

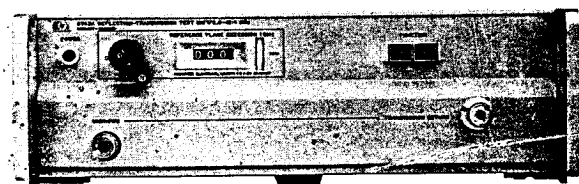
# OPERATING AND SERVICE MANUAL

THIS MANUAL CONTAINS A  
SUPPLEMENT FOR A SPECIAL  
MODIFICATION TO THE  
INSTRUMENT.  
SEE INSIDE COVER.

0-560157

## REFLECTION- TRANSMISSION TEST UNIT

8743A



HEWLETT  PACKARD



OPERATING AND SERVICE MANUAL  
MODIFICATIONS

S-PARAMETER TEST SET  
8743A-H23

SERIAL NO. PREFIX  
1702A AND ABOVE

MODIFICATION PART NO.  
08743-90035  
APRIL 1978  
REV. I - FEBRUARY 1979

USE THIS MODIFICATION  
WITH MANUAL PART NO.  
08743-90010  
PRINTED: JULY 1972

0-550145SR

## INTRODUCTION:

This Modification describes the differences in the 8743A-H23 S-Parameter Test Set. In addition, it describes the manual changes necessary to document the instrument.

## DESCRIPTION:

The Model 8743A-H23 S-Parameter Test Set is a standard 8743A which has been tested to operate to 18 GHz and also provides 10 dB additional dynamic range for transmission measurements and provides an additional 10 dB isolation between the UNKNOWN and TEST ports for reflection measurements. The 8743A-H23 also provides a variable 0 dB to 70 dB attenuation to the UNKNOWN port by means of an internal programmable attenuator. Attenuation is achieved by the external closure of a switch (such as the 59306A HP-IB Relay Actuator).

## MANUAL CHANGES NECESSARY TO DOCUMENT THE HP 8743A-H23:

Page 1-1, Paragraph 1-2:

Change Frequency Range to 2.0-18.0 GHz

Page 1-1, Table 1-1:

Change Frequency Range to 2.0-18.0 GHz

Add to Reflection Coefficient, UNKNOWN port:

12.4 to 18.0 GHz  $\leq$  0.20 (VSWR 1.5)

Add to Reflection Coefficient:

Transmission Return Port:

Reflection Measurement: 12.4-18.0 GHz  $\leq$  .2 (VSWR 1.5)

Transmission Measurement: 12.4-18.0 GHz  $\leq$  .23 (VSWR 1.6)

Add to Coupler Directivity:

2.0-12.4 GHz  $\geq$  30 dB

12.4-18.0 GHz  $\geq$  18 dB typically 20 dB

Page 5-3, Table 5-1:

Change: A5, A6, A7 to HP Part No. 5080-0290, Switch Tree (Matched set of three)

Change: DC1 to HP Part No. 5080-0288, Coupler Assembly, Test

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MANUAL CHANGES (Cont'd):

Page 5-3, Table 5-1 Cont.:

Change: DC2 to HP Part No. 5080-0299, Coupler Assembly, Reference

Add: J101 HP Part No. 1251-0143, Connector, 14 Pin Female

Add: A101 33321H-C03 Attenuator, 70 dB programmable

Change: W3 to HP Part No. 08746-20031, Cable, Patch Line

Change: W6 to HP Part No. 08743-20040, Cable, Coax Line

Delete: W8

Add: W101 HP Part No. 08743-20049, Cable Assembly, CPLR/ATTEN.

Add: W102 HP Part No. 08743-20050, Cable Assembly, ATTEN/CPLR

Add: W103 HP Part No. 08743-60040, Cable Assembly, Attenuator

Change: Rear Panel to HP Part No. 08743-00029

Add: Bracket, Attenuator, HP Part No. 08743-00030

Add: HP P/N 1251-0142, Connector, 14 Pin Male

Page 6-3, Figure 6-4:

Change to Figure 1

Page 6-4, Figure 6-5:

Change to Figure 2

Page 6-5, Figure 6-6:

Change to Figure 3

Add Figure 4.

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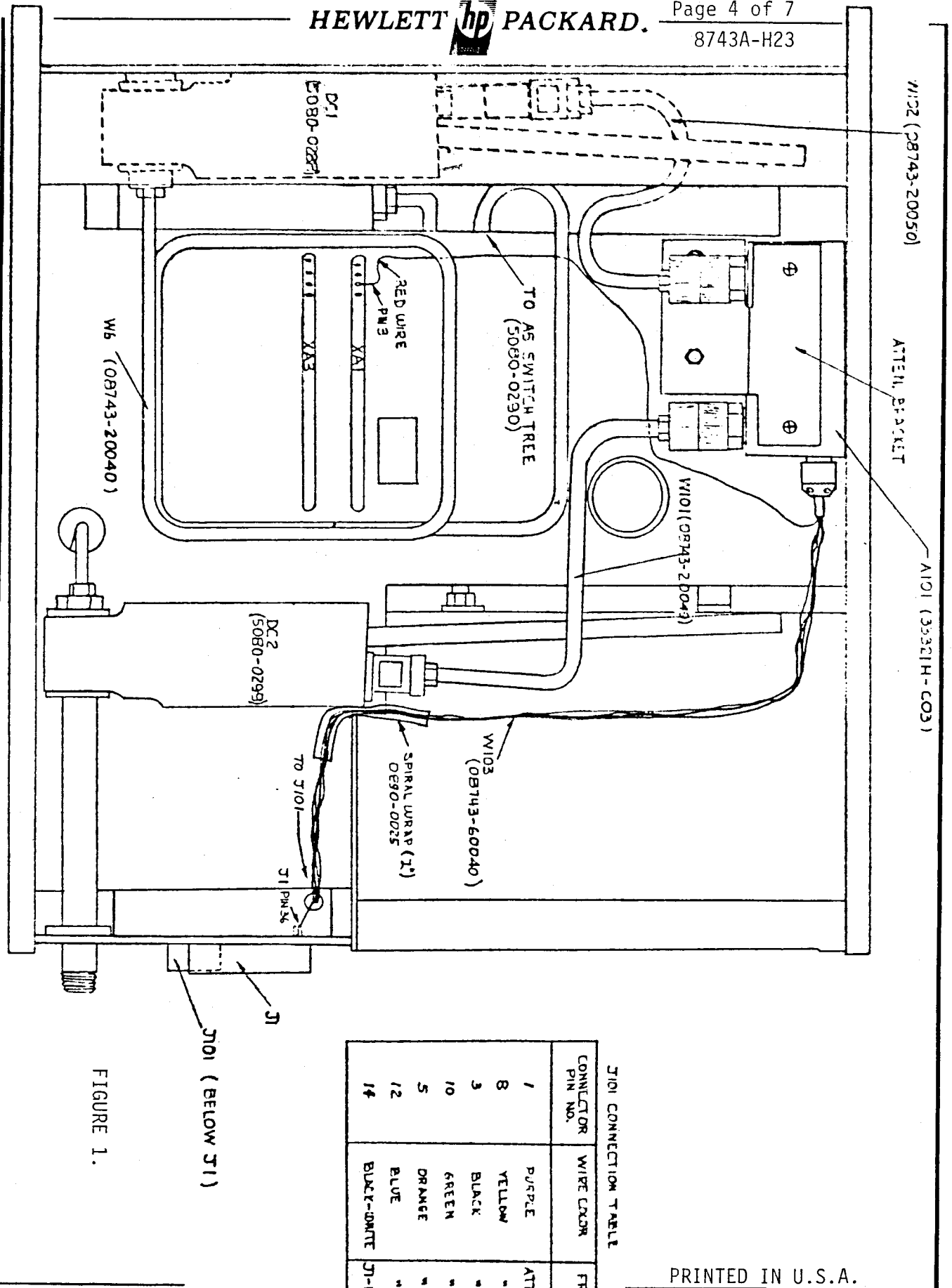


FIGURE 1.

J101 CONNECTION TABLE

| CONNECTOR PIN NO. | WIRE COLOR  | FROM     |
|-------------------|-------------|----------|
| 1                 | PURPLE      | ATTEN    |
| 8                 | YELLOW      | "        |
| 3                 | BLACK       | "        |
| 10                | GREEN       | "        |
| 5                 | ORANGE      | "        |
| 12                | BLUE        | "        |
| 14                | BLACK-WHITE | J1-PIN36 |

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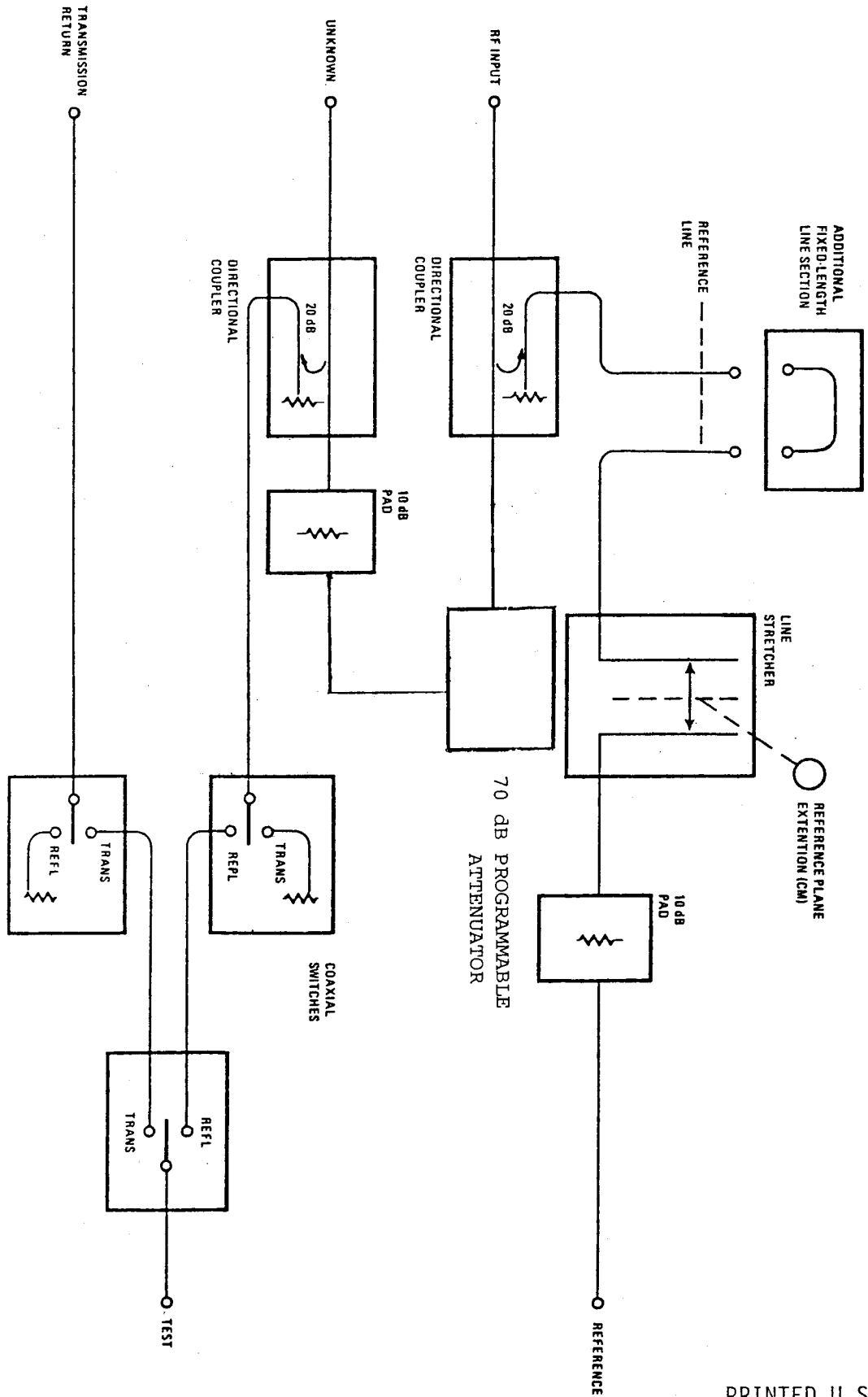


FIGURE 2. SIMPLIFIED RF SCHEMATIC DIAGRAM

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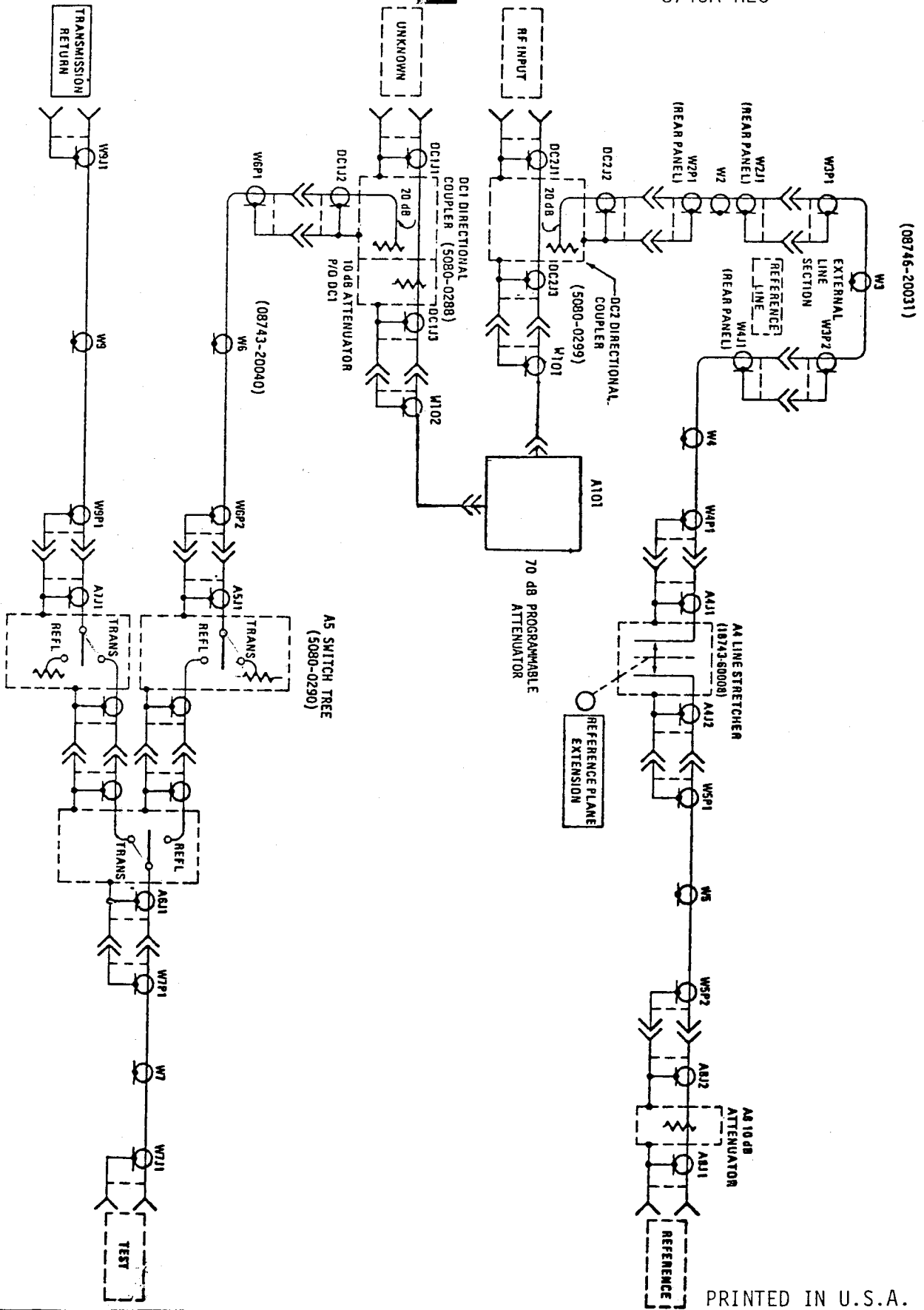
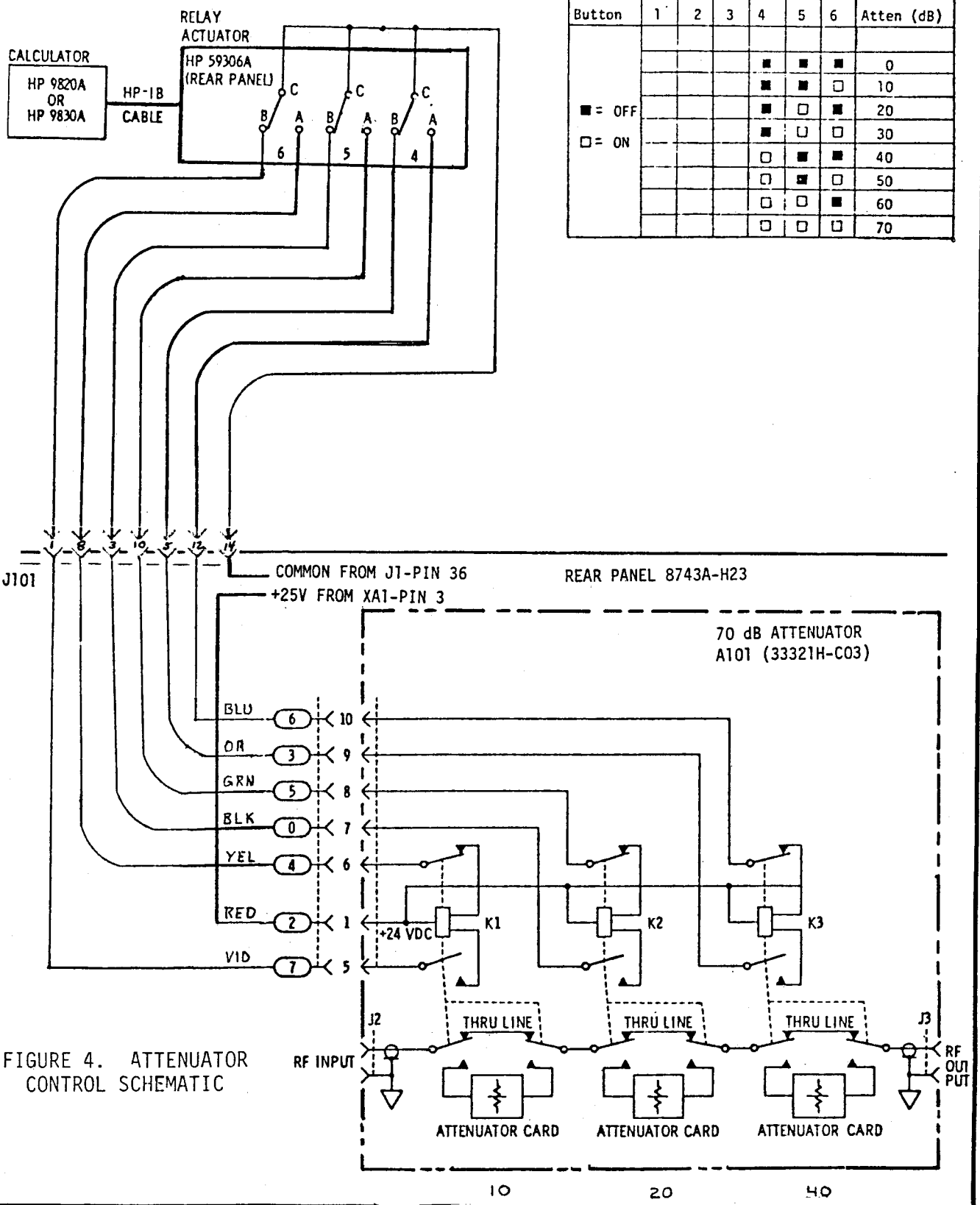


FIGURE 3. 8743A-H23 RF SCHEMATIC DIAGRAM

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| Button | 1 | 2 | 3 | 4 | 5 | 6 | Atten (dB) |
|--------|---|---|---|---|---|---|------------|
|        |   |   |   | ■ | ■ | ■ | 0          |
|        |   |   |   | ■ | ■ | □ | 10         |
|        |   |   |   | ■ | □ | ■ | 20         |
|        |   |   |   | ■ | □ | □ | 30         |
|        |   |   |   | □ | ■ | ■ | 40         |
|        |   |   |   | □ | □ | □ | 50         |
|        |   |   |   | □ | □ | ■ | 60         |
|        |   |   |   | □ | □ | □ | 70         |

■ = OFF  
□ = ON

FIGURE 4. ATTENUATOR CONTROL SCHEMATIC

1-560150SR



## SAFETY

*This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this product.*

## CERTIFICATION

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## WARRANTY

*This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.*

*For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses.*

*For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.*

### LIMITATION OF WARRANTY

*The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.*

*NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.*

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*THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.*

## ASSISTANCE

*Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.*

*For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.*



# REFLECTION-TRANSMISSION TEST UNIT 8743A

## SERIALS PREFIXED: 1226-

This manual applies directly to HP Model 8743A Reflection-Transmission Test Units having serial prefix number 1226-.

## SERIAL PREFIXES NOT LISTED

For serial prefixes above 1226, a "Manual Changes" sheet is included with this manual. For serial prefixes below 1226, refer to the Appendix.

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MANUAL PART NO. 08743-90010  
MICROFICHE PART NO. 08743-90011

Printed: JULY 1972

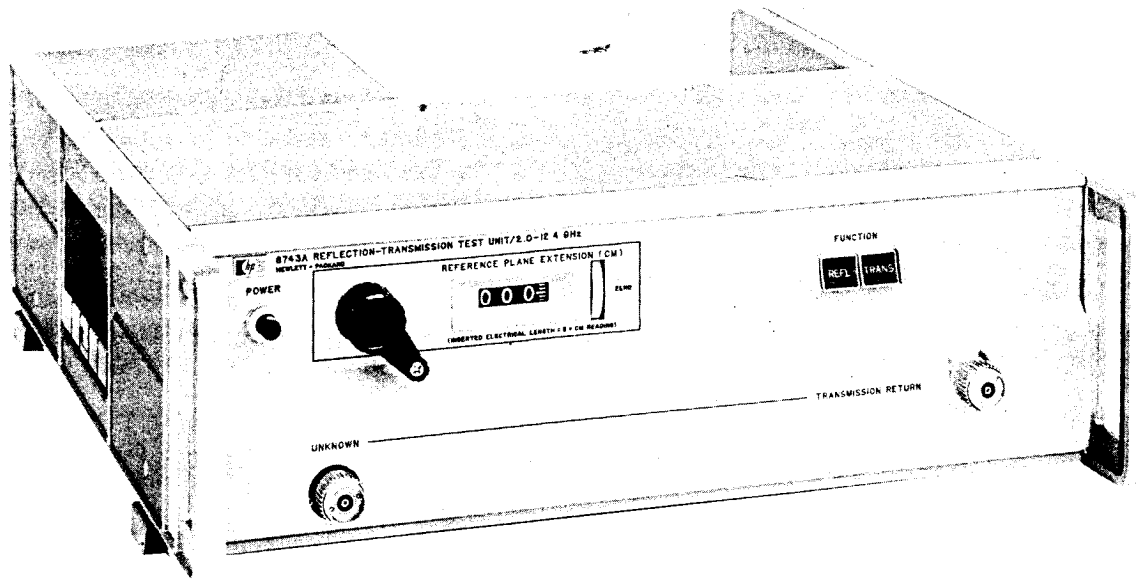
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TABLE OF CONTENTS

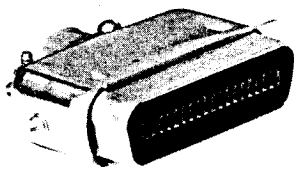
| Section |   | Page | Section |  | Page |
|---------|---|------|---------|--|------|
| I       | GENERAL INFORMATION.....                | 1-1  | 3-6.    | Description of Panel Features  | 3-1  |
|         | 1-1. Description.....                   | 1-1  | 3-8.    | Operating Precautions.....   | 3-1  |
|         | 1-5. Accessories Furnished.....         | 1-1  | 3-9.    | Maximum RF Power.....  | 3-1  |
|         | 1-7. Rack-Mounting Kit.....             | 1-1  | 3-11.   | Measurement Procedures....   | 3-1  |
|         | 1-9. Thirty-six Pin Male Connector..... | 1-1  | 3-13.   | Increased Accuracy for Reflection Measurements by Minimizing Directivity Errors..... | 3-12 |
|         | 1-11. Accessories Available.....        | 1-2  | 3-16.   | Increased Accuracy for Transmission Measurements by Reducing Mismatch Ambiguity..... | 3-12 |
|         | 1-12. Flexible Arm.....                 | 1-2  | 3-18.   | Remote Operation.....  | 3-13 |
|         | 1-14. Attenuator.....                   | 1-2  | 3-20.   | Care of APC-7 Connectors..   | 3-13 |
|         | 1-16. APC-7 Short.....                  | 1-2  | 3-23.   | Contact Replacement .....  | 3-13 |
|         | 1-18. Complementary Equipment ....      | 1-2  | 3-28.   | Coupling Mechanisms.....   | 3-16 |
|         | 1-19. Model 8410A Network Analyzer..... | 1-2  | 3-32.   | Power Switch Lamp Replacement.....   | 3-16 |
|         | 1-21. Signal Source.....                | 1-2  | IV      | MAINTENANCE .....  | 4-1  |
|         | 1-23. Instruments Covered by Manual.    | 1-2  | 4-1.    | Introduction .....   | 4-1  |
| II      | INSTALLATION.....                       | 2-1  | 4-3.    | RF Troubleshooting .....   | 4-1  |
|         | 2-1. Incoming Inspection.....           | 2-1  | 4-5.    | Performance Test Procedures  | 4-1  |
|         | 2-3. Repackaging for Shipment.....      | 2-1  | V       | REPLACEABLE PARTS.....   | 5-1  |
|         | 2-4. Using Original Packaging.....      | 2-1  | 5-1.    | Introduction .....   | 5-1  |
|         | 2-8. Using Other Packaging.....         | 2-1  | 5-3.    | Ordering Information .....   | 5-1  |
|         | 2-10. Preparation For Use.....          | 2-1  | VI      | SCHEMATIC DIAGRAMS .....   | 6-1  |
|         | 2-11. Power Requirements.....           | 2-1  | 6-1.    | Introduction .....   | 6-1  |
|         | 2-13. 115/230 Volt Operation.....       | 2-1  |         |  |      |
|         | 2-16. Power Cable .....                 | 2-1  |         |  |      |
|         | 2-19. Bench Operation .....             | 2-1  |         |  |      |
|         | 2-21. Rack Mounting .....               | 2-1  |         |  |      |
| III     | OPERATION .....                         | 3-1  |         |  |      |
|         | 3-1. Introduction .....                 | 3-1  |         |  |      |

LIST OF ILLUSTRATIONS

| Number | Title  | Page | Number | Title  | Page |
|--------|--|------|--------|--|------|
| 1-1.   | Model 8743A Reflection-Transmission Test Unit .....                                  | 1-0  | 4-1.   | Performance Test .....   | 4-2  |
| 3-1.   | Front Panel Features .....   | 3-2  | 4-2.   | Insertion Loss Troubleshooting .....                           | 4-7  |
| 3-2.   | Rear Panel Features .....  | 3-3  | 4-3.   | Position of Outer Conductor Washer ..                          | 4-8  |
| 3-3.   | Reflection Measurement, Using Network Analyzer with 8413A Display ..                 | 3-4  | 6-1.   | General Information on Schematic Diagrams .....                | 6-1  |
| 3-4.   | Transmission Measurement, Using Network Analyzer with 8413A Display Unit .....       | 3-6  | 6-2.   | Schematic Diagram Notes .....                                  | 6-2  |
| 3-5.   | Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit .....   | 3-8  | 6-3.   | 8743A Component Identification, Top View .....                 | 6-3  |
| 3-6.   | Transmission Measurement, Using Network Analyzer with 8414A Polar Display Unit ..... | 3-10 | 6-4.   | 8743A Component Identification, Bottom View .....              | 6-3  |
| 3-7.   | Measured Reflection Coefficient .....  | 3-12 | 6-5.   | Simplified RF Schematic Diagram ....                           | 6-4  |
| 3-8.   | Locus of Measured Reflection with Load is Moved .....                                | 3-12 | 6-6.   | RF Schematic Diagram .....                                     | 6-5  |
| 3-9.   | Locus of Measured Reflection with Directivity Cancelled .....                        | 3-12 | 6-7.   | Relay Driver Input Circuit Talking ... Schematic Diagram ..... | 6-6  |
| 3-10.  | Typical Transistor Remote Control Circuit .....                                      | 3-13 | 6-8.   | Relay Driver Assy Component Diagram .....                      | 6-7  |
| 3-11.  | APC-7 Connectors .....   | 3-14 | 6-9.   | Relay Driver Assy Component Identification .....               | 6-8  |
| 3-12.  | Pushbutton Selector Bulb Replacement .....   | 3-15 | 6-10.  | Switch Assy Component Identification .                         | 6-8  |
|        |  |      | 6-11.  | Relay Driver Assy Schematic Diagram .....                      | 6-9  |
|        |  |      | 6-12.  | Power Supply Assy Component Identification .....               | 6-10 |
|        |  |      | 6-13.  | Power Supply Schematic Diagram ....                            | 6-11 |
|        |  |      | A-1.   | Pushbutton Lamp Replacement .....                              | A-2  |

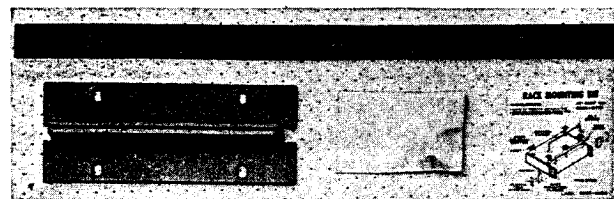
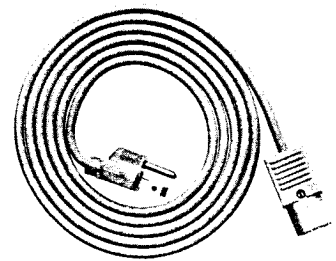


8743A



36 PIN  
CONNECTOR

POWER CABLE



RACK MOUNTING KIT

Figure 1-1. MODEL 8743A REFLECTION-TRANSMISSION TEST UNIT.

LIST OF TABLES

| Number | Title  | Page | Number | Title   | Page |
|--------|--|------|--------|---|------|
| 1-1.   | Specifications.....                              | 1-1  | 4-1.   | Recommended Test Equipment for<br>Performance Test Procedure..... | 4-1  |
| 3-1.   | Contact Closures for Remote<br>Operation.....    | 3-13 |        |   |      |
| 3-2.   | Signal Requirements for Remote<br>Operation..... | 3-13 | 5-1.   | Reference Designation Index.....                                  | 5-2  |

## SECTION I

### GENERAL INFORMATION

#### 1-1. DESCRIPTION.

1-2. The Model 8743A Reflection - Transmission Test Unit is a complementary instrument for the HP 8410A Network Analyzer. It contains microwave circuits for making reflection and transmission measurements from 2.0 to 12.4 GHz. The RF circuit for a transmission or a reflection measurement is set up by a front panel pushbutton or with remote contact closures.

1-3. A calibrated internal line stretcher with a high resolution digital indicator compensates for the electrical length of the device under test - up to 15 cm for reflection tests, and up to 30 cm for transmission tests. If more compensation is needed, additional line may be installed in place of the removable rigid coax link on the rear panel.

1-4. As shown in Figure 6-5 both the reference and test channels are isolated from the signal source by 20 dB. In addition to padding source mismatch, the attenuation in the test channel permits measurements on small-signal devices.

#### 1-5. ACCESSORIES FURNISHED.

1-6. A rack-mounting kit, a male 36-pin connector (HP part number 1251-0084) and a detachable power cable are furnished with the Model 8743A.

#### 1-7. RACK-MOUNTING KIT.

1-8. The rack-mounting kit contains all the hardware needed to adapt the Model 8743A cabinet for installation in equipment racks with standard 19-inch spacing. Instructions for conversion to rack mounting are included with the kit.

#### 1-9. THIRTY-SIX PIN MALE CONNECTOR.

1-10. The 36-pin male connector mates with the rear-panel REMOTE INPUT connector, and permits all necessary remote programming connections to be made to the 8743A. (See Table 3-1 for wiring information.)

Table 1-1. Specifications.

|  |  |
|--|--|
| <u>Frequency Range:</u> 2.0 to 12.4 GHz.   | REFERENCE and TEST channel output ports mate with APC-7 <sup>2</sup> connectors.   |
| <u>Impedance:</u> 50 ohms nominal.   | TRANSMISSION and UNKNOWN ports: APC-7 <sup>2</sup> sexless connectors  |
| <u>Reflection Coefficient</u>  | REMOTE INPUT: 36 pin female.   |
| UNKNOWN port: * 2-8 GHz, $\leq 0.091$ (VSWR 1.2)   |  |
| 8-12.4 GHz, $\leq 0.13$ (VSWR 1.3)   |  |
| TRANSMISSION RETURN port:  | <u>Microwave Switches:</u> Typical switching time, 40 msec. Estimated switch lifetime 1 million cycles.  |
| REFL Measurement: $\leq 0.13$ (VSWR 1.3)   |  |
| TRANS Measurement: $\leq 0.20$ (VSWR 1.5)  | <u>Reference Plane Extension:</u> 0 to 15 cm for reflection; 0 to 30 cm for transmission; calibrated by dial indicator. Indicator is adjustable for initial calibration.   |
| <u>Coupler Directivity:</u> 30 dB  | <u>Transmission-Reflection Selection:</u> Manual by front-panel, lighted pushbuttons. Remote by contact closures or saturated transistors through 36-pin connector at rear panel. Pin 17 to pins 18 or 36 (ground) selects remote operation. Opening or closing pin 24 to pins 18 or 36 selects Reflection or Transmission. Pins 17 and 24 are at 12V and short to ground will draw 12 mA. |
| <u>Insertion Loss:</u>   | <u>Accessories Furnished:</u>  |
| RF Input to REFERENCE output: 30 dB nominal  | Rack-mounting kit  |
| RF Input to UNKNOWN port: 20 dB nominal  | 36-pin male connector  |
| UNKNOWN port to TEST output in Reflection mode: 10 dB nominal                                | Power cable  |
| TRANSMISSION RETURN port to TEST output in transmission mode: <1.5 dB.                       |  |
| <u>Maximum RF input:</u> 8743A damage level, 2 W   |  |
| <u>Connectors:</u>   |  |
| RF INPUT port: Type N <sup>1</sup> female, stainless steel.                                  |  |
| <sup>1</sup> Compatible with connectors whose dimensions conform to MIL-C-39012 or MIL-C-71. | <sup>2</sup> Amphenol RF Division, Danbury, Connecticut.   |
| *Equivalent source reflection coefficient when used with 8410A Network Analyzer.             |  |

**1-11. ACCESSORIES AVAILABLE.****1-12. FLEXIBLE ARM.**

1-13. The Model 11605A Flexible Arm is a combination of three rotary air lines and three swivel joints. It combines the phase stability of rigid line with the flexibility of cable so that devices with any port geometry can be connected to the 8743A.

**1-14. ATTENUATOR.**

1-15. A 50-ohm coaxial attenuator is recommended for transmission measurements. An attenuator connected between the output of the device under test and the HP 11605A Flexible Arm reduces the ambiguity due to mismatch between the 11605A, 8743A, and 8411A. A 10-dB low reflection attenuator, such as a HP 8492A Option 10, reduces this ambiguity to essentially that of the attenuator ( $VSWR \leq 1.25$ ). In addition to reducing error due to mismatch, the 10-dB attenuator makes the test channel power level during calibration the same for transmission and reflection. Also, the combined electrical lengths of the 8492A and 11605A make the electrical length of the test channel in the transmission mode nearly equal to its length in the reflection mode. This means, that since the difference is small, it is possible to calibrate for one mode of operation and switch to the other without recalibrating.

**1-16. APC-7 SHORT.**

1-17. The Model 11565A APC-7 Short is useful for establishing reflection measurement, phase and magnitude, reference.

**1-18. COMPLEMENTARY EQUIPMENT.****1-19. MODEL 8410A NETWORK ANALYZER.**

1-20. The 8410A Network Analyzer measures relative amplitude and phase of two RF input signals. The instrument is capable of single or swept frequency

measurements, in the range of 0.11 to 12.4 GHz. Two plug-in display units are available. The 8413A plug-in unit displays relative amplitude and phase data on a meter. Phase and amplitude output signals allow display of swept signals on an oscilloscope or X-Y recorder. The 8414A plug-in unit displays relative amplitude and phase data in polar coordinates on a 5-inch CRT for either swept or CW mode of measurement.

**1-21. SIGNAL SOURCE.**

1-22. HP 8690 Sweep Oscillator main frames with 8692B, 8693B and 8694B RF plug-in units provide swept frequency coverage of the entire 8743A frequency range. These oscillators have features which make them especially compatible with the 8410A Network Analyzer system. For example, the sweep reference voltage output permits the 8410A phase lock system to track the fastest sweeps for flicker-free oscilloscope displays. Also, the between-sweep pause at the start frequency enables the Network Analyzer to phase lock solidly before a sweep begins.

**1-23. INSTRUMENTS COVERED BY MANUAL.**

1-24. Each Model 8743A carries a two-section, eight-digit serial number (000-00000). The first three digits of the number are a prefix. The contents of this manual apply directly to the Model 8743A which has the same serial number prefix(es) as those listed after SERIALS PREFIXED on the title page.

1-25. Revisions required to adapt this manual to other serial number prefixes are given in a yellow-sheet Manual Changes insert, supplied with the manual. For information concerning serial number prefixes not listed on the title page or in an insert, contact the nearest Hewlett-Packard office listed at the rear of this manual.



## SECTION II

### INSTALLATION

#### 2-1. INCOMING INSPECTION.

2-2. Inspect the instrument for shipping damage as soon as it is unpacked. Check that all accessories listed in Paragraph 1-7 have been included. Check for broken knobs and connectors; inspect cabinet and panel surfaces for dents and scratches. If the instrument is damaged in any way, or fails to operate properly, notify carrier and your nearest Hewlett-Packard Sales and Service Office. For assistance of any kind, including instruments under warranty, contact the nearest Hewlett-Packard Sales Office listed at the back of this manual.

#### 2-3. REPACKAGING FOR SHIPMENT.

##### 2-4. USING ORIGINAL PACKAGING.

2-5. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard offices listed at the rear of this manual. Remove the rear-panel coaxial link, wrap it separately and include in shipping container.

2-6. If the Model 8743A is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container **FRAGILE** to assure careful handling.

2-7. In any correspondence, refer to the instrument by model number and full serial number.

##### 2-8. USING OTHER PACKAGING.

2-9. The following general instructions should be used when repackaging with commercially-available materials:

a. Wrap the 8743A and the rear-panel coaxial link separately in heavy paper or plastic. (If shipping to a Hewlett-Packard service office or center, attach a tag indicating the type of service required, the return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely, and mark it **FRAGILE** to assure careful handling.

e. In any correspondence refer to the instrument by model number and full serial number.

#### 2-10. PREPARATION FOR USE.

##### 2-11. POWER REQUIREMENTS.

2-12. The Model 8743A requires a power source of 115 or 230 volts  $\pm 10\%$ , 50 to 1000 Hz, single phase that can supply approximately 20 watts.

##### 2-13. 115/230 VOLT OPERATION.

2-14. A two-position slide switch on the rear panel of the Model 8743A permits operation from either a 115- or 230-volt power source. The number showing on the switch slider indicates the voltage for which the instrument is connected. The correct line fuse rating for each line voltage is marked on the plate adjacent to the fuse.

2-15. To prepare the Model 8743A for operation, position the 115-230 volt switch so that the number showing on the slider corresponds to the available line voltage, and install a line fuse of correct rating. "Slo-blo" fuses should be used.

#### CAUTION

To avoid damage to the instrument, set the 115-230 switch to the line voltage to be used before connecting the power cable.

##### 2-16. POWER CABLE.

2-17. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. Accordingly, the Model 8743A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds panel and cabinet. The offset pin of the three-prong connector is the grounding pin.

2-18. To preserve the protection feature when operating the Model 8743A from a two-contact outlet, use a three-prong to two-prong adapter (HP part number 1251-0048), and connect the green wire on the adapter to ground.

##### 2-19. BENCH OPERATION.

2-20. The Model 8743A cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The stand inclines the instrument enough to make the panel features easier to see. The plastic feet provide clearance for air circulation and make the Model 8743A self-aligning when stacked on other Hewlett-Packard full rack-width modular instruments.

##### 2-21. RACK MOUNTING.

2-22. All necessary hardware and instructions are contained in the supplied rack-mounting kit (HP part number 5060-0775). Care must be taken to insure that the ambient operating temperature does not exceed 55° C (140° F).



## SECTION III

### OPERATION

#### 3-1. INTRODUCTION.

3-2. The combination of the Model 8743A Reflection-Transmission Test Unit with the Model 11605A Flexible Arm, a signal source, and a compatible phase-amplitude ratio indicator, such as the HP Model 8410A Network Analyzer, makes up a system for measuring reflection and transmission, phase and magnitude, from 2.0 to 12.4 GHz.

3-3. The microwave circuit for a reflection or transmission measurement is set up by pressing a front panel pushbutton or with remote contact closures.

3-4. A calibrated line stretcher with a digital indicator is used to equalize the electrical length of the test and reference channels for initial phase calibration. A thumbwheel allows the digital indicator to be set to zero or to any desired reference. For reflection measurements, in cases where the measurement plane is not to be at the UNKNOWN port, the line stretcher can be adjusted to extend the measurement plane up to 15 cm beyond the UNKNOWN port. For transmission measurements, the line stretcher can be used to determine the total electrical length (up to 30 cm) of the device under test. For either function, additional line may be installed in place of the removable rigid coax link (REFERENCE LINE) on the rear panel.

3-5. A special recess for the HP 8410A Network Analyzer's harmonic frequency converter permits

direct connection to the 8743A with no increase in package dimensions.

#### 3-6. DESCRIPTION OF PANEL FEATURES.

3-7. Front and rear panel controls, connectors, and indicators are described in Figures 3-1 and 3-2. In these figures the numbers on the panel illustrations match the description numbers.

#### 3-8. OPERATING PRECAUTIONS.

##### 3-9. MAXIMUM RF POWER.

3-10. Do not apply more than 2 watts of RF power to the rear-panel RF INPUT. Power in excess of 2 watts may damage the internal directional couplers. When making transmission measurements using the 8410A Network Analyzer, do not apply more than 50 mW to the 8743A TRANSMISSION RETURN port. More than 50 mW may damage the 8411A Harmonic Frequency Converter.

#### 3-11. MEASUREMENT PROCEDURES.

3-12. Procedures for making transmission and reflection measurements using the HP 8743A with the HP 8410A Network Analyzer are included in Figures 3-3 through 3-6.

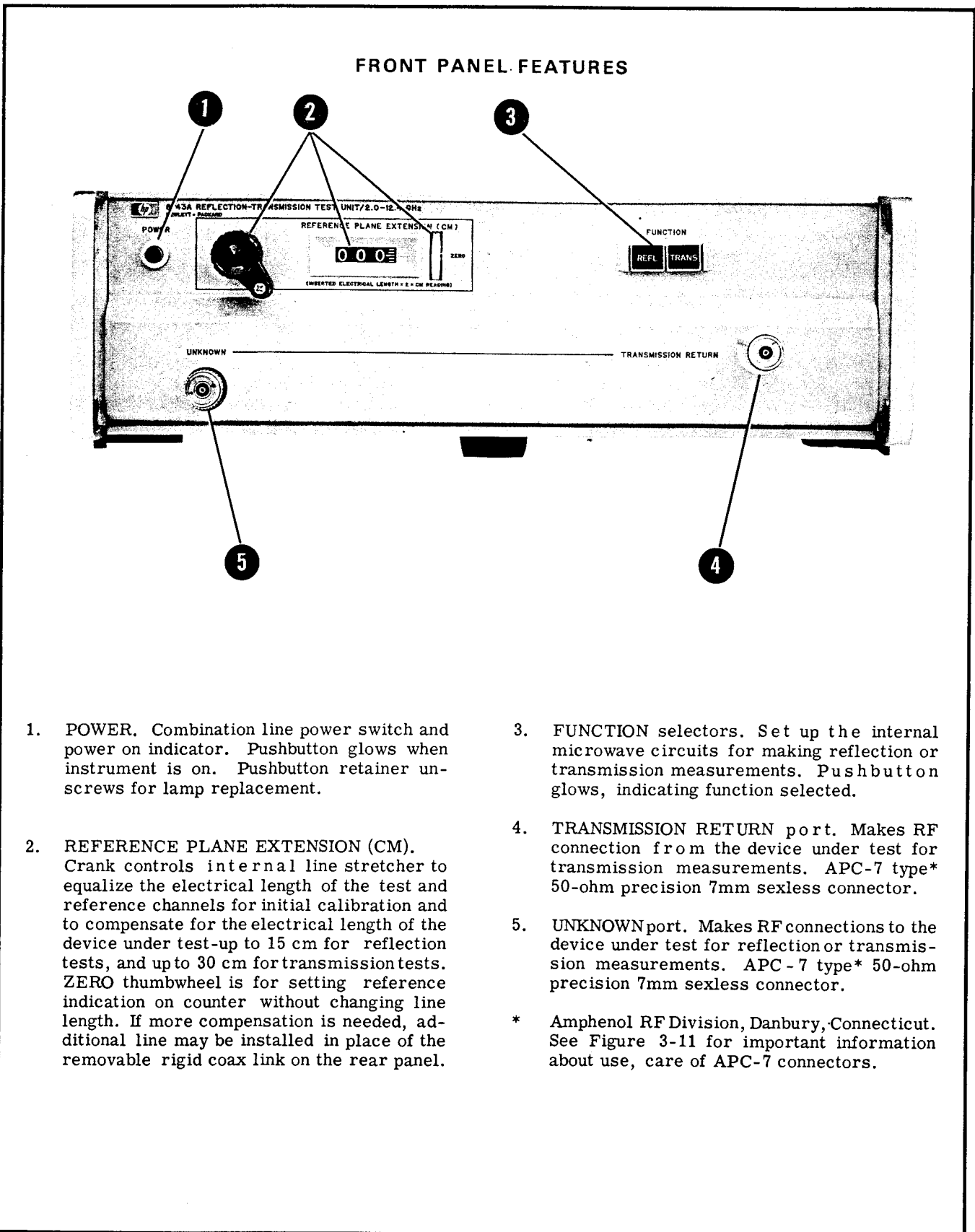


Figure 3-1. Front Panel Features

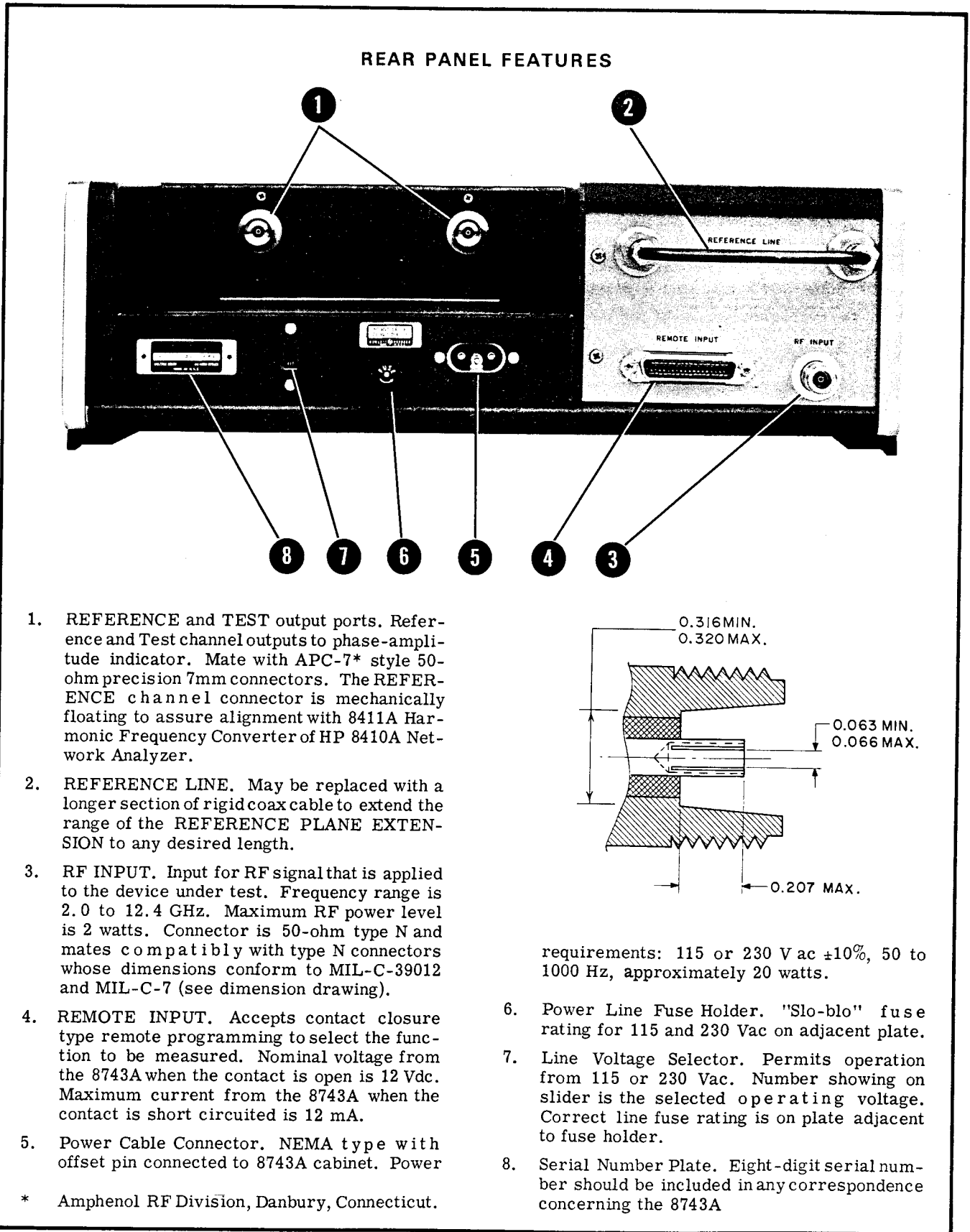


Figure 3-2. Rear Panel Features

### REFLECTION MEASUREMENT

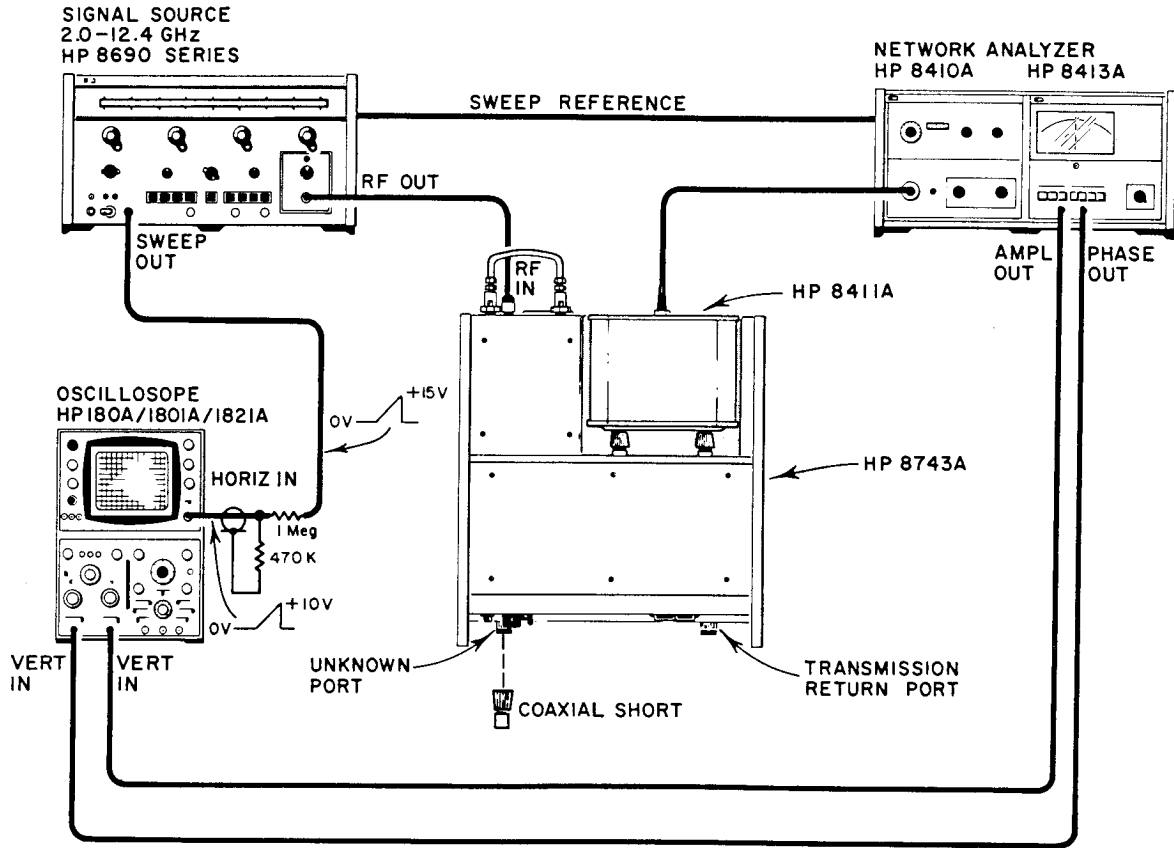


Figure 3-3. Reflection Measurement, Using Network Analyzer with 8413A Display Unit. (Sheet 1 of 2)

**CALIBRATION**

**DESCRIPTION.** Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications using a termination of known magnitude and phase angle.

**PROCEDURE.**

1. Connect equipment as shown in setup.
2. Connect a coaxial short such as the HP 11565A to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Adjust 8413A phase offset control for 180° offset (either polarity).
4. Set the Sweep Oscillator to automatic sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
5. Adjust the oscilloscope to display the swept phase output from the 8413A.
6. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION for a horizontal phase display on the oscilloscope. If the plane of measurement is to be extended beyond the plane of the short, the digital counter should be set to zero so that it can be used to set the required extension accurately. A convenient way to do this is as follows:
  - a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
  - b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION for a horizontal display on the oscilloscope.
7. For swept-frequency measurements, adjust the oscilloscope display as follows:
  - a. Disconnect oscilloscope vertical input from 8413A AMPLITUDE channel, to simulate zero volts dc from 8413A. Note trace position.
  - b. Reconnect vertical input and adjust 8410A test channel gain and amplitude vernier controls so that the average of the trace falls on the zero trace position noted in step (a) above.
  - c. Adjust oscilloscope vertical position for a convenient amplitude reference.
  - d. Disconnect oscilloscope vertical input from 8413A PHASE channel, to simulate zero volts dc from 8413A. Note trace position.
8. To calibrate for single - frequency measurements, perform the following:
  - a. Set the Sweep Oscillator for single-frequency operation.
  - b. Adjust the 8410A PHASE VERNIER for a zero degree indication on the 8413A.
  - c. Adjust 8410A test channel gain and amplitude vernier controls for a 0 dB indication on the 8413A.
- e. Reconnect vertical input and adjust 8410A phase vernier control so that the average of the trace falls on the zero trace position noted in step (d) above.
- f. Adjust oscilloscope vertical position for a convenient phase reference.

**NOTE**

Calibration for greater accuracy is discussed in Paragraph 3-14 and 3-15.

**MEASUREMENT.**

1. Remove the coaxial short and connect the device to be tested to the 8743A UNKNOWN port.
2. Return the 8413A phase offset to zero.
3. For swept - frequency measurements, read magnitude and phase as follows:
  - a. For magnitude, note 8410A test channel gain settings. Increase test channel gain to return oscilloscope display to reference obtained during calibration. The difference in test channel gain settings is the reflection magnitude in return loss<sup>1</sup>.
  - b. For phase, adjust oscilloscope vertical sensitivity and position controls to view the swept - phase display of the device under test. Use the calibrated 8413A output (10 mV/degree) and the oscilloscope vertical calibration to determine phase angle.
4. For single - frequency measurements, read magnitude and phase as follows:
  - a. For magnitude, note 8410A test channel gain settings. Increase test channel gain to return the 8413A meter indication to zero. The difference in test channel gain settings is the reflection magnitude in return loss.<sup>1</sup>
  - b. For phase, adjust the 8413A phase offset for an on scale meter indication on the most sensitive scale. The phase angle is the algebraic sum of phase offset and meter indication.

$$^1 |p| = \frac{1}{\text{Log}^{-1}(0.05 \times \text{Return Loss})}$$

Figure 3-3. Reflection Measurement, Using Network Analyzer with 8413A Display Unit. ( Sheet 2 of 2)

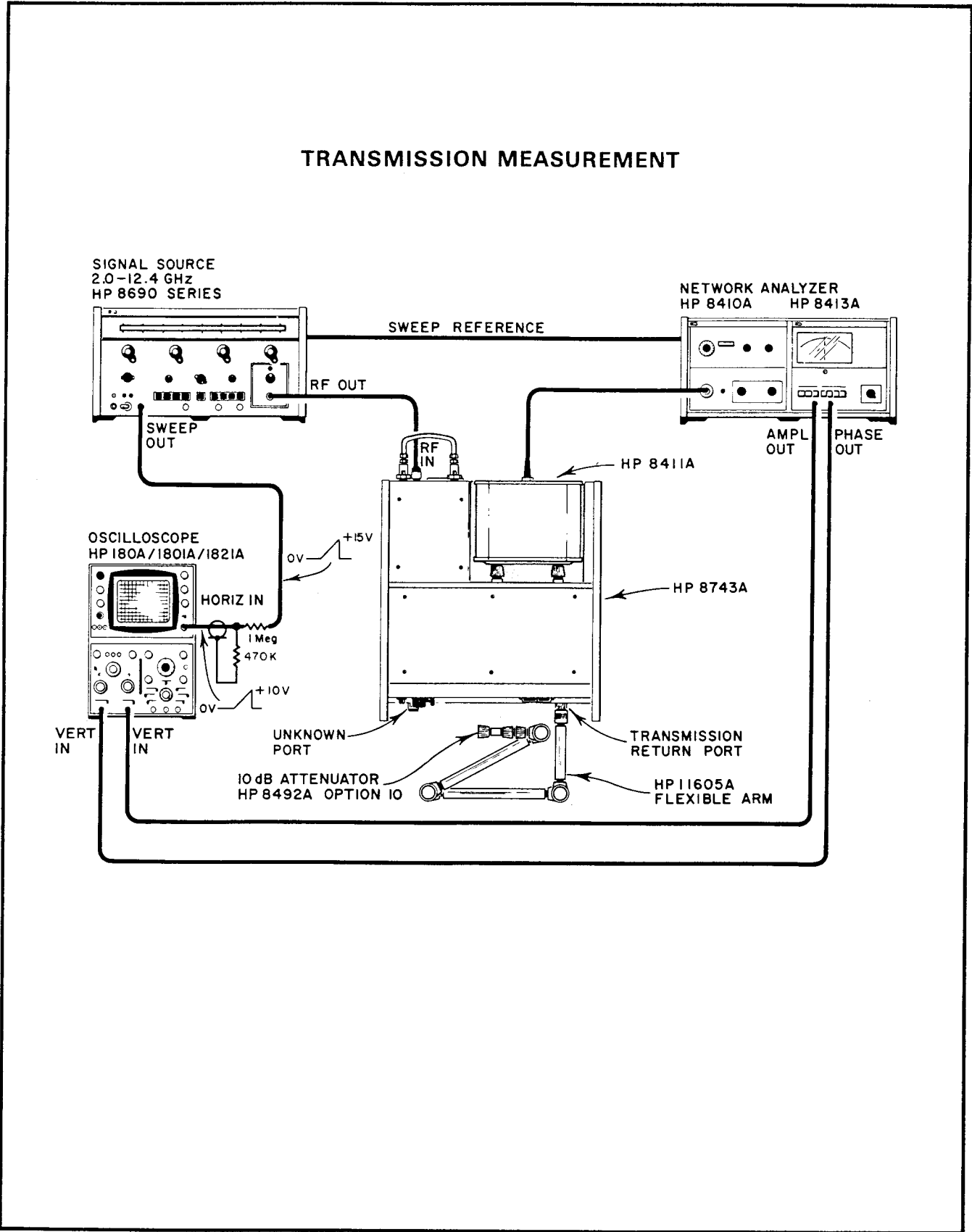


Figure 3-4. Transmission Measurement, Using Network Analyzer with 8413A Display Unit (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

## PROCEDURE.

1. Connect equipment as shown in setup. Connect a 10-dB attenuator, such as the HP 8492A Option 10, to the HP 11605A Flexible Arm (see Paragraph 3-17), and connect the attenuator to the 8743A UNKNOWN port.
2. Dc couple and dc balance the oscilloscope vertical amplifiers. Adjust the oscilloscope to display the swept - phase output from the 8413A.
3. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION for a horizontal phase display on the oscilloscope. If the digital counter is to be used to determine the electrical length of the device under test, it should be set to zero. A convenient way to do this is as follows.
  - a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
  - b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION for a horizontal display on the oscilloscope.
4. For swept - frequency measurements, adjust the oscilloscope display as follows:
  - a. Disconnect oscilloscope vertical input from 8413A AMPLITUDE channel to simulate zero volts dc from 8413A. Note trace position.
  - b. Reconnect vertical input and adjust 8410A test channel gain and amplitude vernier controls so that the average of the trace falls on the zero trace position noted in step (a) above.
  - c. Adjust oscilloscope vertical position for convenient amplitude reference.
  - d. Disconnect oscilloscope vertical input from 8413A PHASE channel to simulate zero volts dc from 8413A. Note trace position.
  - e. Reconnect vertical input and adjust the 8410A PHASE vernier control so that the average of the trace falls on the zero trace position noted in step (d) above.
5. To calibrate for single - frequency measurements perform the following:
  - a. Set the Sweep Oscillator for single-frequency operation.
  - b. Adjust 8410A PHASE VERNIER for zero degree indication on the 8413A.
  - c. Adjust 8410A test channel gain and amplitude vernier controls for a 0 dB indication on the 8413A.
  - f. Adjust oscilloscope vertical position for a convenient phase reference.

MEASUREMENT

1. Insert the device to be tested between the UNKNOWN port and the 10-dB attenuator.
2. For swept - frequency measurements, read magnitude and phase as follows:
  - a. For magnitude, note 8410A test channel gain settings. Adjust test channel gain to return oscilloscope display to reference obtained during calibration. The difference in test channel gain settings is the transmission gain or loss in dB of the device under test.
  - b. For phase, adjust oscilloscope vertical sensitivity and position controls to view the swept - phase display of the device under test. Use the calibrated 8413A output (10 mv/degree) and the oscilloscope vertical calibration to determine phase angle.

## NOTE

The phase display is the combination of linear phase (due to electrical length) and non-linear phase shift. Group delay can be determined from this display (see HP Application Note 92).

3. For single - frequency measurements, read magnitude and phase as follows:
  - a. For magnitude, note 8410A test channel gain settings. Adjust test channel gain to return the 8413A meter indication to zero. The difference in test channel gain settings is the transmission gain or loss in dB of the device under test.
  - b. For phase, adjust the 8413A phase offset for an on-scale meter indication on the most sensitive scale. The phase angle is the algebraic sum of phase offset and meter indication.

Figure 3-4. Transmission Measurement, Using Network Analyzer with 8413A Display Unit (Sheet 2 of 2)



### REFLECTION MEASUREMENT

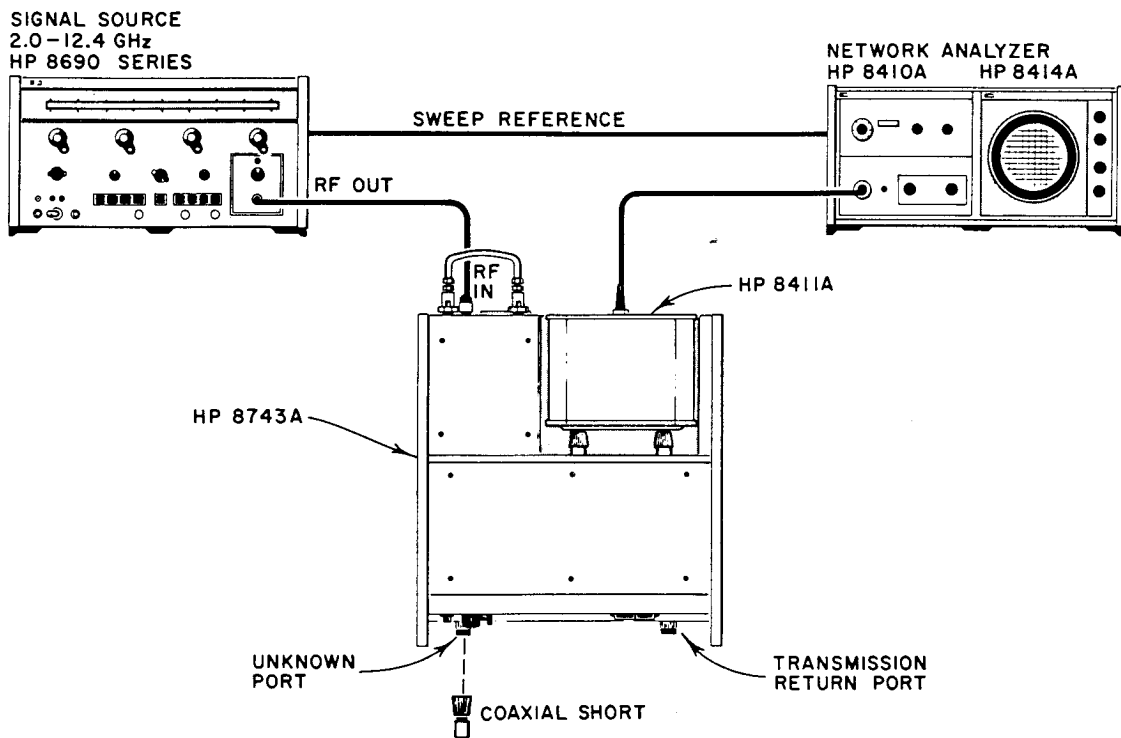


Figure 3-5. Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit (Sheet 1 of 2)



CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

PROCEDURE.

1. Connect equipment as shown in setup.
2. Connect a coaxial short such as the HP 11565A to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Set the Sweep Oscillator to automatic sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
4. Push and hold the 8414A BEAM CTR pushbutton and adjust the centering controls to place the dot in the center of the polar display.
5. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster. If the plane of measurement is to be extended beyond the plane of the short, the digital counter should be set to zero so that it can be used to set the required extension accurately. A convenient way to do this is as follows:
  - a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
  - b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster.
6. Adjust the 8410A PHASE VERNIER, TEST CHANNEL GAIN and AMPL VERNIER controls to place the dot or cluster for a reference indication of  $\Gamma=1/180^\circ$ .

NOTE

Calibration for greater accuracy is discussed in Paragraph 3-14 and 3-15.

MEASUREMENT

1. Remove the coaxial short and connect the device to be tested to the 8743A UNKNOWN port.
2. Read the reflection coefficient, magnitude and phase, (or impedance using a Smith Chart overlay) from the 8414A display.

NOTE

For small reflection coefficients the 8414A resolution can be improved by increasing the 8410A test channel gain. For example, increasing the test channel gain by 20 dB changes the full scale reflection-coefficient calibration from 1.0 to 0.1 at the outer circle.

3. The effective load plane of the device under test may be determined by adjusting the REFERENCE PLANE EXTENSION to again collapse the trace to a dot or smallest cluster. The distance from reference plane to load plane may be read directly from 8743A digital counter (counter set to zero during calibration).

Figure 3-5. Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit (Sheet 2 of 2)

### TRANSMISSION MEASUREMENT

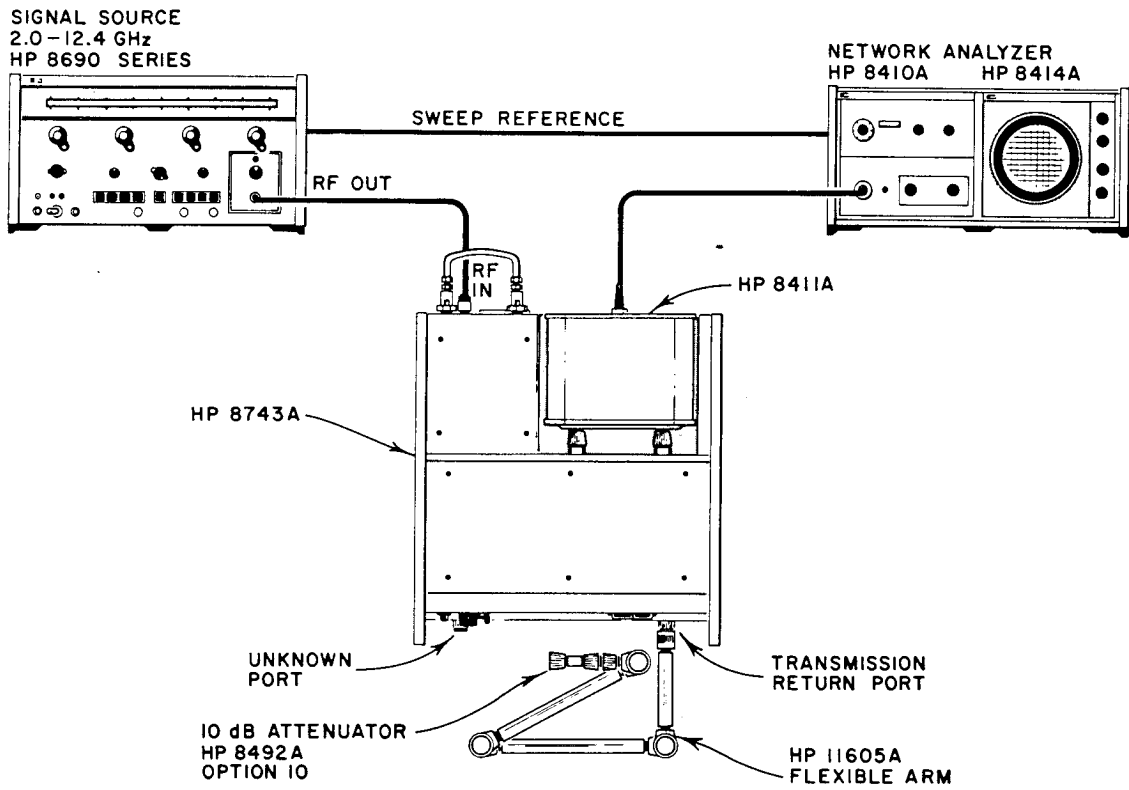


Figure 3-6. Transmission Measurements, Using Network Analyzer with 8414A Polar Display Unit (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

PROCEDURE.

1. Connect equipment as shown in setup. Connect a 10-dB attenuator, such as the HP 8492A Option 10, to the Flexible Arm (see Paragraph 3-17) and connect the attenuator to the 8743A UNKNOWN port.
2. Depress the 8743A TRANS pushbutton.
3. Set the Sweep Oscillator to automatic-sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
4. Push and hold the 8414A beam center pushbutton and adjust the centering controls to place the dot in the center of the polar display.
5. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster. If the digital counter is to be used to determine the electrical length of the device under test, it should be set to

zero. A convenient way to do this is as follows:

- a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
  - b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster.
6. Adjust the 8410A phase and amplitude controls to place the dot or cluster for a reference indication of  $\Gamma=1 \angle 0^\circ$

MEASUREMENT

1. Insert the device to be tested between the UNKNOWN port and the 10-dB attenuator.
2. Note the 8410A test channel gain setting. This is the calibrated gain setting. Adjust the test channel gain controls to locate the CRT display on the outside ring. The difference in test channel gain settings is the magnitude of the transmission gain or loss of the device under test.
3. To determine the electrical length of the device under test perform the following:
  - a. Adjust the REFERENCE PLANE EXTENSION to again collapse the trace to a dot or smallest cluster.
  - b. The electrical length of the device under test is two times the digital counter reading.

Figure 3-6. Transmission Measurements, Using Network Analyzer with 8414A Polar Display Unit (Sheet 2 of 2)

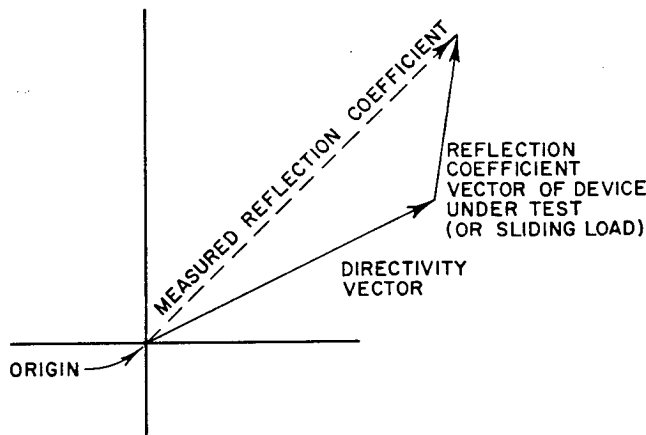


Figure 3-7. Measured Reflection Coefficient.

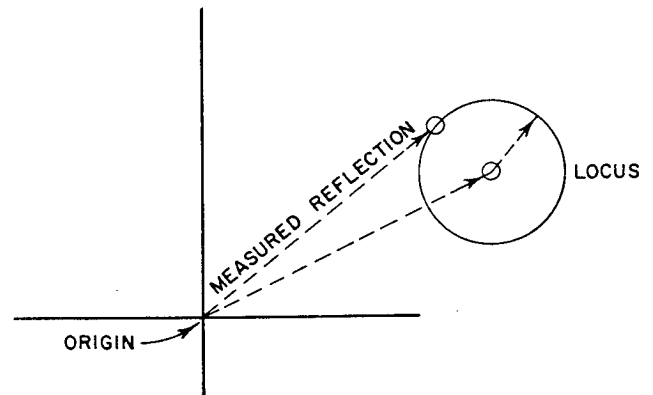


Figure 3-8. Locus of Measured Reflection when Load is Moved.

3-13. INCREASED ACCURACY FOR REFLECTION MEASUREMENTS BY MINIMIZING DIRECTIVITY ERRORS.

3-14. The 8743A internal coupler's directivity errors become significant when measuring small reflection coefficients, but the error can be cancelled at single frequencies. The measured reflection is the vector sum of the directivity vector plus the reflection coefficient of the device under test. (See Figure 3-7.) The error is calibrated out with a sliding load. Figure 3-8 depicts the sliding load in one position at a single-frequency. As the sliding load is moved, the magnitude of its reflection coefficient remains constant but the phase of the coefficient changes. As the load is moved its reflection coefficient indication rotates in a circle of constant magnitude about the directivity vector. The center of this circle is the tip of the directivity vector. If the magnitude of the directivity was zero, the locus circle would be centered about the origin as shown in Figure 3-9. The directivity vector goes from the origin to the center of the locus circle. When the location of the center of the circle is known, the directivity vector can be subtracted from the measured reflection. The resultant is the reflection coefficient of the device under test.

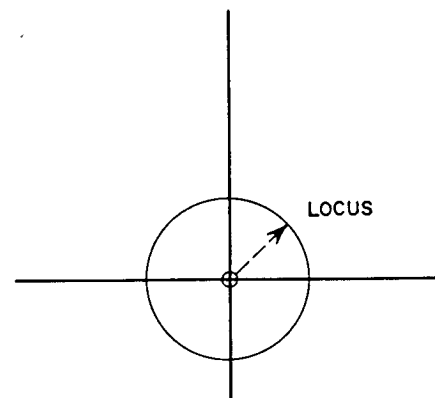


Figure 3-9. Locus of Measured Reflection with Directivity Cancelled

3-16. INCREASED ACCURACY FOR TRANSMISSION MEASUREMENTS BY REDUCING MISMATCH AMBIGUITY.

3-17. A 50-ohm coaxial attenuator is recommended for transmission measurements. An attenuator connected between the output of the device under test and the HP 11605A Flexible Arm reduces the ambiguity due to mismatch between the 11605A, 8743A and 8411A. A 10-dB low-reflection attenuator, such as a HP 8492A Option 10 reduces this ambiguity to essentially that due to the mismatch of the attenuator (VSWR < 1.25). Other values of attenuation may be used; however, values greater than 10 dB will not reduce the mismatch below that of the attenuator. For values less than 10 dB the multiple mismatch between the 11605A, 8743A and 8411A should be taken into consideration. In addition to reducing ambiguity due to mismatch, the 10-dB attenuator makes the test channel power level during calibration the same for transmission and reflection. Also, the combined electrical lengths of the 8492A and the 11605A makes the electrical length of the test channel in the transmission mode nearly equal to its length in the reflection mode. This means that, since the difference is small, it is possible to calibrate for one mode of operation, and switch to the other without recalibrating.

3-15. The vector subtraction can be performed directly with the horizontal and vertical controls on the 8414A polar display. Increase the 8410A TEST CHANNEL GAIN so full scale reflection on the polar display is suitable for the component you wish to measure. Attach a sliding load such as the HP 905A to the 8743A UNKNOWN port. Slide the load and adjust the horizontal and vertical controls until the circle rotates about the center of the CRT. The effect of directivity is now cancelled for this frequency and this test channel gain on the Network Analyzer. The vector subtraction must be done manually with the 8413A. Put the sliding load on the 8743A and measure reflection, phase and magnitude, for three positions of the sliding load. Plot these three points on graph paper and find the center of the circle that goes through these points. The vector from the origin of the graph to this center must be vectorially subtracted from any reflection measurement at this frequency.

3-12

Table 3-1. Contact Closures for Remote Operation.

| J1 Pin No. | Function                 |
|------------|--------------------------|
| 1 thru 16  | No connection            |
| 17         | Remote-Manual Select     |
| 18         | Remote Control Common    |
| 19 thru 23 | No Connection            |
| 24         | Remote TRANS-REFL Select |
| 25         | No Connection            |
| 36         | Remote Control Common    |

**3-18. REMOTE OPERATION.**

3-19. A thirty-six pin connector on the rear panel of the 8743A provides contacts for remote selection of transmission or reflection measurements. Only four of the thirty-six pins are used. The pins and their uses are given in Table 3-1. When remote-manual select pin 17 is open and not connected to a remote control common (pin 18 or 36), the 8743A is in the manual or front panel mode. In this mode of operation, the front-panel pushbuttons are enabled and remote TRANS-REFL select pin 24 is disabled. When remote-manual select pin 17 is connected to a remote control common (pin 18 or 36), the 8743A is in the remote mode. In this mode of operation the front-panel pushbuttons are disabled, and remote TRANS-REFL select pin 24 is enabled, allowing selection of transmission or reflection measurements only through the remote input pin 24. Table 3-2 shows the signal requirements for remote operation. A typical transistor remote control circuit is shown in Figure 3-10. The 8743A supplies approximately +12 Vdc for the open-circuit condition and 12 mA of current for the short-circuit condition.

**3-20. CARE OF APC-7 CONNECTORS.**

3-21. RF connections to and from the device under test and to the phase-amplitude ratio indicator are made with APC-7 style 50-ohm 7 mm sexless connectors. These connectors should be handled with particular care for two reasons:

a. Continuity through APC-7 connectors is obtained by end-to-end contact of the inner and outer conductors. Consequently, the electrical performance of the connector is largely dependent upon the condition of these exposed surfaces.

b. The inner conductor of the front-panel UNKNOWN connector is attached to a directional coupler and any rotational force on the inner conductor may result in damage to the coupler.

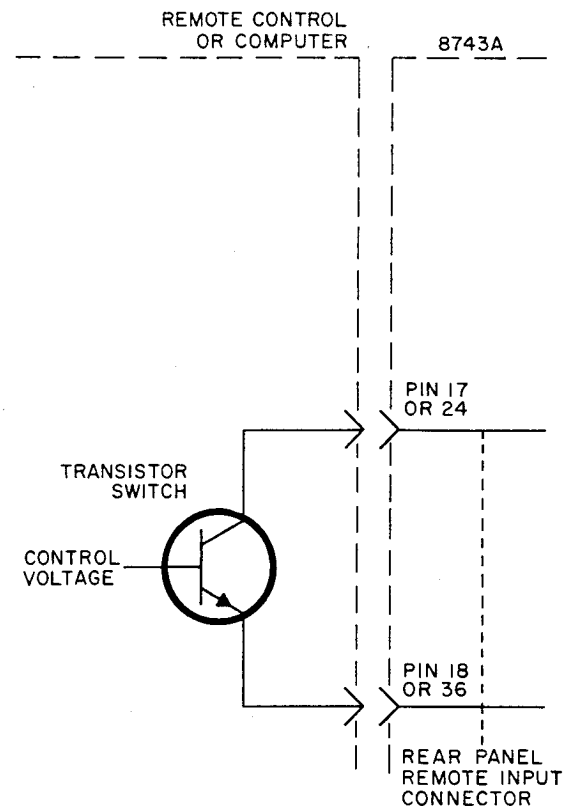


Figure 3-10. Typical Transistor Remote Control Circuit.

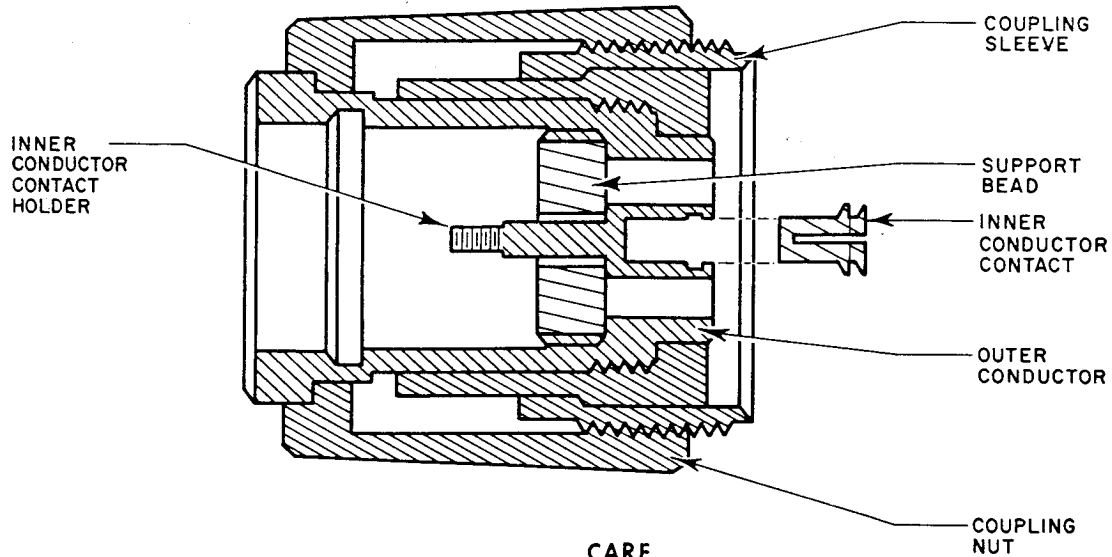
Table 3-2. Signal Requirements for Remote Operation.

| Measurement  | Pin 18 or 36 to: |         |
|--------------|------------------|---------|
|              | Pin 17           | Pin 24  |
| Transmission | shorted          | shorted |
| Reflection   | shorted          | open    |

3-22. Important recommendations about the handling and care of the APC-7 connectors are given in Figure 3-11. The part of an input connector that is most likely to be damaged is the inner conductor contact. Since it protrudes slightly beyond the plane of electrical contact, any wiping action of one connector across the other can damage the contact enough to cause a discontinuity. The risk of this kind of damage can be minimized, as stated in Figure 3-11, by always having the coupling sleeves of the UNKNOWN and TRANSMISSION RETURN connectors fully extended.

**3-23. CONTACT REPLACEMENT.**

3-24. Replacement inner conductor contacts are available from Hewlett-Packard (part number 1250-0907), and from Amphenol RF Division, Danbury, Connecticut (part number 131-129).



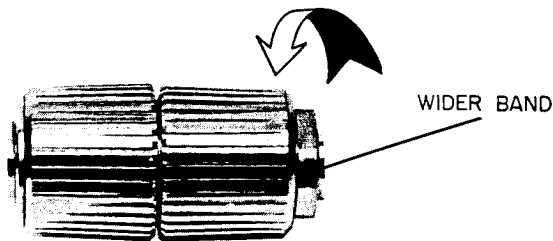
**USE**

**To Connect:**

1. On one connector, retract the coupling sleeve by turning the coupling nut counterclockwise until the sleeve and nut disengage.
2. On the other connector, fully extend the coupling sleeve by turning the coupling nut clockwise. To engage coupling sleeve and coupling nut when the sleeve is fully retracted, press back lightly on the nut while turning it clockwise.
3. Push the connectors firmly together, and thread the coupling nut of the connector with retracted sleeve over the extended sleeve. Leave the other coupling nut in the original position: closing the gap between coupling nuts tends to loosen the electrical connection.

**To Disconnect:**

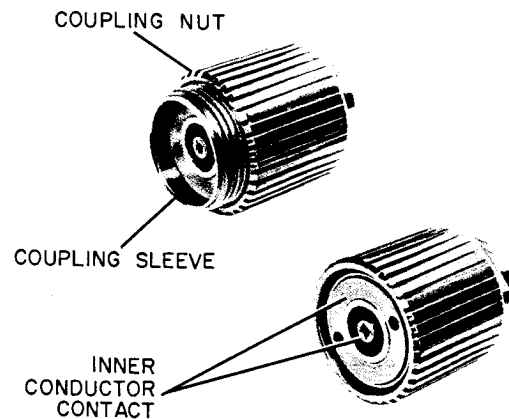
1. Loosen the coupling nut of the connector showing the wider gold band.



2. **IMPORTANT:** Part the connectors carefully to prevent striking the inner conductor contact.

**CARE**

1. Keep contacting surfaces smooth and clean. Irregularities and foreign particles can degrade electrical performance.



2. Protect the contacting surfaces when the connector is not in use by leaving the coupling sleeve extended.
3. Use lintless material and/or firm-bristled brush such as tooth brush for cleaning. If a cleaning fluid is needed use isopropyl alcohol. **IMPORTANT:** Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones, or ether-alcohols such as benzene, toluene, turpentine, dioxane, gasoline, cellosolve acetate, or carbon tetrachloride. Keep exposure of the connector parts to both the cleaning fluid and its vapors as brief as possible.

Figure 3-11. APC-7 Connectors

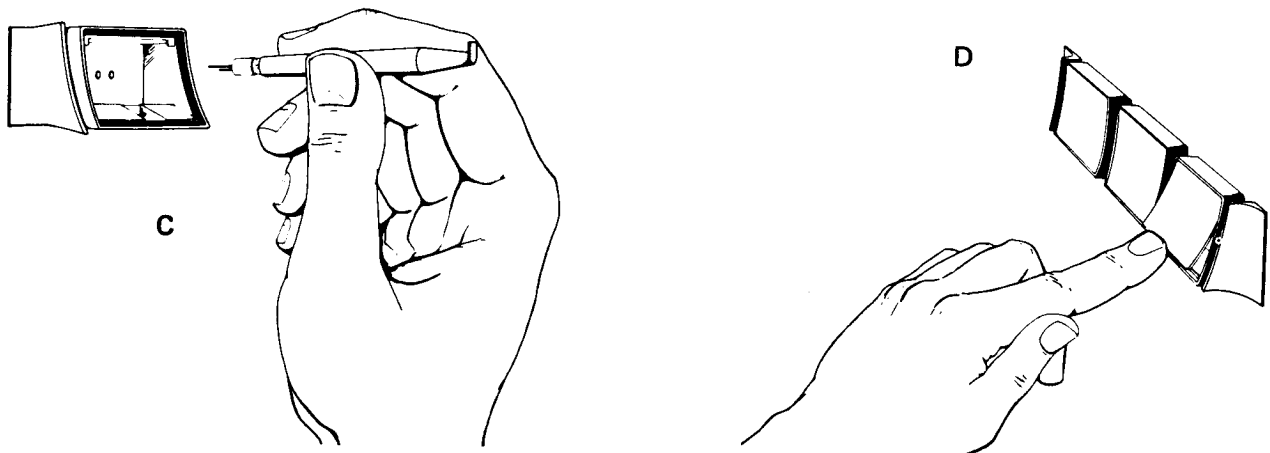
A bulb extractor tool, HP Part No. 4040-0427, has been developed to facilitate bulb replacement for backlighted pushbutton switches of the type shown below.

#### BULB REPLACEMENT PROCEDURE

1. Place the end of the thumb of one hand over the corner of the pushbutton switch. With the bulb extractor tool in the other hand, place the hooked end of the tool into the front of the slot on the bottom of the pushbutton (A) and gently push up until the lower end of the pushbutton lens pops out as shown in B.



2. Remove the pushbutton lens. Place the hollow end of the bulb extractor tool over the bulb to be replaced and gently pull back. The bulb should stick in the extractor and come out of its socket as the extractor is pulled back as shown in C.



3. Remove the old bulb from the hollow end of the extractor and insert the bulb into the hollow end. Using the extractor to hold the new bulb, insert the new bulb into the socket. To separate bulb and extractor, gently twist until it easily slips off the bulb.
4. Replace the pushbutton lens by first positioning the tabs at the top of the lens into the top of the pushbutton and pressing the bottom of the lens into place as shown in D.

#### NOTE

Only the pushbutton lens should be removed for bulb replacement. If the pushbutton is inadvertently pulled out during replacement, remove lens from the pushbutton. Re-insert the pushbutton into the front panel and push in until pushbutton snaps in place. Remainder of procedure is the same as previously given.

Figure 3-12. Pushbutton Selector Bulb Replacement



3-25. The important precautions that apply to the replacement of inner conductor contact are these:

- a. Do not disassemble the connector.
- b. Do not apply more than slight inward pressure to the inner conductor.
- c. Do not apply ANY twisting force to the inner conductor.
- d. Do not attempt to repair contacts.
- e. Do not re-use contacts.

#### CAUTION

Inward pressure or twisting force applied to the inner conductor of the UNKNOWN port connector can render the Model 8743A inoperative.

3-26. Because of the above considerations, contact removal should not be attempted with ordinary hand tools. Only the Hewlett-Packard self-positioning, hypodermic-action contact extractor tool (part number 5060-0236)<sup>1</sup> should be used. This tool exerts no appreciable inward pressure and no twisting force on the inner conductor. Instructions for removing contacts are supplied with the tool.

3-27. No tool is required for installing a replacement contact. Insert the contact gently by hand, applying only enough inward pressure to snap it into place. Then check for proper installation by inspecting the contact for even spacing of its four segments. Also, test for normal spring action by applying light inward pressure against the end of the contact with a pencil eraser. As the pressure is released the contact's spring action should cause it to move outward. If not, the contact is defective and should be replaced.

<sup>1</sup>Part of APC-7 Connector Tool Kit 11591A.

#### 3-28. COUPLING MECHANISMS.

3-29. The coupling mechanism includes the coupling nut and the two-piece coupling sleeve assembly shown in Figure 3-11. Both of these parts can be replaced without access to the inside of the Model 8743A, and without disturbing either of the conductors. A special spanner wrench, HP Stock Number 5060-0237<sup>1</sup>, is required.

3-30. To remove a coupling mechanism:

- a. Fully extend the coupling sleeve to provide a guide for the spanner wrench.
- b. Align the wrench so both pegs engage the holes in the end of the coupling sleeve assembly.
- c. Unscrew the sleeve assembly by turning the wrench counterclockwise.

3-31. When installing a coupling mechanism, set the coupling nut in place on the connector first, then thread on the coupling sleeve assembly, and tighten it firmly with the spanner wrench. Extending the coupling sleeve helps to keep the spanner in position during the final tightening.

#### CAUTION

The UNKNOWN port connector is part of a directional coupler. When tightening a coupling sleeve assembly on this connector, do not apply excessive torque. Excessive torque may be transmitted to the center conductor and may damage the coupler.

#### 3-32. POWER SWITCH LAMP REPLACEMENT.

3-33. The lamp that indicates line power is applied to the Model 8743A is housed in the POWER switch pushbutton. To replace the lamp, unscrew the retaining ring near the front panel, pull out the pushbutton, and remove the lamp. Replacement lamp part number is HP 2140-0052, LAMP: GLOW.



## SECTION IV MAINTENANCE

### 4-1. INTRODUCTION.

4-2. This Preliminary Operating and Service Manual provides instructions for testing the performance of the 8743A. The complete Operating and Service Manual will include more detailed maintenance information. If repair of the Model 8743A is necessary before the complete manual is received, contact the nearest Hewlett-Packard office for instructions. HP office locations are listed in the back pages of this manual.

### 4-3. COMPLETE OPERATING AND SERVICE MANUAL.

4-4. To obtain a copy of the complete Operating and Service Manual, when it is available, fill out and return the mailing card inside the front cover of this

manual. If this mailing card is not filled out and returned, the complete Operating and Service Manual will not be sent.

### 4-5. PERFORMANCE TEST PROCEDURES.

4-6. The performance test procedures presented in Figure 4-1 are useful for incoming inspection and periodic evaluation, and after repair. The specifications of Table 1-1 are the performance standards. Test equipment required for the procedures is listed in Table 4-1. Instruments other than those recommended may be used, provided their performance equals or exceeds the critical specifications listed in the table.

Table 4-1. Recommended Test Equipment for Performance Test Procedure

| Instrument                  | Critical Specifications  | Recommended HP Model  |
|-----------------------------|--|---|
| Sweep Oscillator            | Frequency Range: 2.0 to 12.4 GHz<br>Output Power: 1 mW minimum into 50 ohm<br>Power Variation: $\pm 7$ dB<br>VSWR: $< 3:1$ | 8690A, B/8692A, B (2 to 4 GHz)<br>8690A, B/8693A, B (4 to 8 GHz)<br>8690A, B/8694A, B (8 to 12.4 GHz) |
| Network Analyzer            | No substitute may be used  | 8410A/8411A/8413A and 8414A   |
| Oscilloscope                | Bandwidth: 5 MHz minimum<br>Sensitivity: 50 mV/cm<br>Horizontal Sweep Rate: 25 ms/cm                                       | 140A/1405A/1422A or<br>180A/1801A/1821A and<br>141A/1416A   |
| Short                       | 50-ohm short (APC-7 connector)   | 11565A  |
| 50-ohm Coaxial Sliding Load | 50-ohm coaxial sliding termination with APC-7 connector.<br>SWR: $\leq 1.05$   | 907A  |
| Swept Slotted Line          | Frequency Range: 2.0 to 12.4 GHz<br>Impedance: 50 ohm<br>Output Connector: APC-7<br>Residual VSWR: $< 1.02$                | 817A  |

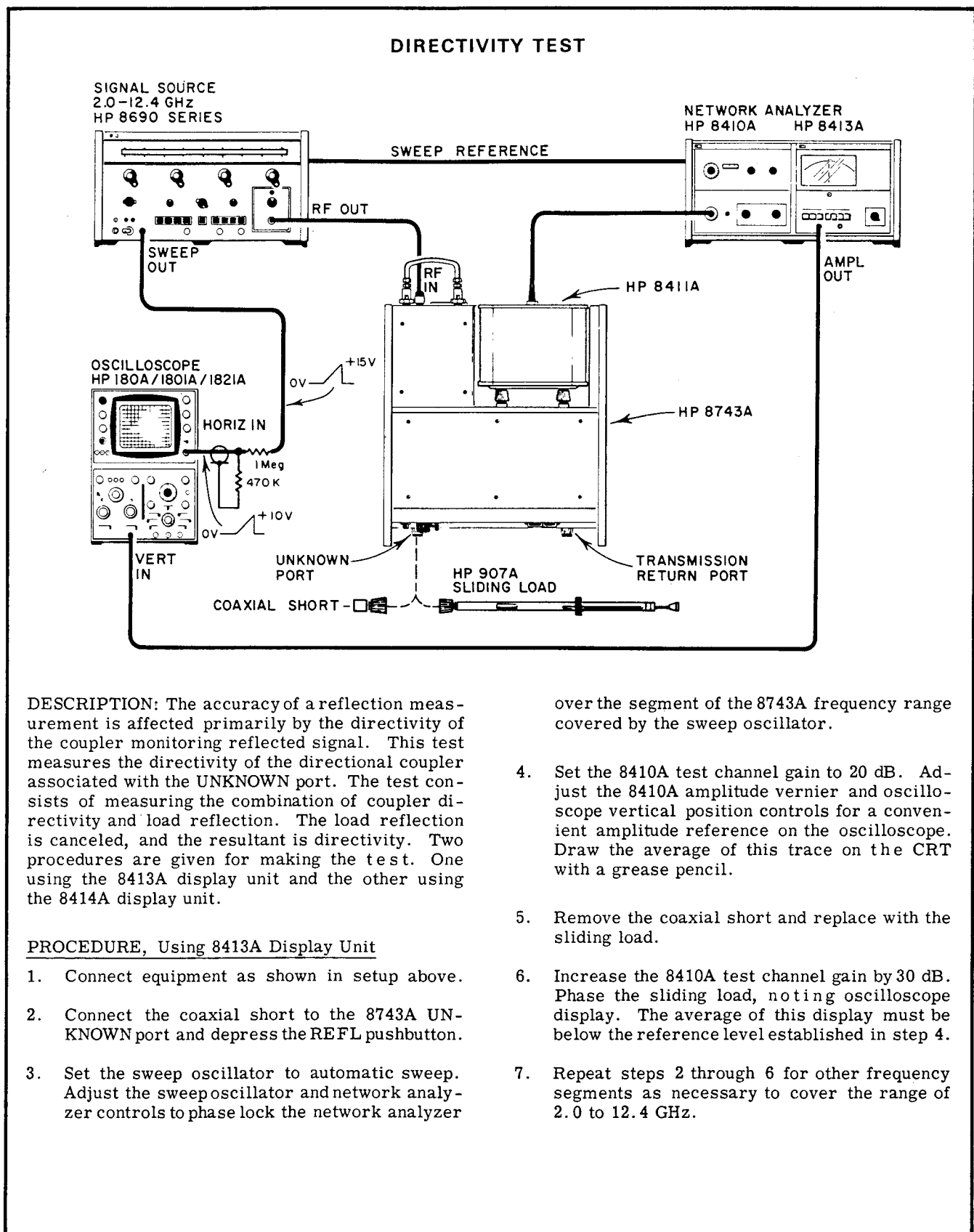


Figure 4-1. Performance Test (Sheet 1 of 4)

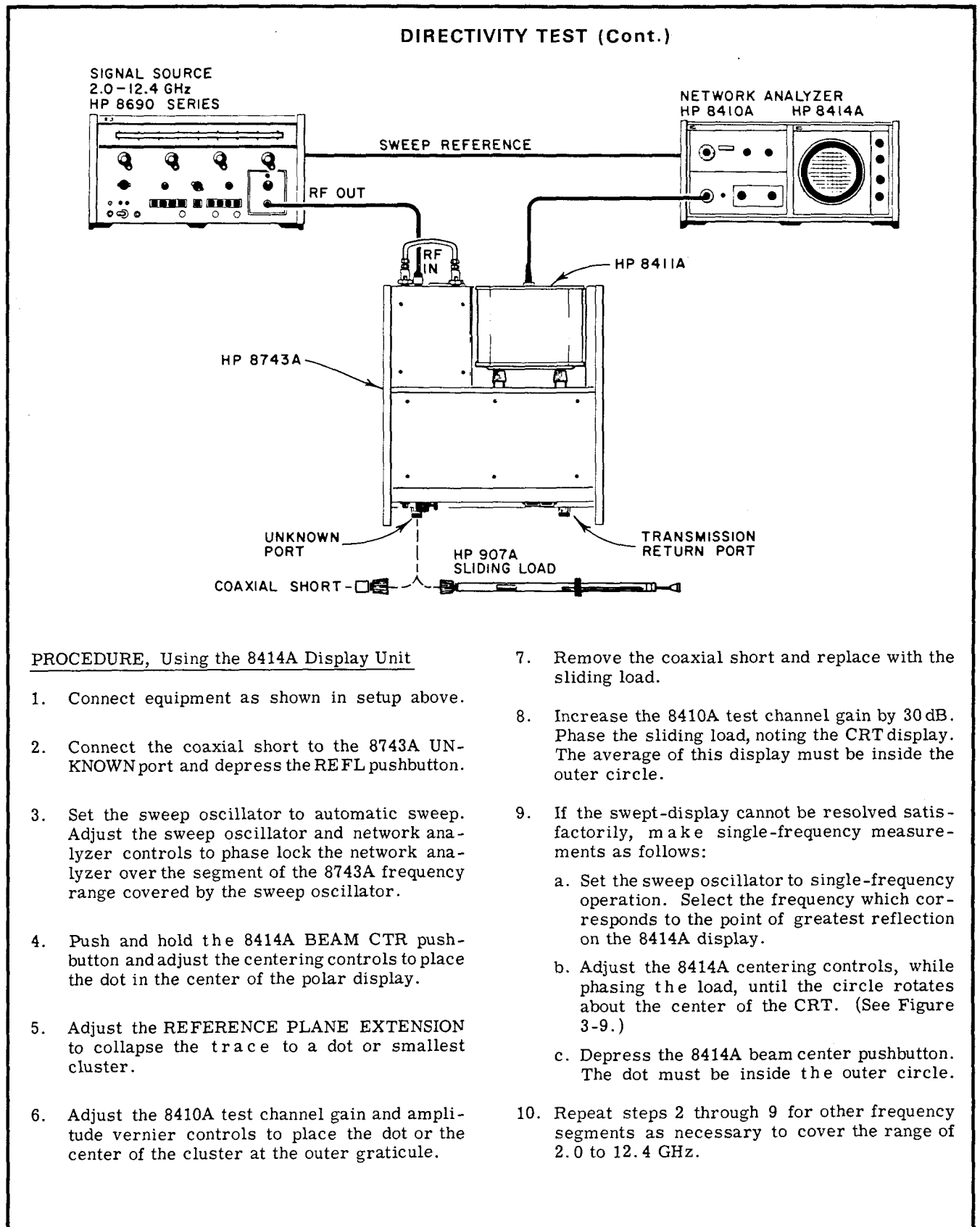


Figure 4-1. Performance Test (Sheet 2 of 4)

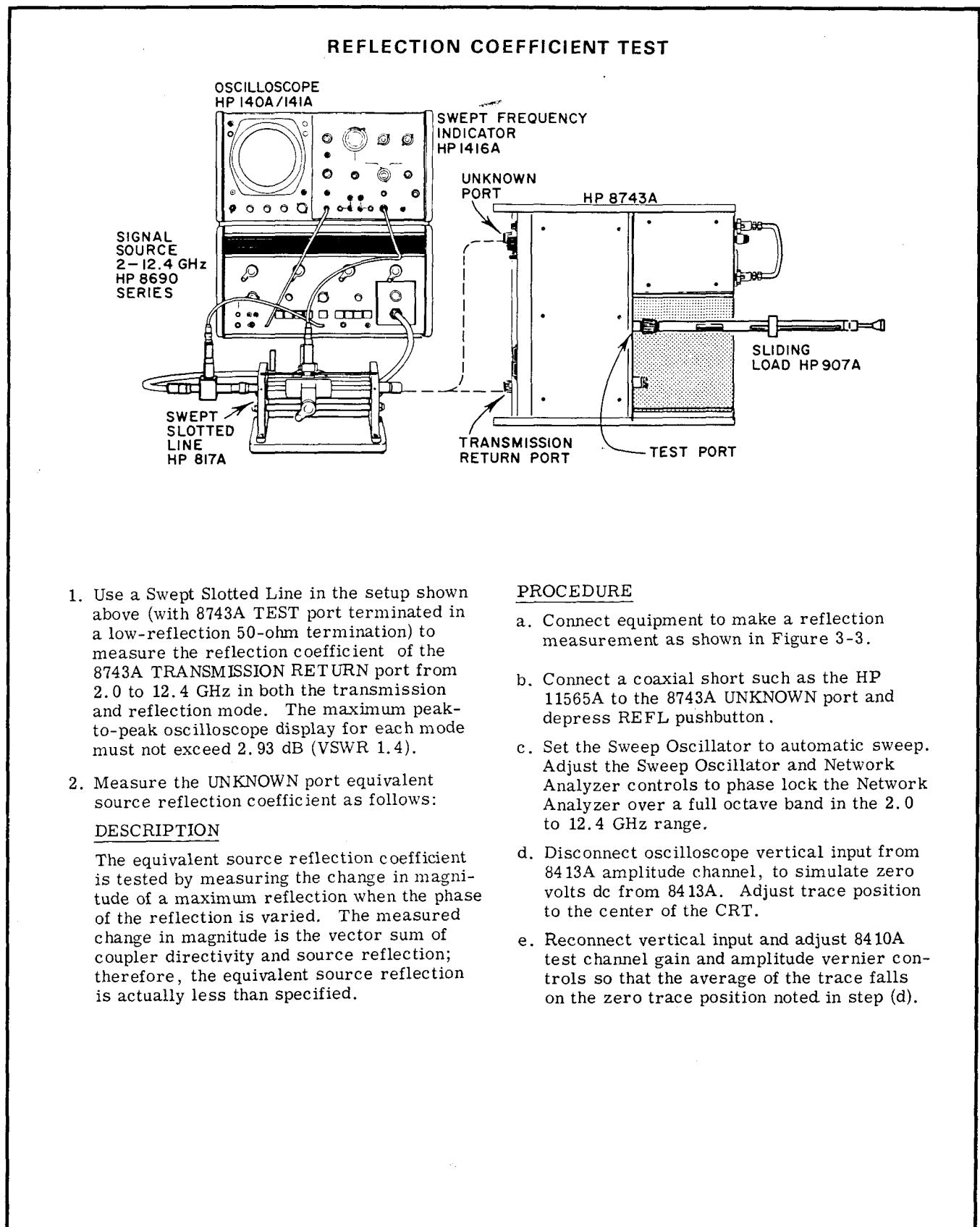


Figure 4-1. Performance Test (Sheet 3 of 4)

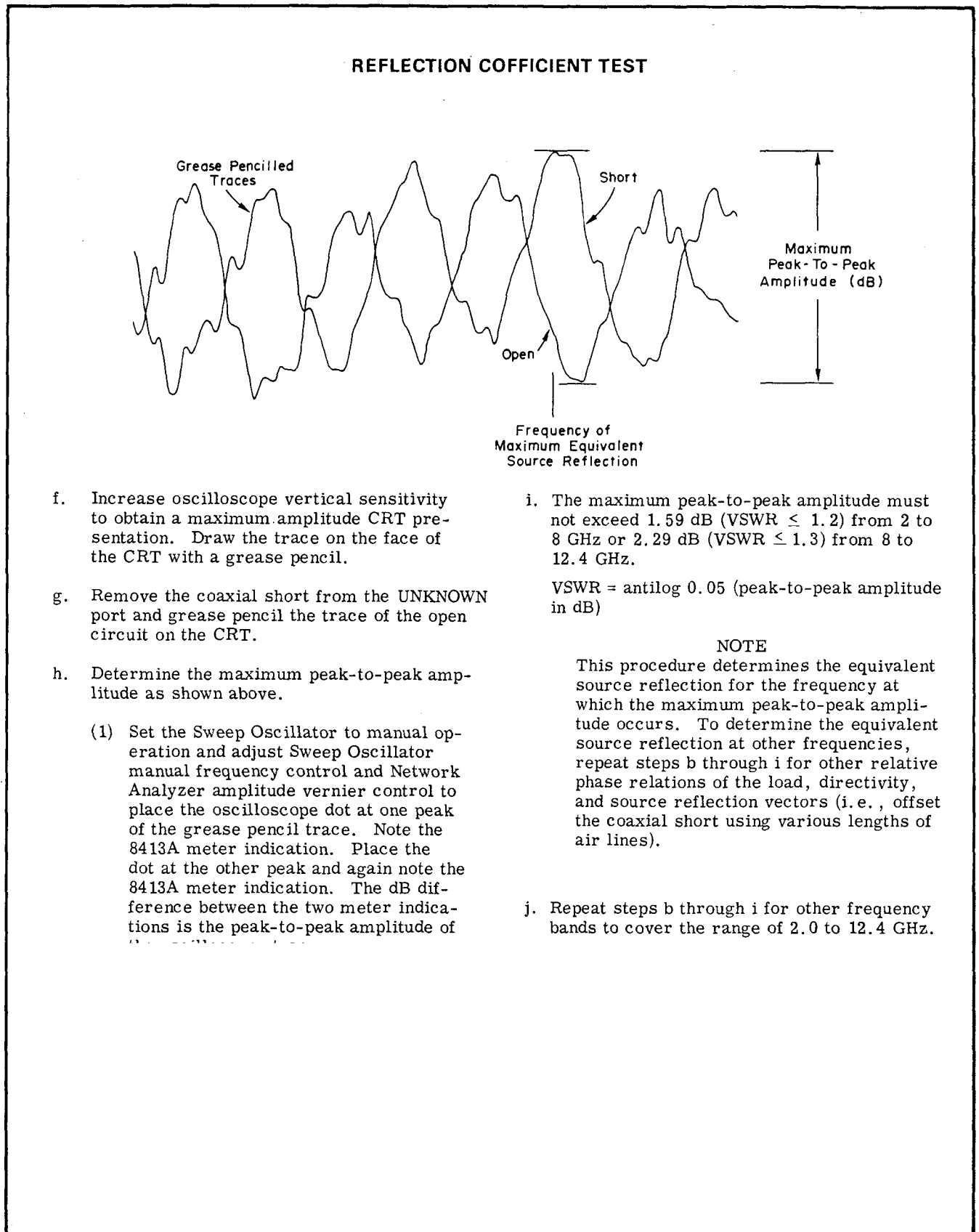


Figure 4-1. Performance Test (Sheet 4 of 4)

5. Unsolder the white and green wires (which come through the deck) from the A5 Assembly.
6. Remove the six coaxial switch mounting screws accessible from the bottom of the instrument.
7. Remove the A5, A6, and A7 Assemblies from the instrument as one unit.
8. Disconnect the switch to be replaced and unsolder the appropriate white and green wires. Mark the wires so they may be soldered to the proper terminals on the new switch.

**Installation.** To install the A5, A6, and A7 Assemblies:

1. Assemble the three coaxial switches into one unit.
2. Solder the white and green wires removed in step 8 of the removal procedure.
3. Insert the A5, A6, and A7 Assemblies into the 8743A as one unit. Do not install mounting screws.
4. Connect cables W6 and W9 to the appropriate switches and tighten each connector.
5. Connect cable W7 to the A6 Assembly and tighten connector.
6. Install the large thin securing nut to the TEST output connector.
7. Install the six coaxial switch mounting screws. Insure that green and white wires are not routed or pinched between switches and mounting deck.
8. Solder the wires removed in step 5 of the removal procedure, matching wire colors to the wires previously installed.
9. Perform the insertion loss troubleshooting procedure in Figure 4-2. If sharp power variations occur during any check, vary the torque on each coaxial switch connector, while observing the frequency response curve, until power variation is minimum.

## RF TROUBLESHOOTING

### Introduction.

8743A RF troubles can be divided into two general categories, repeatability and insertion loss. Repeatability problems are generally caused by the RF coaxial switches, and insertion loss problems are generally caused by connectors or cables. Because the troubleshooting approach for each of these problems is different, this service note discusses each category separately.

### Repeatability.

#### NOTE

Repeatability is a supplemental performance characteristic and not an instrument specification.

Repeatability is the change in insertion loss when the coaxial switches are cycled and is normally not a factor in measurement accuracy. The change in 8743A insertion loss when the coaxial switches are cycled is typically less than 0.2 dB. When the equipment is calibrated in one mode of operation and reflection and transmission measurements are both made without recalibrating, repeatability can degrade measurement accuracy. For best accuracy the equipment should be calibrated and measurements made in one mode of operation to keep insertion loss the same for both calibration and measurement.

Repeatability problems are generally due to the center conductor flipper inside the switch not making contact with the same pressure each time the switch is cycled. To isolate a repeatability problem to a single switch, use the following procedure.

**Transmission Check.** Setup the 8743A, Network Analyzer, and Display Unit to calibrate for a transmission measurement (connect a through section between the 8743A UNKNOWN and TRANSMISSION RETURN ports). Cycle the coaxial switches by alternately pressing the TRANS and REFL push-buttons while observing the transmission display for repeatability.

**Reflection Check.** Setup the 8743A, Network Analyzer, and Display Unit to calibrate for a reflection measurement (connect a coaxial short to the 8743A UNKNOWN port). Cycle the coaxial switches by alternately pressing the TRANS and REFL push-buttons while observing the display for repeatability. Determine the faulty switch as follows:

1. If a repeatability problem occurred in both the REFLECTION and TRANSMISSION checks, replace A6 Test Port Relay Assembly (HP Part No. 08743-60009).
2. If a repeatability problem occurred in the REFLECTION check only, replace A5 Unknown Port Relay Assembly (HP Part No. 08743-60011).
3. If a repeatability problem occurred in the TRANSMISSION check only, replace A7 Transmission Return Port Relay Assembly (HP Part No. 08743-60010).

### Insertion Loss.

Insertion loss problems are generally caused by a discontinuity in a connector or cable. The indication that a problem may exist is an increase or decrease in the Network Analyzer's displayed magnitude at one or more frequencies during calibration. The Network Analyzer displays the ratio of reference channel to test channel power; therefore, a loss of power in the reference channel will appear on the display as an increase in test channel power. The direction of a spike in the displayed trace isolates the trouble to either the reference or test channel. Generally a discontinuity will show up at higher frequencies; therefore, troubleshooting should be done in X-band and then the instrument should be checked over the remaining operating range. To isolate an insertion loss problem, perform the troubleshooting procedure in Figure 4-2.

## COAXIAL SWITCH REPLACEMENT PROCEDURE.

**Removal.** To remove the A5, A6, and A7 Assemblies:

1. Remove the 8743A top and bottom covers.
2. Remove circuit board assemblies A1 and A3.
3. Remove cable W7 as follows:
  - a. Remove the large thin nut securing the TEST output connector to the sub-deck.
  - b. Disconnect W7 from the A6 Assembly using a 3/4 inch open-end wrench, and slide as much of the cable as possible through the hole in the sub-deck.
4. Loosen W6 and W9's connectors to the A5 and A7 assemblies using a 3/4 inch open-end wrench.



Section IV

Step 1

Connect equipment as shown in Figure 4-2. Set sweep oscillator for maximum leveled power over frequency band of interest.

Step 2

Press TRANS pushbutton. Monitor TEST output frequency response. Power should vary less than 2 dB from maximum to minimum. (Refer to response curve A).

NO  
NO  
Response curve indicates a relative increase in power at one or more frequencies. Disconnect W3 (rear-panel external REFERENCE LINE). Connect crystal detector to W2J1 (rear-panel connector for REFERENCE LINE closest to side panel). Monitor TEST port frequency response. Power should have no sharp spikes or holes and should vary less than about 2 dB from maximum to minimum.

YES  
NO  
Troubleshoot W2 and associated connectors. (See Note 2.)

Troubleshoot W3, W4, W5 and associated connectors. (See Notes 1 and 2.)

Response curve indicates a relative decrease in power at one or more frequencies. Troubleshoot Flexible Arm, W7, W8, W9, A6, A7, and associated connectors.  
Note  
W7, W8, and A6 are common to two RF paths; therefore, perform step 3. If step 3 checks OK, the trouble is most likely the Flexible Arm, W8 or A7. (See Note 2.)

Step 3

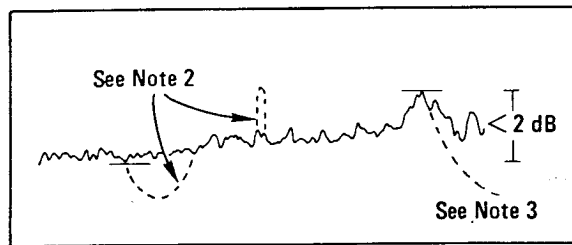
Disconnect through section from UNKNOWN port and press REFL pushbutton. Monitor TEST output frequency response with UNKNOWN port open and shorted. The average of the two traces should vary less than 2.0 dB (refer to response curve B) and the maximum to minimum at any frequency (equivalent source reflection) should be less than 1.6 dB from 2 to 8 GHz or 2.3 dB from 8 to 12.4 GHz.

NO  
If the maximum to minimum at any frequency is greater than 1.6 dB from 2 to 8 GHz or 2.3 dB from 8 to 12.4 GHz, replace DC1 and its 10-dB attenuator. (See Note 5.) If the average of the two traces is greater than 2 dB, troubleshoot W6, W7, W8, A5 and A6, and associated connectors. If step 2 checked OK trouble is most likely W6 or A5. If both step 2 and step 3 indicate a trouble, connect the thermistor mount to the UNKNOWN port and monitor the frequency response. If the response curve indicates a relative decrease, trouble is most likely W8. If the UNKNOWN port frequency response is OK, the trouble is most likely A6 or W7.

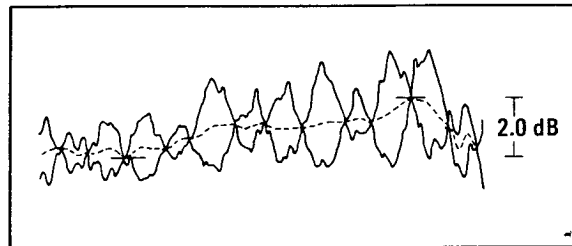
Figure 4-2. Insertion Loss Troubleshooting (Sheet 2 of 4)



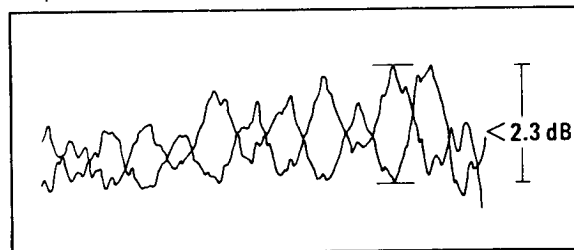
Response Curve A



Response Curve B



Response Curve C



NOTE 1

Reflections from a discontinuity on one side of the line stretcher will combine with reflections in the line stretcher or with reflections from the other side of the line stretcher. The response curve is the resultant of all discontinuities. By changing the line stretcher position, the phase relationship between the sets of reflections changes and the response curve will be altered. Monitor frequency response at several REFERENCE PLANE EXTENSION settings. If the overall power variation is greater than 2 dB at any REFERENCE PLANE EXTENSION setting, the trouble may be in the line stretcher or discontinuities on each side of the line stretcher.

NOTE 2

A relative increase in power indicates a trouble in the reference channel. A relative decrease in power indicates a trouble in the test channel. A narrow spike is most likely caused by poor contact of cable center conductor pins, one finger of a female pin not making contact, or gross outer conductor separation. A power change over a broader frequency range is most likely caused by a cable outer conductor grounding problem. For outer conductor grounding problems on instruments with Serial Numbers 928-00315 and below, disassemble the cable and add a washer (HP Part No. 5000-8676) as shown in Figure 2.

Figure 4-2. Insertion Loss Troubleshooting (Sheet 3 of 4)

RF TROUBLESHOOTING

## NOTE 3

If a cable's center conductor is not centered it may distort a switch's center conductor contact and cause an increase in insertion loss. The increased insertion loss is most likely to occur from 11 to 12.4 GHz (See Response Curve A.)

## NOTE 4

Although cable ends appear to be perfect they may still present a discontinuity. Also trimming these cable ends requires special tools. Therefore, if you are unable to eliminate a discontinuity, replace the suspected cable.

## NOTE 5

Directional Coupler DC1 (HP Part No. 08743-60005) includes a tuned 10 dB attenuator. If the troubleshooting procedure step 3 indicates a trouble in DC1 the problem could be the 10 dB attenuator. Check the coupler directivity using the Operating and Service Manual Performance Test Procedure. If the directivity is OK the trouble is most likely the 10 dB attenuator. The attenuator may be replaced using the following procedure:

## CAUTION

Do not unscrew flat head screws, or brass attenuator housing connector. If the brass parts move, directivity may be degraded.

1. Using a 1/2 inch open end wrench, hold the brass attenuator housing connector to keep it from rotating. Using plastic jawed, or padded vise grip pliers, unscrew the round stainless steel part (not the part with the flats).
2. Remove attenuator cartridge. Do not remove gold plated center conductor contacts. A special tool is required to install these contacts.
3. Install a new attenuator cartridge (HP Part No. 08743-60014) with a washer on each side of the cartridge.

## NOTE

The marked end of the cartridge has the lowest reflection and should go into the coupler.

4. Install the round stainless steel part removed in step 1.

Figure 4-2. Insertion Loss Troubleshooting (Sheet 3 of 4)

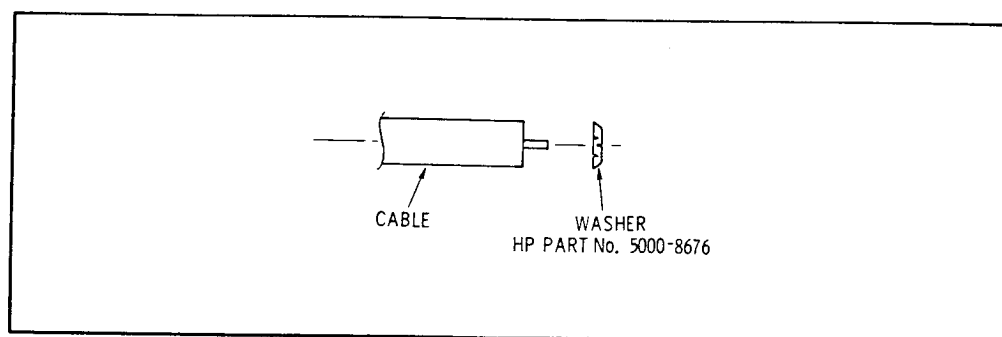


Figure 4-3. Position of Outer Conductor Washer

## SECTION V REPLACEABLE PARTS

### 5-1. INTRODUCTION.

5-2. This section contains information for ordering replaceable parts. Parts are listed in alpha-numerical order by reference designation together with their HP stock numbers and descriptions.

### 5-3. ORDERING INFORMATION.

5-4. When ordering a replacement part listed in Table 5-1:

a. Quote the Hewlett-Packard stock number for the part.

b. Address the order or inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

5-5. To order a part not listed in the tables:

a. Give a complete description of the part including its function and location.

b. Give the instrument model number and complete serial number.

c. Address the order of inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

#### REFERENCE DESIGNATORS

|                              |                         |                      |  |
|------------------------------|-------------------------|----------------------|--|
| A = assembly                 | F = fuse                | MP = mechanical part | V = vacuum, tube, neon bulb, photocell, etc. |
| B = motor                    | FL = filter             | P = plug             | VR = voltage regulator                       |
| BT = battery                 | IC = integrated circuit | Q = transistor       | W = cable                                    |
| C = capacitor                | J = jack                | R = resistor         | X = socket                                   |
| CP = coupler                 | K = relay               | RT = thermistor      | Y = crystal                                  |
| CR = diode                   | L = inductor            | S = switch           | Z = tuned cavity, network                    |
| DL = delay line              | LS = loud speaker       | T = transformer      |  |
| DS = device signaling (lamp) | M = meter               | TB = terminal board  |  |
| E = misc electronic part     | MK = microphone         | TP = test point      |  |

#### ABBREVIATIONS

|                                   |                              |   |                               |
|-----------------------------------|------------------------------|---|-------------------------------|
| A = amperes                       | H = henries                  | N/O = normally open   | RMO = rack mount only         |
| AFC = automatic frequency control | HDW = hardware               | NPO = negative positive zero (zero temperature coefficient) | RMS = root-mean square        |
| AMPL = amplifier                  | HEX = hexagonal              | NPN = negative-positive-negative                            | RWV = reverse working voltage |
| BFO = beat frequency oscillator   | HG = mercury                 | NRFR = not recommended for field replacement                | S-B = slow-blow               |
| BE CU = beryllium copper          | HR = hour(s)                 | NSR = not separately replaceable                            | SCR = screw                   |
| BH = binder head                  | HZ = hertz                   | OBD = order by description                                  | SE = selenium                 |
| BP = bandpass                     | IF = intermediate freq       | OH = oval head  | SECT = section(s)             |
| BRS = brass                       | IMPG = impregnated           | OX = oxide  | SEMICON = semiconductor       |
| BWO = backward wave oscillator    | INCD = incandescent          | P = peak  | SI = silicon                  |
| CCW = counter-clockwise           | INCL = include(s)            | PC = printed circuit  | SIL = silver                  |
| CER = ceramic                     | INS = insulation(ed)         | PF = picofarads = 10 <sup>-12</sup> farads                  | SL = slide                    |
| CMO = cabinet mount only          | INT = internal               | PH BRZ = phosphor bronze                                    | SPG = spring                  |
| COEF = coefficient                | K = kilo = 1000              | PHL = Phillips  | SPL = special                 |
| COM = common                      | LH = left hand               | PIV = peak inverse voltage                                  | SST = stainless steel         |
| COMP = composition                | LIN = linear taper           | PNP = positive-negative-positive                            | SR = split ring               |
| COMPL = complete                  | LK WASH = lock washer        | P/O = part of   | STL = steel                   |
| CONN = connector                  | LOG = logarithmic taper      | POLY = polystyrene  | TA = tantalum                 |
| CP = cadmium plate                | LPF = low pass filter        | PORC = porcelain  | TD = time delay               |
| CRT = cathode-ray tube            | M = milli = 10 <sup>-3</sup> | POS = position(s)   | TGL = toggle                  |
| CW = clockwise                    | MEG = meg = 10 <sup>6</sup>  | POT = potentiometer   | THD = thread                  |
| DEPC = deposited carbon           | MET FLM = metal film         | PP = peak-to-peak   | TI = titanium                 |
| DR = drive                        | MET OX = metallic oxide      | PT = point  | TOL = tolerance               |
| ELECT = electrolytic              | MFR = manufacturer           | PWV = peak working voltage                                  | TRIM = trimmer                |
| ENCAP = encapsulated              | MHZ = mega hertz             | RECT = rectifier  | TWT = traveling wave tube     |
| EXT = external                    | MINAT = miniature            | RF = radio frequency  | U = micro = 10 <sup>-6</sup>  |
| F = farads                        | MOM = momentary              | RH = round head or right hand                               | VAR = variable                |
| FH = flat head                    | MTG = mounting               |   | VDCW = dc working volts       |
| FIL H = fillister head            | MY = "mylar"                 |   | W/ = with                     |
| FXD = fixed                       | N = nano (10 <sup>-9</sup> ) |   | W = watts                     |
| G = giga (10 <sup>9</sup> )       | N/C = normally closed        |   | WIV = working inverse voltage |
| GE = germanium                    | NE = neon                    |   | WW = wirewound                |
| GL = glass                        | NI PL = nickel plate         |   | W/O = without                 |
| GRD = ground(ed)                  |                              |   |                               |

Table 5-1. Reference Designation Index

| Reference Designation | Part No.    | Description #                     | Note |
|-----------------------|-------------|-----------------------------------|------|
| A1                    | 08743-60001 | POWER SUPPLY ASSY                 |      |
| A1C1                  | 0160-2930   | C:FXD CER 0.01 UF +80-20% 100VDCW |      |
| A1C2                  | 0180-0141   | C:FXD ELECT 50 UF +75-10% 50VDCW  |      |
| A1CR1                 | 1901-0026   | DIODE:SILICON 0.75A 200PIV        |      |
| A1CR2                 | 1901-0026   | DIODE:SILICON 0.75A 200PIV        |      |
| A1CR3                 | 1901-0026   | DIODE:SILICON 0.75A 200PIV        |      |
| A1CR4                 | 1901-0026   | DIODE:SILICON 0.75A 200PIV        |      |
| A1CR5                 | 1901-0200   | DIODE:SILICON 3A 100PIV           |      |
| A1CR6                 | 1902-3193   | DIODE BREAKDOWN:13.3V 5%          |      |
| A1Q1                  | 1854-0071   | TRANSISTOR:SILICON NPN            |      |
| A1Q2                  | 1854-0039   | TRANSISTOR:SILICON 2N3053         |      |
| A1Q3                  | 1854-0071   | TRANSISTOR:SILICON NPN            |      |
| A1R1                  | 0698-3640   | R:FXD MET OX 1.8K OHM 5% 2W       |      |
| A1R2                  | 0757-0421   | R:FXD MET FLM 825 OHM 1% 1/8W     |      |
| A1R3                  | 0757-0199   | R:FXD MET FLM 21.5K OHM 1% 1/8W   |      |
| A1R4                  | 0811-1672   | R:FXD WW 3.3 OHM 5% 2W            |      |
| A1R5                  | 0698-3154   | R:FXD MET FLM 4.22K OHM 1% 1/8W   |      |
| A1R6                  | 0757-0438   | R:FXD MET FLM 5.11K OHM 1% 1/8W   |      |
| A1R7                  | 2100-1758   | R:VAR WW 1K OHM 10% LIN 1/2W      |      |
| A2                    | 08743-60002 | SWITCH ASSY                       |      |
| A2CR1                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A2CR2                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A2DS1                 | 2140-0213   | LAMP:INCANDESCENT 28V 0.04A       |      |
| A2DS2                 | 2140-0213   | LAMP:INCANDESCENT 28V 0.04A       |      |
| A2Q1                  | 1854-0071   | TRANSISTOR:SILICON NPN            |      |
| A2Q2                  | 1854-0071   | TRANSISTOR:SILICON NPN            |      |
| A2R1                  | 0757-0438   | R:FXD MET FLM 5.11K OHM 1% 1/8W   |      |
| A2R2                  | 0698-3450   | R:FXD MET FLM 42.2K OHM 1% 1/8W   |      |
| A2R3                  | 0757-0438   | R:FXD MET FLM 5.11K OHM 1% 1/8W   |      |
| A2R4                  | 0757-0438   | R:FXD MET FLM 5.11K OHM 1% 1/8W   |      |
| A2R5                  | 0698-3450   | R:FXD MET FLM 42.2K OHM 1% 1/8W   |      |
| A2R6                  | 0757-0438   | R:FXD MET FLM 5.11K OHM 1% 1/8W   |      |
| A2R7                  | 0757-1000   | R:FXD MET FLM 51.1 OHM 1% 1/2W    |      |
| A2S1                  |             | NOT SEPARATELY REPLACEABLE        |      |
| A2S2                  |             | NOT SEPARATELY REPLACEABLE        |      |
| A3                    | 08743-60038 | RELAY DRIVER ASSY                 |      |
| A3C1                  | 0150-0121   | C:FXD CER 0.1 UF +80-20% 50VDCW   |      |
| A3CR1                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR2                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR3                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR4                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR5                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR6                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR7                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR8                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR9                 | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |
| A3CR10                | 1901-0025   | DIODE:SILICON 100WV 100MA         |      |

# See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont.)

| Reference Designation | Part No.               | Description #  | Note |
|-----------------------|------------------------|--|------|
| A3CR11                | 1902-0551              | DIODE BREAKDOWN:6.19V 5%   |      |
| A3Q1                  | 1854-0039              | TRANSISTOR:SILICON 2N3053  |      |
| A3Q2                  | 1854-0039              | TRANSISTOR:SILICON 2N3053  |      |
| A3Q3                  | 1853-0012              | TRANSISTOR:SILICON PNP   |      |
| A3Q4                  | 1853-0012              | TRANSISTOR:SILICON PNP   |      |
| A3Q5                  | 1854-0071              | TRANSISTOR:SILICON NPN   |      |
| A3Q6                  | 1853-0020              | TRANSISTOR:SILICON PNP   |      |
| A3Q7                  | 1853-0020              | TRANSISTOR:SILICON PNP   |      |
| A3Q8                  | 1854-0071              | TRANSISTOR:SILICON NPN   |      |
| A3Q9                  | 1854-0071              | TRANSISTOR:SILICON NPN   |      |
| A3R1                  | 0698-3408              | R:FXD MET FLM 2.15K OHM 1% 1/2W  |      |
| A3R2                  | 0698-3408              | R:FXD MET FLM 2.15K OHM 1% 1/2W  |      |
| A3R3                  | 0757-0199              | R:FXD MET FLM 21.5K OHM 1% 1/8W  |      |
| A3R4                  | 0757-0443              | R:FXD MET FLM 11.0K OHM 1% 1/8W  |      |
| A3R5                  | 0698-0084              | R:FXD MET FLM 2.15K OHM 1% 1/8W  |      |
| A3R6                  | 0757-0442              | R:FXD MET FLM 10.0K OHM 1% 1/8W  |      |
| A3R7                  | 0698-0084              | R:FXD MET FLM 2.15K OHM 1% 1/8W  |      |
| A3R8                  | 0757-0442              | R:FXD MET FLM 10.0K OHM 1% 1/8W  |      |
| A3R9                  | 0698-3136              | R:FXD MET FLM 17.8K OHM 1% 1/8W  |      |
| A3R10                 | 0757-0290              | R:FXD MET FLM 6.19K OHM 1% 1/8W  |      |
| A3R11                 | 0757-0442              | R:FXD MET FLM 10.0K OHM 1% 1/8W  |      |
| A3R12                 | 0757-1078              | R:FXD MET FLM 1.47K OHM 1% 1/2W  |      |
| A3R13                 | 0698-3406              | R:FXD MET FLM 1.33K OHM 1% 1/2W  |      |
| A3R14                 | 0698-3406              | R:FXD MET FLM 1.33K OHM 1% 1/2W  |      |
| A3R15                 | 0757-0462              | R:FXD MET FLM 75K OHM 1% 1/8W  |      |
| A4                    | 08741-60004            | LINE STRETCHER ASSY  |      |
| A5                    | 08743-60011            | RELAY ASSY,UNKNOWN PORT  |      |
| A6                    | 08743-60009            | RELAY ASSY,TEST PORT   |      |
| A7                    | 08743-60010            | RELAY ASSY,TRANSMISSION RETURN PORT  |      |
| C1                    | 0180-0198              | C:FXD ELECT 1500 UF 50/60VDCW  |      |
| DC1                   | 08743-60005            | DIRECTIONAL COUPLER(TEST)  |      |
| DC2                   | 08743-60004            | DIRECTIONAL COUPLER(INPUT)   |      |
| DS1                   | 2140-0244              | LAMP:GLOW  |      |
| F1                    | 2110-0336<br>2110-0340 | FUSE:CARTRIDGE 1/2A 250V SLOW-BLOW(115VAC)<br>FUSE:CARTRIDGE 0.25A SLOW-BLOW(230VAC) |      |
| J1                    | 1251-0085              | CONNECTOR:FEMALE 36-PIN MINIATURE  |      |
| J2                    | 1251-2357              | SOCKET:3-PIN(AC POWER)   |      |
| Q1                    | 1854-0072              | TRANSISTOR:SILICON NPN 2N3054  |      |
| R1                    | 0698-3162              | R:FXD MET FLM 46.4K OHM 1% 1/8W  |      |
| S1                    | 3101-1244              | SWITCH:PUSHBUTTON SPDT(AC AND PILOT LIGHT)   |      |
| S2                    | 3101-1235              | SWITCH:SLIDE DPDT(115/230V AC)   |      |
| T1                    | 9100-2728              | TRANSFORMER:24.4V  |      |
| W1                    | 8120-1348              | CABLE ASSY:POWER CORD  |      |
| W2                    | 08743-20021            | CABLE ASSY:DC2 TO W3   |      |
| W3                    | 08745-20064            | CABLE ASSY:EXTERNAL REFERENCE LINE   |      |

# See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont.)

| Reference Designation | Part No.    | Description #   | Note |
|-----------------------|-------------|---|------|
| W4                    | 08743-20023 | CABLE ASSY:W3 TO A4   |      |
| W5                    | 08743-20024 | CABLE ASSY:A4 TO A8   |      |
| W6                    | 08743-20033 | CABLE ASSY:A5 TO DC1  |      |
| W7                    | 08743-20026 | CABLE ASSY:A6 TO TEST OUTPUT  |      |
| W8                    | 08743-20027 | CABLE ASSY:DC2 TO UNKNOWN PORT  |      |
| W9                    | 08743-20035 | CABLE ASSY:A7 TO TRANSMISSION RETURN PORT   |      |
| XF1                   | 1400-0084   | FUSEHOLDER:EXTRACTOR POST TYPE  |      |
|                       |             | MISCELLANEOUS   |      |
|                       | 0370-0770   | LENS  |      |
|                       | 5000-6469   | LABEL:PUSHBUTTON "TRANS"  |      |
|                       | 5000-6470   | LABEL:PUSHBUTTON "REFL"   |      |
|                       | 08743-60014 | 10 DB ATTENUATOR CARTRIDGE  |      |
|                       |             | THIS MANUAL IMPLEMENTS A DIFFERENT COLOR SCHEME FOR THE STANDARD INSTRUMENT. COLORS PRIOR TO THIS CHANGE ARE NOW AVAILABLE AS OPTIONS. REFER TO THE LIST BELOW. |      |
|                       |             | 8743A STANDARD - INDICATES COLOR SCHEME FOR THE 8740A BEGINNING WITH INSTRUMENTS SERIAL PREFIXED 1226. (INCLUDES MINT GRAY FRONT PANEL AND OLIVE GRAY CABINET). |      |
|                       |             | 8743A OPTION A85 - INDICATES LIGHT GRAY FRONT PANEL.  |      |
|                       |             | 8743A OPTION X95 - INDICATES COLOR SCHEME FOR 8743A PRIOR TO SERIAL PREFIX 1226. (INCLUDES LIGHT GRAY FRONT PANEL AND BLUE-GRAY CABINET).                       |      |
|                       | 0370-0974   | PUSHBUTTON, JADE GRAY(STANDARD)   |      |
|                       | 0370-0767   | PUSHBUTTON, GRAY(OPT A85, X95)  |      |
|                       | 0370-0975   | BEZEL:END CAP(LEFT)JADE GRAY(STANDARD)  |      |
|                       | 0370-0765   | BEZEL:END CAP(LEFT)GRAY(OPT A85, X95)   |      |
|                       | 0370-0976   | BEZEL:END CAP(RIGHT)JADE GRAY(STANDARD)   |      |
|                       | 0370-0766   | BEZEL:END CAP(RIGHT)GRAY(OPT A85, X95)  |      |
|                       | 5000-8705   | SIDE COVER:REAR,OLIVE GRAY(STANDARD)  |      |
|                       | 5000-0736   | SIDE COVER:REAR,BLUE-GRAY(OPT X95)  |      |
|                       | 5000-8707   | SIDE COVER:FRONT,OLIVE GRAY(STANDARD)   |      |
|                       | 5000-0737   | SIDE COVER:FRONT,BLUE-GRAY(OPT X95)   |      |
|                       | 5040-0351   | BEZEL:COUNTER,MINT GRAY(STANDARD)   |      |
|                       | 5040-0204   | BEZEL:COUNTER,GRAY(OPT A85, X95)  |      |
|                       | 5060-0268   | COVER ASSY:BOTTOM,OLIVE GRAY(STANDARD)  |      |
|                       | 5060-0228   | COVER ASSY:BOTTOM,BLUE-GRAY(OPT X95)  |      |
|                       | 5060-8737   | RETAINER:HANDLE ASSY,OLIVE GRAY(STANDARD)   |      |
|                       | 5060-0766   | RETAINER:HANDLE ASSY,BLUE-GRAY(OPT X95)   |      |
|                       | 08743-00018 | PANEL:REAR,MINT GRAY(STANDARD)  |      |
|                       | 08743-00002 | PANEL:REAR,LIGHT GRAY(OPT X95)  |      |
|                       | 08743-00019 | COVER ASSY:TOP,OLIVE GRAY(STANDARD)   |      |
|                       | 08743-00004 | COVER ASSY:TOP,BLUE-GRAY(OPT X95)   |      |
|                       | 08743-00020 | TOP COVER:REAR CORNER,OLIVE GRAY(STANDARD)  |      |
|                       | 08743-00005 | TOP COVER:REAR CORNER,BLUE-GRAY(OPT X95)  |      |
|                       | 08743-00021 | FILLER PLATE:CENTER,OLIVE GRAY(STANDARD)  |      |
|                       | 08743-00006 | FILLER PLATE:CENTER,BLUE-GRAY(OPT X95)  |      |
|                       | 08743-00022 | FILLER PLATE:SIDE,OLIVE GRAY(STANDARD)  |      |
|                       | 08743-00007 | FILLER PLATE:SIDE,BLUE-GRAY(OPT X95)  |      |

# See introduction to this section for ordering information

| Reference Designation | Part No.   | Description #   | Note |
|-----------------------|--|---|------|
|                       | 08743-00024<br>08743-00013<br>08743-00023<br>08743-00014<br><br>08745-20068<br>08745-2019<br>08745-20069<br>08745-2020 | PANEL: FRONT, MINT GRAY(STANDARD)<br>PANEL: FRONT, LIGHT GRAY(OPT A85, X95)<br>SUB-DECK, OLIVE GRAY(STANDARD)<br>SUB-DECK, BLUE-GRAY(OPT X95)<br><br>TRIM: LOWER FRAME, MINT GRAY(STANDARD)<br>TRIM: LOWER FRAME, LIGHT GRAY(OPT A85, X95)<br>TRIM: UPPER FRAME, MINT GRAY(STANDARD)<br>TRIM: UPPER FRAME, LIGHT GRAY(OPT A85, X95) |      |

# See introduction to this section for ordering information

## SECTION VI SCHEMATIC DIAGRAMS

### 6-1. INTRODUCTION.

6-2. The schematic diagrams in this section represent the circuits electrically. They are not wiring diagrams, though wire colors are given where practical.

6-3. The circuits are arranged according to signal flow; consequently, some switch and circuit assemblies may be shown in part on more than one diagram. If so, the reference designation is preceded by P/O, for "Part Of", and is followed by a notation of the

number of parts into which the assembly has been divided.

6-4. Some of the general information obtainable from the schematic diagrams is shown in Figure 6-1. Notes and explanations of symbols pertaining to all the diagrams are contained in Figure 6-2. Notes about specific components, circuits, or conditions are given on the diagram to which they apply.

6-5. As an aid to finding components and assemblies in the set of diagrams, each diagram has a box labelled Reference Designations that contains all the reference designations appearing on the diagram.

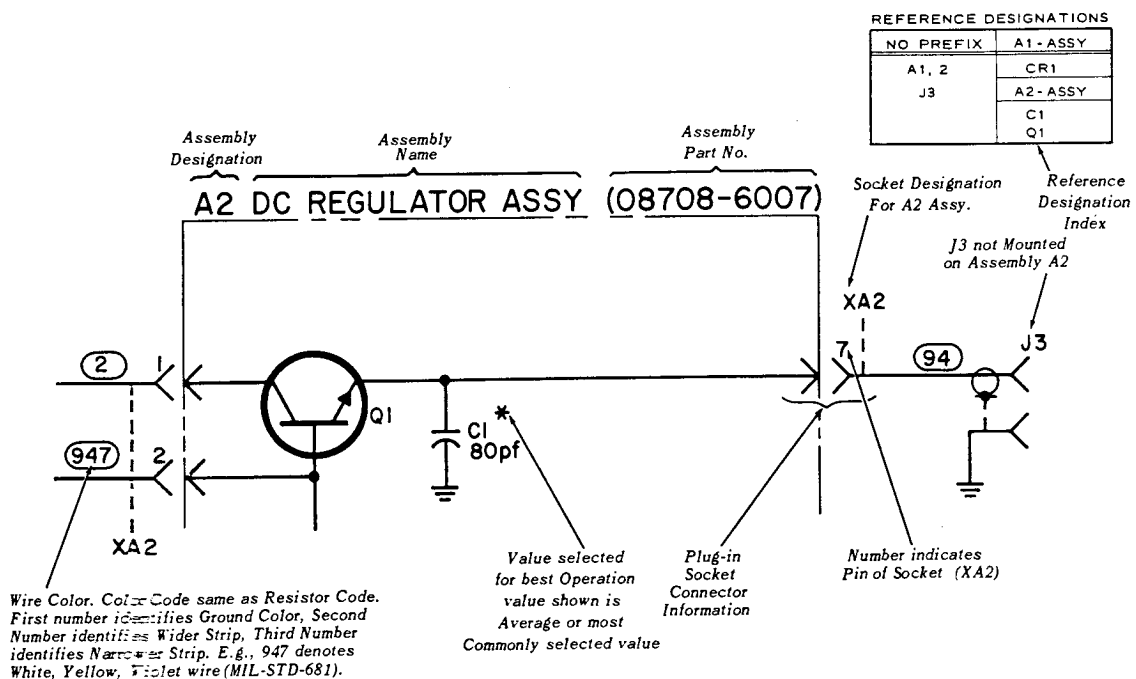


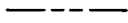




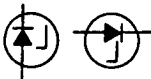







Figure 6-1. General Information on Schematic Diagrams



1. Resistance in ohms, capacitance in microfarads unless otherwise noted.
2. Voltages shown on schematic diagrams taken with HP 414A AUTOVOLTMETER: input resistance 100 M  $\Omega$ , accuracy  $\pm(1\%$  of reading  $+0.5\%$  of full scale).
3. Unless otherwise indicated on schematic, voltages taken with negative terminal of voltmeter connected to A7TP2.
4. \* Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.
5. P/O = Part Of.
6.  Encloses front panel designations.  
 Encloses rear panel designation.
7.  Circuit assembly borderline.  
 Other assembly borderline.
8.  Numbers in circles on circuit assemblies show locations of test points. Matching numbers are etched on the circuit assemblies.
9.  Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the ground color, second number the wider stripe, and the third number identifies the narrower stripe. E. G.,  denotes white ground, yellow wide stripe, violet narrow stripe.
10.  Voltage regulator (breakdown) diode.
11.  Power Supply Common (not chassis ground).
12.  Screwdriver adjustment.
13.  Panel control.
14.  Heavy dashed line indicates feedback path.
15.  Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

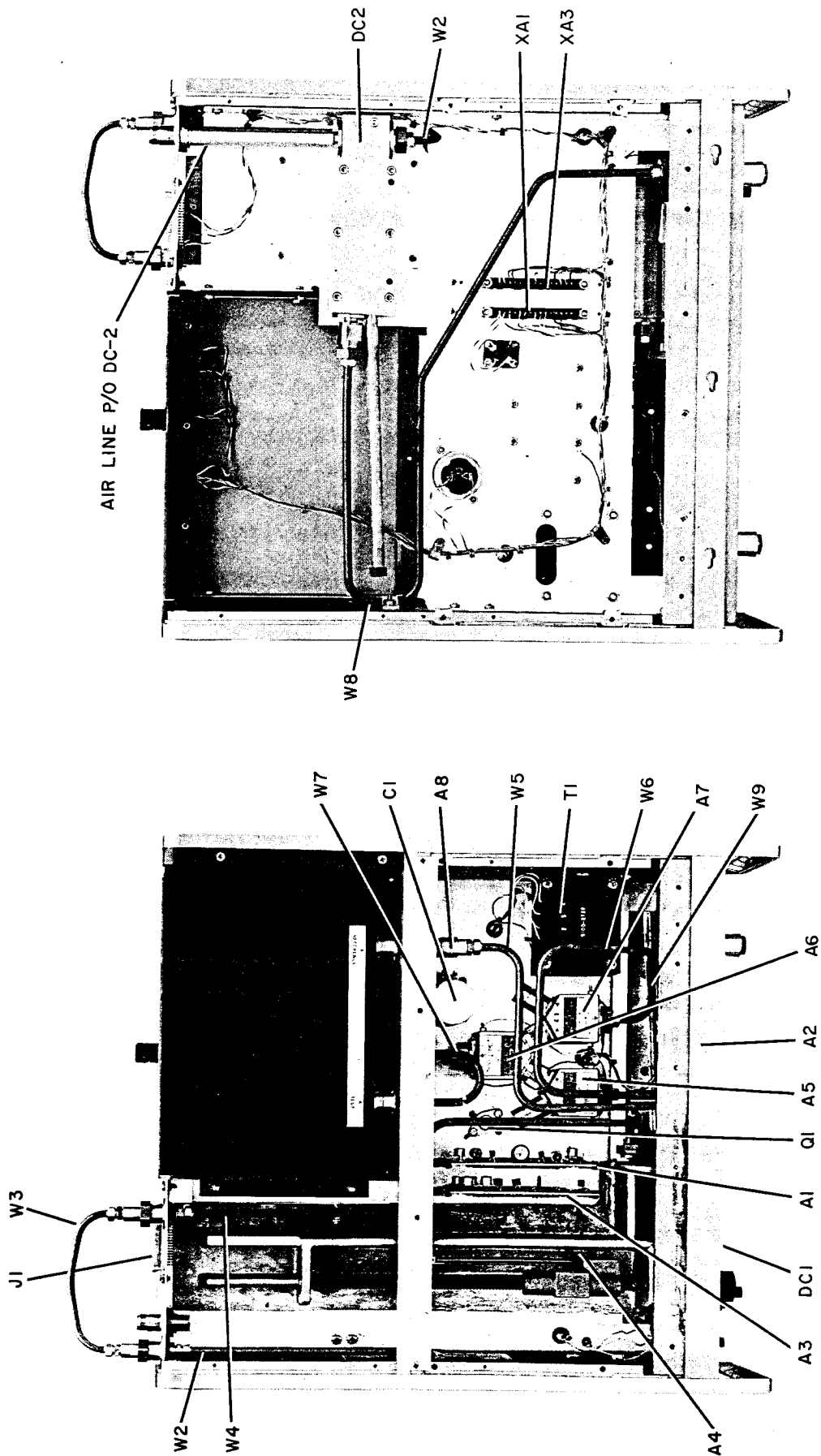


Figure 6-3. 8743A Component Identification, Top View

Figure 6-4. 8743A Component Identification, Bottom View

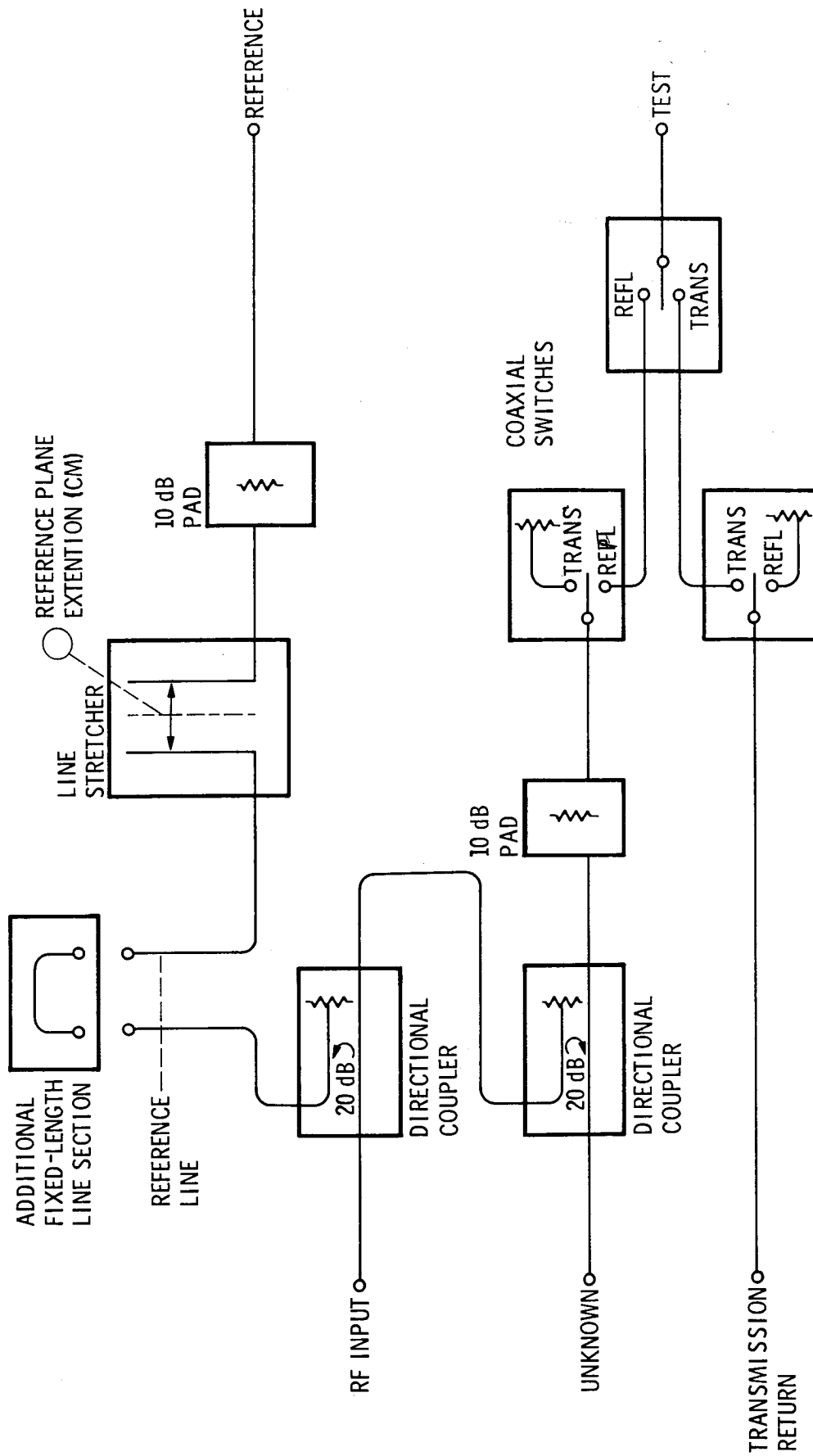


Figure 6-5. Simplified RF Schematic Diagram

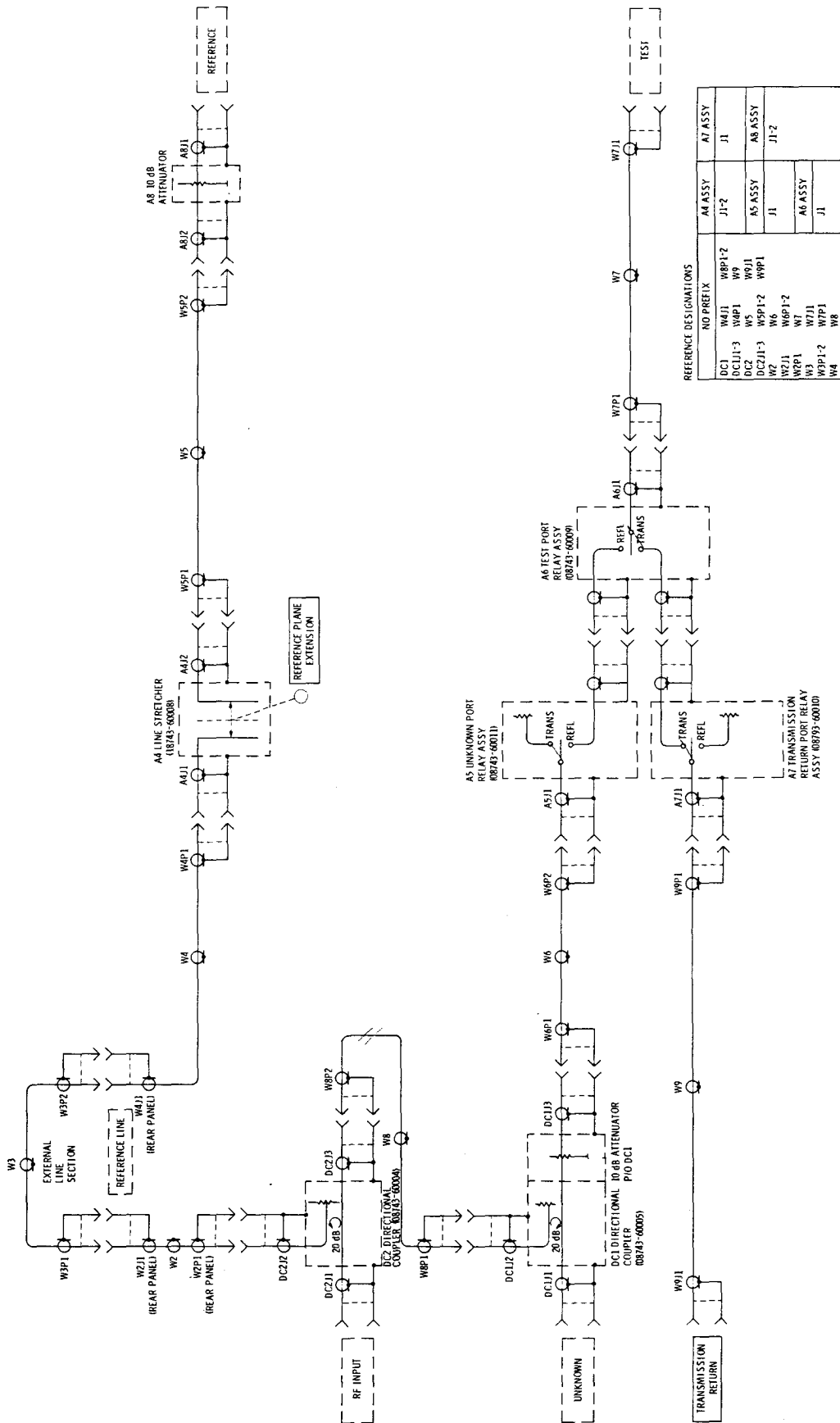
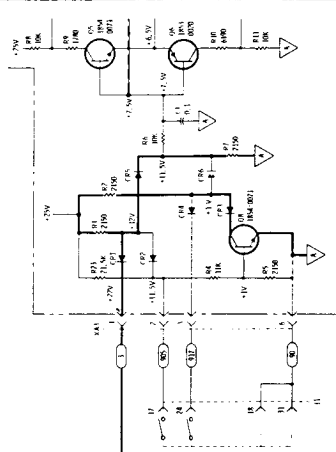


Figure 6-6. RF Schematic Diagram

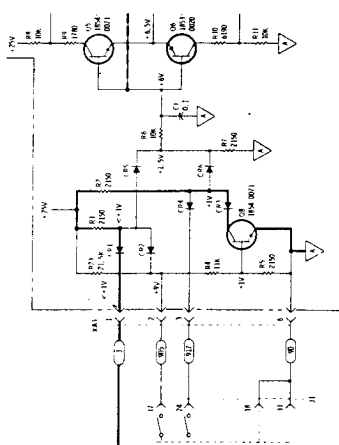
**MANUAL CONTROL**

**REFLECTION**



**REFLECTION**  
A high output from the flip-flop reverse biases CR1. With CR1 open the majority of current through R1 flows through CR5 and R7. The voltage across R7 is > 6V which turns Q5 on and Q6 off.

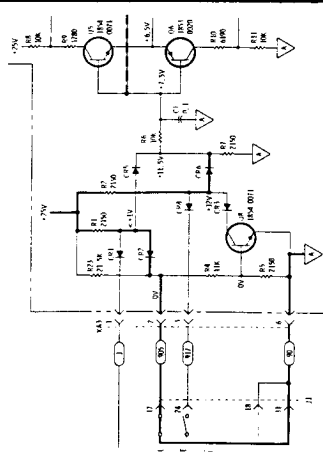
**TRANSMISSION**



**TRANSMISSION**  
A low output from the flip-flop causes CR1 to conduct which reverse biases CR5. The voltage across R7 decreases to < 3V which turns Q5 off and Q6 on.

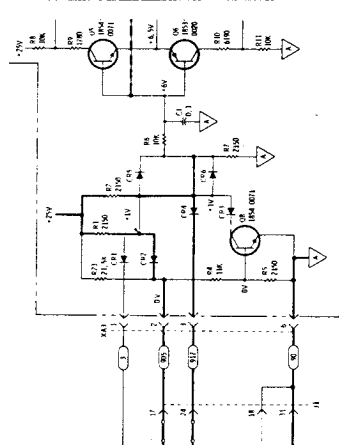
**REMOTE CONTROL**

**REFLECTION**



**REFLECTION**  
Shorting pin 17 to pin 18 or 36 of J1 causes CR2 to conduct and clamps R1-CR5 junction to about +1V. With R1-CR5 junction clamped the flip-flop output has no effect, and CR5 is open. Thus manual (front-panel) operation is disabled.  
**REFLECTION**  
Shorting pin 17 to pin 18 or 36 of J1 cuts Q9 off by shorting base to emitter. With Q9 cut off CR6 conducts and the voltage across R7 is high (> 6V) which turns Q5 on and Q6 off.

**TRANSMISSION**



**REMOTE OPERATION SELECT**  
Shorting pin 17 to pin 18 or 36 of J1 causes CR2 to conduct and clamps R1-CR5 junction to about +1V. With R1-CR5 junction clamped the flip-flop output has no effect, and CR5 is open. Thus manual (front-panel) operation is disabled.  
**TRANSMISSION**  
Shorting pin 24 to pin 18 or 36 of J1 causes CR4 to conduct and CR6 is open. The voltage across R7 is low (< 3V) which turns Q5 off and Q6 on.

Figure 6-7. Relay Driver Input Circuit Talking Schematic Diagram

**FLIP-FLOP.** In manual or front panel operation the flip-flop controls the relay driver circuit. The flip-flop output is taken from the collector or Q2. Depressing the REFLECTOR pushbutton grounds the base of Q2, cutting Q2 off. The output is then high. Depressing the TRANS pushbutton cuts Q1 off. When Q1 is cut-off its collector is high which causes Q2 to conduct. The output of Q2 is then low.

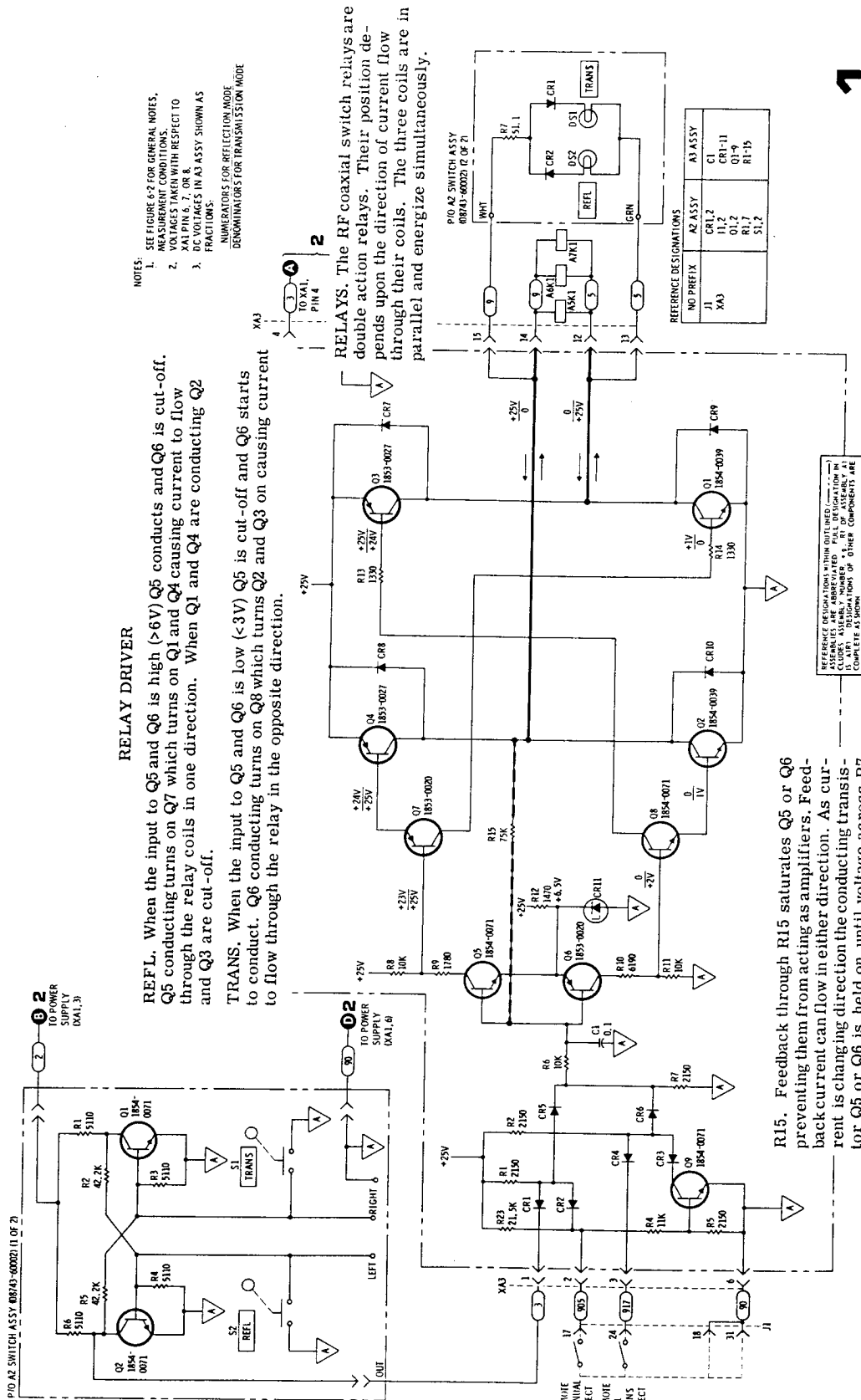


Figure 6-8. Relay Driver Talking Schematic Diagram



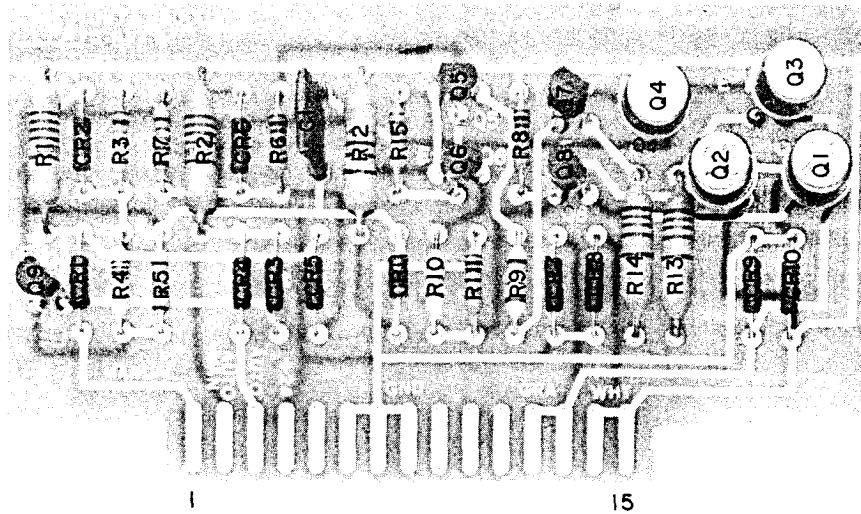


Figure 6-9. Relay Driver Assy Component Identification  
 (Applies to A3 Assembly, HP Part No. 08743-60038  
 except for Q1 through Q4, which are identified on  
 the PC Board.)

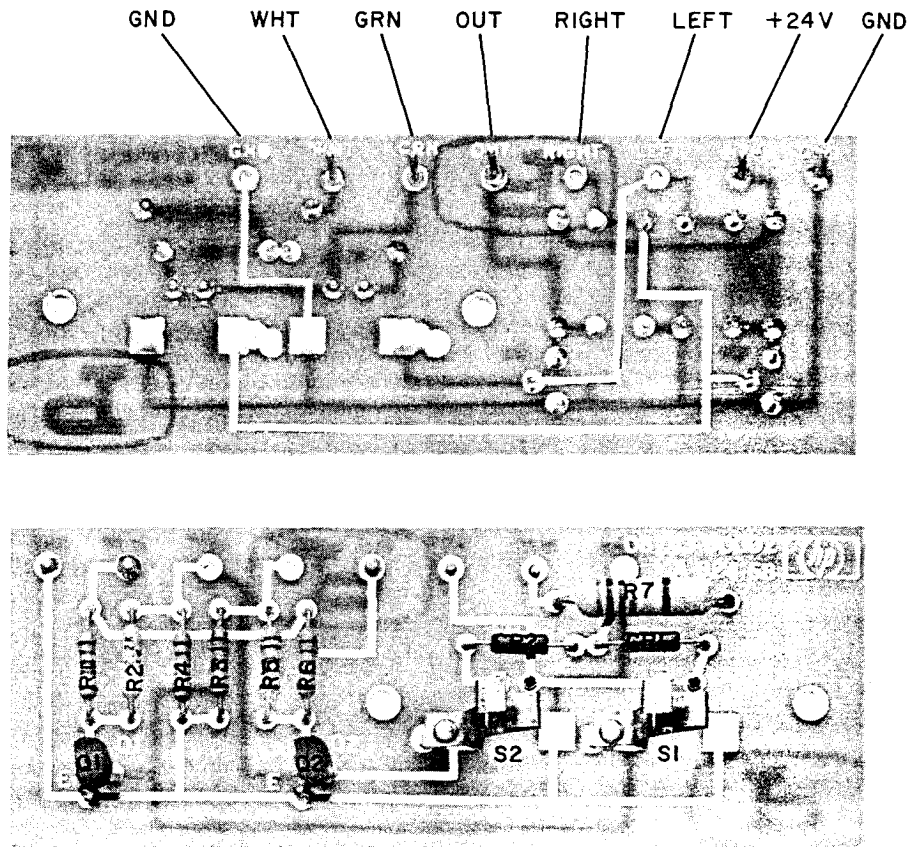
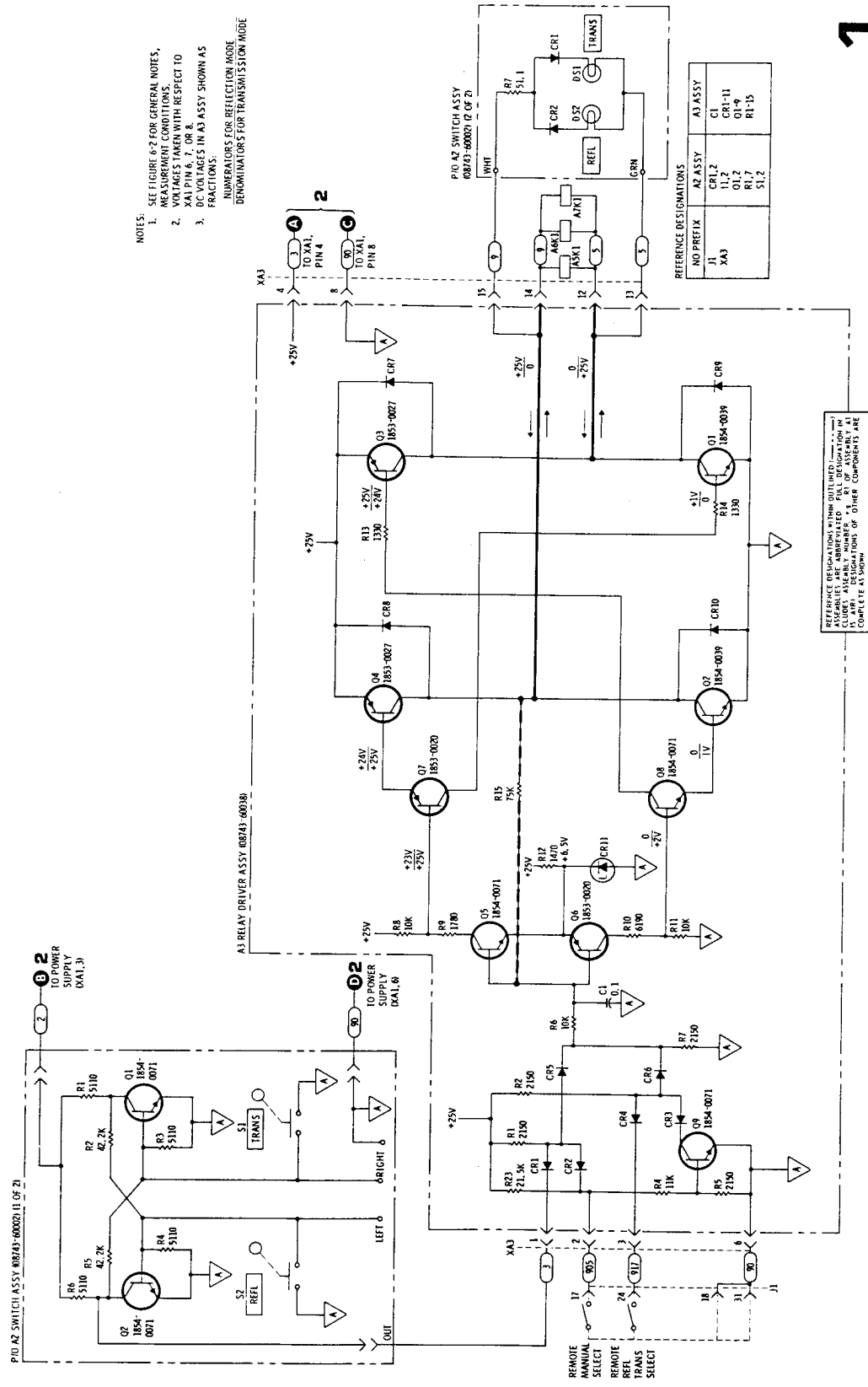


Figure 6-10. Switch Assy Component Identification



NOTES:  
 1. SEE FIGURE 6-2 FOR GENERAL NOTES, MEASUREMENT CONDITIONS, AND TEST POINTS WITH RESPECT TO XA1 PINS AND XA4 PINS.  
 2. DC VOLTAGES IN A3 ASSY SHOWN AS FRACTIONS:  
 NUMERATORS FOR REFLECTION MODE  
 DENOMINATORS FOR TRANSMISSION MODE

REFERENCE DESIGNATIONS WITHIN OUTLINED ARE FULL DESIGNATION IN CLUSTER. ABBREVIATED FULL DESIGNATION IN CLUSTER ARE DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Figure 6-11. Relay Driver Assy Schematic Diagram



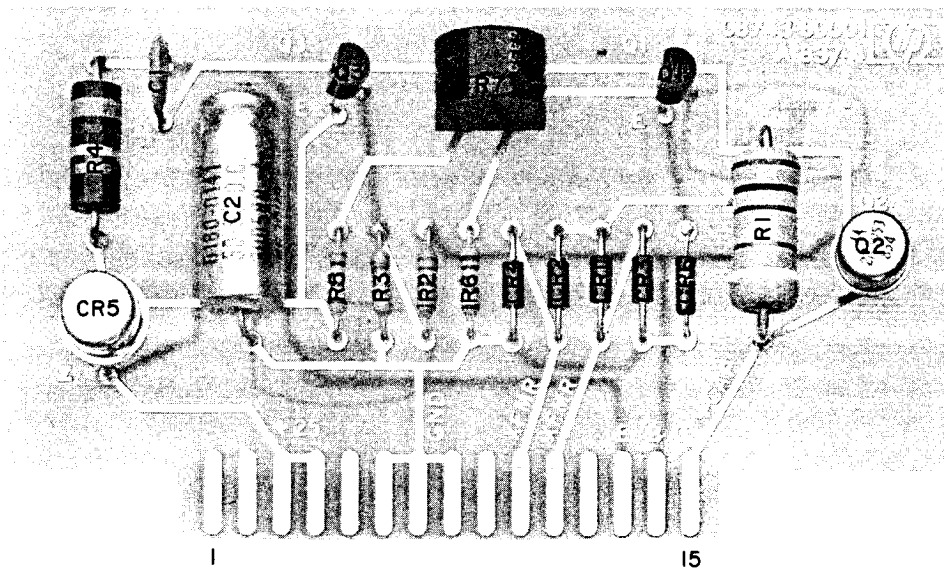


Figure 6-12. Power Supply Assy Component Identification





# MANUAL CHANGES

To adapt this manual to instruments with Serial Numbers listed in the table below, make the indicated manual changes.

Information for adapting this manual to instruments with Serial Numbers not listed below may be included in a yellow MANUAL CHANGES insert supplied with this manual. Information about Serial Numbers not covered in any of these ways can be obtained from the nearest Hewlett-Packard office.

► NEW ITEM.

| SERIAL PREFIX OR NUMBER | MAKE MANUAL CHANGES | SERIAL PREFIX OR NUMBER | MAKE MANUAL CHANGES |
|-------------------------|---------------------|-------------------------|---------------------|
| 834-                    | A, B, C, D          |                         |                     |
| 917, 928                | B, C, D             |                         |                     |
| 968-, 990-              | C, D                |                         |                     |
| 1141                    | D                   |                         |                     |

### CHANGE A

Page 5-3, Table 5-1:

Change A3R12 to HP Part No. 0757-0816 R: FXD MET FLM 681 OHM 1% 1/2W.

Change A3R15 to HP Part No. 0757-0458 R: FXD MET FLM 51.1K OHM 1% 1/8W.

### CHANGE B

Page 5-3, Table 5-1:

Change F1 (115V) to HP Part No. 2110-0008 FUSE: 1/2A SLOW-BLOW.

Change F1 (230V) to HP Part No. 2110-0340 FUSE: 0.25A SLOW-BLOW.

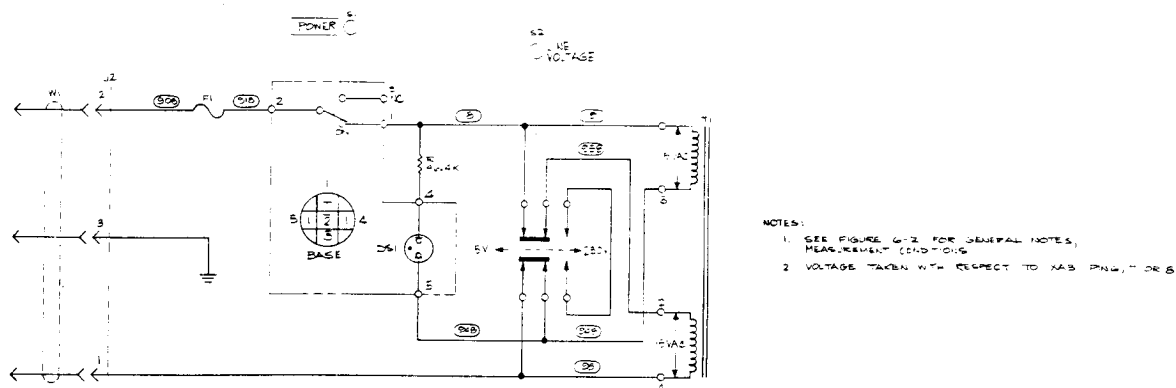
Change S1 to HP Part No. 3101-0100 (Same description).

Change S2 to HP Part No. 3101-1235 (Same description).

Change W1 to HP Part No. 8120-0078 (Same description).

Page 6-11, Figure 6-13:

Replace power supply primary circuit with partial schematic shown below.



### CHANGE C

Page 5-2, Table 5-1:

Change A1R4 to HP Part No. 0811-1672 R: FXD WW 0.82 OHM 5% 2W.

Change A3 to HP Part No. 08743-60003 (Same description).

### CHANGE D

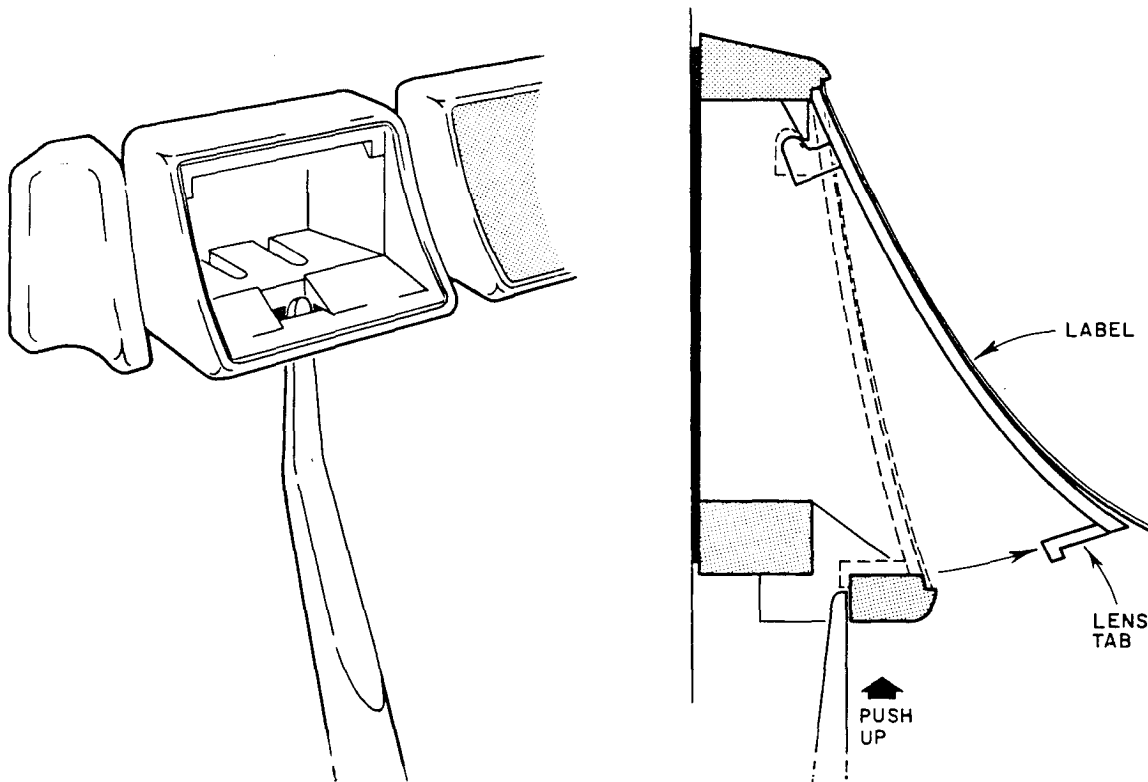
Page 3-15, Figure 3-12:

Use the following Figure 3-12 in place of the Figure 3-12 shown in the manual.

Page 5-4, Table 5-1:

Delete 08743-00024 listing.

### PUSHBUTTON LAMP REPLACEMENT



1. DO NOT REMOVE PUSHBUTTON. Remove pushbutton lens and label by inserting a soldering aid or other small, blunt tool in the slot in the bottom of the pushbutton. Press tool forward against lens tab to release lens and label. If pushbutton comes out see NOTE in Step 3.
2. Remove defective lamp. A needle-nose pliers or tweezers can be used as an extracting tool. Install new lamp (HP part number 2140-0213).
3. Press lens and label into place in pushbutton opening.

#### NOTE:

- If the pushbutton has been removed:
- a. Reinstall pushbutton, lens and label removed.
  - b. Insert the metal contactor in slot of pushbutton as shown. If contactor is not inserted in slot properly, switch may stay on at all times.

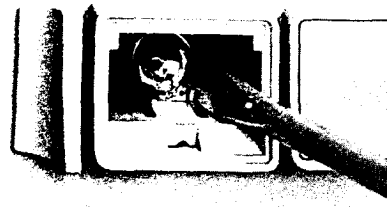


Figure A-1. Pushbutton Lamp Replacement

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