SIEMENS-ALLIS

INSTRUCTIONS

PORTABLE TEST SET
TYPE PTS-2
FOR
TYPE LA LOW VOLTAGE POWER CIRCUIT BREAKERS
STATIC OVERCURRENT TRIP SYSTEM

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INTRODUCTION

General

Allis-Chalmers portable test set number 18-468-400-501 is designed for testing the Static overcurrent tripping system of the LA line of low voltage power circuit breakers. It provides means for testing all three components of the system, i.e., the breaker mounted tripping current transformers, the magnetic tripping actuator, and the static trip device. Thus the portable test set, using power from an ordinary 115 volt convenience outlet, can provide circuit breaker testing equivalent to much more expensive and cumbersome primary current testing.

This instruction book provides all the information necessary to test all models of Allis-Chalmers static trips from the original 1962 first generation models to the latest Static Trip II types. Additional installation and operating instructions for the first generation devices are contained in instruction book number 18X4392 and for Static Trip II devices in 18X4827. The theory of operation of the trip devices is explained in 18X4433 for the older types and in 18X4814 for Static Trip II.

Factory calibration of static trip devices is done with sinusoidal current from a closely regulated ac power supply and with high quality instruments that are frequently recalibrated. These conditions cannot be duplicated with the portable tester. In particular, 115 Volt line voltage fluctuations during field testing may affect results. Therefore, minor discrepancies between factory calibration and test set readings can be disregarded.

However, 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 115 Volt line is available. The value of the line voltage is not critical. It can be anywhere from 105 to 125 Volts but the value should not vary more than ±2-1/2% during testing.

Static Trip Calibration Marks

Because each Allis-Chalmers static trip device is individually calibrated during test and because the location of the calibration points varies from device to device it is impossible to prepoint the identification letters adjacent to the calibration 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 pick-up" dot is the third calibration dot counted clockwise from the reference dot. On Static Trip II devices the direction of counting is also indicated by the "increase" arrow.

Restoring Lost Calibration

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 static trips). If the pointer does not line up calibration has been lost by the knob being turned on the shaft. To restore calibration loosen the knob set screw, make sure the shaft is turned fully counterclockwise, set the pointer on the reference dot, and retighten the set screw. Recheck to be sure the knob is still counterclockwise against the stop. (Do not use excessive force. To do so will damage the potentiometer.)

DESCRIPTION

The test set is pictured in FIG. 1. FIGS. 2 and 3 show typical test set-ups, and FIG. 4 is a schematic wiring diagram.

Rating

Input - 115 Volts, 60 Hz, 7 Amps.
Output - 0 to 135 Volts, 60 Hz, 6 Amps. Max.
Maximum continuous output on high scale - 1.35 Amps.
Maximum continuous output on low scale - 0.65 Amps.
DC Output - 0 to 22 Volts
Max. Continuous Current - 350 MA.

Construction Details

The schematic diagram reveals that the tester is basically a variable voltage ac supply with a built-in reactor to smooth the current against the trip device non-linear impedance, and a current limiting resistor for the low current range. A small variable dc supply is included for testing the tripping actuator. The fuse on the front panel protects this supply.

Panel Controls

Selector Switch

In the "Static Trip Test" position this switch connects the red banana plug lead to the operating coil of the trip relay, 4B, which is mounted on the auxiliary panel inside the case. When this relay is energized by the output of a static trip device under test, it removes power and stops the clock. In the "Actuator Test" position the selector switch connects the red banana plug to the internal dc supply and de-energizes the ac output leads (green and white banana

plugs). This allows these leads to hang free without hazard while testing the actuator on the breaker.

Figure 1. – Portable Test Set

"Start Timing" Pushbutton

Picks up the start relay, device X, which seals itself in, applies power, and starts the clock.

"Reset" Pushbutton

De-energizes the start relay, resets the tripping relay, and resets the clock, all in readiness for the next test.

"Push and Hold for Power" Button

By-passes the start and tripping relay contacts so that current can be adjusted without undesired interruption of power. The button is spring return to prevent accidental prolonged application of high currents.

Stop Clock

Records static trip device operating time. The sweep hand is scaled in hundredths of a second to permit accurate measurement of static trip "Short Time" delays. The totalizing hand is scaled in seconds but one revolution is one minute (60 seconds, not 100 seconds). Since the longer delay times when testing static trips may be more than one minute, it is necessary when recording such delays either to keep track of the number of revolutions of the totalizing hand or to use a separate clock or watch for totalizing.

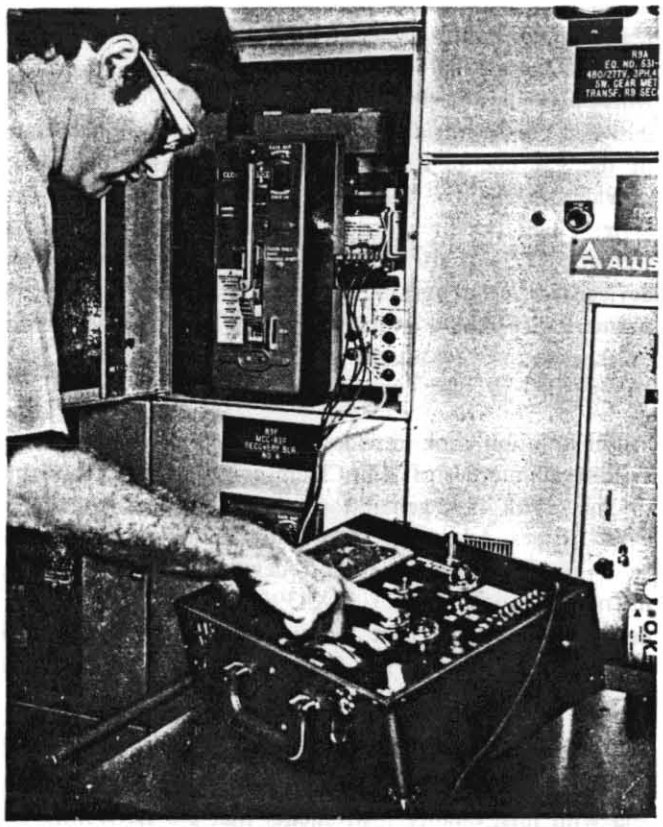


Figure 2. – Testing Static Trip Device on the Breaker

Voltmeter Leads

The voltmeter leads are shielded to avoid electrical noise pickup that may interfere with static trip operation. The plugs are tip plugs which fit the jacks in the faceplate of the trip device. The black plug is negative and the yellow positive. These leads are the only connections to the voltmeter.

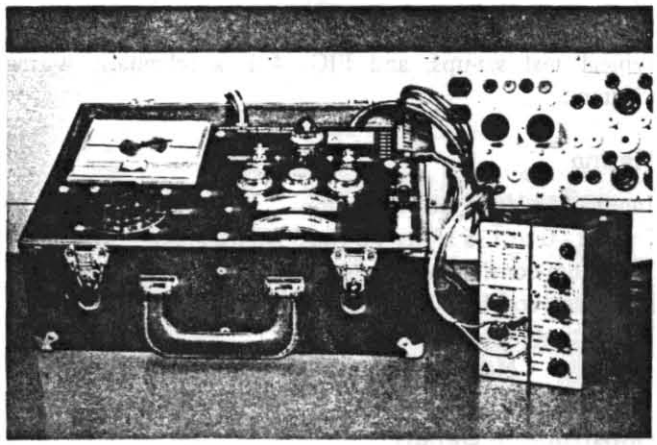
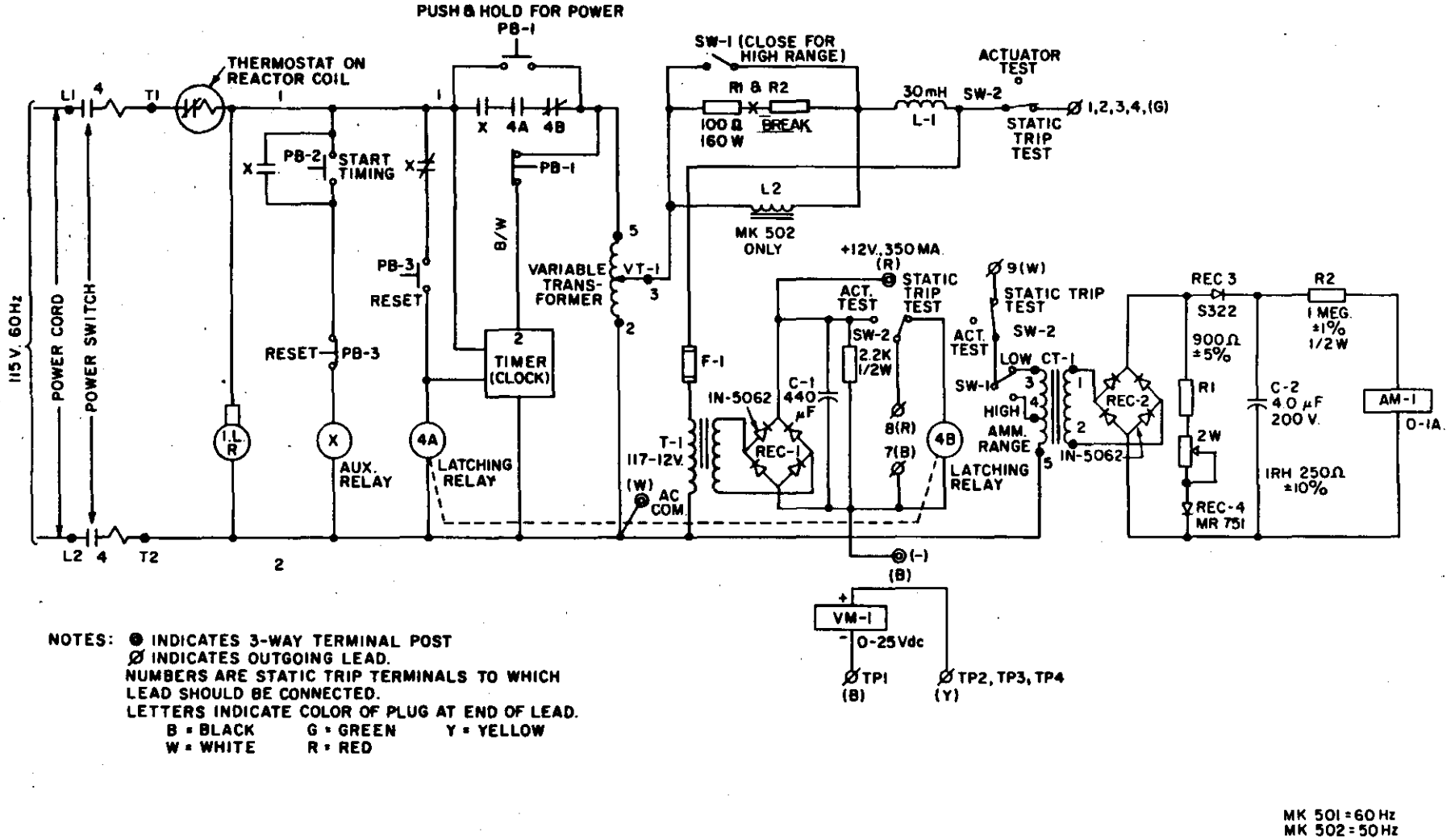


Figure 3. – Bench Testing a Static Trip Device



NOTES: ⊕ INDICATES 3-WAY TERMINAL POST
Ø INDICATES OUTGOING LEAD.
NUMBERS ARE STATIC TRIP TERMINALS TO WHICH LEAD SHOULD BE CONNECTED.
LETTERS INDICATE COLOR OF PLUG AT END OF LEAD.
B = BLACK G = GREEN Y = YELLOW
W = WHITE R = RED

MK 501 = 60 Hz
MK 502 = 50 Hz

Figure 4. – Test Set Schematic Diagram

Ammeter

The ammeter circuit is special being designed to read peak current divided by $\sqrt{2}$, which closely approximates the trip device response to non-sinusoidal currents. This ammeter scheme greatly reduces the amount of filtering required, thereby permitting the use of a much smaller and lighter reactor. If an ordinary ac ammeter were inserted in the ac line between the tester and the static trip device, it would be found to disagree significantly with the tester ammeter because of current distortion, caused by the saturating characteristic of the power supply transformers in the static trip device. However, if the tester ammeter is suspected of error, it may be checked by shortcircuiting the tester ac output (green and white banana plugs) through an accurate ac ammeter. The readings should then agree, within the rated accuracy of the instruments, because the current will be sinusoidal. The tester ammeter accuracy is $\pm 2\%$ of full scale. Two ammeter ranges are provided, controlled by the "Ammeter Range" switch. The "Low" range is 0 to 1 Ampere which permits accurate reading of pick-up currents. The "High" range is 0 to 10 Amperes. However maximum available current is about 7 Amperes.

Overload Protection

To minimize weight, the reactor has been designed so that it will withstand the higher current settings long enough for normal testing, but not continuously. A thermal overload is provided that will trip the power switch if for any reason currents above about four Amperes are maintained too long. If settings at the higher currents are made without undue delay, the overload will not operate. In addition to the thermal overload, a thermostat (mounted against the reactor coil surface) will operate if cumulative heating raises the temperature to a dangerous level. Both of these devices remove power and cause the red indicating light to go out. The coil thermostat resets automatically after a cooling period of five or six minutes. The power switch must be reset manually by pushing it to the "off" position. Cooling time for the power switch is two to six minutes.

TESTING STATIC TRIP II DEVICES

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

The foliowing 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 II.

The selector switch should be in the "Static Trip Test" position for all static trip device tests. The ammeter range switch should be in the "Low" position for best accuracy when testing with current values of 1.0 Ampere or less and should be in the "High" position when testing with more than 1.0 Ampere. Current must be readjusted when switching ranges because the range switch also inserts a 80 ohm current limiting resistor in the "Low" range position.

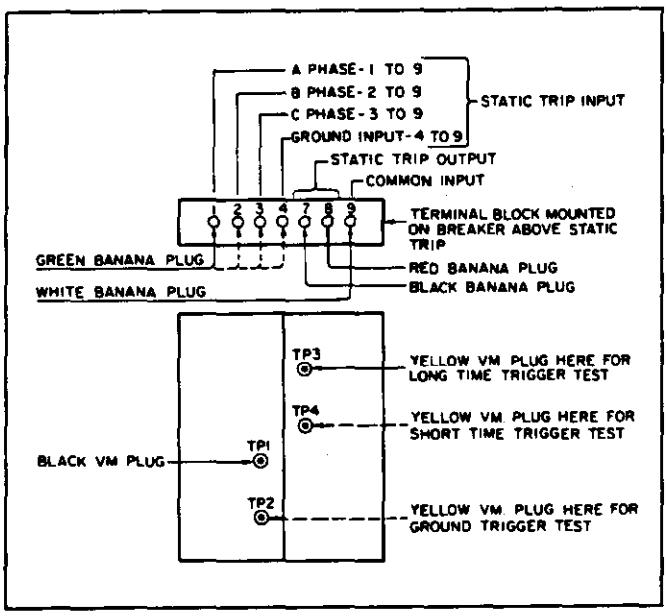


Figure 5. – Test Connections for Static Trip II

Testing with the Static Trip on the Breaker

CAUTION

The static trip input is capacitively coupled to the circuit breaker frame, through a surge capacitor. Therefore to insure against electrical shocks be sure to ground the frame when testing with the circuit breaker out of the cubicle.

Connections

FIGURE 5 shows how to connect the test set leads to the trip device. The red and black banana plugs may be left disconnected for pickup tests to avoid trigger instability. However they should be plugged into terminals 8 and 7 as shown for all other tests.

Long Time Pickup Test

It is not necessary to operate the breaker for this or other pickup tests.

1. Leave the red and black banana plugs disconnected. To test phase "A" connect the green plug to terminal 1 and the white plug to terminal 9. Connect the black voltmeter plug to TP1 and the yellow one to TP3.
2. Set "Long Time Pickup" on dot "A". Place the selector switch on "Static Trip Test", and the ammeter range switch on "Low".
3. Turn the power switch on. The red light should come on. Push the "Press and Hold for Power" button.
4. Raise the current gradually until the voltmeter deflects suddenly to 15 Volts or more. This should occur at 0.5 Ampere $\pm 10\%$.

5. Decreasing the current slightly should cause the voltmeter reading to drop to a low value.
6. Repeat for the other phases and for other settings and compare with the bottom line of Table I.

NOTE

The sudden appearance of this "trigger" voltage indicates that the timed delay has started. If the current drops slightly, causing the trigger voltage to disappear, the timing circuit resets instantly and timing will start over upon the next appearance of triggering.

Short Time Pickup Test

1. Connect the yellow voltmeter plug to TP4 and the black one to TP1, the green plug to terminal 1, and the white to 9.

TABLE I
STATIC TRIP II
RATING TABLE – AMPERES

Breaker Type and Frame Size	Tripping XMFR Rating (Primary)	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-600 600 Amperes	80	40	50	60	70	80	90	100	100	–	–	40	80
	200	100	125	150	175	200	225	250	250	30	50	100	200
	400	200	250	300	350	400	450	500	500	60	100	200	400
	600	300	375	450	525	600	675	750	600	90	150	300	600
LA-1600 1600 Amperes	200	100	125	150	175	200	225	250	250	–	50	100	200
	400	200	250	300	350	400	450	500	500	60	100	200	400
	800	400	500	600	700	800	900	1000	1000	120	200	400	800
	1600	800	1000	1200	1400	1600	1800	2000	1600	240	400	800	1600
LA-3000 3000 Amperes	2000	1000	1250	1500	1750	2000	2250	2500	2500	300	500	1000	2000
	3200	1600	2000	2400	2800	3200	3600	4000	3000	480	800	1600	3200
LA-4000 4000 Amperes	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	–	0.15	0.25	0.50	1.00

General Notes

1. The "Tripping XFMR Rating" values represent the primary value of 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" thru "G" as shown in the rating table.
3. The pick-up settings of the instantaneous and short time delay elements are continuously adjustable, and are calibrated at 3, 5, 8 and 12 multiples of the long time pick-up 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 pickup is as follows.

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

6. The short time element and ground element have 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 an LA-600 breaker and 40 amperes for an LA-1600 breaker.

2. Set "Long Time Pickup" on "A", Instantaneous at maximum (fully counterclockwise), Long Time Band on 6, and Short Time Pickup on 3X.

3. Press the "Push and Hold" button.

4. Raise the current gradually until trigger voltage of 15 Volts or more appears. This should occur at 1.5 Amperes ±10% (3 x 0.5).

5. Repeat for "Short Time Pickup" settings of 5X, 8X, and 12X. To avoid overheating do not maintain the higher currents any longer than necessary.

Ground Pickup Test

1. Connect the green plug to terminal 4, the white plug to 9, the black voltmeter plug to TP1, and the yellow voltmeter plug to TP2.

2. Set "Ground Pickup" on the "15%" dot.

3. Press the "Push and Hold" button and raise the current gradually until trigger voltage of 15 Volts or more appears. This should occur at 0.15 Ampere ±10%. Repeat for the 25% (0.25A) and other settings. See the bottom line of Table I for settings in Amperes.

TABLE II
TYPES OF STATIC TRIP II DEVICES AVAILABLE

Type TI – A dual trip device normally used for phase overcurrent protection. The long time pick-up range is selected from the trip rating table and is continuously adjustable from "A" thru "G" in the field. The instantaneous element is continuously field adjustable from 3 to 12 multiples of the long time pick-up setting selected. The long time delay is field adjustable with a choice of six bands.

Type TIG (optional) – A dual trip device which provides phase overcurrent protection same as Type TI plus sensitive ground fault protection for 3-wire and 4-wire circuits on systems with either phase-to-phase or phase-to-neutral loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 15% through 100% of the tripping transformer rating. When used on 4-wire circuits, a fourth tripping transformer is required. It is mounted in the cubicle, and wired to the breaker through secondary disconnects.

Type TIG(T) (optional) – Same as Type TIG, except a ground target is provided to give a visual indication of a trip initiated by a ground fault.

Type TS (optional) – A selective trip device used for phase overcurrent protection which provides time delay tripping only. It allows complete field adjustment of the long time band and pick-up plus the short time band and pick-up. The short time pick-up can be adjusted from 3 to 12 multiples of the long time pick-up setting. Any one of the three short time bands can be chosen to be used with any of the six long time bands.

Type TSG (optional) – A selective trip device which provides phase overcurrent protection same as Type TS plus sensitive ground fault protection for 3-wire and 4-wire circuits for systems with either phase-to-phase or phase-to-neutral loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 15% through 100% of the tripping transformer rating. When used on 4-wire circuits, a fourth tripping transformer is required. It is mounted in the cubicle, and wired to the breaker through secondary disconnects.

Type TSG(T) (optional) – Same as Type TSG, except a ground target is provided to give a visual indication of a trip initiated by a ground fault.

Type TSI (optional) – A triple selective trip device used for phase overcurrent protection which provides long time delay, short time delay, and instantaneous elements. It allows complete field adjustment of the long time band and pick-up, the short time band and pick-up and the instantaneous pick-up. Both the short time and instantaneous elements can be adjusted to pick up at 3 to 12 multiples of the long time pick-up setting. Any one of the three short time bands can be chosen to be used with any of the six long time bands.

Type TSIG (optional) – A triple selective trip device which provides phase overcurrent protection same as Type TSI plus sensitive ground fault protection for 3-wire and 4-wire circuits on systems with either phase-to-phase or phase-to-neutral loading. Ground current pick-up settings are independent of the phase pick-up settings, and continuously adjustable in the field from 15% through 100% of the tripping transformer rating. When used on 4-wire circuits, a fourth tripping transformer is required. It is mounted in the cubicle, and wired to the breaker through secondary disconnects.

Type TSIG(T) (optional) – Same as Type TSIG, except a ground target is provided to give a visual indication of a trip initiated by a ground fault.

Instantaneous Trip Test

There is no trigger output for "Instantaneous Trip" but tripping of the breaker and/or operation of the test set trip relay will indicate instantaneous trip operation.

1. Connect the red and black plugs to terminals 8 and 7 per FIGURE 5, the green plug to 1, and the white plug to 9. The voltmeter plugs are not needed.
2. Set "Long Time Pickup" on "A", "Long Time Band" on 6, "Short Time Pickup" at maximum (full counterclockwise), and "Instantaneous Pickup" on 3X.
3. Press the "Reset" button and then the "Start Timing" button. (It is not necessary to hold the "Start Timing" button because the start relay, device X, seals itself in.)
4. Close the breaker.
5. Raise the current slowly until the breaker trips. This should occur at 1.5 Amperes $\pm$ 10% (3 x 0.5).
6. Repeat for other settings as desired. Avoid maintaining high currents longer than necessary to get accurate readings.

Long Time Delay Test

Test delay at an input current of 6 times pickup setting.

1. Connect the green plug to terminal 1, the white plug to terminal 9, the black banana plug to 7, and the red to 8. Connect the black voltmeter plug to TP1 and the yellow to TP3.
2. Set "Long Time Pickup" on "A", "Long Time Band" on 1, "Short Time" and "Instantaneous" pickups fully counterclockwise, and "Short Time Band" at maximum (fully clockwise).
3. Press the "Push and Hold" button and adjust current to 3.0 Amperes (6 times "A" pickup).
4. Press the reset button until the clock is reset to zero.
5. Close the breaker.
6. Press the "Start Timing" button. (It is not necessary to hold this button. Power will be maintained until the static trip device times out.)
7. When the breaker trips, check the operating time against the table on the trip device faceplate and against the curves on FIG. 6. While it may differ some from the exact faceplate value, it should fall within the band on the curve. If not, refer to "Testing the Tripping Actuator."
8. Repeat steps 6 and 7 one or more times to verify the test results. Repeatability accuracy should be very high.
9. Repeat for other time bands and other values of times pickup current as desired. All points should fall within the bands on FIG. 6. Each time band should have precisely twice the delay of the next lower band.

NOTE

When timing at values of current only slightly above pickup, line voltage fluctuations may cause de-triggering and result in erroneous operating times. (See note at the end of "Long Time Pickup Test".) Therefore it is advisable to watch the voltmeter during timing to note whether trigger voltage is maintained.

Short Time Delay Test

1. Connect the green plug to terminal 1 (phase A), the white plug to terminal 9, the red plug to 8, black plug to 7. The voltmeter plugs are not needed.
2. Set "Long Time Pickup" on "A", "Long Time Band" on 6, "Instantaneous Pickup" at maximum, "Short Time Pickup" at 3X (1.5 Amp.), and "Short Time Band" on "Maximum".
3. Press the "Push and Hold" button and adjust the current to 2 Amperes or more.
4. Close the breaker.
5. Press the "Reset" button.
6. Press the "Start Timing" button. The breaker should trip in 0.4 to 0.5 seconds. See FIGURE 6.
7. Repeat for "Short Time Band" settings of "Intermediate" and "Minimum" and for other values of current and pickup settings if desired. Compare with FIGURE 6. Make current adjustments as quickly as possible to avoid overheating.

Ground Time Delay Test

1. Connect the green plug to terminal 4, the white plug to 9, the red to 8, and the black to 7. The voltmeter plugs are not needed.
2. Set "Ground Pickup" on 15% (0.15A.) and "Ground Time Band" on "Maximum".
3. Press the "Push and Hold" button and adjust the current to 0.5 Amperes or more. (Erroneous time delays may be obtained at lower currents due to test set wave shape distortion. Also the target, if any, may fail to operate for the same reason.)
4. Close the breaker.
5. Press the reset button.
6. Press the "Start Timing" button. The breaker should trip in 0.4 to 0.5 seconds. See FIGURE 6. If there is a ground target, the red button should pop out. Reset the target by pushing the button in.
7. Repeat for other "Ground Time Band" settings and also for other pickup and current values if desired. Make current adjustments above 1.0 Ampere quickly to avoid overheating.

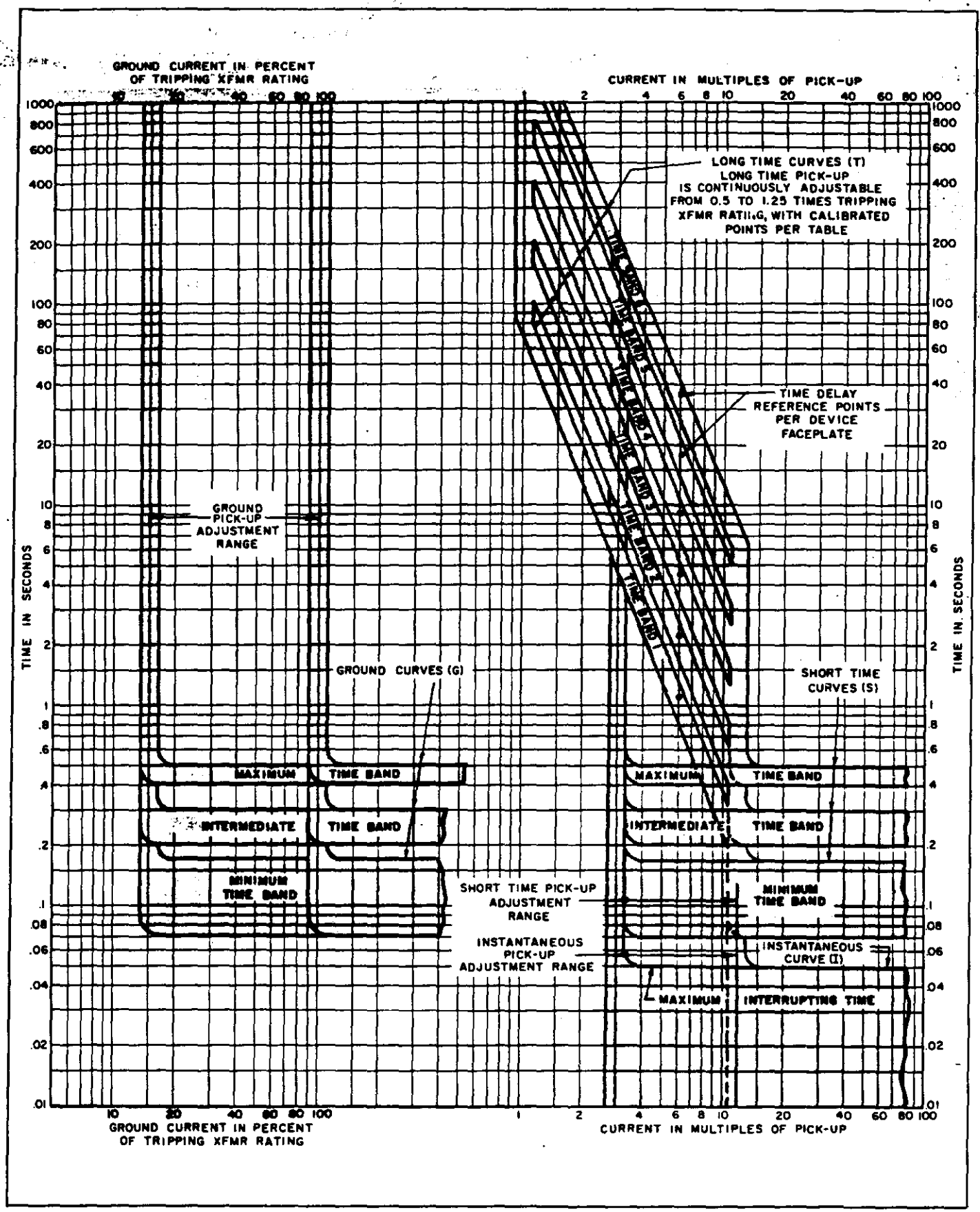


Figure 6. – Time-Current Curves – Static Trip II

Bench Testing Static Trip II Devices

Connections

With the static trip device away from the breaker it is necessary to make connections to the fanning strip which terminates the wiring cord of the trip device. Place the fanning strip under the outer row of screws of the terminal block on the test set, and tighten all screws. The end of the fanning strip nearest the cord must connect to terminal 1. Connections can now be made to the brass jacks on the terminal block, using the test set banana plugs exactly as done when testing with the trip device on the breaker. The terminal block is not connected internally. It serves only as a means of connection for the banana plugs.

Test Procedures

The testing procedures are exactly the same as given in "Testing with the Static Trip on the Breaker" except of course, that any reference to the breaker is ignored.

TESTING FIRST GENERATION TRIP DEVICES

Connections

The connections to first generation static trip devices terminate on an 8 point or 9 point terminal block on the side of the case. See FIGURE 7. To allow using the test set plugs to connect to this terminal block, insulated alligator clips are furnished for clipping onto the terminal block screws. Four of the clips accept the four banana plugs in the rear and the other two clips accept the pin plugs for the voltmeter.

The bottom line of Table III gives the calibrated settings in secondary amperes for first generation trip devices and on the same page available models are listed and described. FIGURES 10, 11, 12 and 13 are time-current curves for the various models.

Connections from the test set are different for different models and are shown on FIGURES 8A through 8D.

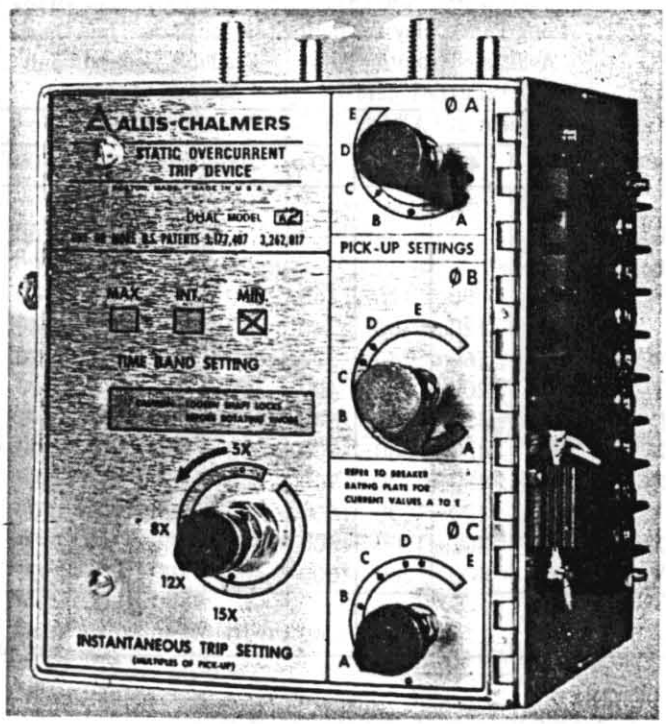


Figure 7. – First Generation Static Trip-Terminal Block Arrangement

It will be helpful to note certain differences between these static trips and Static Trip II devices: (1) There are three long time pickup 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; the device is just marked to show which time band it contains. (3) The instantaneous pickup is labeled "Instantaneous Trip Setting", and (4) the short time pickup is labeled "Transfer to Short Time". (5) There are no test jacks on the device faceplates. Voltmeter connections for trigger indication are made to points on the terminal block as shown on FIGURE 8A to 8D. A separate lead, part number 18-722-625-506, is furnished to extend the voltmeter

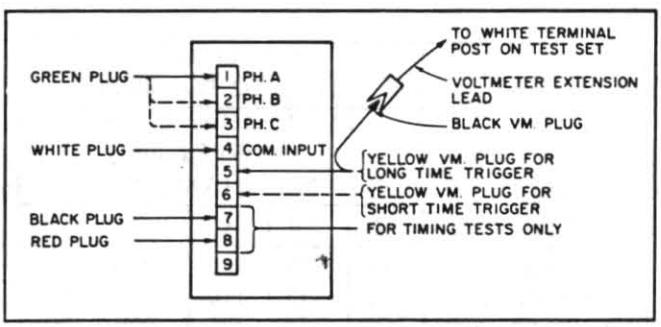


Figure 8A. – Test Connections Models A, A1, A2, A3, C3, D, D1, D2

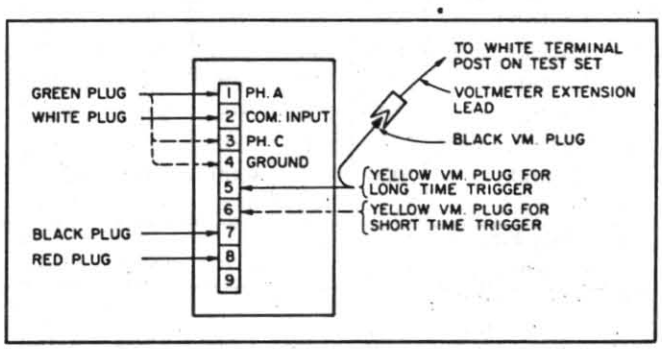


Figure 8B. – Test Connections Models AG, AG1, AG2, DG, DG1

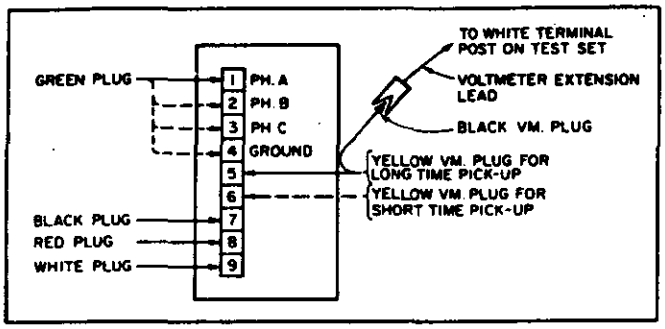


Figure 8C. – Test Connections Models 4WAG and 4WDG

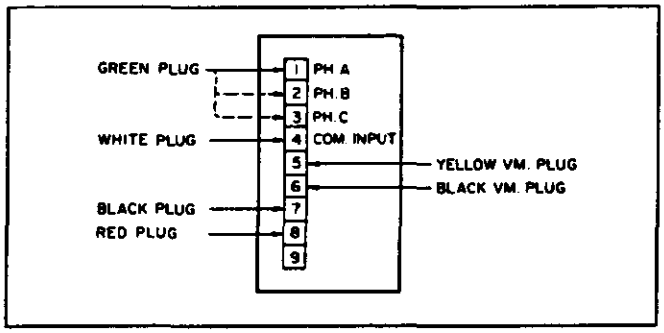


Figure 8D. – Test Connections Models C, C1, and C2

negative lead (black plug) so it will reach the test set for FIGURES 8A, 8B & 8C. (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 8A to 8D, the test instructions in "Testing with the Static Trip on the Breaker" (omitting Step 1 in each case) can be used for testing first generation trip devices also. Compare results with Table III and FIGURES 9A, 9B, 10, 11 and 12 as applicable.

Bench Testing

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

TABLE III
TRIP RATING TABLE – FIRST GENERATION STATIC TRIPS

Breaker Type	Models A3, AG2, 4WAG, D2, DG1, 4WDG — Long Time Delay Elements Available Pickup Settings (Amperes)					Tripping Transformer Group No.	Models AG2 and DG1 — Long Time Delay Element Available Ground Fault Settings (Amperes) — Percent of "A" Pickup				Models 4WAG and 4WDG — Inst. or Short Time Delay Available Ground Fault Settings (Amperes) — Percent of "A" Pickup			
	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 Pickup 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 LA4000 is 4000A.

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 pickup settings of the instantaneous and short time delay elements are calibrated at 3, 5, 8 and 12 multiples of the long time delay pickup 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 pickup 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 pickup 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.

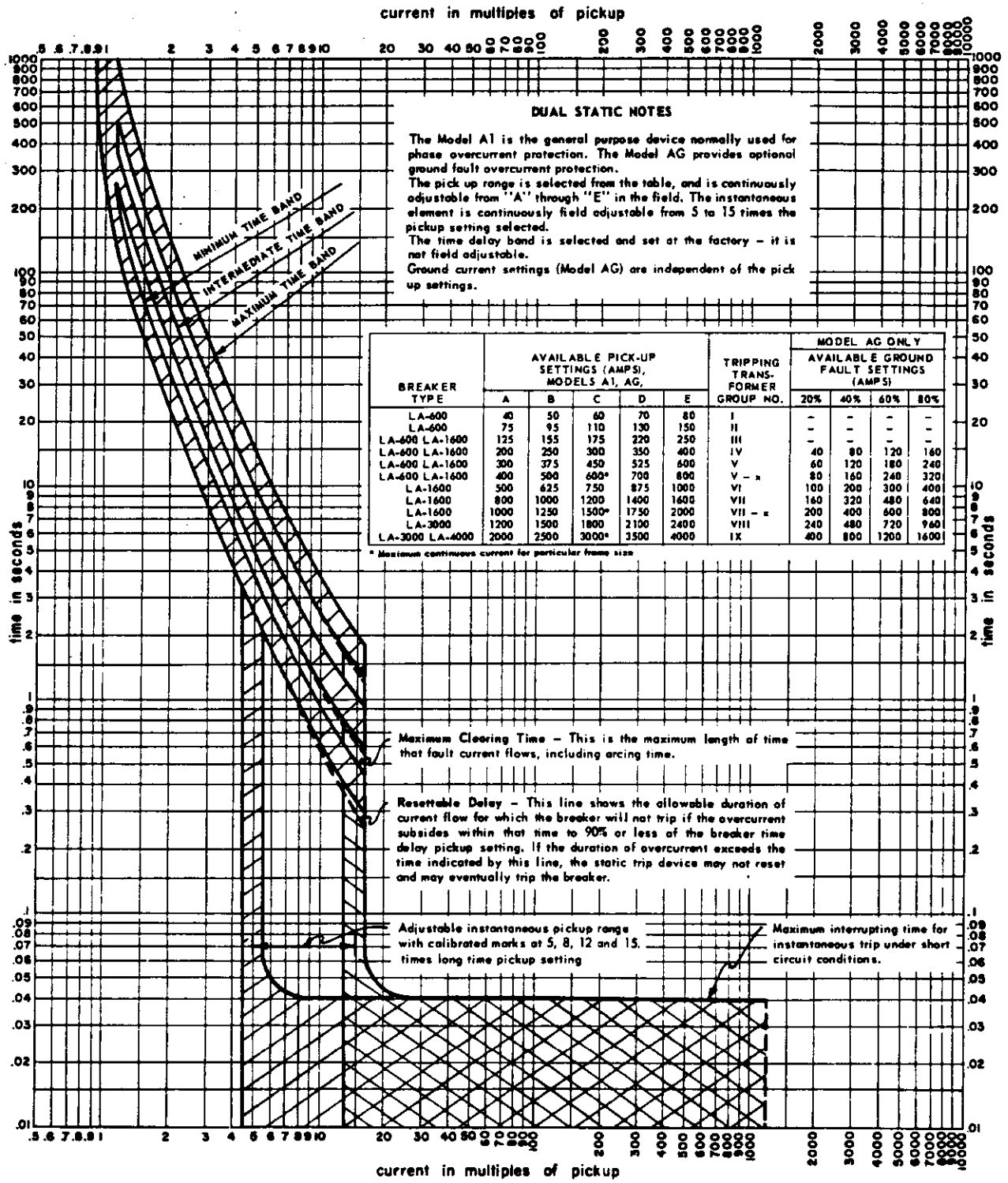
Model AG (optional) – provides phase overcurrent protection plus sensitive ground fault overcurrent protection for systems with phase-to-phase loading. Ground current pickup settings are independent of the phase pickup settings, and continuously adjustable in the field from 20% through 80% of the minimum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

Model 4WAG (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 pickup settings are independent of the phase pickup settings, and continuously adjustable in the field from 20% through 80% of the minimum phase pickup 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 pickup and short time delay and pickup. 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 plus sensitive ground fault overcurrent protection for systems with phase-to-phase loading. Ground current pickup settings are independent of the phase pickup settings, and continuously adjustable in the field from 20% through 80% of the minimum phase pickup setting shown in column "A."

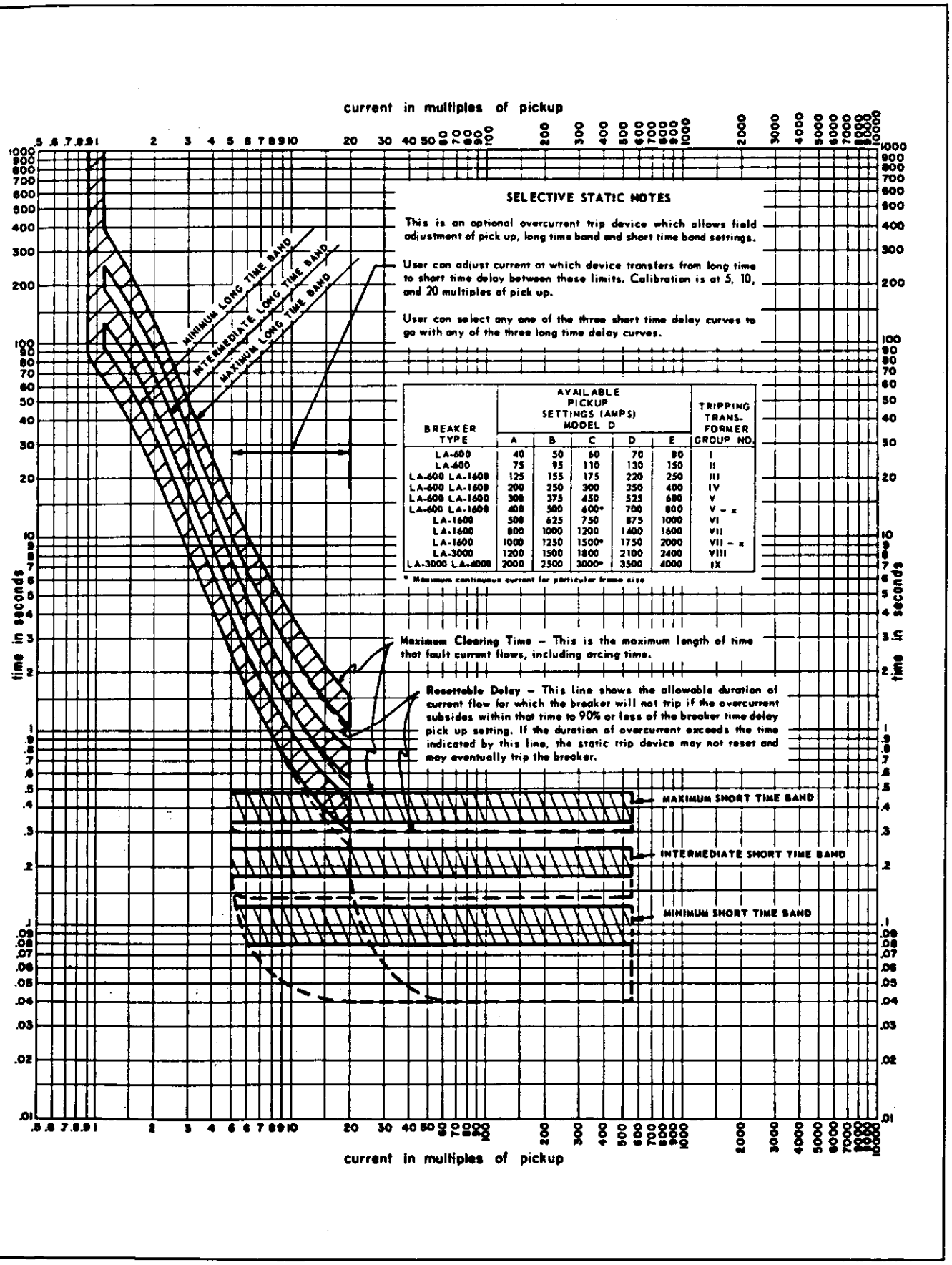
Model 4WDG (optional) – provides phase overcurrent protection plus sensitive ground fault overcurrent protection for 3-wire and 4-wire circuits for systems with phase-to-neutral loading. Ground current pickup settings are independent of the phase pickup settings and continuously adjustable in the field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



BREAKER TYPE	AVAILABLE PICK-UP SETTINGS (AMPS), MODELS A1, AG, A	B	C	D	E	TRIPPING TRANSFORMER GROUP NO.	MODEL AG ONLY AVAILABLE GROUND FAULT SETTINGS (AMPS) 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 9A. – Time Current Curves – Models A, A1, A2, AG, AG1



BREAKER TYPE	AVAILABLE PICKUP SETTINGS (AMPS) MODEL D					TRIPPING TRANSFORMER GROUP NO.
	A	B	C	D	E	
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
LA-600 LA-1600	300	375	450	525	600	V
LA-600 LA-1600	400	500	600*	700	800	V – x
LA-1600	500	625	750	875	1000	VI
LA-1600	800	1000	1200	1400	1600	VII
LA-1600	1000	1250	1500*	1750	2000	VII – x
LA-3000	1200	1500	1800	2100	2400	VIII
LA-3000 LA-4000	2000	2500	3000*	3500	4000	IX

* Maximum continuous current for particular frame size

Figure 9B. – Time Current Curves – Models D, D1

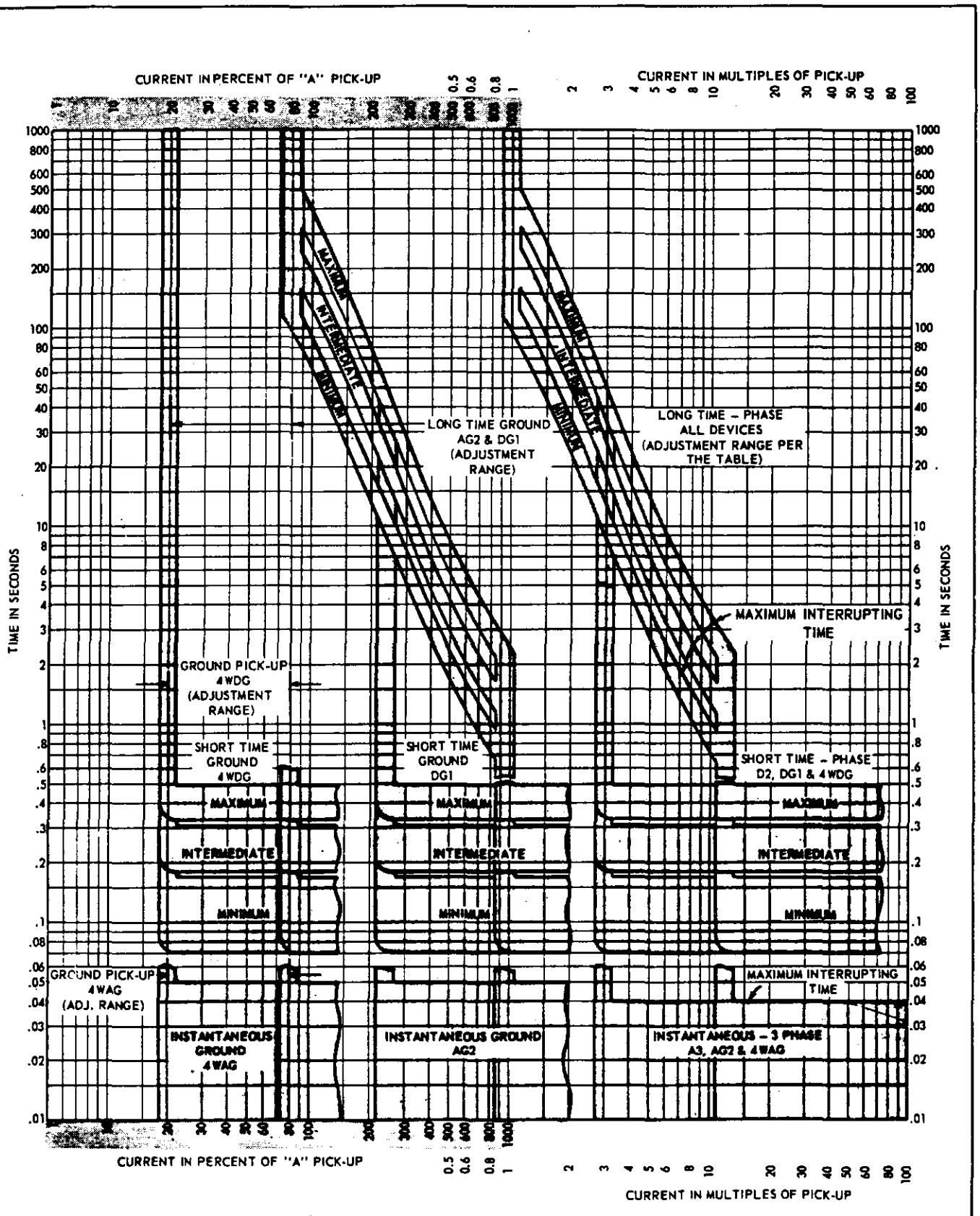


Figure 10. – Time Current Curves – Models A3, AG2, D2, DG1, 4WAG, 4WDG

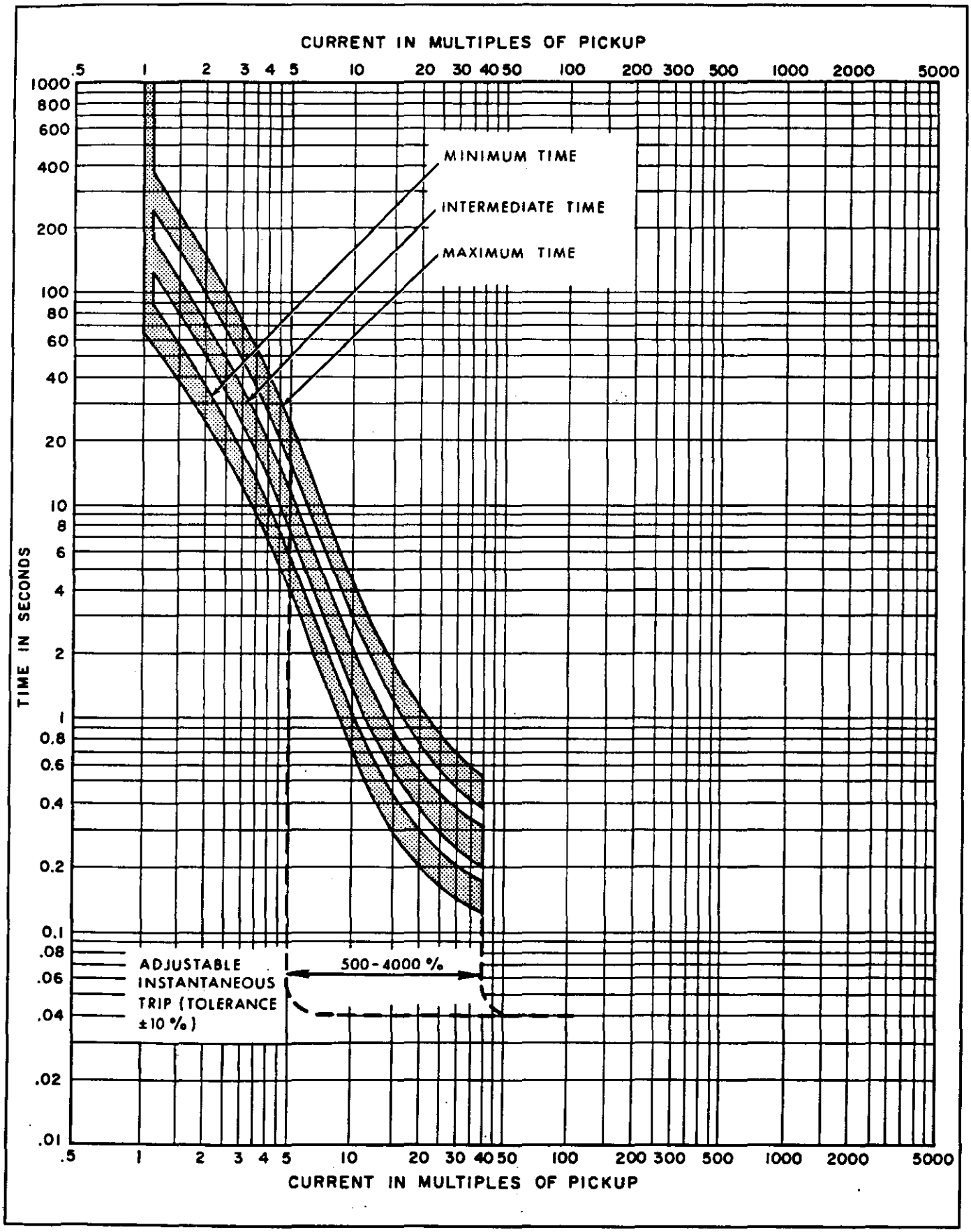


Figure 11. – Time Current Curves – Models C, C1, C2

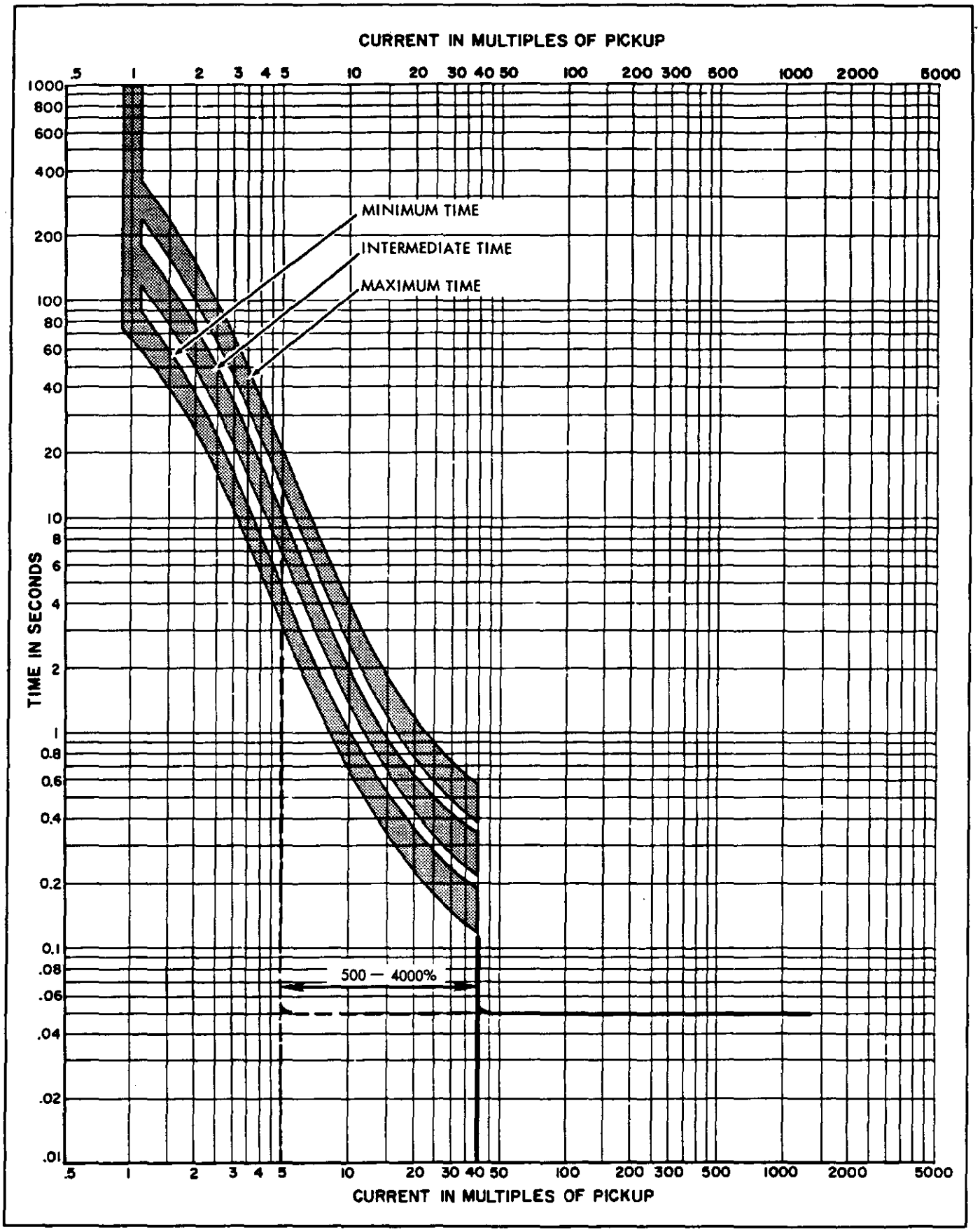


Figure 12. – Time Current Curves – Model C3

COMMENTS ON TEST RESULTS

There are several things that can throw the 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.

(a) Recheck test connections to make sure they are correct.

(b) Verify knob calibration. See section "Restoring Lost Calibration."

(c) Return the knob to the previous setting making sure that the pointer lines up accurately with the right calibration dot (see section Static Trip Calibration Marks), and repeat the test.

(d) If there seem to be errors in the same direction for all settings the ammeter may be in error. 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 plugs into the same points. Check the test set at several values of current in both the low and high ranges. The two ammeters should agree within approximately 3% of full scale for all readings.

(e) If pickup settings meet design tolerance but time delays do not, the timer may be defective. Check it against a stop watch.

(f) As pointed out in the introduction line voltage fluctuations may cause timing errors. Watch the ammeter during the timing interval and adjust the current control as necessary to hold current constant.

REPAIR OF STATIC TRIP DEVICES

Because of the complexity of the semiconductor 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 is defective, contact your nearest Allis-Chalmers representative for instructions on returning the unit to the factory for repair.

TESTING THE TRIPPING ACTUATOR

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

Testing with the Actuator on the Breaker

1. Turn the selector switch to the "Actuator Test" position. This deenergizes the green and white plugs.
2. Connect the red banana plug to terminal 8 and the black banana plug to terminal 7 of the static trip device. Connect the yellow voltmeter plug to the red terminal post on the test set and the black voltmeter plug to the black post.
3. Close the breaker.
4. Slowly raise the voltage from the internal dc supply with the "Current Adjust" knob, and note the voltage at which the breaker trips. This should be somewhere between about 4.5 Volts and 9.0 Volts.
5. Failure of the breaker to trip at any voltage even up to 12 Volts may be due to the plunger of the actuator not being reset fully by the breaker mechanism. This can be checked visually. See the circuit breaker instruction book.
6. Measure the actuator coil resistance. The coil leads are the small red and black wires connected to terminals 7 and 8 on the static trip terminal block. The measurement should be made with the static trip device disconnected. For Static Trip II loosen the seven screws and remove the connecting strip from the terminal block. For first generation static trips lift the red and black actuator coil wires from the terminal block and measure between the wires. (Be sure to reconnect correctly with the red wire on 8 and the black on 7.) There are two types of actuator. If the resistance is between 25 and 30 Ohms, tripping voltage should not be more than 6 Volts. If resistance is between 30 and 40 Ohms, tripping voltage should not be more than 9 Volts.

Bench Testing Actuators

1. Turn the selector switch to the "Actuator Test" position. This deenergizes the green and white plugs.
2. Connect the actuator red lead and the yellow voltmeter plug to the red post on the test set. Connect the black actuator lead and the black voltmeter plug to the black post.
3. Manually reset the actuator by pushing the plunger rod all the way in.
4. Slowly raise the internal dc supply voltage with the "Current Adjust" knob and note the voltage at which the actuator trips.

5. Check the actuator coil resistance and determine whether the tripping voltage satisfies the applicable maximum value. See step 6 in the preceding section.

CAUTION

Although the tripping actuator can be easily disassembled, doing so may partially demagnetize it and remagnetizing requires special equipment.

TESTING THE TRIPPING TRANSFORMERS

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

The third link in the protection system is the breaker-mounted tripping current transformers. When secondary current testing is done with the static trip on the 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 pickup values above tolerance. However, there would be no way of knowing whether the problem was in the static trip or the transformers. Moreover, an open circuit in the transformer winding or wiring 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 breaker remove it or disconnect it. For Static Trip II, disconnect by removing the connecting strip from the terminal block. For first generation static trips, remove the wiring from the terminal block.

Breakers that are wired for four wire ground fault protection have a tripping current transformer external to the breaker either on the neutral bus or the ground strap. This external CT is wired to the breaker through secondary disconnect fingers. To test this CT the breaker must be in the cubicle in the "Test" position. If in doubt refer to the breaker wiring diagram.

There are two tests to be made, i.e., winding continuity and exciting current.

Continuity Test

The continuity test must be performed on tripping transformers rated 1000:1 Amperes or higher because normal exciting current is too low to read. The exciting current test will verify continuity on transformers of lower rating.

An ohmmeter is most suitable for the continuity test. For breakers with Static Trip II, test in turn across terminals 1 to 9, 2 to 9, and 3 to 9 of the terminal block for phase A, B, and C, respectively. For breakers with first generation trip devices test from each of the three heavy black wires to the heavy white wire. If the cubicle is wired for four wire ground protection (See Section Test Preparations), check the remote mounted CT by testing from 4 to 9 for Static Trip II and from the white wire to the wire that was connected to terminal 9 for a breaker with model 4WAG or 4WDG trip device.

Exciting Current Test

The purpose of this test is to reveal any shorted turns in the tripping transformer windings. Sixty Hertz ac voltage is applied to the secondary winding of the tripping transformer and the exciting current is monitored. Short circuited turns will be revealed by excessive exciting current and sometimes by overheating of the winding.

The test set is used as the source of ac voltage and the test set ammeter is used to monitor exciting current. Because the source for the internal dc power supply is the test set ac output, the dc output voltage is proportional to the ac output voltage and can be used to monitor the exciting voltage.

For exciting current tests the selector switch should be in the "Static Trip Test" position and the ammeter range switch should be in the "Low" position.

TABLE IV
TRIPPING TRANSFORMER EXCITATION TEST

Tripping Transformer Rating	Test Set Voltmeter Setting	Approx. Exciting Voltage	Approx. Variable Transf. Setting	Maximum Allowable Exciting Current
Amperes	Volts	Volts		Amperes
80:1	4.5	33.5	25	0.25
150:1	10.0	67	50	0.15
200:1	10.0	67	50	0.15
250:1	10.0	67	50	0.15
400:1	10.0	67	50	.05
600:1	21.0	134	100	.05
800:1	21.0	134	100	.03
1000:1 and up	21.0	134	1000	<.02

Connections

For breakers with Static Trip II plug the white lead into terminal 9 and the green lead into terminals 1, 2, and 3 in turn for phases A, B, and C, respectively. Connect the

green plug to terminal 4 to test the neutral bus or ground strap transformer. See "Test Preparations."

For first generation static trips it is recommended that bolted connections be made to the three black and one white tripping transformer leads that were removed from the terminal block, and that the black leads be wired to terminals 1, 2 and 3 and the white lead to terminal 9 of the terminal block on the test set. The test set green and white plugs can then be used to make connections just as on Static Trip II. For breakers using model 4WAG or 4WDG the fourth (remote CT) lead should be similarly extended and connected to terminal 4 of the test set terminal block.

Test Procedure

1. Connect the green plug to terminal 1 and the white plug to terminal 9. Connect the black voltmeter plug to the black terminal post on the test set and the yellow plug to the red post.
2. Refer to the second column of Table IV, for the voltmeter setting corresponding to the rating of the tripping transformers being tested.
3. Raise the voltage slowly with the "Current Adjust" control until the proper voltmeter setting is reached.
4. Note the ammeter reading and compare with the maximum allowable exciting current given in Table IV. A reading in excess of the value in the table indicates a defective tripping transformer.
5. Table IV also lists the approximate ac voltage actually applied and the approximate variable transformer "Current Adjust" setting. The figure .02 Ampere shown for tripping transformers rated 1000 Amperes and up is used because that is about the lowest readable current on the test set ammeter. Normal exciting current may be so small that ammeter deflection cannot be observed. That is why a separate continuity check must be performed on these ratings.