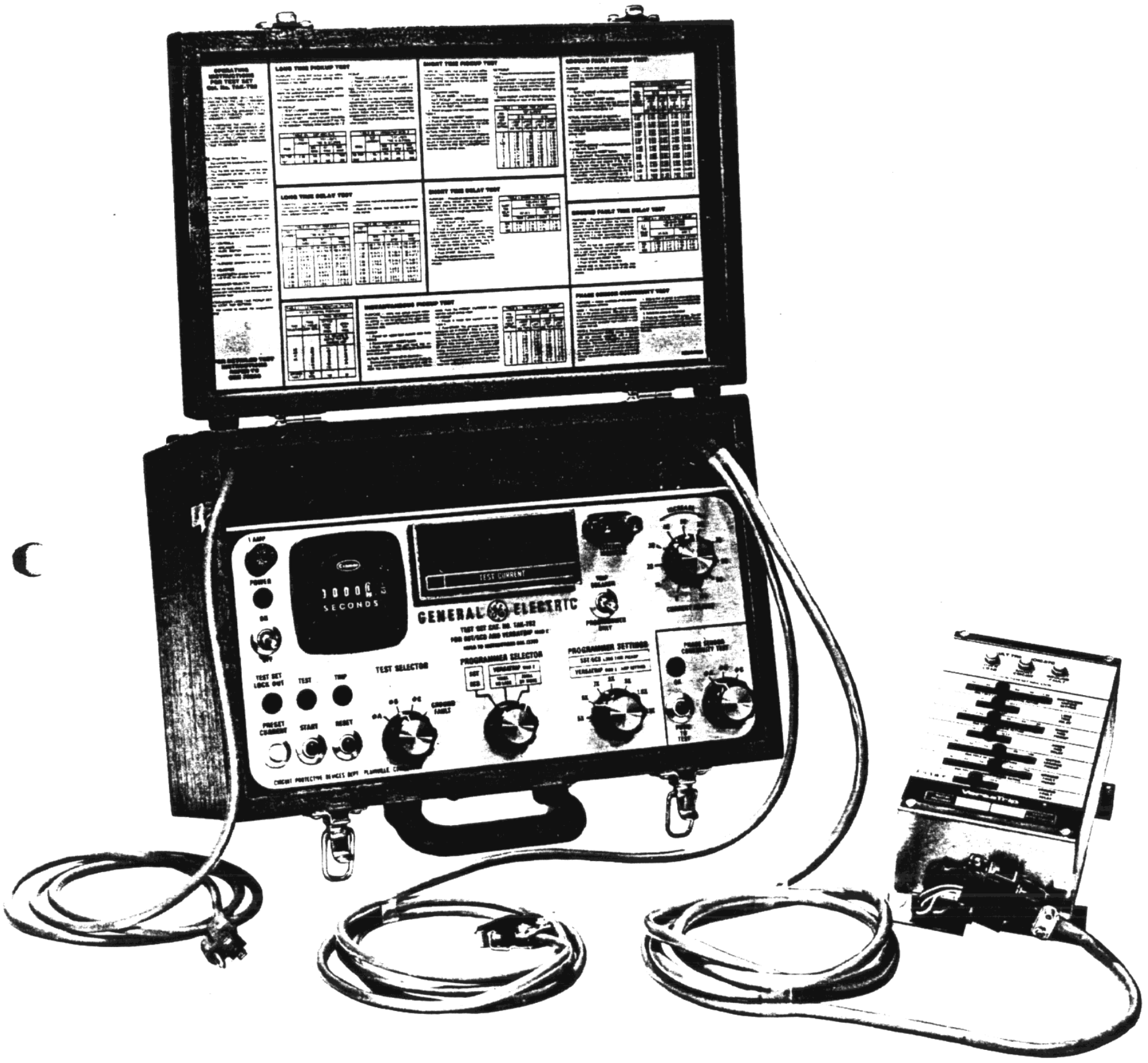
INSTRUCTIONS

GEK-73300-2

TEST SET Cat. No. TAK-TS2

For Testing VersaTrip Model 2 Solid-state Trip Devices used on Molded Case and Insulated Case Circuit Breakers



These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

DISTRIBUTION EQUIPMENT DIVISION
PLAINVILLE, CONNECTICUT USA

GENERAL ELECTRIC

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INTRODUCTION

The TAK-TS2 Test Set is a portable instrument designed for field testing the performance of VersaTrip model 2 solid-state overcurrent trip devices. The complete trip device system is comprised of the following components:

1. Solid-state Programmer Unit

2. Phase Current Sensors

3. Flux Shift Magnetic Trip Device

4. Fourth-wire Neutral Sensor for units containing a Ground Fault trip element for use on three-phase, four-wire load circuits.

All components, except the Neutral Sensor, are integrally mounted on the circuit breaker. When used, the Neutral Sensor is separately mounted in the bus or cable compartment of the switchgear. In drawout construction, it is automatically connected to the trip device on the breaker via a drawout secondary disconnect block.

The TAK-TS2 Test Set is used to perform the various trip device tests in two basic modes:

"A" — Solid State Programmer Unit Only
"B" — Complete Trip Device System

WARNING: *THESE TESTS CAN BE CONDUCTED ONLY ON A DEENERGIZED BREAKER - ONE WHICH IS COMPLETELY DISCONNECTED FROM ITS PRIMARY AND CONTROL POWER SOURCES.*

SOLID-STATE PROGRAMMER UNIT ONLY - MODE "A"

These tests are conducted with the programmer unit disconnected from the breaker. When performing the following tests, the programmer unit can remain mounted on the breaker, or can be completely removed from it.

Test Scope

1. Verify the time-current characteristics and pick-up calibration of the various trip elements.

Designations for the trip elements are abbreviated as follows:

LT - Long Time
ST - Short Time
INST - Instantaneous
GF - Ground Fault

2. Verify operation of the Fault Trip indicators on Programmer units so equipped.

COMPLETE TRIP DEVICE SYSTEM — MODE "B"

For these tests, the programmer unit is connected to the breaker through the test set.

Test Scope

1. All Programmer Unit tests previously described, plus the provision to optionally switch the Programmer's output to activate the Flux Shift Magnetic Trip Device to verify its operation via physically tripping the breaker.

2. Check continuity of the Phase Sensors.

SPECIFICATIONS

Input: 105-125 Vac 50/60 Hz
Power Consumption: 150 watts maximum
Weight: 20 pounds
Dimensions: 15 in. L x 9 in. H x 9¾ in. D

APPLICABLE TIME-CURRENT CURVES

VersaTrip Mod 2
LT, ST & INST GES-6184, 6186, 6187, 6188
VersaTrip Mod 2
Ground Fault GES-6185, 6189, 6190, 6191

OPERATING CONTROLS

The Test Set indicators and operating controls are self identified on the front panel arrangement. (See Fig. 1).

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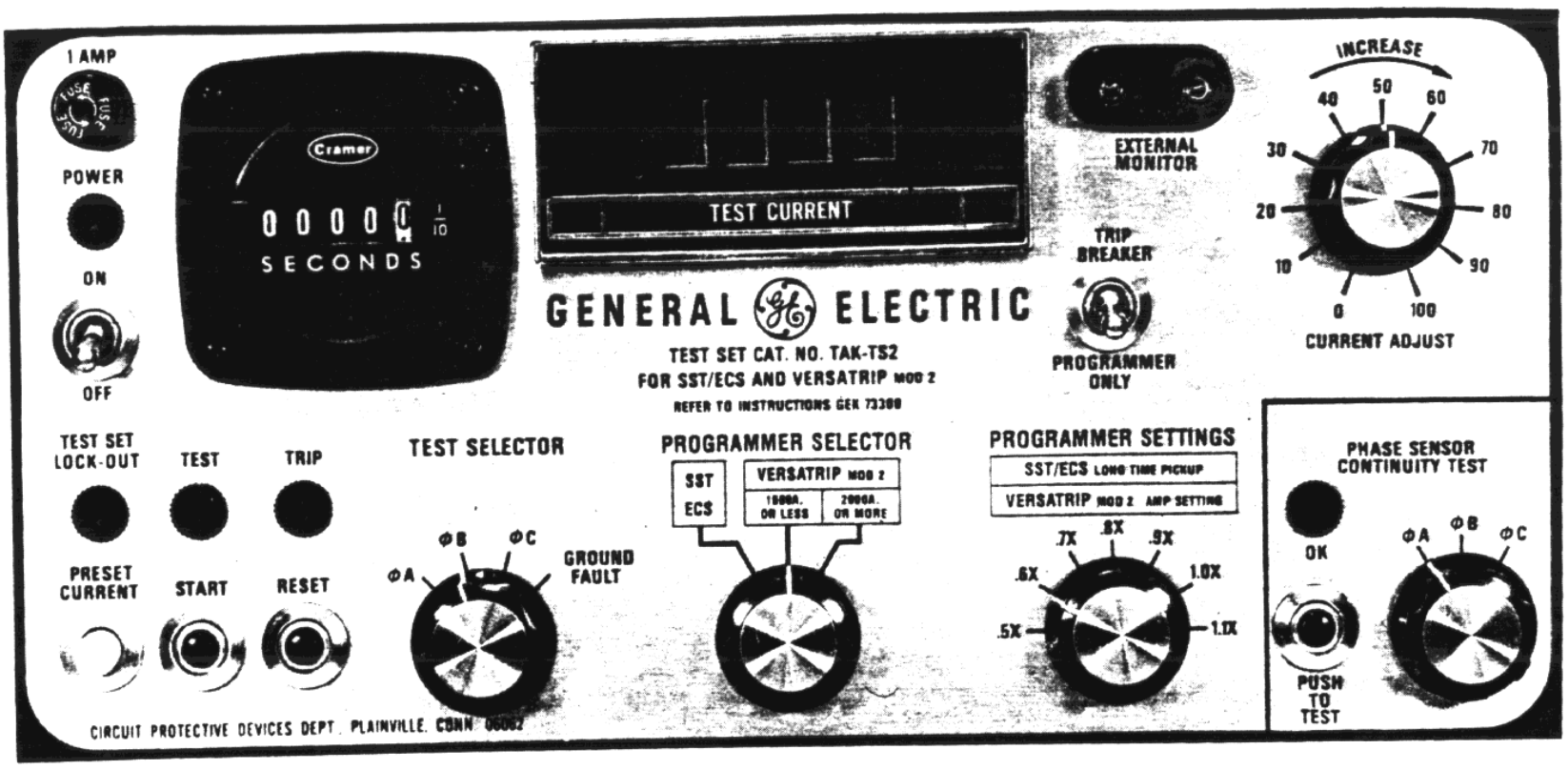


Fig. 1. Front panel

OPERATING CONTROLS

The Test Set indicators and operating controls are self identified on the front panel pictured above.

ON-OFF SWITCH

Applies 115 VA-c input power to the test set. A red companion LED indicator, located directly above, illuminates when the switch is ON. Protection is provided by a one ampere fuse located above the indicator light.

PRESET CURRENT BUTTON

Enables the operator to pre-establish (via the CURRENT ADJUST control) the desired test current prior to initiating a test. For this control to function, the programmer unit must be connected to the test set.

START BUTTON

Initiates the test by applying current to the programmer. The current persists until the unit trips or the reset button is actuated.

RESET BUTTON

Resets the test set logic so that a new test sequence can be initiated. It also stops a test in progress.

TEST SELECTOR

Positioned according to the trip element under test-phase overcurrent or GROUND FAULT.

PROGRAMMER SELECTOR

Set according to the type of trip device to be tested, i.e. SST/ECS; VersaTrip model 2 with sensor ampere rating of 1600 A or less; VersaTrip model 2 with sensor ampere ratings of 2000 A or more.

PROGRAMMER LONG TIME PICKUP SETTING SELECTOR

Establishes a test current magnitude consistent with and specifically for each LT pickup set point on the programmer. *For all phase current testing (LT, ST and INST elements), the position of this control must match the setting on the programmer.*

PHASE SENSOR CONTINUITY TEST

This section of the panel contains controls for checking electrical continuity of each phase sensor circuit. The selector determines the phase to be tested. Proper continuity exists when the OK LED indicator lights up when the PUSH TO TEST button is depressed. No light signifies that a high resistance or open circuit exists in the CT or its wiring harness.

CURRENT ADJUST KNOB

A variable transformer for establishing the desired level of test current to be applied to the programmer.

TRIP BREAKER — PROGRAMMER ONLY SWITCH

Provides a choice of two test modes:

"Programmer Only" Position **(Mode A)**

The programmer's trip signal output is confined to the test set circuitry and cannot trip the breaker.

"Trip Breaker" Position **(Mode B)**

The programmer's trip signal output is directed to the circuit breaker's magnetic trip device to physically trip the breaker. This mode establishes the integrity of the magnetic trip device and the programmer's capability to actuate it.

TEST CURRENT METER

Provides digital readout of the magnitude of the test current being applied to the programmer unit.

ELAPSED TIME METER

A mechanical counter which records the programmer's tripping time in seconds and tenths. It must be manually reset after completion of each test.

> **NOTE:** *When operating the test set from a 50 Hz supply, readings of the Elapsed Time Meter must be multiplied by 1.2.*

TEST SET LOCK-OUT INDICATOR

To prevent possible damage to the programmer unit when subjected to abnormally prolonged or continuous testing at high current levels, a lock-out circuit is provided. This circuit monitors the current-time input to the programmer such that when a predetermined limit is exceeded, the test set becomes inoperative for a period of approximately 70 seconds. It then automatically resets to its normal operating state. A lock-out condition exists whenever the TEST SET LOCK-OUT indicator is lit.

TRIP INDICATOR

An LED which, when lit, indicates that an acceptable trip signal has been delivered by the programmer. Conversely, a trip not accompanied by the light signifies that the trip signal amplitude is too low. Upon completion of a test, the TRIP indicator stays lit until the RESET or PRESET CURRENT button is depressed.

TEST INDICATOR

This LED lights whenever the PRE-SET CURRENT or START controls are activated.

EXTERNAL MONITOR JACKS, TEST SET ACCURACY

The test current values displayed on the Test Current Meter are accurate to within ± three percent of the meter reading. These limits are contingent upon a clean sine wave input voltage to the test set. Wave distortion can cause additional error.

Should greater accuracy be desired, provision is made for connecting external instruments via the EXTERNAL MONITOR jacks on the front panel. These jacks are connected across an isolated, precision 0.2 ohm resistor in series with the test current circuit. Output at these jacks is shown in Table 1.

The EXTERNAL MONITOR jacks may be employed also in conjunction with a storage oscilloscope for more accurate trip time measurement. For trip times less than one second, the test set time meter is capable of a single digit approximation only (nearest 0.1 second).

TABLE I — EXTERNAL MONITOR OUTPUT

PROGRAMMER SELECTOR	TEST SELECTOR	AMPERE SETTING	EXTERNAL OUTPUT (ac) PER UNIT TEST CURRENT
VersaTrip Mod 2 1600 Amperes or less	ϕA, ϕB, ϕC	.5X	25mV
		.6X	30mV
		.7X	35mV
		.8X	40mV
		.9X	45mV
		1.0X	50mV
	Ground Fault	Any	50mV
VersaTrip Mod 2 2000 Amp to 4000 Amps	ϕA, ϕB, ϕC	.5X	50mV
		.6X	60mV
		.7X	70mV
		.8X	80mV
		.9X	90mV
		1.0X	100mV
	Ground Fault	Any	100mV

X = Sensor ampere rating

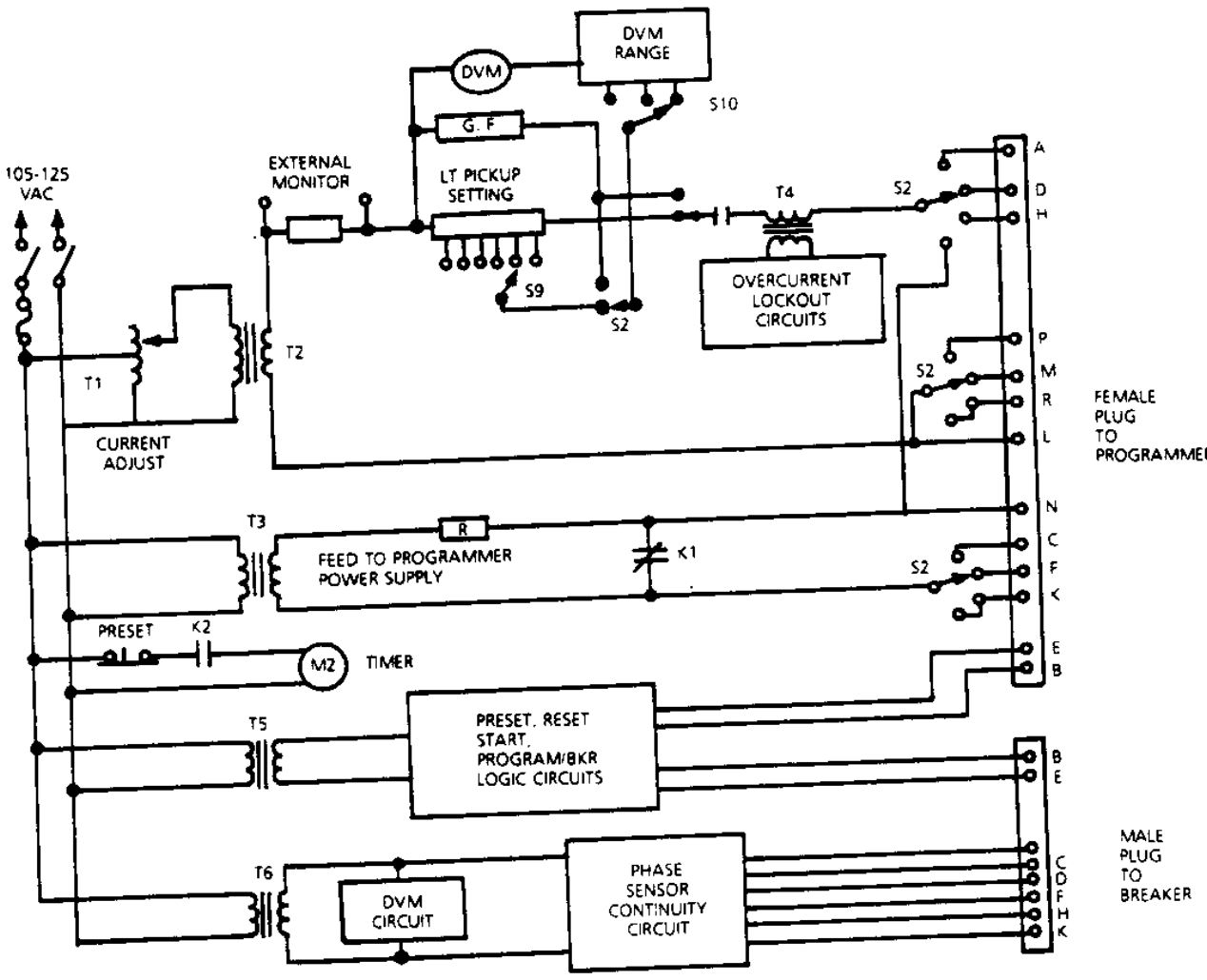


Fig. 2. Simplified Schematic of Test Set TAK-TS2

THE TEST SET CIRCUIT

A brief description of the test set circuitry is given below. Refer to the simplified schematic of Figure 2.

1. Input voltage is applied to the test set through a three-wire power cord with a ground conductor. The chassis and metal parts are grounded to protect the operator.

2. Output voltages are isolated from the input voltage by means of multiple winding iron core transformers.

3. All power to the test set is supplied through the ON-OFF switch and a one ampere slo-blo fuse.

4. T2 is a 12.6 volt filament transformer that provides low-voltage simulated fault signal currents to the programmer via the TEST SELECTOR switch S2 when relay contact K2 is closed. The test current is adjusted by variable transformer T1.

Switches S2, S9 and S10 provide the appropriate resistor selection for the digital meter.

The EXTERNAL MONITOR is a precision shunt resistor which provides an output that is an accurate representation of the test current.

5. The overcurrent lock-out circuit protects the programmer from prolonged or continuous testing at high current levels. Once energized, the circuit will lock out the test set for approximately 70 seconds and then automatically reset.

6. T3 is an isolation transformer that feeds the power supply of the programmer. Power is transferred when relay K1 is energized (normally closed contact opens). K1 is energized slightly before K2 in order to ensure that power supply voltage is available before test current is applied.

7. Power is applied to the timer by relay contact K2.

8. Transformer T5 powers the test set logic circuitry.

9. Transformer T6 powers the PHASE SENSOR CONTINUITY TEST circuit and the drive circuitry for the digital voltmeter.

10. A complete schematic diagram and parts list is given on pages 18 & 19.

How to Obtain Access to the Electronic Programmer for Testing

VersaTrip Model 2 Programmers used with Type TPSS, THSS Power Break Circuit Breakers — Frame size 1600 amperes or less.

a) *Breakers without the electrical operator accessory*
   1) Push the "off" button on the front of the circuit breaker.
   2) Remove the four top cover screws and remove the cover from the breaker. The programmer is now readily accessible.

b) *Breakers with the electrical operator accessory*
   1) Push the "off" button on the front of the circuit breaker.
   2) Remove the four top cover screws and remove the cover from the circuit breaker.
   3) Completely loosen the screw on the center of the middle cover. The screw is located directly in front of the close solenoid. Lift off the middle cover.
   4) The programmer is now readily accessible.

VersaTrip Model 2 Programmers used with Type TPSS, THSS Power Break Circuit Breakers — Frame size 2000 amperes or more.

a) *With or without electrical operator assembly*
   1) Push "off" button.
   2) Remove four screws holding the escutcheon cover over the VersaTrip programmer. Remove the escutcheon cover.
   3) Remove the four remaining screws and remove the cover of the breaker. The programmer is now readily accessible.

VersaTrip Model 2 Programmers used with Breaker Types THJS, THJSS, THKS, THKSS.

a) Push the "push to trip" button on the front of the circuit breaker.
b) Remove the pouch cover protecting the VersaTrip model 2 programmer.
c) Remove the two screws that secure the programmer to the circuit breaker frame.
d) The programmer may now be removed and access obtained to the connectors at the back of the programmer.

CONNECTING THE TEST SET

SAFETY PRECAUTIONS

WARNING: *BEFORE CONNECTING THE TEST SET TO THE BREAKER TRIP DEVICE SYSTEM, ENSURE THAT THE CIRCUIT BREAKER IS COMPLETELY DISCONNECTED FROM ITS POWER SOURCE. ON DRAWOUT EQUIPMENT, RACK THE BREAKER TO ITS DISCONNECTED POSITION. VERIFY THAT THE BREAKER IS OFF.*

CAUTION: *NEVER DISENGAGE THE HARNESS CONNECTOR FROM THE PROGRAMMER UNIT ON A BREAKER THAT IS ENERGIZED AND CARRYING LOAD CURRENT. THIS WILL OPEN-CIRCUIT THE CURRENT SENSORS, ALLOWING DANGEROUS AND DAMAGING VOLTAGES TO DEVELOP. SEE FIG. 2.*

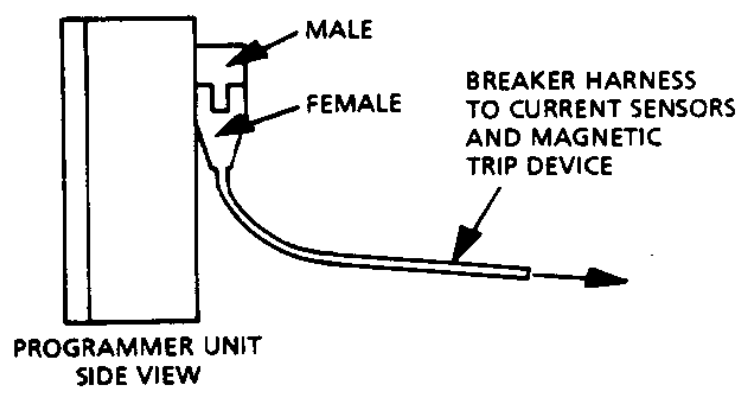


Fig. 2. Normal In Service breaker connection

CONNECTIONS

NOTE: *Before proceeding with the following connection work, ensure that the test set power supply cord is not connected.*

"Programmer Only" Test — Mode "A" (See Fig. 3)

1. Disconnect the breaker harness from the programmer unit.

2. Plug the test set female connector lead to the receptacle on the rear of the programmer.

3. The test set male connector lead need not be connected to the breaker harness for "Programmer Only" testing. However, the Fig. 4 connection should be used if "Complete System" tests are to be run also.

"Complete System" Test — Mode "B" (See Fig. 4)

1. Disconnect the breaker harness from the programmer unit and reconnect its female connector to the male connector lead from the test set.

2. Plug the test set female connector lead into the receptacle on the rear of the programmer.

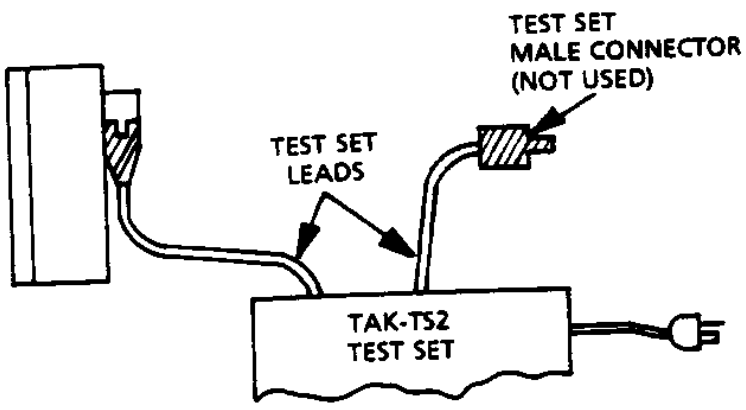


Fig. 3. Connection for Programmer Only test

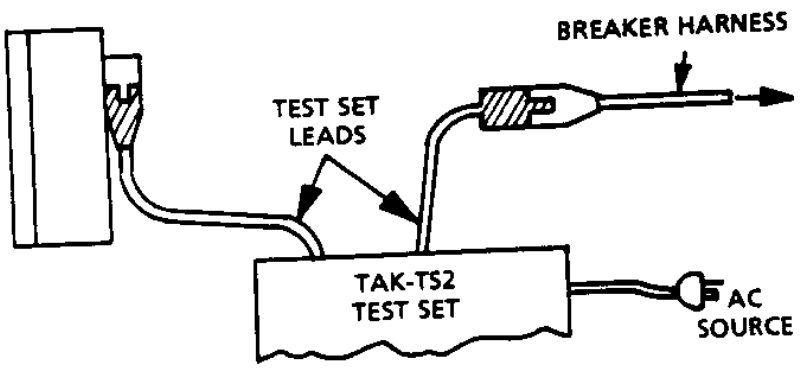


Fig. 4. Connection for Complete System test

VersaTrip Model 2 Programmers used with Type TPSS, THSS, Power Break Circuit Breakers — Frame size 1600 amperes or less.

Circuit breaker types TPSS, THSS have an interlock system that consists of a programmer and/or cover interlock. Frame sizes rated 1600 amperes or less have a combined programmer and cover interlock so that removal of either will prevent closure of the breaker. In this case, for a complete system check, remove the vent screen in the cover directly beneath the programmer. The screen is held in place by a compression fit between the screen and the molded slots in the cover and can be removed by pulling the screen from the slot. Removal of the screen will permit the test set cables to enter the circuit breaker for the connection shown in Figure 4. To satisfy the interlock mechanism, the cover must be replaced before testing. For breakers with an electrical operator accessory, both the middle and top covers must be replaced. At the completion of testing, be certain that the vent screen that was removed is reinstalled in the breaker cover.

VersaTrip Model 2 Programmers used with Type TPSS, THSS Power Break Circuit Breakers — Frame size 2000 amperes or more.

Direct access to the programmer is obtained with the cover removed. Simply connect per Figure 4. It is not necessary to replace the breaker top cover for testing on breakers with an electrical operator accessory. The top cover must be replaced on breakers without the electrical operator accessory.

VersaTrip Model 2 Programmers used with Breaker Types TJS, TJSS, THKS, THKSS.

Breaker types THJS, THJSS, THKS, THKSS are provided with an interlock system wherein the breaker cannot be closed with the programmer removed. For a complete system check, it will, therefore, be necessary to remove the programmer, connect the test set cables as shown in Figure 4 and reinstall the programmer in the breaker, carefully routing the test set cables between the top of the programmer and the breaker current sensors.

PRELIMINARY TEST PROCEDURE

The following steps should be conducted before starting functional tests.

1. Position the test set controls as follows:

   PROGRAMMER SELECTOR: Set to programmer type to be tested.

   CURRENT ADJUST: Rotate to zero

   TEST SELECTOR: ϕA

   TRIP BREAKER — PROGRAMMER ONLY: As desired.

   AMPERE SETTING SELECTOR: Position this knob identical to the programmer's ampere setting.

2. Record the "In Service" settings of the programmer so that its set points can be restored upon completion of testing.

3. Connect the test set power cord to the 105-125 vac power source.

4. Turn power ON.

5. Push the START button. The elapsed time meter will start to run and the TEST indicator should light and remain lit.

6. Push the RESET button. The elapsed time meter will stop and the TEST indicator light will go out.

7. Mechanically reset the elapsed time meter. Functional testing, described individually for each trip element in subsequent pages, may now begin.

LONG TIME PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. For any given ampere setting, this is achieved in two steps:

1. Test for NO PICKUP at a current value slightly below the published lower tolerance limit. See Note 1.

2. Test for PICKUP at a current value slightly above the published upper tolerance limit. See Note 2.

PROCEDURE

NO PICKUP

1. Programmer settings:

   LONG TIME DELAY — set on MIN band.

   The INT or MAX bands may be used if desired.

2. Position Test Set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   AMPERE SETTING SELECTOR — Must match the programmer's ampere setting.

   TEST SELECTOR — ϕ A, B or C

   TEST CURRENT — Preset the no trip test current shown in Table 2.

3. Reset timer and push RESET button.

4. Push START — Allow test to run until time delay of Table 2 has expired. Unit should NOT trip. For 50 Hz operation, multiply timer readings by 1.2.

PICKUP

1. Position Test Set controls — Same as NO PICKUP, Step 2, except:

   Preset CURRENT LEVEL to the trip current shown in Table 2.

2. Reset timer and push RESET button.

3. Push START. Allow test to run until unit trips. The time meter reading should conform to Table 2 limits. For 50 Hz. operation, multiply timer readings by 1.2.

   If unit does not trip within the specified time, repeat the test, carefully monitoring and readjusting the test current as necessary. Transient dips in the supply voltage could lower the test signal current below its pickup value, causing the programmer's timing circuit to reset.

Repeat PICKUP and NO PICKUP tests on the other phases.

TABLE 2
LONG TIME PICKUP

PROGRAMMER RESPONSE	TEST CURRENT	TIME LIMITS (SECONDS)		
		MIN BAND	INT BAND	MAX BAND
NO TRIP	1.00	250	500	1000
TRIP	1.30	<200	<400	<800

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

NOTES:

1. *Lower test limits are extended below the published pickup tolerance to allow for test set accuracy.*

2. *Upper test limits exceed the published pickup tolerance to allow for test set accuracy plus nominal dips in test set supply voltage. During testing, the test current should be monitored and adjusted if necessary.*

LONG TIME (LT) TRIP BAND TEST

PURPOSE

Verify that the LT characteristic conforms to its upper and lower band limits. This test requires measurement of delay times at three different values of test current.

PROCEDURE

1. Position test set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   AMPERE SETTING SELECTOR — Must match the programmer's ampere setting.

   TEST SELECTOR — ϕ A, B, or C

   TEST CURRENT — From Table 3, select three test current values. Preset the first value.

   NOTE: *These values must be below the short time and instantaneous pickup settings on the programmer, otherwise a premature trip signal will be received from those functions.*

2. Reset timer and push RESET button.

3. Push START. Allow test to run until trip occurs. TIME meter reading should conform to Table 3 limits. For 50 Hz. operation, multiply timer readings by 1.2.

4. Repeat the above test at the other two test values. This step verifies the linearity of the T-C characteristic.

5. Repeat the test on the other phases at one test value.

Repeat the above test series on the other delay bands.

TABLE 3
LONG TIME TRIP BANDS

PROGRAMMER LONG TIME TRIP BAND SETTING	TEST SET CURRENT ADJ SETTING	TRIP-TIME LIMITS IN SECONDS MIN	MAX
MAX	1.50	240.8	407.4
	2.00	135.4	229.2
	3.00	60.2	101.8
	4.00	33.8	57.3
	5.00	21.6	36.7
	6.00	15.0	25.5
	7.00	11.0	18.7
	8.00	8.4	14.3
	9.00	6.6	11.3
	10.00	5.4	9.2
INT	1.50	120.0	203.7
	2.00	67.7	114.6
	3.00	30.1	50.9
	4.00	16.9	28.6
	5.00	10.8	18.3
	6.00	7.5	12.7
	7.00	5.5	9.3
	8.00	4.2	7.2
	9.00	3.3	5.7
	10.00	2.7	4.6
MIN	1.50	60.2	101.8
	2.00	33.8	57.3
	3.00	15.0	25.5
	4.00	8.4	14.3
	5.00	5.4	9.2
	6.00	3.7	6.4
	7.00	2.7	4.7
	8.00	2.1	3.6
	9.00	1.6	2.8
	10.00	1.3	2.3

*Reflecting the ±3% test set accuracy, all test limits are extended beyond the published band limits of the time-current curves. During testing, the test current should be monitored and readjusted if necessary.

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

SHORT TIME PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at any desired pickup setting — one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Programmer settings:

   ST DELAY BAND — As desired.

   INST PICKUP — Must be set higher than the ST pickup setting, otherwise the unit will trip first on INST mode.

2. Position Test Set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   AMPERE SETTING SELECTOR — Must match the programmer's ampere setting.

   TEST SELECTOR — ϕ A, B, or C

   TEST CURRENT — Preset an upper test current limit from Table 4.

3. Reset timer and push RESET button.

4. Push START. The unit must trip in less than one second, as indicated by the timer. For 50 Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) —

Starting at the lower tolerance limit (Table 4), test incremental increases in test current until a trip occurs in less than one second, as indicated by the timer. Push the PRE-SET CURRENT button, read the actual pickup value.

NO PICKUP

1. Programmer settings — Same as PICKUP, Step 1.

2. Position Test Set controls — Same as PICKUP, Step 2 except:

   TEST CURRENT — Preset the lower test current limit from Table 4.

3. Push START. The unit must not trip in less than one second. However, a trip may occur after one second due to a signal from the LT element. For 50 Hz operation, multiply timer readings by 1.2.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 4
SHORT TIME PICKUP

PROGRAMMER SHORT TIME PICKUP SETTING	CURRENT ADJUST SETTING			
	60 Hz		50 Hz	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
1.5	1.30	1.70	1.27	1.65
2	1.75	2.27	1.69	2.20
2.5	2.18	2.83	2.11	2.75
3	2.61	3.40	2.54	3.30
4	3.49	4.54	3.39	4.40
5	4.36	5.67	4.24	5.50
6	5.23	6.80	5.08	6.59
7	6.11	7.93	5.92	7.69
8	6.98	9.07	6.78	8.79

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

SHORT TIME DELAY TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Programmer settings:

   INST PICKUP — Use maximum setting.

   SHORT TIME PICKUP — Use minimum setting.

2. Position Test Set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   AMPERE SETTING SELECTOR — Must match the programmer's ampere setting.

   TEST SELECTOR — ϕ A, B or C

   TEST CURRENT — Preset a test value two steps higher than the programmer's ST pickup setting (e.g., preset 5 for a 3.0 pickup setting). This avoids measurement at the knee of the time-current curve, where the time delay may be longer than the time limits given in Table 5.

3. Reset timer and push RESET button.

4. Push START. Observe trip time.

Repeat the above test on the other time bands, then check at least one band on each of the other phases.

TABLE 5
SHORT TIME DELAY

PROGRAMMER DELAY TIME SETTING	TIME LIMITS (SEC.)	
	LOWER	UPPER
MIN	0.095	0.17
INT	0.21	0.30
MAX	0.35	0.48

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

INSTANTANEOUS TRIP POINT TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at a given pickup setting — one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

AMPERE SETTING SELECTOR — Must match the programmer's ampere setting.

TEST SELECTOR — ϕ A, B, or C

TEST CURRENT — Preset an upper test current limit from Table 6.

2. Reset timer and push RESET button.

3. Push START. The unit must trip immediately as indicated by little or no discernible timer movement.

ACTUAL PICKUP VALUE (if desired) —

Starting at the lower tolerance limit (Table 6), test incremental increases in test current until an INST trip occurs (no discernible timer movement). Push the PRESET CURRENT button, read the actual current value.

NO PICKUP

1. Position Test Set controls — Same as PICKUP, Step 1, except:

TEST CURRENT — Preset the lower test current limit from Table 6.

2. Push START. The unit must not trip instantaneously (as in PICKUP, Step 3) — the INST element is not activated at these lower limit values. However, the unit is subject to and will respond to a time delayed trip signal from the LT element. Also, if so equipped, it responds to any ST element whose pickup is set below the INST setting. In either event, the delayed trip produces definite movement of the timer, a positive indication that the unit did not trip via the INST mode.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 6
INSTANTANEOUS TRIP POINT

PROGRAMMER INSTANTANEOUS PICKUP SETTING	CURRENT ADJUST SETTING			
	60 Hz		50 Hz	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
2.0	1.74	2.27	1.69	2.20
2.5	2.18	2.83	2.11	2.75
3.0	2.60	3.40	2.54	3.30
4.0	3.49	4.54	3.39	4.40
5.0	4.36	5.67	4.24	5.50
6.0	5.23	6.80	5.08	6.59
7.0	6.11	7.93	5.92	7.69
8.0	6.98	9.07	6.78	8.79
10.0	8.73	11.33	8.47	10.99

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

GROUND FAULT TRIP POINT TEST

PURPOSE

Verify that pickup occurs within tolerance. Two tests are required at a given pickup setting — one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   TEST SELECTOR — GROUND FAULT

   TEST CURRENT — Preset an upper test current limit from Table 7.

2. Reset timer and push RESET button.

3. Push START. The unit must trip, timer will indicate less than one second. For 50 Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) —

Starting at the lower limit (Table 7), test incremental increases in test current until a trip occurs in less than one second, as indicated by the timer. Push the PRESET CURRENT button, read the actual pickup value.

NO PICKUP

1. Position Test Set controls — Same as PICKUP, Step 1 except:

   TEST CURRENT — Preset the test current lower limit from Table 7.

2. Reset timer and push RESET button.

3. Push START. The unit should not trip, timer will read greater than one second delay. Discontinue the test after one second. If the test is allowed to run longer than 30 seconds, a trip signal can be received from the LT element for some programmer setting combinations. For 50 Hz operation, multiply timer readings by 1.2.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 7
GROUND FAULT TRIP POINT

PROGRAMMER GROUND FAULT PICKUP SETTING	CURRENT ADJUST SETTING			
	60 Hz		50 Hz	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
0.18X 0.2X	0.157 0.174	0.204 0.227	0.152 0.169	0.198 0.220
0.22X 0.25X	0.192 0.218	0.249 0.283	0.168 0.212	0.242 0.275
0.27X 0.3X	0.235 0.260	0.306 0.340	0.229 0.254	0.297 0.330
0.35X 0.4X	0.305 0.348	0.397 0.453	0.296 0.339	0.385 0.440
0.45X 0.48X	0.392 0.419	0.510 0.544	0.381 0.407	0.495 0.528
0.5X 0.6X	0.436 0.523	0.567 0.680	0.424 0.508	0.550 0.659
0.7X 0.75X	0.611 0.654	0.793 0.850	0.593 0.635	0.769 0.824

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

GROUND FAULT DELAY TIME TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Position Test Set controls:

   PROGRAMMER SELECTOR — Switch to the type of programmer being tested.

   TEST SELECTOR — Ground Fault

   TEST CURRENT — Preset the "current adjust" control to the fully clockwise position. This ensures that the test current is well above the knee of the curve for all GROUND FAULT pickup settings.

2. Reset timer and push RESET button.

3. Push START. Observe trip time.

Repeat test on the other time bands.

TABLE 8
GROUND FAULT DELAY

PROGRAMMER DELAY TIME SETTING	TIME LIMITS (SECONDS)	
	Lower	Upper
MIN.	0.065	0.12
INT	0.165	0.24
MAX	0.30	0.40

IF TEST RESULTS DO NOT CONFORM, SEE PAGE 16

PHASE SENSOR CONTINUITY TEST

PURPOSE

Check continuity of the breaker-mounted phase sensors.

NOTE 1. The test set does not measure accuracy of the phase sensors. This can be established only by testing the complete trip device as a system, in conjunction with the breaker, using a commercially available high current - low-voltage ac test set.

NOTE 2. The test set is not for use in testing the equipment-mounted neutral sensor employed with trip devices equipped with a ground fault trip element for three-phase, four-wire applications. This neutral sensor is excluded from the scope of the circuit breaker/trip device test procedures, and instead should be treated as an integral part of the maintenance and testing activity associated with the switchgear equipment.

PROCEDURE

1. Ensure all power is removed from the circuit breaker and that the male connector from the test set is connected to the female connector of the circuit breaker harness.

2. Select the phase to be tested.

3. Push the PUSH-TO-TEST button. The OK light must light while the PUSH-TO-TEST button is depressed. Absence of the OK light indicates a high resistance or open circuit in the CT or wiring harness. The PUSH-TO-TEST button must be released between tests.

TRIP INDICATORS

As an optional accessory, programmers may be equipped with,pop-out type, fault trip indicators.

In operation, these plungers pop out each time their respective trip element delivers a trip signal. If a programmer trips on LT overload, only that indicator is activated. For short circuits a single indicator serves both the ST and INST elements and is activated by either. The GF indicator responds only to a ground fault trip.

When testing programmers so equipped, the trip indicators are functioning properly if they are activated each time their respective trip element trips.

IF TEST RESULTS DO NOT CONFORM

— Review the test instructions to see that the proper procedure is being followed.

— Check all settings on the programmer unit.

— Is the PROGRAMMER SELECTOR switch in the correct position for the PROGRAMMER being tested?

— Is the TEST SELECTOR switch in the GROUND FAULT position for ground fault testing? In the ϕA, ϕB or ϕC position for all other tests?

— Does the PROGRAMMER AMPERE SETTING control on the test set match the programmer's LT pickup setting?

— Is the TRIP BREAKER — PROGRAMMER ONLY switch in the proper mode?

— Are all cable connectors fully engaged?

— If the ST element trips too soon or at too low a level, the INST pickup setting is probably too low. The INST pickup must be set at a higher value than the ST element. Pickup band tolerances must also be recognized.

— Timer makes noise but does not operate. Push RESET button. Manually reset timer.

— When using 50Hz power, the timer reading must be multiplied by 1.2.

— See Section OPERATING CONTROLS regarding test set accuracy. Is the TEST CURRENT meter zeroed?

— Use the EXTERNAL MONITOR jacks as described in OPERATING CONTROLS to check the current level that is being applied to the programmer unit. These jacks may be used also to monitor trip time.

— If results do not conform after repeating the test(s), replace the programmer. Do not reinstall a defective programmer on the circuit breaker.

COMPLETION OF TESTS

After trip device testing has been completed, the following procedures must be diligently executed preparatory to restoring the circuit breaker to service:

— *Ensure that the breaker is fully disconnected from any power source.*

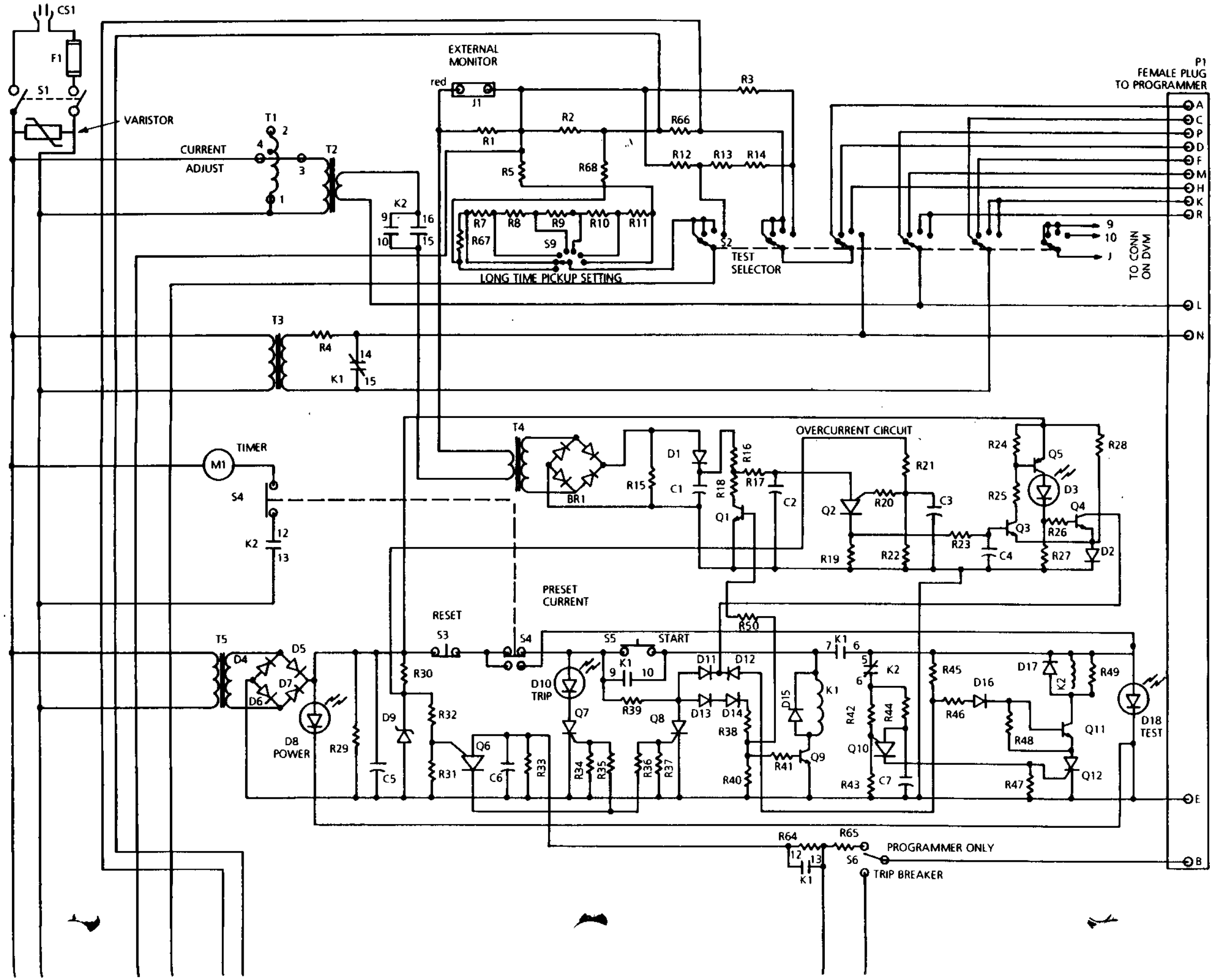
— *Disengage the test set connectors from the programmer and the female circuit-breaker harness connector.*

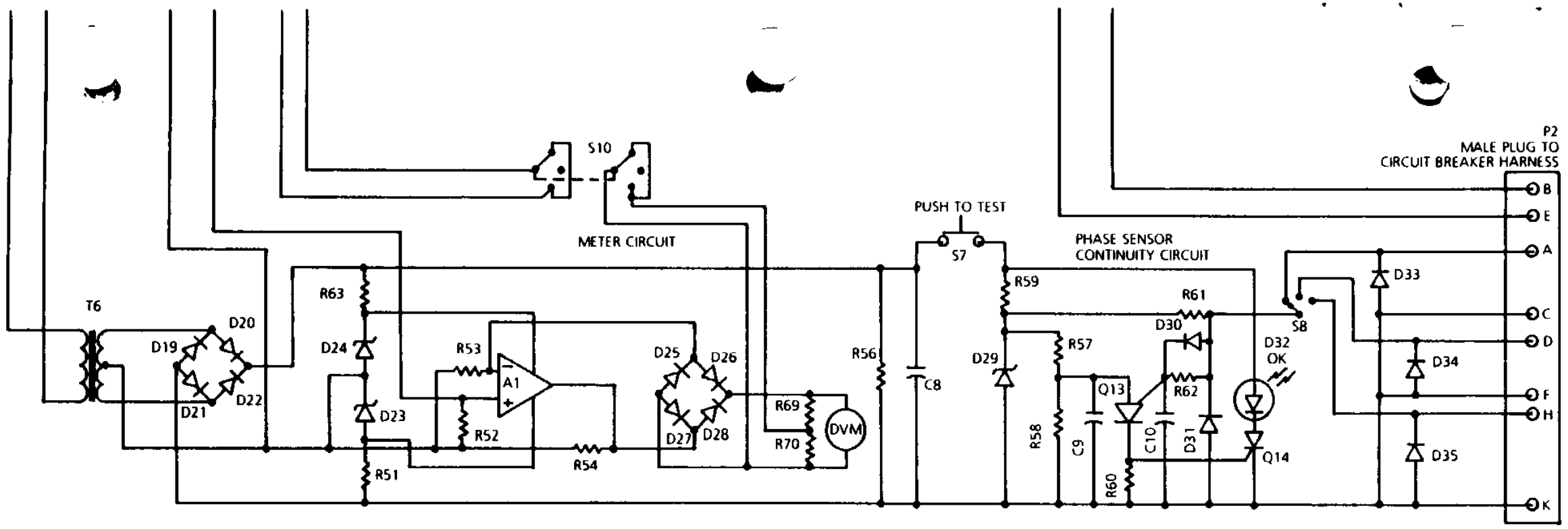
— *Reconnect the female harness connector to the programmer unit. Failure to do this voids the breaker's automatic trip system.*

— *Reset all trip indicators on the programmer.*

— *If the programmer's adjustment knobs were moved to different settings during testing, restore them to their "as received" settings.*

– NOTES –


CS1
F1
S1
VARISTOR
CURRENT
ADJUST
T1
T2
EXTERNAL
MONITOR
red
J1
R1
R2
R3
R66
R5
R68
R12
R13
R14
K2
R7
R8
R9
R10
R11
R67
S9
S2
LONG TIME PICKUP SETTING
TEST
SELECTOR
P1
FEMALE PLUG
TO PROGRAMMER
A
C
P
D
F
M
H
K
R
L
N
TO CONN
ON DVM
T3
R4
K1
TIMER
M1
S4
K2
T4
BR1
D1
C1
R15
R18
R16
R17
C2
Q1
OVERCURRENT CIRCUIT
R21
Q2
R20
C3
R19
R22
R23
C4
R24
Q5
R28
R25
D3
Q4
Q3
R26
R27
D2
PRESET
CURRENT
RESET
S3
S4
S5
START
R50
T5
D4
D5
D7
D6
D8
POWER
R29
D9
C5
R30
R32
R31
Q6
C6
R33
D10
TRIP
Q7
R34
R35
R39
Q8
R36
R37
D11
D12
D13
D14
R38
R40
D15
K1
R41
Q9
R42
R44
Q10
R43
C7
K1
K2
R45
R46
D16
D17
R48
R49
Q11
Q12
R47
D18
TEST
E
B
R64
R65
PROGRAMMER ONLY
S6
TRIP BREAKER



PARTS LIST

RESISTORS	
R1	0.2 Ohm ± .1% – 25W
R2	0.5 Ohm ± 1% – 50W
R3	20.0 ± 1% – 25W
R4	3000 Ohm ± 5% – 10W
R5, R12, R58	1K ± 1% ¼W
R7	261 ± 1% ¼W
R8	196 ± 1% ¼W
R9	154 ± 1% ¼W
R10	121 ± 1% ¼W
R11	100 ± 1% ¼W
R13	715 ± 1% ¼W
R14	7870 ± 1% ¼W
R15	806 ± 1% ½W
R16, R17, R18, R32	100K ± 1% ¼W
R19, R20, R44, R52, R62	1 MEG ± 10% – ¼W
R21	332K ± 1% – ¼W
R22	681K ± 1% – ¼W
R23, R24, R28	51K ± 5% – ¼W
R25	22K ± 5% – ¼W
R26, R34, R37, R40, R48, R60	1K ± 5% – ¼W
R27	220 ± 5% – ¼W
R30, R39, R45	2.2K ± 5% – ½W
R31	34K ± 1% – ¼W
R33	10 ± 1% – 3W
R35, R36, R41	2.2K ± 5% – ¼W
R38, R46	4.7K ± 5% – ¼W
R42, R43	10K ± 5% – ¼W
R47	270 ± 5% – ¼W
R49	2.7K ± 5% – ½W
R51, R63	1K ± 5% – ½W
R53	1406 ± 0.1% – ⅛W
R54, R50	100K ± 5% – ¼W

RESISTORS	
R56	100K ± 10% – ½W
R57	3.65K ± 1% – ¼W
R59	100 ± 5% – 2W
R61	680 ± 5% – ½W
R64	560 ± 5% – ½W
R65	68 ± 5% – ½W
R66	1.0 ± 1% 50W
R67	365 Ω ± 1% ¼W
R68	549 Ω ± 1% ¼W
R69, R70	1500 ± 0.1% ⅛W

CAPACITORS	
C1	1.0 ± 10% – 250 VDC
C2	270 ± 10% – 15 VDC (Tantalum)
C3, C4, C6, C9, C10	.1 ± 10% – 100 VDC
C5, C8	150 – 75 VDC (Aluminum)
C7	.33 ± 10% – 50 VDC

DIODES	
BRI	Varo VE18
D1, D2, D11, D12, D13, D14, D16, D25, D26, D27, D28, D30	1N4148
D4, D5, D6, D7, D15, D17, D19, D20, D21, D22, D31, D33, D34, D35	1N5060
D3, D8, D10, D18, D32	LED – 28V – 20 ma
D9	15V ± 1% – 1W
D23, D24	1N4740 – 10V – 1W
D29	1N5352B – 15V – 5W

TRANSISTORS AND SCRS	
Q1, Q3, Q4, Q9, Q11	GES930LF18
Q2, Q6, Q10, Q13	2N6028
Q5	2N5087
Q7, Q8, Q12, Q14	C103B
A1	OP. Amp. MC1741CP

SWITCHES	
S1	JBT ST22K
S2	Centralab SA2021-4C-000
S3	Grayhill 4002
S4	Grayhill 46-05-08-502-0101
S5, S7	Grayhill 4001
S6	JBT ST12D
S8, S9	Centralab SA2001-4C-000
S10	Centralab SA2003-4C-000

TRANSFORMERS	
T1	Variable Transformer G.E. 9T92A1
T2	Stancor P8641
T3	Triad N-48X
T4	G.E. 5678743G4
T5, T6	Stancor P8601

MISCELLANEOUS	
Relays K1, K2	Allied T154-4C-28 VDC
Connector P1	Amp 201298-1
Connector P2	Amp 201297-1
DVM	Digitec 2770-02
EXTERNAL MONITOR JACK	H. H. Smith 269RB
TIMER	Cramer 636S10084
VARISTOR	V150LA20A

Fig. 6. Schematic and Parts List — Test Set TAK-TS2 (Dwg. 139C4767)

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