and construction of the Model CB-845X Test Set to make it a safe piece of test equipment as well as one that is accurate, reliable, and easy to use.

It must be remembered that the unit is capable of producing high voltage and current levels that can be deadly if personnel came in contact weigh them.

When stacking units, make sure feet of the top unit are firmly seated in the depressions in the top of the bottom unit. If the output unit is elevated to get it closer to the device under test, be sure it is secured on a sturdy platform.

For maximum safety of unit operation, the power cord should be connected to a properly grounded power supply receptacle.

Always de-energize the test set before handling any of the output terminals, moving test leads or changing connections on the test set or device under test.

Never connect the unit outputs or test circuits to a device to be tested that is energized.

Protect the unit from rain, water, oil, or any substance that could cause an electrical hazard or damage the unit. Do not set the unit in water or use it in wet areas.

The CB-845X should be properly operated and serviced by qualified individuals who have familiarized themselves with the unit and thoroughly read the instruction manual provided with it.

If questions arise concerning care, operation, or application of the unit that are not explained in the instruction manual, contact a Multi-Amp Corporation representative.

INPUT CIRCUIT

INPUT VOLTAGE:

The Multi-Amp CB-845X Circuit Breaker Test Set is designed to operate on a single phase 208 or 240 volt input. The selector switch on the front of the unit is used to select the input voltage tap that matches either 208 or 240 volt power supply available.

INPUT CONNECTIONS:

Due to the wide variation in individual user requirements with regard to wire sizes, terminations and length of leads, all units are supplied with input socket and matching plug only. The plug will accept a wide range of wire sizes more than adequate for the duty required. The power source must have sufficient capacity, and the input leads must be large enough to maintain RATED input voltage at the INPUT terminals of the test set. Although the test sets are designed to operate satisfactorily at 95-105% of rated voltage, any drop in voltage below RATED at the input terminals will result in a proportional decrease in the maximum available output.

NOTE: To achieve published output currents, the rated input voltage must be maintained at the test set terminals during the test.

GROUNDING:

A grounding terminal is provided in the input plug to match that provided in the input socket. A properly connected ground wire contained in the input cable selected should be connected to a properly grounded power supply receptacle.

SAFETY GROUND:

If an extra measure of safety is desired, a ground wire can be connected externally of the input power cord and connector. The size of this conductor should not be less than 1/2 the cross section of the current carrying input leads (three wire sizes less) and in no event smaller than #10. This wire should be securely connected to the enclosure of the test set (preferably the control section) and to an approved ground.

SELECTION OF INPUT LEADS

INPUT LEADS:

When utilizing maximum output from the test set, the input line currents may be as high as 400% of nameplate rating. The following table has been prepared to aid in selecting the proper wire size for the input leads. To use the table, follow the four steps that follow:

1. Determine the rated input current from the nameplate on the test set. Be sure to choose the correct current for the input voltage being used.

2. Multiply this value by four.

3. Determine the length of the input lead required. This is in circuit-feet, therefore, it is the one-way distance from the test set to the power source.

4. Select the proper wire size from the table using factors 2 and 3 above.

   Example: Step 1 - 30 amperes (from input circuit breaker rating)
   Step 2 - 4 x 30 = 120 amperes
   Step 3 - 80 ft. (distance from test set control section to input power source)
   Step 4 - # 6 wire (from chart)

SELECTOR CHART FOR INPUT LEADS

LENGTH OF INPUT LEADS

DISTANCE FROM TEST SET TO POWER SOURCE

FEET

FOUR (4X) TIMES RATED INPUT CURRENT	20	40	60	80	100	120	140
50	8	8	8	8	8	8	8
75	8	8	8	8	8	8	6
100	8	8	8	8	6	6	4
125	8	8	8	6	6	4	4
150	8	8	8	6	4	4	2
175	8	8	6	4	4	2	2
200	8	8	6	4	4	2	2
225	8	8	6	4	2	2	1
250	8	6	4	4	2	2	1
275	8	6	4	2	2	1	1/0
300	8	6	4	2	2	1	1/0
325	8	6	4	2	1	1	2/0
350	8	4	2	2	1	1/0	2/0
375	8	4	2	2	1/0	2/0	2/0
400	8	4	2	1	1/0	2/0	
425	8	4	2	1	1/0	2/0	
450	8	4	2	1	2/0		
475	6	4	2	1/0	2/0		
500	6	4	2	1/0	2/0		
525	6	2	1	1/0	2/0		
550	6	2	1	1/0			
575	6	2	1	2/0			
600	6	2	1	2/0			

The wire sizes in this chart will result in voltage drops of ten volts or less.

OUTPUT CIRCUIT

Seven high current output terminals are provided on the Model CB-845X output unit to supply a continuously adjustable output current for a wide variety of test circuit current requirements.

The output circuit is not grounded and is not polarity sensitive so the current output terminals can be used interchangeably without regard to polarity.

The maximum current available will depend on the current requirements and impedance of the device to be tested as well as the current leads selected to perform the test, the power input cable and the capacity of the power source available at the test site.

IT SHOULD BE NOTED THAT THERE IS NO RELATIONSHIP BETWEEN THE AMMETER RANGES AND THE RATING OF THE OUTPUT TERMINAL. All ammeter ranges can be used in conjunction with the output terminals for any output current level that does not exceed the ammeter range selected.

SELECTION OF OUTPUT LEADS

OUTPUT CONNECTIONS:

Model CB-845X is equipped with output connection bars for attachment of the high current test leads provided or any others suitable for the test application.

The following information on the selection of output leads will provide the user with a guide for choosing the proper test leads for his application.

Due to the voltage drop from the inductive reactance of the test circuit, a significant loss of current will result for each inch of test lead. Therefore, when choosing test leads, the length and size of leads chosen will determine the maximum available test current. It is worthwhile to sacrifice cross section of test leads for the sake of reducing length. Every inch of lead that can be eliminated provides worthwhile increase in available test current. Heating is not a significant problem in testing, even though the leads become hot. Paralleling of sufficient cables provides higher test currents. Each cable can be fitted with a compression lug on each end, then bolted to the output terminals or stab board of the test set.

When testing ground grids, the two cables between the test set and the ground grid should be twisted together or bundled with tape or cord to maintain the close proximity which minimizes inductive reactance.

OVERLOAD CAPACITY

Model CB-845X is rated at 5.5 kVA output and has two output terminals capable of supplying rated current. The current rating of these output terminals may be exceeded for short durations provided the voltage is sufficient to "push" the desired current through the device under test and the connecting test leads. The figures below represent the overload capacity at a given output current at 77 degrees (25 C) versus time ON and time OFF

PERCENT RATED CURRENT	MAXIMUM TIME ON	MINIMUM TIME OFF
100 %	30 minutes	30 minutes
200 %	75 seconds	6 minutes
300 %	25 seconds	4 minutes

TEST PROCEDURES FOR

MOTOR OVERLOAD RELAYS

TIME DELAY

1. Set-up CB-845X with:

   a. Power ON/OFF Switch in OFF position (instrument displays off).
   b. OUTPUT CONTROL Knob at minimum "0" position.
   c. OUTPUT MODE Switch in center OFF position.
   d. Proper INPUT VOLTAGE selected.

2. Connect one end of a high-current lead to one side of thermal element or current coil in overload relay. Connect other end of this lead to the appropriate output terminal of test set.

3. Connect one end of second high-current lead to other side of thermal element or current coil in overload relay. Connect other end of this lead to the common terminal (see SELECTION OF OUTPUT LEADS, page 8).

4. Connect test set to suitable single-phase power supply.

5. Turn test set ON with POWER ON/OFF Switch (instrument displays should light).

6. Use RANGE SWITCH to select ammeter range so test current will be near full scale and no less than 10% of full scale.

7. Put ammeter DISPLAY MODE Switch in MEMORY position.

8. Connect a pair of light leads (timer leads) from Normally Closed Contacts or Normally Open Contacts of overload relay to binding posts of test set labeled CONTACTS.

9. Select appropriate timer STOP MODE.

10. Select desired timer display mode and range.

11. Rotate OUTPUT CONTROL knob clockwise and momentarily press OUTPUT MODE Switch in MOM. and release. Observe current reading retained by ammeter.

12. Continue to rotate OUTPUT CONTROL Knob clockwise while jogging (repeatedly moving to MOM. position and releasing) OUTPUT MODE Switch until desired test current is reached. Suggested test current is three times (3x) the rating of thermal relays or three times (3x) the pick-up current of magnetic relays.

NOTE: If the relay utilizes a high impedance thermal element or operating coil and the desired current cannot be reached with OUTPUT CONTROL Knob at maximum clockwise rotation, return knob to zero and change leads to shorter and/or larger cross sectional size. Repeat steps 11 an 12 (see SELECTION OF OUTPUT LEADS, page 8).

NOTE: Before starting test, allow time for thermal element to cool; or in the case of magnetic overload relays, for the piston to reset. Incorrect tripping time may otherwise result.

13. Put ammeter DISPLAY MODE in NORMAL position.

14. Start test by moving OUTPUT MODE Switch to MAINT. position.

NOTE: Test current may decrease (fall off) during the test because the resistance or impedance of the test circuit increases as it heats up. Rotate OUTPUT CONTROL Knob clockwise to keep test current at desired value.

15. When overload relay trips, timer stops and output is de-energized. Timer indicates total elapsed time of the test in seconds or cycles.

16. Turn test set OFF with POWER ON/OFF Switch.

IMPORTANT NOTE

In order to obtain accurate tripping times with some types of magnetic overload relays, particularly those using viscosity oil, it may be necessary to "preheat" the relay by running rated current through the relay for a few minutes.

INSTANTANEOUS ELEMENT

1. Set-up CB-845X with:

   a. Power ON/OFF Switch in OFF position (instrument displays off).
   b. OUTPUT CONTROL Knob at minimum "0" position.
   c. OUTPUT MODE Switch in center OFF position.
   d. Proper INPUT VOLTAGE selected.

2. Connect one end of a high-current lead to one side of instantaneous element in overload relay. Connect other end of this lead to the appropriate output terminal of test set.

3. Connect one end of second high-current lead to other side of instantaneous element in overload relay. Connect other end of this lead to the common terminal (see SELECTION OF OUTPUT LEADS, page 8).

4. Connect test set to suitable single-phase power supply.

5. Turn test set ON with POWER ON/OFF Switch (instrument displays should light).

6. Use RANGE Switch to select ammeter range so test current will be near full scale and no less than 10% of full scale.

7. Put ammeter DISPLAY MODE Switch in MEMORY position.

8. Connect a pair of light leads (timer leads) from Normally Closed Contacts or Normally Open Contacts of overload relay to binding posts of test set labeled CONTACTS.

9. Select appropriate timer STOP MODE.

10. Select desired timer display mode and range.

11. Rotate OUTPUT CONTROL Knob clockwise and momentarily press OUTPUT MODE Switch in MOM. and release. Observe current reading retained by ammeter.

NOTE: If the relay utilizes a high impedance thermal element or operating coil and the desired current cannot be reached with OUTPUT CONTROL Knob at maximum clockwise rotation, return knob to zero and change current leads to shorter and/or larger cross sectional size. Repeat step 11.

12. Continue step 11 until overload relay trips. Observe current reading retained on ammeter. Timer indicated elapsed time of test in cycles or seconds.

NOTE: To avoid tripping error caused by interference of time delay element, allow thermal element to cool; or in the case of magnetic overload relays, for the position to reset.

13. Repeat test, starting with OUTPUT CONTROL Knob at position just below trip current of instantaneous element observed in step 12.

14. When overload relay trips, timer stops and output is de-energized. Current reading is retained on ammeter. Timer indicates elapsed time in seconds or cycles.

15. Turn test set OFF with POWER ON/OFF Switch.

IMPORTANT NOTE

Refer to the manufacturer's instructions for instantaneous trip time. If increasing test current does not decrease tripping time, current at which minimum tripping time was first observed is the instantaneous trip current value.

TEST PROCEDURES FOR

MOLDED CASE CIRCUIT BREAKERS

THERMAL ELEMENT

1. Set-up CB-845X with:

   a. Power ON/OFF Switch in OFF position (instrument displays off).
   b. OUTPUT CONTROL Knob at minimum "0" position.
   c. OUTPUT MODE Switch in center OFF position.
   d. Proper INPUT VOLTAGE selected.

2. Connect one end of a high-current lead to one pole of side of circuit breaker. Connect other end of this lead to a high current output terminal of test set.

3. Connect one end of second high-current lead to other side of same pole of circuit breaker. Connect other end of this lead to the common terminal (see SELECTION OF OUTPUT LEADS, page 8).

4. Connect test set to suitable single-phase power supply.

5. Turn test set ON with POWER ON/OFF Switch (instrument displays should light).

6. Use RANGE Switch to select ammeter range so test current will be near full scale and no less than 10% of full scale.

7. Put ammeter DISPLAY MODE Switch in MEMORY position.

8. Place timer STOP MODE Switch in CURRENT position.

9. Select desired timer display mode and range.

10. Rotate OUTPUT CONTROL Knob clockwise and momentarily press OUTPUT MODE Switch in MOM. and release. Observe current reading retained by ammeter.

11. Continue to rotate OUTPUT CONTROL Knob clockwise while jogging (repeatedly moving to MOM. position and releasing) OUTPUT MODE Switch until desired test current is reached. Suggested test current is three times (3x) the rating of the circuit breaker.

NOTE: If the relay utilizes a high impedance thermal element or operating coil and the desired current cannot be reached with OUTPUT CONTROL Knob at maximum clockwise rotation, return knob to zero and change current leads to shorter and/or larger cross sectional size. Repeat steps 10 and 11.

NOTE: Before starting test, allow time for the thermal element to cool, otherwise incorrect tripping time may result.

12. Put ammeter DISPLAY MODE in NORMAL position.

13. Start test by moving OUTPUT MODE Switch to MAINT. position.

NOTE: Test current may decrease (fall off) during the test because the resistance or impedance of the test circuit increases as it heats up. Rotate OUTPUT CONTROL Knob clockwise to keep the test current at desired value.

14. When circuit breaker trips, timer stops, and output is de-energized. Timer indicates elapsed time in seconds or cycles.

15. Turn test set OFF with POWER ON/OFF Switch.

IMPORTANT NOTE

Some types of circuit breakers trip only under high current fault conditions, usually ten times (10x) rated current. They have only instantaneous characteristics, therefore, they will not trip using usual procedure described above. Refer to INSTANTANEOUS TEST PROCEDURES FOR MOLDED CASE CIRCUIT BREAKERS.

INSTANTANEOUS ELEMENT

1. Set-up CB-845X with:

   a. Power ON/OFF Switch in OFF position (instrument displays off).
   b. OUTPUT CONTROL Knob at minimum "0" position.
   c. OUTPUT MODE Switch in center OFF position.
   d. Proper INPUT VOLTAGE selected.

2. Connect one end of a high-current lead to one pole of side of circuit breaker. Connect other end of this lead to the appropriate high current output terminal of test set.

3. Connect one end of second high-current lead to other side of same pole of circuit breaker. Connect other end of this lead to the common terminal (see SELECTION OF OUTPUT LEADS, page 8).

4. Connect test set to suitable single-phase power supply.

5. Turn test set ON with POWER ON/OFF Switch (instrument displays should light).

6. Use RANGE Switch to select ammeter range so test current will be near full scale and no less than 10% of full scale.

7. Put ammeter DISPLAY MODE Switch in MEMORY position.

8. Place timer STOP MODE Switch in CURRENT position.

9. Select desired timer display mode and range.

10. Rotate OUTPUT CONTROL Knob clockwise and momentarily press OUTPUT MODE Switch in MOM. and release. Observe current reading retained by ammeter.

NOTE: If the relay utilizes a high impedance thermal element or operating coil and the desired current

cannot be reached with OUTPUT CONTROL Knob at maximum clockwise rotation, return knob to zero and change current leads to shorter and/or larger sectional size. Repeat step 10 only.

11. Continue step 10 until circuit breaker trips. Timer indicates elapsed time of test in seconds or cycles.

NOTE: To avoid tripping error caused by time delay element over heating, allow time for it to cool.

12. Repeat test, starting with OUTPUT CONTROL Knob at position just below trip current of instantaneous element observed in step 11.

13. When circuit breaker trips, timer stops and output is de-energized. Current reading is retained on ammeter. Timer indicates elapsed time in seconds or cycles.

14. Turn test set OFF with POWER ON/OFF Switch.

IMPORTANT NOTE

Refer to the manufacturer's instructions for instantaneous trip time. If increasing test current does not decrease tripping time, current at which minimum tripping time was first obtained is the instantaneous trip current value.

GROUND FAULT TRIP

1. Set-up CB-845X with:

   a. Power ON/OFF Switch in OFF position (instrument displays off).
   b. OUTPUT CONTROL Knob at minimum "0" position.
   c. OUTPUT MODE Switch in center OFF position.
   d. Proper INPUT VOLTAGE selected.

2. Connect one end of a high-current lead to one pole of side of circuit breaker. Connect other end of this lead to the appropriate high current output terminal of test set.

3. Connect one end of second high-current lead to other side of same pole of circuit breaker. Connect other end of this lead to the common terminal (see SELECTION OF OUTPUT LEADS, page 8).

4. Connect test set to suitable single-phase power supply.

5. Turn test set ON with POWER ON/OFF Switch (instrument displays should light).

6. Use RANGE Switch to select ammeter range so test current will be near full scale and no less than 10% of full scale.

7. Put ammeter DISPLAY MODE Switch in MEMORY position.

8. Place timer STOP MODE Switch in CURRENT position.

9. Select desired timer display mode and range.

10. Rotate OUTPUT CONTROL Knob clockwise and momentarily press OUTPUT MODE Switch in MOM. and release. Observe current reading retained by ammeter.

11. Continue to rotate OUTPUT CONTROL Knob clockwise while jogging (repeatedly moving to MOM. position and releasing) OUTPUT MODE Switch until desired test current is reached. Suggested test current is one and one half time times (1.5x) the rating of the ground fault trip device.

NOTE: If the relay utilizes a high impedance thermal element or operating coil and the desired current cannot be reached with OUTPUT CONTROL Knob at maximum clockwise rotation, return knob to zero and change current leads to shorter and/or larger cross sectional size. Repeat steps 10 and 11 (see SELECTION OF OUTPUT LEADS, page 8).

12. Put ammeter DISPLAY MODE in NORMAL position.

13. Start test by moving OUTPUT MODE Switch to MAINT. position.

14. When device trips, timer stops, and output is de-energized. Timer indicates elapsed time in seconds or cycles.

15. Turn test set OFF with POWER ON/OFF Switch.

IMPORTANT NOTE

Refer to the manufacturer's instructions for proper test current value and tripping time.

MAINTENANCE OF MOLDED CASE

CIRCUIT BREAKERS

The molded case circuit breaker essentially consists of two separate elements. One element is a set of contacts and suitable mechanical linkage for manual operation of the breaker as a switch in an electric circuit. The other element is a device to sense and react to an overload or short circuit. Normally, the time delay overload device is thermal and the instantaneous overload device, when supplied, is magnetic. The thermal element usually uses a bi-metallic strip; two pieces of dissimilar material bonded together. An overload causes an increase in heat which will result in moving the bi-metallic unit and eventually trip the circuit breaker. The magnetic element operates with no intentional time delay to provide instantaneous protection against high magnitude faults.

PLANNED MAINTENANCE PROGRAM

A scheduled program for maintenance of molded case circuit breakers consists primarily of "good housekeeping" in conjunction with visual inspections and electrical tests. A brief outline is given below:

1. Clean

   All types of molded case circuit breakers should be externally cleaned so the heat produced in normal operation can be dissipated properly. It is possible for dirt or dust caused by normal plant conditions to accumulate and prevent proper dissipation of heat, resulting in a nuisance operation of the breaker.

2. Tighten Connections

   This is particularly important because loose electrical connections can cause extra heat which may result in an unnecessary operation of the breaker.

3. Test

   The molded case circuit breaker should be subjected to a simulated overload and the tripping time measured. This is important because after a period of inactivity, the overload device may become stiff or inoperable. The only way to determine this condition and eliminate the stiffness is to electrically operate the breaker on a periodic basis. Manually opening and closing the main contacts of the breaker does not move any of the mechanical linkage associated with the overload device. Testing may be as often as every 6 months or as long as every 3 or 4 years, depending upon conditions where the breaker is installed.

OVERLOAD RELAYS

APPLICATION

The prime function of the motor overload relay is to prevent operation of a motor for too long when an overload condition exists.

In general, motor starters are applied to a given horsepower range of motors. The voltage and current requirements of the application will "size" the starter under NEMA requirements, but the actual starting current, running current and ambient temperature will determine the overload relay rating required to protect the motor without nuisance tripping.

Selection of the properly rated overload relay can be made by reference to tables or charts supplied by the manufacturer of the overload relays and motors. Whenever a motor trips out, it is poor practice to operate the over-load relay indiscriminately; the motor may actually be working under an overload condition or the overload relay may be operating improperly. Up-rating the overload relay could permit an overload to continue, resulting in deterioration of the motor insulation and reduction in motor life. Therefore, careful analysis should be made about the cause of the nuisance trip before changing the rating of the overload relay.

Operating characteristics of the motor overload relay should be verified at regular intervals. Typical practice dictates inspection of overload relays at periods of one to two years, with an actual test of tripping time to be made at intervals of two years. The test interval can vary with the type of service involved and the importance of the motor to the process or production.

TYPES

Motor overload relays incorporate an element which actuates a set of contacts connected to the motor control circuit. These contacts open the circuit of the holding coil in the motor starter and interrupt the power to the motor.

In general, there are three types of motor overload relays in use:

1. Thermal - melting alloy or solder pot
2. Thermal - bimetallic strip
3. Electromagnetic

In thermal type relays, time-current characteristics are obtained by the thermal properties of the melting alloy or bimetallic strip. In the magnetic type, a damped plunger or moving iron device is used to produce time delays.

1. Thermal - melting alloy or solder pot

   In this type, tripping is the result of heat generated by the motor load current passing through a "heater" in the overload relay. This overload relay consists of a brass shaft which is surrounded by solder. Fixed to one end of the shaft is a small ratchet wheel.

As long as the solder is solid, this assembly is immobile. When the motor control circuit contacts are closed, a spring is held compressed by the immobility of the ratchet wheel. An overloaded condition in the motor increases the ratchet wheel. An overloaded condition in the motor increases the current through the heater, thus melting the solder and releasing the energy in the spring. This interrupts the circuit of the holding coil in the motor starter and shuts down the motor.

The starter may be reset only after the temperature of the heater has cooled sufficiently to permit the solder to reset and again make the ratchet and shaft immobile. Reset is usually accomplished by an external pushbutton on the face of the starter. Many heaters offer a selection of either manual or automatic reset.

2. Thermal - bimetallic strip

This type uses a bimetallic strip - two pieces of dissimilar metal bonded together. An increase in heat will cause movement of this bimetallic unit and eventually open a set of contacts in the motor control circuit, thus opening the holding coil circuit and shutting down the motor.

The principle of operation is the same as the melting alloy type. When the bimetallic element has cooled sufficiently, the motor control circuit may be reset either manually or automatically.

3. Electromagnetic

In This type of motor overload relay, a damped plunger or moving iron device is used to produce the delays required and initiate the trip signal to the interrupting device. The most common type of magnetic overload relay utilizes a plunger or iron core piston which extends from an oil filled dashpot into the operating coil of the relay.

When the electromagnetic field produced by the operating coil is strong enough, the piston moves through the oil and opens the contacts of the relay. A time-delay is achieved by the oil in the contacts of the relay. A time-delay is achieved by the oil in the dashpot retarding the movement of the piston. Usually magnetic overload relays with oil dashpots have facilities which permit adjusting their minimum operating current (pick-up point) and their time delay characteristics.

PLANNED MAINTENANCE PROGRAM

A scheduled program for maintenance of motor overload relays consists primarily of "good housekeeping" with visual inspections and electrical tests. A brief outline is given below:

1. Clean

   All types of motor overload relays should be cleaned periodically to ensure continued, reliable operation. It is possible for dirt or dust created by conditions in the plant to prevent parts of the relay from moving. Also these same conditions can prevent the proper dissipation of normal heating, resulting in unnecessary operation of thermal type overload relays.

2. Tighten Connections

   This is particularly important in thermal overload relays. Loose electrical connections can cause extra heat which may result in a nuisance operation of the relay.

3. Inspect Heater Size

   Determine that the specified heater is used in thermal overload relays. Too often, oversized heaters are arbitrarily installed to eliminate unexplained trips. Actually, the original heaters may have oxidized over time and become smaller in cross section. In that event, the heat required to operate the relay is provided by a smaller amount of current than that intended by the original design. This may make the relay trip prematurely and the heater appear undersized.

4. Inspect Settings (Where applicable)

   Most magnetic overload relays have adjustable settings for minimum operating current and time delay characteristics. These should be adjusted to the specified settings.

5. Test

   The motor overload relay should be subjected to a simulated overload and the tripping time measured. This time should be compared to the manufacturer's specifications or the relay's time current curves to make certain that the relay is operating properly. A tolerance of ± 15% is usually acceptable. If the relay's curves or specifications are not available, it is suggested that the Heat Damage Curve of the motor be used as a guide for maximum trip time at 300% of motor full load current.

CB-845X MAINTENANCE INSTRUCTIONS

Maintenance intervals depend on usage, but a maximum of every six months is recommended.

WARNING: DO NOT SERVICE UNIT UNLESS IT IS DISCONNECTED FROM ITS POWER SOURCE.

1. Enclosure

   The enclosure can be cleaned with a soft cloth. If heavily soiled, the cloth can be dampened with an approved cleaning agent that does not attack the finish or leave residue.

2. Control Panel

   The control panel can be wiped clean with a soft, dry cloth. Do not wipe the meter lenses with a cloth. If a breath of air will not remove dirt, brush it away lightly with a soft bristle instrument brush.

3. Variable Autotransformer

   The brushes are designed for long life, but should be checked periodically for excessive wear or chipping. The brushes must be changed before the brush knife edge is worn off and particularly before the brass brush holder touches the contact surface or serious damage will result. The brush contact area should be inspected for burning, pitting, dirt or debris. If necessary, burnish surface of the contact surface with a burnishing tool, remove filings, and clean surface with a swab moistened with alcohol.

4. Other Components

   Check all knobs, printed circuit boards, screws, fasteners, connections and terminals for tightness and proper position. Remove dust with a soft brush and breath of air. Output terminal connection tightness is particularly important. If they become loose, excessive heating of the terminals and poor current output will result.

5. Insulation

   Check wiring and other insulated components for burning, cracking or other damage. Check interconnect cable for insulation damage and that connectors are sound.

IMPORTANT NOTES

Do not use lubricants or solvents of any kind in the test set except as specifically recommended.

If damage or malfunction is suspected or repairs deemed necessary, consult at Multi-Amp Corporation Representative for assistance if it is unclear what course of action is needed. Please provide model and serial number when making inquires.

Consult Multi-Amp for service and repair instructions for returning unit to the factory.

If it is desired to service the output section, the four bottom feet must be removed before removing the enclosure.

SERVICE AND REPAIR ORDER INSTRUCTIONS

If factory service is required or desired, contact the factory for return instructions.

A Service & Repair Order (RA) number will be assigned for proper handling of the unit when it arrives at the factory.

If desired, a letter with the number and instructions can be provided.

Provide the factory with model number, serial number, nature of the problem or service desired, return address, your name, and where you can be reached should the factory need to contact you.

A purchase order number, cost limit, billing, and return shipping instructions may also be provided if desired.

National Bureau of Standards traceable calibration and certification of two types is available if desired at additional cost.

CLASS ONE: A certificate is provided verifying the traceability and calibration of the equipment.

CLASS N: That which is required for nuclear power plants. A certificate of traceability and calibration along with "as found" and "as left" data are provided.

If an estimate is requested, provide the name and contact information of the person with approval/disapproval authority.

Pack the equipment appropriately to prevent damage during shipment. If a reusable crate or container is used, the unit will be returned in it if in suitable condition.

Put the RA number on the address label of the shipping container for proper identification and faster handling.

CB-845X PARTS LIST

DESCRIPTION	PART NO.
Connector, 3 wire, 20A receptacle, grounded (for power input)	1297
Circuit Breaker, 2 pole, 30A 250V	9477
Binding post, white	169
Lens, red indicator (output lamp)	8855
Lamp, 24V (output lamp)	8856
Lamp holder, cartridge (output lamp)	8858
Assembly, current transducer	9012
Assembly, control logic PCB	9343
Assembly, power supply PCB	8616
Enclosure, metal (control section)	9467
Transformer, input auto	9475
Transformer, variable	614
Transformer, output, 60Hz	9473
Switch, input selector	9476
Switch, initiate	9067
Knob, pointer (ammeter range selector)	2130
Assembly, triac	9479
Assembly, interconnect cable (4')	9487
Fuse, 25A, 250V, FNW	9480
Fuse, .125A, 250V, MDL (control)	981
Fuse holder, 1 pole, 600V, HPC (main)	954
Fuse holder, 1 pole, 250V, HKP (control)	949
Assembly, lens, red (timer & ammeter)	9574
Filter, line, 120V	6344

CB-845X ACCESSORY KIT

P/N 9482

QUANTITY	DESCRIPTION	PART NO.
1 pair	Accessory lead, timer, 2/C #18 AWG	1282
1 each	Connector, 3 wire, 20A, plug	1402
1 pair	Accessory cable assembly, #4 AWG	2265
1 pair	Accessory cable assembly, # 4/0 AWG	9311
5 each	Fuse, 25A, 250V, FNW	9480
5 each	Fuse, .125A, 250V, MDL	981

For parts not listed and components of assemblies, please consult the factory.

WARRANTY STATEMENT

Multi-Amp Corporation warrants to the original purchaser that the product is free of defects in material and workmanship for a period of one (1) year from date of shipment. This warranty is limited and shall not apply to equipment which has damage, or cause of defect, due to accident, negligence, improper operation, faulty installation by the purchaser, or improper service or repair by any person, company or corporation not authorized by Multi-Amp Corporation.

Multi-Amp Corporation will, at its option, either repair or replace those parts and/or materials that it deems to be defective. Any costs incurred by the purchaser for the repair or replacement of such parts and/or materials shall be the sole responsibility of the original purchaser.

THE ABOVE WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED ON THE PART OF THE MULTI-AMP CORPORATION, AND IN NO EVENT SHALL THE MULTI-AMP CORPORATION BE LIABLE FOR THE CONSEQUENTIAL DAMAGES DUE TO THE BREACH THEREOF.

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