Errata

Title & Document Type: HP 8719A, 8720A/B Microwave Network Analyzer Service Manual

Manual Part Number: 08720-90108

Revision Date: 1990-09-01

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.tm.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

www.valuetronics.com

HP 8719A
HP 8720A/B
MICROWAVE
NETWORK ANALYZER
SERVICE MANUAL

SERIAL NUMBERS

This manual applies directly to network analyzers with these serial number prefixes:

HP 8719A: 3029A
HP 8720A: 2914A
HP 8720B: 3029A

For additional information, see *Instrument History* section of this manual.

©Copyright HEWLETT-PACKARD COMPANY 1989
1400 FOUNTAINGROVE PARKWAY, SANTA ROSA, CA 95403 U.S.A.

MANUAL PART NO. 08720-90108
Microfiche Part Number 08720-90106
Printed: SEPTEMBER 1990

HEWLETT
PACKARD

www.valuetronics.com

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.

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

EXCLUSIVE REMEDIES

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.

BP24A.2

www.valuetronics.com

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer, make sure the common terminal is connected to the neutral (grounded side of the mains supply).

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from their power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

www.valuetronics.com

TABLE OF CONTENTS

SERVICE AND EQUIPMENT OVERVIEW

PREVENTIVE MAINTENANCE

VERIFICATION

Operator's Check

System Verification

Performance Tests

ADJUSTMENTS

www.valuetronics.com

ADJUSTMENTS (cont'd)

TROUBLESHOOTING AND BLOCK DIAGRAM

ISOLATE FAULTY GROUP

POWER SUPPLY

DIGITAL CONTROL

www.valuetronics.com

DIGITAL CONTROL (cont'd)

SOURCE

RECEIVER

ACCESSORIES

SERVICE KEY MENUS

www.valuetronics.com

www.valuetronics.com

www.valuetronics.com

INTRODUCTION

This *Hewlett-Packard Service Manual* is a complete guide to servicing the HP 8719A, 8720A, or 8720B microwave network analyzer alone or in a system. It is part of a two manual set, which also includes the *Operating Manual*.

This manual contains information required to maintain, test, troubleshoot, and repair the analyzer. The rest of this section describes the organization of that information. This section also includes the *Table of Service Test Equipment*, which lists the equipment (and its critical specifications) required to monitor or adjust the instrument.

NOTE: In this manual, all front panel keys are shown in brackets in bold type, e.g. **[SYSTEM]**; softkey labels are shown in a bold italic type, e.g. ***[SERVICE MENU]***.

ORGANIZATION OF SERVICE MANUAL

Tabs are used to divide the major sections of this manual. The names of the tabs following this section, and the contents, are described below.

- *Preventive Maintenance* consists of routine tasks to be performed by the operator every six months or more often, to ensure that the instrument is maintained in good working condition.
- *Verification* consists of three parts.

  Operator's Check: a brief procedure that tests all circuits in the analyzer to verify with 80% confidence that the instrument is functioning properly. It does not verify conformance to specifications.

  System Verification: a procedure designed to verify system-level error-corrected measurement performance. Known traceable standards are measured and compared with recorded data. This automated procedure is contained in firmware internal to the analyzer, and requires a disk drive.

  Performance Tests: step-by-step procedures that verify certain individual performance specifications of the network analyzer.
- *Adjustments* provides instructions for adjustment and alignment of the instrument after repair or replacement of an assembly. Some of the adjustments are semi-automated procedures for altering correction constants (non-mechanical adjustments). The tab itself illustrates how to remove the instrument covers and how to set the A9 CPU jumper.

www.valuetronics.com

NOTE: The next eight, white-tabbed sections are the core troubleshooting sections.

- *Troubleshooting and Block Diagram*. The troubleshooting strategy is to systematically verify portions of the network analyzer, and thus narrow down the cause of a problem to the defective assembly. This section is the first of a series of troubleshooting procedures. It checks the operation of the network analyzer independent of system peripherals, and suggests how to remedy system problems. The tab also illustrates how to remove the instrument covers and how to set the A9 CPU jumper.

  The *Overall Block Diagram* concludes this section.

- *Isolate Faulty Group* is used after a problem has been shown to be in the network analyzer. This initial *instrument* troubleshooting section can be used equally productively on location or over the phone to isolate the fault to one of the five functional groups in the network analyzer.

- *Power Supply*
- *Digital Control*
- *Source*
- *Receiver*
- *Accessories*

  Each of the first four functional group sections above verifies its constituent assemblies until the faulty assembly is identified. *Accessories* verifies external RF cables and calibration kit devices.

NOTE: the following sections are, for the most part, reference material.

- *Service Key Menus* documents the functions of the menus accessed from the ***[SERVICE]*** softkey. These menus let the operator test, verify, adjust, control and troubleshoot the analyzer. All of the internal tests and the 23 analog bus nodes are documented here. HP-IB service mnemonics are included.

- *Error Terms* can be powerful preventive maintenance and troubleshooting tools, besides being the basis for accuracy enhancement. This section documents the access and use of these internally-stored terms.

- *Theory of Operation* explains the overall operation of the instrument, the division into functional groups, and the operation of each functional group.

- *Replaceable Parts* provides part numbers and illustrations of the replaceable assemblies and miscellaneous chassis parts, together with ordering information.

- *Replacement Procedures* provides procedures to disassemble portions of the instrument when certain assemblies are to be replaced. Cover removal is illustrated on this tab.

- *Post-Repair Procedures* contains the *Table of Related Service Procedures*. It is a table of adjustments and verification procedures to be performed after repair or replacement of each assembly.

- *Instrument History* contains information required to make this manual compatible with earlier shipment configurations of the instrument.

www.valuetronics.com

TABLE OF SERVICE TEST EQUIPMENT

The first part of Table 1, *Service Test Equipment*, lists all of the equipment required to verify, adjust, and troubleshoot the analyzer and perform the operator's check. The table also notes the use and critical specifications of each item, and the recommended models.

The second part of the table is similar to the first but it relates specifically two adjustments: the display adjustments for models with color CRTs and the optional *Fractional-N Spur and FM Sideband Adjustment*.

Table 1. Service Test Equipment (1 of 2)

Instrument	Critical Specs	Recommended Model	Use
Frequency Counter	Freq: 0.13 to 20 GHz Accuracy: 3 ppm	HP 5343A, 5350B, 5351B	V,A,T
Power Meter	Freq: 0.13 to 20 GHz Range: −30 to +15 dBm Accuracy: ±0.05 dB	HP 436A, 438A	V,A,T
Power Sensor	Freq: 0.13 to 20 GHz Range: −30 to +20 dBm	HP 8485A	V,A,T
DVM	Resolution: 10 mV	Any	A,T
Oscilloscope	Bandwidth: 100 MHz	Any	T
Disc Drive	CS80 protocol	HP 9122C/D/S, 9153B, 9133A/H/L	V,A
Printer	Raster graphics capability	HP 2225A, 9876A, 2673A	V,A[1]
HP-IB Cables		HP 10833A/B/C/D	V,A
RF Cable Set	3.5 mm connectors	HP 85131C/D/E/F	V,A,T
Tool Kit	No substitute	08720-60004	A,T
3.5 mm Calibration Kit[2]	No substitute	HP 85052B/D	V,A,T,OC
3.5 mm Verification Kit[3]	No substitute	HP 85053B	V

1. The printer is not used for adjustments unless the optional *Fractional-N Spur and FM Sideband Adjustment* is being performed.
2. Calibration can also be done in other connector types with these kits:
   7 mm HP 85050B/D
   Type-N HP 85054B
   Appropriate cables will be required (refer to *System Overview* in the *Operating Manual*).
3. Verification can also be done in other connector types with these kits:
   7 mm HP 85051B
   Type-N Hp 85055A
   Appropriate cables and calibration kits will be required.

www.valuetronics.com

Table 1. Service Test Equipment (2 of 2)

The following equipment is needed only for the ***HP 8719A/20B Display Intensity Adjustments*** which apply to color CRTs.

Instrument	Critical Specs	Recommended Model	Use
Photometer	No substitute	TEK J16 opt 2	A
Photometer Probe	No substitute	TEK J6503 opt 2	A
Light Occluder	No substitute	TEK 016-0305-00	A

The following equipment is needed only for the optional ***Fractional-N Spur and FM Sideband Adjustment***, which is recommended for improving spectral purity after replacement of the A13 assembly but is NOT required:

Instrument	Critical Specs	Recommended Model	Use
Series 200/300 Controller	No substitute	HP 216, 236, 220, 310	A
BASIC 3.0, 4.0, or 5.0	No substitute	HP 98613A	A
Spectrum Analyzer	No substitute	HP 8566A/B	A
RF Cable	Type-N connector	8120-4780 (part of HP 11851B)	A
BNC Cable		8120-1840	A
3.5 mm (f) to Type-N Adapter		1250-1745	A
HP 8720A Automated Adjustment Software	No substitute	08720-10002	A

Notes:

V = Verification (System Verification and Performance Tests)
A = Adjustments
T = Troubleshooting
OC = Operator's Check

www.valuetronics.com

INTRODUCTION

Preventive maintenance consists of four tasks. It should be performed at least every six months—more often if the instrument is used daily on a production line or in a harsh environment. Error terms, for example, are more meaningful when checked more often but, again, instrument usage should be the criterion. The four tasks are to

- Check the front panel connectors,
- Check the error terms,
- Clean the fan filter, and
- Clean the glass filter (and CRT as required).

CHECK THE FRONT PANEL CONNECTORS

Visually inspect the front panel connectors. They should be clean and the center pin centered. If so, gage the connectors (gages are supplied in the HP 85052B calibration kit). Confirm that the recession is correct:

Front panel 3.5 mm connector center pin recession: 0.0002 to 0.0018 inch

Also inspect and gage the connectors of the calibration kit devices. Refer to the calibration kit manual for center pin recession specifications.

If the connectors are dirty or damaged, refer to the *Microwave Connector Care* manual, behind the *Connector Care and Applications* tab in the *Operating Manual*. That manual details connector care techniques including cleaning and gaging connectors, damage signs, making good connections, proper handling and storage.

CHECK THE ERROR TERMS

Error terms (E-terms or calibration coefficients) are an indication of the condition of the instrument, its calibration kits, and cables. When tracked over a period of time, error terms can signal and identify system component and performance degradation. Error term comparisons are best made with data generated periodically by the same instrument and cal kit (the kit normally used with the network analyzer). For this reason, generating error terms at the time of installation and at regular intervals thereafter is recommended.

www.valuetronics.com

A related recommendation is to establish a log book to store the error term plots and the results of the yearly verification.

Perform a Full 2-Port Calibration

To obtain hard copy error term plots, connect a printer or plotter to the analyzer via an HP-IB cable prior to turning on the instruments.

1. Turn on the instruments and press **[PRESET] [LOCAL]** ***[SYSTEM CONTROLLER]*** to give control to the analyzer. Then press **[[CAL]** ***[CALIBRATE MENU] [FULL 2-PORT] [REFLECT'N]*** to begin the calibration.
2. a. Connect an open to port 1 and press ***[(S11): OPEN]***.
   b. Connect a short to port 1 and press ***[(S11): SHORT]***.
   c. Either connect a broadband load to port 1 and press ***[(S11): LOADS] [BROADBAND] [DONE: LOADS]*** or

   Connect a sliding load to port 1 and press ***[(S11): LOADS] [SLIDING]***. Set the slide and press ***[SLIDE Is SET]***; reposition the slide and press ***[SLIDE Is SET]*** four more times. Then press ***[SLIDING LOAD DONE]***. Connect the lowband load, press ***[LOWBAND]*** and then ***[DONE: LOADS]***.
3. Repeat step 2 for S22 at port 2.
4. When the cal coefficients have been calculated, press ***[TRANSMISSION]***. Connect a single cable or cable pair, consistent with normal system use, between ports 1 and 2 and press ***[FWD. TRANS. THRU] [FWD.MATCH THRU] [REV.TRANS THRU] [REV.MATCH THRU] [TRANS. DONE]***.
5. Connect loads to ports 1 and 2 or the cables (consistent with normal system use). Press **[AVG]** ***[IF BW]*** **[1] [0] [x1]** to change the IF bandwidth to 10 Hz. Then press **[CAL]** ***[RESUME CAL SEQUENCE] [ISOLATION] [FWD ISOL'N ISOLN STD]***. After the beep, press ***[REV ISOL'N ISOL'N STD] [ISOLATION DONE]*** and then ***[DONE 2-PORT CAL]***.

Plot the Error Terms

6. Press **[DISPLAY]** ***[MORE] [TITLE] [ERASE TITLE]*** and use the knob and softkeys to enter the serial numbers of the instrument and calibration kit, type of load and date. For example, INST=A12345/KIT=N67890/BROADBAND/DATE. Press ***[DONE]***.
7. Press **[SCALE REF]** ***[REFERENCE POSITION]*** **[7] [x1]** to position the display. Then press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[3] [1] [x1]** ***[EXECUTE TEST]*** **[COPY]** ***[PLOT]*** (or ***[PRINT]***) to copy Cal Coef 1.
8. Repeat step 7, substituting the values of table 1 to plot cal coefficients 2 through 12.

www.valuetronics.com

Table 1. Suggested Scale and Repeatability Values for Cal Coef Plots

Cal Coef	Test	Scale (dB)	Repeatability
1 (E_{DF})	31	10	±5 dB
2 (E_{SF})	32	10	±2 dB
3 (E_{RF})	33	10	±1 dB
4 (E_{XF})	34	20	±5 dB
5 (E_{LF})	35	10	±2 dB
6 (E_{TF})	36	10	±0.5 dB
7 (E_{DR})	37	10	±5 dB
8 (E_{SR})	38	10	±2 dB
9 (E_{RR})	39	10	±1 dB
10 (E_{XR})	40	20	±5 dB
11 (E_{LR})	41	10	±2 dB
12 (E_{TR})	42	10	±0.5 dB

9. The plots generated should closely match previously generated plots. Variations due to connector repeatability factors are indicated in Table 1. Greater variations indicate a system degradation due to changes in the cal kit devices, the front panel test port connectors, or the network analyzer itself.

   To compare the plots to typical plots or to learn more about their significance, see the *Error Terms* or *Accessories* sections of this manual.

10. Store the plots for future reference and for use as troubleshooting tools.

CLEAN THE FAN FILTER

Clean the fan filter regularly. How regularly depends on the operating environment. It is a good idea to check it weekly and clean it as necessary. If the message, "CAUTION: Air Flow Restricted: Check Fan Filter" is displayed, immediately check for items (like a piece of paper) on the fan filter that may be impeding the air flow. If the fan filter is not blocked, clean it as follows:

1. Turn OFF the instrument and disconnect the HP-IB cables from the rear panel.
2. Remove the plastic fan filter retainer —use either a flat blade screwdriver or your fingers to pry it off; it should "pop" off easily.
3. Clean the foam fan filter with a vacuum cleaner or shake it out thoroughly to remove the dust and dirt. Clean fan filters are nearly translucent.
4. Replace the fan filter and snap on the fan filter retainer.

www.valuetronics.com

CLEAN THE GLASS FILTER (AND CRT AS REQUIRED)

1. A gasket between the CRT and glass filter limits air dust infiltration between them. Thus cleaning the outer surface of the glass filter is usually sufficient. Use a soft cloth and, if necessary, a cleaning solution recommended for optical coated surfaces: HP part number 8500-2163 is one such solution.

   If, after cleaning the outer surface of the glass filter, the CRT appears dark or dirty or unfocused, clean the inner surface and the CRT.

2. Remove the softkeys cover (a plastic cover through which the front panel softkeys protrude): *carefully* insert a thin, flat screwdriver blade (or your fingernail) between the upper left corner of the softkeys cover and the glass filter (see Figure 1). Be extremely careful not to scratch or break the glass. Carefully pull the cover forward and off.

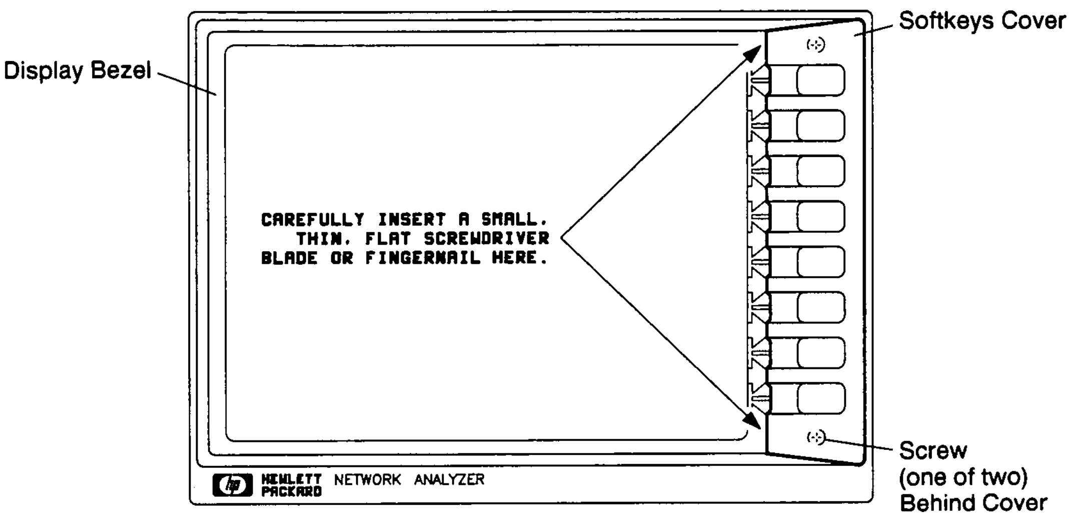


Figure 1. Removing the Glass Filter

3. Remove the two screws that are now uncovered.

4. Remove the display bezel assembly by pulling out the end that is now free and pivoting it around its left edge until it is released.

5. Clean the CRT surface and the inner glass filter surface gently, as in step 1.

6. Allow the surfaces to dry and then reassemble the instrument.

www.valuetronics.com

INTRODUCTION

This section includes three types of procedures to check the health of the analyzer:

- Operator's Check (page 1) tests all circuits in the analyzer. If the tests pass successfully, it verifies (with approximately 80% confidence) that the analyzer is functioning properly. *In Case of Difficulty* information is included here.
- System Verification (page 5) uses a verification kit to verify the system-level error-corrected measurement uncertainty specification for the analyzer.
- Performance Tests (page 23) verifies the source and dynamic range specifications of the analyzer. The specifications are listed in the *Specifications* section of the *Operating Manual* and on the performance test record.

OPERATORS CHECK

DESCRIPTION

The operator's check consists of two softkey initiated tests: "OP CK PORT 1" and "OP CK PORT 2".

A short is connected to port 1 (port 2) to reflect all the source energy back into the analyzer for an S11 (S22) measurement.

The first part of "OP CK PORT 1" checks the repeatability of the transfer switch. An S11 measurement is stored in memory and the switch is toggled to port 2 and then back to port 1 where another S11 measurement is made. The difference between the memory trace and the second trace is switch repeatabilty.

The remaining parts of both tests also exercise the source across its full frequency range at −10 dBm and then the internal attenuator is adjusted in 5 dB steps over a 55 dB range. The receiver inputs are tested across their full frequency range at several power levels in ratio modes.

The resulting measurements must fall within a limit testing window to pass the test. The window size is based on both source and receiver specifications.

www.valuetronics.com

The operator's check determines that:

1. The source is phase-locked across the entire frequency range.
2. All three samplers are functioning properly.
3. The transfer switch is operational.
4. The attenuator steps 5 dB at a time.

EQUIPMENT

Short 3.5 mm (f) .... HP part number 1250-1769
(p/o calibration kit HP 85052B)

PROCEDURE

1. Allow the analyzer to warm up for 30 minutes.
2. First, run the test for port 1: press **[PRESET]**, then **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** ***[EXTERNAL TESTS]***.
3. The display should show "TEST 21 Op Ck Port 1" in the active entry area.
4. Press ***[EXECUTE TEST]*** to begin the test.
5. At the prompt, connect the short to the port indicated. Make sure the connection is tight.
6. Press ***[CONTINUE]***.
7. The test is a sequence of subtests. At the end of the subtests, the test title and result will be displayed. If all tests pass successfully, the overall test status will be "PASS". If any test fails, the overall test status will be "FAIL".
8. Next, run the test for port 2: press the step **[▲]** key. The display should show "TEST 22 Op Ck Port 2" in the active entry area.
9. Repeat steps 4 through 7.
10. If both tests pass, the analyzer is about 80% verified. If either test fails refer to *In Case of Difficulty* information in this section, or:
    a. Make sure that the connection is tight. Repeat the test.
    b. Visually inspect the connector interfaces and clean if necessary (refer to the *Microwave Connector Care Manual* supplied in the *Opearting Manual*).
    c. Verify that the short meets published specifications.
    d. Substitute another short, and repeat the test.

www.valuetronics.com

e. Finally, suspect a problem with the analyzer. Refer to the detailed tests located in this section, or fault isolation procedures located in the *Troubleshooting* sections.

IN CASE OF DIFFICULTY

This section describes common problems or apparent failures, as well as easy solutions that can be performed with the instrument covers on. An operator can solve many problems easily and quickly, with minimal network analyzer experience and some simple tools.

If the listed solution does not seem to fix the problem, go to the *Troubleshooting* section in this *Service Manual*, or contact your local HP service representative.

The problems are listed below by symptom, together with solutions.

Symptom: **Instrument appears dead and the instrument fan is off.**
Solution: Check that the main power supply line is providing power. Check the two LEDs on the rear panel: the green LED should be ON and the red LED should be OFF. Check that the line voltage selector switch position matches the line power voltage (120 Vac or 240 Vac). Check the fuse (refer to *Installation* in the User's Guide).

Symptom: **Display screen is blank or out of focus, but CH 1 or CH 2 LED is lit.**
Solution: Adjust the display intensity or focus with the front panel keys. Refer to *[DISPLAY]* Key in Chapter 4 of the *Reference*, and *Display Intensity and Focus Correction Constants* in the *Adjustments* section.

Symptom: **Self test fail message is displayed on the CRT immediately after power-on or preset.**
Solution: Contact a qualified service technician.

Symptom: **Phase lock error message is displayed (this includes the "PHASE LOCK CAL FAILED" message).**
Solution: Contact a qualified service technician.

Symptom: **Internal transfer switch will not switch and the lower front panel LEDs are not lit.**
Solution: Contact a qualified service technician.

Symptom: **Measurements are not repeatable, especially after measurement calibration.**
Solution: Check all RF cables and connections. Visually inspect all connectors, and clean if necessary (refer to the *Microwave Connector Care Manual*, supplied in the *Operating Manual*). Review proper connection techniques to ensure good, repeatable connections.

Symptom: **Instrument cannot be programmed via HP-IB.**
Solution: Check the HP-IB cabling connections. Check that the HP-IB addresses match the addresses being programmed (refer to Chapter 7 of the *Reference*). Check that the analyzer is set to either ***[TALKER/LISTENER]*** or ***[USE PASS CONTROL]*** under the **[LOCAL]** key. Check that the controller can program an instrument that is known to be working.

www.valuetronics.com

Symptom: **Instrument states cannot be saved or recalled from external disc.**
Solution: Check the HP-IB cabling connections. Check the address of the disc drive. Make sure the analyzer is set to ***[SYSTEM CONTROLLER]*** under the **[LOCAL]** key. Check that the disc drive works normally with a controller. Initialize the disc.

Symptom: **Printer/plotter does not respond to front panel commands.**
Solution: Check the address of the printer or plotter. Make sure the analyzer is set to ***[SYSTEM CONTROLLER]*** under the **[LOCAL]** key.

Symptom: **"CAUTION: Air Flow Restricted. Check Fan Filter" message is displayed on CRT.**
Solution: Check if anything is blocking the fan. Clean the fan filter (refer to the *Routine Maintenance* information in this manual).

www.valuetronics.com

SYSTEM VERIFICATION

DESCRIPTION

System verification is a procedure used to verify the system-level error-corrected measurement uncertainty specification for the network analyzer.

The verification procedure is contained in the firmware internal to the analyzer. The procedure involves first calibrating the analyzer, then measuring a set of verification devices at specific frequencies, and comparing the measured data to the traceable data and uncertainty limits supplied with the kit on a disc. The difference between the measured data and the supplied traceable data of the devices must fall within the uncertainty limits at *all* frequencies to pass the system verification. If this procedure is performed by a Hewlett-Packard customer engineer, and the system passes the verification at all frequencies, as well as the performance tests, a Certificate of Traceability is issued.

VERIFICATION KIT

A verification kit is used in the following procedure to verify that the network analyzer system is working within its specifications and that you have performed a valid measurement calibration. The kit consists of two attenuators, a 25Ω mismatch airline, a 50Ω airline, a data disc containing the factory measured verification data, a printout of the factory uncertainties for the devices in the kit, and a Certificate of Calibration.

SYSTEM VERIFICATION CYCLE AND KIT RE-CERTIFICATION

The recommended system verification cycle is one year. It is also recommended that the verification kit be re-certified annually. For more information about kit re-certification, refer to the manual of the verification kit being used.

www.valuetronics.com

MEASUREMENT UNCERTAINTY

Associated with any network analyzer are measurement errors that add uncertainty to the measured results. This uncertainty defines how accurately a device under test (DUT) can be measured.

The measurement calibration procedure, also called accuracy enhancement, characterizes and effectively removes the systematic (repeatable) errors. This is accomplished by measuring a set of calibration devices with known characteristics. However, residual systematic errors remain after accuracy enhancement, primarily due to the limitations of how accurately the electrical characteristics of the calibration devices can be defined and determined. Also, there are random (non-repeatable) errors that cannot be quantified and measured. The residual systematic errors, along with the random errors, continue to affect measurements after accuracy enhancement, adding a total uncertainty to the measurement results.

The measurement uncertainty is defined to be the sum of the residual systematic (repeatable) and random (non-repeatable) errors in the measurement system after accuracy enhancement. The systematic errors are directivity, source match, load match, reflection and transmission frequency tracking, and isolation (crosstalk). Random errors include errors due to noise, drift, connector repeatability, and test cable stability. A complete description of system errors and how they affect measurements is provided in the *Reference* section of the Operating Manual under *Accuracy Enhancement Fundamentals* in chapter 5, *Measurement Calibration*.

The measurement uncertainty limits for system verification are the sum of the worst-case uncertainties associated with measuring the verification devices on the factory HP 8510 system *plus* the worst-case uncertainties associated with measuring these same devices on the system being verified.

EQUIPMENT

The system verification procedure verifies the minimum HP 8719A or HP 8720 system, which includes the following instruments and accessories:

- the network analyzer
- calibration kit
- test port return cables

NOTE: Additional equipment or accessories used with the above system are not verified by system verification.

www.valuetronics.com

The following equipment and accessories are required to verify the network analyzer system (for information on compatible printers, refer to the *General Information* section of the *Operating Manual*).

- HP 9122C/D/S CS80 disc drive
- HP 2225A ThinkJet printer (or other compatible printer)
- HP 10833 A/B/C/D HP-IB cables (2)
- Verification kit (see below)
- Calibration Kit (see below)
- Test port return cables (see below)

Description	3.5 mm	7 mm	Type-N
Calibration Kit	85052B/D	85050B/D	85054B/D
*Verification Kit	85053A/B	85051A/B	85055A
Cables	85131D/F	85132D/F	85132D/F

*The HP 85051B, 85053B, and 85055A verification kits with serial number prefix 2815A and higher, provide a data disc compatible with the HP 8720B, and HP 8719A. Kits ordered previous to the 2815A serial prefix, or HP 85051A and 85053A verification kits, can be upgraded by recertifying the kit through a local sales and service office.

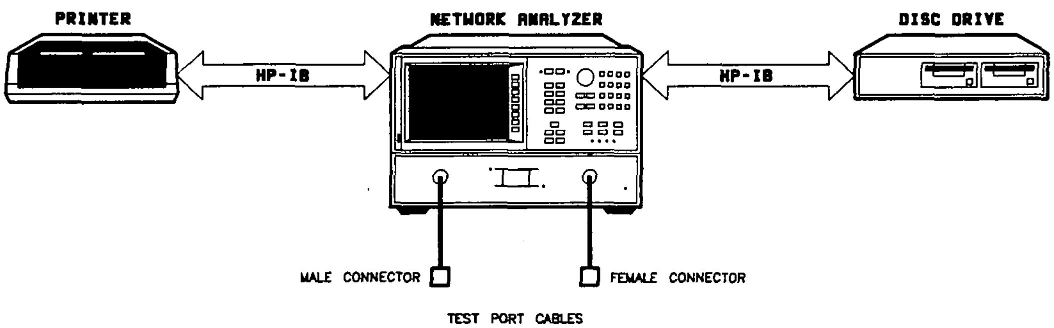


Figure 1. System Verification Setup

www.valuetronics.com

PROCEDURE

1. Connect the system as shown in Figure 1.
2. Insert the verification disc (supplied in the verification kit) into drive 0 (left disc drive).
3. Allow the system to warm up for one hour.
4. Review the *Microwave Connector Care Manual* supplied in the *Operating Manual* for proper care and connection techniques for microwave connectors. Proper connections and clean, undamaged connectors are critical for accurate measurement results.

Initialization

5. Press **[PRESET]**, then **[LOCAL]** ***[SYSTEM CONTROLLER]***. This allows the analyzer to control the bus. No other controller should be connected to the bus. Press ***[DISC UNIT NUMBER]***, and change the setting if necessary.
6. Press ***[SET ADDRESSES]*** and check the disc unit number, and the address of the disc drive and printer. The default unit number and address for the disc drive are both 0. The default address for the printer is 1.
7. If a printout of data for only a particular verification device is desired, go to the next step; the record function will be turned on later in the verification procedure.

   If a printout of *all* verification data for *all* devices is required, press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [RECORD ON]***. All results will be printed. Note that if this record function is turned on now, it cannot be turned off during the verification procedure. (Make sure the paper in the printer is set up so that printing starts at the top of the page.)
8. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS] [SYS VER TESTS]***. The message "TEST 26 Sys Ver Init −ND−", will be displayed. The "−ND−" indicates the test status. A listing of the test status codes that may appear during this procedure is available in Table 1 below. If the record function is on, "/REC" will also be displayed.

Table 1. Listing of Test Status Codes

PASS	
FAIL	
(NA)	NOT AVAILABLE
−ND−	NOT DONE
−IP−	IN PROGRESS
DONE	

9. Press ***[EXECUTE TEST]***. This recalls the instrument state file from the disc and sets up the analyzer for a measurement calibration. When it is done initializing, "TEST 26 Sys Ver Init DONE" will be displayed. Do not preset or power cycle the instrument. Do not attempt to recall a previous calibration. These actions will destroy the initialization achieved in steps 8 and 9.

www.valuetronics.com

Measurement Calibration

The following measurement calibration procedure characterizes and effectively removes the systematic errors present in the system. This involves measuring a set of calibration devices, supplied in the calibration kit, with known electrical characteristics. Following the calibration, the verification procedure will verify that the sum of the residual errors present after calibration is within the specified uncertainty limits. The measurement calibration must be performed before continuing on to the system verification. The calibration and verification kits used must be of the same connector type.

NOTE: Do not preset or power cycle the instrument. If you do, you must repeat steps 8 and 9.

NOTE: **For sexed connectors only:** Test port cabling must be configured such that the device end of **test port 1 is male** and the device end of **test port 2 is female.** This will ensure that the verification devices are correctly inserted.

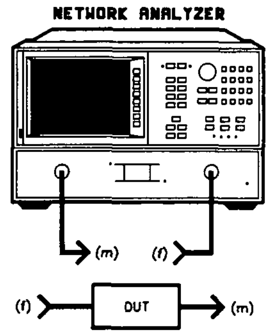


Figure 2. Test Port Cabling

10. Press **[CAL]** ***[CAL KIT]*** and select the type of cal kit to be used. Then press ***[RETURN] [CALIBRATE MENU] [FULL 2-PORT] [REFLECT'N]***.
11. Connect the open circuit to the port 1 cable. Press ***[S11: OPEN]***. (If calibrating in type-N, connect the female open to port 1 and press **[OPEN (M)]**. The (M) refers to the sex of the test port or cable connector to which the open is being connected.)
12. When the measurement is complete, disconnect the open. (Measurements are complete when the instrument beeps and the softkey that was pressed is underlined.)
13. Connect the short to the port 1 cable. Press ***[S11: SHORT]***. (For type-N, connect the female short and press **[SHORT (M)]**.)
14. When the measurement is complete, disconnect the short.

www.valuetronics.com

15. Press *[S11: LOADS]*. Connect a load to the port 1 cable.

NOTE: For broadband measurements, use either a broadband load or a combination of low-band and sliding loads. Use the same loads used during normal calibrations.

16. Press either *[BROADBAND]* or *[SLIDING]*, depending on which device is used. If you select *[SLIDING]*, you must also measure a lowband load to complete the loads calibration.
17. When the measurement is complete, press *[DONE: LOADS]*. Leave the load connected to the port 1 cable.
18. Connect the open to the port 2 cable. Press *[S22: OPEN]*. (For type-N, connect the male open and press **[OPEN (F)]**.)
19. When the measurement is complete, disconnect the open. Connect the short to the port 2 cable. Press *[S22: SHORT]*. (For type-N, connect the male short and press **[SHORT (F)]**.)
20. When the measurement is complete, disconnect the short.
21. Press *[S22: LOADS]*. Connect a load to the port 2 cable. Press either *[BROADBAND]* or *[SLIDING]*, depending on which device is used. If you select *[SLIDING]*, you must also measure a lowband load to complete the loads calibration.
22. When the measurement is complete, press *[DONE: LOADS]*. Leave the load connected to the port 2 cable.
23. Press *[REFLECT'N DONE]*.
24. After the calibration coefficients are computed, the 2-port cal menu is returned to the screen.
25. Press *[ISOLATION] [FWD ISOL'N ISOL'N STD] [REV ISOL'N ISOL'N STD]*.
26. When the measurement is complete, press *[ISOLATION DONE]*. Disconnect the loads.
27. Press *[TRANSMISSION]*.
28. Connect the two test port return cables together to form a "thru" configuration.
29. Press *[FWD. TRANS. THRU]*.
30. When the measurement is complete, press *[FWD. MATCH. THRU]*.
31. Continue with the *[REV. TRANS. THRU]* and *[REV. MATCH. THRU]* measurements.
32. Press *[TRANS. DONE]*.
33. Press *[DONE 2-PORT CAL]*.
34. The save softkey menu will automatically be displayed. Save the calibration in any register.
35. Calibration is now complete.

www.valuetronics.com

System VerificationThe following verification procedure is contained in the analyzer firmware. For each verification device the analyzer reads a file from the verification disk and sequentially measures the magnitude and phase for all four S-parameters.

The device number and test number for each verification device are as follows:

Verification Device	Test Number	Device Description
1	27	20dB attenuator
2	28	40/50 dB attenuator
3	29	50Ω airline
4	30	25Ω mismatch airline

36. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[2] [7] [x1].**
37. In the active entry area on the CRT, the following will be displayed:

    "TEST 27 Ver Dev 1"

38. If the record function was turned on in step 7, or if a printout is not desired, go to the next step.

    If a printout of the data for this device is desired, press **[SYSTEM]** ***[SERVICE MENU] [TEST OPTIONS] [RECORD ONI]*** **[SYSTEM]** ***[SERVICE MENU] [TESTS]***. Make sure the paper in the printer is set up so that printing starts at the top of the page.

39. Press ***[EXECUTE TEST]***.

NOTE: When printing test results, press **[FORM FEED]** on the printer to create page breaks in appropriate places.

40. When prompted, insert the 20 dB attenuator.

Connecting Device

When measuring 3.5 mm devices, connect the female end of the device to the port 1 cable.

When measuring 7 mm devices, connect the "A" end of the device to the port 1 cable. With the device label facing the user, the "A" end is on the left.

When measuring type-N devices, connect the female end of the device to the port 1 cable.

For instructions on the proper connection of the 50Ω and 25Ω airlines, refer to *Connecting the Airlines*.

41. Press ***[CONTINUE]***. The tests will begin.
42. If the record function is off (printout is not required), the program will pause after each S-parameter measurement and you will need to press ***[CONTINUE]*** after each measurement. (There are eight measurements for each device--magnitude and phase for each of the four S-parameters.)

www.valuetronics.com

NOTE: Although the verification limits for all four S-parameters are calculated, only the uncertainties associated with the items indicated in the following chart will be used for the system verification. The other characteristics are less significant for verifying system performance; therefore, they will not appear on the printout. If a measurement fails, note which device and S-parameter failed, and continue on with the remaining tests.

Also note that both the measured data and the factory data are displayed on the CRT.

Verification Device	S11/S22 Magnitude	S11/S22 Phase	S21/S12 Magnitude	S21/S12 Phase
20 dB attenuator	x		x	x
40 dB attenuator	x		x	x
3.5 mm beadless airline	x		x	x
Stepped impedance airline (rho = 0.6 std)	x	x	x	x

43. When all tests are complete, the TESTS softkey menu will appear. Disconnect the verification device.
44. Enter Test 28 (using step keys, entry keys, or RPG). Repeat steps 38 through 43 with the 40 or 50 dB attenuator.
45. Enter Test 29 (using step keys, entry keys, or RPG). Repeat steps 38 through 43 with the 50Ω airline.
46. Enter Test 30 (using step keys, entry keys, or RPG). Repeat steps 38 through 43 with the 25Ω mismatch airline.
47. The printout of the measurements shows both a plot of the measurement and a list of the measured frequencies with corresponding data. The plot includes both the measured data trace and the supplied factory data trace. The listing includes only the measured data. If there is a failure at any frequency, an asterisk will be next to the measured data and the out-of-specification measured data on the plot will be blanked out.

IN CASE OF FAILURE

1. If correction has been turned off and the message CAUTION: CALIBRATION REQUIRED is displayed, repeat the entire procedure with special attention paid to the cautions in step 9.
2. Ensure that the system is properly cabled. Refer to Figure 2. Improper cabling may cause failure (especially with the 25Ω airline).
3. Verify that the disc in the verification kit matches the devices in the kit. Check the serial number of the device against the serial number encoded in the title area of the display when the instrument state files for that device are recalled.
4. **HP 8720A ONLY:** instruments with firmware revision A.01.00, dated March 8, 1988, when verified with the HP 85054B type-N cal kit may fail due to a firmware error. See service note 8720-3.
5. Refer to *Troubleshooting*.

www.valuetronics.com

Connecting the Airlines

This section provides step-by-step procedures for connecting 3.5 mm, 7 mm, and type-N airlines and mismatch airlines.

Before making any connections, take care to avoid electrostatic discharge by wearing a grounded wrist strap. In addition, it is good practice to grasp the outer shell of the test port connector just before you make any connections to the test set. This discharges any static electricity on your body by providing a conductive path to an earth ground.

3.5 mm

The following procedure applies to the 7.5 cm 50Ω airline and the 25Ω mismatch airline with 3.5 mm connectors. Before proceeding with the connection procedure, assemble the airline and center conductor by removing the center conductor from its plastic case and inserting the female end of the center conductor into the outer conductor so that the female end of the center conductor is toward the end of the outer conductor without the connector nut (leave the protective cap on the male end of the outer conductor to prevent the center conductor from falling out of the outer conductor). Replace the protective cap on the female end of the airline until you are ready to use the airline.

Follow the *exact* sequence of steps when connecting these devices.

CAUTION

Be especially careful not to drop either the center conductor or the outer conductor when handling these airlines. Irreparable damage will result if these devices are dropped.

Connect the airline as follows:

1. Always connect the female end of the center conductor first. Remove the protective cap from the female end of the outer conductor (leave the cap on the other end for now).

CAUTION

During this procedure, you will be touching the exposed center conductor of the test port with the center conductor of the airline. Ground yourself to prevent electrostatic discharge (ESD).

www.valuetronics.com

CAUTION

Since the female end of the center conductor is beadless, special care should be taken to visually center and align the female pin on the male pin it is being connected to. This is recommended so damage to the internal contact fingers can be avoided. Do not attempt to connect these devices at an angle to the mating connector.

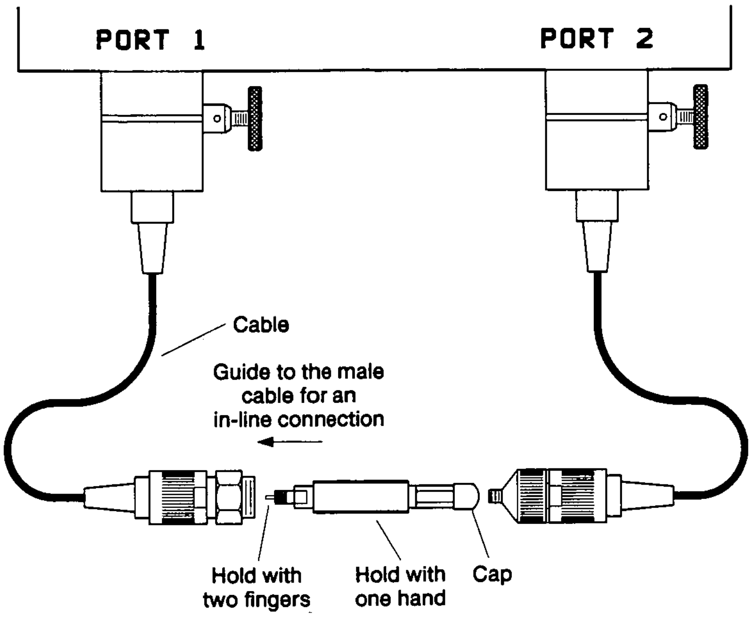


Figure 3. Aligning the Center Conductor

2. Pull the center conductor from the outer conductor just enough to be able to hold the center conductor with two fingers while holding the outer conductor with the other hand. Guide the center and outer conductors to the male cable for an in-line connection. Mate the female end of the airline center conductor with the center conductor of the cable connector.
3. Connect the outer conductor of the airline to the outer conductor of the cable connector. Hand tighten this connection.
4. Mate the male end of the airline with the cable connector. Hand tighten this connection.

www.valuetronics.com

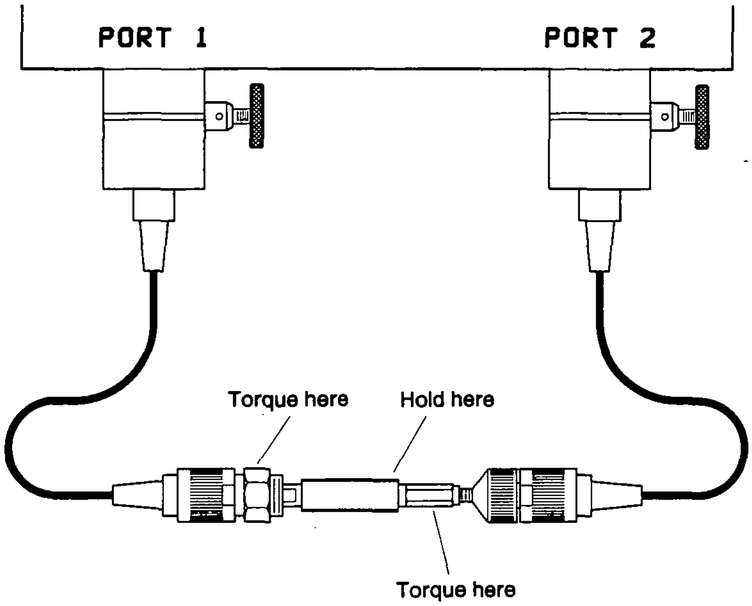


Figure 4. Torquing the Connection

5. Hold the plastic insulation cover on the airline to keep the airline from turning and torque each connection 90 N-cm, (8 in-lb). It may be necessary to use a 5/16 inch open end wrench to hold the airline stationary if it can not be prevented from rotating by hand.

To disconnect the airline:

1. Remove one cable from the airline and replace the plastic cap on the airline to prevent the center conductor from sliding out of the outer conductor. If the center conductor of the airline does not disengage from the cable center conductor, gently pull the airline center conductor from the cable center conductor and push the airline center conductor back inside the outer conductor of the airline.

2. Remove the cable from the other end of the airline. If the airline will not be used again immediately, slide the center conductor out of the outer conductor and store the center conductor in the plastic case provided. Replace the other plastic cap on the outer conductor and store the center and outer conductors in the foam lined storage case.

www.valuetronics.com

7 mm

The following procedure applies to the 10 cm 50Ω airline and the 25Ω mismatch airline with 7 mm connectors. Before proceeding with the connection procedure, verify that the center conductor is installed in the proper orientation. The end of the center conductor with the mark on it should be installed toward the end of the outer conductor that is closest to the 'H' in the HP logo on the label. Reversal of the center conductor changes device characteristics.

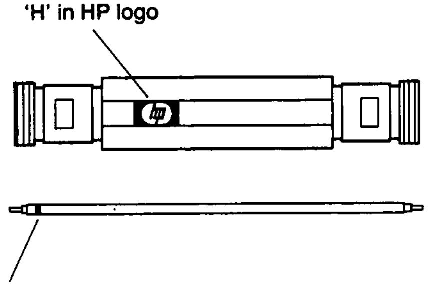


Figure 5. Airline Center Conductor Placement

Follow the *exact* sequence of steps when connecting these devices.

CAUTION

Be especially careful not to drop either the center conductor or the outer conductor when handling these airlines. Irreparable damage will result if these devices are dropped.

Connect the airline as follows:

1. Fully retract the threads on the port 1 cable connector.

NOTE: This procedure refers to the 'A' end of the airline as the end closest to the 'H' in the HP logo on the label of the outer conductor. The other end will be referred to as the 'B' end.

CAUTION

During this procedure you will be touching the exposed center conductor of the test port with the center conductor of the airline. Ground yourself to prevent electrostatic discharge (ESD).

www.valuetronics.com

2. Remove the cap from the 'A' end of the outer conductor. Leave the cap on the 'B' end for now.

3. Insert the center conductor into the outer conductor so that the mark on the center conductor is closest to the 'A' end of the outer conductor. Do not let the center conductor scrape the edge of the outer conductor. Damage may result.

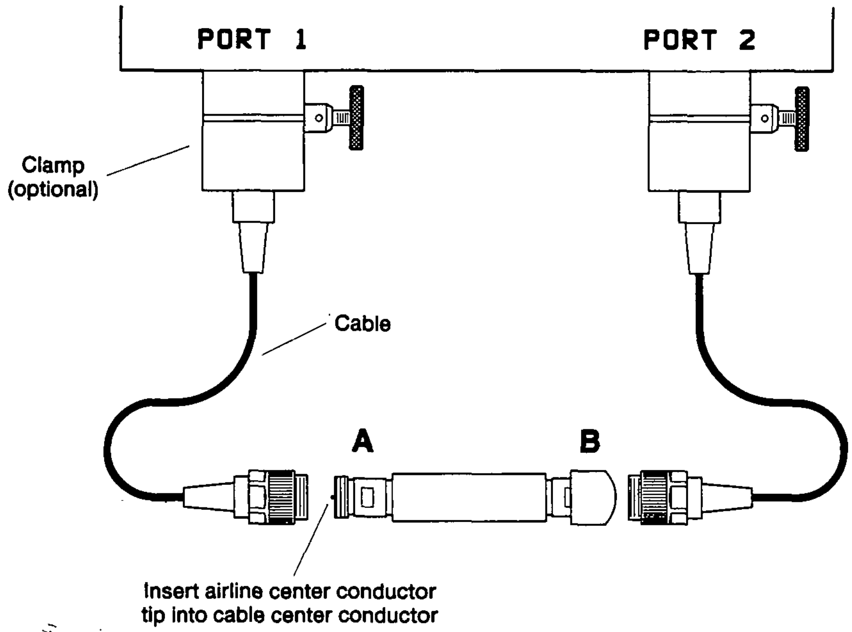


Figure 6. Connecting the Airline

4. Bring the 'A' end of the airline to the port 1 cable. Gently press on the cap at the 'B' end of the airline so that the center conductor tip emerges from the 'A' end of the airline.

5. Insert the tip of the center conductor (emerging from the 'A' end) into the cable center conductor (Figure 6). Mate the outer conductors of the airline and port 1 cable connector finger tight.

6. Gently remove the cap from the 'B' end of the outer conductor. Fully retract the threads on the port 2 cable.

7. Align the center conductor of the port 2 cable connector with the center conductor of the airline. Insert the tip of the airline center conductor into the center conductor of the port 2 cable connector.

8. Mate the outer conductors of the port 2 cable connector and airline finger tight.

www.valuetronics.com

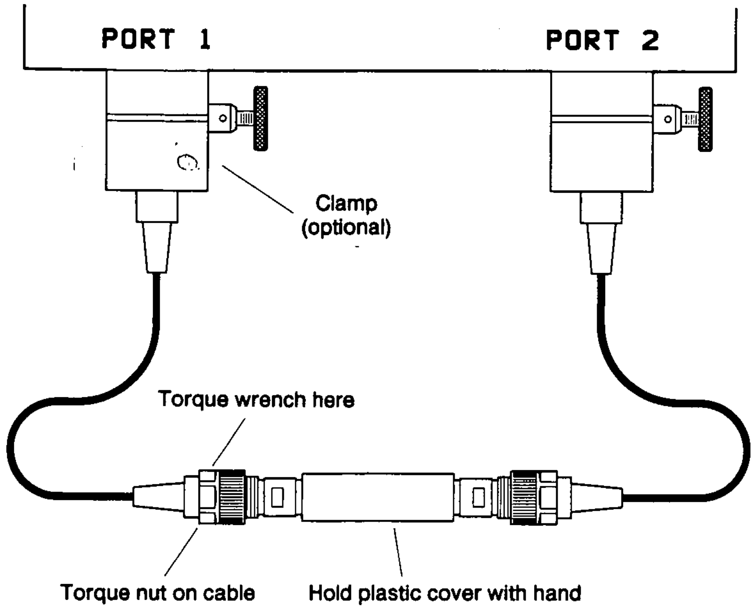


Figure 7. Torquing the Connection

9. Torque each airline-to-cable connection by holding the plastic insulation cover on the airline to keep the airline from turning while torquing the connection (136 N-cm, 12 in-lb) with a 3/4 inch torque wrench (Figure 7). It may be necessary to use a 1/2 inch open end wrench on the airline wrench flats to hold the airline stationary if the airline can not be prevented from rotating by hand.

To disconnect the airline:

1. Remove one cable from the airline and replace the plastic cap on the airline to prevent the center conductor from sliding out of the outer conductor.
2. Remove the cable from the other end of the airline. If the airline will not be used again immediately, slide the center conductor out of the outer conductor and store the center conductor in the plastic case provided. Replace the other plastic cap on the outer conductor and store the center and outer conductors in the foam lined storage case.

www.valuetronics.com

Type-N

The following procedure applies to the 50Ω airline and the 25Ω mismatch airline with type-N connectors. Before proceeding, assemble the airline by removing the center conductor from its plastic case and inserting the female end of the center conductor into the outer conductor so that the female end of the center conductor is toward the female end of the outer conductor (Figure 8). Leave the protective cap on the male end of the outer conductor to prevent the center conductor from falling out of the outer conductor. Replace the protective cap on the female end of the airline until you are ready to use the airline.

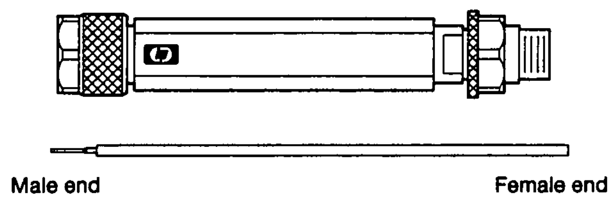


Figure 8. Airline Center Conductor Placement

Follow the *exact* sequence of steps when connecting these devices.

CAUTION

Be especially careful not to drop either the center conductor or the outer conductor when handling these airlines. Irreparable damage will result if these devices are dropped.

Connect the airline as follows:

1. Always connect the female end of the center conductor first. Remove the protective cap from the female end of the outer conductor (leave the cap on the other end for now). Verify that the female end of the center conductor emerges from the female end of the outer conductor.

CAUTION

You are touching an exposed center conductor. Ground yourself to prevent electrostatic discharge (ESD).

www.valuetronics.com

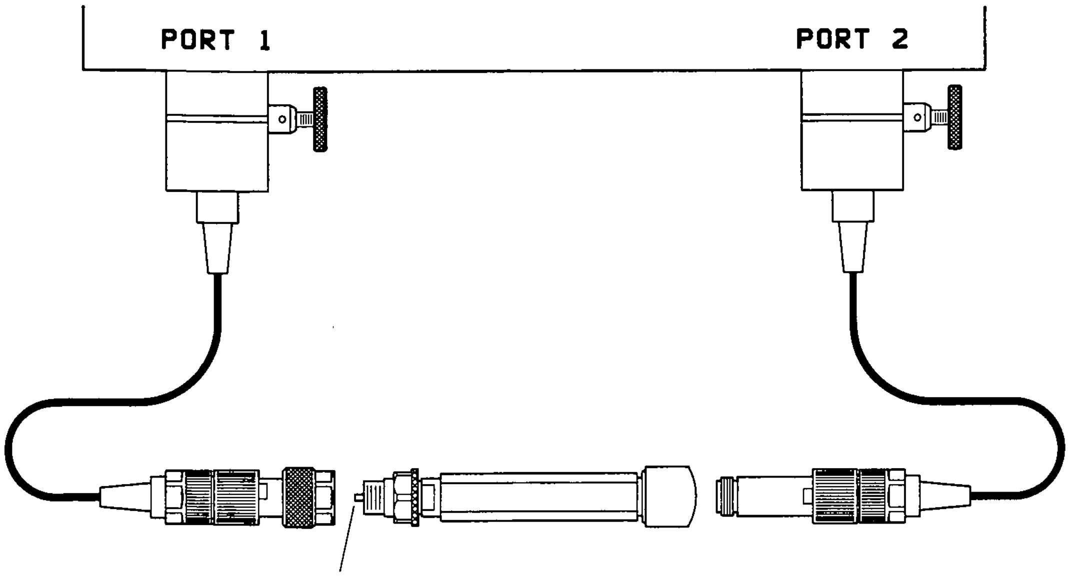


Figure 9. Connecting the Airline

2. Hold the airline and center conductor as shown and bring the center and outer conductor to the cable adapter. Mate the female end of the airline center conductor with the center conductor of the cable adapter.
3. Push the airline's female coupling sleeve forward and turn the adapter nut to mate the outer conductor of the airline with the adapter. Hand tighten this connection.
4. To connect the male end of the airline, align and insert the male end of the airline center conductor into the female end of the cable adapter and mate the outer conductors. Hand tighten this connection.

www.valuetronics.com

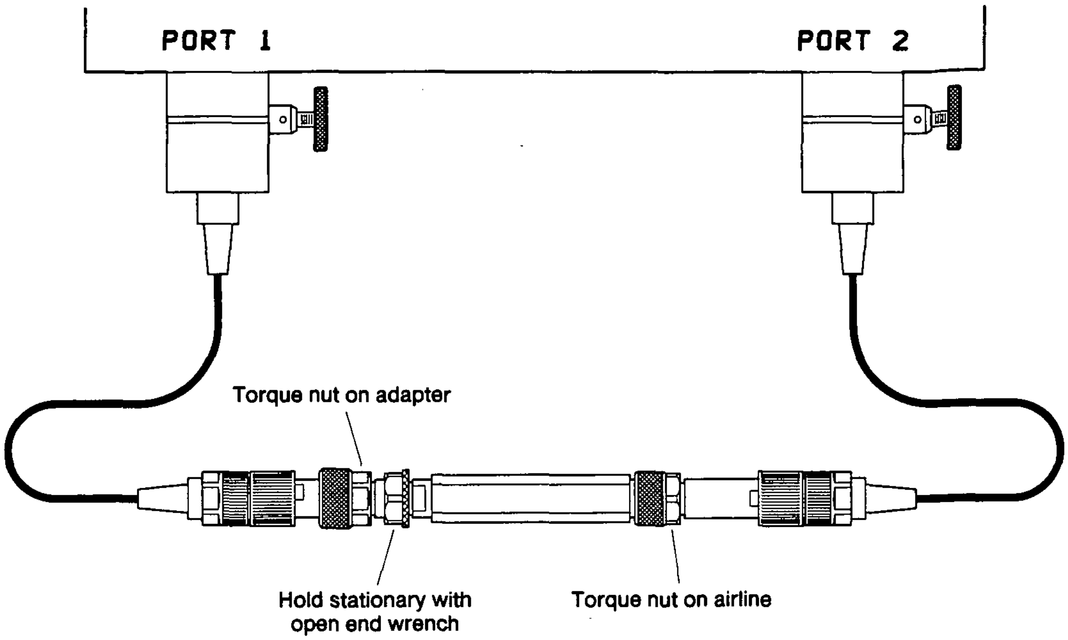


Figure 10. Torquing the Connection

5. Hold the sliding female coupling sleeve on the female end of the outer conductor with a 3/4 inch open end wrench to keep it from turning and torque the connection to 136 N-cm (12 in-lb).
6. Torque the male nut on the other end of the airline.

To disconnect the airline:

1. Disconnect the male end of the airline and replace the plastic cap on the airline to prevent the center conductor from sliding out of the outer conductor.
2. Disconnect the other end of the airline. If the airline will not be used again immediately, slide the center conductor out of the outer conductor and store the center conductor in the plastic case provided. Replace the other plastic cap on the outer conductor and store the center and outer conductors in the foam lined storage case.

www.valuetronics.com

PERFORMANCE TESTS

INTRODUCTION

This section consists of step-by-step performance tests that verify certain performance specifications of the network analyzer. They may be performed singly, or in any order desired. Approximately one hour is required to complete the performance tests, not including instrument warm-up time of 30 minutes.

The performance tests and page numbers are:

PERFORMANCE TEST TOOLS

Run the analyzer internal tests before performing the performance tests (press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS] [INTERNAL TESTS] [EXECUTE TEST]***. These quick, automated internal checks may save time by indicating an instrument fault before time is invested doing performance tests. Internal tests are described in the *Service Key Menus* section of this manual.

The *Microwave Connector Care Manual* (HP part number 08510-90064) contains specific information on the use, cleaning, mating, and gaging of 3.5 mm connectors, as well as precision 7 mm, SMA, and type-N connectors. Make sure that the test equipment used in each test meets its own published specifications and that all connectors are clean.

The table of Service Test Equipment in the *Service and Equipment Overview* section lists the necessary equipment (and critical specifications) to perform the performance tests. Equipment lists for individual tests are provided in each performance test.

The *Performance Test Record* at the end of this section provides a list of the specifications and acceptable limits for the performance tests, as well as a column to record actual measurements.

The table of Related Service Procedures in the *Post-Repair Procedures* section shows which performance tests and adjustments are interactive. Refer to it following adjustment or repair of the instrument.

www.valuetronics.com

CALIBRATION CYCLE (PERFORMANCE VERIFICATION)

The performance of the network analyzer should be verified at least once per year. Verification consists of performing system verification and performance tests.

IF THE INSTRUMENT FAILS A TEST

Refer to "If The Instrument Fails This Test" (at the end of each performance test) for troubleshooting hints and references to other manual sections to help resolve any problems.

www.valuetronics.com

Frequency Range and Accuracy Performance Test

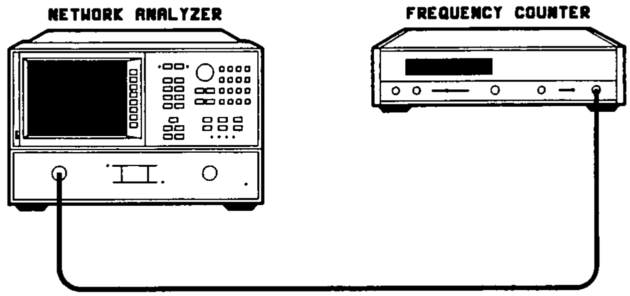


Figure 11. Frequency Range and Accuracy Test Setup

EQUIPMENT

Frequency counter .... HP 5350B
RF cable .... HP 85131C/D

DESCRIPTION AND PROCEDURE

This test checks the frequency accuracy of the analyzer over its entire frequency range. See the *Performance Test Record* (at the end of this section) for specifications. Warm-up time: 30 minutes.

1. Connect the equipment as shown in Figure 11 and press **[PRESET] [MENU]** ***[CW FREQ]***.
2. Press **[1] [3] [0] [M/u]** to select a CW frequency of 130 MHz. Record the frequency counter reading on the *Performance Test Record*.
3. Repeat step 2 for each of the instrument frequencies listed on the *Performance Test Record*.

IF THE INSTRUMENT FAILS THIS TEST

If any frequency measured is close to specification limits (either in or out of specification), check the time base accuracy of the counter used.

If the analyzer fails by a significant margin at all frequencies (especially if the deviation increases with frequency), the master time base probably needs adjustment. In this case, refer to the frequency accuracy adjustment in *Adjustments*. See *Source* for related troubleshooting information.

www.valuetronics.com

Power Level Performance Test

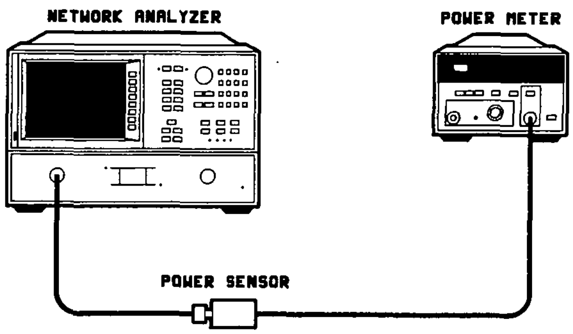


Figure 12. Power Level Test Setup

EQUIPMENT

Power meter .... HP 436A or 438A
Power sensor .... HP 8485A
3.5 mm (f)/3.5 mm (f) adapter .... 85052-60012 (part of HP 85052B/D)

DESCRIPTION AND PROCEDURE

The source power level is tested at 201 frequencies across the frequency range of the analyzer. See the *Performance Test Record* (at the end of this section) for specifications. Warm-up time: 30 minutes.

1. Zero and calibrate the power meter. Set the cal factor on the power meter to the average value of the power sensor between 0.13 and 20 GHz. (For example, if the power sensor cal factor is 100% at 0.13 GHz and 92% at 20 GHz, set the cal factor to 96%.)
2. Connect the power sensor to port 1 of the analyzer as shown in Figure 12.
3. On the analyzer, press **[PRESET] [MENU]** ***[SWEEP TYPE MENU] [LOG FREQ] [RETURN]*** to change the type of sweep.

www.valuetronics.com

4. During the sweep, note the maximum and minimum power level readings on the *Performance Test Record*. The maximum should be less than −7 dBm; the minimum, more than −13 dBm. The instrument remains at each frequency point for 1.5 seconds to allow the power meter sufficient time to settle.

   Press ***[SWEEP TIME MANUAL]*** **[3] [0] [0] [x1]** to begin the 300 second sweep.

   The standard HP 8720 will sweep only to 19.990 GHz in preset mode. To check the power level at 20 GHz, press **[MENU]** ***[CW FREQ]*** **[2] [0] [G/n]**. The power level observed should be between −7 dBm and −13 dBm.

IF THE INSTRUMENT FAILS THIS TEST

Ensure that the power meter and power sensor are operating to specification. Inspect the analyzer port 1 connector, the adapter and the power sensor connector for damage. Poor match at these connections can generate power reflections and cause the analyzer to appear to be out of limits. Repeat the measurement at port 2 (press **[MEAS]** ***[Refl: REV S22]*** to drive port 2).

Marginal failures (especially at the high or low end) may be due to the power sensor cal factor approximation method of step 1. A cal factor approximation of ±4%, as in the above example, induces an error of about 0.15 dB. To eliminate the cal factor approximation as the cause of failure, press **[MENU]** ***[CW FREQ]*** and rotate the knob to the frequency in question. Set the cal factor on the power meter to the value indicated by the power sensor. The corrected power level reading should be between −7 dBm and −13 dBm.

The source relies on the *Power Adjustments* for proper performance. Refer to *Adjustments* for additional information.

In case of catastrophic failure, refer to *Source Troubleshooting*.

www.valuetronics.com

Dynamic Range Performance Test

EQUIPMENT

Calibration kit .... HP 85052B/D*
RF cable set .... HP 85131C/D

*other cal kits may be used if working in a different connector type

DESCRIPTION AND PROCEDURE

Dynamic range is checked by comparing the noise floor to the test port output power level (determined in the power level performance test). See the *Performance Test Record* (at the end of this section) for specifications.

1. Press **[PRESET] [AVG]** *[IF BW]* **[1] [0] [0] [x1] [MENU]** *[NUMBER of POINTS]* **[8] [0] [1] [x1] [SCALE REF] [2] [5] [x1] [MEAS]** *[Trans: FWD S21]* to set up the first measurement.

2. Connect a thru (RF cable) between ports 1 and 2. Press **[CAL]** *[CALIBRATE MENU] [RESPONSE & ISOL'N] [RESPONSE] [THRU]*. At the beep, when the thru has been measured, press *[DONE: RESPONSE]* and remove the thru.

   Connect 50 ohm terminations to ports 1 and 2. Press **[AVG]** *[AVERAGING ON]* **[CAL]** *[RESUME CAL SEQUENCE] [ISOL'N STD]*. At the beep, when one ofthe terminations has been measured over 16 sweeps, press *[DONE RESP ISOL'N CAL]*.

3. Press **[AVG]** *[SMOOTHING ON] [SMOOTHING APERTURE]* **[.] [2] [x1]**. When the measurement has been averaged sixteen times, press **[MKR]** and use the knob to determine the maximum points in the frequency bands listed in the *Performance Test Record*. Record the S21 maximum points there.

   NOTE: To emphasize the frequency bands, press **[MKR] [.] [5] [G/n]** *[MARKER 2]* **[2] [G/n]** *[MARKER 3]*. Then move marker 3 with the knob to find the maximum points in the three frequency bands.

4. Press **[MEAS]** *[Trans: REV S12]* **[AVG]** *[AVERAGING OFF] [SMOOTHING OFF]* to set up the second measurement. Repeat steps 2 and 3. Record the S12 maximum points in the *Performance Test Record*.

IF THE INSTRUMENT FAILS THIS TEST

First suspect the connections, the calibration standards and the cable. Visually inspect all of the connectors and repeat the test. In case of repeat failure, gage the connectors (see the *Microwave Connector Care Manual*), substitute calibration standards and cable. Perform the sampler check (see *Adjustments and Correction Constants*).

Refer to the *Isolate Faulty Group* section for additional help.

www.valuetronics.com

PERFORMANCE TEST RECORD

(OPTION 003 INSTRUMENTS USE REVERSE SIDE.)

Use this sheet to record the results of performance tests. You may wish to copy it first and retain this sheet as a master.

Instrument serial number:______________ Temperature:______________

Date and time:______________ Humidity:______________

Operator:______________

Frequency Range and Accuracy

Specification: **HP 8719A frequency range: 130 MHz to 13.5 GHz ± frequency accuracy.**
HP 8720A/B frequency range: 130 MHz to 20 GHz ± frequency accuracy
Frequency accuracy: ±10 ppm (25°C ±5°C)

Instrument Frequency	Specification Lower Limit	Specification Upper Limit	Measured Value
130 MHz	129.998 700 MHz	130.001 300 MHz	______
300 MHz	299.997 000 MHz	300.003 000 MHz	______
700 MHz	699.993 000 MHz	700.007 000 MHz	______
1.0 GHz	0.999 990 GHz	1.000 010 GHz	______
2.0 GHz	1.999 980 GHz	2.000 020 GHz	______
3.5 GHz	3.499 965 GHz	3.500 035 GHz	______
5.0 GHz	4.999 950 GHz	5.000 050 GHz	______
8.0 GHz	7.999 920 GHz	8.000 080 GHz	______
10.0 GHz	9.999 900 GHz	10.000 100 GHz	______
13.5 GHz	13.499 865 GHz	13.500 135 GHz	______
15.0 GHz	14.999 850 GHz	15.000 150 GHz	______
20.0 GHz	19.999 800 GHz	20.000 200 GHz	______

Power Level

Specification: **−10 dBm ±3 dB across frequency range**

		Measured Value			Measured Value
Maximum:	**−7 dBm**	______ dBm	**Maximum:**	**−13 dBm**	______ dBm

Dynamic Range

Specification: listed below

Frequency Range	Specification	S21 Measured Value	S12 Measured Value
0.13 to 0.5 GHz	>70 dB	______ dB	______ dB
0.5 to 2 GHz	>80 dB	______ dB	______ dB
2 to 13.5 GHz	>85 dB	______ dB	______ dB
2 to 20 GHz	>85 dB	______ dB	______ dB

www.valuetronics.com

OPTION 003 PERFORMANCE TEST RECORD

(INSTRUMENTS WITHOUT OPTION 003 USE REVERSE SIDE.)

Use this sheet to record the results of performance tests. You may wish to copy it first and retain this sheet as a master.

Instrument serial number:________________ Temperature:____________________

Date and time:____________________ Humidity:______________________

Operator:________________________

Frequency Range and Accuracy

Specification: **HP 8719A frequency range: 130 MHz to 13.5 GHz ± frequency accuracy**
HP 8720A/B frequency range: 130 MHz to 20 GHz ± frequency accuracy
Frequency accuracy: ±10 ppm (25°C ±5°C)

Instrument Frequency	Specification Lower Limit	Specification Upper Limit	Measured Value
130 MHz	129.998 700 MHz	130.001 300 MHz	__________
300 MHz	299.997 000 MHz	300.003 000 MHz	__________
700 MHz	699.993 000 MHz	700.007 000 MHz	__________
1.0 GHz	0.999 990 GHz	1.000 010 GHz	__________
2.0 GHz	1.999 980 GHz	2.000 020 GHz	__________
3.5 GHz	3.499 965 GHz	3.500 035 GHz	__________
5.0 GHz	4.999 950 GHz	5.000 050 GHz	__________
8.0 GHz	7.999 920 GHz	8.000 080 GHz	__________
10.0 GHz	9.999 900 GHz	10.000 100 GHz	__________
13.5 GHz	13.499 865 GHz	13.500 135 GHz	__________
15.0 GHz	14.999 850 GHz	15.000 150 GHz	__________
20.0 GHz	19.999 800 GHz	20.000 200 GHz	__________

Power Level

Specification: **−10 dBm ±3 dB across frequency range, port 1 only**

		Measured Value
Maximum Power Level:	**−7 dBm**	__________ dBm
Minimum Power Level:	**−13 dBm**	__________ dBm

Dynamic Range

Specification: listed below

Frequency Range (GHz)	S21 Specification	S21 Measured Value	S12 Specification	S12 Measured Value
0.13 to 0.5	>99 dB	________ dB	Not tested	
0.5 to 2	>98 dB	________ dB	>55 dB	________ dB
2 to 8	>97 dB	________ dB	>65 dB	________ dB
8 to 13.5	>95 dB	________ dB	>65 dB	________ dB
13.5 to 20	>95 dB	________ dB	>65 dB	________ dB

www.valuetronics.com

INTRODUCTION

The accuracy of the analyzer is achieved and maintained through mechanical adjustments and correction constants. The correction constants are empirically derived data that are stored in memory and then recalled to refine the instrument's measurements and to define its operation.

Any time the A9 CPU assembly is replaced, all of the correction constants must be regenerated and stored on the new assembly. Alternatively, the data can be retrieved from disk. HP recommends that you store the correction constant data to disk now by referring to the EEPROM backup disk procedure in this section.

ORDER OF ADJUSTMENTS

When performing more than one adjustment, perform them in this order:

www.valuetronics.com

TEST EQUIPMENT

See the *Table of Service Test Equipment* in the *Service and Equipment Overview*.

INSTRUMENT COVER REMOVAL

See the facing tab. The covers need not be removed for routine maintenance.

A9 CC (CORRECTION CONSTANT) JUMPER POSITION

Move the A9 CC jumper, as explained below, to the ALTER position to change correction constants. The instrument is shipped, and should be operated, with the A9 CC jumper in the NORMAL position.

www.valuetronics.com

A9 CC Jumper Position Procedure

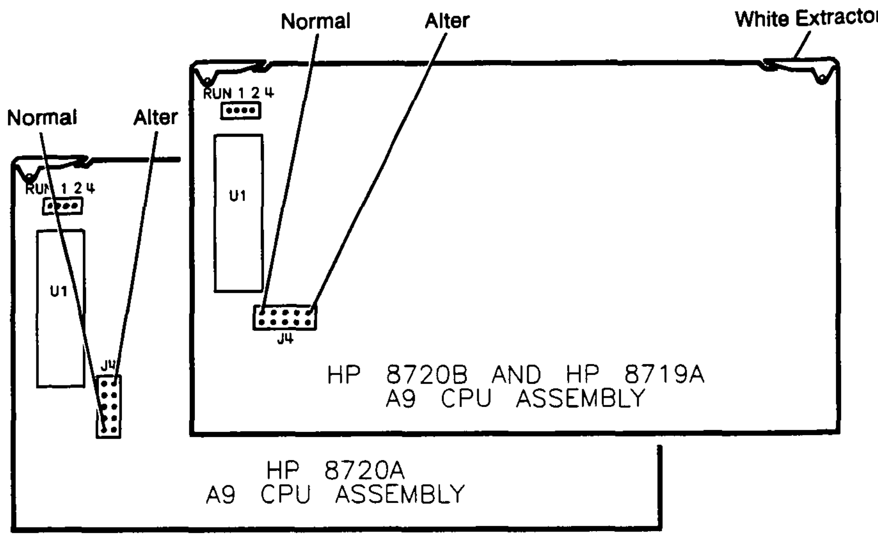


Figure 1. A9 CC Jumper Location

CAUTION: Turn off power before removing or installing assemblies.

1. Remove the top cover and PC board stabilizer of the analyzer.
2. The location of the assemblies in the upper portion of the instrument is shown on a label on the under side of the top cover. Remove the A9 CPU assembly and move the A9 CC jumper to the ALTER position (see Figure 1).
3. Replace the A9 assembly and run the correction constant routine(s).
4. Return the A9 CC jumper to the NORMAL position when finished.

NOTE: Update the EEPROM backup disk by performing the EEPROM backup disk procedure.

www.valuetronics.com

HP 8719A/20B Display Position and Focus Adjustments

No display adjustments, other than those in this manual, can be performed in the field (this includes both customers and service centers). Any other adjustments to the display will void the warranty. These adjustments are optional as they have been performed at the factory and should rarely require adjustment in the field.

DESCRIPTION AND PROCEDURE

Equipment required: none. Warm-up time: 30 minutes

Vertical Position Adjustment

1. To access vertical and focus adjustments controls, remove the side panel nearest the display.

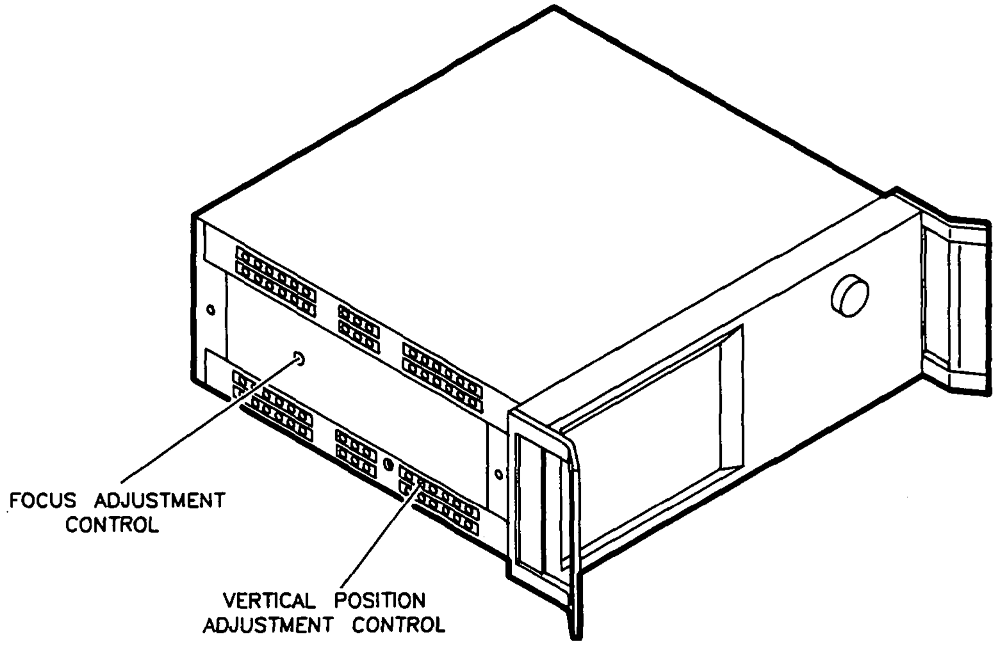


Figure 2. Vertical Position Adjustment Control

2. Insert a narrow, preferably non conductive, flat head screw driver (at least 2 inches long) into the vertical position hole.

3. Adjust the control until the softkey labels are aligned with the softkeys

Focus Adjustment

4. Use screwdriver as in step 3 to adjust the focus until display has the most readability.

www.valuetronics.com

HP 8719A/20 Display Degaussing (Demagnetizing)

EQUIPMENT

Any CRT Demagnetizer or Bulk Tape Eraser

DESCRIPTION AND PROCEDURE

Should the display become magnetized, or if color purity is a problem, cycle the power several times. Leave the instrument off for at least 15 seconds before turning it on. This will activate the automatic degaussing circuit in the display. If this is insufficient to achieve color purity, a commercially available demagnetizer must be used (either a CRT demagnetizer or a bulk tape eraser can be used). Follow the manufacturer's instructions keeping in mind the following: it is imperative that at first it be placed no closer than 4 inches (10 cm) from the face of the CRT while demagnetizing the display. If this distance is too far to completely demagnetize the CRT, try again at a slightly closer distance until the CRT is demagnetized.

CAUTION

Applying an excessively strong magnetic field to the CRT face can permanently destroy CRT.

Like most displays, the CRT can be sensitive to large magnetic fields generated from unshielded motors. In countries that use 50 Hz, some 10 Hz jitter may be observed. If this problem is observed, remove the device causing the magnetic field.

www.valuetronics.com

HP 8719A/20B Display Intensity Adjustments

EQUIPMENT

Photometer	Tektronix J16
Photometer Probe	Tektronix J6503
Light Occluder	Tektronix 016-0305-00

DESCRIPTION AND PROCEDURE

There are three display intensity adjustments: background, maximum, and operating default. In general, these adjustments should not be required. However, when either the A19 GSP, A9 CPU, or A18 display assemblies are replaced, perform a visual inspection of the display. If it appears to heed adjustment proceed with these adjustments.

NOTE: This procedure should be performed with a photometer and only by qualified service personnel.

Warm-up time: 30 minutes.

Background Adjustment

1. Remove the top cover of the analyzer (refer to the figure on the *Adjustments* tab. Check that the jumper on A9 CPU is in the ALTER position.

2. In a dimly lit room (or with the analyzer CRT shaded from bright lights), press **[PRESET]** **[SYSTEM]** ***[SERVICE MENU]*** (softkey 8) ***[TESTS]*** (softkey 1) **[45]** **[x1]**.

3. The CRT should display:

   Intensity Cor —ND-

NOTE: The display could be so far out of adjustment that the annotation will be very difficult to read.

4. Press ***[EXECUTE TEST]*** (softkey 1) and **[YES]** (softkey 2) at the prompt to alter the correction constants. Alternating vertical bars of three different intensities will be drawn on the CRT. Each bar has a number written below it (either 0, 1, or 2).

5. Adjust the analyzer front panel knob until the vertical bar labeled "1" is just barely visible against the black border. Vertical bar "0" must not be visible.

   With no changes to the analyzer, continue with the next test.

www.valuetronics.com

Maximum Intensity Adjustment

This adjustment ensures that the light output at the 100% intensity level is equal to, or less than, 150 NITs. The level is set using a photometer to measure the output light. 100% is the maximum intensity level of light output from the display.

CAUTION

Operating the display at intensities higher than 150 NITs may reduce the life of the display.

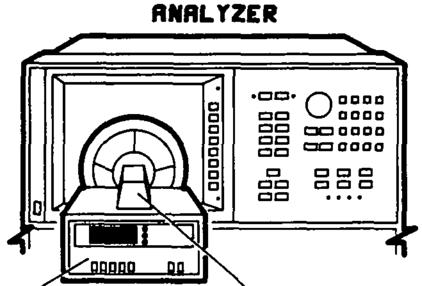


Figure 3. Maximum Intensity Adjustment Set-up

6. Press the top softkey.

7. Set the photometer probe to NORMAL. Press **[POWER]** on the photometer to turn it on and allow 30 minutes warm-up. Zero the photometer according to the manufacturer's instructions. The analyzer CRT should have an all white screen.

8. Center the photometer on the analyzer CRT as shown in Figure x. Adjust the analyzer front panel knob to the maximum (clockwise) position. If the photometer registers greater than 150 NITs *(90), turn the front panel knob until a reading of no more than 150 NITs (90) registers on the photometer. If the photometer registers a reading of less than 150 NITs (90) and greater than 100 (60) NITs, proceed to the next step. If the photometer registers a reading of less than 100 NITs (60), the display is faulty.

* **NOTE:** The above intensity levels are read without a display bezel installed. The glass filter transmits 60% of the display light, therefore 150 NITs would be 90 NITs with the bezel installed.

www.valuetronics.com

Operating Default Intensity Adjustment

This adjustment sets the default level display intensity. The analyzer normally presets to the same intensity level that was last used. This level is stored in volatile memory. If you power on and off, the memory is lost. Then the analyzer will use the default display intensity to ensure that the display is visible and eliminate concern that the display may not be functioning.

9. Press the top softkey on the analyzer to bring up the next display adjustment mode.

10. Center the photometer on the analyzer CRT as shown in Figure 3. Adjust the analyzer front panel knob until the photometer registers 100 NITs of output light if the glass bezel assembly is not installed. Adjust for 60 NITs if the glass bezel is installed.

11. Press the top softkey on the analyzer and observe the CRT:

    - "DONE" displayed: the adjustment is done. Refer to the *EEPROM Backup Disk Procedure* to store the new correction constants. This completes the series of three *Display Intensity Adjustments*.

    - "DONE" and "CORRECTION CONSTANTS NOT STORED" displayed: refer to *A9 CC Jumper Position* to reposition jumper; rerun routine.

    - Continued improper operation: refer to *Troubleshooting* to isolate the problem.

www.valuetronics.com

HP 8720A Display Intensity and Focus Correction Constants

NOTE: After installing a display, immediately check the power supply voltages as outlined in *Power Supply*.

DESCRIPTION AND PROCEDURE

This procedure stores the display intensity and focus settings as correction constants. Equipment required: none. Warm-up time: 5 minutes.

1. Check A9 CC jumper position. In the RESPONSE area of the front panel, press **[DISPLAY]**. Then press the bottom softkey, *[MORE]*. The top five softkeys (which may not be legible) are:

   [SPLIT DISP on OFF]
   [BEEP DONE ON off]
   [BEEP WARN on OFF]
   [INTENSITY]
   [FOCUS]

2. Press ***[INTENSITY]*** (fourth softkey from the top) and rotate the RPG knob clockwise to increase the intensity of the display; counterclockwise, to decrease.
3. Press ***[FOCUS]*** (fifth softkey from the top) and rotate the RPG knob for best focus. The intensity and focus adjustments are slightly interactive.
4. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[4] [5] [x1]**. When the CRT displays "Foc/Int Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants.
5. If the display does not indicate "Foc/Int Cor DONE", refer to *Isolate Faulty Group.*

www.valuetronics.com

Serial Number Correction Constant

DESCRIPTION AND PROCEDURE

This procedure customizes the replacement A9 CPU assembly by storing the instrument's unique serial number as a correction constant in EEPROM. Equipment required: none. Warm-up time: 5 minutes.

CAUTION: Perform this procedure ONLY if the A9 CPU assembly has been replaced.

1. Check A9 CC jumper position. Note the ten character serial number on the rear panel identification label.
2. Press **[PRESET] [DISPLAY]** ***[MORE] [TITLE] [ERASE TITLE]***. Rotate the RPG knob to position the arrow below each character of the instrument serial number and press ***[SELECT LETTER]*** to enter each in turn. Enter a total of ten characters: four digits, one letter, and five final digits.

   Press ***[BACKSPACE]*** or ***[ERASE TITLE]*** to correct errors. When the title is complete and correct, press ***[DONE]***.

CAUTION

Mistakes cannot be corrected after step 3 is performed.

3. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [9] [x1]**. When the display shows "Serial Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constant.
4. To check the serial number recognized by the instrument, press **[DISPLAY]** ***[MORE] [TITLE]***. The number displayed in the title area of the CRT (upper left) should be the instrument serial number. If not perform step 5.
5. If this procedure did not end with "DONE", either the A9 CC jumper was not in the ALTER position or the serial number entered did not conform to the required format or a valid serial number was already stored. In any case, confirm that the A9 CC jumper is in the ALTER position, confirm that the serial number is correct, and repeat this procedure. Contact HP if the procedure still does not end with "DONE".

www.valuetronics.com

Option Numbers Correction Constant

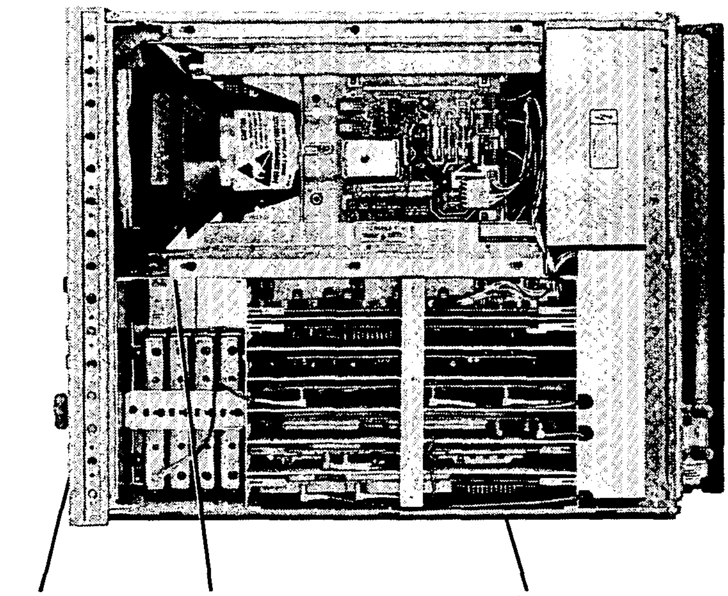


Figure 4. Location of Registration Number Label

DESCRIPTION AND PROCEDURE

Special information is stored on the A9 CPU assembly of instruments with option 001 (1 Hz resolution) or option 010 (time domain) or option 003 (extended dynamic range) or any combination. Equipment required: none. Warm-up time: 5 minutes.

Perform steps 1 through 4 *only* if:

(1) the instrument has option 001 or 010 or both, AND
(2) the A9 CPU assembly has been replaced, AND
(3) the serial number correction constant procedure has been performed.

NOTE: Perform step 5 after steps 1 through 4 (if applicable) to add option 003 to the A9 CPU EEPROM.

1. Remove the top cover of the instrument. Check the A9 CC jumper position (it must be in the ALTER position). Note the registration number on the registration number label (see Figure 4).

www.valuetronics.com

2. Press **[PRESET] [DISPLAY]** ***[MORE] [TITLE] [ERASE TITLE].*** Rotate the RPG knob to position the arrow below each character of the registration number, and press ***[SELECT LETTER]*** to enter each in turn.

   Press ***[BACKSPACE]*** or ***[ERASE TITLE]*** to correct errors. When the title is complete and correct, press ***[DONE]***.

CAUTION

Mistakes cannot be corrected after step 3 is performed.

3. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [0] [x1]**. When the display shows "Option Cor", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constant.
4. If this procedure did not end with "DONE", either the A9 CC jumper was not in the ALTER position or the registration number entered did not conform to the required format. In either case, confirm that the A9 CC jumper is in the ALTER position and repeat this procedure. Contact HP if the procedure still does not end with "DONE".
5. To reactivate option 003, the A9 CC jumper must be in the ALTER position. Turn on the analyzer and press **[SYSTEM]** ***[SERVICE MENU] [PEEK/POKE] [PEEK/POKE ADDRESS]*** **[1314608] [x1]** (for HP 8720As use address 659248). Then press ***[POKE]*** **[1][x1]**.

Power cycle the instrument. The CRT should indicate that option 003 is installed. Return the A9 CC jumper to the NORMAL position.

www.valuetronics.com

Analog Bus Correction Constants

DESCRIPTION AND PROCEDURE

This procedure calibrates the analog bus by using three reference voltages (ground, +0.37V and +2.5V). It then stores the calibration data as correction constants in EEPROM. Equipment required: none. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [4] [x1]**. When the display shows "ABUS Cor", press ***[EXECUTE TEST]*** and then press ***[YES]*** at the query to alter the correction constants.
2. If this procedure did not end with "DONE", refer to *Digital Control*.

IF Amplifier Correction Constants

EQUIPMENT

RF cable .... HP 85131C/D/E/F

DESCRIPTION AND PROCEDURE

These correction constants compensate for possible discontinuities of signals greater than −30 dBm. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [7] [x1]** and then press ***[EXECUTE TEST]*** when "IF Step Cor" appears. Press ***[YES]*** at the query to alter the correction constants.
2. At the prompt, connect the RF cable (the thru) between ports 1 and 2 (see Figure 5) and press ***[CONTINUE]***.
3. If the procedure does not end with "DONE", refer to *Digital Control*.

www.valuetronics.com

ADC Linearity Correction Constants

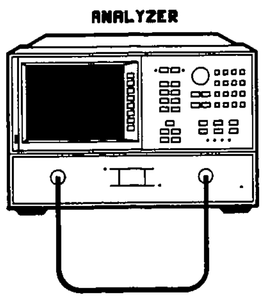


Figure 5. ADC Linearity Correction Constants Setup

EQUIPMENT

RF cable .... HP 85131C/D/E/F

DESCRIPTION AND PROCEDURE

These correction constants improve dynamic accuracy by shifting small signals to the most linear part of the ADC quantizing curve. Warm-up time: 5 minutes.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[4] [8] [x1]**. When the CRT displays "ADC Ofs Cor", press ***[EXECUTE TEST]***.
2. Connect the RF cable between ports 1 and 2 (see Figure 5). Press ***[YES]*** at the query to alter the correction constants.
3. If this procedure did not end with "DONE", refer to *Digital Control*.

www.valuetronics.com

Source Pretune Correction Constants

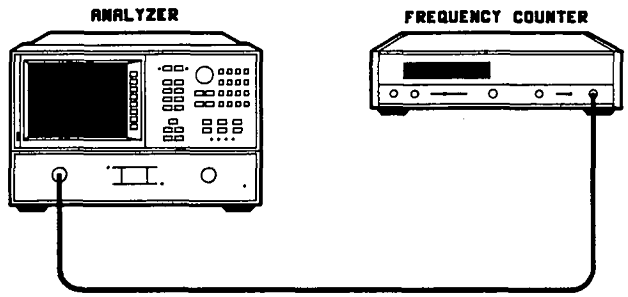


Figure 6. Source Pretune Correction Constants Setup.

EQUIPMENT

Frequency counter .... HP 5350B*
RF cable .... HP 85131C/D/E/F

*The frequency accuracy of the HP 8566A/B spectrum analyzer is sufficient for this procedure.

DESCRIPTION AND PROCEDURE

This adjustment generates two correction constants which pretune the YIG oscillators to insure proper phase lock. Warm-up time: 30 minutes.

1. Check A9 CC jumper position. Connect the equipment as shown in Figure 6 and then press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS] [ADJUSTMENT TESTS].*** When the CRT displays "Pretune Adj", press ***[EXECUTE TEST]***. Press ***[YES]*** at the query to alter the correction constants.
2. When the prompt, "Set source to 2.145 GHz, then continue" appears, use the RPG knob to adjust the frequency of the analyzer source to within 5 MHz of 2.145 GHz (2.140 GHz to 2.150 GHz). The measured frequency will vary with the SRC DAC tune number. Press ***[CONTINUE]*** when the frequency is set.
3. When the prompt, "Set source to 8.325 GHz, then continue" appears, set the measured frequency as above to within 5 MHz of 8.325 GHz (8.320 to 8.330 GHz). Then press ***[CONTINUE]***.
4. When the CRT displays "DONE", press **[PRESET]**.
5. If any error messages appear, refer to *Source*.

www.valuetronics.com

EEPROM Backup Disk Procedure

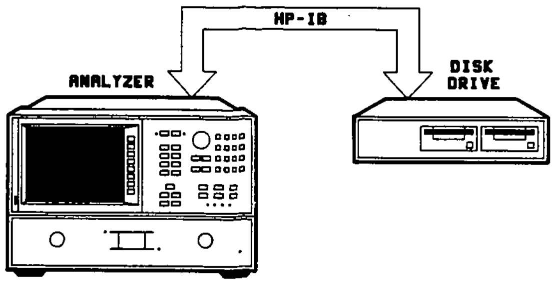


Figure 7. EEPROM Backup Procedure Setup

EQUIPMENT

CS80 disk drive .... HP 9122S/D
HP-IB cable .... HP 10833A/B/C/D
3.5 in microfloppy disk .... HP 92192A (box of 10)

DESCRIPTION AND PROCEDURE

Correction constants are stored in EEPROM on the A9 assembly. The great value of the EEPROM backup disk is its capability to store all of the correction constant data to a new or repaired A9 assembly without having to rerun the correction constant procedures.

- Make an EEPROM backup disk and keep it current.
- Store the correction constant data to the EEPROM backup disk each time a correction constant routine is performed.
- Retrieve correction constant data from the EEPROM backup disk if the A9 assembly is replaced.

How to Make an EEPROM Backup Disk and Store Correction Constant Data to It

1. Connect the instruments as shown in Figure 7 and turn them on. Make sure the drive is set to HP-IB address 00. Then press **[LOCAL]** ***[SYSTEM CONTROLLER]***.
2. If the disk is not initialized, press **[SAVE]** ***[STORE TO DISK] [DEFINE STORE] [INITIALIZE DISK] [INIT DISK? YES]***.

www.valuetronics.com

3. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [MORE] [STORE EEPR ON]*** to store the EEPROM data with the instrument state.

4. Press **[SAVE]** ***[STORE TO DISK] [TITLE FILES] [TITLE FILEn] [ERASE TITLE]*** and then use the RPG and softkeys to title the file "N12345" (the first character must be a letter; 12345 represent the last five digits of the instrument's serial number).

   When finished, press ***[DONE] [RETURN] [STORE N12345]***.

5. Label the disk with the serial number of the instrument and the words "EEPROM Backup Disk."

How to Retrieve Correction Constant Data from the EEPROM Backup Disk

NOTE: HP 8719A/20B - put A9 CC jumper in ALTER position and continue with step 4.

1. Connect the instruments as shown in Figure 7. Make sure the drive is set to HP-IB address 00.

2. Make sure the A9 CC jumper is in the ALTER position. Install the new A9 assembly.

3. Turn on the instruments. If the analyzer display is dark, press **[DISPLAY]** ***[MORE]*** (bottom softkey) ***[INTENSITY]*** (fourth softkey from top) and then turn the RPG knob.

   If the display is unfocused, press **[DISPLAY]** ***[MORE]*** (bottom softkey) ***[FOCUS]*** (fifth softkey from top) and then turn the RPG knob. See "Display Intensity and Focus Correction Constants" for more information.

NOTE: Disregard noisy trace data or error messages on the display now.

4. Press **[LOCAL]** ***[SYSTEM CONTROLLER]*** **[RECALL]** ***[LOAD FROM DISK] [READ FILE TITLES]*** *[**LOAD** N12345]* where N12345 represents the file name of the EEPROM data for the analyzer. "FILE 1" is the filename of the EEPROM data disk supplied.

5. Perform the serial number and, if applicable, the option number correction constant routines.

6. Press **[PRESET]** and verify that good data was transferred to EEPROM by performing a simple measurement.

7. In case of difficulty, refer to *Troubleshooting*.

www.valuetronics.com

HP 8720A Display Image Size, Position and Trace Alignment Adjustments

DESCRIPTION AND PROCEDURE

The horizontal and vertical gain and position adjustments are made with four potentiometers on the A18A1 assembly on the underside of the display. The trace alignment potentiometer is on the same assembly, as shown in Figure 8. Equipment required: none. Warm-up time: 5 minutes.

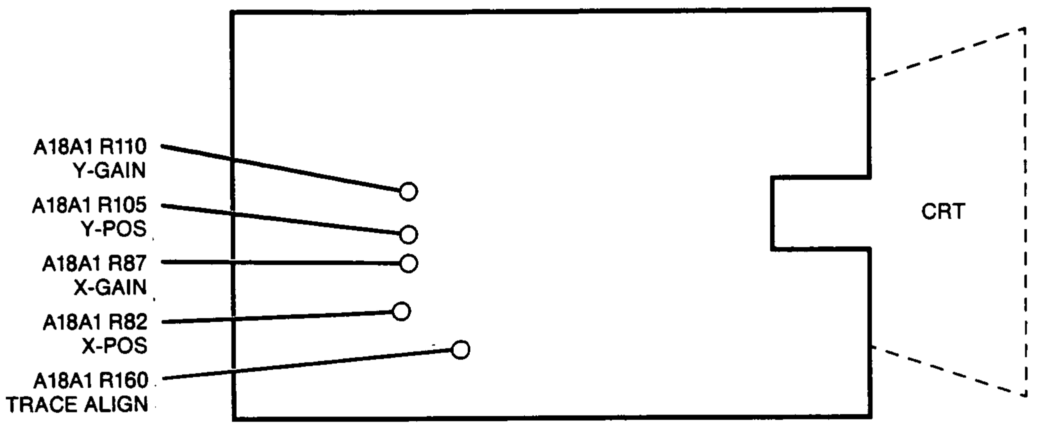


Figure 8. Gain, Position and Alignment Adjustment Locations

1. The initial screen should show a graticule 13.5 cm (5.25 in) wide and 11.4 cm (4.5 in) high. The graticule should not be centered on the screen because the notations which appear at its four sides differ in size. It should appear level, not slanted.
2. If the display appears as described above, no adjustments are required. Otherwise, turn off the HP 8720A, remove the A9 CPU assembly, pivot open the instrument and turn it on again.
3. Make the following adjustments:

Reference Designator	Adjustment	Description
A18A1R110	Y-gain	Adjust for a 12 cm (4.75 in) high display.
A18A1R105	Y-position	Adjust to vertically center image.
A18A1R87	X-gain	Adjust for a 17 cm (6.75) wide display.
A18A1R82	X-position	Adjust to horizontally center image.
A18A1R160	trace align	Adjust for level image.

4. If the adjustments are ineffective, check the voltages as outlined in *Digital Control*. If the voltages are correct, replace the display.

www.valuetronics.com

Reference Assembly VCO Tune Adjustment

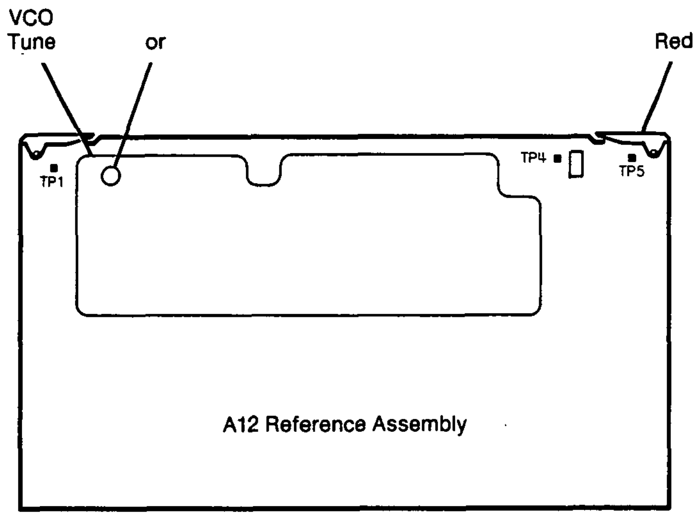


Figure 9. VCO Tune Adjustment Location

EQUIPMENT

Extender board, large .... part of tool kit HP p/n 08720-60004

DESCRIPTION AND PROCEDURE

This adjustment centers the reference assembly VCO (voltage controlled oscillator) in its tuning range. Warm-up time: 30 minutes.

1. Remove the instrument top cover. If VCO TUNE on the A12 assembly (red extractors) is accessible, continue with step 2. See Figure 9. Otherwise, install the A12 assembly on the extender. Use SMB cables as required (the EXT REF cable need not be reconnected now).
2. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS ON]*** **[1] [5] [x1]** to display "VCO Tune."
3. Press **[MKR]** and **[SCALE/REF]** ***[SCALE/DIV]*** **[.] [5] [x1]**.
4. Adjust VCO TUNE with a non-metallic adjustment tool to 0.0V ±500 mV (within one division of the reference line). The adjustment is sensitive.
5. If VCO TUNE cannot be adjusted as specified, and the instrument passes the Abus test, the A12 assembly must be replaced.

www.valuetronics.com

Frequency Accuracy Adjustment

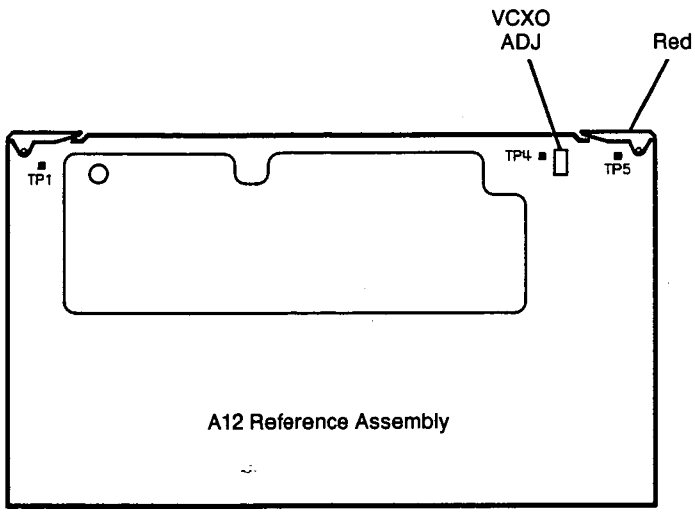


Figure 10. VCXO Adjustment Location

EQUIPMENT

Frequency counter . . . . HP 5350B
RF cable . . . . HP 85131C/D

DESCRIPTION AND PROCEDURE

This adjustment sets the VCXO (voltage controlled crystal oscillator) frequency to maintain the instrument's frequency accuracy. Warm-up time: 30 minutes.

1. Connect port 1 of the analyzer to the frequency counter input (see Figure 6). Press **[PRESET] [MENU]** ***[CW FREQ]*** **[1] [3] [.] [5] [G/n]**.
2. If the measured frequency is 13.5 GHz ±135 kHz, no adjustment is necessary, although the instrument can easily be adjusted much closer.
3. Otherwise, locate the A12 assembly (red extractors) and adjust VCXO ADJ (see Figure 10) for a frequency counter reading as close to 20 GHz as possible. It must be within ±200 kHz.
4. If you are unable to adjust the frequency as specified, replace the A12 assembly.

www.valuetronics.com

Sampler Check

EQUIPMENT

RF cable .... HP 85131C/D
3.5 mm (f) 50 ohm termination (2) ...... HP 909D option 011 (85052-60011)*

*or use one female and one male termination (85052-60010) with an (f)/(f) adapter (85052-60012), all part of HP 85052B calibration kit

DESCRIPTION AND PROCEDURE

Samplers are adjustable only at the factory. New samplers which do not pass the following check must be replaced. Warm-up time: 30 minutes.

NOTE: Make sure all connections are good before checking a sampler or concluding it is faulty.

1. Connect the RF cable from port 1 to port 2 (Figure 3). Turn on the instrument and press **[START] [3] [G/n] [MKR FCTN]** ***[MKR SEARCH ON] [TRACKING ON] [SEARCH: MIN]***. Perform step 2, 3 or 4 to check the A, B or R sampler.

A Sampler Check

2. a. To check the A sampler (A65, at port 1) press **[MEAS]** ***[TRANS: REV S12]***. The minimum marker reading should be >-7 dB (within 7 dB of the 0 dB reference line); option 003: >-27 dB (within 27 dB of the reference line).

   b. Press **[START] [1] [3] [0] [M/u] [AVG]** ***[IF BW]*** **[1] [0] [0] [x1]** to set the start frequency and bandwidth. Remove the RF cable and connect a 50 ohm termination at each port. Press **[SCALE REF] [2] [0] [x1] [REFERENCE VALUE] [-] [7] [0] [x1]** to rescale the CRT.

   c. Press **[AVG]** ***[AVG FACTOR]*** **[3] [2] [x1]** ***[AVERAGING ON]*** **[MKR FCTN]** ***[MRK SEARCH] [SEARCH MAX]***. After 32 sweeps have been averaged, the maximum marker reading should be <-70 dB (below the reference line).

   If the readings in steps 2a or 2c are not as specified, replace A65.

B Sampler Check

3. a. To check the B sampler (A66, at port 2) press **[MEAS]** ***[TRANS: FWD S21]***. The minimum marker reading should be >-7 dB (option 003: >2 dB).

   b. Press **[START] [1] [3] [0] [M/u] [AVG]** ***[IF BW]*** **[1] [0] [0] [x1]** to set the start frequency and bandwidth. Remove the RF cable and connect a 50 ohm termination at each port. Press **[SCALE REF] [2] [0] [x1] [REFERENCE VALUE] [-] [7] [0] [x1]** to rescale the CRT.

www.valuetronics.com

c. Press **[AVG]** ***[AVG FACTOR]*** **[3] [2] [x1]** ***[AVERAGING ON]*** **[MKR FCTN]** ***[MRK SEARCH][SEARCH MAX]***. After 32 sweeps have been averaged, the maximum marker reading should be <-70 dB (below the reference line).

If the readings in steps 3a or 3c are not as specified, replace A66.

R Sampler Check

4. To check the R sampler (A64, internal) perform steps 2a and 3a (the first part of the A sampler and B sampler check). If both readings are not as specified, replace A64.

www.valuetronics.com

Power Adjustments

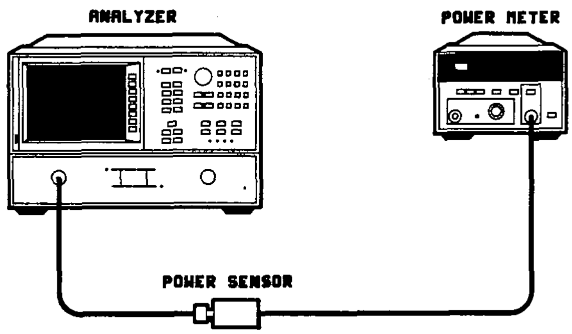


Figure 11. Power Adjustments Setup

EQUIPMENT

Power meter .... HP 436A or 438A
Power sensor .... HP 8485A
3.5 mm (f)/(f) adapter ...... 85052-60012 (part of HP 85052B calibration kit)

Low Band Power Level Adjustment

DESCRIPTION AND PROCEDURE

This adjustment equalizes the maximum power level in the frequency bands below 2 GHz and above 2 GHz to ensure proper ALC (automatic leveling control) operation. Warm-up time: 30 minutes.

1. Remove the covers and fasteners so that the analyzer can be pivoted open (see *Adjustments and Correction Constants* tab). Turn on the instrument and press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [ALC OFF]*** **[MENU]** ***[CW FREQ]*** **[.] [1] [3] [G/n]** to lock the ALC circuit and enter CW mode.
2. Zero and calibrate the power meter. Connect the power sensor to port 1 of the analyzer. Set the cal factor of the power meter to the value of the power sensor for 0.13 GHz.

NOTE: If phase lock error messages appear, adjust ALC OFF fully clockwise (see Figure 14).

3. Rotate the RPG knob slowly to increase the frequency to 2 GHz. Note the maximum power level and frequency (typically below 0.5 GHz) in columns 1 and 3 of the table below. If there are two peaks, note both.

www.valuetronics.com

Maximum Power <2 GHz			Maximum Power >2 GHz	
Power Level		Frequency	Power Level	Frequency
Before	After			
(1) ________ dBm ________ dBm	(2) ________ dBm ________ dBm	(3) ________ GHz ________ GHz	(4) ________ dBm ________ dBm	(5) ________ GHz ________ GHz

4. Rotate the RPG knob slowly to increase the frequency to 10 GHz. Change the cal factor of the power meter as required. Note the maximum power level and frequency (one or two peaks, typically around 2.2 GHz and 8 GHz) in columns 4 and 5. Figure 12 shows a typical power level plot.

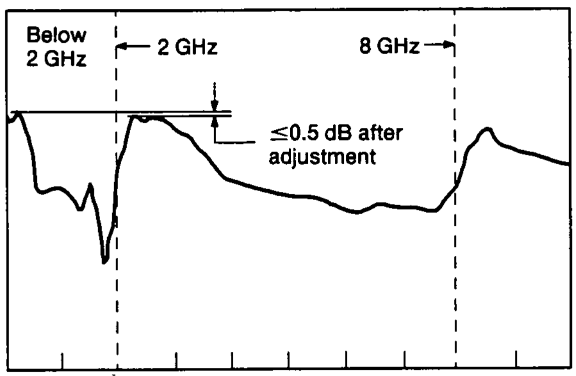


Figure 12. Typical Power Level Plot

5. If the greater power peak below 2 GHz (column 1) is within 0.5 dB of the greater power peak above 2 GHz (column 4), no adjustment is required. Continue with the following automatic leveling control adjustment.

   Otherwise, reset the analyzer to the frequency of the greater power peak below 2 GHz (column 3).

6. Adjust LEVEL ADJ (see Figure 13) to within 0.5 dB of the power peak above 2 GHz (column 4). Note the reading in column 2.

www.valuetronics.com

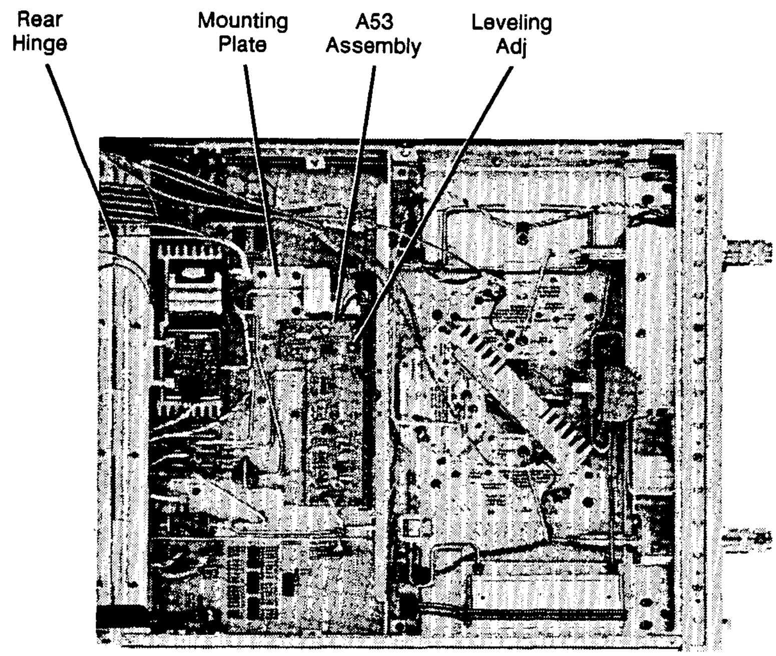


Figure 13. Location of LEVEL ADJ Adjustment

7. Adjusting LEVEL ADJ can change the relative levels of the power peaks. If two power peaks were noted below 2 GHz (and entered in column 1), recheck both peaks and note the power levels in column 2.

8. Ultimately, the maximum power level below 2 GHz must be within 0.5 dB of the maximum power level above 2 GHz, as shown in Figure 12. When adjusted, perform the following automatic leveling control adjustment.

   If you are unable to perform this adjustment as specified, suspect the A53 mixer/amp and A58 modulator assemblies. Refer to *Source* for troubleshooting help.

www.valuetronics.com

Automatic Leveling Control Adjustment

DESCRIPTION AND PROCEDURE

This adjustment sets the RF power level with the ALC off and with the ALC on, to reduce power spikes and phase lock problems.

NOTE: First perform the low band power level adjustment. The analyzer should still have the power sensor connected to port 1 and it should be in the ALC OFF service mode.

1. Rotate the RPG knob of the analyzer to the frequency of maximum power (as determined in the previous procedure). Set the cal factor on the power meter to the value indicated by the power sensor.

   Adjust ALC OFF (see Figure 14) for a power meter reading of -7 ± 0.1 dBm.

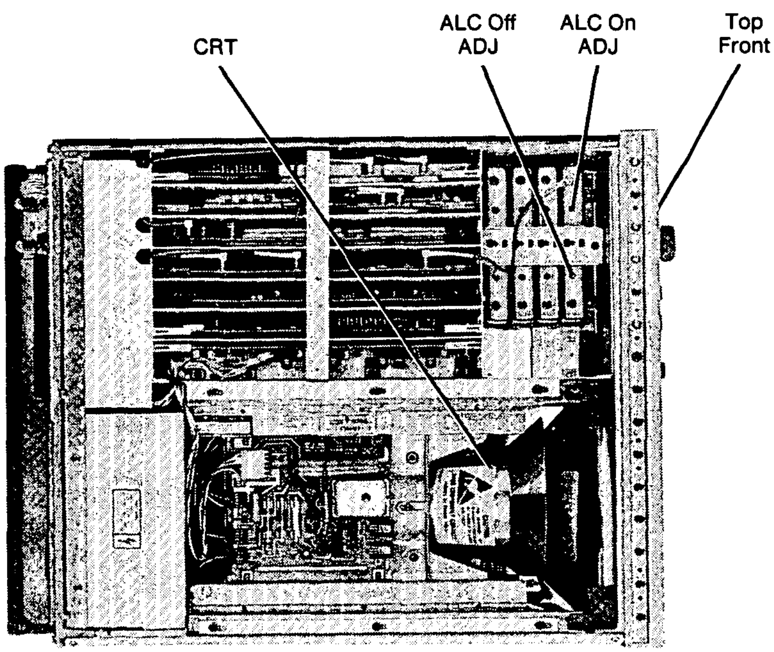


Figure 14. Location of Automatic Leveling Control Adjustments

2. On the analyzer, press **[6] [.] [5] [G/n] [SYSTEM]** ***[SERVICE MENU] [ALC ON]*** to reset the frequency and turn on the ALC.

   Adjust ALC ON (see Figure 14) for a power meter reading of -10 ± 0.1 dBm.

3. If you are unable to perform this adjustment, refer to *Source.*

www.valuetronics.com

Optional Fractional-N Spur and FM Sideband Adjustment

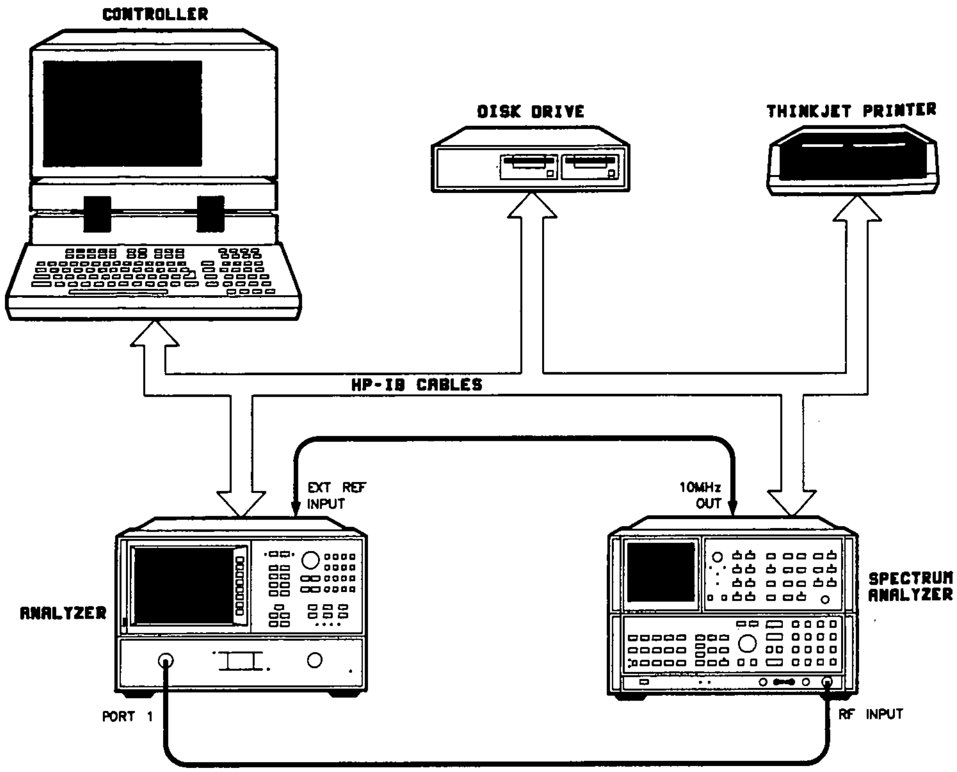


Figure 15. Fractional-N Spur and FM Sideband Adjustment Setup

EQUIPMENT

Spectrum analyzer	HP 8566A/B
RF cable	8120-4780 (part of HP 11851B cable set)
3.5 mm (f)/type-N (f) adapter	1250-1745
Disk drive	HP 9122S/D
Automated adjustment software disk	08720-10002
Controller	HP 9000, model 216, 220, 226, 236 or 310
Printer	HP 2225A
HP-IB cable (4)	HP 10833A/B/C/D
BNC cable	8120-1840

www.valuetronics.com

DESCRIPTION AND PROCEDURE

This OPTIONAL adjustment minimizes the spurs caused by the API (analog phase interpolator, on the fractional-N assembly) circuits. It also improves the FM sideband characteristics. In general, neither effect is very significant to the performance of the analyzer.

Spectral purity is not specified for the analyzer although each instrument and replacement A13 assembly is optimized at the factory for spectral purity performance. The factory adjustment software is made available to analyzer users who may require optimized performance. Warm-up time: 30 minutes.

1. Connect the equipment as shown in Figure 15.
2. Make sure the instruments are set to their default HP-IB addresses:

Disk drive	00
Printer	01
Network Analyzer	16
Spectrum analyzer	18

3. Load the BASIC operating system and the required binaries (ERR, GRAPH, IO, KBD, MAT, MS, CS80, HPIB and CRTA).
4. Insert the automated adjustment software disk into the disk drive, type LOAD "API_ADJ" and press **[ENTER]** or **[RETURN]** on the controller.
5. Press **[RUN]** and then press any key. The program will begin with a calibration.

NOTE: The signal to be nulled is automatically centered; disregard all others.

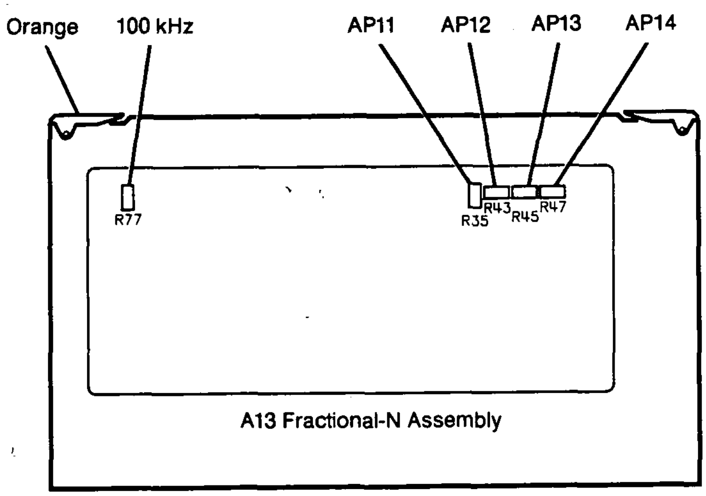


Figure 16. Location of API and 100kHZ Adjustments

www.valuetronics.com

6. When prompted, adjust API1 (see Figure 16) for minimum signal amplitude. Press any key to continue.
7. Repeat step 6 to adjust API2, API3, API4 and 100kHZ.
8. In a minute, a composite plot should appear below the specification trace on the controller CRT.
   a. Press **[HRDCOPY]** to print a hardcopy of the plot.
   b. Press **[NEXT]** to continue the program.
   c. Press **[RE-PLOT]** to adjust the plot to specification. When prompted, turn API1 to minimize the signal centered on the spectrum analyzer display. Press any key and adjust API1 as prompted until the message "Measurement in Progress" appears on the controller CRT.

   When the composite plot and specification trace appear, press **[RE-PLOT]** or **[HRDCOPY]**, if desired, and **[NEXT]** to continue the program.
9. Repeat step 8 for the 100 kHz adjustment, using the 100kHZ adjust in place of API1.
10. Press **[NEXT]** to complete this procedure.
11. If the composite plot is below the specification trace, the adjustment is satisfactory.

    If the composite plot is out of specification, repeat the adjustment.

    If the composite plot can not be adjusted satisfactorily, replace A13.

Cal Kit Defaults Correction Constants

DESCRIPTION AND PROCEDURE

This procedure loads the default calibration kit definitions from ROM into EEPROM. These mathematical device models match the characteristics of the HP 85052B/D 3.5 mm, 85050B/D 7 mm, and 85054B/D type-N calibration kits. They must be stored in EEPROM for error correction to work properly in measurement calibrations with these kits. Equipment required: none. Warm-up time: 5 minutes.

Perform this procedure only if the A9 CPU has been replaced.

NOTE: Ifthe analyzer is an HP 8720A with firmware revision A.01.00, go to "Rev. A.01.00 Description and Procedure," below.

1. Check A9 CC jumper position. Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[5] [1] [x1]**. When the display shows "Cal Kit Def," press ***[EXECUTE TEST]***. Then press ***[YES]*** at the query to alter the correction constants.
2. If this procedure did not end with "DONE," refer to *Digital Control*.

www.valuetronics.com

REV A.01.00 DESCRIPTION AND PROCEDURE

There is an error in the mathematical model for the type-N calibration kit (85054B) stored in the HP 8720A firmware (revision A.01.00, dated March 8, 1988). The value of C0 for the open (calibration standard #2) was stored as 883.08 rather than 88.308 (x 10^{-15} F). The incorrect value can cause system verification to fail.

This problem can be corrected using the procedure provided below, which uses the peek/poke service feature to enter the correct values into EEPROM. It has already been performed on all units with serial numbers after 2749A00206, as well as some earlier units. However, note that this procedure needs to be repeated every time internal test #51 (Cal Kit Def) is executed, since running that test with the A9 CPU jumper in the ALTER position will cause the original (incorrect) default values to be recalled, erasing any corrections that may have been made by using this procedure.

Perform the first step of the procedure below to check whether the HP 8720A has the correct capacitance value. If it does not, continue with the rest of the procedure to load the correct value into EEPROM.

1. Press **[PRESET] [CAL]** ***[CAL KIT [3.5mm]] [CAL KIT: N 50Ω] [MODIFY N 50Ω]***, then ***[DEFINE STANDARD] [2] [X1] [STD TYPE: OPEN] [C0]***. The correct value for this capacitance should be 88.31 x 10^{-15} F. If the capacitance value is wrong, continue with the next step.
2. Store the EEPROM to disk by performing the "EEPROM Backup Disk Procedure" in the *Adjustments* section. This is important! If you make mistakes while peeking/poking in memory, you may need to reload the contents of EEPROM and start over again.
3. Move the jumper on the A9 CPU board to the ALTER position.
4. Execute internal test #51, Cal Kit Def by pressing **[SYSTEM]** ***[SERVICE MENU] [TESTS] [5] [1] [x1] [EXECUTE TEST]*** and then ***[YES]*** when asked if its OK to alter correction constants.
5. Press ***[RETURN] [PEEK/POKE]***. For each row in the table below:
   - Press ***[PEEK/POKE ADDRESS]***, enter the address given in the table, and terminate the address by pressing ***[X1]***.
   - Press ***[POKE]***, enter the decimal value from the second column, and terminate the value by pressing ***[X1]***.

   Repeat these two steps until all eight values have been poked.

   If you accidentally poke a value into the wrong address, either poke the original value back in if you remember it or load the EEPROM data back from disk and start over again from step 3.

Address	Decimal Value
655748	3
655750	32
655754	0
655756	34
655758	127
655802	0
655804	34
655806	127

www.valuetronics.com

6. To verify that the correct change has been made, press **[PRESET] [CAL]** ***[CAL KIT [3.5mm]] [CAL KIT: N 50Ω] [MOFIDY N 50Ω]***, then ***[DEFINE STANDARD] [2] [x1] [STD TYPE: OPEN] [C0].*** The value displayed for this capacitance should read 88.31 x 10^{-15} F. If the capacitance value is wrong, repeat steps 4 and 5 to poke the values in again, and then repeat this step to verify.
7. Restore the A9 CPU jumper to the NORMAL position.
8. Now that the EEPROM contains the correct values, make a backup copy of EEPROM again.

www.valuetronics.com

INTRODUCTION

The troubleshooting strategy of the HP 8720A is based on a verification (rather than symptomatic) approach. The first step is to verify the operation of the network analyzer independent of system peripherals. This section, *Troubleshooting*, takes that step and also suggests how to remedy system problems external to the analyzer.

The analyzer overall block diagram is at the end of this section.

The next section, *Isolate Faulty Group*, assumes that the fault is within one of the instrument's five functional groups: power supply, digital control, source, receiver and accessories. *IFG* identifies the group and refers the technician to the appropriate section. These first sections, *Troubleshooting* and *Isolate Faulty Group*, stress simple, straight forward procedures.

Each of the five sections following *IFG* verifies, one at a time, the assemblies within a group until the faulty assembly is identified. These five sections employ more lengthy, complicated procedures.

INITIAL OBSERVATIONS

A system failure can be caused by a problem in the network analyzer and its accessories (cables, calibration and verification kits) or outside the network analyzer, in HP-IB related components (peripheral devices, an external controller, programming). If the failure is obviously in the analyzeror its accessories, go directly to the *Isolate Faulty Group* section. Otherwise disconnect all of the peripheral HP-IB and RF cables from the analyzer.

www.valuetronics.com

Turn on the network analyzer and watch for the following in this order:

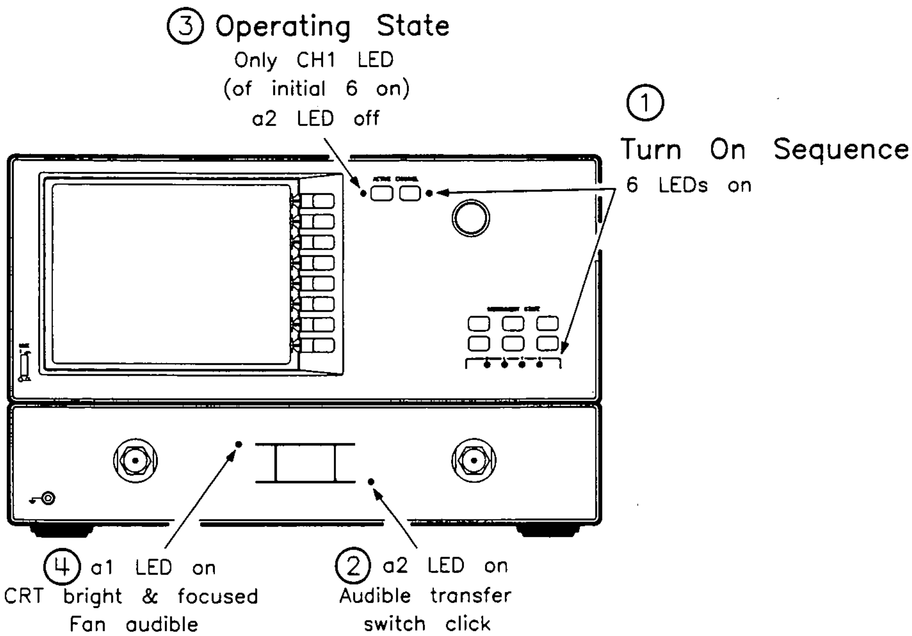


Figure 1. Turn On Sequence

In case of unexpected results, check AC line power to the instrument. Check the fuse (rating listed on rear panel, spare inside holder). Check the line voltage setting (use small screwdriver to change).

Refer to *Isolate Faulty Group* if the problem persists and the analyzer does NOT use HP-IB.

TROUBLESHOOTING HP-IB SYSTEMS

Check the network analyzer's HP-IB functions with a known working passive peripheral (like a plotter or printer or disc). Connect the peripheral via a good HP-IB cable to the analyzer. Press **[LOCAL]** ***[SYSTEM CONTROLLER]*** to enable the analyzer to control the peripheral. Then press ***[SET ADDRESSES]*** and the softkeys to see the device addresses recognized by the HP 8720A. The factory default addresses are:

Device	**HP-IB Address**
8720/8719	16
Plotter	5
Printer	1
Disc (drive)	0
Controller	21

www.valuetronics.com

Other addresses may be used with two provisions: (1) each device must have its own address and (2) the address set on each device must match the one recognized by the analyzer (and displayed on the CRT). Peripheral addresses are often set with a rear panel switch. Refer to the manual of the peripheral to read or change its address.

If Using a Plotter or Printer. Make sure it has power, pens, paper, pinch wheels down, and so forth. Plotters should not be in VIEW mode; some plotters need to have P1 and P2 positions set. Press **[COPY]** and then ***[PLOT]*** or ***[PRINT]***.

If the result is a copy of the CRT display, HP-IB is functional in the analyzer. Continue with *Troubleshooting Systems with Multiple Peripherals*, *Troubleshooting Systems with Controllers*, or the *Isolate Faulty Group* section.

If the result is not a copy of the CRT display, suspect HP-IB problems in the analyzer: refer to the *Digital Control* section.

If Using a Disc Drive. Make sure the drive has power, an initialized disc in the *correct* drive, and the proper disc unit number and volume number (press **[LOCAL]** to see; default is 0, 0.) With hard disc (Winchester) drives, make sure the configuration switch is properly set (see drive manual).

Press **[START] [2] [G/n] [SAVE]** ***[STORE TO DISC] [STORE FILE 1]***. Then press **[PRESET] [RECALL]** ***[LOAD FROM DISC] [LOAD FILE 1]***. If the resultant trace starts at 2 GHz, HP-IB is functional in the analyzer. Continue with *Troubleshooting Systems with Multiple Peripherals*, *Troubleshooting Systems with Controllers*, or the *Isolate Faulty Group* section.

If the resultant trace does not start at 2 GHz, suspect HP-IB problems in the analyzer: refer to the *Digital Control* section.

Troubleshooting Systems with Multiple Peripherals

Connect any other system peripherals (but not a controller) one at a time and check their functionality. Any problems observed are in the peripherals or HP-IB cables, or are HP-IB address problems (see above).

www.valuetronics.com

Troubleshooting Systems with Controllers

Passing the preceding checks indicates that the HP-IB functions are normal in the analyzer. Therefore, if the analyzer has not been operating properly with an external controller, suspect the controller. Check the following:

- HP-IB interface hardware must be installed, see *BASIC User's Manual*.
- Select code, see *BASIC User's Manual*.
- I/O and HP-IB binaries loaded, see *BASIC User's Manual*.
- Compatibility, must be HP 9000 series 200/300, see *System Overview*.
- HP-IB cables, see limits in *User's Guide*.
- Programming syntax, see the *HP-IB Programming Guide*.

If the analyzer appears to be operating unexpectedly but has not completely failed, go to the *Isolate Faulty Group* section.

www.valuetronics.com

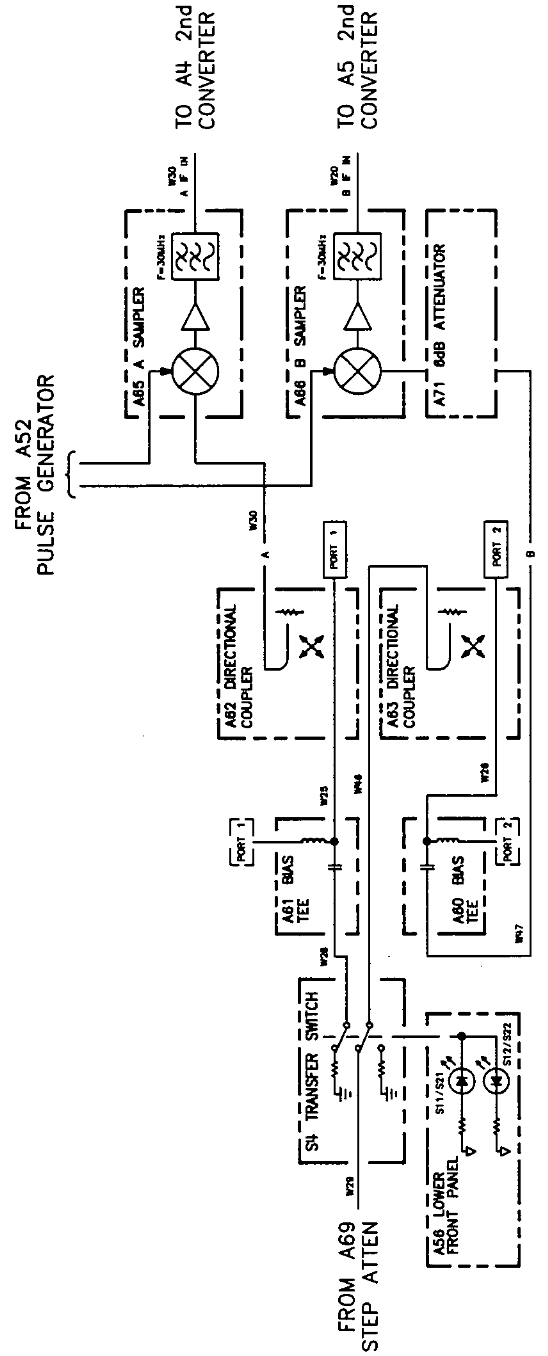


Figure 3. Option 003 Partial Block Diagram

www.valuetronics.com

INTRODUCTION

The purpose of this section is to determine which major group of assemblies in the HP 8720A is faulty. The premise of the following troubleshooting sections is that each successive group depends on the proper functioning of previous groups to work. For example, each functional group depends on the power supply group. Hence the power supply group is examined first. Similarily, for the receiver portion of the instrument to function, the source assemblies must be operating properly. Troubleshoot the functional groups and the assemblies in the order presented.

The checks that isolate the faulty functional group are reproduced twice: first in a longer, tutorial format and then in a brief checklist format. The main points in both formats are numbered the same for easy cross reference. Either format can be used to start troubleshooting the instrument on location or over the phone. Both formats conclude with a reference to Table 1, the *Functional Group Assemblies and Equipment* table which lists, by functional group, all of the assemblies and the associated service equipment.

POWER SUPPLY

Turn on the instrument.

1. Check to see that the fan is operating properly: the fan has two speeds. It is normal for the fan to run at high speed when the instrument is first turned on, and then change to low speed. Thereafter, fan speed changes continue at random intervals, depending on instrument temperature.
2. *Check the rear panel (A15) LEDs: the green LED should be on; the red LED should be off.*
3. Check the A8 post-regulator LEDs: remove the instrument top cover; all of the green LEDs should be on. Look for this many LEDs: HP 8719A/20B - 9; HP 8720A - 10.

If the above checks yield unexpected results:

a. Refer to Table 1, at the end of this section to see the associated assemblies and required equipment.

b. Go to the *Power Supply* troubleshooting section to continue troubleshooting.

If the above checks indicate normal instrument operation, proceed with the next paragraph.

www.valuetronics.com

DIGITAL CONTROL

Cycle power.

4. All six upper front panel LEDs and the a2 lower front panel LED should turn on, and then you should hear an audible click and see the a2 LED turn off, the a1 LED turn on, and all upper front panel LEDs except CH 1 turn off.
5. The display should be bright and focused.
6. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [x1]** to verify that the PRESET tests passed.
7. Press **[0] [x1]** ***[EXECUTE TEST]*** to run ALL INT test.
8. Press **[1] [9] [x1]** ***[EXECUTE TEST]*** to run the ABUS test and check to see that the test passes.

If the above checks yield unexpected results or any test fails:

a. Refer to Table 1, at the end of this section to see the associated assemblies and required equipment.

b. Go to the *Digital Control* troubleshooting section to continue troubleshooting.

Otherwise, proceed with the next paragraph.

SOURCE

9. Check the display to make sure there are no phase lock error messages. If messages are present:

   a. Refer to Table 1, at the end of this section to see the associated assemblies and required equipment.

   b. Go to the *Source* troubleshooting section to continue troubleshooting.

10. Connect a power sensor to port 1. Press **[MENU]** ***[CW]*** to check power at 1 GHz, and then press **[▲]** repeatedly to check power at 2, 5, 10, and 20 GHz (HP 8719: 2, 5, 10, and 13.5 GHz). The power should be between −13 dBm and −7 dBm. Press **[MEAS]** ***[S22]*** and connect the power sensor to port 2. Repeat the measurement from port 2 (Option 003: typically power at port 2 is difficult to measure: less than -30 dB below 4 GHz; about -30 dB above 4 GHz. Do not check port 2 unless the transfer switch is suspect.) If the power is not within specification at either port:

    a. Refer to Table 1, at the end of this section to see the associated assemblies and required equipment.

    b. Go to the *Source* troubleshooting section to continue troubleshooting.

Otherwise, continue with the next paragraph.

www.valuetronics.com

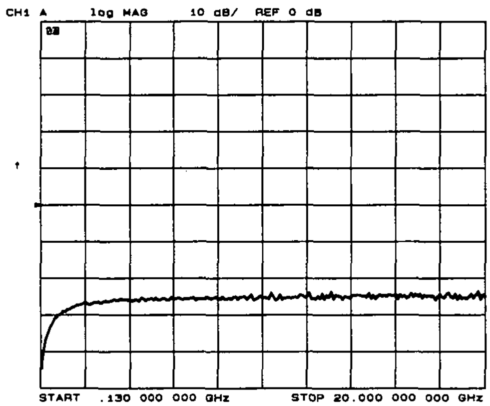
RECEIVER

11. Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [R].*** The trace should show a relatively flat line at about −23 ±2 dB.

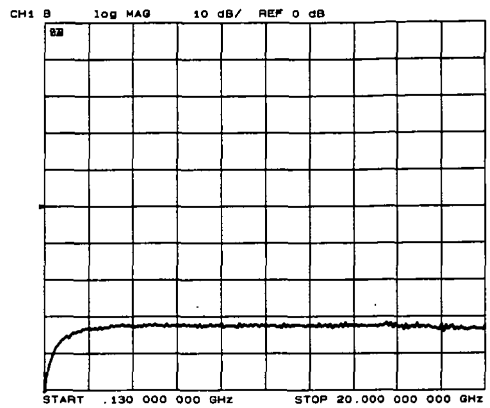
12. Connect an open or short to port 1. Press ***[A]*** to look at input A (port 1). The trace should resemble Figure 1a below, with a minimum of about −43 dB at 130 MHz and a value around −23 ±5 dB over the flat section.

13. To check input B (port 2), connect an open or short to port 2, then press ***[B] [TESTSET REV]*** to drive port 2. Again, the trace should resemble Figure 1a below. (Option 003: the trace should resemble Figure 1b.)

If any input shows unexpected results, refer to Table 1 for the associated assemblies and equipment required. Then go to the *Receiver* troubleshooting section. Otherwise, proceed to *Accessories*.



(a)



(b)
opt 003 only

Figure 1. Typical Input A and B Trace

ACCESSORIES

If the instrument has passed all of the above checks but is still making incorrect measurements, probably either the cables or the calibration kit devices are faulty. Only the analyzer and the suspect cable or calibration kit devices are required to troubleshoot such problems. Turn to the *Accessories* troubleshooting section.

www.valuetronics.com

Table 1. Functional Group Assemblies and Required Equipment

Functional Group	Assemblies Included	Required Equipment			
		DVM	Power Meter	Freq. Counter	Scope
Power Supplies	A8 Post-Regulator A15 Preregulator	●			
Digital Control	A1 Front Panel A2 Front Panel Interface A9 CPU A10 Digital IF A16 Rear Panel A18 Display A19 GSP A51 Interface	●		●	●
Source	A7 ALC A11 Phaselock A12 Reference A13 Fractional-N Analog A14 Fractional-N Digital A52 Pulse Generator A53 Source Mixer/Amp A54 YIG 2 A55 YIG 1 A57 Cavity Oscillator A58 Modulator A59 Isolator A60/61 Bias Tee A64 Sampler A67 Power Splitter A68 10 dB Attenuator A69 Step Attenuator A70 3 dB Attenuator S1/2/3 Microwave Switch	●	●	●	●
Receiver	A4/5/6 Second Converter A10 Digital IF A62/63 Coupler A65/66 Sampler	●		●	●
Accessories	—				

www.valuetronics.com

ISOLATE FAULTY GROUP WORKSHEET (1 of 2)

(Photocopy for multiple use.)

User ______________________________ Date ______________

Serial Number ____________ Firmware Revision __________ Phone ______________

COMPLAINT ____

____

____

		YES (Normal)	NO (Abnormal)
POWER SUPPLY	Turn instrument on.		
1.	Fan operating?	☐	☐
2.	Rear panel: green LED on? red LED off?	☐	☐
3.	All A8 green LEDs on?	☐	☐

If any "NO" boxes are checked, see Table 1, then *Power Supply* section.

DIGITAL CONTROL	Cycle power.		
4.	Do all six upper front panel LEDs turn on, then five off?	☐	☐
	Audible click, a1/a2 LEDs toggle?	☐	☐
5.	CRT bright and focused?	☐	☐
6.	Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [x1]** ***[EXECUTE TESTS]***. PRESET pass?	☐	☐
7.	Press **[0] [x1]** ***[EXECUTE TESTS]***. ALL INT tests pass?	☐	☐
8.	Press **[1] [9] [x1]** ***[EXECUTE TESTS]***. ABUS pass?	☐	☐

If any "NO" boxes are checked, see Table 1, then *Digital Control*.

SOURCE	Press **[PRESET]**.		
9.	Does the instrument phase lock (is the display free of phase lock error messages)?	☐	☐
	If "NO", see Table 1, then *Source*.		
10.	Does the CW power at the output port measure −10 dBm ± 3dB? (Option 003: port 1 only)	☐	☐
	If "NO", see Table 1, then *Source*.		

www.valuetronics.com

ISOLATE FAULTY GROUP WORKSHEET (2 of 2)

(Photocopy for multiple use.)

RECEIVER	YES (Normal)	NO (Abnormal)
11. Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [R]***. Does the display show a flat trace at −23 dBm?	☐	☐
12. Connect an open or short to port 1. Press ***[A]***. Does the display show a trace similar to Figure 1?	☐	☐
13. Move the open or short to port 2. Press ***[B] [TESTSET [REV]]*** Does the display show a trace similar to Figure 1?	☐	☐

If any "NO" boxes are checked, see Table 1, then *Receiver*.

ACCESSORIES

If the instrument has passed all of the above tests (all "YES" boxes checked) but is still making incorrect measurements, the problem is most likely with the cables or calibration kit devices. Refer to the *Accessories* section.

SOLUTION ____

____

____

____

NOTE: Following assembly replacement, refer to the *Related Service Procedures* table in the *Post-Repair Procedures* section. The table specifies accessory adjustment and verification procedures following assembly replacement.

Adjustments Performed	Verifications Performed
____________________	____________________
____________________	____________________
____________________	____________________

www.valuetronics.com

INTRODUCTION

Either the A15 red LED is not OFF or one or more of the A8 green LEDs is not ON (as determined in a previous section, *Troubleshooting*). This abnormal situation may mean the A15 preregulator or A8 post-regulator is not functioning properly, but faults elsewhere in the instrument can also affect these power supply assemblies. So the suggested troubleshooting sequence is to check:

- Fan and power supply error messages (see *Start Here*)
- A15 preregulator and loads
- A8 post-regulator and loads

LED State Definitions

LEDs may turn on or off, blink, or flash. But within this section, they are described as being in only two states:

- **ON.** Bright and steady, normal green LED state, abnormal red LED state.
- **OFF.** No light at all, abnormal green LED state, normal red LED state.

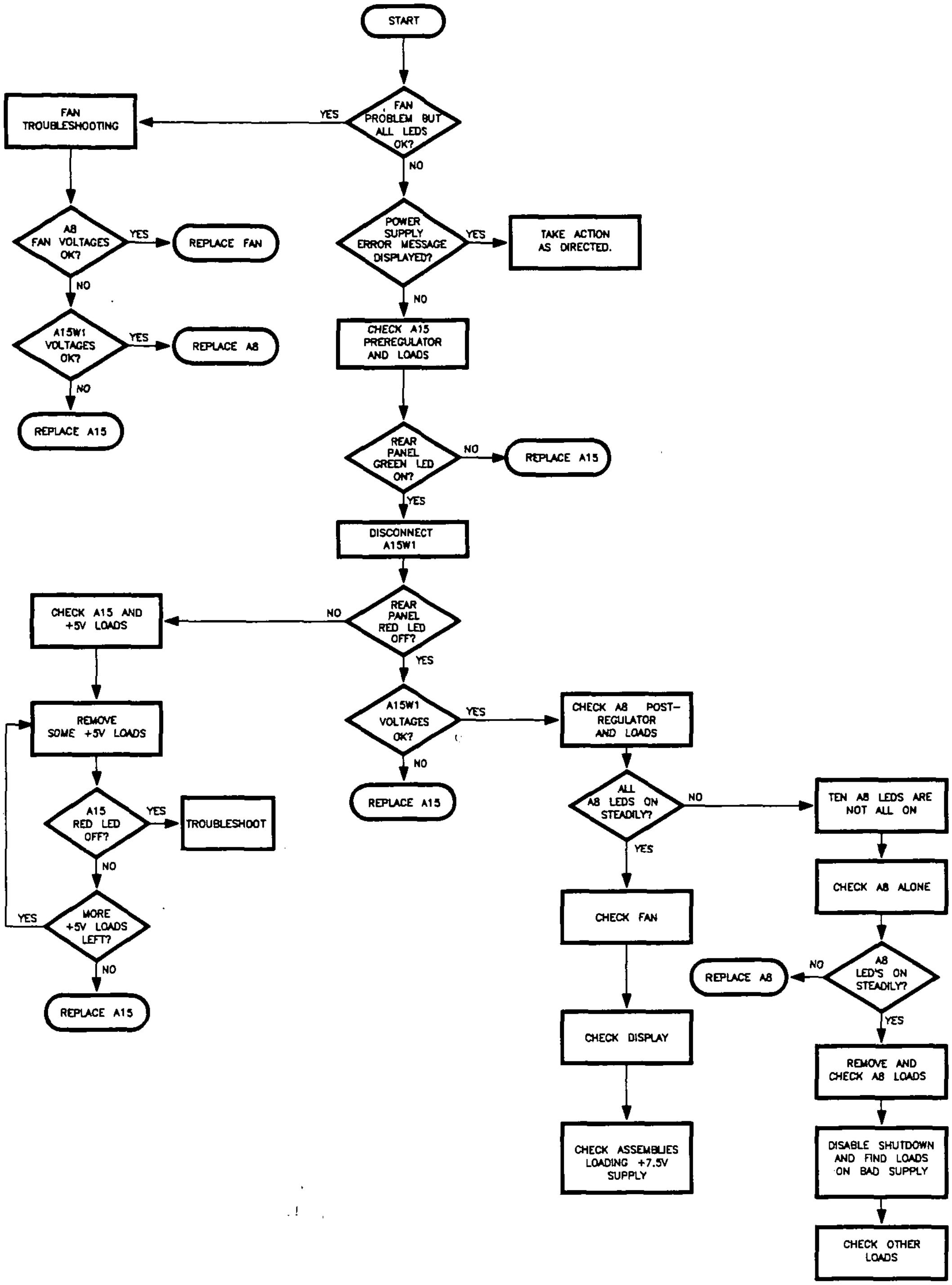
WARNING

Hazards are involved in power supply troubleshooting. It should be performed only by qualified persons.

NOTE: Turn OFF the instrument before removing or replacing assemblies or connectors.

www.valuetronics.com

Power Supply Troubleshooting Flowchart



www.valuetronics.com

START HERE

Fan

If the fan does not seem to be operating normally (at steady speed, either high or low) and these conditions are true:

- A15 rear panel red LED OFF, green LED ON (see Figure 1)
- A8 LEDs (all ten) ON (see Figure 5)

refer to *Fan Troubleshooting*, page 9.

Power Supply Error Messages

If any of the following error messages are displayed, take action as recommended:

Power Supply Hot. Check the temperature of the operating environment: it should be less than +55°C (131°F). Make sure the fan is operating at high speed and there is at least 15 cm (6 in) spacing behind and all around the instrument. If the fan is at slow speed or not working, refer to *Fan Troubleshooting*, page 9.

Air Flow Restricted: Check Fan Filter. Clean the fan filter. For best air flow and cooling, operate the instrument with all of the covers in place. If the problem persists, continue with *Check A15 Preregulator and Loads*, next.

Power Supply Shut Down! *One or more supplies on* A8 has been shut down due to overcurrent, overvoltage, or undervoltage. Continue with *Check A15 Preregulator and Loads*, next.

CHECK A15 PREREGULATOR AND LOADS

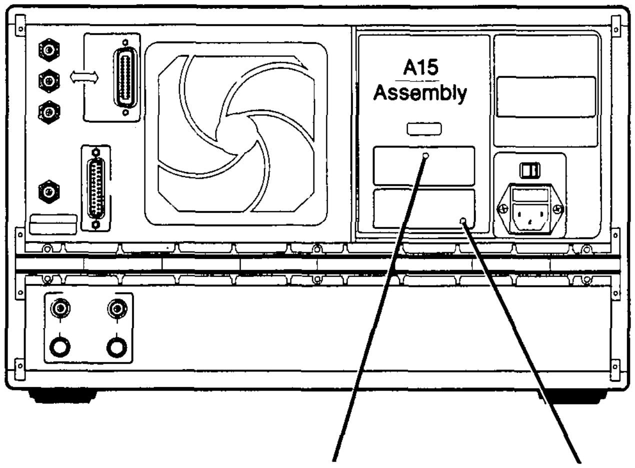
Check A15 Green LED on Rear Panel

If the green LED is not ON, check the fuse, line selector, and line voltage (see Figure 1).

If the green LED is not ON and the fuse, selector and voltage are correct, replace A15.

www.valuetronics.com

Rear Panel of HP 8720A



NOTE: LEDs in same location on HP 8719A and 8720B.

Figure 1. Location of A15 Power Supply Diagnostic LEDs

Disconnect A15W1 and Check Red LED

Disconnect A15W1 from A8 and observe the A15 red LED on the rear panel:

- If the red LED is OFF, refer to *Check A15W1 Voltages*.
- If the red LED is not OFF, the fault is probably in A15, +5VDIG, +5VCPU, or one of the assemblies loading these supplies. Continue with the next check.

Check A15 and +5V Loads

Remove the A8 through A14 assemblies (see label on instrument top cover) and turn on the instrument.

- If the A15 red LED is OFF, reinsert the assemblies one at a time, starting with A8, until the A15 red LED is ON (disregard the A8 green LEDs). Replace the assembly that turns ON the A15 red LED.
- If the A15 red LED is not OFF (with A8 to A14 removed), reinsert A8 to A14 and then remove the remaining +5V loads one at a time in the order shown below until the A15 red LED goes OFF:

  A51: Disconnect W12 (the ribbon cable going from A17 to A51, see label on top cover). If the A15 red LED goes OFF, the fault is in the lower box: continue with *Remove A51 Loads*.

  A1/A2 and A16 (see label on top cover or *Disassembly and Replacement Procedures* section for location): replace the assembly whose removal causes the A15 red LED to go OFF.

www.valuetronics.com

If the A15 red LED is not OFF (with A1, A2, A8 to A14, A16, and W12 disconnected), replace the A15 preregulator.

Remove A51 Loads

Remove the nine cables that connect the following components in the lower box to A51. They are listed in clockwise order from W12 and shown on the label on the instrument top cover.

A60/A61/S4 bias tees and transfer switch	(at A51J3)
A52 pulse generator	(at A51J4)
A66 B sampler	(at A51J15)
A65 A sampler	(at A51J14)
A64 R sampler	(at A51J16)
A69 step attenuator	(at A51J2)
A53/A57 mixer/amp and cavity oscillator	(at A51J9)
A55 YIG 1 (2-8 GHz)	(at A51J10)
A54 YIG 2 (8-20 GHz)	(at A51J11)

Reconnect W12 and observe the A15 red LED:

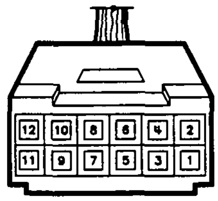
- A15 red LED OFF: replace the cables one at a time. Replace the assembly that turns ON the A15 red LED.
- A15 red LED not OFF: check the A51 interface assembly for defects; repair or replace it.

www.valuetronics.com

Check A15W1 Voltages

Measure the output voltages of A15 at A15W1P1 (see Figure 2 for values). If any of the voltages are out of tolerance, replace A15. If all the voltages are correct, continue with *Check A8 Post-Regulator and Loads*.

HP 8719A HP 8720B Pin	A15W1P1 Voltages
1	N/C
2	+125 to +100
3, 4	+22.4 to +33.6
5, 6	−22.4 to −33.6
7	N/C
8	+9.4 to −14
9, 10	−9.4 to −14
11	+32 to +48
12	N/C



HP 8720A Pin	A15W1P1 Voltages
1, 2	+22.4 to +33.6
3, 4	−22.4 to −33.6
5	N/C
6	+9.4 to +14
7, 8	−9.4 to −14
9	+32 to +48
10	N/C

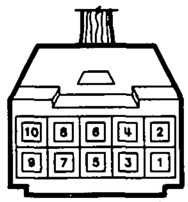


Figure 2. Voltages at A15W1P1

CHECK A8 POST-REGULATOR AND LOADS

Reconnect A15W1. If all of the A8 post-regulator green LEDs are not ON, go to *A8 LEDs Are Not All ON*. Otherwise, if the A15 red LED is still not OFF, continue.

Number of A8 green LEDs
HP 8719A/20B: 9
HP 8720A: 10

Check Fan

If the fan is not operating normally, go to *Fan Troubleshooting*.

www.valuetronics.com

Check Display

Remove the W42 display power cable from A8 (see Figure 3) and check the A15 red LED:

- A15 red LED not OFF: reconnect W42 and continue with *Check Assemblies Loading +7.5V Supply.*
- A15 red LED OFF (HP 8720A): replace the A18 display assembly.
- A15 red LED OFF (HP 8719A/20B): reconnect W42, disconnect A18W1 from A19,
  - A15 red LED OFF: replace the A18 display assembly.
  - A15 red LED not OFF: replace the A19 GSP assembly.

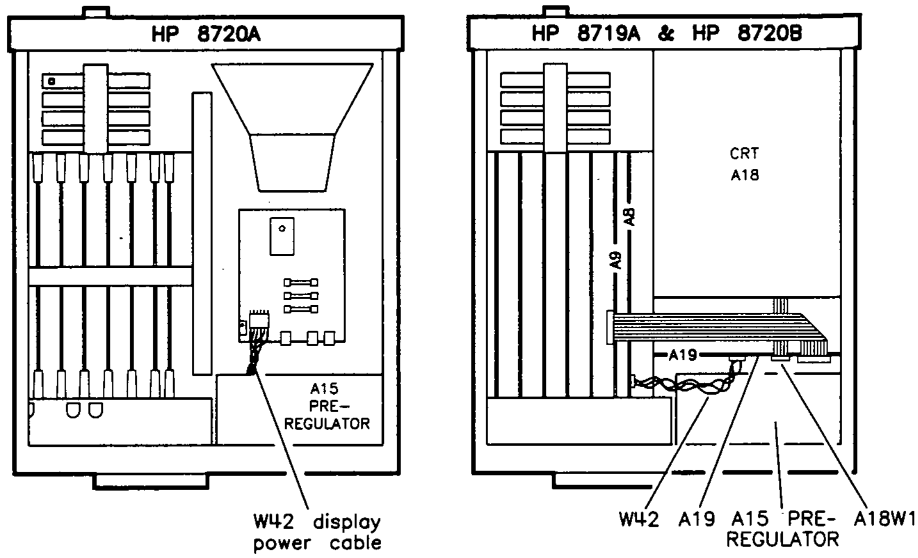


Figure 3. Location of W42 Display Power Cable

Check Assemblies Loading +7.5V Supply

Remove the A9, A10, A12, A13 and A14 assemblies.

- A15 red LED OFF: reinsert the assemblies one at a time until the A15 red LED goes ON (disregard the A8 green LEDs). Replace the assembly that turns the LED ON.
- A15 red LED not OFF: either the A8 post-regulator or the A17 motherboard is faulty; check them for shorts and solder bridges. Refer to the *Power Supply Block Diagram*, Figure 7, for help.

A8 LEDs ARE NOT ALL ON

When the A8 LEDs are not all on, the fault could be in the A8 assembly itself, in an upper box assembly, in a lower box assembly or in the display.

www.valuetronics.com

Check A8 Alone

Remove A8 from its cavity but keep A15W1 connected. Disconnect the W42 display power cable and short test point AGND to chassis ground with a clip lead. Test points and LEDs are identified on the circuit board and in Figure 5.

- Any A8 LEDs (except +5VD) not ON: check the fuses along the top edge of A8, pull any burnt ones out of their sockets and replace them. If any fuse burns out again or any LEDs are still not ON, replace A8.
- All A8 LEDs (except +5VD) ON: the problem is not in A8. Reinsert A8, reconnect the display cable, and remove the short to chassis ground.

Check Upper Box Assemblies

Remove these assemblies from the instrument: A9, A10, A11, A12, A13, and A14 (see top cover label). Turn the instrument on and observe the A8 LEDs:

- Several A8 LEDs flash: disconnect power to YIG2 (A54J1). Without control from A9 both YIGs may turn on at the same time and overload the power supply. Reinsert the assemblies one at a time. Replace the faulty assembly or continue. Reconnect YIG2.
- All A8 LEDs ON: reinsert the assemblies one at a time and replace the assembly that produces the "LEDs not all ON" condition.
- All A8 LEDs not all ON: reinsert the assemblies and continue.

Check Lower Box Assemblies

Disconnect W12 (the A51 ribbon cable) and turn on the instrument.

- All A8 LEDs ON: reconnect W12 and disconnect the cables to these loads: A60, A61, S4, A52, A66, A65, A64, A69, A53, A57, A55, and A54 (see top cover label).

  Reconnect the assemblies one at a time and replace the assembly that produces the "LEDs not all ON" condition.
- All A8 LEDs not ON: reconnect W12 and check the display.

Check the Display

Disconnect W42 (the display power cable) and turn on the instrument.

- All A8 LEDs ON (HP 8720A): replace the A18 display assembly.
- All A8 LEDs ON: (HP 8719A/20B): reconnect W42, disconnect A18W1 from A19,
  - All A8 LEDs ON: replace the A18 display assembly.
  - All A8 LEDs not OFF: replace the A19 GSP assembly.
- Ten A8 LEDs not all ON: one of the *remaining* loads or the motherboard is faulty. Reconnect W42 and continue.

www.valuetronics.com

Check the Remaining Loads and Traces

Use the shutdown disable feature to determine which remaining load or trace may be faulty.

Briefly Disable the Shutdown Circuitry. Connect test point SDIS to chassis ground with a jumper wire. Turn the instrument on and note any LEDs that are not ON. IMMEDIATELY REMOVE THE JUMPER WIRE.

Identify the Faulty Assembly. Refer to the *Power Supply Block Diagram* (Figure 7, at the end of this section) and note the mnemonics of the voltages of any A8 LED that was not ON in the previous step. The assemblies that have not yet been checked are these:

A4, A5, A6, A7, A1/A2, A16 (unchecked assemblies)

If the mnemonics noted above indicate a particular assembly could be faulty, check it first. Otherwise remove each of the unchecked assemblies one at a time in the order listed. Turn on the instrument and observe the A8 LEDs. Replace the assembly that turns ON all of the LEDs.

If, after removing all of the above assemblies, the A8 LEDs are not all ON, inspect A17, the motherboard. Look for solder bridges and shorted traces, especially the traces that carry the supplies whose LEDs faulted when A8TP5 was grounded earlier.

NOTE: This is the end of the troubleshooting sequence. The following procedures are branches of the preceding sequence and other sections.

FAN TROUBLESHOOTING

The fan (and display in monochrome instruments) as well as other assemblies share the 18 volt supplies from A15.

Measure A8 Fan Voltages

Remove A8 from the motherboard but keep A15W1 connected. Remove the W42 display power cable and short test point AGND to chassis ground with a clip lead. Turn on the instrument and measure the voltages as indicated.

Measurement Point	Measurement Range (volts)
A8P1 pin 31	+5.3 to +15.4
A8P1 pin 32	−13.5 to −14.9

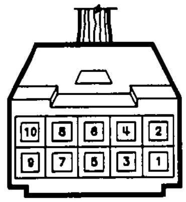
If the preceding measurements are within range, replace the fan.

Measure A15 Fan Voltages

If you haven't already measured the 18 volt supplies from A15, disconnect A15W1 from A8. Turn on the instrument and measure the **unloaded** voltages at A15W1P1 pins 1 through 4 (see Figure 4).

If the measurements are within range, replace A8.
If the measurements are not within range, replace A15.

www.valuetronics.com



HP 8719A HP 8720B Pin	HP 8720A Pin	A15 Preregulator Mnemonic	A15W1P1 (Disconnected) Voltage Range
3,4	1, 2	+18V	+22.4 to +33.6
5,6	3, 4	−18V	−22.4 to −33.6

Figure 4. Voltages at A15W1P1

DISPLAY POWER TROUBLESHOOTING

This procedure is an entry point from the *Digital Control* section and assumes the following:

- The supply voltages are faulty at A18,
- The A15 rear panel red LED is OFF and the green LED is ON, and
- All ten A8 green LEDs are ON.

If these assumptions are false, go back to the beginning of *Power Supply*.

Verify A8 Display Voltages

Remove A8 from the motherboard but keep A15W1 connected. Remove the W42 display power cable and short A8TP3 (AGND) to chassis ground with a clip lead. Turn the instrument on. Refer to Table 1 and Figure 5 to continue.

www.valuetronics.com

Table 1. Display Voltage Measurements

HP 8719A and HP 8720B

Step	Measurement Pt.	Voltage Range	Observation: Action
1	A8TP1 (+65V)	+64.6V to +65.4V	bad: disconnect A15W1 and do step 3
2	A8TP3 (+5VD)	+4.9V to +5.3V	bad: do step 4
3	A15TW1P1 pins 1,2 (+65V)		good: replace A8 bad: replace A15
4	A8P1 pins 18, 19	+4.9V to +5.3V	good: replace A8 bad: replace A15

HP 8720A

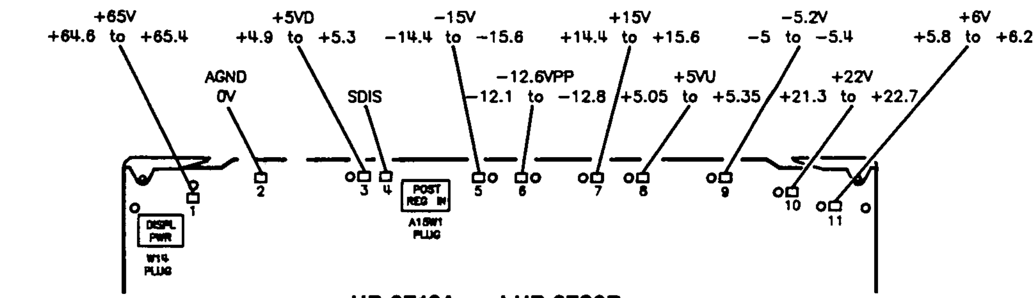
Step	Measurement Pt.	Voltage Range	Observation: Action
1	A8TP1 (+15VDSP)	+14.5V to −15.5V	bad: disconnect A15W1 and do step 4**
2	A8TP2 (−15VDSP)	−14.4V to −15.6V	bad: disconnect A15W1 and do step 5
3	A8TP4 (+5VD)	+4.9V to +5.3V	bad: do step 6**
4	A15W1P1 pins 1, 2 (+15VDSP)	+22.4V to +33.6V	good: replace A8 bad: replace A15
5	A15W1P1 pins 3, 4 (−15VDSP)	−22.4V to −33.6V	good: replace A8 bad: replace A15
6	A8P1 pin 18, 19 (+5VD)	+4.9V to +5.3V	good: replace A8 bad: replace A15

**Suspect cable W42 if the voltage is good at A8.

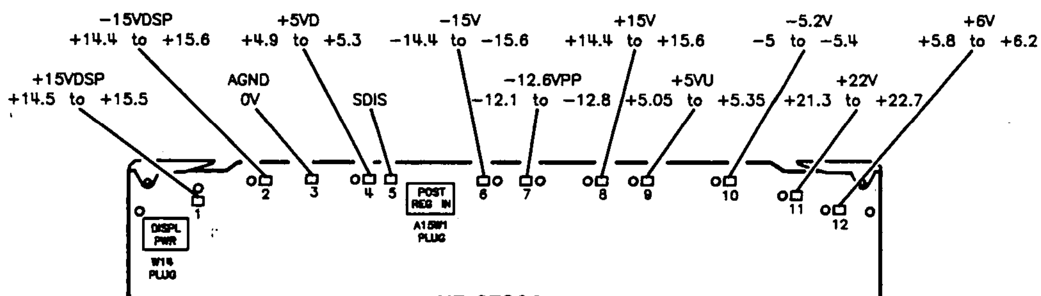
www.valuetronics.com

TEST POINT VOLTAGES

This procedure is an entry point from *Isolate Faulty Group*. Measure the DC voltages at the A8 test points as shown in Figure 5.



HP 8719A and HP 8720B
A8 Post-Regulator Assembly



HP 8720A
A8 Post-Regulator Assembly

Figure 5. A8 Post-Regulator Test Point Voltages

www.valuetronics.com

In Case Of Difficulty

If any of the A8 test point voltages is not within the range shown in Figure 5, determine which assembly, A8 or A15, is faulty.

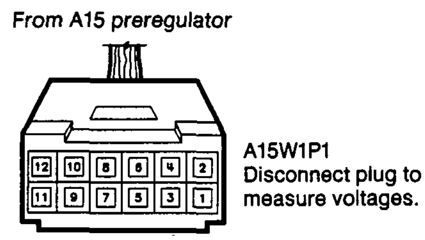
NOTE: Turn OFF the instrument before removing or replacing any assemblies or connectors.

1. If the +5VD voltage at A8TP4 is out of tolerance, put the A8 assembly on an extender board and measure the voltage at A8P1 pins 18 and 19.

   - correct voltage (+4.9V to +5.3V) at A8P1 pins 18, 19: replace A8
   - incorrect voltage at A8P1 pins 18, 19: replace A15.

2. If the voltage at any test point except A8TP4 is out of tolerance, disconnect A15W1 from A8 and measure the voltages at A15W1P1 (see Figure 6).

HP 8719A HP 8720B Pin (Mnemonic)	**A15W1P1 Voltage**
1	N/C
2	+125 to +100
3, 4	+22.4V to +33.6V
5, 6	−22.4V to −33.6V
7	N/C
8	+9.4V to −14V
9, 10	−9.4V to −14V
11	+32V TO +48V
12	N/C



HP 8720A Pin (Mnemonic)	**A15W1P1 Voltage**
1, 2 (+18V)	+22.4V to +33.6V
3, 4 (−18V)	−22.4V to −33.6V
5	N/C
6 (+8V)	+9.4V to +14V
7, 8 (−8V)	−9.4V to −14V
9 (+25)	+32V to +48V
10	N/C

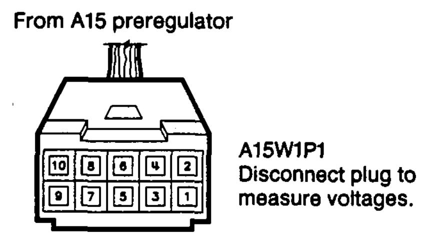


Figure 6. A15W1P1 Voltages

- correct voltages at A15W1P1: A8 or one of its loads is faulty. To troubleshoot, go to the paragraph titled *Ten A8 LEDs Are Not All On*. Perform that procedure **measuring** the power supply voltages (instead of observing the A8 LEDs).
- incorrect voltages at A15W1P1: replace A15.

www.valuetronics.com

INTRODUCTION

Use this section to determine which digital control assembly of the instrument is faulty. The digital control assemblies are:

- A1 front panel
- A2 front panel interface
- A9 CPU
- A10 digital IF
- A16 rear panel
- A18 display
- A19 GSP (HP 8719A/20B only)
- A51 interface

START HERE

Abus Test Failure

If the abus (analog bus) test failed in *Isolate Faulty Group*, perform the analog bus correction constant routine as described in the *Adjustments* section. Note that phase lock problems can interfere with tests and adjustments. If this seems to be the case, press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SOURCE PLL OFF]*** to eliminate the phase lock interference. Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [9] [x1]** ***[EXECUTE TEST]*** to run the abus test again. If it fails, replace the A10 assembly and return to *Isolate Faulty Group*. If it passes, return to *Isolate Faulty Group*.

Fatal Errors

If the CRT displays a fatal error, go to *Fatal Error Troubleshooting*.

HP-IB Failures

If you suspect HP-IB failure, go to *HP-IB Troubleshooting*.

www.valuetronics.com

PRELIMINARY CHECKS (ALL MODELS)

Several of the following checks are designated for the HP 8719A and HP 8720B or HP 8720A. Undesignated checks apply to all instruments.

NOTE: Be sure the A9CC jumper is in the "normal" position for these procedures.

HP 8719A/20B A9 CPU CHECK

1. Check LED Pattern After Cycling Power

Cycle the power on the analyzer and observe the four red LEDs (labeled RUN-1-2-4) on the top edge of the A9 CPU board. The RUN LED should be on after the instrument is powered up.

If the RUN LED is not on, replace the A9 CPU after verifying the power supply.

2. Check LED Pattern With Preset Key Held In

Press and hold down the **[PRESET]** key while observing the four LEDs on A9. The RUN LED should be off, and the 1-2-4 LEDs should stay in a fixed, random pattern.

3. Check LED Pattern After Preset Key is Released

Release the **[PRESET]** key and watch for the following sequence:

1. The RUN LED turns on.
2. The 1-2-4 LEDs perform a rapid count as shown at right.
3. The RUN LED remains on.
4. The 1-2-4 LEDs flash randomly.

RUN	1	2	4
●	○	○	○
●	●	○	○
●	●	●	○
●	●	●	●

If this sequence is observed, go to *Display Check*.

If the RUN LED does not remain on, and the A9CC jumper is in the "normal" position, replace the A9 CPU assembly and repeat the three LED pattern checks.

If the RUN LED remains on but the 1-2-4 LEDs are held in any of the patterns in Table 1, and the A9CC jumper is in "normal" position, replace the A9 firmware ICs. (Firmware ICs are not separately replaceable. Replacement kits are listed in the *Replaceable Parts* section.

Table 1. HP 8719A/20B LED Code and Pattern Versus Test Failed

LED Code Sum (RUN 1 2 4)	Message Displayed on CRT	Faulty Component
● ● ○ ○	ROM 1L FAIL	U24
● ● ○ ○	ROM 1M FAIL	U4
● ● ● ○	ROM 2L FAIL	U25
● ● ● ○	ROM 2M FAIL	U5

END OF HP 8719A/20B A9 CPU CHECK

www.valuetronics.com

HP 8720A A9 CPU CHECK

Observe the four red LEDs (labeled H-1-2-4) on the top front edge of the A9 CPU assembly, cycle power and watch the LEDs:

- H(alt) LED does not turn ON: press **[PRESET]** and again observe the H LED.
  - H LED turns ON: check the power supply (it would appear to be turning on slowly since the H LED did not turn ON at power-on).
  - H LED does not turn ON: replace A9 after verifying the power supply.
- H LED turns ON and remains ON: see *Stuck Key*.
- H LED turns ON momentarily: continue with the next paragraph.

Hold in the **[PRESET]** key and observe the red H-1-2-4 LEDs. The H LED should be ON; LEDs 1-2-4 may be in any pattern. Release the **[PRESET]** key and watch for this sequence:

1 H LED turns OFF.
2 1-2-4 LEDs perform rapid binary count from 1 to 6.
3 H LED remains OFF.
4 1-2-4 LEDs flash randomly.

- Proper sequence observed: go to the paragraph titled *Display Check*.
- Unexpected sequence observed: make sure the correction constant jumper on the A9 assembly is in the normal (lowest) slot. Press **[PRESET]** again and watch LEDs 1-2-4 closely for a rapid binary count.

  If the LEDs complete a binary count to six but get stuck ON or OFF (instead of flashing), go to *A1/A2 Front Panel Troubleshooting*.

  If the LEDs do NOT complete a binary count to six but get stuck ON or OFF (instead of flashing), the A9 CPU assembly has failed a self-test. The failed test and faulty component can be determined by summing the binary coded values of the lit LEDs, as shown in Table 2.

Table 2. HP 8720A LED Code Sum and Pattern vs. Test Failed

LED Code Sum	H	1	2	4	Message Displayed on CRT	Faulty Component
1		•			HP Logo	Main CPU
2			•		Rom 1M or 1L FAIL	EPROM-MNPRG MSB1 or LSB1
3		•	•		ROM 2M or 2L FAIL	EPROM-MNPRG MSB2 or LSB2
4				•	ROM 3M or 3L FAIL	EPROM-MNPRG MSB3 or LSB3
5		•		•	CM RAM FAIL m<**>[1]	COMS RAM (long term)
6			•	•	D RAM FAIL m<**************>[1]	Dynamic RAM (main)

[1]M is MSB, L is LSB, * is for P or F (for Pass or Fail). For LED Code Sum 2 through 4, see Replaceable Parts; for 1 or 5 or 6, replace A9 CPU Assembly.

END OF HP 8720A A9 CPU CHECK

www.valuetronics.com

DISPLAY CHECK (ALL MODELS)

If the display is not bright and focused with legible labels, skip to *Display Troubleshooting*, otherwise continue.

FRONT PANEL CONTROL CHECK (ALL MODELS)

Press **[PRESET]**. All six upper front panel LEDs should turn ON, and within five seconds after release, five should turn OFF (CH 1 LED stays ON).

Press **[CH 2]** and **[CH 1]**. As each key is pressed, the LED next to it should turn ON (and the other LED turn OFF).

- If either of these checks fails, go to *A1/A2 Front Panel Troubleshooting*.

Press **[MEAS]** ***[Refl: REV S22]*** and observe the LEDs on the lower front panel.

- If the a1 LED turns OFF and the a2 LED turns ON and a click is audible, continue with *Diagnostic Checks*.
- If the LEDs do not switch or a click is not audible, suspect a faulty transfer switch or associated cables. Press **[MENU]** ***[POWER]*** **[-] [2] [0] [x1]** and listen for the click of the attenuator. Attenuator activity indicates that the W12 cable is good; troubleshoot S4 and its associated cables. Attenuator inactivity indicates a problem with W12 (the lower box control and power cable).

DIAGNOSTIC CHECKS

The analyzer incorporates 20 internal diagnostic tests. Most tests can be run as part of one or both major test sequences: all internal (#0) and preset (#1). A few tests can be run only singly. To run the ALL INTERNAL test, press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[0] [x1]** ***[EXECUTE TEST].*** Then press **[1] [x1]** to see the results of the PRESET test. If either sequence fails, press the **[▲]** or **[▼]** keys to find the first occurance of a FAIL message for tests 1 through 20. Refer to Table 3 for further troubleshooting information.

www.valuetronics.com

Table 3. Internal Diagnostic Tests with Commentary

Test	Sequence[1]	Probable Failed Assembly[2]: Comments and Troubleshooting Hints
0 All Int	---	--: Executes tests 3-11, 13-16, 20.
1 Preset	---	--: Executes tests 2-11, 14-16. Runs at power-on or preset.
2 ROM	P	A9: Repeats on fail; refer to Table 1 to replace ROM or A9.
3 CMOS RAM	P,AI	A9: Replace A9.
4 Main DRAM	P,AI	A9: Repeats on fail; replace A9.
5 DSP Wr/Rd	P,AI	A9: Replace A9.
6 DSP RAM	P,AI	A9: Replace A9.
7 DSP ALU	P,AI	A9: Replace A9.
8 DSP Intrpt	P,AI	A9/A10: Remove A10, rerun test. If fail, replace A9. If pass, replace A10.
9 DIF Control	P,AI	A9/A10: Most likely A9 assembly.
10 DIF Counter	P,AI	A10/A9/A12: Check analog bus node 17 for 1 MHz. If correct, A12 is verified; suspect A10.
11 DSP Control	P,AI	A10/A9: Most likely A10.
12 Fr Pan Wr/Rd	---	A2/A1/A9: Run test 23. If fail, replace A2. If pass, problem is on bus between A9 and A2 or on A9 assembly.
13 Rear Panel	AI	A16/A9: Disconnect A16, and check A9J2 pin 48 for 4 MHz clock signal. If OK, replace A16. If not, replace A9.
14 Post-reg	P,AI	A15/A8/Destination assembly: See ***Power Supply*** section.
15 Frac-N Cont	P,AI	A14: Replace A14.
16 Sweep Trig	P,AI	A14,A10: Most likely A14.
17 ADC Lin	---	A10: Replace A10.
18 ADC Ofs	---	A10: Replace A10.
19 ABUS Test	---	A10: Replace A10.
20 FN Count	AI	A14/A13/A10: Most likely A14 or A13, as previous tests check A10. See *Source* section to troubleshoot.

1 P = part of PRESET sequence; AI = part of ALL INTERNAL sequence.
2 in decreasing order of probability.

www.valuetronics.com

FATAL ERROR TROUBLESHOOTING (ALL MODELS)

A fatal error message indicates that the A9 assembly processor is failing its own self-test. This may be due to either faulty data or address lines or a faulty A9 assembly.

To troubleshoot a fatal error, first remove all data and address destination assemblies. Remove or disconnect these items:

A1, A2, A10, A12, A13, A14, A16, W12.

- If the instrument still displays a fatal error, either replace the A9 assembly or inspect the motherboard (A17) for faulty traces.
- If the instrument no longer displays a fatal error, replace the assemblies one at a time until the fatal error reappears. When it does reappear, the likelihood is that a shorted data or address line exists on that assembly.

DISPLAY TROUBLESHOOTING (ALL MODELS)

Continue with *HP8719A/20B Display Troubleshooting* for color CRT instruments or *HP8720A Display Troubleshooting* for monochrome instruments.

HP 8719A/20B DISPLAY TROUBLESHOOTING

If the display is faulty in intensity or focus, perform the *Display Intensity and Focus Adjustments* in the *Adjustments* section. If this does not resolve the problem, continue.

Measure Display Power Supply Voltages Entering A19

Measure the power supply voltages entering the A19 assembly coming from the A8 assembly. Check pins 1 and 2 for +65 ±0.4 V, and pin 6 for +5.16 ±0.2 V. See Figure 1.

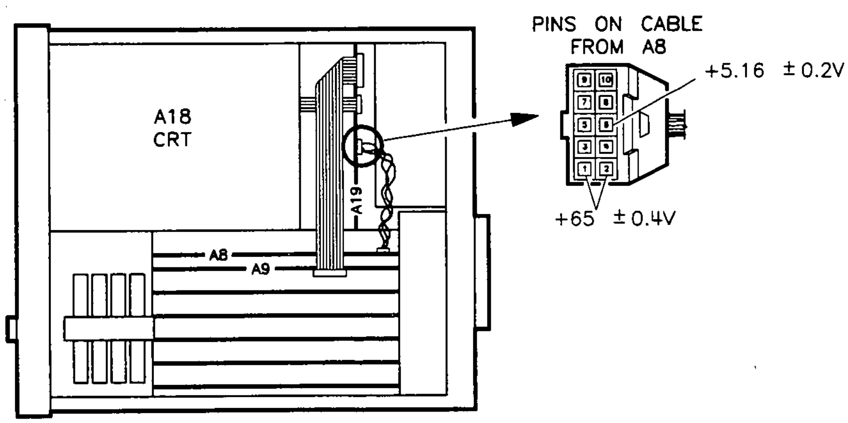


Figure 1. A19 GSP Voltages from A8

- Voltages incorrect: return to the "Power Supply" section.
- Voltages correct: continue.

www.valuetronics.com

Display Power Supply Troubleshooting

Measure the display power supply voltages on the A19 GSP assembly. Check pins 2, 4, and 6 for +65 ±0.4 V. (See Figure 2.)

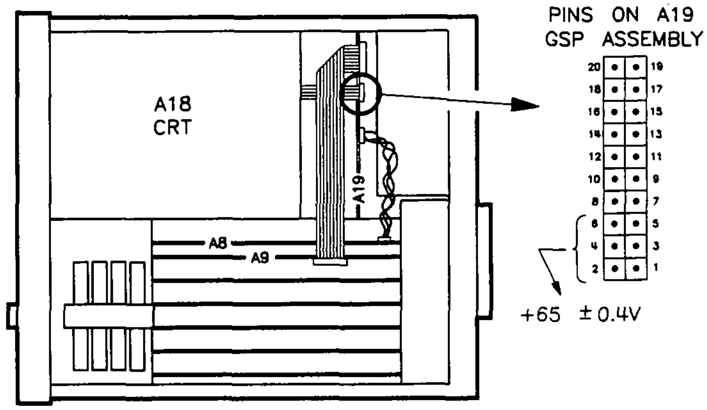


Figure 2. Display Power Supply Voltages from A19

- Voltages incorrect: replace A19 GSP assembly.
- Voltages correct: continue with "Run Display Test 52."

Run Display Test 52

On the analyzer, press **[PRESET] [SYSTEM]** ***[SERVICE MENU]*** (softkey 8) **[TESTS] [52] [x1]** (softkey 1). The CRT should display: `52 Disp/cpu com -ND-`

Press ***[EXECUTE TEST]*** (softkey 1). As soon as you press the key, all of the LEDs should flash and the display should blank. Also note,

- All LEDs (except a1) remain OFF, display blank: go to *Run Remaining Display Tests.*
- Some LEDs ON or display not blank: continue.

Inspect Ribbon Cable and Repeat Display Test 52

Inspect the A9-A19 ribbon cable for a loose connection. Repeat "Run Display Test 52" and observe the display.

- All LEDs (except a1) remain OFF, display blank: go to *Run Display Tests.*
- Some LEDs ON or display not blank: continue.

www.valuetronics.com

Perform Walking One Pattern

Disconnect the A19 end of the A9-A19 ribbon cable. Use an oscilloscope to verify a walking one pattern is transfering from the A9 CPU through the cable. The walking one pattern is found on pins 3 through 10, and 13 through 20. See Figure 3.

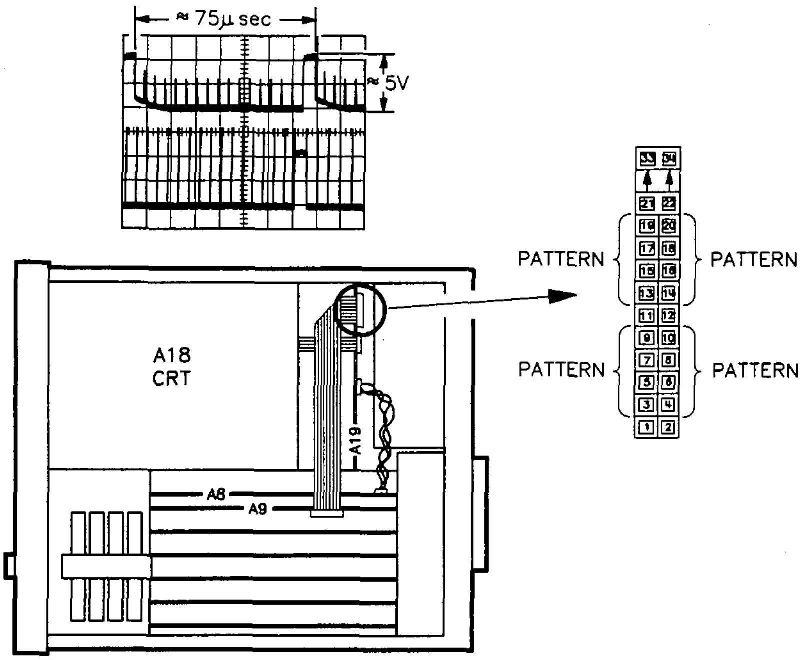


Figure 3. A9 CPU Walking One Pattern

- Signal not present at A19 end of cable:
  Check for signal at A9 connector of the ribbon cable:
  - Signal not at A9: replace A9 assembly.
  - Signal at A9: replace cable.
- Signal present at A19 end of cable: continue.

Run Remaining Display Tests

Run display tests 53 through 58. In each test the front panel LEDs should flash and then turn OFF. The display should blank (except in test 58 where it dims).

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU]*** (softkey 8) ***[TESTS]*** (softkey 1) **[53] [x1]** ***[EXECUTE TEST]*** (softkey 1) to observe the next test. Repeat for tests 54 through 58. Based on the results, you will replace either A19 or A18.

www.valuetronics.com

If some LEDs (except a1) remain ON or the display does not blank (or dim):
Replace A19 assembly.

If (1) the display power supply is ok, and
(2) the intensity or focus or vertical adjustment is ineffective, and
(3) all LEDs (except a1) go OFF and the display is blank (or dim) on tests 53 through 58:
Replace A18.

END OF HP 8719A/20B DISPLAY TROUBLESHOOTING

HP 8720A DISPLAY TROUBLESHOOTING

- If the intensity and focus are reasonable but the display looks abnormal, go to the *Check Display Test Pattern* paragraph, below.
- If the intensity and focus are not reasonable or if the display is discontinuous or choppy, see *Check Display Intensity and Focus*, below.
- If the display is blank, continue.

Check Display Power Supplies

Refer to Figure 4 and measure the power supply voltages on the A18 display.

- If these voltages are incorrect, refer to the paragraph titled *Display Power Troubleshooting* in the *Power Supply* section.
- If these voltages are correct, either replace the fuses next to the display cable plug or, if the fuses are good, replace the entire display.

www.valuetronics.com

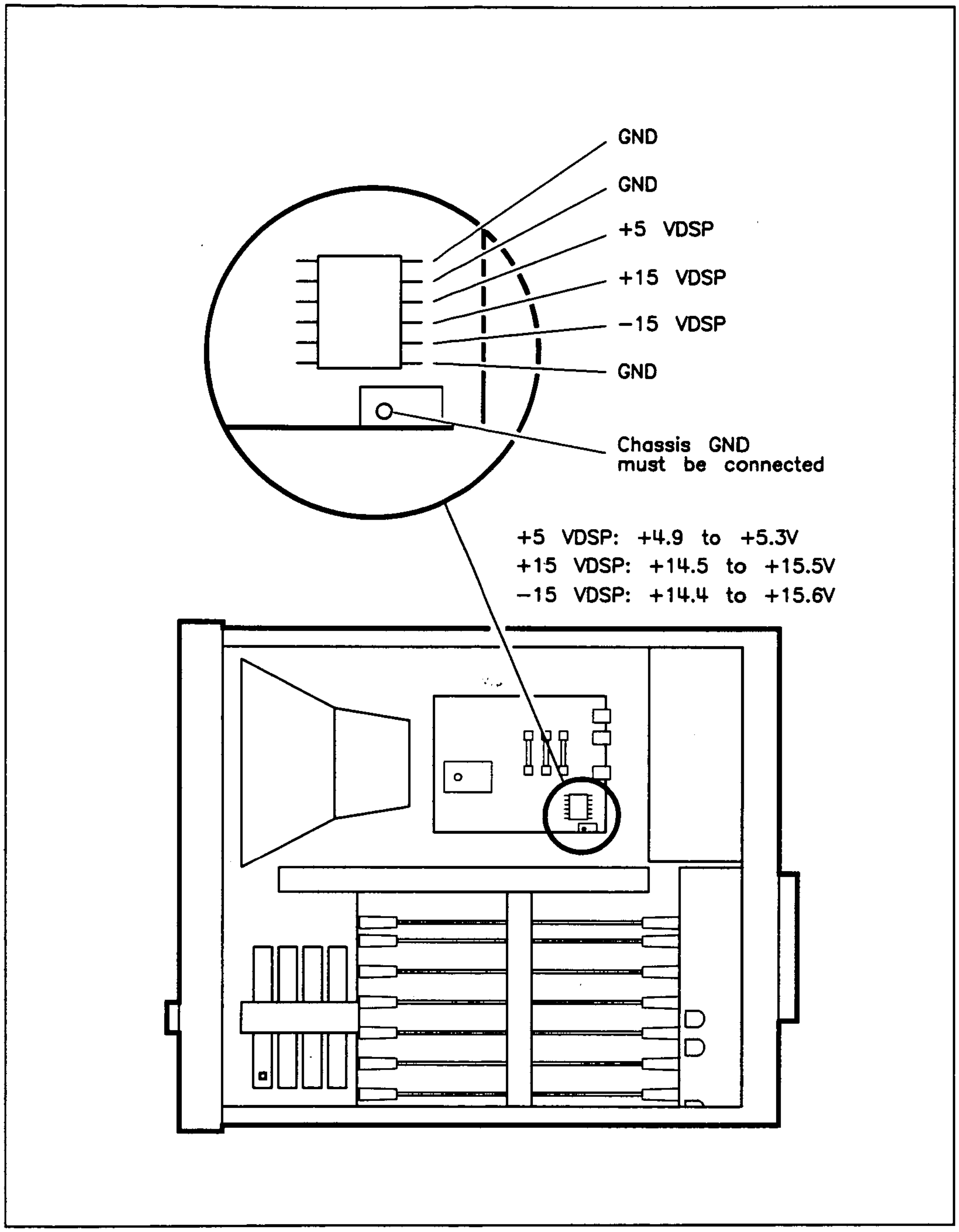


Figure 4. A18 Display Voltages

www.valuetronics.com

Check Display Test Pattern

Turn off the HP 8720A and remove the A9 CPU assembly to isolate the display from the rest of the instrument (except the focus and intensity controls). Turn the instrument on. The display should show a test pattern like Figure 5.

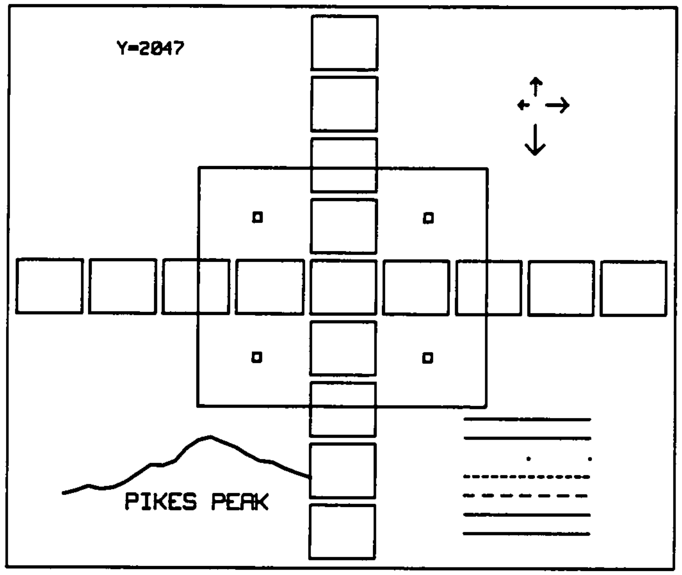


Figure 5. Display Test Pattern

- If the display is abnormal (with A9 removed) replace the display.
- If the display is normal (with A9 removed) but blanks out or displays abnormal characters when A9 is reinserted, continue.

Check Display Intensity and Focus

Refer to the *Adjustments and Correction Constants* section of this manual to perform the display intensity and focus correction constants routine. If either correction constant cannot be set, continue with this procedure.

www.valuetronics.com

Turn OFF the instrument. Raise the upper portion of the HP 8720A to gain access to the underside of the display. Disconnect the intensity/focus control cable from the display X-Y-Z analog assembly (see Figure 6).

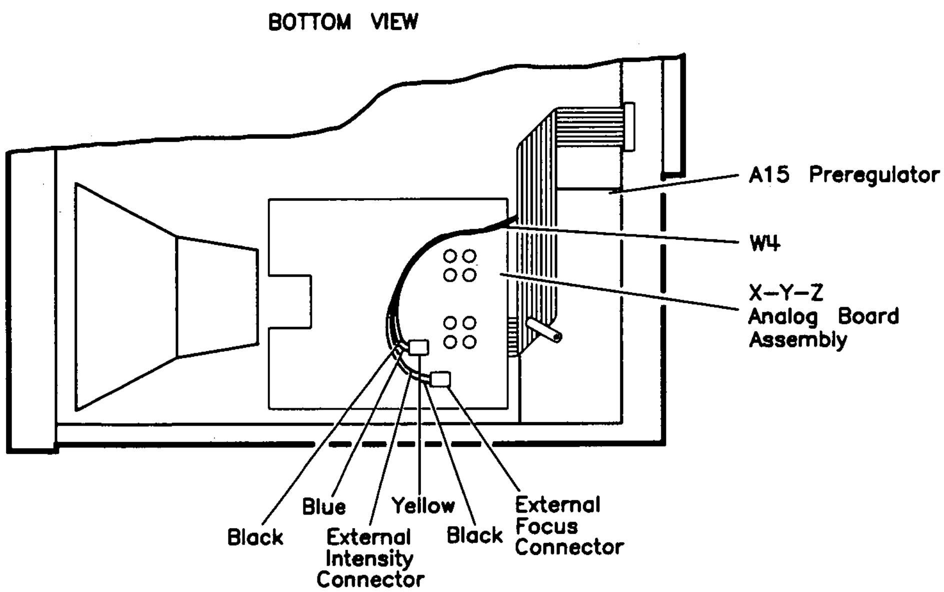


Figure 6. Intensity/Focus Cable Location Diagram

Turn ON the instrument and press **[DISPLAY]** ***[MORE] [INTENSITY]*** (see Figure 7 as required).

www.valuetronics.com

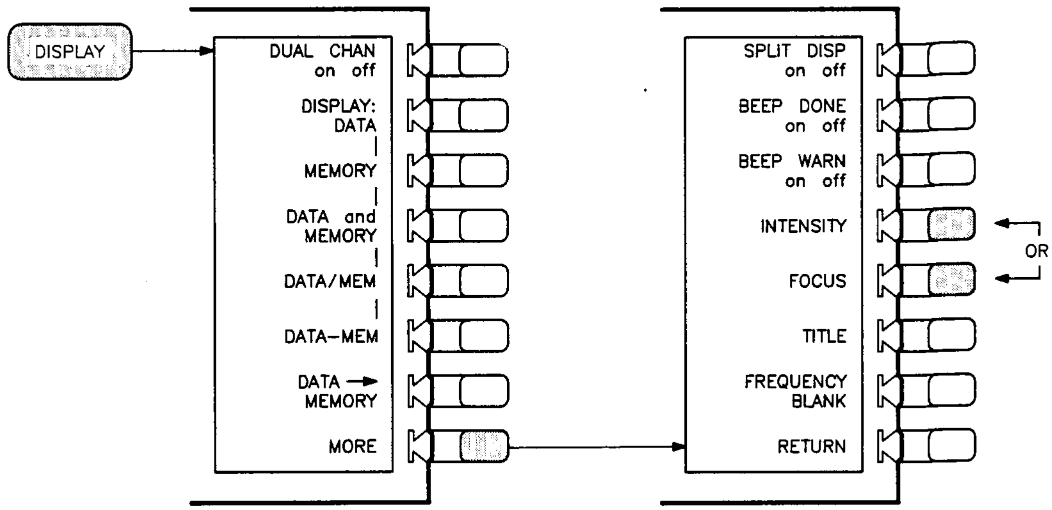


Figure 7. Intensity and Focus Softkeys

Connect a voltmeter to the blue intensity wire and ground. Turn the RPG knob one revolution CW (clockwise) and one revolution CCW (counter-clockwise).

Press ***[FOCUS]*** and measure the yellow focus wire while turning the RPG CW and CCW, as before. Compare the results to Table 4.

Table 4. Cable Voltages

Wire Color (Function)	**Adjustment Range (Nominal)** Minimum (CCW or [↓])	Maximum (CW or [↑])
blue (intensity)	0V	1V
yellow (focus)	0.4V	13.7V

- If the voltages are correct, replace A18.
- If the voltages are incorrect, identify the faulty assembly (intensity/focus cable, RPG, or A2), as follows.

www.valuetronics.com

Identify the Faulty Assembly

Verify the intensity/focus cable with an ohmmeter.

Check the RPG by pressing the [▲] and [▼] keys and noting whether they produce the voltages of Table 4. (RPG pulses may also be verified with an oscilloscope.)

If both the intensity/focus cable and the RPG are verified, replace the A2 assembly.

END OF HP 8720A DISPLAY TROUBLESHOOTING

HP-IB TROUBLESHOOTING

This procedure assumes that checks performed in the *Troubleshooting* section have isolated an HP-IB problem to the analyzer. Now perform the following test to check the internal communication path between the A9 CPU and the A16 rear panel. (This test does not check HP-IB paths external to the analyzer.)

Press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [3] [X1]** ***[EXECUTE TEST]*** to perform internal test 13 (rear panel) and note the results:

- Test 13 fails: the problem is most likely the A16 rear panel assembly. If the A9 CPU assembly has not been verified by checking its self-test results, press ***[TESTS]*** and scroll through tests 2 to 11. If any test from 2 to 11 has failed, refer to Table 3, *Internal Diagnostic Tests*, earlier in this section. If tests 2 to 11 have passed, replace A16.
- Test 13 passes: the A9 CPU assembly can communicate with A16 to a 50% confidence level. If you are confident of the *Troubleshooting HP-IB Systems* checks performed in the *Troubleshooting* section, replace A16.

A1/A2 FRONT PANEL TROUBLESHOOTING

Press **[PRESET]** and observe the six upper front panel LEDs:

- No LEDs ON or all six LEDs remain ON, see *No Front Panel Control.*
- CH 1 and A1 LEDs are not the only LEDs ON after five seconds, see *Stuck Key*.

No Front Panel Control

If all six front panel LEDs never turn ON, or if they remain ON, there is a control problem between A9 and A1/A2.

Remove the A1/A2 front panel and visually inspect the ribbon cable that connects the front panel to the motherboard. Also, inspect the interconnecting ribbon cable between A1 and A2. Make sure the cables are properly connected. Replace any cables that appear bad.

If a controller is available, write a simple command to the analyzer. If the analyzer successfully implements the command, the problem is probably on A1/A2 or is a faulty A1/A2 ribbon cable to motherboard connection.

www.valuetronics.com

Stuck Key

Following PRESET, with one exception (noted later), the analyzer signals stuck keys in two ways:

- CH 1 and A1 LEDs are not the only LEDs ON five seconds after PRESET.
- All six LEDs flash ON and then OFF within two seconds of PRESET (five seconds is normal).

Stuck keys cause the instrument to enter the front panel error codes test and generate a unique pattern of front panel LEDs for each key pressed or stuck. To determine which key is stuck, match the pattern of LEDs ON to Table 5. Free the stuck key or replace the A1 front panel.

The exception is the case of a stuck PRESET key. In this instance, the A9 CPU H LED remains ON.

www.valuetronics.com

Table 5. Front Panel Key Codes

Decimal Number	LED Pattern CH1	CH2	R	L	T	S	Key	Front Panel Block
0							CAL	Response
1						●	3	Entry
2					●		k/m	Entry
3					●	●	DISPLAY	Response
4				●			AVG	Response
5				●		●	2	Entry
6				●	●		1	Entry
7				●	●	●	3	Softkey
8			●				5	Softkey
9			●			●	9	Entry
10			●		●		G/n	Entry
11			●		●	●	CH 1	Active Channel
12			●	●			CH 2	Active Channel
13			●	●		●	8	Entry
14			●	●	●		7	Entry
15			●	●	●	●	1	Softkey
16		●					STOP	Stimulus
17		●				●	SAVE	Instrument State
18		●			●		RECALL	Instrument State
19		●			●	●	MENU	Stimulus
20		●		●			START	Stimulus
21		●		●		●	COPY	Instrument State
22		●		●	●		SYSTEM	Instrument State
23		●		●	●	●	6	Softkey
24		●	●				SCALE REF	Response
25		●	●			●	6	Entry
26		●	●		●		M/u	Entry
27		●	●		●	●	MEAS	Response
28		●	●	●			FORMAT	Response
29		●	●	●		●	5	Entry
30		●	●	●	●		4	Entry
31		●	●	●	●	●	2	Softkey
32	●						SPAN	Stimulus
33	●					●	⬇	Entry
34	●				●		ENTRY OFF	Entry
35	●				●	●	CENTER	Stimulus
36	●			●			8	Softkey
37	●			●		●	⬆	Entry
38	●			●	●		LOCAL	Instrument State
39	●			●	●	●	7	Softkey
40-47	Not used							
48	●	●					BACK SP	Entry
49	●	●				●	—	Entry
50	●	●			●		x1	Entry
51	●	●			●	●	MKR	Response
52	●	●		●			MKR FCTN	Response
53	●	●		●		●	.	Entry
54	●	●		●	●		0	Entry
55	●	●		●	●	●	4	Softkey

www.valuetronics.com

START HERE

The use of this section is based on several assumptions:

- The analog bus has passed test #19. (If not, press **[SYSTEM]** ***[SERVICE MENU] [TESTS]*** **[1] [9] [x1]** ***[EXECUTE TEST]***. If the test fails, return to the *IFG* (*Isolate Faulty Group*) section. If the test passes, continue.)
- A phase lock error message was observed in *IFG* (go to *Phase Lock Error Message Displayed*, next) or
- Incorrect power levels were observed in *IFG* (go to *Power Not Within Specifications*, below) or
- A performance test or adjustment failed (continue).

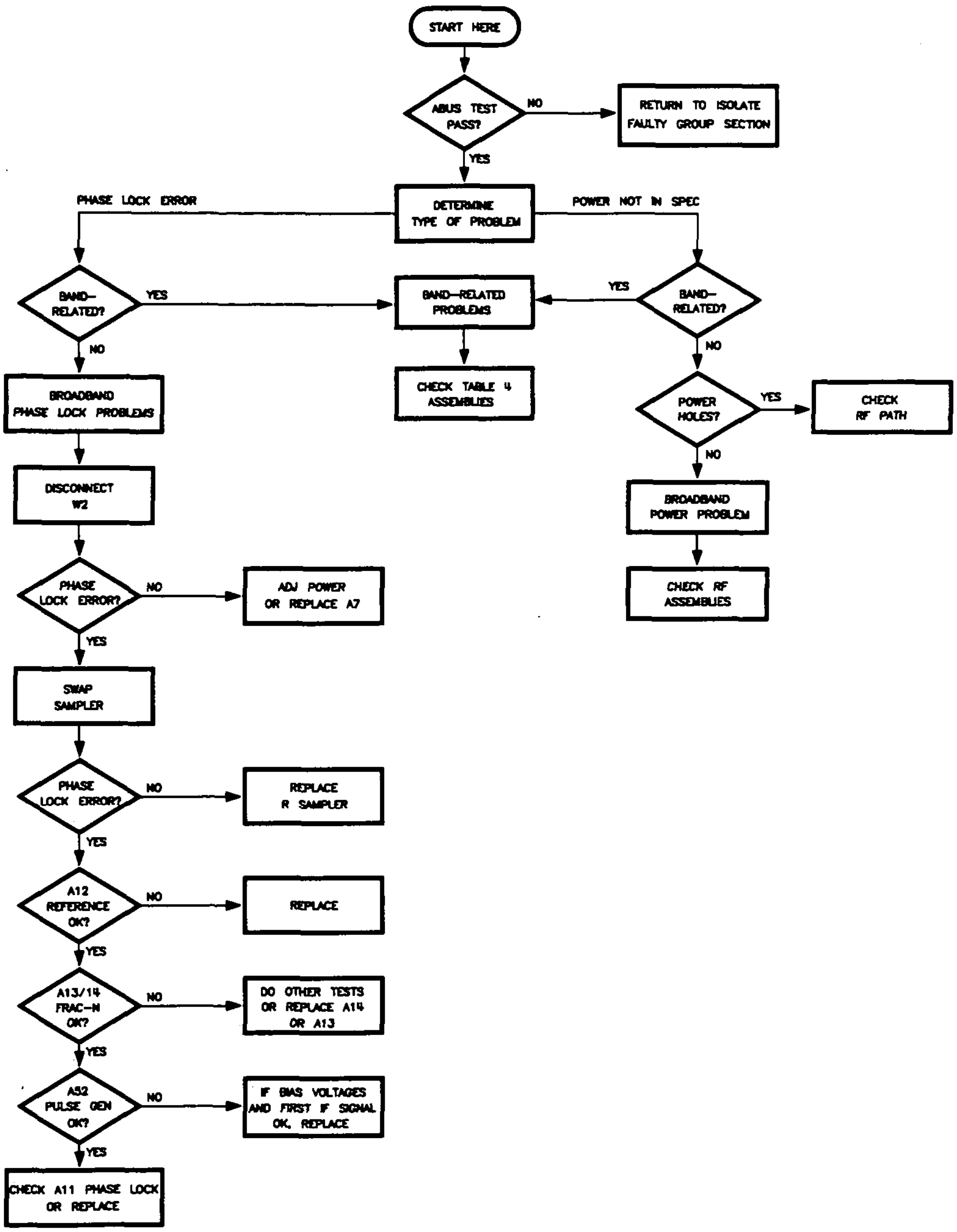
NOTE: Abus waveforms shown in this section apply to the HP 8720; the portion appropriate for the HP 8719A is indicated.

Phase Lock Error Message Displayed

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS]*** **[9] [x1]** to view the 0.5V/GHz signal to the YIG oscillator drives. Note that for each band, the waveform should start and stop exactly as shown in Figure 1, with only one ramp in each band. A problem in one band should not affect the appearance of the waveform in other bands.

www.valuetronics.com

Source Troubleshooting Flowchart



www.valuetronics.com

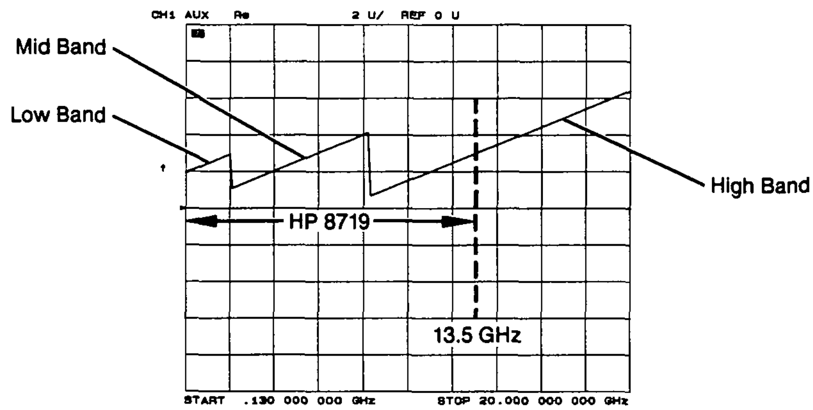


Figure 1. 0.5V/GHz Waveform at Abus Node 9

- *If the waveform appears normal in at least one but not all frequency bands, go to Band-Related Problems.*
- If the waveform appears abnormal in all frequency bands, refer to *Broadband Phase Lock Problems*, below.

Power Not Within Specifications

- If power holes exist, use the block diagram (in *Isolate Faulty Group*) and the location diagram (on the instrument cover) to check the cables and connections in the RF path.
- If power levels are incorrect in one or two bands only, go to *Band-Related Problems*.
- If power levels are incorrect in all three bands, go to *Broadband Power Problems*.

BROADBAND PHASE LOCK PROBLEMS

Phase lock problems can be caused by incorrect pretune correction constants. Perform the source pretune correction constant procedure (service test 43, see *Adjustments*) to fix this potential problem. Then press **[PRESET]** to see if the phase lock problem persists. If the phase lock problem persists, continue. It could be caused by a fault in one of these source assemblies:

A7 ALC	A11 phase lock	A12 reference
A13 fractional-N analog	A14 fractional-N digital	A51 interface
A52 pulse generator	A58 modulator	A64 R sampler
A67 power splitter	A68 20 dB attenuator	A70 3 dB attenuator

www.valuetronics.com

Check A7 ALC by Disconnecting W2

Disconnect flexible cable W2 at A17J15 (on the underside of the A17 motherboard) to remove the modulator control from A7. If the phase lock problem persists, reconnect W2 and see *Swap Samplers to Check A64 R Sampler*, next.

If the phase lock error message disappears, reconnect the cable and turn the ALC ON potentiometer fully clockwise (see the location diagram on the instrument top cover).

- If phase lock is no longer a problem, perform the power adjustments.
- If the phase lock problem is still present, replace A7.

Swap Samplers to Check A64 R Sampler

At A66J3 (the B sampler, see location diagram), replace the IF OUT cable with the IF OUT cable removed from A64J3 (the R sampler). Press **[MEAS]** ***[Refl: REV S22]***. If the phase lock problem persists, the R sampler was not the problem. Continue with *Check Open Loop Power*.

If the phase lock error message disappears, either the control voltage, bias voltage, RF signal or the R sampler itself is faulty. Check for about +0.22V on the green sampler control wire: if it is bad, replace A51. Check the +15V and −15V bias voltages (see *A51 Interface Power Supplies*): if they are bad, troubleshoot A51.

If the control and bias voltages are good, use a power meter and the flexible cable from the tool kit to troubleshoot the RF signal path. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE] [DAC NUM HIGH BAND]*** **[1] [0] [0] [x1]** to enter the service mode. The RF power level out of the power splitter, toward the R sampler, should be at least −13 dBm. If the power level is correct, check the 20 dB attenuator (A68) and replace it or the R sampler. If the power level is not correct, troubleshoot A67 (insertion loss, 7.5 dB).

Check Open Loop Power

Verify that the source oscillators are working by measuring open loop power at the test port. Connect a power meter to port 1. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [SRC TUNE] [DAC NUM HIGH BAND] [1] [0] [0] [x1]***. The power at port 1 should be at least −20 dBm. (You may have to change the DAC number slightly to achieve a good power reading.)

If power is present, proceed with *Check A12 Reference*.

If the power level is lower than −20 dBm, continue with *Check A11 Pretune DAC*. If the pretune DAC is good, then check the insertion loss of the devices in the RF patch between S1 and the A67 power splitter. The insertion loss of the modulator should be about 3 dB or less. Use the above key sequence to generate open loop power from the source.

If no power is present, refer to *A51 Interface Power Supplies* at the end of this section, to check the bias voltages to YIG1 and YIG2. If the voltages are correct, refer to Figure 6 to troubleshoot the source hardware.

www.valuetronics.com

Check A12 Reference

Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS]*** **[1] [4] [x1]** ***[COUNTER: ANALOG BUS]*** to check the 100 kHz signal from A12: the counter should read .100 MHz.

Press **[1] [7] [x1]** to check the 1 MHz signal: the counter should read 1.000 MHz.

If either counter reading is incorrect, replace A12.

Check A14 Fractional-N

Fractional-N Checks With ABUS. Press **[2] [1] [x1]** and compare the fractional-N tuning voltage to Figure 3.

www.valuetronics.com

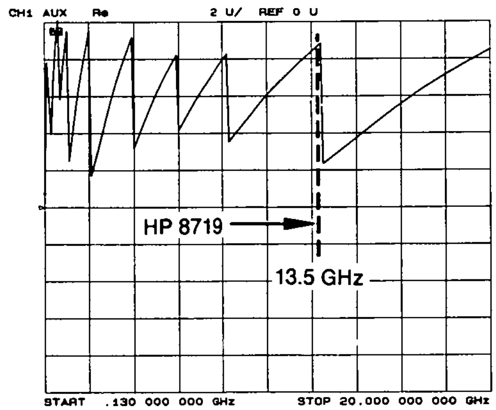


Figure 3. Fractional-N Tuning Voltage Waveform at Abus Node 21

Press ***[COUNTER: FRAC N]*** **[MENU]** ***[CW FREQ]*** and set the instrument to the frequencies of column one in Table 1.

Table 1. VCO Range Check Frequencies

Front Panel	Counter Value
130 MHz	119.988 to 120.012 MHz
249.99999 MHz	239.975 to 240.024 MHz

- If the voltage waveform resembles Figure 3 but the counter values do not match Table 1, A14 is almost certainly faulty.
- If the voltage waveform and the counter values are bad, continue with *A14 VCO Exercise*, below.
- If the instrument passes both checks, the probability is greater than 90% that A13 and A14 are functional: go to *Check Pulse Generator* (or continue with *A14 VCO Range Check with Oscilloscope* to confirm).

A14 VCO Range Check with Oscilloscope

Connect an oscilloscope to A14TP1 (labeled VCO/2). Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [FRAC N TUNE ON].*** Vary the fractional-N VCO frequency with the RPG knob. If the waveforms do not resemble Figure 4 at the frequencies indicated, replace A14.

www.valuetronics.com

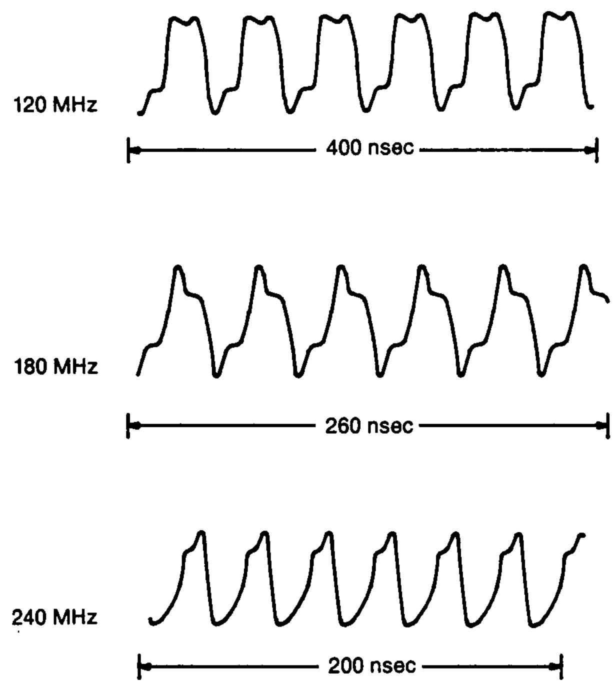


Figure 4. VCO/2 Waveforms at A14TP1

A14 VCO Exercise

The tuning voltage range of the VCO is approximately +1 to +14 volts. This procedure substitutes power supplies for the normal voltages from A13 to check the frequency range of the A14 VCO.

Remove the A13 assembly. Put the A14 assembly on an extender board. Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS] [COUNTER: FRAC N]*** to set the internal counter to the frac-N node. In turn, jumper each of the three supply voltages to A14TP14 and observe the frequency as shown in Table 2.

Table 2. VCO Excercise Matrix

Supply Test Point 8719A/20B	8720A	Voltage Mnemonic	A14 Test Point	Counter Frequency
A8TP7	A8TP8	+15V	A14TP14	>240 MHz
A8TP8	A8TP9	+5VU	A14TP14	≅155 MHz
A8TP2	A8TP3	AGND	A14TP14	<105 MHz

If the frequency changes are not correct, replace A14.

www.valuetronics.com

A14 Divide-by-N Circuit Check

NOTE: The A13 assembly should still be out of the instrument and the A14 assembly on an extender board.

Jumper A14TP14 to the +5VU supply and connect an oscilloscope to A14J3 (labeled VCO/N OUT). Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [FRAC N TUNE ON].*** Vary the fractional-N frequency from 118 MHz to 242 MHz.

- If the period of the signal does not vary from 15.5 µsec to 7.5 µsec, replace A14.
- If the period does vary as prescribed, remove the jumper and reinsert A14.

A14-to-A13 Digital Control Signals Check

Place A13 on the extender board and reconnect all of the flexible cables (the one to A14J1 is optional). The A14 assembly generates a TTL cycle start (CST) signal every 10 microseconds when the VCO is oscillating. Connect an oscilloscope to A14TP3 (CST). (Suggested vertical scale: 0.2V/div). If there is no signal, replace A14.

Use the CST signal as an external trigger for the oscilloscope and observe the signals listed in Figure 5. Since these TTL signals are generated by A14 to control A13, check them at A13 first. The signals should look similar to the waveforms in Figure 5.

Mnemonic	A13 Location	A14 Location
CST	none	TP3
L FNHOLD	P2-2	P2-2
FNBIAS	PG-5	PG-5
API1	P2-32	P2-32
API2	P2-3	P2-3
API3	P2-34	P2-34
API4	P2-4	P2-4
API5	P2-35	P2-35
FNLATCH	P1-28	P1-58

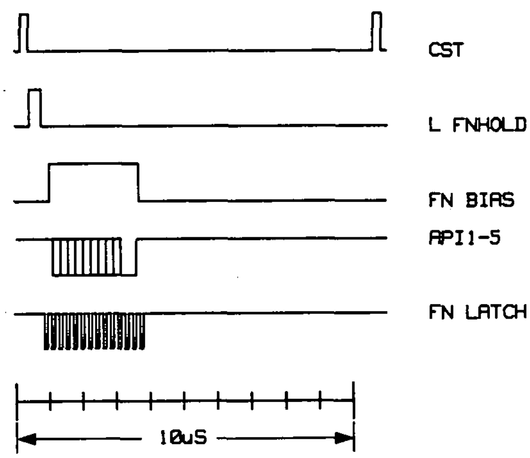


Figure 5. A14 TTL Signals at A14TP3

- If these signals are bad, replace A14.
- If they are good, replace A13.

www.valuetronics.com

A52 Pulse Generator Check

Monitor the 1st IF signal at the output of A7: disconnect the SMB cable from A11 to A7, connect an SMB tee to A7, reconnect the 1st IF cable to one arm and connect an oscilloscope to the other arm. Connect a frequency counter to port 1. Then perform these steps:

1. Press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES] [FRAC N TUNE]*** **[1] [8] [0] [M/u]** to set the fractional-N VCO to 180 MHz.
2. Press ***[SRC TUNE] [DAC NUM LOW BAND]*** and rotate the RPG to change the DAC number to about 1138. Readjust the DAC number as required to measure an output frequency of about 0.91 GHz.

   Now the oscilloscope should display the IF signal as a sine wave of about 10 MHz. The actual frequency can be expressed as this equation:

   Oscilloscope frequency =(counter frequency) −(180 MHz) x (harmonic)
3. Repeat step 2 using the information in the second and third lines of Table 3.

Table 3. First IF Settings

DAC Number Band	Approximate DAC Number On CRT	Approximate Source Frequency On Counter	Harmonic	Oscilloscope Frequency
Low	1138 (All models)	0.910 GHz	5	10 MHz
Mid	1185 (All models)	4.870 GHz	27	10 MHz
High	2265 (HP 8720)	15.67 GHz	87	10 MHz
High	712 (HP 8719)	10.27 GHz	57	10 MHz

- If the IF signals are proper, go to *A11 Phase Lock*.
- If the IF signals are improper, check the pulse generator bias voltages (see *A51 Interface Power Supplies*). If the voltages are correct, replace the A52 pulse generator.

A11 Phase Lock

At this point it is very likely that A11 is faulty, since the other assemblies have been verified. Replace A11.

www.valuetronics.com

BAND-RELATED PROBLEMS

Table 4 lists assemblies potentially responsible for band-related problems.

First, refer to *Check A11 Pretune DAC* and *Check A11 YO Drivers* to verify that the main and FM coil drivers are functional. If they are not, replace A11.

If the A11 drivers are good, check the insertion loss of the other assemblies indicated in Table 4. (Always start by measuring the power of S1.) Press **[SYSTEM]** ***[SERVICE] [SERVICE MODES] [SRC TUNE] [DAC NUM xxx BAND]*** (xxx stands for low, mid or high) to set up the source. The DAC number displayed in the active entry area of the display correlates to a specific drive voltage applied to the source oscillators. It is often necessary to adjust this number to achieve an output signal.

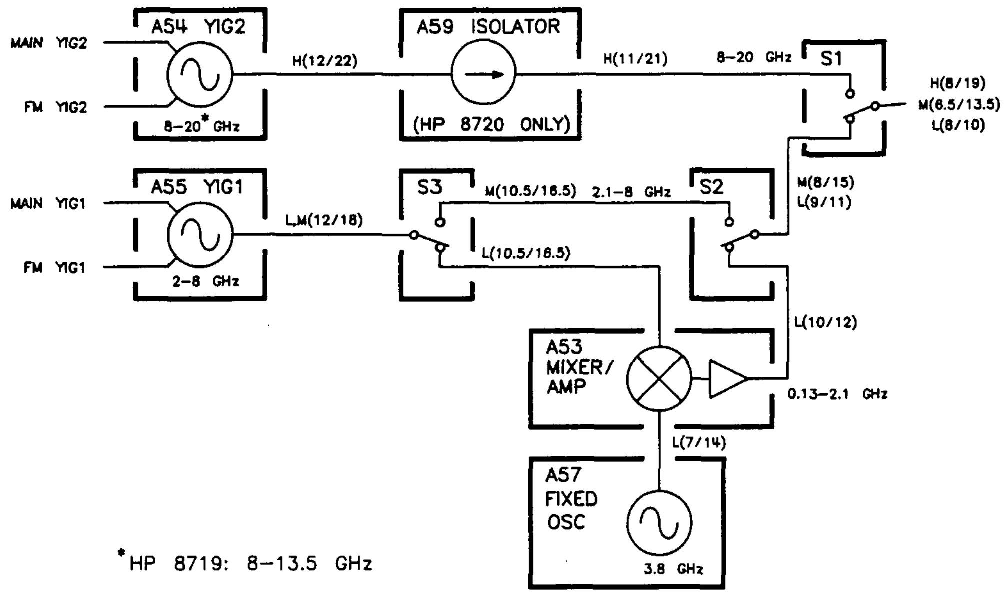
NOTE: Problems in RF components, crimped RF cables, and improper connections which generally cause power holes in an RF signal may cause symptoms that indicate a band-related problem. Therefore, you should start by measuring power from S1. If the power here is good, then all of the components in Figure 6 are verified. Continue troubleshooting with *Broadband Power Problems* to check other RF components. Also keep these points in mind:

- See the *Troubleshooting* tab to remove the instrument covers and pivot open the instrument.
- Cables or improper connections can be the problem in all cases.
- Use the flexible RF cable from the tool kit to measure power at otherwise inaccessible connections.
- Before replacing suspect assemblies, refer to *A51 Interface Power Supplies* to check bias voltages.
- Before replacing A54 or A55 (the YIGs), refer to *A11 Phase Lock Check* to verify the main and FM coil drive signals from A11.

Table 4. Assemblies Potentially Responsible for Band-Related Problems

Low Band	Mid Band	Low & Mid Bands	High Band
A57 A53 S2 S1	S2 S3	A55 A11 S1 S2 S3	A54 A11 A59 (HP 8720 only) S1

www.valuetronics.com



L = low band M = mid band H = high band

H (12/22) means high band power level (minimum/maximum)

Figure 6. Block Diagram of Assemblies Potentially Responsible for Band-Related Problems

Check A11 YO Drivers

A11 YIG Main Coil Drive Check. Press [SYSTEM] *[SERVICE MENU] [SERVICE MODES] [SOURCE PLL OFF]* [MENU] *[NUMBER OF POINTS]* [2] [1] [x1] to observe the YIG coil drive waveforms. Connect an oscilloscope to the points indicated in Table 5 and compare the waveforms to the figures noted.

A11 YIG FM Coil Drive Check. Press [PRESET] [MENU] *[SWEEP TIME MANUAL]* [2] [x1] to observe the YIG FM coil drive waveforms. Connect an oscilloscope to the points indicated in Table 5 and compare the waveforms to the figures noted. The YIG2 FM coil drive signal is very small, about one-fifth the size of the YIG1 signal.

www.valuetronics.com

Table 5. YIG Coil Drive Waveform Check

Monitor Point	Signal Mnemonic	See Figure
A11P2 pin 58	YIG1 main coil	7a*
A11P2 pin 60	YIG2 main coil	7b*
SMB tee at A11J2	YIG1 FM coil drive	7c
SMB tee at A11J3	YIG2 FM coil drive	7c

*Slow sweep speed of oscilloscope to about 0.2 seconds/division.

If the YIG coil drive signals are incorrect, replace A11.

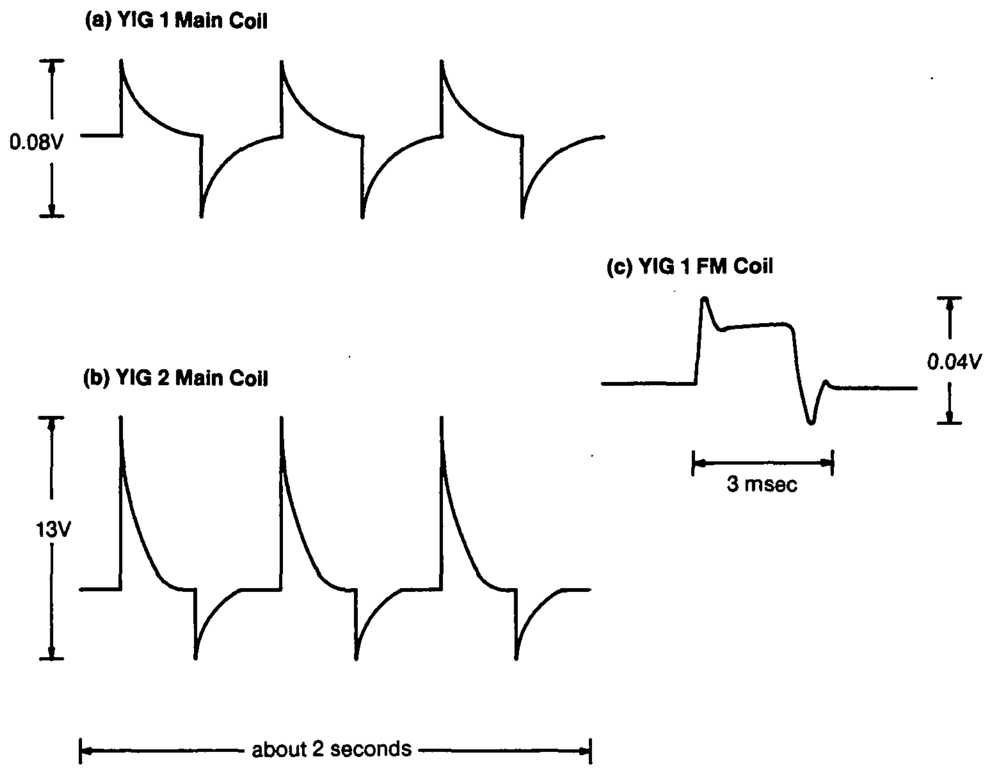


Figure 7. YIG Coil Drive Waveforms

www.valuetronics.com

BROADBAND POWER PROBLEMS

This section assumes that a power problem exists across the full frequency range, but that no error message is displayed on the CRT. The problem may affect port 1 or port 2 or both. Suspect assemblies include:

A7 ALC	A69 step attenuator	A58 modulator
A70 3 dB attenuator	A67 power splitter	S4 transfer switch
A60 bias tee	A61 bias tee	A62 directional coupler
A63 directional coupler	A64 sampler	A71 6 dB attenuator

To troubleshoot, press **[MENU]** ***[CW FREQ]*** **[3]** **[G/n]**. For port 2 problems also press **[MEAS]** ***[Refl: REV S22]***.

A7 ALC/Signal Separation Check

Disconnect the cable W2 at A17J15 (underside of motherboard, near front) to eliminate modulator control and measure the power at the faulty port:

- At least 0 dBm at the port: replace the A7 ALC assembly.
- Option 003 instruments, at least −20 dBm at port 2: replace the A7 ALC assembly.
- Less than 0 dBm at the port: press **[MEAS]** and ***[Refl: REV S22]*** or ***[Refl: FWD S11]*** and measure power at the second port:
  - Less than 0 dBm at the second port: continue with *A69 Step Attenuator Check* and *A67 Power Splitter Check*, next.
  - At least 0 dBm at the second port (option 003 instruments, at least −20 dBm at port 2): either the directional coupler or the bias tee or the transfer switch (S4) is faulty. The power loss through each of these components should be negligible.

A69 Step Attenuator Check

Measure the input and output power of the step attenuator; the loss should be negligible.

NOTE: if the 5 dB attenuation steps seem inconsistent in use, do this:

1. Reconnect the step attenuator to the transfer switch. Connect an open or short to port 1.
2. Press **[SYSTEM]** ***[SERVICE MENU]*** ***[INPUT PORTS]*** ***[A]*** **[SCALE REF]** ***[REFERENCE POSITION]*** **[9]** **[x1]** to set up the instrument.
3. Press **[MENU]** ***[POWER]*** and then press **[▼]** repeatedly to reduce the output power. The A channel trace on the display should step down about 5 dB with each keystroke. If the steps are irregular or unrepeatable, replace the step attenuator.

www.valuetronics.com

A67 Power Splitter Check

Check the power loss of both legs of the power splitter, A67. Remove the mounting screws from the splitter assembly, remove the assembly altogether, and measure the input power through the access hole in the chassis.

- Insertion loss greater than 7.5 dB: replace the power splitter.

A58 Modulator and A70 3 dB Attenuator Check

With W2 still disconnected (at A17J2) from A58 (the modulator), determine the insertion loss of the A58 modulator and A70 3 dB attenuator.

- If the insertion loss through the modulator is not about 1 dB at 130 MHz increasing to 3 dB or less at 20 GHz (2 dB or less at 13.5 GHz), replace A58.
- If the insertion loss of the attenuator is not approximately 3 dB, replace A70.

A51 INTERFACE POWER SUPPLIES

Power is supplied to the lower box assemblies through ribbon cable W12 which connects to A51 at A51J1 (see location diagram on the instrument cover). Table 6 lists the supply voltages at A51J1, the assemblies that use these supplies, and the source of each supply for each assembly. Note that address and control lines are not shown.

Measuring Lower Box Bias Voltages

To check bias voltages, locate the suspected assembly and measure the voltages at the jack (J) and pin (p) noted.

- If the voltages are correct, return to the source troubleshooting procedure that referenced this step and continue.
- If any voltage is incorrect, disconnect cable W12 at A51J1 and measure the same voltage at the end of the cable (see the top row of Table 6 and Figure 8).
  - If the W12 voltages are correct, A51 is faulty.
  - If the W12 voltages are incorrect, refer to *A8 Test Point Voltages* (in *Power Supply*) to check these supplies and troubleshoot if necessary. If the supplies at A8 are correct, check cable W12 and traces on the A17 (upper box) motherboard.

www.valuetronics.com

Table 6. A51 Interface Power Supplies

Lower Box Assemblies	A51J1 Voltages				
	−15V	+5V	+15V	+22V	−5.2V
W12 cable	W12P1p21	W12P1p22	W12P1p23	W12P1p24	W12P1p25
A52 pulse generator	A51J4p2		A51J4p3		A51J4p4
A53 mixer/amp	A51J9p3		A51J9p4	A51J9p6	A51J9p5
A54 YIG2			A51J11p1	A51J11p2* A51J11p4*	
A55 YIG1	A51J10p2*	A51J10p4		A51J10p3* A51J10p6*	
A56 lower front panel				A51J3p3	
A57 LO	A53J2p5			A53J2p6	
A64 R sampler	A51J16p3		A51J16p4		
A65 A sampler	A51J14p3		A51J14p4		
A66 B sampler	A51J15p3		A51J15p4		
A69 step attenuator				A51J2p6	

*Supply passes through other components and voltage may be lower.

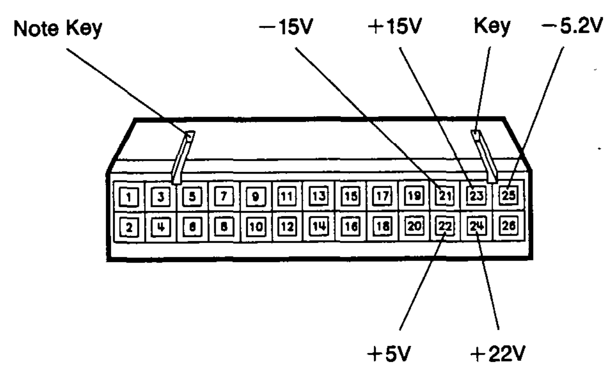


Figure 8. Voltages at Pins of W12P1

www.valuetronics.com

INTRODUCTION

Use this section to determine which receiver assembly of the instrument is faulty. The two receiver assemblies that affect all three signal paths are the A10 digital IF and A12 reference assemblies. The receiver assemblies that are associated with specific signal paths are listed in Table 1.

Table 1. Receiver Assemblies and Associated Paths

Signal Path	Port	Directional Coupler	Sampler	2nd Converter
R	internal	(A68, 20 dB attn)	A64	A6
A	1	A62	A65	A4
B	2	A63	A66	A5

START HERE

If all three signal paths showed unexpected results in the *Isolate Faulty Group* section, probably A12 or A10 is faulty: continue with *All Signal Paths Look Bad*, next.

If at least one signal path looked good, but the others did not, go to *At Least One Signal Path Looks Good*.

www.valuetronics.com

ALL SIGNAL PATHS LOOK BAD

For the receiver to operate properly, the A10 digital IF and 2nd converter assemblies must receive signals from the A12 assembly. Those signals are the 2nd LO and the 4 MHz signal.

2nd LO Check

Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS]*** **[1] [6] [x1]** ***[COUNTER: ANALOG BUS]*** to check the 2nd LO signal with the analog bus counter.

- Counter reads 9.996 MHz: continue with *4 MHz Check*.
- Counter does not read 9.996 MHz: perform the *A12 VCO Tune Adjustment*.
  - Successful adjustment, problem cured: perform the *Frequency Accuracy Performance Test* for verification.
  - Unsuccessful adjustment or problem persists: replace A12 assembly.

4 MHz Check

Use an oscilloscope to observe the 4 MHz signal at A10P2 pin 6 (either monitor the signal on the underside of the motherboard or use the extender board).

- 4 MHz sine wave signal at A10P2 pin 6: replace A10.
- 4 MHz sine wave signal not at A10P2 pin 6: check signal at A12P2 pin 36.
  - 4 MHz signal not at A12P2 pin 36: replace A12.
  - 4 MHz signal at A12 (but not A10): check the motherboard trace.

AT LEAST ONE SIGNAL PATH LOOKS GOOD

One good signal path indicates that at least one sampler, one 2nd converter, A12 and much of A10 are functional. Thus substitution is a convenient troubleshooting approach. If two signal paths are bad, repeat the steps of this section for each suspect signal path.

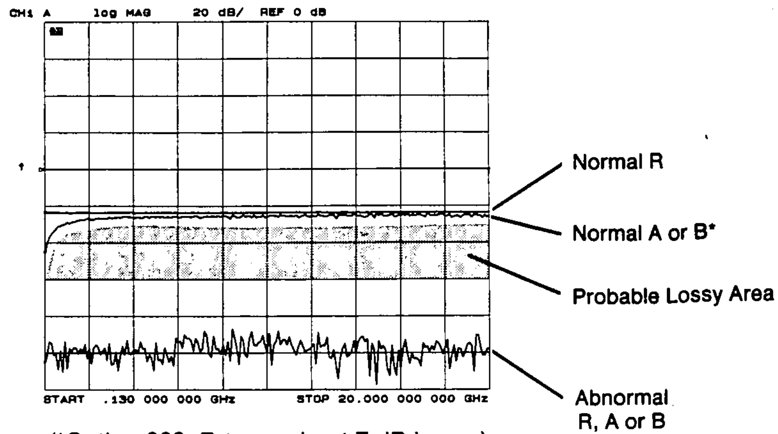
NOTE: to see the traces again, connect a short to port 1 to see signal path A or to port 2 to see signal path B. Then press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [INPUT PORTS]*** and ***[R]*** or ***[A]*** or ***[B] [TESTSET REV]***.

If the R signal path trace is bad, the R sampler is nonetheless good (or there would be a phase lock problem): go directly to *2nd Converter Check*.

If the A or B signal path is very low (not just lossy, see Figure 1) and the R signal path is good, go to *A and B Sampler Check by Substitution*.

www.valuetronics.com

If the A or B signal path appears slightly low, as in the shaded area of Figure 1, the problem is possibly a faulty directional coupler or, more probably, a lossy sampler. To isolate the fault, continue with *Directional Coupler Check*, next.



(*Option 003: B trace about 7 dB lower.)

Figure 1. Normal and Abnormal Signal Path R, A and B Traces (Note scale and reference position.)

Directional Coupler Check

To quickly check the directional coupler by elimination, connect the RF flexible cable from the output of A68 (the step attenuator) directly to the J2 RF INPUT of the suspect signal path sampler. Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [A]*** or ***[B]*** and compare the trace to Figure 2.

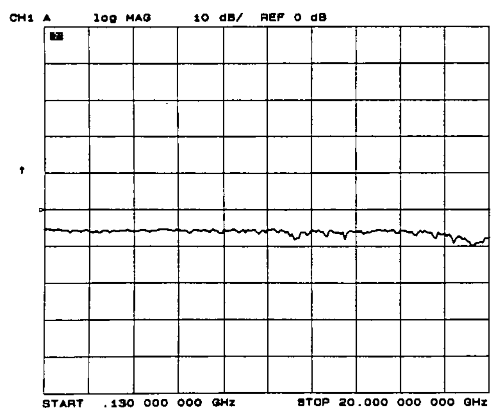


Figure 2. Directional Coupler Check CRT Trace

www.valuetronics.com

- Trace similar* to Figure 2: the sampler is good, therefore the coupler is lossy. Replace the coupler.

  *Minor power variations are probably due to the flexible cable and are of no concern.

- Trace abnormally low: the sampler is suspect, therefore the coupler is good. Troubleshoot the associated sampler by referring to *Sampler Voltage Check*.

A and B Sampler Check by Substitution

Disconnect the 20 dB attenuator A68 from the power splitter A67. Connect the flexible RF cable (part of the tool kit) from A67 to J2 (the RF input) of the suspect sampler. Move the faulty sampler IF cable from A17J11 (or A17J12 if signal path B is faulty) to A51J18 (labeled "TO R SAMPLER"). Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [A]*** or ***[B]*** and see whether the instrument phase locks. Disregard the trace.

- Instrument phase locks (no error message): the sampler under test is normal. Go to *2nd Converter Check*.
- Instrument displays "PHASE LOCK CAL FAIL" error message: either the sampler or its control and bias voltages are faulty. Continue with *Sampler Voltage Check*.

Sampler Voltage Check

NOTE: The BIAS CONTROL line is not used.

Check the SAMPLER CONTROL voltage (green wire) at the suspect sampler. The voltage should be about +0.22V when the sampler is on. If the sampler control voltage is wrong, replace A51, the interface assembly. (Do NOT replace the sampler: the problem is in the control signals.)

Check the +15V and −15V supply voltages.

- If the supply voltages are within 5% of nominal, replace the sampler.
- If the supply voltages are incorrect, refer to *A51 Interface Power Supply* at the end of the *Source* troubleshooting section.

Restore the sampler cables to their normal positions.

2nd Converter Check

NOTE: repair signal path R before troubleshooting signal path A or B.

Faulty R Signal Path. If R is the bad signal path, substitute A6 (R 2nd converter) with a 2nd converter from the working signal path. Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [R]*** and compare the CRT trace to the signal path R trace of Figure 1.

- Normal trace: replace the faulty 2nd converter.
- Abnormal trace: replace A10.

www.valuetronics.com

Faulty A or B Signal Path. If A is the bad signal path, remove A6 (the working R signal path 2nd converter) and install A4 (the suspect A signal path 2nd converter) in its place. If B is the bad signal path, substitute A6 with A5.

Press **[SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [R]*** and compare the CRT trace to the signal path R trace of Figure 1.

- Normal trace means the substitute 2nd converter functions: replace A10.
- Abnormal trace means the substitute is faulty: replace A4 (or A5).

www.valuetronics.com

INTRODUCTION

In a broad sense, measurement failures can be divided into two categories:

- hard failures which impede the normal functioning of the analyzer or prohibit the use of a feature and,
- soft failures which don't affect the normal functioning of the analyzer but render incorrect measurement data.

The emphasis of this troubleshooting section is soft failures. Soft failures are usually caused by faulty calibration devices or connectors, bad cables, improper calibration techniques, or RF cabling problems within the analyzer.

At this time, the analyzer is assumed to be free of hard failures--it passed the previous checks provided in *Isolate Faulty Group*. Any remaining anomaly must be a soft failure. Use the following procedures to isolate the fault.

START HERE

Accessories troubleshooting is organized in three major sections. It is suggested that the procedures be performed in the order given:

1. Inspect and Gage Connectors: Check the physical condition of the test port connectors and calibration kit devices.
2. Switch Repeatability: Check the operation of the mechanical transfer switch.
3. Inspect Error Terms: Use the error terms to isolate faulty components and troubleshoot.

www.valuetronics.com

INSPECT AND GAGE CONNECTORS

1. Inspect the test port connectors on the front panel of the analyzer. Check for bent or broken center pins and loose connector bulkheads.

   Gage both connectors. (Gages are part of the HP 85052B calibration kit.) The specified test port connector center pin **recession** is 0.0002 to 0.0018 inches. The center pin must be recessed.

   If the center pin recession is incorrect, replace the entire connector assembly (see *Disassembly and Replacement Procedures* and the figure labeled *Front Panel* in *Replaceable Parts*).

2. Inspect the calibration kit devices for bent or broken center conductors and other physical damage. Gage each device. The mechanical specifications for each device are given in the calibration kit manual.

   If any calibration device is out of mechanical tolerance, replace the device.

SWITCH REPEATABILITY

Calibration does not compensate for the repeatability of the mechanical transfer switch, so the switch can be a source of error. To check the switch, use the following procedure:

1. Press **[PRESET] [AVG]** *[IF BW]* **[1] [0] [0] [x1]** to set the bandwidth to 100 Hz.

2. Press **[CAL]** *[CALIBRATE MENU] [RESPONSE]* to access the response calibration menu.

   Connect a short to test port 1 and press *[SHORT] [DONE RESPONSE]*.

3. Press **[DISPLAY]** *[DATA→MEMORY] [DATA/MEM]* **[SCALE REF] [.] [0] [1] [x1]** to display data/memory and scale the trace.

4. Press **[MEAS]** and then repeatedly press *[S22] [S11]* to switch back and forth between S22 and S11. Return to the S11 measurement condition.

   The trace should be within a 0.06 dB window around the 0 dB reference line (3 divisions in either direction).

5. Press **[MEAS]** *[S22]* **[DISPLAY]** *[DATA]* to check the switch at port 2.

   Repeat steps 2, 3 and 4, only this time monitor the S22 trace for the 0.06 dB window.

www.valuetronics.com

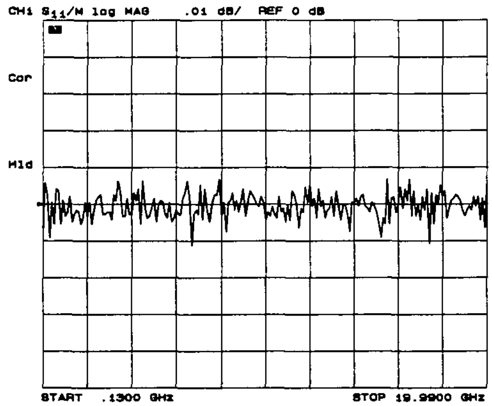


Figure 1. Typical Switch Repeatability Trace

INSPECT ERROR TERMS

Error terms are basically a measure of a "system": a network analyzer and calibration kit and any cables used. As required, refer to the *Error Terms* troubleshooting section for:

- The specific measurement calibration procedure used to generate the error terms,
- The routines required to extract error terms from the instrument, and
- Typical error term data.

Use Table 1 to cross-reference error term data to system faults.

Table 1. Components Related to Specific Error Terms

Component	Directivity	Source Match	Refl't'n Tracking	Isolation	Load Match	Transmission Tracking
cal kit load	x					
cal kit/open/ short		x	x			
test port conn	x	x	x	x	x	x
coupler	x	x	x	7*,19*	x	x
bias tee		x	x	x	x	x
transfer switch		x	x	16*	x	x
step attenuator		x	x		x	x
power splitter		x	x		x	x
sampler			x	4*		x
A10 digital IF				x		
external cables					x	x

*Frequency, in GHz, at which the component is more likely to contribute to crosstalk.

www.valuetronics.com

If problems are detected using error term analysis, use the following approach to isolate the fault:

1. Check the cable by examining the load match and transmission tracking terms. If those terms look suspicious, go to *Cable Test*.

2. Verify the cal kit devices:

   Loads: If the directivity error term looks good, the load and the port are good. If directivity looks bad, connect the same load on the other port and measure its directivity. If the second port looks bad, as if the problem had shifted with the load, replace the load. If the second port looks good, as if the load had not been the problem, troubleshoot the first port by continuing with *Isolate the Fault in the RF Path*.

   Shorts and opens: If the source match and reflection tracking terms look good, the shorts and the opens are good. If these terms look bad while the rest of the terms look good, proceed to *Verify Shorts and Opens*. If other error terms also indicate a problem, proceed with *Isolate the Fault in the RF Path*.

Isolate the Fault in the RF Path

Since the calibration devices have been verified, the problem exists in the test port connector, the coupler, or elsewhere in the internal RF path. Table 1 shows which assemblies affect each error term. If more than one error term is bad, note which assemblies are common to each of the bad terms. These are the suspects.

There are two methods of fault isolation. The simpler of the two methods can be used only with option 010 (time domain) instruments. (To check, press **[SYSTEM]**. If the middle softkey is labeled ***[TRANSFORM MENU]***, the instrument has option 010.)

Continue with *Time Domain Fault Isolation*, next, if possible, or go to *Assembly Substitution Fault Isolation*, following.

Time Domain Fault Isolation. Connect a short to the port that exhibits the problem. Preset the instrument. Make sure you are driving the problem port: press **[MEAS]** *[S22]* to troubleshoot port 2.

Press **[SYSTEM]** ***[TRANSFORM MENU] [TRANSFORM ON]*** **[STOP] [1] [0] [G/n] [FORMAT]** ***[LIN MAG]*** **[SCALE REF] [1] [0] [k/m]** to turn on time domain and scale the display.

The CRT should show a trace similar to Figure 2, typical plots of the analyzer's RF path. The traces show reflections starting at the port's connector, continuing back into the instrument. Each spike in the trace represents a discontinuity or mismatch in the system. These usually occur at connections between assemblies and cables or at bends in the cables.

Significant mismatches will be obvious.

www.valuetronics.com

Mismatches which cause the instrument to generate unusual error terms or fail system verification will be obvious on the linear magnitude scale. Such mismatches will go offscale, as the short does. Some variation from port to port and instrument to instrument is normal. Minor mismatches are inherent in the construction of the instrument. Refer to Figure 2 and use the minor mismatches as markers to identify specific areas of the instrument.

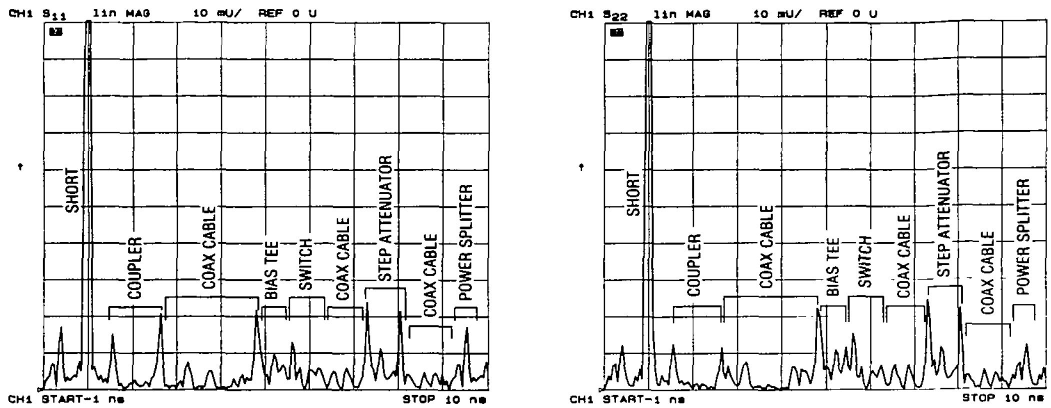


Figure 2. Typical Time Domain Plot of Internal RF Path (Option 003: see Figure 5.)

NOTE: Hewlett-Packard does not provide specifications for the individual assemblies internal to the analyzer. Therefore, the figures used within this section are intended as a guideline only. The only specifications warranted by Hewlett-Packard are those listed in the *Specifications* table in the *Operating Manual*.

Assembly Substitution Fault Isolation. At this point, the error term problem has been isolated to a specific port and you should have a list of suspected assemblies. Since the analyzer has two identical ports, you can swap identical assemblies between the port 1 and port 2 signal paths and then regenerate the error terms. When the problem moves from one port to another, you have found the offending assembly.

Before trying this, be sure to inspect the front panel test port connector for obvious damage. Tighten all semi-rigid cable connectors inside the instrument.

Cable Test

The load match error term is a good indicator of cable problems. Further verification of cable faults can be achieved by measuring the reflection of the cable. Perform an S11 1-port calibration directly at port 1 (no cables). Then connect the suspect cable to port 1 and terminate the open end in 50 ohms.

Figure 3 shows the return loss trace of a good (left side) and poor cable. Note that the important characteristic of a cable trace is its level (the good cable trace is much lower) not its regularity. Refer to the cable manual for return loss specifications.

www.valuetronics.com

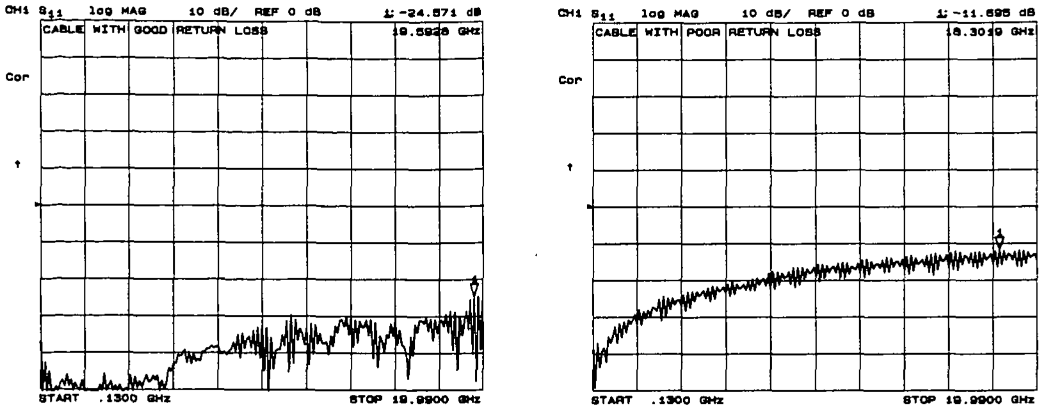


Figure 3. Typical Return Loss Traces of Good and Poor Cables

Verify Shorts and Opens

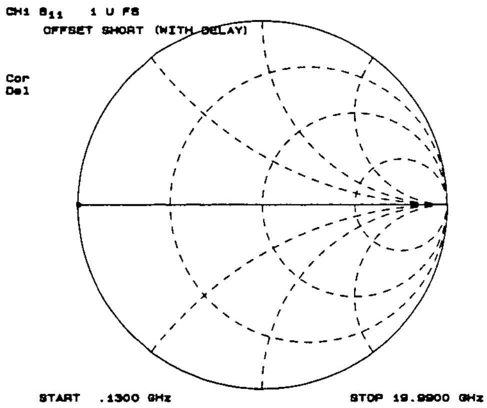
Substitute a known good short and open of the same connector type and sex as the short and open in question. If the devices are not from one of the standard calibration kits, refer to *Modifying Calibration Kits* in Chapter 5 of the *Reference* to use the ***[MODIFY CAL KIT]*** function. Set aside the short and open that are causing the problem.

1. Perform an S11 1-port calibration using the good short and open. Then press **[FORMAT]** ***[SMITH CHART]*** to view the devices in Smith chart format.
2. Connect the good short to port 1. Press **[SCALE REF]** ***[ELECTRICAL DELAY]*** and turn the RPG to enter enough electrical delay so that the trace appears as a dot at the left side of the circle.

   Replace the good short with the questionable short at port 1. If the trace of the questionable short does not appear very similar to the known good short, the questionable short is not suitable for use with the analyzer.
3. Connect the good open to port 1. Press **[SCALE REF]** ***[ELECTRICAL DELAY]*** and turn the RPG to enter enough electrical delay so that the trace appears as a dot at the right side of the circle (see Figure 4, right).

   Replace the good open with the questionable open at port 1. If the trace of the questionable open does not appear very similar to the known good open, the questionable open is not suitable for use with the analyzer.

www.valuetronics.com



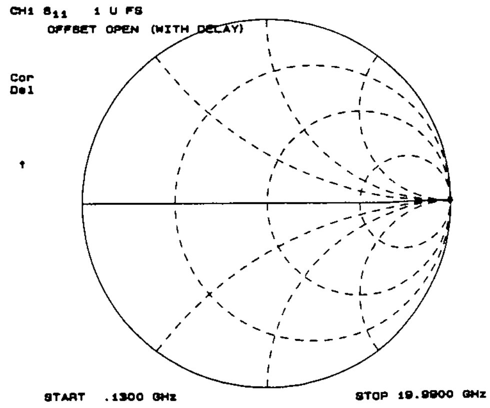


Figure 4. Typical Smith Chart Traces of Good Short (left) and Open

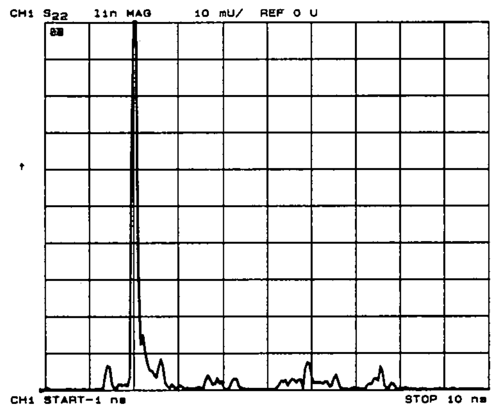


Figure 5. Typical Time Domain Plot of Option 003 Internal RF Path

www.valuetronics.com

INTRODUCTION

This section describes the functions of the service key menus. These menus are used to test, verify, adjust, control and troubleshoot the instrument. They are divided into two groups: internal diagnostics and service modes. When applicable, the HP-IB mnemonic is written in parentheses following the key. See *HP-IB Mnemonic Definitions* at the end of this section.

INTERNAL DIAGNOSTICS SUMMARY

The internal diagnostics menus are shown in Figure 1 and described in the following paragraphs. The internal diagnostics keys are ***[TESTS]***, ***[TEST OPTIONS]*** and ***[SELF-DIAGNOSE]***.

www.valuetronics.com

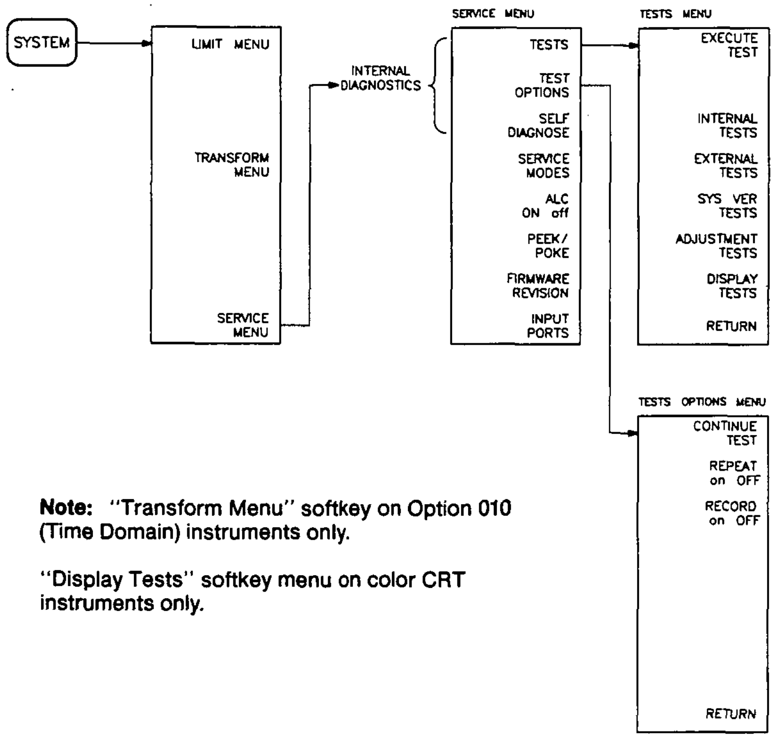


Figure 1. Internal Diagnostics Menus
(See Figure 2 for Service Modes Menus.)

TESTS MENU

[TESTS] (TEST[D]). This softkey makes TEST the active function and accesses a menu that can be used to select or execute tests 0 through 51 (default =1). Instruments with color CRTs have additional tests. Remember, HP-IB commands appear in parentheses following the keystroke: ***[KEYSTROKE A]*** (COMMAND A).

The tests are divided by function into the categories, described below. To access the first test in each category, press the category softkey. To access the other tests, use the number pad, step keys or knob. The test number, name, and status abbreviation will be displayed in the active entry area of the CRT.

Table 1 shows the test status abbreviation that appears on the CRT, its definition, and the equivalent HP-IB code. The HP-IB command to output the test status of the most recently executed test is OUTPTESS. Refer to *HP-IB Service Mnemonic Definitions* at the end of this section for more information.

www.valuetronics.com

Table 1. Test Status Terms

CRT Abbreviation	Definition	HP-IB Code
PASS	PASS	0
FAIL	FAIL	1
—IP—	IN PROGRESS	2
(NA)	NOT AVAILABLE	3
—ND—	NOT DONE	4
DONE	DONE	5

[EXECUTE TEST] (EXET). This runs the selected test and may display these softkeys:

[CONTINUE] (TESR1) continues the selected test.
[YES] (TESR2) alters correction constants during adjustment tests.
[NEXT] (TESR4) displays the next choice.
[SELECT] (TESR6) chooses the option indicated.
[ABORT] (TESR8) terminates the test and returns to the tests menu.

NOTE: Descriptions of tests in each of the next four categories are given under the heading *Test Descriptions* in the following pages.

[INTERNAL TESTS]. These tests are completely internal and self-evaluating. They do not require external connections or user interaction.

[EXTERNAL TESTS]. These are additional self-evaluating self-tests. However, these require some user interaction (such as keystrokes).

[SYS VER TESTS]. These tests are part of the system verification procedure, and are also used to examine the contents of the measurement calibration arrays. The procedure is in the *Verification* section. Information about the calibration arrays is provided in the *Error Terms* section.

[ADJUSTMENT TESTS]. These tests generate and store the correction constants; refer to *Adjustments*.

[DISPLAY TESTS]. These tests apply to color CRT instruments only. They check the display and GSP assembly.

TEST OPTIONS MENU

[TEST OPTIONS] accesses softkeys that affect the way tests (routines) run, or supply necessary additional data.

[CONTINUE TEST] (TESR1). This restarts the test where it was stopped.

www.valuetronics.com

[REPEAT on OFF] (TO2). This toggles the repeat function on and off. When ON, the selected test will run 10,000 times unless stopped by pressing any key. The current number of passes and fails is displayed on the CRT.

[RECORD on OFF] (TO1). This toggles the record function on and off. When ON, certain test results are sent to a printer via HP-IB. This is especially useful for correction constants. Remember, the instrument must be in system controller mode or pass control mode to print (refer to Chapter 7 of the *Reference*).

SELF DIAGNOSE SOFTKEY

[SELF DIAGNOSE] examines in order the pass/fail status of all internal tests and displays "NO FAILURE FOUND" if no tests have failed.

If a failure is detected, the routine displays the assembly or assemblies most probably faulty and assigns a failure probability factor to each assembly.

TEST DESCRIPTIONS

The analyzer has over 50 internal test routines that test, verify, and adjust the instrument. This section describes those tests.

Internal Tests

This group of tests runs without external connections or operator interaction. All return a PASS or FAIL condition. All run on power-up and PRESET except as noted.

0 **ALL INT**. This runs only when selected. It is the following subset of internal tests: first, the ROM tests 3 and 4; then tests 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, and 20. If any of these tests fail, this test displays a FAIL status. Use the RPG knob to scroll through the tests and see which failed. If *all* pass, the test displays a PASS status. Each test in the subset retains its own test status.

1 **PRESET**. This runs the following subset of internal tests: first, the ROM/RAM tests 2, 3, and 4; then tests 5, 6, 7, 8, 9, 10, 11, 14, 15, and 16. If any of these tests fail, this test returns a FAIL status. Use the RPG knob to scroll through the tests and see which failed. If *all* pass, this test displays a PASS status. Each test in the subset retains its own test status. This same subset is available over HP-IB as "TST?". It is not performed upon remote preset.

2 **ROM**. This test is part of the ROM/RAM tests and cannot be run separately. Refer to the *Digital Control* troubleshooting section for more information. If there is no FAIL message after preset or power-on, the test has passed.

3 **CMOS RAM**. Part of the ROM/RAM tests, this test verifies the A9 CPU CMOS (long-term) memory with a non-destructive write/read pattern that does not erase data. If a FAIL message is not displayed, the test has passed. A destructive version that writes over stored data is documented in *ROM/RAM Tests* at the end of this section.

4 **Main DRAM**. Part of the ROM/RAM tests, this verifies the A9 CPU main memory (DRAM) with a non-destructive write/read test pattern. If a FAIL message is not displayed, the test has passed. A destructive version is documented in *ROM/RAM Tests* at the end of this section.

www.valuetronics.com

5 **DSP Wr/Rd.** This verifies the ability of the main processor and the digital signal processor (DSP), both on the A9 CPU assembly, to communicate with each other through DRAM. Verifies that programs can be loaded to the DSP. Verifies most of the main RAM access circuits.

6 **DSP RAM.** This verifies the A9 CPU RAM associated with the digital signal processor by using a write/read pattern.

7 **DSP ALU.** This verifies the A9 CPU high-speed math processing portions of the digital signal processor.

8 **DSP Intrpt.** This tests the ability of the A9 CPU digital signal processor to respond to interrupts from the the A10 digital IF ADC.

9 **DIF Control.** This tests the ability of the A9 CPU main processor to write/read to the control latches on the A10 digital IF.

10 **DIF Counter.** This tests the ability of the A9 CPU main processor to write/read to the triple divider on the A10 CPU. It primarily tests the A9 CPU data buffers and A10 digital IF, but it also requires the 4 MHz clock from the A12 reference to pass.

11 **DSP Control.** This tests the ability of the A9 CPU digital signal processor to write to the control latches on the A10 digital IF. Feedback is verified by the main processor. It primarily tests the A10 digital IF, but failures may be caused by the A9 CPU.

12 **Fr Pan Wr/Rd.** This runs only when selected, and tests the ability of the A9 CPU main processor to write/read to the front panel processor. It primarily tests the A2 front panel interface and processor, with interrupts, but also requires A9 CPU data buffering and address decoding. (See also tests 23 and 24 below.)

13 **Rear Panel.** This runs only when selected or with ALL INTERNAL. It tests the ability of the A9 CPU main processor to write/read to the rear panel control elements. It mostly tests the A16 rear panel, but also requires A9 CPU data buffering and address decoding. (It does *not* test the HP-IB interface; for that see the *Introductory Operating Guide.*)

14 **Post Reg.** This polls the status register of the A8 post-regulator, and flags the following conditions: heat sink too hot, inadequate air flow, or post-regulated supply shutdown.

15 **Frac N Cont.** This tests the ability of the A9 CPU main processor to write/read to the control element on the A14 fractional-N (digital) assembly. The control element must be functioning, and the fractional-N VCO must be oscillating (although not necessarily phase-locked) to pass.

16 **Sweep Trig.** This tests the sweep trigger (L SWP) line from the A14 fractional-N to the A10 digital IF. L SWP synchronizes the receiver with the sweep.

17 **ADC Lin.** This runs only when selected, and tests the linearity of the A10 digital IF ADC using the built-in ramp generator. The test generates a histogram of the ADC linearity, where each data point represents the relative "width" of a particular ADC code. Ideally, all codes have the same width; different widths correspond to non-linearities.

18 **ADC Ofs.** This runs only when selected, and tests the ability of the offset DAC ont he A10 digital IF to apply a bias offset to the IF signals before the ADC input. Primarily tests the A10 digital IF.

www.valuetronics.com

19 **ABUS Test**. This runs only when selected, and measures several analog bus reference voltages (all nodes from the A10 digital IF) to test analog bus accuracy. It primarily tests the A10 digital IF.

20 **FN Count**. This test uses the internal counter to count the A14 fractional-N VCO frequency (120 to 240 MHz) and the divided fractional-N frequency (100 kHz). It requires the 100 kHz signal from A12 and the counter gate signal from A10 to pass.

External Tests

These tests require either external equipment and connections or operator interaction of some kind to run. Tests 23 and 24 are comprehensive front panel checks, more complete than test 12, that check the front panel keys and knob.

21 **Op Ck Port 1.** This test and the next are used in the Operator's Check procedure, documented in the *Verification* section of this manual. It requires the external connection of a short, and tests port 1 and the phase lock system.

22 **Op Ck Port 2**. Same as 21, but port 2.

23 **Fr Pan Seq**. This tests the RPG and all A1 front panel keys, as well as the front panel microprocessor on the A2 assembly. It prompts the user to rotate the RPG, then press each key in an ordered sequence. It continues to the next prompt only if the current prompt is correctly satisfied.

24 **Fr Pan Diag**. Similar to 23 above, but the user rotates the RPG or presses the keys in any order, and this test displays the command the instrument received.

25 **ADC Hist**. Factory use only.

Sys Ver Tests

These tests apply mainly to system-level, error-corrected verification and troubleshooting. Tests 26 to 30 are associated with the system verification procedure, documented in the *Verification* section. Tests 31 to 42 facilitate examining the calibration coefficient arrays (error terms) resulting from a measurement calibration; refer to the *Error Terms* section for details.

26 **Sys Ver Init**. This recalls the initialization state for system verification from disc, in preparation for a measurement calibration. It must be done *before* 27, 28, 29, or 30 are performed.

27 **Ver Dev 1**. This recalls verification limits from disc for verification device #1 in all applicable S-parameter measurements. It performs pass/fail limit testing of the current measurement.

28 **Ver Dev 2**. Same as 27 above for device #2.

29 **Ver Dev 3**. Same as 27 above for device #3.

30 **Ver Dev 4**. Same as 27 above for device #4.

31-42 **Cal Coef 1-12**. These tests copy error term data from a measurement calibration array to display memory. A measurement calibration must be complete and correction must be on. Definition of calibration arrays depends on the current calibration type. After execution, memory is automatically displayed. Formatting, markers, and graphics function normally. Refer to the *Error Term* section for details.

www.valuetronics.com

Adjustment Tests

These tests are used in the *Adjustments* section of this manual.

43 **Pretune Adj.** This generates two correction constants for use in establishing phase-lock.

44 **ABUS Cor**. This measures three fixed voltages on the ABUS, and generates new correction constants for ABUS amplitude accuracy in both high resolution and low resolution modes.

45 **Intensity Cor (HP 8719A/20B)**. This stores the current values of the adjustments made in the "HP 8719A/20B Display Intensity Adjustments."

Foc/Int Cor. (HP 8720A). This stores the current values of the focus and intensity adjustments (under *[DISPLAY]*) for recall at power-on.

46 **Disp 2 Ex (HP 8719A/20B)**. This displays a rainbow of 15 colors plus white, ranging from pure red (0) to green (33) to blue (67) and beyond. Press softkey 8 (bottom) to exit.

Disp 2 Ex. (HP 8720A). This writes the "secondary test pattern" to the display for display adjustments. Press **[PRESET]** to exit this adjustment.

47 **IF Step Cor**. This measures the gain of the IF amplifiers (A and B only) located on the A10 digital IF, to determine the correction constants for absolute amplitude accuracy. It provides smooth dynamic accuracy and absolute amplitude accuracy in the −30 dBm input power region.

48 **ADC Ofs Cor**. This measures the A9 CPU ADC linearity characteristics, using an internal ramp generator, and stores values for the optimal operating region. During measurement, the receiver adds an offset bias to the IF signals so they are centered in the optimal region. This improves low-level dynamic accuracy.

49 **Serial Cor**. This stores the serial number (input by the user in the display title menu) in EEPROM. Note that this routine will not overwrite an existing serial number.

50 **Option Cor**. This stores the option registration number (required for option 001 or 010 or both).

51 **Cal Kit Def.** This loads the default calibration kit definitions (device model coefficients) into EEPROM.

Display Tests (HP 8719A/20B)

These tests apply to the HP 8719A/20B analyzers with color CRTs. The tests do *not* signal a PASS/FAIL condition on the CRT; the CRT will be blank or dim. Instead, the six upper front panel LEDs indicate the PASS/FAIL status:

All six LEDs OFF: PASS.
Any LED ON: FAIL.

Press **[PRESET]** to exit the test.

52. **Disp/cpu com.** This checks the CPU's capability to communicate with the A19 GSP assembly.

53. **DRAM cell.** This tests the DRAM on A19.

www.valuetronics.com

54. **Main VRAM.** This tests the VRAM on A19.

55. **VRAM bank.** The GSP tests all the cells in each of the 4 VRAM banks.

56. **VRAM/video.** This test verifies that the A19 GSP can write and read shift register transfers. It also checks the video signals LHSYNC, LVSYNC, and LBLANK to verify that they are active and toggling.

57. **RGB outputs.** This test confirms that the analog video signals are correct and functional.

58. **Inten DAC.** This verifies that the intensity DAC can be set low and high.

Test Patterns

Test patterns, with one exception, are for factory only. Test patterns are displayed by entering the test number *[x1] [EXECUTE TEST] [CONTINUE]*. The test pattern will be displayed and the softkey labels blanked.

To exit, press softkey 8 (bottom).

NOTE: In all solid test patterns, an extremely thin full-screen horizontal line is visible about 1/4 screen height from the bottom. This condition is characteristic of the CRT does not indicate any problem.

59. **Test pat 1.** This all white pattern is used to verify the light output of the A18 display and to check for color purity.

60-62. **Test Pat 2-4.** These all Red, Green, and Blue patterns show the color purity of the CRT and its capability to independently control each gun color. In case of problems, refer to the "HP 8719A/20B Display Degaussing (Demagnetizing)" procedure in the "Adjustments" section.

63. **Test Pat 5.** This is a 16-step gray scale pattern.

64. **Test Pat 6.** This 3-step gray scale pattern is used in the "Background Adjustment" of the display.

65. **Test Pat 7.** This convergence pattern is for factory use only.

66-67. **Test Pat 8-9.** These crosshatch and inverse crosshatch patterns are for factory use only.

68. **Test Pat 10.** This H pattern is for factory use only.

69. **Test Pat 11.** This normally solid white pattern checks the pixel stretching circuit of the A19 GSP assembly. Sixteen alternating white and gray vertical stripes indicate problems with the STRETCH line and LFIRSTPIX.

70. **Test Pat 12.** This repeating gray scale pattern is for factory use only.

71. **Test Pat 13.** This color rainbow pattern is the same as test 46.

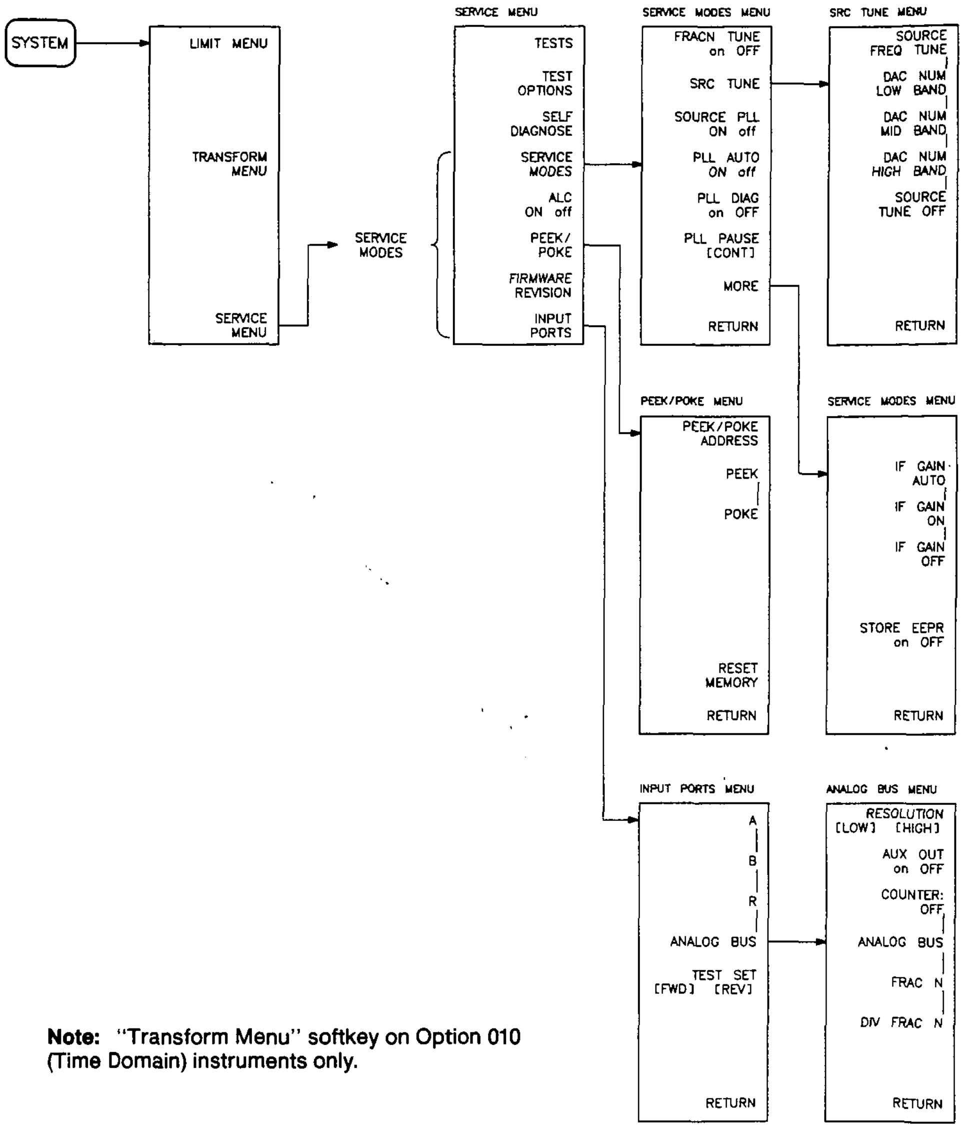
72. **Test Pat 14.** This character set represents the different types and sizes of characters available. Control characters are not displayed.

73. **Test Pat 15.** This bandwidth pattern provides a quick visual verification of the bandwidth of the display. It consists of multiple alternating white and black vertical stripes. Each stripe should be clearly visible. A limited bandwidth would smear these lines together. No field adjustment is possible.

www.valuetronics.com

SERVICE MODES SUMMARY

The service modes menus are shown in Figure 2 and described in the following paragraphs. The service modes softkeys are ***[SERVICE MODES]***, ***[ALC ON off]***, ***[PEEK/POKE]***, ***[FIRMWARE REVISION]*** and ***[INPUT PORTS]***.



Note: "Transform Menu" softkey on Option 010 (Time Domain) instruments only.

Figure 2. Service Modes Menus

www.valuetronics.com

SERVICE MODES MENU

This menu accesses other menus and softkeys that allow you to control and monitor various circuits for troubleshooting. To access the service modes menu, press **[SYSTEM]** ***[SERVICE MENU] [SERVICE MODES]*** (see Figure 2).

[FRACN TUNE on OFF] (SM1<on|off>). This mode is useful for testing the A13 and A14 fractional-N circuits. It allows you to directly control and monitor the output frequency of the fractional-N VCO (120 MHz to 240 MHz).

The front panel keys or knob can be used to enter the frequencies of interest. The output of the A14 assembly can be checked at A14TP1 (VCO/2) with an oscilloscope, a frequency counter, or a spectrum analyzer. The frequency is one-eighth the VCO frequency generated on the A14 assembly.

[SRC TUNE] (SM2E). Use this mode to test the pretune functions of the phase lock and source assemblies. See *SRC Tune Menu*, following.

[SOURCE PLL ON off] (SM3<on|off). With this mode turned OFF, the source stays in the pretune mode and does not attempt to complete the phase lock sequence. Also, all phase lock error messages are disabled. The fractional-N circuits and the receiver operate normally. Therefore, the instrument sweeps, but the source is being driven by the pretune DAC in a stair-stepped fashion.

[PLL AUTO ON off] (SM4<on|off>). During normal operation (PLL AUTO ON) when the instrument encounters phase lock problems (e.g. "harmonic skip"), it will automatically attempt to determine new pretune values. It will continue to do this until phase lock is achieved. This mode allows you to disable that function so that the phase-locked loop is not continuously trying to recalibrate itself. With PLL AUTO OFF the frequencies and voltages are not changing as they are when they are attempting to phase lock, so troubleshooting the phase-locked loop circuits is more convenient.

[PLL DIAG on OFF] (SM5<on|off>). The instrument starts a new phase lock sequence at the beginning of each band. This normally occurs very rapidly, making it difficult to troubleshoot phase lock problems. Turning this mode ON slows the process down, allowing you to inspect the steps of the phase lock sequence (pretune, acquire, and track) by pausing at each step. The steps are indicated on the CRT, along with the channel (C1 or C2) and band number (B2 through B11).

This mode can be used with PLL PAUSE to halt the process at any step. It can also be used with the analog bus counter.

[PLL PAUSE]. This mode is used only with PLL DIAG mode. ***[CONT]*** indicates that it will continuously cycle through all steps of the phase lock sequence. ***[PAUSE]*** holds it at any step of interest. This mode is useful for troubleshooting phase-locked loop problems.

[MORE]. This accesses the service modes more menu listed below.

www.valuetronics.com

SERVICE MODES MORE MENU

[IF GAIN AUTO]. This mode is the normal operating condition and works in conjunction with IF GAIN ON and OFF. The A10 assembly includes a switchable attenuator section and an amplifier that amplifies low-level 4 kHz IF signals (for A and B inputs only). This mode allows the A10 IF section to automatically determine if the attenuator should be switched in or out. The switch occurs when the A or B input signal is approximately −30 dBm.

[IF GAIN ON]. This mode locks out the A10 IF attenuator sections, regardless of the amplitude of the A or B IF signal. Be aware that input signal levels above −30 dBm at the sampler input will saturate the ADC and cause measurement errors. Turning this ON switches out both the A and B attenuation circuits; they cannot be switched independently. This mode is useful for checking the A10 IF gain amplifier circuits.

[IF GAIN OFF]. This mode forces the A10 IF gain attenuators to be switched in, regardless of the amplitude of the A or B IF signal. It is important to note that small input signals will appear noisy, and raise the apparent noise floor of the instrument. Turning this OFF switches both the A and B gain amplifier circuits; they cannot be switched independently. This mode is useful for checking the A10 IF gain amplifier circuits.

[STORE EEPR on OFF]. This mode allows you to store the correction constants that reside in non-volatile memory (EEPROM) onto a disc. Correction constants improve instrument performance by compensating for specific operating variations due to hardware limitations (refer to the *Adjustments* section). Having this information on disc is useful as a backup, in case the constants are lost (perhaps due to a CPU board failure). Without a disc backup the correction constants can be regenerated manually, although the procedures are more time consuming.

SRC TUNE MENU

This mode is useful for testing the pretune functions of the phase lock and source assemblies. Press **[SYSTEM]** *[SERVICE MENU]* *[SRC TUNE]* to access the menu (shown in Figure 2.)

[SOURCE FREQ TUNE] (SM2E). This mode allows direct control of the pretune frequency of the source if the instrument does not indicate "Phase Lock Cal Failure". Use the front panel keys, knob or step arrows to enter any frequency within range of the instrument.

NOTE: If the instrument displays the "Phase Lock Cal Failure" message, use the *[DAC NUM xxx BAND]* keys below. The relationship between DAC numbers and frequency varies from instrument to instrument. The DAC numbers below are guidelines only.

[DAC NUM LOW BAND] (SM2L). Allows entry of digital data directly into the DAC on the A11 phase lock assembly. Use the front panel keys, knob or step arrows to enter DAC numbers in the range of 300 through 1800 to generate frequencies from 130 MHz to 2 GHz.

www.valuetronics.com

[DAC NUM MID BAND] (SM2M). As above but for DAC numbers ≅300 to 2500; frequency range =2 GHz to 8 GHz.

[DAC NUM HIGH BAND] (SM2H). As above but for DAC numbers ≅0 to 3600; frequency range =8 GHz to 20 GHz (HP 8719: to 1700 for 13.5 GHz).

[SOURCE TUNE OFF] (SM2D). This key disables the source freq tune modes.

ALC ON OFF SOFTKEY

[ALC ON off] (ALC <ON|OFF>). This toggles the ALC circuit on and off. When off, the ALC voltage to the modulator is held at a constant level. (That level is set by the automatic leveling control off adjustment.) Use ALC OFF to troubleshoot source power problems.

PEEK/POKE MENU

The *[PEEK/POKE]* softkey displays a menu that allows you to access different memory locations and view or change the contents. Access the menu by pressing **[SYSTEM]** *[SERVICE MENU]* *[PEEK/POKE]* as shown in Figure 2. The keys are described below.

CAUTION: PEEK/POKE capability is intended for service use only.

[PEEK/POKE ADDRESS] (PEEL[D]). This softkey accesses any memory address and displays it in the active entry area of the CRT. Use the RPG, entry keys, or step keys to enter the memory address of interest.

[PEEK] (PEEK). This softkey displays the data at the memory address accessed by pressing *[PEEK/POKE ADDRESS]*.

[POKE] (POKE[D]). This softkey allows you to change the data at the memory address accessed by the *[PEEK/POKE ADDRESS]* softkey. Use the RPG, entry keys, or step keys to change the data.

[RESET MEMORY]. This softkey allows you to reset or clear the memory where instrument states are stored. To do this, press *[RESET MEMORY]* **[PRESET]**.

www.valuetronics.com

FIRMWARE REVISION SOFTKEY

Press *[FIRMWARE REVISION]* (following **[SYSTEM]** *[SERVICE MENU]*, see Figure 2) to display the current firmware revision information. The number and implementation date appear in the active entry area of the CRT as shown in Figure 3 below. Another way to display the firmware revision information is to cycle power.

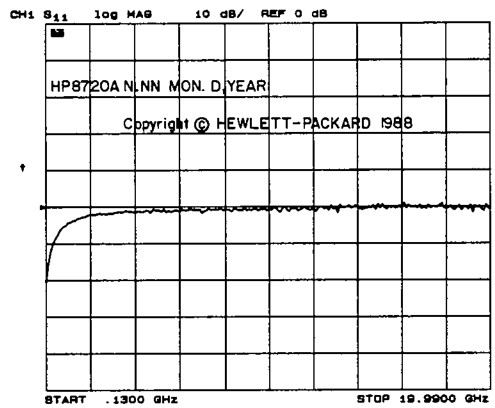


Figure 3. Location of Firmware Revision Information on CRT

INPUT PORTS MENU

This menu allows the user to display any one of four input signals on the active channel and drive either front panel port. The input ports, A, B, R and analog bus, are explained below.

[A]. Displays the A input signal without dividing by the reference; useful for troubleshooting components in the A input path.

[B]. Same as *[A]*, above, but for B.

[R]. Displays the R input signal alone; useful for troubleshooting components in the R input path.

[ANALOG BUS] (ANAB<ON|OFF>). This key displays the current analog bus input (which can be one of 23 nodes throughout the instrument). It also accesses the analog bus menu, described below. For a description of the capabilities of the analog bus and the location of its nodes, refer to *Description of the Analog Bus*, below.

[TESTSET [FWD]]. This toggles between FWD to drive port 1 and REV to drive port 2. Press this key to exercise the transfer switch S4 or check the operation of port 2. This key functions only after *[A]*, *[B]*, or *[R]*, above, has been selected.

www.valuetronics.com

ANALOG BUS MENU

This menu lets the user select and monitor voltage and frequency nodes with the analog bus and internal counter as shown in Figure 2 and explained below.

[RESOLUTION [LOW]]. This toggles between low and high **RESOLUTION**. Use low resolution for large voltages (between +10 and −10 volts). Use high resolution to measure small voltages (less than 0.5 volts, positive or negative).

[AUX OUT on OFF]. This allows you to monitor the analyzer's analog bus nodes (except nodes 1 through 4) with external equipment (oscilloscope, voltmeter, etc.). To do this, connect the equipment to the AUX INPUT BNC connector on the rear panel, and press *[AUX OUT]*.

CAUTION

NEVER input any signal to the AUX INPUT rear panel connector with this function turned ON. Doing so can cause damage to the instrument.

[COUNTER: OFF]. This switches the internal counter off and removes the counter display from the CRT. The counter can be turned on with one of the next three keys. (Note: Using the counter slows the sweep.) The counter bandwidth is 16 MHz unless otherwise noted for a specific node.

NOTE: OUTPCNTR is the HP-IB command to output the counter's frequency data.

[ANALOG BUS]. This switches the counter to count the analog bus.

[FRAC N]. This switches the counter to count the A14 fractional-N VCO frequency at the node shown on the *Overall Block Diagram*.

[DIV FRAC N]. This switches the counter to count the A14 fractional-N VCO frequency after it has been divided down to 100 kHz for phase locking the VCO.

DESCRIPTION OF THE ANALOG BUS

The analog bus is a single multiplexed line that networks 23 nodes within the instrument. It can be controlled from the front panel, or through HP-IB, to make voltage and frequency measurements just like a voltmeter, oscilloscope, or frequency counter. The next few paragraphs provide general information about the structure and operation of the analog bus. See *Analog Bus Nodes*, below, for a description of each individual node. Refer to the *Overall Block Diagram*, in the *Troubleshooting* section, to see where the nodes are located in the instrument.

The analog bus consists of a source section and a receiver section. The source can be any one of the 23 nodes described in *Analog Bus Nodes* or the A14 fractional-N VCO, or the A14 fractional-N VCO divided down to 100 kHz. The receiver portion can be either the main ADC or the frequency counter. When analog bus traces are displayed, frequency is the x-axis. For a linear x-axis in time, switch to CW time mode (or sweep a single band).

www.valuetronics.com

The Main ADC

The main ADC is located on the A10 assembly and makes voltage measurements in two ranges (see ***[RESOLUTION]***, above).

The Frequency Counter

The frequency counter is located on the A14 assembly and can count one of three sources: the selected analog bus node, the A14 fractional-N VCO (FRAC N), or the A14 fractional-N VCO divided down to 100 kHz (DIV FRAC N). Its frequency range is 100 kHz to 16 MHz.

The counts are triggered by the phase lock cycle; one each at pretune, acquire, and track for each bandswitch. (The service mode, SOURCE PLL, must be ON for the counter to be updated at each bandswitch). The counter works in swept modes or in CW mode. It can be used in conjunction with SERVICE MODES for troubleshooting phase lock and source problems.

To read the counter over HP-IB, use the command OUTPCNTR.

Notes

- Fast-moving waveforms may be sensitive to sweep time.
- Anything occurring during bandswitches is not visible.
- The analog bus input impedance is about 50K ohms.
- Waveforms up to approximately 200 Hz can be reproduced.
- About 0.750 MHz is a typical counter reading with no AC signal present.
- The display and marker units (U) correspond to volts.

ANALOG BUS NODES

The following paragraphs describe the 23 analog bus nodes. They are listed in numerical order and are grouped by assembly. Refer to the *Overall Block Diagram* for node locations.

Press **[PRESET] [SYSTEM]** ***[SERVICE MENU] [INPUT PORTS] [ANALOG BUS]*** and then use the front panel keys or knob to select an analog bus node. Terminate the entry by pressing **[x1]**.

www.valuetronics.com

A10 Digital IF

1 **+0.37V** (+0.37V reference)

Check for a flat line at approximately +0.37V. This is used as the voltage reference in the *Analog Bus Correction Constants* adjustment for calibrating out the analog bus high/low resolution gain and offset errors. The absolute voltage level is not critical, but it should be the same in high and low resolution.

2 **+2.50V** (+2.50V reference)

Check for a flat line at approximately +2.5V. This voltage is used in the *Analog Bus Correction Constants* adjustment as a reference for calibrating the analog bus low resolution circuitry.

3 **Aux Input** (Rear panel input)

This selects the rear panel AUX INPUT to drive the analog bus for making voltage and frequency measurements. It can be used to look at test points within the instrument on the CRT (using the CRT as an oscilloscope). Connect the test point of interest to the AUX INPUT BNC connector on the rear panel. This feature can be useful if an oscilloscope is not available. Also, it can be used for testing voltage-controlled devices by connecting the driving voltage of the DUT to the AUX IN connector. You can look at the driving voltage on one display channel while displaying the DUT S-parameter response on the other display channel.

With *[AUX OUT]* turned ON, you can examine analog bus nodes with external equipment (see *[AUX OUT on OFF]* under the *Analog Bus Menu* heading). See *HP-IB Service Mnemonic Definitions* for HP-IB considerations.

4 **A10 Gnd** (Ground reference)

This is used in the *Analog Bus Correction Constants* adjustment as a reference for calibrating the analog bus low and high resolution circuitry.

A11 Phase Lock

5 **A11 Gnd** (Ground reference)

6 **A11 Gnd** (Ground reference)

7 **A11 Gnd** (Ground reference)

www.valuetronics.com

8 **Swp Err** (Phase error voltage)

This node measures the voltage at the output of the phase comparator on the A11 phase lock assembly. This error voltage corresponds to the difference in frequency between the divided IF and the 1 MHz reference frequency from the A12 assembly.

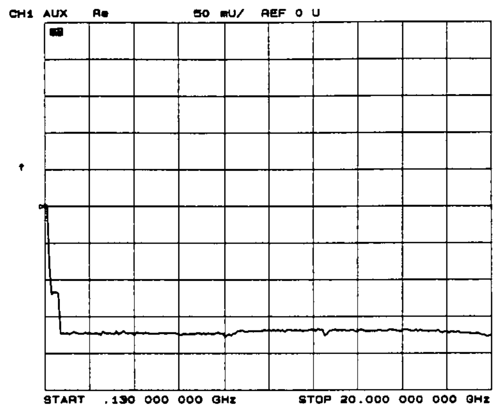


Figure 4. Node 8: Swp Err, Phase Error Voltage

9 **0.5V/GHz** (Source oscillator tuning voltage)

This node displays the tuning voltage ramp used to tune the source oscillators. You should see a voltage ramp like the one shown in Figure 5. If this waveform is correct, you can be confident that the A11 phase lock assembly, the source assemblies, the A13/A14 fractional-N assemblies, and the A52 pulse generator are working properly and the instrument is phase locked. If you see anything else, refer to the *Source* troubleshooting section.

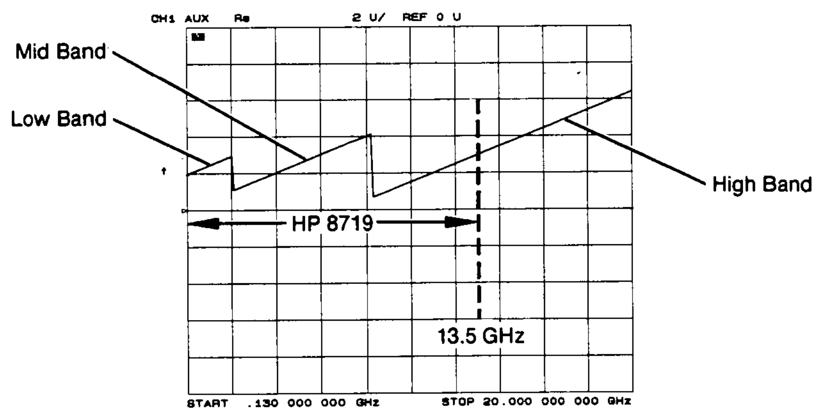


Figure 5. Node 9: 0.5V/GHz, Source Tuning Voltage

www.valuetronics.com

10 **A11 Gnd** (Ground reference)

11 **IF** (IF used for phase lock)

Counter ON: analog bus Reading: 10 MHz

This node displays the IF frequency (see Figure 6) as it enters the A11 phase lock assembly via the A7 ALC assembly. This signal comes from the R sampler output and is used to phase lock the source.

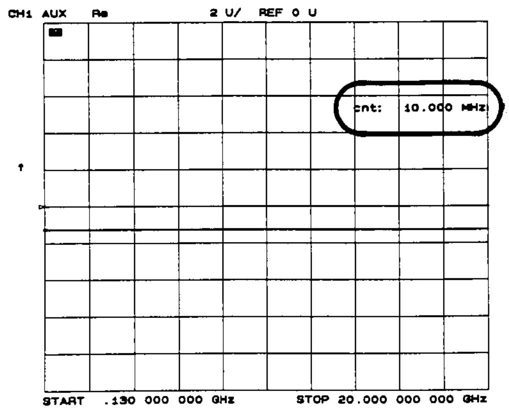


Figure 6. Location of Internal Counter Reading on CRT

12 **IF Det** (IF on A11 phase lock after 40 MHz filter)

This node detects the IF as a voltage at the output of the 40 MHz filter on the A11 phase lock assembly. The trace should be a flat line at about −1.7V as shown in Figure 7.

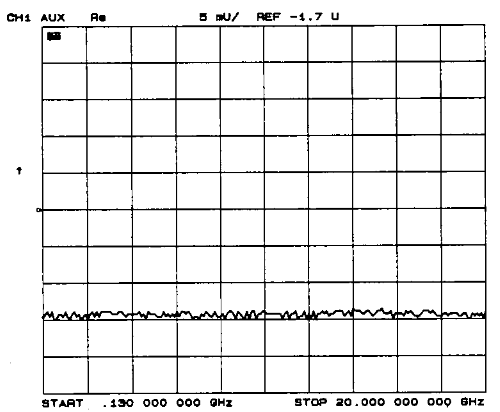


Figure 7. Node 12: Typical IF Detector Voltage Trace

www.valuetronics.com

A12 Reference

13 **Ext Ref** (Rear panel external reference input)

This node is used to detect an external reference voltage. If an external reference (timebase) is used, the voltage level should be about −0.6V. If an external reference is not used, the voltage level should be about −0.87V.

14 **100 kHz** (100 kHz reference frequency)

Counter ON: analog bus Reading: .100 MHz

This node counts the A12 100 kHz reference signal that is used on A13 (the fractional-N analog assembly) as a reference frequency for the phase detector.

15 **VCO Tune** (A12 VCO tuning voltage)

This node displays the tuning voltage for the A12 VCO. It is used in the reference assembly VCO tune adjustment.

16 **2nd LO** (2nd converter reference)

Counter ON: analog bus Reading: 9.996 MHz

This node counts the 2nd LO used by the 2nd converter assemblies to produce the 2nd IF of 4 kHz.

17 **PL Ref** (Phase lock reference)

Counter ON: analog bus Reading: 1 MHz

This node counts the reference signal used by the phase comparator circuit on the A11 phase lock assembly.

18 **VCXO Tune** (40 MHz VCXO tuning voltage)

This node displays the voltage used to fine tune the A12 reference VCXO to 40 MHz. You should see a flat line at some voltage level (the actual voltage level varies from instrument to instrument). Anything other than a flat line indicates that the VCXO is tuning to different frequencies. Refer to the frequency accuracy adjustment in the *Adjustments* section.

19 **A12 Gnd** (Ground reference)

20 **A12 Gnd** (Ground reference)

www.valuetronics.com

A14 Fractional-N (Digital)

21 **FN VCO Tun** (A14 FN VCO tuning voltage)

This node displays the A14 FN VCO tuning voltage. This voltage comes from the A13 fractional-N (analog) assembly and is the return path for the fractional-N phase-locked loop. If the A13 and A14 assemblies are functioning properly and the VCO is phase locked, the trace should look like the trace shown in Figure 8. Any other waveform indicates that the FN VCO is not phase locked. The vertical lines in the trace indicate the band crossings. (The counter can also be enabled to count the VCO frequency. Use CW mode.)

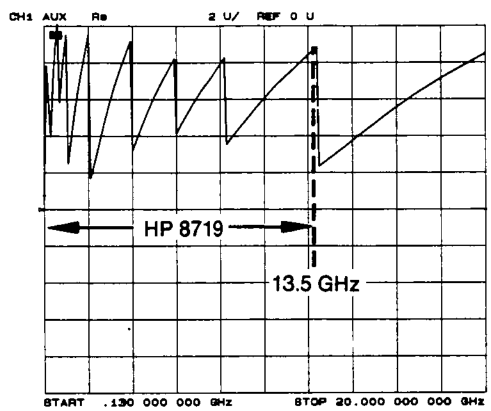


Figure 8. Node 21: FN VCO Tun, FN VCO Tuning Voltage

22 **A14 Gnd** (Ground reference)

23 **Count Gate** (Analog bus counter gate)

This node checks the analog bus counter gate signal. You should see a flat line at +5V. The counter gate activity occurs during bandswitches, and therefore is not visible on the analog bus. To view the bandswitch activity, look at this node on an oscilloscope, using ***[AUX OUT ON]*** (refer to ***[AUX OUT on OFF]*** under the *Analog Bus Menu* heading.

www.valuetronics.com

HP-IB SERVICE MNEMONIC DEFINITIONS

All service routine keystrokes have equivalent remote HP-IB commands. Most of the service mnemonics have been documented previously with the corresponding keystroke. A few unique softkeys are documented here.

Undocumented softkeys must be accessed remotely by invoking the system menu (MENUSYST) and using the BASIC command (SOFTn), where "n" represents the softkey number. Softkeys are numbered 1 to 8 from top to bottom.

An HP-IB overview for the analyzer is provided in chapter 11 of the *Reference*. HP-IB programming information is also provided in the *HB-IB Programming Guide* and the *HP-IB Quick Reference.*

Invoking Tests Remotely

Many tests require operator response to displayed prompts. These prompts can be anticipated and the appropriate response sent remotely, over the bus, to the network analzyer.

- Any time a service routine prompts the user and waits for a response, or when the test finishes, bit 1 of the Event Status Register B is set (bit 1 = service routine waiting). Reading this register resets the bit.

  Initiate the test and either wait in a loop for the "service routine waiting" bit to be set, or enable the bit to interrupt (ESNB[D]). See *Status Reporting* in the *Introductory Programming Guide.*

- If the "service routine waiting" bit is set because of a service routine prompt, respond to the prompt with a TESRn command (see *Tests Menu*, at the beginning of this section).

Symbol Conventions

[]	An optional operand
D	A numerical operand
<>	A necessary appendage
|	An either/or choice in appendages.

www.valuetronics.com

Analog Bus Codes

ANAI[D] Measures and displays the analog input. The preset state input to the ABUS is the rear panel AUX IN. The other 22 nodes may be selected with [D] only if the ABUS is enabled (ANABon).

OUTPCNTR Outputs the counter's frequency data.

OUTPERRO Reads any prompt message sent to the error queue by a service routine.

OUTPTESS Outputs the integer status of the test most recently executed. Status codes are those listed under TST?.

TST? Executes the power-on self test and outputs an integer test status. Status codes are as follows:

0 = pass
1 = fail
2 = in progress
3 = not available
4 = not done
5 = done

www.valuetronics.com

ROM/RAM TESTS

A9 CC Jumper Position Procedure

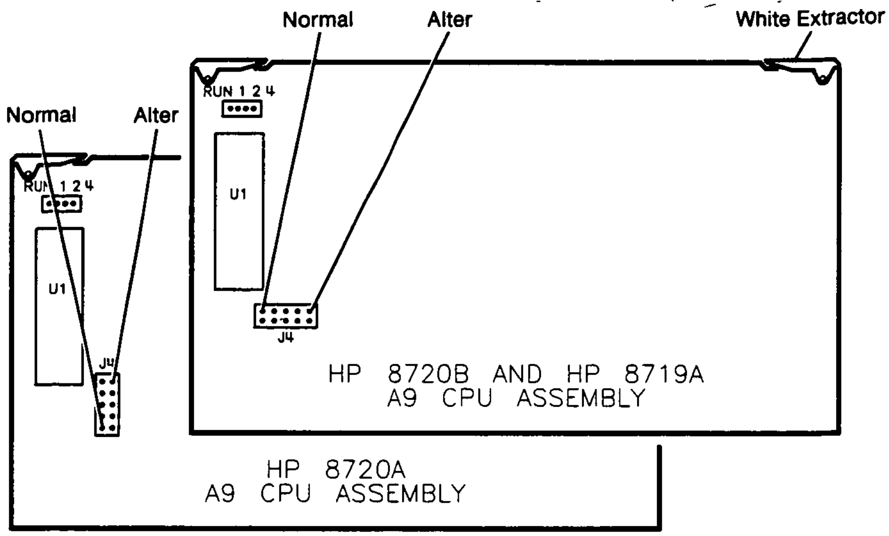


Figure 9. A9 CC Jumper Location

These tests, internal tests 2 through 4, are normally run at preset and power-on. However a jumper on the A9 CPU assembly (see *Figure 9*) can be set in one of five positions with the following results:

Position	Result
ALTER	With the jumper in this far right (or top) position, correction constants can be altered, written over in EEPROM. This is used only for correction constant adjustments. Internal tests 2 through 4 are not performed.
CMOS	This **destructive** version of the CMOS RAM test (internal test 3) continuously writes over information stored there.
DRAM	This **destructive** version of the main DRAM test (internal test 4) continuously writes over information stored there.
SKIP	This position skips ROM and RAM testing.
NORMAL	The far left (or bottom) position is the normal position. In this position, EEPROM is protected, and ROM and non-destructive RAM tests are run.

For additional information, see *Internal Tests* (near the front of this section) and the *Digital Control* troubleshooting section.

www.valuetronics.com

Error Terms

INTRODUCTION

Error terms are factors used for error correction, or accuracy enhancement, in the analyzer when correction is turned on. Error terms are numbers generated and stored in internal arrays during a measurement calibration. They are also known as E-terms or measurement calibration coefficients.

Error terms can also serve a diagnostic purpose. Specific parts of the analyzer and its accessories directly contribute to the magnitude and shape of the error terms. Since we know this correlation and we know what typical error terms look like, we can examine error terms to monitor system performance or to identify faulty components in the system.

Error terms are created by measuring well-defined calibration devices over the frequency range of interest and comparing the measured data with the ideal model for the devices. The differences represent systematic (repeatable) errors of the network analyzer system. The resulting calibration coefficients are good representations of the systematic error sources. For details on error correction, refer to Chapter 5 of the *Reference*.

Use the procedures below to generate and examine error terms. No external controller is required. This information can be useful in two ways:

- **Preventive Maintenance**. A stable, repeatable system should generate repeatable error terms over long time intervals, for example, six months. Make a hardcopy record (print or plot) of the error terms, then periodically compare current error terms with the record. A sudden shift in error terms reflects a sudden shift in systematic errors, and may indicate the need for further troubleshooting. A long-term trend often reflects drift, connector and cable wear, or gradual degradation, indicating the need for further investigation and preventive maintenance. Note that the system may still conform to specifications. The cure is often as simple as cleaning and gaging connectors or inspecting cables.
- **Troubleshooting.** If a subtle failure or mild performance problem is suspected, the magnitude of the error terms should be compared against values generated previously with the same instrument and calibration kit. This comparision will produce the most precise view of the problem.

  However, if previously generated values are not available, compare the current values to the typical values listed in Table 2, *Uncorrected Performance*, and shown graphically on the plots in this section. If the magnitude exceeds its limit, the corresponding system component should be inspected. If the condition causes system verification to fail, the component should be replaced.

www.valuetronics.com

Consider the following while troubleshooting:

- All parts of the network analyzer system, including cables and calibration devices, can contribute to systematic errors and impact the error terms.
- Connectors must be clean, gaged, and within specification for error term analysis to be meaningful.
- Avoid unnecessary bending and flexing of the cables following measurement calibration, to minimize cable instability errors.
- Use good connection techniques during the measurement calibration. The connector interface *must* be repeatable. Refer to the *Microwave Connector Care Manual* for information on connection techniques and on cleaning and gaging connectors.
- Use error term analysis to troubleshoot minor, subtle performance problems. Refer to the *Troubleshooting* section if a blatant failure or gross measurement error is evident.
- It is often worthwhile to perform the procedure twice (using two distinct measurement calibrations) to establish the degree of repeatability. If the results do not seem repeatable, check all connectors and cables.

MEASUREMENT CALIBRATION PROCEDURE

1. Press **[PRESET] [CAL]** ***[CALIBRATE MENU] [FULL 2-PORT]*** to perform a full 2-port calibration (with slight modifications):

   This calibration sequence is comprised of three parts:

   REFLECTION: For these measurements (short, open, loads), connect the calibration device directly to the test port. Use the female devices for port 1. Adapt the male devices for port 2.

   TRANSMISSION: Use a single cable or cable pair (consistent with the normal use of the system) for these measurements.

   ISOLATION: Leave the cables connected for this measurement. Press **[AVG]** ***[IF BW]*** **[1] [0] [x1] [CAL]** to change the IF bandwidth to 10 Hz. Then press ***[RESUME CAL SEQUENCE] [ISOLATION]***. Connect leads to cable end and port.

2. Store this calibration into an internal register or on disc.

www.valuetronics.com

Table 1. Calibration Coefficient Terms and Tests

Cal Coeff.	Calibration Type				Test Number
	Response	Resp & Isol'n[1]	1-port	2-port	
1 2 3	E_R or E_T	E_X E_D E_T (E_R)	E_D E_S E_R	E_{DF} E_{SF} E_{RF}	31 32 33
4 5 6				E_{XF} E_{LF} E_{TF}	34 35 36
7 8 9				E_{DR} E_{SR} E_{RR}	37 38 39
10 11 12				E_{XR} E_{LR} E_{TR}	40 41 42

NOTES:

- Meaning of first subscript: D=directivity; S=source match; R=reflection tracking; X=crosstalk; L=load match; T=transmission tracking.
- Meaning of second subscript: F=forward; R=reverse.

1. Resp & Isol'n cal yields:: E_X or E_T if a transmission parameter (S_{21}, S_{12}) or E_D or E_R if a reflection parameter (S_{11}, S_{22})

ERROR TERM INSPECTION

NOTE: If correction is not on, press **[CAL]** ***[COR ON]*** now.

Press **[SYSTEM]** ***[SERVICE MENU]*** ***[TESTS]*** **[3] [1] [x1]** ***[EXECUTE TEST]*** to display the first calibration measurement trace (Table 1 lists the test numbers). The test copies the calibration measurement trace for the selected error term into display memory and displays it.

Use the scale, reference, and marker functions to study the error term trace and determine its magnitude. Compare it to the *Error Term Descriptions* below and to earlier data measured on the system. If system-specific data is not available, refer to the typical uncorrected performance specifications listed in Table 2. To make a hardcopy of a trace, see *Hardcopy Procedure*, below.

If an error term seems much worse than the typical values, you may want to perform a system verification to make sure that the system still conforms to specifications. If system verification fails, refer to *Troubleshooting*.

www.valuetronics.com

Table 2. Uncorrected Performance

UNCORRECTED PERFORMANCE
The following table shows typical performance without accuracy enhancement. RF cables not used except as noted.

	Frequency Range (GHz)			
	0.13 to 0.5	**0.5 to 2**	**2 to 8**	**8 to 20**
Directivity	32 dB	32 dB	30 dB	20 dB
Source Match	20 dB	18 dB	14 dB	10 dB
Load Match[2]	32 dB	28 dB	15 dB	12 DB
Reflection Tracking[1]	±2 dB	±2 dB	±2 dB	±3 dB
Transmission Tracking[1,2]	±1 dB	±1 dB	±1 dB	±1 dB
Crosstalk	70 dB	75 dB	73 dB	73 dB

1. Excludes −1/+3 dB slope, typical, in magnitude response from 2.0 to 20 GHz and rolloff below 2 GHz, which is typically −4 dB at 1 GHz, −9 dB at 500 MHz, and −20 dB at 130 MHz.
2. Measured with RF cables.

Hardcopy Procedure

To make a hardcopy record of the trace: Connect a printer or plotter and press **[LOCAL]** ***[SYSTEM CONTROLLER]*** **[COPY]** ***[PRINT]*** (or ***[PLOT]***). Title each trace with the title feature or manually so that it can be identified later. Refer to Chapter 9 of the *Reference* for more copying information.

ERROR TERM DESCRIPTIONS

Following are descriptions of each error term, its significance, typical results, and guidelines to interpretation. The same description applies to both the forward (F) and reverse (R) terms. The plots shown with each are typical of a working system following a full 2-port calibration as performed in *Measurement Calibration Procedure*, above.

It may be helpful to define some of the terms used in the descriptions below:

- R signal path: refers to the reference signal path. It includes the power splitter A67, 20 dB attenuator A68, R sampler A64, and associated semi-rigid coax cables.
- A input path: refers to the port 1 input path and includes the power splitter A67, step attenuator A69, transfer switch S4, bias tee A61, directional coupler A62, and A sampler A65.
- B input path: refers to the port 2 input path. It includes the power splitter A67, step attenuator A69, transfer switch S4, bias tee A60, directional coupler A63, and B sampler A66.

www.valuetronics.com

Directivity (EDF and EDR)

Description. These are the uncorrected forward and reverse directivity error terms of the system. The directivity error of the test port is determined by measuring the S11 and S22 reflection of the calibration kit load. The load has a much better return loss specification than does the uncorrected test port, therefore any power detected from this measurement is assumed to be due to directivity error.

Significant System Components. The load used in the calibration is the most important component. The test port connector and the coupler also greatly affect the measured directivity error.

Affected Measurements. The measurements most affected by directivity errors are measurements of low reflection devices; highly reflective device measurements will appear normal.

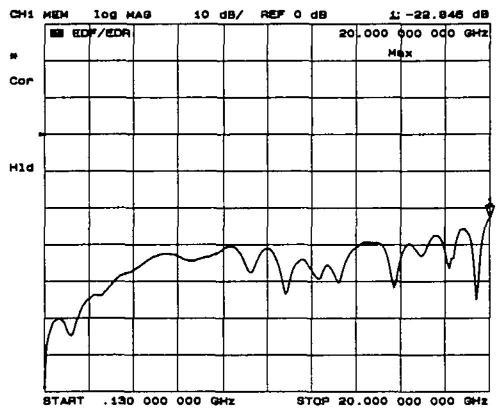


Figure 1. Typical EDF/EDR Without Cables

www.valuetronics.com

Source Match (ESF and ESR)

Description. These are the forward and reverse uncorrected source match terms of the driven port. They are obtained by measuring the reflection (S11, S22) of an open and then a short connected directly to the ports. Source match is a measure of the match between the coupler and test set connector, as well as the match between all components from the source to the output port.

Significant System Components. The open and short calibration devices are important, as are the coupler and test port connectors. The power splitter, bias tees, step attenuator, and transfer switch may also contribute to source match errors.

Affected Measurements. The measurements most affected by source match errors are reflection and transmission measurements of highly reflective DUTs.

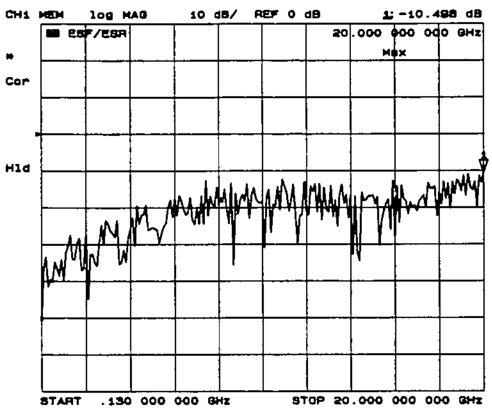


Figure 2. Typical ESF/ESR Without Cables

www.valuetronics.com

Reflection Tracking (ERF and ERR)

Description. Reflection tracking is the difference between the frequency response of the reference path (R path) and the frequency response of the reflection test path (A or B input path). These error terms are characterized by measuring the reflection (S11, S22) of the open and the short during the measurement calibration. Note that coupler response is included in this error term. Typically this appears as a slope of −1 to +3 dB in magnitude response from 2 to 20 GHz and a rolloff below 2 GHz, with approximate values of −4 dB at 1 GHz, −9 dB at 500 MHz, and −20 dB at 130 MHz.

Significant System Components. The open and short calibration devices have an effect on reflection tracking. But large variations in this error term may indicate a problem in one of the signal paths. Suspect the R signal path if the problem appears in both ERF and ERR. Troubleshoot the A or B input paths first if only one reflection tracking term is affected.

Affected Measurements. All reflection measurements (high or low return loss) are affected by the reflection tracking errors.

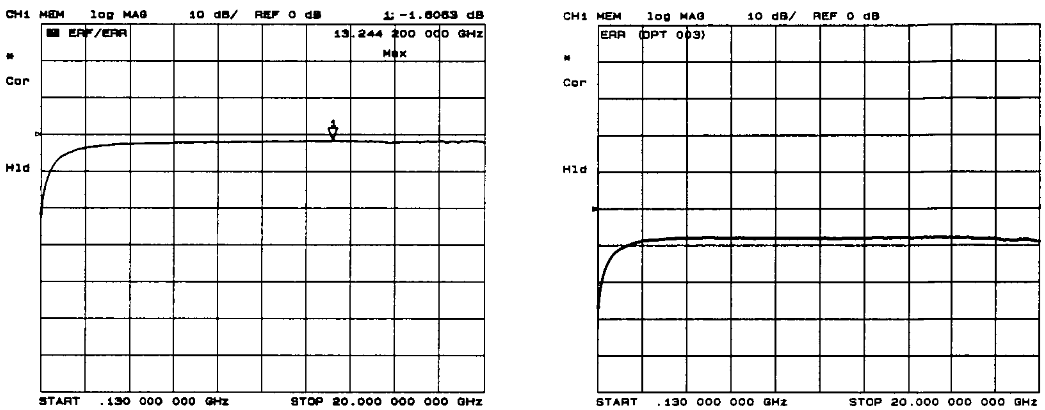


Figure 3. Typical ERF/ERR without Cables

ERF/ERR Non-option 003 Models — *ERR Option 003 Models*

ERF Option 003 Models

www.valuetronics.com

Isolation (Crosstalk, EXF and EXR)

Description. These are the uncorrected forward and reverse isolation error terms that represent leakage between the test ports and the signal paths. The isolation error terms are characterized by measuring transmission (S21, S12) with loads attached to both ports during the measurement calibration. Since these terms are low in magnitude, they are usually noisy (not very repeatable). The error term magnitude changes dramatically with IF bandwidth: a 10 Hz IF bandwidth must be used in order to lower the noise floor beyond the crosstalk specification. Using averaging will also reduce the peak-to-peak noise in this error term.

Significant System Components. Loose cable connections or leakage between components in the lower box are the most likely cause of isolation problems. The transfer switch, bias tees, couplers, and samplers are the most susceptible components.

Affected Measurements. Isolation errors affect both reflection and transmission measurements, primarily where the measured signal level is very low. Examples include reflection measurements of a well-matched DUT, and transmission measurements where the insertion loss of the DUT is large.

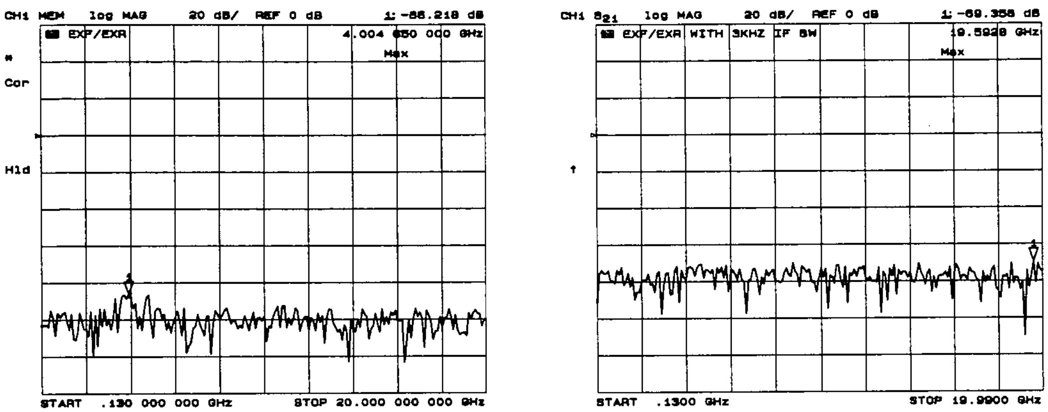


Figure 4. Typical EXF/EXR with 10 Hz Bandwidth and with 3 kHz Bandwidth

www.valuetronics.com

Load Match (ELF and ELR)

Description. Load match is a measure of the impedance match of the test port that terminates the output of a 2-port device. The match of test port cables is included. Load match error terms are characterized by measuring the S11 and S22 responses of a "thru" configuration during the calibration procedure.

Significant System Components. Large variations in the forward or reverse load match error terms may indicate a bad "thru" cable or a poor connection of the cable to the test port.

Affected Measurements. The measurements most affected by load match errors are all transmission measurements, and reflection measurements of a low insertion loss two-port device, such as an airline.

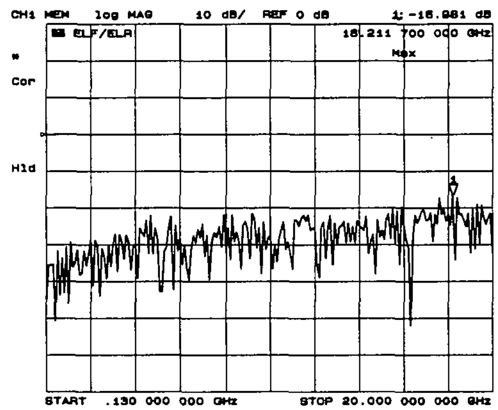


Figure 5. Typical ELF/ELR

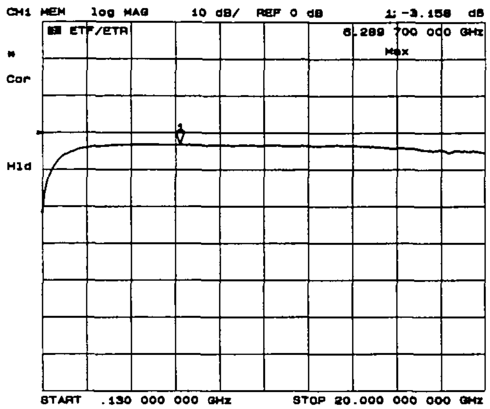
www.valuetronics.com

Transmission Tracking (ETF and ETR)

Description. Transmission tracking is the difference between the frequency response of the reference path (including R input) and the frequency response of the transmission test path (including A or B input) while measuring transmission. The response of the test port cables is included. These terms are characterized by measuring the transmission (S21, S12) of the "thru" configuration during the measurement calibration. Note that coupler response is included in this error term. Typically transmission tracking appears as a slope of −1 to +3 dB in magnitude response from 2 to 20 GHz and a rolloff below 2 GHz, with approximate values of −4 dB at 1 GHz, −9 dB at 500 MHz, and −20 dB at 130 MHz.

Significant System Components. Large variations in this error term probably indicate a problem in the reference signal path (if both ETF and ETR are bad) or in the A or B input path. The "thru" cable also has an effect on transmission tracking.

Affected Measurements. All transmission measurements are affected by transmission tracking errors.



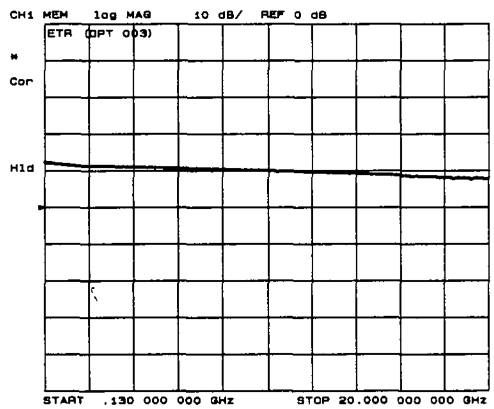


Figure 6. Typical ETF/ETR

ETF/ETR Non-option 003 Models
ETF Option 003 Models

ETR Option 003 Models

www.valuetronics.com

INTRODUCTION

Theory of Operation provides a general description of the system, and operating theory of the network analyzer functional groups. Operation is explained to the assembly level only: component-level circuit theory is not provided. Simplified block diagrams illustrate the operation of each functional group. An overall block diagram is provided at the end of the section.

SYSTEM OPERATION

The HP 8720 and HP 8719 microwave network analyzers integrate a synthesized source, signal separation devices, a three-channel receiver for measurement of test device characteristics, and a large-screen display. Figure 1 is a simplified block diagram of the network analyzer system.

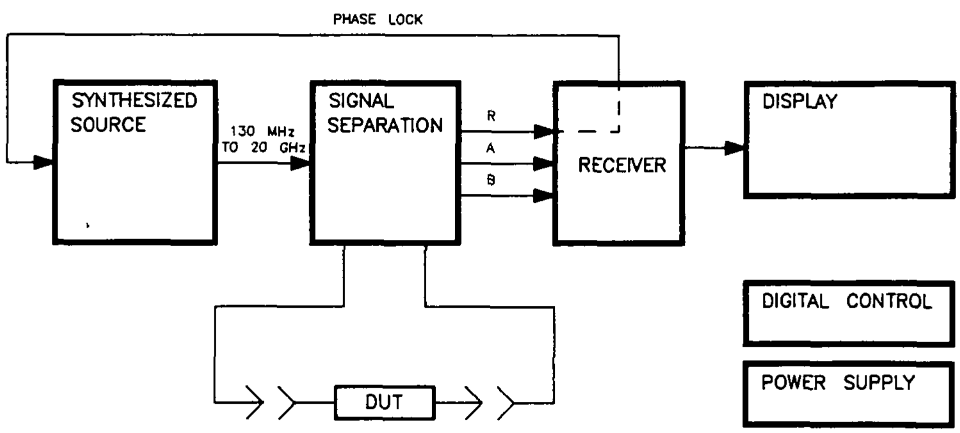


Figure 1. Simplified System Block Diagram

www.valuetronics.com

The built-in synthesized source of the HP 8720 generates a swept or CW (continuous wave) signal in the range of 130 MHz to 20 GHz. (HP 8719: to 13.5 GHz). The source output power is leveled by an internal ALC (automatic leveling control) circuit, to a maximum level of −10 dBm at the front panel measurement ports. A portion of the source signal is routed to the R sampler in the receiver, and fed back to the source for phase lock.

The signal separation devices separate the source signal into a reference path and a test path. They provide attenuation for the source signal, RF path switching to allow simultaneous forward and reverse measurements, and external connections for the DUT (device under test). The signal transmitted through or reflected from the DUT goes to the receiver for comparison with the reference signal.

The receiver converts the source signal to a 4 kHz IF (intermediate frequency) for signal processing, retaining both magnitude and phase characteristics. The IF is converted to digital signals, which are processed into magnitude and phase information. The processed and formatted data is finally routed to the CRT for display, and to the HP-IB for remote operation. Details of analyzer data processing are provided in chapter 1 of the *Operating and Programming Reference*.

In addition to the analyzer, the system includes cables for interconnections, and calibration standards for accuracy enhanced measurements.

FUNCTIONAL GROUPS OF THE ANALYZER

The operation of the analyzer is most logically described in five functional groups. Each group consists of several major assemblies, and performs a distinct function in the instrument. Some assemblies are related to more than one group, and in fact all the groups are to some extent interrelated and affect each other's performance.

Power Supply. The power supply functional group provides power for the other assemblies in the instrument.

Digital Control. The digital control group, which includes the front and rear panels and the display, as well as the CPU, provides control to all assemblies in the network analyzer. Color CRT models also use an additional assembly, the GSP.

Source. The source group supplies a phase-locked and leveled microwave signal to the device under test.

Signal Separation. The signal separation group performs the function of an S-parameter test set, dividing the source signal into a reference path and a test path, and providing connections to the device under test.

Receiver. The receiver group measures and processes the input signals for display.

The following pages describe the operation of the assemblies within each of the functional groups. (Note that assemblies numbered A51 and above are located in the lower portion of the instrument, and all others are in the upper portion.)

www.valuetronics.com

POWER SUPPLY THEORY

The power supply functional group consists of the A15 preregulator and the A8 post-regulator. These two assemblies constitute a switching power supply that provides regulated DC voltages to power all assemblies in the network analyzer. The A15 preregulator is enclosed in a casting at the rear of the instrument behind the display. It is connected to the A8 post-regulator by a wire bus A15W1. Figure 2 is a simplified block diagram of the power supply group (for a more detailed diagram, refer to the *Power Supply* tab in the troubleshooting section).

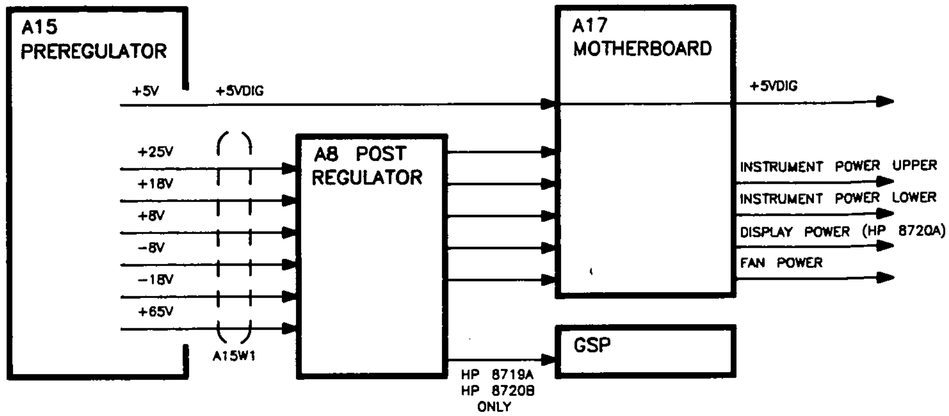


Figure 2. Power Supply Functional Group, Simplified Block Diagram

A15 Preregulator

The A15 preregulator rectifies and steps down the line voltage. It provides a fully regulated +5V digital supply, and several preregulated voltages that go to the A8 post-regulator assembly for additional regulation. It includes the line power module, a 60 kHz switching preregulator, and overvoltage protection for the +5V digital supply. It provides LEDs, visible from the rear of the instrument, to indicate circuit status.

Line Power Module. The line power module includes the line power switch, voltage selector switch, and main fuse. The line power switch is activated from the front panel. The voltage selector switch, accessible at the rear panel, adapts the network analyzer to local line voltages of approximately 115V or 230V. The main fuse, which protects the input side of the preregulator against drawing too much line current, is also accessible at the rear panel. Refer to the *User's Guide* for line voltage tolerances and other power considerations.

Preregulated Voltages. The switching preregulator converts the line voltage to several DC voltages. The preregulated +5V digital supply goes directly to the motherboard. The following preregulated voltages are routed through A15W1 to the A8 post-regulator for final regulation:

+25V	+8V	−18V
+18V	−8V	+65V

www.valuetronics.com

The +5V Digital Supply. The +5VD supply is regulated by a control loop in the A15 preregulator. It goes directly to the motherboard, and from there to all assemblies requiring a digital supply. A +5V sense line returns from the motherboard to the A15 preregulator. The +5VCPU line is derived directly from +5VD but a different line takes it through the motherboard and the A8 post-regulator to the A9 CPU assembly, and the A1/A2 front panel. In the HP 8719A/20B, the +5VCPU is also used by the A19 GSP (but not the A18 display). In the HP 8720A, the +5VCPU is routed through the motherboard for use by the A18 display.

The preregulator will only function if the +5V digital supply is loaded by one or more assemblies, and if the +5V sense line is working. If not, the other preregulated voltages will not be correct.

Shutdown Indications: the Green and Red LEDs. Two power supply LEDs are visible through the rear panel casting. The green LED is on in normal operation. It is off if line power is not connected or not turned on; if the voltage selector switch on the rear panel is set incorrectly; or if the line fuse has blown.

The red LED, which is off in normal operation, lights to indicate a fault in one or more of the preregulated voltages. This may be an overvoltage, undervoltage, overcurrent, or overtemperature condition. Refer to the *Power Supply* tab in the troubleshooting section for more information.

A8 Post-Regulator

The A8 post-regulator filters and regulates the DC voltages received from the A15 preregulator. It provides fusing and shutdown circuitry for individual voltage supplies. It distributes regulated constant voltages to individual assemblies throughout the instrument. It includes an overtemperature shutdown circuit, the variable fan speed circuit, and the air flow detector. Nine (in the 8719A/20B) or ten (HP 8720A) green LEDs provide status indications for the individual voltage supplies.

Voltage Indications: the Green LEDs. The green LEDs along the top edge of the A8 assembly are on in normal operation, to indicate the correct voltage is present in each supply. If they are off or flashing, a problem is indicated. The steps to trace the cause of the problem are explained under *Power Supply* in the troubleshooting section.

Shutdown Circuit. The shutdown circuit is triggered by overcurrent, overvoltage, undervoltage, or overtemperature. It protects the instrument by causing the regulated voltage supplies to be shut down. It also sends status messages to the A9 CPU to trigger warning messages on the CRT. The following voltages are not shut down:

+5VD and +5VCPU digital supplies from A15
fan power
display power

The shutdown circuit can be disabled momentarily for troubleshooting purposes by jumpering the SDIS line to ground.

www.valuetronics.com

Variable Fan Circuit and Air Flow Detector. The fan power is derived directly from the +18V and −18V supplies from the A15 preregulator. The fan is not fused, so that it will continue to provide airflow and cooling when the instrument is otherwise disabled. If overheating occurs, the main instrument supplies are shut down and the fan runs at full speed. An overtemperature status message is sent to the A9 CPU to initiate a warning message on the CRT. The fan also runs at full speed if a low airflow situation is detected, such as a clogged air filter or inadequate clearance. (Full speed is normal at initial power-on if the instrument is warm.)

HP 8719A/20B Display Power. The A8 post regulator supplies the A19 GSP assembly with +5VCPU and +65V. The +5VCPU is used by the A19 GSP (but not the A18 display). The +65V is used by the A18 display (but not the A19, +65V is only routed through it to the display). Both supply voltages can function (to operate the display) even when other power supplies are shut down. They are individually regulated; not connected to the regular shutdown circuitry.

HP 8720A Display Power. The A8 assembly supplies three voltages to the display through a wire cable. These supplies are +5VCPU, +15VDSP, and −15VDSP. The +15VDSP and −15VDSP supplies are unique to the display and are not used by any other assemblies; they are individually fused and regulated in the post-regulator assembly. They are not connected to the protective shutdown circuitry, so that the A18 display assembly can operate during troubleshooting when other supplies do not work.

www.valuetronics.com

DIGITAL CONTROL THEORY

The digital control functional group (Figure 3) provides control for the entire network analyzer. It provides math processing functions, as well as communications between the analyzer and an external controller and/or peripherals. The HP 8719A/20B have one additional assembly, the A19 GSP.

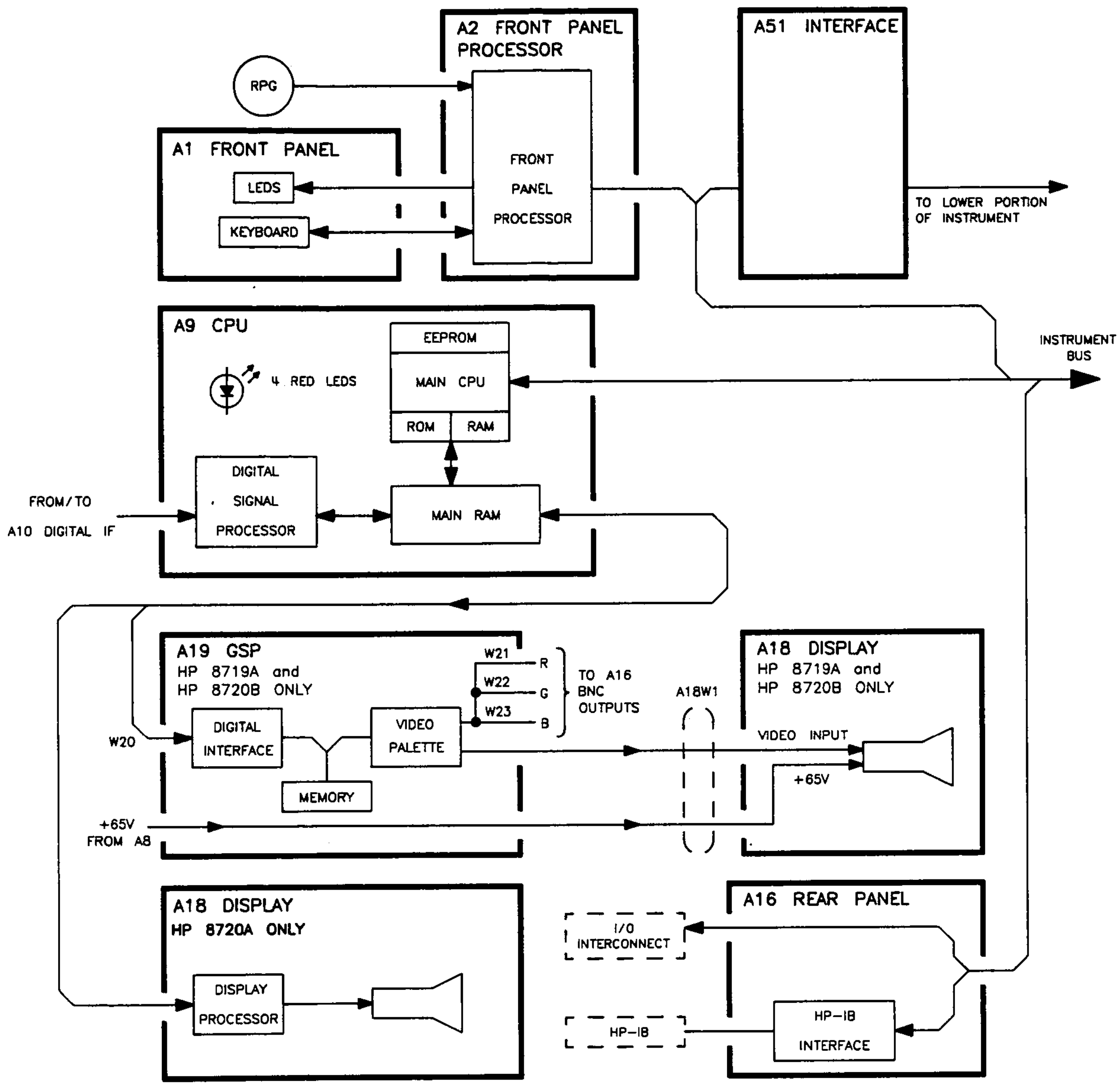


Figure 3. Digital Control Group, Simplified Block Diagram

www.valuetronics.com

A1 Front Panel

The A1 front panel assembly provides manual user interface with the analyzer. It includes the keyboard for local user inputs, and the front panel LEDs that indicate instrument status. The RPG (rotary pulse generator) is not electrically connected to the front panel, but provides user inputs directly to the front panel processor.

A2 Front Panel Processor

The A2 front panel processor detects and decodes user inputs from the front panel and the RPG, and transmits them to the CPU. It has the capability to interrupt the CPU to provide information updates. It controls the front panel status LEDs; and auxiliary controls for the display focus and intensity to allow softkey control without mechanical adjustment of the display assembly.

A9 CPU

The A9 CPU assembly contains the main CPU (central processing unit), the digital signal processor, and memory storage. The main CPU is the master controller for the analyzer, including the other dedicated microprocessors. The memory includes ROM, RAM, CMOS RAM and EEPROM. Data from the receiver is serially clocked into the A9 CPU assembly from the A10 digital IF.

Main CPU. The main CPU maintains digital control over the entire instrument through the instrument bus. It receives external control information from the front panel or via HP-IB, and performs processing, formatting, and error correction operations on the raw data in the main RAM. It controls the digital signal processor, the front panel processor, the graphics signal processor, the logic circuit in the A51 interface assembly, and the HP-IB interface. In addition, when the analyzer is the system controller, the main CPU controls peripheral devices through HP-IB.

ROM. The main CPU has a dedicated ROM (read-only memory) that contains the operating system for instrument control.

CMOS RAM. Front panel settings (instrument states) can be stored in the CMOS RAM (random access memory), with a large capacitor providing at least 72 hours of backup storage when external power is off.

EEPROM. The EEPROM (electrically-erasable programmable ROM) contains factory-set correction constants unique to each instrument. These constants correct for hardware variations to increase performance. To guard against inadvertant correction constant changes, the A9 CPU assembly includes a jumper that is normally set in a write-protect mode. The correction constants can be updated by executing the routines in the *Adjustments and Correction Constants* section of this manual.

Main RAM. The main RAM is a shared memory for the CPU, the digital signal processor, and the display processor. It stores the raw data received from the digital signal processor, while additional calculations are performed on it by the main CPU. The display processor reads the resulting CRT image from the main RAM and displays it on the CRT. The display is updated frequently, and asynchronously with the data processing operations, to provide a flicker-free image. Detailed information on the data processing sequence is provided in chapter 1 of the *Reference*.

www.valuetronics.com

Digital Signal Processor. The digital signal processor receives the digitized data from the A10 digital IF. It computes discrete Fourier transforms to extract the complex magnitude and phase data from the 4 kHz IF signal, and performs ratioing and averaging operations. The resulting data is written into the main RAM.

HP 8719A/20B Display

The color display consists of two assemblies: the A19 GSP and the A18 display. The A19 GSP is an interface between the A9 CPU and the A18 display. The GSP reads formatted data from the A9 CPU and converts that data to video signals (digital TTL horizontal and vertical synch signals) and RGB signals. It sends the video and RGB signals to the A18 display and to the A16 rear panel. The GSP also passes the +65V supply to the A18 display. The GSP itself uses the +5VCPU supply voltage.

The A18 color display is a 7.5 inch scan CRT with associated drive circuitry. It receives its power and input signals from the A19 GSP as noted above. The A18 automatically degauses itself to minimize color impurity each time the analyzer is turned on.

A18 Display

The A18 display is a 20.8 cm (9 in) vector display with a dedicated microprocessor-controlled digital interface. It reads the formatted data from the main RAM on the A9 assembly and displays it on the CRT.

The A18 display receives three power supply voltages: +5VCPU, +15VDSP, and −15VDSP. The +15VDSP and −15VDSP supplies are unique to the display and are not used by any other assemblies; they are individually fused and regulated in the post-regulator assembly.

The display also includes the focus and intensity circuits that are controlled by the front panel interface.

A16 Rear Panel

The A16 rear panel includes the HP-IB interface, a dedicated bus controller that monitors and controls the handshake and data lines of the external bus. It communicates messages from a remote controller to the CPU, and from the CPU to peripherals on the bus. The HP 8719A and HP 8720B have red, green and blue video output signals which can be accessed via 3 BNC connectors on rear panel.

The I/O interconnect provides a TTL output signal to indicate pass/fail status during limit testing.

A51 Interface

The A51 interface routes the power and control circuitry from the upper portion of the instrument to the components in the lower portion.

www.valuetronics.com

SOURCE GROUP THEORY

The source functional group produces a stable output signal by phase locking a YIG oscillator to a synthesized VCO (voltage controlled oscillator). The full frequency range of the source is generated in subsweeps by harmonic mixing. The output is a swept or CW signal between 130 MHz and 20 GHz (HP 8719: 13.5 GHz), with a maximum leveled power of −10 dBm at the front panel measurement ports (minimum −65 dBm). Figure 4 illustrates the operation of the source functional group.

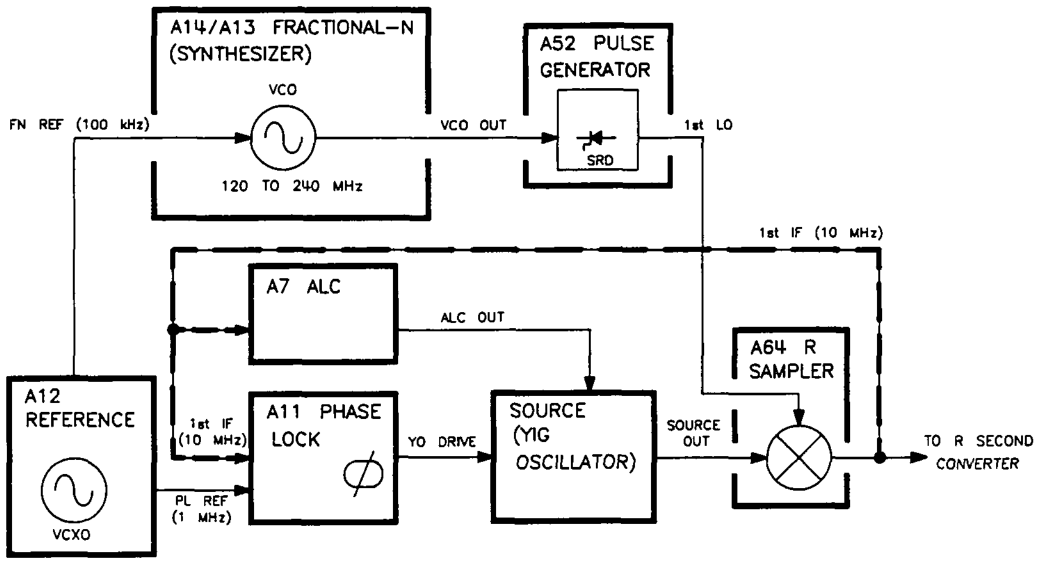


Figure 4. Source Functional Group, Simplified Block Diagram

The subsweep sequence takes place in the following steps. The paragraphs below describe the details of this process, and provide additional information on the assemblies in the source group.

1. The source is pretuned high. The source signal (SOURCE OUT) is fed to the R sampler.
2. A signal (VCO OUT) is generated by the VCO in the fractional-N synthesizer.
3. A comb of harmonics (1st LO) is produced in the pulse generator.
4. A synthesizer harmonic (1st LO) and the source signal (SOURCE OUT) are mixed in the sampler. A difference frequency (1st IF) is generated.
5. The 1st IF signal from the R sampler is fed back and compared to a reference. A tune current is generated.
6. The tune current is used to set the frequency of the source YIG oscillator.
7. Phase lock is acquired and a synthesized subsweep is generated. The source tracks the synthesizer.

www.valuetronics.com

1. Source Pretune

When a frequency range is set from the front panel or controller, the pretune DAC (digital-to-analog converter) in the A11 phase lock assembly sets the source YIG oscillator frequency about 10 MHz higher than the set start frequency. This signal (SOURCE OUT) goes to the R sampler assembly.

2. A14/A13 Fractional-N Synthesizer

The A14/A13 fractional-N assemblies comprise the synthesizer. The source feedback circuit phase locks the YIG oscillator to the synthesizer output signal as explained below under *A11 Phase Lock: Comparing Phase and Frequency*.

The VCO in the A14 fractional-N (digital) assembly generates a swept or CW signal in the range of 120 to 240 MHz, such that a harmonic is 10 MHz below the desired start frequency. This is divided down and phase locked (in the A13 assembly) to a 100 kHz signal FN REF from the A12 reference. A programmable divider is set to some number, N, such that the integer part of the expression F_{VCO}/N is equal to 100 kHz. To achieve frequencies between integer multiples of the reference, the divider is programmed to divide by N part of the time and by N+1 part of the time. The ratio of the divisions yields an average equal to the desired fractional frequency. API (analog phase interpolator) current sources in the A13 assembly correct for phase errors caused by the averaging. The resulting synthesized signal goes to the pulse generator.

3. A52 Pulse Generator: the Harmonic Comb

The signal from the synthesizer drives a step recovery diode (SRD) in the A52 pulse generator assembly. The SRD generates a comb of harmonic multiples (1st LO) of the VCO frequency, which goes to the samplers. One of the harmonics is 10 MHz below the desired start frequency.

4. A64 R Sampler: Down-Converting the Signals

The A64 assembly is part of the receiver functional group. It is also included here because it is an integral part of the source phase locking scheme. In the R sampler, the 1st LO signal from the pulse generator is mixed with the SOURCE OUT signal from the source. The difference IF (intermediate frequency) produced is nominally 10 MHz. For phase locking, part of this IF signal is routed back to the A11 phase lock assembly. (Additional information on the sampler assemblies is provided in *Receiver Theory*.)

5. A11 Phase Lock: Comparing Phase and Frequency

The 10 MHz 1st IF signal from the A64 sampler is fed back to the A7 ALC assembly (explained below) and the A11 phase lock assembly. In A11 it is amplified, limited, and filtered to produce a 10 MHz square wave. This is divided down to 1 MHz, then applied to a phase/frequency detector that compares it to a crystal controlled 1 MHz signal (PL REF) from the A12 reference assembly (see *A12 Reference: the Crystal Reference Frequencies*, below). Any phase or frequency difference between these two signals produces a proportional DC voltage.

www.valuetronics.com

6. Tuning the YIG Oscillator

The output of the phase/frequency detector is filtered to remove any 1 MHz feedthrough, and fed to an integrator. The output of the integrator is converted to a tune current. This brings the appropriate YIG oscillator closer to the desired frequency, which in turn reduces the phase/frequency detector output voltage. When the voltage is reduced to zero, and the divided-down 1st IF frequency is equal to the 1 MHz reference frequency PL REF, phase lock is achieved.

7. Phase Locked Sweep

When the source is phase locked to the synthesizer at the start frequency, the synthesizer starts to sweep. The phase-locked loop forces the source to track the synthesizer, maintaining a constant 10 MHz 1st IF signal.

The full sweep is generated in a series of subsweeps, by phase locking the source signal to the harmonic multiples of the synthesizer. At the transitions between subsweeps, phase lock is broken, the source is pretuned for the next subsweep, and the phase lock sequence is repeated. Table 1 lists the subsweep frequencies from the synthesizer and the source.

Table 1. Subsweep Frequencies

Band	Synthesizer (MHz)	HP 8720 Harmonic Number (N)	HP 8720 Source (GHz)	HP 8719 Harmonic Number (N)	HP 8719 Source (GHz)
Low	120 to 240	(1)	0.130 to 0.250	(1)	0.130 to 0.250
	120 to 180	(2)	0.250 to 0.370	(2)	0.250 to 0.370
	120 to 240	(3)	0.370 to 0.730	(3)	0.370 to 0.730
	144 to 237.6	(5)	0.730 to 1.198	(5)	0.730 to 1.198
	132 to 234.2	(9)	1.198 to 2.118	(9)	1.198 to 2.118
Mid	124 to 235	(17)	2.118 to 4.006	(17)	2.118 to 4.006
	148 to 224.7	(27)	4.006 to 6.078	(27)	4.006 to 6.078
	164 to 223.4	(37)	6.078 to 8.278	(37)	6.078 to 8.278
High	156 to 236.4	(53)	8.278 to 12.529	(57)	8.218 to 13.510
	144 to 239.9	(87)	12.529 to 20.000		

A12 Reference: the Crystal Reference Frequencies

This assembly provides stable reference frequencies to the rest of the instrument by dividing down the output of a 40 MHz VCXO (voltage-controlled crystal oscillator). One of the divided-down signals is the 100 kHz FN REF for phase locking the synthesizer signal in A13. Another is the 1 MHz main phase-locked loop reference signal PL REF that goes to the phase comparator in A11.

(The 2nd LO signal and the timing signal for the A10 digital IF assembly are explained in *Receiver Theory*.)

www.valuetronics.com

The EXT REF rear panel input provides the option of using an external reference with a frequency of 1, 2, 5, or 10 MHz, instead of the internal 40 MHz VCXO.

Source Block: The YIG Oscillator Signals

The source block includes two YIG oscillators and a 3.8 GHz fixed oscillator. The outputs of these oscillators produce the source signal. In phase-locked operation, this signal tracks the stable output of the synthesizer. Figure 5 illustrates the assemblies in the source block.

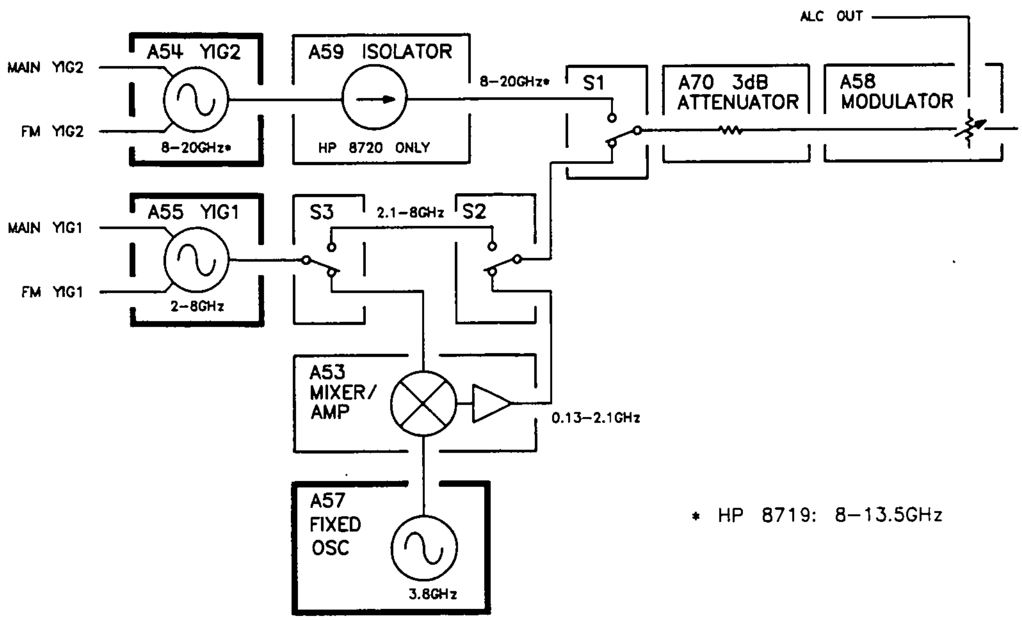


Figure 5. Simplified Diagram of the Source Block

Each YIG oscillator has a main coil and an FM coil. These are analogous to the woofer and the tweeter in a stereo speaker: the woofer reproduces low frequencies and the tweeter reproduces high frequencies. Similarly in the YIG oscillators, the main coils allow large, slow changes in frequency but cannot respond to high frequency deviations, which are sent to the faster-acting FM coils.

The tune current from the A11 phase lock assembly splits into two paths. One path is lowpass filtered, removing high frequency components, and goes to the YIG main coils; the other path is highpass filtered, removing low frequency components, and goes to the YIG FM coils. The filters are matched in stop-band response, such that one picks up where the other leaves off. Each path is further divided into two paths, one for driving each of the YIG oscillators.

www.valuetronics.com

The full YIG oscillator frequency range is achieved in three bands:

Band	Frequency Range
Low	130 MHz to 2.1 GHz
Mid	2.1 to 8.3 GHz
High	8.3 to 20.0 GHz

In the low band, the 2 to 8 GHz output of YIG1 and the fixed 3.8 GHz output of the A57 fixed oscillator are mixed in the A53 mixer/amplifier assembly. In this band, S1 and S2 switch A53 into the circuit, and S3 selects the output of S2.

In the mid band, the fundamental output of YIG1 is used (no mixing). S1 and S2 switch the mixer/ amplifier A53 and the fixed oscillator A57 out of the circuit.

The high band uses the output of YIG2. The isolator A59 improves the effective source match between YIG2 and the modulator A58. In high band, switch S3 selects the YIG2 output.

In the A58 modulator assembly, the YIG oscillator signal is modulated by the ALC OUT signal (explained below) to provide power control and leveling. The leveled signal is attenuated by 3 dB in the A70 assembly to improve the match between the modulator and the signal separation devices.

A7 ALC: Automatic Leveling Control

Part of the 10 MHz 1st IF signal from the A64 sampler goes to the A7 ALC (automatic leveling control) assembly. This assembly is part of a leveling loop that maintains constant power across the sweep. The ALC loop, illustrated in figure 6, detects the power level, compares it to a fixed reference voltage, and adjusts the modulator to improve power flatness.

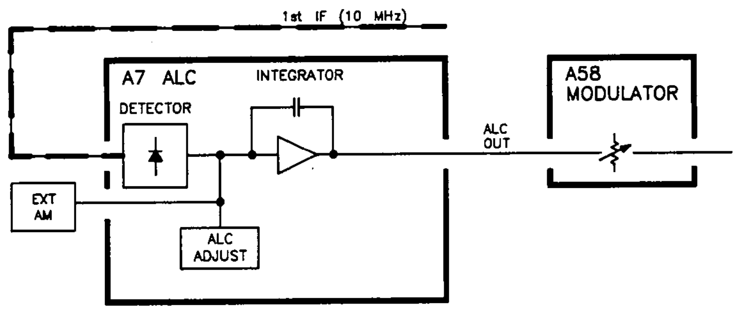


Figure 6. Simplified Diagram of the ALC Circuit

The 1st IF signal coming into the A7 ALC assembly is detected to give a voltage proportional to the power amplitude. This voltage is compared to a reference voltage proportional to the desired power level in dBm, and the resulting signal represents the error between actual and desired power. The error voltage is amplified to drive the modulator A58 and correct the source power level.

www.valuetronics.com

At the transitions between subsweeps, when the IF signal is temporarily interrupted, the modulator is switched to a fixed attenuation to limit the maximum unleveled power to −10 dBm.

The EXT AM input is provided to allow a DC signal of 0 to +10V (approximately 1 V/dB) to be applied at the rear panel. This signal can be used for continuous control of the output power, in addition to the standard stepped power control using the internal attenuator.

www.valuetronics.com

SIGNAL SEPARATION

The signal separation devices separate the source signal into a reference path and a test path. They provide attenuation for the source signal, RF path switching to allow simultaneous forward and reverse measurements, and external connections for the device under test. Figure 7 illustrates the assemblies in the signal separation block. (For troubleshooting purposes, the signal separation devices are included with the source functional group. Refer to the *Source* troubleshooting section.)

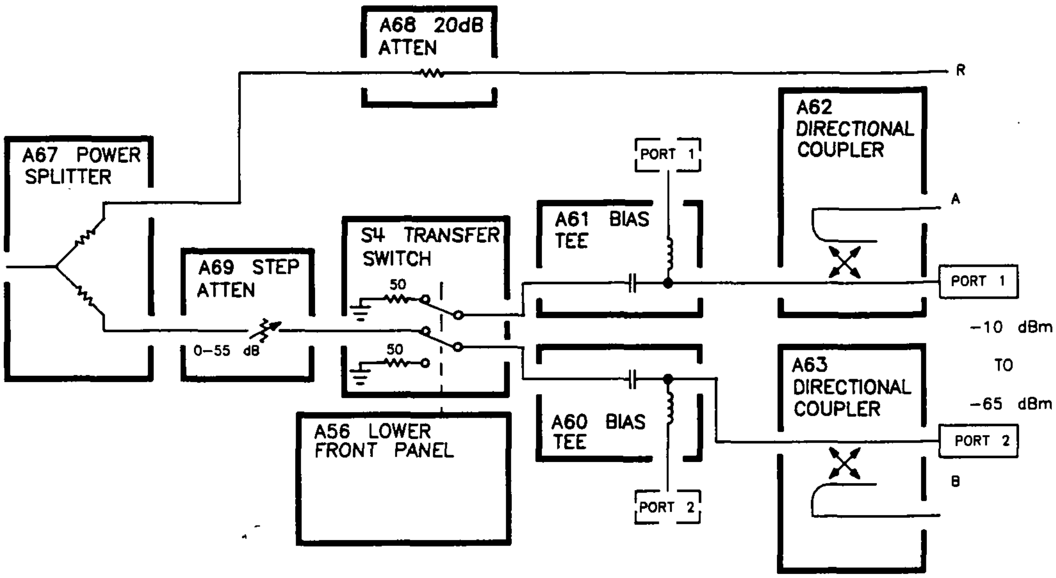


Figure 7. Signal Separation, Simplified Block Diagram
(For Option 003 Instruments see Figure 3 in Troubleshooting Section)

A67 Power Splitter, A68 Attenuator

The power splitter divides the source signal into two parts. One part of the signal is routed to the R sampler A64 for reference and phase lock. The 10 dB attenuator A68 isolates the R signal path from the rest of the system, and helps ensure that the R signal is not subject to gain compression.

The remainder of the source signal is routed through the step attenuator, transfer switch, and couplers to the test ports, where the device under test is connected.

A69 Step Attenuator

The step attenuator provides power control for the source signal. It is an electro-mechanical attenuator, controlled by the A9 CPU, that provides 0 to 55 dB of attenuation in 5 dB steps. It adjusts the power level to the DUT without changing the level of the incident power in the reference path.

www.valuetronics.com

S4 Transfer Switch

The output of the step attenuator is fed into the transfer switch S4. This is a coaxial electromechanical switch with very low loss. It switches between the port 1 and port 2 measurement paths, automatically enabling alternate forward and reverse measurements. In addition, S4 provides an internal termination for the measurement port that is inactive.

A56 Lower Front Panel Assembly

The A56 lower front panel assembly provides an interface for the transfer switch control voltages, and for the DC voltage from the rear panel to the bias tees. LEDs on the lower front panel indicate the status of the transfer switch.

A60 and A61 DC Bias Tees

The DC bias tees provide a means of biasing active devices with an external DC voltage connected to the rear panel DC BIAS CONNECT ports. The DC voltage is applied directly to the center conductor of the test port connectors. A blocking capacitor ensures that the bias current goes only to the device under test, and not back into the source. Likewise, an inductor in the bias path prevents RF from being imposed on the external DC supply.

A62 and A63 Directional Couplers

The test signal goes into the through-line arm of the couplers, and from there to the test ports (−10 dBm to −65 dBm) and the device under test. The coupled arm of the couplers carries the signal reflected from or transmitted through the device under test to the receiver for measurement. The coupling coefficient of the directional couplers is nominally 20 dB (40 dB at 130 MHz).

Option 003 (Extended Dynamic Range)

The option 003 instrument is configured for extended dynamic range with forward transmission measurements (S21). This configuration differs from the standard instrument in that the main arm of the port 2 coupler is connected (through a 6 dB attenuator) to the sampler. Thus, for S21 measurements, the normal 20 dB coupler loss is eliminated.

Note that measurements in the reverse direction (S12) now include the coupling loss of both arms. Dynamic range in the reverse direction, is reduced. The instrument modification is shown (as a shaded section) in Figure 3 of the *Isolate Faulty Group* section.

www.valuetronics.com

RECEIVER THEORY

The receiver measures and processes the input signals into digital information for display on the CRT. Figure 8 is a simplified block diagram of the receiver functional group. The A12 reference assembly, which is part of the source group, is also included in the illustration to show how the 2nd LO signal is derived.

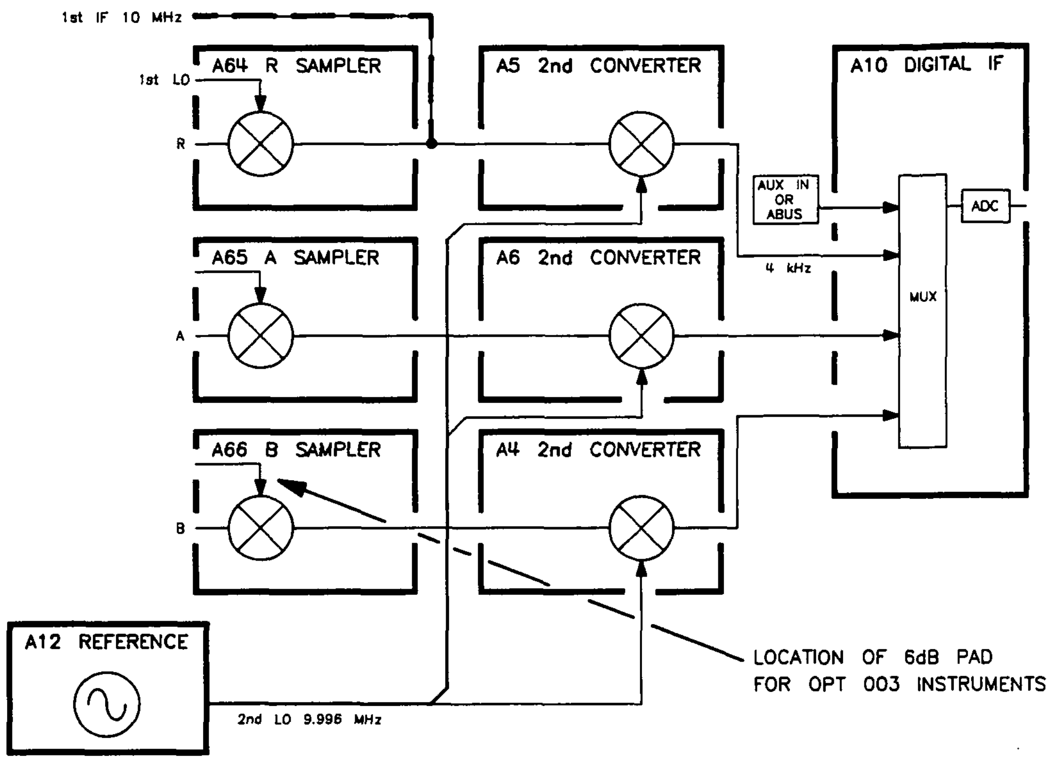


Figure 8. Receiver Functional Group, Simplified Block Diagram

Samplers and Second Converters

Each input signal goes to one of three identical pairs of sampler and second converter assemblies (R, A, and B) that down-convert the signals to a fixed 4 kHz 2nd IF with magnitude and phase corresponding to the input.

The 1st LO Signal is a comb of harmonics of the synthesizer signal, produced by a step recovery diode in the A52 pulse generator. Refer to *Source Group Theory* for details.

www.valuetronics.com

A64/A65/A66 Samplers. The signal from the source is mixed with the 1st LO harmonics in the samplers. One of the harmonic signals is 10 MHz below the desired frequency. The mixing products are filtered, leaving only the difference between that harmonic and the source frequency: this fixed 10 MHz signal is the 1st IF ($F_{IF} = F_S - NF_{VCO}$, where N is the harmonic number). Part of the 1st IF signal from the R sampler is fed back to the A7 ALC and the A11 phase lock assembly to complete the source phase-locked loop. The 1st IF from all three samplers goes to the corresponding second converters.

2nd LO Signal. The stable 2nd LO signal is produced in the A12 reference assembly by phase locking and mixing a 39.984 MHz VCO with the 40 MHz VCXO to derive a difference of 16 kHz. This is compared to a 16 kHz reference produced by dividing 40 MHz by 2500. The phase-locked output of the 39.984 MHz oscillator is divided by 4 to provide the 9.996 MHz 2nd LO.

A4/A5/A6 Second Converters. The 1st IF and the 2nd LO are mixed in the second converter. The resulting difference frequency is a constant 4 kHz 2nd IF signal that retains the amplitude and phase characteristics of the measured signal. The 2nd IF signals from all three second converter assemblies are input to the A10 digital IF assembly.

A10 Digital IF

In this assembly, the 2nd IF signals from the A and B second converters go through a gain stage. Signals lower than −30 dB on these two signal paths are amplified by 24 dB to ensure that they can be detected by the ADC (analog-to-digital converter). For troubleshooting purposes, the gain can be forced on or off using the service menus (refer to the *Receiver* tab in the troubleshooting section.) The R path signal is fixed at a level high enough to maintain phase lock, and therefore requires no amplification.

All three signals are sampled at a 16 kHz rate set by a divided-down 4 MHz clock pulse from the A12 reference assembly. The signals are sequentially multiplexed into the ADC, where they are converted to digital form. The ADC conversions are triggered by timing signals from the CPU or the synthesizer, or an external signal at the rear panel EXT TRIG connector. The digitized data is serially clocked into the A9 CPU assembly to be processed into magnitude and phase data. The processed and formatted data is finally routed to the CRT for display, and to the HP-IB for remote operation. Refer to *Digital Control Theory* in this section and to *Data Processing* in the first chapter of the *Reference* for more information on signal processing.

An additional input to the A10 assembly is the analog bus (ABUS), a built-in service tool for testing analog circuits within the instrument. This is a single multiplexed line that networks analog nodes throughout the instrument, or monitors an external input at the rear panel AUX INPUT connector. It is controlled by the CPU, and used like an oscilloscope or frequency counter to make internal voltage and frequency measurements.

www.valuetronics.com

INTRODUCTION

This section contains information for ordering replaceable parts for three instruments. The replaceable parts include major assemblies, chassis hardware, but not parts of major assemblies (except as noted). Table 1 lists major reference designations and abbreviations used in the parts lists.

Within the parts lists, these abbreviations indicate parts specific to a particular instrument.

(19A)	HP 8719A
(20A)	HP 8720A
(20B)	HP 8720B
(19A, 20B)	HP 8719A and 8720B

Parts common to all instruments are not qualified by one of the abbreviations above.

Refer to the "Replacement Procedures" section of this manual for hints on removing and replacing assemblies.

REPLACEABLE PARTS FIGURES

The visual differences between the HP 8719A, 8720A and 8720B analyzers are, for the most part, slight. Thus most of the figures show the HP 8720A only. Significant differences are noted.

ADJUSTMENTS AND VERIFICATION

Adjustments or verification procedures or both may be required to assure that the analyzer meets its published specifications following replacement of an assembly. "Post Repair Procedures" lists such requirements.

R-E (REBUILT-EXCHANGE) ASSEMBLIES COST LESS

Lower cost assemblies are available through the rebuilt-exchange program. These factory *rebuilt* (repaired and tested) assemblies meet all factory specifications required of a new assembly. They are offered on an *exchange* (trade-in) basis only. The defective assembly must be returned for credit, so R-E assemblies are not suitable for stock or spares. Figure 1 illustrates the rebuilt-exchange procedure. Figure 2 shows all major assemblies, including those that can be replaced on an exchange basis.

If you have any questions, contact your HP customer engineer.

www.valuetronics.com

REPLACEABLE PARTS LIST

Figures 2 through 12 assist in location and identification of all replaceable parts. Table 2 is a list of miscellaneous replaceable accessories. Figures 2 through 12 include corresponding lists that provide the following information:

1. Hewlett-Packard part number.
2. Part number check digit (CD).
3. Part quantity as shown in the corresponding figure. There may or may not be more of the same part located elsewhere in the instrument.
4. Part description, using abbreviations in Table 1.
5. A typical manufacturer of the part in a five-digit code (refer to the Manufacturers Code List in Table 1 for addresses).
6. The manufacturer's part number.

ORDERING INFORMATION

To order a part listed in the replaceable parts lists, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts lists, include the instrument model number, complete instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

How to Order Parts...Fast!

When you know which parts you need to repair the instrument, contact Hewlett-Packard's direct ordering team by calling the following toll-free number:

(800) 227-8164
Monday through Friday, 6 am to 5 pm (Pacific Standard Time)

The parts specialists have direct online access to replacement parts inventory corresponding to the *Replaceable Parts* list in this manual. There is a charge for hotline one day delivery, but four day delivery time is standard. After hours and holidays, call (415) 968-2347.

This information applies to the United States only. Outside the United States, contact your nearest HP office.

www.valuetronics.com

Table 1. Reference Designations, Abbreviations, and Manufacturers Code List

REFERENCE DESIGNATIONS

A .... Assembly
CR .... Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DS .... Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device
F .... Fuse
FL .... Filter
J .... Electrical Connector (Stationary Portion), Jack
MP .... Miscellaneous Mechanical Part
P .... Electrical Connector (Movable Portion), Plug
Q .... Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R .... Resistor
S .... Switch
TP .... Test Point
U .... Integrated Circuit
W .... Cable, Transmission Path, Wire

ABBREVIATIONS

A

ADJ .... Adjust, Adjustment
AMP .... Amplifier
ASSY .... Assembly
ATTN .... Attenuator

B

BD .... Board
BNC .... Type of Connector

C

C .... Capacitance, Capacitor
CBL .... Cable
CHAM .... Chamfer
CPU .... Central Processing Unit

D

D .... Deep, Depletion, Depth, Diameter, Direct Current
DB .... Decibel, Double Break
DBL .... Double

E

EXT .... Extended, Extension, External, Extinguish

F

F .... Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FL .... Flash, Flat, Fluid
FLTR .... Filter, Floater

G

GHZ .... Gigahertz

H

HD .... Hand, Hard, Head, Heavy Duty
HEX .... Hexadecimal, Hexagon, Hexagonal

I

ID .... Identification, Inside Diameter
IN .... Inch, Indium
INTL .... Internal

K

KB .... Knob

L

LED .... Light Emitting Diode
LG .... Length, Long
LKWR .... Lockwasher

M

MACH .... Machine
MM .... Millimeter
MTLC .... Metallic

N

NEG .... Negative

O

OD .... Olive Drab, Outside Diameter

P

PAN-HD .... Pan Head
PC .... Picocoulomb, Piece, Printed Circuit
PNL .... Panel
P/O .... Part of
PN .... Part Number

R

R .... Rear
RFI .... Radio Frequency Interference

S

SAMP .... Sampler
SCR .... Screw, Scrub, Silicon Controlled Rectifier
SHFT .... Shaft
SHLDR .... Shoulder
SKT .... Skirt, Socket
SLDR .... Solder
SMB .... Subminiature, B Type (Snap-On Connector)
SST .... Stainless Steel

T

THD .... Thread, Threaded
THK .... Thick

V

VDC .... Volts, Direct Current

W

W .... Watt, Wattage, White, Wide, Width, Wire

X

XSTR .... Transistor

Y

YIG .... Yttrium-iron-garnet

Z

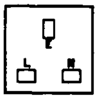
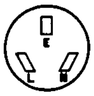
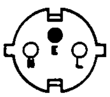
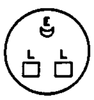
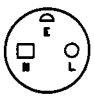
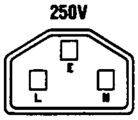
ZN-P .... Zinc Plate

MANUFACTURERS CODE LIST

Mfr. Code	Manufacturer Name	Address		Zip Code
00000	Any Satisfactory Supplier			
28480	Hewlett-Packard Company Corp. Hq.	Palo Alto	CA	94304
55787	Gas Spring Corp.	Montgomervyille	PA	18936
71400	Cooper Industries Inc.	Houston	TX	77210

www.valuetronics.com

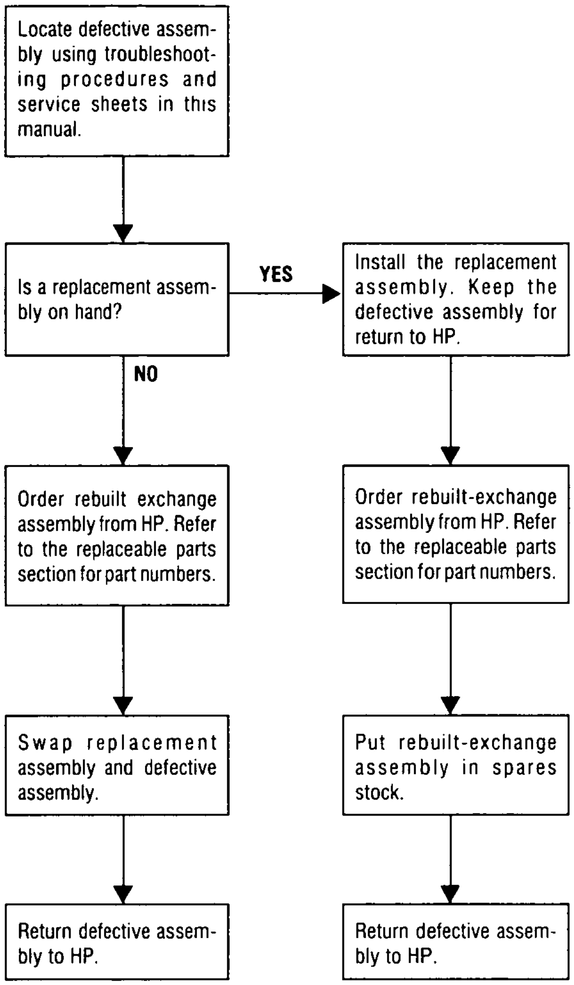
Table 2. Power Cable and Plug Part Numbers

Plug Type[1]	Cable HP Part Number[2]	CD[3]	Plug Description[2]	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	0 6	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	0 4	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, Republic of So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight SEV1011.1959 24507,Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	2 3	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight CEE22-VI (System Cabinet Use)			

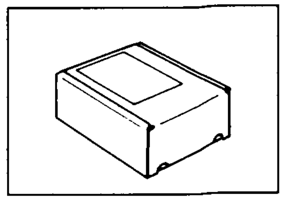
1. E = Earth Ground; L = Line; N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
3. The Check Digit (CD) is a coded digit that represents the specific combination of numbers used in the HP Part Number. It should be supplied with the HP Part Number when ordering any of the power assemblies listed above, to expedite speedy delivery.

www.valuetronics.com

Use this fast, efficient, economical method to keep your Hewlett-Packard instrument in service.



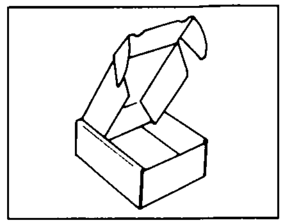
A.



Rebuilt-exchange assemblies are shipped individually in boxes like this. In addition to the circuit assembly, the box contains:

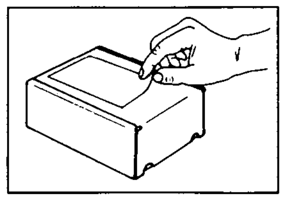
- Exchange assembly failure report
- Return address label

B.



Open box carefully - it will be used to return defective assembly to HP. Complete failure report. Place it and defective assembly in box. Be sure to remove enclosed return address label.

C.



Seal box with tape. Inside U.S.A.*, stick preprinted return address label over label already on box, and return box to HP. Outside U.S.A., do not use address label; instead address box to the nearest HP office.

*HP pays postage on boxes mailed in U.S.A.

Figure 1. The Low Cost Rebuilt-Exchange Procedure

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08415-60001	0	1	(20A) FRONT PANEL KEYBD ASSY	28480	08415-60001
A1	08720-60016	6	1	(19A, 20B) FRONT PANEL KEYBD ASSY	28480	08720-60016
A2	08753-60076	8	1	(20A) FRONT PANEL INTERFACE BD ASSY	28480	08753-60076
A2	08753-60091	7	1	(19A, 20B) FRONT PANEL INTERFACE BD ASSY	28480	08753-60091
A3				NOT ASSIGNED		
A4, A5, A6	08415-60004	3	3	SECOND CONVERTER	28480	08415-60004
A7	08415-60007	6	1	ALC BD ASSY	28480	08415-60007
A8	08415-60008	7	1	(20A) POST-REGULATOR BD ASSY	28480	08415-60008
A8	08415-69008	5		(20A) POST-REGULATOR BD ASSY (R-E)	28480	08415-69008
A8	08720-60008	7	1	(19A, 20B) POST-REGULATOR BD ASSY	28480	08753-60008
A8	08720-69008	4		(19A, 20B) POST-REGULATOR BD ASSY (R-E)	28480	08720-69008
A8F1	2110-0425	0	3	FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F2	2110-0424	9	2	FUSE .75A 125V NTD .25X.27	28480	2110-0424
A8F3	2110-0425	0		FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F4	2110-0424	9		FUSE .75A 125V NTD .25X.27	28480	2110-0424
A8F5	2110-0476	1	2	FUSE 4A 125V NTD .25X.27	71400	GMW-4
A8F6	2110-0425	0		FUSE 2A 125V NTD .25X.27	28480	2110-0425
A8F7	2110-0476	1		FUSE 4A 125V NTD .25X.27	71400	GMW-4
A8F8	2110-0047	2	1	FUSE 1A 125V NTD .25X.27	71400	GMW-1
A8F9	2110-0046	1	1	FUSE .5A 125V NTD .25X.27	28480	2110-0046
A9	08415-60109	9	1	(20A) CPU BD ASSY	28480	08415-60109
	08720-60020		1	(20A) FIRMWARE	28480	08720-60020
A9	08415-69109	7		(20A) CPU BD ASSY (R-E)	28480	08415-69109
A9	08720-60013	4	1	(20B) CPU BD ASSY	28480	08720-60013
A9	08720-69013	2		(20B) CPU BD ASSY (R-E)	28480	08720-69013
	08720-60009	8	1	(20B) FIRMWARE	28480	08720-60009
A9	08719-60006	2	1	(19A) CPU BD ASSY	28480	08719-60006
A9	08719-69006	0		(19A) CPU BD ASSY (R-E)	28480	08719-69006
	08719-60003	9	1	(19A) FIRMWARE	28480	08719-60003
A10	08753-60095	1	1	DIGITAL IF BD ASSY	28480	08753-60095
A10	08753-69095	9		DIGITAL IF BD ASSY (R-E)	28480	08753-69095
A11	08415-60011	2	1	PHASE LOCK BD ASSY	28480	08415-60011
A11	08415-69011	0		PHASE LOCK BD ASSY (R-E)	28480	08415-69011
A12	08720-60012	3	1	REFERENCE BD ASSY	28480	08720-60012
A12	08720-69012	1		REFERENCE BD ASSY (R-E)	28480	08720-69012
A13*	08415-60013	4	1	FRACTIONAL N ANALOG BD ASSY	28480	08415-60013
A13*	08415-69013	2		FRACTIONAL N ANALOG BD ASSY (R-E)	28480	08415-69013
A14	08415-60014	5	1	FRACTIONAL N DIGITAL BD ASSY	28480	08415-60014
A14	08415-69014	3		FRACTIONAL N DIGITAL BD ASSY (R-E)	28480	08415-69014
A15	08753-60015	5	1	(20A) PREREGULATOR ASSY	28480	08753-60015
A15	08753-69015	3		(20A) PREREGULATOR (R-E)	28480	08753-69015
A15	08753-60098	4	1	(19A, 20B) PREREGULATOR ASSY	28480	08753-60098
A15	08753-69098	2		(19A, 20B) PREREGULATOR ASSY (R-E)	28480	08753-69098
A15F1	2110-0655	8	1	FUSE-3.15A 250V	28480	2110-0655
A16	08753-60016	6	1	REAR PANEL BD ASSY	28480	08753-60016
A16	08753-60094		1	(19A, 20B) REAR PANEL BD ASSY	28480	08753-60094
A16	08753-69094		1	(19A, 20B) REAR PANEL BD ASSY (R-E)	28480	08753-69094
A17	08720-60017	8	1	(20A) MOTHERBD ASSY (INCLUDES MOTHERBD RIVETED TO CAGE ASSY AND FRAME)	28480	08415-60017
A17	08720-60011	2	1	(19A, 20B) MOTHERBD ASSY (INCLUDES MOTHERBD RIVETED TO CAGE ASSY AND FRAME)	28480	08720-60011
A18	08753-60066	6	1	(20A) DISPLAY ASSY	28480	08753-60066
A18	08753-69066	4		(20A) DISPLAY ASSY (R-E)	28480	08753-69066
A18	2090-0210	7	1	(19A, 20B) DISPLAY ASSY	28480	2090-0210
A18	5140-8484	3		(19A, 20B) DISPLAY ASSY (R-E)	28480	5140-8484
A19	08753-60202			(19A, 20B) GRAPHICS SYSTEM PROCESSOR ASSY	28480	08753-60202
A19	08753-69202			(19A, 20B) GRAPHICS SYSTEM PROCESSOR ASSY (R-E)	28480	08753-69202
A20-A50				NOT ASSIGNED		

*For the optional fractional-N adjustment procedure, also order the automated adjustments disc (see page 33/34). Refer to *Post-Repair Procedures* for details.

Figure 2. Major Assemblies (1 of 4)

www.valuetronics.com

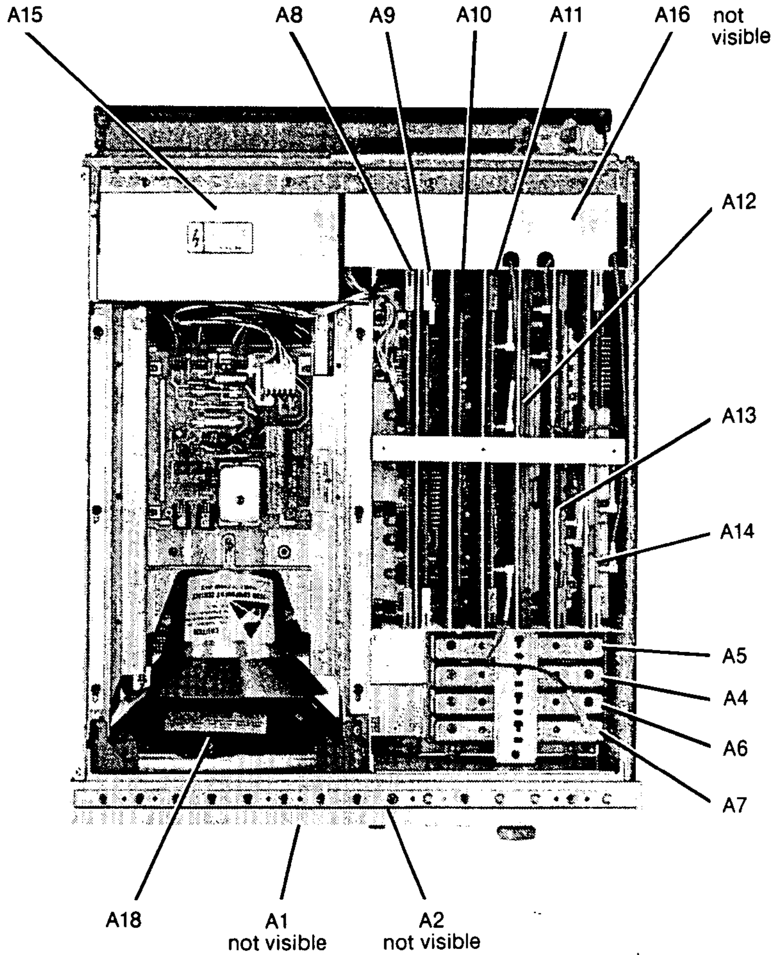


Figure 2. Major Assemblies (2 of 4)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A51	08415-60051	0	1	INTERFACE BD ASSEMBLY	28480	08415-60051
A52	5086-7456	1	1	PULSE GENERATOR (INCLUDES BIAS BD)	28480	5086-7456
A52	5086-6456	9		PULSE GENERATOR (R-E) (INCLUDES BIAS BD-NOT SEPARATELY REPLACEABLE).	28480	5086-6456
A53	08415-60068	9	1	MIXER/AMP (INCLUDES BIAS BD)	28480	08415-60068
A53	08415-69068	7		MIXER/AMP (R-E) (INCLUDES BIAS BD-NOT SEPARATELY REPLACEABLE).	28480	08415-69068
A54	08415-60069	0	1	(20A, 20B) YIG 2 8-20 GHZ	28480	08415-60069
A54	08719-60005	0	1	(19A) YIG 2 8-13.5 GHZ	28480	08719-60005
A55	5086-7470	9	1	YIG 1 2-8 GHZ	28480	5086-7470
A55	5086-6470	7		YIG 1 2-8 GHZ (R-E)	28480	5086-6470
A56	08415-60056	5	1	LOWER FRONT PANEL BD ASSEMBLY	28480	08415-60056
A57	86222-60007	7	1	FIXED OSCILLATOR 3.8 GHZ	28480	86222-60007
A58	08415-60058	7	1	MODULATOR	28480	08415-60058
A59	0955-0265	4	1	(20A, 20B) ISOLATOR	28480	0955-0265
A60, A61	5086-7458	3	2	BIAS TEE	28480	5086-7458
A60, A61	5086-6458	1		BIAS TEE (R-E)	28480	5086-6458
A62, A63	08720-60029	2	2	DIRECTIONAL COUPLER	28480	08720-60029
A64, A65, A66	5086-7457	2	3	SAMPLER	28480	5086-7457
A64, A65, A66	5086-6457	0		SAMPLER (R-E)	28480	5086-6457
A67	5086-7408	3	1	POWER SPLITTER	28480	5086-7408
A68	0955-0216	5	1	MICROWAVE ATTENUATOR 8 GHZ MAX	28480	0955-0216
A69	83595-60019	5	1	STEP ATTENUATOR	28480	83595-60019
A70	0955-0427	0	1	ATTENUATOR FIXED 3DB	28480	0955-0427
A71	0955-0462	3	1	ATTENUATOR, 6DB FIXED (OPT 003 ONLY)	28480	0955-0462
A71MP1	08720-20030	1	1	SHIELD, ATTN/CABLE (OPT 003 ONLY)	28480	08720-20030
S1, S2, S3	08415-60057	6	3	MICROWAVE SWITCH	28480	08415-60057
S4	08720-60006	5	1	TRANSFER SWITCH	28480	08720-60006

Figure 2. Major Assemblies (3 of 4)

www.valuetronics.com

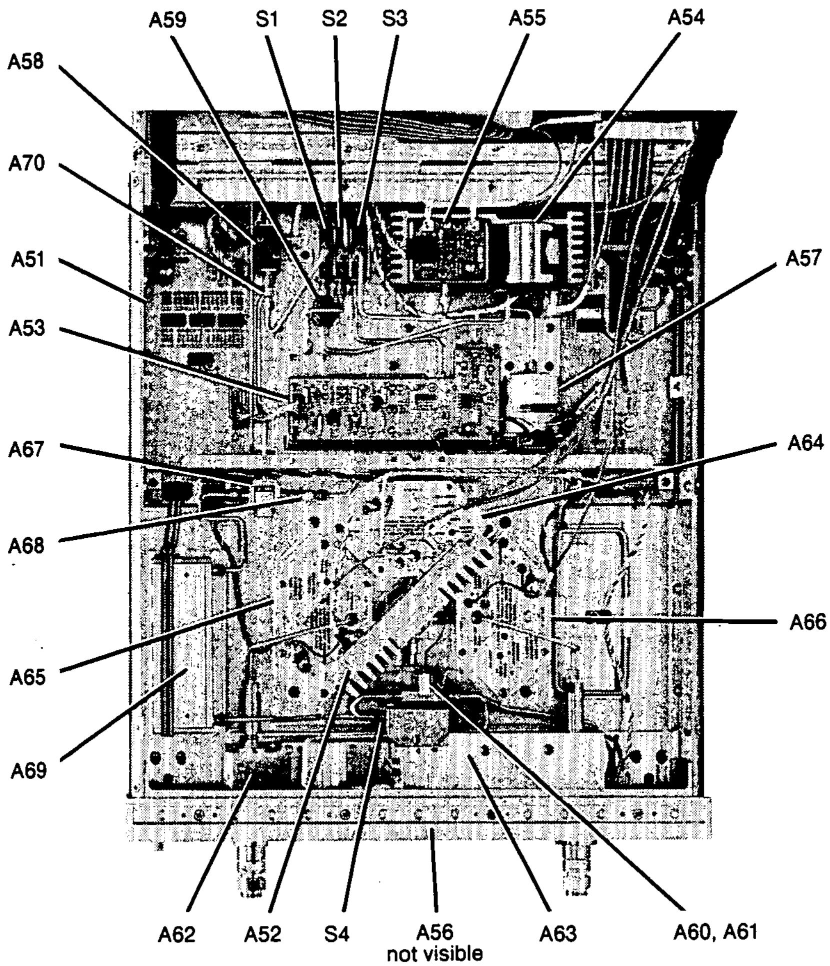


Figure 2. Major Assemblies (4 of 4)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A57W1	08415-60061	2	1	CABLE ASSY-A57/A53J2	28480	08415-60061
A64W1	08513-60023	5	3	CABLE ASSY-A64/A51J16	28480	08513-60023
A65W1	08513-60023	5		CABLE ASSY-A65/A51J14	28480	08513-60023
A66W1	08513-60023	5		CABLE ASSY-A66/A51J15	28480	08513-60023
A69W1				RIBBON CABLE ASSY-NOT SEPARATELY REPLACEABLE		
S4W1	08415-60064	5	1	CABLE ASSY-A56J2/S4,A60,A61	28480	08415-60064
W1	08415-20077	6	1	SEMI-RIGID RF CABLE - A70/S1	28480	08415-20077
W2	08415-60038	3	2	FLEXIBLE RF CABLE ASSY-A17J15 ALC/MOD	28480	08415-60038
W3	08415-20066	3	1	SEMI-RIGID RF CABLE - S1/S2	28480	08415-20066
W4	08753-60041	7	1	(20A) CABLE ASSY-A18 DISPLAY FOCUS - INTEN/A17J2	28480	08753-60041
W5	08415-20065	2	1	SEMI-RIGID RF CABLE - S2/S3	28480	08415-20065
W6	08415-20078	7	1	SEMI-RIGID RF CABLE - A53/S3	28480	08415-20078
W7	08415-20074	3	1	SEMI-RIGID RF CABLE - S3/A55	28480	08415-20074
W8	08415-60031	6	1	FLEXIBLE RF CABLE ASSY - A11J2/A55J2 Y1G1 FMC	28480	08415-60031
W9	08415-60030	5	1	FLEXIBLE RF CABLE ASSY-A17J13/A55J3 Y1G1 MC	28480	08415-60030
W10	08415-60065	6	2	CABLE ASSY - A54J1/A51J11	28480	08415-60065
W11	08415-20080	1	1	SEMI-RIGID RF CABLE - A57/A53	28480	08415-20080
W12	08753-60037	1	2	RIBBON CABLE ASSY - A51J1/A17J7	28480	08753-60037
W13	08415-60033	8	1	FLEXIBLE RF CABLE ASSY - A11J3/A54J2 YIG 2 FMC	28480	08415-60033
W14	08415-60062	3	1	CABLE ASSY-R.PNL PORT1,PORT2 BIAS CONNECT/A51J17	28480	08415-60062
W15	08415-60032	7	1	FLEXIBLE RF CABLE ASSY-A17J14/A54J3 Y1G2 MC	28480	08415-60032
W16	08415-60038	3		FLEXIBLE RF CABLE ASSY-A51J19ALCOUT/ A17J9	28480	08415-60038
W17	08415-60029		1	FLEXIBLE RF CABLE ASSY-A51J18 IF IN/A64J3 IF OUT		
W18	08415-60037	2	1	FLEXIBLE RF CABLE ASSY - A17J10 IF IN/A51J20 IF OUT	28480	08415-60037
W19	08415-60065	6		CABLE ASSY - A52J2/A51J4	28480	08415-60065
W20	08415-60028	1	1	FLEXIBLE RF CABLE ASSY - A17J12 B IF IN/A66 SAMP B J3	28480	08415-60028
W21	08415-60035	0	1	FLEXIBLE RF CABLE ASSY-A14J1/A52J1	28480	08415-60035
W22	08415-20071	0	1	SEMI-RIGID RF CABLE - A66/A63 (OPT 003: NOT USED)	28480	08415-20071
W23	08415-20067	4	1	SEMI-RIGID RF CABLE - A64J2 RF IN/A68	28480	08415-20067
W24	08415-60066	7	2	CABLE ASSY - A51J3/A56J1	28480	08415-60066
W25	08415-20068	5	1	SEMI-RIGID RF CABLE - A61/A62	28480	08415-20068
W26	08415-20069	6	1	SEMI-RIGID RF CABLE - A60/A63	28480	08415-20069
W27	08415-20081	2	2	SEMI-RIGID RF CABLE - A60/S4 (OPT 003: NOT USED)	28480	08415-20081
W28	08415-20081	2		SEMI-RIGID RF CABLE - A61/S4	28480	08415-20081
W29	08415-20075	4	1	SEMI-RIGID RF CABLE - S4/A69	28480	08415-20075
W30	08415-20072	1	1	SEMI-RIGID RF CABLE - A65/A62	28480	08415-20072
W31	08415-60027	0	1	FELXIBLE RF CABLE ASSY - A17J11/A65 SAMP A J3 IF OUT	28480	08415-60027
W32	08415-20070	9	1	SEMI-RIGID RF CABLE - A69/A67	28480	08415-20070
W33	08415-60063	4	1	CABLE ASSY-A53J1/A51J9	28480	08415-60063
W34	08415-20076	5	1	SEMI-RIGID RF CABLE - A58/A67	28480	08415-20076
W35	08415-20079	8	1	SEMI-RIGID RF CABLE - A59/A54	28480	08415-20079
W36	08415-20073	2	1	SEMI-RIGID RF CABLE - A53/S2	28480	08415-20073

Figure 3. Cables (1 of 4)

www.valuetronics.com

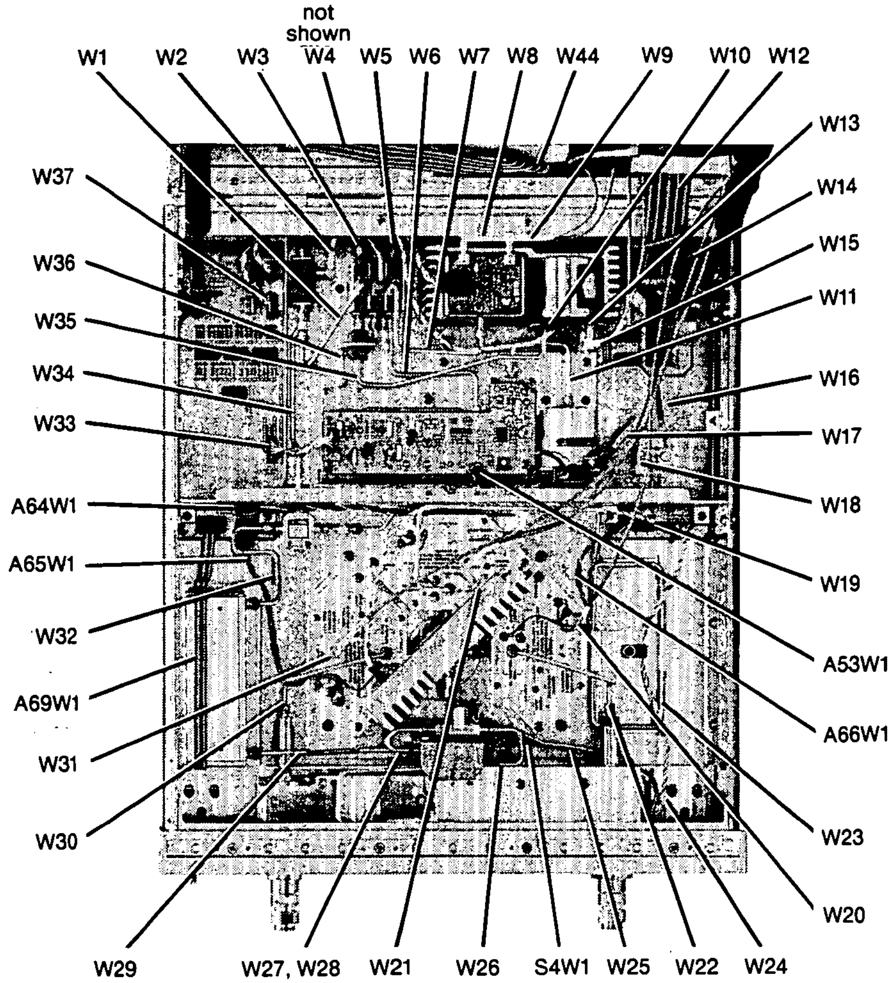
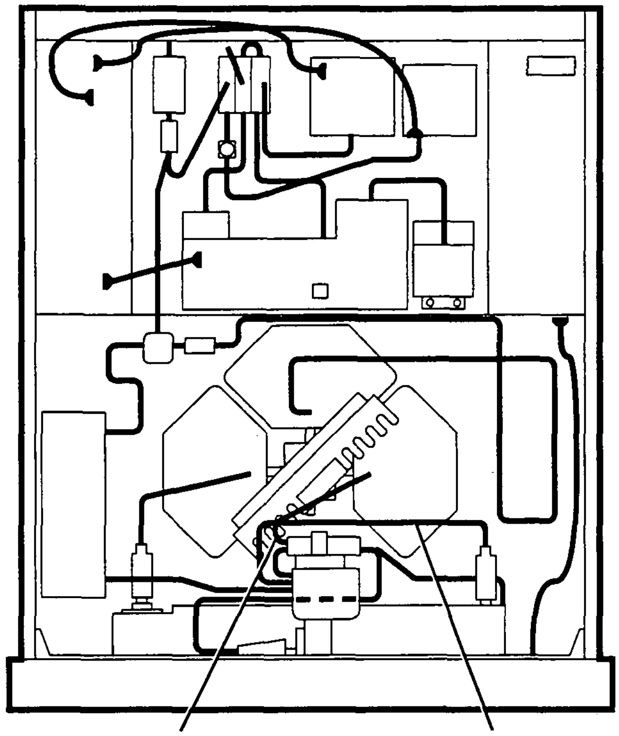


Figure 3. Cables (2 of 4)

www.valuetronics.com



INSERT SHOWING OPTION 003 SPECIFIC CABLES

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15W1	08753-60042	8	1	CABLE ASSY-A15/A8J2, A17J3	28480	08753-60042
A16W1	08753-60033	7	1	RIBBON CABLE ASSY-A16/A17J6	28480	08753-60033
W37	08415-60066	7		CABLE ASSY - A51J10/A55J1	28480	08415-60066
W38	08415-60041	8	1	FLEXIBLE RF CABLE ASSY-A13J1/A14J3	28480	08415-60041
W39	08415-60040	7	1	FLEXIBLE RF CABLE ASSY-A13J2/A12J2	28480	08415-60040
W40	08753-60026	8	1	FLEXIBLE RF CABLE ASSY-A12J1/	28480	08753-60026
		1	1	R. PANEL EXT REF		
W41	08415-60039	4	1	FLEXIBLE RF CABLE ASSY-A7/A11J1	28480	08415-60039
W42	08753-60044	0	1	(20A) CABLE ASSY-A8J1/A18J1	28480	08753-60044
W42	08753-60113	4	1	(19A/20B) CABLE ASSY-A8J1/A19	28480	08753-60113
W43	08753-60037	1	1	RIBBON CABLE ASSY-A17J1/A2	28480	08753-60037
W44	08753-60038	2	1	(20A) RIBBON CABLE ASSY A18/A17J4 DISPLAY	28480	08753-60038
W44	08513-60036	0	1	(19A,20B) RIBBON CABLE ASSY A9/A19	28480	08753-60112
W45				CABLE ASSY-FAN/A17 (P/O FAN ASSY)		
W46	08720-20028	7	1	SEMI-RIGID RF CABLE - S4/A63 (OPT 003 ONLY)	28480	08720-20028
W47	08720-20029	8	1	SEMI-RIGID RF CABLE - A60/A71 (OPT 003 ONLY)	28480	08720-20029

Figure 3. Cables (3 of 4)

www.valuetronics.com

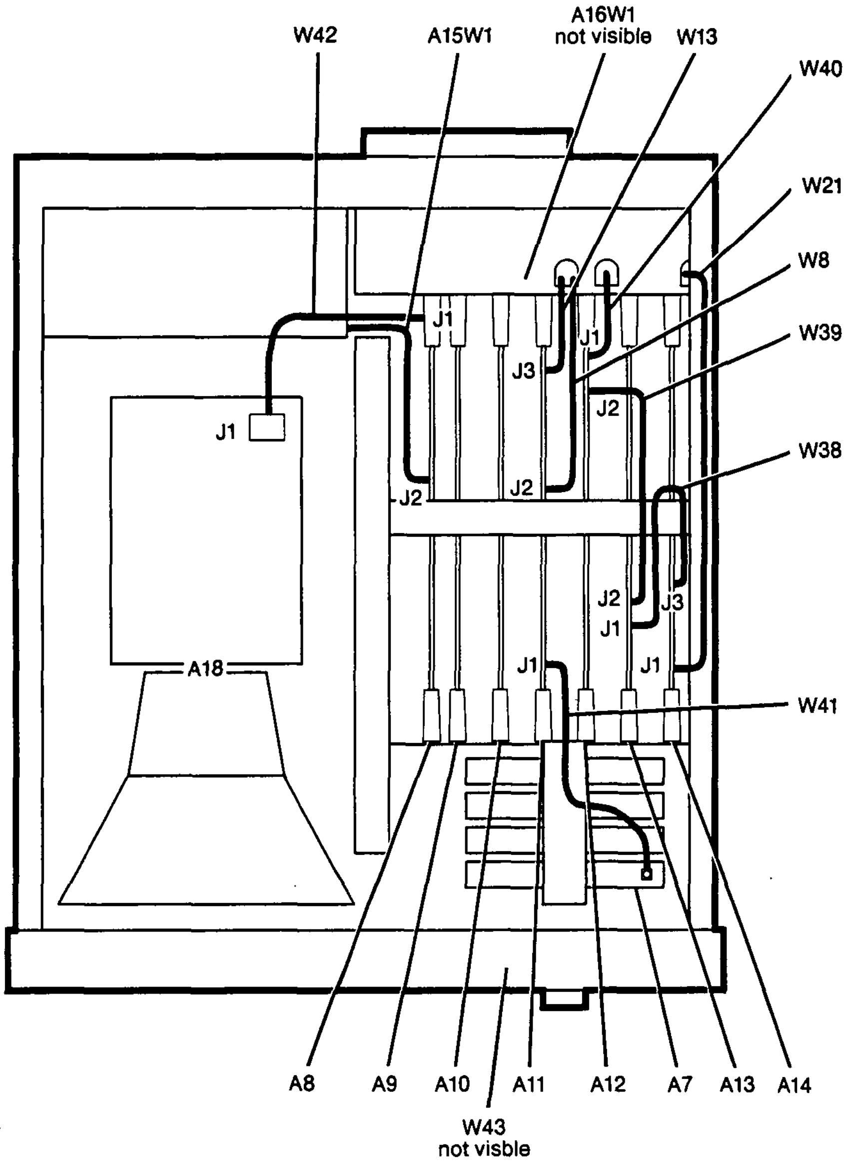


Figure 3. Cables (4 of 4)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08757-40005	5	1	LINE SWITCH KEY	28480	08757-40005
	1460-1573	1	1	SPRING-EXT .138-IN-OD SST PSVT	28480	1460-1573
	08753-00017	1	1	(20A) LINE SWITCH ACTUATOR	28480	08753-00017
	08753			(19A, 20B) LINE SWITCH ACTUATOR	28480	08753-00048
	08753-00036	4	1	SWITCH INSULATOR	28480	08753-00036
2	08415-00001	4	1	FRONT DRESS PANEL-UPPER	28480	08415-00001
3	0370-2992	8	1	KNOB-BASE 1-1/8 JGK .252-IN-ID	28480	0370-2992
	2190-0016	3	1	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0043	8	1	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	08757-60053	5	1	ROTARY PULSE GENERATOR (RPG)	28480	08757-60053
4	5021-3427	2	2	WASHER-TEST PORT CONNECTOR	28480	5021-3427
	5021-3428	3	2	NUT FLANGE-TEST PORT	28480	5021-3428
	5062-1272	7	2	CONNECTOR-TEST PORT	28480	5062-1272
5	1510-0038	8	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
	2190-0067	4	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0067
	2950-0006	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
6				SCREW-MACHINE-SEE FIGURES 6 AND 7		
7				SCREW-MACHINE-SEE FIGURES 6 AND 7		
8*	0515-1232	5	2	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
	3050-1192	3	1	WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-1192
13	08753-40001	7	1	(20A) SOFTKEYS COVER	28480	08753-40001
13	08757-40012	4	1	(19A/20B) SOFTKEYS COVER	28480	08757-40012
14	08720-60003	2	1	(20A) DISPLAY BEZEL ASSEMBLY SCREW-MACHINE-SEE FIGURES 8 AND 9	28480	08720-60003
14	08719-60004			(19A) DISPLAY BEZEL ASSEMBLY	28480	08719-60004
14	08720-60021			(20B) DISPLAY BEZEL ASSEMBLY	28480	08720-60021
14A	08757-20034		1	DISPLAY GASKET (NOT SHOWN)	28480	08757-20034

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

Figure 4. Front Panel (1 of 4)

www.valuetronics.com

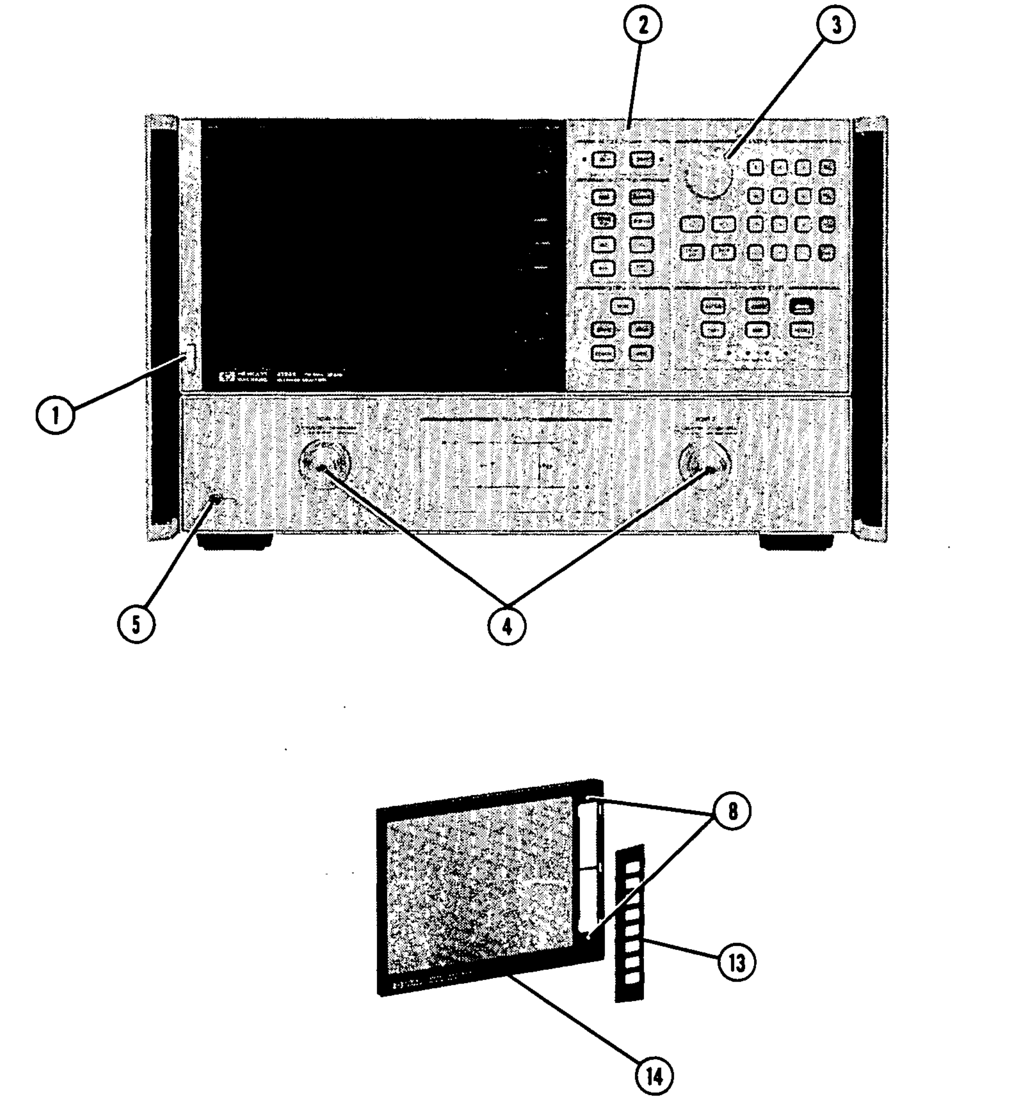


Figure 4. Front Panel (2 of 4)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
6				SCREW-MACHINE-SEE FIGURES 6 AND 7		
7				SCREW-MACHINE-SEE FIGURES 6 AND 7		
8*	0515-1232	5	2	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
	3050-1192	3	1	WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-1192
W43				RIBBON CABLE ASSY-A17J1/A2-SEE FIGURE 3		
9*	0515-0897	6	8	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
10	0510-1148	2	4	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
11*	0515-1112	0	4	SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	28480	0515-1112
12	08415-00002	5	1	FRONT SUB-PANEL-UPPER	28480	08415-00002
13	08753-40001	7	1	SOFTKEYS COVER	28480	08753-40001
15				SCREW-MACHINE-SEE FIGURES 8 AND 9		
16	08415-00051	4	1	FRONT DRESS PANEL-LOWER	28480	08415-00051
17	08415-00052	5	1	FRONT SUB-PANEL-LOWER	28480	08415-00052
18	0510-1148	2	3	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
19*	0515-0897	6	4	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
20	08757-20034	8	1	(20A) GASKET-DISPLAY	28480	08757-20034
20	08757-40104	2		(19A/20B) GASKET-DISPLAY	28480	08757-40010
21	08757-40003	3	1	SUPPORT-BEZEL	28480	08757-40003
22				SCREW-MACHINE-SEE FIGURE 10		
23	5060-9436	7	1	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436

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

Figure 4. Front Panel (3 of 4)

www.valuetronics.com

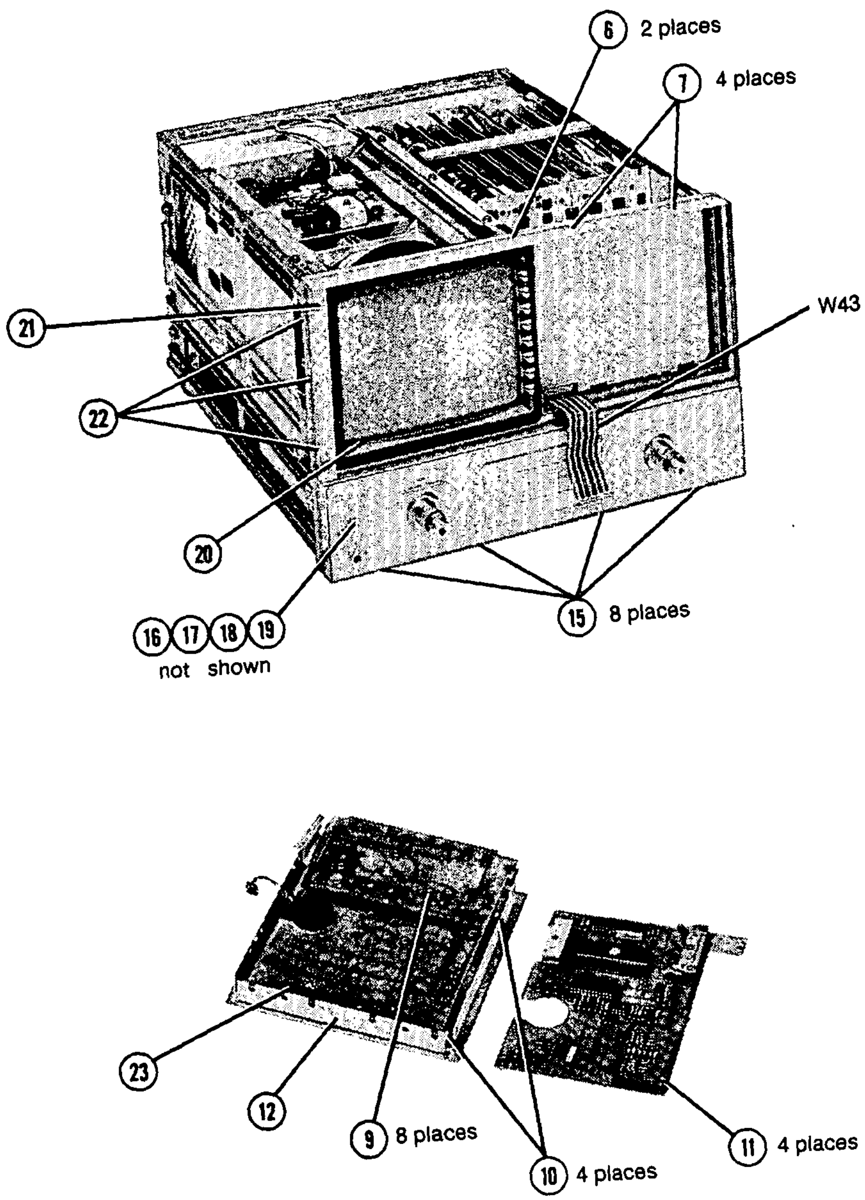
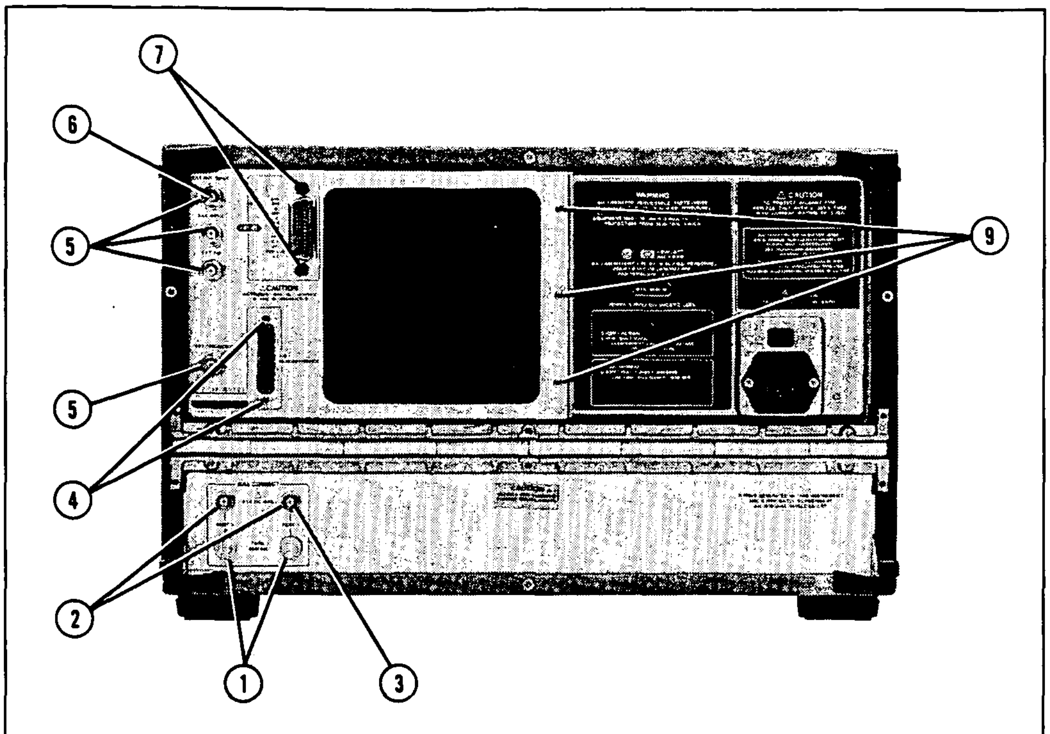


Figure 4. Front Panel (4 of 4)

www.valuetronics.com



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15F1				FUSE - SEE FIGURE 2		
A16				REAR PANEL BOARD ASSEMBLY - SEE FIGURE 2		
1	1400-0110	4	2	FUSEHOLDER-BIPIN SKT 5A 125 V	28480	1400-0110
	1400-0112	6	2	FUSEHOLDER CAP FOR USE WITH H-P P/N	28480	1400-0112
	2110-0046	1	2	FUSE .5A 125V NTD .25X.27	28480	2110-0046
	2190-0016	3	2	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
2	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESC.
	1250-0083	1	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
3	0360-1632	0	1	TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
4	1251-2942	7	2	SCREW LOCK KIT-SUBMIN D CONN	28480	1251-2942
5	2190-0102	8	4	WASHER-LK INTL T 15/32 IN .472-IN-ID	28480	2190-0102
	2950-0035	8	4	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESC.
6	*08753-60026*	*8*	*1*	*FLEXIBLE RF CABLE ASSEMBLY - EXT REF*	*28480*	*08753-60026*
7	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
8				SCREW-MACHINE - SEE FIGURES 6 AND 7		
9*	0515-0886	3	3	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0886
10				SCREW-MACHINE - SEE FIGURES 6 AND 7		
11	3150-0484	6	1	AIR FILTER, GUARD, & RETAINER; 4.65 X 4.65	28480	3150-0484
11*	0515-1817	2	4	SCREW-MACH M3.5 X 0.6 20MM-LG	28480	0515-1817
12	08415-00053	6	1	(20A) REAR PANEL	28480	08415-00053
12	08720-00017		1	(19A/20B) REAR PANEL	28480	08415-00053
13	08415-60036	1	1	FAN-TUBE AXIAL (INCLUDES W45 CABLE ASSY)	28480	08415-60036

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

Figure 5. Rear Panel (1 of 2)

www.valuetronics.com

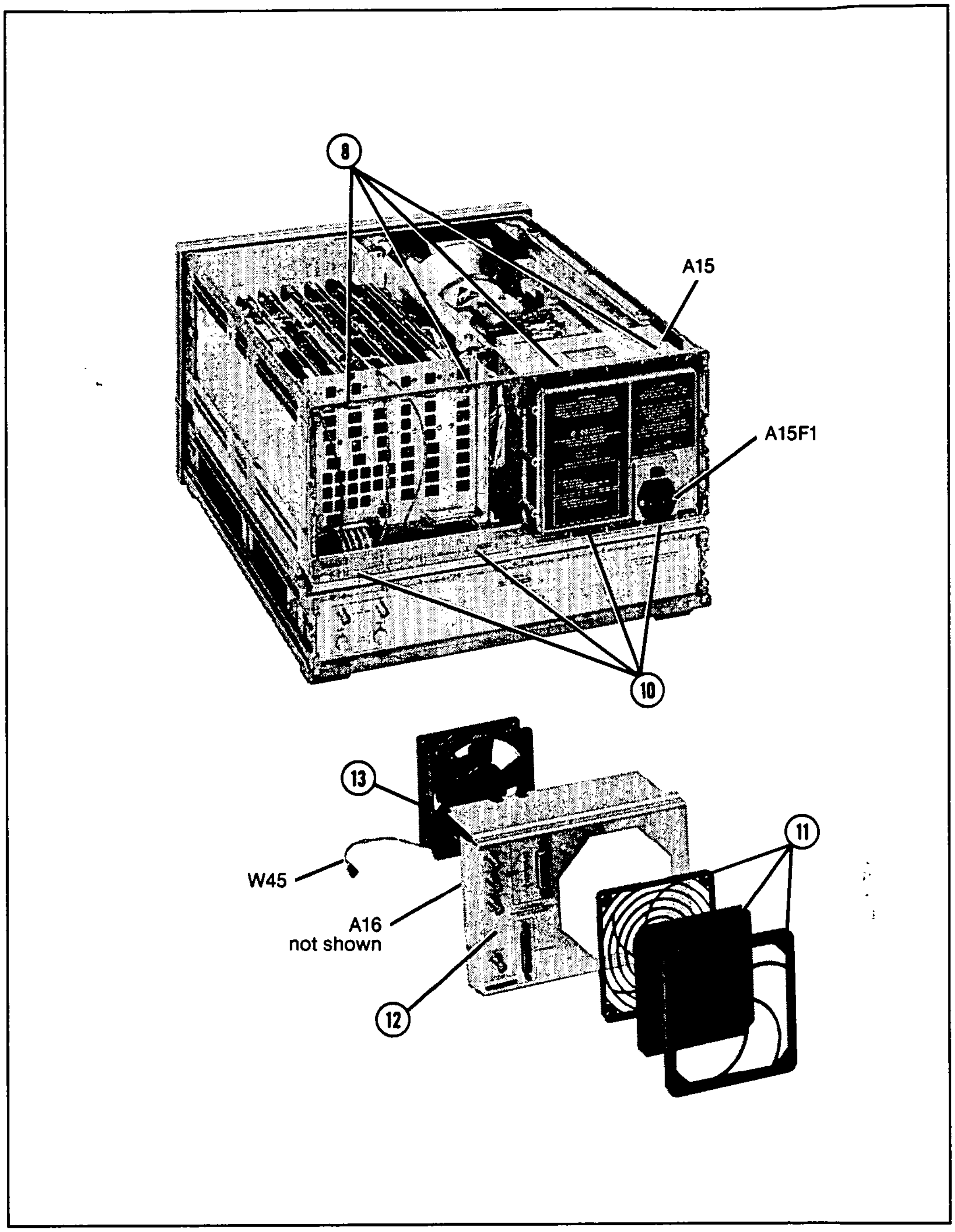


Figure 5. Rear Panel (2 of 2)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8F1				FUSE - SEE FIGURE 2		
A8F2				FUSE - SEE FIGURE 2		
A8F3				FUSE - SEE FIGURE 2		
A8F4				FUSE - SEE FIGURE 2		
A8F5				FUSE - SEE FIGURE 2		
A8F6				FUSE - SEE FIGURE 2		
A8F7				FUSE - SEE FIGURE 2		
A8F8				FUSE - SEE FIGURE 2		
A8F9				FUSE - SEE FIGURE 2		
1*	0515-1114	2	6	(20A) SCREW-MACH M4 X 0.7 10MM-LG PAN-HD	28480	0515-1114
1*	0515-0390	4	3	(19A/20B) 5MM 4 X 0.7 6MM PNTX	28480	0515-0390
2*	3050-0893	9	6	(20A) WASHER-FL MTLC 4.0 MM 4.4-MM-ID	28480	3050-0893
3*	0515-1091	4	6	SCREW-MACHINE ASSY M3.5 X 0.6	00000	ORDER BY DESC.
4*	0515-1236	9	4	SCREW-MACH M3 X 0.5 14MM-LG	28480	0515-1236
5	08753-20062	8	1	STABILIZER CAP	28480	08753-20062
	08753-40005	1	1	PC BD STABILIZER	28480	08753-40005
5*	0515-1105	1	2	SCREW-MACH M3 X 0.5 10MM-LG PAN-HD	28480	0515-1105
5*	3050-0891	7	2	WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891
6	08720-00007	6	1	CAN HOLDDOWN LOCATOR HOLDDOWN (P/O CAN HOLDDOWN)	28480	08720-00007
7	08415-40001	8	1	CAN GUIDE-PLASTIC	28480	08415-40001
8*	0515-1232	5	1	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
9*	0515-1234	7	2	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
10*	0515-1331	5	1	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
11	5181-5525		1	SPRING CLIP 41 X 30 MM	28480	5181-5525

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

Figure 6. Top View of Instrument Top Half (1 of 2)

www.valuetronics.com

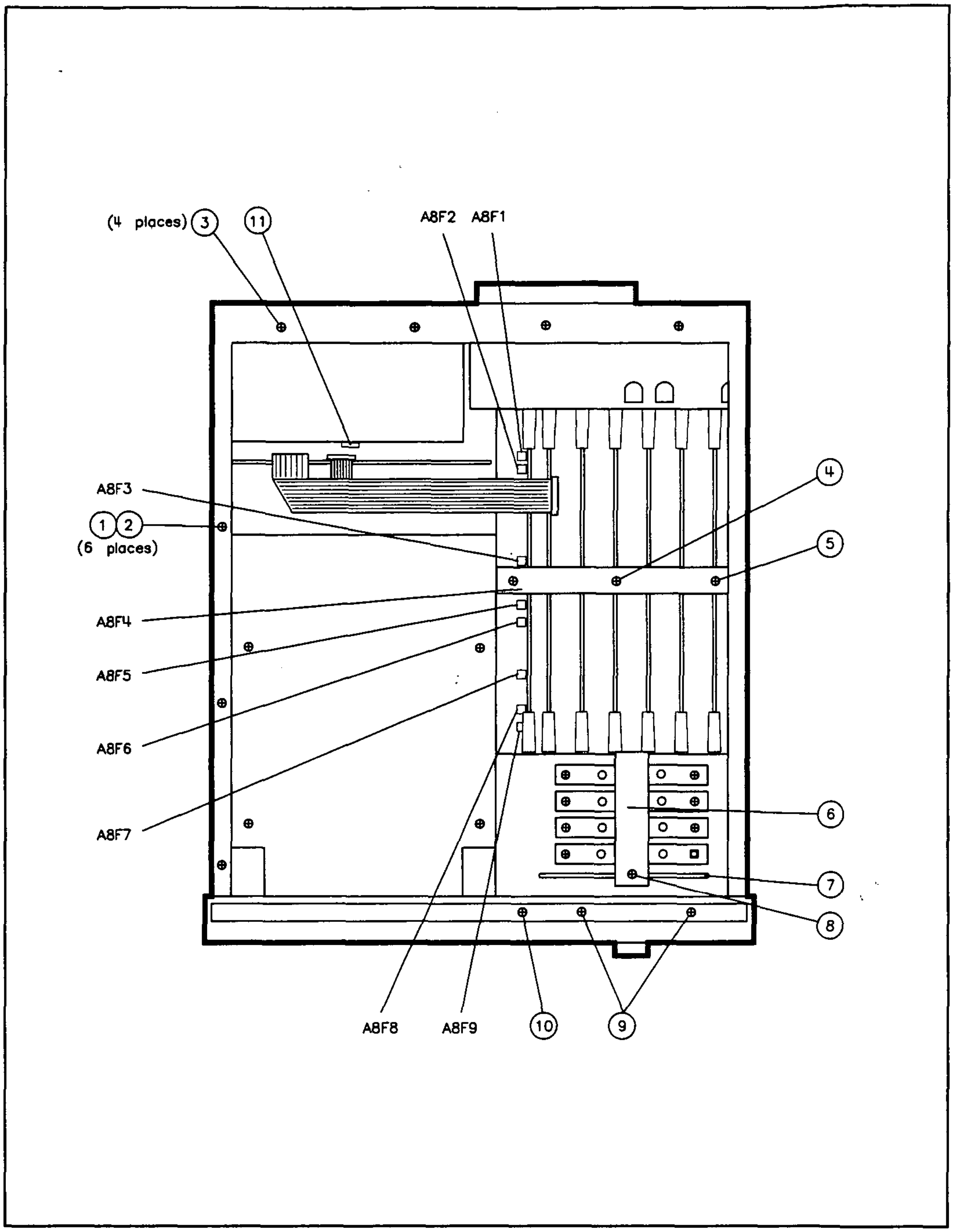


Figure 6. Top View of Instrument Top Half (2 of 2)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17				MOTHERBOARD - SEE FIGURE 2		
W4				(20A) CABLE ASSY-FOCUS/INTENSITY A18/A17J2 SEE FIGURE 3		
W44				(20A) RIBBON CABLE ASSY-A17J4/A18 SEE FIGURE 3		
1*	0515-1234	7	1	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
2	5041-7250	9	3	CABLE CLIP	28480	5041-7250
3*	0515-1091	4	8	SCREW-MACHINE ASSY M3.5 X 0.6	00000	ORDER BY DESC.
4	1390-0681	7	2	FASTENER-SNAP-IN BALL STUD 10 MM BALL	55787	A9012
4*	2190-0669	2	2	WASHER-LK HLCL 8.0 MM 8.1-MM-ID	28480	2190-0669
5*	0515-1114	2	6	SCREW-MACH M4 X 0.7 10MM-LG PAN-HD	28480	0515-1114
6*	3050-0893	9	6	WASHER-FL MTLC 4.0 MM 4.4-MM-ID	28480	3050-0893
7	08753-20046	8	2	INSULATION-CABLE	28480	08753-20046
8*	0515-1331	5	1	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
9				HINGE HALF - SEE FIGURE 8		

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

Figure 7. Bottom View of Instrument Top Half (1 of 2)

www.valuetronics.com

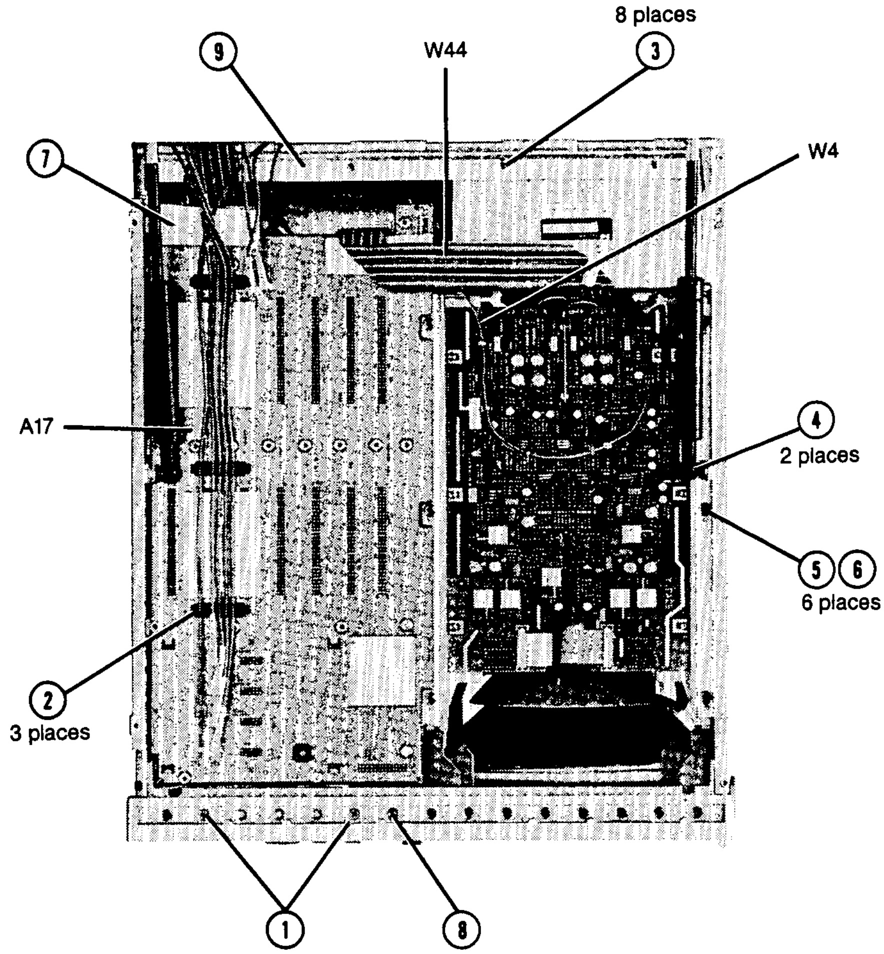


Figure 7. Bottom View of Instrument Top Half (2 of 2)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08720-20022	1	2	HINGE HALF	28480	08720-20022
	08720-20027	6	1	HINGE PIN	28480	08720-20027
2*	0515-1232	5	27	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
3*	0515-1642	1	2	SCREW-MACH M3 X 0.5 40MM-LG PAN-HD	28480	0515-1642
4	08415-00059	2	2	MOUNTING BRACKET - S1/S2/S3	28480	08415-00059
5	08415-20060	7	1	HEATSINK	28480	08415-20060
6	2360-0117	6	8	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.
	3050-0227	3	5	WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
7	08415-00063	8	1	REAR DECK	28480	08415-00063
8	08415-00060	5	1	MOUNTING BRACKET - A57	28480	08415-00060
9	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.
10	2360-0242	8	2	SCREW-MACH 6-32 1.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.
11	0360-0268	6	1	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0268
12*	0515-0887	4	12	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	28480	0515-0887
13	08415-00054	7	1	DECK-FRONT	28480	08415-00054
14	08415-00065	0	1	BRACKET-W23	28480	08415-00065
15	1400-0053	4	1	CLMP-CA .187-DIA .375-WD NYL	28480	1400-0053
16	08720-00062	7	1	MOUNTING BRACKET-S4/A60/A61	28480	08720-00062
17	08720-00056	9	1	MOUNTING BRACKET-A62/A63	28480	08720-00056
18*	0535-0008	1	3	NUT-HEX DBL-CHAM M4 X 0.7 3.2MM-THK	00000	ORDER BY DESC.
*	2190-0586	2	3	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
19	2510-0043	6	4	SCREW-MACH 8-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.
20*	0515-1112	0	6	SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	28480	0515-1112
21*	0515-1110	8	4	SCREW-MACH M3 X 0.5 12MM-LG PAN-HD	28480	0515-1110
22*	0515-0885	2	4	SCREW-MACH M4 X 0.7 8MM-LG PAN-HD	28480	0515-0885
23				SCREW-MACHINE - SEE FIGURE 8		
24	08415-20064	1	4	PC BD GUIDE	28480	08415-20064
25	08415-00061	6	2	BRACKET-GAS SPRING BALL	28480	08415-00061
	1530-0387	2	2	GAS SPRING	55787	FE11E-327293-P1-40
	2190-0669	2	2	WASHER-LK HLCL 8.0 MM 8.1-MM-ID	28480	2190-0669
26*	0515-1234	7	4	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
27*	0515-1091	4	4	SCREW-MACHINE ASSY M3.5 X 0.6	00000	ORDER BY DESC.
28	08720-20023	2	2	ALIGNMENT ARM	28480	08720-20023
	0515-1114	2	2	SCREW-MACH M4 X 0.7 10MM-LG PAN-HD	28480	0515-1114

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

Figure 8. Top View of Instrument Bottom Half (1 of 2)

www.valuetronics.com

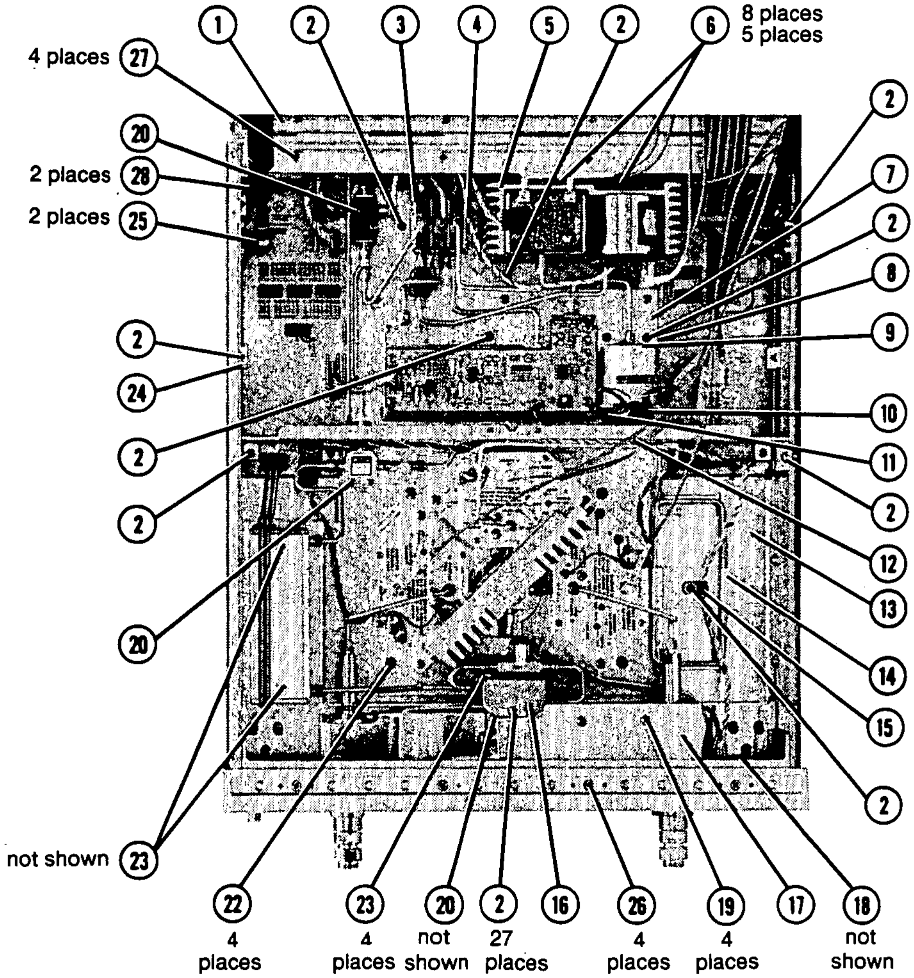
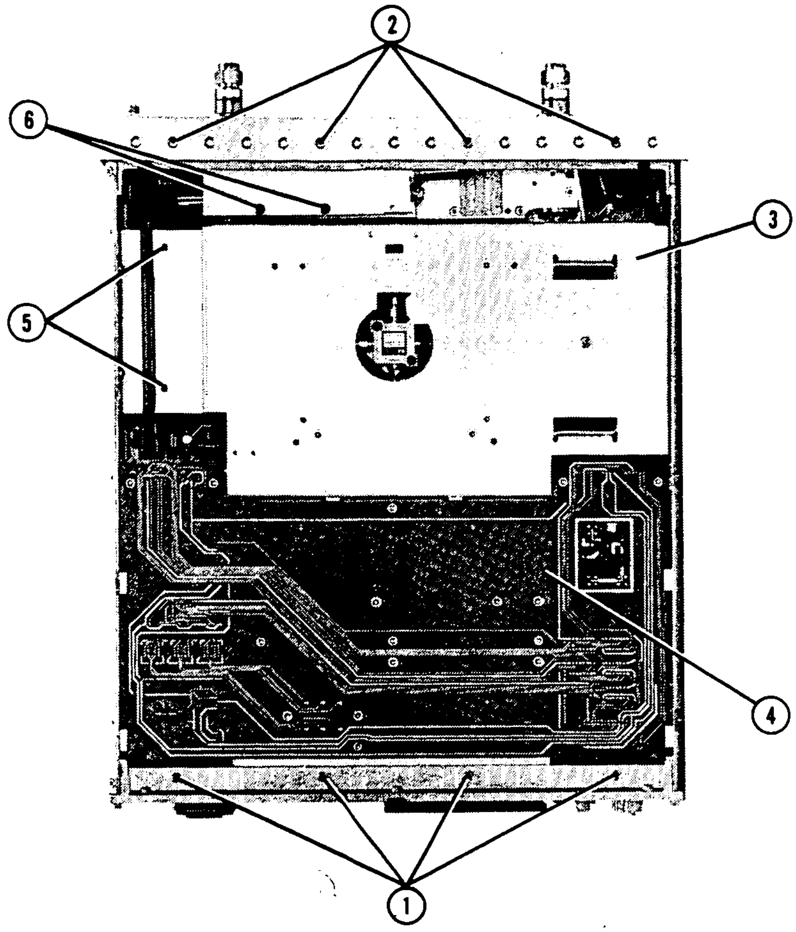


Figure 8. Top View of Instrument Bottom Half (2 of 2)

www.valuetronics.com

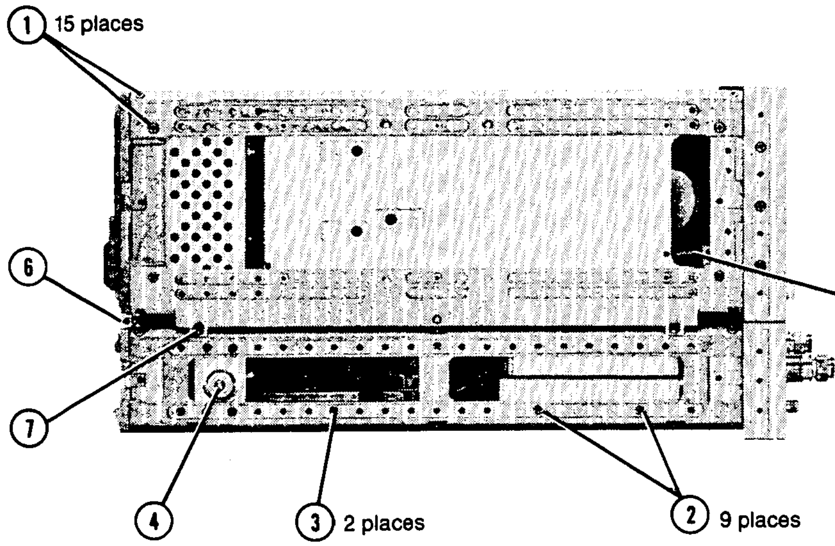


Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1091	4	4	SCREW-MACHINE ASSY M3.5 X 0.6	00000	ORDER BY DESC.
2*	0515-1234	7	4	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
3	08415-00054	7	1	DECK-FRONT	28480	08415-00054
4				A51 INTERFACE-SEE FIGURE 2		
5	2200-0105	4	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.
6	2510-0043	6	2	SCREW-MACH 8-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESC.

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

Figure 9. Bottom View of Instrument Bottom Half

www.valuetronics.com



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1331	5	15	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
2*	0515-1232	5	13	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
3*	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
	08415-20064		4	SUPPORT-PC BOARD	28480	08415-20064
4*	2190-0669		2	WASHER-LK HLCL 8.0 MM 8.1 MM-ID	28480	2190-0669
	08415-00061	6	2	BRACKET-GAS SPRING BALL	28480	08415-00061
	1390-0661	7	2	FASTENER-SNAP-IN BALL STUD 10 MM BALL	55787	A9012
5				SPRING .138 OD - SEE FIGURE 4		
6				HINGE PIN - SEE FIGURE 8		
7	0515-1499	6	4	SCREW-MACH M3.5 X 0.6 4MM-LG PAN-HD	28480	0515-1499

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

Figure 10. Side View (1 of 3)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	0515-1331	5	15	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
2*	0515-1232	5	13	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
3*	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
	08415-20064		4	SUPPORT-PC BOARD	28480	08415-20064
4*	2190-0669		2	WASHER-LK HLCL 8.0 MM 8.1 MM-ID	28480	2190-0669
	08415-00061	6	2	BRACKET-GAS SPRING BALL	28480	08415-00061
	1390-0661	7	2	FASTENER-SNAP-IN BALL STUD 10 MM BALL	55787	A9012

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

Figure 10. Side View (2 of 3)

www.valuetronics.com

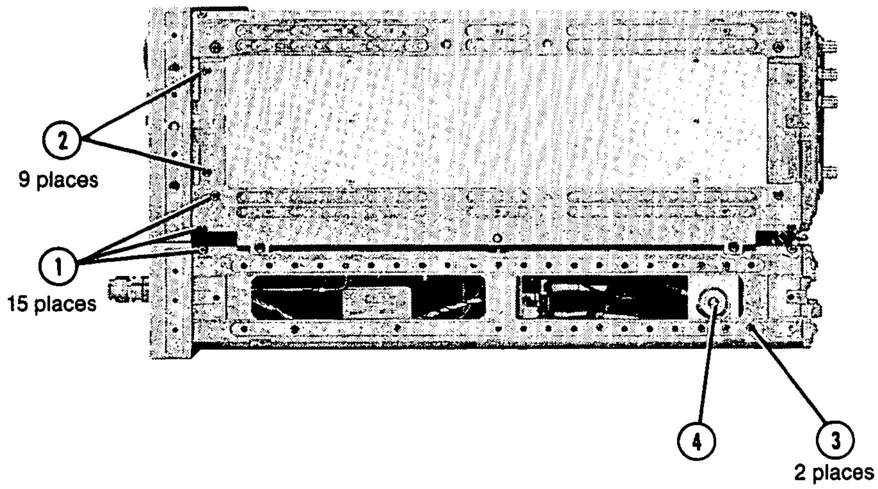


Figure 10. Side View (3 of 3)

www.valuetronics.com

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	5062-3735	1	1	COVER-TOP (47)*	28480	5062-3735
2	5021-5806	5	1	REAR FRAME-UPPER	28480	5021-5806
3	5021-5802	1	1	REAR FRAME-LOWER	28480	5021-5802
4	08720-00015	0	1	COVER-RIGHT SIDE (47)*	28480	08720-00015
4	08720-00016	1	1	COVER-LEFT SIDE (47)*	28480	08720-00016
5	5062-3992	2	1	FRONT HANDLE KIT (46)*	28480	5061-9692
	0515-1132	4	12	HANDLE SCREWS	28480	0515-1132
6	1460-1345	5	2	TILT STAND	28480	1460-1345
7	5041-8801	8	4	FOOT-BOTTOM	28480	5041-8801
8	5062-3747	5	1	COVER-BOTTOM (47)*	28480	5062-3747
9	5041-8802	9	1	TRIM TOP	28480	5041-8802
10	5021-8401	2	1	FRONT FRAME-LOWER (46)*	28480	5021-8401
11	5021-8405	6	1	FRONT FRAME-UPPER (46)*	28480	5021-8405
12	5021-5837	2	2	SIDE STRUT-UPPER TOP CORNER	28480	5021-5837
13	5021-5961	3	2	SIDE STRUT-UPPER BOTTOM CORNER	28480	5021-5961
14	5021-5887	2	2	SIDE STRUT-LOWER	28480	5021-5887
15	5041-8821	2	4	REAR PANEL STANDOFF	28480	5041-8821
16	5062-3992	3		FRONT HANDLE REPLACEMENT (46)*	28480	5062-3992
17	5021-8499	8		HANDLE TRIM STRIP	28480	5021-8499
				TOUCH-UP PAINT		
46	6010-1146	6		DOVE GRAY	28480	6010-1146
47	6010-1147	7		FRENCH GRAY	28480	6010-1147
48	6010-1148	8		PARCHMENT	28480	6010-1148
50	6010-1150	2		COBBLESTONE	28480	6010-1150

*The numbers in parenthesis in the descriptions refer to the matching touch-up paint.

Figure 11. Chassis Parts and Touch-up Paint (1 of 2)

www.valuetronics.com

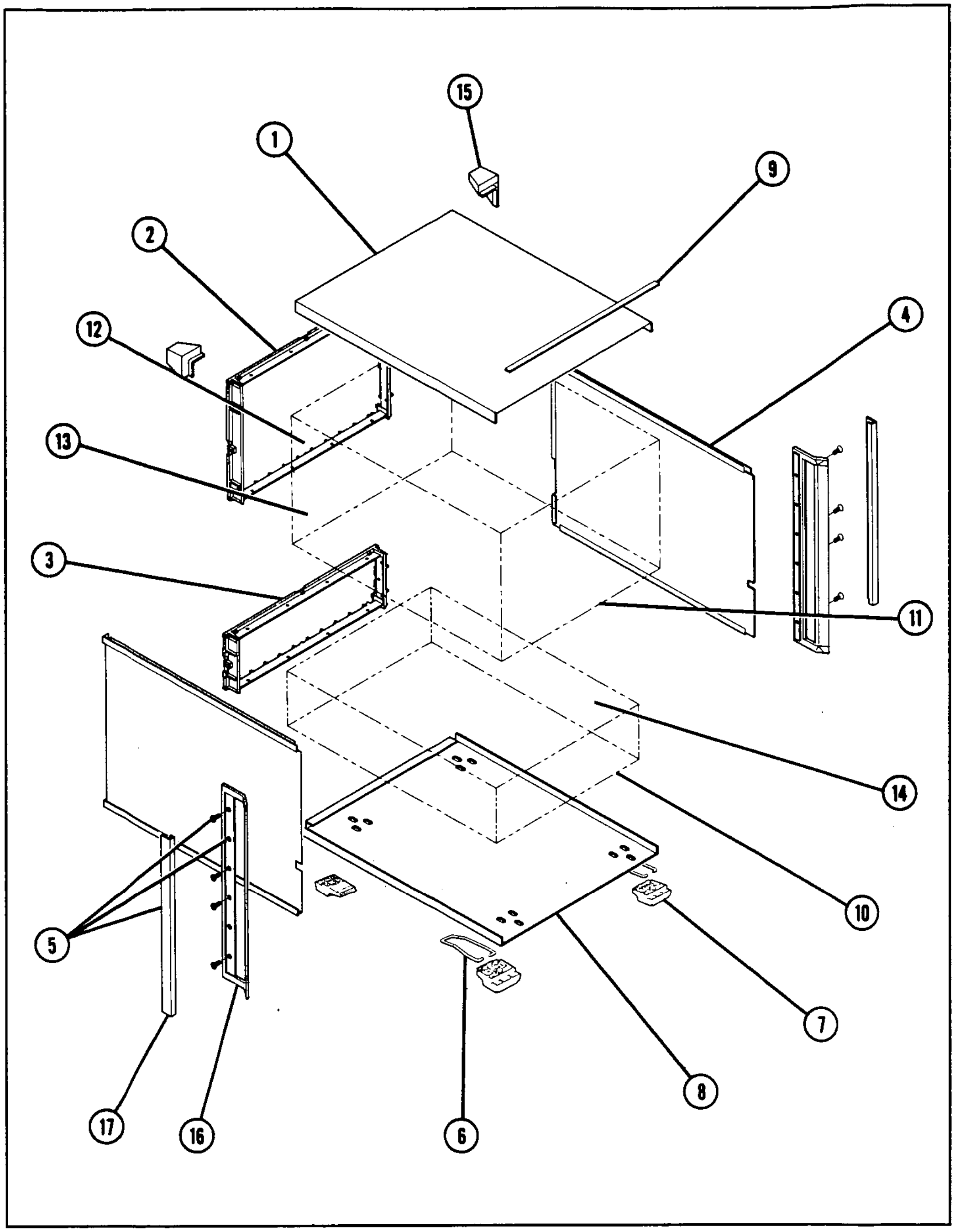
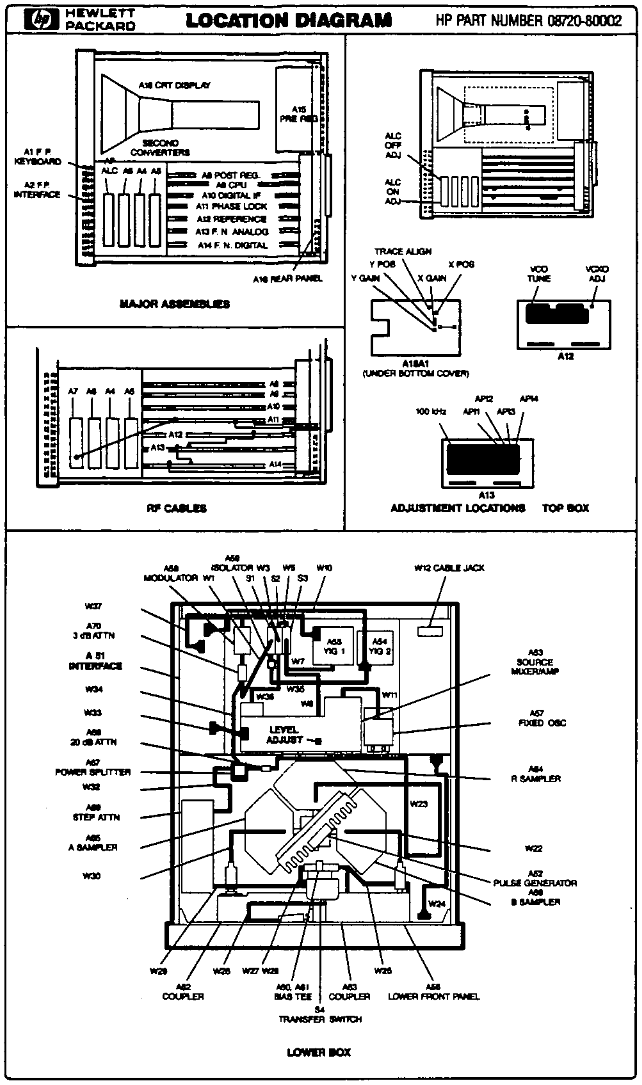


Figure 11. Chassis Parts and Touch-Up Paint (2 of 2)

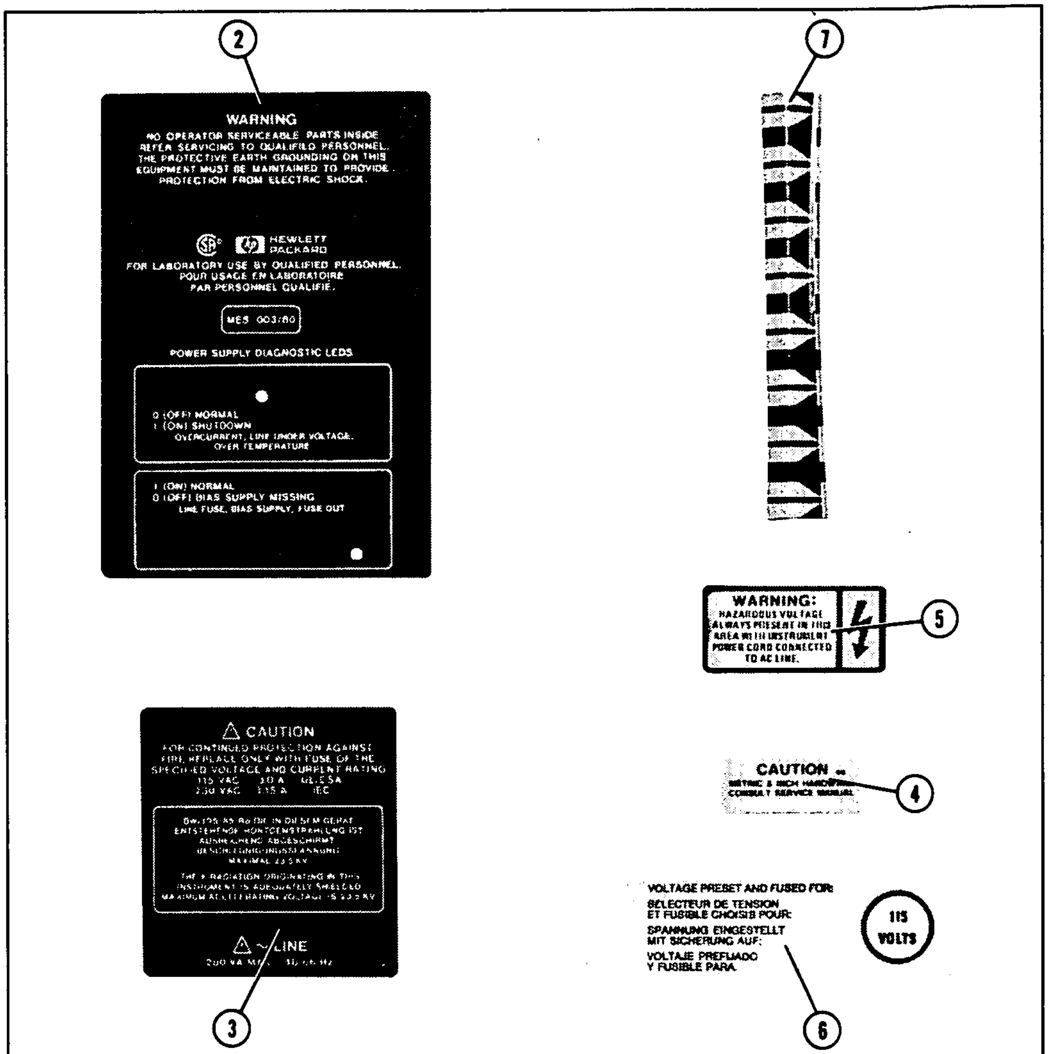
www.valuetronics.com



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	08720-80011	4	1	(19A/20B) LABEL - LOCATION DIAGRAM	28480	08720-80002
1	08719-80002	3	1	(20A) LABEL - LOCATION DIAGRAM	28480	08720-80011

Figure 12. Replaceable Labels (1 of 2)

www.valuetronics.com



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
2	08753-80002	2	1	(20A) LABEL-LED OPERATION WARNING	28480	08753-80002
2	08753-80074	8	1	(19A/20B) LABEL-LED OPERATION WARNING	28480	08753-80074
3	08753-80001	1	1	(20A) LABEL-CAUTION FUSE RATING	28480	08753-80001
3	08753-80080	6	1	(19A/20B) LABEL-LED OP. WARNING	28480	08753-80080
4	7121-2527	5	1	LABEL-METRIC HARDWARE CAUTION	28480	7121-2527
5	7120-4295	6	1	LABEL-HAZARDOUS VOLTAGE WARNING	28480	7120-4295
6	7120-6999	1	1	LABEL-LINE VOLTAGE SELECTOR SWITCH	28480	7120-6999
7	08753-80005	5	1	(20A) LABEL-PARALLAX SOFTKEY MENU	28480	08753-80005

Figure 12. Replaceable Labels (2 of 2)

www.valuetronics.com

Table 3. Miscellaneous Replaceable Accessories

HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
			SERVICE TOOLS		
08720-60004	3	1	TOOL KIT	28480	08720-60004
			BD ASSY-EXTENDER FOR 2ND CONVERTERS		
			BOARD ASSEMBLY-EXTENDER		
			ADAPTER SMB (M) SMB (M)		
			ADAPTER BNC (F) TO SMB (F)		
			ADAPTER SMA (F) SMA (F)		
			ADAPTER SMA (M) SMA (M)		
			SMB TEE		
			FUSE .5A 125V		
			FUSE 1A 125V		
			FUSE 2A 125V		
			FUSE 4A 125V		
			FUSE 3.15A 250V		
			CABLE ASSEMBLY-EXTENDER RF		
			CABLE ASSEMBLY-SMA FLEX		
			WRENCH-OPEN ENDED 5.5		
			BAG PLASTIC 12.0 X 15.0D		
			ACCESSORIES		
0955-0446	3	1	BANDPASS FILTER	28480	0955-0446
08515-60003	3	2	ANTI-ROTATION CLAMP, TEST PORT	28480	08515-60003
8710-1764	0	1	TORQUE WRENCH 20MM 8IN-LB	28480	8710-1764
			SOFTWARE		
08720-10002	6		AUTOMATED ADJUSTMENTS DISK	28480	08720-10002
08720-20003	8	1	HP 8719A/20B EXAMPLE PROGRAMS DISK	28480	08720-20003
08720-10001	5	1	HP 8720A EXAMPLE PROGRAMS DISK	28480	08720-10001
			DOCUMENTATION		
08720-90105	8	1	HP 8719A/20B COMPLETE MANUAL SET	28480	08720-90105
08720-90106	9		HP 8719A/20B MANUAL SET MICROFICHE	28480	08720-90105
08720-90107	0		HP 8719A/20B OPERATING MANUAL	28480	08720-90107
08720-90108	1		HP 8719A/20B SERVICE MANUAL	28480	08720-90108
08720-90109	2		HP 8719A/20B USER'S GUIDE	28480	08720-90109
08720-90110	5		HP 8719A/20B QUICK REFERENCE	28480	08720-90110
08720-90001	3	1	HP 8720A COMPLETE MANUAL SET	28480	08720-90001
08720-90002	4		HP 8720A OPERATING & PROGRAMMING MANUAL	28480	08720-90002
08720-90003	5		HP 8720A ON-SITE SYSTEM SERVICE MANUAL	28480	08720-90003
08720-90022	8	1	HP 8720A CHANGE SUPPLEMENT	28480	08720-90022
08720-90008	0		HP 8720A USER'S GUIDE	28480	08720-90008
08720-90010	4		HP 8720A QUICK OPERATING GUIDE	28480	08720-90010
08720-90013	7		HP 8720A INTRODUCTORY PROGRAMMING GUIDE	28480	08720-90013
08720-90014	8		HP 8720A QUICK REFERENCE GUIDE	28480	08720-90014
08510-90064	4		CONNECTOR CARE MANUAL	28480	08510-90064
5954-1566	3		AN326 PRINCIPLES OF MICROWAVE CONNECTOR CARE	28480	5954-1566
85052-90038	9		HP 85052B/D 3.5MM CALIBRATION KIT MANUAL	28480	85052-90038
85053-90013	1		HP 85053B 3.5 MM VERIFICATION KIT MANUAL	28480	85053-90013
85130-90012	4		HP 85130D 3.5 MM SPECIAL ADAPTER SET MANUAL	28480	85130-90012
85043-90009	3		HP 85043B SYSTEM RACK MANUAL	28480	85043-90009
85050-90022	9		HP 85050B/D 7MM CALIBRATION KIT MANUAL	28480	85050-90022
85051-90016	2		HP 85051B 7MM VERIFICATION KIT MANUAL	28480	85051-90016
85130-90006	6		HP 85130B 7MM SPECIAL ADAPTER SET MANUAL	28480	85130-90006
85054-90013	2		HP 85054B TYPE-N CALIBRATION KIT MANUAL	28480	85054-90013
85055-90001	9		HP 85055A TYPE-N VERIFICATION KIT MANUAL	28480	85055-90001
85130-90010	2		HP 85130C TYPE-N SPECIAL ADAPTER SET MANUAL	28480	85130-90010
85131-90007	8		HP 85131C/D 3.5MM TEST PORT CABLE MANUAL	28480	85131-90007
85131-90009	0		HP 85131E/F 3.5MM TEST PORT CABLE MANUAL	28480	85131-90009
85132-90008	0		HP 85132C/D 3.5MM TEST PORT CABLE MANUAL	28480	85132-90008
85132-90010	4		HP 85132E/F 3.5MM TEST PORT CABLE MANUAL	28480	85132-90010
			UPGRADE KITS		
08720-60024			(19A/20A/20B) OPTION 003 UPGRADE KIT: EXTENDED DYNAMIC RANGE	28480	08720-60024

www.valuetronics.com

INTRODUCTION

This section contains procedures for removing the following assemblies:

- A1/A2 front panel and rotary pulse generator
- A18 display
- A16 rear panel and A15 preregulator
- A64/A65/A66 samplers
- J1/J2 test port connectors, A62/A63 directional couplers, and A56 lower front panel
- A60/A61 bias tees and S4 transfer switch
- A69 step attenuator
- A51 interface
- A53 mixer/amplifier
- A55 YIG 1 and A54 YIG 2
- S1/S2/S3 microwave switches

ADJUSTMENTS AND PERFORMANCE TESTS

When an assembly is replaced adjustment(s) and/or performance tests may be necessary to assure the analyzer meets its published specifications. Refer to the *Post-Repair Procedures* section of this manual for the specific adjustments and performance tests to be performed.

COVER REMOVAL

Many of the disassembly procedures in this section require the top portion of the instrument to be pivoted open or the covers to be removed. Details on how to remove the instrument covers and hardware to pivot open the analyzer are located on the tab labeled *Replacement Procedures*.

www.valuetronics.com

CAUTION

This product contains static-sensitive components. When handling these components or assemblies, work on an anti-static surface and use a static grounding bracelet.

WARNING

DISCONNECT THE AC POWER CORD FOR ALL DISASSEMBLY PROCEDURES! With the AC power cable connected to the instrument, the AC line voltage is present on the terminals of the line power module on the rear panel, and the LINE power switch, whether the switch is ON or OFF. The AC line voltage on these terminals can, if contacted, produce fatal electrical shock. Be aware that capacitors inside the instrument may remain charged even though the instrument has been disconnected from its AC power source.

www.valuetronics.com

A1/A2 Front Panel and Rotary Pulse Generator Replacement

TOOLS REQUIRED

Small and large Pozidriv screwdrivers
Very small flat edge screwdriver
7/16" open-end wrench
1/16" Allen wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 1.

To Disassemble

1. Remove the handles and side covers. Pivot open the instrument, and remove the three screws from the bottom edge of the frame. (Refer to the tab at the front of this section for details).
2. Remove the bezel's softkey cover (item 1) by sliding your fingernail under the left edge, near the top or bottom of the cover. Pry the softkey cover away from the bezel. If you use another tool, take care not to scratch the glass.
3. Remove the two screws and washers (item 2) exposed by the previous step. The bezel (item 3) is now free from the frame. Remove it.
4. Remove the trim strip from the top edge of the front frame by prying under the strip with a flat screwdriver.
5. Remove four screws: two from the top edge of the frame and two from the bottom edge of the frame (item 4).
6. Disconnect the ribbon cable from the front panel by pressing down and out on the connector locks. The front panel is now free of the instrument.

To Remove the Rotary Pulse Generator (RPG)

7. Disconnect the cable from the A2J5 RPG connection and remove the RPG from the front panel assembly.
8. Loosen the screws in the RPG knob (item 5). Pull the knob off the RPG shaft.
9. Remove the nut and washer from the RPG shaft.

To Reassemble

10. Reverse steps 1 through 9 to reassemble the front panel.

www.valuetronics.com

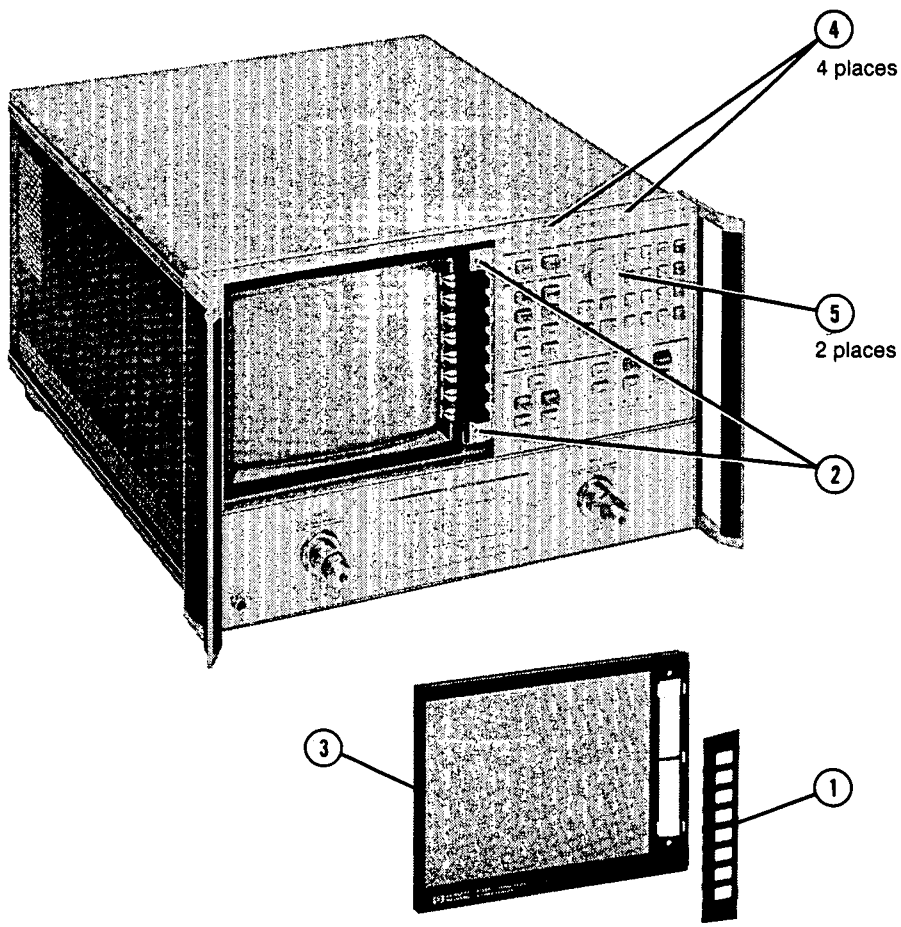


Figure 1

www.valuetronics.com

A18 Display Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
Small flat edge screwdriver
Pliers

PROCEDURE

To Disassemble

The items shown in parentheses refer to the corresponding item numbers in Figure 1.

1. Remove the handles, power cord, and the top and side covers (refer to the tab at the front of this section for details).
2. Remove the bezel's softkey cover (item 1) by sliding your fingernail under the left edge, near the top or bottom of the cover. Pry the softkey cover away from the bezel. If you use another tool, take care not to scratch the glass.
3. Remove the two screws and washers (item 2) exposed by the previous step. The bezel (item 3) is now free from the frame. The bezel is heavy for its size. Carefully remove it.

www.valuetronics.com

A18 Display Replacement

(Refer to Figure 2 for the rest of this procedure.)

HP 8719A/20B:

4. Remove the four screws (item 1) from the top of the display.
5. Disconnect the display power cable assembly (item 2) from A19.
6. Gently slide the display forward and out of the aluminum card cage.

HP 8720A:

4. Remove the six screws and washers from the top guide rails of the display (item 1).
5. Turn the instrument on its right side and remove the left gas spring by first removing the retainer clip with pliers, and then prying off each end of the spring with a flat edge screwdriver.

NOTE: As the instrument is turned on its side the gas springs will force the two halves of the instrument apart from each other.

6. Remove the six screws and washers from the bottom guide rails of the display. Disconnect the 4-wire bundle (not shown) from the focus and intensity jacks on the underside of the display.
7. Return the instrument to the upright position. Disconnect the power supply cable (item 2).
8. Apply fingertip pressure to the rear of the display's frame. Slide the display approximately three inches out of the mainframe to allow access to the large ribbon cable connector located at the rear of the display. Disconnect the ribbon cable.
9. Slide the display completely out of the mainframe.

To Reassemble

10. To install a new display unit, reverse the preceding steps. When reconnecting the 4-wire bundle to the display, note that the yellow/black pair goes to the EXT FOCUS jack; and the blue/black pair goes to the J2 EXT jack.

www.valuetronics.com

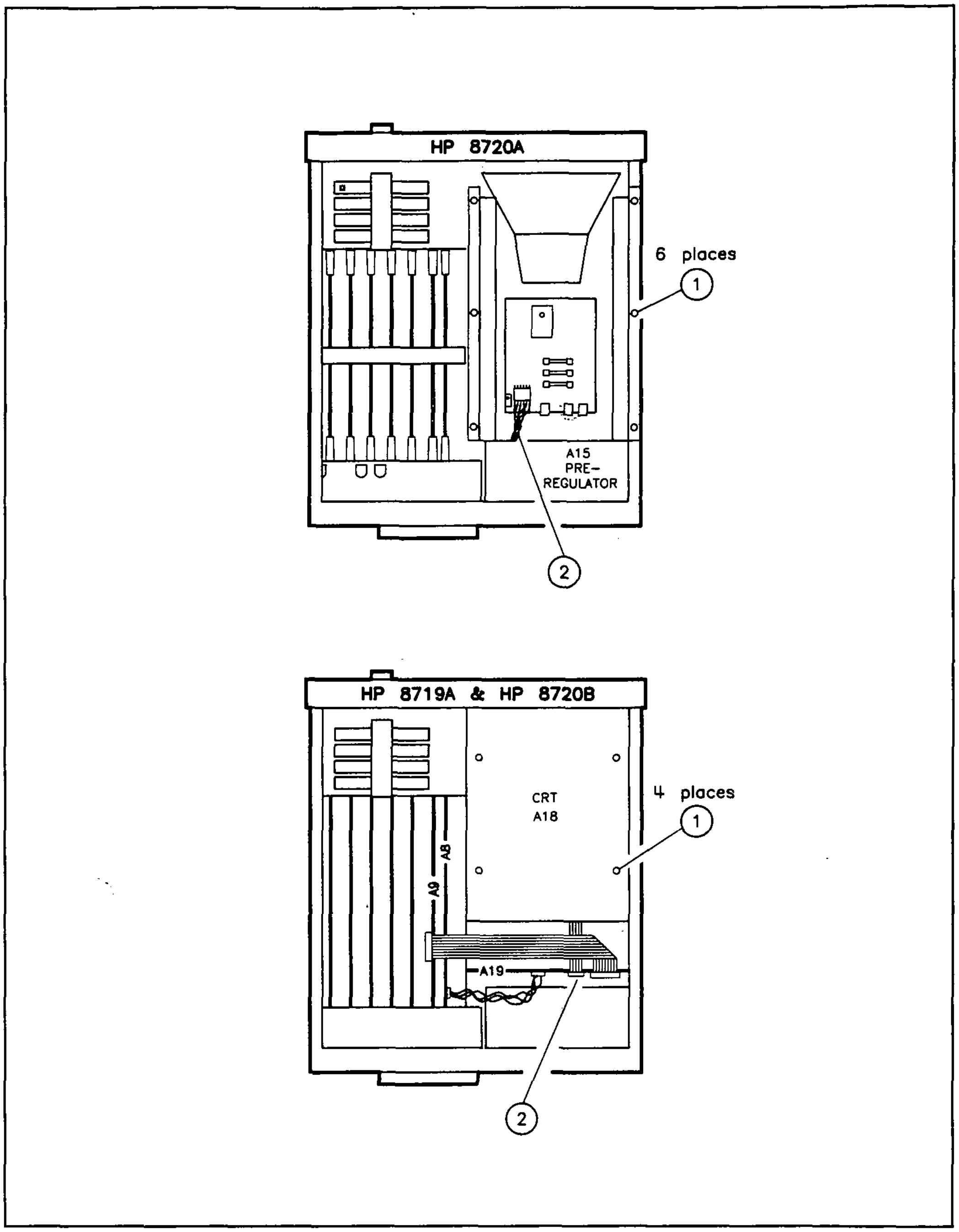


Figure 2

www.valuetronics.com

A16 Rear Panel and A15 Preregulator Replacement

TOOLS REQUIRED

Large and small Pozidriv screwdrivers
Flat edge screwdriver
Pliers
9/32" open-end wrench
3/16" open-end wrench
9/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 3.

To Disassemble

1. Remove the handles, power cord, top and side covers and pivot open the instrument (refer to the tab at the front of this section for details).
2. Disengage the coax cables from the cable clip located on the motherboard (item 1).
3. Disconnect the ribbon cable from the interface board (item 2).
4. Disconnect the coax on the pulse driver labeled A53J1 PULSE DR (item 3).
5. Disconnect the A55J3 YIG 1 MC and A54J3 YIG 2 MC coax cables from the motherboard (item 4).
6. Disconnect the A54J2 YIG 2 FM C from the A54J2 connection (item 5). Also, disconnect the A55J2 YIG 1 FM C from the A55J2 connection (item 6).
7. Using pliers, remove the wire clamps from the two gas springs.
8. Lift the A12 reference assembly from its motherboard connector, and disconnect the EXT REF INPUT coax from A12J3.
9. Turn the instrument on its side.

NOTE: As the instrument is turned on its side, the gas springs will force the two halves of the instrument apart from each other.

10. Remove the gas springs by prying off each end with a flat edge screwdriver.
11. Remove seven screws from the back panel assembly; two from the bottom, three from the back, and two from the top (items 9 and 10).
12. Pull the rear panel assembly away from the frame. Disconnect the HP-IB ribbon cable and the fan cable assembly.

www.valuetronics.com

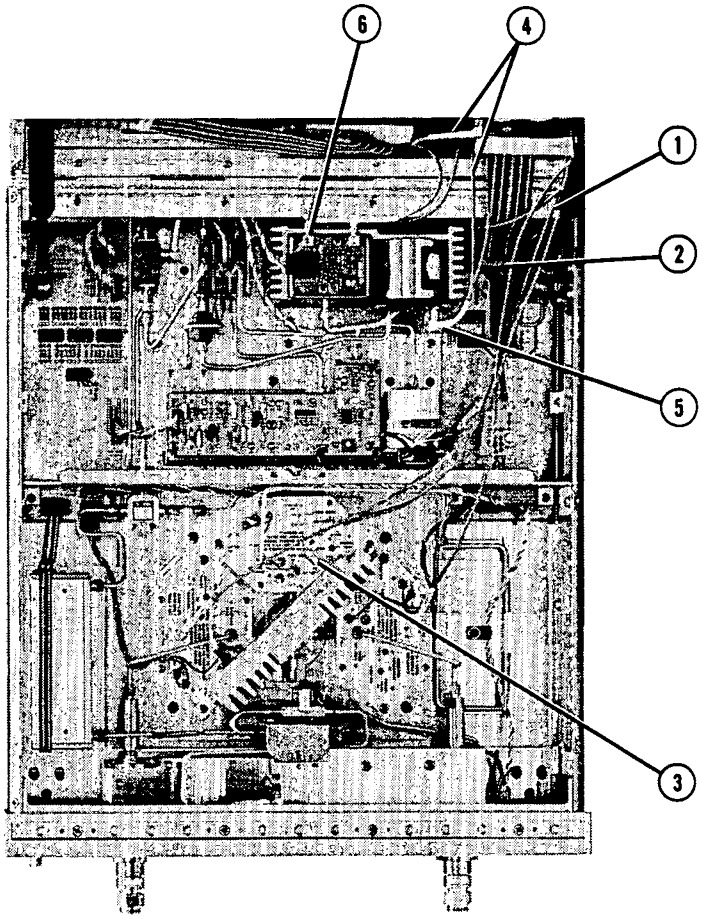


Figure 3 (1 of 2)

www.valuetronics.com

To Remove the A16 Rear Panel Assembly

13. Remove the hex screws (item 7) from the HP-IB connector and the I/O INTERCONNECT.

    HP 8720A: Remove the hex nuts and lock washers from the three BNC connectors (item 8).

    HP 8719A/20B: Disconnect cables W21, W22, and W23 from their SMB connectors on the A19 assembly. Remove the hex nuts and lock washers from the BNC connectors labeled AUX INPUT, EXT AM, and EXT TRIGGER.

To Remove the Preregulator

14. Remove the remaining four screws in the rear frame; two on the top and two on the bottom (items 11 and 12).
15. Disconnect the preregulator ribbon cable from the A8 post-regulator board assembly.
16. Pull the preregulator assembly away from the frame. Disconnect the cable assembly at the J3 preregulator connection to the motherboard.

To Reassemble

17. To install a new preregulator, reverse the above procedure.

www.valuetronics.com

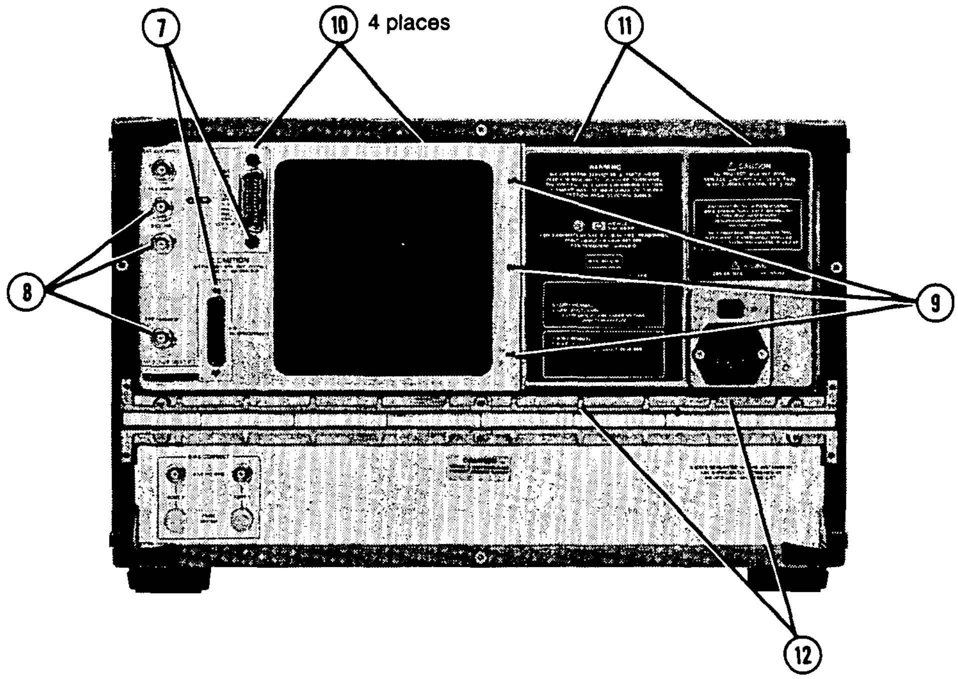


Figure 3 (2 of 2)

www.valuetronics.com

A64/A65/A66 Sampler Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
5/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 4.

To Disassemble

1. Remove the handles, top cover, both side covers, and pivot open the instrument (refer to the tab at the front of this section for details).

To Remove the A or B Sampler

2. Disconnect the J3 IF OUTPUT coax cable (item 1).
3. Remove the COUPLER/J2 RF INPUT semi-rigid cable (item 2).
4. Remove two screws (item 3).
5. Disconnect each sampler to be replaced from the pulse driver at the LO INPUT J1 connection.

To Remove the R Sampler

6. Disconnect the J2 RF INPUT connection (item 4).
7. Disconnect the J3 IF OUTPUT coax cable (item 5).
8. Disconnect the pulse driver cable assembly at the interface board connection (item 6).
9. Disconnect the A52J1 PULSE DRIVE coax cable (item 7).
10. Turn the instrument on a side.

NOTE: As the instrument is turned on its side the gas springs will force the two halves of the instrument apart from each other.

11. Remove the bottom cover (refer to the tab at the front of this section for details).
12. Remove two screws on the pulse driver (item 8) while keeping one hand on the heat sink of the pulse driver assembly.
13. Pull the heat sink portion of the pulse driver straight off the pulse driver assembly.
14. Return the instrument to the upright position.

www.valuetronics.com

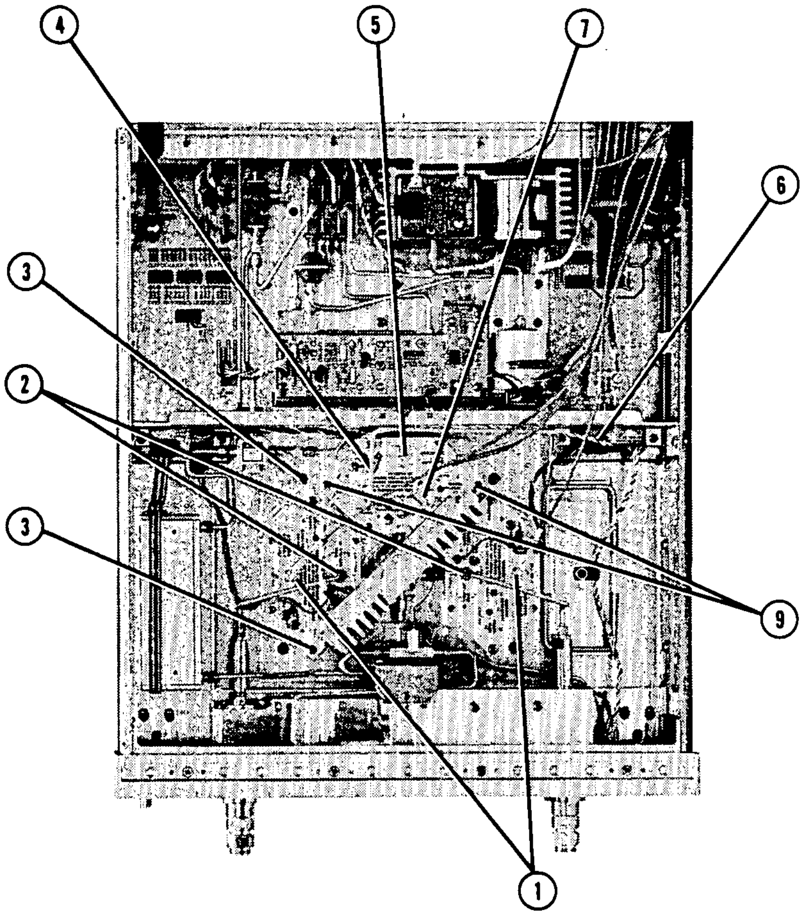


Figure 4 (1 of 2)

www.valuetronics.com

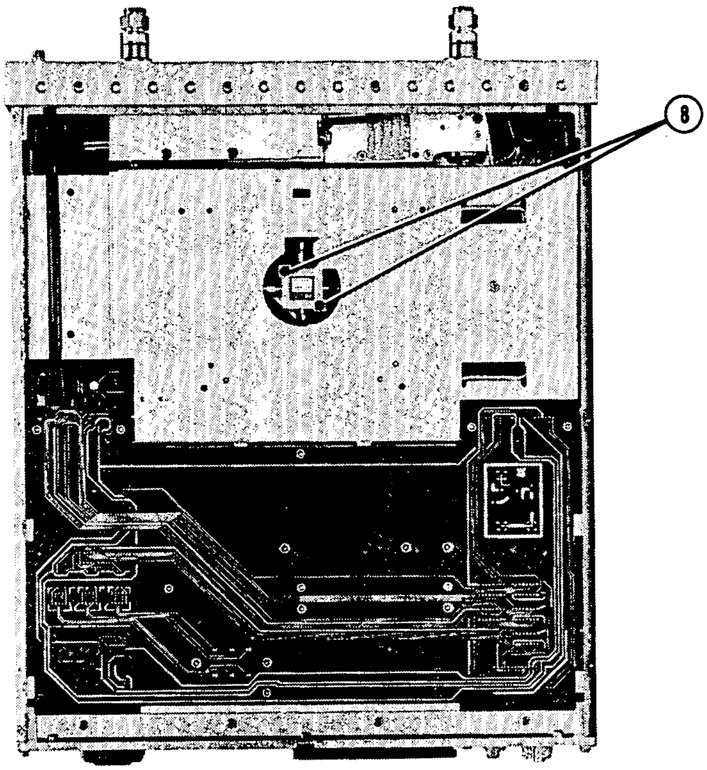


Figure 4 (2 of 2)

www.valuetronics.com

15. Remove two screws from the top side of the sampler (item 9).
16. Disconnect the sampler from the pulse driver at the LO INPUT J1 connection.

To Reassemble

17. Reverse the above procedure to reassemble the unit.

www.valuetronics.com

J1/J2 Test Port Connectors, A62/A63 Directional Couplers, and A56 Lower Front Panel Replacement

TOOLS REQUIRED

Large and small Pozidriv screwdrivers
5/16" open-end wrench
1" open-end wrench
5/8" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 5.

To Remove the Test Port Connectors and Directional Couplers

1. Remove the test port connector at the gold fitting before the test port flange nut.
2. Remove the test port flange nut and the washer underneath (item 1).
3. Remove the side and bottom covers, and pivot open the instrument (refer to the tab at the front of this section).
4. Turn the instrument on its side and remove the PORT 1 coupler/bias tee cable (item 2).
5. Return the instrument to the upright position.
6. Remove one sampler/coupler semi-rigid cable for each port (item 4).
7. Remove the PORT 2 coupler/bias tee semi-rigid cable (item 5).
8. Remove the screw from the top of the bias tee mounting bracket (item 6).
9. Disconnect the two cable assemblies on the front panel board (items 7 and 8).
10. Remove four screws on the top and four screws on the bottom of the front frame (item 9).
11. Pull the front panel assembly free from the frame.
12. Remove the two screws from the bottom side of the PORT 1 coupler bracket. Remove the remaining two screws from the top of the PORT 2 coupler bracket.

To Remove the Front Panel Board

13. Remove the remaining four screws from the front panel board.

www.valuetronics.com

To Reassemble

14. Reverse the above procedure to reassemble the unit.

NOTE: When replacing a test port connector, refer to the *Connector Care* section in the *Operating Manual* for connector gage information.

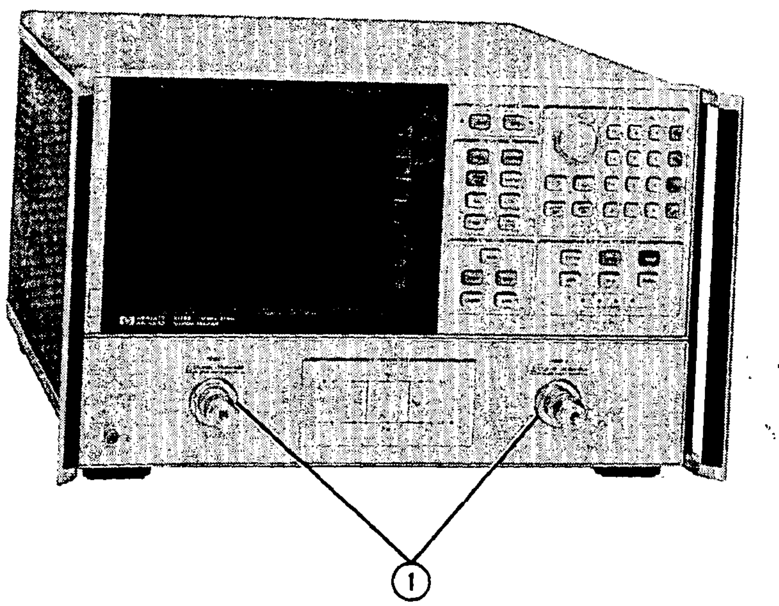


Figure 5 (1 of 3)

www.valuetronics.com

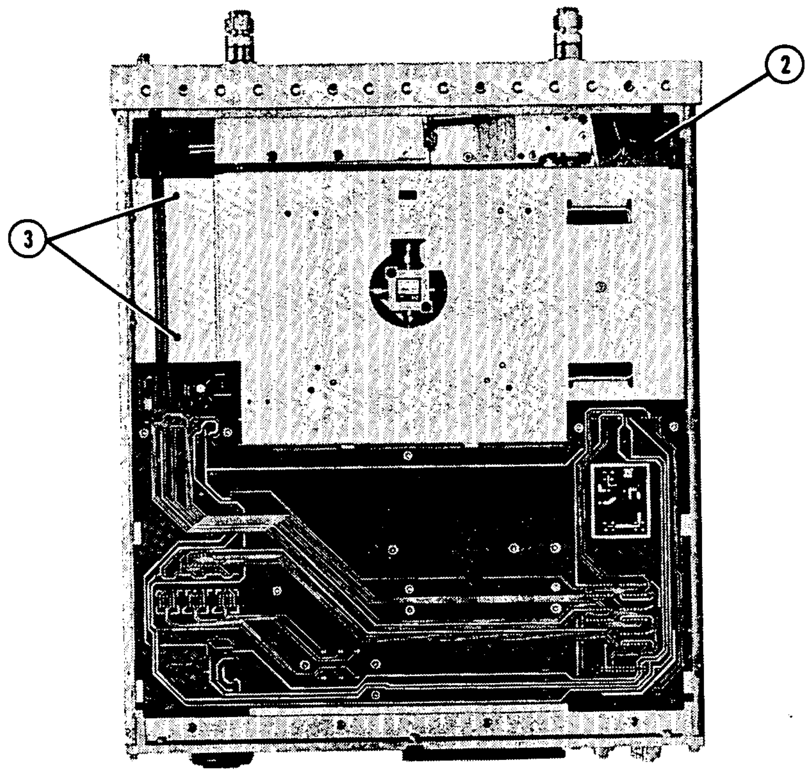


Figure 5 (2 of 3)

www.valuetronics.com

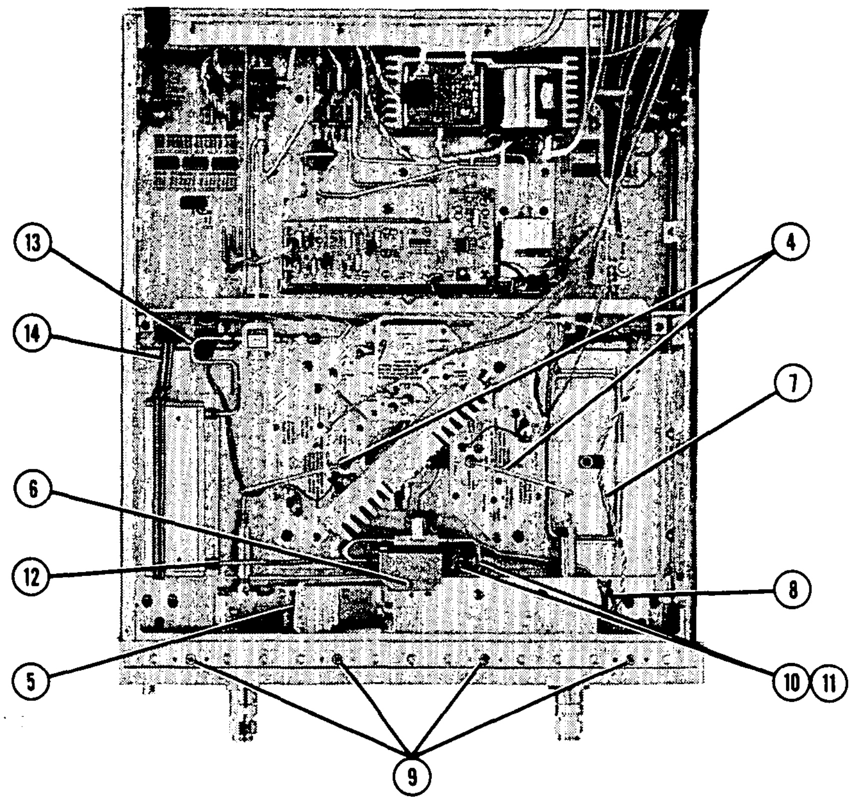


Figure 5 (3 of 3)

www.valuetronics.com

A60/A61 Bias Tees and S4 Transfer Switch Replacement

TOOLS REQUIRED

5/16" open-end wrench
Large and small Pozidriv screwdrivers

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 5.

To Remove the Bias Tees

1. Remove the handles, side covers, and pivot open the instrument (refer to the tab at the front of this section).
2. Disconnect the two bias tee/coupler cables at the bias tee connection (items 10 and 11). Disconnect the step attenuator/transfer switch cable at the attenuator connection (item 12).
3. Disconnect the cable assembly from the lower front panel board (item 8).
4. Remove the screw on the top of the mounting bracket (item 6).
5. Lean the bias tee/transfer switch assembly back towards the rear of the instrument and then slide it towards the front of the instrument to pull it free.

NOTE: One cable and two screws must be removed for each bias tee that is to be removed.

To Remove the Transfer Switch

6. Remove the remaining semi-rigid cable.
7. Remove the two screws that hold the transfer switch to the mounting bracket.

To Reassemble

8. Reverse the above procedure to reassemble the unit.

NOTE: If there is difficulty in reattaching the bias tees to the mounting bracket, remove the transfer switch from the mounting bracket to first attach the bias tees.

www.valuetronics.com

A69 Step Attenuator Replacement

TOOLS

Large Pozidriv screwdriver
Small Pozidriv screwdriver
5/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 5.

To Disassemble

1. Remove the handles, side, and bottom covers and pivot open the instrument (refer to the tab at the front of this section). Turn the instrument on its side.
2. Remove the two screws from the mounting bracket underneath the A69 step attenuator (item 3). Return the instrument to the upright position.
3. Disconnect the two semi-rigid cables at the step attenuator connection: (items 12 and 13).
4. Disconnect the ribbon cable from the interface board (item 14).

To Reassemble

5. Reverse the above procedure to reassemble the unit.

www.valuetronics.com

A51 Interface Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
3/16" open-end wrench
Flat edge screwdriver

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 6.

To Disassemble

1. Remove the side and bottom covers, and pivot open the instrument (refer to the tab at the front of this section).
2. Disconnect the ribbon cable from the rear of the interface board (item 1).
3. Disconnect the cable assembly labeled J17 REAR PANEL (item 2).
4. Disconnect three coax cables from the middle of the interface board labeled:

   A51J18 IF IN (item 3)
   A51J19 ALC OUT (item 4)
   A51J20 IF OUT (item 5).
5. Disconnect three cable assemblies from the front of the interface board labeled:

   J3 BIAS TEES AND TRANSFER SWITCH (item 6)
   J4 PULSE GEN (item 7)
   J15 B SAMPLER (item 8).
6. Disconnect two cable assemblies and one ribbon cable from the front of the interface board that are labeled:

   J16 R SAMPLER (item 9)
   J14 A SAMPLER (item 10)
   J2 ATTENUATOR (item 11).
7. Disconnect three cable assemblies from the rear of the interface board labeled:

   J9 CAVITY OSC (item 12)
   J10 YIG 1 (item 13)
   J11 YIG 2 (item 14).
8. Turn the instrument on the right side.

www.valuetronics.com

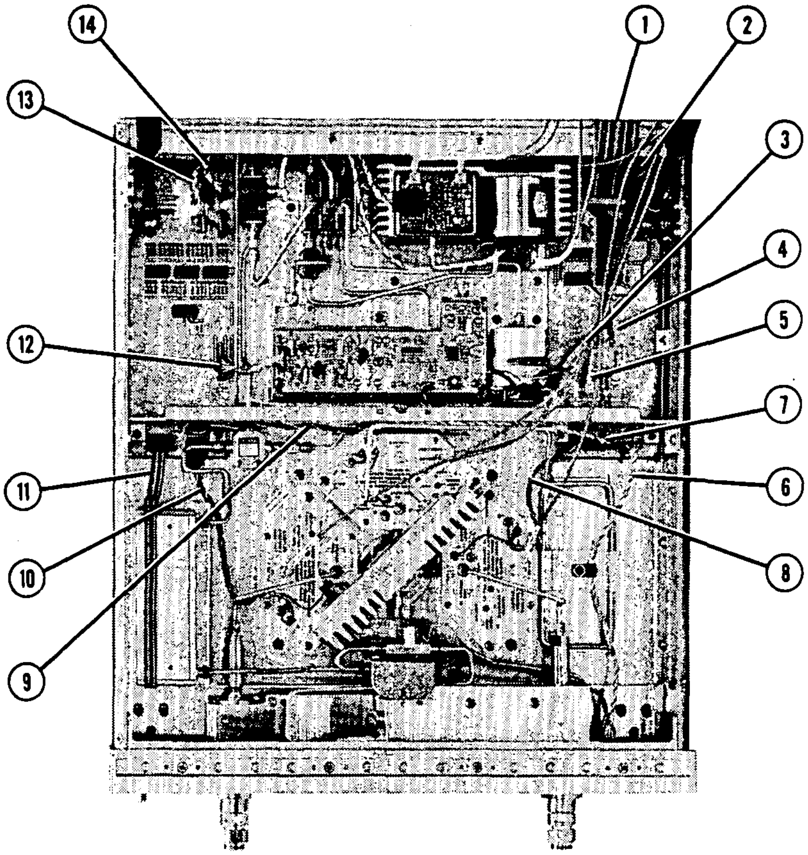


Figure 6 (1 of 4)

www.valuetronics.com

9. Remove the left gas spring. First remove the clamp spring and then pry each end of the gas spring off with a flat edge screwdriver.
10. Remove the nine screws that attach the interface board to the sheet metal of the main deck (item 15).
11. Remove seven screws on the left side strut (item 16). Pull the side strut free from the frame.
12. Pull the interface board straight out from the bottom of the instrument to disconnect the pins from the microswitches.

To Reassemble

13. Set the right side of the interface board into the board guides on the right side strut (item 17).
14. Align the six pins from the microswitch assembly to the sockets on the interface board (item 18).
15. Align the left side of the interface board into the guides on the left side strut.
16. Reverse the above procedure starting with step 12 to reassemble the unit.

www.valuetronics.com

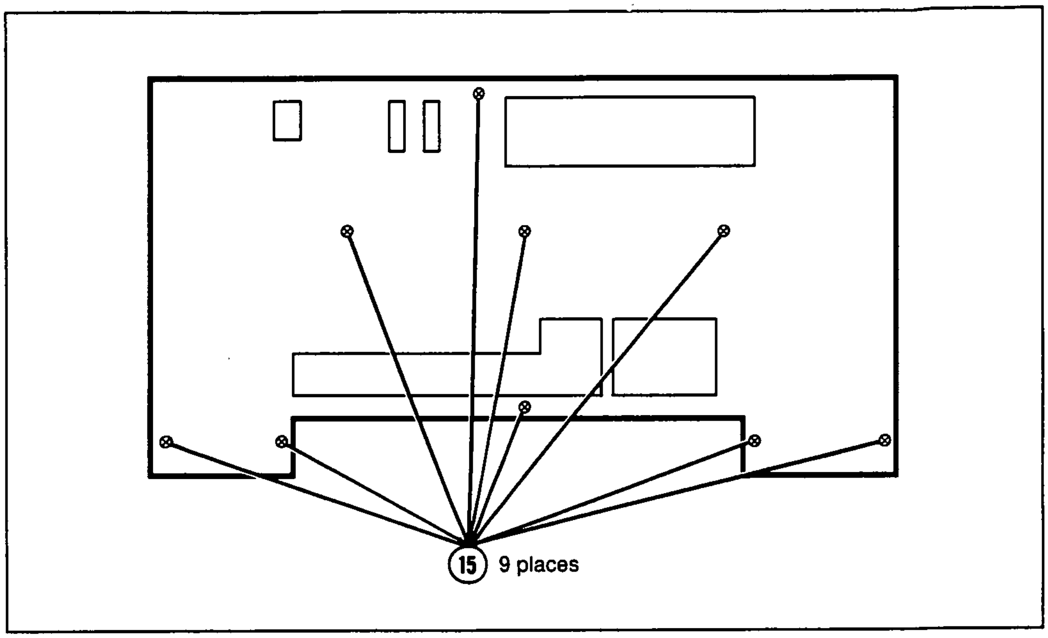


Figure 6 (2 of 4)

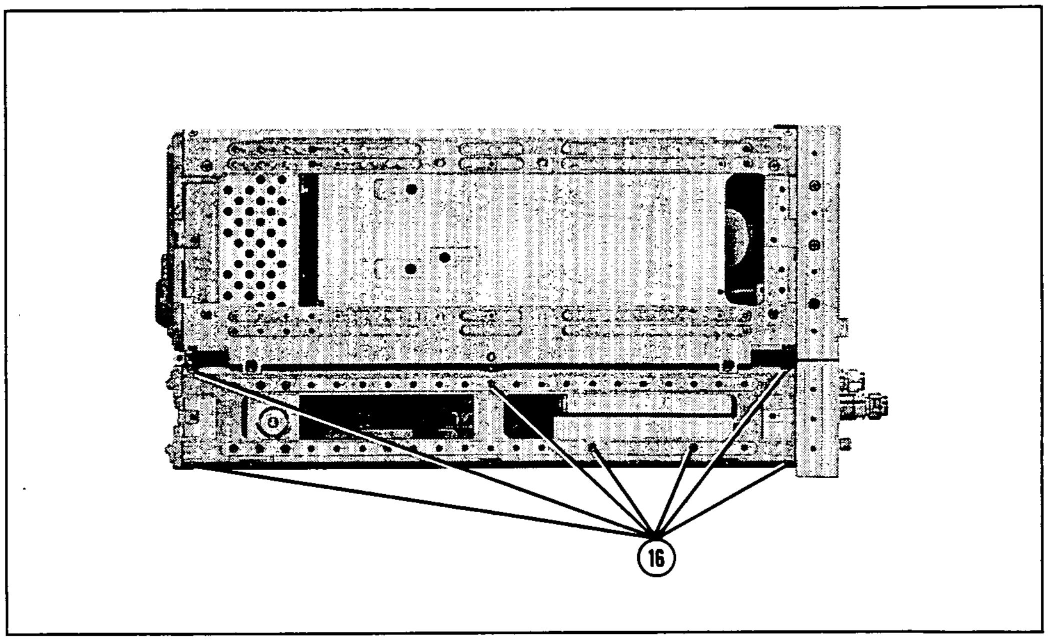


Figure 6 (3 of 4)

www.valuetronics.com

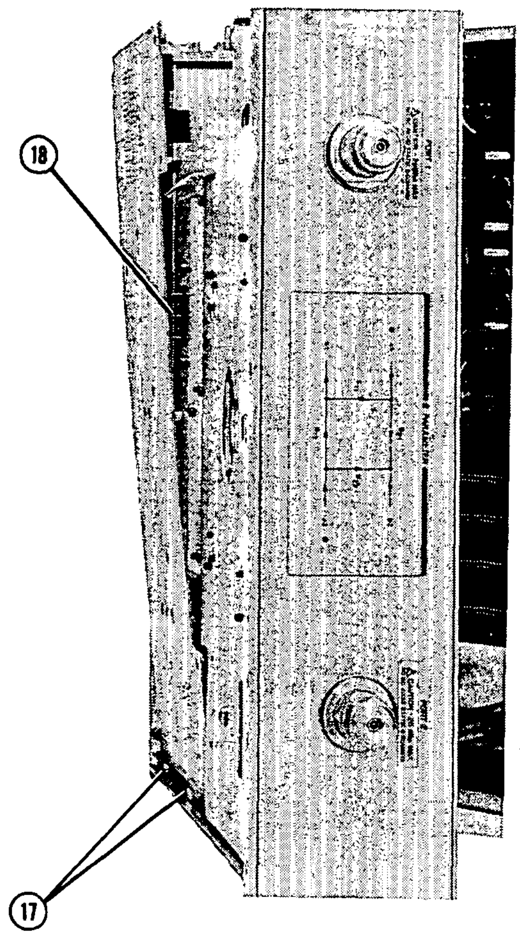


Figure 6 (4 of 4)

www.valuetronics.com

A53 Mixer/Amplifier Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
5/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 7.

To Disassemble

1. Remove the handles and side covers and pivot open the instrument (refer to the tab at the front of this section).
2. Disconnect the two cable assemblies from the mixer/amplifier connection labeled J1 (item 1) and J2 (item 2).
3. Disconnect the two semi-rigid cables (items 3 and 4) at the mixer/amplifier connection.
4. Remove the fixed oscillator cable (item 5).
5. Remove the screw that connects the mixer/amplifier bracket to the main deck (item 6).
6. Slide the mixer/amplifier assembly toward the rear of the instrument and then pull free from the instrument.

To Reassemble

7. Reverse the above procedure to reassemble the unit.

www.valuetronics.com

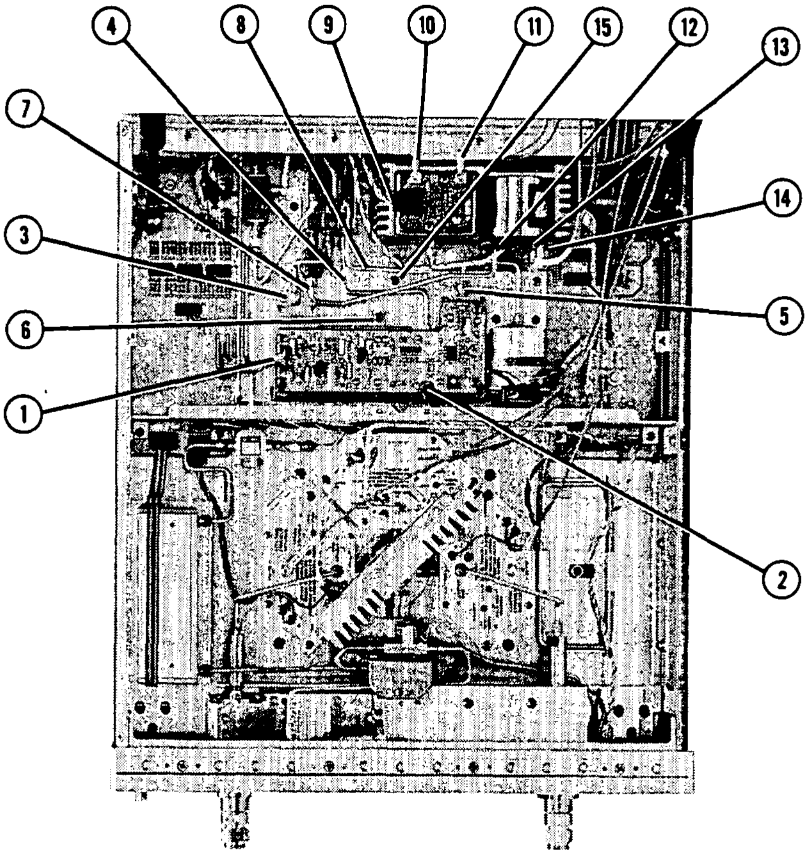


Figure 7

www.valuetronics.com

A55 YIG 1/A54 YIG 2 Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
5/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 7.

To Disassemble

1. Remove the handles and side covers and pivot open the instrument (refer to the tab at the front of this section).
2. Remove the following semi-rigid cables:

   fixed oscillator/mixer/amplifier (item 5)
   YIG 2/isolator (item 7)
   YIG 1/SW 3 (item 8).
3. Disconnect the following cables at the YIG 1 connection:

   A55J1 YIG 1 cable assembly (item 9)
   A55J2 YIG 1 FM C (item 10)
   A55J3 YIG 1 MC (item 11).
4. Disconnect the following cables at the YIG 2 connection:

   A54J1 YIG 2 cable assembly (item 12)
   A54J3 YIG 2 MC (item 13)
   A54J2 YIG 2 FM C (item 14).
5. Remove two screws from the heat sink (item 15).
6. Slide the oscillator assembly toward the front of the instrument and then straight up to pull it free from the main deck.
7. Remove four screws from the heat sink to remove YIG 1: two from the rear, and two from the bottom (not shown).
8. Remove four screws from the rear of the heat sink to remove YIG 2 (not shown).

To Reassemble

9. Reverse the above procedure to reassemble the instrument.

www.valuetronics.com

S1/S2/S3 Microwave Switch Replacement

TOOLS REQUIRED

Large Pozidriv screwdriver
5/16" open-end wrench

PROCEDURE

The items shown in parentheses refer to the corresponding item numbers in Figure 8.

To Disassemble

1. Remove the handles and side covers and pivot open the instrument (refer to the tab at the front of this section).
2. Disconnect the following semi-rigid cables from the switch connection:

   mixer/amplifier/SW 2 (item 1)
   mixer/amplifier/SW 3 (item 2).
3. Remove the modulator/SW1 and YIG 1/SW3 semi-rigid cables (items 3 and 4).
4. Disconnect the isolator from SW1 (item 5).
5. Remove the two screws that attach the mounting bracket to the main deck (item 6). Lift the switch assembly straight up to disconnect the pins. Then remove the switch assembly from the instrument.
6. Remove the SW2/SW3 or the SW1/SW2 cable, depending on which switch is to be replaced.
7. Remove one screw on each end of the switch package to detach the mounting bracket.

To Reassemble

8. Reverse the above procedure to reassemble the unit.

www.valuetronics.com

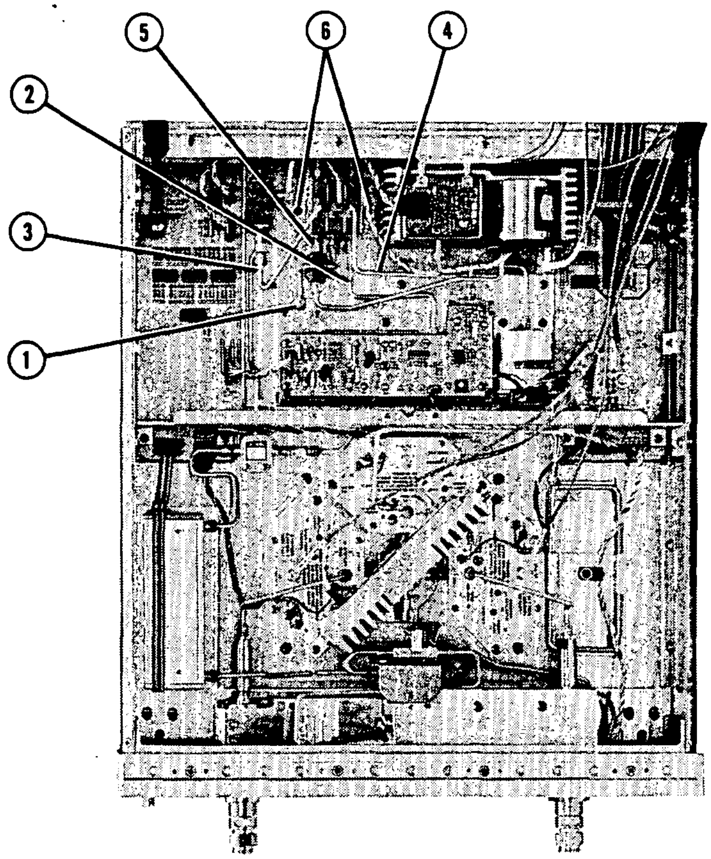


Figure 8

www.valuetronics.com

Post-Repair Procedures

INTRODUCTION

Repairing the analyzer or replacing an assembly is seldom the final step in the repair process. The assemblies of the instrument are both complex and interactive. An adjustment or instrument check or both is usually required following a repair. Table 1, *Related Service Procedures*, addresses the question of what to adjust and verify following a repair.

The first column of Table 1 lists every replaceable assembly in the instrument. The second column notes adjustments that should be performed following replacement of an assembly. The third column references the internal test or other method used to verify the proper functioning of the instrument following repair.

Generating a new set of error term plots is always a good idea following a major repair. Include the new plots in the system log for future reference. See *Error Terms* for more information.

www.valuetronics.com

Table 1. Related Service Procedures (1 of 2)

Replaced Assembly	Adjustments/ Correction Constants	Verification
A1 Front Panel	None	Internal tests #12, 23, and 24
A2 Front Panel Processor	Display Intensity and Focus CC	Internal test #12
A4/A5/A6 Second Converter	None	System Verification
A7 ALC	Power Adjustment	Power Level
A8 Post-Regulator	None	Self-Test Check A8 test point voltages
A9 CPU	Display Intensity and Focus CC Serial Number CC Option Number CC Analog Bus CC ADC Linearity CC Source Pretune CC IF Amplifier CC Cal Kit Defaults CC	System Verification
A10 Digital IF	Analog Bus CC ADC Linearity CC If Amplifier CC	Internal tests #17, 18, and 19 System Verification Dynamic Range
A11 Phase Lock	Analog Bus CC Source Pretune CC	Frequency Accuracy
A12 Reference	Reference Assembly VCO Tune Adjustment Frequency Accuracy Adjustment	Frequency Accuracy
A13 Fractional-N (Analog)	None*	Frequency Accuracy Internal test #20
A14 Fractional-N (Digital)	None	Frequency Accuracy Internal test #20
A15 Preregulator	None	Check A15 LEDs
A16 Rear Panel	None	Internal Test #13: Rear Panel
A17 Motherboard	None	Self-Test Operator's Check
A18 Display (HP 8719A/20B)	HP 8719A/20B Display Position and Focus	Observation
	HP 8719A/20B Display Intensity Adjustments	Observation
A18 Display (HP 8720A)	Display Intensity and Focus CC Display Image Size, Position and Trace Alignment	Observation
A19 GSP (HP 8719A/20B)	HP 8719A/20B Display Intensity Adjustments	Observation

www.valuetronics.com

Table 1. Related Service Procedures (2 of 2)

Replaced Assembly	Adjustments/ Correction Constants	Verification
A51 Interface	None	Operator's Check
A52 Pulse Generator	Power Adjustment	System Verification
A53 Mixer/Amp Assembly	Power Adjustment	Power Level Frequency Accuracy
A54 YIG2 8-20 GHz	None	Power Level Frequency Accuracy
A55 YIG1 2-8 GHz	None	Power Level Frequency Accuracy
A56 Lower Front Panel Assembly	None	Observation (watch LEDs when switching from S11 to S22)
A57 Fixed Oscillator	Power Adjustment	Power Level Frequency Accuracy
A58 Modulator	Power Adjustment	Power Level
A59 Isolator	None	Power Level
A60/61 DC Bias Tees	None	System Verification
A62/A63 Directional Couplers	None	System Verification
A64 R Sampler	Sampler Check Power Adjustment	System Verification AND Power Level
A65 A Sampler	Sampler Check	System Verification
A66 B Sampler	Sampler Check	System Verification
A67 Power Splitter	None	System Verification
A68 20 dB Attenuator	None	Operator's Check
A69 Step Attenuator	None	Operator's Check
A70 3 dB Attenuator	None	Operator's Check
S1/S2/S3 Switches	None	Operator's Check
S4 Transfer Switch	None	Operator's Check

*Although no adjustments are required after replacing an A13 assembly, the Fractional-N Spur and FM Sideband Adjustment is recommended for optimization of spectral purity. It requires the HP 8720A Automated Adjustment Software which should be ordered along with the replacement A13 board. See *Replaceable Parts* for part numbers. Further information can be found in the *Adjustments* section.

www.valuetronics.com

INTRODUCTION

This manual applies directly to the instrument it came with, specifically to network analyzers with the serial number prefixes on the title page.

With the information provided in this section, this manual can be adapted to apply to any earlier instrument version. For additional information see *Analyzers Covered by this Manual* in the *General Information* section of the *Operating Manual*.

HOW TO USE THIS SECTION

This section documents the HP 8720A, 8719A, and 8720B separately. For each instrument, a table lists the changes opposite the serial number prefix of your instrument.

DETERMINING WHICH INSTRUMENT HISTORY CHANGES APPLY

Find the prefix number range your instrument falls into, then follow the corresponding directions. Actual changes are provided at the end of this section.

Table 1a. Changes for the HP 8720A

Prefix Numbers	Directions
2914A	Use the existing manual documentation.
2906A or below	Implement Change A.

www.valuetronics.com

Table 1b. Changes for the HP 8719A

Prefix Numbers	Directions
3025A	Implement Change B
3010A	Implement Change B
2922A	Implement Change B
2909A or below	Implement Changes A and B

Table 1c. Changes for the HP 8720B

Prefix Numbers	Directions
3019A	Implement Change B
3010A	Implement Change B
2912A	Implement Change B
2909A or below	Implement Changes A and B

www.valuetronics.com

CHANGE A

Change A only applies to:

HP 8720As with serial prefix numbers of 2906A and below.
HP 8719As with serial prefix numbers of 2909A and below.
HP 8720Bs with serial prefix numbers of 2909A and below.

Make the following changes to the Replaceable Parts section:

Replaceable Parts page 8:

Change A62 and A63 to HP part number 08720-60030, CD 5, Directional coupler.

CHANGE B

Change B only applies to:

HP 8719As with serial prefix numbers of 3025A and below.
HP 8720Bs with serial prefix numbers of 3019A and below.

Make the following changes to the Replaceable Parts section:

Replaceable Parts page 6:

Change A19 to HP part number 08753-60092, (19A, 20B) GRAPHICS SYSTEM PROCESSOR ASSY

Change A19 to HP part number 08753-69092, (19A, 20B) GRAPHICS SYSTEM PROCESSOR ASSY (R-E)

www.valuetronics.com

www.valuetronics.com

HP 8719A and HP 8720A/B Service Manual
INDEX

Entries in this index are identified by a two or three word acronym and number. Each acronym, as explained in the KEY on the bottom of each page, stands for one of nineteen sections. Each section has its own tab.

Example: "*[A]* Softkey .... SKM 13" means that the softkey *[A]* is described in the *Service Key Menus* section on page 13.

Use this index to learn more about:

- Softkeys: keys next to the CRT, printed *[SOFTKEY]* in text.
- Hardkeys: dedicated front panel keys, printed **[HARDKEY]** in text.
- CRT messages: visible during normal operation and service routines.
- Error messages: indexed without the initial "CAUTION".
- Analog bus nodes: listed by name and number.
- Adjustments: listed by title and function.

ASSEMBLIES

The assemblies below are indexed as follows:

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com

KEY:

ACC	Accessories	PS	Power Supply
ADJ	Adjustments	RCV	Receiver
DC	Digital Control	RP	Replaceable Parts
ET	Error Terms	SEO	Service and Equipment Overview
IFG	Isolate Faulty Group	SKM	Service Key Menus
IH	Instrument History	SRC	Source
PM	Preventive Maintenance	TO	Theory of Operation
PRO	Replacement Procedures	TS	Troubleshooting
PRP	Post-Repair Procedures	VER	Verification

www.valuetronics.com