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SECTION 1: INTRODUCTION

1.1 GENERAL INFORMATION

The Trip Unit Test Kit is used to test and verify the pickup levels and time delay settings of a breaker's Trip Unit. The original Test Kits were developed to test the Amptector Trip Units of the DS Breaker. With the introduction of microprocessor based Trip Units (Digitrip, Optim, etc), modifications to the original Test Kits (-G01 and -G02) were required to accommodate lower power requirements of the microprocessor. These modifications, in combination with various Test Kit Adapters, allow maintenance personnel to utilize the Test Kit they already own when testing the newer generations of Trip Units.

The Test Kit Adapter (Style # 8779C02G04) for the Magnum DS Digitrip Trip Units, converts the 11-pin banana plug on the Test Kit, to a 14-pin plug. This 14-pin plug, plugs into the Trip Unit Test Port, located on the face of the Trip Unit. (see Figure 4)

SECTION 2: TEST KIT / BREAKER INFORMATION

2.1 TEST KIT / ADAPTER INFORMATION

2.1.1 TEST KIT CONTROLS (SEE FIGURE 1)

The following are the identifications and functions of the Test Kit controls. Any time these are referred to in the following portions of this publication they will be in italics and underlined as shown in the following definitions of the functions.

POWER ON/OFF – Turns on power to the Test Kit.

STOP – This switch manually cuts off the test current to the Trip Unit.

LONG DELAY PICKUP – This light is not functional for Magnum DS trip units.

TEST – Starts the test.

RESET – Resets the Test Kit after a test.

CALIB – Used in conjunction with CURRENT ADJUST allowing for setting a pre-determined current level prior to a test.

INST Operative / Read Amps – For testing the Instantaneous function on Amptector Trip Units. (Not functional with Magnum DS trip units.)

SHORT DELAY Operative / Read Amps – For testing the Short Delay function.

GROUND TEST – For testing the Ground Fault function.

EXT. AM – Allows for connection of an external ammeter to read current levels. Jumper must be installed when not using external ammeter.

CIRCUIT SELECTOR – Permits checking of all Trip Unit phase input circuits. Since all feed into a common pickup and timing circuit, it is only necessary to use one phase to test all the solid state circuitry functions. It is only necessary to use one circuit function (e.g., long delay pickup) to verify that each phase (A, B, and C) performs similarly.

TIMER ON/OFF – The timer is used to calculate and display the time-delay functions of the Trip Unit.

RESET (Timer) – Resets the timer after a test.

HI / LO AMPS – Selects the "level" of current to be injected. (LO AMPS is typically for checking Long Delay Pickup or Ground Fault Pickup, and HI AMPS is for checking Short Delay Pickup or Instantaneous Level)

CURRENT ADJUSTMENT – Adjusts the secondary current injected into the Trip Unit.

2.1.2 TEST KIT ADAPTER

The Magnum DS Test Kit Adapter (8779C02G04) is used to connect the Test Kit's 11-pin plug to the Magnum DS Digitrip Trip Unit 14-pin test port. In addition, the Auxiliary Power Module (PRTAAPM), which is permanently connected to the Adapter, must be connected to a 120 V, 50/60 HZ source to supply control power to the Trip Unit. (see Figure 2)

2.1.3 ZONE INTERLOCK SHORTING PLUG

The Zone Interlock Shorting Plug (8779C02G06) is required when the breaker is removed from the switchgear cell for testing. The Shorting Plug must be installed on the breaker secondary contacts to defeat zone-interlock wiring. (see Figure 3)

2.1.4 TEST KIT OPERATION GUIDELINES

To minimize thermal stress on the Test Kit and Trip Unit, hold CALIB (momentary) toggle switch for no more than 15 to 20 seconds at a time.

If current persists after the test is complete, use STOP switch to turn off the current.

When checking settings on the Trip Unit, the general procedure is to start with the high current settings and work down to the lowest current setting. This avoids unnecessary dial changes after calibration.

The output current is a function of the line voltage, which must be sinusoidal and have good regulation.

If the Test Kit RESET lamp will not light, check to make sure that no trip LED's are lit on the Trip Unit. If so, press the "trip reset" pushbutton on the face of the Trip Unit.

2.2 CIRCUIT BREAKER INFORMATION

2.2.1 TRIP UNIT TOLERANCE BANDS

Long Delay Times of the Trip Unit are top of band, therefore expect shorter times when testing.

Short Time, Instantaneous, and Ground Fault values are mid-band, which have +/- 10% tolerance.

2.2.2 TRIP UNIT TEST GUIDELINES

Testing of the Trip Unit must be performed with the Trip Unit properly installed in the breaker.

The long time function has a memory circuit with a reset time of 36 times the long delay time setting; i.e., for a LDT setting of 4 seconds the reset time is 144 seconds (36x4). Therefore, for long delay time tests, there must be a time delay greater than the calculated reset time or the ac control power to the Trip Unit must be interrupted between tests to clear the memory circuit. To do this, remove the ac supply to the Auxiliary Power Module rather than disconnecting the plug from the Test Kit Adapter. A thermal memory jumper may need to be repositioned to the "inactive" position to disable the thermal memory. This jumper is shipped from the factory in the "active" position.

If a trip function LED on the Trip Unit is lit prior to a test, press the "trip reset" pushbutton on the Trip Unit.

When bench testing a breaker wired for zone interlock applications, shorting plug 8779C02G06 must be installed per Figure 5.

SECTION 3: CHECKING THE TEST KIT

3.1 GENERAL INFORMATION

This check should be performed when the Test Kit is first received, or for a maintenance check. A more rigorous check would be to perform all Trip Unit tests on a standard Trip Unit.

3.2 HARDWARE CONNECTIONS (REFER TO FIGURE 2)

1. Connect the 11-pin banana plug on the Test Kit to the corresponding port on the Test Kit Adapter.
2. Connect the 14-pin plug from the Test Kit Adapter into the corresponding test port on the Trip Unit.

3.3 SETTING THE TEST KIT

1. TIMER ON/OFF switch to "OFF".
2. HI/LO AMPS switch to "LO AMPS".
3. CURRENT ADJUSTMENT to "ZERO".

3.4 TESTING THE TEST KIT

1. Plug the APM and the Test Kit into 120 volt, 60 Hz source. (Test Kit can be used on 50 Hz but timer readings must be multiplied by 6/5.)
2. Turn the Test Kit POWER ON/OFF switch "ON".
 - 2A. POWER ON/OFF pilot lamp (red) should light.
 - 2B. RESET pilot lamp (amber) should light. If RESET pilot lamp is not lit, push RESET button. RESET pilot lamp should then light.
3. Turn TIMER ON/OFF switch to "ON". Timer should not run.
4. Push TEST button.
 - 4A. TEST pilot lamp (red) should light.
 - 4B. RESET pilot lamp (amber) should go out.
 - 4C. TIMER should operate, counting seconds.
5. Operate STOP toggle switch (momentary) to "STOP".
 - 5A. TIMER should stop.
 - 5B. RESET pilot lamp (amber) should light.
 - 5C. TEST pilot lamp (red) should go out.
6. Push manual RESET button on timer. TIMER should reset to zero.
7. Hold CALIB toggle switch (momentary) in "CALIB" position and turn CURRENT ADJUSTMENT knob from zero to maximum. Ammeter should read from zero to approximately 8 amperes.

Note: If current reading remains at zero, check to see that the shorting bar is across "EXT AM" Terminals and that the terminals are tight. If the shorting bar is missing a substitute can be made using #10 wire and spade terminals.

8. Return CURRENT ADJUSTMENT knob to "ZERO".
9. *Note: This step should be performed with the breaker in the open position. If the main contacts are closed, the breaker will trip open.*
- 9A. Put HI/LO AMPS switch in "HI AMPS" position. Hold CALIB toggle switch (momentary) in "CALIB" position and turn CURRENT ADJUSTMENT knob from zero to maximum. Ammeter should read from zero to approximately 50 amperes.
10. If any of the above checks do not function as intended, operate the STOP switch and RESET button and repeat the check. If the situation persists, contact Cutler-Hammer.

SECTION 4: TESTING THE TRIP UNIT

4.1 LEGEND

I_n = Rating Plug Value (must match Sensor Rating, I_s)

I_g = Ground Fault Current Pickup (See Table 1)

I_t = Test Kit Trip Current

$I_{n/s} = I_n / I_s$

I_{pu} = Trip Unit Dial Setting

I_r = Long Delay Pickup x Short Delay Pickup

4.2 GENERAL SETUP

1. Hardware Connections (refer to Figure 2):
 - 1A. Connect the 11-pin banana plug on the Test Kit to the corresponding port on the Test Kit Adapter.
 - 1B. Connect the 14-pin plug from the Test Kit Adapter into the corresponding test port on the Trip Unit.
2. Plug the APM and the Test Kit into 120 volt, 60 Hz source. (Test Kit can be used on 50 Hz but timer readings must be multiplied by 6/5.) The green "Unit Status" LED should flash indicating that the Trip Unit is operational.
3. Turn the Test Kit POWER switch "ON".

4. It is recommended that a check of the Trip Unit per Section 4.3 below be performed prior to performing any of the other tests.

4.3 CHECKING THE TRIP UNIT

1. Remove the ac supply from the Auxiliary Power Module.
2. Set the Test Kit as follows:
 - 2A. TIMER ON/OFF switch to "OFF". 2. HI-LO switch to "LO AMPS".
 - 2C. CURRENT ADJUSTMENT to "ZERO".
3. Push RESET button and then the TEST button.
4. Slowly increase current via CURRENT ADJUSTMENT knob until green "Unit Status" LED located on upper left hand corner of Trip Unit starts to flash. This must occur at 1.8 amperes or less to indicate that the Trip Unit is functional.
5. Reconnect the APM to the ac supply.

4.4 CHECKING LONG DELAY PICKUP (L.D.P.U.)

1. Set Test Kit as follows:
 - 1A. TIMER switch to "OFF".
 - 1B. HI-LO switch to "LO AMPS".
 - 1C. CIRCUIT SELECTOR switch to "A".
 - 1D. CURRENT ADJUSTMENT to "ZERO".
2. Set the long delay setting on Trip Unit to desired setting.
3. Push RESET button and then the TEST button.
4. Slowly increase current via CURRENT ADJUSTMENT knob until the "Unit Status" LED on Trip Unit starts to flash quickly. This should occur at the pickup current, which will be the long delay setting of the Trip Unit times 5 amperes (+/- 10%). The rate of flashing will slow to normal when the current is lowered below the pickup setting. NOTE THAT THE LONG DELAY PICKUP LAMP ON THE TESTER WILL NOT LIGHT.
5. Use STOP switch to cut off current.
6. Repeat 3 and 4 with the CIRCUIT SELECTOR switch on "B" and then on "C". (See section 2.2.2 regarding the Trip Unit's thermal memory circuit)

4.5 CHECKING LONG DELAY TIME (L.D.T.)

(SEE SECTION 2.2.2 REGARDING THE TRIP UNIT'S THERMAL MEMORY CIRCUIT)

1. Set the Test Kit as follows:
 - 1A. TIMER switch to "OFF".
 - 1B. HI-LO AMPS switch to "HI AMPS".
 - 1C. CIRCUIT SELECTOR switch to "A".
 - 1D. CURRENT ADJUSTMENT to "ZERO".
2. If equipped, set Short Delay and Instantaneous Pickups on Trip Unit to maximum (or off) to prevent trip of the breaker by these functions.
3. Set desired Long Delay Pickup and Long Delay Time on Trip Unit.
4. Toggle CALIB switch to "CALIB" position and increase current on tester, using CURRENT ADJUSTMENT, to 6 X LDPU current setting. (Do not hold in the "CALIB" position for more than 15 –20 seconds)
5. Push RESET button.
6. Turn TIMER "ON". If TIMER does not read zero, push manual RESET button on TIMER.
7. Push TEST button. TIMER will stop when Trip Unit trips the breaker. Timer should read less than the dial setting but not under 2/3 of the setting; e.g., if set at 24, it should be more than 16 seconds but less than 24 seconds. NOTE: $I^2t = \text{CONSTANT}$, therefore, trip time at a current other than 6 (I_r) is calculated as follows: $(6 / z)^2 \times \text{Long Delay Time} = \text{Trip Time at } z \text{ current}$, where z = multiples of LDPU at which test current is applied. Example: Long Delay Time Setting = 24 seconds. Then for 3 times LDPU current setting applied, the Long Delay Trip Time would be as follows:

$(6 / 3)^2 \times (24 \text{ seconds}) = 96 \text{ second Long Delay Time at } 3 \text{ LDPU. Remember to use } 5 \text{ amperes times LDPU setting to set the tester current.}$

4.6 CHECKING INSTANTANEOUS (IF APPLICABLE)

1. Set Long Delay Pickup and Time to maximum and set Short Delay Pickup to M1 setting, so that these functions do not trip the breaker.
2. Set desired Inst. pickup on the Trip Unit. Note: Pickup setting should not exceed the capability of the Test Kit (approx. 50 amperes).

3. Set the Test Kit as follows:

- 3A. TIMER switch to "OFF".
- 3B. CURRENT ADJUSTMENT to "ZERO".
- 3C. Set HI-LO AMPS switch to "HI AMPS".

4. Push RESET button.
5. Toggle CALIB switch in "CALIB" position and using the CURRENT ADJUSTMENT knob, set current to about 3/4 of pickup setting. (Do not hold in the "CALIB" position for more than 15 –20 seconds)
6. Push TEST button and increase current steadily, using CURRENT ADJUSTMENT knob, until the breaker trips and red Test lamp goes out.
7. Prior to returning CURRENT ADJUSTMENT to "ZERO", hold CALIB switch in "CALIB" position momentarily to read the trip current.

4.7 CHECKING SHORT DELAY PICKUP (S.D.P.U.) (IF APPLICABLE)

1. Set Trip Unit Short Delay Time to minimum (.1 sec.) and Instantaneous to off.
2. Set desired Short Delay Pickup on the Trip Unit. Note that the Short Delay Pickup (I_r) is the product of the Long Delay Setting times the Short Delay Pickup Setting.
3. Set the Test Kit as follows:
 - 3A. SHORT DELAY switch in "OPERATIVE" position.
 - 3B. CURRENT ADJUSTMENT to "ZERO".
 - 3C. TIMER to "OFF".
 - 3D. Set HI-LO AMPS switch to "LO AMPS" if Short Delay Pickup is less than 8 amperes or to "HI AMPS" if it is greater than 8 amperes.
4. Push RESET button.
5. Toggle CALIB switch in "CALIB" position and using the CURRENT ADJUSTMENT knob, set current to about 3/4 of pickup setting. (Do not hold in the "CALIB" position for more than 15 –20 seconds)
6. Push TEST button and increase current steadily, using CURRENT ADJUSTMENT knob, until the breaker trips and red TEST lamp goes out.
7. Prior to returning CURRENT ADJUSTMENT to "ZERO", hold CALIB switch in "CALIB" position momentarily to read the trip current.

4.8 CHECKING SHORT DELAY TIME (IF APPLICABLE)

Note: Zone Selective Interlocking essentially disables Short Delay Time. This function is provided as a standard feature on all Magnum Trip Units. To test the Short Delay Time when the breaker is removed beyond the test position in the switchgear, the zone interlock shorting plug must be utilized (see Figure 5). Without this, all Short Delay Time values will be minimum.

1. Dial Short Delay and Long Delay Pickup on Trip Unit as desired. *Note: 2.5 times the short delay pickup setting should not exceed the capability of the Test Kit (approx. 50 amperes).* i.e. Maximum short delay pickup (I_t) = 4. Note that the Short Delay Pickup (I_t) is a function of the Long Delay Setting times the Short Delay Pickup setting.
2. Set Long Delay Time to maximum, and Instantaneous "off", so that these functions do not trip the breaker.
3. If the breaker secondary contacts are not connected to the switchgear Zone Interlock wiring (breaker is beyond the test position), install the Zone Interlock Defeat adapter.
4. Set the Test Kit as follows;
 - 4A. TIMER switch to "OFF".
 - 4B. HI-LO AMPS switch to "HI AMPS".
 - 4C. CURRENT ADJUSTMENT to "ZERO".
5. Toggle the CALIB switch to "CALIB" position and adjust current, using CURRENT ADJUSTMENT knob, to 2.5 times pickup setting. Note that if the breaker is closed, it will trip. Do not reclose the breaker until the test current is adjusted to the proper value.
6. Reset Trip Unit by pressing the "trip reset" pushbutton on the Trip Unit.
7. Close the breaker.
8. Turn TIMER "ON". If TIMER does not read zero, push RESET (Timer) button.
9. Push RESET button.

10. Push TEST button. TIMER will give an approximate reading of the delay. *Note: This is not accurate enough for close timing of short delay but, it will show the difference between the band calibrations.*
11. Remove the Zone Interlock Defeat adapter, and repeat the test. Time delay should read minimal.

4.9 CHECKING GROUND PICKUP (IF TRIP UNIT IS SO EQUIPPED)

1. Set desired Ground Fault Pickup on Trip Unit.
2. Set the Test Kit as follows:
 - 2A. HI-LO AMPS switch to "LO AMPS".
 - 2B. CURRENT ADJUSTMENT to "ZERO".
 - 2C. TIMER to "OFF".
3. Push RESET button.
4. Hold GROUND TEST momentary switch in down position during steps 5 and 6.
5. Push TEST button.
6. Increase CURRENT ADJUSTMENT slowly until the breaker trips.
7. Prior to returning CURRENT ADJUSTMENT to "ZERO", hold GROUND TEST switch in the down position and CALIB switch in "CALIB" position to read the trip current.
8. For pickup values see Table 1 below. *Note that the pickup values shown on the Test Kit are in secondary amperes. To convert the Test Kit reading to primary values, multiply ammeter readings by $I_n / 5$.*

(1) Examples:

(a) Assume $I_t = 1.2$ amps, $I_n = 200$, pickup setting = .25, then: $I_g = 1.2 \times 200 / 5 = 48$ primary amperes. Table 1 shows expected value of 1.25 amperes. 1.2 amperes is within the + 10% tolerance.

For reference purposes, Table 2 shows primary Ground Fault amperes

Note: Expect increased pickup currents due to the required sensor exciting current.

4.10 CHECKING GROUND DELAY TIME

Note: Zone Selective Interlocking essentially disables Ground Delay Time. This function is provided as a standard feature on all Magnum Trip Units. To test the Ground Delay Time when the breaker is removed beyond the test position in the switchgear, the zone interlock shorting plug must be utilized (see Figure 5). Without this, all Ground Delay Time values will be minimum.

1. Set desired Ground Fault Time setting on Trip Unit.
2. Set the Test Kit as follows:
 - 2A. TIMER to "OFF".
 - 2B. CURRENT ADJUSTMENT to "ZERO".
 - 2C. HI-LO AMPS switch to "LO AMPS".
3. If the breaker secondary contacts are not connected to the switchgear Zone Interlock wiring (breaker is beyond the test position), install the Zone Interlock Defeat adapter.
4. While holding the GROUND TEST momentary switch and the CALIB switch in the down positions, turn CURRENT ADJUSTMENT knob to get a current above pickup value (see Table 1 and Step 8 of section 4.9 above). *Note that if the breaker is closed, it will trip. Do not reclose the breaker until current is adjusted to the desired value.*
5. Release CALIB and GROUND TEST switches.
6. Reset Trip Unit by pressing the "trip reset" pushbutton on the Trip Unit.
7. Close the breaker.
8. Turn TIMER "ON". If TIMER does not read zero, push manual RESET (Timer) button.
9. Push RESET button.
10. While holding GROUND TEST momentary switch in the down position, push the TEST button. Timer will give an approximate reading of the delay.
11. Remove the Zone Interlock Shorting Plug, and repeat the test. Time delay should read minimal.

Table 1 - Ground Fault Current Pickup Settings (Test Kit Display Amperes)

Installed Rating Plug Amperes (I_n)	Pickup Setting (I_g) ⁽¹⁾ and Corresponding Pickup Levels (Secondary Amperes) ⁽²⁾							
	.25	.30	.35	.40	.50	.60	.75	1.0
100	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
200	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
250	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
300	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
400	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
600	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
800	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
1000	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
1200	1.25	1.50	1.75	2.00	2.50	3.00	3.75	5.00
1600	1.25	1.50	1.75	2.00	2.50	3.00	3.75	3.75
2000	1.25	1.50	1.75	2.00	2.50	3.00	3.00	3.00
2400	1.25	1.50	1.75	2.00	2.50	2.50	2.50	2.50
3200	1.25	1.50	1.75	2.00	2.00	2.00	2.00	2.00
4000	1.25	1.50	1.50	1.50	1.50	1.50	1.50	1.50
5000	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20

Table 2 - Ground Fault Current Pickup Settings (Primary Amperes)

Installed Rating Plug Amperes (I_n)	Pickup Setting (I_g) ⁽¹⁾ and Corresponding Pickup Levels (Secondary Amperes) ⁽²⁾							
	.25	.30	.35	.40	.50	.60	.75	1.0
100	25	30	35	40	50	60	75	100
200	50	60	70	80	100	120	150	200
250	63	75	88	100	125	150	188	250
300	75	90	105	120	150	180	225	300
400	100	120	140	160	200	240	300	400
600	150	180	210	240	300	360	450	600
800	200	240	280	320	400	480	600	800
1000	250	300	350	400	500	600	750	1000
1200	300	360	420	480	600	720	900	1200
1600	400	480	560	640	800	960	1200	1200
2000	500	600	700	800	1000	1200	1200	1200
2400	600	720	840	960	1200	1200	1200	1200
3200	800	960	1120	1200	1200	1200	1200	1200
4000	1000	1200	1200	1200	1200	1200	1200	1200
5000	1200	1200	1200	1200	1200	1200	1200	1200

⁽¹⁾ For the Digitrip 1150, settings are non-discrete, and may fall between the values listed above. The corresponding pickup values must then be calculated. ($I_g \times I_n$, max 1200A)

⁽²⁾ Except as noted, tolerances on pickup levels are $\pm 10\%$ of values shown in chart.



1 POWER ON/OFF – Turns on power to the Test Kit.

2 STOP – This switch manually cuts off the test current to the Trip Unit.

3 LONG DELAY PICKUP – This light is not functional for Magnum DS trip units.

4 TEST – Starts the test.

5 RESET – Resets the Test Kit after a test.

6 CALIB – Used in conjunction with CURRENT ADJUST allowing for setting a pre-determined current level prior to a test.

7 INST Operative / Read Amps – For testing the Instantaneous function on Amptector Trip Units. (Not functional with Magnum DS trip units.)

8 SHORT DELAY Operative / Read Amps – For testing the Short Delay function.

9 GROUND TEST – For testing the Ground Fault function.

10 EXT. AM – Allows for connection of an external ammeter to read current levels. Jumper must be installed when not using external ammeter.

11 CIRCUIT SELECTOR – Permits checking of all Trip Unit phase input circuits. Since all feed into a common pickup and timing circuit, it is only necessary to use one phase to test all the solid state circuitry functions. It is only necessary to use one circuit function (e.g., long delay pickup) to verify that each phase (A, B, and C) performs similarly.

12 TIMER ON/OFF – The timer is used to calculate and display the time-delay functions of the Trip Unit.

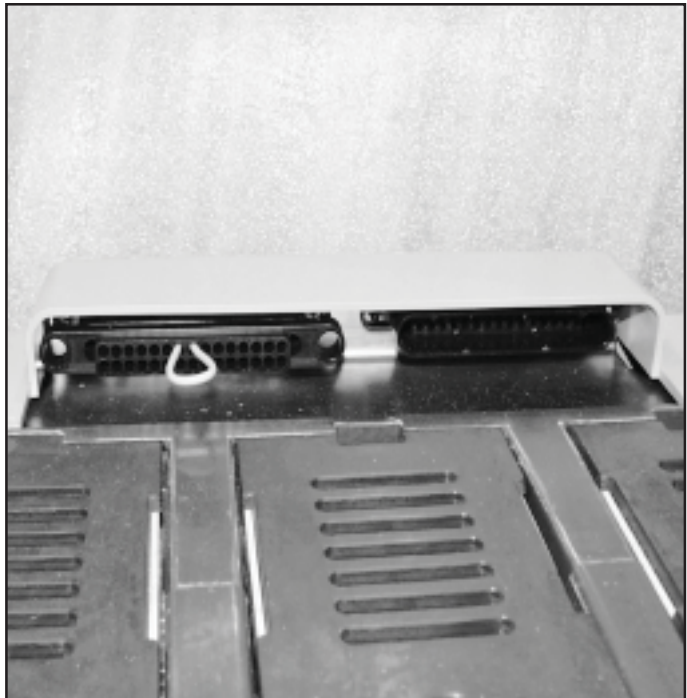
13 RESET (Timer) – Resets the timer after a test.

14 HI / LO AMPS – Selects the “level” of current to be injected. (LO AMPS is typically for checking Long Delay Pickup or Ground Fault Pickup, and HI AMPS is for checking Short Delay Pickup or Instantaneous Level)

15 CURRENT ADJUSTMENT – Adjusts the secondary current injected into the Trip Unit.

Figure 1. Test Kit Controls and Legend

SECTION 5: FIGURES AND TABLES

*Figure 2. Test Kit and Adapter**Figure 3. Zone Interlock Shorting Plug**Figure 4. Trip Unit Face Plate Showing Test Port Connection**Figure 5. Zone Interlock Shorting Plug Installed on Circuit Breaker.*

This instruction booklet is published solely for information purposes and should not be considered all inclusive. If further information is required, you should consult Cutler-Hammer.

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