

# Functional Test Kit Instructions



For use on

- Power Circuit Breaker Trip Units
- Series NRX Circuit Breakers
- Digitrip 310+ MCCB
- Digitrip 210+ MCCB

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## Functional Test Kit

The Functional Test Kit (see Figure 1) is a handheld battery powered tester capable of testing trip elements for Digitrip family of Magnum power circuit breaker trip units.

The Digitrip 520 family includes the Digitrip 220+, 520, 520i, 520M, 520Mi, 520MC and 520MCI. In addition it can test the Digitrip1150 family consisting of the Digitrip 1150, 1150i and Digitrip 1150V and 1150Vi by overlaying a nameplate on the tester.

An Auxiliary Power Module is included to provide trip unit power to illuminate the trip units having display LEDs.

The molded case Digitrip 310+ and 210+ circuit breakers can also be tested with the addition of the respective overlay and test cable assembly supplied in the kit. The type of tests that can be performed are trip unit Power Up, Long Time Trip, Instantaneous Trip, Short Delay Trip, and Ground (Earth) Fault Trip. These test selections are chosen via the switch labeled "Select Test" on the Test Kit. (See Figure 1).

### Description

Functional Test Kit  
including Universal 120/230 V  
Aux. Power Module

### Style #

70C1056G54



Figure 1. Functional Test Kit - Complete.

## Test Kit Function and Power Up Check

The tester is powered by two banks of 9V batteries. These power sources are designated by LEDs A and B on the front of the test kit (see Figure 2).



Figure 2. LEDs A and B.

The condition of the batteries can be tested by plugging one of the test cables assemblies that is included in the test kit, setting the dial to POWER UP, and pressing the Push to Test button. Both lights should light up.

**Note:** As a feature to ensure batteries are not discharged inadvertently, a test cable must be plugged into the unit for the LEDs to light up.

Source A consists of a single 9V battery that is used as a current source during testing. Source B consists of six 9V batteries connected in series, and it provides the voltage used for the test sequences.

If either of the LEDs does not light up during power up test, replace the respective batteries by opening the test kit case using the four phillips head screws on the rear corners of the case (see Figure 3). Use caution when re-assembling to avoid pinching the wires in the case.

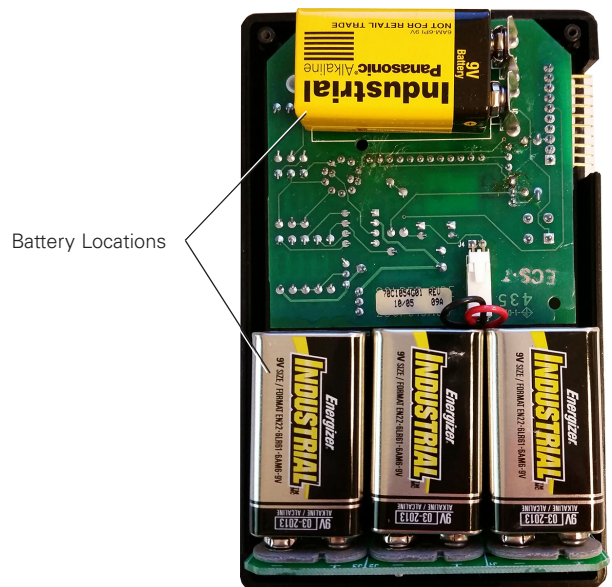


Figure 3. Battery Locations.

## Digitrip 520 Family

### Digitrip 520 Family of Power Circuit Breakers Test Procedure

#### When to Test

Power circuit breakers (Magnum) and Medium Voltage (Type VCP-T, VCP-TR, T-VAC, and T-VACR) circuit breakers can be tested prior to start-up or with the circuit breaker out of its cell or in the Test, Disconnected, or Withdrawn (or Removed cell positions).

**Note:** Since time-current settings are based on desired system coordination and protection schemes, the protection settings selected and preset should be reset to their as-found conditions if altered during any routine test sequence.

### **⚠ CAUTION**

**TESTING A CIRCUIT BREAKER WHILE IN-SERVICE AND CARRYING LOAD CURRENT IS NOT RECOMMENDED FOR POWER AND MEDIUM VOLTAGE CIRCUIT BREAKERS.**

**TESTING THAT RESULTS IN THE TRIPPING OF THE CIRCUIT BREAKER SHOULD BE DONE ONLY WITH THE CIRCUIT BREAKER IN A DEENERGIZED SYSTEM OR IN THE TEST OR DISCONNECTED CELL POSITIONS OR WHILE IT IS ON A TEST BENCH.**

**PERFORMING TESTS WITHOUT THE EATON-APPROVED TEST KIT MAY DAMAGE THE DIGITRIP UNIT.**

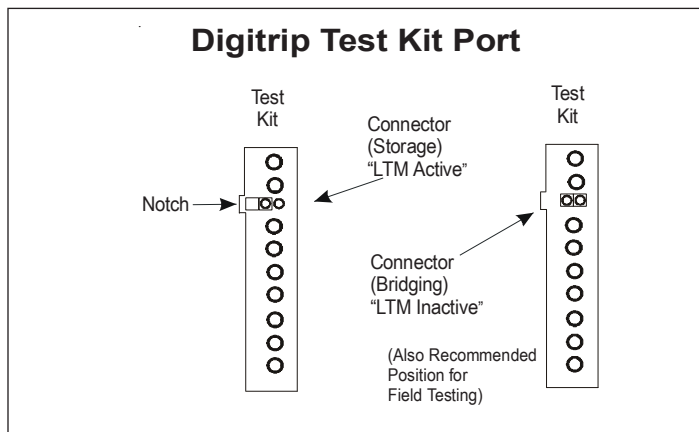
#### Setup Digitrip 520 Family

Before testing, write down all settings in use so that they may be restored after test are completed.

- Remove the circuit breaker’s plexiglass cover and the additional cover over the Digitrip “Test Kit” port pins. This is done by applying a screwdriver under the lip to pop off the cover.
- If necessary, reposition the Thermal Memory jumper temporarily to a “bridging” position in order to defeat memory for these tests. (See Figure 4).

### **⚠ CAUTION**

**BEFORE PLUGGING A TEST KIT INTO THE TEST PORT, VERIFY THAT THE LTM JUMPER IS IN THE INACTIVE POSITION (SEE FIGURE 4). AFTER TESTING, RETURN THE LTM JUMPER TO ITS ORIGINAL POSITION.**



**Figure 4. Long Time Memory (LTM) Jumper.**

To begin testing:

- Connect the Test Kit cable (style 5720B57) from the left side of the Functional Test Kit to the “Test Kit” port pins located on the front panel of the Digitrip unit. The trip unit end of the cable is designed in such a way that it will only fit over the “Test Kit” pins correctly.

#### Power Up

- Set the Select Test switch on the Test Kit to the “POWER UP” position.
- Push the Test pushbutton on the Test Kit to verify battery voltages are available from both power sources. Both Battery Voltage LEDs A and B should light.

**Note:** The cable has an interlock feature and must be connected to the tester to enable battery power. In the event that either LED does not light. Observe Digitrip status. Unit Status LED should flash at a rate of about one second on / one second off. Release Test pushbutton.

On Digitrip 520M/520MC/520MCV units, a current value can be observed by pressing the Step pushbutton to select the Phase 2 readout. The readout value should be approximately 30% of the Plug rating.

#### Instantaneous Trip

1. Set Select Test switch to “INST” position.
2. Set Instantaneous Pickup of Digitrip to 2x and Short Delay Setting to 10x.
3. Close the circuit breaker. Push the Test pushbutton and release immediately after the circuit breaker trips or the Digitrip indicates trip condition.
4. Check that the Instantaneous Trip LED on the Digitrip is flashing at a 4 or 5 second repetition rate.
5. Reclose the circuit breaker and reset the trip unit by depressing the Reset pushbutton.

#### Maintenance Mode (ARMS) (if applicable on certain Digitrip 520MC or Digitrip MCV)

This fast acting analog trip function can be verified in the following manner:

1. Set Select Test switch to “INST/M.M.”
2. Set Instantaneous Pickup of Digitrip to OFF, Short Delay to MI, and Long Delay to 1.0x.
3. Set Maintenance Mode to the ON setting. Apply auxiliary power to receptacle in the upper right hand corner of the Digitrip.
4. The blue LED will light, indicating the Maintenance Mode (MM) is active.
5. Set the MM reduction setting to R5 (maximum reduction-lowest pickup setting).
6. Push Test on the Test Kit and release immediately. Circuit breaker should trip. INST LED should flash at a 4 or 5 second repetition rate.

Reposition MM to 0/1 to do other testing. Reclose the circuit breaker and reset the trip unit by depressing the reset button.

#### Short Delay Trip (not applicable on Digitrip 220)

1. Position Select Test switch to SHORT.
2. Position Inst to 6x setting or higher; Short Pickup to 2x.
3. Push Test button and release immediately after trip.
4. Short Time LED should flash.
5. Reset Breaker and trip unit.
6. Reposition the Short Pickup setting to 4x or higher.

### Long Delay Pickup and Trip

1. Set the Select Test to "LONG" position.
2. On the circuit breaker, set the Short Delay setting to 4x or higher.
3. Set Long Pickup to 0.4x; Long Delay to 2 seconds.
4. Push Test and hold.
  - Status indicator LED on the trip unit should flash rapidly, indicating an overload.
  - Long Delay Trip should occur in 5-8 seconds; Long Delay Trip LED should flash.
  - Release Test after Trip, reclose the circuit breaker and reset the trip unit.

**Note:** After a circuit breaker trip has occurred, release the "Push to Test" pushbutton immediately. If held too long after a trip, the Digitrip unit will reenter its protection algorithm to start timing out for a second trip. In this process, the previous expected trip LED indication may get cleared.

### Ground Fault Trip (if applicable)

Test the ground fault protection system to verify compliance with paragraph 230-95(C) of the National Electrical Code (NEC) which requires that all equipment ground fault protection systems be tested when first installed.

1. Set Select Test to the "GROUND" position.
2. Plug in the Ground Fault Test Connector supplied with the kit to the circuit breaker's "B" secondary contact block. This provides a temporary jumper from terminals B-6 to B-7 of the circuit breaker (see Figure 6).

**Note:** The circuit breaker will have to be in its Disconnected Position to plug in this connector. This jumper connection could be accomplished by other means. No setting changes are required for this test.

3. Hold Test pushbutton until circuit breaker trips and/or Digitrip Ground (Earth) Fault indicator flashes.

When testing is completed, **remove the Ground Fault Connector jumper with the yellow tag** and disconnect cable from both trip unit and Test Kit. Test Kit components should be stored together in case.

**Note:** For Digitrip 520M and 520MC products;

- Before removing the test cable, set the Select Test back to the "Power Up" position.
- Depress the "Push to Test" pushbutton and then on the Digitrip depress the Reset pushbutton.

This action will provide a complete reset of the Digitrip's cause of trip memory and eliminate relighting of previous test trip LED when the circuit breaker is put back into service.

**Note:** After completion of testing;

1. Always disconnect cable from Test Kit to prevent accidental operation and battery drainage.
2. Reset all Digitrip settings to their original condition, including LTM jumper.
3. Install the small cover on the Digitrip and install the circuit breaker's plexi-glass cover.

**Note:** On the left side of Figure 4, a relief notch is shown next to the jumper to accommodate a non connected "storage" position. Some Digitrip units may not have this notch. LTM is made active in this case by placing the jumper over the outer pin and letting it hang down.

### Digitrip 220

The original Digitrip 220 (not the 220+) can be tested using the Test Kit. This Digitrip 220 has an adjustable Instantaneous setting, but uses a fixed Long Delay set at 1.0x and a fixed Long Time set at 10 seconds at 6x. The Instantaneous can be tested as indicated above for the 520 family of trip units, and following the directions below.

However, the Long Time test requires the hand held tester be set at the SHORT setting (200 mA or 200%).

- Hold "Push to Test" button in and view the Status LED flashing rapidly.
- The circuit breaker/Digitrip should trip in 60 to 90 seconds.



## Digitrip 1150 Family

### Digitrip 1150 family Test Procedure

The Digitrip 1150 family consists of the Digitrip 1150, 1150i (Magnum Breaker) and the Digitrip 1150V, Vi (Medium Voltage type VCP-T, VCP-TR and TVAC, TVACR).



**Figure 5. Testing Digitrip 1150 with Magnum Breaker in Disconnected Cell Position.**

#### Setup

Before testing, apply the overlay onto the handheld tester for the Digitrip 1150 to aid in the test sequence.

- Remove the circuit breaker's plexiglass cover. At this time, also apply the Aux power to the Digitrip right corner connector if the Digitrip is not already powered up.
  - Note the Digitrip trip setting "as found" so that they can be restored after testing is completed. This can be accomplished by entering the VIEW SETtings menu and recording each of the settings.
- Enter the Program Setting menu. Temporarily enter test settings by depressing the Reset pushbutton and selecting ProGraM SETtings (in the middle display) using the down arrow VIEW pushbutton.
- Select CURRENT and then LSIG (curve). Make the following test settings:
  - LONG SLOPE = I2T
  - LONG Pickup = 0.4x
  - LONG TIME = 2
  - SHORT PU = 4x
  - INST = 2.5x
  - GROUND = 0.24x or 0.4x.
  - Push SAVE to transfer Test settings into memory.
  - VOLTAGE Settings (if applicable) must be DISABLED at this time while performing these current injection type tests.
- Remove cover over Digitrip "Test Kit" port pins by applying screwdriver under lip to pop off cover.

To begin testing, connect the Test Kit cable (style 5720B57) from the left side of the Functional Test Kit to the "Test Kit" port pins located on the front panel of the Digitrip unit. The trip unit end of the cable is designed in such a way that it will only fit over the "Test Kit" pins the correct way.

#### Power Up

- Set Select Test switch on the Test Kit to the "POWER UP" position.
- Push the Test pushbutton on the Test Kit to verify battery voltages are available from both power sources.
  - Both Battery Voltage LEDs A and B should light. In the event that either of the LEDs don't light, refer to the note on page 8 at the end of the Long Delay Pickup and Trip section.
- Observe Digitrip status. Unit Status LED should flash at a rate of one second on and one second off. Release Test pushbutton.

#### Instantaneous Trip

- Set Select Test switch to "INST" position and close the circuit breaker.
- Push Test pushbutton and release immediately after breaker trips. Note: The cable has an interlock feature and must be connected to the tester to enable battery power. In the event that either LED does not light, refer to the note on page 8 at the end of the Long Delay Pickup and Trip section.

#### Maintenance Mode Testing (if supplied and applicable)

The fast acting analog current can be verified using the Test Kit. For the Digitrip 1150/1150V (ARMS version), use the following settings made to the LSIG curve:

- LSIG = 1
- SDPU = M1
- INST = OFF
- MAINTENANCE MODE = 2.5x
- Maintenance Mode ENABLED

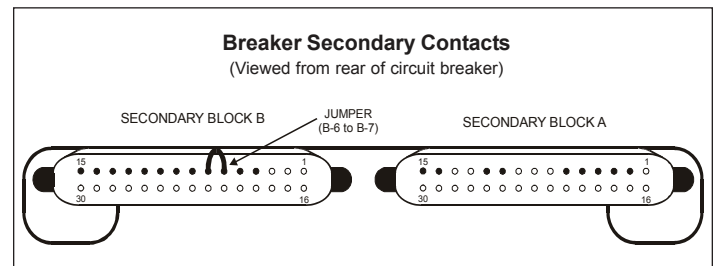
The Maintenance Mode ENABLED message will be displayed on the trip unit.

- Set the Test Kit to INST/M.M.
- Depress the "Push the Test" button and release.
  - The circuit breaker should trip and the trip unit Instantaneous LED should flash.
- Reset the Digitrip and reinstall the original settings.

When replacing battery six-pack (battery B), replace all batteries at the same time using standard 9 V alkaline batteries.

#### Short Delay Trip

- Set the Select Test switch to the "SHORT" position.
- Push the Test pushbutton and hold for a maximum of one second. Release immediately after trip. The Short Delay Trip LED should flash after trip.
- Reset the Digitrip and red trip flag on the circuit breaker.



**Figure 6. Breaker Secondary Contact Jumper for Ground Fault Test (Magnum or Medium Voltage Breaker).**

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### Long Delay Pickup and Trip

1. Set the Select Test switch to the "LONG" position.
2. Push Test and hold. Status indicator LED on Digitrip should flash quickly, indicating a Long Pickup overload condition in progress.
  - Long Delay Trip of circuit breaker should occur in 5 - 8 seconds accompanied by flashing Long Delay trip LED.
3. Release test pushbutton immediately after trip.

**Note:** After a circuit breaker trip has occurred, release the "Push to Test" pushbutton immediately. If held in too long after a breaker trip, the Digitrip unit will re-enter its protection algorithm to start timing out for a second trip. In this process, the expected trip LED indication may get cleared and a "CHECK AUX SWITCH" alarm message may appear on the display. This message would be as expected if the test pushbutton is held in too long.

### Ground Fault Trip (if applicable)

Test the ground fault protection system to verify compliance with paragraph 230-95(C) of the NEC which requires that all equipment ground fault protection systems be tested when first installed.

Set Select Test to the "GROUND" position. Plug in the Ground Fault Test Connector supplied with the kit to the circuit breaker's "B" secondary contact block. (See Figure 6.)

**Note:** The circuit breaker will have to be in its Disconnected Position to plug in this connector. This connection could be accomplished by other means. No setting changes are required for this test. Hold Test pushbutton until breaker trips and/or Digitrip Ground (Earth) Fault indicator flashes.

**Note:** After completion of testing;

- Always disconnect cable from Test Kit to prevent accidental operation and battery drainage.
- Reset all Digitrip settings to their original condition.
- Install the small cover on the Digitrip and install the circuit breaker's plexiglass cover.

When testing process is completed, remove the Ground Fault Connector jumper and disconnect cable from both trip unit and Test Kit. Test Kit components should be stored together in case.

## Series NRX

### Series NRX Circuit Breakers Test Procedure



Figure 7. Testing a Series NRX Circuit Breaker.

### Setup

Before testing, write down all settings in use so that they may be restored after tests are completed.

To begin testing;

1. Connect the Series NRX test cable to the Test Kit and the circuit breaker.
2. Use the following settings:
  - Long PU = 0.6x
  - Long Time = 2
  - Inst = 2x
  - SD: 10x
  - GROUND = 0.25

### Power Up

- 1a Charge and close the breaker for every trip test and racked to disconnect position
- 1b Set the Select Test switch on the Test Kit to the "POWER UP" position.
2. Position switch located on test cable to PHASE.
  3. Push the Test button;
    - LEDs A and B should light on test kit
    - The Status LED should flash Green on Digitrip, if not release the test button.
    - Unit should not trip
  4. Release the Test button.

### Instantaneous Trip

1. Set the Select Test switch to the "INST" position.
2. Push the Test pushbutton and hold for a maximum of one second. Release immediately after circuit breaker trip.
3. Inst LED should flash red.
4. Reset the trip unit and reclose the breaker.

### Short Delay Trip

1. Set the Select Test switch to the "SHORT" position.
2. Position the Inst Pickup to 10x.
3. Position the SD Pickup to 2X.
4. Push the Test pushbutton and hold for a maximum of one second. Release immediately after circuit breaker trip.
5. The Short time LED should flash red.
6. Reset the trip unit and close the breaker.

### Long Delay Pickup and Trip

1. Set the Short Pickup and INST to 10x.
2. Set the Select Test to the "LONG" position.
3. Push Test and hold.
  - Status indicator LED on the trip unit should flash green rapidly.
  - Long Delay Trip is 3 to 35 seconds.
  - Long Delay trip LED should flash red.
4. Release Test after trip. Reset the circuit breaker and trip unit.

**Note:** After a circuit breaker trip has occurred, release the "Push to Test" pushbutton immediately. If held too long after a trip, the Digitrip unit will reenter its protection algorithm to start timing out for a second trip. In this process, the previous expected trip LED indication may get cleared.

### Ground Fault Trip (if applicable)

Test the ground fault protection system to verify compliance with paragraph 230-95 (C) of the NEC which requires that all equipment ground fault protection systems be tested when first installed.

1. Set the switch on the cable to "GROUND".
2. Push Test button and hold for 1 second or release immediately after circuit breaker trips.
3. The trip and/or Ground Fault LED flashes.
4. Reset the circuit breaker and trip unit.

**Note:** Restore all temporary connections made for the purpose of conducting tests to proper operating conditions before returning the breaker to service.

Record the test results on the test form provided with the equipment.

## Digitrip 310+

### Digitrip 310+ Circuit Breakers Test Procedure

#### Setup

Before testing, write down all settings in use so that they may be restored after tests are completed.

To begin testing;

1. Connect the Digitrip 310+ cable assembly (style 5721B14) into the side connector of the handheld unit. Plug the other end of the cable into the test port.
 

**Note:** The test plug may be covered by a "dummy connector" used to protect the test plug pins during shipment. Ease the dummy connector off using a screw driver to expose the male test pins underneath.
2. Position Trip/No Trip switch on cable assembly to the Trip position and set the Ground Fault switch to the "Off" position.
3. On the circuit breaker set the ( $I_r$ ) switch and SDPU ( $I_{SD}$ ) switch to maximum.

#### Power Up

- Set the Select Test switch on the Test Kit to the "POWER UP" position.
- Push the Test pushbutton on the Test Kit to verify battery voltages are available from both power sources. Both Battery Voltage LEDs A and B should light.

#### Short Delay Trip

1. Set the Select Test to the "INST" position.
2. Position the
  - Trip/No Trip switch on the cable assembly to "Trip" position,
  - Ground Fault switch to the "OFF" position.
3. On the breaker, set the short delay switch to 2.
4. Press the "Push to Test" button and hold for 1 second.
  - The breaker should trip.
5. Reset the breaker.

#### Long Delay Pickup and Trip

1. Set the Select Test to the "LONG" position.
2. Set Short Delay switch,  $I_{sd}$  to 4 or higher.
3. Depress the Memory Reset button on the cable for 5 seconds.
4. Set the  $I_r$  switch as specified in the overlay (test card) for the specific breaker.
  - a. The highest setting for most frames
  - b. Varies in the NG and RG depending on the frame
5. Set the Long Delay time,  $t_{LD}$  or  $t_r$ , to 2 seconds.
6. Press the "Push to Test" button;
  - a. The Status LED will flash;
  - b. The breaker will trip in 18-22 seconds, depending on the frame.
7. Reset the breaker.

### No Trip Testing

1. Set the Select Test to "INST" position.
2. Position the
  - Trip / No Trip switch on the cable assembly to "No Trip" position,
  - Ground Fault switch to "Off" position.
3. On the breaker set Short Delay to 2.
4. Push Test and hold for 1 second. Release Test button.
  - The yellow TEST / ALARM LED on the circuit breaker should light and the circuit breaker should not trip.

Unplugging the test connector will reset the TEST LED.

**Note:** The Long Delay and Ground Fault tests can also be done in the "No Trip" position.



Figure 8. Testing a Circuit Breaker.

### **⚠ CAUTION**

**IF CIRCUIT BREAKER IS ON LINE, TEST KIT MUST BE IN NO-TRIP SWITCH POSITION OR CIRCUIT BREAKER COULD TRIP.**

### Ground Fault Trip (if applicable)

Test the ground fault protection system to verify compliance with paragraph 230-95(C) of the NEC which requires that all equipment ground fault protection systems be tested when first installed.

1. Set the Select Test switch to "GROUND".
2. Position the Ground Fault switch on the cable assembly to "On".
3. On the circuit breaker, set Ground Fault Pickup,  $I_G$  /GND) to 0.6 or less.
4. Push Test button and hold for 1 second or release immediately after circuit breaker trips.
5. Relatch and reclose the circuit breaker.

### Digitrip 210+

#### Digitrip 210+ Circuit Breaker Test Procedure

##### Setup

Before testing, write down all settings in use so that they may be restored after tests are completed.

To begin testing;

1. Connect the Digitrip 210+ cable assembly (style 5723B81G01) into the side connector of the handheld unit. Plug the other end of the cable into the test port.
 

**Note:** The test plug may be covered by a "dummy connector" used to protect the test plug pins during shipment. Ease the dummy connector off using a screw driver to expose the male test pins underneath.
2. On the circuit breaker set the ( $I_r$ ) switch and SD Profile (for LSI version) or  $I_r$  (for LI version) switch to the maximum. This is position G for the  $I_r$  switch and position S for the SD Profile /  $I_r$  switch.

##### Power Up

- Set the Select Test switch on the Test Kit to the "POWER UP" position.
- Push the Test pushbutton on the Test Kit to verify battery voltages are available from both power sources. Both Battery Voltage LEDs, A and B, should light.

**Note:** This breaker does not have thermal memory reset capability. If the Long Delay trip times are shorter than specified, wait 5 minutes and repeat the test.

##### Long Delay Trip

1. Set the Select Test switch on the test kit to the "LONG" position.
2. Set  $I_r$  switch on the breaker to 100A. Depending on the frame rating of the breaker, this will be a different setting on the switch - Setting G for the 100A frame, Setting D for the 150A frame, and Setting A for the 225A frame.
3. Set the SD Profile or  $I_r$  switch on the breaker to the following position:
  - a. For LSI trip units, set the SD Profile switch to position Q (6x / 300ms)
  - b. For LI trip units, set the  $I_r$  switch to position S (highest setting)
4. Press the "Push to Test" button;
  - a. The Status LED will flash;
  - b. The breaker will trip in 14-18 seconds, depending on the frame.
5. Reset the breaker.

##### Short Delay and/or Instantaneous Trip

1. Set the Select Test switch on the test kit to the "INST/SHORT" position.
2. Set the  $I_r$  switch on the breaker to 100A, as for the Long Delay Trip test.
3. Set the SD Profile (LSI trip units) or  $I_r$  (LI trip units) switch to the J setting. This setting is 2x / 150ms for LSI or 2x for LI.
4. Press the "Push to Test" button
  - a. The Status LED will flash
  - b. The breaker will trip in less than 1 second; release the push-button immediately after the circuit breaker trips.
5. Reset the breaker.



**Notes:**

**Notes:**

**Notes:**

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