

LOCATING CABLE FAULTS USING THE HEWLETT-PACKARD MODEL 4930A CONDUCTOR FAULT LOCATOR

1. GENERAL

1.01 This section covers the use of the Hewlett-Packard Model 4930A Conductor Fault Locator. Refer to Section 106-360-903NB for description and maintenance of this test set.

1.02 Whenever this section is reissued, the reason(s) for reissue will be provided in this paragraph.

2. HOOKUP AND STRAPPING

2.01 All connections to the faulty pair and return pair are made through the test cord. The test

cord is non-detachable and is stored in the test set case when not in use. The test cord is equipped with color-coded clips for connection to the circuits under test.

2.02 There are two methods of fault location using the 4930A. One is with one good wire (2-wire strap) and the other is with two good wires (3-wire strap). The 3-wire strap method should be used whenever possible to obtain the best accuracy from your test set.

2.03 Hookup and Strapping for Shorts (2-wire strap) - For shorts when only one good wire is available, connect the test cord clips as shown in

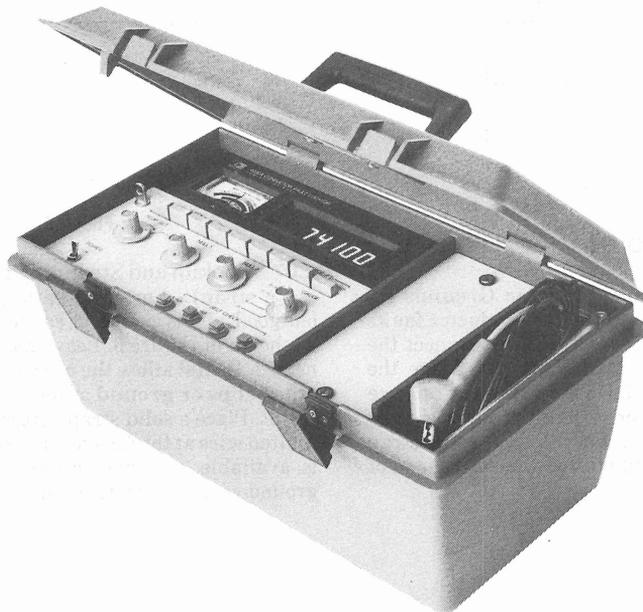


FIGURE 1
Hewlett-Packard Model 4930A Conductor Fault Locator

NOTICE
Not for use or disclosure outside Indiana Bell
except under written agreement.

Figure 2. Leave the orange clip unconnected. **Do not allow the orange clip to contact the other clips or ground**, or measurement errors will result. Place a **solid strap** across the good wire and faulted wire at the far-end of the cable.

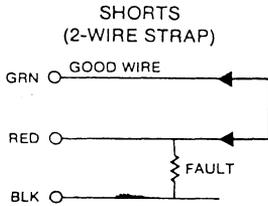


FIGURE 2

2.04 Hookup and Strapping for Shorts (3-wire strap) - For shorts when two good wires are available, connect the test cord clips as shown in Figure 3. Place a **solid strap** across the two good wires and faulted wire at far-end of cable.

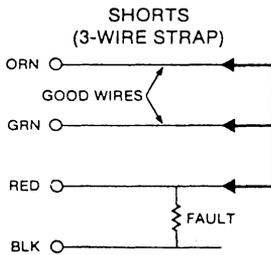


FIGURE 3

2.05 Hookup and Strapping for Grounds (2-wire strap) - For grounded conductor faults when only one good wire is available, connect the test cord clips as shown in Figure 4. Leave the orange clip unconnected. **Do not allow the orange clip to contact the other clips or ground** as measurement errors will result. Place a **solid strap** across the good wire and faulted wire at far-end of cable.

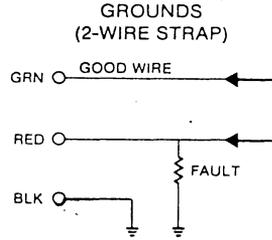


FIGURE 4

2.06 Hookup and Strapping for Grounds (3-wire strap) - For grounded conductor faults when two wires are available, connect the test cord clips as shown in Figure 5. Place a **solid strap** across the two good wires and the faulted wire at far-end of cable.

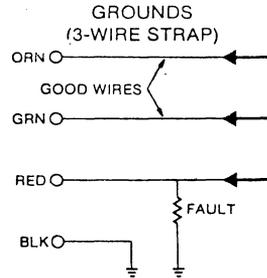


FIGURE 5

2.07 Hookup and Strapping for Crosses (2-wire strap) - For cross battery faults when only one good wire is available, connect the test cord clips as shown in Figure 6. Leave the orange clip unconnected. **Do not allow the orange clip to contact the other clips or ground** as measurement errors will result. Place a **solid strap** across the good wire and faulted wire at the far-end of the cable. If no battery is available, you may connect the black clip to ground as an alternate method.

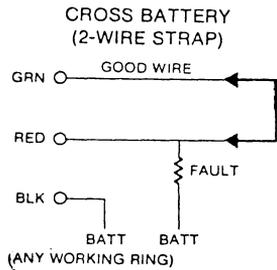


FIGURE 6

2.08 Hookup and Strapping for Crosses (3-wire strap) - For cross battery faults when two good wires are available, connect the test cord clips as shown in Figure 7. Place a **solid** strap across the two good wires and the faulted wire at far-end of cable. If no battery is available, you may connect the black clip to ground as an alternate method.

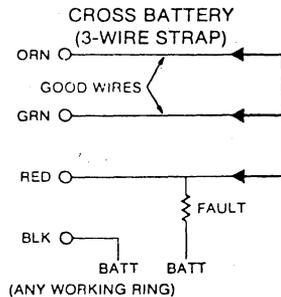


FIGURE 7

2.09 NOTE: Any resistance in the strap can cause errors in the distance readings. The strap should be made as solid as possible, using B-type connectors or solid copper wire.

2.10 NOTE: As noted in the preceding procedures, distance measurements can be made with only one good return wire. However, the good wire must be the same length and gauge as the faulted wire. Whenever possible, it is desirable to use **two** good wires to obtain the highest measurement accuracy from the test set. The two good wire method does not require the same length or gauge as the faulted wire.

3. BASIC OPERATING PROCEDURE

3.01 To open and remove the test set top cover, pull outward then up on the two latches at the front

of the test set. Lift up the cover to about 60° and the rear of the cover will slide free of the case. The cover may also be used as a sun-shield by resting the bottom edge in the notches on top of the case hinges.

3.02 To attach the neckstrap, snap the free end of the strap onto the eye at the left side of the test set front panel.

3.03 The test set is battery powered. To turn the test set on, throw the POWER switch to ON. Return to OFF position when not in use. The cover incorporates an interlock which turns the test set off when the cover is closed. ALWAYS SWITCH POWER OFF WHEN NOT IN USE TO CONSERVE BATTERY.

3.04 To check battery condition, press the CHECK-BATT pushbutton. The meter should indicate in the green GOOD area. NOTE: Battery should be checked prior to each use to verify its condition. If battery is too low, the digital display will not light.

3.05 For hookup and strapping information, see "HOOKUP AND STRAPPING" procedures in paragraph 2.

3.06 The GAUGE switch should be set to the gauge of the **faulted** wire. If a gauge change occurs in the faulted wire, set the GAUGE switch to the **near-end section** gauge. See "MULTI-GAUGE COMPENSATION" procedures in paragraph 5 for more information. When two good wires are used, they may be of different gauge or length than the faulted wire. **Always** set the GAUGE switch to the gauge of the **faulted** wire.

3.07 To make a fault check, press the CHECK-FAULT pushbutton and observe the meter reading. If the meter reads in the black FAULT area, a valid distance measurement can be made. A reading in the gray LIGHT area indicates that a valid reading can be made in most cases. A reading in the white CLEAR area indicates that the fault has dried out or an incorrect hookup, and a valid measurement cannot be made.

3.08 NOTE: If the meter drifts to the left during the fault check, this indicates that the fault is drying out. **DO NOT HOLD THE CHECK-FAULT OR NULL 2 PUSHBUTTONS IN ANY LONGER THAN NECESSARY AS THIS WILL FURTHER DRY OUT THE FAULT.** Proceed with these tests as quickly as possible.

3.09 To perform the strap check, press the CHECK-STRAP pushbutton and observe the meter reading. For a 2-wire strap, use the bottom-left scale. For a 3-wire strap, use the top-left scale. The meter should read in the green GOOD area for a correct strap connection. If the meter reads in the red BAD area, either the strap or hookup is incorrect.

3.10 The test set has a provision of correcting the distance measurement for cable temperature. Press the TEMP SET pushbutton and rotate the TEMP SET knob for the desired temperature setting on the digital display. When the TEMP SET knob is full clockwise until it clicks, the test set is pre-set for a cable temperature of 68°F. The range of the TEMP SET knob is from 0°F to 133°F.

3.11 The first null adjustment cancels out any dc loop voltage caused by multiple faults and balances the reference loop. Press the NULL 1 pushbutton (it will lock in the depressed position) and rotate the NULL 1 knob until the meter pointer is exactly over the NULL mark. To release the NULL 1 button, go to the next step or press the CHECK-STRAP pushbutton.

3.12 The second null adjustment balances the bridge circuits so that the test set can calculate the fault distance. Press the NULL 2 pushbutton (it will lock in the depressed position) and rotate the NULL 2 knob until the meter pointer is exactly over the NULL mark. To release the NULL 2 button, go to the next step or press the CHECK-STRAP pushbutton. **DO NOT USE NULL 2 FUNCTION ANY LONGER THAN NECESSARY TO AVOID DRYING OUT THE FAULT.**

3.13 To read the distance to fault, press the DISTANCE-TO-FAULT pushbutton. This will cause the display to flash five bars, indicating that the test set is calculating the distance. The display will then indicate the fault distance in feet for about six seconds then go off. Proceed to paragraph 3.16 or 3.17 if a strap-to-fault or distance-to-strap reading is desired.

3.14 NOTE: In the event the distance measurement is greater than the test set capability (199,900 feet), the five flashing bars will stop flashing and remain on until another button is pressed or the test set turned off. The flashing bars may flash continuously. Either condition may be the result of a bad strap. If in doubt, perform the strap check procedure in paragraph 3.09.

3.15 NOTE: The distance measurement pushbuttons lock when pressed for a reading. To repeat a distance measurement, press either of the other two distance pushbuttons, then the desired button.

3.16 To make a strap-to-fault measurement, press the DISTANCE STRAP-TO-FAULT pushbutton. This will cause the display to flash five bars, indicating that the test set is calculating the distance. The display will then indicate the distance in feet for about six seconds then go off.

3.17 To make a distance-to-strap measurement, press the DISTANCE-TO-STRAP pushbutton. This will cause the display to flash five bars, indicating that the test set is calculating the distance. The display will then indicate the distance in feet for about six seconds then go off.

4. SELF CHECK PROCEDURE

4.01 A built-in artificial line represents approximately 4,000 feet of 24 AWG cable with a 750 kohm short located approximately 1,800 feet from the test set and approximately 2,200 feet back from the strap. This provides a convenient self check for verifying test set operation. It can also be used as a training aid to familiarize yourself with the operating procedure.

4.02 To hookup to the artificial line, connect the color-coded test cord clips to the SELF CHECK terminals on the front panel. The artificial line is strapped internally.

4.03 Rotate the TEMP SET knob clockwise until it clicks into the NORMAL (68°F) position. Rotate the GAUGE knob to the 24 AWG position.

4.04 Turn the test set ON and perform the "BASIC OPERATING PROCEDURE" (paragraphs 3.04 thru 3.17). The fault distances at 68°F should read 2,200 ±20 feet from the strap or 1,800 ±20 feet from the test set. Distance from the test set to the strap should read 4,000 ±30 feet.

5. MULTI-GAUGE COMPENSATION

5.01 In most cases, faults can be located in multi-gauge cable with one direct reading. It is important, however, to know the locations of any gauge changes so that the proper procedure can be selected.

5.02 If fault is located in end-section gauges: If the fault is suspected in the **near-end gauge section**, set GAUGE switch to near-end gauge and make a DISTANCE-TO-FAULT measurement (see "BASIC OPERATING PROCEDURE"). If this reading indicates the fault is in the near-end section, the reading is correct. If the reading indicates the fault is in the far-end section, set the GAUGE switch to the far-end gauge and make a DISTANCE STRAP-TO-FAULT measurement. NOTE: These measurements are valid for one gauge change or two gauge changes when the fault is located in either the near-end or far-end section.

5.03 If fault is located in mid-section gauges: In the case of gauge changes, with fault in mid-gauge section, proceed as follows:

5.04 (a) If fault is suspected to be in mid-gauge section adjacent to far-end, make a DISTANCE STRAP-TO-FAULT measurement. Subtract length of far-end section from this reading and record. Proceed to paragraph 5.05.

(b) If fault is suspected to be in mid-gauge section adjacent to near-end, make a DISTANCE-TO-FAULT measurement. Subtract length of near-end section from this reading and record. Proceed to paragraph 5.05.

5.05 Multiply the number recorded in paragraph 5.04 by appropriate correction factor in Table 1. Result is distance from gauge change point to the fault.

		MID-GAUGE SECTION				
		19	22	24	26	28
END-GAUGE SECTION	19		0.497	0.314	0.195	0.124
	22	2.01		0.631	0.393	0.249
	24	3.19	1.58		0.623	0.394
	26	5.12	2.54	1.61		0.632
	28	2.09	4.02	2.54	1.58	

TABLE 1

5.06 EXAMPLE:
 DISTANCE STRAP-TO-FAULT Reading = 435 ft.
 Actual length of far-end section = 320 ft.
 Recorded value = 435-320 = 115 ft.

Correction factor from table = 0.497
 Distance fault from gauge change point = 115 X 0.497 = 57 ft.

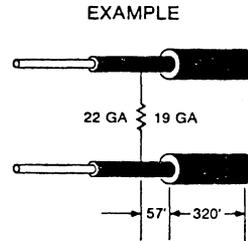


FIGURE 8

6. LOAD POINT COMPENSATION

6.01 Load points will cause a fault to appear farther away if they are located between the fault and the point of measurement. They can be ignored if they are beyond the fault.

6.02 If load point is between strap and fault: If there is a load point between the strap and the fault, their **equivalent wire length** must be subtracted from the DISTANCE STRAP-TO-FAULT reading. To correct for load points, proceed as follows:

6.03 Make DISTANCE STRAP-TO-FAULT reading (see "BASIC OPERATING PROCEDURE").

6.04 Determine whether the load point is located between the strap and fault, or beyond the fault, using the following logic:

- If the DISTANCE STRAP-TO-FAULT reading is **shorter** than the distance from strap to load point, then the load point is **beyond** the fault and the reading in paragraph 6.03 is correct.
- If the DISTANCE STRAP-TO-FAULT reading is **longer** than the distance from strap to load point, the load point is between the strap and fault, therefore the reading must be corrected. Proceed to paragraph 6.05.

6.05 Determine the codes and number of load points between the strap and fault. Refer to Table 2 and subtract **equivalent length** for each

load point from the DISTANCE STRAP-TO-FAULT reading in paragraph 6.03.

SUBTRACT EQUIVALENT LENGTH FROM DISTANCE READING					
TYPE COIL	EQUIVALENT WIRE LENGTH (FEET)				
	19 GA	22 GA	24 GA	26 GA	28 GA
632	496	246	156	97	63
656	354	176	112	69	44
662 or 652	502	249	158	98	63

TABLE 2

6.06 EXAMPLE:

DISTANCE STRAP-TO-FAULT Reading = 1275 ft.
 22 Ga. equivalent for 632 coil = 245 ft.
 Distance to fault from strap = 1029 ft.

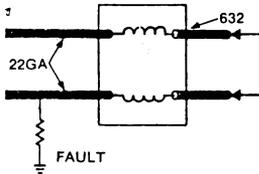


FIGURE 9

6.07 If load point is between test set and fault:

When making a DISTANCE-TO-FAULT measurement, **equivalent wire length** of load points between the test set and the fault must be subtracted from the distance measurement. The procedure for determining the position of the load points in relation to the fault, and compensating the distance reading is similar to the preceding procedure.

7. BRIDGE TAP PROCEDURE

7.01 Fault distance readings on a pair with bridge taps are valid if the fault is located anywhere on the **main cable**.

7.02 However, if the fault is located at **any point** on a bridge tap, the fault distance reading will indicate that the fault is at the point of the bridge tap connection on the **main cable**. To determine the correct location of a fault on a bridge tap, proceed as follows:

7.03 Make a DISTANCE STRAP-TO-FAULT measurement (see "BASIC OPERATING PRO-

CEDURE"). This reading will give the location of the faulty bridge tap connection on the main cable.

7.04 For cross battery and grounded conductor faults: Remove strap from far-end of main cable pair. Connect strap across faulted pair at far-end of bridge tap.

7.05 For Shorts: Remove strap from far-end of main cable. Connect strap across one wire of faulted pair and good wire (or wires if two good wires are available) at far-end of bridge tap.

7.06 Set GAUGE switch to gauge of bridge tap.

7.07 Make a DISTANCE STRAP-TO-FAULT measurement. This reading will give the distance to the fault from the **far-end of the bridge tap**.

8. GOOD PAIR DROP

8.01 In the event that **no good wires** are available for fault locating, it is possible to lay a temporary drop with a good pair of wires. The drop pair can be any convenient gauge and length. Strap the good pair to the bad wire at the far-end of the cable. See "BASIC OPERATING PROCEDURE" for fault location with two good wires.

9. LOCATING A SOLID SHORT

9.01 In the event of a solid or deliberately placed short across two wires of the same gauge, the distance from the test set to the short can be measured. Use the following procedure:

- 9.02** (a) Connect test cord clip as shown in Figure 10. Do not allow the red and black clips to touch the other clips or ground.
- (b) Throw POWER switch ON and set GAUGE switch to gauge of shorted wire.
- (c) Press DISTANCE-TO-STRAP pushbutton to read the distance from the test set to the short.

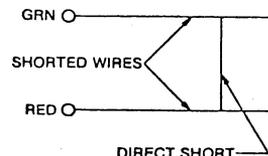


FIGURE 10