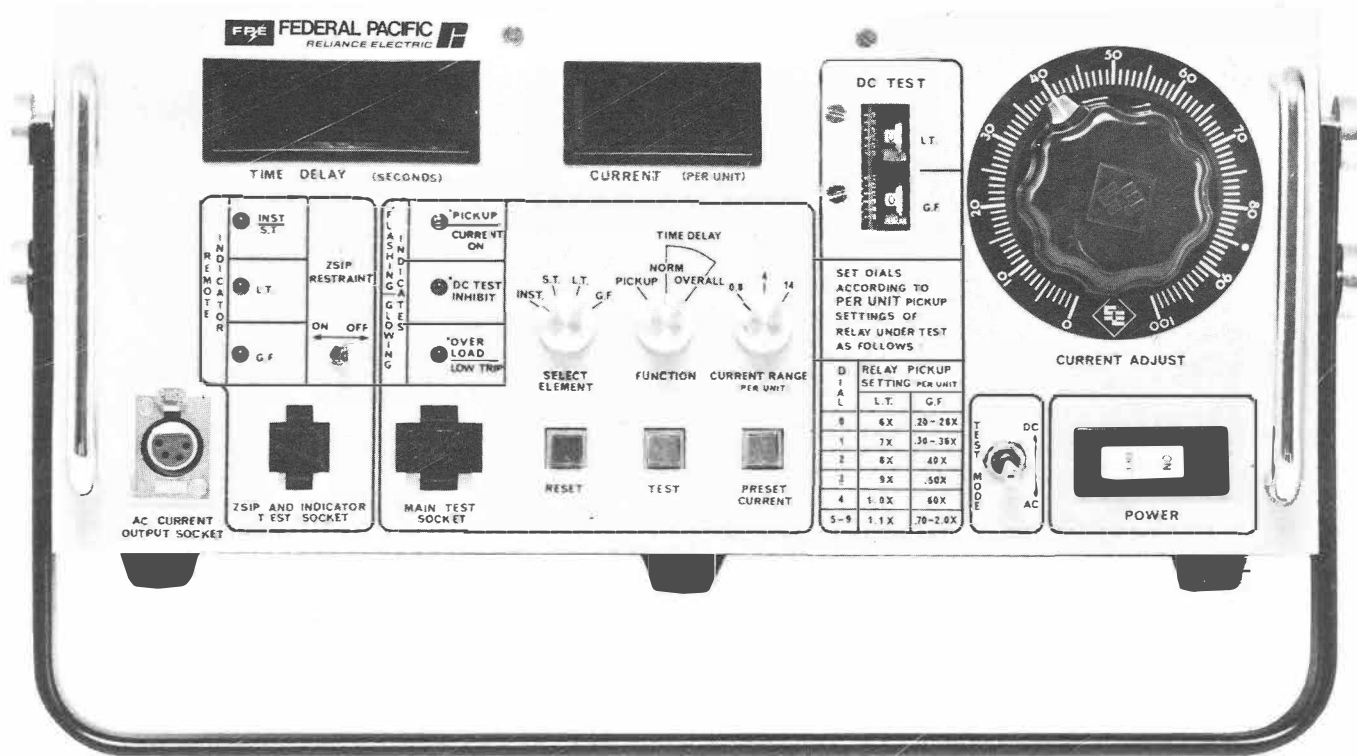




INSTRUCTION MANUAL

TYPE DDT-SSD Test Set



TYPE DDT-SSD TEST SET

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TYPE DDT-SSD TEST SET

Test Set Data

Input voltage — 120 volts AC $\pm 10\%$

Input frequency — 60Hz

Power Requirement — 1kVA

Output AC current —

continuous 30 amp,

maximum 70 amp $\pm 10\%$ momentarily (USD relay connected)

Output DC current —

maximum 2.8 amp $\pm 10\%$

Accuracy — AC Test Mode (including line voltage fluctuation)

Pickup (any element) — $\pm 2\%$

Time delay (Long Time) — $\pm 10\%$

Time delay (other elements) — $\pm 2\%$

Accuracy — DC Test Mode (including line voltage fluctuation)

Pickup (any element) — $\pm 3\%$

Time delay (Long Time) — $\pm 10\%$

Time delay (other elements) — $\pm 2\%$

Operating Temperature $-0^{\circ}\text{C} +40^{\circ}\text{C}$

TYPE DDT-SSD TEST SET

SECTION 1

1. INTRODUCTION & SPECIFICATION

The Federal Pacific Type DDT-SSD Test Set is a portable instrument used for field testing of the Type SSD, three phase, AC Overcurrent Trip Device. It is completely self-contained, and is capable of checking all facets of the relay operation.

This test set is capable of testing of the complete tripping system consisting of the SSD device, current sensors and the trip device solenoid. The breaker will not be tripped as a result of any tests in DC mode. However, in this mode the tests should be carried out only on relays mounted in special enclosures, making them accessible with the breaker door closed.

1.2 Description

A brief description of the 3 phase AC overcurrent trip device is first given for reference purposes. The front panel controls, on the test set are then discussed in detail.

1.2.1 SSD Trip Device:

The unit receives signals from the primary current sensors, senses overloads and faults and determines when to initiate tripping in accordance with preselected instruction. The energy required to activate the direct acting shunt trip is obtained by totally diverting the output of the sensors from the monitoring circuitry to an OUTPUT TRIP PULSE CIRCUIT — after a fault condition has been determined.

Four Time-Current characteristics are provided to preselect fault levels and time delays; instantaneous, short time, long time and ground fault (Fig. 1). The short time and ground fault elements have selectable definite time delay bands. Optionally available are additional I²t short time bands. The long time element has 10 selectable time delay bands. The Test Set is capable of checking each pickup and time delay setting on each element.

The primary current sensors used with the SSD Trip Device have 5 amp secondaries. The maximum pickup setting on the unit is on the Instantaneous element, at 12X sensor ampere tap. This element also has a self-inhibiting (OFF) position on its pickup selector switch. When the Instantaneous pickup switch is in the "OFF" position, the Instantaneous element will not function.

The Type SSD Trip Device also has a ZSIP feature which is available as an option. Either the Ground Fault (G.F.) or the G.F. and Short Time (S.T.) elements can be operated in ZSIP mode. In ZSIP mode, the unit that senses a fault in its own zone operates instantaneously and simultaneously sends a restraint signal to the upstream devices and forces them to revert to the time co-ordinated protection (TCP) mode.

The Test Set is capable of delivering momentarily 70 amp (14 per unit) secondary injection current to the trip device, thereby allowing the complete testing of the instantaneous element. To allow accurate calibration testing of the pickup settings on all elements, the current source of the Test Set is controlled to provide three output ranges with metering from 0.2 per unit to 14 per unit.

The trip device accumulates energy on a trip capacitor after a fault condition has been determined and dumps it into the trip device solenoid. To assure overall operation of the unit, it is necessary to check that this TRIP circuit does accumulate the required amount of energy when given the signal to do so by any of the four elements. The test set has a built-in feature to monitor the trip capacitor voltage and give indication of a LOW TRIP during the Overall Time Delay Test.

1.2.2 Type DDT-SSD Test Set:

The instrument is completely self-contained, including a compartment for storing the test cables and a carrying handle. The handle is also used to tilt the front of the instrument for easier viewing. All the operating controls, indicators and input/output connectors are mounted on the front-panel.

The Test Set comprises basically of a current source and logic circuitry to check the trip functions. The front-panel of the Test Set is shown in (Fig. 3). Each item labelled in Fig. 3 is described below:

- a) **Power Switch:** This is an electromagnetic circuit breaker with a built-in pilot lamp for power indication. It controls the input AC power to all sections of the test set.
- b) **Test Mode Switch:** This switch determines the type of the Test current, either AC or DC, provided by the test set. The AC secondary injection current should be applied to the terminals (marked G, N, A, B and C) of the trip device. DC secondary injection current may be applied to the relay through the 'D' type test plug of the device.

To check calibration of the SSD, it is recommended that AC test mode be used, for better accuracy. When the relay is in service with the circuit breaker, DC test mode can be used to check the function of the unit without interrupting the power system.
- c) & d) **DC Test Inhibit Setting Switches:** The function of them is to detect fault current level and inhibit the operation of the test set. Therefore, these two switches should be set corresponding to the actual L.T. and G.F. element setting on the trip device. In AC test mode, the DC test inhibit circuit will not function at all regardless of the settings.
- e) **Relay Pickup Level Table Used for DC Test Mode:** This lookup table provides a guide for setting of the switches c and d corresponding to the L.T. and G.F. element settings respectively on the trip device. If any trip device setting is not listed on this table, it is recommended that the closest setting lower than the device pickup level be used.
- f) **Secondary Injection Current Adjust Knob:** It provides continuous adjustment of the output current either AC or DC within the range selected.
- g) **Current (per unit) Display:** It is a fixed-decimal point, four digit seven segment LED (light emitting diodes) display. The two fractional digits below decimal point allow readings of the current level as low as 0.02 per unit. This metering circuitry is a peak responding circuit and is calibrated in per unit (one per unit is 5A). In DC test mode, the current display will monitor the highest system phase or ground current.
- h) **Time Delay (seconds) Display:** It is a fixed-decimal point, 5 digit LED display. The display allows timing as low as 0.02 seconds up to 999.99 seconds. The display may appear in five modes during operation as below:
 - i) All five digits are blanked when the FUNCTION switch is set to the PICKUP position.
 - ii) The fractional digits will be displayed when the FUNCTION switch is set to the TIME DELAY position: .00.
 - iii) Up to 0.99 seconds elapsed time, two digits will be displayed: .99.
 - iv) Up to 9.99 seconds elapsed time, four digits will be displayed: 09.99.
 - v) If the test current drops below the element pickup level of the trip device during timing, timing will pause within 1 second.

- i) **Current Range (per unit) Switch:** It controls the output range of the current source and the current meter. The full scale reading of the current display corresponds to the range selected: 0.8 per unit, 4 per unit, and 14 per unit.
- j) **Preset Current Push-button Switch:** The current source is activated when this pushbutton is held depressed. It is used to preset the test current for the various relay functional tests. To avoid ambiguous operation of the trip device during the setting of the current, all test circuits are automatically reset when this pushbutton is depressed.
- k) **Function Switch:** It selects one of these test functions: PICKUP, NORMAL TIME DELAY and OVERALL TIME DELAY.

NORMAL TIME DELAY position will allow checking of the device time delay circuit only and it will be noticed that the solenoid trip coil is not activated.

OVERALL TIME DELAY test will measure overall time delay of the complete trip system including the trip device solenoid coil. The overall time delay may be slightly longer than the normal time delay. The difference is especially significant for the G.F. time delay test.

- l) **Test Pushbutton Switch:** Pressing this pushbutton switch will activate whatever functional test is selected by the function switch.
- m) **Select Element Switch:** This selects the element of the trip device to be tested. The selectable elements are INST., S.T., L.T. and G.F.
- n) **Reset Pushbutton Switch:** It resets all test functions, displays and indicating light.
- o) **Pickup/Current on Indicator:** This glows continuously when the TEST pushbutton switch is depressed. It flashes when the element under test has picked up. During a time delay test if the current drops below the pickup level, the indicator will stop flashing and glow continuously. When the current restores above the pickup level, the indicator will start flashing again.

In DC test mode the flashing of this light without any secondary injection current indicates that the relay has actually been picked up by the system current (either overload or short circuit current, or ground fault current). In the meantime, all the test set functions should be inhibited.
- p) **DC Test Inhibit Indicator:** In the DC test mode, if a load or ground current exceeds the setting of the switches (c or d), this indicator will flash and all test set functions will be inhibited.
- q) **Overload/Low Trip Indicator:** The output of the secondary injection current source is monitored internally. The current source is automatically shut off when the output current exceeds 4 per unit and energized for a period longer than that allowed by the maximum time band of the Long Time Delay. When this condition occurs the indicator flashes.

During OVERALL TIME DELAY test, this indicator will glow continuously if the trip voltage is below 120V or the charging time of the trip capacitor is longer than 1.5 seconds. Either situation may indicate a lower than normal trip energy level.
- r) **ZSIP Restraint Switch:** This switch is used to test the ZSIP function of the unit by using a Self Restraint method. When it is set to the ON position, Restraint Out signal will be fed back into the Restraint In terminal. Therefore, the time delay will be in accordance with the time band setting.

At OFF position the Restraint signal is disconnected and the time delay will be instantaneous (50 m Sec. for S.T. and 20 m Sec. for G.F.).

- s, t, u) **Remote Indicator:** The status of the Remote Indicator contacts of certain type SSD Models are monitored directly by these indicators.

A lighted indicator signals closed contact. The dry contacts for remote indication are activated (from normally open position to close position) when the corresponding element of the trip device picks up and the preset time delay expires. The results can be observed after the Normal Time Delay Test for all elements except the G.F. element. For indication of G.F. trip, the Overall Time Delay can be performed.

- v) **Main Test Socket:** This is a 15-pin female connector. The mating plug of this connector forms part of the Main Test Cable which interfaces the unit with the test set.

In DC test mode, the secondary injection current as well as the regular signals exchange are provided via this Main Test Socket.
- w) **ZSIP And Indicator Test Socket:** This is a 9-pin female connector through which the ZSIP function and Remote Indication contacts status can be tested. A ZSIP and indicator Test Cable is provided for proper interfacing of the unit and the test set.
- x) **AC Current Output Socket:** The output of the AC secondary injection current source is available via this connector. An AC current cable terminated with the mating plug at one end and two alligator clips at the other end is supplied with the test set.

1.3 Specifications

1.3.1 Time Delay Display:

The display has a range from 0.01 seconds to 999.99 seconds. The accuracy of timing is $\pm 2\%$.

1.3.2 Current Display:

The display has a range from 0.01 per unit to 19.99 per unit. The accuracy of the measured AC current is $\pm 2\%$. That of the measured injected DC current is $\pm 3\%$, an additional $\pm 2\%$ is imposed on it due to the internal circuitry tolerance of the SSD device. The accuracy of monitoring the load current is $\pm 10\%$.

1.3.3 Secondary Injection Current Source:

The AC current source is designed to be capable of injecting continuous 30 ampere of momentarily 70 amperes into the input impedance of the relay. Basically it is independent of the load impedance as long as the impedance does not exceed the SSD nominal value, but the current is dependent on the line voltage. Thus, $\pm 10\%$ variation of the injected current may be noticed due to any line voltage fluctuations as well as any increase of the relay impulse as the matching transformers inside the relay warm up during testing.

The DC current source is capable of injecting a maximum of 2.8 amps into the trip device. The variation of the injected current will be $\pm 8\%$ due to the line voltage fluctuation.

An electronic protective circuit in the test set prevents overheating of the source and the matching transformers inside the SSD. This circuit shuts off the current source and resets the test functions when the output current exceeds 4 per unit and is energized for a period longer than that allowed by the maximum time band of the Long Time Delay element.

1.3.4 Interconnecting Cables

The cables required to interconnect the test set to the trip device are provided and housed in a compartment built into the

cover. They are 6.5 ft (2m) in length. These cables can be identified as:

Cable 1: AC Current Cables: One end of the cable is a 4 pin make connector for mating with the test set. The other end consists of two alligator clips for the trip device terminals.

Cable 2: Main Test Cable: One end of the cable is a 15 pin connector for mating with the MAIN TEST SOCKET of the test set. The other end consists of a D-connector for direct interface with the TEST PLUG on the SSD faceplate and two alligator clips for connection to T1 and T2 terminals.

Cable 3: ZSIP and INDICATOR Test Cable: One end of this cable is a mating plug for the ZSIP AND INDICATOR TEST SOCKET on the test set. The other end provides a means for termination on the connectors on the left side of the SSD unit.

1.3.5 Primary Control Power:

120 volts \pm 10%, 60 Hz, 1KVA

1.3.6 Operating Temperature

The operating temperature range of the test set is 0°C to +40°C.

1.3.7 Dimensions

Height — 7 in./178 mm

Width — 16 in./406 mm

Depth — 11.5 in./292 mm

Weight — 50 lbs/22.7 kg

SECTION 2

2. OPERATING INSTRUCTIONS

2.1 Introduction

This section of the manual contains information regarding the operation of the Type DDT-SSD Test Set. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, please contact your nearest Sales Representative or Federal Pacific Electric Company.

The procedures outlined below do not specify any particular calibration points to be tested. The general procedure for each test is given and it is the operator's decision as to which pickup and time delay settings are to be tested. To determine the validity of the results, the operator should refer to the time-current characteristics of the SSD device, as shown in Figure 4. However, a set of recommended calibration points to be checked and results that should be obtained are given in Section 3.

2.2 Preliminary Connections

2.2.1 Connect the instrument to AC line power.

2.2.2 Depress the Power Switch

It is recommended that the CURRENT ADJUST knob be turned fully counter-clockwise prior to and after every test, except when the output current is required to be preset.

2.2.3 Interconnection of Test Set and Type SSD Trip Device for AC TEST

Three cables are provided for interconnection:

- a) Insert the proper mating plug of cable 1 into the AC CURRENT OUTPUT SOCKET on the test set. Connect one of the alligator clips at the other end of the cable to any one of the phase terminals on the SSD (marked A, B, and C). Connect the other alligator clip to the neutral terminal on the SSD (marked N) for all tests pertaining to the overcurrent elements (instantaneous, short time and long time). For the ground fault element tests, connect this clip to the terminal marked G on the SSD.
- b) Insert the proper mating plug of cable 2 into the MAIN TEST SOCKET on the test set. Insert the 15-pin 'D' type plug at the other end of this cable into the TEST SOCKET on the trip device. Connect the two alligator clips brought out from the same end of the 'D' type plug to terminal T1 and T2 on the trip device.
- c) For testing units with ZSIP features, insert the proper mating plug of cable 3 into the ZSIP AND INDICATOR TEST SOCKET on the test set. Insert the 10-pin plug at the other end of this cable into the rectangular opening on the left side of the trip device.

2.2.4 Interconnection of Test Set and Type SSD Trip Device for DC TEST

This test enables a functional check of the trip device in service without having to interrupt the electrical system that the circuit breaker is serving.

The following steps on the Test Set should be completed before proceeding with a preliminary connection to the relay.

- a) Set the TEST MODE switch to the DC position.
- b) Set the DC TEST inhibit setting switches (labelled as L.T. and G.F.) corresponding to the respective relay pickup levels. The Trip Device PICKUP LEVEL table should be used as a guide for setting of the aforementioned switches. Should the situation arise when the G.F. pickup setting is not listed on the table, the closest dial setting lower than the setting should be chosen.

After completing these two steps, the connection described in section 2.2.3(b) should be made.

— CAUTION —

"In Service" Tests on units (D.C. Mode) should be carried out only on elements mounted in special enclosures, making them accessible with the **Breaker Door Closed**.

Under no circumstances apply DC Tests to trip devices mounted in standard manner — which requires the breaker door to be **open** to gain access.

If breaker is open, then regardless of the type of mounting, it can be tested in the D.C. mode.

2.3 Test Procedures

2.3.1 Test Modes

The Type SSD Trip Device is tested in the AC test mode.

- a) **AC Test Mode:** In AC Test Mode, the unit can be tested outside or inside the circuit breaker which, if installed in the switchboard cubicle, must be in the disconnect position. For AC test, the TEST MODE switch on the test set should be set to the AC Position.
- b) **DC Test Mode:** If continuity of electrical service is of utmost importance, the Type SSD Trip Device can be tested in service, without disconnection of the circuit breaker, simply by putting the Test Set in DC Test mode. Before proceeding with any tests in DC mode, two steps (a and b) described in section 2.2.4 should be completed.

2.3.2 Pickup Tests

These tests can be performed either in AC or DC test mode. For these tests, the T1 and T2 terminals do not have to be connected.

- a) Select the element to be tested by the SELECT ELEMENT switch on the test set. Set appropriate pickup selector switch on the trip device to the level to be tested.
- b) Set the FUNCTION switch on the test set to the PICKUP position.
- c) Set the CURRENT RANGE switch to 4 p.u. for long time, 14 p.u. for instantaneous and short time, and 0.8 p.u. or 4 p.u. range for ground fault depending on the pickup level to be tested.
- d) Press the TEST pushbutton. The FLASHING INDICATES PICKUP indicator will glow continuously.
- e) Rotate the CURRENT ADJUST knob clockwise slowly until the pickup indicator begins to flash. The current source shuts OFF immediately when pickup is achieved. But the current reading meter remains displaying the exact pickup level for 2 seconds and then reset to zero automatically. However, the FLASHING INDICATES PICKUP indicator should keep on flashing.
- f) When the instantaneous element is tested and the ZSIP AND INDICATOR TEST plug is connected, the following will be observed: The LED on the relay corresponding to the INST/S.T. will come on, concurrently the indicator (LED) on the test set labelled as REMOTE INDICATOR INST/S.T. will glow. However, the connection of this test plug is not available on DC Test Mode, the indication on the test set will not be observed.

2.3.3 Time Delay Tests (NORMAL)

The purpose of this test is to check the calibration of the time delay circuits of the different trip elements independent of the trip device solenoid. If the recommended test current (6 per unit) is used on AC test mode, the time delay readings should be corresponding to the labelled values on the faceplate of the

unit. For these tests, the T1 and T2 terminals do not have to be connected.

- a) Select the element to be tested by the SELECT ELEMENT switch on the test set.
- b) On AC test mode, set the appropriate time delay selector switch on the trip device to the desired setting. The corresponding pickup selector switch should be set to the minimum pickup setting.
- c) Set the Function switch on the test set to the NORM Time Delay position.
- d) Set the CURRENT RANGE switch to 4 p.u. for ground fault, 14 p.u. for Instantaneous, short time and long time. Preset the test set current by depressing the PRESET CURRENT pushbutton switch and adjusting the CURRENT ADJUST knob to the desired level. The recommended preset currents are tabulated as below:

Elements	Preset Current	
	AC Test Mode	DC Test Mode
Instantaneous	6 per unit	*
Short Time	6 per unit	*
Long Time	6 per unit	6 per unit
Ground Fault	2.5 per unit	2.5 per unit

*The test current should be at least 130% more than the pickup level of the subject element.

— CAUTION —

1. Before pressing the PRESET CURRENT pushbutton switch to preset the current, it is recommended that the CURRENT ADJUST knob be turned fully counter-clockwise.
 2. When ground fault time delay tests at high currents are required, to avoid the unnecessary overheating of the ground element components of the trip device, the current injected into the ground element should not exceed 2.5 p.u. for more than 3 seconds.
- e) Depress the TEST pushbutton switch. The FLASHING INDICATES PICKUP indicator will flash while the test is in progress, and thereby indicates that the element has pickup and is timing. When timing has expired, the FLASHING INDICATES PICKUP Indicator light will cease to flash and disappear. The time delay will be registered on the TIME DELAY display of the test set.
 - f) If the ZSIP and INDICATOR TEST plug is connected to the trip device (Type SSD with 'IR' designation), the corresponding LED on the relay as well as that on the test set (labelled as REMOTE INDICATOR), should glow after the time delay has expired. However, Ground Fault indicators will not come on with this NORM delay test.
 - g) The TIME DELAY display may be initialized by depressing the RESET pushbutton switch or TEST pushbutton switch. The REMOTE INDICATOR LEDs can be reset by the RESET pushbutton switch either on the SSD unit or on the test set.
 - h) The test may be aborted at any time by depressing the RESET pushbutton switch on the test set — this will shut OFF the current source as well as reset the TIME DELAY display.
 - i) The secondary injection current of the test set is line voltage dependent and the long time delay is proportional to the square of the injected current. Line voltage fluctuation during the long time delay test and slight variation of the input impedance of the trip device could render results

outside the tolerance band of the relay. Therefore, for long time delay measurements, the tolerances are $\pm 20\%$. For results within a tolerance of $\pm 10\%$, it is recommended that either continuous manipulation of the CURRENT ADJUST be performed or a constant line voltage to the test set be used.

For short time and ground fault time delay measurements, the tolerances are $\pm 12\%$.

NOTE: To test the Short Time or Ground Fault time delay, the ZSIP/TCP switch with which some Type SSD models are equipped should be set to the TCP mode. Consult section 2.3.6 for detailed ZSIP test.

2.3.4 Time Delay Tests (OVERALL)

These tests will measure the total time delay of the trip system up to and including the energization of the shunt trip coil. Therefore T1 and T2 terminals on the unit must be connected by the two alligator clips from the MAIN TEST SOCKET cable.

The test procedures for the Overall Time Delay Test are the same as that for the Norm. Time Delay Test described in the previous section. The only exception is the Function switch which should be set at the OVERALL TIME DELAY position.

One difference in observation is the Ground Fault indication which should come on after the Overall Time Delay Test for the Ground Fault element.

2.3.5 ZSIP Test

This is part of the S.T. or G.F. time delay test and is applicable only to type SSD-4, SSD-5, SSD-6 and SSD4IR, SSD5IR and SSD6IR.

For this test, the ZSIP AND INDICATOR TEST cable should be connected to the trip device as described in the Preliminary Set-up Procedure.

- a) Set the ZSIP/TCP switch on the unit to the middle position which is the ZSIP mode for the G.F. and the TCP mode for the S.T.
- b) Set the ZSIP RESTRAINT switch on the test set to the ON position.
- c) Carry out the time delay tests for the G.F. and S.T. elements as described in section 3.3.3 or 3.3.4. The time delay registered on the test set should be in accordance with the time band settings on both elements.
- d) Turn the ZSIP RESTRAINT switch on the test set to the OFF position and repeat the time delay tests as before. The time delay for the G.F. should be in the ZSIP mode and for the S.T., it should be in accordance with the time band setting.
- e) Set the ZSIP/TCP switch to the left most position which is the ZSIP mode for both G.F. and S.T. With the ZSIP RESTRAINT switch on the test set in the OFF position, repeat the time delay tests. The results of the tests on both elements should be in the ZSIP mode regardless of the time delay setting on the trip device.
- f) Turn the ZSIP RESTRAINT switch on the test set to the ON position and repeat the same time delay tests. The results should be dictated by the time delay setting of the trip device.

2.3.7 Remote Indicator Test

To determine the validity of the Remote Indication status using the test set, the ZSIP AND INDICATOR TEST plug should be connected to the SSD. After the element under test has timed out, the corresponding LED labelled as REMOTE INDICATOR on the test set will glow. The local indicators on the unit faceplate will also glow. (Applies to SSD1, 2 and 3IR and SSD4, 5 and 6IR.)

SECTION 3

3. RECOMMENDED TEST POINTS FOR AC MODE

3.1 Introduction

This section of the manual discusses the extent to which a trip device must be tested to assure its integrity. The Test Set is capable of checking each pickup and time delay setting on each element as well as optional features such as ZSIP functions and Remote Indication contact status. Since each calibration point is thoroughly checked in the factory, it is usually necessary to check a few selected points to ensure that no damage has been done to the unit since the factory tests.

3.2 Long Time Element

3.2.1 Pickup:

Check position 4 of the selector switch on the SSD unit. This corresponds to a pickup of 1.0 per unit as observed on the table correlating the switch position to actual pickup levels. The current meter should display the level within the range from 0.92 per unit to 1.08 per unit.

3.2.2 Time Delay:

Check position 1 on the trip device selector switch. This corresponds to a time delay, at 6 per unit secondary injection current into the unit, of 4 seconds regardless of any delay position either NORMAL or OVERALL on the Test Set. The digital indicator should read between 3.6 seconds and 4.4 seconds at a constant line voltage, 3.2 seconds and 4.8 seconds considering $\pm 10\%$ line voltage fluctuation.

If the Local and Remote Indication Option is available and the ZSIP and INDICATOR TEST POCKET cable is interconnected, the L.T. LED AND REMOTE INDICATOR L.T. indicator on the trip device and the test set respectively should also be turned on at the end of the test.

3.3 Short Time Element

3.3.1 Pickup:

Check position 1 on the device selector switch. This corresponds to a pickup of 3.0 per unit. The current display should indicate the range from 2.7 per unit to 3.2 per unit.

3.3.2 Time Delay:

Check position 3 on the device selector switch. This corresponds to a definite time delay of 0.45 seconds. The digital timer should read between 0.39 and 0.50 on the NORM DELAY position, and 0.41 and 0.52 on the OVERALL DELAY position at 6 per unit secondary injection current into the unit. The INST/S.T. LED and REMOTE INDICATOR INST/S.T. indicator on the trip device and the test set respectively should be glowing at the end of the test, if the ZSIP AND INDICATOR TEST SOCKET cable is interconnected.

3.4 Instantaneous Element

3.4.1 Pickup:

Check position 2 on the selector switch. This corresponds to a pickup of 6.0 per unit. The current display reading should fall within the range from 5.5 per unit to 6.5 per unit.

3.4.2 Time Delay:

With Instantaneous pickup setting at position 2, preset test current at 6.5 per unit. Set the test set Function switch to the Overall Delay position. Time delay registered should not exceed 0.05 seconds.

3.5 Ground Fault Element

3.5.1 Pickup:

Check position 2 on the trip device selector switch. This corresponds to the pickup levels depending on the model as shown in the following table. The expected range of the measured pickup level is also included.

Model SSD Trip Device	Corresponding Pickup Level at Position 2	Expected Range of Pickup Level Measured
SSD4/4IR-16 SSD5/5IR-16 SSD6/6IR-16	0.4 per unit	0.36 to 0.44 per unit
SSD4/4IR-20 SSD5/5IR-20 SSD6/6IR-20	0.3 per unit	0.27 to 0.33 per unit
SSD4/4IR-32 SSD5/5IR-32 SSD6/6IR-32	0.24 per unit	0.21 to 0.26 per unit
SSD4/4IR-40 SSD5/5IR-40 SSD6/6IR-40	0.24 per unit	0.21 to 0.26 per unit

3.5.2 Time Delay:

Check position 2 on the selector switch. This corresponds to a time delay of 0.20 seconds on the SSD trip device. The digital timer should read between 0.17 seconds to 0.22 seconds on the NORM DELAY position, between 0.39 seconds to 0.50 seconds on the OVERALL DELAY position at the 0.5 p.u. injection current to the relay. For this test, the pickup setting of the Ground Fault element should be set at the zero position. The G.F. LED (if available) and the REMOTE INDICATOR G.F. indicator should turn on at the end of OVERALL Time Delay Test, if the ZSIP AND INDICATOR TEST SOCKET cable is interconnected.

SECTION 4

4. QUICK SETUP GUIDES AND SIMPLIFIED TESTING PROCEDURES WITH RECOMMENDED TEST POINTS

4.1 Introduction

In this section, diagrams to assist quick setup of the DDT-SSD Test Set is provided. These diagrams are especially useful when the calibration of the trip device is required to be checked quickly. However, it is recommended that the more detailed test procedures described in section 2 be read carefully before using the test set.

The recommended test points provided indicates the minimum extent to which a device should be tested to assure its integrity. The test set is capable of checking each pickup and time delay setting on each element as well as optional features such as ZSIP functions and Remote Indication Contact Status. Since each calibration point is thoroughly checked in the factory, it is usually necessary to check a few selected points to ensure that no damage has been done to the unit since the factory tests.

4.2 Setup and Test Procedures

4.2.1 AC Test for Type SSD Trip Device

- a) Long Time pickup: refer to Diagram 1
 - b) Long Time delay: refer to Diagram 2
- If the Local and Remote Indication Option is available and the ZSIP AND INDICATOR TEST SOCKET cable is interconnected, the L.T. LED and REMOTE INDICATOR L.T. indicator on the trip device and test set respectively should be turned on at the end of the test.
- c) Short Time pickup: refer to Diagram 3
 - d) Short Time delay: refer to Diagram 4
 - e) Instantaneous pickup: refer to Diagram 5
 - f) Time delay test on the Instantaneous element: refer to Diagram 6
 - g) Ground Fault pickup: refer to Diagram 7

The recommended pickup setting on the trip device is position 2 of the selector switch. This corresponds to the pickup levels depending on the type of SSD as shown in the table in section 4-51.

- h) Ground Fault delay: refer to Diagram 8
- i) ZSIP Function — Short Time: refer to Diagram 9
- j) ZSIP Function — Ground Fault: refer to Diagram 10

4.2.2 DC Test Setup for Type SSD Trip Device: refer to Diagram 11

Preliminary setup and interconnection between the trip device and test set is shown in Diagram 11. All relay functions can be tested in DC Test Mode with test procedures identical to the AC Test Mode. The exception is test current for the time delay test which is independent on the pickup setting of the element to be tested. To achieve results, the test current for the instantaneous and Short Time delay tests should be 130% or more than the pickup level. However, the same test currents (6 and 2.5 per units for L.T. and G.F. respectively) as in AC Test Mode can be used for Long Time and Ground Fault delay tests.

4.3 General

The tolerance given in the proceeding sections are based on $\pm 8\%$ of the nominal pickup level and $\pm 10\%$ of the nominal time delay of the SSD and accumulative tolerances of the test set. Similarly, bands for other settings may be calculated by noting the nominal values on the unit faceplate or from the time-current characteristics shown in Figure 4.

The Long Time delay and the Short Time delay at position 9 as shown on the table of the unit faceplate, are based on 6 per unit current input. These bands have an inverse time-current characteristic, and nominal delays at other current input levels may be determined from the time-current characteristics.

If the test set has been stored in sub-zero temperature it should be switched on and allowed to warm up for at least 30 minutes before testing is attempted. The tolerances given for the test set are based on sinusoidal 60Hz waveforms.

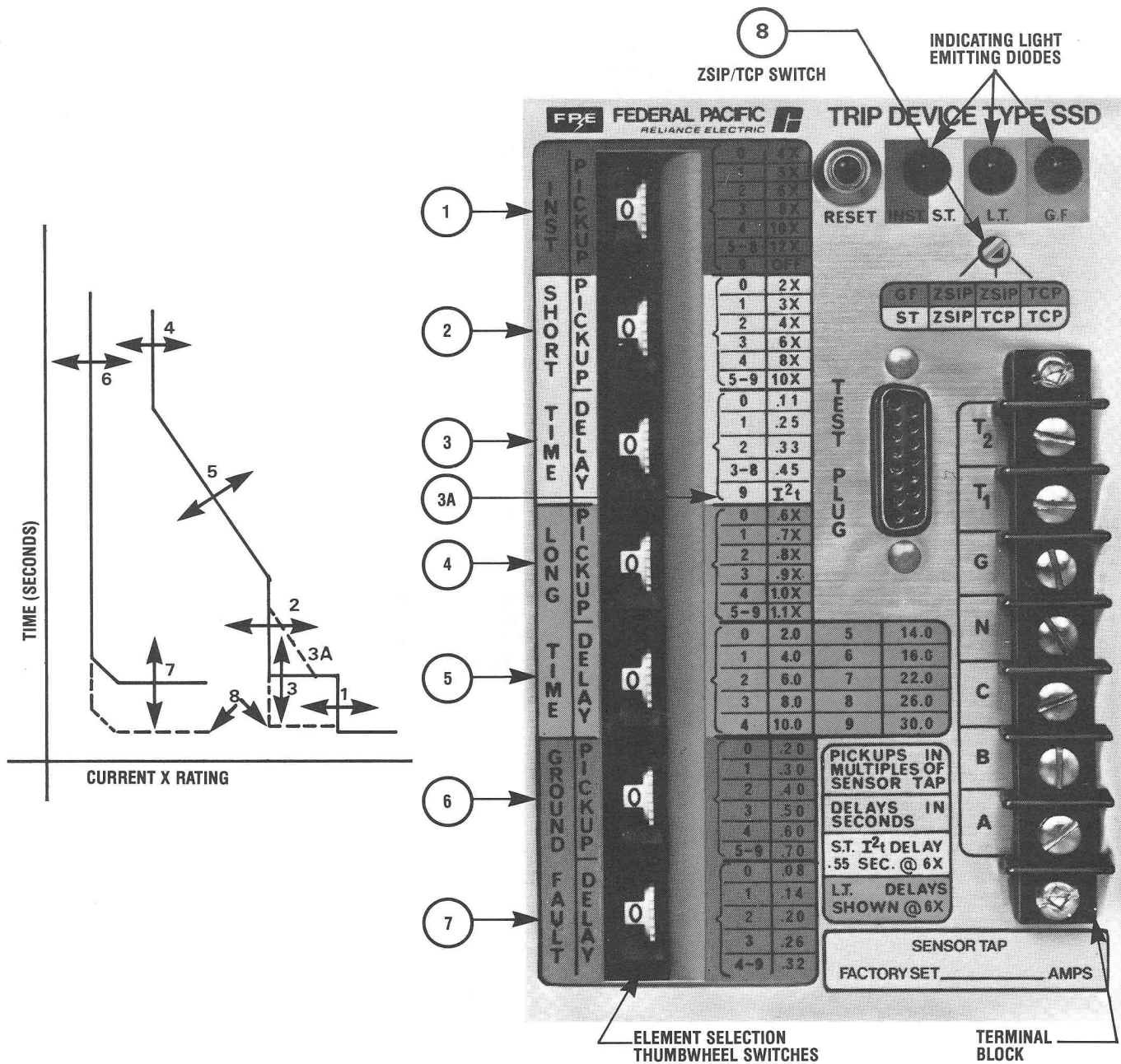


Fig. 1 FACEPLATE LAYOUT — TYPE SSD-6IR TRIP DEVICE

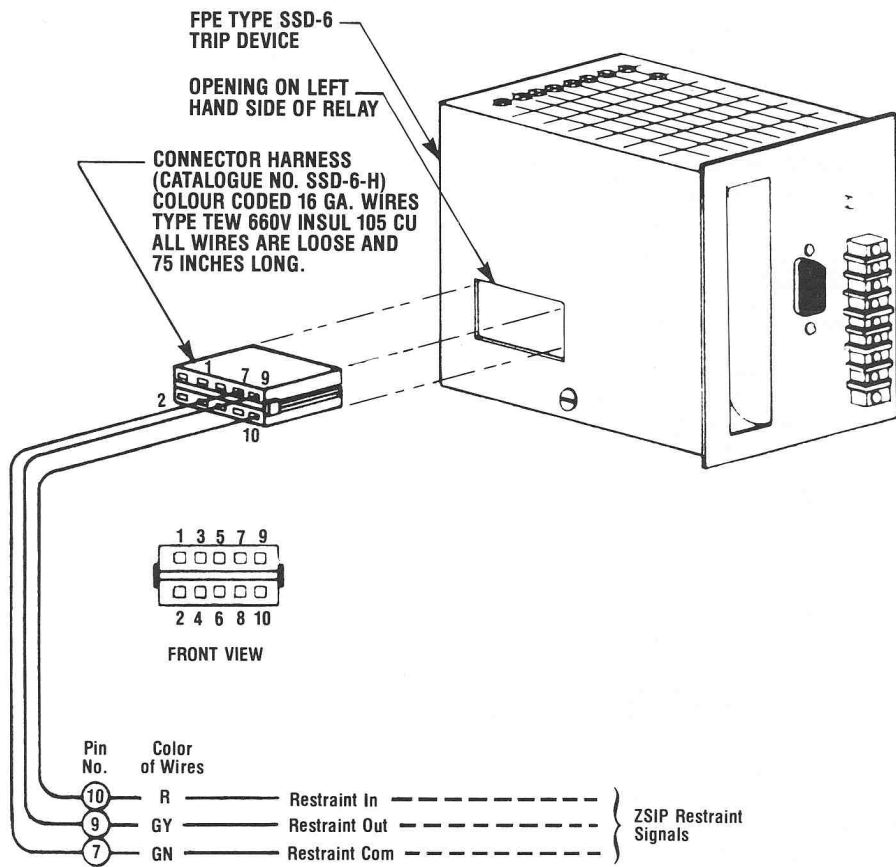
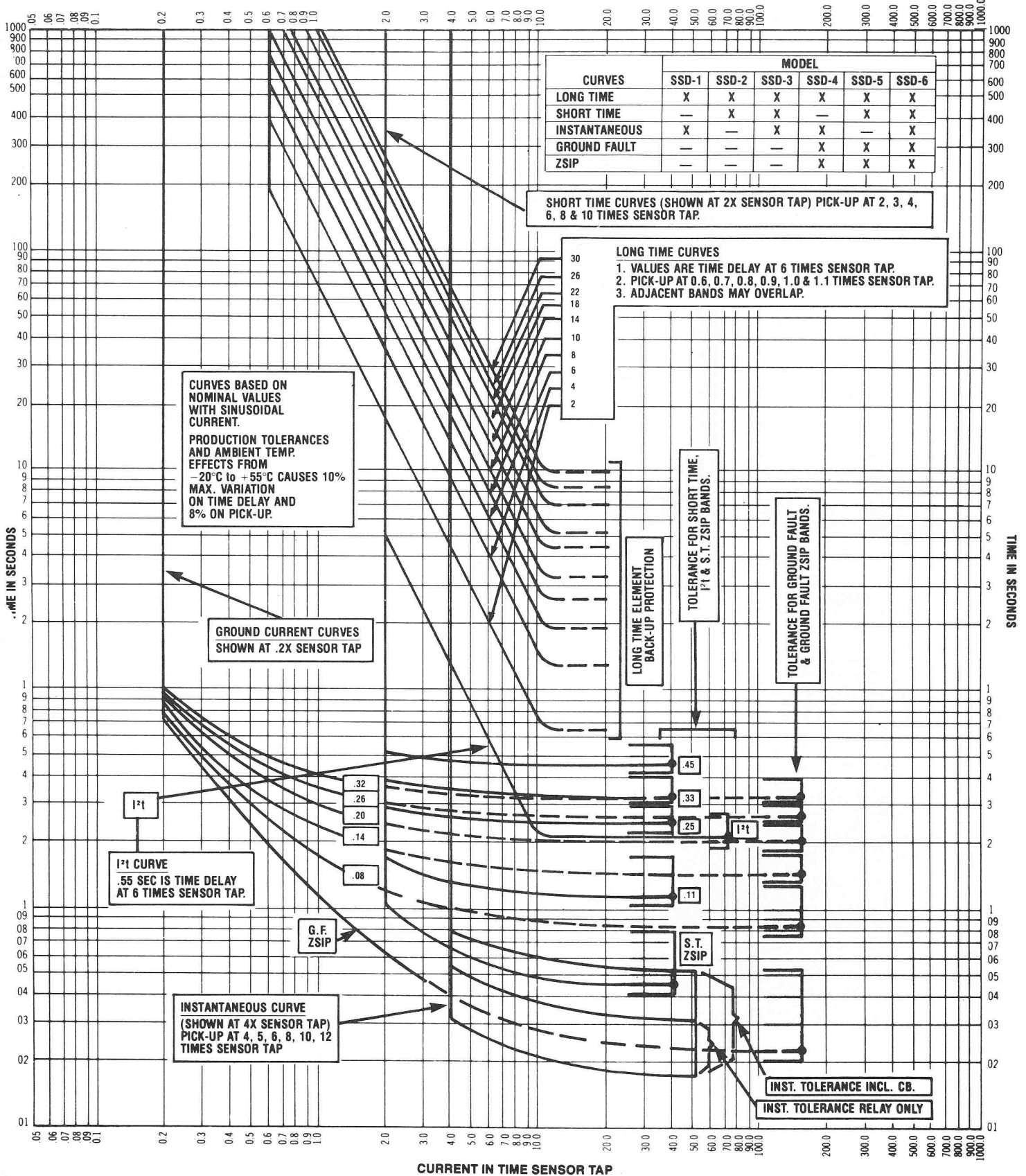


Fig. 2 ZSIP CONNECTIONS FOR SSD-6

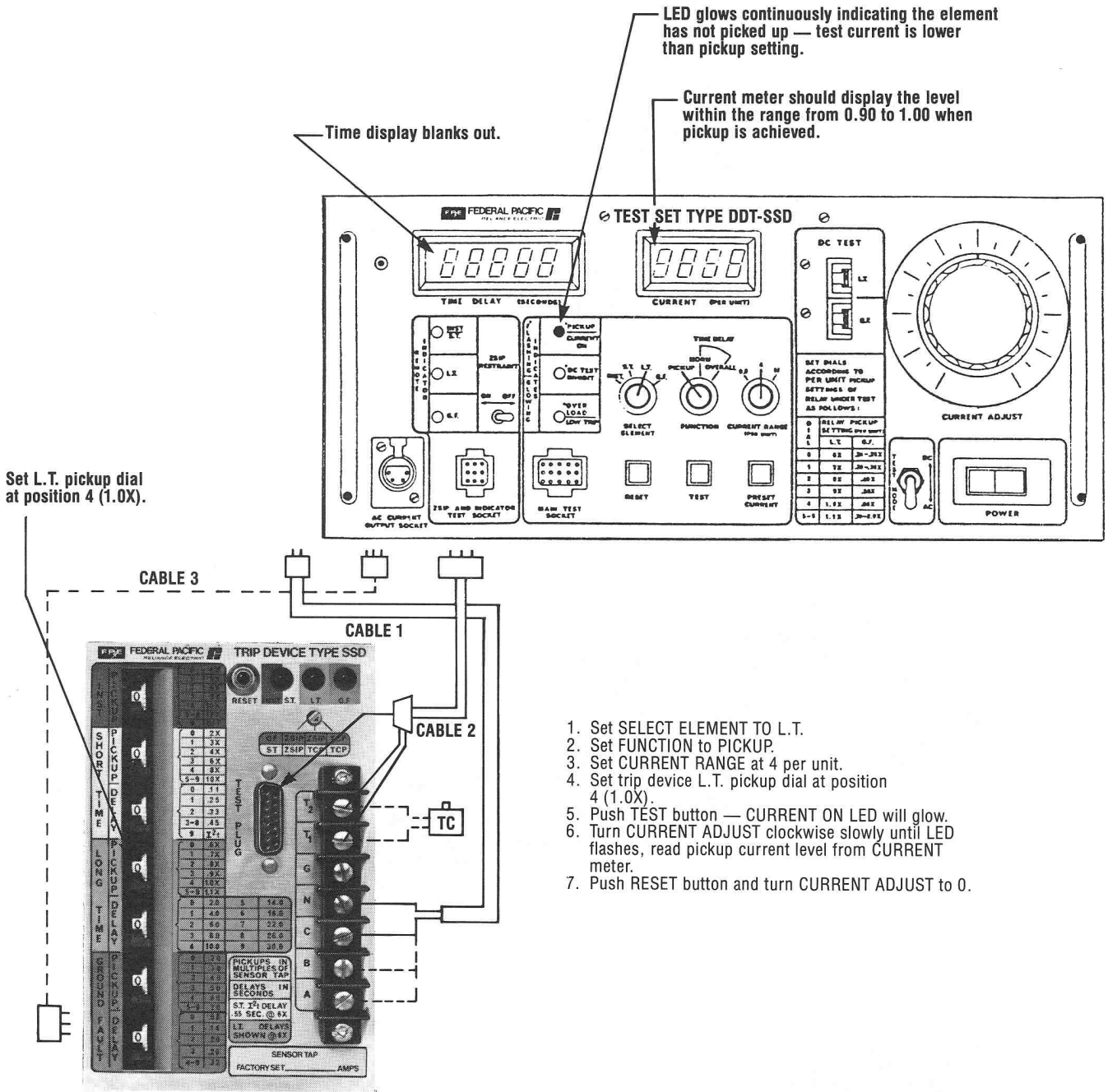
CURRENT IN TIME SENSOR TAP



TIME DELAY VALUES: a) SINGLE LINES, DEVICE TIME ONLY ±10%
b) BAND TOLERANCES INCLUDE ±10% AND BREAKER INTERRUPTING TIME.

Fig. 4 TIME CURRENT CHARACTERISTICS OF SSD TRIP DEVICE

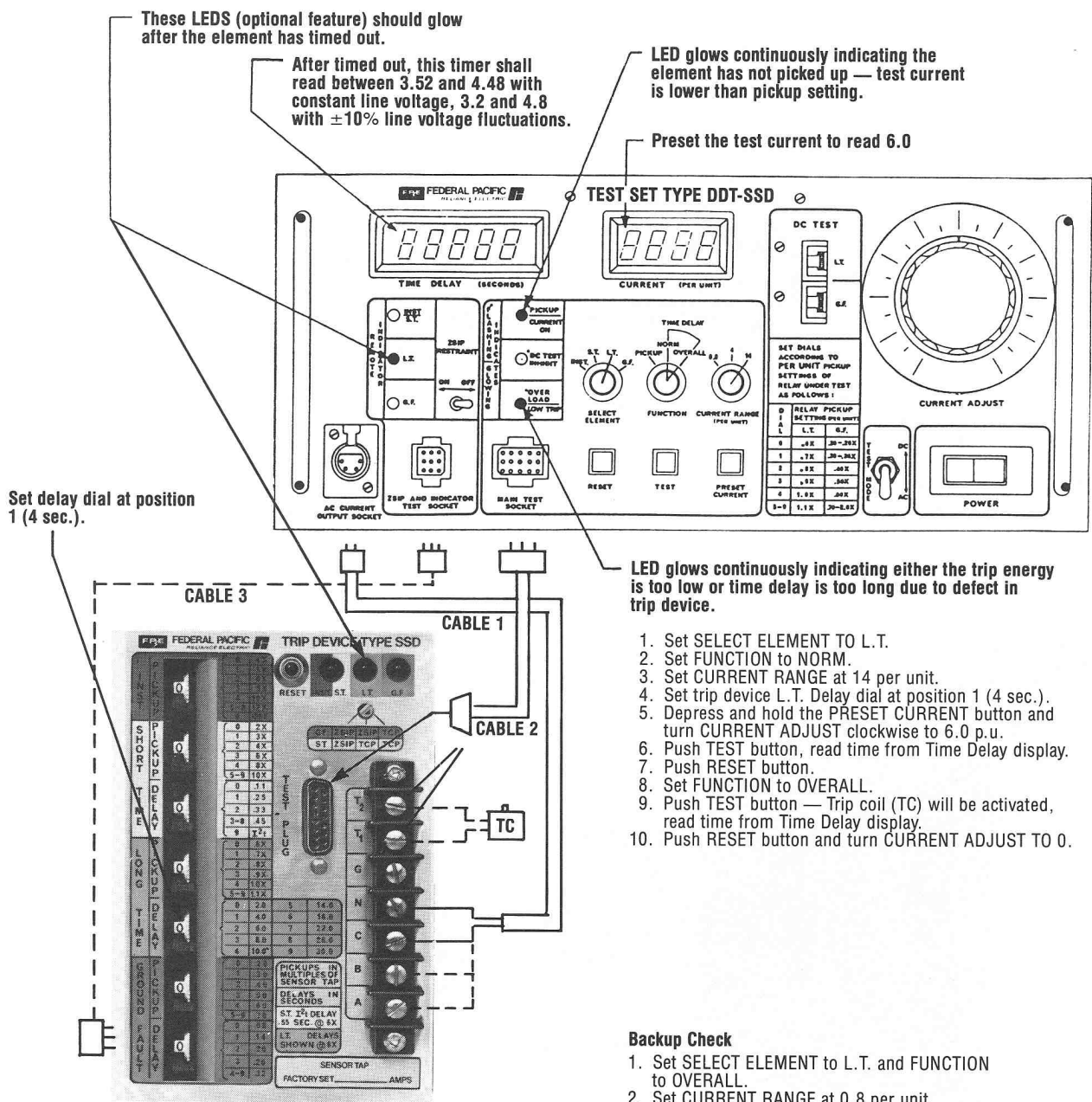
LONG TIME PICKUP



Type SSD Trip Device in A.C. Test Mode

DIAGRAM 1

LONG TIME DELAY



NOTE: Trip coil (TC) should be connected to terminals T₁ T₂ when doing Overall Time Delay test.

Type SSD Trip Device in A.C. Test Mode

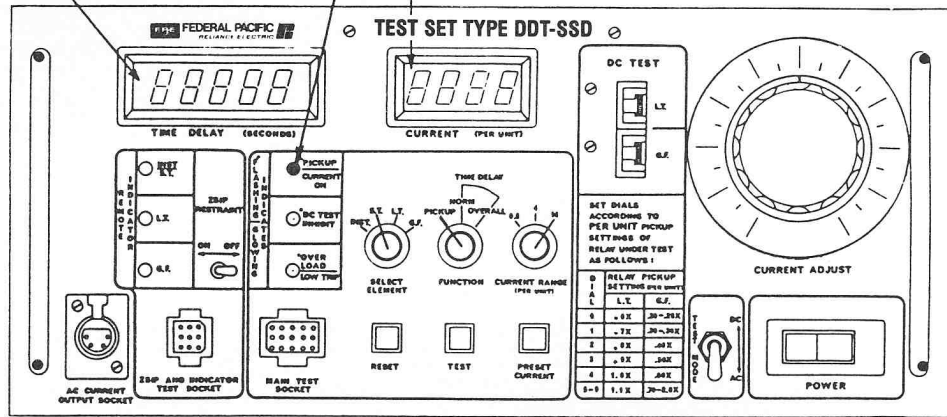
DIAGRAM 2

SHORT TIME PICKUP

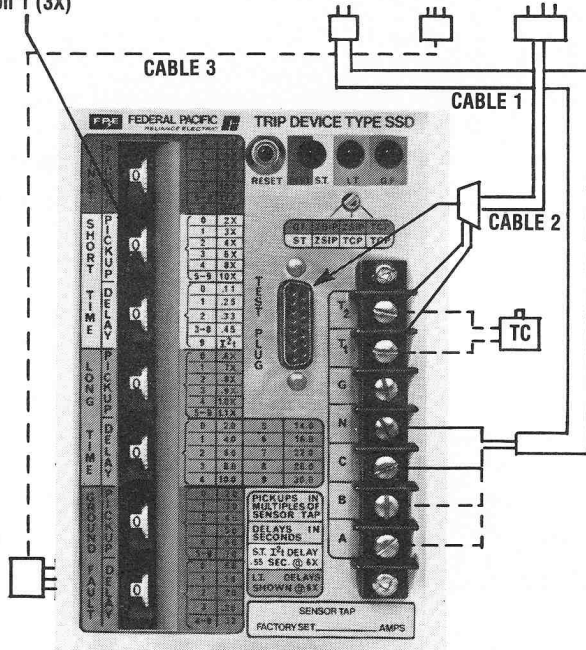
LED glows continuously indicating the element has not picked up — test current is lower than pickup setting.

Time display blanks out.

Current meter should display the level within the range from 2.7 to 3.3 when pickup is achieved.



Set pickup dial at position 1 (3X)

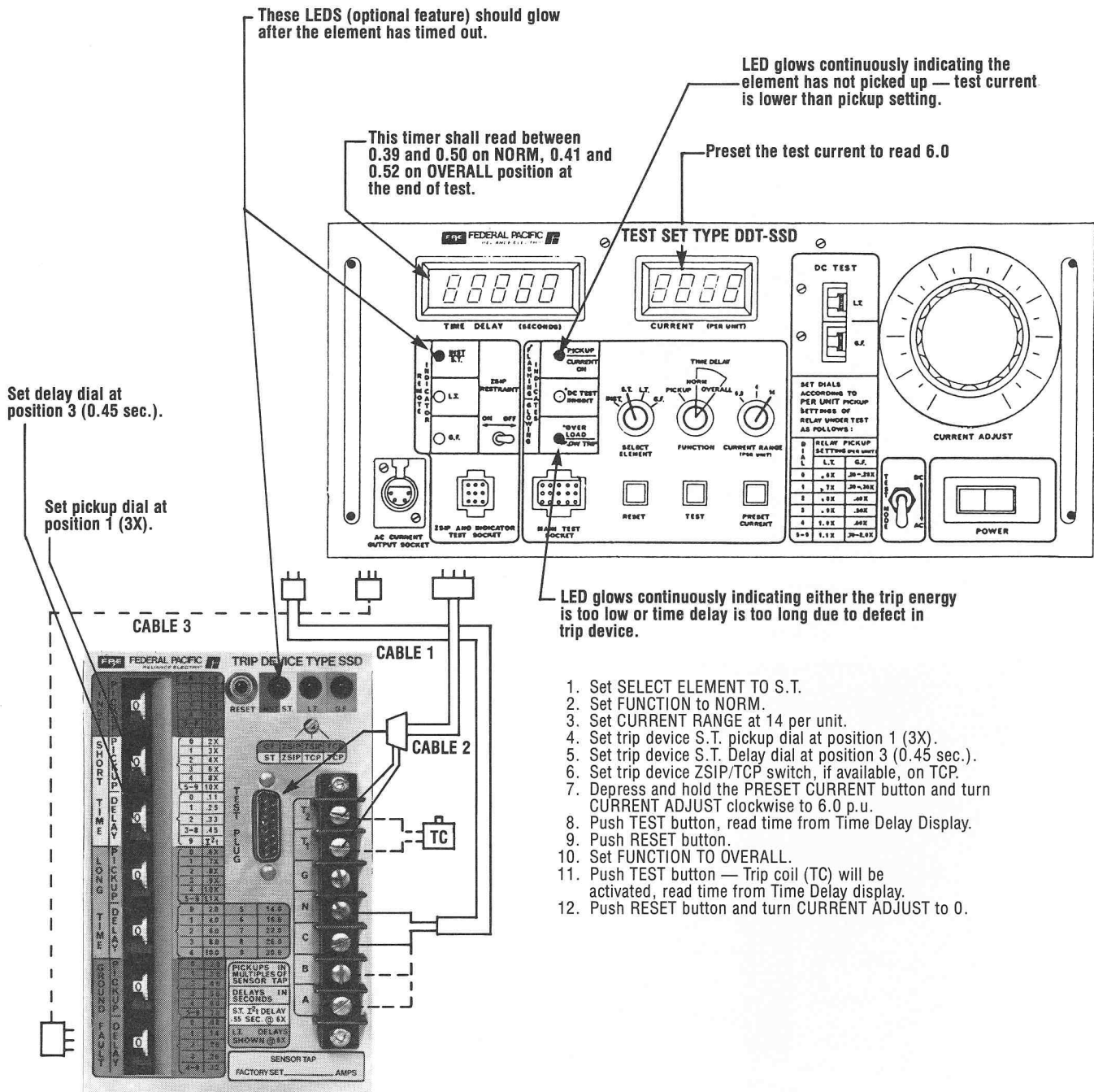


1. Set SELECT ELEMENT TO S.T.
2. Set FUNCTION to PICKUP
3. Set CURRENT RANGE at 14 per unit.
4. Set trip device S.T. pickup to position 1 (3x).
5. Push TEST button — CURRENT ON LED will glow.
6. Turn CURRENT ADJUST clockwise slowly until LED flashes, read pickup current level from Current meter.
7. Push RESET button and turn CURRENT ADJUST to 0.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 3

SHORT TIME DELAY



NOTE: Trip Coil (TC) should be connected to terminals T₁ T₂ when doing Overall Time Delay test.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 4

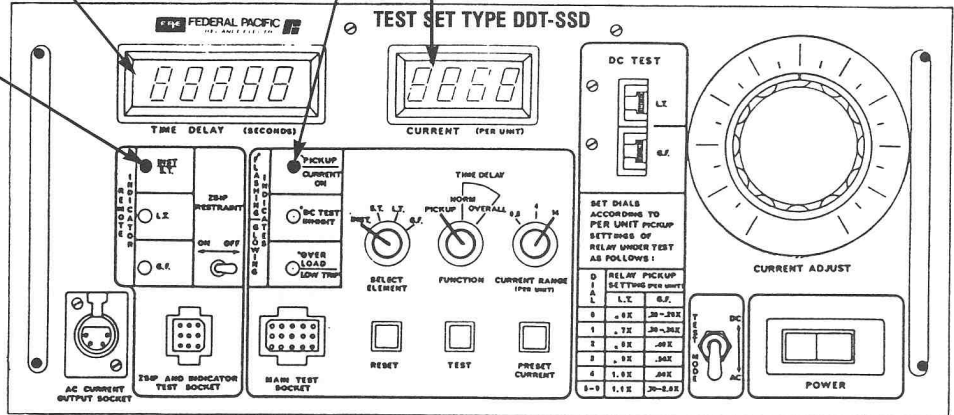
INSTANTANEOUS PICKUP

These LEDs (optional feature) will glow after the element has picked up.

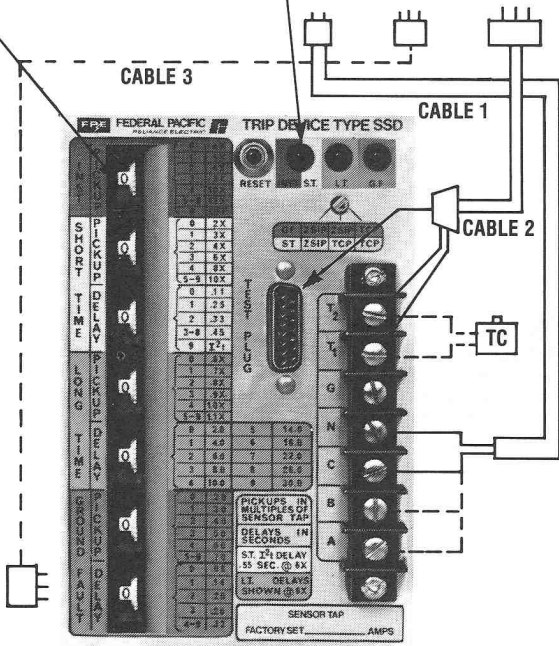
LED glows continuously indicating the element had not picked up — test current is lower than pickup setting.

Time display blanks out.

Current meter should display the level within the range from 5.4 to 6.6 when pickup is achieved.



Set pickup dial at position 2 (6X)

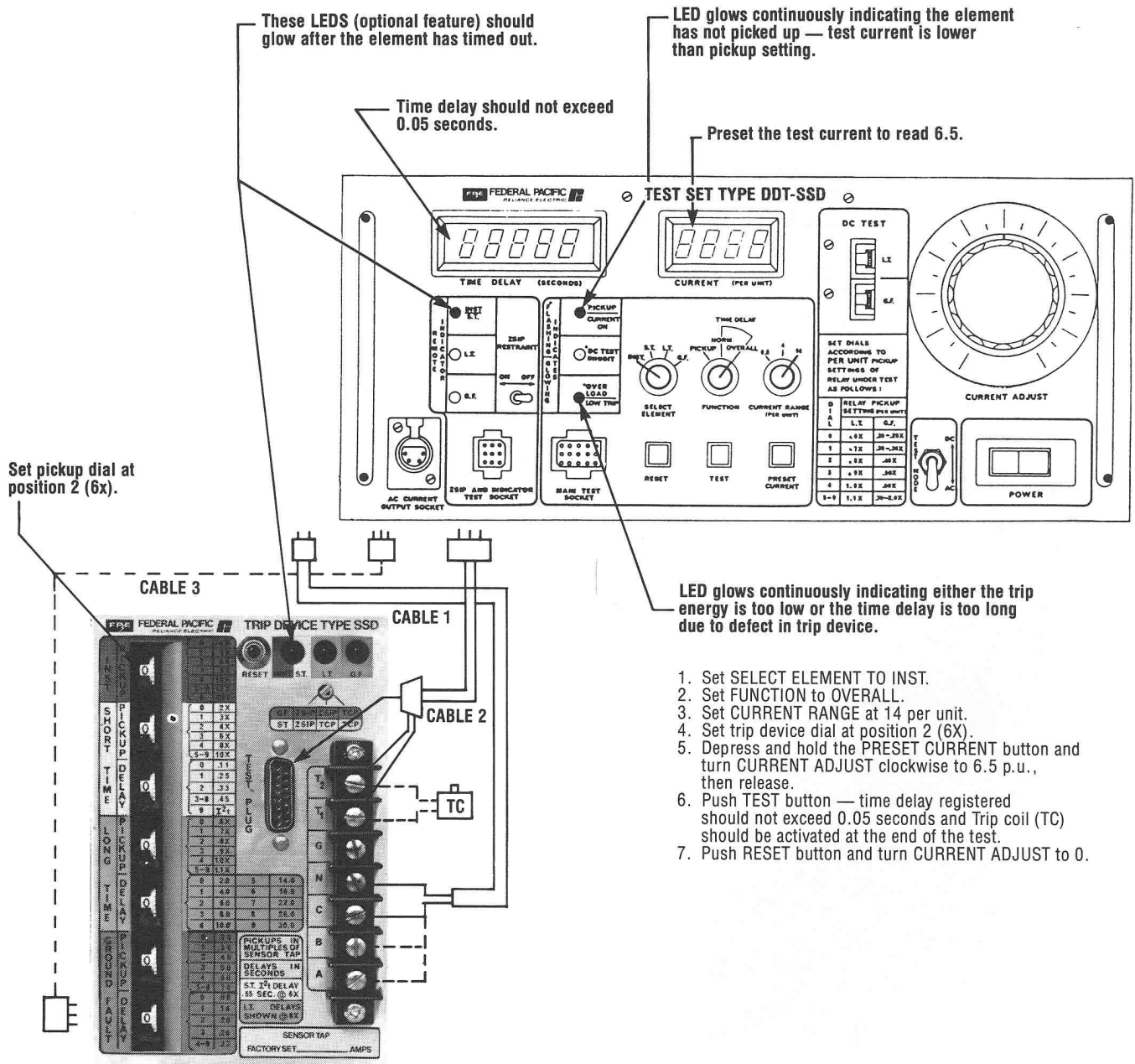


1. Set SELECT ELEMENT TO INST.
2. Set FUNCTION to PICKUP.
3. Set CURRENT RANGE at 14 per unit.
4. Set trip device pickup dial at position 2 (6X).
5. Push TEST button — CURRENT ON LED will glow.
6. Turn CURRENT ADJUST clockwise until LED flashes, read pickup current level from CURRENT meter.
7. Push RESET button and turn CURRENT ADJUST to 0.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 5

TIME DELAY CHECK ON INSTANTANEOUS ELEMENT

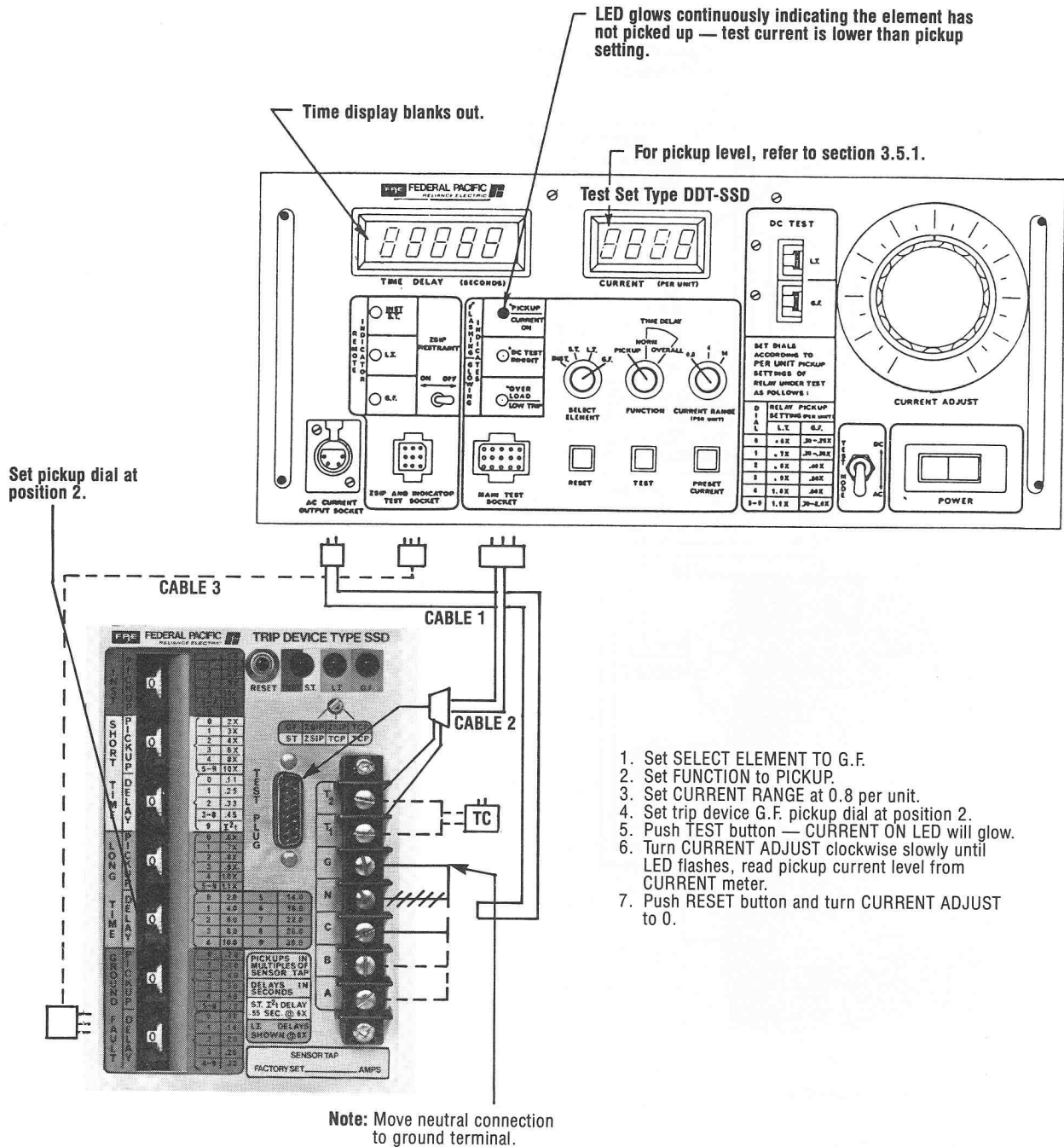


NOTE: Trip coil (TC) should be connected to terminals T₁ T₂.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 6

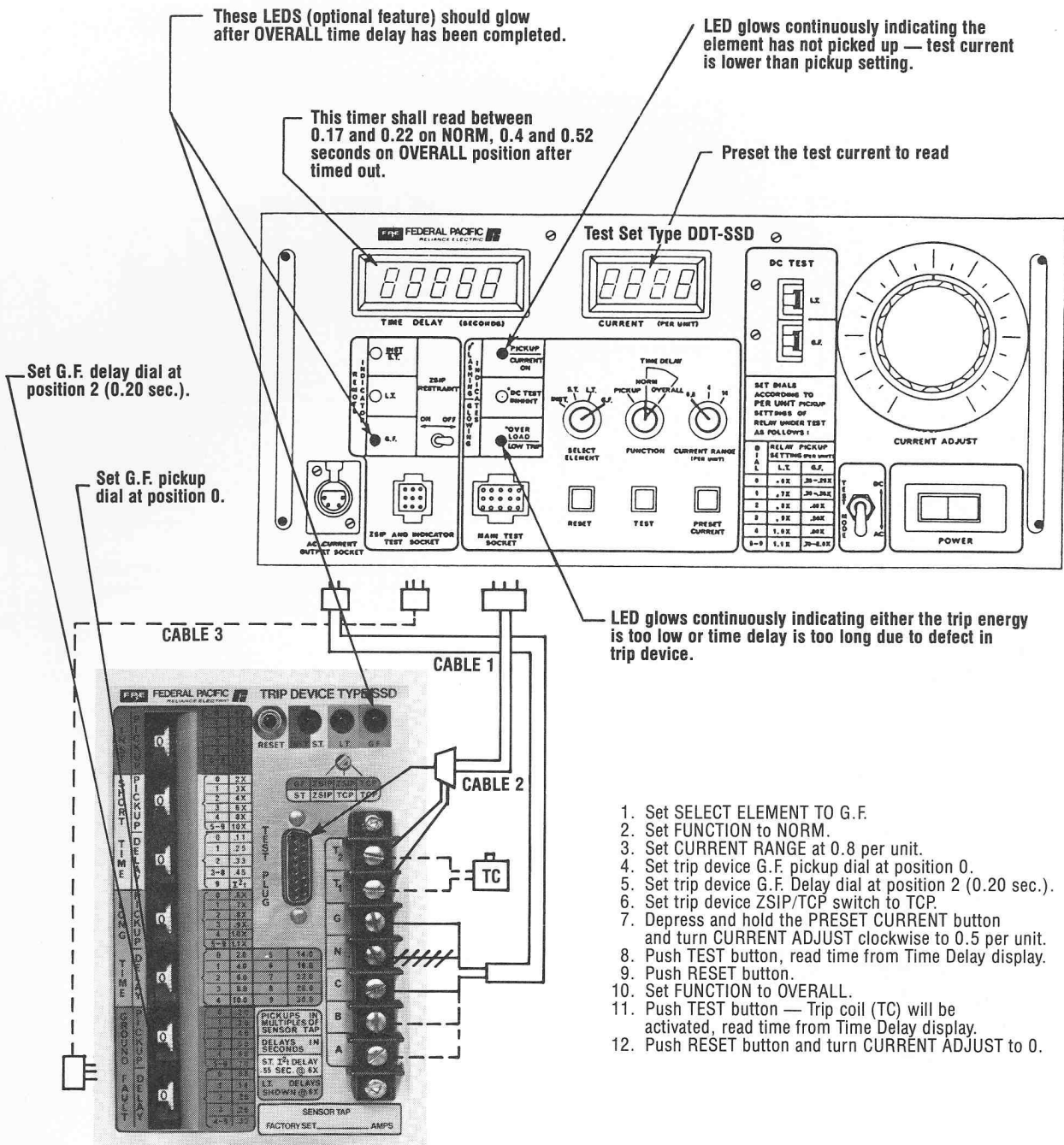
GROUND FAULT PICKUP



Type SSD Trip Device in A.C. Test Mode

DIAGRAM 7

GROUND FAULT DELAY



NOTE 1: Trip coil (TC) should be connected to terminals T₁ T₂ when doing Overall Time Delay Test.

NOTE 2: Move neutral connection to ground terminal.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 8

ZSIP FUNCTION TEST — S.T.

These LEDs (optional feature) should glow after the element has timed out.

LED glows continuously indicating the element has not picked up — test current is lower than pickup setting.

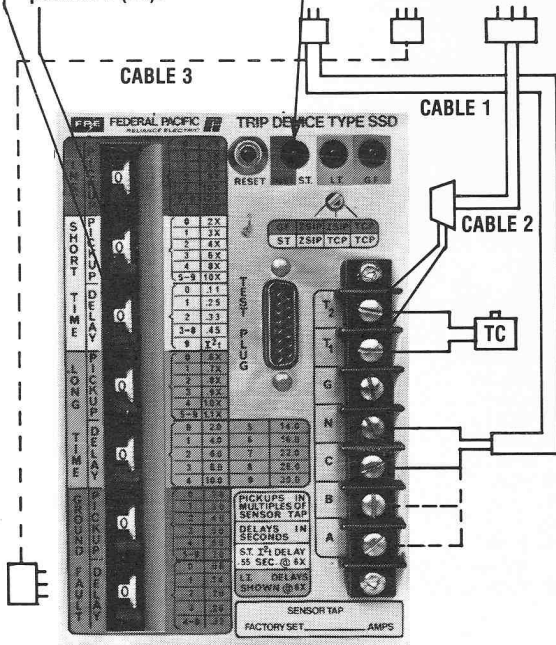
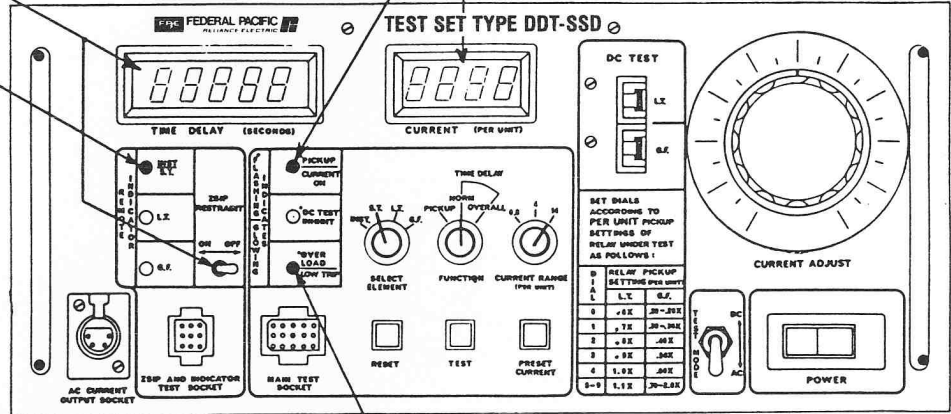
This timer should read between 0.04 and 0.06 with ZSIP RESTRAINT OFF, and 0.40 and 0.50 with ZSIP RESTRAINT ON.

Preset the test current to read 6.0

Set delay dial at position 3 (0.45 sec.).

Set pickup dial at position 1 (3X).

LED glows continuously indicating either the trip energy is too low or time delay is too long due to defect in trip device.



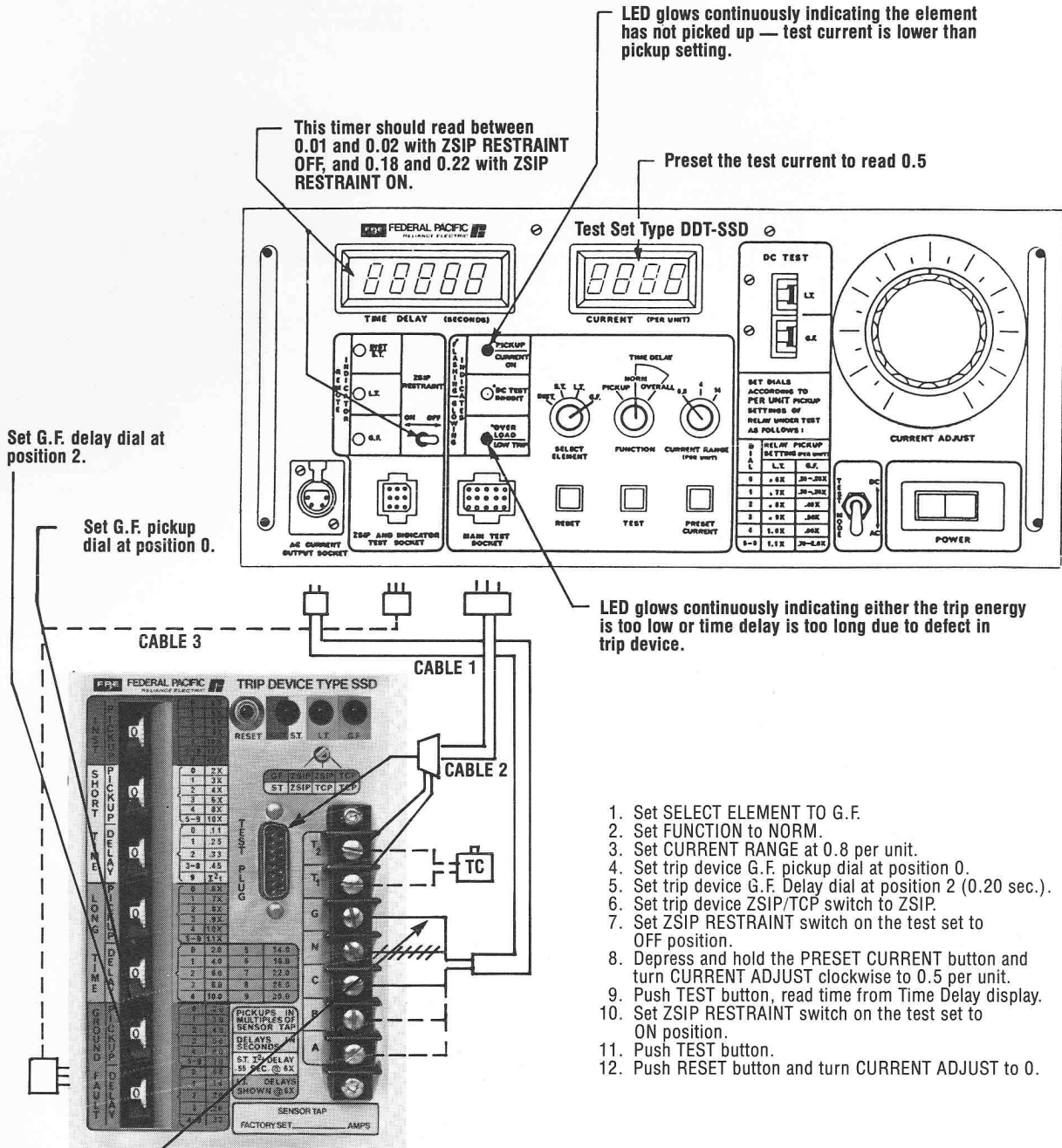
1. Set SELECT ELEMENT to S.T.
2. Set FUNCTION to NORM.
3. Set CURRENT RANGE at 14 per unit.
4. Set trip device S.T. pickup dial at position 1.
5. Set trip device S.T. Delay dial at position 3 (0.45 sec.).
6. Set trip device ZSIP/TCP switch to ZSIP.
7. Set ZSIP RESTRAINT switch on the test set to OFF position.
8. Depress and hold the PRESET CURRENT button.
9. Push TEST button, read time from Time Delay display.
10. Set ZSIP RESTRAINT switch on the test set to ON position.
11. Push TEST button.
12. Push RESET button and turn CURRENT ADJUST to 0.

NOTE: Trip coil (TC) should be connected to terminals T₁ T₂ when doing Overall Time Delay test.

Type SSD Trip Device in A.C. Test Mode

DIAGRAM 9

ZSIP FUNCTION TEST — G.F.



1. Set SELECT ELEMENT to G.F.
2. Set FUNCTION to NORM.
3. Set CURRENT RANGE at 0.8 per unit.
4. Set trip device G.F. pickup dial at position 0.
5. Set trip device G.F. Delay dial at position 2 (0.20 sec.).
6. Set trip device ZSIP/TCP switch to ZSIP.
7. Set ZSIP RESTRAINT switch on the test set to OFF position.
8. Depress and hold the PRESET CURRENT button and turn CURRENT ADJUST clockwise to 0.5 per unit.
9. Push TEST button, read time from Time Delay display.
10. Set ZSIP RESTRAINT switch on the test set to ON position.
11. Push TEST button.
12. Push RESET button and turn CURRENT ADJUST to 0.

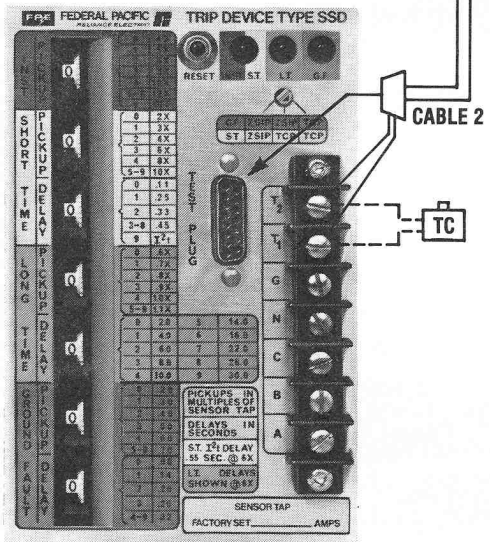
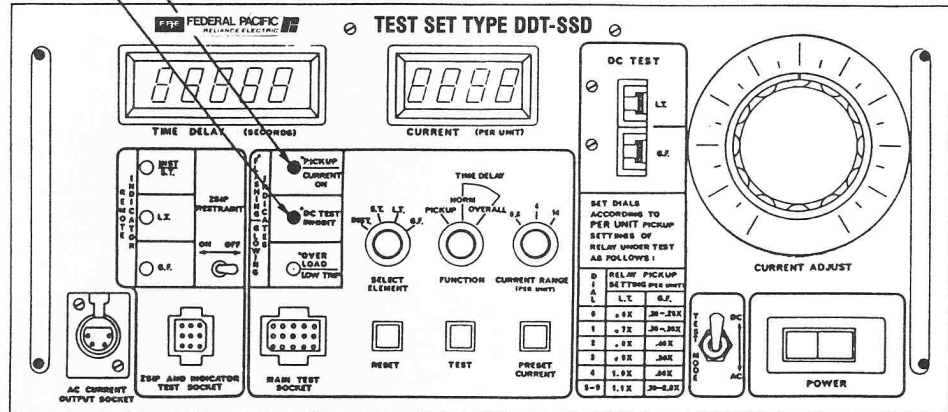
Type SSD Trip Device in A.C. Test Mode

DIAGRAM 10

DC TEST SETUP FOR TYPE SSD TRIP DEVICE

If overload or ground current exceeds the setting of DC test (inhibit) switches (L.T. and G.F.), this LED will flash and all test set functions will be inhibited.

The flashing of this LED without any secondary injection current indicates that the relay has actually been picked up by the system current — either overload, short circuit or ground fault current.



1. Set TEST MODE to DC.
2. Set DC Test (inhibit) switches (L.T. and G.F.) corresponding to the respective relay pickup settings.
3. Set SELECT ELEMENT to be tested.
4. Set FUNCTION to the one desired position.
5. For setting CURRENT RANGE, refer to section 2.3.3.d.
6. Follow test procedure described in AC test mode.

CAUTION

"In Service" Tests (D.C. Mode) should be carried out only on units mounted in special enclosures, making them accessible with the **Breaker Door Closed**.

Under no circumstances apply DC Tests to units mounted in standard manner — which requires the breaker door to be **opened** to gain access to relays.

If breaker is open then regardless of the type of mounting it can be tested in the D.C. mode.

NOTE: Do not attempt to change any settings of the trip device for testing purpose.

Type SSD relay in DC test mode.

DIAGRAM 11

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