

# Operating and Service Manual

## Agilent Technologies 85047A S-Parameter Test Set

### Serial Numbers

**This manual applies directly to any 85047A S-parameter test set with serial number prefix 3033A and above. For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in General Information.**



**Agilent Technologies**

**Manufacturing Part Number: 85047-90001**

**Printed in USA**

**July 1996**

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# Notice

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## **Hewlett-Packard to Agilent Technologies Transition**

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.



**Agilent Technologies**

By internet, phone, or fax, get assistance with all your test and measurement needs.

**Table 1-1 Contacting Agilent**

**Online assistance:** [www.agilent.com/find/assist](http://www.agilent.com/find/assist)

**United States**  
(tel) 1 800 452 4844

**Latin America**  
(tel) (305) 269 7500  
(fax) (305) 269 7599

**Canada**  
(tel) 1 877 894 4414  
(fax) (905) 282-6495

**Europe**  
(tel) (+31) 20 547 2323  
(fax) (+31) 20 547 2390

**New Zealand**  
(tel) 0 800 738 378  
(fax) (+64) 4 495 8950

**Japan**  
(tel) (+81) 426 56 7832  
(fax) (+81) 426 56 7840

**Australia**  
(tel) 1 800 629 485  
(fax) (+61) 3 9210 5947

**Asia Call Center Numbers**

| Country                    | Phone Number   | Fax Number  |
|----------------------------|--|---|
| Singapore                  | 1-800-375-8100   | (65) 836-0252   |
| Malaysia                   | 1-800-828-848  | 1-800-801664  |
| Philippines                | (632) 8426802<br>1-800-16510170 (PLDT<br>Subscriber Only)          | (632) 8426809<br>1-800-16510288 (PLDT<br>Subscriber Only) |
| Thailand                   | (088) 226-008 (outside Bangkok)<br>(662) 661-3999 (within Bangkok) | (66) 1-661-3714   |
| Hong Kong                  | 800-930-871  | (852) 2506 9233   |
| Taiwan                     | 0800-047-866   | (886) 2 25456723  |
| People's Republic of China | 800-810-0189 (preferred)<br>10800-650-0021                         | 10800-650-0121  |
| India                      | 1-600-11-2929  | 000-800-650-1101  |

## **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 Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## **WARRANTY**

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Computer and computer peripherals are warranted for a period of 90 days. Instruments are warranted for a period of one year. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

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 HP service travel areas. 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. In all other areas, products must be returned to a service facility designated by HP.

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.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

## **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.

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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.*

# DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

**Manufacturer's Name:** Hewlett-Packard Co.

**Manufacturer's Address:** 1400 Fountaingrove Parkway  
Santa Rosa, CA 95403-1799  
USA

Declares that the product:

**Product Name:** Test Set

**Model Number:** HP 85047A

**Product Options:** This declaration covers all options of the above product.

Conforms to the following product specifications:

**Safety:** IEC 61010-1:1990 / EN 61010-1:1993  
CAN/CSA-C22.2 No. 1010.1-92

**EMC:** CISPR 11:1990/EN 55011:1991 Group 1, Class A  
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD  
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz  
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

## Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly.

This product was qualified with HP network analyzers.



Santa Rosa, CA, USA 25 Nov. 1998

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

## SECTION CONTENTS

- 1 Using the HP 85047A
- 1 Instruments Covered by Manual
- 2 Description and Operating Characteristics of the Instrument
- 2 Options
- 2 Accessories
- 3 Operating and Safety Precautions
- 4 Specifications
- 6 Additional Equipment Required

The purpose of this manual is to enable you to use your HP 85047A S-parameter test set efficiently and confidently. This manual contains both general and specific information. To use the HP 85047A to perform a specific function (without reading the entire manual), follow the directions in *Using the HP 85047A*.

## USING THE HP 85047A

The HP 85047A has been designed to operate specifically with the HP 8753B/C Option 006 network analyzer and the HP 8702A/B Option 006 lightwave component analyzer.

- To install the instrument, turn to the *Installation* section.
- To check the proper operation of the HP 85047A, see the *Operator's Check* in the *Operation* section.
- To verify that the instrument meets its published specifications, turn to the *Performance Tests* section.
- To troubleshoot the HP 85047A, turn to the *Service* section.

## INSTRUMENTS COVERED BY MANUAL

The instrument serial number is printed on the serial number label affixed to the rear panel of the instrument (see Figure 4). The serial number consists of two parts:

- Prefix: the first four digits and the letter,
- Suffix: the last five digits, unique to each test set.

The contents of this manual apply directly to test sets with the same serial number prefix as the one on the title page under the heading SERIAL NUMBERS.

If the serial prefix of your test set is lower than the one on the title page, your instrument differs from those documented in this manual. Most differences are slight, so you may use the information as presented. However for utmost accuracy, refer to the "Manual Backdating" chapter of this manual. Significant differences, if any, are documented there.

You can order this manual in microfiche form (in 4 x 6 inch microfilm transparency format). The part number appears on the title page.

## **DESCRIPTION AND OPERATING CHARACTERISTICS OF THE INSTRUMENT**

When used with the HP 8753B/C network analyzer or HP 8702A/B lightwave component analyzer, the HP 85047A provides a convenient means of measuring reflection and transmission coefficients (scattering parameters) of one-port or two-port devices. The test set can be operated in either of two frequency ranges: 300 kHz to 3 GHz or 3 MHz to 6 GHz. Both analyzers require option 006 for 6 GHz operation.

Table 1 lists the operating specifications and characteristics of the HP 85047A. The test set is illustrated on the cover of this manual and shown in a typical measurement setup in Figure 6.

## **OPTIONS**

### **Option 001**

Standard test sets with serial prefix 2936A and below had a mechanical transfer switch.

This former option substituted a solid-state switch for the mechanical switch. The solid-state switch allows fast, continuous switching, improved accuracy and increased reliability.

The HP 86389B solid-state switch upgrade kit is available for post-sale installation of the option. Upgrades are performed on a return-to-HP basis. Labor is included. Note that this option is compatible only with these (or higher) firmware revisions: HP 8753B rev 3.00, HP 8753C rev 4.01, or HP 8702B rev 1.00.

For additional information, refer to "Solid-State Switch Operation Considerations" at the end of the "Operation" chapter.

### **Option 009**

This option substitutes a mechanical switch for the solid-state transfer switch.

### **Option 908**

This option supplies the test set with the parts required to rack mount it with handles removed. Refer to the *Installation* section for additional information.

### **Option 910**

This option provides a duplicate test set manual.

### **Option 913**

This option supplies the test set with the parts required to rack mount it with handles. Refer to the *Installation* section for additional information.



## ACCESSORIES

### Accessories Supplied

Figure 1 shows the HP 85047A with the accessories supplied (see *Replaceable Parts* for part numbers):

- Four RF connecting cables
- Interconnect cable
- Performance test disc

### Accessories Available

**Calibration and Accessory Kits.** The calibration kits listed below contain the components required to characterize the systematic errors of various measurement systems. The components also allow adaptation of devices to various measurement systems.

The accessory kits listed contain the components generally required to measure devices with the types of connectors indicated. Additional information is included in the analyzer manual and the data sheet.

| Connector Type  | Calibration Kit                     | Accessory Kit                         |
|---|-------------------------------------|---------------------------------------|
| 7 mm<br>Type-N 50 $\Omega$<br>3.5 mm (SMA)<br>BNC 50 $\Omega$ | HP 85031B<br>HP 85032B<br>HP 85033C | HP 11853A*<br>HP 85033A<br>HP 11854A* |
| *use with HP 85032B type-N 50 $\Omega$ calibration kit        |                                     |                                       |

**Cable Sets.** Use the HP11857D 7 mm test port return cable set to extend the test ports of the HP 85047A. Additional information is included in the analyzer manual.

**Transistor Fixtures.** Three transistor fixtures are available to measure the S-parameters of transistors with the HP 85047A:

- HP11600B\* tests TO-18/TO-72 type transistors.
- HP11602B\* tests TO-5/TO-12 type transistors.
- HP11608A tests 50 $\Omega$  stripline transistors.

\*use with HP11858A transistor fixture adapter

## OPERATING AND SAFETY PRECAUTIONS

### Operating

You need observe only normal precautions in handling and operating the HP 85047A. Do not exceed its operating level input of +26 dBm or 30 Vdc.

### Service

The voltages in this test set do not warrant more than normal caution for operator safety. Nevertheless, service should be performed only by qualified personnel.

## SPECIFICATIONS

### Definitions

The specifications listed in Table 1 range from those guaranteed by Hewlett-Packard to those typical of most HP 85047A instruments but not guaranteed. Codes in the far right column of Table 1 reference a specification definition listed below. These definitions are intended to clarify the extent to which Hewlett-Packard supports the specified performance of the HP 85047A.

**S-1:** This performance parameter is field verifiable using performance tests documented in the service manual.

**S-2:** Due to limitations on available industry standards, the guaranteed performance of the instrument cannot be verified outside the factory. Field procedures can verify performance with a confidence prescribed by available standards.

**T:** Typical but non-warranted performance characteristics intended to provide information useful in applying the instrument. Typical characteristics are representative of most instruments, though not necessarily tested in each unit and not field tested.

*Table 1. Specifications (1 of 2)*

| <b>Parameter</b>                     | <b>Specification</b>  | <b>Code</b> |
|--------------------------------------|---|-------------|
| Directivity <sup>1</sup> (Port 1, 2) | 300 kHz to 1.3 GHz: $\geq 35$ dB <sup>2</sup><br>1.3 GHz to 3 GHz: $\geq 30$ dB<br>3 GHz to 6 GHz: $\geq 25$ dB | S-1         |
| DC bias input range:                 | +30 VDC, $\pm 200$ mA with no degradation in RF specifications ( $\pm 1$ A maximum)                             | S-2         |
| Source Match <sup>1</sup>            | 300 kHz to 1.3 GHz: $\geq 20$ dB<br>1.3 GHz to 3 GHz: $\geq 16$ dB<br>3 GHz to 6 GHz: $\geq 14$ dB              | S-1         |
| Switch Repeatability                 | $\pm 0.03$ dB   | S-1         |

Table 1. Specifications (2 of 2)

| Parameter   | Specification   |  |  | Code |
|---|---|--|--|------|
|   | Range   | Solid-State Switch                                     | Mechanical Switch                                      |      |
| Frequency Range   | 300 kHz to 3 GHz<br>3 MHz to 6 GHz  |  |  | T    |
| Frequency Response <sup>1</sup> :<br>Typical Transmission Tracking<br>Magnitude   | 300 Hz to 3 GHz<br>3 to 6 GHz   | $\pm 2.0$ dB <sup>3</sup><br>$\pm 2.0$ dB <sup>3</sup> | $\pm 1.5$ dB <sup>3</sup><br>$\pm 1.5$ dB <sup>3</sup> | T    |
| Phase <sup>4</sup>  | 300 kHz to 3 GHz<br>3 GHz to 6 GHz  | $\pm 10$ deg<br>$\pm 20$ deg                           |  |      |
| Typical Reflection Tracking<br>Magnitude  | 300 kHz to 3 GHz<br>3 GHz to 6 GHz  | $\pm 2.0$ dB <sup>3</sup><br>$\pm 2.0$ dB <sup>3</sup> | $\pm 1.5$ dB <sup>3</sup><br>$\pm 1.5$ dB <sup>3</sup> |      |
| Phase <sup>4</sup>  | 300 kHz to 3 GHz<br>3 to 6 GHz  | $\pm 10$ deg<br>$\pm 20$ deg                           |  |      |
| Nominal Insertion Loss<br>RF IN to Port 1, 2  | 3 GHz range<br>6 GHz range  | 4.0 dB + 0.8 dB/GHz<br>17.5 dB + 0.8 dB/GHz            | 2.5 dB + 0.5 dB/GHz<br>16 dB + 0.5 dB/ GHz             | T    |
| RF IN to R  | 3 GHz range<br>6 GHz range  | 19 dB + 0.5 dB/GHz<br>34 dB + 0.5 dB/GHz               |  |      |
| Port 1, 2 to A, B   | 16 dB   |  |  |      |
| Typical Isolation between<br>Port 1 and 2   | 3 GHz range<br>6 GHz range  | 100 dB<br>90 dB  |  | T    |
| Impedance<br>Port 1, 2<br>RF IN, R, A, B  | 50 $\Omega$ Nominal<br>50 $\Omega$ Nominal  |  |  | T    |
| Connectors<br>Port 1, 2<br>RF IN, R, A, B<br>DC bias input<br>Limit Test<br>Test Sequence   | 7 mm Center conductor depth: 0.000 to 0.002 inch<br>50 $\Omega$ type-N (f) Pin depth: 0.201 to 0.207 inch <sup>5</sup><br>BNC (f)<br>BNC (f)<br>BNC (f) |  |  |      |
| Damage level  | +26 dBm RF input  |  |  | T    |
| Power   | +22 Vdc from the analyzer via interface cable.  |  |  |      |
| Dimensions  | 432 mm x 90 mm x 495 mm (17 x 3.5 x 19.5 inches)  |  |  |      |
| Weight  | 10 kg (22 lb) net; 15 kg (33 lb) shipping   |  |  |      |
| <ol style="list-style-type: none"> <li>1. Can be greatly improved with accuracy enhancement techniques.</li> <li>2. 300 kHz to 1 MHz environmental range: 25 <math>\pm</math> 5°C. Directivity is typically better than 25 dB in 0° to 55°C range.</li> <li>3. Deviation from mean value.</li> <li>4. Deviation from linear phase.</li> <li>5. Center conductor protrusion from reference plane.</li> </ol> |   |  |  |      |

## ADDITIONAL EQUIPMENT REQUIRED

Table 2 lists additional equipment and accessories required for use with the HP 85047A. The table notes which items are required to verify the performance of the test set and which are required to operate it. Other equipment may be substituted if its specifications meet or exceed the specifications listed in the critical specifications column.

Table 2. Additional Equipment Required

| Instrument   | Critical Specifications  | Recommended Model                              | Use*         |
|--|--|--|--------------|
| Analyzer   |  | HP 8753B/C Option 006<br>HP 8702A/B Option 006 | O, P, T<br>O |
| HP-IB Cables (2)   |  | HP 10833A/B/D                                  | P            |
| Power supply   | range: 0 to +5V, 0 to 100 mA   | HP 6218C                                       | P            |
| 7mm calibration kit  | load RL: $\geq 52$ dB, DC to 5 GHz<br>$\geq 46$ dB, 5 to 6 GHz       | HP 85031B                                      | P            |
| BNC cable  |  | HP P/N 8120-1839                               | P            |
| Adapter, BNC to banana plug                                |  | HP P/N 1251-2277                               | P            |
| Multimeter   | range: DC to 50V   | HP 3456A                                       | T            |
| Oscilloscope   | 100 MHz bandwidth  | HP 1740A                                       | T            |
| RF cable set   | 50 $\Omega$ type-N, three 24 inch phase-matched, one 34 inch         | HP 11851B                                      | T            |
| Disk Drive   | CS80 protocol  | HP 9122C/D                                     | P            |
| 7 mm connector gage  | measurement uncertainty:<br><0.0002 inch                             | part of HP 85050B calibration kit              | T            |
| Power meter  | 300 kHz to 6 GHz<br>power: -30 to +20 dBm<br>accuracy: $\pm 0.05$ dB | HP 436A, HP 438A                               | T            |
| Power sensor   | 300 kHz to 3 GHz<br>power: -30 to +20 dBm                            | HP 8482A                                       | T            |
|  | 3 GHz to 6 GHz<br>power: -30 to +20 dBm                              | HP 8481A, HP 8485A                             | T            |
| * O = operation; P = performance test; T = troubleshooting |  |  |              |

## SECTION CONTENTS

- 1 Initial Inspection
- 1 Environmental Considerations
- 3 Preparation for Use
- 3 Packaging

## INITIAL INSPECTION

Inspect the shipping container (including cushioning material) for damage. If no damage is evident, performing the *Operator's Check* in the *Operation* section should suffice for incoming inspection. If the test set does not pass the *Operator's Check*, refer to the troubleshooting procedures in the *Service* section.

If the shipping container is damaged, keep it until you have checked the contents for completeness. The contents are listed in Table 3. Then check the test set mechanically and electrically. Perform all of the electrical performance tests in the *Performance Tests* section.

If the test set fails the electrical tests, or is damaged, defective, or incomplete, keep the shipping materials and notify both the carrier and the nearest Hewlett-Packard office. The HP office will arrange for repair or replacement of the test set without waiting for settlement of the claim.

Table 3. Components of HP 85047A Test Set

| Item                         | Part Number  |
|------------------------------|--------------|
| Operating and Service Manual | 85047-90001  |
| Interconnect Cable           | 08503-60051* |
| RF Test Set Cables (4)       | 8120-4782*   |
| Performance Test Disc        | 85047-10001  |

\*Shown in Figure 1.

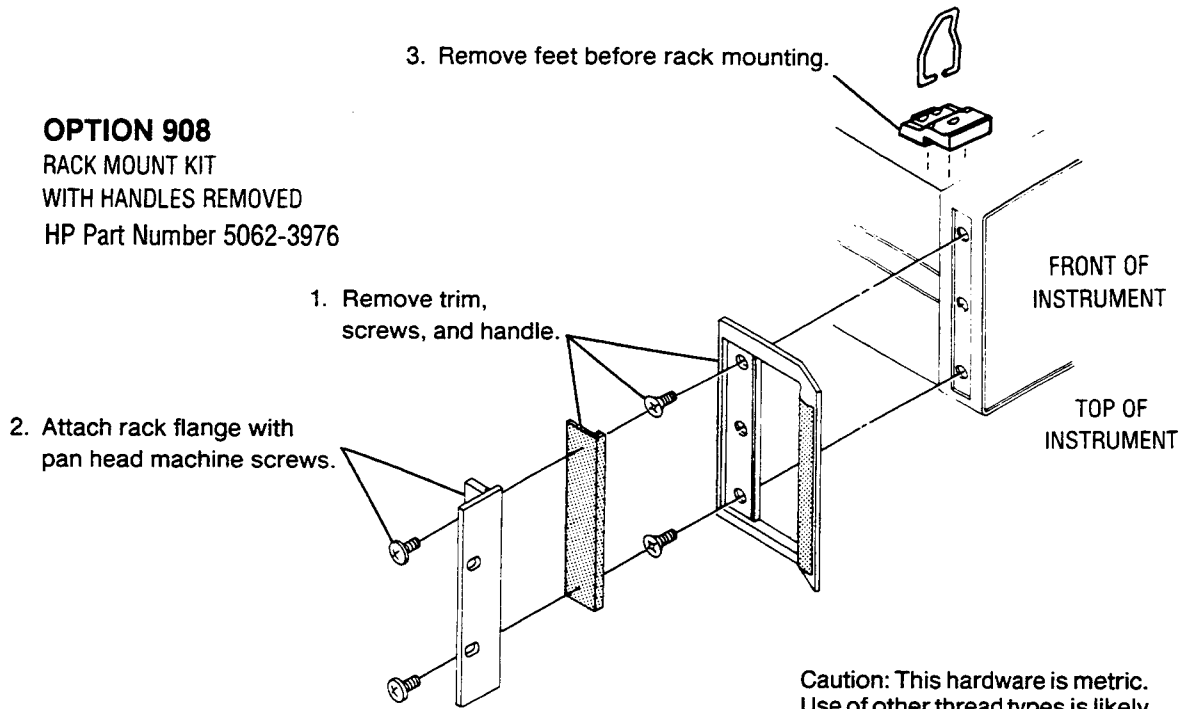
## ENVIRONMENTAL CONSIDERATIONS

### Operation and Storage

For best performance, the HP 85047A should be operated in temperatures between 0°C and +55°C with relative humidity between 5% and 95% at 40°C (noncondensing). It may be operated at altitudes up to 4,500 metres (15,000 feet).

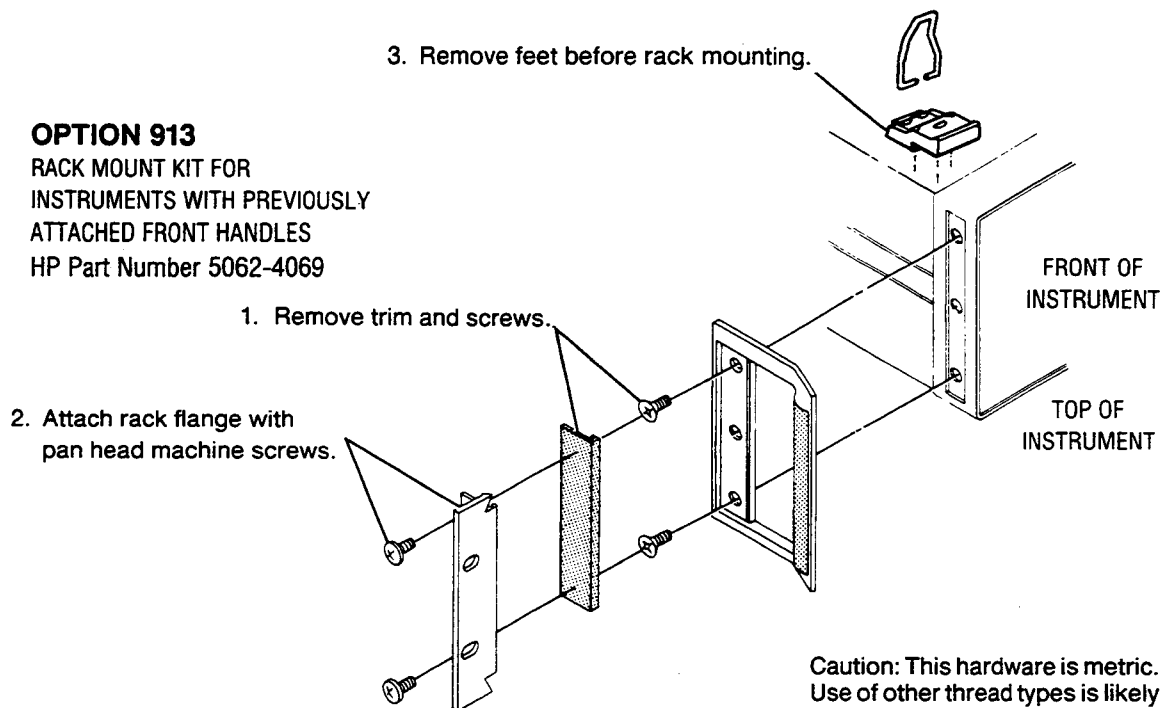
The HP 85047A may be stored in temperatures from -40°C to +75°C, with relative humidity up to 90% at +65°C (non-condensing) and at altitudes up to 15,240 metres (50,000 feet).

**OPTION 908**  
RACK MOUNT KIT  
WITH HANDLES REMOVED  
HP Part Number 5062-3976



Caution: This hardware is metric. Use of other thread types is likely to damage threaded holes.

**OPTION 913**  
RACK MOUNT KIT FOR  
INSTRUMENTS WITH PREVIOUSLY  
ATTACHED FRONT HANDLES  
HP Part Number 5062-4069



Caution: This hardware is metric. Use of other thread types is likely to damage threaded holes.

Figure 2. Attaching Rack Mounting Hardware

## PREPARATION FOR USE

### Positioning the Test Set

Typically the HP 85047A is placed under the network (or lightwave component) analyzer whether it is rack-mounted or used on a bench. To install the flanges to rack mount the instrument (with or without handles) in a standard 19 inch rack, refer to Figure 2. The recommended rack is the HP 85043B. Instructions for rack mounting the HP 85047A in a system configuration with the analyzer are provided in the analyzer manual and in the HP 85043B system rack manual.

To install the HP 85047A for use on a bench, place it under the analyzer. Use an anti-static work surface to lessen the chance of ESD damage.

### Connecting the Test Set

**Mating Connectors.** Ports 1 and 2 of the HP 85047A are precision 7 mm connectors and mate with precision 7 mm connectors.

The RF IN, R, A and B ports of the HP 85047A are 50 $\Omega$  utility type-N female connectors which mate with the corresponding type-N male connectors. These connectors' dimensions conform to US specification MIL-C-39012, except for the center pin protrusion specification which is .201 to .207 inch.

The NETWORK ANALYZER INTERCONNECT connector is a series D 25-contact female connector and mates with the corresponding male connector on the interconnect cable.

The BIAS CONNECT, LIMIT TEST and TEST SEQUENCE connectors are 50 $\Omega$  BNC female connectors and mate with the corresponding male connectors (UG-88/U).

**Power and Control Connections.** Power for the HP 85047A is supplied by the network analyzer through the interconnect cable. The interconnect cable also transmits control signals between the test set and the network analyzer. Connect the interconnect cable from the NETWORK ANALYZER INTERCONNECT connector on the rear panel of the HP 85047A to the TEST SET INTERCONNECT connector on the rear panel of the analyzer.

**Signal Path Connections.** Place the test set under the analyzer and connect its RF IN port to the analyzer's RF OUT port, R to R, A to A and B to B. Use the four cables supplied with the test set.

**Bias Connections.** These BNC connectors supply bias voltages to transistors under test in a transistor fixture. Refer to the transistor fixture manual for additional information.

**Limit Test Connection.** This BNC connector outputs a TTL signal to indicate limit test results.

**Test Sequence Connection.** This BNC connector outputs a user-set TTL signal in a test sequence.

## PACKAGING

If reshipping is required, the test set should be repackaged in the original factory package. Containers and materials identical to those used by the factory are available through Hewlett-Packard offices. To prevent damage to the test port connectors, cover them with plastic caps (HP part number 1401-0123).

Alternatively, comparable packaging materials may be used. Wrap the test set in heavy paper or anti-static plastic. If shipping to an HP Office or Service Center, complete and attach a service tag (in this manual). Use sufficient shock absorbing material on all sides of the HP 85047A to provide a thick, firm cushion and prevent movement. Seal the shipping container securely and mark it **FRAGILE**.

In any correspondence with HP, refer to the HP 85047A by full model and serial number.



## SECTION CONTENTS

- 1 Connector Considerations
- 2 Front Panel Features
- 3 Rear Panel Features
- 6 Operator's Check
- 8 Solid-State Switch Operation Considerations

This section illustrates the features and functions of the front and rear panels of the HP 85047A (Figures 3 and 4). Figure 5 depicts the RF signal path through the test set for each of the four S-parameter measurements. Figure 6 shows a typical test set measurement setup.

## CONNECTOR CONSIDERATIONS

Inspect the 7 mm connectors of port 1 and 2 on a regular basis (frequency should vary with use). The connectors should be clean and the center pin centered.

Gage the 7 mm connectors of port 1 and 2 on a regular basis if DUTs are normally connected directly to them (rather than to cables). Connector dimensions are specified in Table 1. Gages are listed in Table 2. Note that when gaging the connectors, the collet must be removed. Refer to the *Microwave Connector Care* manual for instructions. If the connectors are dirty, damaged, or out of specification, refer to the *Service* section of this manual and the *Microwave Connector Care* manual (part of the analyzer manual set).



### SUSCEPTIBLE TO DAMAGE FROM ESD

ESD (electrostatic discharge) can damage the sensitive devices in this instrument. Use this instrument at a static-safe workstation and wear a grounding strap.

## FRONT PANEL FEATURES

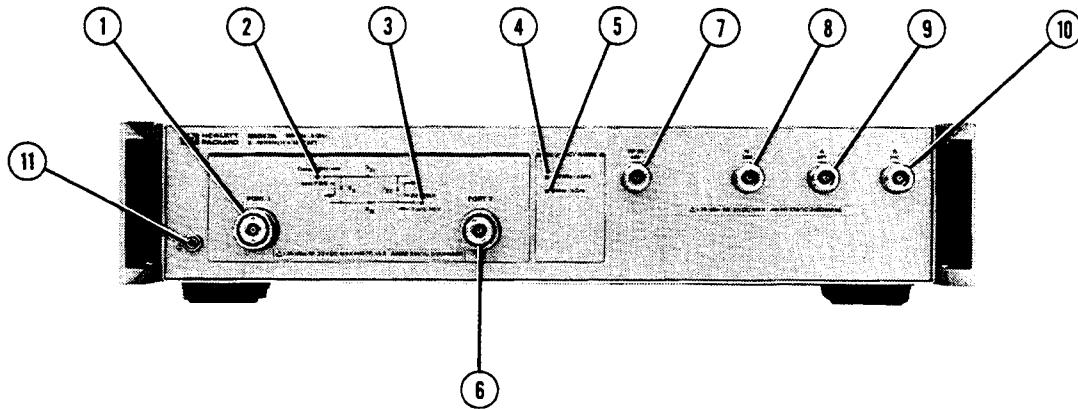


Figure 3. Front Panel Features

1. **PORT 1.** The device under test is connected here, to port 2, or to both.

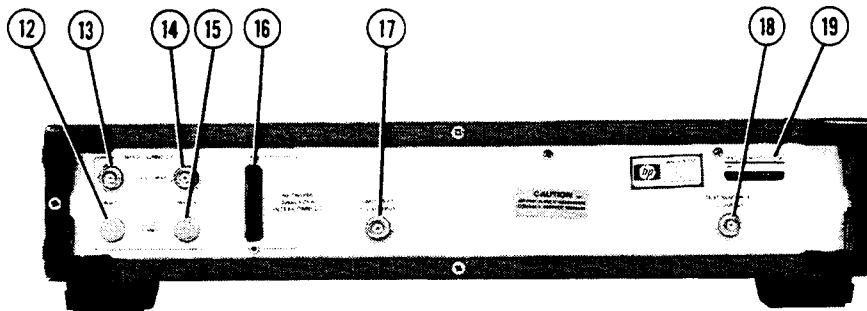


Do not input more than +26 dBm (about 0.4W) or 30 VDC to PORT 1 or PORT 2.

Maximum input to RF, R, A, or B ports is +26 dBm or 3 VDC.

2. **S11 S21 Indicator LED.** This indicator, when lit, means that the test set is in the S11 or S21 measurement mode and power is incident from port 1.
3. **S22 S12 Indicator LED.** This indicator, when lit, means that the test set is in the S22 or S12 measurement mode and power is incident from port 2.
4. **300 kHz–3 GHz LED.** This indicator, when lit, means that the test set and the analyzer are set to operate in the lower frequency range. The test set doubler is off and bypassed.
5. **3 MHz–6 GHz LED.** This indicator, when lit, means that the test set and the analyzer are set to operate in the upper frequency range, nominally above 3 MHz. The test set doubler is turned on.
6. **PORT 2.** The device under test is connected here, to port 1, or to both.
7. **RF IN.** This RF input connector receives the RF signal from the analyzer RF OUT connector.
8. **R.** This RF connector provides the reference signal to input R of the analyzer.
9. **A.** This RF connector provides an RF input signal to input A of the analyzer from a device under test.
10. **B.** This RF connector provides an RF input signal to input B of the analyzer from a device under test.
11. **Ground Input.** This connector provides a front panel ground connection.

## REAR PANEL FEATURES



*Figure 4. Rear Panel Features*

12. **PORT 2 FUSE.** This fuse protects the port 2 bias line. See *Replaceable Parts* for rating and part number.
13. **PORT 2 BIAS CONNECTOR.** This connector (when connected to an appropriate source) biases devices connected to port 2.
14. **PORT 1 BIAS CONNECTOR.** This connector (when connected to an appropriate source) biases devices connected to port 1.
15. **PORT 1 FUSE.** This fuse protects the port 1 bias line. See *Replaceable Parts* for rating and part number.
16. **NETWORK ANALYZER INTERCONNECT.** This connector supplies the test set with power from the analyzer and also serves as a bidirectional control path.
17. **LIMIT TEST.** This connector outputs a TTL signal of the limit test result as follows:
  - Pass: TTL high
  - Fail: TTL low
18. **TEST SEQUENCE.** This connector outputs a TTL signal which can be programmed by the user in a test sequence to be high or low.
19. **SERIAL NUMBER LABEL.** The instrument's serial number and options, if any, are printed here. For information about serial numbers, see *Instruments Covered by Manual* in the *General Information* section.

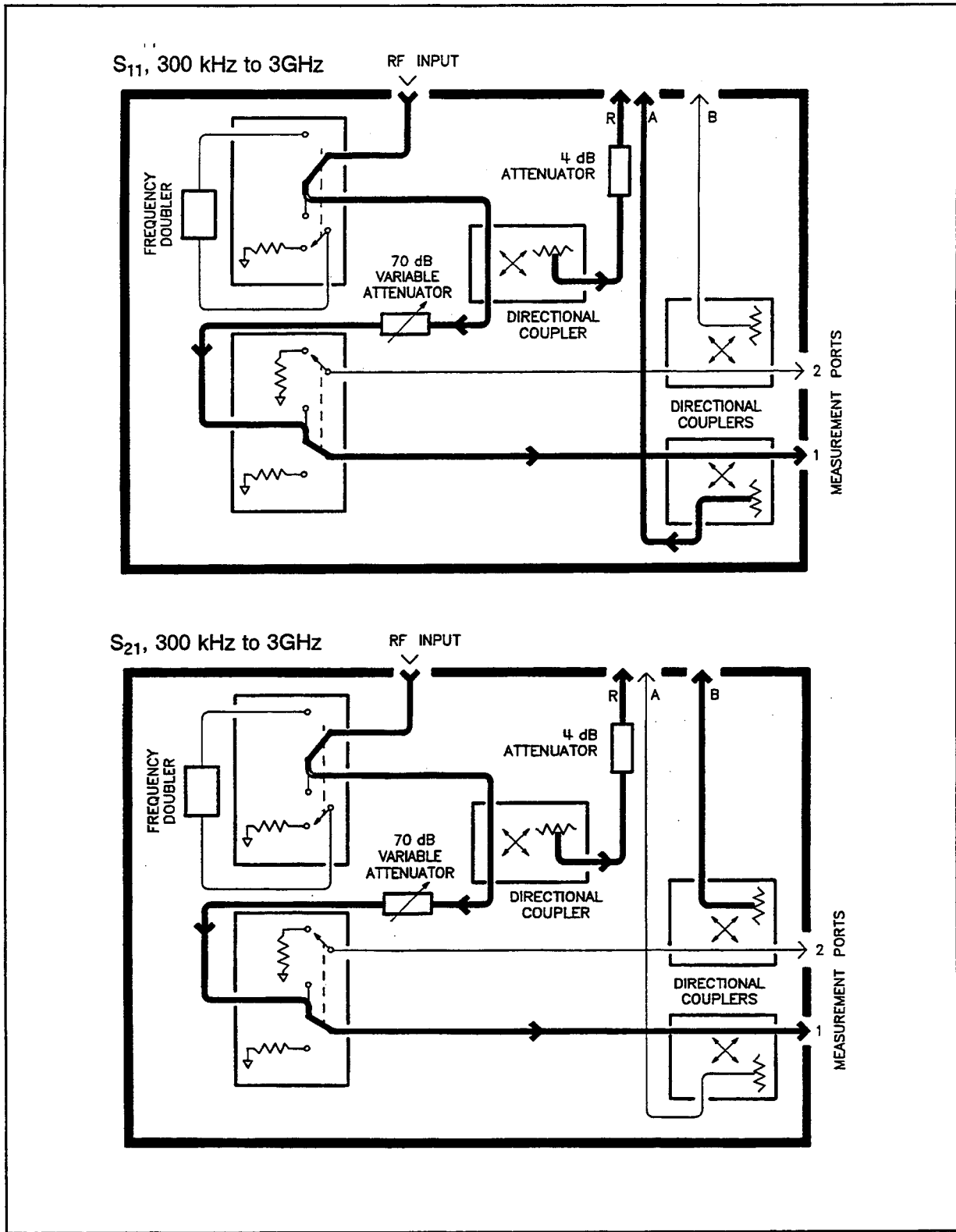


Figure 5. RF Signal Path (1 of 2)

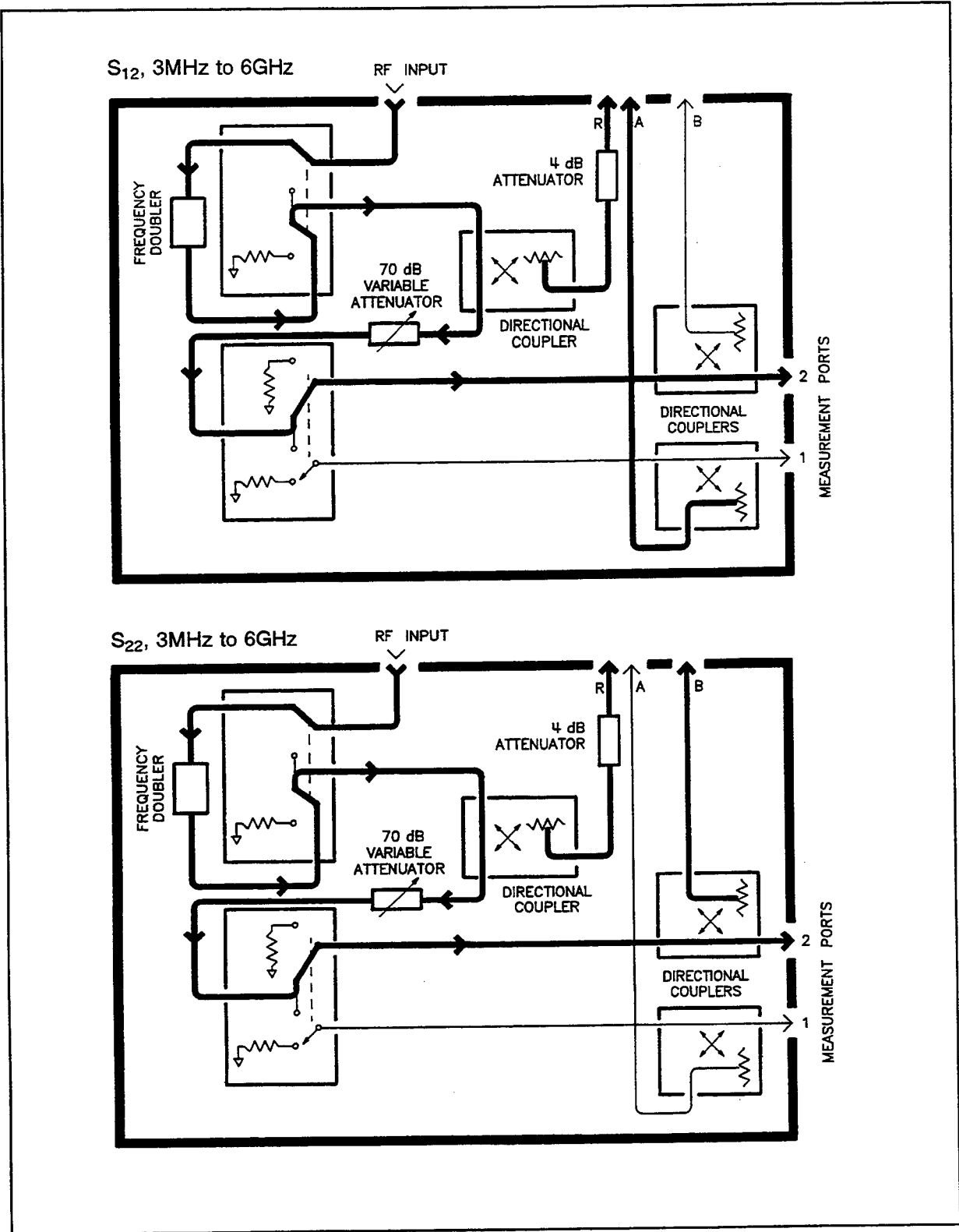


Figure 5. RF Signal Path (2 of 2)

## OPERATOR'S CHECK

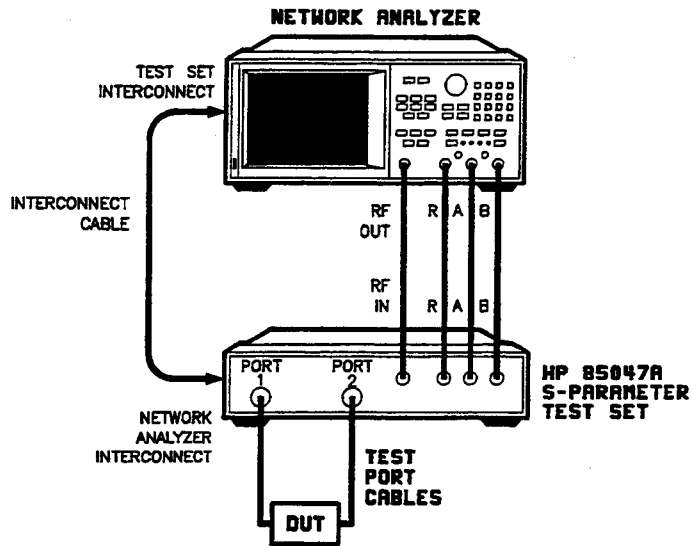


Figure 6. Typical Measurement Setup

## EQUIPMENT

|                               |  |
|-------------------------------|--|
| Network analyzer .....        | HP 8753B/C Option 006 <sup>1</sup>           |
| Interconnect cable .....      | (HP p/n 08503-60051, supplied with test set) |
| RF cable set (4) .....        | (HP p/n 8120-4782, supplied with test set)   |
| 50 ohm 7 mm termination ..... | 909F or 85031-60002 <sup>2</sup>             |
| Test port cable set .....     | HP 11857D                                    |

1. The HP 8702A/B Option 006 lightwave component analyzer can be substituted for the network analyzer in this test.
2. Part of HP 85031B calibration kit.

## DESCRIPTION AND PROCEDURE

Follow this procedure for incoming inspection or instrument operation verification. Passing this check verifies the operation of the test set to 90% certainty. Refer to the *Performance Tests* section for a more rigorous test.

1. Connect the equipment as shown in Figure 6 and turn on the network analyzer but do not connect the DUT. Instead, connect the load to port 1 of the test set.
2. On the network analyzer press **[PRESET] [SCALE REF] [[REFERENCE POSITION] [7] [x1] [MKR FCTN] [MARKER SEARCH] [TRACKING ON] [MAX]** to observe the directivity of port 1. The marker should read less than -30 dB and the trace should look like Figure 7a.

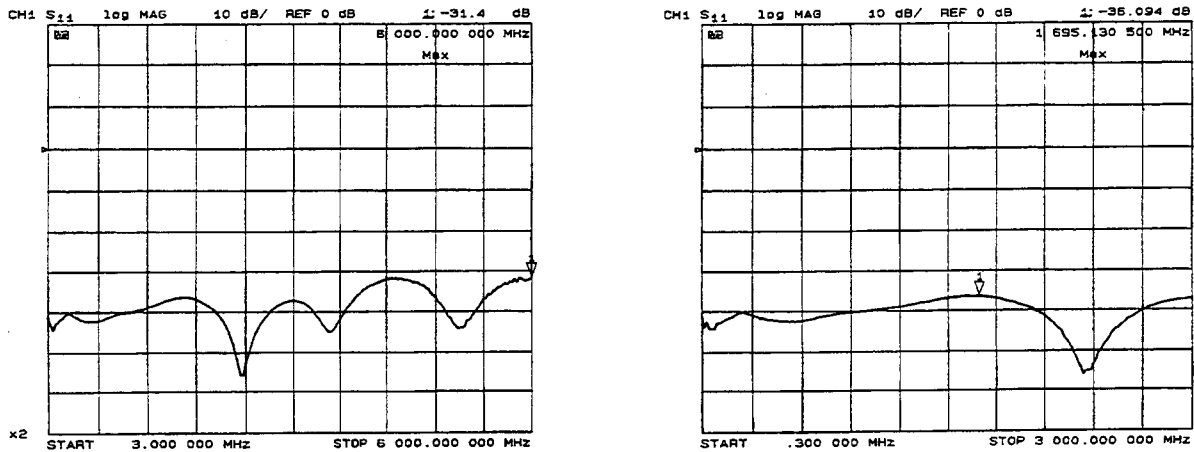


Figure 7. Typical Directivity Trace

3. Press **[SYSTEM] [FREQ RANGE 6 GHz]**. The 3 MHz–6 GHz LED should light.
4. The marker should now read less than  $-25$  dB and look like Figure 7b.
5. Remove the load from port 1. Press **[MENU] [POWER] [ATTENUATOR PORT 1]** and then press **[▲]** seven times. Each time **[▲]** is pressed, there should be an audible click and the trace should drop about 10 dB. Press **[0] [x1]**.
6. Press **[MEAS] [S22]**. The LED near port 2 should light.
7. Press **[MENU] [POWER] [ATTENUATOR PORT 2]** and vary the attenuation as in step 5. The results should be the same as above.
8. Connect the load to port 2. The marker should now read less than  $-25$  dB and look like Figure 7b.
9. Press **[SYSTEM] [FREQUENCY RANGE 3 GHz]**. The 300 kHz–3GHz LED should light.
10. The marker should read less than  $-30$  dB and the trace should resemble Figure 7a.
11. If the test set does not perform as expected, follow these suggestions:

Check that all connections, including the interconnect cable, are clean and properly connected.

If the test set operation is normal, except that the directivity fails, repeat the %IFOperator's Check with a different known good load. If the problem persists, perform the directivity performance test to confirm the problem. Refer to *Service* for troubleshooting.

For troubleshooting of the switch control assembly and attenuator assembly, refer to the %IFService section.

## SOLID–STATE SWITCH OPERATION CONSIDERATIONS

Output power is directed to test port 1 or 2 by a transfer switch which may be mechanical or solid–state.

The solid–state switch affects the operation of the network analyzer system in these ways:

- Full 2–port calibration: all four forward (S11, S21) and reverse (S12, S22) parameters are now updated continuously, as required for full 2–port error correction. This is possible because the solid–state switch can transfer power from port 1 to port 2 continuously. The “Cor” notation on the CRT indicates that all four parameters are being updated.

The mechanical transfer switch does not operate continuously (to prevent its wearing out). After the initial measurement, the analyzer applies power to one port only, as indicated by the “C2” notation. “C2” means only two of the four S–parameters are being updated.

Full 2–port error correction is important in tuning applications, or when a series of devices are connected.

- Nominal insertion loss: increases by 2 to 3 dB. See Table 1 for details.
- Operating noise: lessens as the solid–state switch is not mechanical in operation.
- Reliability: improves because the switch has no moving parts.
- Error messages: “Continuous switching not allowed” is not displayed in dual channel mode unless the channels are set to different attenuator settings.

Upgrade kits are available to enable HP 8753 network analyzers to support solid–state switching.

| Model                 | Kit                 | Description                    |
|-----------------------|---------------------|--------------------------------|
| HP 8753A              | HP 11882A           | HP 8753A to B rev 3.0 firmware |
| HP 8753B <sup>1</sup> | HP 86388A           | HP 8753B to rev 3.0 firmware   |
| HP 8753C              | no upgrade required |                                |

1. Upgrade not required for use with mechanical transfer switch test sets.



## SECTION CONTENTS

- 1 Performance Test Record Description
- 2 Performance Tests Setup and Equipment
- 3 Semi-automated Performance Tests
  - 3 Directivity
  - 3 Directivity With DC Bias
  - 3 Source Match
  - 6 Test Port Switch Repeatability
- 7 Performance Test Record
- 8 Manual Performance Tests
  - 8 Directivity
  - 8 Directivity With DC Bias
  - 8 Source Match
- 12 Test Port Switch Repeatability

The procedures in this section test the directivity, directivity with DC bias, source match, and test port switch repeatability specifications of the HP 85047A test set using the specifications of Table 1 as the performance standards. The tests are semi-automated and contained on a disc supplied with the test set. These semi-automated tests utilize the test sequencing function of the analyzer to execute the tests. Some user interface is also required. HP 8702A/B users must use the *Manual Performance Tests* procedure at the end of this section since test sequencing is not a feature of this analyzer. The semi-automated tests may be performed in other than the order given, however additional keystrokes may be required to load sequences.

## PERFORMANCE TEST RECORD

Directly following these semi-automated tests, a *Performance Test Record*, Table 4, is provided for recording results. A plot of each test result is also printed and will be attached to the *Performance Test Record*. If a listing of each data point is desired in addition, use the **[COPY] [LIST VALUES]** function on the analyzer after the data plot has finished printing. If you choose to print these values, remember: 201 points are measured in each frequency band. Printing will take a few minutes. Restore the display and press **[SYSTEM]** before continuing the sequence.

## PERFORMANCE TESTS SETUP AND EQUIPMENT

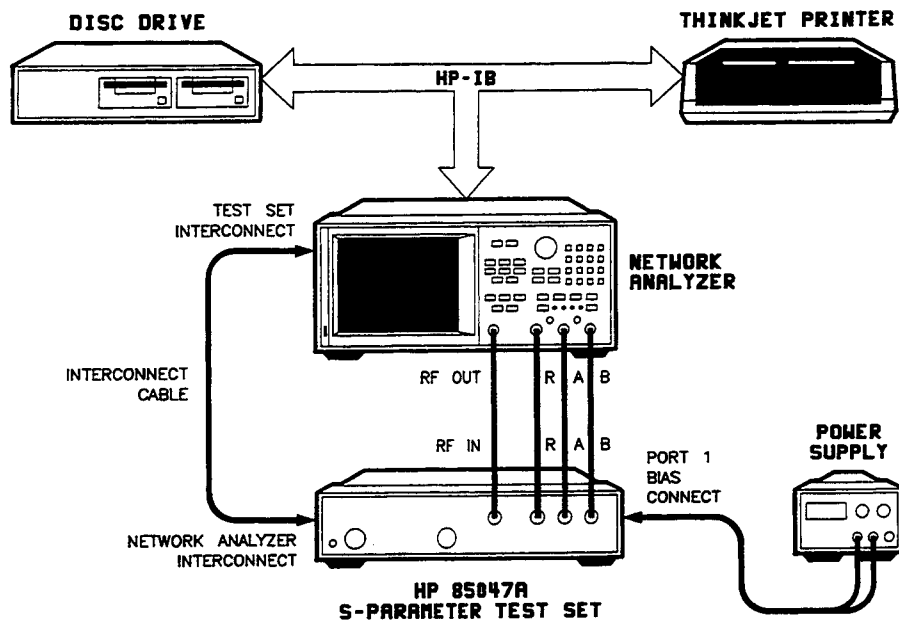


Figure 8. Performance Tests Setup

## EQUIPMENT

| Item                                      | HP Model or Part Number (P/N)      |
|---|------------------------------------|
| Network analyzer                          | HP 8753B/C Option 006 <sup>1</sup> |
| HP-IB cables (2 required)                 | HP 10833A/B/D                      |
| Disc drive                                | HP 9122C/D                         |
| ThinkJet printer                          | HP 2225A                           |
| Power supply                              | HP 6218C                           |
| 7 mm calibration kit                      | HP 85031B                          |
| BNC cable                                 | HP P/N 8120-1839                   |
| Adapter, BNC to banana plug               | HP P/N 1251-2277                   |
| RF cables (4 required)                    | HP P/N 8120-4782 <sup>2</sup>      |
| Test set interconnect cable               | HP P/N 08503-60051 <sup>2</sup>    |
| HP 85047A performance tests software disc | HP P/N 85047-10001 <sup>2</sup>    |

1. HP 8702A/B users must use the manual procedure that follows the *Performance Test Record*.
2. Included with the HP 85047A.

# Directivity, Directivity with DC Bias, and Source Match Semi-Automated Performance Tests

## DESCRIPTION

Directivity is a measure of the ability of a directional device to discriminate between incident and reflected signals. It is the residual signal present at the coupled port with the test port terminated in a perfect 50 ohm load. In this test, the return loss of a standard termination is measured relative to the frequency response of the coupler. Since the reflection coefficient of the termination is much smaller than the directivity term, the measurement made is equivalent to the directivity of the coupler.

The HP 85047A is specified to meet its RF specifications when biased at up to 200 mA DC. The directivity with DC bias tests the directivity performance of the test set under 100 mA conditions. This procedure is a partial calibration since HP does not manufacture a load rated to 200 mA with the required return loss ( $\geq 40$  dB, 300 kHz to 6 GHz). If such a load is available, this test can be performed under the full 200 mA bias. Note that most problems with directivity under DC bias will manifest themselves at 100 mA, as well as at 200 mA, so this test should be sufficient for detecting most failures.

Source match of each test port is determined by examining the calibration coefficient array for the source match error term. These arrays are generated during measurement calibration. The arrays are the difference between the measured known calibration standards and ideal modeled data. The calibration coefficient arrays are a direct indication of uncorrected performance because they represent the systematic errors of the test set.

This procedure tests directivity, directivity with DC bias, and source match in that order. Both ports are measured in two frequency ranges (300 kHz to 3 GHz and 3 MHz to 6 GHz).



**READ THIS PROCEDURE BEFORE ATTEMPTING TO PERFORM IT. Do not leave the 100mA bias turned on any longer than required to perform the test or damage may occur to the load. Know where to turn on and off the bias before using this procedure.**

## PROCEDURE

### Setup

**NOTE:** These performance tests utilize registers 1 and 2 of the analyzer to store calibrations. It will write over any previously stored data. If you wish to save the previously stored data, transfer it to other registers or disc. Refer to the analyzer manual for instructions.

1. Connect the equipment as shown in Figure 8. Set the disk drive HP-IB address to 0 and the printer address to 1. Allow 30 minutes for warm-up.
2. Insert the performance tests disk into disk drive 0. (To change the disk drive number, press **[LOCAL] [DISK UNIT NUMBER]**, the number, and **[x1]**.)
3. On the analyzer, press **[PRESET] [LOCAL] [SYSTEM CONTROLLER]**.

To access the test sequences, press **[SYSTEM] [SEQUENCING MENU] [LOAD SEQ FROM DISC] [READ SEQ FILE TTLS]**.

To load the sequences, press **[LOAD SEQ SETUP] [LOAD SEQ PERFSEQ] [LOAD SEQ SWITCH]**.

4. Press **[SYSTEM] [SEQUENCING MENU] [DO SEQUENCE] [SEQUENCE 1 SETUP]**.

The analyzer will set up an instrument state for each frequency band. The low frequency band is stored in register 1; the high frequency (doubled) band is stored in register 2. During this procedure, the CRT displays this message:

DDING SEQ SETUP , PRESS LOCAL TO ABORT SEQUENCE

When the message disappears, the sequence is complete.

## **S11 and S22 Calibrations**

**NOTE:** When the analyzer beeps and the softkey is underlined, the calibration standard has been measured.

### **S11 High Frequency Calibration**

5. Press **[CAL] [CALIBRATE MENU] [S11 1-PORT]** to begin a one port S11 calibration for the high frequency band.

Use the contents of the HP 85031B calibration kit for the next 3 steps.

6. Connect the open to port 1, press **[OPEN]** to measure it and then remove it.
7. Connect the short to port 1, press **[SHORT]** to measure it and then remove it.
8. Connect a load (termination) to port 1, and press **[LOAD]** to measure it. Do not remove the load.
9. Press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **C o r** will appear on the CRT.

### **S22 High Frequency Calibration**

10. Press **[CAL] [CALIBRATE MENU] [S22 1-PORT]** to begin a one port S22 calibration for the high frequency band.
11. Repeat steps 6 through 8 for port 2 using the remaining load from the calibration kit.
12. When the measurement is complete, press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **C o r** will appear on the CRT. Press **[RE-SAVE REG 2]**. Do not remove the load from port 2.

### **S11 Low Frequency Calibration**

13. Press **[PRESET] [RECALL] [RECALL REG 1] [CAL] [CALIBRATE MENU] [S11 1-PORT]** to begin a one port S11 calibration for the low frequency band.
14. Repeat steps 6 through 8 for port 1 using the same load that was connected to that port.
15. Press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **C o r** will appear on the CRT. Do not remove the load from port 1.

## S22 Low Frequency Calibration

16. Press **[CAL]** **[CALIBRATE MENU]** **[S22 1-PORT]** to begin a one port S22 calibration for the low frequency band.
17. Repeat steps 6 through 8 for port 2 using the same load that was connected to that port.
18. When the measurement is complete, press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, press **[RE-SAVE REG 1]**. Do not remove the load from port 2.

Calibration is complete. Loads should be connected to both ports.

## Measurements



When prompted, turn on DC bias only for the minimum time required to perform the test. Applying DC bias for extended periods of time may damage the loads.

### Port 1 (S11) Low Frequency Test

19. Press **[MEAS]** **[REFL:FWDS11(A/R)]** **[SYSTEM]** **[SEQUENCING MENU]** **[DO SEQUENCE]** **[SEQUENCE 2 PERFSEQ]**, to test low frequency directivity, directivity with DC bias, and source match for port 1.

After directivity has been measured, the program will pause and display PASS or FAIL on the CRT. Test data will automatically print. Note that two specifications cover the low frequency band. Use the marker function to locate the worst case point for each specification. (Press **[MKR]** and rotate the analyzer knob to move the marker.) Record these results on the *Performance Test Record*. When printing is complete, continue.

Press **[SYSTEM]** **[CONTINUE SEQUENCE]** to resume measurements.

At the prompt, turn on DC bias to 100mA (5V). IMMEDIATELY press **[CONTINUE SEQUENCE]** to resume testing.

Wait for the analyzer to take a single trace. At the prompt and beep, IMMEDIATELY turn off DC bias.

Then press **[CONTINUE SEQUENCE]**. The test data will be printed. Use the marker function to locate the worst case points for both specifications in the low frequency band and record them on the *Performance Test Record*.

Press **[SYSTEM]** **[CONTINUE SEQUENCE]** to measure the source match. Record results as before.

### Port 1 (S11) High Frequency Test

20. To test high frequency directivity, directivity with DC bias, and source match for port 1, press **[RECALL]** **[RECALL REG 2]** **[MEAS]** **[REFL:FWDS11(A/R)]** **[SYSTEM]** **[SEQUENCING MENU]** **[DO SEQUENCE]** **[SEQUENCE 2 PERFSEQ]** and follow the prompts as in the previous step.

### Port 2 (S22) Low Frequency Test

21. To test low frequency directivity, directivity with DC bias, and source match for port 2, press **[PRESET]** **[RECALL]** **[RECALL REG 1]** **[SYSTEM]** **[SEQUENCING MENU]** **[DO SEQUENCE]** **[SEQUENCE 2 PERFSEQ]** and follow the prompts as above.

## Port 2 (S22) High Frequency Test

22. To test high frequency directivity, directivity with DC bias, and source match for port 2, press **[RECALL] [RECALL REG 2] [SYSTEM] [SEQUENCING MENU] [DO SEQUENCE] [SEQUENCE 2 PERFSEQ]** and follow the prompts as above.

## IF THE INSTRUMENT FAILS THESE TESTS

Refer to the *Directivity Check* in the *Service* section for troubleshooting.

# Test Port Switch Repeatability Semi-Automated Performance Test

## DESCRIPTION

The test port switch is toggled ten times and the initial trace is compared to the resultant trace in two frequency ranges (3 kHz to 3 GHz and 3 MHz to 6 GHz) for both test ports.

1. Verify that the equipment is set up as shown in Figure 8. The power supply is not used for this test.

Connect a short (not load) to port 1. There should be no connection to port 2.

2. Set the sweep type. Press **[PRESET] [MENU] [SWEEP TYPE MENU] [LOG FREQ]**.

3. Run the sequence. Press **[SYSTEM] [SEQUENCING MENU] [DO SEQUENCE] [SEQUENCE 3 SWITCH]**.

After completion of the measurement, PASS or FAIL is displayed on the CRT. Test data is automatically printed. Use the marker search function to locate the maximum and minimum values. Press **[MKR] [MKR FCTN] [MKR SEARCH]**. Set the search to **[MAX]** and then **[MIN]**. Record these values on the *Performance Test Record*.

4. Press **[SYSTEM] [CONTINUE SEQUENCE]** to resume testing.

The program immediately prompts you to remove the short from port 1 and connect it to port 2. Then press **[CONTINUE SEQUENCE]** to resume testing.

When the program pauses again, the low band switch repeatability test is complete. Record results using the marker search, as before. Test data is printed.

5. To test high band switch repeatability, remove the short from port 2 and connect it to port 1.

Press **[PRESET] [FREQ RANGE 6 GHZ] [SEQUENCE 3 SWITCH]**. The analyzer begins measurements. Follow the prompts, as in steps 3 and 4, and record measurement results for both ports.

This completes the switch repeatability test.

## IF THE INSTRUMENT FAILS THIS TEST

Refer to *RF Switching Components Check* in *Service* for troubleshooting.

Table 4. HP 85047A Performance Test Record

| <b>HP 85047A</b><br>Date _____ Tested By _____<br>Temperature _____ Humidity _____<br>Serial Number _____ |                                       |                          |                       |                       |
|---|---------------------------------------|--------------------------|-----------------------|-----------------------|
| <b>Low Range</b>  |                                       |                          |                       |                       |
| Frequency   | Specification                         | Measurement Uncertainty  | Results               |                       |
| 300 kHz to 1.3 GHz<br>1.3 GHz to 3 GHz  | <b>Directivity</b>                    | ± 1.31 dB<br>± 0.71 dB   | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 35 dB<br>≥ 30 dB                    |                          |                       |                       |
| 300 kHz to 1.3 GHz<br>1.3 GHz to 3 GHz  | <b>Directivity with DC Bias</b>       | ± 1.31 dB<br>± 0.71 dB   | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 35 dB<br>≥ 30 dB                    |                          |                       |                       |
| 300 kHz to 1.3 GHz<br>1.3 GHz to 3 GHz  | <b>Source Match</b>                   | ± 0.50 dB<br>± 0.31 dB   | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 20 dB<br>≥ 16 dB                    |                          |                       |                       |
| <b>High Range</b>   |                                       |                          |                       |                       |
| Frequency   | Specification                         | Measurement Uncertainty  | Results               |                       |
| 3 GHz to 6 GHz  | <b>Directivity</b>                    | ± 0.80 dB                | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 25 dB                               |                          |                       |                       |
| 3 GHz to 6 GHz  | <b>Directivity with DC Bias</b>       | ± 0.80 dB                | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 25 dB                               |                          |                       |                       |
| 3 GHz to 6 GHz  | <b>Source Match</b>                   | ± 0.45 dB                | <b>Port 1</b>         | <b>Port 2</b>         |
|   | ≥ 14 dB                               |                          |                       |                       |
| <b>High Range/Low Range</b>   |                                       |                          |                       |                       |
| Frequency   | Specification                         | Measurement Uncertainty  | Results               |                       |
| 300 kHz to 3 GHz<br>3 GHz to 6 GHz  | <b>Test Port Switch Repeatability</b> | ± 0.006 dB<br>± 0.006 dB | <b>Port 1 Max-Min</b> | <b>Port 2 Max-Min</b> |
|   | ± 0.03 dB<br>± 0.03 dB                |                          | -                     | -                     |
|   |                                       |                          |                       |                       |

# Manual Performance Tests

## INTRODUCTION

Use these procedures **ONLY** if test sequencing is not available on your analyzer. These procedures manually duplicate the semi-automated tests provided in this section. Read the semi-automated tests before performing these manual tests. The semi-automated tests provide a description of the tests, an illustration of the test equipment setup, the equipment required, the *Performance Test Record* and instructions for recording results, and troubleshooting in case the instrument fails the test.

## Directivity, Directivity with DC Bias, and Source Match

### PROCEDURE

#### Setup

**NOTE:** These performance tests utilize registers 1 and 2 of the analyzer to store calibrations. It will write over any previously stored data. If you wish to save the previously stored data, transfer it to other registers or disc. Refer to the analyzer manual for instructions.

1. Connect the equipment as shown in Figure 8. Set the printer HP-IB address to 1 and turn it on. The disc drive is not required for these manual tests.

Turn on the analyzer and press **[PRESET] [LOCAL] [SYSTEM CONTROLLER]**. Allow 30 minutes for warm-up.

2. Set up the analyzer in the doubled band.

Press **[SYSTEM] [FREQ RANGE 6 GHZ] [MENU] [NUMBER OF POINTS] [2] [0] [1] [X1]**.

Press **[AVG] [IF BW] [1] [0] [0] [X1] [MENU] [SWEEP TIME] [0] [X1]**, then **[SAVE] [SAVE REG 2]**.

3. Set up the analyzer for the low frequency band.

Press **[SYSTEM] [FREQ RANGE 3 GHZ] [MENU] [SWEEP TYPE MENU] [LOG FREQ]**.

Press **[RETURN] [NUMBER OF POINTS] [2] [0] [1] [X1] [POWER] [1] [5] [X1]**.

Press **[SAVE] [SAVE REG 1]**.

#### S11 And S22 Calibrations

**NOTE:** When the analyzer beeps and the softkey is underlined, the calibration standard has been measured.



## **S11 High Frequency Calibration**

4. Press **[RECALL] [RECALL REG 2] [CAL] [CALIBRATE MENU] [S11 1-PORT]**.

Use the contents of the HP 85031B calibration kit for the next 3 steps.

5. Connect the open to port 1, press **[OPEN]** to measure it and then remove it.
6. Connect the short to port 1, press **[SHORT]** to measure it and then remove it.
7. Connect a load (termination) to port 1, and press **[LOAD]** to measure it. Do NOT remove the load.
8. Press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **Cor** will appear on the CRT.

## **S22 High Frequency Calibration**

9. Press **[CAL] [CALIBRATE MENU] [S22 1-PORT]** to begin a one port S22 calibration for the high frequency band.
10. Repeat steps 5 through 7 for port 2 using the remaining load from the calibration kit.
11. When the measurement is complete, press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **Cor** will appear on the CRT. Press **[RE-SAVE REG 2]**. Do not remove the load from port 2.

## **S11 Low Frequency Calibration**

12. Press **[PRESET] [RECALL] [RECALL REG 1] [CAL] [CALIBRATE MENU] [S11 1-PORT]** to begin a one port S11 calibration for the low frequency band.
13. Repeat steps 5 through 7 for port 1 using the same load that was connected to that port.
14. Press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, **Cor** will appear on the CRT. Do NOT remove the load from port 1.

## **S22 Low Frequency Calibration**

15. Press **[CAL] [CALIBRATE MENU] [S22 1-PORT]** to begin a one port S22 calibration for the low frequency band.
16. Repeat steps 5 through 7 for port 2 using the same load that was connected to that port.
17. When the measurement is complete, press **[DONE 1-PORT CAL]**. When the analyzer has computed the calibration coefficients, press **[RE-SAVE REG 1]**. Do NOT remove the load from port 2.

Calibration is complete. Loads should be connected to both ports.

## Measurements

18. Run system test 34 and take a single data trace.

Press [SYSTEM] [SERVICE MENU] [TESTS] [3] [4] [X1] [EXECUTE TEST].

Press [MEAS] [REFL:FWD S11 (A/R)] [MENU] [TRIGGER MENU] [SINGLE] [SCALE REF] [5] [X1] [REFERENCE VALUE] [-] [2] [5] [.] [5] [X1] [REFERENCE POSITION] [8] [X1].

Press [CAL] [CORRECTION OFF].

19. Set up directivity limit lines.

Press [SYSTEM] [LIMIT MENU] [EDIT LIMIT LINE].

Press [ADD] [STIMULUS VALUE] [3] [0] [0] [k/m] [UPPER LIMIT] [-] [3] [5] [X1] [LOWER LIMIT] [-] [2] [0] [0] [X1] [DONE].

Press [LIMIT TYPE] [FLAT LINE] [RETURN].

Press [ADD] [STIMULUS VALUE] [1] [.] [3] [G/n] [UPPER LIMIT] [-] [3] [0] [X1] [DONE].

Press [ADD] [STIMULUS VALUE] [3] [G/n] [UPPER LIMIT] [-] [2] [5] [X1] [DONE].

### Port 1 Low Frequency Directivity Test

20. Press [DISPLAY] [DATA/MEMORY] [SYSTEM] [LIMIT MENU] [LIMIT LINE ON] [LIMIT TEST ON].

Press [MKR FCTN] [MKR SEARCH] [SEARCH MAX].

21. Title and print the data.

Press [DISPLAY] [MORE] [TITLE]. Select letters to generate the following title: "DIRECTIVITY". Press [DONE].

Press [COPY] [PRINT].

On the *Performance Test Record*, record the worst case (maximum value) in dB for the appropriate frequency ranges. Use the marker, as needed, to locate these values. Press [MKR] [MKR SEARCH] [SEARCH OFF] and use the analyzer knob move the marker. Note that when measuring the high frequency range, record only the worst case value between 3 GHz to 6 GHz even though the range and limits between 3 MHz to 6 GHz are visible.

22. Press [SYSTEM] [LIMIT MENU] [LIMIT TEST OFF].

### Port 1 Low Frequency Bias Test



**When prompted, turn on DC bias only for the minimum time required to perform the test. Applying DC bias for extended periods of time may damage the loads.**

23. Press [MENU] [TRIGGER MENU]. Turn on the DC bias to 100 mA (5V). IMMEDIATELY press [SINGLE].

Turn OFF the bias as soon as the sweep ends.

24. Press **[MKR FCTN] [MKR SEARCH] [SEARCH MAX] [SYSTEM] [LIMIT MENU] [LIMIT TEST ON]**.

25. Title and print the data.

Press **[DISPLAY] [MORE] [TITLE]**. Select letters to create the following title: DIRECTIVITY WITH 100 MA BIAS. Press **[DONE]**.

Press **[COPY] [PRINT]**.

On the *Performance Test Record*, record the worst case (maximum value) in dB for the appropriate frequency ranges. Use the marker, as needed, to locate these values.

## Port 1 Low Frequency Source Match Test

26. Press **[SYSTEM] [LIMIT MENU] [LIMIT TEST OFF] [CAL] [CORRECTION ON] [SCALE REF] [REFERENCE VALUE] [-] [1] [0] [.] [5] [X1]** to set up the analyzer.

27. Change the limit lines.

Press **[SYSTEM] [LIMIT MENU] [EDIT LIMIT LINE] [SEGMENT] [1] [X1] [EDIT] [UPPER LIMIT] [-] [2] [0] [X1] [DONE]**.

Press **[SEGMENT] [2] [X1] [EDIT] [UPPER LIMIT] [-] [1] [6] [X1] [DONE]**.

Press **[SEGMENT] [3] [X1] [EDIT] [UPPER LIMIT] [-] [1] [4] [X1] [DONE]**.

28. Press **[SYSTEM] [SERVICE MENU] [TESTS] [3] [3] [X1] [EXECUTE TEST]** to perform the measurement.

Turn on the marker search. Press **[MKR FCTN] [MKR SEARCH] [SEARCH MAX]**.

Press **[SYSTEM] [LIMIT MENU] [LIMIT TEST ON]**.

29. Title and print the data.

Press **[DISPLAY] [MORE] [TITLE]**. Select letters to create the following title: SOURCE MATCH. Press **[DONE]**.

Press **[COPY] [PRINT]**.

Record the worst case (maximum value) in dB for the appropriate frequency ranges. Use the marker to locate these values, as needed.

## Port 1 High Frequency Tests

30. Press **[RECALL] [RECALL REG 2]** and repeat steps 18 through 29.

## Port 2 Low Frequency Tests

31. Press **[PRESET] [RECALL] [RECALL REG 1]** and repeat steps 18 through 29 with the following change:

In step 18, eliminate these keystrokes: **[MEAS] [REFL:FWD S11 (A/R)]**.

## Port 2 High Frequency Tests

32. Press **[RECALL] [RECALL REG 2]** and repeat steps 18 through 29 with the following change:

In step 18, eliminate these keystrokes: **[MEAS] [REFL:FWD S11 (A/R)]**.

## TEST PORT SWITCH REPEATABILITY

1. Verify that the equipment is set up as shown in Figure 8. The power supply and disc drive are not required for this test.

### Port 1 Low Frequency Switch Repeatability Test

2. Connect a SHORT (not load) to port 1. There should be no connection to port 2.  
Set up the sweep type for a low frequency band sweep. Press **[PRESET] [MENU] [SWEEP TYPE MENU] [LOG FREQ]**.
3. Set up the analyzer.  
Press **[AVG] [IF BW] [1] [0] [X1] [MENU] [POWER] [2] [0] [X1]**  
Press **[MENU] [TRIGGER MENU] [SINGLE]** and wait for 1 sweep.  
Press **[DISPLAY] [DATA→MEMORY] [DATA/MEM] [SCALE REF] [SCALE/DIV] [.] [0] [1] [X1] [REFERENCE VALUE] [.] [0] [0] [1] [X1]**.
4. Set the limit lines.  
Press **[SYSTEM] [LIMIT MENU] [EDIT LIMIT LINE]**.  
Press **[ADD] [STIMULUS VALUE] [3] [0] [0] [k/m] [UPPER LIMIT] [.] [0] [3] [X1] [LOWER LIMIT] [-] [.] [0] [3] [X1] [DONE]**.  
Press **[LIMIT TYPE] [FLAT LINE] [RETURN]**.  
Press **[ADD] [STIMULUS VALUE] [6] [G/n] [DONE]**.  
Press **[LIMIT TYPE] [SINGLE POINT] [RETURN] [DONE]**.
5. Set a continuous sweep.  
Press **[MENU] [TRIGGER MENU] [CONTINUOUS] [MEAS]**
6. Now toggle the transfer switch 10 times: press **[REFL:REV S22 (B/R)]**. Listen for the switch and look for the LED to change before pressing each next key. Then press **[REFL:FWD S11 (A/R)]** (1 toggle). Again, press **[REFL:REV S22 (B/R)]** and **[REFL:FWD S11 (A/R)]**, (2nd toggle). Continue these keystrokes until the switch is toggled 10 times.
7. Press **[MENU] [TRIGGER MENU] [SINGLE]** and wait for 1 sweep.  
Turn on the marker search. Press **[MKR FCTN] [MKR SEARCH] [TRACKING ON] [SEARCH MAX]**.  
Press **[SYSTEM] [LIMIT MENU] [LIMIT LINE ON] [LIMIT TEST ON]**.
8. Title and print the data.  
Press **[DISPLAY] [MORE] [TITLE]** and select letters to create the following title: "S11 SWITCH REPEATABILITY". Press **[DONE]**.  
Press **[COPY] [PRINT]**.  
Record the maximum value, indicated by the marker, on the *Performance Test Record*. Locate and record the minimum value using the marker to minimum search. Press **[MKR FCTN] [MKR SEARCH] [SEARCH MIN]**.  
Press **[SYSTEM] [LIMIT MENU] [LIMIT TEST OFF]**.

## Port 2 Low Frequency Switch Repeatability Test

9. Press **[MEAS] [REFL:REV S22 (B/R)]**. Disconnect the short from port 1 and connect it to port 2.
10. Press **[MENU] [TRIGGER MENU] [SINGLE]** and wait for 1 sweep. Press **[DISPLAY] [DATA→MEMORY] [DATA|MEM]**.  
  
Press **[MENU] [TRIGGER MENU] [CONTINUOUS] [MEAS]**.
11. Toggle the transfer switch 10 times as done in step 6. This time press **[REFL:FWD S11 (A/R)]**, then **[REFL:REV S22 (A/R)]** (1 toggle). Repeat for 10 toggles, ending on **[REFL:REV S22 (A/R)]**.  
  
Press **[MENU] [TRIGGER MENU] [SINGLE]** and wait for 1 sweep.  
  
Press **[MKR FCTN] [MKR SEARCH] [SEARCH MAX]**.  
  
Press **[SYSTEM] [LIMIT MENU] [LIMIT TEST ON]**.
12. Press **[DISPLAY] [MORE] [TITLE]** and select letters to create the following title: "S22 SWITCH REPEATABILITY". Press **[DONE]**. Press **[COPY] [PRINT]**.
13. Record the marker value as before. Use the marker search to minimum to locate the minimum value and record it.

## Port 1 and 2 High Frequency Switch Repeatability Test

14. Remove the short from port 2 and reconnect it to port 1.  
  
Press **[PRESET] [FREQ RANGE 6 GHZ]**. Repeat steps 3 through 13 but do not press **[PRESET]** again.



# Adjustments

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The HP 85047A S-parameter test set has no adjustable components.





## SECTION CONTENTS

- 1 Rebuilt (Exchange) Assemblies
- 1 How to Use the Parts List
  - Parts Lists and Figures**
- 2 Figure 9. Cables and Major Assemblies
- 3 Figure 10. Front Panel Assembly Components
- 4 Figure 11. Switch Control Board Assembly Components
- 6 Figure 12. Miscellaneous Parts (front view)
- 7 Figure 13. Miscellaneous Parts (top view from rear)
- 8 Figure 14. Miscellaneous Parts (bottom view)
- 9 Figure 15. Chassis Parts (exploded diagram)
- 10 Figure 16. Related Items
- 10 Table 5. Manufacturers Codes and Locations

Use the information in this section to order parts. *Rebuilt (Exchange) Assemblies* describes the associated ordering process. *How to Use the Parts List* explains the bulk of this section. Here's where to find:

- Major components: see Figures 9 and 15
- Circuit board assembly components: see Figures 10 and 11
- Attaching hardware and miscellaneous parts: see Figures 12, 13, 14

## REBUILT (EXCHANGE) ASSEMBLIES

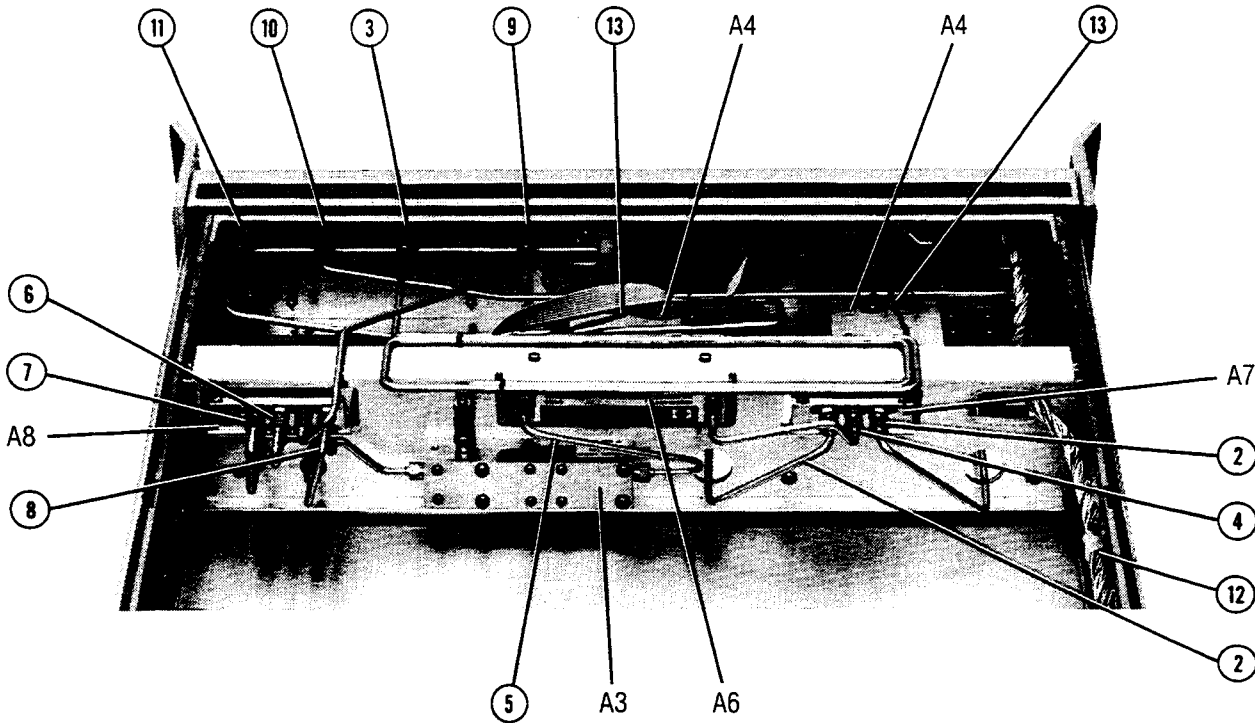
The directional coupler assemblies for channel R and test ports 1 and 2 are replaceable on an exchange basis at a considerable cost saving. The test port assembly includes the RF and DC bias connectors, and is the same assembly for ports 1 and 2. The couplers are listed in Figure 9.

Defective assemblies must be returned for credit to realize the cost savings. Thus, assemblies required for spare parts stock must be ordered by the new assembly part number.

## HOW TO USE THE PARTS LISTS

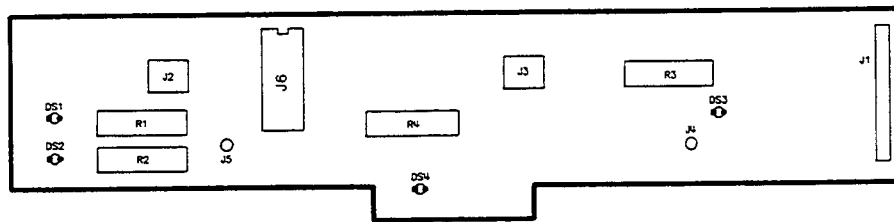
The parts list is a group of figures: illustrations with accompanying lists of replaceable parts. Each list is arranged in alpha-numerical order by reference designator. Parts list terms are:

- Reference Designation: keys the part listed to the illustration.
- HP Part Number: HP's part number (may differ from manufacturer's).
- CD (check digit): serves as an error check, use when ordering a part.
- Qty (quantity): part quantity in the accompanying illustration.
- Description: a brief description of the part, may be used for ordering.
- Mfr Code (manufacturer code): a unique number assigned to each manufacturer, (identified in Table 5).
- Mfr Part Number: may or may not be the same as the HP part number. OBD stands for "order by description".



| Reference Designation | HP Part Number | C D | Qty | Description                              | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|--|----------|-----------------|
| A1                    | SEE FIG 11     |     |     | SWITCH CONTROL BOARD ASSEMBLY            |          |                 |
| A2                    | SEE FIG 10     |     |     | FRONT PANEL ASSEMBLY                     |          |                 |
| A3                    | 5086-7488      | 9   | 1   | COUPLER, CHANNEL R (NEW)                 | 28480    | 5086-7488       |
|                       | 5086-6488      | 7   |     | COUPLER, CHANNEL R (REBUILT)             | 28480    | 5086-6488       |
| A4                    | 5086-7489      | 0   | 2   | COUPLER, TEST PORT (NEW)                 | 28480    | 5086-7489       |
|                       | 5086-6489      | 8   |     | COUPLER, TEST PORT (REBUILT)             | 28480    | 5086-6489       |
| A5                    | 5086-7490      | 3   | 1   | DOUBLER (SEE FIG 14 FOR LOCATION)        | 28480    | 5086-7490       |
| 1                     | 85047-00005    | 4   | 1   | DECK (SEE FIG 14 FOR LOCATION)           | 28480    | 85047-00005     |
| 2                     | 85047-20011    | 4   | 2   | TRANSFER SW-COUPLER A & B RF CABLE       | 28480    | 85047-20011     |
| 3                     | 85047-20012    | 5   | 1   | INPUT R-COUPLER RF CABLE                 | 28480    | 85047-20012     |
| 4                     | 85047-20013    | 6   | 1   | ATTENUATOR-TRANSFER SWITCH RF CABLE      | 28480    | 85047-20013     |
| 5                     | 85047-20014    | 7   | 1   | R COUPLER-ATTENUATOR RF CABLE            | 28480    | 85047-20014     |
| 6                     | 85047-20015    | 8   | 1   | INPUT R RF CABLE                         | 28480    | 85047-20015     |
| 7                     | 85047-20016    | 9   | 1   | DOUBLER-DOUBLER SWITCH RF CABLE          | 28480    | 85047-20016     |
| 8                     | 85047-20017    | 0   | 1   | DOUBLER-DOUBLER SWITCH RF CABLE          | 28480    | 85047-20017     |
| 9                     | 85047-20018    | 1   | 1   | RF IN-DOUBLER SWITCH RF CABLE            | 28480    | 85047-20018     |
| 10                    | 85047-20019    | 2   | 1   | INPUT A-COUPLER RF CABLE                 | 28480    | 85047-20019     |
| 11                    | 85047-20020    | 5   | 1   | INPUT B-COUPLER RF CABLE                 | 28480    | 85047-20020     |
| 12                    | 85047-60006    | 1   | 1   | REAR PANEL-FRONT PANEL RIBBON CABLE ASSY | 28480    | 85047-60006     |
| 13                    | 85047-60004    | 9   | 1   | TRANSFER & DOUBLER SW-SW CONTROL ASSY    | 28480    | 85047-60004     |
| A6                    | 85046-60006    | 0   | 1   | ATTENUATOR, 70 DB                        | 28480    | 85046-60006     |
| A7                    | 5081-8178      | 6   | 1   | TRANSFER SWITCH, DC TO 18 GHZ MECH (NEW) | 28480    | 5081-8178       |
|                       | 5086-7539      | 1   |     | SOLID-STATE TRANSFER SW. (NEW)           | 28480    | 5086-7539       |
|                       | 5086-6539      | 9   |     | SOLID STATE TRANSFER SW. (REBUILT)       | 28480    | 5086-6539       |
| A8                    | 5180-8449      | 4   | 1   | DOUBLER SWITCH                           | 28480    | 5180-8449       |

Figure 9. Cables and Major Assemblies



| Reference Designation | HP Part Number | C D | Qty | Description               | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|---------------------------|----------|-----------------|
| A2                    | 85047-60008    | 3   | 1   | FRONT PANEL ASSEMBLY      | 28480    | 085047-60008    |
| DS1-4                 | 1990-0858      | 8   | 4   | LED, YELLOW, 150 UCD      | 28480    | 1990-0858       |
| J1                    | 1252-0635      | 3   | 1   | CONNECTOR, 20 POST        | 28480    | 1252-0635       |
| J2, 3                 | 1251-6793      | 4   | 2   | SOCKET, 3 PIN             | 01380    | 3-102202-4      |
| J4, 5                 | 1251-0600      | 0   | 2   | CONNECTOR SINGLE POST     | 01136    | 928-196-004140  |
| J6                    | 1200-0508      | 0   | 1   | SOCKET, 14 PIN, DIP       | 02194    | 0002812         |
| MP1                   |                |     |     | NOT USED                  |          |                 |
| MP2                   | 5040-8858      | 3   | 1   | LED STANDOFF STRIP        | 28480    | 5040-8858       |
| R1-4                  | 0698-3408      | 7   | 4   | RESISTOR, 2.15K, 1%, 0.5W | 28480    | 0698-3408       |

Figure 10. Front Panel Assembly Components

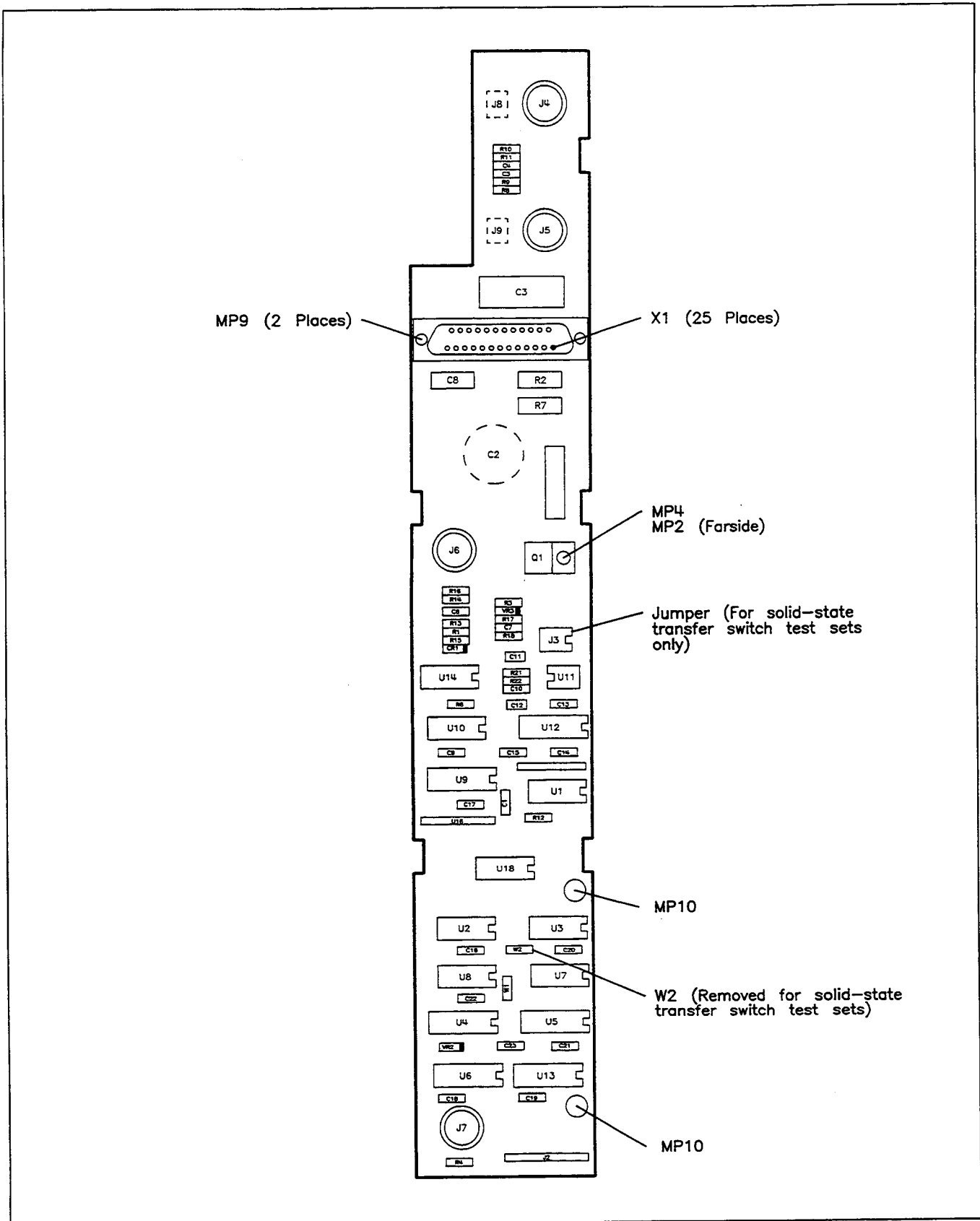
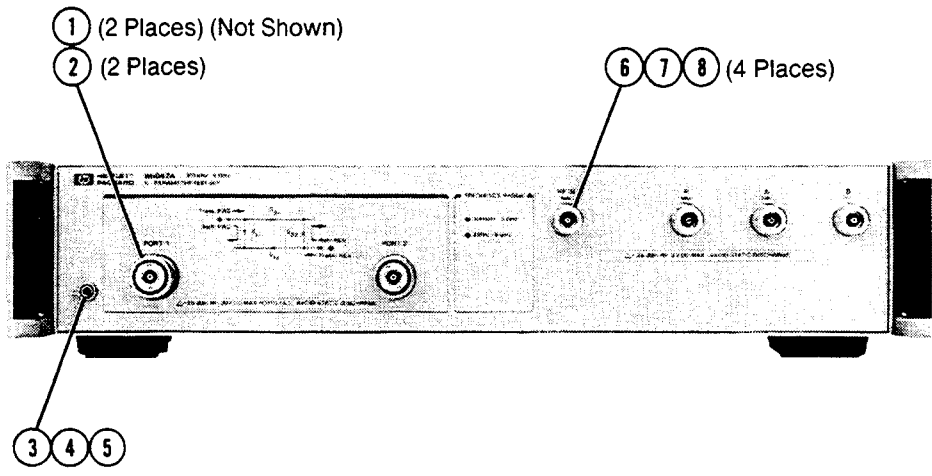


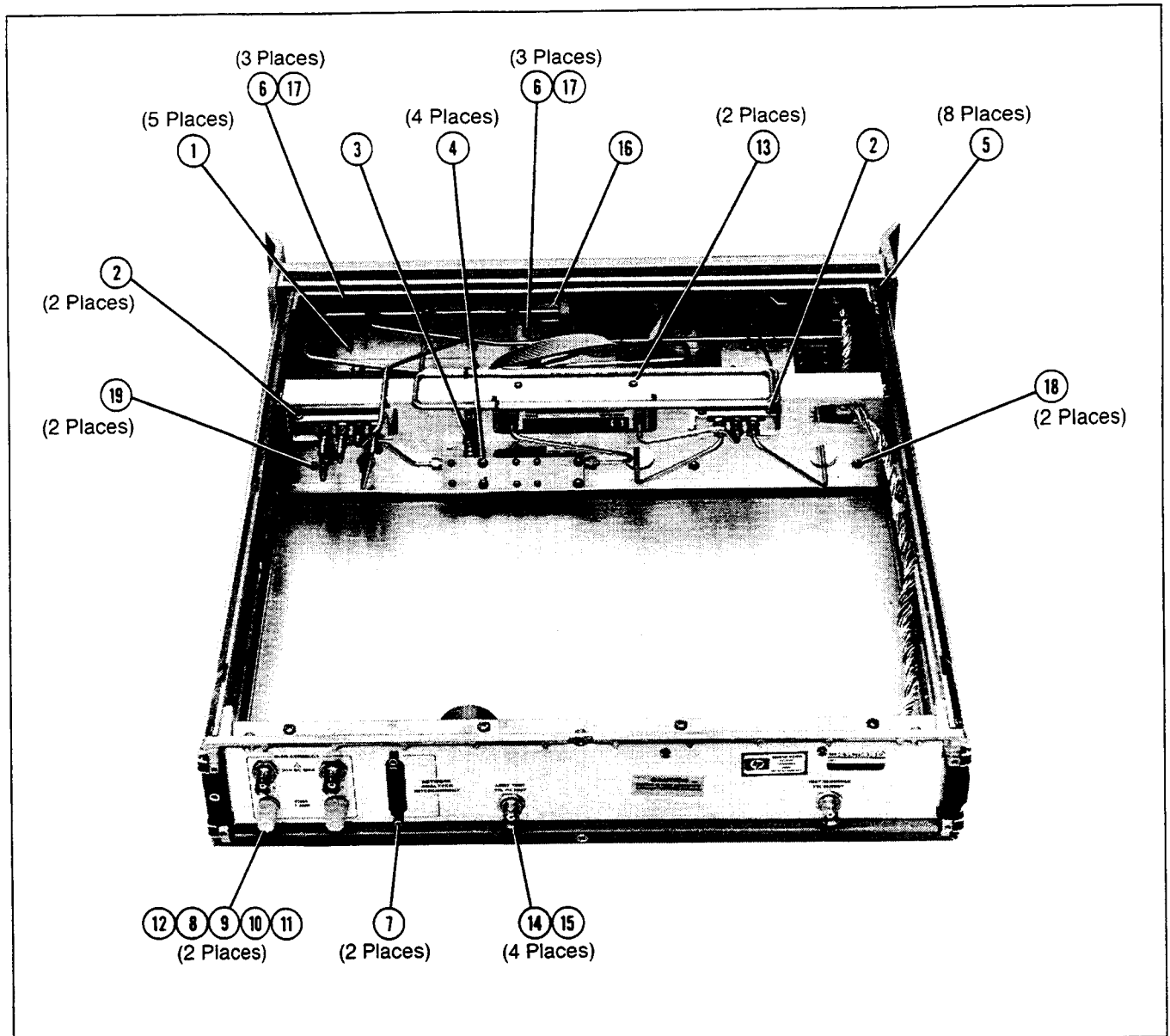
Figure 11. Switch Control Board Assembly Components (1 of 2)

| Reference Designation | HP Part Number | C D | Qty | Description   | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|---|----------|-----------------|
| A1*                   | 85047-60014    | 1   | 1   | SWITCH CONTROL BOARD ASSEMBLY   | 28480    | 85047-60014     |
| C1                    | 0160-4535      | 4   | 1   | CAPACITOR, CERAMIC, 1U, 50V   | 00901    | C330C105KSRKCA  |
| C2*                   | 0180-3374      | 9   | 1   | CAPACITOR, AL, 4700µ, 35V   | 28480    | 0180-3374       |
| C3                    | 0180-2215      | 5   | 1   | CAPACITOR, ALUMINUM, 170U, 15V  | 00493    | 15T171U10X20M   |
| C4, 5                 | 0160-4833      | 5   | 2   | CAPACITOR, CERAMIC, .022U, 100V                                       | 00901    | C124C223K1R5CA  |
| C6, 7                 | 0160-4832      | 4   | 2   | CAPACITOR, CERAMIC, .01U, 100V  | 00901    | C124C103K1X5CA  |
| C8                    | 0180-0116      | 1   | 1   | CAPACITOR, TANTALUM, 6.8U, 35V  | 00901    | T110B685K035AS  |
| C9                    | 0160-4835      | 7   | 1   | CAPACITOR, CERAMIC, 0.1U, 50V   | 28480    | 0160-4835       |
| C10                   | 0160-4832      | 4   | 1   | CAPACITOR, CERAMIC, .01U, 100V  | 00901    | C124C103K1X5CA  |
| C11                   | 0160-4831      | 3   | 1   | CAPACITOR, CERAMIC, 4700P, 100V                                       | 00901    | C114C472K1X5CA  |
| C12                   | 0160-4574      | 1   | 1   | CAPACITOR, CERAMIC, 1000P, 100V                                       | 00901    | C114K102K1R5CA  |
| C13                   | 0160-4535      | 4   | 1   | CAPACITOR, CERAMIC, 1U, 50V   | 00901    | C330C105KSR5CA  |
| C14-23                | 0160-4832      | 4   | 10  | CAPACITOR, CERAMIC, .01U, 100V  | 00901    | C124C103K1X5CA  |
| CR1                   | 1901-0050      | 3   | 1   | SW 80V .2A D7   | 28480    | 1901-0050       |
| J1                    | 1251-2416      | 0   | 1   | CONNECTOR, SERIES D, 25 F   | 04486    | DBU-24S-FO      |
| J2                    | 1251-8600      | 6   | 1   | CONNECTOR, PST  | 28480    | 1251-8600       |
| J3                    | 1200-0796      | 8   | 1   | SOCKET, IC, 8 CONTACT   | 01380    | 640463-1        |
| J4-7                  | 1250-1163      | 0   | 4   | CONNECTOR, RF, BNC F  | 03316    | 28JR175-1       |
| J8, 9                 | 1251-6793      | 4   | 2   | CONNECTOR, HDR, 3   | 01380    | 3-102202-4      |
| MP1                   |                |     |     | NOT USED  |          |                 |
| MP2                   | 0590-1445      | 0   | 1   | INSERT, M3.0x1.5  | 03981    | KF2-M3-ET       |
| MP3                   |                |     |     | NOT USED  |          |                 |
| MP4                   | 0515-0430      | 3   | 1   | MACHINE SCREW, M3.0ST16   | 00000    | OBD             |
| MP5                   |                |     |     | NOT USED  |          |                 |
| MP6                   |                |     |     | NOT USED  |          |                 |
| MP7                   |                |     |     | NOT USED  |          |                 |
| MP8                   |                |     |     | NOT USED  |          |                 |
| MP9                   | 0380-1162      | 3   | 2   | STANDOFF, .350 LONG, 440  | 28480    | 0380-1162       |
| MP10                  | 0380-1880      | 2   | 2   | STANDOFF, 10 MM LONG, M3.0  | 28480    | 0380-1880       |
| Q1                    | 1853-0479      | 7   | 1   | TRANSISTOR, 2N6668  | 28480    | 1853-0479       |
| Q2                    | 1853-0271      | 7   | 1   | TRANSISTOR, 2N4403  | 02037    | 2N4403          |
| R1                    | 0757-0279      | 0   | 1   | RESISTOR, 3.16K, 1 .12W   | 00746    | CRB14           |
| R2                    | 0698-3634      | 1   | 1   | RESISTOR, 470 OHM, 52W  | 02499    | GS-3            |
| R3, 4                 | 0698-3440      | 7   | 2   | RESISTOR, 196 OHM, 1 .12W   | 00746    | OBD             |
| R5                    |                |     |     | NOT USED  |          |                 |
| R6                    | 0757-0465      | 6   | 1   | RESISTOR, 100K, 1.12W   | 00746    | OBD             |
| R7*                   | 0764-0033      | 9   | 1   | RESISTOR, 33 OHM, 5%, 2W  | 28480    | 0764-0033       |
| R8                    | 0757-0394      | 0   | 1   | RESISTOR, 51.1 OHM, 1 .12W  | 00746    | OBD             |
| R9                    | 0698-8827      | 4   | 1   | RESISTOR, 1M, 1.12W   | 00746    | OBD             |
| R10                   | 0757-0394      | 0   | 1   | RESISTOR, 51.1 OHM, 1 .12W  | 00746    | OBD             |
| R11                   | 0698-8827      | 4   | 1   | RESISTOR, 1M, 1.12W   | 00746    | OBD             |
| R12                   | 0698-3453      | 2   | 1   | 196K, 1.12W   | 00746    | OBD             |
| R13                   | 0698-3157      | 3   | 1   | RESISTOR, 19.6K, 15, .12W   | 00746    | OBD             |
| R14                   | 0757-0404      | 3   | 1   | RESISTOR, 100 OHM, 1 .12W   | 00746    | OBD             |
| R15                   | 0757-0462      | 3   | 1   | RESISTOR, 75K, 1.12W  | 01074    | OBD             |
| R16                   | 0698-0085      | 0   | 1   | RESISTOR, 2.61K, 1.12W  | 00746    | OBD             |
| R17                   | 0757-0442      | 9   | 1   | RESISTOR, 10K, 1.12W  | 00746    | OBD             |
| R18                   | 0757-0401      | 0   | 1   | RESISTOR, 100 OHM, 1 .12W   | 00746    | OBD             |
| R19                   | 0757-1078      | 9   | 1   | RESISTOR, 1.47K, 1.5W   | 01074    | OBD             |
| R20                   |                |     |     | NOT USED  |          |                 |
| R21, 22               | 0757-0442      | 9   | 2   | RESISTOR, 10K, 1 .12W   | 00746    | OBD             |
| U1-2                  | 1820-2922      | 0   | 2   | IC, 74HC00, P4NAND  | 02037    | OBD             |
| U3                    | 1820-2921      | 9   | 1   | IC, 74HC04, P6INV   | 28480    | 1820-2921       |
| U4, 5                 | 1820-3146      | 2   | 2   | IC, 74HC175, P4FF-D   | 02037    | OBD             |
| U6                    | 1858-0069      | 1   | 1   | X-AR-5 NPN-18DIP  | 02634    | ULN-2803A       |
| U7, 8                 | 1820-6564      | 4   | 2   | IC, 74HC7266, EXNOR   | 02037    | MC74HC7266N     |
| U9                    | 1820-3373      | 7   | 1   | IC74HC221, P2MVR  | 28480    | 1820-3373       |
| U10                   | 1820-3081      | 4   | 1   | IC, 74HC74, P2FF-D  | 02037    | OBD             |
| U11                   | 1826-0180      | 0   | 1   | IC, 555, P1 TIMER   | 28480    | 1826-0180       |
| U12                   | 1820-4149      | 7   | 1   | IC, 74NC166P, RGTR  | 28480    | 1820-4149       |
| U13                   | 1858-0069      | 1   | 1   | X-AR-5 NPN-18DIP  | 02634    | ULN-2803A       |
| U14                   | 1826-0138      | 8   | 1   | IC, 339, P4COMP   | 28480    | 1826-0138       |
| U15-17                | 1810-0206      | 8   | 3   | RESISTOR PACK, 10K, 8 PINS  | 02499    | OBD             |
| U18                   | 1820-3184      | 8   | 1   | IC, 74HC11, P3AND   | 02037    | OBD             |
| VR1-3                 | 1902-0041      | 4   | 3   | ZENER DIODE, 5.11V, 5 0.4W  | 02037    | SZ30016-1098    |
| W1                    |                |     |     | NOT USED  |          |                 |
| W2*                   |                |     |     | NOT USED  |          |                 |
| W3                    | 1258-0124      | 7   | 1   | JUMPER, J3P1 TO J3P8  | 28480    | 1258-0124       |
| X1-25                 | 1251-3153      | 4   | 25  | CONTACT, SERIES 25 CONNECTOR  | 00000    | OBD             |
|                       |                |     |     | *FOR INSTRUMENTS WITH MECHANICAL TRANSFER SWITCH, USE THE PARTS BELOW |          |                 |
| A1                    | 85047-60007    | 2   | 1   | SWITCH CONTROL BOARD ASSEMBLY   | 28480    | 85047-60007     |
| C2                    | 0180-3759      | 4   | 1   | CAPACITOR, ALUMINUM, 10000U, 35V                                      | 04200    | 80D103P03SMC2   |
| R7                    | 0764-0013      | 5   | 1   | RESISTOR, 56 OHM, 5 2W  | 02499    | OBD             |
| W2                    | 8159-0005      | 0   | 1   | JUMPER  | 28480    | 8159-0005       |



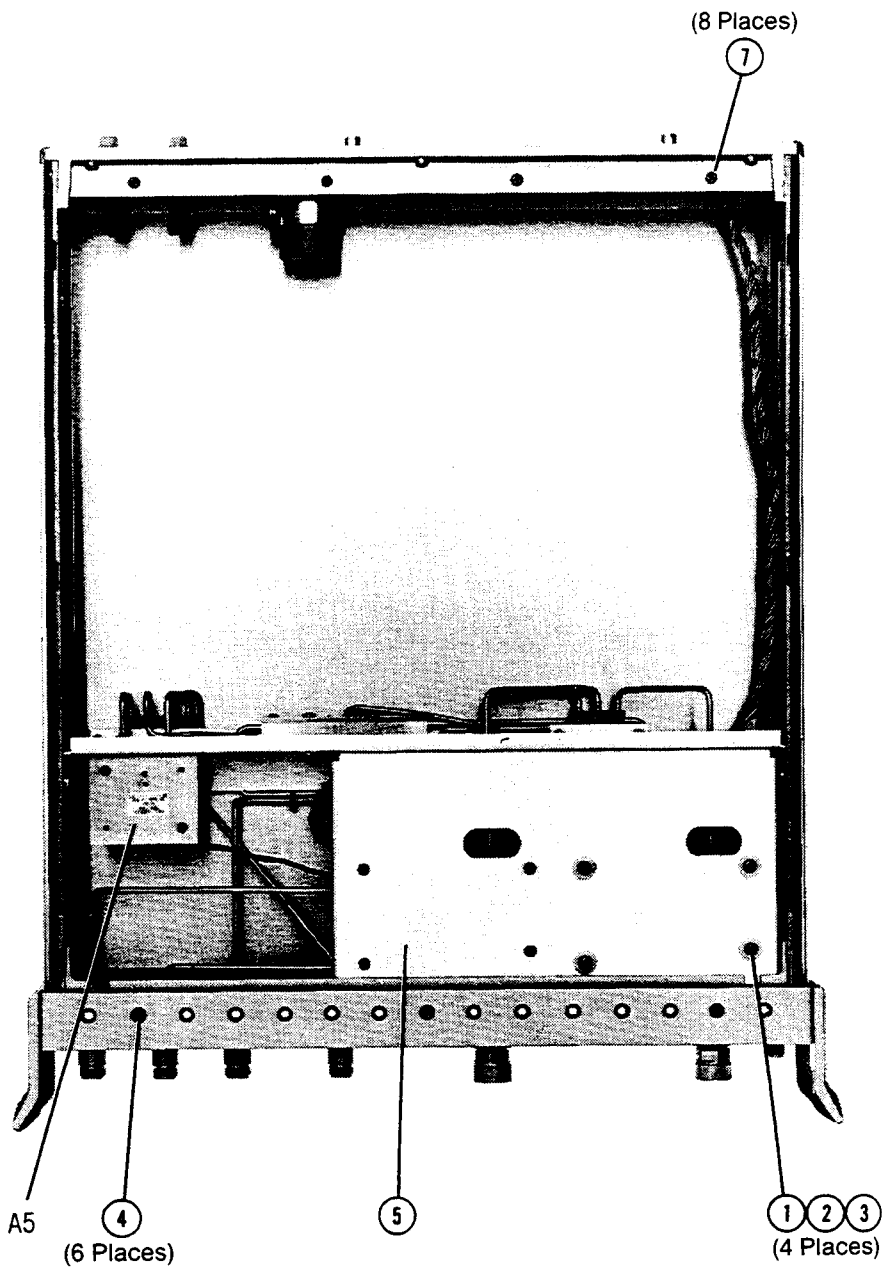
| Reference Designation  | HP Part Number | C<br>D | Qty | Description                                | Mfr Code | Mfr Part Number |
|--|----------------|--------|-----|--|----------|-----------------|
| 1  | 1401-0123      | 1      | 2   | 7 mm CONNECTOR CAP                         | 28480    | 1401-0123       |
| 2  |                |        | 2   | 7 mm CONNECTOR (PART OF COUPLER, SEE NOTE) |          |                 |
| 3  | 1510-0038      | 8      | 1   | BINDER POST ASSEMBLY                       | 28480    | 1510-0038       |
| 4  | 2950-0006      | 3      | 1   | HEX NUT 1/4x32                             | 04604    | 9000            |
| 5  | 2190-0067      | 4      | 1   | LOCK WASHER 0.256ID                        | 04805    | 1914-05         |
| 6  | 5061-5386      | 0      | 4   | TYPE-N (FEMALE) CONNECTOR                  | 28480    | 5061-5386       |
| 7  | 2950-0132      | 6      | 4   | HEX NUT 7/16x28                            | 04604    | 76500NP         |
| 8  | 2190-0104      | 0      | 4   | LOCK WASHER 0.439ID                        | 04805    | 1922-04         |
| <p><b>NOTE:</b> THE COLLET OF THE 7 mm CONNECTOR CENTER CONDUCTOR IS REPLACEABLE WITH A COLLET EXTRACTION TOOL. FOR THE PART NUMBER OF THE COLLET AND THE TOOL, SEE FIGURE 16.</p> |                |        |     |  |          |                 |

Figure 12. Miscellaneous Parts (front view)



| Reference Designation | HP Part Number | C<br>D | Qty | Description                          | Mfr Code | Mfr Part Number |
|-----------------------|----------------|--------|-----|--------------------------------------|----------|-----------------|
| 1                     | 0510-1148      | 2      | 5   | RETAINER CLIP 0.140ID                | 28480    | 0510-1148       |
| 2                     | 0515-1112      | 0      | 4   | MACHINE SCREW 3.0x20                 | 00000    | OBD             |
| 3                     | 0955-0208      | 5      | 1   | 4DB COAXIAL ATTENUATOR               | 28480    | 0955-0208       |
| 4                     | 0515-1233      | 6      | 4   | MACHINE SCREW 3.5x25                 | 00000    | OBD             |
| 5                     | 0515-1331      | 5      | 8   | MACHINE SCREW 4.0x6                  | 00000    | OBD             |
| 6                     | 0535-0024      | 3      | 6   | HEX NUT M3.5                         | 00000    | OBD             |
| 7                     | 1251-2942      | 7      | 2   | LOCK NUT SUBMINATURE D CONNECTOR     | 04486    | D20418-2        |
| 8                     |                |        |     | FUSEHOLDER 5A 125V (PART OF ITEM 11) |          |                 |
| 9                     | 1400-0112      | 6      | 2   | FUSEHOLDER CAP                       | 28480    | 1400-0112       |
| 10                    | 2110-0047      | 2      | 2   | FUSE 1A 125V N                       | 00000    | OBD             |
| 11                    | 85047-60005    | 0      | 2   | FUSE HARNESS ASSEMBLY                | 28480    | 85047-60005     |
| 12                    |                |        |     | LOCKWASHER 0.3771D (PART OF ITEM 11) |          |                 |
| 13                    | 2200-0105      | 4      | 2   | MACHINE SCREW 440x0.312              | 00000    | OBD             |
| 14                    | 2190-0102      | 8      | 4   | LOCK WASHER 0.3771D                  | 00000    | OBD             |
| 15                    | 2950-0035      | 8      | 4   | HEX NUT 15/32x32                     | 00000    | OBD             |
| 16                    | 85046-00005    | 3      | 1   | MOUNTING BRACKET                     | 28480    | 85046-00005     |
| 17                    | 2190-0645      | 4      | 6   | LOCK WASHER M3.5                     | 00000    | OBD             |
| 18                    | 0515-1232      | 5      | 2   | MACHINE SCREW M3.5x8                 | 00000    | OBD             |
| 19                    | 0515-0886      | 3      | 2   | MACHINE SCREW M3.0x6                 | 00000    | OBD             |

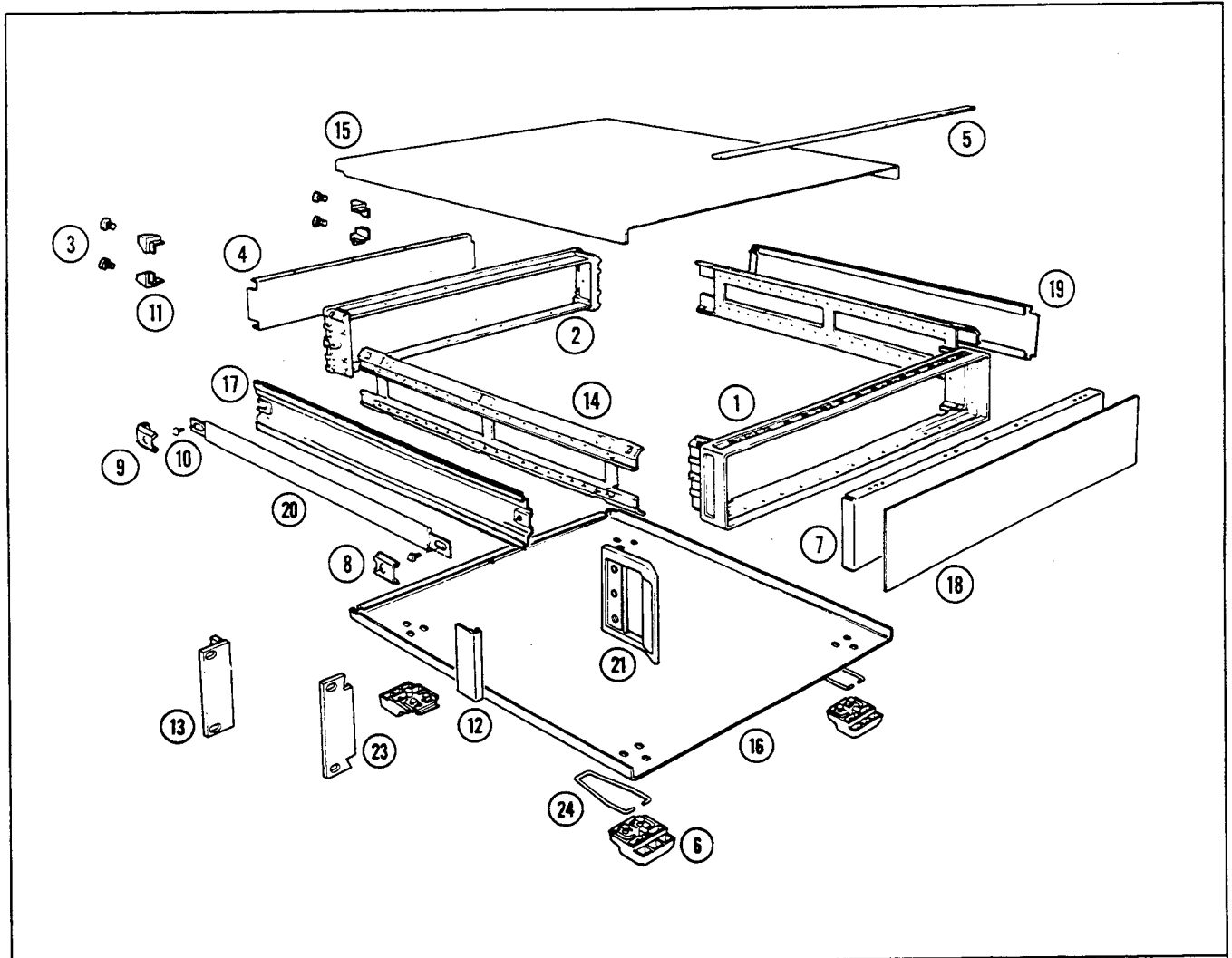
Figure 13. Miscellaneous Parts (top view from rear)



| Reference Designation | HP Part Number | C D | Qty | Description             | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|-------------------------|----------|-----------------|
| 1                     | 85047-20022    | 7   | 4   | SHOULDER WASHER PLASTIC | 28480    | 85047-20022     |
| 2                     | 3050-0892      | 8   | 4   | FLAT WASHER M3.8        | 00000    | OBD             |
| 3                     | 0515-1232      | 5   | 4   | MACHINE SCREW M3.5x8    | 00000    | OBD             |
| 4                     | 0515-1234      | 7   | 6   | MACHINE SCREW M3.5x8    | 00000    | OBD             |
| 5                     | SEE FIG 9      |     |     | DECK                    |          |                 |
| A5                    | SEE FIG 9      |     |     | DOUBLER                 |          |                 |
| 7                     | 0515-1232      | 5   | 8   | MACHINE SCREW M3.5x8    | 00000    | OBD             |

Figure 14. Miscellaneous Parts (bottom view)





| Reference Designation | HP Part Number | C | D | Qty | Description  | Mfr Code | Mfr Part Number |
|-----------------------|----------------|---|---|-----|--|----------|-----------------|
| 1                     | 5021-8401      | 2 |   | 1   | FRONT FRAME  | 28480    | 5021-8401       |
| 2                     | 5021-5802      | 1 |   | 1   | REAR FRAME   | 28480    | 5021-5802       |
| 3                     | 0515-1232      | 5 |   | 4   | MACH SCREW FOR REAR FOOT   | 28480    | 0515-1232       |
| 4                     | 85047-00003    | 2 |   | 1   | REAR PANEL   | 28480    | 85047-00003     |
| 5                     | 5041-8802      | 9 |   | 1   | TOP TRIM STRIP   | 28480    | 5041-8802       |
| 6                     | 5041-8801      | 8 |   | 4   | BOTTOM FOOT  | 28480    | 5041-8801       |
| 7                     | 85047-00002    | 1 |   | 1   | FRONT SUB-PANEL  | 28480    | 85047-00002     |
| 8                     | 5041-8819      | 8 |   | 1   | STRAP HANDLE FRONT CAP   | 28480    | 5041-8819       |
| 9                     | 5041-8820      | 1 |   | 1   | STRAP HANDLE REAR CAP  | 28480    | 5041-8820       |
| 10                    | 0515-1132      | 4 |   | 2   | STRAP HANDLE RETAINER SCREW  | 28480    | 0515-1132       |
| 11                    | 5041-8821      | 2 |   | 4   | REAR FOOT  | 28480    | 5041-8821       |
| 12                    | 5021-8495      | 4 |   | 2   | FRONT HANDLE TRIM  | 28480    | 5021-8495       |
| 13                    | 5062-3976      | 2 |   | 1   | RACK MOUNT KIT FOR USE WITHOUT HANDLES<br>(INCLUDES TRIM AND ATTACHING HARDWARE) | 28480    | 5062-3976       |
| 14                    | 5021-5832      | 7 |   | 2   | SIDE STRUT   | 28480    | 5020-5832       |
| 15                    | 5062-3735      | 1 |   | 1   | TOP COVER  | 28480    | 5062-3735       |
| 16                    | 5062-3747      | 5 |   | 1   | BOTTOM COVER   | 28480    | 5062-3747       |
| 17                    | 5062-3776      | 6 |   | 1   | SIDE COVER (HANDLE SIDE)   | 28480    | 5062-3776       |
| 18                    | 85047-00001    | 0 |   | 1   | FRONT DRESS PANEL  | 28480    | 85047-00001     |
| 19                    | 5062-3752      | 2 |   | 1   | SIDE COVER (W/O HANDLE)  | 28480    | 5062-3752       |
| 20                    | 5062-3704      | 4 |   | 1   | STRAP HANDLE ASSEMBLY  | 28480    | 5062-3704       |
| 21                    | 5062-3798      | 6 |   | 2   | FRONT HANDLE ASSEMBLY  | 28480    | 5062-3798       |
| 22                    | 0515-0896      | 5 |   | 4   | HANDLE MACH SCREWS (NOT SHOWN)   | 28480    | 0515-0896       |
| 23                    | 5062-4069      | 6 |   | 1   | RACK MOUNT KIT FOR USE WITH HANDLES<br>(INCLUDES ATTACHING HARDWARE)             | 28480    | 5062-4069       |
| 24                    | 1460-1345      | 5 |   | 2   | WIRE FOOT STAND<br>NOTE: SEE FIGURE 16 FOR TOUCH-UP PAINT                        | 28480    | 1460-1345       |

Figure 15. Cabinet Parts

| Reference Designation | HP Part Number | C D | Qty | Description                                   | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|---|----------|-----------------|
|                       | 08503-60051    | 7   | 1   | <b>ACCESSORIES SUPPLIED WITH TEST SET</b>     | 28480    | 08503-60051     |
|                       | 8120-4782      | 7   | 4   | INTERCONNECT CABLE                            | 28480    | 8120-4782       |
|                       | 85047-10001    | 1   | 1   | 7.5 INCH RF CABLE                             | 28480    | 85047-10001     |
|                       |                |     |     | PERFORMANCE TEST DISC                         |          |                 |
|                       | 08753-90122    | 8   |     | <b>ACCESSORIES NOT SUPPLIED WITH TEST SET</b> | 28480    | 08753-90113     |
|                       | 08510-90064    | 4   |     | HP 8753B OPERATING AND PROGRAMMING MANUAL     | 28480    | 08510-90064     |
|                       | 5060-0370      | 0   |     | MICROWAVE CONNECTOR CARE MANUAL               | 28480    | 5060-0370       |
|                       | 85050-20001    | 7   |     | COLLET EXTRACTOR TOOL                         | 28480    | 85050-20001     |
|                       |                |     |     | COLLET (FOR 7 mm CONNECTOR)                   |          |                 |
|                       | 6010-1146      | 6   |     | <b>TOUCH-UP PAINT</b>                         | 28480    | 6010-1146       |
|                       |                |     |     | DOVE GRAY PAINT FOR USE ON FRAME AROUND       |          |                 |
|                       | 6010-1147      | 7   |     | FRONT PANEL AND PAINTED PORTION OF HANDLES    | 28480    | 6010-1147       |
|                       |                |     |     | FRENCH GRAY PAINT FOR USE ON SIDE, TOP, AND   |          |                 |
|                       | 6010-1148      | 8   |     | BOTTOM COVERS                                 | 28480    | 6010-1148       |
|                       |                |     |     | PARCHMENT GRAY PAINT FOR USE ON RACK          |          |                 |
|                       |                |     |     | MOUNT FLANGES, RACK SUPPORT FLANGES, AND      |          |                 |
|                       |                |     |     | FRONT PANELS                                  |          |                 |

Figure 16. Related Items

Table 5. Manufacturer Codes and Locations

| Mfr Code | Name                                  | Location               |
|----------|---------------------------------------|------------------------|
| 00000    | ANY SATISFACTORY SUPPLIER             |                        |
| 00493    | UNITED/NIPPON CHEMI-CON INC           | SYRACUSE NY 13200      |
| 00746    | ROHM CORPORATION                      | IRVINE CA 92716        |
| 00901    | KEMET ELEK DIV UNION CARBIDE          | GREENVILLE SC          |
| 01074    | HOLSWORTHY ELECTRONICS LTD            | ENGLAND                |
| 01136    | ELCO INDUSTRIES INC                   | ROCKFORD IL 61101      |
| 01380    | AMP INC                               | HARRISBURG PA 17105    |
| 02037    | MOTOROLA SEMICONDUCTOR PRODUCTS       | PROENIX AZ 85008       |
| 02194    | ROBINSON NUGENT INC                   | FREEMPORT NY 11520     |
| 02499    | TRW INC BOONE DIV                     | BOONE NC 28604         |
| 02634    | SPRAGUE ELECTRIC CO SEMICONDUCTOR DIV | CONCORD NH 03301       |
| 03316    | SPECIALITY CONNECTOR CO INC           | GREENWOOD IN 46227     |
| 03981    | PENN ENGINEERING AND MFG CORP         | DOYLESTOWN PA 18901    |
| 04200    | SPRAGUE ELECTRIC CO                   | NORTH ADAMS MA 01247   |
| 04486    | ITT CANNON ELECTRIC CO                | SANTA ANA CA 92702     |
| 04604    | FEDERAL SCREW PRODUCTS CO             | CHICAGO IL 60618       |
| 04805    | ILLINOIS TOOL WORKS INC               | ELGIN IL 60126         |
| 06691    | HOUSE OF METRICS LTD                  | SPRING VALLEY NY 10977 |
| 28480    | HEWLETT-PACKARD CO CORPORATE HQ       | PALO ALTO CA 94304     |

# Manual Backdating

## INTRODUCTION

This manual applies directly to any HP 85047A with a serial number prefix listed on the title page. Earlier instrument versions (with lower serial prefix numbers) may be slightly different in design or appearance. The purpose of this section is to document these differences.

With the information provided in this section, this manual can be adapted to apply to any earlier instrument version or configuration.

## EARLIER INSTRUMENT VERSIONS

Instruments with serial prefix 2904A use a different switch control board assembly. That assembly is documented on the following pages. Refer to those pages in either of these situations:

- You need to repair the switch control board assembly.
- You need to upgrade the test set to, solid–state transfer switch operation.
- Some early instruments were manufactured with System II cabinet parts. Those instruments had olive green side covers (rather than the current light French gray covers). To determine whether your instrument uses (early) System II or the current System II Plus parts, inspect the front frame:
  - Remove the plastic top trim strip (item 5 of Figure 16B).
  - If a part number is stamped on the frame, the instrument has System II parts; refer to Figure 16B to order cabinet parts.
  - If the word METRIC is stamped on the frame, the instrument has System II Plus parts; refer to Figure 15 to order cabinet parts.

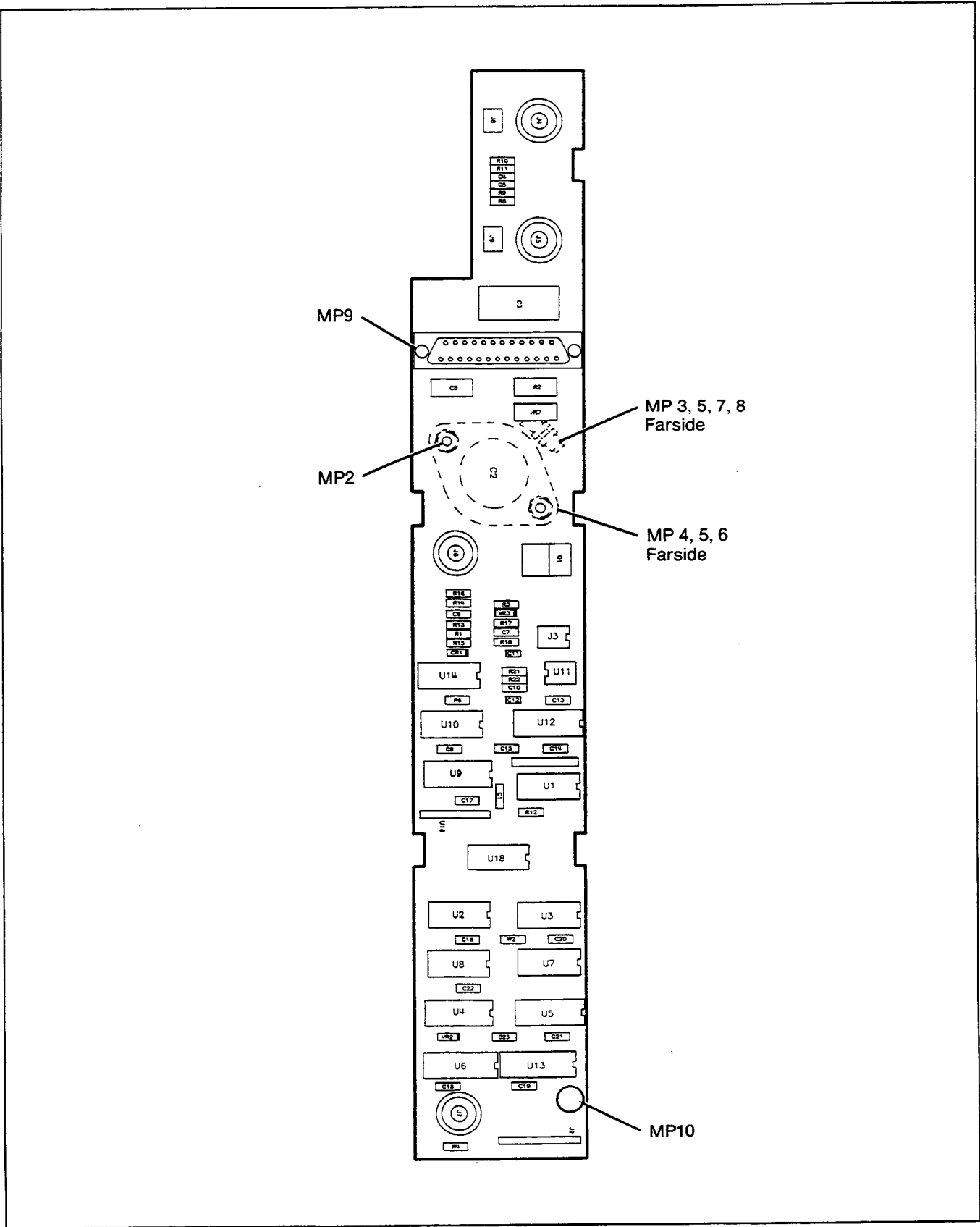
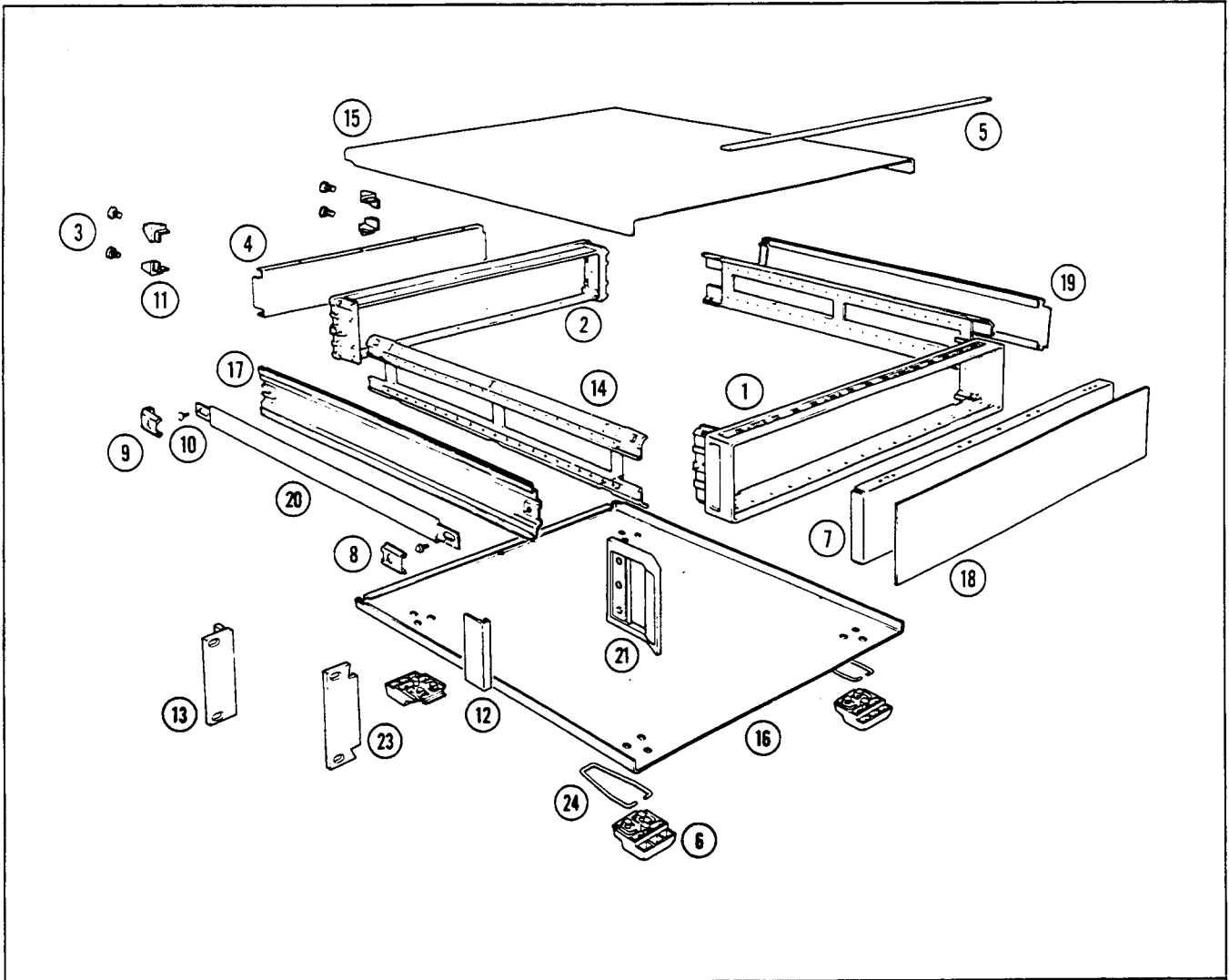


Figure 16A. Switch Control Board Assembly Components (1 of 2)

| Reference Designation | HP Part Number | C D | Qty | Description  | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|-----|--|----------|-----------------|
| 1                     | 85047-60001    | 2   | 1   | SWITCH CONTROL BOARD ASSEMBLY                                      | 28480    | 85047-60001     |
| C1                    | 0160-4535      | 4   | 1   | CAPACITOR, CERAMIC, 1U, 50V  | 00901    | C330C105K5R5CA  |
| C2*                   | 0180-3759      | 4   | 1   | CAPACITOR, ALUMINUM, 10000U, 35V                                   | 04200    | 0180-3759       |
| C3                    | 0180-2215      | 5   | 1   | CAPACITOR, ALUMINUM, 170U, 15V                                     | 00493    | 15T171U10X20M   |
| C4, 5                 | 0160-4833      | 5   | 2   | CAPACITOR, CERAMIC, .022U, 100V                                    | 00901    | C124C223K1R5CA  |
| C6, 7                 | 0160-4832      | 4   | 2   | CAPACITOR, CERAMIC, .01U, 100V                                     | 00901    | C124C103K1X5CA  |
| C8*                   | 0180-0116      | 1   | 1   | CAPACITOR, TANTALUM, 6.8U, 35V                                     | 00901    | T110B685K035AS  |
| C9*, C10              | 0160-4832      | 4   | 1   | CAPACITOR, CERAMIC, .01U, 100V                                     | 00901    | C124C103K1X5CA  |
| C11                   | 0160-4831      | 3   | 1   | CAPACITOR, CERAMIC, 4700P, 100V                                    | 00901    | C114C472K1X5CA  |
| C12                   | 0160-4574      | 1   | 1   | CAPACITOR, CERAMIC, 1000P, 100V                                    | 00901    | C114K102K1R5CA  |
| C13                   | 0160-4535      | 4   | 1   | CAPACITOR, CERAMIC, 1U, 50V  | 00901    | C330C105K5R5CA  |
| C14-23                | 0160-4832      | 4   | 10  | CAPACITOR, CERAMIC, .01U, 100V                                     | 00901    | C124C103K1X5CA  |
| CR1                   | 1901-0050      | 3   | 1   | SW 80V .2A D7  | 28480    | 1901-0050       |
| J1                    | 1251-2416      | 0   | 1   | CONNECTOR, SERIES D, 25 F  | 04486    | DBU-24S-FO      |
| J2                    | 1252-0635      | 3   | 1   | CONNECTOR, PST 20 M 2R   | 28480    | 1252-0635       |
| J3                    | 1200-0796      | 8   | 1   | SOCKET, IC, 8 CONTACT  | 01380    | 640463-1        |
| J4-7                  | 1250-1163      | 0   | 4   | CONNECTOR, R/F, BNC F  | 03316    | 28JR175-1       |
| J8, 9                 | 1251-6793      | 4   | 2   | CONNECTOR, HDR, 3  | 01380    | 3-102202-4      |
| MP1                   |                |     |     | NOT USED   |          |                 |
| MP2                   | 0590-1445      | 0   | 1   | INSERT, M3.0x1.5   | 03981    | KF2-M3-ET       |
| MP3                   | 1210-0013      | 3   | 1   | CLAMP  | 04200    | 4586-97A        |
| MP4                   | 0515-0924      | 0   | 1   | MACHINE SCREW, M3.0  | 00000    | OBD             |
| MP5                   | 2190-0584      | 0   | 1   | LOCK WASHER, M3.0  | 06691    | OBD             |
| MP6                   | 3050-0891      | 7   | 2   | FLAT WASHER, M3.0  | 06691    | OBD             |
| MP7                   | 0515-0911      | 5   | 1   | MACHINE SCREW, M3.0x12   | 00000    | OBD             |
| MP8                   | 0535-0004      | 9   | 1   | HEX NUT, M3.0  | 06691    | OBD             |
| MP9                   | 0380-1162      | 3   | 2   | STANDOFF, .350 LONG, 440   | 28480    | 0380-1162       |
| MP10                  | 0380-1880      | 2   | 2   | STANDOFF, 10 MM LONG, M3.0   | 28480    | 0380-1880       |
| Q1                    | 1853-0479      | 7   | 1   | TRANSISTOR, 2N6668   | 28480    | 1853-0479       |
| Q2                    | 1853-0271      | 7   | 1   | TRANSISTOR, 2N4403   | 02037    | 2N4403          |
| R1                    | 0757-0279      | 0   | 1   | RESISTOR, 3.16K, 1%, .12W  | 00746    | CRB14           |
| R2                    | 0698-3634      | 1   | 1   | RESISTOR, 470 OHM, 5%, 2W  | 02499    | GS-3            |
| R3, 4                 | 0698-3440      | 7   | 2   | RESISTOR, 196 OHM, 1%, .12W  | 00746    | OBD             |
| R5                    |                |     |     | NOT USED   |          |                 |
| R6*                   | 0757-0464      | 5   | 1   | RESISTOR, 90.9K, 1%, .12W  | 00746    | OBD             |
| R7*                   | 0764-0013      | 5   | 1   | RESISTOR, 56 OHM, 5%, 2W   | 02499    | OBD             |
| R8                    | 0757-0394      | 0   | 1   | RESISTOR, 51.1 OHM, 1%, .12W                                       | 00746    | OBD             |
| R9                    | 0698-8827      | 4   | 1   | RESISTOR, 1M, 1%, .12W   | 00746    | OBD             |
| R10                   | 0757-0394      | 0   | 1   | RESISTOR, 51.1 OHM, 1%, .12W                                       | 00746    | OBD             |
| R11                   | 0698-8827      | 4   | 1   | RESISTOR, 1M, 1%, .12W   | 00746    | OBD             |
| R12                   | 0698-3453      | 2   | 1   | 196K, 1%, .12W   | 00746    | OBD             |
| R13                   | 0698-3157      | 3   | 1   | RESISTOR, 19.6K, 15%, .12W   | 00746    | OBD             |
| R14                   | 0757-0404      | 3   | 1   | RESISTOR, 100 OHM, 1%, .12W  | 00746    | OBD             |
| R15                   | 0757-0462      | 3   | 1   | RESISTOR, 75K, 1%, .12W  | 01074    | OBD             |
| R16                   | 0698-0085      | 0   | 1   | RESISTOR, 2.61K, 1%, .12W  | 00746    | OBD             |
| R17                   | 0757-0442      | 9   | 1   | RESISTOR, 10K, 1%, .12W  | 00746    | OBD             |
| R18                   | 0757-0401      | 0   | 1   | RESISTOR, 100 OHM, 1%, .12W  | 00746    | OBD             |
| R19                   | 0757-1078      | 9   | 1   | RESISTOR, 1.47K, 1%, .5W   | 01074    | OBD             |
| R20                   |                |     |     | NOT USED   |          |                 |
| R21, 22               | 0757-0442      | 9   | 2   | RESISTOR, 10K, 1%, .12W  | 00746    | OBD             |
| U1-2                  | 1820-2922      | 0   | 2   | IC, 74HC00, P4NAND   | 02037    | OBD             |
| U3                    | 1820-2921      | 9   | 1   | IC, 74HC04, P6INV  | 28480    | 1820-2921       |
| U4, 5                 | 1820-3146      | 2   | 2   | IC, 74HC175, P4FF-D  | 02037    | OBD             |
| U6                    | 1858-0069      | 1   | 1   | X-AR-5 NPN-18DIP   | 02634    | ULN-2803A       |
| U7*, 8*               | 1820-3192      | 8   | 2   | IC, 74HC7266, P4NOREX  | 28480    | 1820-3192       |
| U9                    | 1820-3373      | 7   | 1   | IC74HC221, P2MVR   | 28480    | 1820-3373       |
| U10                   | 1820-3081      | 4   | 1   | IC, 74HC74, P2FF-D   | 02037    | OBD             |
| U11                   | 1826-0180      | 0   | 1   | IC, 555, P1 TIMER  | 28480    | 1826-0180       |
| U12                   | 1820-4149      | 7   | 1   | IC, 74NC166P, RGTR   | 28480    | 1820-4149       |
| U13                   | 1858-0069      | 1   | 1   | X-AR-5 NPN-18DIP   | 02634    | ULN-2803A       |
| U14                   | 1826-0138      | 8   | 1   | IC, 339, P4COMPT   | 28480    | 1826-0138       |
| U15-17                | 1810-0206      | 8   | 3   | RESISTOR PACK, 10K, 8 PINS   | 02499    | OBD             |
| U18                   | 1820-3184      | 8   | 1   | IC, 74HC11, P3AND  | 02037    | OBD             |
| VR1-3                 | 1902-0041      | 4   | 3   | ZENER DIODE, 5.11V, 5%, 0.4W                                       | 02037    | SZ30016-1098    |
| W1                    |                |     |     | NOT USED   |          |                 |
| W2*                   | 8159-0005      | 0   | 1   | JUMPER   | 28480    | 8159-0005       |
|                       |                |     |     | * FOR SOLID-STATE TRANSFER SWITCH INSTRUMENTS, USE THE PARTS BELOW |          |                 |
| C2                    | 0180-3374      | 9   | 1   | CAPACITOR, AL, 4700U, 35V  | 28480    | 0180-3374       |
| C9                    | 0160-4835      | 7   | 1   | CAPACITOR, CER, 0.14, 50V  | 28480    | 0160-4835       |
| R6                    | 0757-0465      | 6   | 1   | RESISTOR, 100K, 1%, .12W   | 00746    | OBD             |
| R7                    | 0764-0033      | 9   | 1   | RESISTOR, 33 OHM, 5%, 2W   | 28480    | 0764-0033       |
| U7, 8                 | 1820-6564      | 4   | 2   | IC, 74HC7266, EXNOR  | 02037    | MC74HC7266N     |
| W2                    |                |     |     | NOT USED   |          |                 |
| W3                    | 1258-0124      | 7   | 1   | JUMPER, J3P1 TO J3P8   | 28480    | 1258-0124       |

Figure 16A. Switch Control Board Assembly Components (2 of 2)



| Reference Designation | HP Part Number | C | D | Qty | Description  | Mfr Code | Mfr Part Number |
|-----------------------|----------------|---|---|-----|--|----------|-----------------|
| 1                     | 5021-5801      | 0 | 1 | 1   | FRONT FRAME  | 28480    | 5021-5801       |
| 2                     | 5021-5802      | 1 | 1 | 1   | REAR FRAME   | 28480    | 5021-5802       |
| 3                     | 0515-1232      | 5 | 4 | 4   | MACH SCREW FOR REAR FOOT   | 28480    | 0515-1232       |
| 4                     | 85047-00003    | 2 | 1 | 1   | REAR PANEL   | 28480    | 85047-00003     |
| 5                     | 5040-7202      | 9 | 1 | 1   | TOP TRIM STRIP   | 28480    | 5040-7202       |
| 6                     | 5040-7201      | 8 | 4 | 4   | BOTTOM FOOT  | 28480    | 5040-7201       |
| 7                     | 85047-00002    | 1 | 1 | 1   | FRONT SUB-PANEL  | 28480    | 85047-00002     |
| 8                     | 5041-6819      | 4 | 1 | 1   | STRAP HANDLE FRONT CAP   | 28480    | 5041-6819       |
| 9                     | 5041-6820      | 7 | 1 | 1   | STRAP HANDLE REAR CAP  | 28480    | 5041-6820       |
| 10                    | 0515-1132      | 4 | 2 | 2   | STRAP HANDLE RETAINER SCREW  | 28480    | 0515-1132       |
| 11                    | 5040-7221      | 2 | 4 | 4   | REAR FOOT  | 28480    | 5040-7221       |
| 12                    | 5020-8895      | 6 | 2 | 2   | FRONT HANDLE TRIM  | 28480    | 5020-8895       |
| 13                    | 5061-9676      | 9 | 1 | 1   | RACK MOUNT KIT FOR USE WITHOUT HANDLES<br>(INCLUDES TRIM AND ATTACHING HARDWARE) | 28480    | 5061-9676       |
| 14                    | 5021-5832      | 7 | 2 | 2   | SIDE STRUT   | 28480    | 5021-5832       |
| 15                    | 5061-9435      | 8 | 1 | 1   | TOP COVER  | 28480    | 5061-9435       |
| 16                    | 5061-9447      | 2 | 1 | 1   | BOTTOM COVER   | 28480    | 5061-9447       |
| 17                    | 5060-9876      | 9 | 1 | 1   | SIDE COVER (HANDLE SIDE)   | 28480    | 5060-9876       |
| 18                    | 85047-00001    | 0 | 1 | 1   | FRONT DRESS PANEL  | 28480    | 85047-00001     |
| 19                    | 5061-9452      | 9 | 1 | 1   | SIDE COVER (W/O HANDLE)  | 28480    | 5061-9452       |
| 20                    | 5060-9804      | 3 | 1 | 1   | STRAP HANDLE ASSEMBLY  | 28480    | 5060-9804       |
| 21                    | 5061-9498      | 3 | 2 | 2   | FRONT HANDLE ASSEMBLY  | 28480    | 5061-9498       |
| 22                    | 0515-0896      | 5 | 4 | 4   | HANDLE MACH SCREWS (NOT SHOWN)   | 28480    | 0515-0896       |
| 23                    | 5061-9769      | 1 | 1 | 1   | RACK MOUNT KIT FOR USE WITH HANDLES<br>(INCLUDES ATTACHING HARDWARE)             | 28480    | 5061-9769       |
| 24                    | 1460-1345      | 5 | 2 | 2   | WIRE FOOT STAND  | 28480    | 1460-1345       |

Figure 16B. Cabinet Parts

## SECTION CONTENTS

- 1 Overall Troubleshooting Procedure
- 1 Power Supply Voltages Check
- 2 Logic Control Troubleshooting
- 2 RF Troubleshooting
  - 2 RF Switching Components Check
  - 2 Directivity Check
  - 2 RF Power Check
- 3 Switch Control Assembly Troubleshooting
- 3 Theory of Operation

This section contains troubleshooting instructions and figures for the test set. Table 2 lists recommended test equipment.

- Figure 17: test set interconnect connector pins
- Figure 18: RF schematic with power levels at two CW frequencies
- Figure 19: two removable, folded schematics
  - 85047-60007: switch control assembly (for test sets with mechanical transfer switch)
  - 85047-60014: switch control assembly (for test sets with solid-state transfer switch)
- Figure 20: front panel board assembly

## OVERALL TROUBLESHOOTING PROCEDURE

To gain internal access to the test set while it is connected to the analyzer, place the test set on top of the analyzer and make connections to the analyzer with the test set interconnect cable and the RF cable set called out in Table 2.

Begin troubleshooting with the following *Power Supply Voltages Check*. Correct voltages indicate the test set is correctly connected to the analyzer through the interconnect cable and that proper DC power is being supplied by the analyzer.

Follow the *Logic Control Troubleshooting* procedure for switching problems with the step attenuator, transfer switch, or doubler bypass switch, or if the test sequence TTL output is incorrect. If all control signals are correct, proceed to *RF Troubleshooting*.

If other failures occur, or if substandard performance is suspected, refer to the *Directivity Check* in the *RF Troubleshooting* procedure.

## POWER SUPPLY VOLTAGES CHECK

Connect the test set to the analyzer with the test set interconnect cable. Check for the following voltages on the switch control board assembly near the rear panel (see Figure 19). Refer to *Replaceable Parts* for component layout diagrams.

+20 VDC  $\pm$ 5% at C8 (marked +20VF)

+5 VDC  $\pm$ 5% at U3 pin 14

If either voltage is incorrect, check for the following voltage where the supply first enters the assembly:

+22 VDC at J1 pin 14

If the above voltage is correct, troubleshoot the power supply block on the assembly. If the above voltage is not correct, check the interconnect cable and the power supply in the analyzer. Refer to the analyzer manual for assistance.

## LOGIC CONTROL TROUBLESHOOTING

For switching failures of the step attenuator, transfer switch, or doubler bypass switch, also for incorrect test sequence TTL output, refer to *Switch Control Assembly Troubleshooting* to determine if the logic circuitry is delivering the correct signals. If the signals are correct, continue with *RF Troubleshooting*.

## RF TROUBLESHOOTING

### RF Switching Components Check

If the step attenuator fails in the *Operator's Check*, and the control signals are correct, replace the step attenuator.

If the transfer switch is stuck and the control signals are correct, replace the switch. For other problems with the transfer switch, perform the *Test Port Switch Repeatability* performance test. If the test fails, check all internal and external cable connections and repeat the test. If the test still fails, and the control signals are correct, replace the transfer switch.

For doubler problems, verify that control signals are correct, then proceed to the *RF Power Check* to isolate the problem to either the bypass switch or the doubler.

### Directivity Check

If substandard performance is suspected, or if failures occur other than those above, perform the *Directivity* performance test. If the test passes, proceed to the *RF Power Check*. If the directivity test fails, check all cables for loose connections. Clean the test port and open, short, and load connectors. Check for damage to the connectors. Refer to the *Microwave Connector Care* manual (HP part number 08510-90064) for information on connector care and replacement of damaged connector collets. Repeat the directivity test. If the test still fails, replace the test port coupler.

### RF Power Check

Connect the test set to the analyzer with the test set interconnect cable and the 4 RF cables recommended in Table 2. Measure the power levels at outputs R, A, and B, as required, with a power meter and the appropriate power sensor for the frequency range in question. Disconnect the RF cables, one at a time, and connect the power sensor to the test set connector. Refer to Figure 18 for the RF schematic. Two sets of typical power levels are shown with their setups indicated below.



| Power Levels in Parentheses ( ) | Power Levels in Brackets < >   |
|---------------------------------|--------------------------------|
| Doubler Bypassed                | Doubler Engaged                |
| Analyzer Source Power: 0 dBm    | Analyzer Source Power: +20 dBm |
| Analyzer CW Frequency: 1.5 GHz  | Analyzer CW Frequency: 4.5 GHz |

For additional troubleshooting, the switches may be toggled as follows:

Transfer switch: press **[PRESET] [MEAS] [REFL:REV S22 (B/R)]**. Listen for the switch and look for the LED to change. Press **[REFL:FWD S11 (A/R)]** to switch again.

Doubler bypass switch: press **[SYSTEM]** and switch between **[FREQUENCY 6 GHZ]** and **[FREQUENCY 3 GHZ]**.

Attenuator: in S11 measurement mode press **[MENU] [POWER] [ATTENUATOR PORT 1]** (when in S22 measurement mode press **[ATTENUATOR PORT 2]**) and use the step arrow keys or keypad to enter in the desired attenuation.

## Switch Control Assembly Troubleshooting

### Control Signals Check



**Shorting any output of U13 or U6 to its respective +20V supply (pin 10) will damage the IC. Use care when measuring these components.**

Verify the control signals to the step attenuator by checking the voltages at U13. Refer to Figure 19.

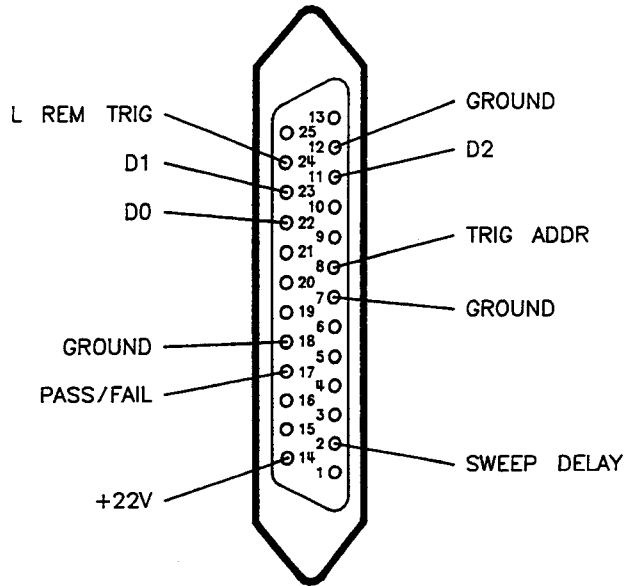
- part number 85047-60007 for test sets with mechanical transfer switch
- part number 85047-60014 for test sets with solid-state transfer switch

Verify the control signals for the doubler bypass switch, transfer switch, and test sequence TTL output by checking the voltages at U6.

If any of the voltages indicated on Figure 19 are incorrect, check the inputs at J1 and use the schematic to troubleshoot as needed. A *Theory of Operation* is provided for assistance.

## THEORY OF OPERATION

The step attenuator, doubler bypass switch, transfer (F/R) switch, and test sequence TTL output are controlled by signals from the analyzer. These control signals are sent to the test set through the test set interconnect cable as shown in Figure 17. The switch control board assembly near the rear panel contains logic circuits to decode the control signals and activate the appropriate drivers to perform the desired command.



**Figure 17. Analyzer Rear Panel Test Set Interconnect Connector Pins**

The control signals consist of a trigger address, 3 data lines (D0 through D2), and an active low trigger signal for latches U4 and U5.

When the trigger address is set high, the data lines control the settings of the attenuator. At the next trigger signal, the data is latched through U5, which activates drivers in U13 to switch the attenuator.

When the trigger address is set low, data lines D0, D1, and D2 affect the doubler bypass switch, the transfer (F/R) switch, and the test sequence TTL output respectively. The test sequence TTL output signal is an extra signal which can be programmed by the user from the test sequencing menus. For application information, refer to the *System Operating and Programming Manual*. On the next trigger signal, the data is latched through U4 to activate drivers in U6 to control the proper switches.

Table 6 summarizes the switching logic.

**Table 6. Switching Logic**

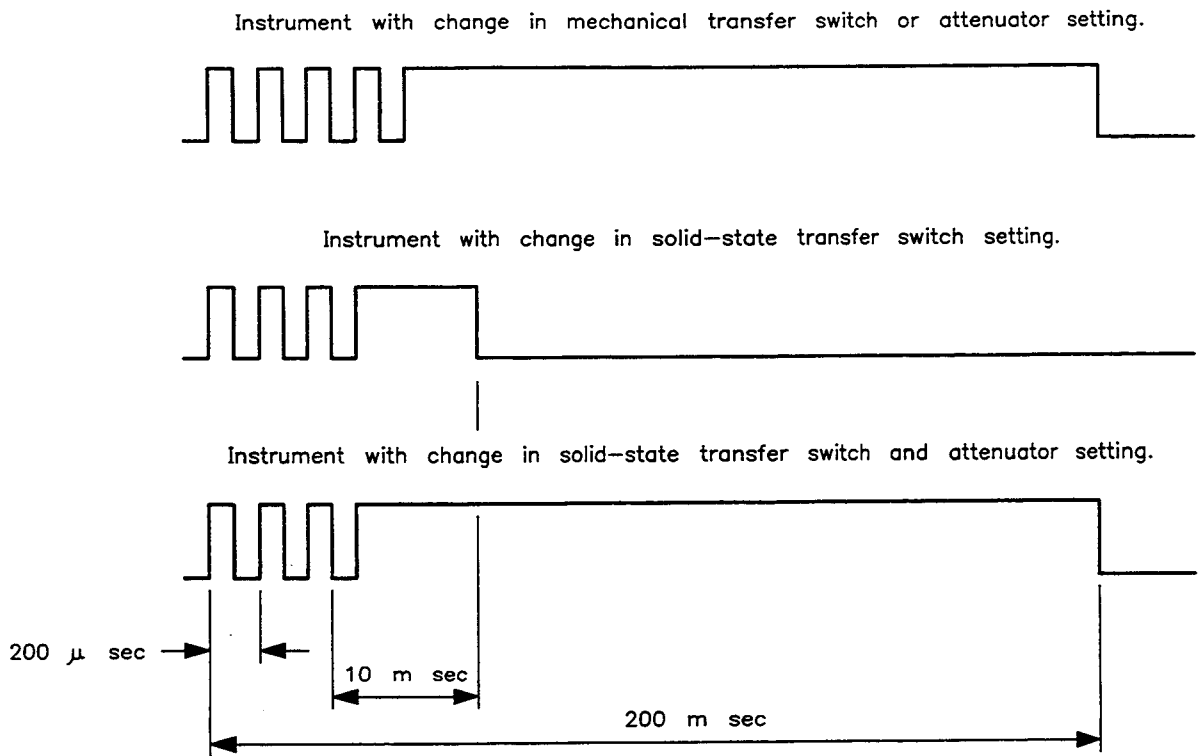
| Signal | J1 Pin | Data | Trigger Address |                            |
|--------|--------|------|-----------------|----------------------------|
|        |        |      | High            | Low                        |
| D0     | 22     | H    | 10 dB disable   | Doubler on                 |
|        |        | L    | 10 dB enable    | Doubler off                |
| D1     | 23     | H    | 20 dB disable   | F/R forward (drive port 1) |
|        |        | L    | 20 dB enable    | F/R reverse (drive port 2) |
| D2     | 11     | H    | 40 dB disable   | TTL output low             |
|        |        | L    | 40 dB enable    | TTL output high            |

The sweep delay line serves two purposes. The first purpose is to identify the test set as an HP 85047A (rather than an HP 85046A). The analyzer counts pulses in the sweep delay signal to identify the test set.

The second purpose is to delay the analyzer sweep whenever a switch has been changed, to allow for switch settling time. This signal is a high pulse which goes low to signal the analyzer to start a sweep.

The pulses are illustrated below.

The power supply is designed so that current will not be provided to the switches until C2 is at least 19 volts. Switching with the voltage too low may lead to a stuck switch failure.



*Figure 17A. Sweep Delay Pulse*

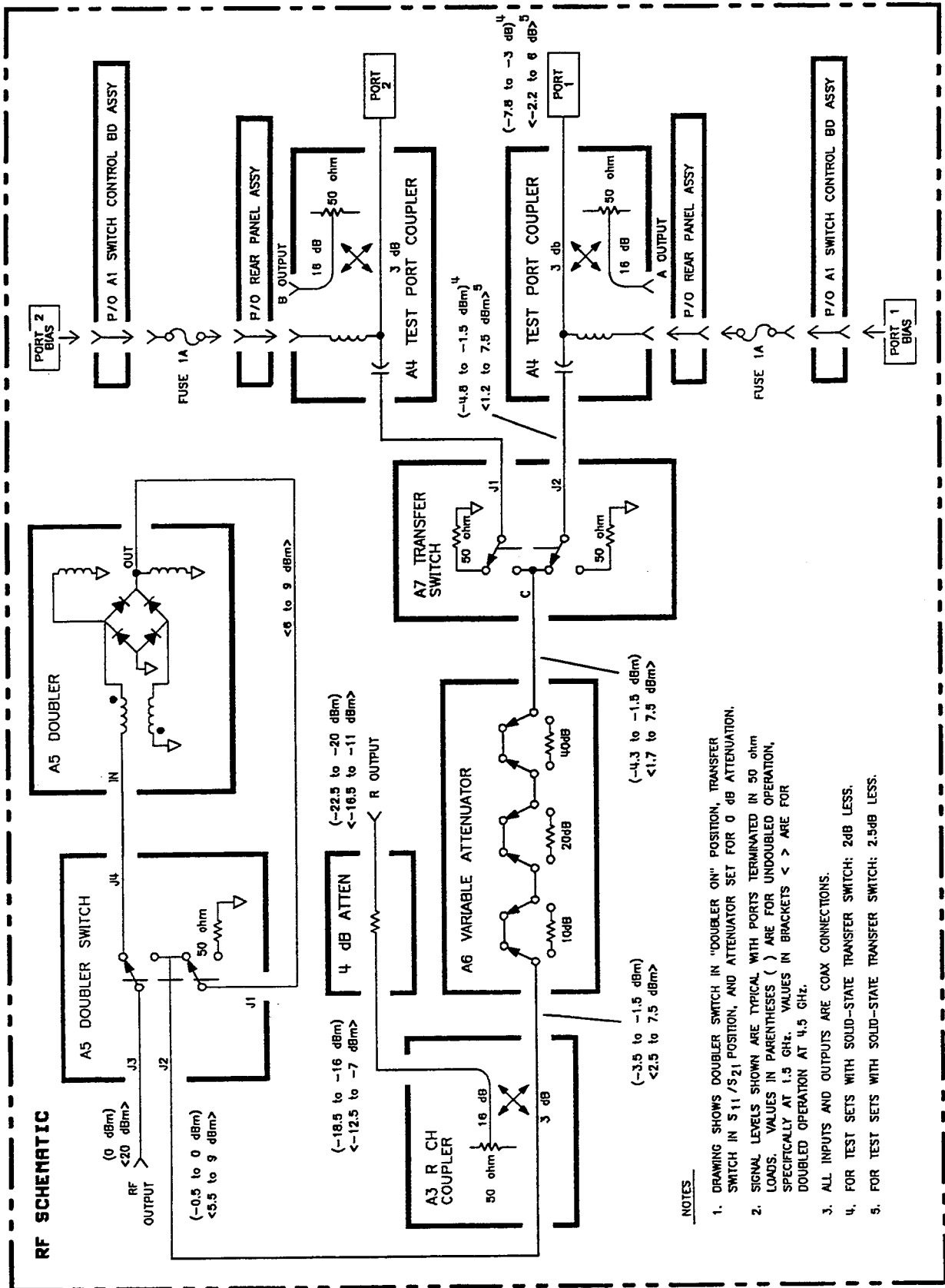


Figure 18. RF Power Levels at (1.5 GHz) and <4.5 GHz>

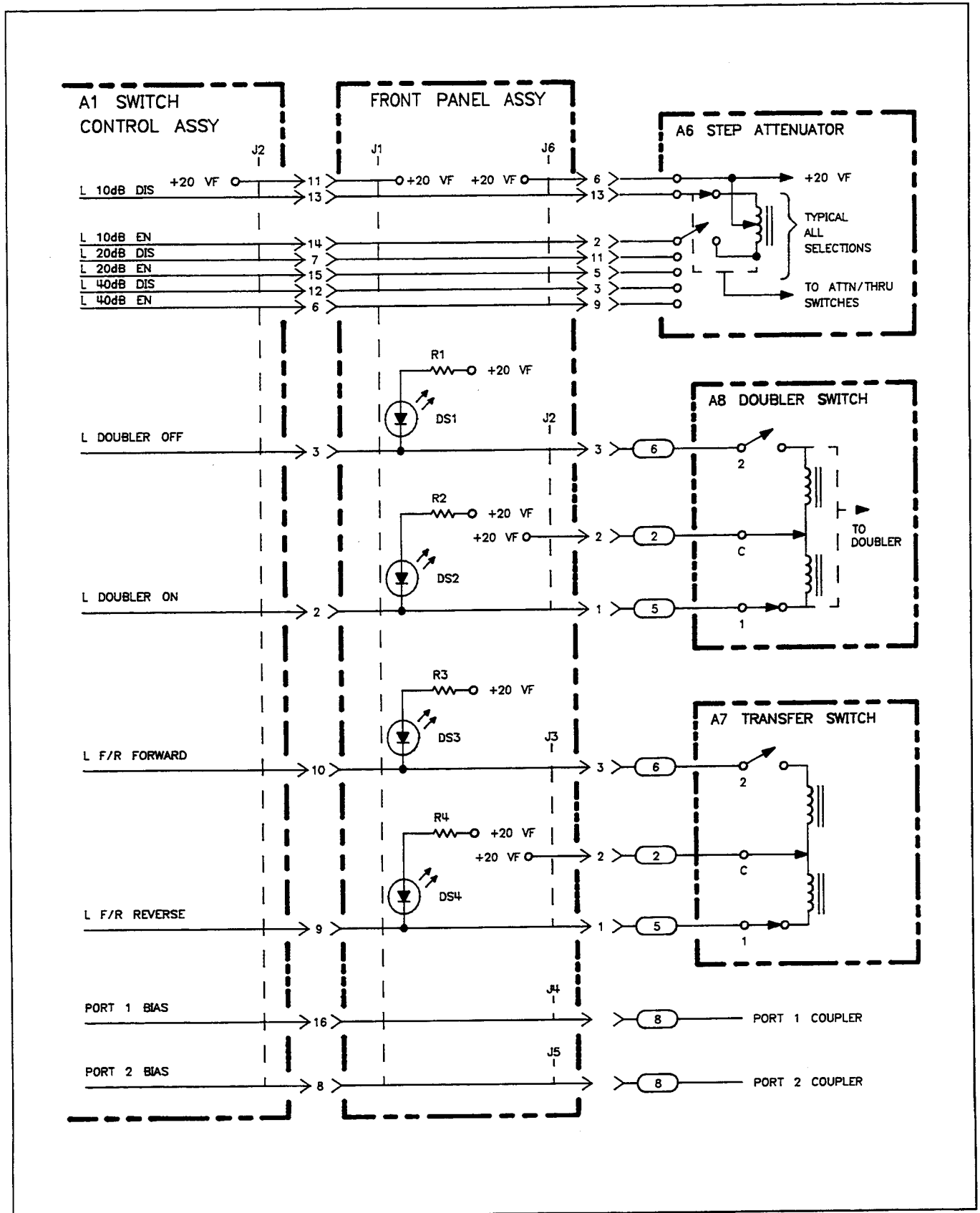
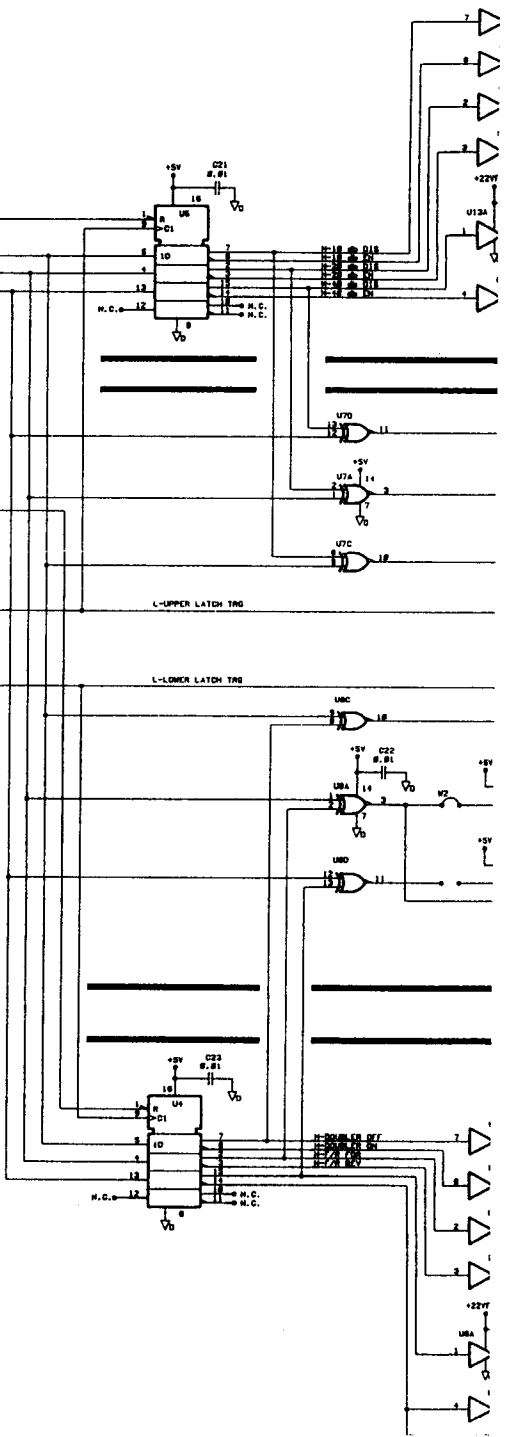
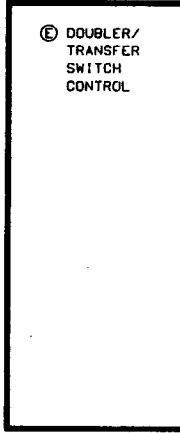
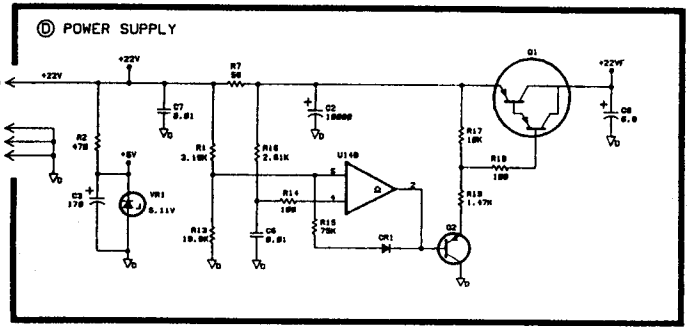
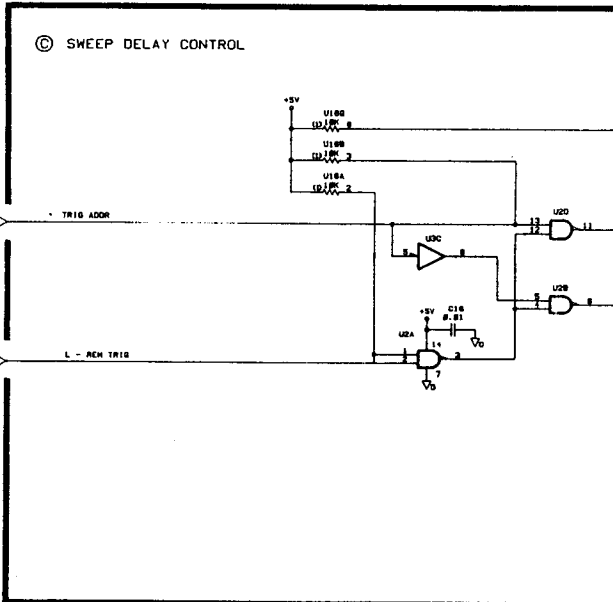
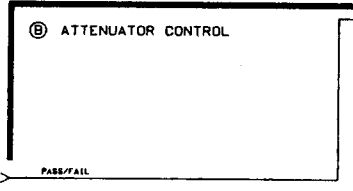
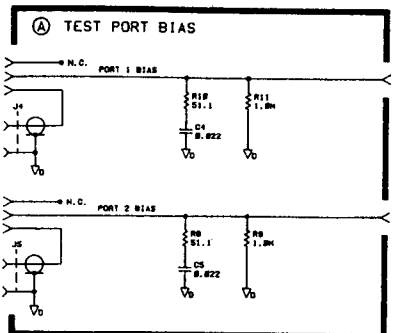
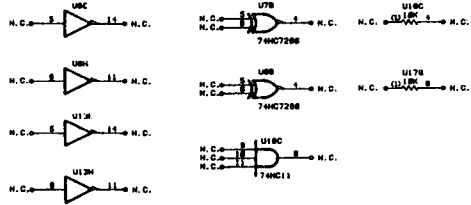


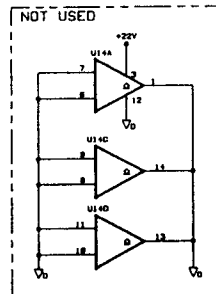
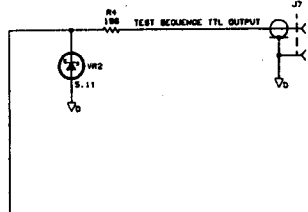
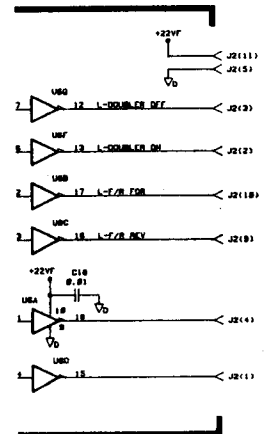
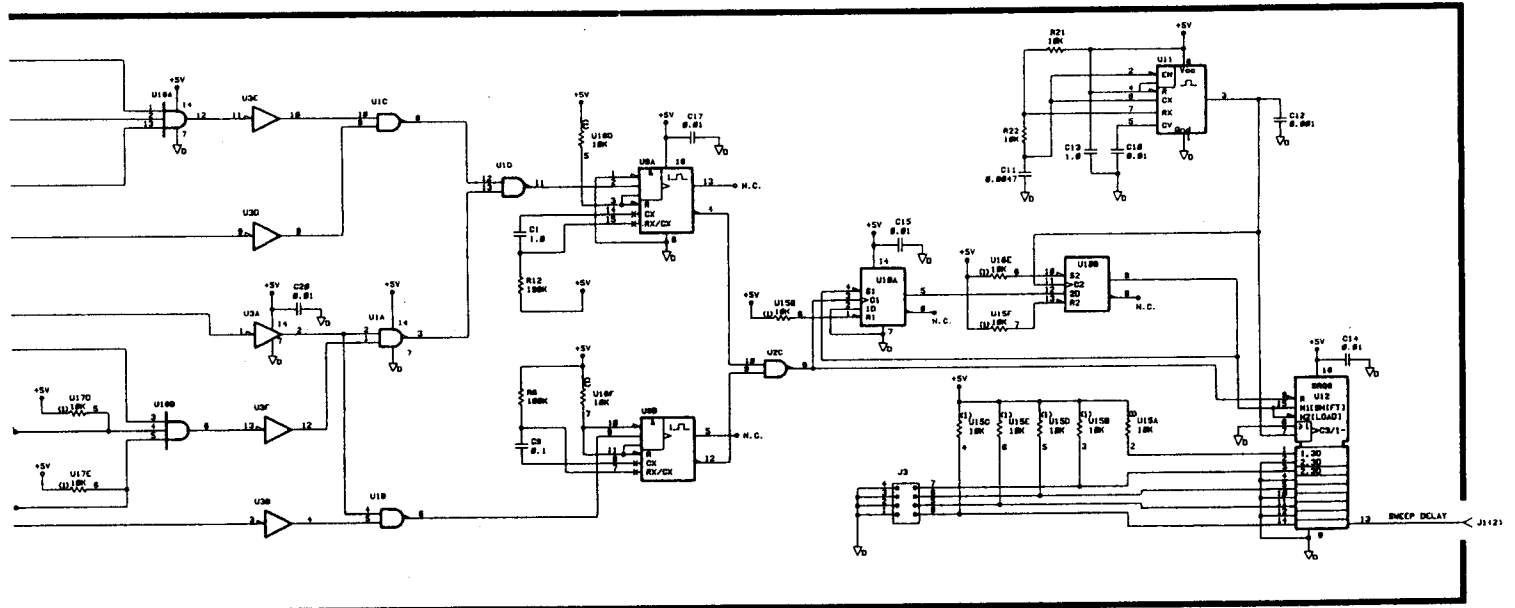
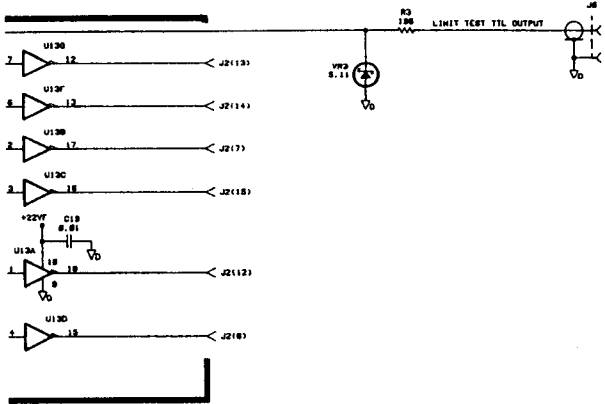
Figure 20. Front Panel Board Assembly



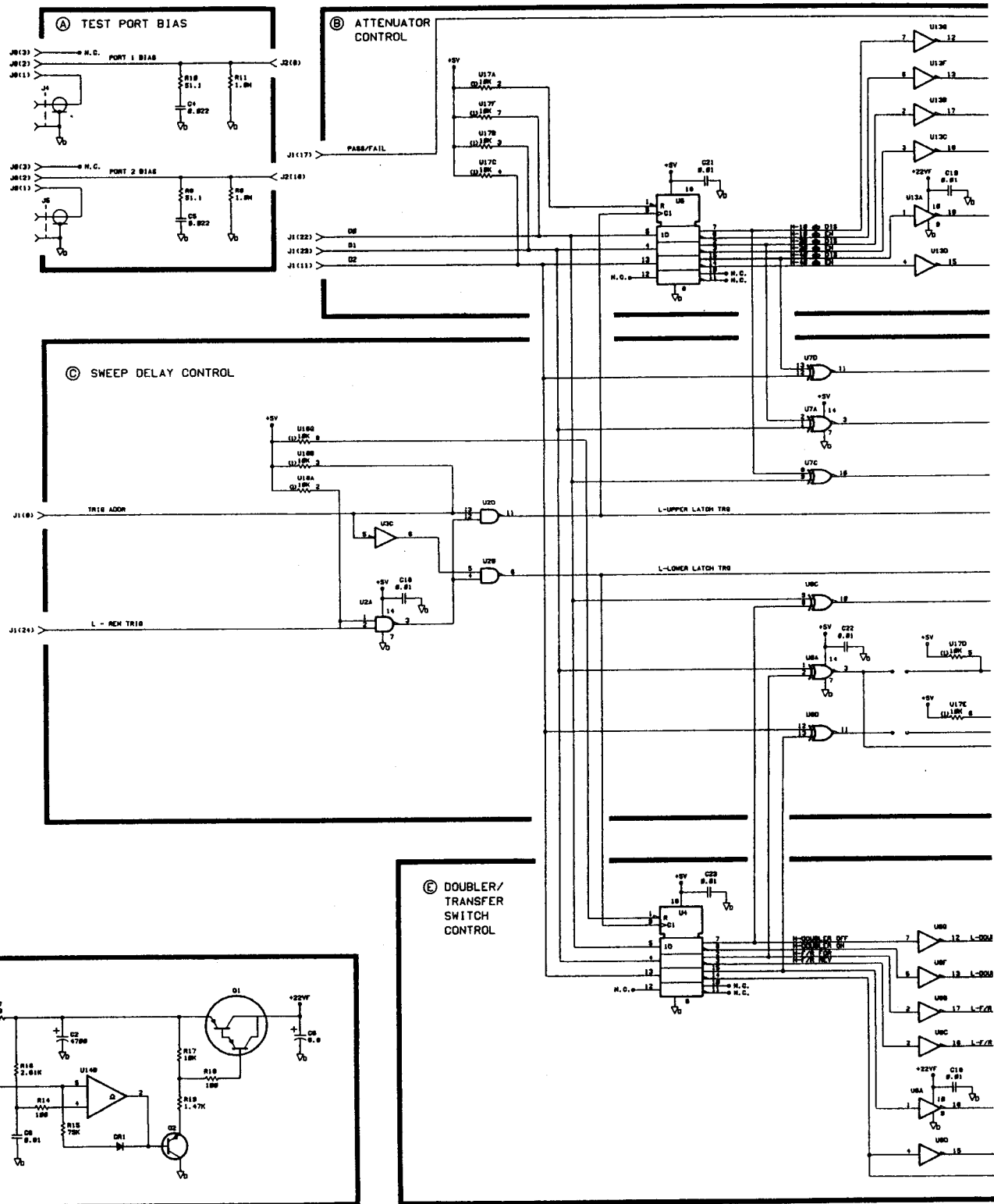


NOTES: UNLESS OTHERWISE SPECIFIED.  
 1. ALL RESISTOR VALUES ARE IN OHMS.  
 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.  
 3. ALL INDUCTOR VALUES ARE IN MICROHENRYS.

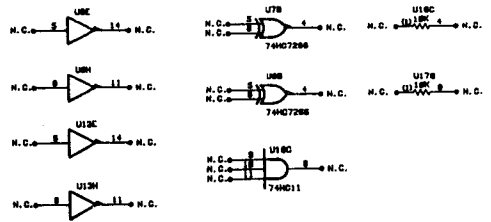
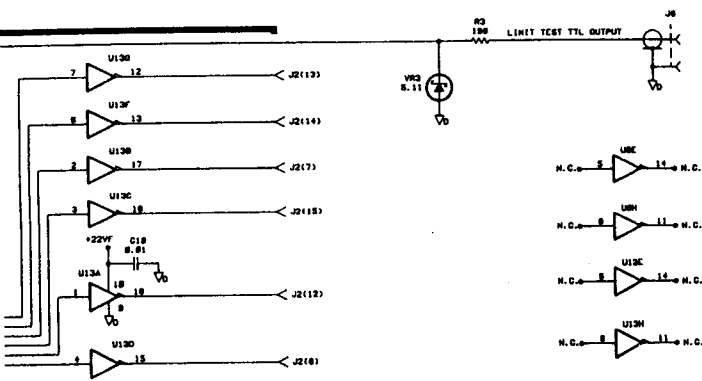
| REFERENCE DESIGNATORS |          |
|-----------------------|----------|
| LAST USED             | NOT USED |
| C23                   |          |
| C12                   |          |
| J8                    |          |
| R2                    | R5 R28   |
| U18                   |          |
| VR2                   | M1       |



|   |       |   |
|---|-------|---|
| <b>SWITCH CONTROL ASSY</b><br><b>MECHANICAL TRANSFER</b><br><b>SWITCH</b> |       | <br>HEWLETT<br>PACKARD<br><b>85047-60007</b><br>PART NUMBER |
| TITLE   | SCALE |   |
| SHEET 1 OF 1  |       | D-85047-60007-1   |

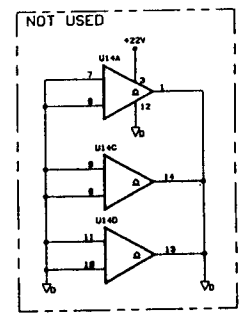
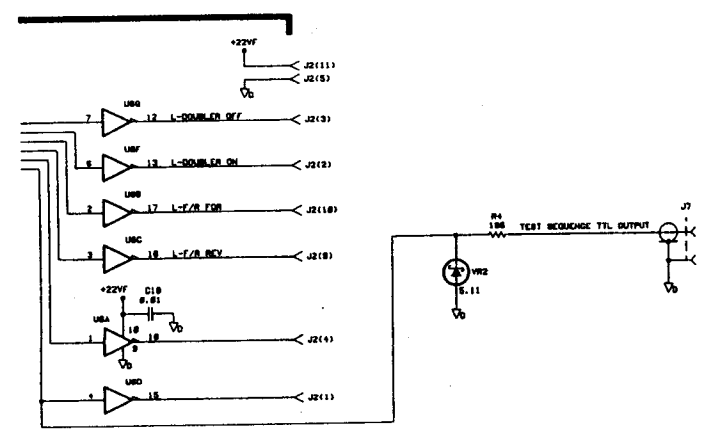
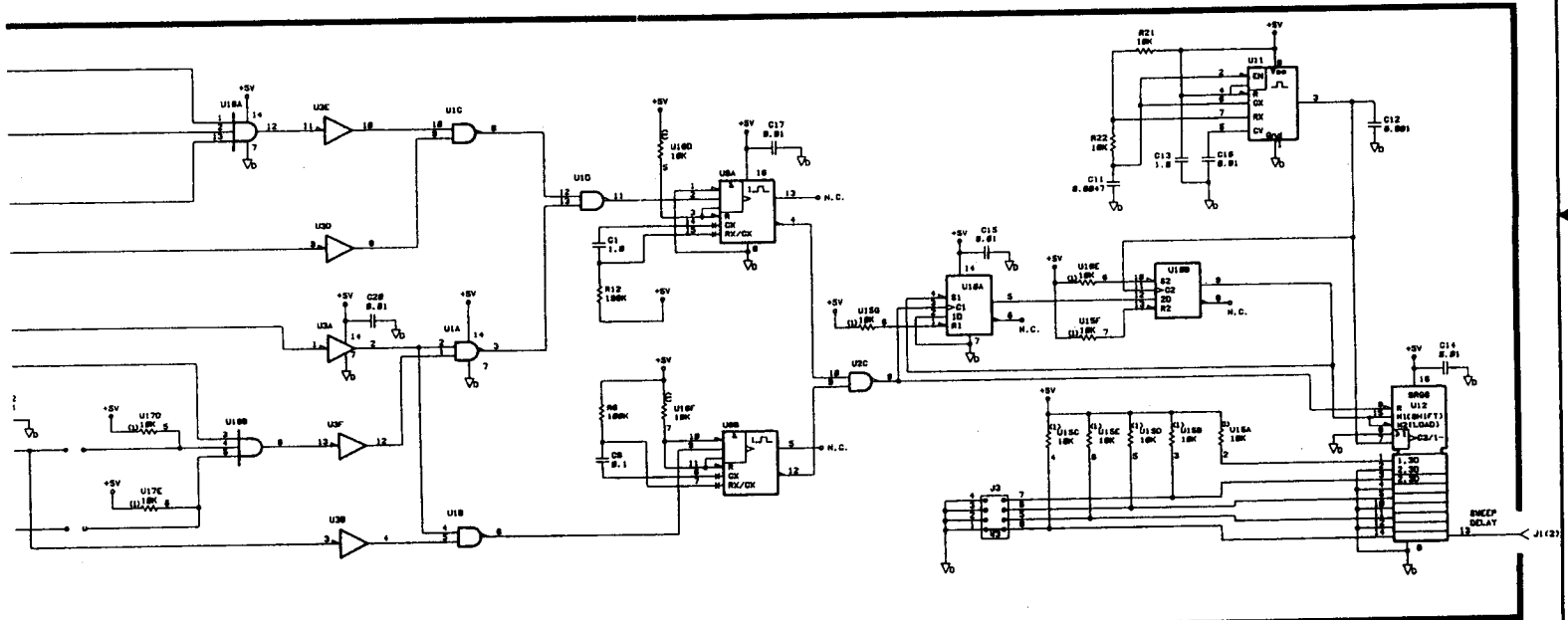






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 3. ALL INDUCTOR VALUES ARE IN MICROHENRYS.

| REFERENCE DESIGNATIONS |          |
|------------------------|----------|
| LAST USED              | NOT USED |
| C23                    |          |
| C21                    |          |
| R2                     |          |
| R22                    | R5 R28   |
| U18                    |          |
| V23                    |          |
| V2                     | V1 V2    |



|  |  |                                      |
|--|--|--------------------------------------|
| <b>SWITCH CONTROL ASSY</b><br><b>SOLID STATE TRANSFER</b><br><b>SWITCH</b> |  | <br><b>HEWLETT</b><br><b>PACKARD</b> |
| TITLE  |  |                                      |
| SCALE  |  | SHEET 1 of 1                         |
| PART NUMBER  |  | 85047-60014<br>85047-60014-1         |

# HP 85047A Operating and Service Manual

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|---|--|

**This is the order of the manual sections:**

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- Operation
- Performance Tests
- Adjustments
- Replaceable Parts
- Backdating
- Service