SIEMENS-ALLIS

Installation • Operation • Maintenance

Instructions

Portable Test Set
Type PTS-3
SG-3128

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The information contained within is intended to assist operating personnel by providing information on the general characteristics of equipment of this type. It does not relieve the user of responsibility to use sound engineering practices in the installation, application, operation and maintenance of the particular equipment purchased.

If drawings or other supplementary instructions for specific applications are forwarded with this manual or separately, they take precedence over any conflicting or incomplete information in this manual.

INTRODUCTION

GENERAL

Siemens-Allis portable test set type number PT-3 is designed for testing the static overcurrent tripping systems used on the LA line and RL line of low voltage power circuit breakers. It provides a means of testing the magnetic tripping actuator as well as the static trip device. The portable test set, using power from an ordinary 120 volt convenience outlet, can provide circuit breaker testing equivalent to much more expensive and cumbersome primary current testing.

This instruction book provides the information necessary to test all models of static trip systems produced by Allis-Chalmers or Siemens-Allis from the original first generation models to the latest versions of Static Trip II™ and *LimiTrip*®. First generation systems are discussed in more detail in instruction book 18X4392, Static Trip II™ in books 18X4827, 18X4433 and SG-3098. *LimiTrip*® is covered in book 18X10107 and SG-3108.

Factory calibration of the trip devices is done with sinusoidal current from a closely regulated supply and with high quality instruments that are frequently recalibrated. These conditions cannot be duplicated in a portable tester. In particular, 120 volt line variations during testing may affect results. Therefore, minor discrepancies between factory calibration and test set readings can be safely disregarded.

The test set itself is quite accurate and can be used to calibrate additional pickup and short time delay values on the trip devices if a sufficiently stable 120 volt line is available. The voltage can be anywhere between 105 and 125 volts, but the value should not vary by more than ± 1.5% during testing.

STATIC TRIP CALIBRATION MARKS

Each static trip of the first generation or Static Trip II™ type, is individually calibrated during factory test and because the location of the calibration points varies from device to device, it is not possible to preprint the identifica-tion letters adjacent to the marks. To identify a letter or label with its calibration dot, start from the reference dot (see "Restoring Lost Calibration") and count the calibration dots around the dial in the direction (clockwise or counterclockwise) indicated by the sequence of the letters or labels. For example, the "C" Long Time Pickup dot is the third calibration dot counted clockwise from the reference dot. On Static Trip II the direction of counting is also the direction indicated by the "increase" arrow.

RESTORING LOST CALIBRATION (EXCEPT *LimiTrip*® DEVICES)

The pointer of each knob when turned counterclockwise against its stop should line up with its reference dot. (Reference dots are black on Static Trip II™ and red on first generation devices). If the pointer does not line up with its reference dot, the knob has turned on its shaft. To restore the knob to its proper location on the shaft, loosen the set screw in the knob, make sure the shaft is turned fully counterclockwise, align the pointer with the reference dot and tighten the set screw. Recheck that the pointer now aligns with the reference dot when it is rotated against its stop. On first generation devices the knob locks must be loosened in order that the shaft can be rotated.

LimiTrip® devices have no calibration marks since the settings of the device are made by switches, rather than with potentiometers.

DESCRIPTION

The test set is pictured in Figure 1 and Figure 2 show typical test set-ups. Figure 3 is the schematic diagram of the complete test set.

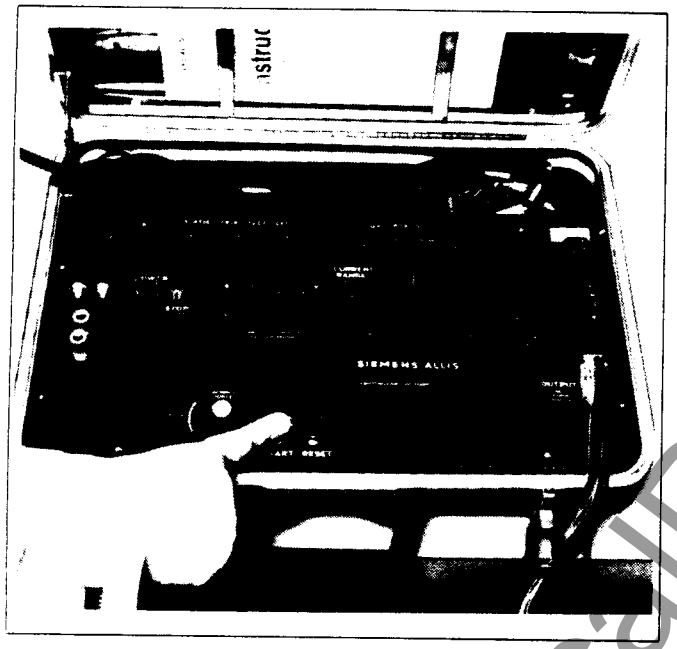


Figure 1. Portable Test Set

RATING

Input - 120 Volts, 50 or 60 Hz, 15 Amps. Maximum.
Output - 0 to 120 Volts, 15 Amps. Maximum.
Maximum continuous current on high scale 1.0 Amp.
Maximum continuous current on low scale 0.75 Amp.
DC output for actuator test - 0 to 22 volts open circuit.

CALIBRATION

Using an R.M.S. reading ammeter and sine wave current, the test set ammeter is factory calibrated on low scale at 0.50 amperes ± 1% and on high scale at 3.00 amperes ± 1%.

The electronic stop clock is factory calibrated at 300 seconds ± 5 seconds.

CONSTRUCTION DETAILS

The test set is basically a variable voltage AC supply, with built in reactors to smooth the current against the trip device non-linear impedance. The output of the AC supply is controlled by a system of relays to start and stop the current. An electronic stop-clock is used to time the duration of current flow, and an ammeter to measure its magnitude. The relays are operated by the output of the trip device under test to stop the current. A small DC voltage source is built into the tester for use in testing the magnetic tripping actuator of the circuit breakers. The output of this small supply is monitored by a built in digital voltmeter.

CONTROL PANEL ARRANGEMENT

SEE FIGURE 1A.

1. Input circuit breakers, 10 ampere thermal trip, manual reset. One circuit breaker is installed in each line of the incoming line cord. The circuit includes an air core current limiting reactor permanently included in each line to limit the available short circuit current. In addition to the current limiting reactors and circuit breaker, the test set includes static over current and ground fault interrupt circuitry.

2. On/Off Switch. This switch controls the input power to the test set control circuit. This switch must be ON for the test set to operate with either the internal phase controlled current source or with an external current source.

3. Internal/External Power Selector Switch. This switch selects the current source for the test current. In the INTERNAL position the test current is controlled by the built in phase-controlled current source. In the EXTERNAL position the test current is controlled by an external variable transformer (not supplied with the test set). The output of the EXTERNAL transformer must be connected to the two YELLOW binding posts labelled EXTERNAL POWER INPUT. The ON/OFF switch must be ON for the test set ammeter, timer and control relays to operate. The test current is then controlled by adjusting the external variable transformer; otherwise the operation of the test set is the same in

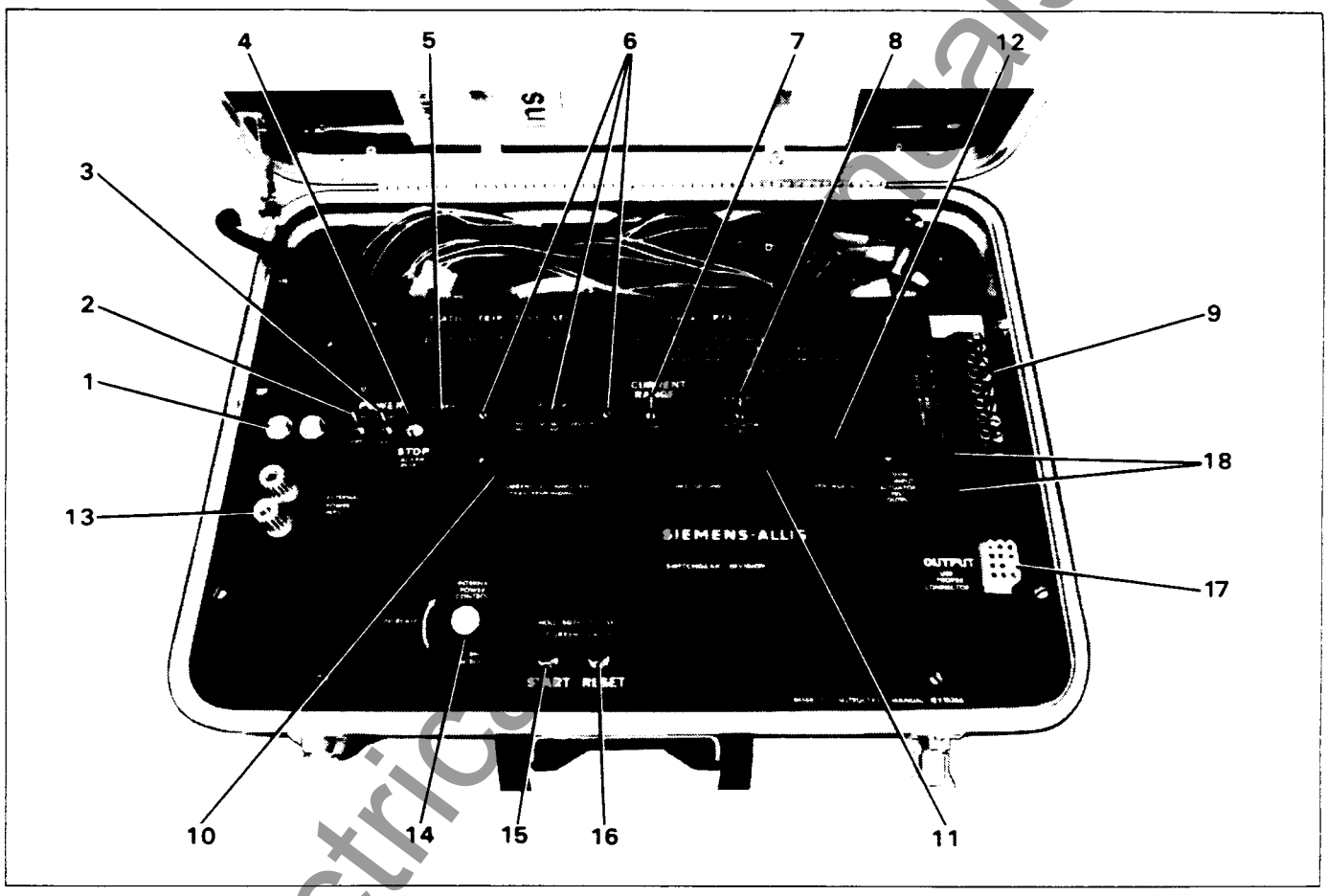


Figure 1A. Front Panel

either case. This external connection may be useful when the incoming power is of poor quality so as to affect the phase control circuitry of the test set. The EXTERNAL position is also used to check the internal ammeter calibration.

4. Stop/Alarm Reset. This is a momentary push button that is used to turn off the current source of the test set when the trip device under test has not tripped. The switch stops the operation of the internal stop-clock and drops out the power control relay. The circuit is reset by pressing the RESET pushbutton. The STOP button also resets the internal over current and ground fault circuitry. Following an over current trip, there is a delay before resetting will be successful.

5. Alarm Light. This is a light emitting diode that is turned on when either the over current or the ground fault interrupt circuit operates. This circuit is reset by pressing the STOP push button.

6. Pick-Up Lights. These light emitting diodes connect directly to the test leads that attach to the trip device under test. When the external leads are properly connected the proper lights will be turned ON to indicate that the trip device has picked up. Three lights are provided; one for LONG-TIME pick-up indicating that the long time circuit of the trip device has been released and the time delay circuit can op for SHORT-TIME pick-up indicating that time circuit of the trip device is activated, ar

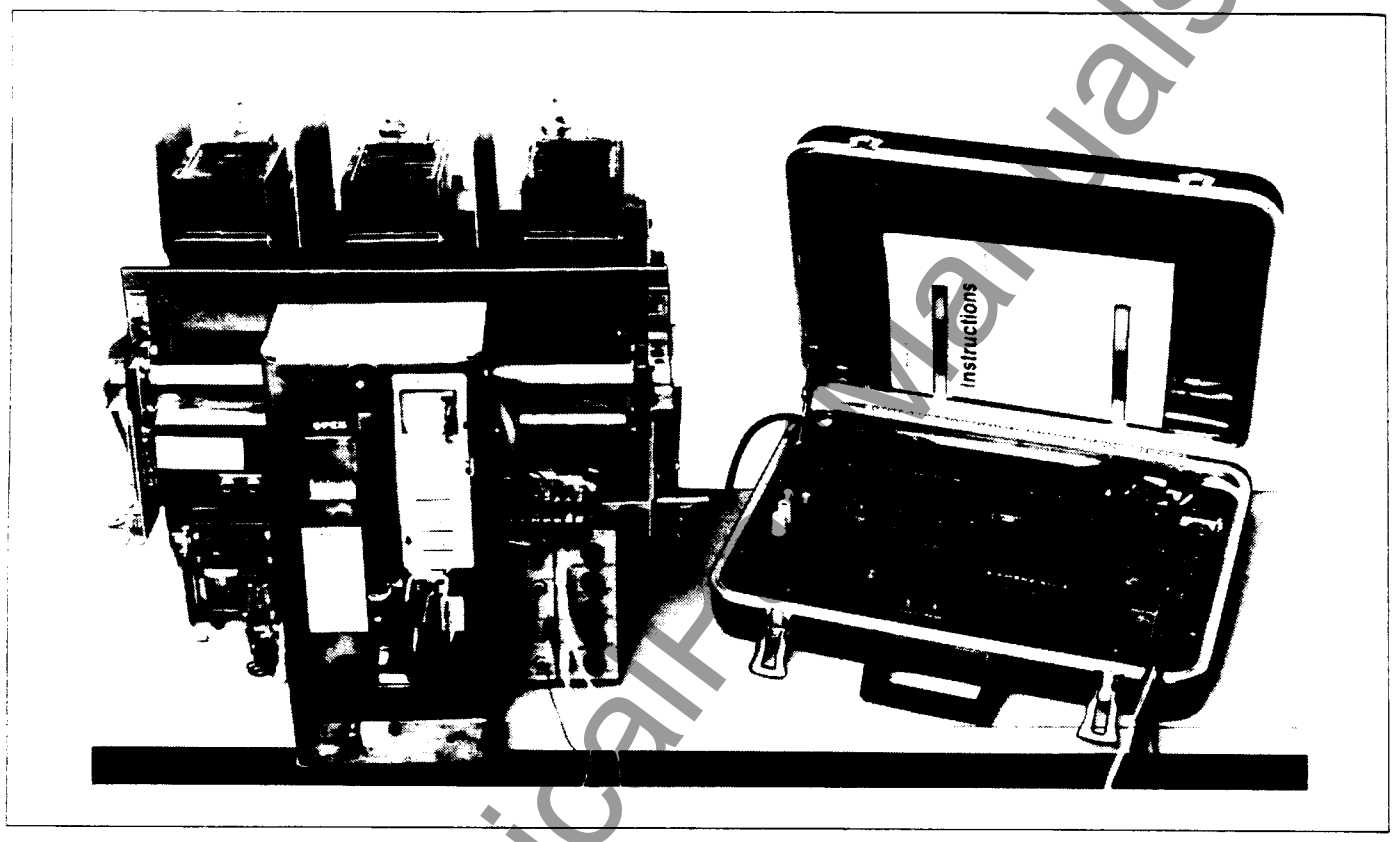


Figure 2. Testing Static Trip Device on the Breaker

GROUND pick-up which indicates that the trip device ground circuit has been activated. Not all of the lights are used in all cases. For example, if the device under test has no ground circuit, the ground light is not used.

7. Range Switch. When in the LOW position, this switch inserts an additional current limiting air core reactor in series with the device under test. It also sets the internal ammeter to its LOW range. In its HIGH position the additional reactor is removed from the circuit and the internal ammeter is set to its HIGH range.

8. Static Trip Test/Actuator Test Selector Switch. When this switch is in the STATIC TRIP TEST position, the test current is supplied to the appropriate terminals of the device under test. In this position the internal VOLTMETER is isolated from the rest of the internal circuitry and the voltage applied to the DVM input terminals will be indicated by the voltmeter. When this switch is in the ACTUATOR TEST position the device current control circuit is connected to the primary winding of a small transformer/rectifier combination. The output of this small DC power supply is connected to the DVM INPUT-ACTUATOR TEST OUTPUT terminals, and the voltmeter indicates the voltage supplied by these terminals.

9. Seven Point Terminal Block. This terminal block is mounted on the test set for convenience in bench testing STATIC TRIP II trip devices. The device fanning strip connects to the terminal block and the test set cord plugs into the appropriately labeled jacks on the terminal block.

10. Ammeter. This digital ammeter is constructed to respond to the peak value of the AC current with the scale reading in amperes RMS. The ammeter is calibrated with sinusoidal waveshape current. For other than sine waves, the ammeter indication is the RMS value for a sine wave with the same peak magnitude. In

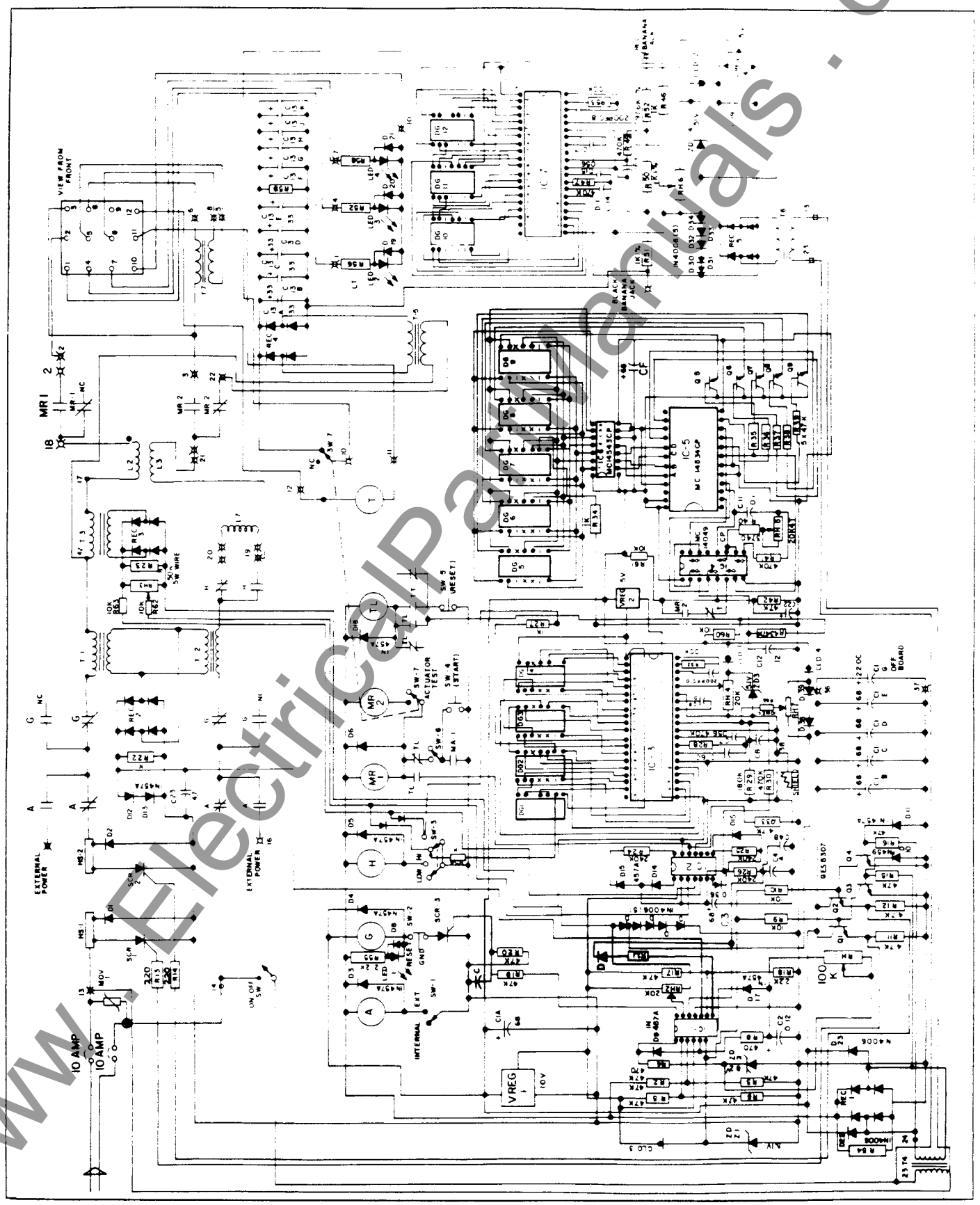


Figure 3. Test Set Schematic Diagram

this way the ammeter approximates the response of the Static Trip devices.

11. Electronic Stop-Clock. The stop clock indicates the time duration that current was supplied to the device under test. The time indicated is from initiation of current until the trip device operates a relay internal to the test set and includes the pick-up time of the internal relay which is about 5 to 10 milliseconds. For trip device testing this slight error can be safely ignored. Note that it is always slightly longer than the actual operating time of the trip device.

12. Voltmeter. This is a digital meter circuit connected to the DVM INPUT/ACTUATOR TEST TERMINALS. The meter indicates 0 to 99 volts DC. (See Item 8 for operation of the selector switch). The voltmeter is not usable externally when the internal power supply is connected to its terminals.

13. External Power Input Terminals. These terminals are used to inject current from an external variable transformer when this method of testing is used.

14. Internal Power Control. This is a five turn potentiometer that controls the internal phase controlled current source. This control is also used to adjust the voltage when the test set is used for testing the magnetic actuator of the circuit breaker.

15. Start Switch. This switch closes the relays in the test set to start current to the trip device under test. The relays latch themselves in and current is stopped when the trip device under test trips or when the STOP push button is operated.

16. Reset Switch. This switch resets the relay circuit and the stop clock. It also changes the time constant for the peak responding ammeter allowing the ammeter to return to zero in a shorter time.

17. Output Connector. This is a 12 pin connector that accepts the cord sets: two cord sets are provided with the test set. One cord set (18-732-184-501) provides the means of connecting to STATIC TRIP II™ type trip devices with the same color coded plugs as used in the previous (PTS-2) test set. With the addition of alligator clips this cord set is also used to test the first generation trip devices. A second cord set (18-732-184-502) is provided to connect to *LimiTrip*® style trip devices. This cord set provides the termination to connect directly to the circuit board where required and has coordinated color coding for the other connections.

18. DVM Actuator Test Output Terminals. These terminals, mentioned earlier, are the input of the digital voltmeter and when connected to the internal power supply by the STATIC TRIP TEST/ACTUATOR TEST switch, become the output to test the magnetic actuator of the circuit breaker. When used as the actuator source, the positive output is the red terminal and the negative is the black terminal. When used as the voltmeter input, the meter will read the same for either polarity.

TESTING STATIC TRIP II™ DEVICES

Trip devices can be tested when mounted on a circuit breaker in the disconnect position in its cubicle, with the device on a circuit breaker removed from its cubicle or with the device separate from the circuit breaker.

The following instructions cover testing of all the elements for the most complicated type of trip device. Other types do not contain all these elements. See the listing and description of available types in Table 1.

The selector switch must be in the "STATIC TRIP TEST" position for all static trip device tests. The ammeter range switch should be in the "LOW" position for all tests below 1.5 amperes, and in the "HIGH" position for all tests above 1.5 amperes. Current must be re-adjusted when changing ranges since the switch also inserts an additional current limiting reactor when in the "LOW" range position.

TESTING STATIC TRIP DEVICE ON CIRCUIT BREAKER

CAUTION The static trip circuit is grounded to the circuit breaker frame through a surge capacitor. Therefore, to insure against electrical shock be sure to ground the frame when testing with the circuit breaker out of the cubicle. NOTE: The test set isolates the power source from its output leads by an open relay contact in each line except when a test is being run. In the case of excessive ground current, the test set will trip out and light the ALARM light.

CONNECTIONS — USE CORD SET 18-732-184-501

Figure 4 shows how to connect the test set leads to the trip device. The red and black banana plugs may be left disconnected for pick-up tests to avoid trigger instability. However, to operate the stop clock they must be connected to terminals 8 and 7 as shown. In some cases, it may be desirable to disconnect these leads to prevent false indications when testing the circuit breaker tripping action since the relay circuit may operate faster than the circuit breaker.

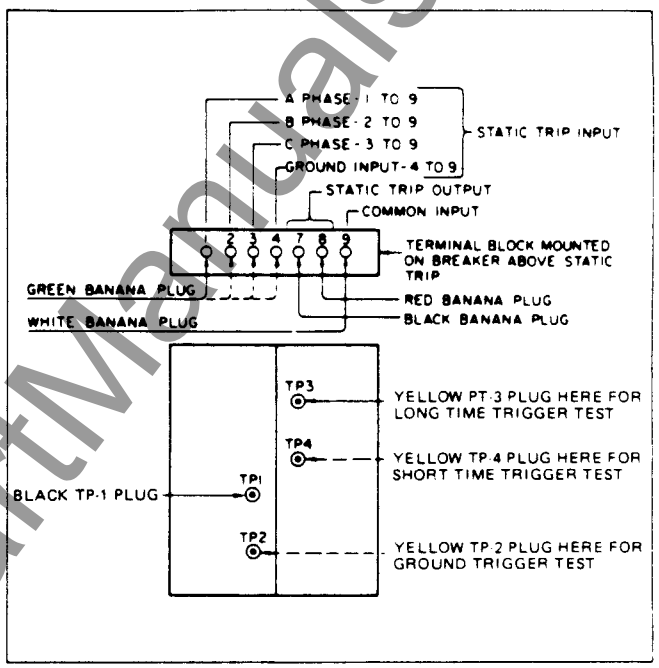


Figure 4. Test Connections for Static Trip II

It is not necessary to operate the circuit breaker for any static trip device tests. If it is desired to test the operation of the circuit breaker, the above tests can be run with the circuit breaker closed and allowing the trip device to open the breaker. It may be desirable to disconnect either the red or black lead from the trip device to assure that the relay in the test set does not interrupt the current before the circuit breaker can open thus confusing the test results when operating the circuit breaker.

GENERAL NOTES

1. The "Tripping XFMR Rating" values represent the primary value to the current transformer ratio in amperes. The secondary value is one ampere.

2. The pick-up settings of the long time element are continuously adjustable and are calibrated at points "A" through "G" as shown in the rating table.

3. The pick-up settings of the instantaneous and short time delay elements are continuously adjustable and

Table 1

Static Trip II™ Rating Table — Amperes

Breaker Type and Frame Size	Sensor Rating (Primary Amps)	Long Time Element Calibrated Pick-Up Settings							Max. Cont. Rating	Ground Element Calibrated Pick-up Settings			
		A	B	C	D	E	F	G		15%	25%	50%	100%
LA-600A	80	40	50	60	70	80	90	100	100	0	0	40	80
	200	100	125	150	175	200	225	250	250	0	50	100	200
	400	200	250	300	350	400	450	500	500	60	100	200	400
	600	300	325	450	525	600	675	250	750	90	150	300	600
LA-800	80	40	50	60	70	80	90	100	100	0	0	40	80
RL-800	200	100	125	150	175	200	225	250	250	0	50	100	200
RLX-800	400	200	250	300	350	400	450	500	500	60	100	200	400
RLH-800	600	300	325	450	525	600	675	250	750	90	150	300	600
RLF-800	800	400	500	600	700	800	900*	1000*	800	120	200	400	800
LA-1600A	200	100	125	150	175	200	225	250	250	0	50	100	200
RL-1600	400	200	250	300	350	400	450	500	500	60	100	200	400
RLX-1600	800	400	500	600	700	800	900	1000	1000	120	200	400	800
RLF-1600	1600	800	1000	1200	1400	1600	1800*	2000*	1600	240	400	800	1600
2000A Frame	200	100	125	150	175	200	225	250	250	0	50	100	200
RL-2000	400	200	250	300	350	400	450	500	500	60	100	200	400
RLF-2000	800	400	500	600	700	800	900	1000	1000	120	200	400	800
	1600	800	1000	1200	1400	1600	1800	2000	2000	240	400	800	1600
	2000	1000	1250	1500	1750	2000	2250*	2500*	2000	300	500	1000	2000
LA-3200A	1600	800	1000	1200	1400	1600	1800	2000	2000	240	400	800	1600
RL-3200	2000	1000	1250	1500	1750	2000	2250	2500	2500	300	500	1000	2000
RLF-3200	2400	1200	1500	1800	2100	2400	2700	3000	3000	360	600	1200	2400
	3200	1600	2000	2400	2800	3200	3600*	4000*	3200	480	800	1600	3200
LA-4000A	3200	1600	2000	2400	2800	3200	3600	4000	4000	480	800	1600	3200
RL-4000	4000	2000	2500	3000	3500	4000	4500*	5000*	4000	600	1000	2000	4000
Secondary Pick-up Current Amperes		0.50	0.625	0.75	0.875	1.00	1.125	1.25	0	0.15	0.25	0.50	1.00

are calibrated at 3, 5, 8 and 12 multiples of the long time pickup setting.

4. The pick-up settings of the ground elements are continuously adjustable and are calibrated in percent of the tripping transformer rating as shown in the rating table.

5. The long time element has 6 bands which are field selectable. The time delay at 6 multiples of pick-up is as follows:

   Band 1 — 1.12 seconds
   Band 2 — 2.25 seconds
   Band 3 — 4.5 seconds
   Band 4 — 9 seconds
   Band 5 — 18 seconds
   Band 6 — 36 seconds

6. The short time element and ground element has 3 bands which are calibrated at minimum, intermediate and maximum, but are continuously adjustable.

7. The maximum interrupting time is the maximum length of time that fault current flows, including arcing time.

8. The lower limit of ground fault recognition is 25 amperes for LA-600, LA-800 and RLA-800 breakers and 40 amperes for an LA-1600 and RL-1600 breaker.

LONG TIME PICK-UP TEST

1. Leave the red and black banana plugs disconnected. To test phase 1 connect the green plug to terminal 1 and the white plug to terminal 9. Connect the black pin plug to TP-1 and the yellow pin plug (TP-3) to terminal TP-3 of the trip device.

2. Set "LONG TIME PICK-UP" on dot "A". Place the selector switch to "STATIC TRIP TEST" position. Set the RANGE switch on "LOW". Set the POWER selector switch to "INTERNAL".

3. Turn the other power switch to "ON". The red digits of the meters should come ON. (The alarm light may also come ON. If so, press the "STOP" - alarm reset button.) Press and hold both the "START" and "RESET" push-buttons.

4. Slowly increase the current by rotating the "INTERNAL POWER CONTROL" in a clockwise direction. This is a five turn control arranged for 50 Hz. operation so a noticeable deadband is evident at zero output and 60 Hz. Increase the current until the "LONG TIME" pick-up light comes ON. This should be at 0.5 ampere ± 10%. The sampling rate of the ammeter is such that the control must be moved very slowly to accurately determine the pick-up current of the trip device.

5. Decreasing the current slightly should cause the light to go out.

6. Repeat the tests for the other phases and settings and compare with the bottom line of Table 1.

NOTE The illumination of the "PICK-UP" light indicates that the timed delay has started. If the current drops slightly, the light will go out, the timing circuit resets instantly and timing will start over upon the next appearance of triggering.

The static trip device level sensing circuits have a very slight amount of hysteresis. That is, the pick-up and drop-out points of the circuit are very nearly but not exactly the same value. If the input current is modulated in amplitude the pick-up light will flash ON and OFF, and the timing circuit can never time out.

SHORT TIME PICK-UP TEST

1. Connect the yellow (TP-4) pin plug to the TP-4 terminal of the trip device, the black pin plug to TP-1, the green plug to terminal 1, and the white plug to terminal 9.

2. Set "LONG TIME PICK-UP" on "A", "Instantaneous fully counterclockwise, "Long Time Band" on 6 and "SHORT TIME PICK-UP" on 3X.

3. Press and hold the START and RESET buttons.

4. Slowly increase the current until the SHORT TIME pick-up light comes ON. This should occur at 1.5 amperes ±10%.

5. Repeat for "SHORT TIME PICK-UP" settings of 5X, 8X, and 12X. The RANGE switch must be set on "HIGH" for these tests. To avoid overheating, do not maintain the higher currents any longer than necessary.

GROUND PICK-UP TEST

1. Connect the green plug to terminal 4 and the white plug to terminal 9, connect the black pin plug to TP-1 and the yellow (TP-2) pin plug to TP-2 on the trip device.

2. Set "GROUND PICK-UP" on the 15% dot.

3. Press and hold the START and RESET buttons and raise the current gradually until the Ground pick-up light turns ON. This should occur at .15 ampere ±15%, repeat for the 25% and other settings. See the bottom line of Table 1 for the settings in amperes.

NOTE If the output of the trip device is connected to the tripping actuator of the circuit breaker, the additional current drawn during tripping may cause confusion. Either disconnect the actuator or set the ground time delay to its MAXIMUM to allow time to read the meter before actual tripping occurs.

INSTANTANEOUS PICK-UP TEST

There is no trigger output for "Instantaneous Trip", but tripping of the circuit breaker and/or operation of the test set relay will indicate instantaneous trip operation. To operate the test set relay, the red and black banana plugs must be connected to the trip device.

1. Connect the green banana plug to terminal 1 and the white one to terminal 9; the pick-up pin plugs are not needed.
2. Set "LONG TIME PICK-UP" on "A", "LONG TIME BAND" on 6, "SHORT TIME PICK-UP" fully counterclockwise, and "INSTANTANEOUS PICK-UP" on 3X.
3. Press and hold the START and RESET buttons.
4. Raise the current slowly until the relay in the test set operates. This can be determined audibly and should occur at 1.5 amperes ±10%.
5. Repeat for the other settings as desired. Avoid maintaining high currents longer than necessary to obtain the readings. On some static trips the relay can be heard to "buzz" when the current is held exactly at the "Pick-Up" value. This is due to the output transistor turning "on and off" as the current varies. Operation of the relay should be positive if the current is increased by 2 or 3% above the pick-up value.

LONG TIME DELAY TEST

If the time delay is tested at an input current 6 times the pick-up setting, the nominal time delays will be as shown in the table on the trip device. Maximum and minimum limits can be determined by reference to the time current characteristic curves, Figure 6.

1. Connect the green plug to terminal 1 and the white plug to terminal 9, the black banana plug to 7 and the red to 8. Connect the black pin plug to TP-1 and the yellow (TP-3) to TP-3.
2. Set "Long Time Pick-Up" on "A", Long Time Band on 1, Short Time and Instantaneous Pick-ups fully counterclockwise and Short Time Band on "MAXIMUM".
3. Press and hold the START and RESET buttons and adjust the current to 3 amperes (6X "A" pick-up).
4. In turn, press the STOP and the RESET buttons. Allow time for the ammeter reading to reach zero.
5. Press the START button. (It is not necessary to hold this button. Power will be maintained until the Static Trip times out.)
6. When the trip device operates, check the reading of the stop clock against the curves in Figure 5. The reading should be approximately the same as shown on the faceplate of the device, but must be within the limits shown on the curves. If not, recheck all settings and repeat the test.
7. Repeat steps 5 and 6 one or more times to verify the test results.
8. Repeat for the other phases (by changing green plug to terminal 2 for phase 2, and terminal 3 for phase 3) time delay bands and other values of current, as desired. All test points should fall within the bands of Figure 5. Each time band should have precisely twice the delay of the next lower band when all other conditions are the same.

NOTE When timing at values of current only slightly above pick-up, line voltage fluctuations may cause detriggering and result in erroneous operating times. Therefore, it is advisable to watch the long time pick-up light to note whether trigger voltage is maintained. In general, it is impractical to test time delay at less than 10% above pick-up.

SHORT TIME DELAY TEST

1. Connect the green plug to terminal 1, the white plug to terminal 9, the red plug to 8 and the black to 7. The pin plugs are not needed.
2. Set Long Time Pick-Up on "A", Long Time Band on 6, Instantaneous Pick-Up fully counterclockwise, Short Time Pick-Up on 3X (1.5 amperes) and Short Time Band on "MAXIMUM".

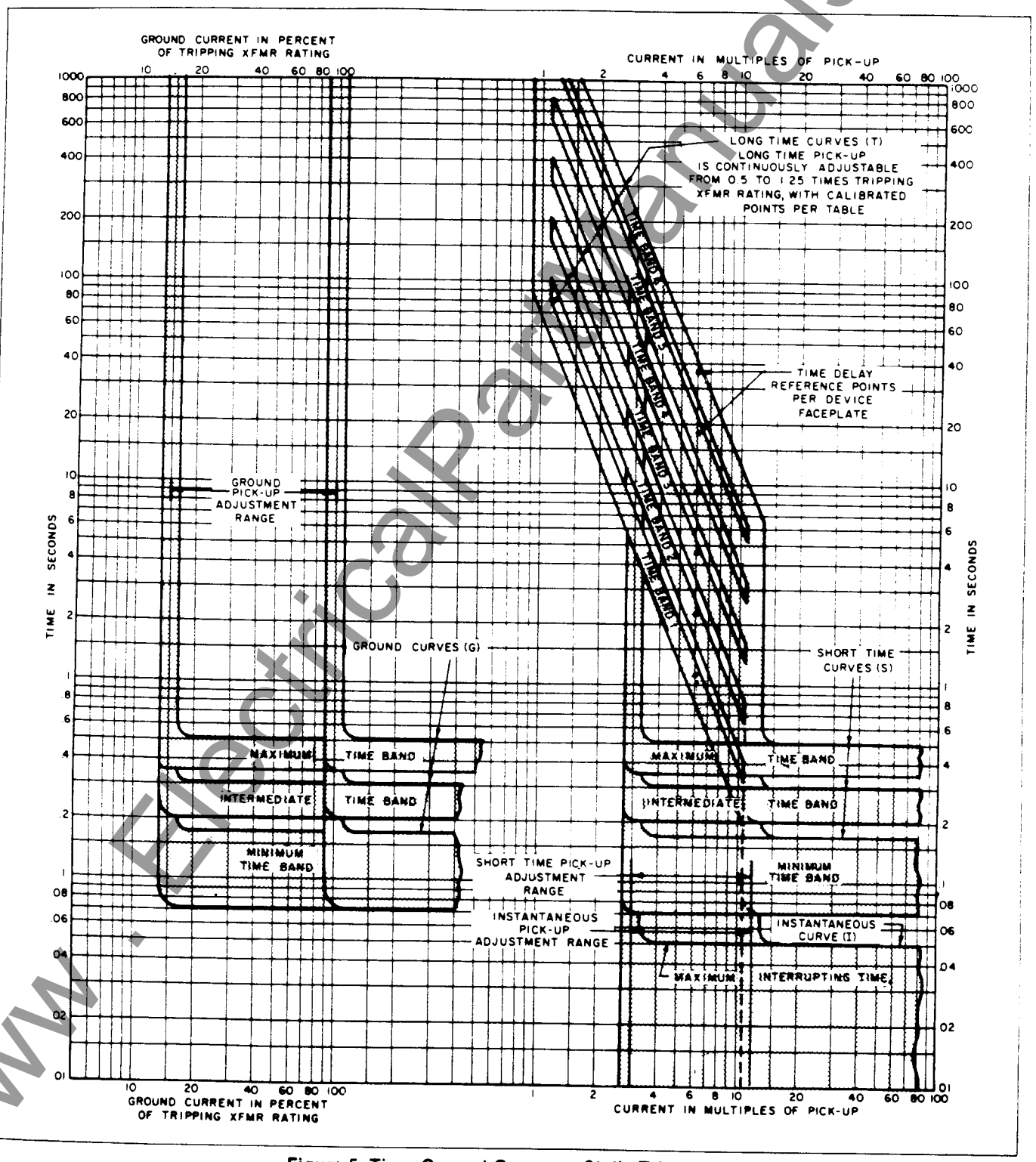


Figure 5. Time-Current Curves — Static Trip II™

3. Press and hold the START and RESET buttons and adjust the current to 2 amperes or more, then release both buttons. In turn, press the STOP and the RESET buttons.

4. Close the circuit breaker, if desired.

5. Press the START button, the delay should be .35 to .50 seconds. See Figure 5.

6. Repeat for "Short Time Band" settings of "Intermediate" and "Minimum", compare to Figure 5. The other phase circuits and different values of current can be tested if desired. Make current settings as quickly as possible to avoid overheating.

GROUND TIME DELAY TEST

1. Connect the green plug to terminal 4, the white plug to terminal 9, the red to terminal 8 and the black to terminal 7. The pin plugs are not needed.

2. Set "Ground Pick-Up" on 15% (0.15 ampere) and "Ground Time Band" on "Maximum".

3. Press and hold the START and RESET buttons and adjust the current to 0.5 ampere or more. (Erroneous time delay readings and failure to trip the circuit breaker or target may occur at lower values of current. The waveshape of current from the test set may not provide enough power to charge the filter capacitor in the trip device before tripping occurs. By running the test at a higher current this effect is minimized.) In turn press the STOP and the RESET button.

4. Close the circuit breaker, if desired.

5. Press the START button. The breaker should trip in 0.4 and 0.5 seconds. See Figure 6. If the device has a target, its red button should pop out.

6. Repeat for other Ground Time Band settings and for other pick-up and current settings, if desired. Make current adjustments above 1 ampere quickly to avoid overheating.

BENCH TESTING STATIC TRIP II DEVICES

CONNECTIONS

With the static trip device away from the circuit breaker it is necessary to make connections directly to the fanning strip of the trip device. A terminal block is provided on the test set to facilitate this connection. Simply connect the fanning strip to the terminal block and tighten all screws. The end of the fanning strip next to the cord must connect to terminal 1, a spacer under one mounting screw of the test set faceplate provides interference if the connections are made incorrectly.

The plugs from the test set can now be connected to the brass jacks on the terminal block exactly as was done when testing the trip device on a circuit breaker. The terminal block is not connected internally. It serves only as a means of connection for the banana plugs.

TEST PROCEDURE

The testing procedures are exactly the same as given in "TESTING THE STATIC TRIP ON THE CIRCUIT BREAKER" except, of course, any reference to the circuit breaker is ignored.

CONNECTIONS — USE CORD SET 18-732-184-501

The connections to the first generation trip devices terminate on an 8 or 9 point terminal block mounted on the side of the device. See Figure 6. To allow using the test set plugs to connect to this terminal block, alligator clips are furnished with the test set to clip onto the terminal block screws. Four of the clips accept the four banana plugs and three accept the pin plugs for the pick-up lights. The bottom line of Table 3 gives the calibrated settings for secondary amperes for the first generation trip devices and on the same page, available models are listed and described. Figures 8A, 8B, 9, 10 and 11 are the time current characteristic curves for the various models. Connections from the test set are different for different models and are shown on Figures 7A through 7D.

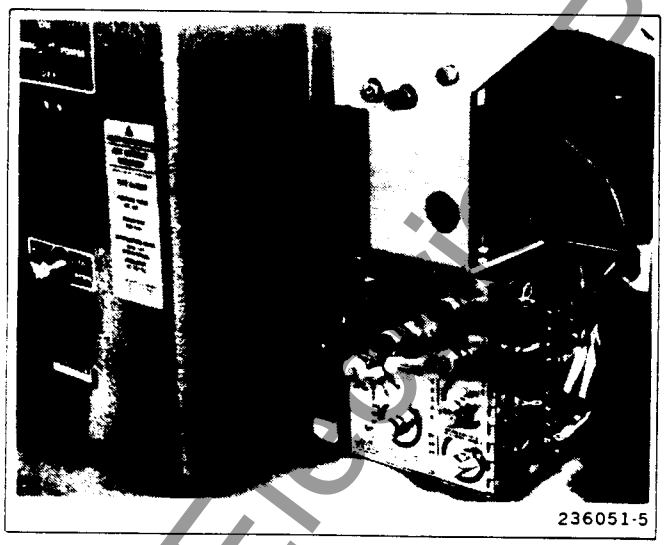


Figure 6. First Generation Static Trip-Terminal Block Is Located on Right Side

It will be helpful to note certain differences between these static trips and STATIC TRIP II™ devices: (1) There are three Long Time Pick-Up knobs, one for each phase, instead of one common knob as on STATIC TRIP II™. (2) There are only three Long Time Bands instead of 6 and they are marked "Maximum", "Intermediate", and "Minimum". On some models, no long time band adjustment is available and the device is marked to show which time band it contains. (3) The Instantaneous Pick-Up is labeled "Instantaneous Trip Setting". (4) The Short Time Pick-Up is labeled "Transfer to Short Time". (5) There are no test jacks provided on the front of the device. Connections for trigger indication are made to points on the terminal block as shown in Figure 7A to 7D. (6) On STATIC TRIP II™ the knob reference dots (knob counterclockwise against stop) are black and the calibration dots are red. On first generation trip devices the reference dots are red and the calibration dots are black on some models and white on others.

TEST PROCEDURES

Keeping the above differences in mind and making careful reference to the appropriate connection diagram on Figure 7A to 7D, the test instructions in "Testing Static Trip on the Breaker" (omitting the connection instructions in each case), can be used for testing first generation trip devices also. Compare the test results with Table 3 and Figures 8A, 8B, 10 and 11 as applicable.

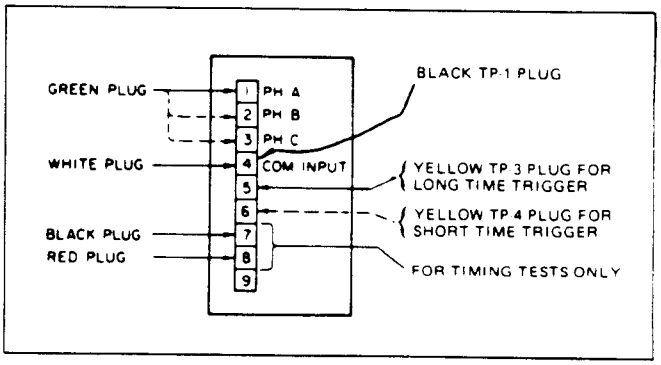


Figure 7A. Test Connections Models A, A1, A2, A2, C3, D, D1, D2

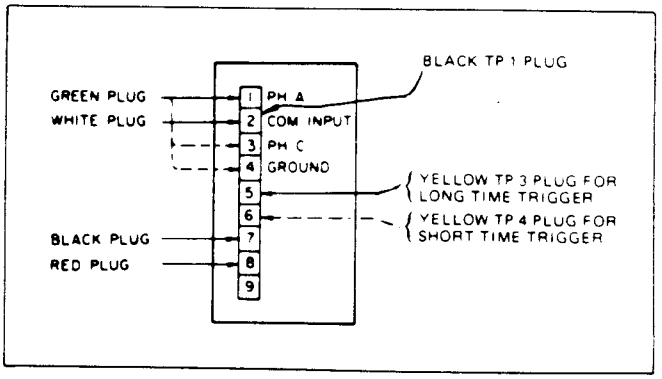


Figure 7B. Test Connections Models AG, AG1, AG2, DG, DG1

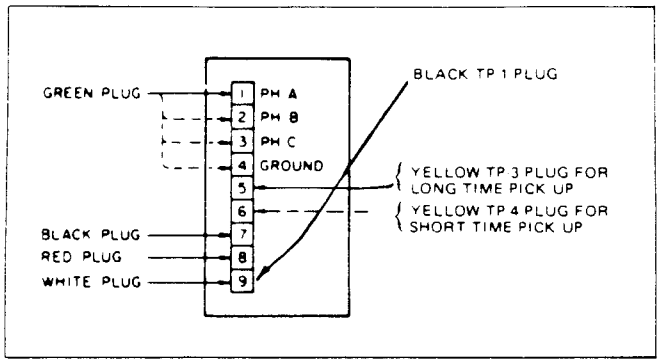


Figure 7C. Test Connections Models 4WAG and 4WDG

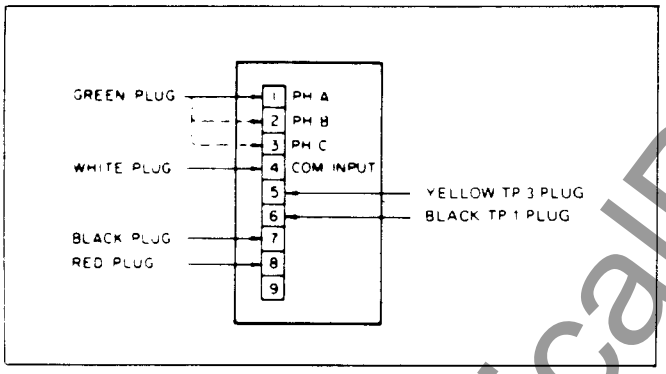


Figure 7D. Test Connections Models C, C1 and C2

BENCH TESTING

The alligator clips described previously are also used to make connections to the first generation trip devices for bench testing, so connections and procedures are the same as when testing with the device on the circuit breaker.

1. Types

   A - Dual Static (long time and instantaneous elements).

   D - Selective Static (long time and short time elements).

   AG - Dual Static with ground fault element for 3-wire circuits.

   DG - Selective Static with ground fault element for 3-wire circuits.

   4WAG - Dual Static with ground fault element for 4-wire or 3-wire circuits.

   4WDG - Selective Static with ground fault element for 4-wire or 3-wire circuits.

2. The pick-up settings of the instantaneous and short time delay elements are calibrated at 3, 5, 8 and 12 multiples of the long time delay pick-up setting.

3. The maximum interrupting time is the maximum length of time that fault current flows, including arcing time.

4. Instantaneous maximum interrupting time may be greater when breakers are closed in on a fault depending on actual fault conditions. The maximum potential increase for a 3-phase fault is 0.01 seconds and for a single-phase ground fault is 0.02 seconds.

5. The lower limit of ground fault recognition is 25 amperes for an LA-600 breaker. For an LA-1600 breaker the lower limit is 40 amperes. Application of Models 4WAG and 4WDG is not recommended for LA-600 breakers having a minimum continuous current setting of less than 75 amperes or an LA-1600 breaker with a minimum continuous current setting of less than 200 amperes.

DUAL DEVICE

MODEL A — a general purpose device normally used for phase overcurrent protection. The pick-up range is selected from the trip rating table and is continuously adjustable from "A" through "E" in the field. The instantaneous element is continuously field adjustable from 3 to 12 multiples of the long time delay pick-up settings selected. The time delay band is selected and set at the factory — it is not field adjustable. Available time delays are minimum, intermediate and maximum.

MODEL AG (optional) — provides phase overcurrent protection plus sensitive ground fault overcurrent protection for systems with phase-to-phase loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 20% through 80% of the minimum phase pick-up setting shown in column "A".

MODEL 4WAG (optional) — provides phase overcurrent protection plus sensitive ground fault overcurrent protec-

Table 2

Trip Rating Table — First Generation Static Trips

Breaker Type	Models A3, AG2, 4WAG, D2, DG1, 4WDG — Long Time Delay Elements Available Pick-Up Settings (Amperes)					Tripping Transformer Group No.	Models AG2 and DG1 — Long Time Delay Element Available Ground Fault Settings (Amperes) — Percent of "A" Pick-Up				Models 4WAG and 4WDG — Inst. or Short Time Delay Available Ground Fault Settings (Amperes) — Percent of "A" Pick-Up			
	A	B	C	D	E		20%	40%	60%	80%	20%	40%	60%	80%
LA-600	40	50	60	70	80	I	---	---	---	---	---	---	---	---
LA-600	75	95	110	130	150	II	---	---	---	---	---	30	45	60
LA-600 LA-1600	125	155	175	220	250	III	---	---	---	---	25	50	75	100
LA-600 LA-1600	200	250	300	350	400	IV	40	80	120	160	40	80	120	160
LA-600 LA-1600	300	375	450	525	600	V	60	120	180	240	60	120	180	240
LA-600 LA-1600	400	500	600	700	800	V-x	80	160	240	320	80	160	240	320
LA-1600	500	625	750	875	1000	VI	100	200	300	400	100	200	300	400
LA-1600	800	1000	1200	1400	1600	VII	160	320	480	640	160	320	480	640
LA-1600	1000	1250	1500	1750	2000	VII-x	200	400	600	800	200	400	600	800
LA-3000	1200	1500	1800	2100	2400	VIII	240	480	720	960	240	480	720	960
LA-3000 LA-4000	2000	2500	3000			IX	400	800	1200	1600	400	800	1200	1600
LA-3000	2000	2500	3000	3500*	4000*	IX-x	400	800	1200	1600	400	800	1200	1600
LA-4000	2000	2500	3000	3500	4000	X	400	800	1200	1600	400	800	1200	1600
Secondary Pick-Up Current-Amperes	0.50	0.625	0.75	0.875	1.00	----	0.10	0.20	0.30	0.40	0.10	0.20	0.30	0.40

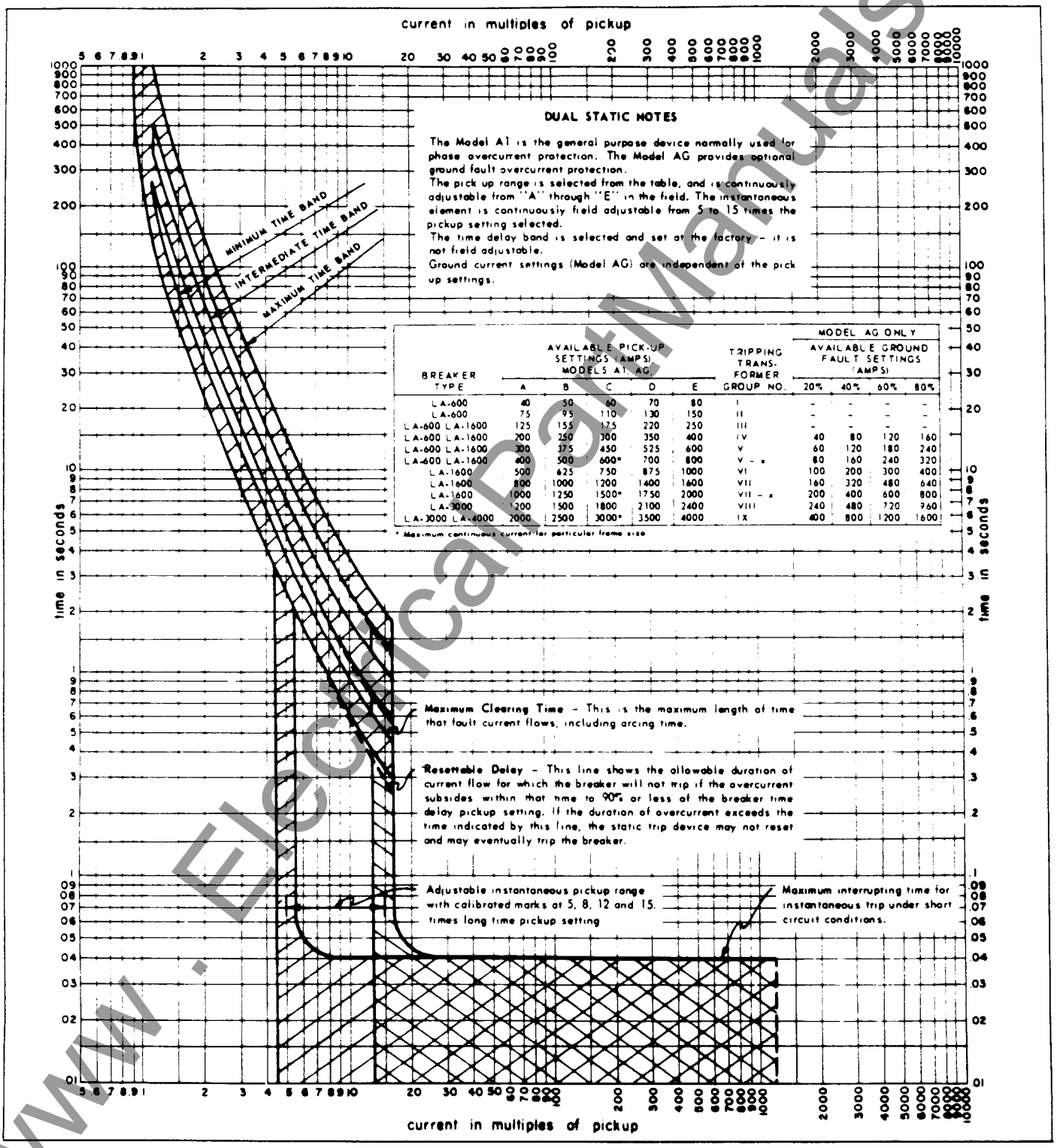
*Maximum continuous current for LA-600 is 600A, LA-1600 is 1600A, LA-3000 is 3000A, and LA-4000 is 4000A.

tion for 3-wire and 4-wire circuits for systems with phase-to-neutral loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field fom 20% through 80% of the minimum phase pick-up setting in column "A".

MODEL D (optional) — an overcurrent trip device which provides time delay tripping only. It allows field adjustment of long time delay and pick-up and short time delay and pick-up. The continuous adjustment feature allows a setting selection anywhere within calibrated points. The user can adjust the current at which the device transfers from long time to short time delay between these limits. Any one of the three short time delay curves can be chosen to be used with any of the three long time delay curves.

MODEL DG (optional) — provides phase overcurrent protection plug sensitive ground fault overcurrent protection for systems with phase-to-phase loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 20% through 80% of the minimum phase pick-up setting shown in column "A".

MODEL 4WDG (optional) — provides phase overcurrent protection plus sensitive ground fault overcurrent protection for 3-wire and 4-wire circuits for systems with phase-to-neutral loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 20% through 80% of the minimum phase pick-up setting in column "A".



BREAKER TYPE	AVAILABLE PICK-UP SETTINGS (AMPS) MODELS A1, AG					TRIPPING TRANSFORMER GROUP NO.	MODEL AG ONLY AVAILABLE GROUND FAULT SETTINGS (AMPS)			
	A	B	C	D	E		20%	40%	60%	80%
LA-600	40	50	60	70	80	I	–	–	–	–
LA-600	75	95	110	130	150	II	–	–	–	–
LA-600 LA-1600	125	155	175	220	250	III	–	–	–	–
LA-600 LA-1600	200	250	300	350	400	IV	40	80	120	160
LA-600 LA-1600	300	375	450	525	600	V	60	120	180	240
LA-600 LA-1600	400	500	600*	700	800	V – x	80	160	240	320
LA-1600	500	625	750	875	1000	VI	100	200	300	400
LA-1600	800	1000	1200	1400	1600	VII	160	320	480	640
LA-1600	1000	1250	1500*	1750	2000	VII – x	200	400	600	800
LA-3000	1200	1500	1800	2100	2400	VIII	240	480	720	960
LA-3000 LA-4000	2000	2500	3000*	3500	4000	IX	400	800	1200	1600

* Maximum continuous current for particular frame size

Figure 8A. Time Current Curves — Models A, A1, A2, AG, AG1

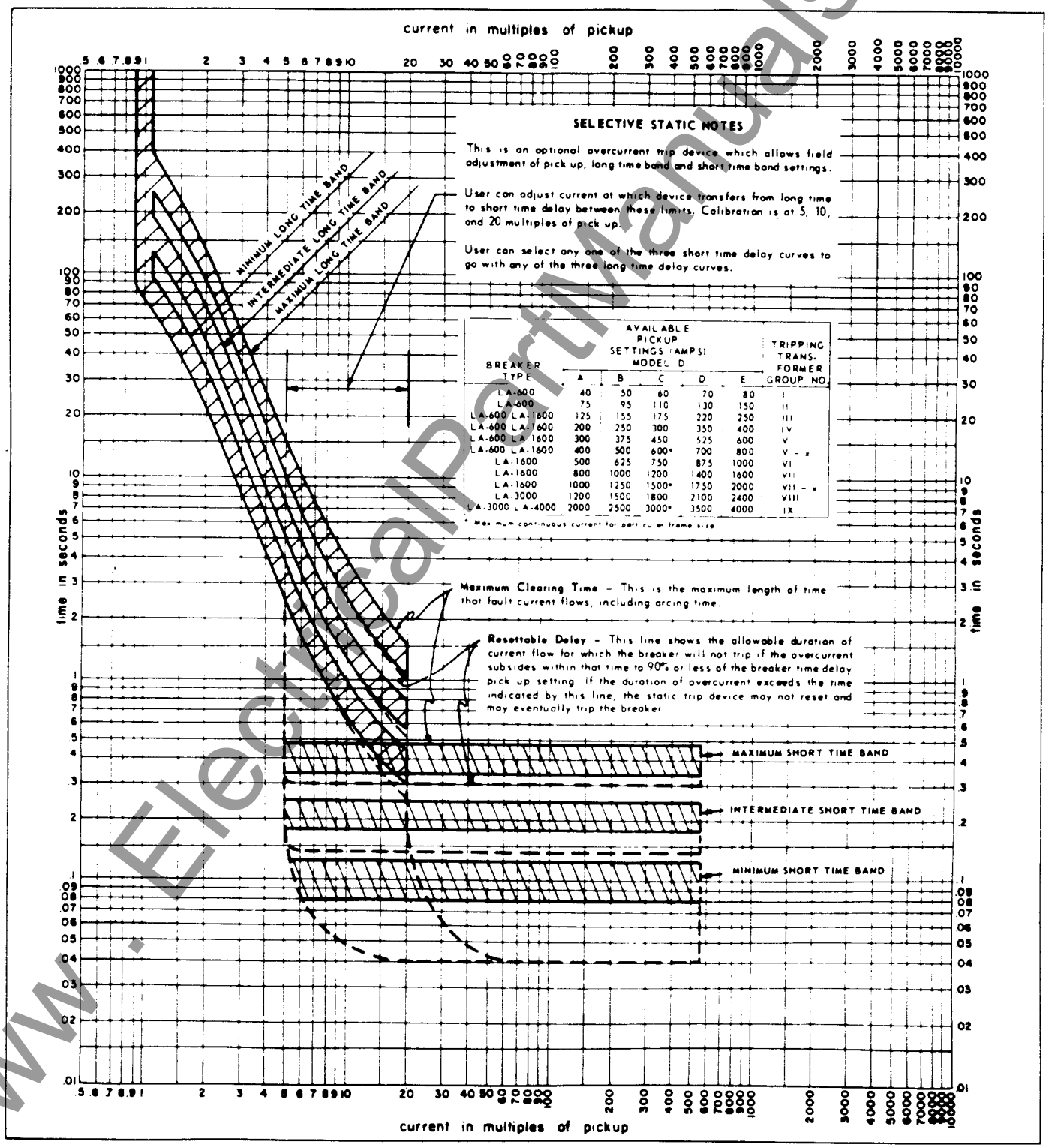


Figure 8B. Time Current Curves — Models D, D1

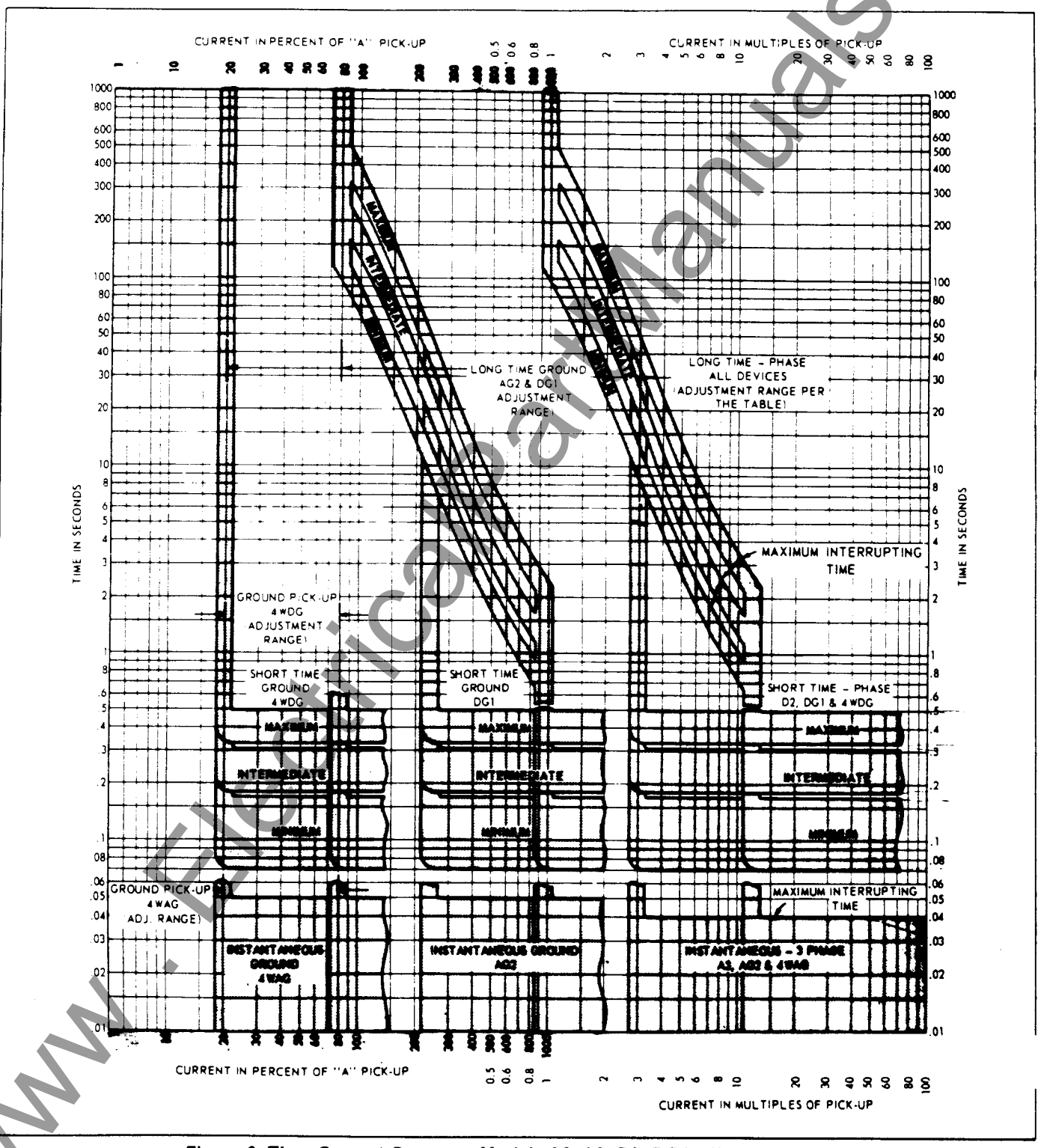


Figure 9. Time Current Curves — Models A3, A2, D2, DG1, 4WAG, 4WDG

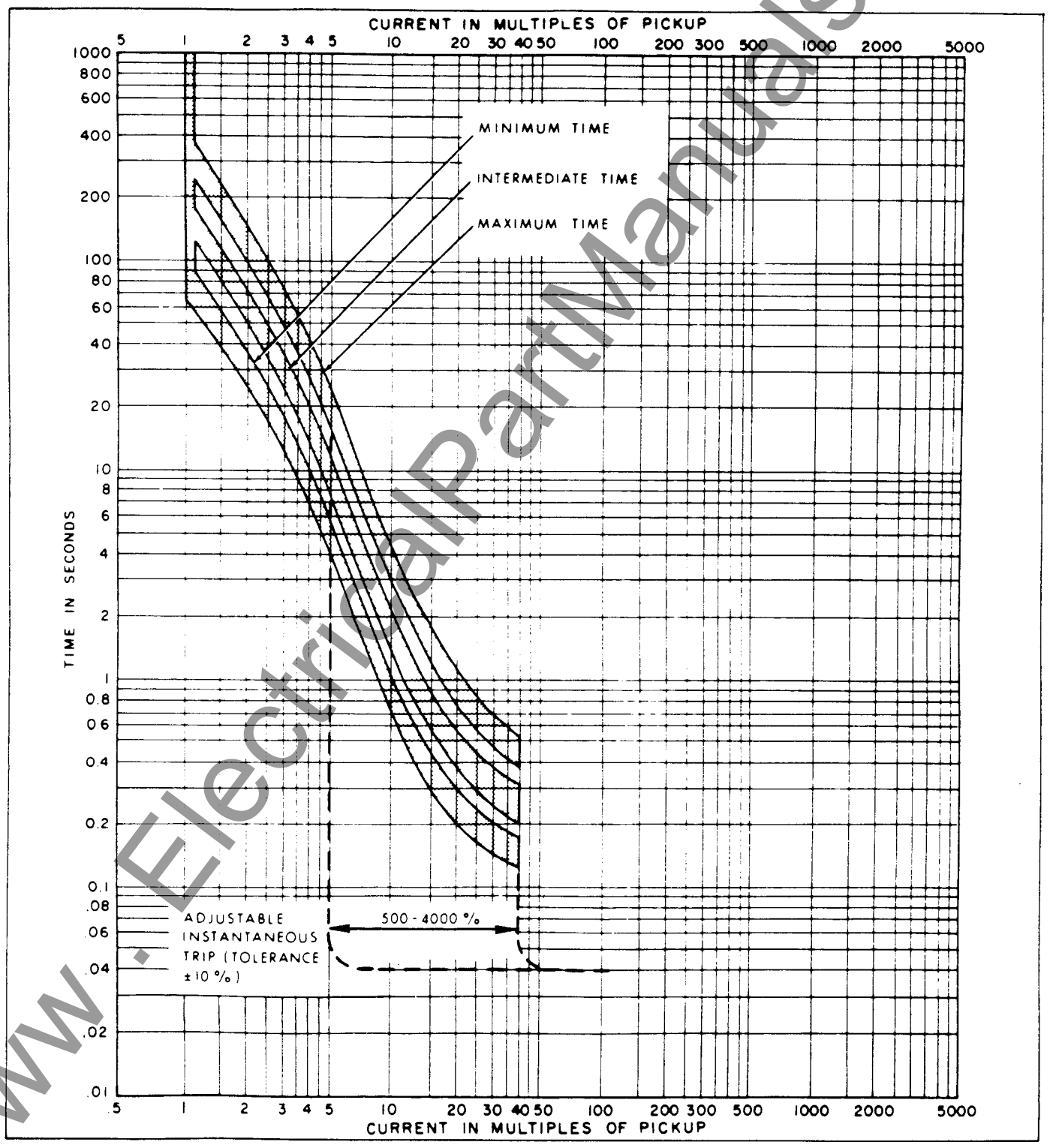


Figure 10. Time Current Curves — Models C, C1, C2

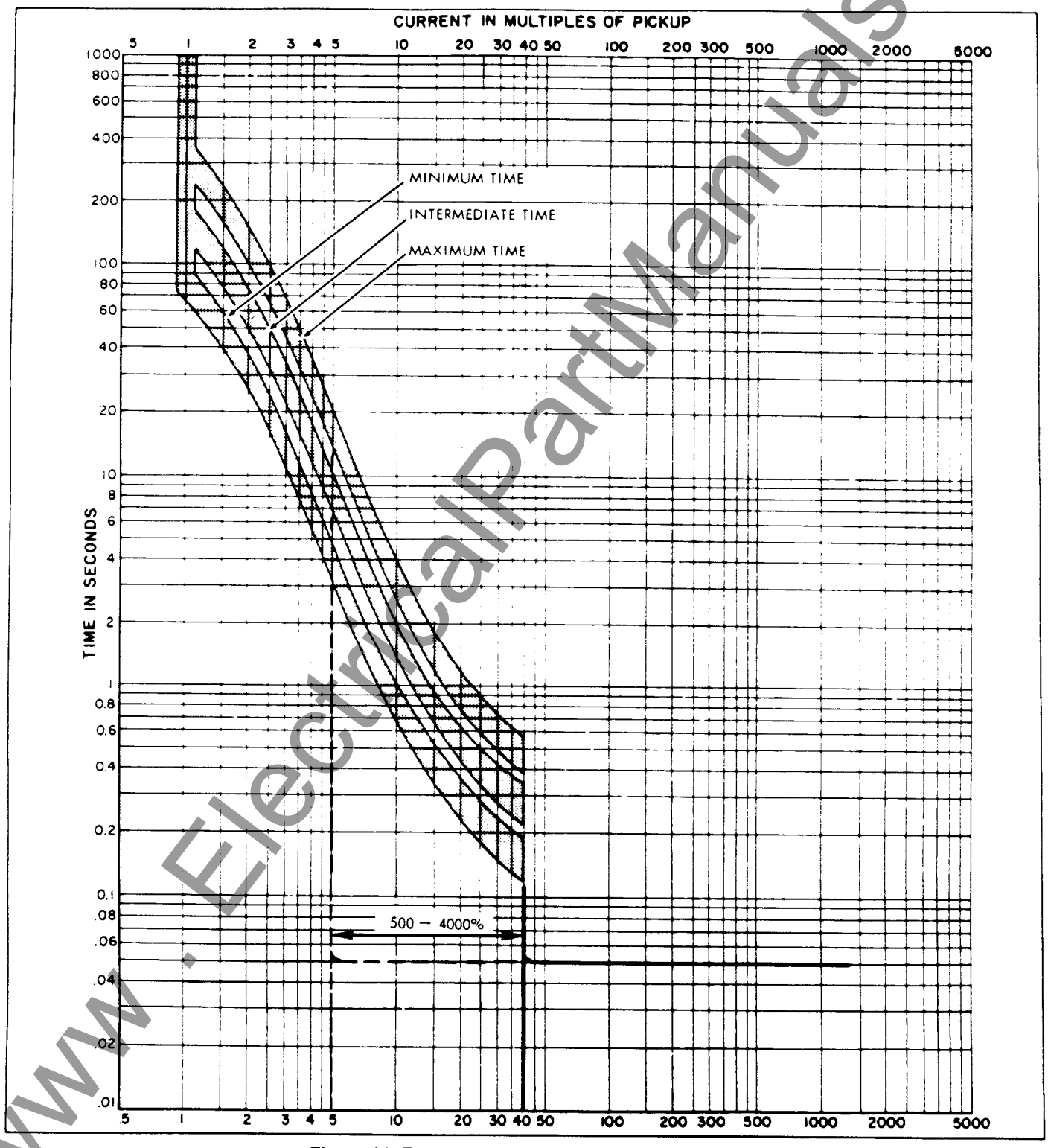


Figure 11. Time Current Curves — Model C3

TESTING *LimiTrip*® DEVICES

It will be helpful to note certain differences between *LimiTrip*® and STATIC TRIP II™ devices: (1) In the *LimiTrip*® system, the power supply and signal transformers are relocated to and combined in the "Sensor Transformers" mounted on the rear of the breaker. There are two cores in each Sensor Transformer. One core provides power to the trip device and the other provides the input signal. The PTS-3 test set is arranged to provide both an input signal and power signal for test purposes. STATIC TRIP II™ device contains both power supply and signal transformers. (2) All adjustments are made with switches in place of potentiometer type controls. (3) Only six long time pick-up settings are provided compared with seven settings for STATIC TRIP II™. (4) Only four long time delay bands are included compared with six for STATIC TRIP II™, the shortest and the longest bands are omitted on *LimiTrip*®. (5) The ground fault tripping option is not available. (6) Instantaneous and short time pick-up settings are switch selectable at 3X, 6X, 8X and 12X as compared to continuously adjustable settings with calibrated points of 3X, 5X, 8X and 12X for STATIC TRIP II™. (7) Time-current curves are in multiples of pick-up setting rather than in multiples of pick-up current.

GENERAL

1. The "Tripping XFMR Rating" values represent the primary value of the sensor transformer in amperes. The secondary value is one ampere.

2. The pick-up settings of the long time element are switch selectable at calibrated points "A" thru "F" as shown in the rating table.

3. The pick-up settings of the instantaneous and short time delay elements are switch selectable at 3, 6, 8 and 12 multiples of the long time pick-up setting.

4. The long time element has 4 bands that are switch selectable. The time delay at 4 multiples of pick-up is as follows:

Band 1 — 2.25 seconds	Band 3 — 9 seconds
Band 2 — 4.5 seconds	Band 4 — 18 seconds

5. The short time element has 3 time delay bands which are switch selectable (minimum, intermediate and maximum).

6. The maximum interrupting time is the maximum length of time that fault current flows, including arcing time.

7. Instantaneous maximum interrupting time may be greater when breakers are closed in on a fault depending on actual fault conditions. The maximum potential increase for a 3-phase fault is 0.01 seconds and for a single-phase ground fault is 0.02 seconds.

CONNECTIONS — USE CORD SET 18-732-184-502

The connections for the *LimiTrip*® trip devices are made with an integral wiring haress that terminates directly on the Sensor transformers on the back of the circuit breaker. To gain access to these terminals, it is necessary to remove the circuit breaker from the cubicle.

The trip device output leads are connected to the tripping actuator by quick disconnect "couplers". To connect the test set output leads, the couplers are disconnected and jack assemblies 18-732-085-501 and 502 are inserted into each of the lines to the actuator. The test set leads are then plugged into the jack assemblies.

The trigger test points are not brought out on the *LimiTrip*® device, so the cord set is provided with "Grabbers" to connect directly to the circuit board inside the device. See Figure 12 for the correct location of the test points. Connect the red "Grabber" to the long time pick-up test point and the black "Grabber" to the pick-up common test point. The red banana plug of the cord set connects to the jack assembly on the red leads of the trip device and the black banana plug to the jack assembly on the black leads of the device.

The connections to the sensor terminals at the rear of the circuit breaker are made as shown in Figure 12A. To test A phase, make the following cord set banana plug connections at the terminals of the A phase Sensor Transformer: Blue banana plug into terminal B (power lead), Green banana plug into terminal G (power lead), Yellow banana plug into terminal Y (signal lead), and the Orange banana plug into terminal O (signal lead). To test the other phases, move all four banana plugs to the Sensor terminals of the phase being tested. Note, on Sensor transformers rated 2000 amperes and up, it is necessary to disconnect either the lead from the test set directly to the *LimiTrip*® device because the low impedance of the power winding may prevent tripping.

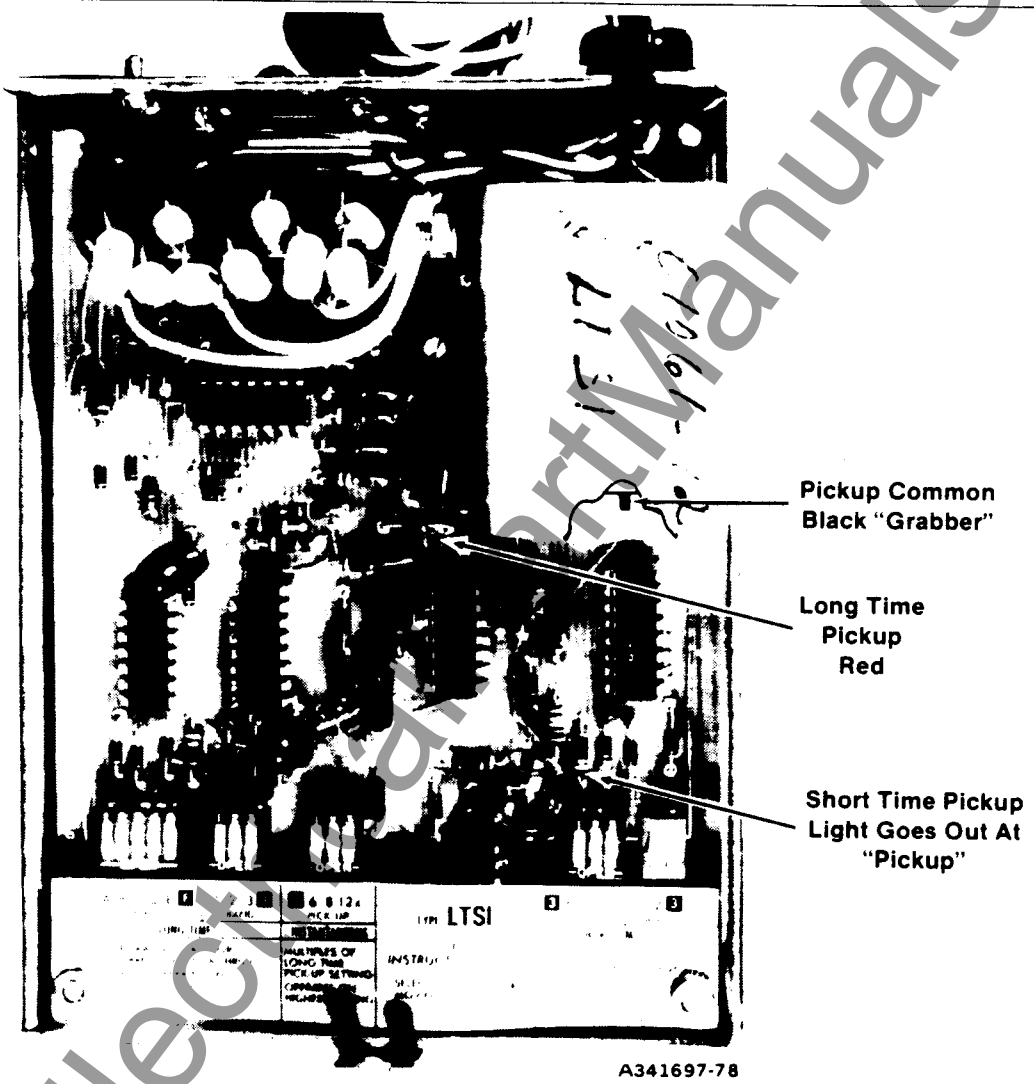


Figure 12. *LimiTrip*® Circuit Board Showing Test Points

SETTINGS OF BANDS AND PICK-UPS

"Pick-up" and "Band" settings are made by closing or opening switches grouped in DIP switch modules for the various functions. A switch is closed when it is moved up, depressing the end opposite the word open.

The "Pick-up" or "Band" setting is determined by the closed switch, in each DIP switch module, FARTHEST AWAY from the black highlighted number or letter. The setting of the function controlled by a module is not affected by the position (open or closed) of other switches in that module closer to the black highlighted number or letter than the desired setting. Where the black highlighted number is the largest number or letter, the setting is controlled by the LOWEST closed switch (Long Time

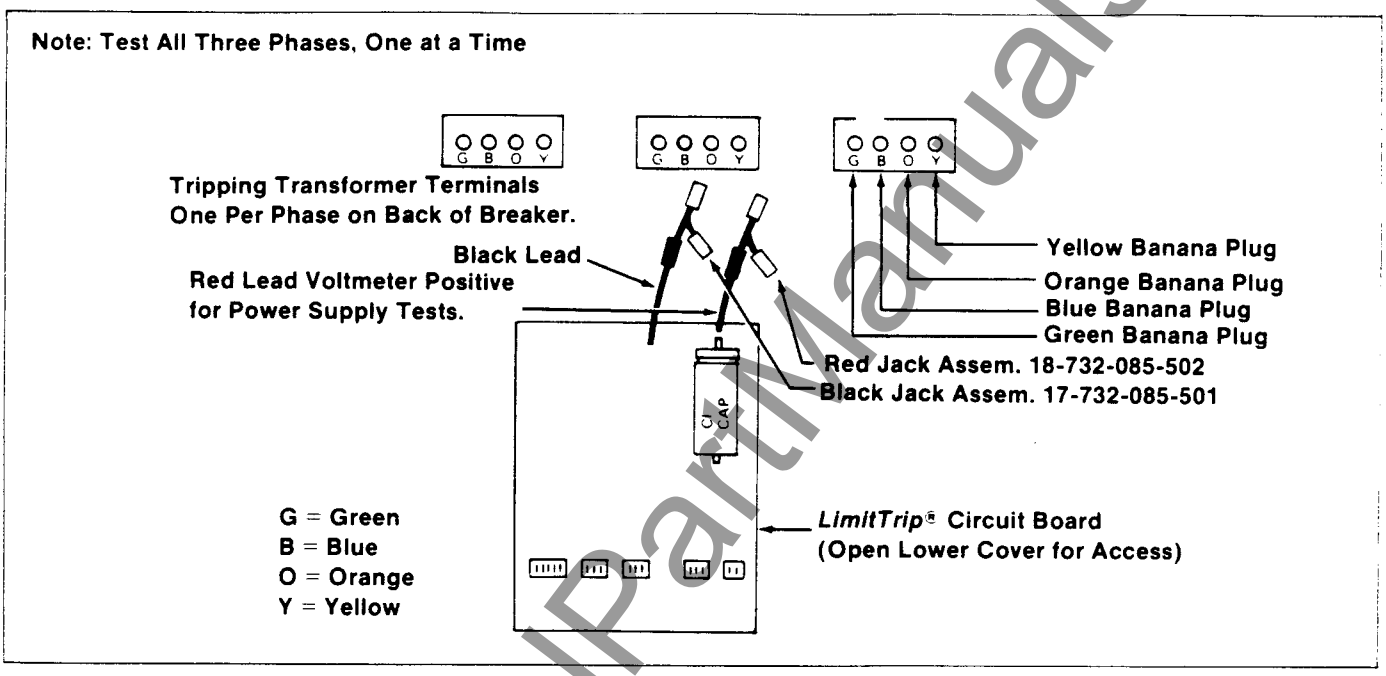


Figure 12A. *LimiTrip*® Test Connections

Pick-Up, Long Time Band, and Short Time Pick-Up). Where the black highlighted number is the smallest number, the setting is controlled by the HIGHEST closed switch (Instantaneous Pick-Up and Short Time Band). The device label adjacent to each switch indicates the setting for that function if it is the farthest closed switch. For example, if Long Time Pick-Up module switch 3 is the farthest closed switch from the black highlighted "F", the device is set at "C" setting of Long Time Pick-Up. If the switches on a module are all open, the setting will be that indicated by the black highlighted number.

TEST — LONG TIME PICK-UP

It is not necessary to operate the circuit breaker during the trip device tests, the breaker can be left open.

1. Make all connections as described in the preceding section, "Connections".

2. Set "Long Time Pick-Up on "A" by closing (depressing) the numbered end of the LONG TIME PICK-UP switch labeled A in the *LimiTrip*®. Place the trip device test set selector switch to "STATIC TRIP TEST" position. Set the range switch on "LOW". Set the POWER selector switch to "INTERNAL".

3. Turn the test set ON. The red digits of the meters should come ON, (the alarm light may turn ON also, press the "STOP" - alarm reset button). Press and hold the START and RESET push buttons.

4. Slowly increase the current by rotating the "INTERNAL POWER CONTROL" in a clockwise direction. Increase the current until the "LONG TIME" pick-up light comes ON; this should be at 0.5 ampere ± 10%. The sampling rate of the digital ammeter is such that the control must be moved very slowly to accurately determine the pick-up current of the trip device.

5. Decreasing the current slightly should cause the light to go OUT.

6. Repeat the tests for the other phases and settings and compare with Table 4A.

Table 3
"*LimiTrip*®" Rating Table — Amperes

Breaker Type & Frame Size	Tripping XMFR Rating (Primary)	Long Time Element Calibrated Pick-Up Settings						Max. Cont. Rating
		A	B	C	D	E	F	
LA-600 600 Amperes	80	40	50	60	70	80	90	90
	200	100	125	150	175	200	225	225
	400	200	250	300	350	400	450	450
	600	300	375	450	525	600	675	600
LA-800	800	400	500	600	700	800	900	800
LA-1600 1600 Amperes	200	100	125	150	175	200	225	225
	400	200	250	300	350	400	450	450
	800	400	500	600	700	800	900	900
	1600	800	1000	1200	1400	1600	1800	1600
LA-3200 3200 Amperes	2000	1000	1250	1500	1750	2000	2250	2250
	3000	1500	1880	2250	2630	3000	3380	3200
LA-4000 4000 Amperes	4000	2000	2500	3000	3500	4000	4500	4000

Table 3A

LONG TIME PICK-UP SETTING	A	B	C	D	E	F
PICK-UP CURRENT, AMPS	.50	.625	.75	.875	1.00	1.125

TEST — SHORT TIME PICK-UP

1. Connect the Red "GRABBER" to the Short Time Pick-Up test point. See Figure 12.
2. Set "LONG TIME PICK-UP" on "A", "INSTANTANEOUS PICK-UP" on "12X" (close the 12X switch). Set "SHORT TIME PICK-UP" on 3X (open all switches).
3. Press and hold the START and RESET buttons.
4. Slowly increase the current until the LONG TIME PICK-UP light goes OUT. This should occur at 1.5 amperes ± 10%. Note: Moving the red grabber connects the Long Time Pick-Up test leads to the Short Time test point, and this signal goes to zero at pick-up.
5. Repeat for "SHORT TIME PICK-UP" settings of 6X, 8X and 12X. The "RANGE" switch must be on "HIGH" for these tests. To avoid over heating, do not maintain the higher currents any longer than necessary.

TEST — INSTANTANEOUS PICK-UP

A trigger test point for "Instantaneous Trip" is not available. Tripping of the circuit breaker and/or operation of the test set relay will indicate instantaneous trip operation. To operate the test set relay, the red and black banana plugs must be connected to the trip device output using the jack assemblies.

1. Connect the test set to the circuit breaker as described in the section under the heading "Connections".

2. Set "LONG TIME PICK-UP" on "A", "LONG TIME BAND" on 4 (all switches open), "SHORT TIME PICK-UP" on 12X (close its 12X switch). Set "INSTANTANEOUS" on 3X (open all switches).

3. Raise the current slowly until the relay in the test set operates. This can be determined audibly and should occur at 1.5 amperes ± 10%.

4. Repeat for the other settings as desired. Avoid maintaining high currents longer than necessary to obtain the readings.

5. If it is desired to test the operation of the circuit breaker, any of the above tests can be run with the circuit breaker closed, allowing the trip device to open the circuit breaker when it operates. It may be desirable to disconnect either the red or black banana plug from the jack assembly to assure that the relay in the test set does not interrupt the current before the circuit breaker can open thus confusing the test results.

TEST — LONG TIME DELAY

1. Connect the test set to the device as described under the heading "CONNECTIONS". Connect the red "Grabber" to the "Long Time Test Point" shown in Figure 12.

2. Set "LONG TIME PICK-UP" on "A" "LONG TIME BAND" on 1, "SHORT TIME PICK-UP" and "INSTANTANEOUS" on 12X.

3. Press and hold the START and RESET buttons and adjust the current to 3 amperes (6 times "A" pick-up).

4. In turn press the STOP and the RESET buttons. Allow time for the ammeter to return to zero.

5. Press the START button. It is not necessary to hold this button. Power will be maintained until the trip device times out.

6. When the trip device operates, check the reading of the stop clock against the curves shown in Figure 13. The reading should be within the limits shown on the curve.

7. Repeat steps 4, 5 and 6 several times to verify the results.

8. Repeat for the other phases, time delay bands and other values of current, as desired. All test points should fall within the bands shown on Figure 13. Each band should have precisely twice the delay of the next lower band when all other conditions are the same.

NOTE When timing at values of current only slightly above pick-up line voltage fluctuations may cause detriggering and result in erroneous operating times. Therefore, it is advisable to watch the long time pick-up light to note whether the trigger voltage is maintained or not. In general, it is impractical to test at less than 10% above pick-up.

TEST — SHORT TIME DELAY

1. Connections to the device as described under the heading "CONNECTIONS". The "Grabber" connections are not needed.

2. Set "LONG TIME PICK-UP" on "A", "LONG TIME BAND" on 4 (all switches open), "INSTANTANEOUS" on "12X", "SHORT TIME PICK-UP" on "3X", and "SHORT TIME BAND" on 1 (Minimum setting, both switches closed).

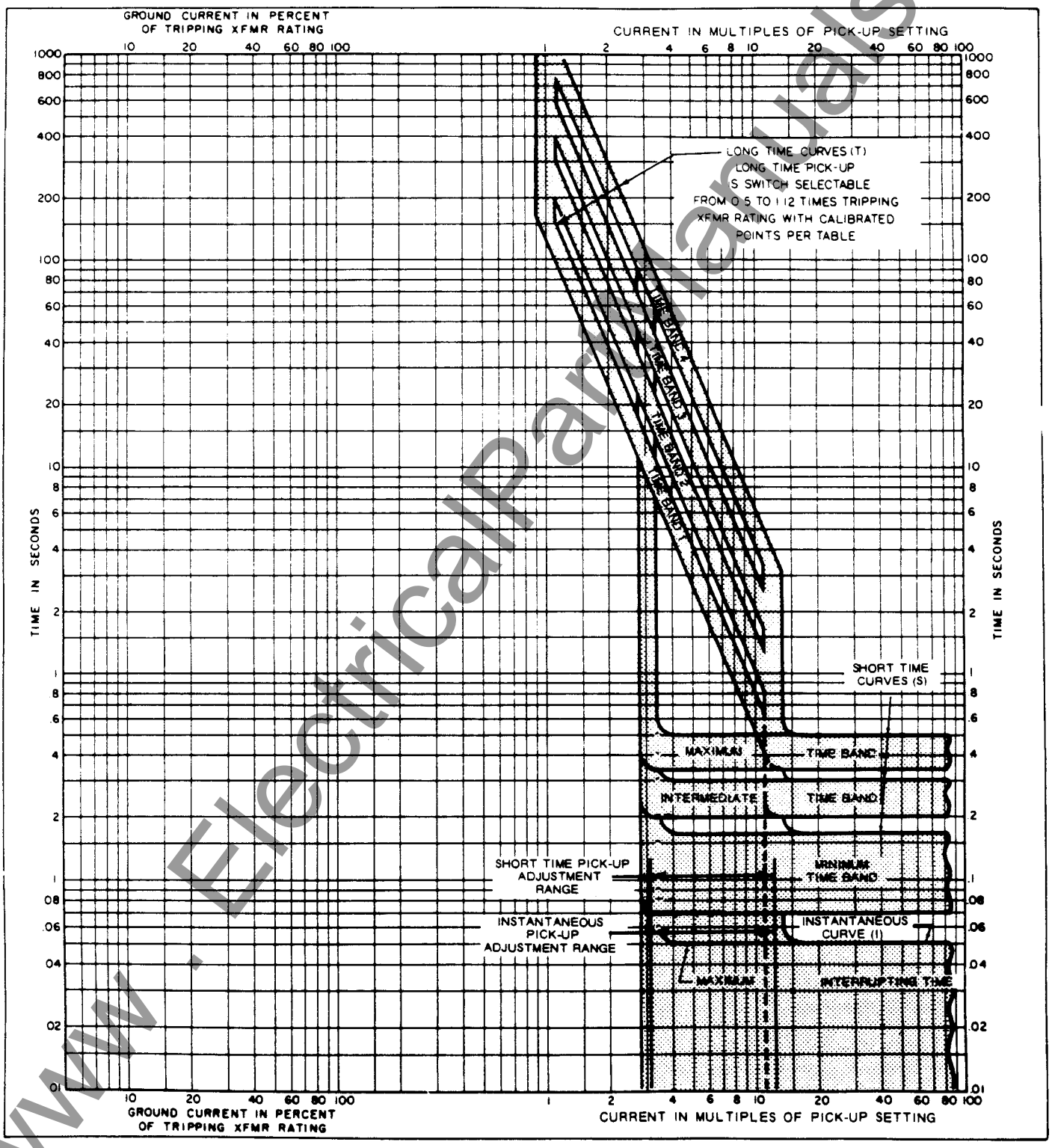


Figure 13. *LimiTrip*® Time/Current Curves

3. Press and hold the START and RESET buttons and adjust the current to 2 amperes or more and then release buttons. In turn, press the STOP and RESET buttons.

4. Close the circuit breaker, if desired.

5. Press the START button, the delay on the stop clock should be 0.07 to 0.170 seconds. See Figure 13.

6. Repeat for "SHORT TIME BANDS" of "INTERMEDIATE" (Band 2) and "MAXIMUM" (Band 3). Compare with Figure 13. The other phases and different values of current can be tested if desired. Make current settings as quickly as possible to avoid overheating.

BENCH TEST — *LimiTrip*® DEVICES

To bench test *LimiTrip*® devices, follow the same procedures previously indicated for testing on the breaker. The following adjustments in procedure and comments should be noted: (The alligator clips are used to connect the test set-cord-set leads to the *LimiTrip*® device for bench testing. (2) Since the wiring harness is attached to the trip device, the color coding of the leads still match the color of the banana plug. (3) The signal circuits share a common ORANGE lead. (4) Connections can be made using any lead of the color coded groups. Again, each signal (Orange-Yellow) and all three pair of power leads (Blue-Green) must be checked.

COMMENTS ON TEST RESULTS

There are several things that can throw test results off so if results don't agree with design values, it is best to verify that equipment and testing procedures are in order before drawing any conclusions.

1. Recheck test connections to make sure that they are correct.

2. Verify device settings and knob calibration. See Section "Restoring Lost Calibration".

3. Return the knob to the previous setting making sure that the pointer lines up accurately with the correct calibration dot (see Section "Static Trip Calibration Marks") and repeat the test.

4. If there seems to be error in the same direction for all settings, the ammeter may be at fault. To check the test set ammeter, connect an ammeter that is known to be accurate to terminals 1 and 9 of the terminal block and plug the green and white leads of cord set 18-732-184-501 into the same terminals. Connect an external Variac to the test set external input terminals and set the input power selector switch to "EXTERNAL". Check the ammeter at several values of current on both the high and low ranges. The two ammeters should agree within approximately 3% of full scale for all readings.

5. If pick-up settings meet design tolerance and the time delays do not, the stop clock may be at fault. This can be checked against a stop watch. The tolerance should be within 5 seconds in 5 minutes (300 seconds).

6. As pointed out in the introduction, line voltage fluctuations may cause timing errors. Watch the ammeter during the timing intervals and adjust the current control as necessary to hold the current constant.

7. Electrical noise may interfere with the internal phase control circuitry and can make testing difficult if not impossible in some cases. An external Variac (Variable transformer) can be used as a source for the test set by-passing the phase control elements. This connection may overcome some testing difficulties.

REPAIR OF STATIC TRIP DEVICES

Because of the complexity of the semi-conductor components and circuits and because some of the components are especially selected or matched, we do not recommend field repair of static trip devices. Moreover, component failure usually does not show up as visual damage and locating the defective component or components requires specialized techniques. Therefore, if the tests described in these instructions indicate that a static trip device or the test set itself is defective, contact your nearest Siemens-Allis representative for instructions on returning the unit to the factory or other authorized service facility for repair.

TESTING THE TRIPPING ACTUATOR

If the device fails to trip the circuit breaker, the trouble may be in the tripping actuator.

TESTING THE ACTUATOR ON THE CIRCUIT BREAKER

1. Place the selector switch in the "Actuator Test" position. This energizes the red and black five-way binding posts.

2. Use the voltmeter lead 18-732-184-503 to connect the five-way binding posts to the actuator leads on the circuit breaker. These connect to the static trip terminals 7 and 8 on circuit breakers with STATIC TRIP II™ or first generation static trip devices. These leads are connected with "Faston Couplers" when *LimiTrip*® devices are supplied; the red post connects to the red wire on the actuator (terminal 8), the black post connects to the black actuator wire (terminal 7). **If the static trip is not disconnected, do not exceed 12 volts DC input while testing the actuator.**

3. Close the circuit breaker.

4. Slowly increase the voltage from the internal supply with the "Power Control" knob. Note the voltage at which the circuit breaker trips. This should be somewhere between 4.5 and 10 volts.

5. Rotate "Power Control" knob counterclockwise to remove power.

6. Failure of the circuit breaker to trip at any voltage even up to 12 volts may be due to the actuator plunger binding. This can be checked manually. **USE EXTREME CAUTION WHEN WORKING ON THE CIRCUIT BREAKER. THE ENERGY STORED IN THE CLOSING AND/OR OPENING SPRINGS MUST BE RESPECTED. ALWAYS DISCHARGE ALL SPRINGS BEFORE PLACING HANDS NEAR THE MECHANISM.** See the circuit breaker instruction book if any problem is evident in the mechanical portion.

7. Measure the actuator coil resistance. This measurement should be made with the static trip disconnected from the actuator. There are two types of actuators of the "sealed" type. One has a resistance of 25 to 30 ohms and should trip between 4.5 and 6 volts maximum. The other type has a resistance of 30 to 40 ohms and its tripping voltage should be between 4.5 and 10 volts.

BENCH TESTING ACTUATORS

1. Set the selector switch to the "Actuator Test" position.

2. Connect the red actuator lead to the red five-way binding post and the black actuator lead to the black five-way binding post.

3. Manually reset the actuator plunger by pushing the rod all the way in. Keep the actuator away from any steel during the test since the steel will change the magnetic circuit of the device.

4. Slowly increase the voltage from the internal supply with the "Power Control" knob. Note the voltage at which the circuit breaker trips. This should be somewhere between 4.5 and 10 volts.

5. Rotate "Power Control" knob counterclockwise to remove power.

6. Check the actuator coil resistance and determine if the tripping voltage satisfies the applicable maximum value as stated in step 7 of the preceding section.

TESTING THE TRIPPING TRANSFORMERS

The tests described in the preceding sections verify performance of the static trip device and the actuator.

The third link in the protection system is the circuit breaker mounted tripping transformers. When secondary current testing is done on the circuit breaker, the tripping transformers are subjected to approximately their normal excitation so that a transformer with shorted turns would show up in the form of pick-up and/or time delay values above tolerance. However, an open circuit in the transformer would not show up at all. Therefore, it is desirable to test the tripping transformers as described in the following.

TEST PREPARATIONS

If the static trip device is on the circuit breaker, disconnect or remove it. For STATIC TRIP II™, disconnect by removing the fanning strip from the terminal block. For first generation static trips, remove the wiring from the terminal block on the side of the trip device. For a circuit breaker with a *LimiTrip*® device, disconnect at the sensor terminals.

Breakers that are wired for four wire ground fault protection have a tripping transformer external to the circuit breaker, either on the neutral or the ground strap. This external transformer is wired to the circuit breaker through secondary disconnect fingers. To test this transformer the circuit breaker must be in the cubicle, in the "TEST" position. If in doubt, refer to the circuit breaker wiring diagram. There are two tests that can be made, winding continuity and exciting current.

CONTINUITY TEST

Except where the transformers exhibit evidence of overheating or other damage, a simple continuity test of the wiring and the transformer winding may be all that is required. For transformers rated 1000/1 and above, an exciting current test can be inconclusive due to the low level of current involved and in the case of some of the windings used with the *LimiTrip*® devices, continuity is the only test that can be run due to the [illegible] required.

An ohm meter is most suitable for the continuity test. For STATIC TRIP II™, test in turn across terminals 1 to 9, 2 to 9, and 3 to 9 of the trip device terminal block, for phase A, B, and C respectively. For a first generation type device, test between each of the heavy black wires and the common white wire. If the cubicle is wired for four wire ground protection, the remote transformer should be checked also; this is between terminal 4 and 9 for STATIC TRIP II™, and between the common white wire and the wire that is connected to terminal 9 on 4WAG and 4WDG trip devices. The circuit breaker should be in the "TEST" position so the terminals are connected to the remote transformer.

For *LimiTrip*® the test is made at the sensor transformer and is made between the O and Y (Orange and Yellow) and the B and G (Blue and Green) at each set of terminals.

EXCITING CURRENT TEST

An exciting current test can be run on the transformers. This is done by applying an AC voltage to the secondary winding and observing the magnetizing current. This test may reveal shorted turns in the windings. Tables 4 and 5

Table 4
Static Trip II™
and
First Generation Tripping Transformers

Tripping Transformer Rating	Exciting Voltage RMS	Maximum Exciting Current RMS
80:1	33.5	0.25
150:1	67	0.15
200:1	67	0.15
250:1	67	0.15
400:1	67	0.05
600:1	134	0.05
800:1	134	0.03
1000:1 and up	134	0.02

show the maximum allowable exciting current for the various transformers and sensors used. Note, the "B" and "G" terminals of the *LimiTrip®* sensors should not be tested for exciting current; due to the small core used, the readings are meaningless.

Table 5
***LimiTrip®* Sensor Transformers**
"O" to "Y" (Signal) Terminals

Sensor Transformer Ratio	Exciting Voltage RMS	Maximum Exciting Current RMS
80:1	4.6	0.25
200:1	7.0	0.15
400:1	17.0	0.05
600:1	32.0	0.05
800:1	34.0	0.03
1000:1 and up	34.0	0.02