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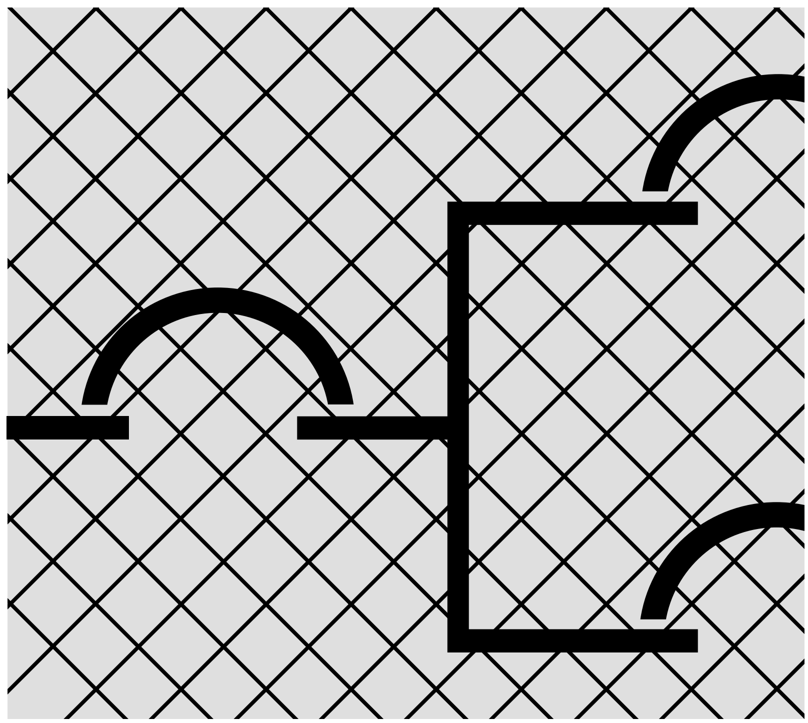
Data Bulletin

Field Testing and Maintenance Guide for MICROLOGIC® Electronic Trip and Thermal-magnetic Molded Case Circuit Breakers



SQUARE D
Schneider Electric

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INTRODUCTION

The service life of molded case circuit breakers depends on proper application, correct installation, environmental conditions and preventive maintenance. Two levels of investigation can ensure that a circuit breaker is able to operate properly:

1. Inspection and preventive maintenance.

2. Performance and verification tests.

To ensure continued suitable performance, periodically inspect the circuit breakers following the procedures outlined in this document. These test procedures will help diagnose operational problems and are provided as an aid or as follow-up to an inspection that reveals potential problems. The inspection, preventive maintenance, and field-testing instructions provided in this document are intended for use with Square D thermal-magnetic, magnetic-only and electronic trip circuit breakers with the MICROLOGIC® trip system.

The standard generally used as a basis for field-testing requirements is the National Electrical Manufacturers Association Standard, NEMA AB 4-1996, “Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.” If additional information or assistance is required, contact your local field sales office. For on-site service, contact The Customer Information Center 24 hours a day at 1-888-SquareD (778-2733).

The inspection and preventive maintenance procedures outlined in this publication may be useful in setting up a routine inspection program. Conduct performance tests only if inspection or daily operation indicates that a circuit breaker may not be adequately providing the protection required by its application. Precisely controlled factory testing conditions are used to establish the characteristic trip curves. If field test results fall outside the characteristic trip curve tolerance band, the test conditions and methods must be carefully evaluated for accuracy.

If questionable results are observed during inspection or performance tests, consult your local field sales office. If it is necessary to return a circuit breaker to the manufacturing facility, use proper packaging and packing materials to avoid shipping damage. Specific repacking instructions are contained in the circuit breaker instructions.

This publication is not intended, nor is it adequate, to verify proper electrical performance of a molded case circuit breaker that has been disassembled, modified, rebuilt, refurbished, or handled in any manner not intended or authorized by the Company.

Thermal-Magnetic Circuit Breaker Testing Inaccuracies

During the last few years there have been increasing incidents of inaccurate field testing. Major obstacles to accurate field testing of circuit breakers are the variables present in modern installations. Variations in enclosures, bussing, cabling and proximity to other equipment contribute to inaccurate field testing.

Another obstacle is ac vs. dc test currents for dc applications. Most manufacturers have tested and certified ac circuit breakers for use in low-voltage dc applications (250 Vdc or less). Based on testing and application experience, it is known that when applying thermal-magnetic circuit breakers, 1000-ampere frame or less, on low-voltage (<250 V) dc systems, the circuit breaker’s thermal characteristics remain unchanged. On the other hand, the magnetic (instantaneous) characteristics change and require a multiplier to determine the dc current necessary to trip the circuit breaker. The multipliers are shown in the *Determining Current Carrying Capacities in Special Applications* data bulletin.

For circuit breakers above 1000 amperes and the special 500 Vdc circuit breakers, the correlation between ac current and dc current is not predictable. For accurate results, these circuit breakers must be tested using dc current.

Field Testing Special 500 Vdc Circuit Breakers

Square D UL Listed 500 Vdc circuit breakers are specially designed, manufactured and calibrated for use on ungrounded uninterruptable power supplies (UPSs). The maximum nominal (loaded) voltage is 500 Vdc and the maximum floating (unloaded) voltage is 600 Vdc.

These circuit breakers are UL Listed when applied with all three poles connected in series as shown on the label of the circuit breaker. The series connection is customer provided and external to the circuit breaker.

Square D UL Listed 500 Vdc circuit breakers are special circuit breakers for dc applications and must be tested using dc current.

- Select the correct time-current trip curve. The trip curves show both the thermal and magnetic trip ranges of the circuit breakers. Precisely controlled factory testing conditions are used to establish all trip curves.
  - Use a dc power supply to test the circuit breakers. The specifications are as follows:
    - Circuit breakers up to 400 ampere dc—Time constant must be 20 milliseconds or less
    - Circuit breakers 450–2500 ampere dc—Time constant must be 25 milliseconds or less
    - DC ripple constant must not exceed 1% RMS
    - Time constant is defined by UL 489 as: “The time constant of the circuit is the time measured on the oscillogram where the current is 63. 2 percent of the prospective current.”

- Make sure ambient temperature and circuit breaker temperature is 25^{o} C ± 3 degrees.

- Remove the circuit breaker from the enclosure. If removing the circuit breaker is not practical, test the circuit breaker in the end-use equipment. If the test results fall outside of the trip curve tolerance, remove the circuit breaker from the enclosure and retest.

- Use correctly sized cables (per NEC tables) with a minimum of four feet (1.22 m) of cable per connection.

- Connect dc power supply to circuit breaker with all poles connected in series as shown on the circuit breaker label.

- Make sure connections to circuit breaker are properly torqued.

- Apply dc test current to trip the circuit breaker. The tripping mechanism in the circuit breaker reacts to the magnetic fields created by the current flowing through the circuit breaker. When current flow is near the trip point of the circuit breaker, the magnetic fields can cause false tripping due to vibration. Perform the following steps to minimize the effects of false tripping: 1) When the circuit breaker trips, reset and close the circuit breaker. 2) Reapply the dc test current to trip the circuit breaker again. 3) Record the current and compare to the trip curve.

Field Testing ac Thermal-Magnetic Circuit Breakers

Circuit breakers are calibrated and tested at the time of manufacture to meet published trip curves. Precisely controlled factory testing conditions are used to establish the trip curves. The circuit breakers are tested individually with minimal interference from magnetic fields, effects of cables, bussing, or proximity to other equipment. Circuit breakers are calibrated individually to give customers a baseline of calibration. This enables them and us to design end-use equipment. The circuit breakers by themselves have one set of operating characteristics and, as an assembly, the end-use equipment has another set of characteristics. That is why UL, NEC and other equipment and installation codes require that the circuit breakers be tested individually and then the end-use equipment tested as an assembly to make sure it functions according to its specifications.

In many cases, circuit breakers are sold without knowing the end-use application. It is not possible or practical to test each circuit breaker installed in all variations of end-use equipment (panelboard, switchboard, MCC, OEM, etc.).

Recommended steps to accurately field test circuit breakers (see test procedures in this manual for specific information):

- Use correct test equipment.
- Make sure ambient temperature and circuit breaker temperature is 25°C ± 3 degrees.
- Remove circuit breaker from enclosure. If removing the circuit breaker is not practical, test circuit breaker in the end-use equipment. If test results fall outside of the trip curve tolerance, remove circuit breaker from enclosure and retest.
- Use correctly sized cables (per NEC tables) with a minimum of four feet of cable per connection.
- Test each pole individually.
- Make sure the connections to the circuit breaker are properly torqued.
- Test circuit breaker and record findings. The tripping mechanisms in the circuit breaker react to the magnetic fields created by the current flowing through the circuit breaker. When current flow is near the trip point of the circuit breaker, the magnetic fields can cause false tripping due to vibration. Do the following steps to minimize the effects of false tripping: 1) After each current pulse or when circuit breaker trips, reset and turn the circuit breaker ON. 2) Reapply the test current to trip the circuit breaker again. 3) Record the current and compare to the trip curve.

Safety Precautions

1. Only qualified electrical workers with training and experience on low-voltage circuits should perform work described in these instructions. Workers must understand the hazards involved in working with or near low-voltage equipment. Such work should be performed only after reading this complete set of

instructions.

2. Some inspections or procedures require that certain parts of the electrical system remain energized at hazardous voltages during the procedure. Observe all specific safety messages (Danger, Warning, Caution) throughout this manual.
3. Wear protective safety equipment, recognize potential hazards, and take adequate safety precautions when performing the procedures outlined in this manual.

Inspection and Preventive Maintenance

Experience shows that molded case circuit breakers normally require little maintenance. The Company recommends that inspection procedures be performed on a regular basis. Inspection frequency depends on operating and environmental conditions associated with the application. Visual inspections as indicated in steps 1, 2, 4, and 7 under Procedures can be performed any time electrical workers or maintenance personnel are in the vicinity of the electrical equipment. Other inspections can be done during normal maintenance intervals. It is recommended that the circuit breaker mechanism be exercised annually as explained in step 5. Inspection and maintenance may be required more frequently if adverse operating or environmental conditions exist.

Guidelines

The molded case of a Square D molded case circuit breaker should not be opened. Opening the case or disassembling the circuit breaker voids the manufacturer’s warranty. Opened or otherwise inoperable circuit breakers should be destroyed or returned to the Company to prevent them from being returned to service. Removal of auxiliary or accessory covers does not constitute opening the molded case.

Procedures

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

Take precautions to ensure that no accidental contact is made with live components during this check.

Failure to observe this precaution will result in death or serious injury.

1. Verify circuit breaker application and rating**.**

   Make sure that the circuit breaker is properly applied within labeled voltages, continuous current (handle) rating, maximum current interrupting ratings and to Company recommendations. Compare the circuit breaker faceplate data to the installation drawings. Verify trip unit settings on MICROLOGIC® electronic trip circuit breakers with the coordination study. After completing inspection and maintenance procedures, ensure that all trip unit settings for all functions are set according to the coordination study.

2. Check for overheating while equipment is energized.

   While the circuit breaker is normally operating, under load and at operating temperature, check the exposed, accessible, insulated face of the circuit breaker and adjacent dead front surfaces of the enclosure for overheating. To do this, place the palm of your hand on the outside of the enclosure. If you cannot maintain a three-second contact with the circuit breaker, the cause should be investigated.

   Allow initially energized circuit breakers at least three hours to reach operating temperature. Compare the surface temperature of individual circuit breakers with the surface temperature of other circuit breakers in the installation. Circuit breaker surface temperatures vary according to loading, position in the panelboard and ambient temperature. If the surface temperature of a circuit breaker is considerably higher than adjacent circuit breakers, the cause should be investigated.

Thermographic inspection methods may also be used to evaluate overheating with equipment energized (see Thermographic Inspection, page 8).

DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

Disconnect all power sources before performing steps 3 through 7. Assume that all circuits are live until they are completely de-energized, tested, grounded and tagged. Consider all sources of power, including the possibility of backfeeding and control power.

Failure to observe this precaution will result in serious injury or death.

3. Check for overheating while the equipment is de-energized.

   Visually inspect electrical components for discoloration. This may indicate overheating. If there is no evidence of overheating or loose connections, do not disturb or retorque connections.

   Copper Connections:
   If evidence of overheating is found on terminals, connectors, conductors or conductor insulation, clean and dress all affected connections and bus bars to NEMA Standards Publication AB 4-1996.

   Aluminum Connections:
   Overheated aluminum connectors must be replaced and damaged portions of the conductor removed. If the conductor is not long enough to properly terminate to the circuit breaker when the damaged portion is removed, make an appropriate splice using a new length of rated conductor.

   I-LINE® Panelboard Connections:
   If the I-LINE® panelboard jaw connections are pitted, discolored or deformed, the circuit breaker must be replaced. I-LINE jaws are gauged and tested during the manufacturing process. They are not field replaceable. Do not bend or adjust them.

   If electrical joint compound is removed from I-LINE connections, it must be reapplied before reinstallation of the circuit breaker(s). This compound is necessary to ensure the integrity of the connection. I-LINE panelboard connections require Square D PJC-7201 joint compound.

   Drawout Connections:
   If the electrical joint compound is removed from drawout connections, it must be reapplied before reinstallation of the circuit breakers. This compound is necessary to ensure the integrity of the connection. Drawout connections for SE circuit breakers require Square D PJC-8311 joint compound. Drawout connections for MASTERPACT® NW circuit breakers require S48899 grease.

   After cleaning and/or replacing damaged parts, torque all connections to values specified by Square D. Refer to Square D Class 601 and Class 602 catalogs for additional information regarding torque values.

4. Check for cracks in the molded case.

   Any circuit breaker with a cracked molded case should be replaced because its ability to withstand short-circuit interruption stresses is reduced.

5. Exercise circuit breaker mechanism:

   Toggle the circuit breaker handle on and off several times to ensure that mechanical linkages are free. Trip the circuit breaker with the push-to-trip button. Reset and turn the circuit breaker back on. Repeat to ensure operability. If the circuit breaker does not trip, or if it does not reset after tripping, it must be replaced.

6. Clean the circuit breaker.

   Remove any buildup of dust, dirt, grease or moisture from circuit breaker surfaces with a lint-free dry cloth or vacuum cleaner. Do not use compressed air. Use caution when using detergent-based cleaners or solvents; these may deteriorate faceplate, labels and insulation materials. Clean contact surfaces of circuit breaker terminals and terminal pads or bus bars with a nonabrasive cleaner. Abrasive cleaners will remove plating, resulting in joint deterioration.

   If electrical joint compound is removed from I-LINE or drawout connections, Square D PJC-7201 or PJC-8311 joint compound, respectively, must be reapplied before reinstalling the circuit breakers. This compound is necessary to ensure the integrity of the connection.

7. Inspect the enclosure.

   The enclosure should be clean and dry. All covers and trim pieces should be in place.

Thermographic Inspection

DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

Only qualified electrical workers with training and experience on low-voltage circuits should perform thermographic inspections. These workers must understand the hazards involved in working with or near low-voltage equipment. Perform such work only after reading this complete set of instructions.

Failure to observe this precaution will result in death or serious injury.

Infrared thermographic inspection techniques may be useful in evaluating the operating condition of circuit breakers and terminations. Comparison to stored infrared thermographic images may be useful for the preventive maintenance of circuit breakers and end-use equipment. The actual amount of heat emitted is a function of both load current and ambient conditions. Interpretation of infrared survey requires experience and training in this type of inspection.

Allow initially energized circuit breakers at least three hours to reach operating temperature. Compare the thermographic images of individual circuit breakers to previously stored images of the same circuit breakers.

Additional Information

For more information concerning Square D circuit breakers, refer to the appropriate instruction manual. These manuals contain installation instructions, mounting information, safety features, wiring diagrams, and troubleshooting charts for specific circuit breakers.

GENERAL CIRCUIT BREAKER PERFORMANCE TESTS

Insulation Resistance Test

The following tests are intended to verify that a circuit breaker is operating properly. Precisely controlled factory testing conditions are used to establish the characteristic trip curves. If field test results fall outside the characteristic trip curve tolerance band, carefully evaluate the test conditions and methods for accuracy.

When questionable conditions or results are observed during inspection and performance tests, consult your local field sales office. Circuit breakers with accessories or factory modifications may require special investigation. If it is necessary to return a circuit breaker to the manufacturing facility, use proper packaging and packing materials to avoid shipping damage. Repacking instructions are contained in the circuit breaker instruction manual.

DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to observe these precautions will result in death or severe personal injury.

Severe environmental conditions can reduce the dielectric strength of molded case circuit breakers. Check insulation resistance during electrical system testing.

To check the insulation resistance, perform the following steps:

1. De-energize and isolate the circuit breaker.
2. Clean the circuit breaker as described earlier.
3. Using a megohmmeter with a capacity of 500–1000 Vdc, apply voltage from:
   A. Each phase-to-ground with the circuit breaker on (circuit breaker contacts closed),
   B. Phase-to-phase with the circuit breaker on (circuit breaker contacts closed),
   C. Between each line and load terminal with the circuit breaker off (circuit breaker contacts open).
4. Record resistance values. Resistance values of less than one megohm (1,000,000) should be investigated.

DANGER

HAZARD OF ELECTRIC SHOCK.

Do not touch the circuit breaker terminals or the test leads while the circuit breaker is being tested.

Failure to observe these precautions will result in death or severe personal injury.

CAUTION

HAZARD OF EQUIPMENT DAMAGE.

Do not apply test voltage to control circuits or accessory terminals; damage to electronic and/or low-voltage components can result.

Failure to observe this precaution will result in equipment damage.

Watts Loss (Circuit Breaker Resistance) Test

The ability of a circuit breaker to perform its intended function is, in part, indicated by its watts loss under actual service conditions. Table 1 lists watts loss values which, if exceeded, could produce overheating in the circuit breaker.

DANGER

HAZARD OF ELECTRIC SHOCK OR BURN.

Avoid contact with live components.

Failure to observe this precaution will result in death or serious injury.

Note: Problems do not necessarily result when circuit breakers have a watts loss greater than the tabulated values. A circuit breaker with a watts loss value greater than those listed, which shows no signs of overheating or nuisance tripping, does not necessarily warrant replacement. For additional guidance, consult your local field sales office.

Use the following procedure to determine the watts loss for a circuit breaker:

1. Put the circuit breaker in service and turn it ON.
2. Measure the service current of each pole of the circuit breaker and record the values using a clamp-on current transformer and appropriate meter.
3. Completely de-energize and remove the circuit breaker from service. Exercise the circuit breaker mechanism as noted in the Inspection and Preventive Maintenance Procedures section, step 5, page 9.
4. Using a low-voltage, high-current supply, apply dc current equal to the ac RMS service current through each pole individually.
5. Measure the voltage drop across each pole.
6. Calculate the watts loss. Multiply the current through each pole by the voltage drop measured across each pole (V x I).
7. Record and compare watts loss results to Table 1, page 12.

   Note: When using a digital low-resistance ohmmeter (DLRO), use the formula $R=P/I^2$ to convert watts values in Table 1 to ohms.

Example 1:
If using a digital low resistance ohmmeter (DLRO), convert your resistance reading, obtained from your DLRO, to watts loss by using the formula $P=I^2R$. I, in this example, would be the service current that you obtained in step 2 of this test. R, in this example, would be the actual reading you obtained from the DLRO meter. Compare the calculated watts loss value to the value obtained from the table to determine if your circuit breaker is within acceptable limits. For a 1600A PE circuit breaker:

$$1600^2 \times .000041 = P$$
$$2560000 \times .000041 = 105.0 \text{ watts}$$

Example 2:
Determine the watts loss for each pole of a 100 A frame FA circuit breaker carrying a service current of 75 A per pole. Using a 75 A dc reference current, the dc voltages measured across each pole are:

Left pole = 0.084 V
Center pole = 0.090 V
Right pole = 0.103 V
Watts loss for each pole is calculated using V x I:
Left pole watts loss = 0.084 V x 75 A = 6.3 watts
Center pole watts loss = 0.090 V x 75 A = 6.75 watts
Right pole watts loss = 0.103 V x 75 A = 7.73 watts

All watts loss values per pole are below the 9.4 watts specified in Table 1 for a 100 A FA circuit breaker.

Example 3:
Determine the watts loss per pole given an 800 A frame ME circuit breaker with an 800 A rating plug, carrying a service current of 800 A per pole. Using an 800 A dc reference current, the dc voltages measured across each pole are:

Left pole = 0.035 V
Center pole = 0.040 V
Right pole = 0.044 V
Watts loss for each pole is calculated using V x I:
Left pole watts loss = 0.035 V x 800 A = 28 watts
Center pole watts loss = 0.040 V x 800 A = 32 watts
Right pole watts loss = 0.044 V x 800 A = 35.2 watts

All watts loss values per pole are below the 52 watts specified in Table 1 for an 800 A ME circuit breaker.

Table 1: Watts Loss at Service Current

Circuit Breaker Type	Frame Size (Amperes)	Circuit Breaker Rating/Ampacity	1-Pole DC Watts Loss
FD, FG, FJ	100	15	5.0
		20	5.0
		25	5.0
		30	5.5
		35	5.5
		40	7.0
		45	7.5
		50	8.0
		60	9.5
		70	11.0
		80	13.0
		90	13.0
		100	14.5
FA, FH, FC	100	15	7.0
		20	7.5
		25	7.5
		30	7.6
		35	7.8
		40	7.8
		45	8.5
		50	8.5
		60	8.5
		70	9.3
		80	9.3
		90	9.4
		100	9.4
FI, IF 600 V	100	20	8.5
		25	9.0
		30	9.0
		35	9.0
		40	9.5
		45	9.5
		50	10.0
		60	10.0
		70	12.0
		80	12.0
		90	13.0
		100	13.0

Continued on next page

Table 1: Watts Loss at Service Current—*Continued*

Circuit Breaker Type	Frame Size (Amperes)	Circuit Breaker Rating/Ampacity	1-Pole DC Watts Loss
FD, FG, FJ	125	15	5.0
		20	5.0
		25	5.0
		30	5.5
		35	5.5
		40	7.0
		45	7.5
		50	8.0
		60	9.5
		70	11.0
		80	13.0
		90	13.0
		100	14.5
		110	16.0
		125	18.0
KA, KH	225/250	70	13.6
		80	13.6
		90	15.7
		100	15.7
		110	15.9
		125	15.9
		150	16.4
		175	16.9
		200	17.5
		225	18.0
		250	18.0
KC, KI, IK	250	110	14.5
		125	16.5
		150	19.5
		175	19.5
		200	23.0
		225	24.5
		250	26.0
LA, LH	400	125	19.0
		150	22.0
		175	24.4
		200	25.0
		225	25.3
		250	25.6
		300	26.2
		350	26.5
		400	27.0
IL 480 V	400	250	39.0
		300	42.0
		350	47.0
		400	49.0
LC, LI, LX, LXI, LE	600	300	43.0
		350	51.0
		400	40.0
		450	51.0
		500	58.0
		600	61.0

Continued on next page

Table 1: Watts Loss at Service Current—*Continued*

Circuit Breaker Type	Frame Size (Amperes)	Circuit Breaker Rating/Ampacity	1-Pole DC Watts Loss
MA, MH	800/1000	125	25.0
		175	28.0
		200	29.0
		225	30.0
		250	30.5
		300	31.0
		350	32.0
		400	32.0
		500	36.5
		600	41.0
		700	46.0
		800	50.0
		900	55.0
		1000	55.0
MX, ME	250	100	8.5
		125	8.5
		150	9.0
		175	10.0
		200	12.0
		225	13.5
		250	15.5
	400	300	19.3
		350	23.0
		400	24.5
		450	27.0
		500	30.5
		600	38.5
	800	700	49.0
		800	52.0
NH	1200	600	38.5
		700	49.0
		800	52.0
		1000	63.0
		1200	77.0
NA, NC, NX, NE	1200	600	40.5
		700	52.0
		800	54.5
		900	66.5
		1000	68.5
		1200	81.0
PA, PH, PC, PX, PE	1200–2000	600	38.5
		700	49.0
		800	52.0
		900	58.0
		1000	63.0
		1200	77.0
		1400	97.0
		1600	105.0
		1800	115.0
		2000	126.0
	2500	2500	168.0
SE	4000	ALL	200.0
MASTERPACT	6000	ALL	150.0

THERMAL-MAGNETIC CIRCUIT BREAKER PERFORMANCE TESTS

Inverse-time Overcurrent Trip Test

DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to observe these precautions will result in death or severe personal injury.

CAUTION

HAZARD OF ELECTRIC SHOCK OR BURN.

Never run an inverse-time overcurrent test on a MAG-GARD® instantaneous-trip circuit breaker or molded case switch. This equipment has no thermal tripping element and provides no overload protection.

Failure to observe this precaution will result in overheating of the MAG-GARD® circuit breaker.

1. Completely de-energize and remove the circuit breaker from service. Conduct the following tests at 300% of the circuit breaker ampere rating to verify the performance of the thermal tripping element on thermal-magnetic circuit breakers using a high-current, low-voltage ac power supply less than 24 V.
2. Test in open air at 25°C (77°F) ambient temperature.
3. Trip times are measured from a “cold start.” A cold start, as defined by Underwriters Laboratories Inc. Standard 489 occurs at 25°C ±3° (77°F ±5°). Therefore, before beginning overcurrent testing, the circuit breaker must be in 25°C (77°F) ambient temperature long enough for all parts to reach that temperature. Circuit breakers that have been in higher ambient temperatures may take two to four hours to reach the steady state temperatures mentioned above.
4. Connect the circuit breaker to a power supply by using a minimum of four feet (1.2 m) of cable on each connection. Size the cable according to the ampere rating of the tested circuit breaker. Refer to the National Electrical Code Table 310-16; use the 75°C column for proper conductor sizing. The cable **must** be properly sized to achieve accurate results.
5. Test each pole of the circuit breaker individually at 300% of rated current using a high-current, low-voltage ac power supply of less than 24 V.
6. Record and compare the trip test values to those in Table 2, page 16. As long as the recorded trip times are below the maximum trip times, the circuit breaker is providing acceptable thermal protection.

If the circuit breaker does not trip within the maximum trip time shown in Table 2, consult your local field sales office.

Example:
If a 20 A test current increases only 10% (2 A) for the duration of an overcurrent trip test, the heat generated during the test may increase by 21%. An overcurrent trip is the result of the heat generated by the current going through the circuit breaker and is a function of current squared.

Heat generated during test:

$$\frac{I^2_{Actual}}{I^2_{Intended}} = \frac{(22)^2}{(20)^2} = \frac{484}{400} = 121\%$$

Test current amperage must be accurate. A small error in the test current amperage results in a large error in trip time.

If verification of the manufacturer’s data is required, compare the trip times to the 300% trip range shown on the trip curve for the specific circuit breaker. Precisely controlled factory testing conditions are used to establish the characteristic trip curves. If field test results fall outside the characteristic trip curve tolerance band, the test conditions and methods must be carefully evaluated for accuracy.

Table 2: Inverse-time Overcurrent Trip Test

For thermal-magnetic circuit breakers (at 300% of rated continuous current of circuit breaker)

Maximum Circuit Voltage (Volts)	Range of Rated Continuous Current (Amperes)	Maximum Trip Time (Seconds)	
		Breaker Voltage 240 V	600 V
240	0–30	50	70
240	31–50	80	100
240	51–100	140	160
600	101–150	200	250
600	151–225	230	275
600	226–400	300	350
600	401–600		450
600	601–800		500
600	801–1000		600
600	1001–1200		700
600	1201–1600		775
600	1601–2000		800
600	2001–2500		850
600	2501–5000		900

Instantaneous (Magnetic) Trip Test

This test simulates short-circuit conditions using a low-voltage test supply less than 24 V. Note that factory test conditions are difficult to duplicate in the field. Verifying the operation of a circuit breaker under short-circuit conditions is more important than finding its exact operating current value. Precise control of test conditions is necessary to duplicate published data and may be impractical under field test conditions.

To keep stray magnetic fields from affecting test results, test cables exiting the circuit breaker must be parallel with the current path of the circuit breaker for a minimum of 10 in. (254 mm). Test results can also be influenced by the wave shape of the supply current. Use a power source with true sinusoidal output and a true RMS or analog D'Arsonval movement ammeter to ensure accurate results. To verify the performance of the instantaneous (magnetic) trip element, proceed as follows:

Note: Test PA and PH circuit breakers with the circuit breaker mounted on a terminal pad kit (catalog number PALTB). PC circuit breakers should be tested with the circuit breaker mounted on the terminal pad kit provided with the circuit breaker.

Test NA and NC circuit breakers in the end-use equipment or lying flat on a piece of 1/8 in. (3 mm) thick steel.

1. Set the circuit breaker instantaneous (magnetic) trip adjustment, if provided, to the high setting. Tests conducted at the high setting insure instantaneous trip protection exists at all lower settings.
2. Connect the circuit breaker to the low-voltage test source with any convenient length of conductor.
3. Test each pole individually by either the run-up or pulse method as follows:

   Run-up Method
   Although the run-up method uses simpler, less expensive equipment, it produces less accurate data than the pulse method. The run-up method involves the following steps:

   A. Connect one pole of the test circuit breaker to the test equipment.

B. Set the current control of the test equipment to a value approximately 70% of the instantaneous trip current setting.

Example:
If the instantaneous (magnetic trip) setting is 2000 A, set the test equipment to 1400 A.

C. Turn the power supply on and increase current from approximately 70% until the circuit breaker trips. Recommended time to increase the current until the circuit breaker trips is between two and five seconds. If the circuit breaker does not open within five seconds, de-energize the supply circuit.

The operator must understand the relationship between actual current and the meter indication in order to accurately interpret the results during this type of testing. Increasing the current too rapidly may result in an erroneous current reading because the meter lags behind the actual current value due to meter damping. Increasing the current too slowly may result in a thermal trip. To overcome this problem and improve the accuracy of the run-up method, use a calibrated oscilloscope to read the current level at the time the circuit breaker trips. To determine RMS current value, read the last peak value and multiply by 0.707.

Pulse Method
If performed properly, the pulse method is more accurate than the run-up method, and is the best method to verify that the circuit breaker conforms to published instantaneous trip values. The pulse method requires that the test equipment have a controlled closing and a pointer-stop ammeter, a calibrated image-retaining oscilloscope, or a high-speed, sampling-rate digital ammeter. The pulse method involves the following steps:

A. Connect one pole of the test circuit breaker to the test equipment.

B. Set the current control of the test equipment to a value approximately 70% of the instantaneous trip current setting.

Example:
If the instantaneous (magnetic) trip setting is 2000 A, set the test equipment to 1400 A.

C. After the circuit breaker is properly connected and adjusted, apply current in approximately 10-cycle pulses.

D. Starting at 70% of the instantaneous trip setting, increase the current of each pulse until the circuit breaker trips. After each pulse, move the circuit breaker handle to the full RESET position and then to the ON position.

E. Repeat step D to recheck and verify this value. Start with the current level below the value measured in step D to ensure a “no trip” on the initial pulse.

4. Record current level and trip time. For field testing of molded case circuit breakers, testing at the lower setting is not necessary. To ensure protection of the rated conductor, the current necessary to trip the circuit breaker instantaneously must not exceed 140% of the high setting for circuit breakers 250 A frame size and below, and 125% of the high setting for circuit breakers 400 A frame size and above. These settings

are printed on the faceplate label of the circuit breaker. If currents higher than these maximum levels are necessary to trip the circuit breaker, consult your local field sales office.

Precisely controlled factory testing conditions are used to establish the characteristic trip curves. If field test results fall outside the characteristic trip curve tolerance band, the test conditions and methods must be carefully evaluated for accuracy.

Rated Current Hold-in Test

This test should be performed only on circuit breakers that have been nuisance tripping under normal conditions.

Conduct the test in a 25°C (77°F) ambient temperature using a high-current, low-voltage ac power supply less than 24 V. Follow the same procedure used in the Inverse-time Overcurrent Trip Test, steps 1-3, page 15. Connect all poles of the circuit breaker in series using cables with the appropriate ampacity for the application. These cables should be 4 ft. (1.22 m) long per terminal (8 ft. [2.43 m] total between poles). All connectors must be properly torqued according to the circuit breaker label specifications.

The circuit breaker should not trip when 100% of the device’s rated current is applied for one hour for circuit breakers rated less than 100 A, or two hours for circuit breakers rated more than 100 A. If the circuit breaker trips, RESET and move the handle from the OFF to ON position several times while under load, then repeat the test. If the tripping condition continues, contact your local field sales office.

MICROLOGIC® ELECTRONIC TRIP CIRCUIT BREAKER PERFORMANCE TESTS

Long-time Trip Test

The long-time ampere rating defines the maximum level of current the circuit breaker will carry continuously. MICROLOGIC electronic trip circuit breakers pick up and begin timing when a phase current exceeds 110% ±10% of the established continuous current rating. The long-time delay feature permits variations of the circuit breaker inverse-time delay characteristic. This delay determines how long the circuit breaker will carry a sustained overcurrent before initiating a trip signal. Performance of the inverse-time overcurrent functions of the circuit breaker can be tested using a high-current, low-voltage ac power supply less than 24 V.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to observe these precautions will result in death or severe personal injury.

1. Completely de-energize and remove the circuit breaker from service.
2. **Important:** Before testing, record pickup and delay settings for all functions. Reset the trip unit to these same settings after the test procedure is completed.
3. If the MICROLOGIC circuit breaker has the integral ground-fault protection function, see test procedures for circuit breakers with integral ground-fault, page 35, before continuing with the test procedure.
4. Use the following settings for the test:

   Long-time/Ampere Rating = Max.
   Long-time/Overload Delay = Min.
   Short-time/Short Circuit = Max.
   Short-time/Short Circuit Delay = Max. (I^2t IN or ON)
   Instantaneous = Max.

   Note: Labeling and trip unit functions are specified by circuit breaker series and catalog numbers. Series and catalog numbers are printed on the circuit breaker.

5. Connect the circuit breaker to a high-current, low-voltage ac power supply less than 24 V. Connect the circuit breaker to the test power source with any convenient length of adequately sized wiring.
6. Test all phases of the circuit breaker individually, or in pairs, for integral ground-fault equipped circuit breakers as required in the special test procedure on page 35.
7. Use the slow "run-up" test method to determine the pickup level. Slowly increase the current until the long-time pickup light glows steadily; this is defined as the pickup level. A memory reset module (Square D catalog number MTM3) must be installed with MX (Series 4, 5), NX (Series 2, 3), and PX (Series 5, 6) circuit breakers to indicate overload pickup.

   Note: All MICROLOGIC electronic trip circuit breakers are equipped with Long-time/Overload Memory or thermal imaging. The Long-time/ Overload Memory can be reset on LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers by using the appropriate memory reset module. Thermal imaging can be inhibited on MASTERPACT circuit breakers equipped with MICROLOGIC Type A, P or H trip units by using either the Hand-held or Full-function Test Kits. See the local field sales office for additional information on the memory reset modules and test kits. If the memory-reset module or test kits are not used, wait at least 15 minutes to allow the memory to clear and reset, before proceeding with the tests.

8. To determine the delay time, set the current to 300% of the ampere rating value. Monitor the time from this pickup point until the circuit breaker trips; this is the delay time.

9. Record pickup and delay values and compare them to Table 3.

   Note: Values lower than those shown in Table 3 are not significant unless nuisance tripping has occurred. As long as the trip times are below the maximum trip times, the circuit breaker is providing acceptable protection to prevent conductor damage.

If the circuit breaker does not trip within the maximum trip time shown in Table 3, consult your local Square D field office. Precisely controlled factory testing conditions are used to establish the characteristic trip curves. If field test results fall outside the characteristic trip curve tolerance band, evaluate the test conditions and methods carefully for accuracy.

Table 3: Long-time Trip Test

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Range (Amperes) Min.	Pickup Range (Amperes) Max.	Acceptable Delay at 300% (Seconds)	NEMA AB-4 Max.Delay (300%) (Seconds)
LE, LX, LXI	1B	250	100	100	115	5-8	160
			125	125	144	5-8	250
			150	150	173	5-8	250
			175	175	201	5-8	275
			200	200	230	5-8	275
			225	225	259	5-8	275
			250	250	288	5-8	350
		400	300	300	345	5-8	350
			350	350	403	5-8	350
			400	400	460	5-8	350
		600	450	450	518	5-8	450
			500	500	575	5-8	450
			600	600	690	5-8	450
MX	4, 5	250	100	100	125	15-22	160
			125	125	156	15-22	250
			150	150	188	15-22	250
			175	175	219	15-22	275
			200	200	250	15-22	275
			225	225	281	15-22	275
			250	250	313	15-22	350
		400	300	300	375	15-22	350
			350	350	438	15-22	350
			400	400	500	15-22	350
		800	450	450	563	15-22	450
			500	500	625	15-22	450
			600	600	750	15-22	450
			700	700	875	15-22	500
			800	800	1000	15-22	500
ME	4, 5, 5A, 5B	250	100	100	115	5–8	160
MX	5B		125	125	144	5–8	250
			150	150	173	5–8	250
			175	175	201	5–8	275
			200	200	230	5–8	275
			225	225	259	5–8	275
			250	250	288	5–8	350
		400	300	300	345	5–8	350
			350	350	403	5–8	350
			400	400	460	5–8	350
		800	450	450	518	5–8	450
			500	500	575	5–8	450
			600	600	690	5–8	450
			700	700	805	5–8	500
			800	800	920	5–8	500

Continued on next page

Table 3: Long-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)	NEMA AB-4 Max.Delay (300%) (Seconds)
ME	3	225	100	100	125	9–16	160
			115	115	144	9–16	250
			125	125	156	9–16	250
			150	150	188	9–16	250
			175	175	219	9–16	275
			200	200	250	9–16	275
			225	225	281	9–16	275
			250	250	313	9–16	350
		400	300	300	375	9–16	350
			350	350	438	9–16	350
			400	400	500	9–16	350
		800	450	450	563	9–16	450
			500	500	625	9–16	450
			600	600	750	9–16	450
			700	700	875	9–16	500
			800	800	1000	9–16	500
NX	2, 3	1200	600	600	750	13–20	450
			700	700	875	13–20	500
			800	800	1000	13–20	500
			900	900	1125	13–20	600
			1000	1000	1250	13–20	600
			1200	1200	1500	13–20	700
NE	2, 3, 3A, 3B	1200	600	600	750	5–8	450
NX	3B		700	700	875	5–8	500
			800	800	1000	5–8	500
			900	900	1125	5–8	600
			1000	1000	1250	5–8	600
			1200	1200	1500	5–8	700
NE	1	1200	600	600	720	10–17	450
			700	700	840	10–17	500
			800	800	960	10–17	500
			900	900	1080	10–17	600
			1000	1000	1200	10–17	600
			1200	1200	1440	10–17	700
PX	5, 6	1200	600	600	750	13–21	450
			700	700	875	13–21	500
			800	800	1000	13–21	500
			900	900	1125	13–21	600
			1000	1000	1250	13–21	600
			1200	1200	1500	13–21	700
		1600	1400	1400	1750	13–21	775
			1600	1600	2000	13–21	775
		2000	1800	1800	2250	13–21	800
			2000	2000	2500	13–21	800
		2500	2500	2500	3125	13–21	850
PE	4	1200	600	600	720	9–16	450
			700	700	840	9–16	500
			800	800	960	9–16	500
		1600	1000	1000	1200	9–16	600
			1200	1200	1440	9–16	700
			1400	1400	1680	9–16	775
			1600	1600	1920	9–16	775
PE	5, 6, 6A, 6B	1200	600	600	720	5–8	450
PX	6B		700	700	840	5–8	500
			800	800	960	5–8	500
			900	900	1080	5–8	600
			1000	1000	1200	5–8	600
			1200	1200	1440	5–8	700
		1600	1000	1000	1200	5–8	600
			1200	1200	1440	5–8	700
			1400	1400	1680	5–8	775
			1600	1600	1920	5–8	775
		2000	1000	1000	1200	5–8	600
			1200	1200	1440	5–8	700
			1400	1400	1680	5–8	775
			1600	1600	1920	5–8	775
			1800	1800	21		

Continued on next page

Table 3: Long-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Range (Amperes) Min.	Pickup Range (Amperes) Max.	Acceptable Delay at 300% (Seconds)	NEMA AB-4 Max.Delay (300%) (Seconds)
			2000	2000	2400	5–8	800
SE, SEH	2	200	100	100	125	11–17	160
			125	125	156	11–17	250
			150	150	188	11–17	250
			175	175	219	11–17	275
			200	200	250	11–17	275
		400	200	200	250	11–17	275
			225	225	281	11–17	275
			300	300	375	11–17	350
			350	350	438	11–17	350
			400	400	500	11–17	350
		800	400	400	500	11–17	350
			450	450	563	11–17	450
			500	500	625	11–17	450
			600	600	750	11–17	450
			700	700	875	11–17	500
			800	800	1000	11–17	500
		1200	800	800	1000	11–17	500
			1000	1000	1250	11–17	600
			1200	1200	1500	11–17	700
		1600	800	800	1000	11–17	500
			1000	1000	1250	11–17	600
			1200	1200	1500	11–17	700
			1600	1600	2000	11–17	775
		2000	1600	1600	2000	11–17	775
			2000	2000	2500	11–17	800
		3000	1600	1600	2000	11–17	775
			2000	2000	2500	11–17	800
			2500	2500	3125	11–17	850
			3000	3000	3750	11–17	900
		4000	1600	1600	1920	11–17	775
			2000	2000	2400	11–17	800
			2500	2500	3000	11–17	850
			3000	3000	3600	11–17	900
			4000	4000	4800	11–17	900
SE, SEH	3, 3A, 3B	400	200	200	230	5–9	275
			250	250	288	5–9	350
			300	300	345	5–9	350
			350	350	403	5–9	350
			400	400	460	5–9	350
		800	600	600	690	5–9	450
			800	800	920	5–9	500
		1200	1000	1000	1150	5–9	600
			1200	1200	1380	5–9	700
		1600	1400	1400	1610	5–9	775
			1600	1600	1840	5–9	775
		2000	1800	1800	2070	5–9	800
			2000	2000	2300	5–9	800
		3000	3000	3000	3450	5–9	900
		4000	3200	3200	3680	5–9	900
			4000	4000	4600	5–9	900
MASTERPACT NW	3.0/5.0/6.0 A, P and H	800	100	100	120	1.5–2.5	160
			250	250	300	1.5–2.5	350
			400	400	480	1.5–2.5	350
			600	600	720	1.5–2.5	450
			800	800	960	1.5–2.5	500
		1200	600	600	720	1.5–2.5	450
			800	800	960	1.5–2.5	500
			1000	1000	1200	1.5–2.5	600
			1200	1200	1440	1.5–2.5	700
		1600	800	800	960	1.5–2.5	500
			1000	1000	1200	1.5–2.5	600
			1200	1200	1440	1.5–2.5	700
			1600	1600	1920	1.5–2.5	775
		2000	1000	1000	1200	1.5–2.5	600
			1200	1200	1440	1.5–2.5	700
			1600	1600	1920	1.5–2.5	775
			2000	2000	2400	1.5–2.5	800

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Table 3: Long-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)	NEMA AB-4 Max.Delay (300%) (Seconds)
MASTERPACT NW	3.0/5.0/6.0 A, P and H	2500	1200	1200	1440	1.5–2.5	700
			1600	1600	1920	1.5–2.5	775
			2000	2000	2400	1.5–2.5	800
			2500	2500	3000	1.5–2.5	850
		3000	1600	1600	1920	1.5–2.5	775
			2000	2000	2400	1.5–2.5	800
			2500	2500	3000	1.5–2.5	850
			3000	3000	3600	1.5–2.5	900
		3200	1600	1600	1920	1.5–2.5	775
			2000	2000	2400	1.5–2.5	800
			2500	2500	3000	1.5–2.5	850
			3000	3000	3600	1.5–2.5	900
			3200	3200	3840	1.5–2.5	900
		4000	2000	2000	2400	1.5–2.5	800
			2500	2500	3000	1.5–2.5	850
			3000	3000	3600	1.5–2.5	900
			3200	3200	3840	1.5–2.5	900
			4000	4000	4800	1.5–2.5	900
		5000	2500	2500	3000	1.5–2.5	850
			3000	3000	3600	1.5–2.5	900
			3200	3200	3840	1.5–2.5	900
			4000	4000	4800	1.5–2.5	900
			5000	5000	6000	1.5–2.5	900
		6000	3000	3000	3600	1.5–2.5	900
			3200	3200	3840	1.5–2.5	900
			4000	4000	4800	1.5–2.5	900
			5000	5000	6000	1.5–2.5	900
			6000	6000	7200	1.5–2.5	900

The Long-time Trip Test can also be done using a secondary injection test kit. LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers use the UTS-3 test kit. The MASTERPACT circuit breaker uses the full-function test kit. These secondary injection test sets do not test the current transformers and connections.

Short-time Trip Test

The short-time pickup characteristic of a MICROLOGIC electronic trip circuit breaker adjusts the level of current at which the short-time delay begins timing. Short-time pickup levels for LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers are multiples of sensor size times the rating plug multiplier. Short-time pickup levels for MASTERPACT circuit breakers with MICROLOGIC trip units are multiples of long-time setting times the sensor size. The short-time delay function determines how long the circuit breaker will wait before initiating a trip signal during a short circuit. Performance of the short-time functions of the circuit breaker can be tested using a high-current, low-voltage ac power supply, less than 24 V.

1. If testing a circuit breaker that is equipped with zone-selective interlocking, follow the Procedure to Defeat Zone-selective Interlocking on page 36. If you are using a secondary injection test kit for these tests, carefully read and follow the test kit instructions about zone-selective interlocking.

   Note: Failure to defeat zone-selective interlocking will result in tripping with no intentional delay.

2. If the MICROLOGIC circuit breaker is equipped with the integral ground-fault protection function, see test procedures for circuit breakers with integral ground-fault, page 35, before continuing.

3. MASTERPACT drawout construction circuit breakers with MICRO-LOGIC trip units may be tested installed or completely removed from the cell. If the circuit breaker is installed, rack the circuit breaker to the test

position. If the circuit breaker is completely removed from the cell, Zone Selective Interlocking must be defeated and a jumper wire must be installed between the T1 and T2 terminals for circuit breakers with integral ground-fault protection.

4. SE drawout construction circuit breakers with the integral ground-fault protection function require an adapter plug (catalog number SEPITK2) when completely removed from the cell. The adapter plug makes the necessary jumper connections on the secondary circuit. These jumper connections are normally made when the circuit breaker is in the connected position. Follow the instructions provided with the plug to ensure proper application.

5. Use the following settings for the test:

   Long-time Pickup/Ampere Rating = Max.
   Long-time/Overload Delay = Max.
   Short-time/Short-circuit Pickup = Min.
   Short-time/Short-circuit Delay = Min.
   Instantaneous = Max.

   Note: For LE Series 1B, ME Series 3, 4, 5, 5A, 5B, NE Series 1, 2, 3, 3A, 3B, PE Series 4, 5, 6, 6A, 6B, and SE Series 2, 3, 3A, 3B trip units, the Min. Short-time/Short-circuit setting will be 0.1 I^2t OUT. For MASTERPACT circuit breakers equipped with MICROLOGIC trip units, the Short-time/Short-circuit Delay setting will be 0.1 I^2t OFF.

6. Connect the circuit breaker to the test source with any convenient length of conductor.

7. For non-ground-fault circuit breakers, test all poles of the circuit breaker individually. For circuit breakers with integral ground-fault, test each pole of the circuit breaker as noted in the special test procedure on page 35.

8. Pickup Test: After the circuit breaker is properly connected, inject each phase of the circuit breaker with a current level equal to the maximum value for the trip range as indicated in Table 4. After the delay time has been satisfied, the circuit breaker should trip.

9. Delay Test: After the circuit breaker is properly connected, apply 300% rated current. Record the delay time. See Table 4 for acceptable values. If the circuit breaker does not trip within expected time limits, disengage power supply.

   Note: All MICROLOGIC electronic trip circuit breakers are equipped with Long-time/Overload Memory or thermal imaging. The overcurrent pulses used to test Short-time Pickup and Delay add to this memory. If the circuit breaker trips at a lower than expected current value after several overcurrent pulses, it may be tripping on the long-time function. The Long-time/Overload Memory can be reset on LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers by using the appropriate memory reset module. Thermal imaging can be inhibited on MASTERPACT circuit breakers equipped with MICROLOGIC A, P or H trip units by using the Hand-held or Full-function Test Kit. If the memory reset module or test kits are not used, wait at least 15 minutes to allow the Memory to clear and reset, before proceeding with the tests.

   The short-time trip test can also be done using a secondary injection test kit. LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers use the UTS-3 test kit. The MASTERPACT circuit breaker uses the full-function test kit. These secondary injection test sets do not test the current transformers and connections.

Table 4: Short-time Trip Test

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Trip Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)
LE	1B	250	100	180	220	0.069–0.11
			125	225	275	0.069–0.11
			150	270	330	0.069–0.11
			175	315	385	0.069–0.11
			200	360	440	0.069–0.11
			225	405	495	0.069–0.11
			250	450	550	0.069–0.11
		400	300	540	660	0.069–0.11
			350	630	770	0.069–0.11
			400	720	880	0.069–0.11
		600	450	810	990	0.069–0.11
			500	900	1100	0.069–0.11
			600	1080	1320	0.069–0.11
LX, LXI	1B	250	100	180	220	1.0–1.7
			125	225	275	1.0–1.7
			150	270	330	1.0–1.7
			175	315	385	1.0–1.7
			200	360	440	1.0–1.7
			225	405	495	1.0–1.7
			250	450	550	1.0–1.7
		400	300	540	660	1.0–1.7
			350	630	770	1.0–1.7
			400	720	880	1.0–1.7
		600	450	810	990	1.0–1.7
			500	900	1100	1.0–1.7
			600	1080	1320	01.0–1.7
ME	4, 5, 5A, 5B	250	100	180	220	0.069–0.1
			125	225	275	0.069–0.1
			150	270	330	0.069–0.1
			175	315	385	0.069–0.1
			200	360	440	0.069–0.1
			225	405	495	0.069–0.1
			250	450	550	0.069–0.1
		400	300	540	660	0.069–0.1
			350	630	770	0.069–0.1
			400	720	880	0.069–0.1
		800	450	810	990	0.069–0.1
			500	900	1100	0.069–0.1
			600	1080	1320	0.069–0.1
			700	1260	1540	0.069–0.1
			800	1440	1760	0.069–0.1
ME	3	225	100	180	220	0.07–0.12
			115	207	253	0.07–0.12
			125	225	275	0.07–0.12
			150	270	330	0.07–0.12
			175	315	385	0.07–0.12
			200	360	440	0.07–0.12
			225	405	495	0.07–0.12
			250	450	550	0.07–0.12
		400	300	540	660	0.07–0.12
			350	630	770	0.07–0.12
			400	720	880	0.07–0.12
		800	450	810	990	0.07–0.12
			500	900	1100	0.07–0.12
			600	1080	1320	0.07–0.12
			700	1260	1540	0.07–0.12
			800	1440	1760	0.07–0.12
MX	5B	250	100	180	220	1.0–1.8
			125	225	275	1.0–1.8
			150	270	330	1.0–1.8
			175	315	385	1.0–1.8
			200	360	440	1.0–1.8
			225	405	495	1.0–1.8
			250	450	550	1.0–1.8
		400	300	540	660	1.0–1.8
			350	630	770	1.0–1.8

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Table 4: Short-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Trip Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)
			400	720	880	1.0–1.8
		800	450	810	990	1.0–1.8
			500	900	1100	1.0–1.8
			600	1080	1320	1.0–1.8
			700	1260	1540	1.0–1.8
			800	1440	1760	1.0–1.8
MX	4, 5	250	100	180	220	0.8–1.5
			125	225	275	0.8–1.5
			150	270	330	0.8–1.5
			175	315	385	0.8–1.5
			200	360	440	0.8–1.5
			225	405	495	0.8–1.5
			250	450	550	0.8–1.5
		400	300	540	660	0.8–1.5
			350	630	770	0.8–1.5
			400	720	880	0.8–1.5
		800	450	810	990	0.8–1.5
			500	900	1100	0.8–1.5
			600	1080	1320	0.8–1.5
			700	1260	1540	0.8–1.5
			800	1440	1760	0.8–1.5
NE	2, 3, 3A, 3B	1200	600	1080	1320	0.069–0.1
			700	1260	1540	0.069–0.1
			800	1440	1760	0.069–0.1
			900	1620	1980	0.069–0.1
			1000	1800	2200	0.069–0.1
			1200	2160	2640	0.069–0.1
NE	1	1200	600	1080	1320	0.07–0.12
			700	1260	1540	0.07–0.12
			800	1440	1760	0.07–0.12
			900	1620	1980	0.07–0.12
			1000	1800	2200	0.07–0.12
			1200	2160	2640	0.07–0.12
NX	3B	1200	600	1080	1320	1.0–1.8
			700	1260	1540	1.0–1.8
			800	1440	1760	1.0–1.8
			900	1620	1980	1.0–1.8
			1000	1800	2200	1.0–1.8
			1200	2160	2640	1.0–1.8
NX	2, 3	1200	600	1080	1320	0.8–1.4
			700	1260	1540	0.8–1.4
			800	1440	1760	0.8–1.4
			900	1620	1980	0.8–1.4
			1000	1800	2200	0.8–1.4
			1200	2160	2640	0.8–1.4
PE	5, 6, 6A, 6B	1200	600	1080	1320	0.069–0.1
			700	1260	1540	0.069–0.1
			800	1440	1760	0.069–0.1
			900	1620	1980	0.069–0.1
			1000	1800	2200	0.069–0.1
			1200	2160	2640	0.069–0.1
		1600	1000	1800	2200	0.069–0.1
			1200	2160	2640	0.069–0.1
			1400	2520	3080	0.069–0.1
			1600	2880	3520	0.069–0.1
		2000	1000	1800	2200	0.069–0.1
			1200	2160	2640	0.069–0.1
			1400	2520	3080	0.069–0.1
			1600	2880	3520	0.069–0.1
			1800	3240	3960	.069–0.1
			2000	3600	4400	0.069–0.1
		2500	2500	4500	5500	0.069–0.1
PE	4	1200	600	1080	1320	0.09–0.125
			700	1260	1540	0.09–0.125
			800	1440	1760	0.09–0.125
			900	1620	1980	0.09–0.125
			1000	1800	2200	0.09–0.125

Continued on next page

Table 4: Short-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Trip Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)
			1200	2160	2640	0.09–0.125
		1600	1000	1800	2200	0.09–0.125
			1200	2160	2640	0.09–0.125
			1400	2520	3080	0.09–0.125
			1600	2880	3520	0.09–0.125
		2000	1000	1800	2200	0.09–0.125
			1200	2160	2640	0.09–0.125
			1400	2520	3080	0.09–0.125
			1600	2880	3520	0.09–0.125
			1800	3240	3960	0.09–0.125
			2000	3600	4400	0.09–0.125
		2500	2500	4500	5500	0.09–0.125
PX	5, 6	1200	600	1080	1320	0.9–1.4
			700	1260	1540	0.9–1.4
			800	1440	1760	0.9–1.4
			900	1620	1980	0.9–1.4
			1000	1800	2200	0.9–1.4
			1200	2160	2640	0.9–1.4
		1600	1400	2520	3080	1.0–1.8
			1600	2880	3520	1.0–1.8
		2000	1800	3240	3960	1.0–1.8
			2000	3600	4400	1.0–1.8
		2500	2500	4500	5500	0.8–1.4
PX	6B	1200	600	1080	1320	1.0–1.8
			700	1260	1540	1.0–1.8
			800	1440	1760	1.0–1.8
			900	1620	1980	1.0–1.8
			1000	1800	2200	1.0–1.8
			1200	2160	2640	1.0–1.8
		1600	1000	1800	2200	1.0–1.8
			1200	2160	2640	1.0–1.8
			1400	2520	3080	1.0–1.8
			1600	2880	3520	1.0–1.8
		2000	1000	1800	2200	1.0–1.8
			200	2160	2640	1.0–1.8
			1400	2520	3080	1.0–1.8
			1600	2880	3520	1.0–1.8
			1800	3240	3960	1.0–1.8
			2000	3600	4400	1.0–1.8
SE, SEH	2	200	100	180	220	0.038–0.09
			125	225	275	0.038–0.09
			150	270	330	0.038–0.09
			175	315	385	0.038–0.09
			200	360	440	0.038–0.09
		400	200	360	440	0.038–0.09
			225	405	495	0.038–0.09
			300	540	660	0.038–0.09
			350	630	770	0.038–0.09
			400	720	880	0.038–0.09
		800	400	720	880	0.038–0.09
			450	810	990	0.038–0.09
			500	900	1100	0.038–0.09
			600	1080	1320	0.038–0.09
			700	1260	1540	0.038–0.09
			800	1440	1760	0.038–0.09
		1200	800	1440	1760	0.038–0.09
			1000	1800	2200	0.038–0.09
			1200	2160	2640	0.038–0.09
		1600	800	1440	1760	0.038–0.09
			1000	1800	2200	0.038–0.09
			1200	2160	2640	0.038–0.09
			1600	2880	3520	0.038–0.09
		2000	1600	2880	3520	0.038–0.09
			2000	3600	4400	0.038–0.09
		3000	1600	2880	3520	0.038–0.09
			2000	3600	4400	0.038–0.09
			2500	4500	5500	0.038–0.09

Continued on next page

Table 4: Short-time Trip Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Trip Range (Amperes) Min.	Max.	Acceptable Delay at 300% (Seconds)
			3000	5400	6600	0.038–0.09
		4000	1600	2880	3520	0.038–0.09
			2000	3600	4400	0.038–0.09
			2500	4500	5500	0.038–0.09
			3000	5400	6600	0.038–0.09
			4000	7200	8800	0.038–0.09
SE, SEH	3, 3A, 3B	400	200	360	440	0.06–0.1
			250	450	550	0.06–0.1
			300	540	660	0.06–0.1
			350	630	770	0.06–0.1
			400	720	880	0.06–0.1
		800	600	1080	1320	0.06–0.1
			800	1440	1760	0.06–0.1
		1200	1000	1800	2200	0.06–0.1
			1200	2160	2640	0.06–0.1
		1600	1400	2520	3080	0.06–0.1
			1600	2880	3520	0.06–0.1
		2000	1800	3240	3960	0.06–0.1
			2000	3600	4400	0.06–0.1
		3000	3000	5400	6600	0.06–0.1
		4000	3200	5760	7040	0.06–0.1
			4000	7200	8800	0.06–0.1
MASTERPACT NW	5.0/6.0 A, P and H	800	100	135	165	0.08–0.14
			250	337	412	0.08–0.14
			400	540	660	0.08–0.14
			600	810	990	0.08–0.14
			800	1080	1320	0.08–0.14
		1200	600	810	990	0.08–0.14
			800	1080	1320	0.08–0.14
			1000	1350	1650	0.08–0.14
			1200	1620	1980	0.08–0.14
		1600	800	1080	1320	0.08–0.14
			1000	1350	1650	0.08–0.14
			1200	1620	1980	0.08–0.14
			1600	2160	2640	0.08–0.14
		2000	1000	1350	1650	0.08–0.14
			1200	1620	1980	0.08–0.14
			1600	2160	2640	0.08–0.14
			2000	2700	3300	0.08–0.14
		2500	1200	1620	1980	0.08–0.14
			1600	2160	2640	0.08–0.14
			2000	2700	3300	0.08–0.14
			2500	3375	4125	0.08–0.14
		3000	1600	2160	2640	0.08–0.14
			2000	2700	3300	0.08–0.14
			2500	3375	4125	0.08–0.14
			3000	4050	4950	0.08–0.14
		3200	1600	2160	2640	0.08–0.14
			2000	2700	3300	0.08–0.14
			2500	3375	4125	0.08–0.14
			3000	4050	4950	0.08–0.14
			3200	4320	5280	0.08–0.14
		4000	2000	2700	3300	0.08–0.14
			2500	3375	4125	0.08–0.14
			3000	4050	4950	0.08–0.14
			3200	4320	5280	0.08–0.14
			4000	5400	6600	0.08–0.14
		5000	2500	3375	4125	0.08–0.14
			3000	4050	4950	0.08–0.14
			3200	4320	5280	0.08–0.14
			4000	5400	6600	0.08–0.14
			5000	6750	8250	0.08–0.14
		6000	3000	4050	4950	0.08–0.14
			3200	4320	5280	0.08–0.14
			4000	5400	6600	0.08–0.14
			5000	6750	8250	0.08–0.14
			6000	8100	9900	0.08–0.14

Instantaneous Trip Test

The instantaneous trip function of a MICROLOGIC electronic trip circuit breaker determines the level of current at which the circuit breaker trips with no intentional delay. Performance of the instantaneous function of the circuit breaker can be tested using a high-current, low-voltage ac power supply less than 24 V.

1. If the MICROLOGIC circuit breaker is equipped with the integral ground-fault protection function, see test procedures for circuit breakers with integral ground-fault, page 35, before continuing.

   Note: Labeling and trip unit functions are specified by circuit breaker series and catalog numbers. Series and catalog numbers are printed on the circuit breaker faceplate label.

2. Use the settings below to test MX Series 4 and 5, NX Series 2 and 3 and PX Series 5 and 6 circuit breakers (the instantaneous trip function is achieved through the instantaneous position on the short-circuit delay switch):

   Ampere Rating = Max.
   Overload Delay = Max.
   Short-circuit = Min.
   Short-circuit Delay = Inst.

   For other LE/LX, ME/MX, NE/NX, PE/PX and SE circuit breakers, use the following settings:

   Long-time Pickup = Max.
   Long-time Delay = Max.
   Short-time Pickup = Max.
   Short-time Delay = Max. (I^2t IN)
   Instantaneous = Min.

   For MASTERPACT circuit breakers with MICROLOGIC trip units, use the following settings:

   Long-time Pickup = Max.
   Long-time Delay = Max.
   Short-time Pickup = Max.
   Short-time Delay = Max. (I^2t ON)
   Instantaneous = 2

   The recommended method of testing the instantaneous trip is the pulse method. This method is the most accurate, but requires that the test equipment have a calibrated image-retaining oscilloscope or a high-speed sampling rate digital ammeter.

3. For non-ground-fault circuit breakers, test all poles of the circuit breaker individually. For circuit breakers with the integral ground-fault function, test each pole of the circuit breaker as noted in the special test procedure on page 35.

4. After the circuit breaker is properly connected and adjusted, apply current in approximately 10-cycle pulses.

5. Starting at 70% of the expected trip value, increase the current in each succeeding pulse until the circuit breaker trips.

6. To recheck and verify, repeat step 5. Start with a current level below the value measured in step 5 to ensure a “no trip” on initial pulse.

Note: All MICROLOGIC electronic trip circuit breakers are equipped with Long-time/Overload Memory or thermal imaging. The overcurrent pulses used to test instantaneous function add to this memory. If the circuit breaker trips at a lower than expected current value after several overcurrent pulses, it may be tripping on the long-time function. The Long-time/Overload Memory can be reset on LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers by using the appropriate memory reset module. Thermal imaging can be inhibited on MASTERPACT circuit breakers equipped with MICROLOGIC A, P or H trip units by using the Hand-held of Full-function test kits. If the memory reset module or test kits are not used, wait at least 15 minutes to allow the Memory to clear and reset, before proceeding with the tests.

7. Compare the pickup value to the one in Table 5 for the appropriate circuit breaker. To obtain accurate results, factory test methods must be duplicated. Be careful to select the correct column (LS or LI), as minimum instantaneous settings may differ.

The instantaneous trip test can also be done using a secondary injection test kit. LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers use the UTS3 test kit. The MASTERPACT circuit breaker uses the full-function test kit. These secondary injection test sets do not test the current transformers and connections.

Table 5: Instantaneous Pickup Test

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Amperes for Trip Unit Type LS (I)(G) Min.	Max.	LI (G) Min.	Max.
LE, LX, LXI	1B	250	100	225	275	180	220
			125	281	344	225	275
			150	338	413	270	330
			175	394	481	315	385
			200	450	550	360	440
			225	506	619	405	495
			250	563	688	450	550
		400	300	675	825	540	660
			350	788	963	630	770
			400	900	1100	720	880
		600	450	1013	1238	810	990
			500	1125	1375	900	1100
			600	1350	1650	1080	1320
ME	4, 5, 5A, 5B	250	100	270	330	180	220
			125	338	413	225	275
			150	405	495	270	330
			175	473	578	315	385
			200	540	660	360	440
			225	608	743	405	495
			250	675	825	450	550
		400	300	810	990	540	660
			350	945	1155	630	770
			400	1080	1320	720	880
		800	450	1215	1485	810	990
			500	1350	1650	900	1100
			600	1620	1980	1080	1320
			700	1890	2310	1260	1540
			800	2160	2640	1440	1760
ME	3	225	100	180	220	180	220
			115	207	253	207	253
			125	225	275	225	275
			150	270	330	270	330
			175	315	385	315	385
			200	360	440	360	440

Continued on next page

Table 5: Instantaneous Pickup Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Amperes for Trip Unit Type LS (I)(G) Min.	LS (I)(G) Max.	LI (G) Min.	LI (G) Max.
ME	3		225	405	495	405	495
			250	450	550	450	550
		400	300	540	660	540	660
			350	630	770	630	770
			400	720	880	720	880
		800	450	810	990	810	990
			500	900	1100	900	1100
			600	1080	1320	1080	1320
			700	1260	1540	1260	1540
			800	1440	1760	1440	1760
MX	5B	250	100	270	330		
			125	338	413		
			150	405	495		
			175	473	578	N/A	
			200	540	660		
			225	608	743		
			250	675	825		
		400	300	810	990		
			350	945	1155	N/A	
			400	1080	1320		
		800	450	1215	1485		
			500	1350	1650		
			600	1620	1980	N/A	
			700	1890	2310		
			800	2160	2640		
MX	4, 5	250	100	180	220		
			125	225	275		
			150	270	330		
			175	315	385	N/A	
			200	360	440		
			225	405	495		
			250	450	550		
		400	300	540	660		
			350	630	770	N/A	
			400	720	880		
		800	450	810	990		
			500	900	1100		
			600	1080	1320	N/A	
			700	1260	1540		
			800	1440	1760		
NE	2, 3, 3A, 3B	1200	600	1620	1980	1080	1320
			700	1890	2310	1260	1540
			800	2160	2640	1440	1760
			900	2430	2970	1620	1980
			1000	2700	3300	1800	2200
			1200	3240	3960	2160	2640
NE	1	1200	600	1080	1320		
			700	1260	1540		
			800	1440	1760		
			900	1620	1980	N/A	
			1000	1800	2200		
			1200	2160	2640		
NX	3B	1200	600	1620	1980		
			700	1890	2310		
			800	2160	2640	N/A	
			900	2430	2970		
			1000	2700	3300		
			1200	3240	3960		
NX	2, 3	1200	600	1080	1320		
			700	1260	1540		
			800	1440	1760	N/A	
			900	1620	1980		
			1000	1800	2200		
			1200	2160	2640		
PE	5, 6, 6A, 6B	1200	600	1350	1650	1080	1320
			700	1575	1925	1260	1540
			800	1800	2200	1440	1760

Continued on next page

Table 5: Instantaneous Pickup Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Amperes for Trip Unit Type LS (I)(G) Min.	LS (I)(G) Max.	LI (G) Min.	LI (G) Max.
PE	5, 6, 6A, 6B		900	2025	2475	1620	1980
			1000	2250	2750	1800	2200
			1200	2700	3300	2160	2640
		1600	1000	2250	2750	1800	2200
			1200	2700	3300	2160	2640
			1400	3150	3850	2520	3080
			1600	3600	4400	2880	3520
		2000	1000	2250	2750	1800	2200
			1200	2700	3300	2160	2640
			1400	3150	3850	2520	3080
			1600	3600	4400	2880	3520
			1800	4050	4950	3240	3960
			2000	4500	5500	3600	4400
		2500	2500	4950	6050	4500	5500
PE	4	1200	600	1080	1320	1080	1320
			700	1260	1540	1260	1540
			800	1440	1760	1440	1760
			900	1620	1980	1620	1980
			1000	1800	2200	1800	2200
			1200	2160	2640	2160	2640
		1600	1000	1800	2200	1800	2200
			1200	2160	2640	2160	2640
			1400	2520	3080	2520	3080
			1600	2880	3520	2880	3520
		2000	1000	1800	2200	1800	2200
			1200	2160	2640	2160	2640
			1400	2520	3080	2520	3080
			1600	2880	3520	2880	3520
			1800	3240	3960	3240	3960
			2000	3600	4400	3600	4400
		2500	2500	4500	5500	4500	5500
PX	6B	1200	600	1350	1650		
			700	1575	1925		
			800	1800	2200	N/A	
			900	2025	2750		
			1000	2250	2750		
			1200	2700	3300		
		1600	1000	2250	2750		
			1200	2700	3300	N/A	
			1400	3150	3850		
			1600	3600	4400		
		2000	1000	2250	2750		
			1200	2700	3300		
			1400	3150	3850	N/A	
			1600	3600	4400		
			1800	4050	4950		
			2000	4500	5500		
		2500	2500	4950	6050	N/A	
PX	5, 6	1200	600	1080	1320		
			700	1260	1540		
			800	1440	1760		
			900	1620	1980	N/A	
			1000	1800	2200		
			1200	2160	2640		
		1600	1400	2520	3080		
			1600	2880	3520	N/A	
		2000	1800	3240	3960		
			2000	3600	4400	N/A	
		2500	2500	4500	5500	N/A	
SE, SEH	3, 3A, 3B	400	200	540	660	360	440
			250	675	825	450	550
			300	810	990	540	660
			350	945	1155	630	770
			400	1080	1320	720	880
		800	600	1620	1980	1080	1320
			800	2160	2640	1440	1760

Continued on next page

Table 5: Instantaneous Pickup Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Amperes for Trip Unit Type LS (I)(G) Min.	Max.	LI (G) Min.	Max.
SE, SEH	3, 3A, 3B	1200	1000	2700	3300	1800	2200
			1200	3240	3960	2160	2640
		1600	1400	3780	4620	2520	3080
			1600	4320	5280	2880	3520
		2000	1800	4860	5940	3240	3960
			2000	5400	6600	3600	4400
		3000	3000	8100	9900	5400	6600
		4000	3200	8640	10560	5760	7040
			4000	10800	13200	7200	8800
SE, SEH	2	200	100	180	220	180	220
			125	225	275	225	275
			150	270	330	270	330
			175	315	385	315	385
			200	360	440	360	440
		400	200	360	440	360	440
			225	405	495	405	495
			300	540	660	540	660
			350	630	770	630	770
			400	720	880	720	880
		800	400	720	880	720	880
			450	810	990	810	990
			500	900	1100	900	1100
			600	1080	1320	1080	1320
			700	1260	1540	1260	1540
			800	1440	1760	1440	1760
		1200	800	1440	1760	1440	1760
			1000	1800	2200	1800	2200
			1200	2160	2640	2160	2640
		1600	800	1440	1760	1440	1760
			1000	1800	2200	1800	2200
			1200	2160	2640	2160	2640
			1600	2880	3520	2880	3520
		2000	1600	2880	3520	2880	3520
			2000	3600	4400	3600	4400
		3000	1600	2880	3520	2880	3520
			2000	3600	4400	3600	4400
			2500	4500	5500	4500	5500
			3000	5400	6600	5400	6600
		4000	1600	4320	5280	2880	3520
			2000	5400	6600	3600	4400
			2500	6750	8250	4500	5500
			3000	8100	9900	5400	6600
			4000	10800	13200	7200	8800
MASTERPACT NW	3.0/5.0/6.0 A, P and H	800	100	130	230	Same Range As LSI	
			250	325	575		
			400	520	920		
			600	780	1380		
			800	1040	1840		
		1200	600	780	1380	Same Range As LSI	
			800	1040	1840		
			1000	1300	2300		
			1200	1560	2760		
		1600	800	1040	1840	Same Range As LSI	
			1000	1300	2300		
			1200	1560	2760		
			1600	2080	3680		
		2000	1000	1300	2300	Same Range As LSI	
			1200	1560	2760		
			1600	2080	3680		
			2000	2600	4600		
		2500	1200	1560	2760	Same Range As LSI	
			1600	2080	3680		
			2000	2600	4600		
			2500	3250	5750		
		3000	1600	2080	3680	Same Range As LSI	
			2000	2600	4600		
			2500	3250	5750		
			3000	3900	6900		

Continued on next page

Table 5: Instantaneous Pickup Test—*Continued*

Circuit Breaker Type	Trip Unit Series	Frame Size (Amperes)	Sensor Size (Amperes)	Pickup Amperes for Trip Unit Type LS (I)(G) Min.	Max.	LI (G) Min.	Max.
MASTERPACT NW	3.05/5.0/6.0 A, P and H	3200	1600	2080	3680	Same Range As LSI	
			2000	2600	4600		
			2500	3250	5750		
			3000	3900	6900		
			3200	4160	7360		
		4000	2000	2600	4600	Same Range As LSI	
			2500	3250	5750		
			3000	3900	6900		
			3200	4160	7360		
			4000	5200	9200		
		5000	2500	3250	5750	Same Range As LSI	
			3000	3900	6900		
			3200	4160	7360		
			4000	5200	9200		
			5000	6500	11500		
		6000	3000	3900	6900	Same Range As LSI	
			3200	4160	7360		
			4000	5200	9200		
			5000	6500	11500		
			6000	7800	13800		

CIRCUIT BREAKERS WITH INTEGRAL GROUND FAULT

MICROLOGIC electronic trip circuit breakers with the integral ground-fault protection function require special attention when testing overload and short-circuit functions. The single-pole primary injection tests for the inverse-time overcurrent, short-time and instantaneous functions will cause ground-fault trips due to the return current path not going through the circuit breaker. To overcome this difficulty, use the looping method for MICROLOGIC circuit breakers with the integral ground-fault feature.

Special Overload and Short-circuit Test Procedures

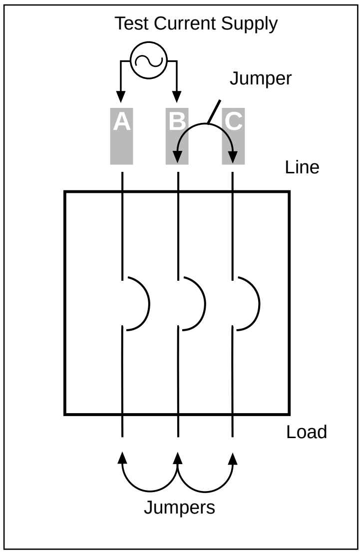


Figure 1: Test Hookup Diagram for Looping Method Test

Looping method:
Looping the current, as shown in Figure 1, balances the amount of current entering and leaving the circuit breaker. This, in effect, eliminates ground-fault trips by keeping the internal ground-fault transformer balanced. Verification of successive poles can be made by varying the connections (loop AC, AB, BC).

Exceptions:

1. The secondary injection test kits provide a method to inhibit or defeat the ground-fault function during long-time, short-time and instantaneous tests. This special test procedure is not necessary.
2. For SE fixed-type construction, connect terminals 16, 17, 18 and 19 together to defeat ground fault for test purposes. For SE drawout circuit breakers, use the adapter plug SEPITK2 to make the necessary connections.
3. Use the Hand-held or Full-function Test Kit to defeat ground-fault functions on MASTERPACT circuit breakers equipped with MICRO-LOGIC trip units.

Procedure for Circuit Breakers Used With POWERLOGIC® Systems

LE, ME, NE, PE, and SE circuit breakers connected to a POWERLOGIC® system are connected via a communications adapter (catalog number CIM3F). If the circuit breaker is tested by the primary injection method, the POWERLOGIC system can remain connected to the circuit breaker during testing without affecting the results.

Note: Testing a circuit breaker connected to a POWERLOGIC® system causes the POWERLOGIC system to react as if the circuit breaker were experiencing the actual faults.

When performing secondary injection testing using the UTS3 test set, the POWERLOGIC system **must** be disconnected from the circuit breaker. This is done by disconnecting the 4-pin plug connection on the adapter. The test set will indicate testing failed if the POWERLOGIC system is left connected when testing. After testing, reconnect the 4-pin plug to the adapter. Follow the instructions for the version of POWERLOGIC software that is installed on the system to verify that communication has been re-established with the circuit breaker.

Procedure to Defeat Zone-selective Interlocking

Zone-selective interlocking is a method of communication between electronic trip overcurrent protective devices. Zone-selective interlocking allows interlocked devices at different levels to work together as a system in which a short circuit or ground fault is isolated and cleared with minimum time delay. The purpose of defeating zone-selective interlocking is to verify the characteristics of the circuit breaker short-time and ground-fault trip delay functions. This is accomplished by disconnecting restraint wiring and installing jumpers as required. In effect, this self-restrains the circuit breaker being tested. Label and disconnect any restraint wires before disconnecting.

Table 6 outlines self-restraint (jumpering) instructions for each of the MICROLOGIC circuit breakers. Use wire size #14–#18.

Note: If self-restraint jumpers are installed to defeat zone-selective interlocking for testing purposes, remove them when testing is complete. Any restraint wires disconnected for the test should be reconnected at this time.

Table 6: Self-restraint Settings

Circuit Breaker Type/ Trip Unit Series	Function (ST or GF)	Connect Terminal (Restraint IN)	To Terminal (Restraint OUT)
LE 1B	Short-time	#5	#6
LE 1B	Ground-fault	#7	#8
ME 3	Both	Violet wire	Gray Wire
ME 4, 5, 5A, 5B	Short-time	#5	#6
ME 4, 5, 5A, 5B	Ground-fault	#7	#8
NE1	Both	#6	#7
NE 2, 3, 3A, 3B	Short-time	#5	#6
NE 2, 3, 3A, 3B	Ground-fault	#7	#8
PE 4	Both	#6	#7
PE 5, 6, 6A, 6B	Short-time	#5	#6
PE 5, 6, 6A, 6B	Ground-fault	#7	#8
SE 2, 3, 3A, 3B (Fixed and Drawout)	Short-time	#23	#24
SE 2, 3, 3A, 3B (Fixed and Drawout)	Ground-fault	#20	#21
SE Drawout (Fully removed from cell)	Both	Use SEPITK2 (see page 35)	Use SEPITK2 (see page 35)
MASTERPACT NW	Both	Z3, Z4, Z5	NA

For test purposes, Zone-selective interlocking can be inhibited on MASTERPACT NW circuit breakers equipped with MICROLOGIC trip units by using the Hand-held or Full-function Test Kit.

GROUND-FAULT PROTECTION AND INDICATION ONLY TESTS FOR RADIAL SYSTEMS

Ground-fault Trip Test

DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to observe these precautions will result in death or severe personal injury.

The ground-fault function of a MICROLOGIC electronic trip circuit breaker provides ground-fault protection for equipment with adjustable pickup and delay values. The ground-fault delay feature determines how long the circuit breaker waits before initiating a trip signal during a ground fault. Performance of the ground-fault functions of the circuit breaker can be tested using a high-current, low-voltage ac power supply less than 24 V.

SE drawout construction circuit breakers with the integral ground-fault test feature require an adapter plug (Square D catalog number SEPITK2) when the circuit breaker is completely removed from the cell. The adapter plug will make the necessary jumper connections on the secondary circuit. These jumpers are normally made when the circuit breaker is in the connected position. Follow the instructions provided with the adapter plug to ensure proper application.

Test Procedure

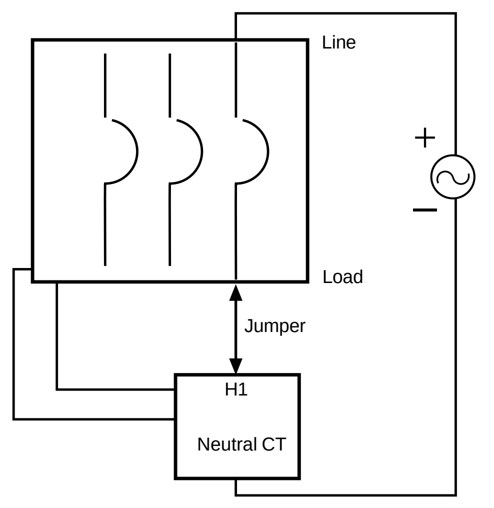
1. Completely de-energize and remove the circuit breaker from service.
2. **Important:** Before testing, record pickup and delay settings for all functions. Reset the trip unit to these same settings after the test procedure is completed.
3. If testing a circuit breaker that is equipped with zone-selective interlocking, follow the procedure to defeat zone-selective interlocking on page 36. If you are using a secondary injection test kit for these tests, carefully read and follow the test kit instructions about zone-selective interlocking.

   Note: Failure to defeat zone-selective interlocking will result in trip time inaccuracy.
4. Use these settings for the test:

   Long-time Pickup/Ampere Rating = Max.
   Long-time/Overload Delay = Max.
   Short-time/Short-circuit Pickup = Max.
   Short-time/Short-circuit Delay = Max. (I^2t IN or ON)
   Instantaneous = Max.
   Ground-fault Pickup = Min.
   Ground-fault Delay = Min. (I^2t OUT or OFF)

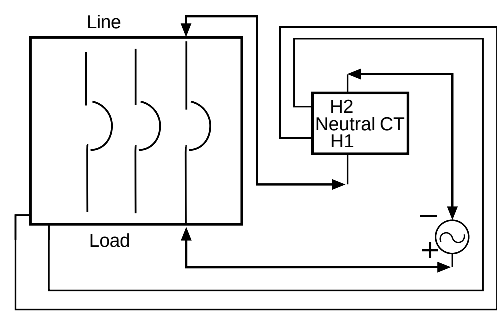
   Note: Do not use the INSTANT setting for ground-fault delay. On Series 2 SE circuit breakers, use ground-fault delay setting “2 .”

   Do not use 0 delay on MASTERPACT circuit breakers. Use the “0.1” setting.



See circuit breaker instruction bulletin for connections to circuit breaker and neutral CT.

Figure 2: Test Hookup Diagram for Neutral CT Phasing Test



See circuit breaker instruction bulletin for connections to circuit breaker and neutral CT.

Figure 3: Test Hookup Diagram for Neutral CT Size Test

5. Follow the hookup procedure appropriate to the test application.

   For circuit breakers without a neutral current transformer, go to step 8.

   For circuit breakers with the integral ground-fault function in a three-phase, four-wire system, an externally-mounted neutral current transformer (CT) must be used. The neutral CT is connected to the circuit breaker by a shielded cable (#14 AWG wire is recommended).

   Note: When testing MASTERPACT circuit breakers equipped with MICROLOGIC trip units, disconnect or turn off 24 Vdc control power to F1 and F2, if equipped. Also, if necessary, disconnect the Hand-held or Full-function Test Kit from the trip unit.

6. Verify correct phasing of the neutral CT (three-phase, four-wire systems) by performing a No Trip Test as follows:

   1. Connect the circuit breaker and neutral CT as shown in Figure 2. The jumper must go from the load connection on the circuit breaker to the H1 connection on the neutral CT (or the side of the neutral CT that has the red dot). Connect the secondary of the neutral CT according to the circuit breaker instruction manual or the neutral CT instructions.

      Note: When testing MASTERPACT circuit breakers equipped with MICROLOGIC trip units, read the amperage display on the trip unit. If the display is either blank or inaccurate, stop the test and check the connections between the terminals on the neutral CT and the trip unit. Terminal X1 on the neutral CT must connect to terminal T3 on the trip unit. Terminal X2 on the neutral CT must connect to terminal T4 on the trip unit.

   2. Apply current above the ground-fault pickup level and maintain longer than the ground-fault delay.

   3. The circuit breaker must not trip. No trip indicates that both the phase CT and neutral CT are phased properly.

7. Verify the correct size of the neutral CT (three-phase, four-wire systems) by performing a Trip Test as follows:

   1. Connect the circuit breaker and neutral CT as shown in Figure 3. Connect the polarity (+) terminal of the high current injection unit to the LOAD side of the circuit breaker. The jumper must go from the line connection on the circuit breaker to the H1 connection on the neutral CT (or the side of the neutral CT that has the red dot). Connect the non-polarity (–) terminal of the high current injection unit to H2 on the neutral CT (on the line side of the circuit breaker). Connect the secondary of the neutral CT according to the circuit breaker instruction manual or the neutral CT instructions.

   2. Apply current.

   3. The circuit breaker must trip at half the value of ground-fault pickup. Tripping indicates that both the phase CT and neutral CT have the same turns ratio (same size).

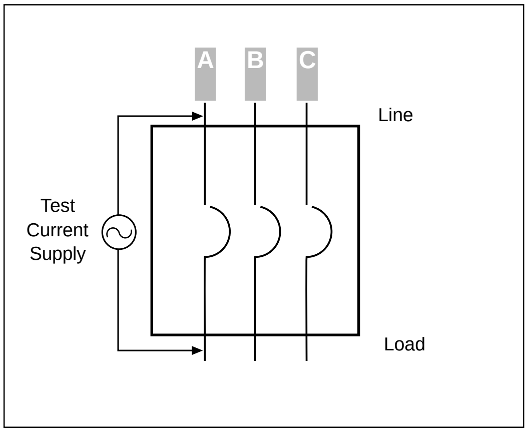


Figure 4: Test Hookup Diagram for Circuit Breaker Without Neutral CT

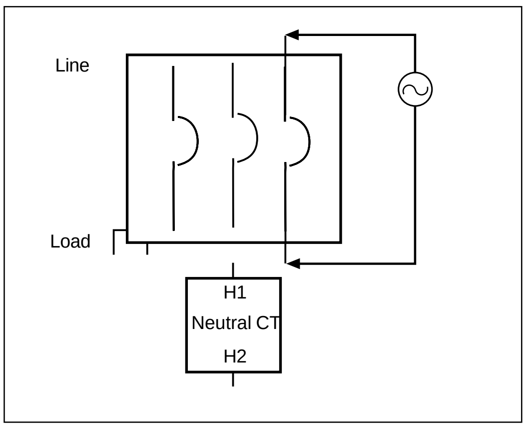


Figure 5: Test Hookup Diagram for Ground-fault Pickup and Delay Test

8. Test ground-fault pickup and delay by performing a Trip Test as follows:

    1. Connect the circuit breaker as shown in Figure 4, (three-phase, three-wire systems) or Figure 5, page 39 (three-phase, four-wire systems).

       Note: The recommended method of testing ground-fault pickup and delay is the "pulse" method. This method will be the most accurate, but requires that the test equipment have a calibrated image-retaining oscilloscope or a high-speed sampling rate digital ammeter. An accurate timer is needed to monitor delay time.

    2. After the circuit breaker is properly connected and closed, apply current in short pulses of 10-cycle duration.

       Note: For Series 2 SE circuit breakers, current must be applied for a minimum of two seconds.

    3. Starting at 70% of the expected trip value, increase the current on each succeeding pulse until the circuit breaker trips.

    4. Reclose the circuit breaker and reduce the current level; pulse again to determine if the pickup level found was overshot.

    5. Repeat steps 8-2, 8-3 and 8-4 to further isolate the pickup point.

    6. To determine delay time, test each pole of the circuit breaker individually at 150% of the ground-fault pickup setting. Monitor the time from this pickup point until the circuit breaker trips to obtain the delay time.

    7. Record pickup and delay values and compare results to Table 7.

The ground-fault test can also be done using a secondary injection test kit. LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE circuit breakers use the UTS3 test kit. The MASTERPACT circuit breaker uses the full-function test kit. These secondary injection test sets do not test the current transformers and connections.

Tests for Ground-fault Alarm Only: LE, ME, NE, PE and SE Circuit Breakers

All MICROLOGIC circuit breakers with the ground-fault alarm feature are supplied with an integral ground-fault test feature. A 120 V power source is required to operate the integral test feature. The test circuitry simulates a ground-fault when the test button on the front of the circuit breaker is depressed. When the push-to-test button on the front of the circuit breaker is pressed, the ground-fault alarm only circuit breaker will not trip or indicate a trip. The ammeter in the circuit breaker will indicate a current value while the push-to-test button is engaged. When connected to a POWERLOGIC system via a communications adapter (Square D catalog number CIM3F), the POWERLOGIC system will indicate a ground-fault current value while the push-to-test button is engaged. The POWERLOGIC system indicates an alarm condition if the push-to-test button is pressed for two seconds. The circuit breaker takes a maximum of one second to communicate an alarm condition. The POWERLOGIC system updates the condition only as frequently as the scan time is set on the POWERLOGIC system.

Instructions for the ground-fault trip test, page 37, can be applied to ground-fault alarm-only circuit breakers with the following exceptions:

A. Ground-fault alarm only circuit breakers have no trip or delay features. Therefore the Universal Test Set (catalog number UTS3) will display no time values.

B. Ground-fault zone-selective interlocking is not available on ground-fault alarm only circuit breakers.

C. If the pulse test method is used, the pulse signal must be long enough for the POWERLOGIC system to recognize the alarm condition.

To primary injection test a ground fault alarm only circuit breaker, the circuit breaker must be connected to the POWERLOGIC system via an adapter (Square D catalog number CIM3F). The POWERLOGIC system is designed to indicate a ground-fault alarm condition. Apply the ground-fault current for a sufficient amount of time for the POWERLOGIC system to indicate an alarm condition.

When secondary injection testing using the UTS3 test set, the circuit breaker must be disconnected from the POWERLOGIC system. To disconnect the circuit breaker from the POWERLOGIC system, detach the 4-pin plug connection on the adapter. The test set will indicate the circuit breaker failed if the POWERLOGIC system remains connected when testing. After testing, reconnect the 4-pin plug to the adapter. Follow the instructions for the version of POWERLOGIC software that is installed on the system to verify that the communication has been re-established with the circuit breaker.

Note: Testing a circuit breaker connected to a POWERLOGIC system causes the POWERLOGIC system to react as if the circuit breaker were experiencing the actual faults.

Table 7: Ground-fault Test

Circuit Breaker Type	Trip Unit Series	Sensor Size (Amperes)	Pickup Test Acceptable Range (Amperes) Min.	Max.	Test (Amperes)	Delay Test Delay (Seconds.) Min.	Max.
LE, LX, LXI	1B	250	40	50	75	0.070	0.125
		400	64	80	120	0.070	0.125
		600	96	120	180	0.070	0.125
ME	4, 5, 5A, 5B	250	48	55	75	0.070	0.100
		400	64	80	120	0.070	0.100
		800	128	160	240	0.070	0.100
ME	3	225	39	50	68	0.100	0.175
		400	70	88	120	0.100	0.175
		800	140	176	240	0.100	0.175
MX	5B	250	40	50	75	0.070	0.100
		400	64	80	120	0.070	0.100
MX	4, 5	250	52	80	120	0.100	0.125
		400	70	88	132	0.100	0.125
NE	2, 3, 3A, 3B	250	48	55	75	0.070	0.100
		600	96	120	180	0.070	0.100
		1200	192	240	360	0.070	0.100
NE	1	1200	210	264	360	0.100	0.175
NX	3B	250	40	50	75	0.070	0.100
		600	96	120	180	0.070	0.100
		1200	192	240	360	0.070	0.100
NX	2, 3	250	52	80	120	0.100	0.125
		600	100	125	180	0.100	0.125
		1200	200	250	360	0.100	0.125
PE	5, 6, 6A, 6B	1200	192	240	360	0.070	0.100
PX	6B	1600	256	320	480	0.070	0.100
		2000	500	640	960	0.070	0.100
		2500	500	640	960	0.070	0.100
PE	4	1200	210	264	360	0.120	0.180
		1600	280	352	480	0.120	0.180
		2000	350	440	600	0.120	0.180
		2500	438	550	750	0.120	0.180
PX	5, 6	1200	180	250	360	0.090	0.125
		1600	250	320	480	0.090	0.125
		2000	310	400	600	0.090	0.125
		2500	410	600	750	0.090	0.125
SE	3, 3A, 3B	400	64	80	120	0.060	0.100
		800	128	160	240	0.060	0.100
		1200	192	240	360	0.060	0.100
		1600	256	320	480	0.060	0.100
		2000	320	400	960	0.060	0.100
		2500	400	500	960	0.060	0.100
		3000	480	600	960	0.060	0.100
		4000	640	800	960	0.060	0.100
SE	1, 2	200	32	40	60	0.070	0.125
		400	64	80	120	0.070	0.125
		800	128	160	240	0.070	0.125
		1200	192	240	360	0.070	0.125
		1600	256	320	480	0.070	0.125
		2000	480	600	900	0.500	0.800
		3000	480	600	900	0.500	0.800
		4000	480	600	900	0.500	0.800
MASTERPACT NW	6.0 A, P and H	100	26	35	50	0.08	0.14
		250	65	90	140	0.08	0.14
		400	100	140	200	0.08	0.14
		600	100	140	200	0.08	0.14
		800	140	190	285	0.08	0.14
		1000	175	230	350	0.08	0.14
		1200	210	276	415	0.08	0.14
		1600	430	550	825	0.08	0.14
		2000	430	550	825	0.08	0.14
		2500	430	550	825	0.08	0.14
		3000	430	550	825	0.08	0.14
		3200	430	550	825	0.08	0.14
		4000	430	550	825	0.08	0.14
		5000	430	550	825	0.08	0.14

AVAILABLE TEST EQUIPMENT FOR L-, M-, N-, P- AND S-FRAME CIRCUIT BREAKERS WITH MICROLOGIC ELECTRONIC TRIP UNITS

Local Current Meter Kit

Local current meters (catalog numbers ALAM and ALAMP) offer real-time current metering capabilities and, if the circuit breaker trips, the meters indicate the type of trip:

- Overload
- Short circuit
- Ground fault

The current meter provides a simple means of troubleshooting the cause of a trip, and comes installed in all full-function (LE, ME, NE, PE and SE) circuit breakers. The current meter provides on-line assistance with:

- Identifying overloaded or unbalanced phases
- Defining the level of ground-fault current flowing on the circuit

The ALAM kit is for use with all series of L-, M-, N- and S-frame MICROLOGIC electronic trip circuit breakers. The ALAMP kit is for use on all series of P-frame MICROLOGIC electronic trip circuit breakers, and is different only because of the orientation of the trip unit cavity.

Memory-reset Module

Memory reset modules (catalog numbers MTMB, MTM2 and MTM3) are used to reset the long-time memory on MICROLOGIC electronic trip circuit breakers. This allows faster primary injection testing of the circuit breakers.

- The MTMB module is for use with MICROLOGIC Series B electronic trip systems.
- The MTM3 module is for use with MICROLOGIC Series 3 trip systems.
- The MTM2 module is for use with Series 2 SE electronic trip circuit breakers.

Primary Injection Test Kit

Adapter plug kits (catalog numbers SEPITK1 and SEPITK2) use jumpers in certain terminals to properly connect the secondary sensing wiring in SE drawout construction circuit breakers. The SEPITK1 test kit is for use with Series 1 SED circuit breakers; the SEPITK2 test kit is for use with Series 2 and above SED circuit breakers.

Universal Test Set

The optional Universal Test Set (catalog number UTS3) is a microprocessor-based system used to test all LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE MICROLOGIC circuit breakers. This test set will thoroughly test each function of the trip unit. The Universal Test Set is a secondary injection tester and does not take current transformer tolerances into consideration.

The UTS3 test set includes:

- The test module for standard and full-function MICROLOGIC Series B trip systems
- A self-test module
- A power cord
- A ribbon cable
- An instruction manual

Replacement UTS3 test set parts and test modules for MICROLOGIC circuit breakers with older series trip systems are available (see the supplementary catalog).

AVAILABLE TEST EQUIPMENT FOR MASTERPACT CIRCUIT BREAKERS WITH MICROLOGIC ELECTRONIC TRIP UNITS

Full-function Test Kit

The full-function test kit is a microprocessor-based system used to test MASTERPACT circuit breakers with MICROLOGIC electronic trip units. The full-function test kit is a secondary injection tester and does not test the current transformers and connections.

The full-function test kit is designed to be used as a stand-alone tester or in conjunction with a personal computer. The full-function test kit alone performs the following tests:

- Protection function verification (LSIG)
- Compliance with trip curve
- Electrical and mechanical tests of trip system
- Zone-selective interlocking tests
- Inhibition of ground-fault protection for use during primary injection testing
- Inhibition of thermal imaging for use during primary injection testing
- Supply control power to the trip unit to energize displays

Hand-held Test Kit

The hand-held test kit is a small battery-powered unit. It is designed to provide convenient secondary injection tests on MASTERPACT circuit breakers with MICROLOGIC electronic trip units. The hand-held test kit is powered by five 9 V batteries and can be used to do the following:

- Verify trip unit operation by tripping the circuit breaker with a secondary injection signal
- Supply control power to the trip unit to energize displays
- Inhibit thermal imaging for primary injection testing
- Inhibit ground-fault for primary injection testing
- Zone-selective interlocking tests*

* Only provides power to trip unit to indicate a ZSI signal was received. Will not initiate the command to send a ZSI restraint signal.

GLOSSARY

AMMETER/TRIP INDICATOR (local current meter/trip indicator): a module that mounts directly to the circuit breaker trip unit. The ammeter (current meter) reports rms phase and ground-fault current values as measured by the trip unit. Current values are displayed one phase at a time. The trip indicator displays whether the circuit breaker tripped as a result of an overload, short-circuit, or ground-fault condition.

CIRCUIT BREAKER: a device designed to open and close a circuit manually and to open the circuit automatically when an overcurrent occurs without damage to itself when properly applied within its rating. See also molded case circuit breaker.

CONTINUOUS CURRENT RATING: the designated amperes (RMS ac or dc) that a device or assembly will carry continuously in free air without tripping or exceeding temperature limits.

CONTROLLED HIT POWER SUPPLY: an ac power supply that can produce a symmetrical (no asymmetrical component) current wave for the entire test pulse.

CURRENT TRANSFORMER (current sensor)(CT): an instrument transformer that converts actual system current to a lower value of current for metering or control.

DRAWOUT CIRCUIT BREAKER: a circuit breaker and a supporting structure designed so the assembly can be moved to either the main circuit connected or disconnected position without removing connections or mounting supports.

ELECTRONIC TRIP CIRCUIT BREAKER: a circuit breaker that uses current sensors and electronic circuitry to sense, measure, and respond to current levels.

FIBER OPTIC COMMUNICATIONS PORT: a port in the ribbed area of MICROLOGIC electronic trip units. On LE, LX, LXI, ME, MX, NE, NX, PE, PX and SE trip units the fiber optic communications port occasionally flickers. This does not indicate circuit breaker performance.

GROUND-FAULT: an unintentional current path, through ground, back to the source.

GROUND-FAULT DELAY: the length of time the circuit breaker trip unit will delay before initiating a trip signal to the circuit breaker after a ground fault has been detected.

GROUND-FAULT PICKUP: the level of ground-fault current at which the trip system begins timing.

INSTANTANEOUS PICKUP: the current level at which the circuit breaker will trip with no intentional time delay.

INTEGRAL GROUND-FAULT PROTECTION: internal circuit breaker components that provide ground-fault protection for equipment.

INTERRUPTING RATING: the highest current at rated voltage that a circuit breaker is intended to interrupt under standard test conditions. When the circuit breaker can be used at more than one voltage, the interruption rating for each level is labelled on the circuit breaker. The interruption rating of a circuit breaker must be equal to or greater than the available short-circuit current at the point at which the circuit breaker is applied on the system.

INVERSE TIME: a qualifying term indicating that there is a purposely introduced delayed tripping in which the delay decreases as the magnitude of the current increases.

I^2t IN: an inverse time delay characteristic.

I^2t ON: an inverse time delay characteristic.

I^2t OUT: a constant time delay characteristic.

I^2t OFF: a constant time delay characteristic.

LOCAL CURRENT METER: ammeter/trip indicator.

LONG-TIME AMPERE RATING: an adjustment that, in combination with the installed rating plug, establishes the continuous current rating of a MICROLOGIC full-function electronic trip circuit breaker.

LONG-TIME DELAY: the length of time the circuit breaker will carry a sustained overcurrent (greater than the long-time pickup value) before initiating a trip signal.

LONG-TIME PICKUP: the current at which the long-time delay function is initiated.

MAG-GARD®: the Square D family of instantaneous-trip circuit breakers (motor short-circuit protectors).

MICROLOGIC®: the Square D family of electronic trip systems available on molded case circuit breakers and insulated case circuit breakers.

MICROLOGIC TRIP SYSTEM: a system that consists of a MICROLOGIC trip unit and current transformers.

MICROLOGIC TRIP UNIT: a programmable microprocessor-based device that measures and times current flowing through the circuit breaker, and initiates a trip signal when appropriate.

MOLDED CASE CIRCUIT BREAKER: a circuit breaker that is assembled as an integral unit in a supportive and enclosed housing of insulating material.

NEUTRAL CURRENT TRANSFORMER: a current transformer that encircles the neutral conductor; required on circuit breakers with ground-fault protection when applied on a grounded system.

OVERCURRENT: any current in excess of the rated continuous current of equipment or the ampacity of a conductor.

OVERLOAD: a sustained low-level overcurrent.

PUSH-TO-TRIP BUTTON: a button for manually tripping the circuit breaker.

RATING PLUG: a component that plugs into the MICROLOGIC full-function electronic trip unit, establishing the maximum continuous current rating of the circuit breaker.

SENSOR AMPERE RATING: the size of the current transformer for rated output.

SENSOR PLUG: field replaceable component used on MASTERPACT circuit breakers equipped with MICROLOGIC trip units to set the current rating (In).

SHORT-TIME DELAY: the length of time the circuit breaker will carry a short circuit current (greater than the short-time pickup value) before initiating a trip signal.

SHORT-TIME PICKUP: the current at which the short-time delay function is initiated.

THERMAL-MAGNETIC CIRCUIT BREAKER: a general term for circuit breakers that use bimetals and electromagnetic assemblies to provide both overload and short circuit overcurrent protection.

ZONE-SELECTIVE INTERLOCKING (ZSI): a communication capability between electronic trip systems and ground-fault relays that permits a short circuit or ground fault to be isolated and cleared by the nearest upstream device with no intentional time delay.

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