Service Manual

HP 70907A and HP 70907B External Mixer Interface

HEWLETT PACKARD

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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.

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Caution

The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a *caution* sign until the indicated conditions are fully understood and met.

Warning

The *warning* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *warning* sign until the indicated conditions are fully understood and met.

General Safety Considerations

Warning

Before this instrument is switched on, **make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.**

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

Warning

There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful.

Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

Caution

Before this instrument is switched on, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

HP 70000 Modular Measurement System Documentation Outline

Instruments and modules of the HP 70000 Modular Measurement System are documented to varying levels of detail. Modules that serve as masters of an instrument require operation information in addition to installation and verification instructions. Modules that function as slaves in a system require only a subset of installation and verification information.

Manuals Supplied with Module

Installation and Verification Manual

Topics covered by this manual include installation, specifications, verification of module operation, and some troubleshooting techniques. Manuals for modules that serve as instrument masters will supply information in all these areas; manuals for slave modules will contain only information needed for slave module installation and verification. Master module documentation may also include some system-level information.

Operation Manual

Operation Manuals usually pertain to multiple- and single-module instrument systems. Topics include preparation for module use, module functions, and softkey definitions.

Programming Manual

Programming Manuals also pertain to multiple- and single-module instrument systems. Programming Manual topics include programming fundamentals and definitions for remote programming commands.

Service Manual, Available Separately

This manual provides service information for a module, including module verification tests, adjustments, troubleshooting, replaceable parts lists, and replacement procedures. For ordering information, contact a Hewlett-Packard Sales and Service Office. This manual is not always immediately available for new products.

Note Some earlier service manuals are titled *Technical Reference.*

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1

General Information

Introduction

This is the service manual for the HP 70907A/B External Mixer Interface module. This manual contains information needed to test, adjust, and service the HP 70907A/B to the assembly level.

Manual Organization

This manual is divided into the following eight chapters:

Chapter 1, "General Information," contains lists of service kit contents, recommended test equipment, and sales and service offices. Also included are instructions for returning an instrument for service, and information about electrostatic discharge (ESD).

Chapter 2, "Verification Software," contains information needed to use the HP 70907A/B Module Verification software.

Chapter 3, "Verification Tests," contains information on the tests used to verify the electrical operation of the module.

Chapter 4, "Adjustment Procedures," contains module-adjustment procedures.

Chapter 5, "Troubleshooting," contains troubleshooting information, including ROM replacement, WRITE/PROTECT switch location information, and error-code definitions.

Chapter 6, "Replacement Procedures," contains removal and replacement information for the major assemblies.

Chapter 7, "Replaceable Parts," contains the information needed to order mechanical parts and replacement assemblies for the module.

Chapter 8, "Major Assembly and Cable Locations," contains figures identifying all major assemblies and cables, and front- and rear-panel "J" designations.

Manual Conventions

The following text conventions are used throughout this manual:

Keys physically on an instrument are represented in this way: (KEY)
Softkeys, keys defined by software or firmware, are represented in this way: **softkey**
Text that appears on the CRT is represented in this way: `screen text`

Safety Considerations

Before servicing this module, read the safety markings on the instrument and the safety instructions in the manual. Refer to the summary of safety information in the front of the manual.

The instrument is manufactured and tested to international safety standards. However, to prevent instrument damage and ensure your personal safety, all cautions and warnings must be heeded.

Serial Numbers

Attached to the front frame of the module is a serial-number label. The serial number is in two parts. The first four digits and letter are the prefix; the last five digits are the suffix. The prefix changes only when a major change is made to the module. The suffix is assigned sequentially and is different for each module.

Firmware Compatibility

HP 70907A Requirements

For the HP 70907A to function properly in an HP 70000 Modular Measurement System, the HP 70900 Local Oscillator (LO) must have a firmware version of 860203 or later. If the LO firmware version is 850730, a controller-board/firmware-upgrade kit can be ordered (HP part number 70900-60137).

HP 70907B Requirements

For the HP 70907B to function properly in an HP 70000 Modular Measurement System, the HP 70900 Local Oscillator (LO) must have a firmware version of 900314 or later.

LO Firmware Version 860203 or Earlier

If the HP 70900 local oscillator firmware version is 860203 or earlier, an LO controller-board/firmware-upgrade kit (HP part number 70900-60137) can be ordered. If HP 70907B Option 098 is ordered, this controller board/firmware-upgrade kit is included.

LO Firmware Version 861015 to 891102

If the HP 70900 local oscillator firmware version is from 861015 to 891102, an LO firmware-upgrade kit (HP part number 70900-60138) can be ordered. If HP 70907B Option 099 is ordered, this firmware-upgrade kit is included.

Module Options

HP 70907A

The HP 70907A External Mixer Interface module has the following module options:

Option 910 This option adds another *HP 70907A/B External Mixer Interface Installation and Verification Manual.*

Option 915 This option adds the module service documentation and module verification software.

HP 70907B

The HP 70907B External Mixer Interface module has the following module options:

Option 098 This option adds the LO controller-board/firmware-upgrade kit. Refer to "Firmware Compatibility" above for information about which LO firmware versions are needed for compatibility with the 70907B module.

Option 099 This option adds the LO firmware-upgrade kit. Refer to "Firmware Compatibility" above for information about which LO firmware versions are needed for compatibility with the 70907B module.

Option 910 This option adds another *HP 70907A/B External Mixer Interface Installation and Verification Manual.*

Option 915 This option adds the module service documentation and module verification software.

Module Verification Software

The HP 70907A/B Module Verification Software documented in this manual is available through Hewlett-Packard Sales and Service Offices. The HP 70907A/B Module Verification Software contains the verification tests and adjustments used to service the HP 70907A/B.

Directions for using the HP 70907A/B Module Verification Software are in Chapter 2. Verification test information is in Chapter 3; adjustment information is in Chapter 4.

Service Kit

The HP 71000 System Service Kit (HP part number 71000-60002) is the general service kit for HP 70000 Modular Measurement System modules. This kit includes servicing tools used to repair all HP 70000 Modular Measurement System modules, and a modification procedure for the HP 70001A Mainframe. The modification allows access to HP 70000 Modular Measurement System modules during bench testing and repair. Refer to the latest version of Service Note 70001A-1 for a full listing of the HP 71000 System Service Kit contents.

Several of the items in the HP 71000 System Service Kit are used when servicing HP 70907A/B modules. These items are identified in Table 1-1. The quantities listed in Table 1-1 are the quantities of the item that are supplied in the HP 71000 System Service Kit.

Table 1-1. Service Tools for the HP 70907A/B

HP Part Number	Qty	Description
70001-60013	1	Extender Module
8710-1651	1	Hex-Ball Driver 8mm
8710-1728	1	Bandpass Filter Tuning Tool
85680-60093	3	Cable Assembly—BNC (m) to SMB (f)
5061-9021	7	Cable Assembly, 390 mm—SMB (f) to SMB (f)

Recommended Test Equipment

Table 1-2 gives standard and specialized test equipment needed when testing or adjusting the HP 70907A/B.

Only equipment listed in Table 1-2 may be used during the HP 70907A/B verification tests and adjustments. If equipment other than the recommended models is used, Hewlett-Packard will not be responsible for the accuracy of the tests or adjustments.

Table 1-2. Recommended Test Equipment

Equipment	Recommended Model or HP Part Number	Verif. Tests	Adj. Proc.
Synthesized Source	HP 8663A	√	√
Power Sensor	HP 8485A	√	√
Power Sensor	HP 8481D	√	√
Power Meter	HP 436A	√	√
Synthesized Sweeper *(2 required)*	HP 8340A	√	√
Noise Figure Meter	HP 8970B	√	
Level Generator	HP 3335A	√	
Microwave Network Analyzer	HP 8757A	√	√
Controller	HP 9000 Series 200/300	√	√
HP 70000 Series Mainframe*	HP 70001A	√	√
Spectrum Analyzer	HP 8566B	√	
Scalar Network Analyzer	HP 8757E	√	
Precision DVM	HP 3456A		√
Local Oscillator	HP 70900B		√
Accessories			
SMB (f) Short Termination	1250-0911		√
50Ω Coaxial Feedthrough	HP 10100C		√
20:1 Resistive Divider	HP 10020A		√
Connector Saver *(2 required)*	85027-60002	√	
6 dB Attenuator	HP 8493C, Option 006	√	√
30 dB Attenuator	HP 11708A	√	√
Module Service Extender*	70001-60013	√	√
Excess Noise Source	HP 346C	√	

*Either an extender module or a modified mainframe is required. Refer to "Service Kit" in this chapter.

Table 1-2. Recommended Test Equipment (continued)

Equipment	Recommended Model or HP Part Number	Verif. Tests	Adj. Proc.
Power Splitter	HP 11667B	√	
Directional Bridge	HP 85027B	√	
Detector *(2 required)*	HP 11664E	√	√
Calibrated Open/Short	85027-60004	√	
350 MHz Low Pass Filter	CIRQTEL LT13-350AA	√	
50 Ω Termination	HP 909D	√	
170 MHz Low Pass Filter	CIRQTEL LT13-170AA	√	
Adapters			
Type N (m) to BNC (f)	1250-1476	√	
SMA (f) to SMB (m)	1250-0674	√	√
BNC (f) to SMA (m)	1250-1200	√	√
SMA (f) to SMA (f)	1250-1158	√	√
Type N (m) to APC 3.5 (f)	1250-1744	√	
APC 3.5 (f) to APC 3.5 (m)	85027-60002	√	
Type N (m) to SMA (f)	1250-1250	√	
SMB (f) to SMB (f)	1250-0672	√	√
Type N (f) to SMB (f)	1250-0673	√	
SMA (m) to SMA (m)	1250-1159	√	
Type N (m) to BNC (m)	1250-0780		√
APC 3.5 (f) to APC 3.5 (f)	5061-5311		√
Type N (f) to APC 3.5 (f)	1250-1745		√
Cables			
BNC (m) to BNC (m)	HP 10503A	√	√
SMA (m) to SMA (m)	8120-1578	√	
APC 3.5 (m) to APC 3.5 (m)	8120-4921	√	√
BNC (m) to SMB (f)	85680-60093	√	√

Repair Matrix

Table 1-3 below identifies the tests and adjustments that must be completed when an assembly is replaced or repaired.

Table 1-3. HP 70907A/B Repair Matrix

Assembly	Tests Required	Adjustments Required
A1 Miscellaneous Bias Board	6. Main LO Output Amplitude and Harmonics 7. Aux. LO Output Amplitude and Harmonics 11. LO Input Sensitivity 12. Diagnostics	1. LO Leveling Amplifier 2. Mixer Bias
A2 Calibration Source Board	4. Module Gain and Calibration Source 17. 321.4 MHz IF Input Return Loss	6. Module Gain 7. Calibration Source
A3 Last Converter Board	1. Noise Figure 2. Third Order Intercept 3. 21.4 MHz Output Response 4. Module Gain and Calibration Source 8. 300 MHz Output Amplitude and Harmonics 9. 321.4 MHz Output Response 10. IF Subharmonics 12. Diagnostics 13. 300 MHz Input Sensitivity 14. Close-in Sidebands 15. 21.4 MHz Daisy Chain Loss 16. 21.4 MHz Input/Output Isolation 17. 321.4 MHz IF Input Return Loss	4. 300 MHz Output/Bandpass 5. 321.4 MHz Bandpass 6. Module Gain
A4 Power Supply/Control Board	4. Module Gain and Calibration Source 5. Front Panel LEDs 12. Diagnostics 14. Close-in Sidebands 15. 21.4 MHz Daisy Chain Loss	2. Mixer Bias 3. Tune + Span DAC* 7. Calibration Source
A5 Leveling Amplifier	6. Main LO Output Amplitude and Harmonics 7. Aux. LO Output Amplitude and Harmonics 11. LO Input Sensitivity 12. Diagnostics	1. LO Leveling Amplifier
A6 Isolator	6. Main LO Output Amplitude and Harmonics	1. LO Leveling Amplifier
A7 Front Panel Board	4. Module Gain and Calibration Source 5. Front Panel LEDs 6. Main LO Output Amplitude and Harmonics 17. 321.4 MHz IF Input Return Loss	3. Tune + Span DAC*
A8 Attenuator	4. Module Gain and Calibration Source	6. Module Gain 7. Calibration Source
K2 RF Switch	6. Main LO Output Amplitude and Harmonics 4. Module Gain and Calibration Source†	1. LO Leveling Amplifier 7. Calibration Source†
†Only applies to the HP 70907A. *Only applies to the HP 70907B.		

Returning Instruments for Service

The original shipping containers and materials, or the equivalent, must be used when repackaging the mainframe with modules, or modules alone. Packaging materials identical to the original factory packaging can be purchased through any Hewlett-Packard Sales and Service Office. However, if these shipping materials are not available, instruments can be repackaged for shipment using the information below.

Caution

Instrument damage can result from using packaging materials other than the original shipping materials or equivalent. Never use styrene pellets as packaging materials. They do not adequately cushion the instrument or prevent it from shifting in the carton. They cause instrument damage by generating static electricity.

Use the following procedure to prepare the instrument for shipment:

1. Fill out a blue repair card (located at the end of this chapter) and attach it to the instrument. Also send copies of any error messages and performance data recorded for the instrument. If a blue repair card is not available, send the following information with the returned instrument:

   a. Type of service required.
   b. Description of the problem; state if the problem is constant or intermittent.
   c. Name and phone number of technical contact person.
   d. Return address.
   e. Model number of returned instrument.
   f. Full serial number of returned instrument.
   g. List of any accessories returned with instrument.

2. Pack the instrument in the original shipping materials (or the equivalent). However, if these not available, instruments can be repackaged for shipment using the following instructions.

   a. Wrap the instrument in anti-static plastic to reduce the possibility of ESD-caused damage.
   b. For instruments that weigh less than 54 kg (120 lb), use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength. The carton must be large enough and strong enough to accommodate the instrument. Allow at least three to four inches on all sides of the instrument for packing material.
   c. Surround the equipment with three to four inches of packing material to protect the instrument and prevent it from moving in the carton. If packing foam is not available, the best alternative is S.D.-240 Air Cap™ from Sealed Air Corporation (Commerce, California 90001). Air Cap is a plastic sheet filled with 1-1/4 inch air bubbles. Use the pink (antistatic) Air Cap to reduce static electricity. Wrapping the instrument several times in this material should both protect the instrument and prevent it from moving in the carton.

3. Seal the carton with strong nylon adhesive tape.

4. Mark the carton "FRAGILE, HANDLE WITH CARE."

5. Retain copies of all shipping papers.

Electrostatic Discharge Information

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-safe work station.

Figure 1-1 shows an example of a static-safe work station. Two types of ESD protection are shown: (a) conductive table mat and wrist strap combination, and (b) conductive floor mat and heel strap combination. The two types *must* be used together to ensure adequate ESD protection. Refer to Table 1-4 for a list of static-safe accessories and their part numbers.

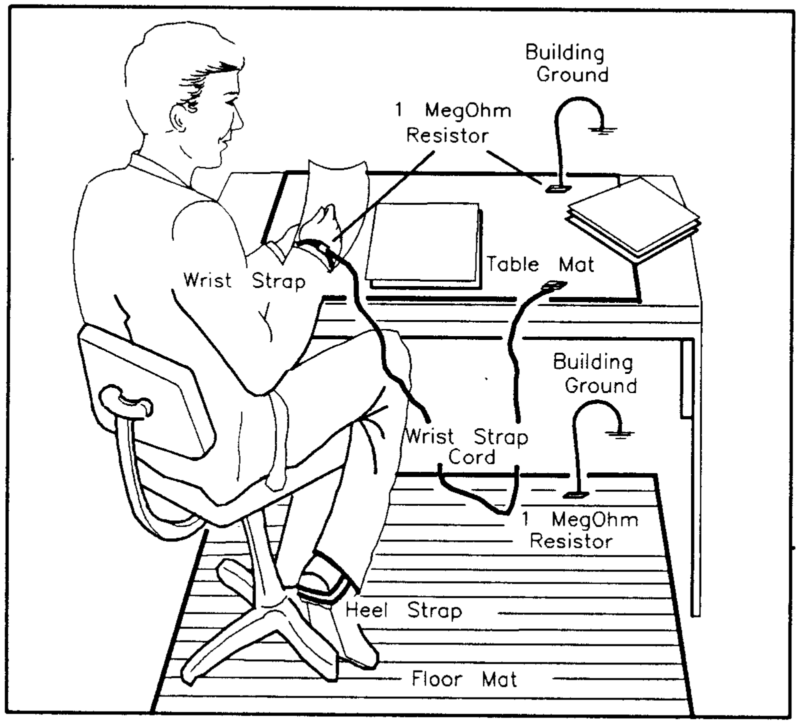

Figure 1-1. Static-Safe Work Station

Reducing ESD Damage

Below are suggestions that may help reduce the amount of ESD damage that occurs during testing and servicing instruments.

PC Board Assemblies and Electronic Components

- Handle these items at a static-safe work station.
- Store or transport these items in static-shielding containers.

Caution

Do not use erasers to clean the edge connector contacts. Erasers generate static electricity and degrade the electrical quality of the contacts by removing the thin gold plating.

Do not use paper of any kind to clean the edge-connector contacts. Paper or lint particles left on the contact surface can cause intermittent electrical connections.

Do not touch the edge-connector contacts or trace surfaces with bare hands. Always handle board assemblies by the edges.

PC board assembly edge-connector contacts may be cleaned by using a lint-free cloth with a solution of 80% electronics-grade isopropyl alcohol and 20% deionized water. This procedure should be performed at a static-safe work station.

Test Equipment

- Before connecting any coaxial cable to an instrument connector for the first time each day, *momentarily* short the center and outer conductors of the cable together.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from the instrument.
- Be sure that all instruments are properly earth-grounded to prevent buildup of static charge.

Static-Safe Accessories

Table 1-4. Static-Safe Accessories

Accessory	Description	HP Part Number
Static-control mat and ground wire	Set includes: 3M static-control mat, 0.6m × 1.2m (2 ft × 4 ft) ground wire, 4.6 m (15 ft) (The wrist strap and wrist-strap cord are *not* included. They must be ordered separately.)	9300-0797
Wrist-strap cord	1.5m (5 ft)	9300-0980
Wrist strap	Black, stainless steel with four adjustable links and 7-mm post-type connector (The wrist-strap cord is *not* included.)	9300-1383
ESD heel strap	Reusable 6 to 12 months	9300-1169
Hard-surface static-control mat*	Large, black, 1.2m × 1.5m (4 ft × 5 ft)	92175A
	Small, black, 0.9m × 1.2m (3 ft × 4 ft)	92175C
Soft-surface static-control mat*	Brown, 1.2m × 2.4m (4 ft × 8 ft)	92175B
Tabletop static-control mat*	58 cm × 76 cm (23 in. × 30 in.)	92175T
Antistatic carpet*	Small, 1.2m × 1.8m (4 ft × 6 ft)	
	natural color	92176A
	russet color	92176C
	Large, 1.2m × 2.4m (4 ft × 8 ft)	
	natural color	92176B
	russet color	92176D

*These accessories can be ordered either through a Hewlett-Packard Sales Office or through HP DIRECT Phone Order Service. In the USA, the HP DIRECT phone number is (800) 538-8787. Contact your nearest Hewlett-Packard Sales Office for more information about HP DIRECT availability in other countries.

Sales and Service Offices

Hewlett-Packard has Sales and Service Offices around the world providing complete support for Hewlett-Packard products. To obtain servicing information, or to order replacement parts, contact the nearest Hewlett-Packard Sales and Service Office listed in Table 1-5.

In any correspondence, be sure to include the pertinent information about model numbers, serial numbers, and assembly part numbers.

Note Within the USA, a toll-free phone number is available for ordering replacement parts. Refer to "Ordering Information" in Chapter 7 for the phone number and more information.

Table 1-5. Hewlett-Packard Spectrum Analyzer Sales and Service Offices

IN THE UNITED STATES

California

Hewlett-Packard Co.
1421 South Manhattan Ave.
P.O. Box 4230
Fullerton, CA 92631
(714) 999-6700

Hewlett-Packard Co.
301 E. Evelyn
Mountain View, CA 94039
(415) 694-2000

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia

Hewlett-Packard Co.
2000 South Park Place
P.O. Box 105005
Atlanta, GA 30339
(404) 955-1500

Illinois

Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
(312) 255-9800

New Jersey

Hewlett-Packard Co.
120 W. Century Road
Paramus, NJ 07653
(201) 265-5000

Texas

Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
(214) 231-6101

IN AUSTRALIA

Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
895-2895

IN CANADA

Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
(514) 697-4232

IN FRANCE

Hewlett-Packard France
F-91947 Les Ulis Cedex
Orsay
(6) 907-78-25

IN GERMAN FEDERAL REPUBLIC

Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Berner Strasse 117
Postfach 560 140
D-6000 Frankfurt 56
(0611) 50-04-1

IN GREAT BRITAIN

Hewlett-Packard Ltd.
King Street Lane
Winnersh, Wokingham
Berkshire RG11 5AR
0734 784774

IN OTHER EUROPEAN COUNTRIES

Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 Widen (Zurich)
(0041) 57 31 21 11

IN JAPAN

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi, 3 Chome
Suginami-ku Tokyo 168
(03) 331-6111

IN PEOPLE'S REPUBLIC OF CHINA

China Hewlett-Packard, Ltd.
P.O. Box 9610, Beijing
4th Floor, 2nd Watch Factory Main Bldg.
Shuang Yu Shu, Bei San Huan Rd.
Beijing, PRC
256-6888

IN SINGAPORE

Hewlett-Packard Singapore Pte. Ltd.
1150 Depot Road
Singapore 0410
273 7388
Telex HPSGSO RS34209
Fax (65) 2788990

IN TAIWAN

Hewlett-Packard Taiwan
8th Floor, Hewlett-Packard Building
337 Fu Hsing North Road
Taipei
(02) 712-0404

IN ALL OTHER LOCATIONS

Hewlett-Packard Inter-Americas
3495 Deer Creek Rd.
Palo Alto, California 94304

2

Verification Software

Introduction

Verification Software is the program designed to automate the module's verification tests and adjustment procedures. Included in this chapter is a step-by-step procedure to load the software and get the verification tests or adjustment procedures underway. For more detailed information, refer to the sections regarding individual menus. Listed below are the major divisions of this chapter.

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  Computer Language Compatibility ... 2-2
  Printer Compatibility ... 2-3
Alternate Key Labels ... 2-3
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General Information

This documentation supports Module Verification Software, Revision A.02.00 or greater. Use this software with slave modules that have an HP 70900 local oscillator as a master. A softkey-driven menu and user-interface screens control the software. The disks included with this module provide programs that test whether the module meets its characteristics for system operation.

The *Installation and Verification Manual* for the HP 70900 local oscillator contains configuration information for predefined models of HP 70000 Modular Spectrum Analyzers. The software automatically reads your system configuration data from the HP-MSIB (Hewlett-Packard Modular System Interface Bus) to determine which system or modules you are using.

Refer to "Verification Tests" in Chapter 3 and "Adjustment Procedures" in Chapter 4 for individual test setups and test descriptions. Chapter 1 contains a list of recommended test equipment.

Computer Compatibility

Module Verification Software is written in HP 9000 Series BASIC 4.0 and can run on the following HP 9000 Series 200/300 computers. Minimum RAM requirement is 2.5 megabytes.

HP 9816	HP 9920 (with HP 35721A Monitor)
HP 9836	HP 9000 Series 300 computer

When using an HP 9000 Series 300 computer, a medium-resolution monitor and either an HP 98203C or an HP 46020A keyboard are required. A high-resolution monitor will preclude printing graphical test results. Due to the various keyboards supported, some minor text differences appear in the menus and softkeys displayed on-screen. Refer to "Alternate Key Labels," below.

Computer Language Compatibility

The software program runs on HP BASIC 4.0, or later, with the BIN files in RAM that are listed below. A procedure for loading HP BASIC is provided in "Installing Verification Software" later in this chapter.

CLOCK	ERR	HPIB	MAT
CS80*	GRAPH	IO	MS
DISK†	GRAPHX	KBD	PDEV‡

*Optional – supports Winchester disk drives.
†Optional – supports microfloppies and older Winchester disk drives.
‡Optional – provides debugging features for program development.

In an SRM (shared resource management) environment, the following BIN files are also required:

DCOMM
SRM

Note

If you have set up some RAM memory for specific usage, be aware that this program uses RAM memory Volume ":MEMORY, 0, 15". Move any information stored at this Volume to another location before running the Verification Software program.

Printer Compatibility

Module Verification Software supports any HP-IB printer; however, many of the printed test results require a graphics printer. Graphical test results are not output to a non-graphics printer.

Alternate Key Labels

For simplicity in this document, we assume that you are using an HP 9000 Series 200 keyboard. Refer to the list below if your keyboard key labels do not match the ones used in text.

Keyboard Key Labels	Alternate Key Labels
EXECUTE	RETURN
ENTER	RETURN
RUN	press SYSTEM, then RUN
CONTINUE	press SYSTEM, then CONTINUE

Configuring the Hardware

Procedure

1. Connect the HP 70000 Modular Spectrum Analyzer to the computer port determined by the following criteria:
   a. For computers with an HP 98624A HP-IB Interface, connect your analyzer to the port labeled HP-IB SELECT CODE 8. Check that the address switch on the HP 98624A HP-IB Interface board assembly matches the HP-IB controller device address. If needed, refer to the *HP 9000 Series 200/300 Peripheral Installation Guide, Volume 1*.
   b. For computers without an HP 98624A HP-IB Interface, connect the HP 70000 Modular Spectrum Analyzer to the port labeled HP-IB SELECT CODE 7.
2. Connect the HP-IB cables from the test equipment to the computer's HP-IB SELECT CODE 7 port.
3. Use a 0.5 meter HP-IB cable (HP 10833D, or similar cable) to connect the external disk drive's HP-IB to the HP-IB SELECT CODE 7 port.

Note Occasionally disk drives exhibit unpredictable behavior when sharing the HP-IB with instruments. If you find this occurring, connect the disk drive to a separate HP-IB interface.

4. Set the external test equipment and the HP 70000 Modular Spectrum Analyzer line switches to ON. Allow the equipment to warm up as specified for the verification tests or adjustment procedures.
5. Turn the disk drive (if used) and computer ON.

Installing Verification Software

Use the following steps to get the program loaded and running. Later sections of this chapter contain more specific program-operation information.

Two assumptions are made with the Module Verification Software. One is that you are using standard HP-IB addresses for the active devices of the microwave test station. The second is that all passive devices for the microwave test station are available. If either of these assumptions is inaccurate, you are prompted for data during program execution.

Software Version

View the version number of the software program after loading the first program disk. Look in the right-hand side of the initial display. Specific numbers vary, but the version number looks like this: `Rev. A.02.00`

Locate the program part number printed on the disk labels.

Procedure

1. Load BASIC 4.0 or later, with the appropriate binaries, into an HP 9000 Series 200/300 Computer. If necessary, refer to an HP BASIC reference manual.

Caution Make backup copies of all write-protected disks. If the program data on an individual disk should become altered, it cannot be ordered separately. The entire set of disks must be ordered to replace any one.

2. Assign the MSI (mass storage is) to the drive you will use as the default drive. As an example, assigning the MSI to a disk drive looks like this: `MSI ":,700,0"`
3. Insert Executive Disk 1 into the assigned default drive. Type the following command line: `LOAD "MOD_VERF",1`
4. Press (EXECUTE). The software version number appears in the screen that is next displayed.
5. Follow the on-screen prompts and load Executive Disk 2. Press (CONTINUE). Loading Executive Disk 2 may require up to two minutes.

Note Be sure the Executive Disk 3 you load is the disk that belongs with the module you wish to test.

6. Replace Executive Disk 2 with Executive Disk 3, then press PROCEED. If the date and time prompt appears, enter the date and time in the specified format. (This message appears only if date and time are not current.)
7. If you are using your module's software for the first time, a message appears stating that mass storage data is needed. Press PROCEED and follow the on-screen prompts to create a mass storage data file. Once mass storage data is stored, this message will not reappear.
8. An error message may be displayed at this point. If the DUT (device under test) does not match the module listed in the HP-MSIB Address Map, or if the software you are using belongs to another module of your system, refer to "Error Messages" at the end of this chapter to determine a course of action.
9. Load the Operating Disk as directed. The Operating Disk probably needs to remain in the drive specified as the MSI default drive. Load the Driver Disks into the drive specified on-screen.
10. Load all Driver Disks. Insert each Driver Disk and press PROCEED. This process may require up to six minutes.
11. If you have not entered serial numbers for passive devices that require calibration data for test purposes, on-screen prompts request the data now. Enter the data via the Calibration Data screen. Press CREATE to access this screen. For a detailed explanation of entering calibration data, refer to "Edit Calibration Data" under "Menus" in this chapter. Enter the serial number for each device specified, or bypass the device to continue if it is not used now. After entering and storing data for passive devices, this prompt screen will not reappear.

Note

In the future, you can access calibration data stored on Operating Disks, rather than enter the data for passive devices of a given serial number each time you begin testing. The program displays any additional passive devices requiring serial numbers and calibration data. Serial numbers are only required for passive devices that need their calibration data stored on the Operating Disk. You are prompted to enter serial numbers for these devices only.

12. You may perform any of the items listed below after satisfying the above conditions:

- Select **FINAL TEST** to perform procedures for which the required test equipment is present, automatically.
- Press **equipment menu** and return to the Equipment Menu. From here you can modify the status of the equipment in the menu (make it unavailable, readdress it, change the private bus, etc.). Refer to "Equipment Menu" under "Menus" in this chapter.
- Press **test menu** to choose between verification tests or adjustment procedures. If you have already entered either the verification test or adjustment menus, the screen allowing you to choose one or the other does not reappear. To retrieve the Test or Adjust selection screen, select **main menu** from the Test Menu softkeys. In the Main Menu, press **RESTART**. Be aware that pressing **RESTART** purges status information for any tests you have already run. You determine individual tests or individual adjustments to perform via the menu you select.
- Press **MAIN MENU** to customize your test process via any other menu.

Module Verification Software Overview

Testing Multiple Modules

Verification Software tests only one module at a time. If you have more than one module to test in your system, test them separately. If you have tested a module and want to change the module being tested without turning off the controller, follow the steps below.

1. Get to the Main Menu, then press `equipment menu`.
2. In the Equipment Menu edit screen, move the item indicator to the Device Model number column next to the Module Under Test.
3. Press `SELECT`, modify the model number, and press (ENTER).
4. Press `DONE`, then `main menu`.
5. From the Main Menu, press `test menu`. If `ERROR MESSAGE: Selected instrument under test is ______; but the software supports the _______ module` appears, press either `RELOAD` and follow the on-screen prompts to load test software, or `CHANGE DUT` to gain access to the Equipment Menu or HP-MSIB Address Menu. From the Equipment Menu, you can select the module under test's model number and modify it to the module number of the software now loaded. From the HP-MSIB Address Menu, select the module to test that matches the software you already have loaded. Otherwise, press `ABORT`.

Error Messages or Warnings Defined

There are three kinds of error messages or warnings generated by the program.

- One appears briefly at the bottom of the CRT display. The program then goes automatically to a menu that asks you for corrections or modifications.
- Another type of error message begins with `ERROR MESSAGE` and provides special softkeys. These errors are user-correctable and anticipated by the program. There is usually a `Possible Fix` message displayed to help you clear the problem.
- The final type begins with `ERROR` and provides no special softkeys. The message informs you of an unanticipated error. There is no suggested fix displayed. If you cannot recover from one of these errors, please contact your Hewlett-Packard Sales and Service Office.

Final Tests Defined

Tests defined as Final Tests are a subset of all available verification tests for a given module. After *any* module-level adjustment or repair, run Final Tests. Once a module has passed the Final Tests, install it into any mainframe and expect performance within its specified characteristics. Perform tests classified as Additional Tests after troubleshooting or adjustments to be sure of the proper operation of specific assemblies. The `FINAL TEST` softkey has no defined purpose while performing adjustments.

Single Tests Defined

You may select individual tests with this program. Refer to "Test Menu" under "Menus" in this chapter for a description of selecting individual tests. As explained in "Final Tests," specific assembly performance is checked by running assembly-associated performance tests. Refer to Chapter 5, "Troubleshooting," for a cross-reference of tests to perform versus assembly adjusted, repaired, or changed.

Printing Test Results

The program shows whether each procedure passed or failed. You may configure the computer operations to format and print test results via the Parameter Menu. If an HP-IB printer is on the bus and an address is provided in the Equipment Menu, and you configured the Parameter Menu to print test results, the program automatically prints the test results. The printout includes a title and summary page.

The title page lists the following data:

- Module software used and the test date.
- Serial number of the module tested.
- Firmware version of the module tested.
- Power line frequency.
- Test person's identification.
- Test equipment model numbers and names, addresses, and ID or serial number.

The Summary Page lists total test time beside the titles of tests performed. The Summary Page also includes test results beneath one of the following categories:

- `Not all Final Tests have been completed ... etc.`
- `The following Final Tests need to be completed:`
- `The following tests showed insufficient performance:`
- `The following tests met the appropriate requirements:`
- `The following additional tests were not completed:`

Menus

Menu Structure

The first menu presented allows you to go to the Main Menu, to begin Final Tests, or to return to the Equipment Menu. From the Main Menu, access any of the following menus:

Menu	Page
Main Menu	2-11
Mass Storage Menu	2-11
Parameter Menu	2-13
Equipment Menu	2-14
Edit Calibration Data	2-16
HP-MSIB Address Menu	2-17
Test Menu	2-17

Except for the Test Menu, these menus are configuration menus through which you initialize the software for program operation. Via these menus, you enter information about disk drives, environment conditions, test equipment, the module under test, etc. Refer to the information following the menu name in this chapter for details.

In the Test Menu, you select and execute module-related procedures. The Test Menu provides some testing options. Refer to "Test Menu" in this chapter for details.

The Mass Storage Menu, the Parameter Menu, and the Equipment Menu have two menu screens. One is the edit screen, the other is the command screen. (The previously mentioned menus use only the command screen.)

- In edit screens, you can edit displayed data or input data to the screen.
- In command screens, you may perform various menu-specific functions, which include storing edited data, selecting test mode, accessing the help screen, accessing the Main Menu, etc.

Edit and Command Screen Menus

The following softkeys are present for menus that appear in Figures 2-1 through 2-4. Not all of the menus have edit screens, but all have command screens. When softkey labels are written in lowercase letters, a sub-level softkey menu exists for that particular softkey. Softkey labels written in uppercase letters indicate there no further sub-level softkey menus exist for that softkey.

Edit Screen Menus

The following softkeys are present for edit menus that appear in Figures 2-1 through 2-4.

SELECT OR SELECT/TOGGLE — either one of these keys appears in the Edit Menu. SELECT activates the column item where the cursor is located, while SELECT/TOGGLE activates predefined choices in the menu.

DONE — exits the edit screen, then displays the menu's command screen.

Command Screen Menus

The following softkeys are present for the command menus pictured in Figures 2-1 through 2-4. An additional softkey, edit cal data, appears only in the Equipment Menu command screen. Refer to "Equipment Menu Command Screen" for information about this softkey.

main menu returns you to the "Main Menu." Refer to "Main Menu" in this chapter for details.

EDIT appears if there is an edit screen in the menu you are working in. Pressing this key returns you to the menu's edit screen.

STORE appears if you have data that needs to be stored on the OPERATING VOLUME. The HP-MSIB Address Menu does not require this softkey, therefore it does not appear in that command menu.

- **CREATE** appears if you tried to store data without an existing file available. CREATE activates the store function and creates a file on the OPERATING VOLUME.
- **REPEAT** appears if the correct Operating Disk containing calibration data is not in the disk drive. This key allows you to insert the Operating Disk into the disk drive and try again.
- **ABORT** displays the Main Menu screen. ABORT is available in various special task screens but never in a menu screen. In general, pressing this key a time or two will display the Main Menu, which has a quit softkey.

  If the Main Menu has not appeared for the first time, pressing ABORT produces a message asking you to press (RUN), which returns you to where you were when you pressed ABORT.

HELP accesses menu and softkey descriptions. Listed below are softkey selections and functions available via this softkey.

- **NEXT PAGE** takes you to the top of the next available menu page.
- **PREVIOUS PAGE** returns you to the top of the preceding menu page.
- **PRINT HELP** generates a printout of help-screen information.
- **DONE** returns you to the command or edit screen of the menu you were previously in.

quit displays the quit screen. This softkey is available only from menu command screens. After you press quit, you are asked if you really want to return to BASIC operating system. The following two softkey selections are available via the quit softkey.

- **YES** stops the program, retains any data files you stored before pressing quit, and returns you to BASIC operating system. (You can press (RUN) to restart the program and return to the Main Menu. The program retains all previously entered and stored data.)

NO displays the edit screen of the previous menu, or the command screen if there is no edit screen.

Cursor Keys and Menu Selections

When a cursor is present, use either the cursor arrow-keys or the RPG (rotary pulse generator) knob to position the cursor at the column item you wish to edit.

Note

In most cases, there are more selections available than are displayed on-screen. Be sure to move the cursor to the right and down as far as you can. **NEXT PAGE** and **PREVIOUS PAGE** keys are provided to speed your vertical searches.

Main Menu

From the Main Menu screen you can access all other menus. There is no edit screen for this menu. Figure 2-1 illustrates the Main Menu softkey organization.

Main Menu Softkeys

Aside from the common softkeys, there are two special softkeys presented in the Main Menu. One is **FINAL TESTS**, which begins the final test sequence for a module. The second is the **RESTART** softkey. Press **RESTART** to reconfigure the program and retest a module, or to test a different module. Pressing this key affects the test status column of both the Test Menu edit screen and HP-MSIB address screen. The remaining Main Menu softkeys include **mass storage**, **parameter menu**, and **equipment menu**. Each of these menus is explained in detail in their sections of this chapter.

If you have stored calibration data on another HP 70000 Software Product Operating Disk, replace your current Operating Disk with that one and access the data. Be sure to return the Operating Disk belonging with your module under test to the default drive.

Mass Storage Menu

The BASIC operating system can use a number of mass storage devices. These include internal disk drives, external disk drives, and SRM systems. You are prompted to assign the areas where the program stores system and operation data. You do this by assigning Volume Labels to an **msus** (mass storage unit specifier). An msus is a string expression that points to a mass storage location. A mass storage Volume is composed of one or more files. Files are data items or subprograms. A Volume might consist entirely of files on a floppy disk, or some number of files on a small portion of a hard disk. The Mass Storage Menu lists Volume Labels that show the location of certain types of program information. These Volume Labels are explained below.

- DATA is where the test results are temporarily stored.
- ERROR LOG is where unanticipated errors are recorded for possible future use.
- OPERATING is where all the program data is stored.

The program retrieves specific information from the following Volume Labels:

- SYSTEM contains the Executive Disk 3 program code. There must be an msus assigned to this Volume Label.
- OPERATING contains the menu configuration files and calibration data.
- DRIVER DISK contains the driver instrument control program code. There must be an msus assigned to this Volume Label.
- TEST DISK contains the module performance tests programs.
- ADJUST DISK contains the module adjustment procedures.

Volume Labels each have a default msus. From the Mass Storage Menu, you can reassign the current msus or directory path designation to another designation. You cannot edit Volume Labels, but you may edit their msus designations and directory path data fields.

Mass Storage Menu Edit Screen

The Mass Storage Menu softkeys and their functions are described below.

SELECT activates the column item where the cursor is located.

DONE exits the edit screen, then displays the Mass Storage Menu command screen.

1. Use either the keyboard arrow keys or the RPG knob to position the cursor next to the column item you wish to edit. The annotations `<=more` and `more=>` indicate that you must scroll the screen left or right to view off-screen column items.
2. Press **SELECT**. Key in the new location (msus or Directory Path). Press **ENTER** when data entry for the selected item is complete.

Note Leave the Directory Path field blank unless you are using an SRM system, or HP BASIC 5.0 (or later version) that uses directory path hierarchy.

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3. Repeat steps 1 and 2 until you have finished editing. Press **DONE** to display the Mass Storage Menu command screen.

The Data Volume is predefined to use RAM DISK `":MEMORY,0,0"`. If this RAM disk is not initialized to at least 1040 records, or contains additional files not required by module verification, BASIC error 64 may occur. Either reinitialize the RAM disk or use the Mass Storage Menu edit screen to select another medium.

Mass Storage Menu Command Screen

From the command screen, you can press **STORE** to save the edited data. Saving Mass Storage Menu data for the first time causes an error message prompting you to create a file. Do this simply by pressing **CREATE**.

Next, press **main menu** to return to the Main Menu screen, or press **EDIT** and return to the Mass Storage Menu edit screen.

Parameter Menu

You may determine some operating conditions of the software program in the Parameter Menu. You can select the printer and its output parameters, decide whether you want the program beep feature on or off, include a message on the test-results output, etc. Use the SELECT/TOGGLE softkey to select the parameter item and enter data, or toggle to a predefined state. The parameter items and their appropriate selections are defined below.

Parameter Menu Edit Screen

Results sent to:	Your choices are Screen or Printer. Press SELECT/TOGGLE. When `Screen` is displayed, the test results appear on the CRT. When `Printer` is displayed, test results are displayed on-screen and printed out.
Output Format:	Your choices are Graph or Table. Press SELECT/TOGGLE. When `Graph` is displayed, test results are generated in a graph format if appropriate for the particular test results (a graphics printer is required if `Printer` and `Graph` are both selected). When `Table` is displayed, the test results are output in a table format.
Printer Lines:	Lines allowed are from 50 to 70. Press SELECT/TOGGLE. Enter a number from 50 to 70 to set the number of lines per printed page.
Line Frequency:	Valid frequency selections are 50, 60, and 400 Hz. Press SELECT/TOGGLE until the power line frequency for your system is displayed. The line frequency value affects some test results.
Beeper to be activated:	Your choices are Yes or No. Press SELECT/TOGGLE. When `Yes` is displayed, the warning and time-lapse reminder beeps are activated. When `No` is displayed, the program's beep feature is disabled.
Verify equipment on HP-IB:	Your choices are Yes or No. Press SELECT/TOGGLE to indicate your choice. `Yes` causes the program to verify the presence of each instrument on HP-IB at the address shown in the Equipment Menu. Select `No` to bypass this feature.
Test person's ID:	Press SELECT/TOGGLE, then enter your name or ID number to include it on the output report.
Number lines added:	Lets you include a printed message with the test results. Depending on the program, you can enter up to 30 lines, with no more than 30 characters per line. Enter the message you wish to have printed in this screen by selecting User Line.
User Line:	1. Position the cursor to the left-hand side of a User Line in the menu. Press SELECT/TOGGLE. 2. The prompt, `Enter additional information`, appears. Type in your message (up to 30 characters per line), then press ENTER.

3. After you have entered your message, reposition the cursor at **Number lines added:**. Enter the number of user lines your message occupies, then press (ENTER).

Parameter Menu Command Screen

Press **DONE** when you are finished with the Parameter Menu edit screen. The next screen displayed is the command screen. Press **STORE** to save any edited Parameter Menu data, **EDIT** to return to the edit screen, or **main menu** to return to the Main Menu screen.

Saving Parameter Menu data for the first time causes an error message. The message prompts you to create a file. Do this simply by pressing **CREATE**.

Equipment Menu

The Equipment Menu edit screen displays a list of all the equipment required to test your DUT completely. Next to each DEVICE TYPE in the equipment list is a column labeled DEVICE MODEL for the model number, ADDRESS for the HP-IB address, SERIAL or ID NO. (for example, calibration lab number), and PRIVATE BUS for private bus designation (as for HP 8757A Network Analyzers, etc.).

Chapter 1 contains a table of required test equipment. Using preferred models of test equipment assures the most complete verification and adjustment testing. Refer to "Verification Tests" in Chapter 3 and "Adjustment Procedures" in Chapter 4 for individual test descriptions and test setups.

Equipment Menu Edit Screen

From the Equipment Menu edit screen you can enter data about your test equipment. You cannot edit the DEVICE TYPE column.

You may use either the cursor arrow keys or the RPG knob to position the cursor at the column item you wish to edit.

1. Edit a DEVICE MODEL item by locating the cursor beside the model number you wish to edit. Press **SELECT**, type the model number, then press (ENTER).
2. Edit an ADDRESS by locating the cursor beside the address you want to edit. Press **SELECT**, edit the address, then press (ENTER).

   If the DEVICE MODEL has no address in the ADDRESS column, **Missing ETE** is included in the Status column next to the tests that required the device. Tests tagged with **Missing ETE** are not performed.

   Valid active device addresses are restricted to the following ranges:

   - 700 to 730 and 800 to 830 for an HP 70000 Modular Spectrum Analyzer master module.
   - 700 to 730 for any other device type.

   These three-digit HP-IB address include the HP-IB select code and the actual HP-IB address. For example, an HP 70000 Modular Spectrum Analyzer HP-IB select code of 8 and an HP-IB address of 21 yields an address of 821. The addresses of DUTs that function as slaves should match their master device's address.

Address passive devices (non-programmable devices such as sensors, directional bridges, and detectors) as either `Available` or `Not Available`. For some of the passive devices, entering `Available` in the address column requires entering calibration data and a serial number for the device. The calibration data for a passive device is stored on Operating Disks.

Passive devices tagged `Not Available` in the address column cause `Missing ETE` to be printed next to the test names on the test results that are output for any procedure that required the missing device. Tests tagged with `Missing ETE` are not performed.

3. Edit a SERIAL NUMBER by locating the cursor beside the serial number. Press **SELECT**, enter the new serial number (10 digits or less), then press (ENTER). Some passive devices that have `Available` displayed in the address column must also have a serial-number entry.
4. Enter 19 in the PRIVATE BUS column if you are to use a Microwave or Full Microwave source with a network analyzer. Configure these instruments by connecting the source's HP-IB cable to the network analyzer's SYSTEM INTERFACE connection.
   a. Move the cursor through the DEVICE TYPE column until you reach the Full Microwave or Microwave source, then move horizontally to the PRIVATE BUS column.
   b. Enter `19` and press (ENTER). The program enters the ADDRESS column data for the selected source when 19 appears in the PRIVATE BUS column. Nineteen is the only allowable address for sources on a private bus. Refer to the network analyzer's manual for addressing information.

Equipment Menu Command Screen

After you have finished editing the Equipment Menu, press **DONE** to enter the Equipment Menu command screen. Press **STORE** to save the edited data.

Saving Equipment Menu data for the first time generates an error message prompting you to create a file. Do this simply by pressing **CREATE**.

This command screen displays the following additional softkeys:

edit cal data displays the Select Passive Device screen. From this screen, move the cursor to the passive device that needs its calibration data edited. Press **SELECT**, then enter the required data. Refer to "Edit Calibration Data" in this chapter for more information.

NO ADDRESS appears only if the program cannot find an instrument at a specified HP-IB address. To check which instruments are not responding, follow the steps below.

1. Access the Equipment Menu edit screen.
2. Scroll the ADDRESS column for flashing addresses, then be sure that the instrument is on.
3. **SELECT** the flashing address and either correct the address or press **NO ADDRESS** to delete all fault-addresses from the edit menu.

Note

Either exiting the Equipment Menu or entering the Test Menu causes the program to search the addresses in the Equipment Menu for instruments assigned to HP-IB, if this feature is selected in the Parameter Menu.

4. Press main menu to return to the Main Menu, or edit cal data to enter calibration data for passive devices. Pressing edit cal data displays the Select Passive Device screen. Refer to the following section for more information.

Edit Calibration Data

The Select Passive Device screen displays all passive devices needing calibration data entered. Press edit cal data to enter the Select Passive Device screen. The program requires calibration data for some of the passive devices listed in the Equipment Menu edit screen.

Note

Selecting a passive device needing a serial number generates a prompt requesting that you enter the number via the Equipment Menu. If you have formerly entered calibration data for a passive device of a given serial number and you would rather not reenter the data, replace your current Operating Disk with one containing data for passive devices from previous testing. Press REPEAT to access the calibration data from that disk. If you only need to enter the passive device's calibration data, press CREATE to enter the Edit Calibration Data screen, then begin at step 4.

1. Locate the cursor beside the device and press SELECT. The next screen displayed allows you to delete or edit data related to the passive device.

Note

Not all frequencies are listed on the screen at once. Be sure to enter calibration data for frequencies listed on the next pages of the display.

2. If you edit the factory default FREQUENCY or CAL FACTORS values, enter valid calibration factors for each frequency edited.

Note For power sensors, you must enter a frequency and calibration factor for 10 MHz and 300 MHz, even if the device has no factor listed at 10 MHz or 300 MHz. Enter the values from the list of valid factors, below. Other frequencies outside the normal range of the device may also be required. Prior to using your device, you may need to calibrate it at these frequencies to ensure accurate measurement results.

Passive Device	Calibration Factors
Mixers	16 to 24 dB
Directional Couplers	8 to 11 dB
Noise Sources	12 to 16 dB
Sensors	0.3 to 1.6 (stored as a percentage by the program)

Edit Calibration Data Edit Screen

1. Move the cursor to a column item and press SELECT. Enter the new frequency or calibration factor, then press ENTER. (It is not necessary to enter new frequency values in numeric order. The program sorts them before storing them on the Operating Disk.)
2. To delete an item, move the cursor to the column item. Press SELECT, clear the line, then move to another item. Repeat the above process as needed to edit frequency values or calibration data for any passive devices.

Edit Calibration Data Command Screen

1. After you have entered the necessary data, press DONE. The Equipment Menu command screen is displayed.
2. From the command screen, you can press main menu when you are ready to continue with the program.

HP-MSIB Address Menu

The HP-MSIB Address Menu lists the names and HP-MSIB addresses of the modules in the HP 70000 Modular Spectrum Analyzer that you may select to test. The HP-MSIB address of the master and the system are the same. In other words, the address of the master module determines the address of the system. For information on configuring the software to test a specific module, refer to "Equipment Menu" in this chapter.

There is no edit screen for this menu. The command screen has a SELECT MODULE softkey but requires no STORE softkey. Locate the cursor next to the module you wish to test. Press SELECT MODULE. Be sure the module selected here matches the Module Under Test listed in the Equipment Menu.

Test Menu

Pressing test menu from the Main Menu screen accesses the Test or Adjust selection screen. If ERROR MESSAGE: The _____ is listed as the DUT in the Equipment Menu, but the _____ is selected in the HP-MSIB Address Menu appears, the possible fix information suggests you select either MODIFY MODULE to enter new ROM data or CHANGE DUT to select the module you wish to test.

If you press MODIFY MODULE, on-screen commands help you change the model and serial number to the module you want to test. If you press CHANGE DUT, go either to the Equipment Menu to change the model number or to the HP-MSIB Address Map to select the module number you want to test.

To begin the testing process, select TEST to run verification tests or ADJUST to perform adjustments procedures. Press main menu to return to the Main Menu.

If you have pressed FINAL TEST, and wish to get to the adjustment procedures, press main menu, RESTART, TEST MENU, then ADJUST. If you are in the adjustment procedures and want to get to the verification tests, press main menu, RESTART, TEST MENU, then TEST.

Caution Pressing either RESTART or equipment menu any time after testing begins purges Test Menu Status column information. Selecting a new module to test in the HP-MSIB Map Screen Menu also deletes the Status column data. The assumption is that verification-test status will most likely be modified if you are moving between modules, ETE model numbers, or to the adjustment procedures.

After selecting Tests, the names of the verification tests are displayed. Review the Status column for tests performed.

Additional test equipment is required to perform tests beside which Missing ETE is listed. To review which additional test equipment is required, locate the cursor beside the test name, then press SINGLE TEST. The Missing ETE screen displays the missing test equipment for that test.

A message stating that calibration data for passive devices is missing may also appear. If the correct Operating Disk is in the default drive, store the calibration data there. Press CREATE to build the data file. After the problem is cleared, the Test Menu is displayed.

Test Menu Command Screen

The Test Menu only has a command screen. It deviates from the command screen formats previously described. The following list defines the softkeys available in this menu.

FINAL TEST — begins a sequence of final tests, which are a subset of verification tests. A full calibration requires all verification tests. Review the Test Menu Test Name list for all available tests. During the final test sequence, the keys listed below are also available.

- END SEQUENCE — interrupts the test sequence at the end of the test in progress. The Test Menu is displayed with an additional softkey labeled RESUME TESTING. Press this key to resume the test sequence where the program left off.

ABORT — ends the testing process and displays the Test Menu. From there you may choose some other action.

RESUME TESTING allows you to continue the final test sequence after you have pressed FINAL TEST followed by END SEQUENCE.

SINGLE TEST lets you select an individual test to run. If **Missing ETE** is listed in the Status column, you can review which test equipment is missing. Locate the cursor beside that test name, then press SINGLE TEST. The Missing ETE screen is displayed. If you choose to return to the Test Equipment Menu via the Test Menu to install the missing test equipment, you lose the status of any tests that have run. To run a single test that has the necessary ETE, locate the cursor beside the test name and press SINGLE TEST.

multiple test softkey lets you organize a group of tests sequentially. Locate the cursor beside the test you want to run. Press SELECT to assign the first number of the series to that test. Continue to locate the cursor and press SELECT until you have organized the tests you want to run. Press END LIST when you are ready to begin testing. During testing, the following softkeys are also available.

END SEQUENCE — interrupts the test sequence at the end of the test in progress, then displays the Test Menu.

ABORT — ends the testing process and displays the Test Menu. From there you may choose some other action.

repeat mult. softkey allows you to select a test sequence (you determine the quantity and order). The tests loop through this sequence until you decide to stop them. Locate the cursor beside the test you want to run, press SELECT, move the cursor to the next test, press SELECT, etc. Continue selecting tests until you are ready to begin testing. It is acceptable to select the same test for repeated testing. Press END LIST to start the test sequence. During testing, the following softkeys are also available.

END SEQUENCE — interrupts the test sequence at the end of the test in progress, then displays the Test Menu.

ABORT — ends the testing process and displays the Test Menu. From there you may choose some other action.

more keys toggles between SUMMARY, select output, and PURGE CAL DATA and the previously explained Test Menu command screen softkeys.

SUMMARY — gives you a printout of the current test(s) run.

select output — chooses an output device. You can print test results by pressing PRINTER, or you can print the current display by pressing SCREEN. Press RETURN to return to the previous set of softkeys in the Test Menu command screen.

PURGE CAL DATA Pressing this softkey deletes stored calibration data for the spectrum analyzer and any other calibration routines used for testing. Before module verification tests can be run again, equipment calibration routines have to be redone.

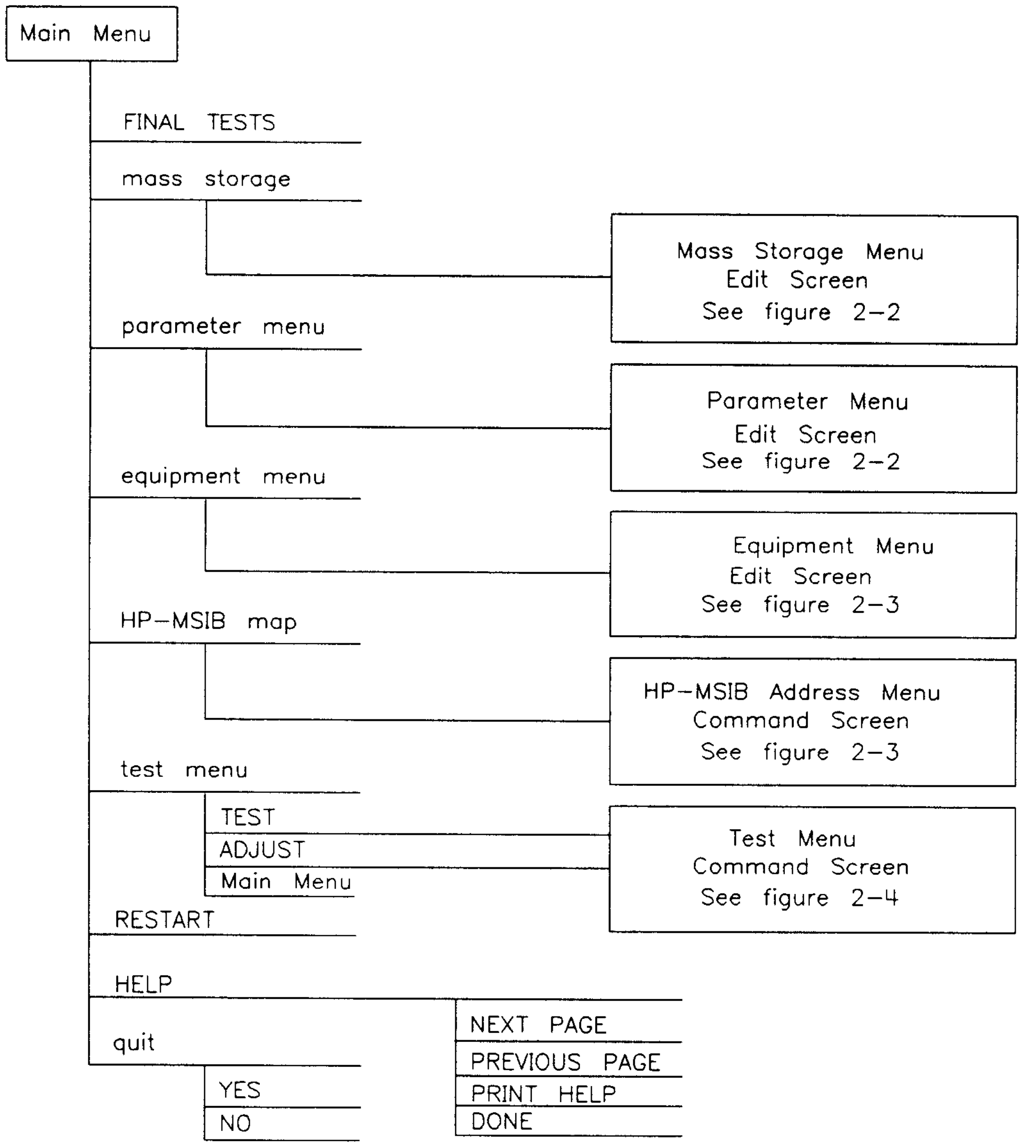
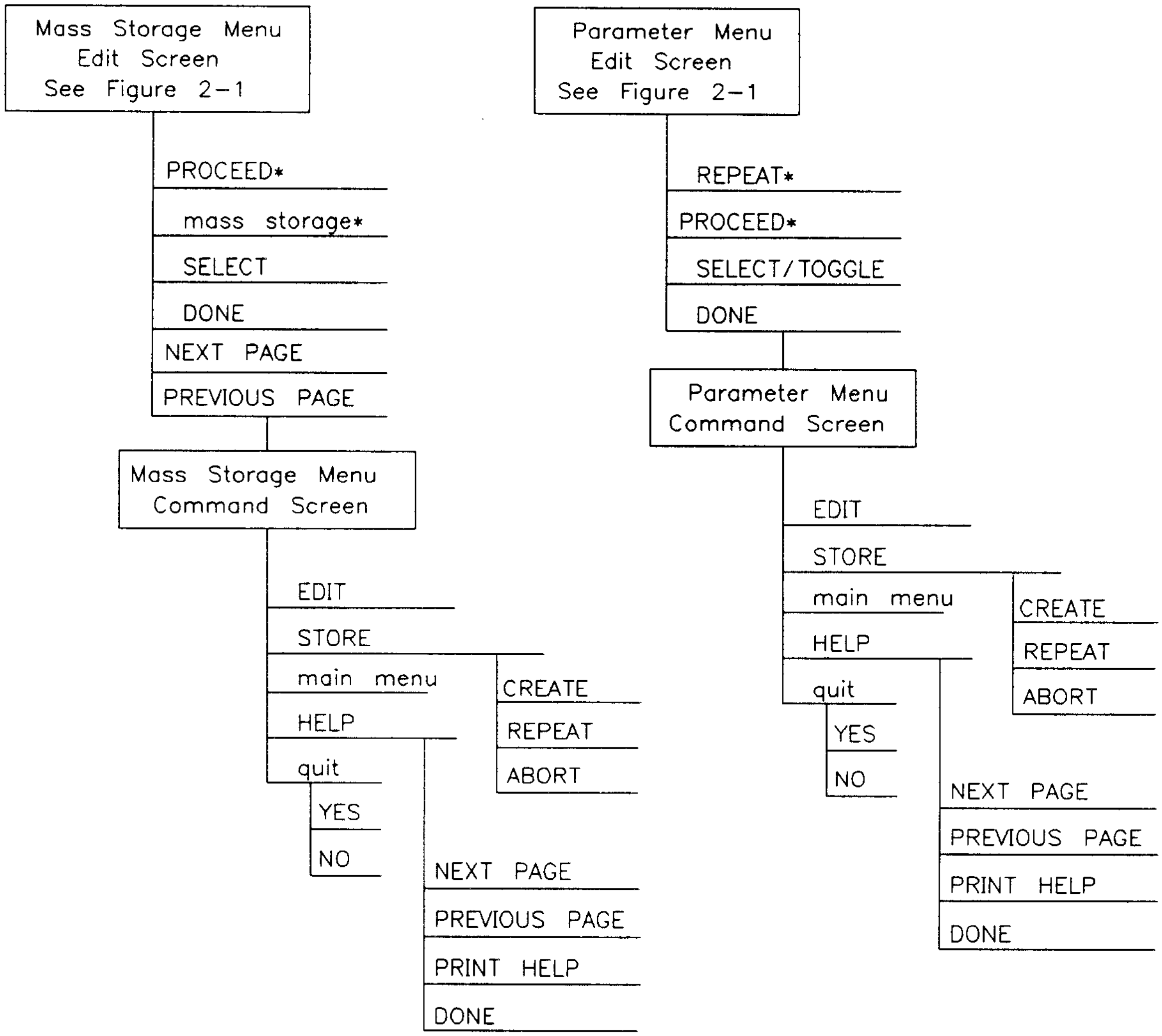
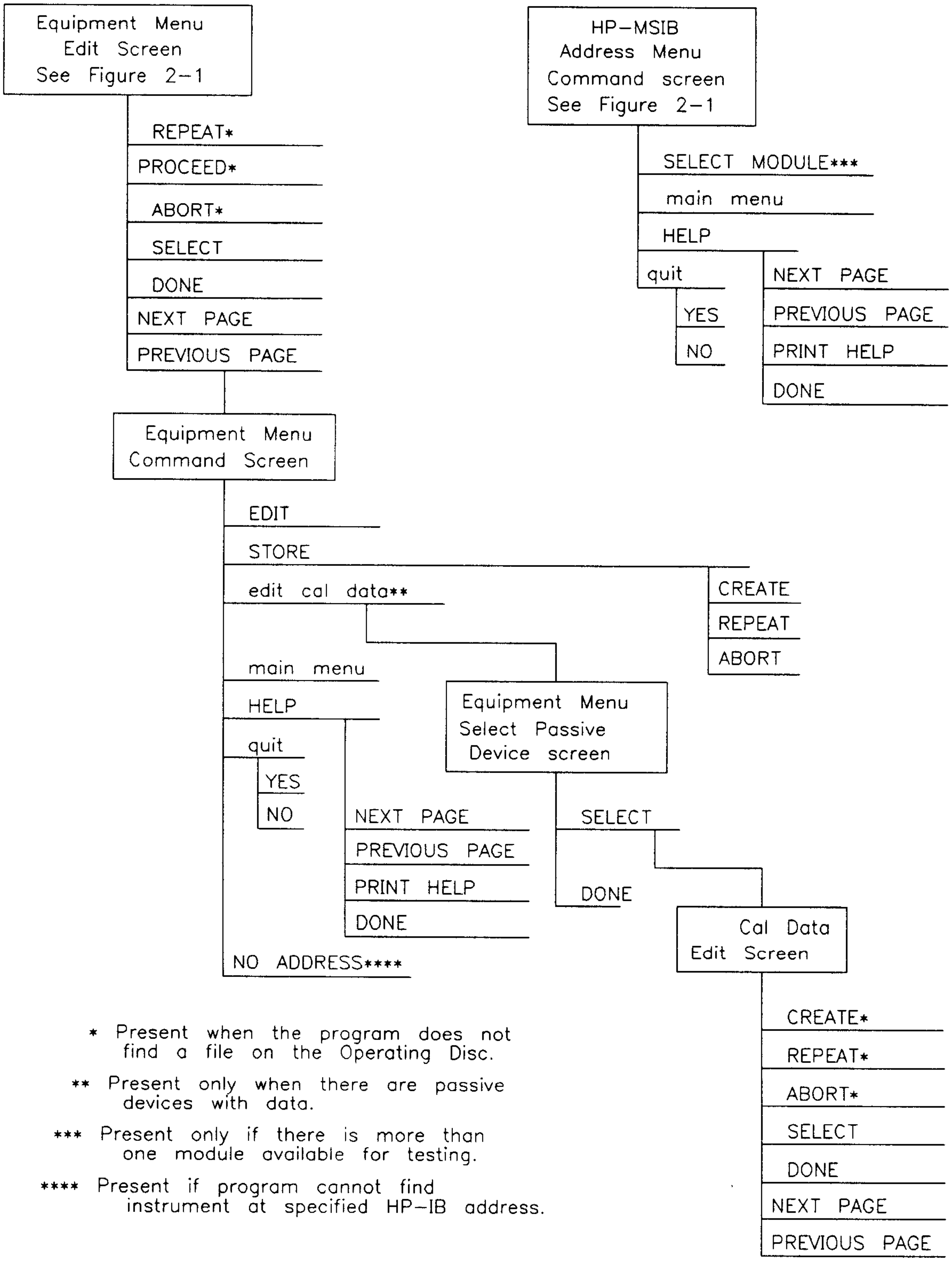


Figure 2-1. Main Menu Softkeys



* Present when the program does not find a file on the Operating Disc.

Figure 2-2. Mass Storage Menu and Parameter Menu Softkeys



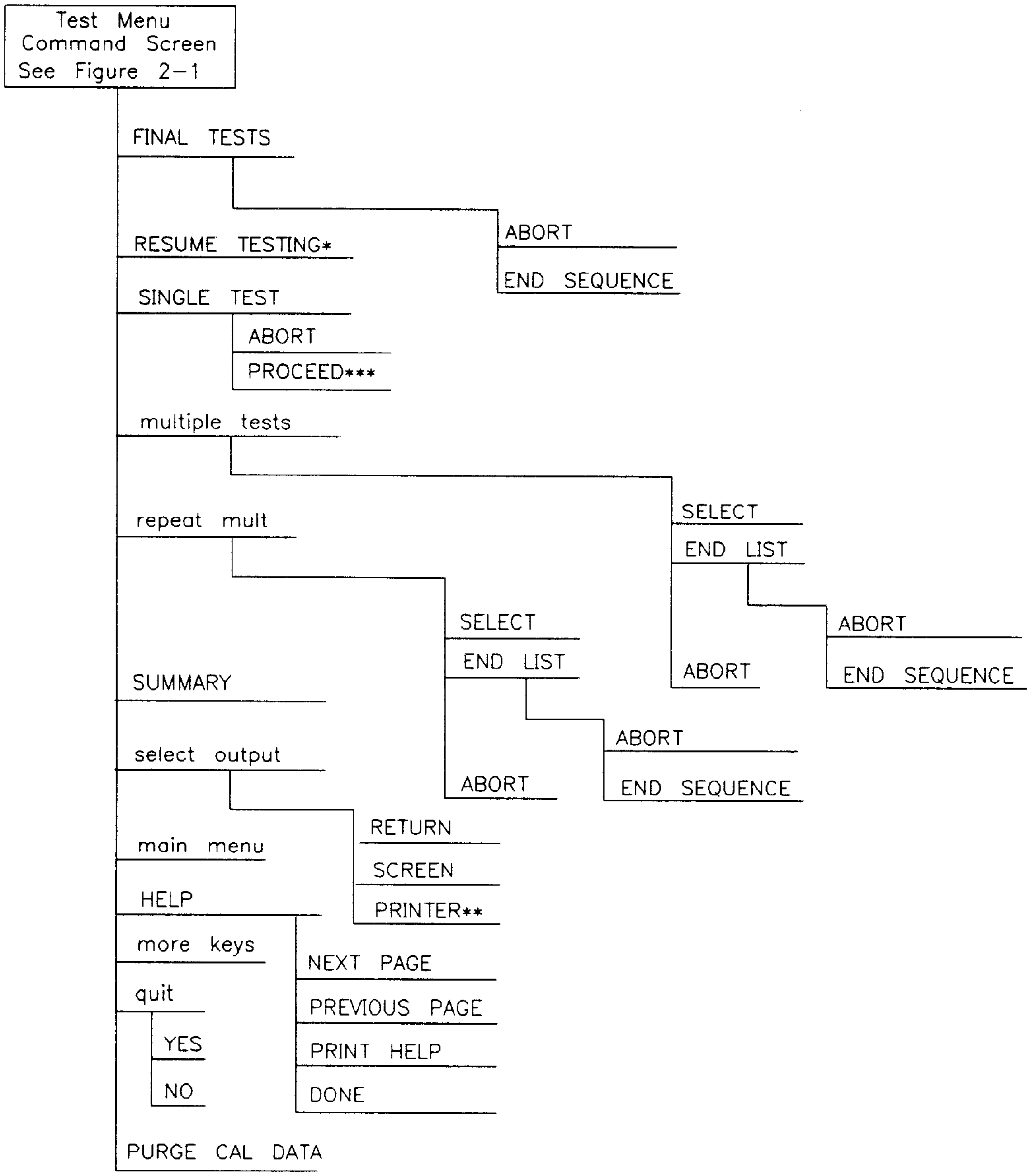
* Present when the program does not find a file on the Operating Disc.

** Present only when there are passive devices with data.

*** Present only if there is more than one module available for testing.

**** Present if program cannot find instrument at specified HP-IB address.

Figure 2-3. Equipment Menu and HP-MSIB Map Screen Menu Softkeys



*Present only if END SEQUENCE was previously selected for FINAL TESTS.

**Present only if a printer address is available in Equipment Menu.

***Present when you've selected SINGLE TEST for a test having **Missing ETE** in the status column.

Figure 2-4. Test Menu Softkeys

Error and Status Messages

User interface messages used with HP 70000 Series software products are alphabetized in this section. The messages are designed to provide information about test results, operator errors, system conditions, etc. Refer to your *HP BASIC Language Reference* for system error information.

`Aborted`

You aborted the test indicated.

`EEPROM for _____ is defective.`

The EEPROM needs to be replaced.

`Failed`

The module under test needs adjustment or repair to pass the test number indicated.

`CAUTION: Passthru address is incorrect. (See Edit Screen).`

The address of the microwave source is not set to 19, or the address specified in the Equipment Menu does not match the address of the synthesized source. Return to the edit screen of the Equipment Menu to modify addresses in either the address column or the private bus column.

`CAUTION: Some Model #'s are not supported. (See Edit Screen).`

You have model numbers in the Equipment Menu that are not supported by the software. Ignore this caution if you are sure program memory contains a driver for these models. A driver that is required but missing causes the error message `Undefined function or subprogram` to appear on-screen. You are returned to the Test Menu.

`Equipment list is not acceptable.`

You attempted to enter the Test Menu, but the program could not locate all the instruments for which you have specified HP-IB addresses. Verify that the indicated equipment is turned on, then return to the Equipment Menu edit screen to verify accuracy of addresses that are flashing in either the address column or the private bus column.

`Equipment list shows no analyzer to test.`

The DUT has no assigned HP-IB address. Return to the Equipment Menu and edit the Address column.

`ERROR: Address matches system disk drive.`

You entered an HP-IB address matching that of the computer's external disk drive. HP-IB protocol allows only one instrument per address.

`Address not in acceptable range.`

You entered an HP-IB address outside the range 700 to 730, inclusive.

`ERROR: Duplicate HP-IB address.`

You attempted to exit the Equipment Menu after assigning the same HP-IB address to different model numbers. HP-IB protocol allows only one instrument per address. (It is acceptable to assign the same address to identical model numbers, implying multiple use of the same instrument.)

ERROR: **Non-responding HP-IB address.**

You attempted to exit the Equipment Menu after assigning an HP-IB address to an instrument not responding on HP-IB.

ERROR: **Search for ____ unsuccessful.**

The program tried to find the disk identified but could not. Either assign a drive to the disk and press REPEAT or insert the required disk into its appropriate drive. Press REPEAT.

ERROR: **Some devices listed as Available require serial numbers.**

You pressed View Cal Data, then selected a device to which you have not assigned a required serial number. Display the Equipment Menu edit screen and assign the serial number.

ERROR MESSAGE: **Address is HP-IB controller address.**

You entered an HP-IB address matching the computer's address. HP-IB protocol allows only one instrument per address.

ERROR MESSAGE: **Attempt to close file ____ failed.**

There is a problem with the data file on the Operating Disk. Correct the problem, then do one of the following:

- Press REPEAT to try again.
- Press CREATE to create a new file.
- Press ABORT to return to the Main Menu.

ERROR MESSAGE: **Attempt to create file ____ failed.**

There is a problem with the data file on the Operating Disk. Correct the problem, then do one of the following:

- Press REPEAT to try again.
- Press CREATE to create a new file.
- Press ABORT to return to the Main Menu.

ERROR MESSAGE: **Attempt to Edit Mass Storage failed.**

Your edits to the Mass Storage Menu were not valid. Return to this menu and correct the errors.

ERROR MESSAGE: **Attempt to store Mass Storage failed.**

You pressed ABORT after pressing STORE mass storage. The Mass Storage Menu failed. Press ABORT to return to the Main Menu.

ERROR MESSAGE: **Bad instrument address in equipment list. Address matches controller.**

You entered an HP-IB address matching that of the controller. HP-IB protocol allows only one instrument per address and only one controller per HP-IB system. (The factory preset controller address is 21.)

ERROR MESSAGE: **Calibration data frequency exceed acceptable limits.**

Return to the Calibration Data edit screen and correct the data entries that are flashing.

ERROR MESSAGE: **Calibration data frequency is less than minimum range of ____.**

The frequency entered next to the device in the Cal Data edit screen is out of the device's operating range. The return to this screen is automatic. Enter valid frequencies for the values that are flashing.

ERROR MESSAGE: **Calibration data frequency is greater than maximum range of ____.**

The frequency entered next to the device in the Cal Data edit screen is out of the device's operating range. The return to this screen is automatic. Enter valid frequencies for the values that are flashing.

ERROR MESSAGE: **Calibration data for ____ is blank for some frequencies listed.**

Return to the Calibration Data edit screen to enter the calibration data for frequencies indicated with flashing markers.

ERROR MESSAGE: **Calibration data for ____ is less than minimum range of ____.**

The factor entered next to the device in the Cal Data edit screen is out of the device's operating range. The return to this screen is automatic. Enter valid values for the ones that are flashing.

ERROR MESSAGE: **Calibration data for ____ is greater than maximum range of ____.**

The factor entered next to the device in the Cal Data edit screen is out of the device's operating range. The return to this screen is automatic. Enter valid values for the ones that are flashing.

ERROR MESSAGE: **Calibration data file not found for ____ with serial number ____.**

The data file cannot be found or there is a problem with the data file on the Operating Disk. Correct the problem, then either press REPEAT to try again or press (CONTINUE).

ERROR MESSAGE: **DUT does not have an address.**

You attempted to leave the Test Equipment Menu, but the program cannot verify the DUT at the specified HP-IB address. First check the address. If the address is correct, cycle the main power of the system under test.

ERROR MESSAGE: **DUT was not at address in the equipment list. DUT was expected at address ____.**

The DUT is not at the specified address, or HP-IB is at fault, or main power is off on the DUT. Press ABORT, then return to the Equipment Menu to verify the address.

ERROR MESSAGE: **DUT was not found at address in equipment list.**

The address specified for the DUT is not valid. Press ABORT, then return to the Equipment Menu to verify the address.

ERROR MESSAGE: **Equipment address matches external disk drive.**

You entered an equipment address matching that of the external disk drive. HP-IB protocol allows only one instrument per address.

ERROR MESSAGE: **Equipment Menu data not found on ____.**

The program could not find the Equipment Menu data file on the Operating Disk. **Possible Fix** instructions appear with the on-screen error message. If the data file is available in a location other than the one currently specified in the Mass Storage Menu, return to that menu and change the msus and/or the directory path of the Operating Disk. It may also be that the Operating Disk accessed by the program is not the one containing the Equipment Menu file. Insert the correct Operating Disk, then press REPEAT or (CONTINUE).

ERROR MESSAGE: Equipment does not have an address.

There is no address assigned to the DUT. Return to the Equipment Menu edit screen and verify or enter an address in the Address column.

ERROR MESSAGE: ERROR XXX in XXXXX ____ .

An unanticipated occurrence in the program caused a program failure. For clarification, call your Hewlett-Packard Sales and Service Office.

ERROR MESSAGE: File ____ not found while assigning I/O path.

You attempted to STORE a list (equipment, mass storage, or parameter) for the first time on the current Operating Disk. **Possible Fix** instructions appear with the on-screen error message. Follow the on-screen instructions or return to the Mass Storage Menu to change the location of the Operating Disk.

ERROR MESSAGE: Incorrect Volume found. ____ required.

The wrong disk is in the required storage medium. Either correct the fault and press REPEAT to retry, or select mass storage to return to the Mass Storage Menu. From here you can indicate a different mass storage drive.

ERROR MESSAGE: Parameter Menu data not found on ____.

The program could not find Parameter Menu data file on the Operating Disk. **Possible Fix** instructions appear with the on-screen error message. If the data file is available in a location other than the one currently specified in the Mass Storage Menu, return to that menu and change the msus and/or the directory path of the Operating Disk. It may also be that the Operating Disk accessed by the program is not the one containing the Parameter Menu data file. Insert the correct Operating Disk, then press REPEAT or (CONTINUE).

ERROR MESSAGE: Read ____ data from file ____ failed.

There is a problem with the data file on the Operating Disk. Correct the problem, then either press REPEAT to try again or (CONTINUE) to use default values.

ERROR MESSAGE: Selected instrument under test is ____; but the software supports the ____.

The module entered in the HP-MSIB map is not currently supported by software. Either load the correct software or select a different module in the Equipment Menu or HP-MSIB Map Menu.

ERROR MESSAGE: Sensor model # ____ not supported.

Software does not support the sensor model number entered for the Signal Sensor in the Equipment Menu. Return to the Equipment Menu and select a sensor with a model number that is supported. (Refer to Chapter 1 for a list of supported equipment.)

ERROR MESSAGE: `Test Parameter data file not found on ____.`

The program could not find parameter-list data file on the Operating Disk. `Possible Fix` instructions appear with the on-screen error message. If the data file is available in a location other than the one currently specified in the Mass Storage Menu, return to that menu and change the msus and/or the directory path of the Operating Disk. It may also be that the Operating Disk being accessed by the program is not the one containing the parameter-list data file. Insert the correct Operating Disk, then press REPEAT or (CONTINUE).

ERROR MESSAGE: `The _____ is listed as the DUT in the Equipment Menu, but the _____ is selected in the HP-MSIB Address Menu.`

The DUT and the model selected in the HP-MSIB Address Map do not agree. You are given suggested fix instructions either to modify the module or change the DUT.

ERROR MESSAGE: `The Operating Disk is write protected.`

Make a working copy of the Operating Disk and store the original in a safe place, or remove the write-protect.

ERROR MESSAGE: `Too many Cal Data frequencies were eliminated. There must be at least two frequencies.`

Only one Cal Frequency remains in the Cal Data edit screen. Return to that screen and enter more frequencies in the Frequency column.

ERROR MESSAGE: `Write ____ data to file ____ failed.`

There is a problem with the data file on the Operating Disk. Correct the problem, then do one of the following:

- Press REPEAT to try again.
- Press CREATE to create a new file.
- Press ABORT to return to the Main Menu.

ERROR MESSAGE: `Wrong device at specified address. DUT was expected at address ____.`

The address specified for the DUT is actually that of a test instrument. `Possible Fix` instructions appear with the on-screen error message. If necessary, return to the Equipment Menu.

ERROR MESSAGE: `____ Volume was not located.`

The program cannot access the listed Volume. If the Volume is correct, press REPEAT to retry. If the Volume is incorrect, press `mass storage` to return to the Mass Storage Menu. From here you can indicate a different mass storage medium for the Volume in question.

FORMAT ERROR: `Observe date format and character position.`

You entered the date/time in an unacceptable format. Enter date/time in the format `dd mmm yyyy` and `hh:mm`, then press (ENTER).

`Hdw Broken`

Actual test results far exceed the expected results. This is often an indication of a hardware failure (hardware broken) or incorrect connections.

Logging errors to ERRORLOG failed. Operating Disk is write protected.

The program tried to store error data onto the Operating Disk and could not because of the write-protect. Make a working copy of the Operating Disk and store the original in a safe place, or remove the write-protect.

KEYBOARD SYSTEM CRASH WITH KEYBOARD: ____.

The software program does not support the current keyboard. Install a keyboard having one of the part numbers listed at the beginning of this chapter, then restart the program.

Passed

The module meets the tested characteristics.

PAUSED. PRESS CONTINUE.

You pressed (PAUSE) on the computer keyboard. Press (CONTINUE) to resume program execution.

PRGM ERROR

The program detected an error within itself. For clarification contact Hewlett-Packard Signal Analysis Division.

Reading errors from ERRORLOG failed. Check disk at _____.

The program tried to read error data from the Operating Disk. Check that the Operating Disk is installed in the drive specified in the error message.

Return to Equipment Menu to enter serial number for _____.

You must return to the Equipment Menu edit screen and enter a SERIAL or ID NO. for the passive device selected before you can edit the device's calibration data.

Setup Error

The program aborted the test after attempting to verify the test setup. Ensure that all required ETE is present, has been turned on, and is properly connected.

SORRY, but your SERIAL NUMBER must end in a NUMERIC -- This is _____.

Contact Hewlett-Packard Signal Analysis Division for assistance.

Test can not be done.

Required ETE is missing. Return to the Equipment Menu and enter all ETE listed as required for the current test.

TEST_LIST is not compatible.

A bad test list exists. Contact Hewlett-Packard Signal Analysis Division for assistance.

The controller does not have sufficient memory. This software cannot load. See the computer hardware system documentation for information on adding additional memory.

Either refer to the appropriate manual to extend the memory capability of your system, or off-load some data to make room for the program.

The ____ at address ____ was not found on HP-IB.

When Verify HP-IB is set to ON in the Parameter Menu, this error message displays the ETE with the address that is either missing or not set to ON.

`The 436A is in lowest range, waiting 10 seconds.`

The current power measurement requires the lowest power-meter range. Program execution will resume in 10 seconds.

`The 8902A needs repair (Error 6).`

There is a problem related to the HP 8902A. Correct the fault or return to the Equipment Menu where you can enter a different model number.

`The DUT must have an HP-IB address.`

You attempted to leave the Equipment Menu, but the program cannot find the HP 70000 system at the assigned HP-IB address.

`THIS COLUMN CAN NOT BE EDITED.`

You pressed SELECT with the cursor positioned in the first column of the Mass Storage edit screen or the Equipment Menu edit screen. This column cannot be edited.

`THIS IS ____ AND FOUND DUPLICATE FILES: ____.`

Contact Hewlett-Packard Signal Analysis Division for assistance.

`This test can not be selected because of missing ETE.`

You were in either Multiple Tests or Repeat Multiple, then tried to select a test that has missing ETE. This is not allowed. Check the Status column of the Test Menu to verify a `Missing ETE` tag next to the test name you attempted to select.

`Timed Out`

The program aborted the test.

`WARNING: Duplicate Address`

You entered a duplicate HP-IB address to an item in the Equipment Menu. (You may have to scroll through the menu to find the duplication.)

`WARNING: Duplication may exclude specific tests.`

You assigned two generic device functions to one ETE. (For example, the TOI test will not be run if you assign a single HP 3335A as both the required level generator and the required general source.)

`WARNING: String is too long. It has been truncated.`

You entered too many characters in a user's line of the Parameter Menu edit screen. Select the line and enter 30 or fewer characters.

`Write protected.`

You attempted to store data on a write-protected disk. After correcting the fault, press (CONTINUE).

3

Verification Tests

Introduction

The HP 70907A/B module does not have module specifications, so the tests in this chapter verify the operation of the module. All of the tests for the HP 70907A/B are listed below; final tests are listed in **bold**. All of the tests are automated; refer to Chapter 2 for instructions on running the verification software. Refer to "Repair Matrix" in Chapter 1 for information about which tests and adjustments must be run after module repair.

1. Noise Figure 3-12
2. Third Order Intercept 3-14
3. **21.4 MHz Output Response** 3-16
4. **Module Gain and Calibration Source** 3-18
5. **Front Panel LEDs** 3-20
6. **Main LO Output Amplitude and Harmonics** 3-22
7. Auxiliary LO Output Amplitude and Harmonics 3-24
8. 300 MHz Output Amplitude and Harmonics 3-26
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10. IF Subharmonics 3-30
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15. 21.4 MHz Daisy Chain Loss 3-40
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17. 321.4 MHz IF Input Return Loss 3-44

Caution

The HP 70907A/B module contains assemblies that can be damaged by electrostatic discharge. All work performed on the HP 70907A/B should be done at a static-safe work station. Refer to "Electrostatic Discharge Information" in Chapter 1.

Recommended Frequency Reference Connections

Figures 3-1 and 3-2 show the recommended order for connecting test equipment when a frequency reference is required.

Calibrated Frequency Reference

Figure 3-1 shows the recommended frequency reference connections for a calibrated frequency reference.

When frequency measurements are made that use a calibrated frequency standard as a reference, a frequency counter (such as an HP 5343A or HP 5386A frequency counter) should be connected as directly as possible to the frequency standard.

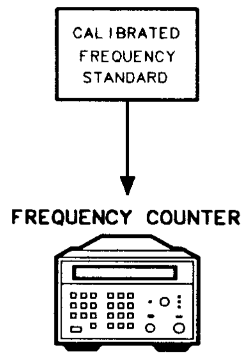


Figure 3-1. Calibrated Frequency Reference Connections

Frequency-Synchronized Test System

Figure 3-2 shows the recommended frequency-reference connections for a frequency-synchronized test system.

For test measurements that require equipment to be synchronized to a common frequency reference, optimum spectral purity is usually desired. These relative measurements do not require the absolute frequency calibration of a frequency standard. Instead, a frequency reference with sufficient drive level, stability, and spectral purity is chosen as the system reference. Figure 3-2 shows a frequency-synchronized test equipment system using the 10 MHz internal frequency reference of an HP 8663A Synthesized Signal Generator as the system reference.

Note

The rear-panel 10 MHz OUTPUT of the HP 3335A Synthesizer/Level Generator lacks the spectral purity required for most applications as a frequency reference, and should not be connected to other test equipment.

The HP 8902A Measuring Receiver does not have a standard rear-panel 10 MHz OUTPUT.

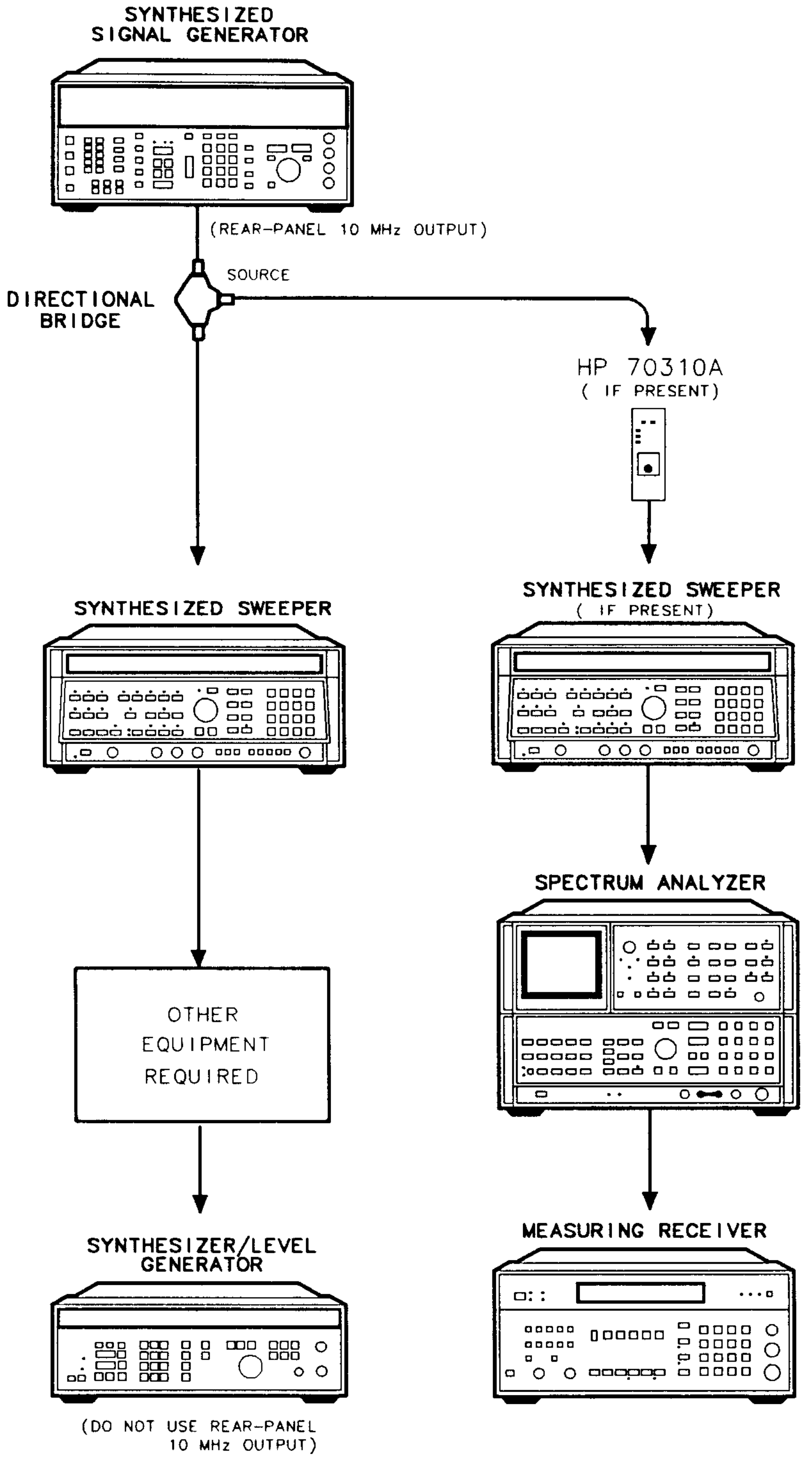


Figure 3-2. Frequency-Synchronized Test System Connections

Electronic Test Equipment Calibration

The verification tests require characterization of the sources, calibrated spectrum analyzer, microwave network analyzer, and noise figure meter. The routines store characterization data

calibration factors for the required test equipment, and if the factors are not present (or not current for the calibrated spectrum analyzer) invocation of a calibration routine is automatic.

Calibration Routine

The calibration screen lists instruments requiring calibration within the current performance test group (tests that use common instruments). Each performance test group displays a calibration screen which includes any instruments requiring calibration.

The controller treats aborted tests as a hard reset, which restarts the test. In sequence-mode, the calibration screens are transparent; in single-mode, the operator can move from test to test. The Exit Cal softkey allows loading of a previously selected test.

Test Equipment Calibrations

Synthesized Source Calibration (HP 8663A)

This routine calibrates the amplitude settings for the synthesized source, which drives the DUT's 300 MHz IN. The routine also calibrates the amplitude degradation caused by the BNC/SMB cable assembly. Refer to Figure 3-3.

Required Equipment

Synthesized Source .... HP 8663A
Power Sensor .... HP 8485A
Power Meter .... HP 436A
BNC (m) to SMB (f) Cable 85680-60093
N (m) to BNC (f) Adapter 1250-1476
SMA (f) to SMB (m) Adapter 1250-0674

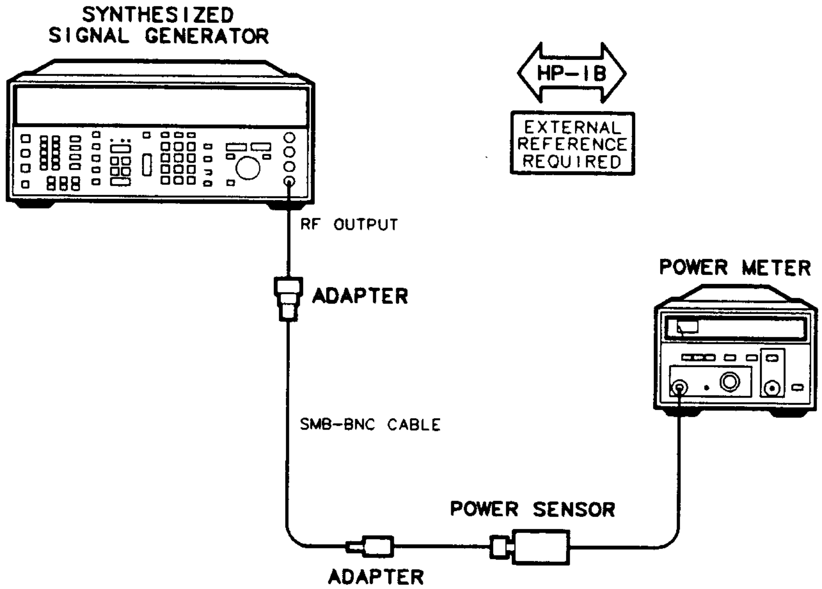


Figure 3-3. Synthesized Source Calibration Setup

The power sensor connects directly to the synthesized source output, which is incremented in amplitude from −5 to +5 dBm. Each amplitude adjusts to achieve the correct power output. The routine stores final amplitude settings in controller common memory.

Full Microwave Source Calibration (HP 8340A)

This routine calibrates the frequency response of the synthesized sweeper and the frequency response of the 6 dB fixed attenuator and APC cable assembly. Refer to Figure 3-4.

Required Equipment

Synthesized Sweeper .... HP 8340A
6 dB Fixed Attenuator .... HP 8493C, Option 006
Power Sensor .... HP 8485A
Power Meter .... HP 436A
APC 3.5 (f) to APC 3.5 (f) Adapter 5061-5311
APC 3.5 (m) to APC 3.5 (m) Cable 8120-4921

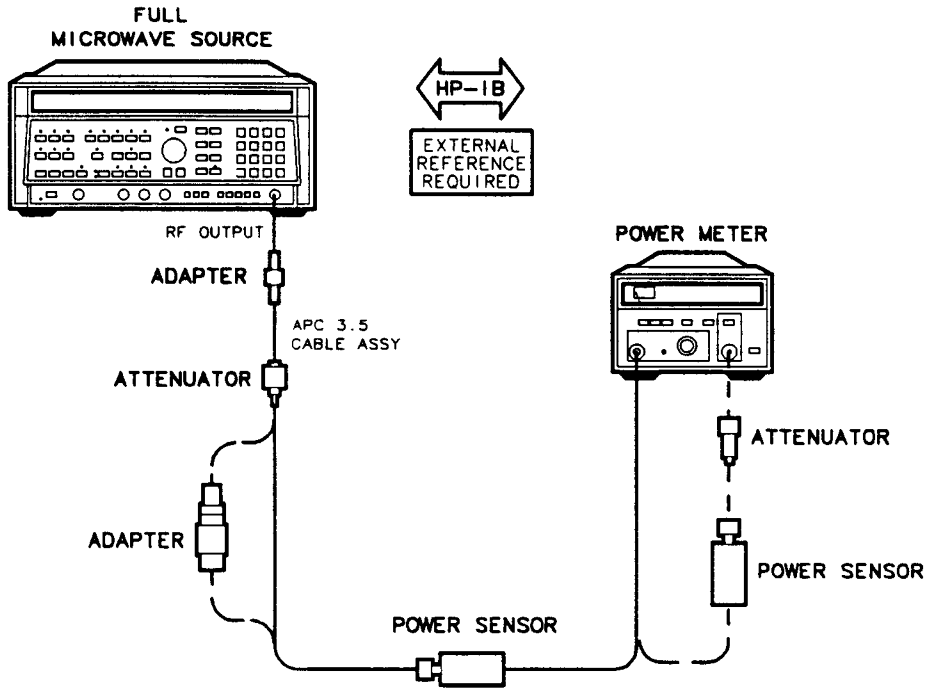


Figure 3-4. Microwave Source Calibration Setup

The synthesized sweeper steps in discrete CW frequencies from 10 MHz to 22 GHz. At each frequency, the amplitude of the full synthesized sweeper adjusts until the power meter reads either −10 or +0.5 dBm, depending on the step frequency. The routine stores the full synthesized sweeper amplitudes in controller common memory.

Microwave Source Calibration (HP 8340A)

The calibration setup is identical to the full microwave source setup except that the HP 8481D Power Sensor replaces the HP 8485A Power Sensor. Refer to Figure 3-4.

Required Equipment

Synthesized Sweeper	HP 8340A
6 dB Fixed Attenuator	HP 8493C, Option 006
30 dB Fixed Attenuator	HP 11708A
Power Meter	HP 436A
Power Sensor	HP 8481D
APC 3.5 (f) to APC 3.5 (f) Adapter	5061-5311
Type N (f) to APC 3.5 (m) Adapter	1250-1750
APC 3.5 (m) to APC 3.5 (m) Cable	8120-4921

Noise Figure Meter Calibration (HP 8970B)

The noise figure meter noise-source-drive output connects to the 28 V dc bias input of the excess noise source. The output of the noise source connects to the input of the noise figure meter.

Required Equipment

Noise Figure Meter	HP 8970B
Excess Noise Source	HP 346C
SMA (f) to SMB (m) Adapter	1250-0674
Type N (m) to BNC (f) Adapter	1250-1476
BNC (m) to SMB (f) Cable	85680-60093
BNC (m) to BNC (m) Cable	HP 10503A

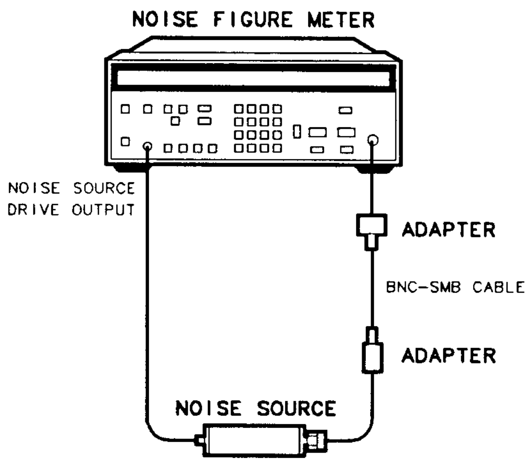


Figure 3-5. Noise Figure Meter Calibration Setup

Spectrum Analyzer Calibration (HP 8566B)

This routine characterizes the calibrated spectrum analyzer IF and RF paths. The routine stores the characterization data as measurement amplitude corrections on the operating disk. The following paragraph describes the Cal IF routine.

Required Equipment

External Reference
Level Generator .... HP 3335A
BNC (m) to BNC (m) Cable .... HP 10503A
BNC (f) to SMA (m) Adapter 1250-1200
SMA (f) to SMA (f) Adapter 1250-1158
APC 3.5 (m) to APC 3.5 (m) Cable 8120-4921
Type N (m) to APC 3.5 (f) Adapter 1250-1744

Note

Reference to the HP 8566B Calibrated Spectrum Analyzer implies use of the same RF cable used during calibration of the analzyer; they are a matched set. If a test requires the calibrated analyzer, always connect to the cable rather than directly to the analyzer input.

Cal IF. Refer to Figure 3-6. The level generator (at 20 MHz) helps to characterize the step gain, resolution bandwidth filter-switching amplitude error, resolution bandwidth frequency error, resolution bandwidth filter errors, and log fidelity errors. All measurements normalize to the 10 kHz resolution bandwidth setting.

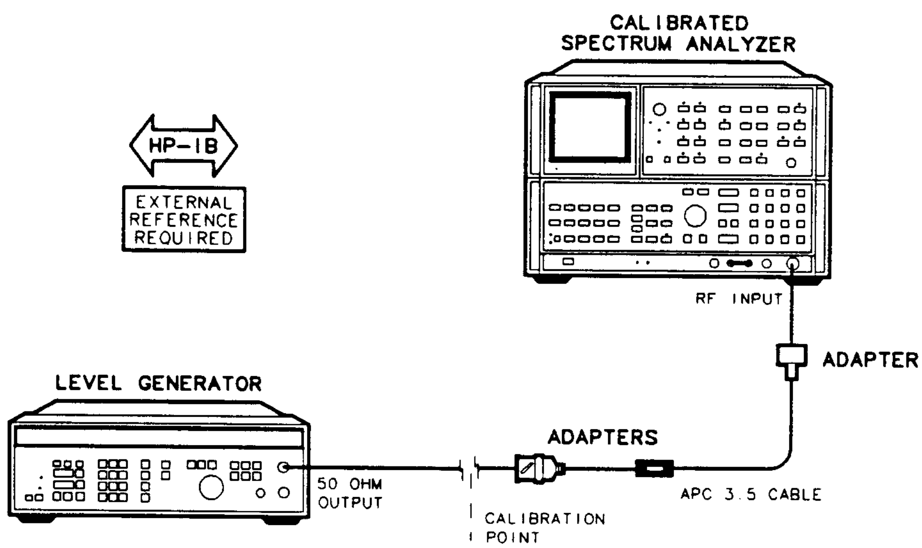


Figure 3-6. Cal IF Test Setup

Return Loss Test Block Calibration

This routine provides open/short calibration of the detectors and the microwave network analyzer used in return loss performance tests. The particular return loss test determines the calibration frequency ranges. The calibration data is stored in controller common memory. Refer to Figure 3-7.

Required Equipment

Synthesized Sweeper	HP 8340A
Microwave Network Analyzer	HP 8757A
Power Splitter	HP 11667B
Directional Bridge	HP 85027B
Detector *(2 required)*	HP 11664E
Calibrated Open/Short	85027-60004
APC 3.5 (m) to APC 3.5 (m) Cable	8120-4921
APC 3.5 (f) to APC 3.5 (f) Adapter	5061-5311
APC 3.5 (f) to APC 3.5 (m) Adapter (2 required)	85027-60002

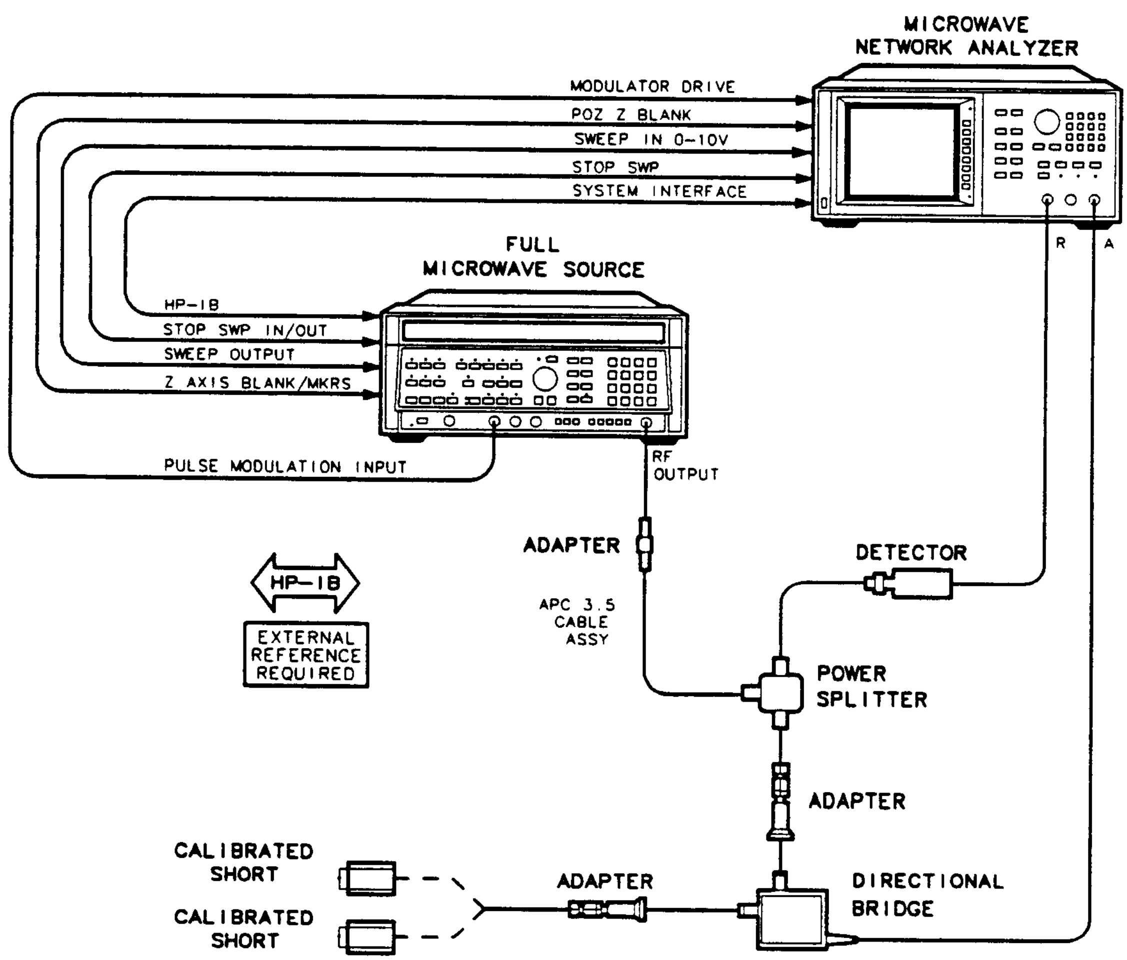


Figure 3-7. Return Loss Test Block Calibration Setup

The microwave network analyzer is in A/R ratio mode for all return loss measurements. The synthesized sweeper provides the incident signal.

The operator connects the calibrated short to the directional bridge test port, then chooses to calibrate either an individual port calibration or all test ports. The full microwave-source/Microwave-network spectrum analyzer combination sweeps over a port-dependent frequency range given in the test descriptions. The operator then connects the calibrated open to the test port. The routine saves the responses from the two setups.

The routine converts the short/open data from logarithmic to linear, averages the converted data, then converts back to logarithmic data. The averaged logarithmic data is stored in controller common memory.

1. Noise Figure

Purpose

This test measures the DUT gain and noise figure as a function of frequency.

Description

The noise figure is compared to a specified limit which ensures that the DUT does not contribute an excessive amount of noise to the spectrum analyzer displayed average noise level. Note that the noise figure calibration routine must be performed before running this test.

Equipment

Connect the noise source to the DUT 321.4 MHz front panel IF input. Connect the rear panel 21.4 MHz output to the input of the noise figure meter. The DUT gain and noise figure are measured at the 321.4 MHz IF input frequency.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Noise Figure Meter	HP 8970B
Synthesized Source	HP 8663A
HP 70000 Series Mainframe	HP 70001A
	70900A/B
Accessories	
Module Service Extender	70001-60013
Noise Source	HP 346C
(1250-2015 adapter required for HP 70907A only)	
Adapters	
Type N (m) to BNC (f) *(2 required)*	1250-1476
Cables	
BNC (m) to SMB (f) *(2 required)*	85680-60093
BNC (m) to BNC (m)	HP 10503A

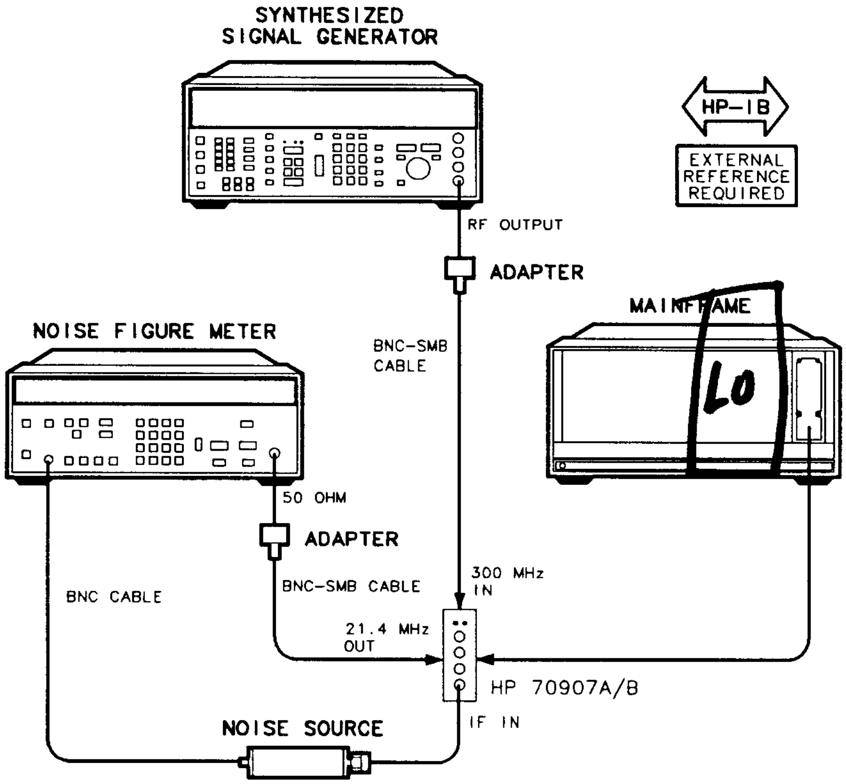


Figure 3-8. Noise Figure Test Setup

2. Third Order Intercept

Purpose

This test measures the amount of third-order intermodulation created inside the DUT as a result of mixing two discrete incoming RF signals. These intermodulation products show up as spurious signals on the spectrum analyzer display during operation.

Description

The spectrum analyzer measures the lower distortion product, then steps up the separation frequency to measure the fundamentals and the upper distortion product. The test then calculates the TOI from these measurements. Note that the TOI calibration routine must be run before performing this test.

Equipment

Connect two sources to the DUT front panel IF input through 6 dB attenuators and a power splitter. Connect the calibrated spectrum analyzer to the 21.4 MHz output. The two sources are set to the previously calibrated frequencies and separations.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Synthesized Source	HP 8663A
HP 70000 Series Mainframe	HP 70001A
Spectrum Analyzer	HP 8566B
Synthesized Sweeper *(2 required)*	HP 8340A
Accessories	
Module Service Extender	70001-60013
6 dB Fixed Coaxial Attenuator *(2 required)*	HP 8493C, Option 006
Power Splitter	HP 11667B
350 MHz Low Pass Filter *(1250-2015 adapter required for HP 70907A only)*	CIRQTEL LT13-350AA
Adapters	
SMA (f) to SMA (f)	1250-1158
Type N (m) to SMA (f)	1250-1250
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m) *(3 required)*	8120-1578
BNC (m) to SMB (f)	85680-60093

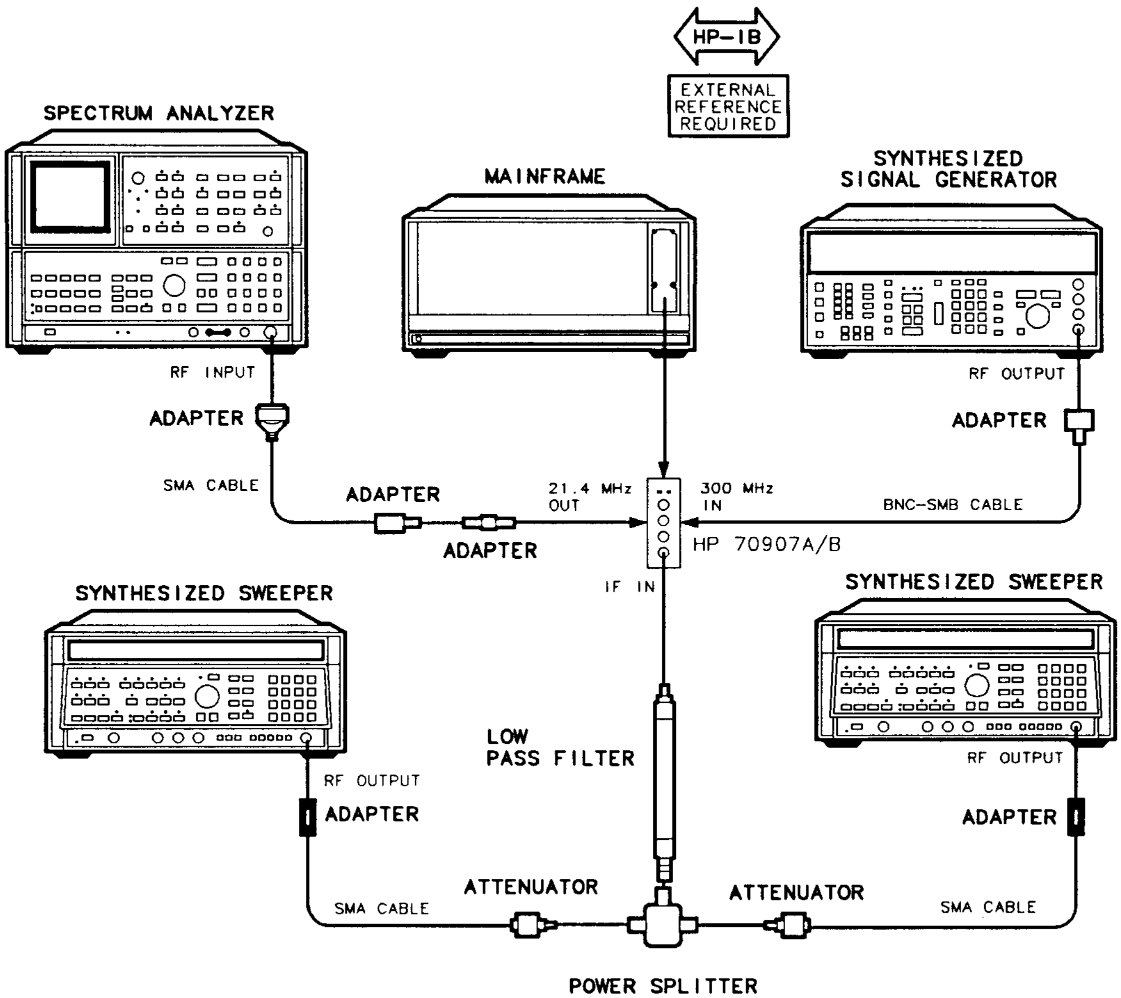


Figure 3-9. Third Order Intercept Test Setup

3. 21.4 MHz Output Response

Purpose

This test measures the passband response of the 21.4 MHz IF output port.

This is a final test.

Description

This passband is determined by the responses of the bandpass filters in the DUT last converter. The RF source is stepped through the 321.4 MHz IF, which causes a response to step through the 21.4 MHz output bandpass. The filter response is measured and its shape plotted. The 10.7 MHz response rejection is also measured.

Equipment

Connect a calibrated RF source to the DUT IF input through a 6 dB attenuator. Connect a power sensor to the 21.4 MHz output. The RF source is stepped through 321.4 MHz IF, which causes a response to step through the 21.4 MHz output bandpass. The filter response is measured and its shape plotted.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Synthesized Source	HP 8663A
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Power Meter	HP 436A
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
6 dB Fixed Coaxial Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
Adapters	
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m)	8120-1578
BNC (m) to SMB (f)	85680-60093

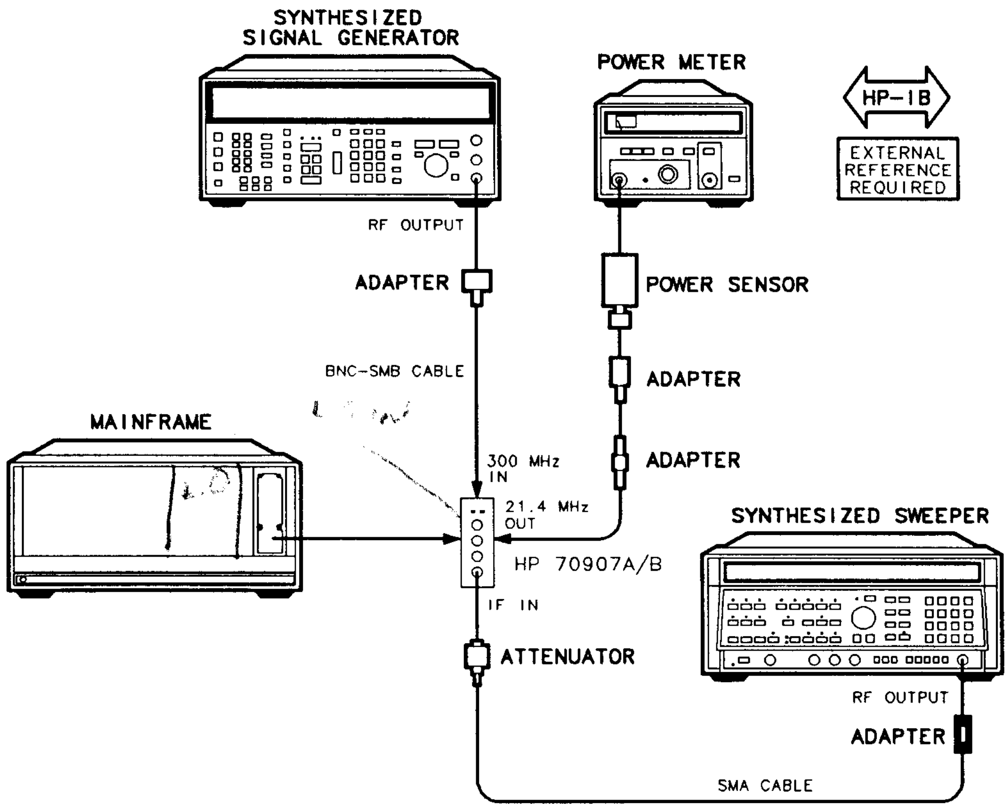


Figure 3-10. 21.4 MHz Output Response Test Setup

4. Module Gain and Calibration Source

Purpose

This test measures the DUT overall gain and the frequency range and power level of the DUT internal calibration source.

This is a final test.

Description

The module gain is measured and stored for further use.

The calibration source power level is measured and compared to the module gain to determine the calibration source power level.

The LO source is set to the minimum and maximum corresponding calibration source frequencies, and the analyzer is set to measure each response.

Equipment

Connect the calibrated RF source and 6 dB attenuator to the DUT IF input. Connect a power sensor to the 21.4 MHz IF output.

Disable the calibrated RF source. The DUT internal calibration source is enabled and routed through the DUT.

Connect the calibrated spectrum analyzer to the 21.4 MHz output. Connect the synthesized LO source to the DUT LO input.

Test Equipment	**Preferred HP Model or Part Number**
Controller	HP 9000 Series 200/300
Synthesized Source	HP 8663A
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper ~~(2 required)~~	HP 8340A
Spectrum Analyzer	HP 8566B
Power Meter	HP 436A
Power Sensor	HP 8485A

Accessories

Module Service Extender	70001-60013
6 dB Fixed Coaxial Attenuator	HP 8493C, Option 006

(1250-2015 adapter required for HP 70907A only)

Adapters

SMA (f) to SMA (f) *(2 required)*	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to SMA (f)	1250-1250
Type N (m) to BNC (f)	1250-1476

Cables

SMA (m) to SMA (m) *(3 required)* 8120-1578
BNC (m) to SMB (f) 85680-60093

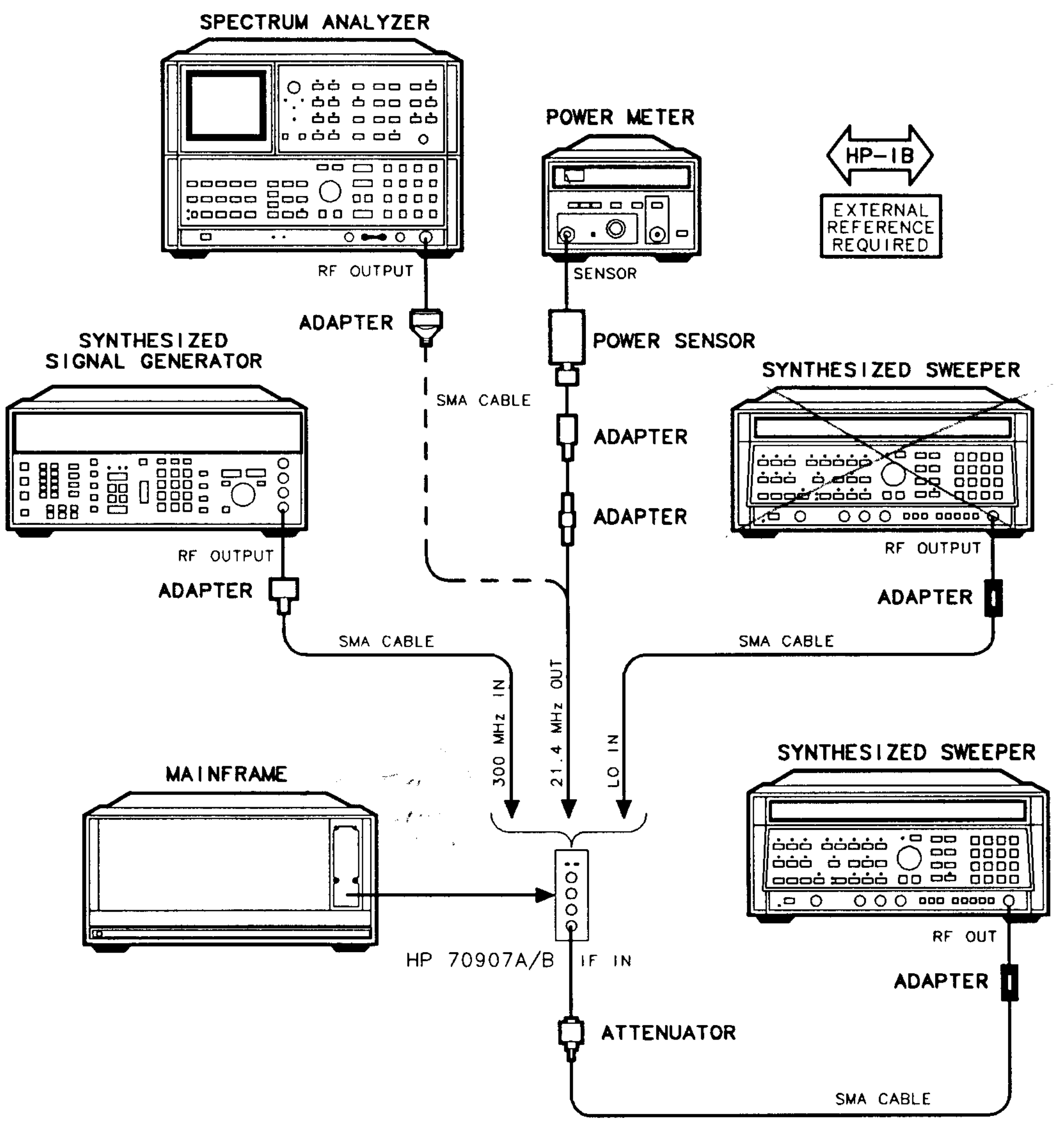


Figure 3-11. Module Gain and Calibration Source Test Setup

5. Front Panel LEDs

Purpose

This test visually verifies that the front-panel LEDs are functioning properly. The ability of the internal controller to operate the LEDs is tested as well. The error-and-diagnostics-sensing capability is not tested in this procedure.

This is a final test.

Description

The operator is prompted to make a softkey selection that agrees with the state of the LEDs at the beginning of the test. The ACT (active) LED is turned off and the ERR (error) LED is turned on. The operator is again prompted to input the state of the LEDs via the softkey selection.

Equipment

Connect the synthesized sweeper to the DUT LO input.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Synthesized Source	HP 8663A
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Accessories	
Module Service Extender	70001-60013
Adapters	
SMA (f) to SMA (f)	1250-1158
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m)	8120-1578
BNC (m) to SMB (f)	85680-60093

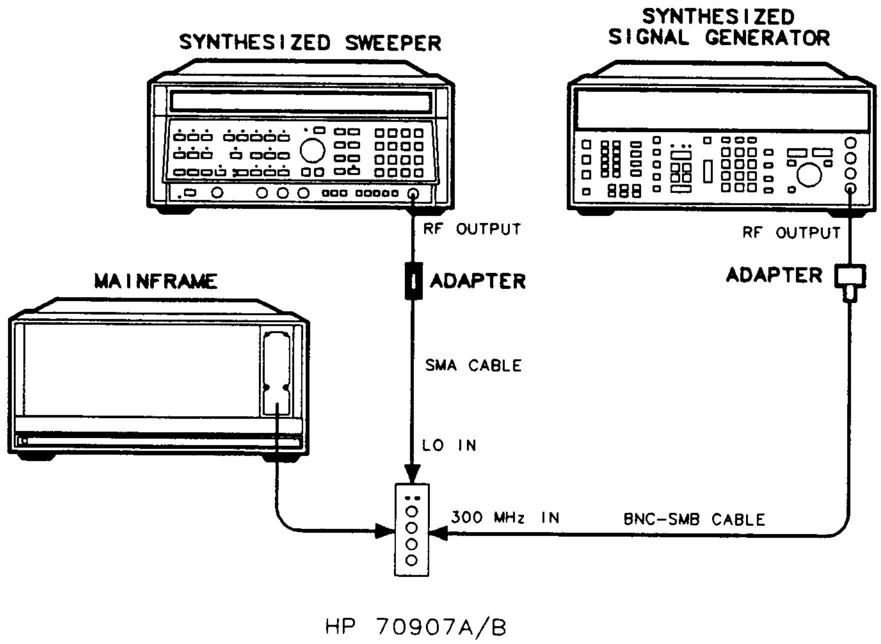


Figure 3-12. Front Panel LEDs Test Setup

6. Main LO Output Amplitude and Harmonics

Purpose

This test measures the fundamental absolute amplitude and second harmonic relative amplitude of the main LO output. This measurement ensures that the leveling loop is adjusted and operating properly.

This is a final test.

Description

The fundamental amplitude is measured using the power meter and power sensor. The calibrated spectrum analyzer is then connected to the LO output and the power of the second harmonic is measured. The results are compared with test limits.

Equipment

Connect the synthesized sweeper to the DUT LO input.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Power Meter	HP 436A
Power Sensor	HP 8485A
(1250-2015 adapter required for HP 70907A only)	
Accessories	
Module Service Extender	70001-60013
Adapters	
SMA (f) to SMA (f)	1250-1158
Type N (m) to SMA (f)	1250-1250
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578

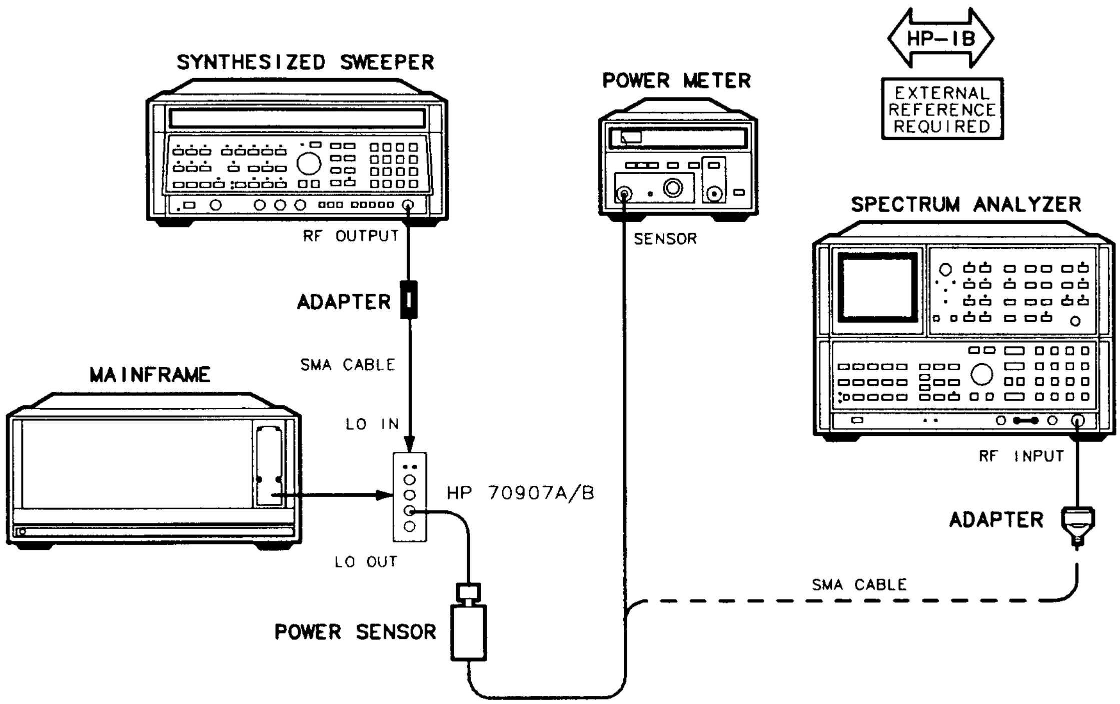


Figure 3-13. Main LO Output Amplitude and Harmonics Test Setup

7. Auxiliary LO Output Amplitude and Harmonics

Purpose

This test measures the fundamental absolute amplitude and second harmonic relative amplitude of the auxiliary LO output. This measurement ensures that the leveling loop is adjusted and operating properly.

Description

The fundamental amplitude is measured using the power meter and power sensor. The calibrated spectrum analyzer is then connected to the LO output and the power of the second harmonic is measured. The results are compared with test limits.

Equipment

Connect the synthesized sweeper to the DUT LO input.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Power Meter	HP 436A
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
50Ω Termination	HP 909D
(1250-2015 adapter required for HP 70907A only)	
Adapters	
SMA (f) to SMA (f)	1250-1158
Type N (m) to SMA (f)	1250-1250
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578

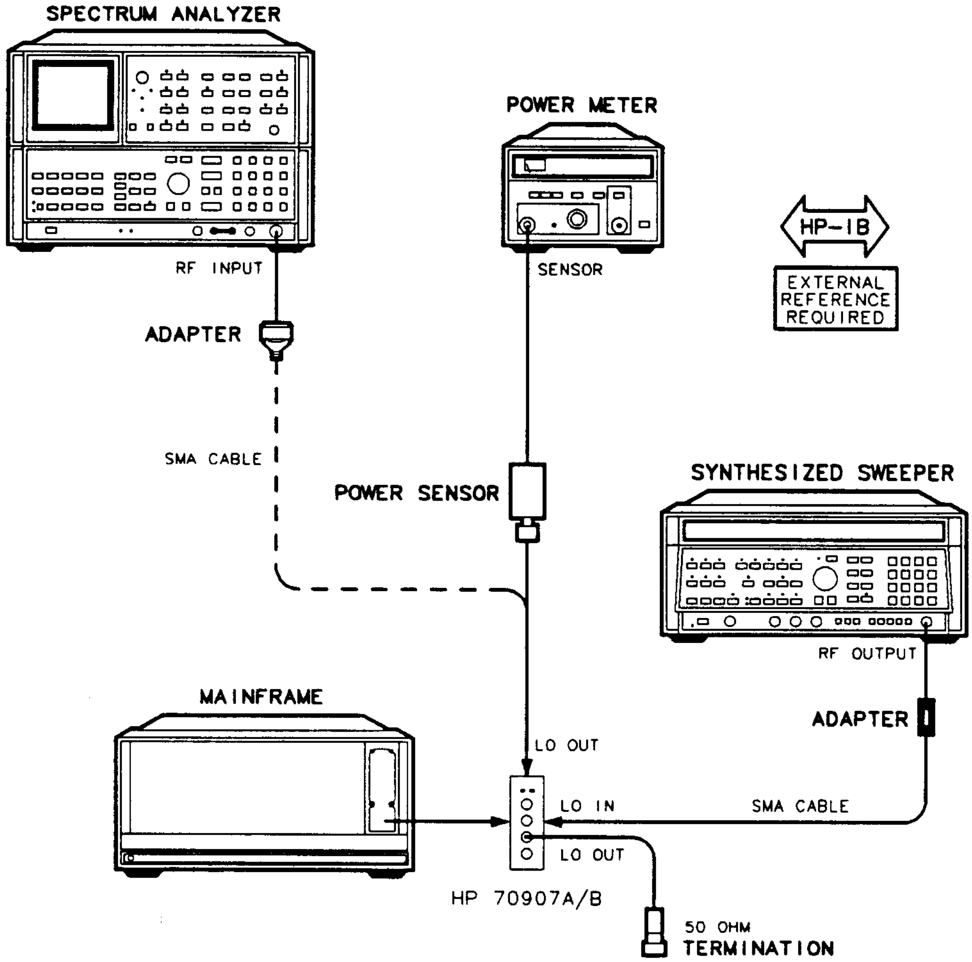


Figure 3-14. Auxiliary LO Output Amplitude and Harmonics Test Setup

8. 300 MHz Output Amplitude and Harmonics

Purpose

This test measures the absolute amplitude of the rear panel 300 MHz output port, and the relative amplitude of the second harmonic at this port.

Description

The fundamental and second harmonic power levels are measured. The level of the second harmonic is referenced to the fundamental amplitude.

Equipment

Connect the Synthesized Source to the 300 MHz input port. Connect a power sensor to the 300 MHz output port to measure the total power. Then, connect the calibrated spectrum analyzer to the output port.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Spectrum Analyzer	HP 8566B
Power Meter	HP 436A
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
Adapters	
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to SMA (f)	1250-1250
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m)	8120-1578
BNC (m) to SMB (f)	85680-60093

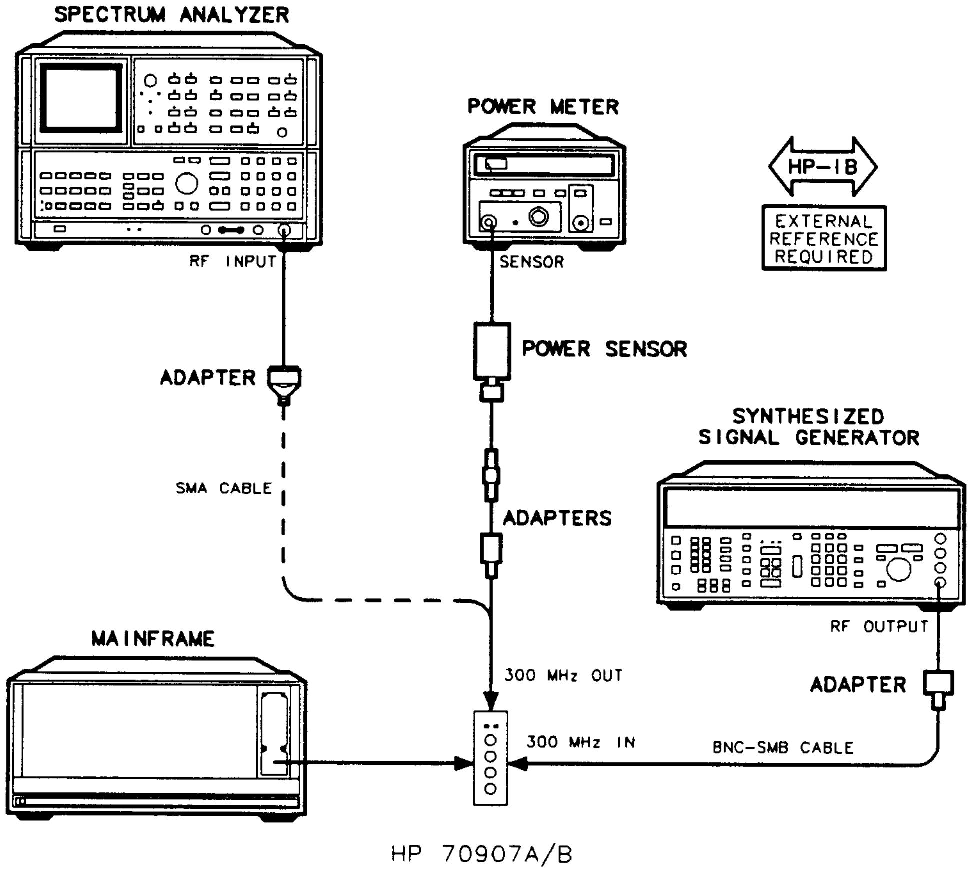


Figure 3-15. 300 MHz Output Amplitude and Harmonics Test Setup

9. 321.4 MHz Output Response

Purpose

This test measures the gain and passband response of the rear panel 321.4 MHz output port.

Description

The RF source is stepped across the IF input range. The low-power sensor measures the 321.4 MHz passband, which is plotted. The 321.4 MHz output port level offset is determined by subtracting the 21.4 MHz value from the 321.4 MHz value.

Equipment

Connect a calibrated RF source to the DUT IF input through the 6 dB attenuator. Connect a power sensor to the 21.4 MHz output. Connect a second low-power sensor to the 321.4 MHz output port.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Synthesized Sweeper	HP 8340A
Power Meter *(2 required)*	HP 436A
Power Sensor	HP 8481D
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
Adapters	
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (f) to SMB (f)	1250-0673
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m)	8120-1578
BNC (m) to SMB (f)	85680-60093

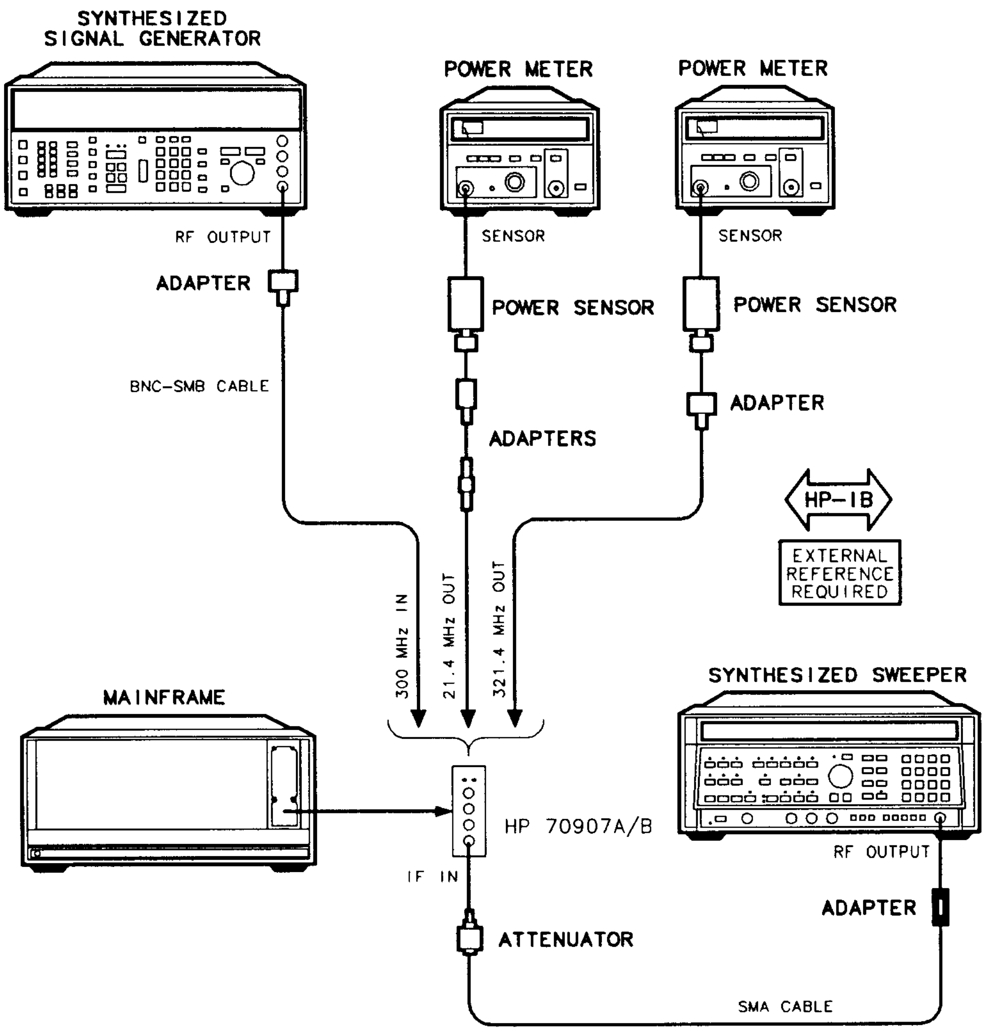


Figure 3-16. 321.4 MHz Output Response Test Setup

10. IF Subharmonics

Purpose

This test measures IF subharmonic responses, which are usually generated by input frequencies of one-half and two-thirds times the internal IF frequencies away from the desired 321.4 MHz IF input frequency.

Description

A reference amplitude is first measured at 321.4 MHz and stored. Each selected frequency is measured for a response. All response values are corrected relative to the reference measurement.

Equipment

Conncect the calibrated RF source to the front panel IF input through a 6 dB attenuator and 170 MHz lowpass filter. Connect the calibrated spectrum analyzer to the 21.4 MHz IF output.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator *(1250-2015 adapter required for HP 70907A only)*	HP 8493C, Option 006
170 MHz Low Pass Filter	CIRQTEL LT13-170AA
Adapters	
SMA (m) to SMA (m)	1250-1159
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (f)	1250-0674
Type N (m) to SMA (f)	1250-1250
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578
BNC (m) to SMB (f)	85680-60093

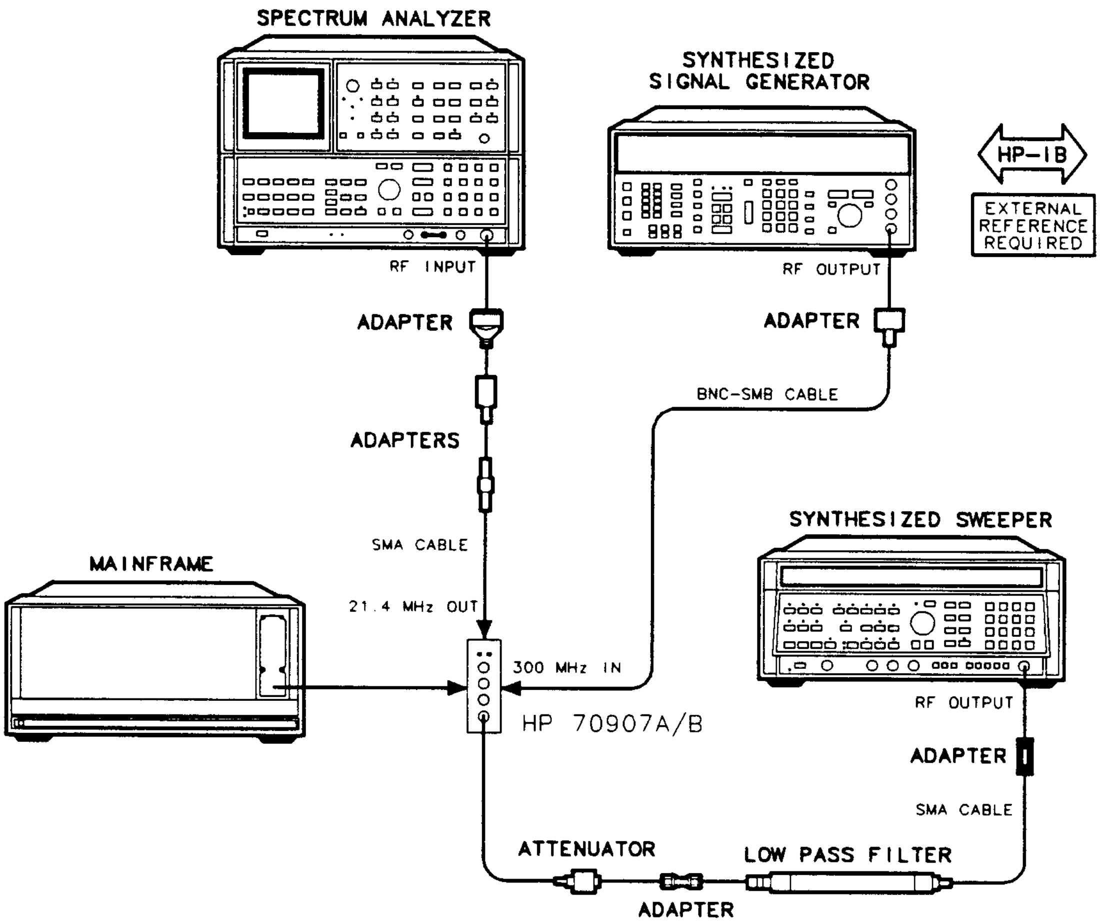


Figure 3-17. IF Subharmonics Test Setup

11. LO Input Sensitivity

Purpose

This test measures the LO input amplitude. The LO leveling loop and the LO unleveled detector are exercised as well.

Description

The LO input amplitude and frequency are set and the LO unleveled detector is monitored for several LO frequencies. (The leveling amplifier gain rolls off with frequency and periodic characteristics in frequency response due to standing waves caused by first converter mismatch. Therefore, the amplitude and frequency must be reset as the LO unleveled detector is monitored.) The maximum LO input amplitude is not measured since this input level is typically beyond the range of most microwave sources.

The LO leveled status is initially checked without an LO input. If the LO is unleveled, the test continues. The synthesized source is set to input a +8 dBm power level and the DUT is checked for an unleveled state. If the LO is leveled, the test continues.

The RF input from the synthesized source is turned off; then, at each LO frequency, it is set to an amplitude level of −0.6 dBm measured by the power meter. The RF input is turned on and the DUT is checked for an unleveled condition. If a leveled condition exists, the test passes.

Equipment

Connect the synthesized sweeper to the LO input of the DUT.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Power Meter	HP 436A
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
Power Splitter	HP 11667B
Adapters	
SMA (m) to SMA (m)	1250-1159
SMA (f) to SMA (f)	1250-1158
Cables	
SMA (m) to SMA (m)	8120-1578

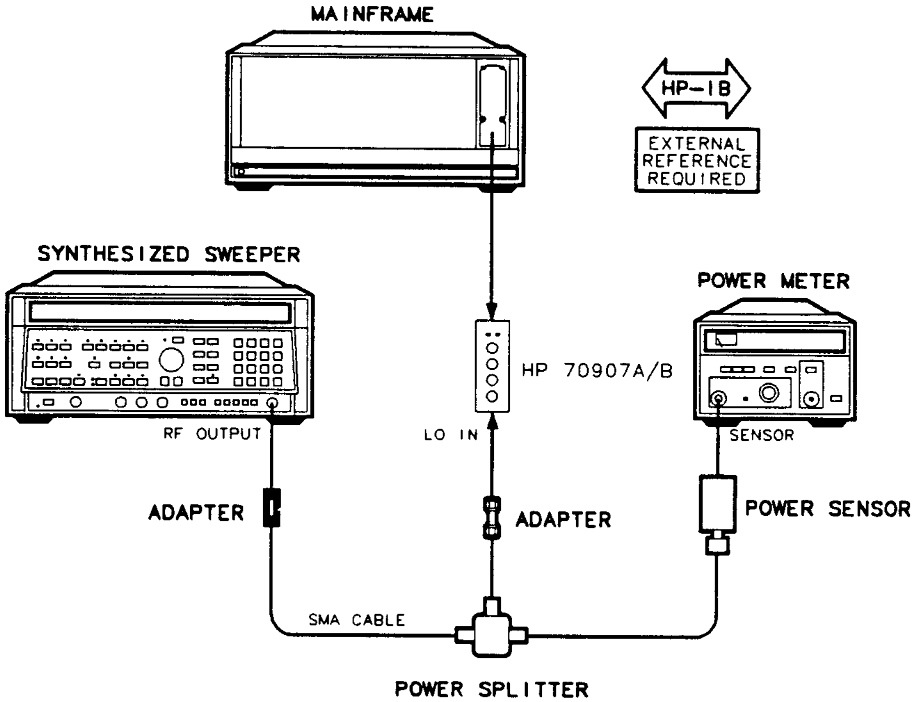


Figure 3-18. LO Input Sensitivity Test Setup

12. Diagnostics

Purpose

This test exercises and verifies the diagnostic detectors in the LO ALC loop and the 3rd converter.

This is a final test.

Description

Various states are set up in the DUT by selectively turning off the three input sources. As each state occurs, the detector status byte is read and checked for proper state.

To test the IF level detector, the RF source is set low, then stepped up in small increments while monitoring the IF level status bit. The level at which the bit toggles is determined. The RF source is set high, and the test is repeated to determine the upper threshold.

In a similar fashion, the synthesized source connected to the 300 MHz input is set low first, then high, in order to determine the lower and upper thresholds of the reference level detector.

The LO level detector is not step tested in the manner of the IF level or reference level detectors. The LO source is turned on and off in combination with the RF source and synthesized source, and the detector status byte is read for a proper low or high condition.

Equipment

Connect the synthesized LO source to the DUT LO input through the isolator. Connect the calibrated RF source to the DUT IF input through the 6 dB pad. Connect the synthesized source to the DUT 300 MHz input.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Synthesized Sweeper *(2 required)*	HP 8340A
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
Adapters	
SMA (f) to SMA (f) *(2 required)*	1250-1158
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578
BNC (m) to SMB (f)	85680-60093

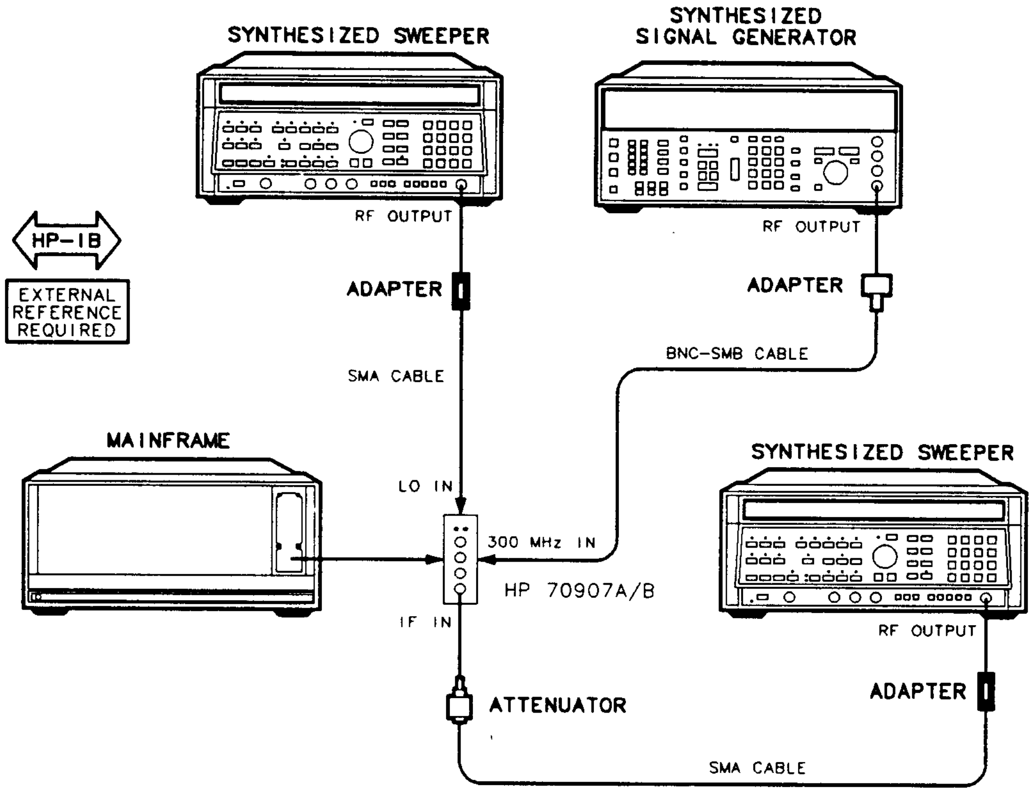


Figure 3-19. Diagnostics Test Setup

13. 300 MHz Input Sensitivity

Purpose

This test measures the range over which the 300 MHz input may be varied without degrading the output 21.4 MHz IF beyond its specifications.

Description

The synthesized sweeper is set to 321.4 MHz at the DUT IF input. The spectrum analyzer is connected to the DUT 21.4 MHz IF output. The synthesized signal generator is set to 300 MHz at 0 dBm at the DUT 300 MHz input and a reference measurement is taken. The signal generator is varied over several frequencies and amplitudes while the analyzer monitors the 21.4 MHz IF output.

Equipment

Connect the synthesized sweeper to the 300 MHz input of the DUT.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
Adapters	
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to SMA (f)	1250-1250
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578
BNC (m) to SMB (f)	85680-60093

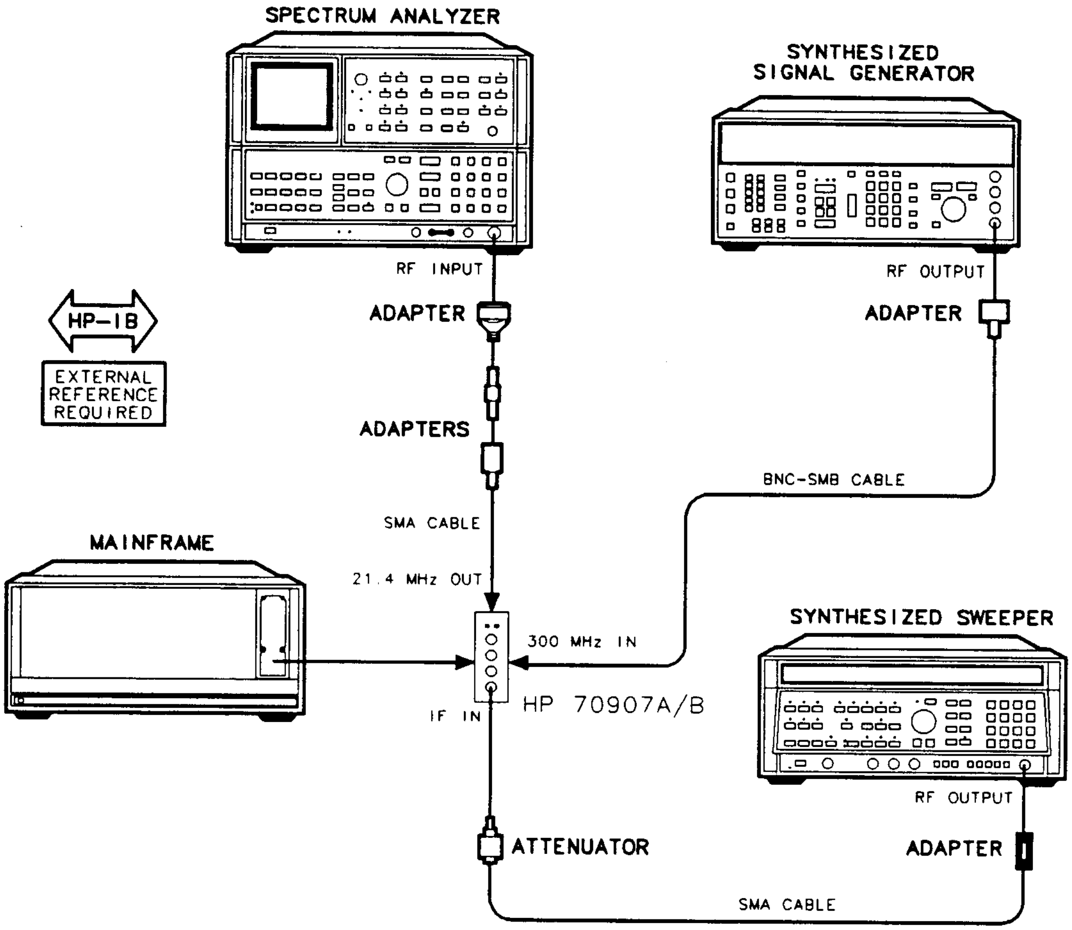


Figure 3-20. 300 MHz Input Sensitivity Test Setup

14. Close-In Sidebands

Purpose

This test checks power supply and other DUT-related sidebands. These sidebands are discrete responses that are added to the input signal by the DUT at offset frequencies that are harmonics of power supply switching.

This is a final test.

Description

The RF section is set to 321.4 MHz. The 21.4 MHz output power is measured, then checked (between −2.5 and −6.0 dBm). The center frequency of the calibrated spectrum analyzer is set to measure the 40 kHz or 80 kHz sideband, then the power is measured. If the relative measurement exceeds the test limit by more than 4.0 dB, the spectrum analyzer is set to a lower resolution bandwidth and video bandwidth. A five-sweep video average is initiated and the sideband power is measured again. If the power is too high, the test fails. If the first sideband tested is within test limits, the second sideband is not tested.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Source	HP 8663A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator *(1250-2015 adapter required for HP 70907A only)*	HP 8493C, Option 006
Adapters	
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to SMA (f)	1250-1250
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578
BNC (m) to SMB (f)	85680-60093

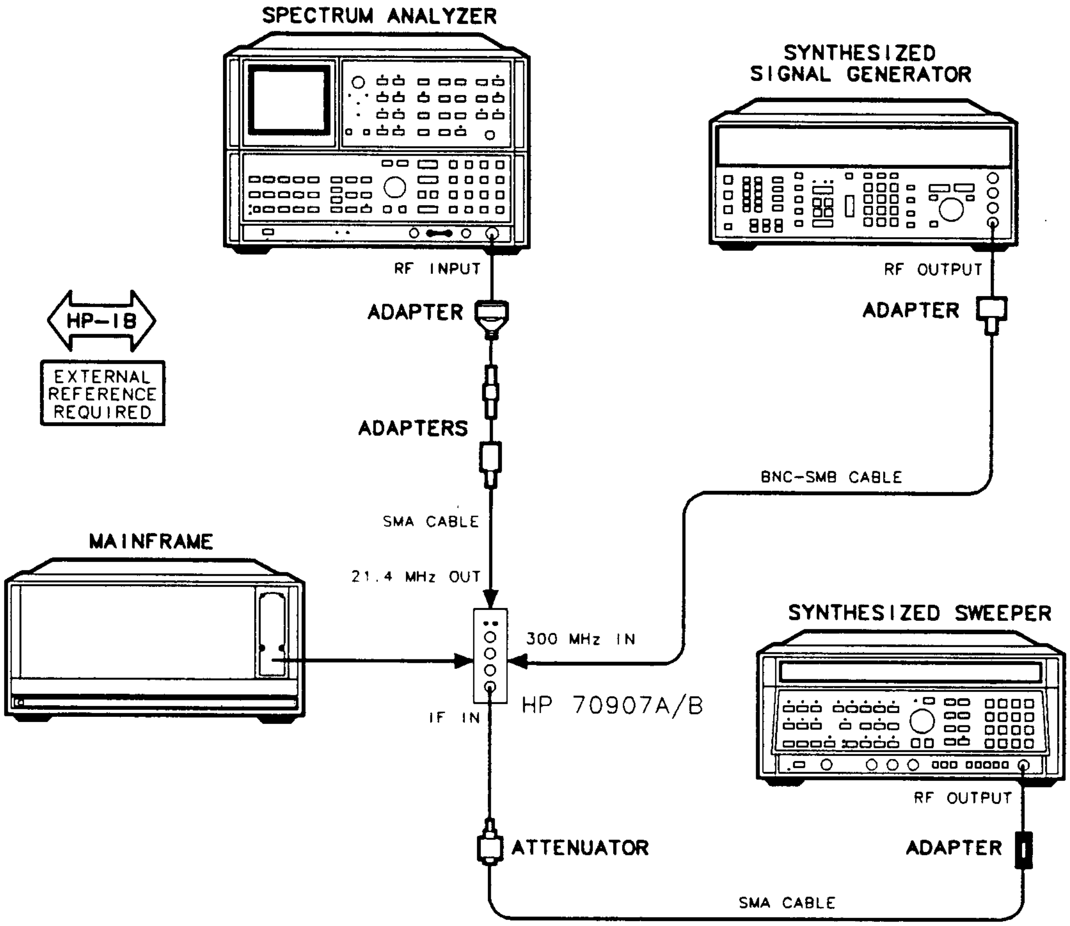


Figure 3-21. Close-In Sidebands Test Setup

15. 21.4 MHz Daisy Chain Loss

Purpose

This test measures the amount of loss in the path from the external 21.4 MHz input port to the 21.4 MHz output port. This path is used in conjunction with other RF Sections or EMIM modules in a spectrum analyzer system.

Description

The external 21.4 MHz path is chosen, and the gain (loss) through this path is measured.

Equipment

Connect the calibrated RF source to the external 21.4 MHz input port. Connect a power sensor to the 21.4 MHz output port.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Power Meter	HP 436A
Power Sensor	HP 8485A
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
Adapters	
SMA (f) to SMA (f)	1250-1158
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Cables	
SMA (m) to SMA (m)	8120-1578

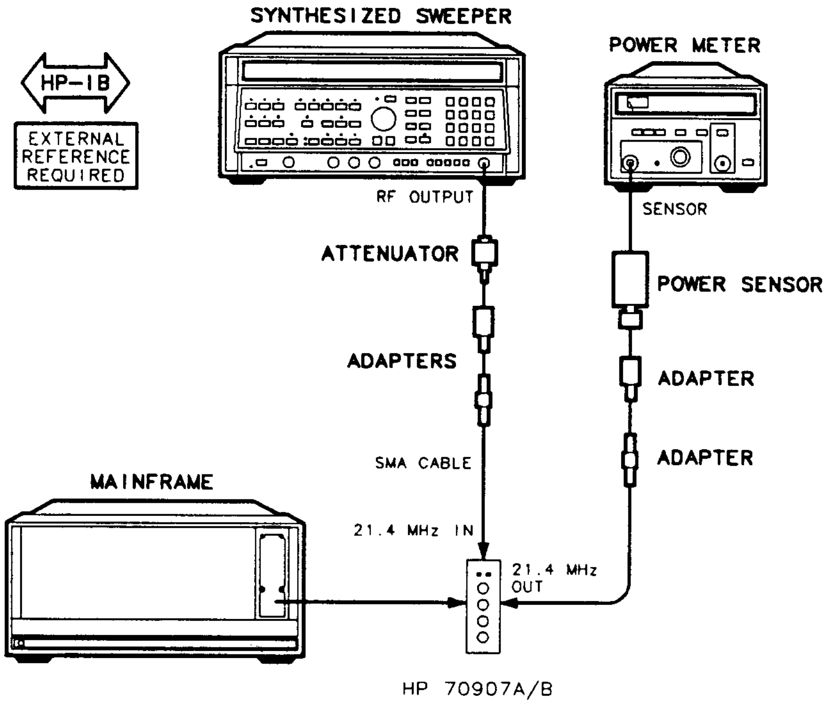


Figure 3-22. 21.4 MHz Daisy Chain Loss Test Setup

16. 21.4 MHz Input/Output Isolation

Purpose

This test measures the isolation between the external 21.4 MHz input port and the 21.4 MHz output port when internal 21.4 MHz is selected.

This is a final test.

Description

The external 21.4 MHz path is selected first, and a reference amplitude measured. The internal 21.4 MHz path is then selected, and the signal level at the spectrum analyzer is compared to the reference to determine the port isolation.

Equipment

Connect the calibrated RF source to the external 21.4 MHz input port. Connect the calibrated spectrum analyzer to the 21.4 MHz output port.

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Spectrum Analyzer	HP 8566B
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
Adapters	
SMB (f) to SMB (f)	1250-0672
SMA (f) to SMB (m)	1250-0674
Type N (m) to SMA (f)	1250-1250
Cables	
SMA (m) to SMA (m) *(2 required)*	8120-1578

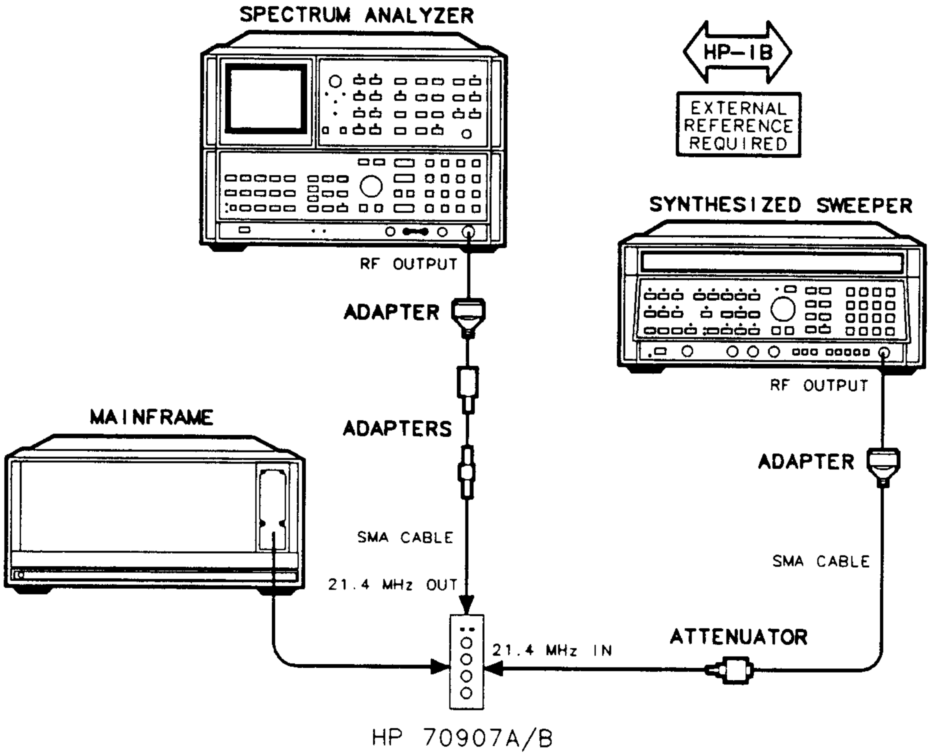


Figure 3-23. 21.4 MHz Input/Output Isolation Test Setup

17. 321.4 MHz IF Input Return Loss

Purpose

This test measures the return loss of the IF input port. This ensures that a proper match can be made to an external mixer.

Description

A scalar network analyzer and directional bridge are used to measure the return loss of the IF input port.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
HP 70000 Series Mainframe	HP 70001A
Synthesized Sweeper	HP 8340A
Synthesized Source	HP 8663A
Scalar Network Analyzer	HP 8757E
Accessories	
Module Service Extender	70001-60013
Connector Saver *(2 required)*	85027-60002
(1250-2015 adapter required for HP 70907A only)	
Directional Bridge	85027B
AC Detector	HP 11664E
Power Splitter	HP 11667B
Adapters	
SMA (f) to SMA (f)	1250-0672
Type N (m) to BNC (f)	1250-1476
Cables	
SMA (m) to SMA (m)	8120-1578
BNC (m) to SMB (f)	85680-60093

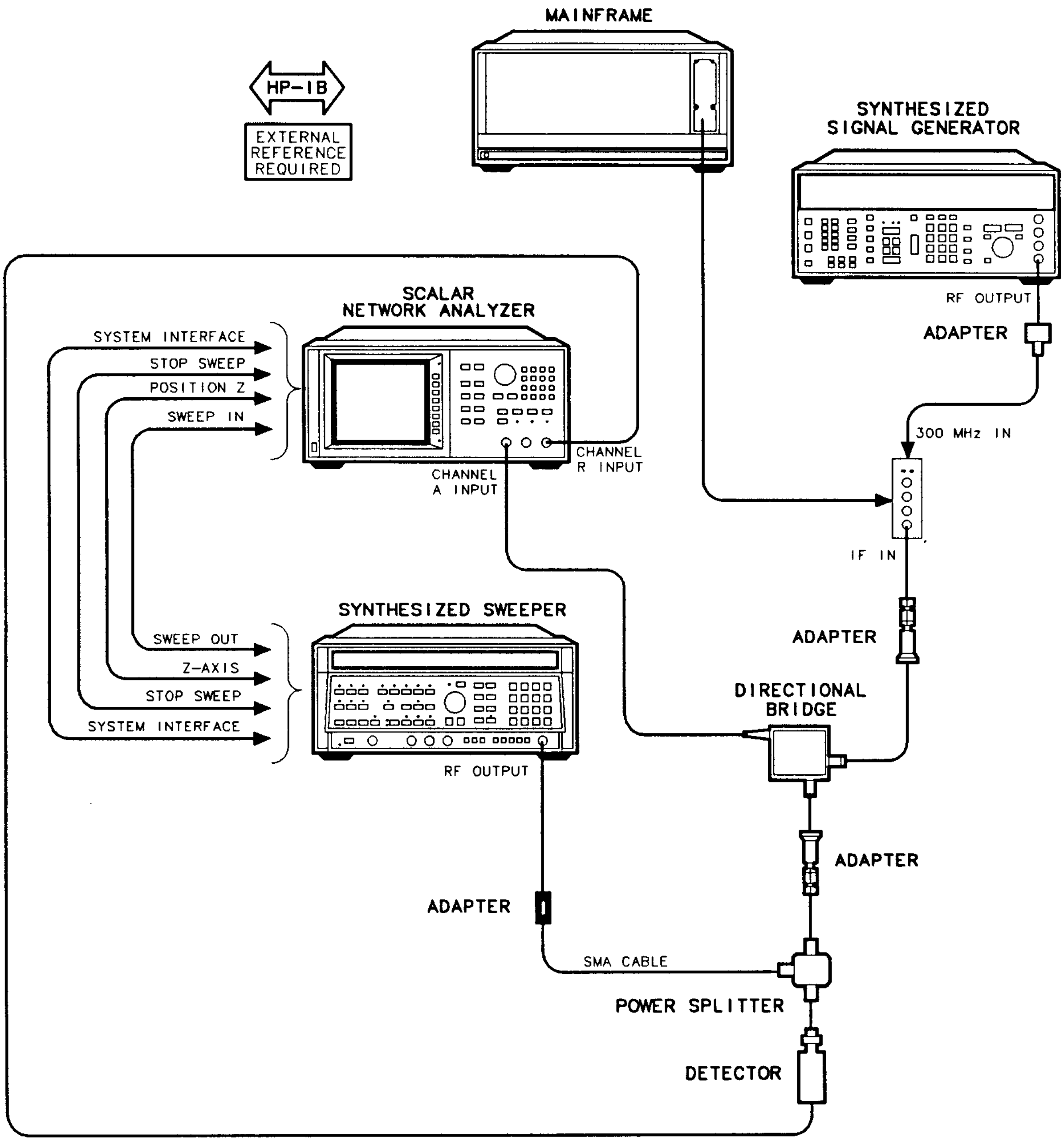


Figure 3-24. 321.4 MHz IF Input Return Loss Test Setup

4

Adjustment Procedures

Introduction

This chapter contains information about the adjustments for the HP 70907A/B External Mixer Interface module. All of the adjustments are automated; refer to Chapter 2 for instructions on running the verification software. Refer to "Repair Matrix" in Chapter 1 for information about which tests and adjustments must be run after module repair.

Contents

The adjustments with their corresponding page numbers are listed below.

1. Last Converter Adjustment 4-4
2. Calibration Source Adjustment 4-11
3. LO Leveling Amplifier Adjustment 4-14
4. Miscellaneous Bias Voltage Adjustment 4-16
5. Tune + Span Adjustment (HP 70907B) 4-18

Caution The HP 70907A/B module contains assemblies that can be damaged by electrostatic discharge. All work performed on the HP 70907A/B should be done at a static-safe work station. Refer to "Electrostatic Discharge Information" in Chapter 1.

Adjustable Components

Adjustable components are listed in Table 4-1 by reference designator and name. The adjustment procedure number and name is also included.

Recommended Test Equipment

Table 1-2, Recommended Test Equipment, lists test equipment and accessories required to perform the adjustment procedures. Any equipment that satisfies the critical specifications given in the table may be substituted for the preferred test equipment. Module Verification Software contains only the drivers for equipment listed in the table. Additional drivers have to be written by the user to support substituted test equipment.

Adjustment Equipment

Service accessories and electrostatic discharge (ESD) accessories are listed in Chapter 1. For adjustments that require a nonmetallic tuning tool, use the fiber tuning tool, HP part number 8170-0033. Never try to force the adjustment of any component. This is especially critical when tuning slug-tuned inductors or variable capacitors.

Caution To avoid blowing the mainframe line fuse or any module fuse, the mainframe line power must be off before connecting or disconnecting the module service extender cable.

Preparing for Adjustments

1. With the mainframe line switch off, remove the HP 70907A/B External Mixer Interface.
2. Install the module service extender and connect the extender cable to the RF section.
3. Connect the equipment as illustrated in the appropriate test setup, then set the mainframe line switch to on.

Note The test equipment must be allowed to warm up for 30 minutes before proceeding with an adjustment.

4. Load and run the appropriate adjustment routine. Refer to Chapter 2, "Verification Software," for information related to loading the software or initiating an adjustment routine.

HP-IB Symbol

The Hewlett-Packard Interface Bus (HP-IB) symbol that appears on the adjustment procedure setups indicates that the controller and test equipment need to be linked together with HP-IB cables.

External Frequency Reference

Some adjustment procedures require an external frequency reference. This is indicated by the external reference symbol on the test setup drawing. Equipment such as sources, analyzers, and frequency counters must be connected to the same frequency standard. The device under test (DUT) must also be connected to this frequency standard.

Refer to "External Frequency Reference" in Chapter 3 for more information. Figures 3-1 and 3-2 illustrate the preferred frequency reference connections. In all cases, the specified aging rate requirement is $<10^{-9}$/day. The synthesized sweeper, synthesized source, and calibrated spectrum analyzer listed in Table 1-2 have internal time bases that meet the aging rate requirement.

Table 4-1. Adjustable Components

Adjustment	Adjustment Name	Adjustment Test
A1R1	Mixer Bias −5 V Adjust	4. Miscellaneous Bias Voltage Check
A1R2	Mixer Bias +5 V Adjust	4. Miscellaneous Bias Voltage Check
A1R17	Mixer Bias 0 V Adjust	4. Miscellaneous Bias Voltage Check
A1R62	LO Level	3. LO Leveling Amplifier Adjustment
A1R70	Gate Bias	3. LO Leveling Amplifier Adjustment
A2R1	Thermal Track Adjust	2. Calibration Source Adjustment
A2R22	Power Out Adjust	2. Calibration Source Adjustment
A3C9	321.4 MHz BPF Adjust	1. Last Converter Adjustment
A3C10	321.4 MHz BPF Adjust	1. Last Converter Adjustment
A3C11	321.4 MHz BPF Adjust	1. Last Converter Adjustment
A3C12	321.4 MHz BPF Adjust	1. Last Converter Adjustment
A3C13	278.6 MHz Notch Filter Adjust	1. Last Converter Adjustment
A3C24	300 MHz Bandpass Filter Adjust	1. Last Converter Adjustment
A3C25	300 MHz Bandpass Filter Adjust	1. Last Converter Adjustment
A3R18	Module Gain Adjust	1. Last Converter Adjustment
A3R49	300 MHz Power Level Adjust	1. Last Converter Adjustment
A4R27	Tune + Span −50 mV Adjust	5. Tune + Span Adjustment (HP 70907B)
A4R29	Tune + Span +50 mV Adjust	5. Tune + Span Adjustment (HP 70907B)

1. Last Converter Adjustment

Purpose

This procedure is used to adjust the 300 MHz output power, 300 MHz bandpass filter, 278.6 MHz notch filter, 321.4 MHz bandpass filter, and the module gain. These circuits are located on the A3 Last Converter Assembly.

Description

The 300 MHz output power is adjusted by setting the synthesized source to 300 MHz at the reference amplitude. Then, A3R49 is adjusted for the desired power meter reading.

The 300 MHz bandpass filter is adjusted by first normalizing trace A, of the microwave network analyzer, with a through-path measurement. The resistive divider is then connected to A3TP1 with the ground connected to A3TP3. Capacitors A3C24 and A3C25 are adjusted for optimum bandpass filter shape.

Note The converter cover must be removed to access A3TP1 and A3TP3.

The 278.6 MHz notch filter is adjusted by setting the synthesized sweeper to a center frequency of 278.6 MHz. Capacitors A3C9, A3C10, A3C11, and A3C12 are then preset as follows: A3C9 and A3C12 to minimum, A3C10 and A3C11 to mid-range. Then, A3C9 through A3C12 are adjusted for optimum bandpass at 278.6 MHz. Capacitor A3C13 is adjusted for minimum level at this frequency.

The 321.4 MHz bandpass filter is adjusted by setting the synthesized sweeper to a center frequency of 321.4 MHz. Capacitors A3C9 through A3C12 are then preset as follows: A3C9 and A3C12 to minimum, A3C10 and A3C11 to mid-range. Capacitor A3C10 is adjusted for a peak response on the network analyzer display. Capacitor A3C11 is adjusted for the proper dip at the display cursor. Capacitor A3C12 is adjusted for a peak response. Capacitor A3C9 is adjusted for overall flatness within the pass band. The controller then runs through a test routine to ensure correct bandpass filter alignment at frequencies between 278.6 and 321.4 MHz.

The module gain is adjusted by setting the synthesized sweeper to 321.4 MHz at the reference amplitude. The synthesized sweeper is connected to the DUT front-panel IF input. Overall module gain is adjusted with A3R18 for correct power level at the rear-panel 21.4 MHz output.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Precision DVM	HP 3456A
Synthesized Sweeper	HP 8340A
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Sensor	HP 8485A
Local Oscillator	HP 70900B
HP 70000 Series Mainframe	HP 70001A
Microwave Network Analyzer	HP 8757A/E
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
Detector	HP 11664E
20:1 Resistive Divider	HP 10020A
50Ω Coaxial Feedthrough	HP 10100C
30 dB Reference Attenuator	HP 11708A
Adapters	
SMA (f) to SMB (m)	1250-0674
SMA (f) to SMA (f)	1250-1158
SMA (m) to BNC (f)	1250-1200
SMB (f) to SMB (f)	1250-0672
Type N (m) to BNC (m)	1250-0780
APC 3.5 (f) to APC 3.5 (f)	5061-5311
Cables	
APC 3.5 (m) to APC 3.5 (m)	8120-4921
BNC (m) to SMB (f)	85680-60093
BNC (m) to BNC (m)	HP 10503A

Procedure

Refer to "Preparing for Adjustments" in this chapter, then connect the equipment as shown in the following setup figures. Load and run the Last Converter routine. Make the adjustments as defined by the computer. Find the location of the adjustments by referring to Figure 4-2. Refer to Chapter 2, "Verification Software," for detailed information about loading and running the software.

Note Allow the test equipment to warm up for 30 minutes before proceeding with this adjustment.

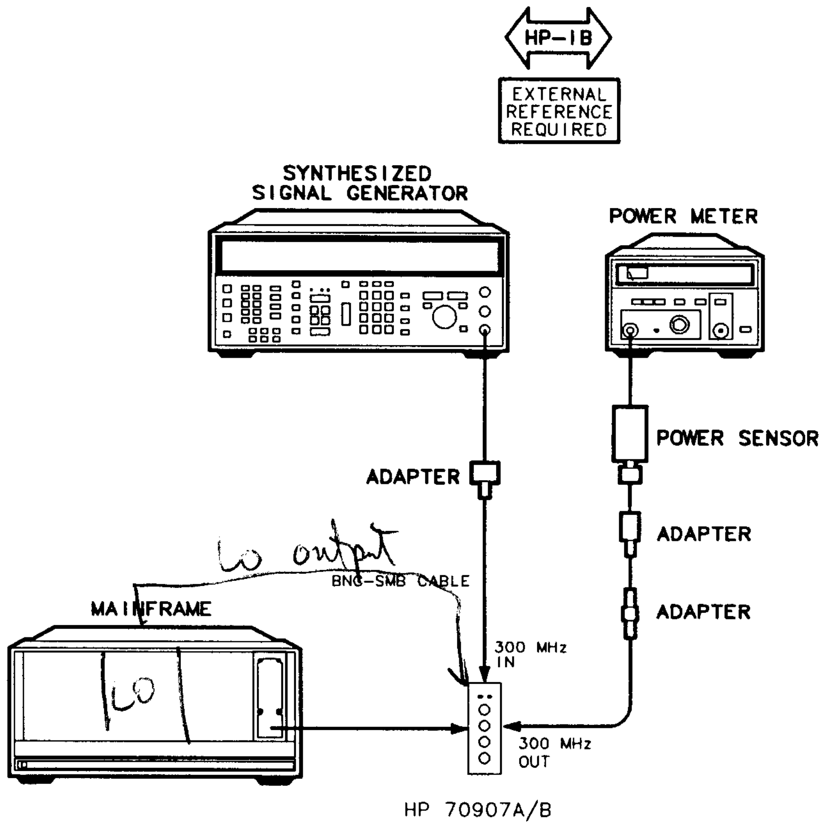


Figure 4-1. 300 MHz Output Power Setup

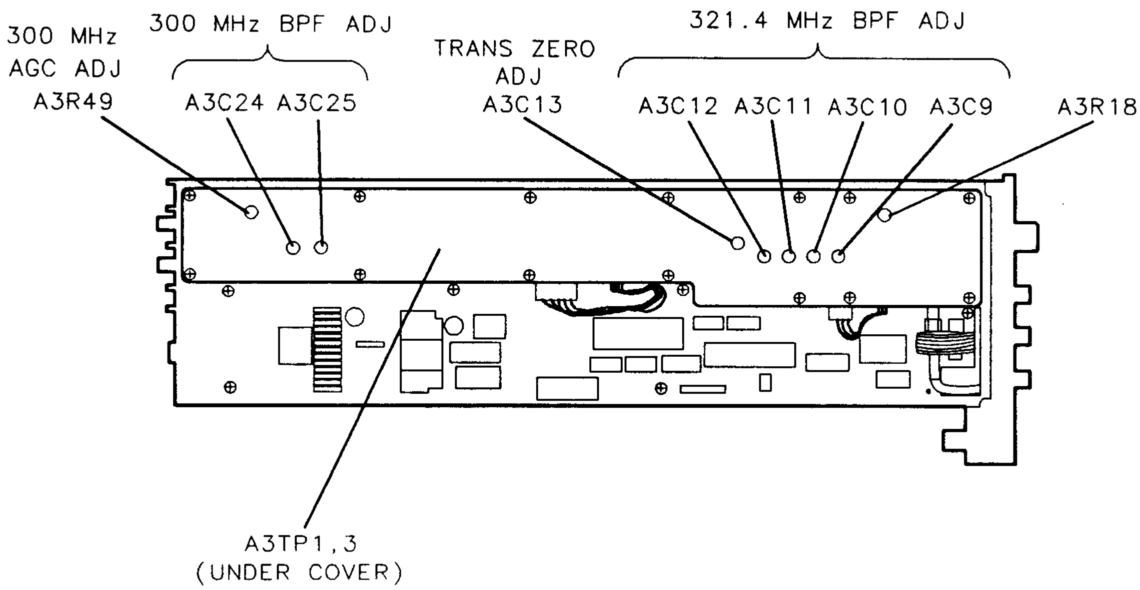


Figure 4-2. Last Converter Adjustment Locations

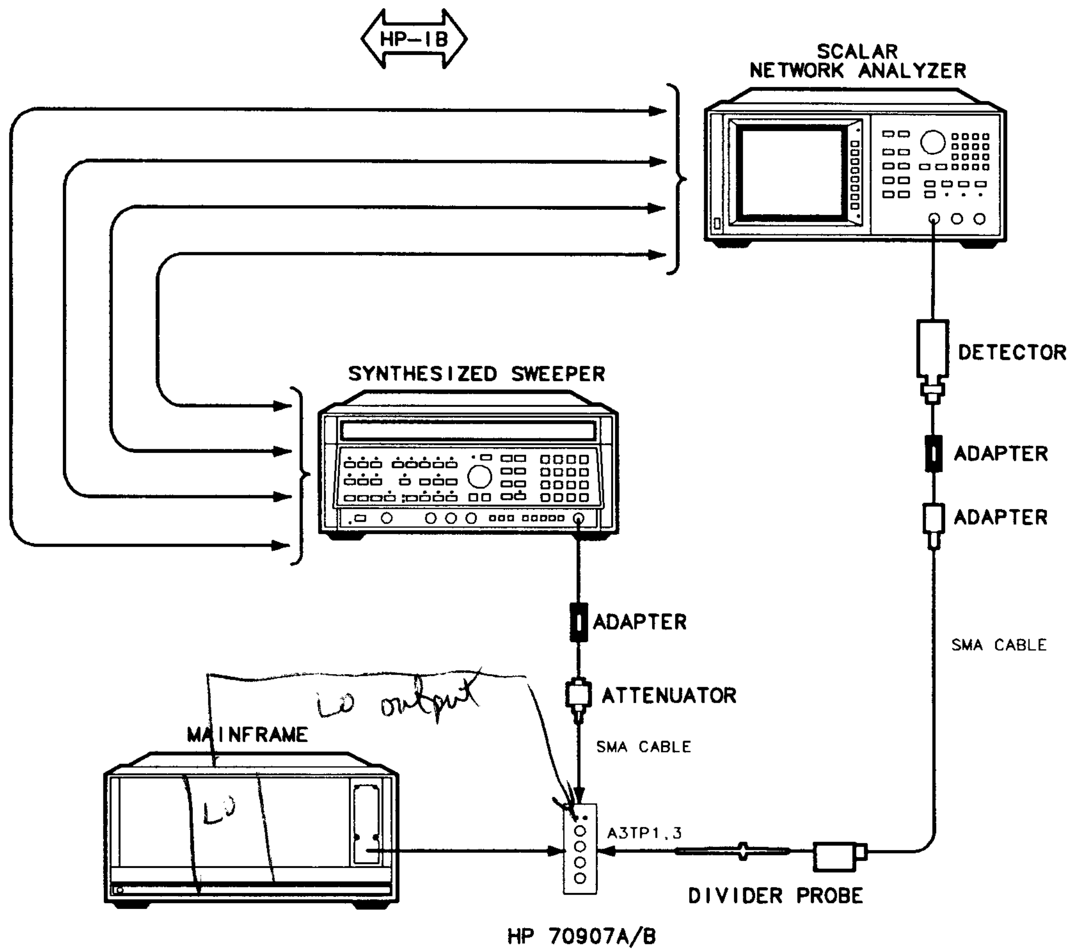


Figure 4-3. 300 MHz Bandpass Filter Setup

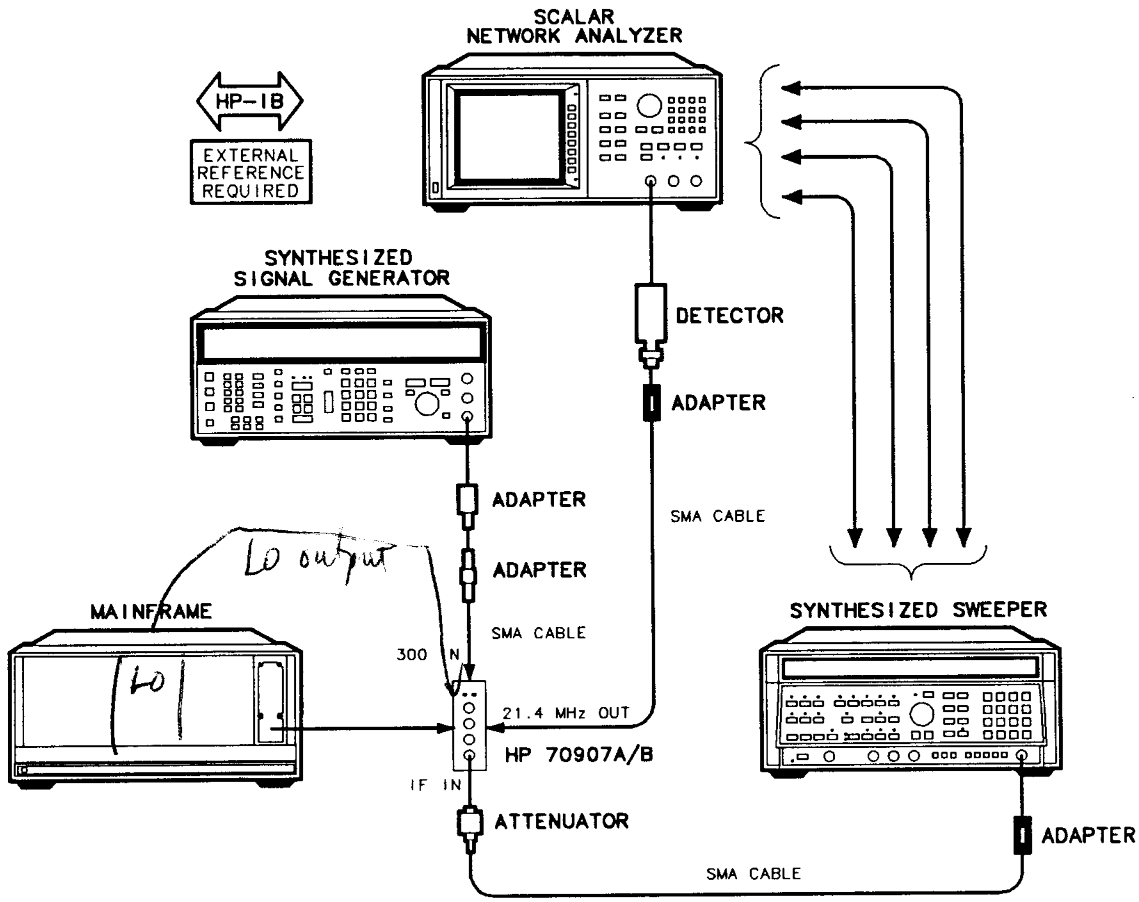


Figure 4-4. 278.6 MHz Notch and 321.4 MHz Bandpass Filter Setup

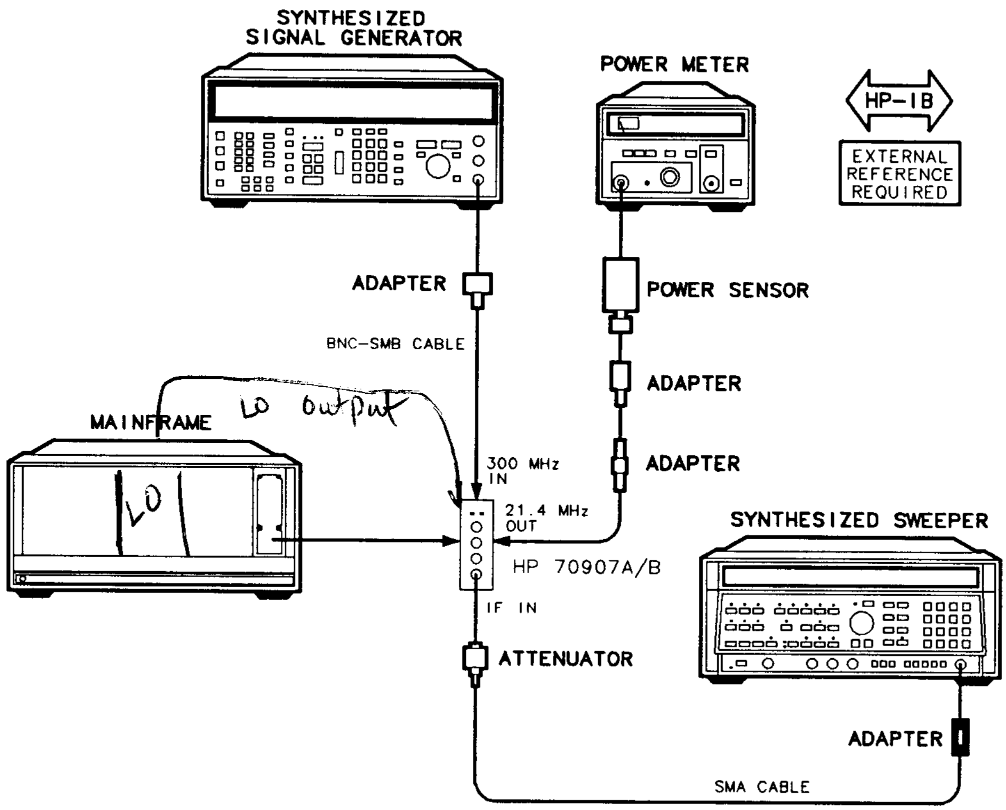


Figure 4-5. Module Gain Setup

2. Calibration Source Adjustment

Purpose

Note The following description applies to the HP 70907B only. A procedure for adjusting the A2 Calibration Source in the HP 70907A is provided in the software.

This procedure is used to adjust the 321.4 MHz calibration source. Both temperature compensation tracking and output power level are adjusted.

Description

The temperature compensation tracking is adjusted by connecting a precision DVM to A2TP3 with the ground connected to A2TP4. Resistor A2R1 is then adjusted for a 0 V DVM reading.

The calibration source power level adjustment requires that a synthesized sweeper be set to the reference amplitude at 321.4 MHz and connected to a low power sensor. The source is adjusted precisely. The source is connected to the front-panel IF input. The DUT is set to external 321.4 MHz input. This reference power is measured with the power sensor connected to the rear-panel 21.4 MHz output. The source is set to minimum amplitude. The DUT is switched to internal 321.4 MHz input, which applies the calibration source to the module. Resister A2R22 is adjusted to match the calibration source power to the reference power at the rear-panel 21.4 MHz output.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Precision DVM	HP 3456A
Synthesized Sweeper *(2 required)*	HP 8340A
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Sensor	HP 8485A
Low Power Sensor	HP 8481D
Local Oscillator	HP 70900B
HP 70000 Series Mainframe	HP 70001A
Accessories	
Module Service Extender	70001-60013
6 dB Attenuator	HP 8493C, Option 006
(1250-2015 adapter required for HP 70907A only)	
30 dB Reference Attenuator	HP 11708A
Adapters	
SMA (f) to SMB (m)	1250-0674
Type N (m) to BNC (m)	1250-0780
APC 3.5 (f) to APC 3.5 (f)	5061-5311

2. Calibration Source Adjustment

Type N (f) to APC 3.5 (f) 1250-1745

Cables

APC 3.5 (m) to APC 3.5 (m) 8120-4921
BNC (m) to SMB (f) 85680-60093
BNC (m) to BNC (m) .... HP 10503A

Procedure

Refer to "Preparing for Adjustments" in this chapter, then connect the equipment as shown in Figure 4-6. Load and run the Calibration Source routine. Make the adjustments as defined by the computer. Figure 4-7 illustrates the adjustment locations. Refer to Chapter 2, "Verification Software," for detailed information about loading and running the software.

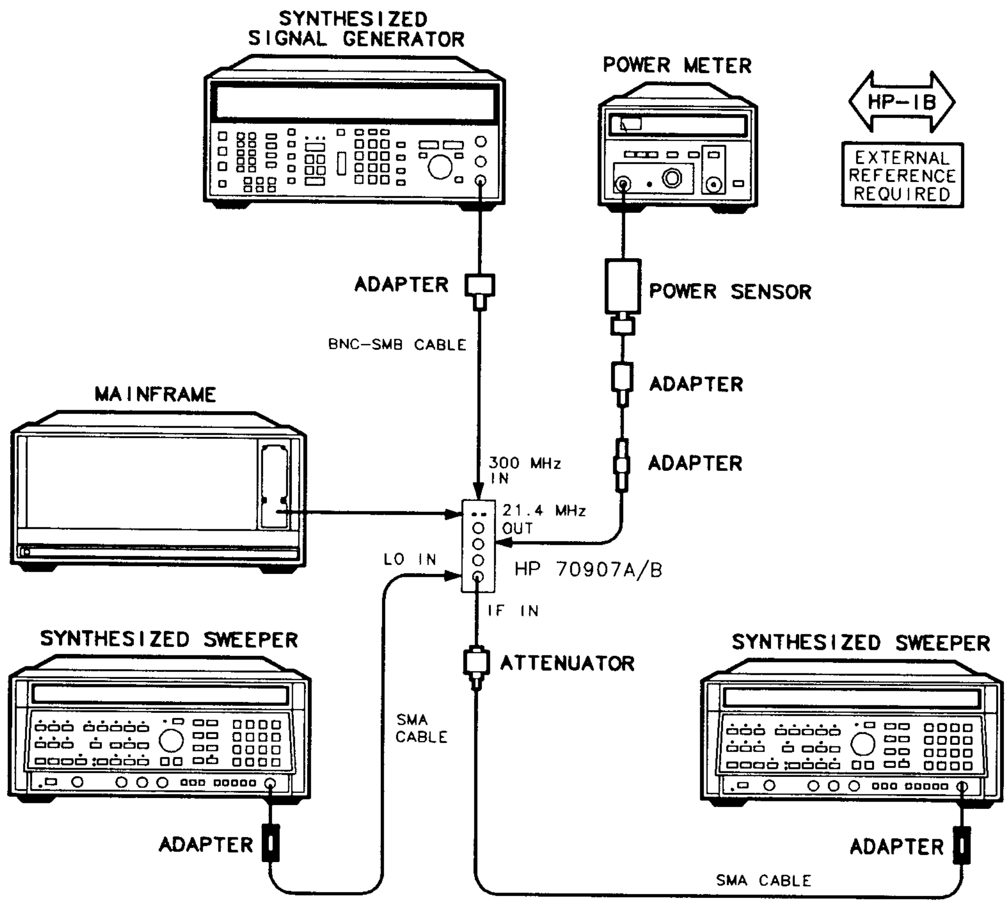


Figure 4-6. Calibration Source Setup

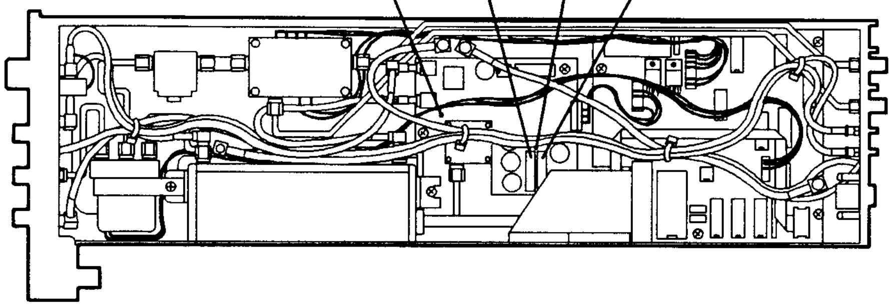


Figure 4-7. Calibration Source Adjustment Locations

3. LO Leveling Amplifier Adjustment

Purpose

This procedure is used to adjust the gate bias voltage for the LO Leveling Amplifier and the power level of the front-panel LO output.

Description

The gate bias voltage is adjusted, using gate bias control A1R70, to the voltage shown on the leveling amplifier microcircuit marked GATE BIAS.

The power level is adjusted using A1R62 for a power meter reading of 15.6 dBm.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Precision DVM	HP 3456A
Synthesized Sweeper	HP 8340A
Power Meter	HP 436A
Power Sensor	HP 8485A
(1250-2015 adapter required for HP 70907A only)	
Local Oscillator	HP 70900B
HP 70000 Series Mainframe	HP 70001A

Accessories

Module Service Extender	70001-60013

Adapters

APC 3.5 (f) to APC 3.5 (f)	5061-5311

Cables

APC 3.5 (m) to APC 3.5 (m)	8120-4921

Procedure

Refer to "Preparing for Adjustments" in this chapter, then connect the equipment as shown in Figure 4-8. Load and run the Calibration Source routine. Make the adjustments as defined by the computer. Figure 4-9 illustrates the adjustment locations. Refer to Chapter 2, "Verification Software," for detailed information about loading and running the software.

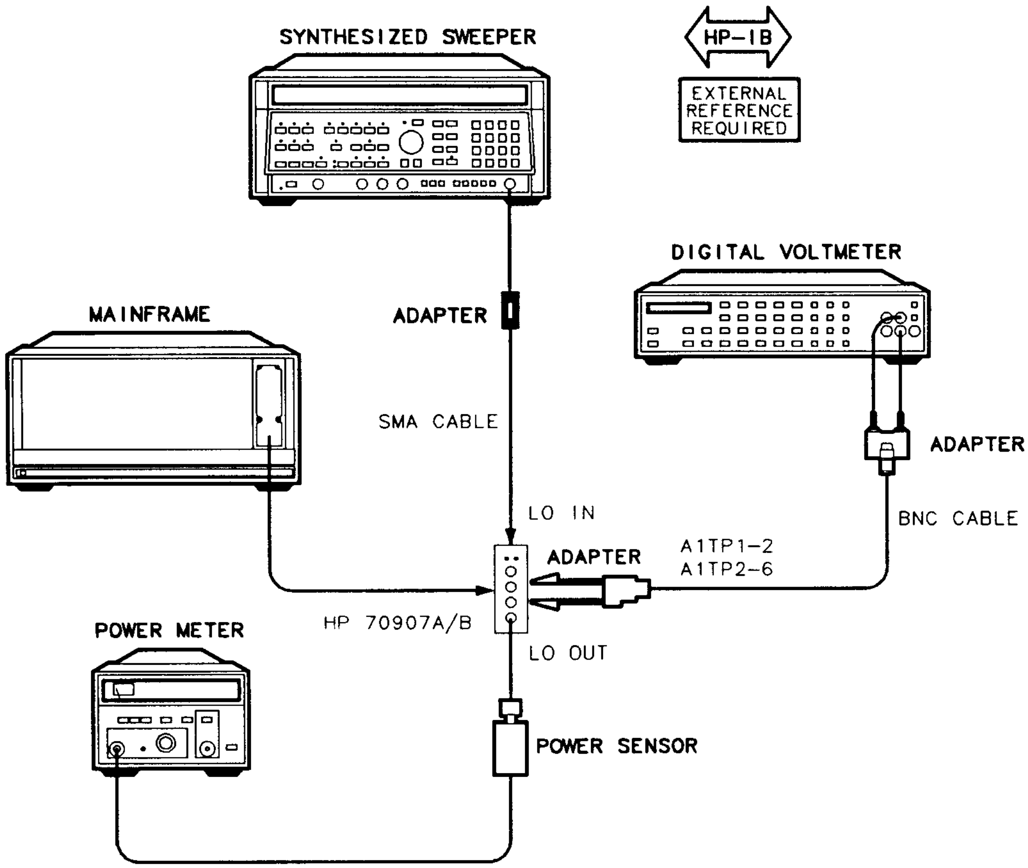


Figure 4-8. LO Leveling Amplifier Setup

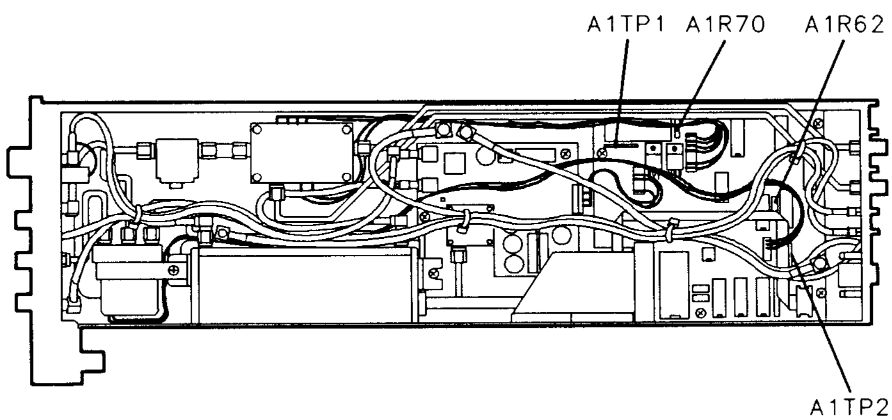


Figure 4-9. LO Leveling Amplifier Adjustment Locations

4. Miscellaneous Bias Voltage Adjustment

Purpose

This procedure is used to adjust the external mixer bias circuitry in the DUT.

Description

50 mV

The controller sets the mixer bias DAC to 0 (all bits off). Resistor A1R1 is adjusted for a DVM reading of −5 V. The controller sets the mixer bias DAC to 255 (all bits on). Resistor A1R2 is adjusted for a DVM reading of +5 V. The controller sets the mixer bias DAC to 128. Resistor A1R17 is adjusted for a DVM reading of 0 V.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Precision DVM	HP 3456A
Local Oscillator	HP 70900B
HP 70000 Series Mainframe	HP 70001A
Accessories	
Module Service Extender	70001-60013

Procedure

Refer to "Preparing for Adjustments" in this chapter, then connect the equipment as shown in Figure 4-10. Load and run the Calibration Source routine. Make the adjustments as defined by the computer. Figure 4-11 illustrates the adjustment locations. Refer to Chapter 2, "Verification Software," for detailed information about loading and running the software.

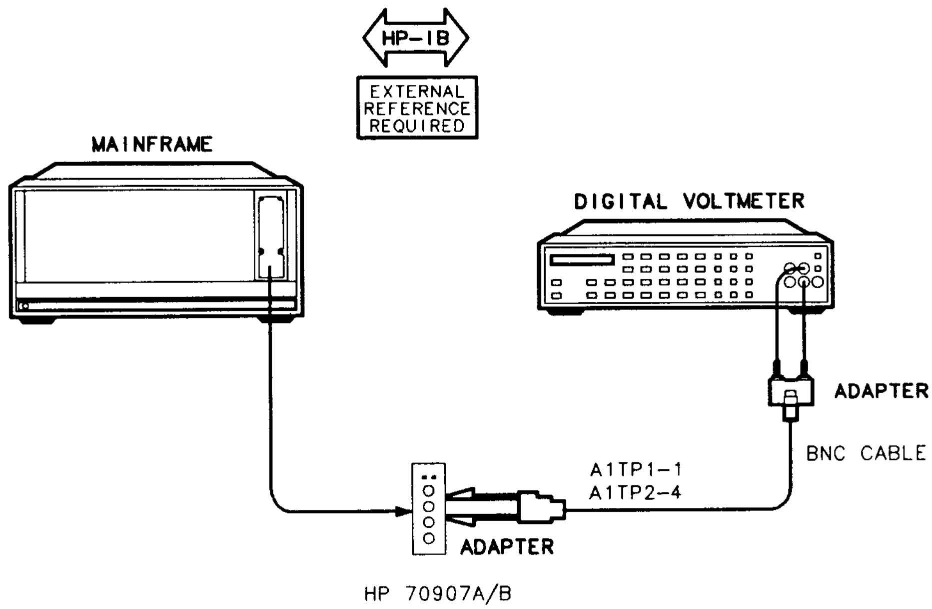


Figure 4-10. Miscellaneous Bias Voltage Check Setup

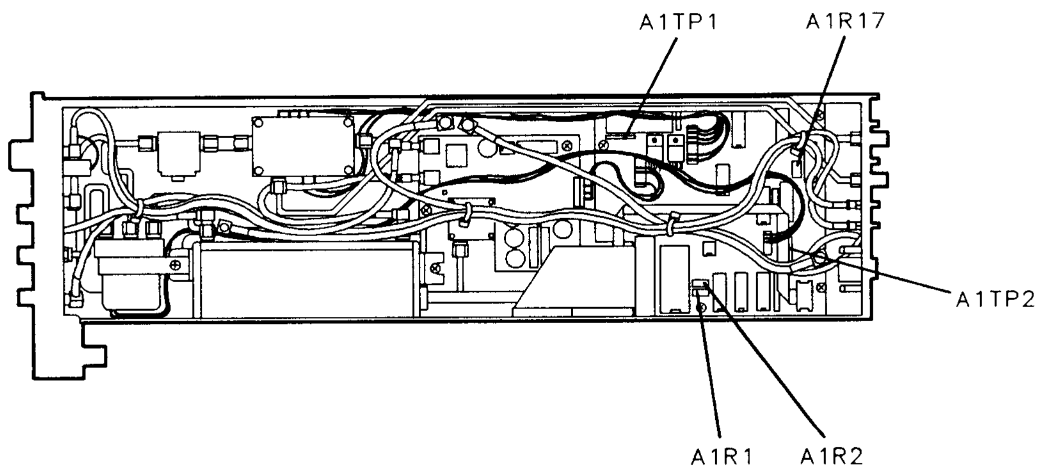


Figure 4-11. Miscellaneous Bias Voltage Check Adjustment Locations

NEED LO [illegible] FROM 70900

OR

[illegible]

5. Tune + Span Adjustment (HP 70907B)

Purpose

This procedure is used to adjust the Tune + Span DAC circuitry. This has up to ±50 mV influence on the front-panel Tune + Span output voltage used to tune external mixer preselectors.

Description

The controller sets the Tune + Span DAC to zero (all bits off). Resistor A4R29 is adjusted for a DVM reading of −50 mV. The controller sets the Tune + Span DAC to 255 (all bits on). Resistor A4R27 is adjusted for a DVM reading of +50 mV.

Equipment

Test Equipment	Preferred HP Model or Part Number
Controller	HP 9000 Series 200/300
Precision DVM	HP 3456A
Local Oscillator	HP 70900B
HP 70000 Series Mainframe	HP 70001A
Accessories	
Module Service Extender	70001-60013
SMB (f) Short Termination	1250-0911
Cables	
BNC (m) to BNC (m)	HP 10503A

Procedure

Refer to "Preparing for Adjustments" in this chapter, then connect the equipment as shown in Figure 4-12. Load and run the Calibration Source routine. Make the adjustments as defined by the computer. Figure 4-13 illustrates the adjustment locations. Refer to Chapter 2, "Verification Software," for detailed information about loading and running the software.

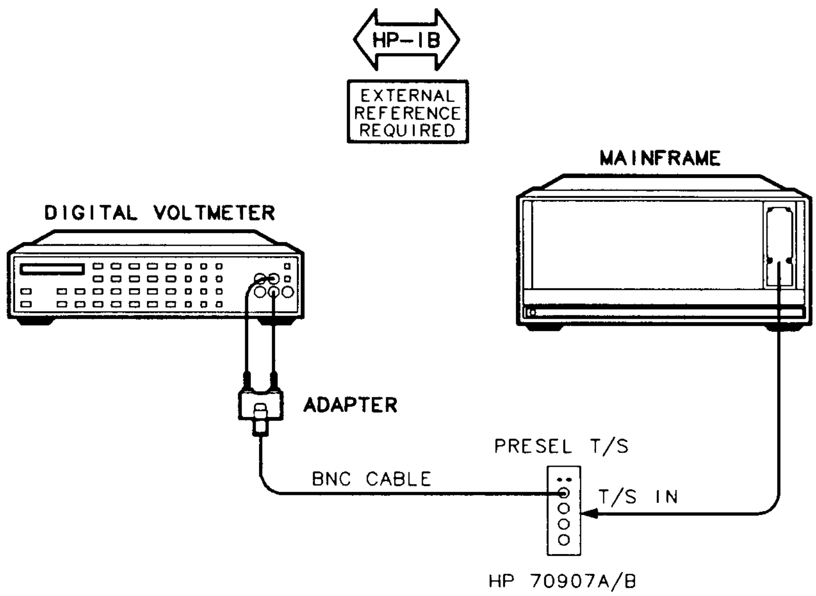


Figure 4-12. Power Supply/Controller Check Setup

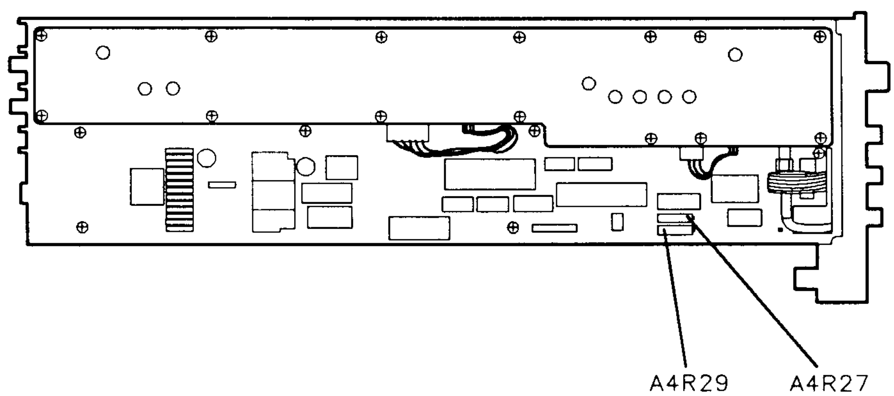


Figure 4-13. Power Supply/Controller Check Adjustment Locations

NEED LO & [illegible] FROM 70900, NOT SETUP FOR [illegible]
AND [illegible]

[illegible]

5

Troubleshooting

Introduction

This chapter contains troubleshooting information for the HP 70907A/B External Mixer Interface module (EMIM). In addition, the "ROM Replacement" section in this chapter tells how to locate the ROM and what needs to be done after the ROM is replaced.

Assembly-Level Troubleshooting Information

The first three sections of this chapter, "Power-Up Problems," "Error Codes," and "Verification Test Failures," will help you isolate problems to the assembly level. "Power Supply Troubleshooting" in the "A4 Power Supply/Control Board Assembly" section also has a procedure for isolating power-supply problems to the specific faulty assembly.

The module-level block diagram and interconnect diagram are located at the end of this chapter.

Component-Level Troubleshooting Information

The last six sections in this chapter contain mainly component-level troubleshooting information:

A1 Miscellaneous Bias Board Assembly
A2 Calibration Source Board Assembly
A3 Last Converter Board Assembly
A4 Power Supply/Control Board Assembly
A7 Front Panel Board Assembly

Notes

While troubleshooting, refer to the overall block diagram at the end of this chapter and to the major assembly and cable locations figure in Chapter 8. The parts lists, schematics, and component-location diagrams for the HP 70907A/B module's board assemblies are in the *HP 70907A/B Component-Level Information Package.*

The power levels, voltages, and so on, given in this chapter are for troubleshooting purposes only. Refer to the *HP 70907A/B Installation and Verification Manual* for specifications.

Caution

This module contains components that can be damaged or destroyed by electrostatic discharge. All work performed on the module should be done at a static-safe work station. Refer to the electrostatic discharge information in Chapter 1.

Power-Up Problems

A power-up sequence executes automatically when the module is turned on. If the module cannot complete its power-up sequence, the module may prevent the master module from establishing a link with the display. If this problem occurs, either the HP 70907A/B or the master module will have a flashing front-panel ERR LED. A partial or blank display may also be present.

Use the following procedure if the HP 70907A/B External Mixer Interface module will not complete its power-up sequence, or if it causes the HP 70000 Modular Measurement System to hang up (become unresponsive) when the system is turned on. Refer to Figure 5-1 for the location of the items called out in the procedure.

Caution

Turn off the mainframe power before replacing the fuse, and before disconnecting or reconnecting any cables. Instrument damage may occur if the mainframe power is on when these actions are taken.

1. Turn off the mainframe power and remove the HP 70907A/B module.
2. Remove the module's left-side cover.
3. Install an extender module in the mainframe. (Refer to "Service Kit" in Chapter 1 for the extender-module part number.)
4. Connect the HP 70907A/B module to the extender module.
5. Turn on the mainframe power.
6. Check to see if the green LED (A4CR9) in the center of the A4 Power Supply/Controller board assembly is lit. If the green LED is lit, skip to step 8. If it is not lit, turn off the mainframe power and check the fuse, replacing it if needed. Then turn on the mainframe power again.
7. If the fuse blows (opens) again, turn off the mainframe power. Then, remove ribbon cable W11 going to the A7 Front Panel board assembly, remove ribbon cable W13 going to the right side of the module, and remove the two cables (W12 and W14) which power the A3 Last Converter board assembly. Replace the fuse, then turn the mainframe power on again.
   - If the fuse blows for a second time, there is a short on one or more of the supplies present on the A4 board assembly. Refer to the "A4 Power Supply/Controller" troubleshooting section.
   - If the fuse does *not* blow again, replace the removed cables one at a time until the fuse does blow. Be sure to turn off mainframe power before reconnecting each cable. If the fuse blows after W11 is replaced, the A7 board assembly is probably faulty. If it blows after W13 is replaced, the A1 board assembly is probably faulty. If it blows after W12 or W14 are replaced, the A3 board assembly is probably faulty. Refer to the appropriate

theory-of-operation section in this chapter for additional information on the assembly which is causing the short.

8. Measure the voltage at A4TP1-1 (this is the test point for A4U11 pin 3).
   - If the voltage measures +5 V, there is a problem with the A4 Controller section. Refer to the "A4 Power Supply/Controller" troubleshooting section.
   - If the voltage is *not* +5 V, turn off the mainframe power, disconnect ribbon cable W11 going to the A7 Front Panel board assembly, then turn the mainframe back on.
9. Remeasure the voltage on A4TP1-1.
   - If the voltage is now +5 V, then the A7 Front Panel board assembly is loading the supply down. Refer to the "A7 Front Panel" troubleshooting section.
   - If the voltage still does not measure +5 V, then refer to the "A4 Power Supply/Controller" troubleshooting section.

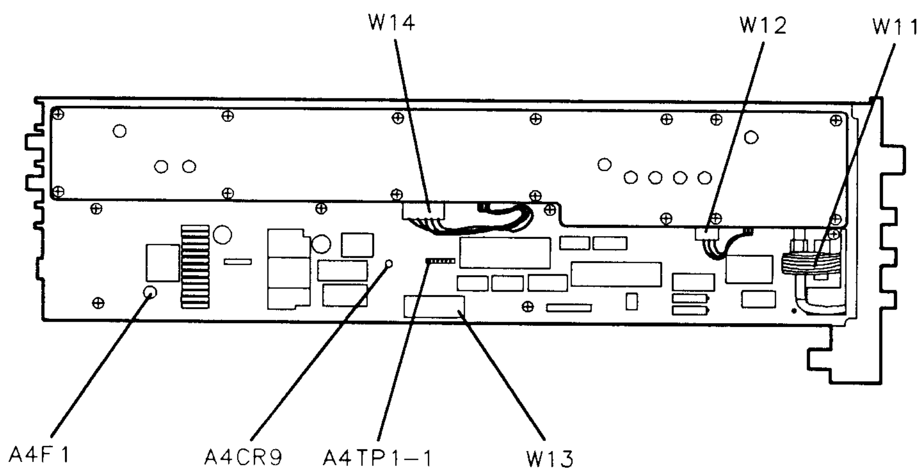


Figure 5-1. Location of A4CR9, A4F1, A4TP1-1, W11, W12, W13, and W14

Error Codes

The error codes generated by the HP 70907A/B External Mixer Interface module (EMIM) are listed below in numerical order.

Error Types	Error Numbers
Usage/Operating	2000 to 2999
Hardware Warning	6000 to 6999
Hardware Broken	7000 to 7999

Usage/Operating Errors

These errors occur when the instrument is used incorrectly.

2000 `Rom check error` — This error occurs when a check sum (test) is performed on the internal slave ROM and the value reported does not match the previously stored value in the ROM. If this error occurs, the module operation should be questioned even if no additional errors are reported and the module seems to be functioning nominally. The ROM should be replaced. Refer to the ROM replacement section of this document.

2001 `Illegal Cmd` — This error occurs when the microprocessor on the A4 Power Supply/Control board assembly encounters a command that it does not recognize. This error can be caused by the master element's sending such a command. However, if the error is repeated when the HP 70907A/B module is moved to another mainframe, the problem may be a faulty (open or shorted) W15 module-to-module cable, or a faulty A4 Power Supply/Control board assembly.

2002 `Illegal parameter` — Refer to 2001 Illegal Cmd.

2006 `Param out of range` — Refer to 2001 Illegal Cmd.

2009 `Protocol error` — Refer to 2001 Illegal Cmd.

2026 `Check mixer bias` — This error occurs in response to an improper load impedance on the front-panel mixer bias port.

Verify that a load impedance exists, connected to the front-panel mixer bias port, such that:

$$|(I_{bias} \times R_{load})| \leq 2.5V$$

where I_{bias} = mixer bias current in amps
R_{load} = real part of the load impedance

If the load impedance satisfies the condition stated above, attempt to perform the Miscellaneous Bias Board dc Volts adjustment. If the board was out of adjustment, replace the original load and see if the error returns. If it returns, or if the alignment procedure was impossible to run due to the failure, refer to "Mixer Bias Tests" in the "Verification Test Failures" section of this chapter, and "A1 Miscellaneous Bias Board Assembly" in this chapter.

Hardware Warning Errors

These error codes report the status of the HP 70907A/B hardware or indicate that some of the hardware may be broken. These error codes indicate that measurement accuracy may be impaired.

6000 `EAROM unprotected` — This error indicates that the WRITE/PROTECT switch (on the A4 board assembly) is in the WRITE position. Push the WRITE/PROTECT switch to the PROTECT position. Do not use a metallic tool to change the switch, as this may cause EAROM failure. If the switch was already in the PROTECT position, there is a problem on the A4 board assembly.

Hardware Broken Errors

The following error codes are generated by hardware or firmware failures within the module.

7001 `LO unleveled` — This error occurs in response to an insufficient LO output power at the primary LO output port of the A5 Leveling Amplifier. This detector is monitored continually while the module is powered up.

Verify that the power into the A5 Leveling Amplifier is between +4 and +12 dBm. If the input power is correct, refer to the "LO Amplitude and Harmonics" and "LO Input Amplitude Range" sections in this chapter.

7004 `300 MHz error` — This error occurs in response to an insufficient 300 MHz second LO power level at the LO port of mixer A3U3 on the A3 Last Converter board assembly. This detector is monitored continually while the module is powered up.

Verify that the 300 MHz input power to the module is between −1 and +1 dBm. If the input power is correct, refer to "300 MHz Reference Input Range" and "300 MHz Reference Amplitude and Harmonics" in the "Verification Test Failures" section of this chapter.

7005 `321.4 MHz error` — (HP 70907A only) This error occurs, in response to an insufficient 321.4 MHz IF power level at the output of the 321.4 MHz BPF on the A3 board assembly, when the calibration signal is used to run a diagnostic check of the HP 70907A RF path. This diagnostic check is run at power-up and when instrument self-test is invoked either remotely or from the front panel.

This error should be accompanied by a `7006 21.4 MHz error`. Because of problems with circuit oscillations, the 321.4 MHz detector was removed from the A3 board assembly starting with module serial prefix 2638A00275. Therefore, if the module has a serial number lower than 2638A00275 and does not have the 7006 error along with the 7005 error, there is probably a problem with the 321.4 MHz detector on the A3 board assembly. If only a 321.4 MHz error is present, refer to "Diagnostics" in the "Verification Test Failures" section of this chapter.

If both the 21.4 MHz and 321.4 MHz errors are present, verify that the calibration source is functional. This will have to be done at the RF output of the A2 board assembly (A2J3) because the A3 board assembly is probably faulty. If the calibration-source power is nominal, then confirm that the signal is present at A3J1, the input to the A3 Last Converter. If the signal is present at A3J1, the A8 Attenuator and the W2 and W3 cables are functional. If the proper signal level is present at A3J1, then one of the high-gain low-noise preamplifiers on the A3 board assembly is probably faulty. Refer to "Diagnostics" in the "Verification Test Failures" section of this chapter.

7006 `21.4 MHz error` — (HP 70907A only) This error occurs, in response to an insufficient 21.4 MHz IF power level at the output of the 21.4 MHz SPDT switch on the A3 board assembly, when the calibration signal is used to run a diagnostic check of the HP 70907A RF path. This diagnostic check is run at power-up and when instrument self-test is invoked either remotely or from the front panel.

If this error occurs without a concurrent `7005 321.4 MHz error`, then the problem exists on the A3 Last Converter board assembly after the A3U3 mixer. More than likely one of the 21.4 MHz IF amplifiers is non-functional or the 21.4 MHz detector is faulty. Refer to "Diagnostics" in the "Verification Test Failures" section of this chapter.

If this error appears along with a `7005 321.4 MHz error`, then refer to the last paragraph in the `7005 321.4 MHz error` information above.

Verification Test Failures

Refer to the following information if the HP 70907A/B External Mixer Interface module fails one of its module verification tests. Before proceeding with the instructions given below, make sure that the test setup is correct and the test equipment is functioning properly.

Note

While troubleshooting, refer to the schematics and component location diagrams in *HP 70907A/B Component-Level Information*. Make sure that the schematic or component location diagram matches the board assembly being repaired. The board assembly HP part number appears on both the board assembly and the schematic and component location diagram that documents the board assembly.

The verification test information is given in the following order:

1. Noise Figure
2. Third Order Intercept
3. 321.4 MHz Output Response
4. Module Gain and Calibration Source
5. Front Panel LEDs
6. Main LO Output Amplitude and Harmonics
7. Aux. LO Output Amplitude and Harmonics
8. 300 MHz Output Amplitude and Harmonics
9. 321.4 MHz Output Response
10. IF Subharmonics
11. LO Input Sensitivity
12. Diagnostics
13. 300 MHz Input Sensitivity
14. Close-In Sidebands
15. 21.4 MHz Daisy Chain Loss
16. 21.4 MHz Input/Output Isolation
17. 321.4 MHz IF Input Return Loss

1. Noise Figure

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most probable cause is a problem on the A3 board assembly in one of the following areas:

- Misaligned 300 MHz or 321.4 MHz bandpass filter (BPF) (function blocks Ⓗ and Ⓥ).
- Excessively noisy transistors A3Q1 or A3Q2 (function blocks Ⓠ and Ⓡ).

Use the following procedure to isolate the problem, repairing as necessary:

1. Perform the 300 MHz Output/Bandpass and 321.4 MHz Bandpass adjustment procedures, and make sure that the module gain from the 321.4 MHz input to the 21.4 MHz output is meeting test limits (about +30.5 dB). Then, rerun the test.
2. If the test fails again, confirm that the dc collector bias current in A3Q1 is 17 mA and the collector bias current in A3Q2 is 34 mA. If the bias currents are correct, replace A3Q1 and then A3Q2, remeasuring the noise figure after each replacement.
3. If the test still fails, make sure that the combined cable loss for W1, W2, and W3 is less than 1 dB. If there is too much loss, determine which cable is faulty and replace it. Then rerun the test.
4. If the cable loss is acceptable, then the problem is probably a faulty A3Q10 or A3Q11.

2. Third Order Intercept

(Refer to the A3 Last Converter theory of operation for additional background information.)

If this test fails, the most probable cause is a problem on the A3 board assembly in one of the following areas:

- Misaligned 300 MHz or 321.4 MHz BPF (function blocks Ⓗ and Ⓥ).
- Either the first or second 321.4 MHz IF amplifier stage (function blocks Ⓠ and Ⓡ).
- The mixer A3U3 (function block Ⓛ).
- Either the third or fourth 21.4 MHz IF Amplifier stage (function blocks Ⓝ and Ⓔ).

Use the following procedure to isolate the problem, repairing as necessary:

1. Perform the 300 MHz Output/Bandpass and 321.4 MHz Bandpass adjustment procedures, and make sure that the module gain from the 321.4 MHz input to the 21.4 MHz output is meeting test limits (about +30.5 dB). Then, rerun the test.
2. Make sure that the collector dc bias currents are correct for all four IF amplifiers. If any of the bias currents are different than those shown below, determine and correct the problem. Then, rerun the test.

   Bias current for A3Q1 (function block Ⓠ) should be 17 mA.
   Bias current for A3Q2 (function block Ⓡ) should be 34 mA.
   Bias current for A3Q10 (function block Ⓝ) should be 11 mA.
   Bias current for A3Q11 (function block Ⓔ) should be 11 mA.

3. If the bias currents are correct, rerun the test while using a resistive divider or active probe to measure the distortion products at test points A3TP2 and A3TP4. Calculate the TOI value, using the equation shown below, and compare the calculated value to the value obtained by the TOI test. If the calculated value is approximately the same as the test value, replace A3Q1 and A3Q2. Then, rerun the test.

   $$TOI = \left(S + \frac{\Delta}{2}\right)$$

   where:

   S = input signal level in dBm.
   Δ = difference between signal and distortion product in dB at the measured point.

4. If the calculated value is better than the test value, remeasure the distortion products at the 21.4 MHz output of the diplexer (function block Ⓜ) where the diplexer is connected to the IF port of the mixer (function block Ⓛ). Calculate this new value of TOI and compare it to the value obtained by the TOI test. Replace A3Q10 and A3Q11 if the new calculated value is better than the test value. Replace A3U3 if the new calculated value is about the same as the test value. Then, rerun the test.

3. 321.4 MHz Output Response

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is one of the following problems on the A3 board assembly:

- Misaligned 321.4 MHz BPF (function block Ⓥ).
- Faulty A3 circuitry loading down the RF path.

Use the following procedure to isolate the problem, repairing as necessary:

1. Perform the 321.4 MHz Bandpass adjustment procedure. Then, rerun the test.
2. After readjustment, if the response still cannot be tuned to meet the test limits, then characterize the bandpass response at the output of the 321.4 MHz BPF (function block Ⓥ). Use an active or resistive divider probe connected to A3TP2 and A3TP4. The frequency-response test limits are the same at this point as they are at the 21.4 MHz output port; the frequency is just translated up by 300 MHz.
3. If it is still not possible to adjust the 321.4 MHz BPF correctly to provide the desired frequency response, make sure that the first and second 321.4 MHz IF amplifiers (function blocks Ⓠ and Ⓡ) are dc biased correctly: the collector dc bias for A3Q1 should be 17 mA; the collector dc bias for A3Q2 should be 34 mA. If the bias is correct, there is a problem with the 321.4 MHz BPF or input filter structure. Troubleshoot and repair as necessary.
4. If it is possible to adjust the frequency response to meet the test limits, then the problem is located in the 21.4 MHz IF path. To find the faulty components, use an active probe to determine the frequency response at various points in the circuit path.

4. Module Gain and Calibration Source

(Refer to the A2 Calibration Source and the A3 Last Converter theory of operation for additional information.)

There are three separate module-operation parameters that are verified in this test:

- 321.4 MHz to 21.4 MHz module gain.
- Calibration source power level.
- Calibration source tuning range.

321.4 MHz to 21.4 MHz Module Gain

If this test fails, the most likely cause is a problem on the A3 Last Converter board assembly. Use the following procedure to isolate the problem, repairing as necessary.

1. Perform the 300 MHz Output/Bandpass, 321.4 MHz Bandpass, and Module Gain adjustment procedures to confirm that the 321.4 MHz BPF and gain adjustments are set correctly. Then, rerun the test.
2. If the adjustment procedure cannot be completed, then verify that the insertion loss is less than 0.5 dB for the following assemblies: Cable assemblies W1 and W2, A8 attenuator assembly (when set to 0 dB), and the 321.4 MHz switch (function block Ⓐ) on the A2 Calibration Source board assembly.
3. If the insertion loss from the front panel to A3J1 (321.4 MHz IF input) is acceptable, then use an active probe to measure the gain of the 321.4 MHz IF section of A3.
   a. Insert a 321.4 MHz signal of known power level (between −32 dBm and −37 dBm) into A3J1.
   b. Measure the 321.4 MHz signal power at A3TP2 and A3TP4. The signal gain should be approximately +22.0 dB ±1.5 dB. If the signal gain is correct, the problem is either in A3U3 (the mixer) or in the 21.4 MHz IF circuitry. Using the active probe, trace the 21.4 MHz signal until the circuit responsible for the gain reduction is identified.
   c. If the signal gain is incorrect, the problem is in the 321.4 MHz IF circuitry. Use the active probe and trace the 321.4 MHz signal until the circuit responsible for the gain reduction is identified.

Calibration Source Power Level (HP 70907B only)

If this test fails, the most likely cause is a problem on the A2 Calibration Source board assembly. Perform the Calibration Source adjustment procedure, then rerun the test. Information is given below for the two different failure conditions: failure due to too low or too high output power, and failure due to no output power.

Low/High Output Power. If the 21.4 MHz power level is measurable and at the correct frequency, but cannot be adjusted, the likely cause is an A2 board assembly problem shown below. If the output frequency is incorrect, proceed to "No Output Power."

- Malfunctioning ALC loop (function block Ⓔ).
- Too low (less than −15 dBm) 321.4 MHz signal output from A2U2 (function block Ⓕ).

Use the following procedure to isolate the problem, repairing as necessary:

1. Run the Calibration Source adjustment. If the current-mirror voltage potential between A2TP4 and A2TP3 cannot be adjusted to 0.0 V, then the problem most likely is a faulty A2Q1 or A2CR9. After repair, rerun the test.
2. If the current-mirror adjustment can be performed correctly, then check the following:
   a. The output of operational amplifier A2U1 (pin 6) is at the positive rail (+11 V) for a low-power condition and at the negative rail (−11 V) for a high-power condition.
   b. Check the operation of current buffer A2Q2 (emitter of A2Q2 should be approximately 0.65 V below the voltage at A2U1 pin 6).
   c. Check the operation of pin diode A2CR1.
3. In a low-power condition, if the above voltages are correct, verify that A2U6 is sinking the appropriate amount of current by measuring the voltage at A2U6 pin 3 (+5 V). If the voltage is incorrect, replace A2U6.
4. If the voltage at A2U6 pin 3 is correct, then confirm that the appropriate amount of LO power is getting to the A2 assembly:
   a. Disconnect W20 from A2J2 (LO INPUT).
   b. Connect a power meter to the end of W20 that was just disconnected.
   c. Verify that the measured power is greater than +12 dBm. If the power is incorrect, troubleshoot the LO delivery path and repair as necessary.
   d. If the power level is correct, A2U2 is faulty. Replace the A2 board assembly.

No Output Power. If the test fails because there is no output power, use the following procedure to isolate the problem:

1. Verify that the voltage at A2U6 pin 3 is +5 V. If it is not, replace A2U6 and rerun the test.
2. Verify that the voltage at A2U1 pin 6 is approximately +11 V. If the voltage is incorrect, troubleshoot and repair the ALC loop as necessary.
3. If the voltage is correct, verify that A2CR1 is biased correctly. The voltage at the anode of diode A2CR1 should be approximately 3.7 V.
4. If A2CR1 is correctly biased, then confirm that the appropriate amount of LO power is getting to the A2 assembly:
   a. Disconnect W20 from A2J2 (LO INPUT).
   b. Connect a power meter to the end of W20 that was just disconnected.
   c. Verify that the measured power is greater than +12 dBm. If the power is incorrect, troubleshoot the LO delivery path and repair as necessary.
   d. If the power level is correct, A2U2 is faulty. Replace the A2 board assembly.

Calibration Source Tuning Range

If this test fails, the most likely cause is either a problem in the LO delivery path or a faulty A2 Miscellaneous Bias board assembly. Use the following procedure to isolate the problem:

1. Confirm that the appropriate amount of LO power is getting to the A2 assembly:
   a. Disconnect W20 from A2J2 (LO INPUT).
   b. Connect a power meter to the end of W20 that was just disconnected.
   c. Verify that the power over the LO frequency range of 4.8224 GHz to 5.4624 GHz is greater than +12 dBm. If the power is incorrect, troubleshoot the LO delivery path and repair as necessary.
2. If the power level is correct, then A2U2 is faulty and the A2 board assembly must be replaced.

5. Front Panel LEDs

(Refer to the A7 Front Panel theory of operation for additional information.)

If this test fails, the most likely cause is either a faulty front-panel LED on the A7 Front Panel board assembly or a problem on the A4 Power Supply/Control board assembly.

Use the following procedure to isolate the problem:

1. Remove the right-side module cover.
2. Use the test program to toggle (turn on and off) the LEDs.
3. Measure the voltage at the cathode end of each LED. Use a digital voltmeter (DVM) with a fairly long test point. The expected voltages are given in the table below.

Table 5-1. A7DS1 and A7DS2 Cathode Voltages

LED Color	Reference Designation	Activated (On)	Deactivated (Off)
Green	A7DS1	+2.00 V	+5 V
Red	A7DS2	+1.77 V	+5 V

- If the cathode voltage does not measure +5 V when the LED is deactivated, then the +5 V supply is not present on the A7 Front Panel board assembly. This voltage comes through the W11 ribbon cable from the A4 Power Supply/Control board assembly. Troubleshoot and correct this problem, then rerun the Front Panel LEDs test.
- If the cathode voltage measures +5 V when the LED is activated, or approximately +2.00 V when the LED is deactivated, then there is a problem with the LED driver circuit on the A4 Power Supply/Control board assembly. Most likely, either driver FET A4Q1 has opened up or driver FET A4Q2 has shorted out. Repair as necessary and rerun the test.
- If neither of the above conditions exist, replace the suspect LED and rerun the test.

6. Main LO Output Amplitude and Harmonics
7. Aux. LO Output Amplitude and Harmonics

(For additional information, refer to the information about leveling-loop related circuits in the A1 Miscellaneous Bias theory of operation.)

Main (Front-panel) LO Output Amplitude

If this test fails, the most likely cause is one of the following:

- Faulty A5 Leveling Amplifier.
- Faulty semirigid cables.
- Faulty K2 RF Switch (HP 70907B only).
- Faulty Isolator.

If the Test Failure Is Accompanied by a `7001 LO unleveled` Error. Use the following procedure to isolate the problem:

1. Verify that the power at the rear-panel LO input is between +4 and +11 dBm.
2. Verify that the supply voltages are correct. Refer to the A5 Leveling Amplifier simplified block diagram or the A5 label for the correct dc levels.
3. If the LO input power and supply voltages are correct, try to perform the LO Leveling Amplifier adjustment.
4. If the LO Leveling Amplifier adjustment still cannot be done, or if it does not correct the error, check the LO input to A5:
   a. Disconnect W7 from the A5 LO input.
   b. Connect a power meter to the end of W7 that was just disconnected.
   c. Measure the LO power. If the power is not between +4 and +11 dBm, replace W7. Then, rerun the test.
5. If the power is between +4 and +11 dBm, make sure that the

   leveling-amplifier circuitry on the A1 Miscellaneous Bias assembly is functioning nominally.
   a. Check the voltage levels at pins 1, 2, and 3 of A1U7A.
   b. Check the voltage on the emitter of A1U5D.
6. If the voltage levels are correct, replace the A5 Leveling Amplifier.

If the Test Failure Is Not Accompanied by a `7001 LO unleveled` Error. The most likely cause is either the cable or the switch (HP 70907B only).

If the power output is too high, perform the LO Leveling Amplifier adjustment, then rerun the test.

If there is no output problem, or the output power is too low, use the following procedure to isolate the problem:

1. Verify that the power at the rear-panel LO input is between +4 and +11 dBm.
2. Verify that the supply voltages are correct. Refer to the A5 Leveling Amplifier simplified block diagram or the A5 label for the correct dc levels.

3. If the input power and supply voltages are correct, verify that the power output of the A6 Isolator is +16 dBm ±1 dBm. If the A6 output is correct, check the following items, repairing as necessary. Then rerun the test.
   - Verify that K2 is functional and directing the LO signal to the front panel (HP 70907B only).
   - Inspect the front-panel connector and the two semirigid cables in this path, W8 and W20.
4. If the output power of the A6 Isolator is incorrect, measure the power at the A5 Leveling Amplifier main output directly. If the A5 output power is between +15 dBm and +18 dBm, then replace the A6 Isolator.
5. If the A5 output power is *not* between +15 dBm and +18 dBm, make sure that the leveling-amplifier circuitry on the A1 Miscellaneous Bias assembly is functioning nominally.
   - Check the voltage levels at pins 1, 2, and 3 of A1U7A.
   - Check the voltage on the emitter of A1U5D.
6. If the voltage levels are correct, replace the A5 Leveling Amplifier.

Auxiliary (Rear-panel) LO Output Amplitude

If this test fails, the most likely cause is one of the following:

- Incorrect LO input power.
- Faulty hardware in the LO signal path.
- Faulty A5 Leveling Amplifier.

If the Auxiliary LO Output Power Is Too High. Use the following procedure to isolate the problem:

1. Perform the LO Leveling Amplifier adjustment procedure, then rerun the test.
2. If the amplitude is still too large, replace the A5 Leveling Amplifier.

If the Power Out of the Auxiliary LO Output Is Too Low. Use the following procedure to isolate the problem:

1. Confirm that the power at the rear-panel LO input is between +4 and +11 dBm.
2. If the input power level is correct, confirm that the power at the A5 auxiliary LO output port is between +7 dBm and +15 dBm. If the A5 power level is correct, inspect semirigid cable W9 and the rear-panel LO output connector. Repair as necessary.
3. If the A5 power level is incorrect, or if the output power is still low after replacing W9 and the rear-panel connector, replace the A5 Leveling Amplifier.

Main and Auxiliary LO Output Harmonics

If the harmonic content of either the main or auxiliary outputs is too high, confirm that the proper LO input signal is present at the rear-panel input. The LO input signal should be +4 to +11 dBm in amplitude, with harmonics equal to or lower than −21 dBc. If the LO input signal is correct, replace the A5 Leveling Amplifier.

8. 300 MHz Output Amplitude and Harmonics

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is one of the following problems on the A3 board assembly:

- Misaligned level adjustment.
- Faulty circuitry in the first LO amplifier (function block Ⓐ).
- Faulty circuitry in the 300 MHz AGC (function block Ⓒ).

If there is no output power at all, the problem is probably in either in the first LO amplifier or the 300 MHz AGC.

Use the following procedure to isolate the problem, repairing as necessary:

1. Perform the level adjust section of the 300 MHz Output/Bandpass adjustment. Then rerun the performance test.
2. Confirm that the bias level for A3Q5 is 40 mA dc.
3. Use a DVM to check that a reference voltage of approximately 0.28 V exists at A3U7 pin 3 (function block Ⓒ) and that the voltage can be adjusted using A3R49.
4. With no 300 MHz power applied to the rear-panel input, verify that the voltage at A3U7 pin 2 is approximately 0.0 V. If the voltage is incorrect, repair the detector diode bias string as necessary.
5. Verify that the loop-amplifier output voltage (A3U7 pin 6) is approximately +11 V (positive supply rail). If the voltage is incorrect, replace A3U7.
6. Verify that the voltage at the emitter of current buffer A3Q9 is approximately 0.65 V below the voltage at A3U7 pin 6. If the voltage is incorrect, either A3Q9 or A3CR15 are faulty.
   - If the A3Q9 emitter voltage is approximately 0.0 V, replace A3Q9.
   - If the A3Q9 emitter voltage is approximately 11 V, replace A3CR15.
7. If everything is performing nominally to this point, use an active or resistive probe to track the 300 MHz signal through the RF path (300 MHz reference input to 300 MHz reference output). Repair as necessary.

9. 321.4 MHz Output Response

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is one of the following problems on the A3 board assembly:

- Misaligned 321.4 MHz BPF (function block Ⓥ).
- Faulty IF circuitry on the A3 board assembly.

Use the following procedure to isolate the problem, repairing as necessary:

1. Perform the 321.4 MHz Bandpass adjustment procedure. Then rerun the test.
2. If the problem still exists after readjustment, make sure that the first and second 321.4 MHz IF amplifiers (function blocks Ⓠ and Ⓡ) are dc-biased correctly. The collector dc bias for A3Q1 should be 17 mA; the collector dc bias for A3Q2 should be 34 mA. If the bias is incorrect, troubleshoot and correct the problem. Then, rerun the test.
3. If the bias is correct, the most likely cause is a problem with the input-filter structure of the first 321.4 MHz IF amplifier stage (function block Ⓠ). Troubleshoot and repair as necessary.

10. IF Subharmonics

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the problem is probably on the A3 board assembly:

- Test failures for IF subharmonic frequencies of 107.133 MHz or 160.7 MHz are probably caused by a faulty filter/matching network prior to the first 321.4 MHz IF amplifier (function block Ⓠ).
- Test failures for IF subharmonic frequencies of 307.1333 MHz or 310.7 MHz are probably caused by a misaligned 321.4 MHz BPF (function block Ⓥ).

Test Failures for IF Subharmonic Frequencies of 107.133 or 160.7 MHz

The frequency response of the filter/matching network prior to the first 321.4 MHz IF amplifier is critical in determining the IF subharmonic performance. Use the procedure below to isolate the problem:

1. Use an active or resistive divider probe to measure the swept frequency response of the first 321.4 MHz IF amplifier. Use coupling capacitor A3C4 as the probe point. The typical response is shown in the figure below.

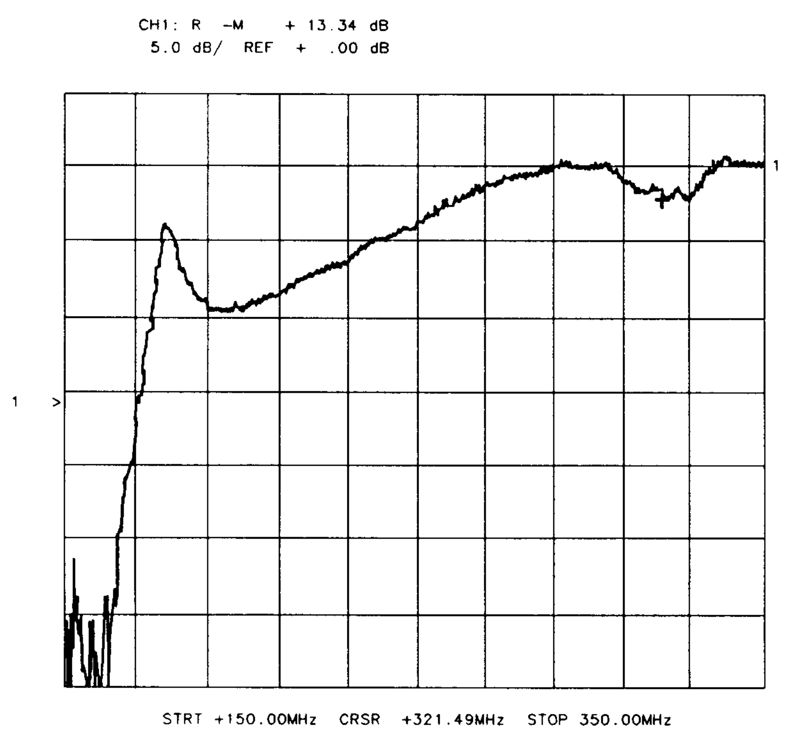


Figure 5-2. Typical Swept Frequency Response for the 1st IF Amplifier

2. Measure the dc collector bias currents in A3Q1, A3Q2, A3Q10 and A3Q11. If any or all of the bias currents are different than those shown below, troubleshoot and repair the amplifier circuits as necessary.

   Bias current for A3Q1 (function block Ⓠ) should be 17 mA.
   Bias current for A3Q2 (function block Ⓡ) should be 34 mA.
   Bias current for A3Q10 (function block Ⓝ) should be 11 mA.
   Bias current for A3Q11 (function block Ⓔ) should be 11 mA.

3. If none of the previous steps have revealed anything, trace the various signal levels through the RF path using an active probe. This should identify the circuit contributing the major portion of the distortion.

Test Failures for IF Subharmonic Frequencies of 307.1333 or 310.7 MHz

Test failures for IF subharmonic frequencies of 307.1333 MHz or 310.7 MHz are probably caused by a misaligned 321.4 MHz BPF (function block Ⓥ). Confirm that the 321.4 MHz BPF is adjusted correctly, running the 321.4 MHz Bandpass adjustment if necessary. Then, rerun the test.

11. LO Input Sensitivity

(Refer to the leveling-amplifier related information in the A1 Miscellaneous Bias theory of operation for additional information.)

There are two conditions under which this test will fail: either no error is indicated when there is an error condition (low LO input power), or an error is indicated when the LO input power is acceptable. The most likely cause of these conditions is one of the following problems:

- Misadjusted leveling-amplifier related circuits.
- Faulty ALC loop circuitry.
- Faulty A5 Leveling Amplifier.

No Error Indication when Error Condition Exists

When the LO input power is reduced to a certain point, a `7001 LO unleveled` should be generated and the green LED A1DS1 should go off. If this does not happen, the problem is probably either faulty ALC loop circuitry or misadjusted circuits (gate bias or power-output level) on the A1 Miscellaneous Bias board assembly. Use the following procedure to isolate the problem:

1. Perform the LO Leveling Amplifier adjustment to make sure that the gate bias and power-output level are properly adjusted. Then, rerun the test.
2. If the problem still exists, measure the reference voltage at A1TP2-6 and the LO detector voltage at A1TP2-5. In this instrument condition, the reference voltage (approximately −0.25 V) should be smaller than the detector voltage. If the reference voltage is larger than the detector voltage, replace the A5 Leveling Amplifier.
3. If the reference voltage is smaller than the detector voltage, verify the following voltages and repair as necessary:

   A1U7A pin 1 should be approximately +11 V.
   A1U7B pin 7 should be approximately −11 V.
   A1U4B collector voltage should be +5 V.

Error Indication when No Error Condition Exists

If the green LED A1DS1 turns off and an `7001 LO unleveled` error is indicated when sufficient LO input power is being applied, the most likely cause is a faulty A5 Leveling Amplifier. Use the following procedure to isolate the problem, repairing as necessary:

1. Verify that an input power level of +8 dBm is present at the rear-panel LO input.
2. Perform the LO Leveling Amplifier adjustment to verify that the A5 Leveling Amplifier is properly adjusted. Then, rerun the test.
3. If the problem still exists, measure the reference voltage at A1TP2-6 and the LO detector voltage at A1TP2-5. In this instrument condition, the reference voltage (approximately −0.25 V) should be larger than the detector voltage. If the reference voltage is larger than the detector voltage, verify the following voltages and repair as necessary:

   A1U7A pin 1 should be approximately −11 V.
   A1U7B pin 7 should be approximately +11 V.
   Collector voltage of A1U4B should be less than 1.5 V (TTL low).

4. If the reference voltage is smaller than the detector voltage, confirm that power is getting to A5.
   a. Disconnect W7 from the A5 LO input.
   b. Connect a power meter to the end of W7 that was just disconnected.
   c. If the measured LO power is greater than +5 dBm, replace the A5 Leveling Amplifier.

12. Diagnostics

(For additional information, refer to leveling-loop information in the A1 Miscellaneous Bias theory of operation and to the A3 Last Converter theory of operation.)

This tests the operation of two detectors: the 21.4 MHz IF detector (A3 board function block Ⓧ) and the leveled/unleveled detector (A1 board function block Ⓓ). If this test fails, the most likely cause is one of the following problems:

- Incorrect module gain.
- Faulty A3 Last Converter board assembly.
- Faulty A5 Leveling Amplifier assembly.
- Faulty A1 Miscellaneous Bias board assembly.

Note

A third detector, the 321.4 MHz detector, may be present on A3 boards in HP 70907A modules that have serial numbers earlier than 2638A00275. The 321.4 MHz detector was removed from later versions of the board due to continuing problems with circuit oscillations. If an A3 Last Converter board is encountered with this detector still present, make the following modifications:

- Remove A3C17, A3Q13, and A3U4.
- Install A3R86 as shown in the component-level information for the 70907-60004 board assembly.
- Replace A3R9, A3R10, A3R11, A3R12, A3R13, and A3R14 with the components listed on the parts list for the 70907-60004 board assembly.

21.4 MHz Detector

If the state of the 21.4 MHz detector (A3J7-3) is always high, indicating an error, use the following steps to isolate the problem:

1. Verify that a signal level of approximately −4 dBm is present at A3J5 (21.4 MHz IF output). If the signal level is incorrect, there is a problem with module gain. Perform the Module Gain and Calibration Source test.
2. If the signal level at the 21.4 MHz IF output is correct, there is a problem with the 21.4 MHz detector. Confirm that the reference voltage at A3U8 pin 2 is approximately 0.055 V. Then, measure the voltage on A3U8 pin 3.
   - If the voltage at A3U8 pin 3 is greater than the reference voltage at A3U8 pin 2, then replace A3U8. (The output voltage is a TTL high when it should be a TTL low.)
   - If the voltage at A3U8 pin 3 is approximately 0.0 V, then there is something wrong with the buffer amplifier A3Q12 or the detector A3CR3. Troubleshoot and repair as necessary.

LO Leveled/Unleveled Detector

If the state of the LO leveled detector (A1J1-9) is always high, indicating an error, use the following steps to isolate the problem:

1. Verify that the front-panel LO output signal level is approximately +16 dBm. If the signal level is incorrect, there is a problem with the A5 Leveling Amplifier. Run the Main LO Output Amplitude and Harmonics test.
2. If the signal level at the front-panel LO output is correct, there is a problem with the detector. Measure the reference voltage at A1TP2-6 and the detector voltage at A1TP2-5.
   - If the voltage at A1TP2-6 is greater than the voltage on A1TP2-5, then there is a problem in either the leveling-loop amplifier A1U7A or the detector amplifier A1U7B. Troubleshoot and repair as necessary.
   - If the voltage at A1TP2-6 is less than the voltage at A1TP2-5, then the detector in A5 is probably nonfunctional. Replace the A5 Leveling Amplifier.

13. 300 MHz Input Sensitivity

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most probable cause is one of the following problems on the A3 board assembly:

- Incorrect 300 MHz drive level at the LO port of mixer A3U3.

If this test is accompanied by an `7004 300 MHz error`, refer to the Diagnostics test failure information in this chapter. If the `7004 300 MHz error` is not present, the input-signal level is probably acceptable.

Use the following procedure to isolate the problem:

1. Use an active probe to measure the 300 MHz signal power level at test points A3TP1 and A3TP3 (A3U3 LO input port). Verify that the power level is approximately +20 dBm and does not vary greatly with a input power level change of −2.2 dBm to +2.2 dBm. If the LO power level is greater than +17 dBm, replace the mixer (A3U3) and then rerun the test. [As long as the power level is larger than +17 dBm, the second stage 300 MHz amplifier (function block Ⓙ) is saturated and the conversion loss of the mixer should be independent of the power level.]
2. If the power level at test points A3TP1 and A3TP3 is less than +17 dBm, confirm that the dc collector bias level of A3Q5 is 42 mA, and that of A3Q7 is 60 mA.
3. If the A3Q5 bias levels are correct, use an active probe to trace the 300 MHz signal through the LO drive path to determine where the reduction in gain or signal level is occurring.

14. Close-In Sidebands

(Refer to the A4 Power Supply Control theory of operation for additional information.)

If this test fails, the most probable cause is improper regulation or filtering on the A4 Power Supply Control board assembly. Use the following procedure to isolate the problem, repairing as necessary:

1. Use an oscilloscope to measure the 40 kHz ripple on the +8, +12 and −12 V supplies (A4TP1-2, A4TP1-5, and A4TP1-4). If the ripple is too small to be effectively measured using an oscilloscope, use a spectrum analyzer with a resistive divider probe.
2. If needed, measure the supply ripple on the A2 Calibration Source assembly dc feeds (A2J1 pins 2 and 4). If the supply that is causing the problem can be isolated, troubleshoot and repair as necessary. It is likely that a regulator or filter capacitor is malfunctioning.

If the steps above failed to reveal the source of the ripple, make sure that the test environment is not contributing to the problem.

15. 21.4 MHz Daisy Chain Loss

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is that either A3CR8, A3CR9, or A3CR10 are not functioning correctly. Additional loss will occur in the 21.4 MHz IF daisy-chain path if A3CR9 is not sufficiently forward-biased, or if A3CR10 or A3CR8 are not sufficiently reverse-biased.

Use the following procedure to isolate the problem, repairing as necessary:

1. Verify that when the module is in the daisy-chain mode, the following switch-driver voltages are present:

   The voltage at A3U6 pin 1 should be approximately +11 V.
   The voltage at A3U6 pin 7 should be approximately −11 V.
   The voltage at the switch control line (A3J8-3) should be greater than 2.5 V (TTL high).

2. If the switch-driver voltages are correct, confirm that the node voltages at the cathode sides of A3CR9 and A3CR8 are approximately 4.6 V. The anode of A3CR9 should be +5 V.

16. 21.4 MHz Input/Output Isolation

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is a problem on the A3 board assembly in the 21.4 MHz SPDT switch (function block Ⓖ).

Use the following procedure to isolate the problem, repairing as necessary:

1. While the module is in the IF-output mode, confirm that the SPDT switch is functioning correctly by checking the pin-diode bias.

   The voltage at A3U6 pin 1 should be approximately −11 V.
   The voltage at A3U6 pin 7 should be approximately +11 V.
   The voltage at switch-control line A3J8-3 should be less than 0.8 V (TTL low).

2. If the voltages are correct, confirm that the node voltages at the cathode sides of A3CR9 and A3CR8 are approximately 4.6 V. The anode of A3CR8 should be approximately 5.0 V.
3. Measure the voltage at the cathode side of A3CR10. The voltage should be approximately −0.4 V.

17. 321.4 MHz IF Input Return Loss

(Refer to the A3 Last Converter theory of operation for additional information.)

If this test fails, the most likely cause is in one of the following areas:

- A problem in the A3 board assembly input-filter structure (function block Ⓠ).
- A problem in the IF input signal path before the A3 board assembly.

Capacitor A3C87 was chosen specifically to help improve the IF input match. However, because the return losses of the A3 ports are extremely dependent on component parasitics, the components in this filter/matching structure, especially A3C87, should be suspect if this test fails.

For HP 70907A, the IF signal path before the A3 board assembly consists of the front-panel IF input connector and cable assemblies W1, W20, and W3. For HP 70907B, the IF signal path before A3 consists of the front-panel IF input connector, cable assemblies W1 and W3, and the IF relay (function block Ⓐ) on the A2 Calibration Source board.

Use the following procedure to isolate the problem:

1. Measure the input return loss of the A3 board assembly to determine whether the problem is on the A3 board assembly or in the IF input signal path before A3:
   a. Disconnect W3 from the A3J1.
   b. Measure the input return loss at A3J1. If the return loss is less than 18 dB, then the problem is in the IF input signal path. Troubleshoot and repair as necessary. Then rerun the test.
2. If the return loss is greater than 18 dB, the problem is on the A3 assembly. Perform the 321.4 MHz Bandpass adjustment, then rerun the test.
3. If there is still a problem, verify that the dc collector bias current of A3Q1 is 17 mA. If the bias level is incorrect, troubleshoot and repair as necessary.
4. If the bias level is correct, then the problem is probably in the A3 board assembly input filter/matching structure (function block Ⓠ).

ROM Replacement

The ROM, A4U15, is located on the left side of the module. See Figure 5-3 for parts location. Refer to Chapter 7, "Replaceable Parts" for the ROM part number.

Caution

The ROM is easily damaged or destroyed by electrostatic discharge and should be replaced only at a static-safe work station. Leave the new ROM in its static-safe packaging until right before you install it into the board assembly. Refer to the electrostatic discharge information in Chapter 1.

After A4U15 is replaced, either by itself or as part of the A4 board assembly, the module serial number must be written to the new A4 board assembly. The procedure to do this is included in the HP 70907A/B Module Verification Software. Use a nonmetallic tool to change the WRITE/PROTECT switch to the WRITE position before running the software procedure. Remember to return the switch to the PROTECT position after running the software procedure. Figure 5-3 shows the location of the WRITE/PROTECT switch.

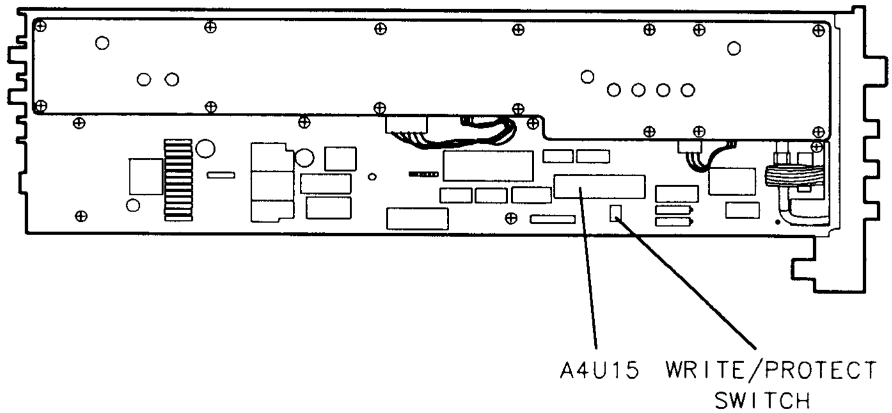


Figure 5-3. ROM and WRITE/PROTECT Switch Locations

A1 Miscellaneous Bias Board Assembly

While troubleshooting the A1 board assembly, refer to the A1 schematic in the *HP 70907A/B Component-Level Information* binder.

A1 Miscellaneous Bias Board Assembly Circuit Descriptions

The A1 board assembly provides a variety of module functions:

- Energy storage for A8 Attenuator and K2 RF Switch driver.
- Mixer-bias current for the front-panel connector.
- Drive and interface circuitry for the A8 Attenuator and K2 RF Switch.
- Leveling-loop related circuits for the A5 Leveling Amplifier.
- Regulated +7 V, +5 V, and filtering for the positive and negative 12 V power supplies.

Mixer Bias Circuit (Function Block Ⓑ)

A 12-bit DAC, used in conjunction with a precision voltage-to-current feedback loop, generates the mixer bias current (function block Ⓑ). The mixer bias current is adjustable from −10 mA to +10 mA in 7 μA steps with an absolute accuracy of ±15 μA. Zener diodes limit the mixer-bias output voltage to ±3 V.

Precision Voltage-to-Current Feedback Loop. The 12-bit DAC, A1U1, interfaces with the data and address bus from the A4 board assembly's microprocessor. The DAC accepts a binary number between 0 and 4095 and then provides a voltage between −5 V and +5 V at the output of A1U2.

The voltage at the output of A1U2 is compared by A1U3 to a buffered version of the voltage dropped across sense resistor A1R15. The resulting difference voltage is amplified and applied to the push/pull current buffer (A1U4D and A1U5A). This buffer sources or sinks current through A1R15 to produce a voltage drop equal to the DAC output voltage at A1U2 pin 6 (A1TP1-1), thus closing the feedback loop.

The zero point for differential amplifier/buffer A1U6 is set by adjusting A1R17. The DAC output voltage is calibrated by adjusting A1R1 (for −5V) and A1R2 (for +5V) while binary numbers of 0 and 4095, respectively, are applied to the DAC. The DAC output voltage is monitored at A1TP1-1.

Mixer-Bias Output Voltage Limiting Circuit. To protect a biasable mixer, two zener diodes (A1VR1 and A1VR2) are used to limit the mixer-bias output voltage to a maximum of ±3.0 V. The zener diodes' placement in the circuit is such that the voltage drop across the zener diodes and the mixer-bias output voltage are the same:

- The mixer-output voltage consists of the voltage at the emitter of push/pull current buffer (A1U4D and A1U5A) minus the voltage developed across the sense resistor A1R15.
- The voltage drop across A1VR1 and A1VR2 consists of the voltage at the cathode of A1VR1 (essentially equal to the voltage present at the emitters of A1U4D and A1U5A) minus the voltage at the cathode of A1VR2 (a buffered version of the voltage drop across A1R15).

Therefore, the output voltage is limited to the maximum voltage that can be dropped across the zener diodes before they clamp.

Bias Error Detector. Amplifier A1U7D subtracts the voltage developed across sense resistor A1R15 from the voltage of the emitter of the push/pull current buffer (A1U4D and A1U5A) and then amplifies this signal by one (unity). This results in the voltage present at A1U7D pin 14 being the same as the output voltage.

When the voltage at A1U7D pin 14 exceeds ±2.48 V, the output voltage of A1U8A or A1U8B goes to a TTL low. Inverting comparator A1U12A buffers and inverts this voltage, resulting in an output at A1J1-25 that is a TTL high (indicating a potential error condition).

Bias Enable Circuit. When the bias enable line (A1J1-26) goes to a TTL high, the output of A1U7C is driven to its positive supply voltage. This output turns on the current buffer transistor A1U4A, setting the switch A1K1 to the proper state (mixer bias output grounded).

Attenuator/Switch Drive Circuit (Function Block Ⓒ)

The A1 assembly has all of the interface and drive circuitry used to operate the A8 Attenuator and the K2 RF switch, which are used during calibration.

Microprocessor Interface. Latch A1U13 is the interface between the A4 board's microprocessor and the attenuator drive circuitry on A1. The digital commands, in the form of TTL high or low logic states, come in from A4 on data lines D0 through D3 (A1J1-17, A1J1-20, A1J1-19, and A1J1-13).

Data lines D0 through D2 are responsible for controlling different A8 Attenuator sections: D0 controls section 1, which has 10 dB of attenuation; D1 controls section 2, which has 40 dB of attenuation; D2 controls section 3, which has 20 dB of attenuation. Data line D3 is responsible for controlling the K2 RF Switch assembly.

Each output of latch A1U13 drives two comparator amplifiers in either A1U14 or A1U15. The outputs from pins 3 and 4 drive the comparator amplifiers in A1U14; the outputs from pins 5 and 6 drive the comparator amplifiers in A1U15.

Attenuator and Switch Control. The comparator amplifiers in A1U14 and A1U15 provide the complementary analog ±15 V drive signals for an octal darlington driver array (A1U17). Six of the A1U17 outputs drive the control coils in the A8 Attenuator; two of the outputs drive the control coils in the K2 switch.

The A8 and K2 control coils operate similarly. The A8 control coils operate in the following way. Each attenuator section has one solenoid with two windings: one for "IN" and one for "OUT". Once a section changes state, the internal contacts of the activated coil open, shutting off current flow. At the same time, internal contacts for the adjoining coil close so it can be activated when desired to switch the attenuator state back to its original condition.

Power-Up Sequence Control. During module power up, if one of the attenuator or switch coils loads down the +15VS supply severely, A1C17 might never acquire enough energy to switch the A8 Attenuator or K2 RF Switch. This would leave the module attenuation or LO path in an undefined state.

This potential power-up problem is avoided by using a Schmitt-trigger circuit (A1U5B and A1U4C). The Schmitt-trigger circuit deprives the darlington drivers in A1U17 of base current until A1C17 (function block Ⓐ) charges up enough to drive the attenuator and switch coils properly.

Power-Down Sequence Control. During power-down, the module is set to 70 dB of attenuation. This is accomplished by the A4 board's sending the LRESET command over A1J1-16 to clear latch A1U13. The Schmitt trigger (A1U5B and A1U4C) also makes sure that A1U17 has the base current necessary to switch the attenuator to 70 dB attenuation and hold it there until A1C17 (function block Ⓐ) has discharged to a sufficiently low point.

Latch A1U13 must be prevented from changing the attenuator setting after the LRESET command is received. This is accomplished by deriving the supply voltage for A1U13 from a power supply (voltage regulator A1U10), that is active until A1C17 no longer has enough energy to drive the attenuator or switch coils. The unregulated voltage for A1U10 is the +15 V supply, and the positive terminal of A1C17 is also connected to the +15 V supply. Therefore, by the time the voltage is low enough that the output voltage of A1U10 causes A1U13 to be inactive, the +15 V supply is no longer capable of driving the attenuator or switch coils.

Leveling-Loop Related Circuits (Function Blocks Ⓓ, Ⓐ, and Ⓔ)

The A1 board assembly provides the following leveling-loop related circuits for the A5 assembly:

- Leveling loop amplifier
- PIN-diode modulator current buffer
- LO leveled/unleveled detection circuit
- +7 and +5 V bias voltage
- Gate-bias voltage adjustment

Leveling Loop Amplifier and PIN-Diode Modulator Current Buffer. The LO output power is sampled by an AM detector located in the A5 microcircuit assembly and comes onto A1 through A1J3-1 (function block Ⓓ). The detected voltage is approximately −100 mV for a +12 dBm LO output level. The detector output voltage is compared to the reference voltage (set using A1R62). The difference signal is then amplified, buffered, and applied (through A1J3-3) to the PIN diode modulator in the A5 Leveling Amplifier, thereby closing the ALC loop.

LO Leveled/Unleveled Detection Circuit. When the output power at the front-panel LO output is too low, the reference voltage is more negative than the detector voltage (function block Ⓓ). This drives the output of A1U7A to its positive rail (approximately +11 V). The output of A1U7A is then fed into the inverting terminal of A1U7B, causing the output of A1U7B to go to the negative voltage rail (approximately −11 V). This turns transistor A1U4B off, causing the A1U4B collector voltage to become +5 V and thereby turning off the "LO leveled" LED A1DS1.

The voltage at the collector of A1U4B is also monitored by the A4 Power Supply/Control board through A1J1-9. A TTL high (+5 V) at this detector indicates an error condition. Note that this error detector is not a window detector; it only checks for insufficient power output. Power output that is too high will go unflagged and A1DS1 will not go off.

+7 and +5 Volts Bias Voltage and Gate-Bias Voltage Adjustment. Two three-terminal voltage regulators (function block Ⓐ) provide bias voltage for the A5 Leveling Amplifier: A1U11 provides +5 V to bias the GaAs FETs in A5 for the first two stages, and A1U9 provides +7 V to bias the GaAs FETs for the output stage.

The gate-bias voltage is set by adjusting A1R70 (function block Ⓔ) while monitoring the voltage at A1TP1-2.

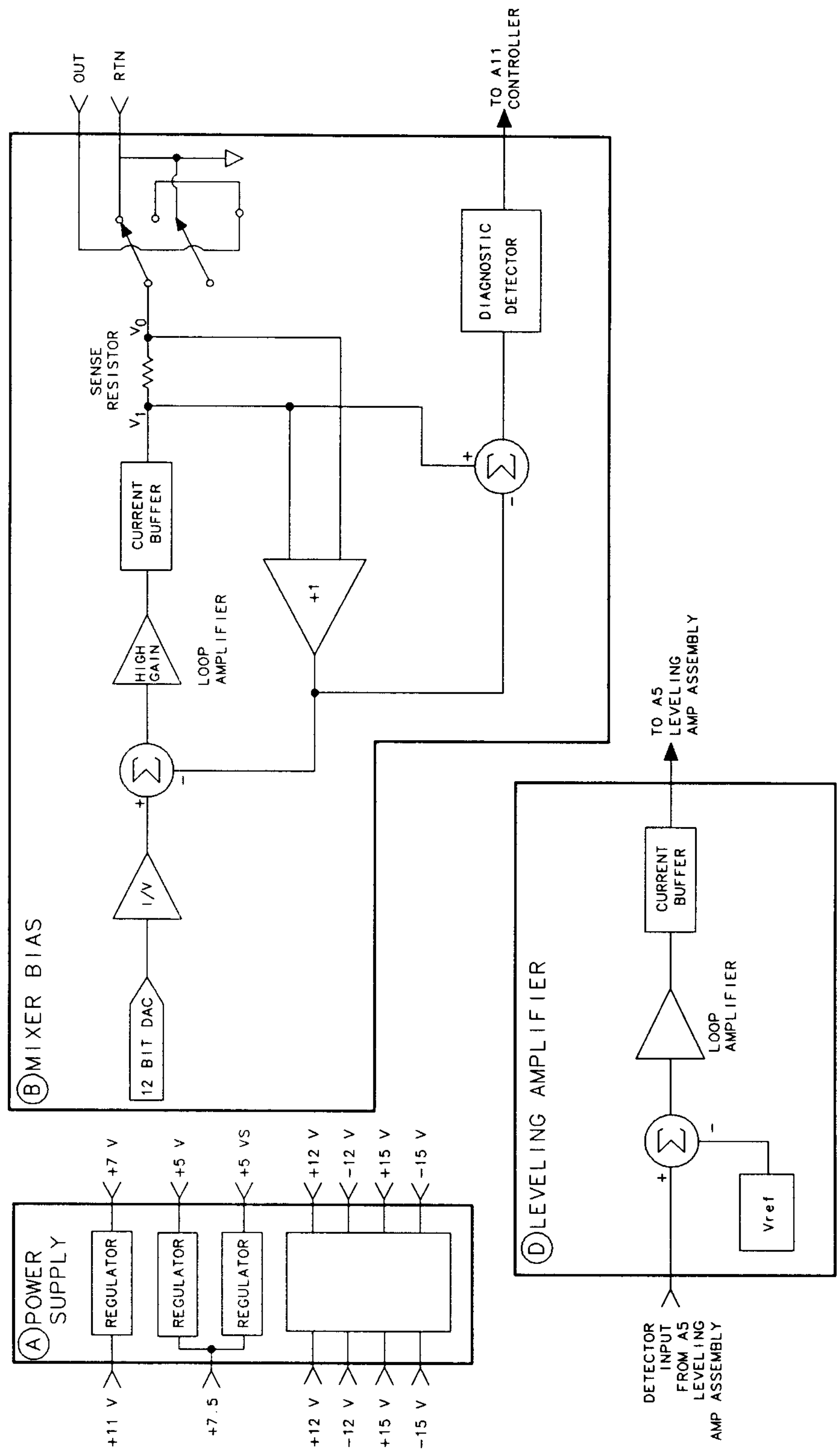


Figure 5-4. A1 Miscellaneous Bias Simplified Block Diagram

A2 Calibration Source Board Assembly

While troubleshooting the A2 board assembly, refer to the A2 schematic in the *HP 70907A/B Component-Level Information* binder.

A2 Calibration Source Board Assembly Circuit Descriptions (HP 70907A)

The A2 Calibration Source board assembly uses A2U3, a surface acoustic wave (SAW) resonator, to produce a calibration signal (321.4 MHz at −35 dBm). After receiving instructions from the A4 Power Supply/Control board assembly, the A2 board assembly uses a PIN switch to connect the signal to the RF output (A2J3) or to short it to ground through A2CR7.

Tune Voltage Amplifier Circuitry (Function Block Ⓐ)

The Tune Voltage Amplifier converts the Tune/Span voltage, which can range from +4.5 to +9.9 V, to a voltage range of approximately −5 to +7 V to tune the VCO in function block Ⓑ. The Tune/Span adjustment A2R6 is used to set the total tune range to 115 kHz. A2CR3 is a 21.5 V zener diode used to shunt any voltage at the Tune/Span input that is greater than 21.5 V. A2R41 is part of a control circuit that is used to tune the VCO to its minimum frequency when the Calibrator Source is not being used.

VCO Circuitry (Function Block Ⓑ)

The VCO generates a 321.4 MHz signal at approximately −10 dBm. The frequency can be varied 115 kHz around 321.4 MHz by the control voltage applied to varactors A2CR11 through A2CR14. The oscillator's output is leveled by an AGC loop consisting of detector A2CR10, amplifier A2U1B, and PIN attenuator A2CR8. The minimum frequency of the oscillator is set by the surface acoustic wave resonator A2U3 and the combined capacitance of the varactors. As the tune voltage changes from −5 to +7 V, the capacitance of the varactors decreases and the resonant frequency of the varactor/resonator network increases. The primary function of A2L7 and A2L8 is to resonate with the input and output capacitances of A2U3 at 321.4 MHz thereby reducing the loss through the resonator circuit. The inductance values and Q of A2L7 and A2L8 also affect tune range and sensitivity. Transistor A2Q2 provides active bias for amplifier A2Q1 and assures that the collector current of A2Q1 remains constant over temperature. The AGC LEV ADJ A2C19 is adjusted to set the gain of A2Q1 to assure that the AGC loop can level the output as the oscillator is tuned. The output of A2Q1 is split 4 ways: to the main feedback path to the resonator, to the attenuator path through PIN diode A2CR8 and A2C8 to AC ground (−12VFF), to the output attenuator (function block Ⓔ), and to the amplitude detector A2CR10 and A2C12. Amplifier A2U1B compares a portion of the output from the detector to the voltage across A2CR9, amplifies the voltage difference between them, and uses it to control the amount of current through A2CR8. The dc current through A2CR8 determines its impedence which affects the main output signal level. PWR LEV ADJ A2R27 adjusts the amount of offset voltage that is summed with the detector's output and controls the 321.4 MHz output level. A2Q3 is a switch that is used to short one end of A2R41 (function block Ⓐ) to ground when the Calibrator Source's output is not being used.

Voltage Reference Circuitry (Function Block Ⓒ)

This block provides a stable, low noise 6.2 V reference for use in the AGC section of the VCO (function block Ⓑ) and the Tune Voltage Amplifier (function block Ⓐ). A2CR16 is a 6.2 V zener reference diode and its output is filtered by the low pass filter comprised of A2R28 and A2C15 to produce + REF.

PIN Switch Circuitry (Function Block Ⓓ)

The PIN switch driver A2U2A provides drive current for switch A2Q3 and PIN switch diodes A2CR6 and A2CR7. During a system calibration, the input at A2J1-3 is pulled high which causes the output of A2U2A to go to approximately −10.5 V. This negative voltage at A2U2A pin 1 turns switch A2Q3 off, turns A2CR7 off, and turns A2CR6 on to connect the signal from the output attenuator (block Ⓔ) to the RF output J3. When the calibrator source is not in use, the 321 select input is pulled low which causes the output of A2U2A to go to +10.5 V and turn A2Q3 on, turn A2CR7 on, and turn A2CR6 off. With A2CR7 on and A2CR6 off, most of the signal from the Output Attenuator is shunted to ground and the output at J3 is reduced by approximately 50 dB.

Output Attenuator Circuitry (Function Block Ⓔ)

The output attenuator attenuates the VCO's output by −25 dB to produce a −35 dBm output signal. The attenuator also isolates the VCO from the RF Output A2J3 and minimizes the effect that load changes would have on the VCO's output.

Power Supply Circuitry (Function Block Ⓕ)

The components in this block provide additional filtering of the +12 V and −12 V supplies from the A4 Power Supply/Control assembly to produce the +12 VF and −12 VF for use in this assembly.

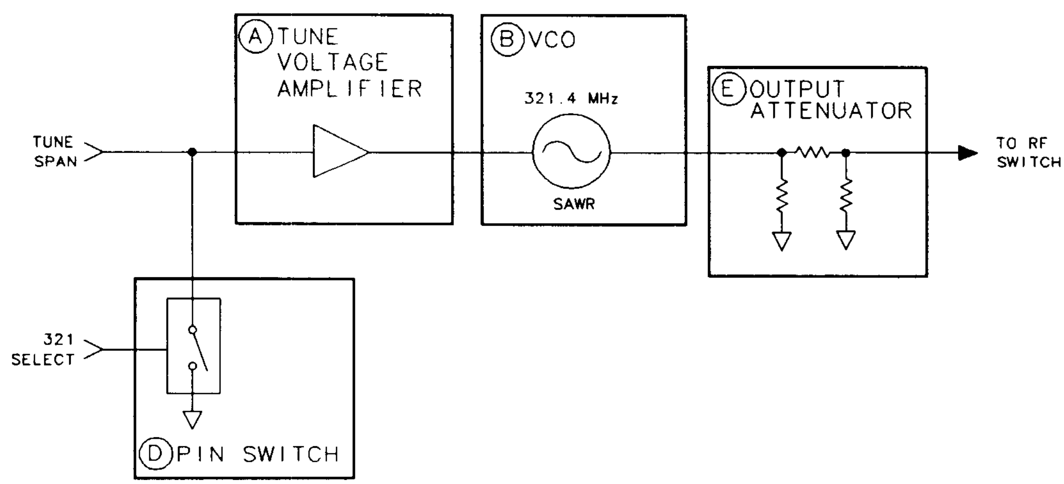


Figure 5-5. HP 70907A: A2 Calibration Source Simplified Block Diagram

A2 Calibration Source Board Assembly Circuit Descriptions (HP 70907B)

The A2 Calibration Source board assembly has the following functions:

- Produces a synthesized calibration signal of 321.4 MHz at −35.0 dBm (function blocks Ⓕ, Ⓔ, and Ⓓ).
- Uses an IF relay to switch either the calibration signal or the IF input signal into the module's RF path (function blocks Ⓐ, and Ⓑ).

Divide-by-16 Circuitry (Function Block Ⓕ)

The first LO signal (3.0 to 6.6 GHz) comes in on A2J2 and is divided by 16 using the divide-by-16 microcircuit, A2U2. Because the power supplies for A2U2 are turned on by the same signal sequence that switches the calibration signal into the RF path, A2U2 operates only when the module is calibrating.

The minimum input-drive level for A2U2 is approximately +10 dBm at 5.1424 GHz; however, the typical drive level is approximately +15 dBm. Given a 5.1424 GHz input signal, the A2U2 output power is approximately −10 dBm at 321.4 MHz. When A2U2 is operating, a substantial amount of current is generated: the +7 V supply delivers approximately 120 mA, the −4 V supply delivers approximately 90 mA, and the +5 V supply delivers approximately 85 mA. The total dc power dissipation is 1.625 W. To dissipate the generated heat, A2U2 is attached to a gold-plated connector base which makes physical contact with the module center body.

The output from A2U2 is filtered by a four-element elliptic low-pass filter (LPF). If the output signal is close to 321.4 MHz, the parallel combination of A2C10 and A2L2 helps control the second-harmonic content by creating a null at 642.8 MHz (second harmonic of 321.4 MHz). The filtered RF output signal is then fed into the ALC loop circuitry.

ALC Circuitry (Function Block Ⓔ)

The precision temperature-compensated ALC loop levels the RF signal received from the divide-by-16 circuitry. The ALC loop contains the following circuits:

- ALC modulator.
- RF-loop amplifier.
- Directional coupler/detector circuit.
- Unity gain/temperature compensation buffer
- Integrating amplifier/current buffer circuit.

ALC Modulator. The ALC modulator consists of a voltage divider created by A2CR1 and the 50Ω input impedance of the RF-loop amplifier A2U6. The typical attenuation range of the modulator is −3.0 dB to −26.0 dB. The modulator attenuation factor has to increase as the gain of the RF loop amplifier increases.

RF-Loop Amplifier. RF-loop amplifier A2U6, with approximately 18 dB of power gain, is used to amplify the RF signal so that it is in the desired power window of the ALC-loop detector (between 0.0 dBm and −12.0 dBm). The relative high gain of this RF-loop amplifier requires the attenuation factor of the modulator to be large. Because of the PIN diode characteristics, the dB/ma attenuation factor increases thus increasing the overall loop gain and improving the ALC's leveling accuracy. After being amplified, the signal is fed into the detector circuit.

Detector Circuit. The directional coupler/detector is formed by A2R13, A2R14, A2R18, and the 50Ω output impedance of A2U6; the detector-diode is A2CR9A; and the sample-and-hold capacitor is A2C7.

The insertion loss of the coupler/detector is approximately 7 dB. Therefore, to achieve a desired output power of −35 dBm when using a 27 dB output attenuator, the power level at detector-diode A2CR9A must be approximately −1 dBm.

Sample-and-hold capacitor A2C7 stores the average dc voltage of the rectified RF energy from detector-diode A2CR9A. This average voltage is approximately +50 mV for an input power of −1.0 dBm (output power of approximately −8.0 dBm). The detector slope is linear at approximately +15 mV/dB. The detected voltage is then fed into a unity-gain, high-impedance buffer.

Unity-Gain/Temperature-Compensation Buffer. Schottky diode A2CR9B, in the feedback path of operational amplifier A2U7, provides an offset voltage for the unity-gain, high-impedance buffer.

Detector-diode A2CR9A and offset-diode A2CR9B are matched diodes located in the same package to allow thermal tracking; this essentially cancels any dc bias-voltage changes due to environmental effects. Matching the dc bias voltages of A2CR9A and A2CR9B maximizes the thermal-tracking and temperature-compensation performance of the circuit. The dc bias voltages are matched by adjusting A2R1 so that the voltage potential between A2TP4 and A2TP3 is less than 100 μV.

The output of the unity gain/temperature compensation buffer amplifier A2U7 is fed into the ALC loop integrating amplifier A2U1.

Integrating Amplifier/Current Buffer. ALC-loop integrating amplifier A2U1 is set up for a 98 kHz unity-gain crossover. The amplifier has a 98 kHz compensation zero that compensates for a pole around 100 kHz in the detector. These factors provide circuit stability by providing a controlled 20 dB per decade slope at unity-gain crossover. The error voltage from A2U1 is fed into the current-buffer transistor A2Q2. The current-buffer transistor drives the pin-modulator diode A2CR1, thus closing the ALC loop.

The final total ALC loop unity-gain crossover is approximately 12 kHz; the phase margin is approximately 80°. The ALC-loop gain is relatively high: open-loop gain at dc is approximately 60 dB, resulting in a sensitivity factor of 1000:1 for the input- to output-power change. High open-loop gain is desirable because as the open-loop gain increases, the output power becomes less sensitive to changes in the input power.

After leaving the ALC loop, the signal goes to the IF Relay (function block Ⓐ).

Divide-by-16 Power Supplies and VREF Circuitry (Function Block Ⓓ)

Discrete voltage regulators on A2 convert the ±12 V module supplies to the voltages needed to power the divide-by-16 microcircuit, A2U2. The power supplies for A2U2 are switched on at the same time that the calibration signal is switched into the module's RF path. This sequence is used because it is undesirable to leave A2U2 powered up unless the module is calibrating.

The power-up sequence for A2U2 starts when the relay control (function block Ⓑ) activates relay A2K1, which then switches the +12V supply to A2U4. The output of A2U4 is a precision +5 V signal which is used as a reference voltage by the following circuits:

- The discrete voltage regulators, which generate the +5 V, +7 V, and −4 V divide-by-16 power supplies.
- The voltage reference (VREF) circuit, which provides the ALC-loop reference voltage.

Discrete Voltage Regulators. The +5 V, +7 V, and −4 V divide-by-16 power supplies are obtained by using discrete voltage regulators to scale the precision +5 V signal. The voltage regulators consist of two non-inverting and one inverting operational amplifier circuits (A2U3A, A2U3B, and A2U3D) with current buffers built into the feedback loops.

Each voltage-regulator circuit is compensated with a dominant pole created by the 0.01 μf feedback capacitor and the net input impedance (approximately 10 kΩ) at the inverting terminal of the operational amplifier. This combination results in a dominant pole with a unity-gain crossover at approximately 1.5 kHz.

VREF Circuit. The ALC-loop reference voltage (VREF) is derived from the precision +5 V using a simple resistive-divider circuit. Variable resistor A2R23 is used to adjust the VREF level.

IF Relay and Relay Control Circuitry (Function Blocks Ⓐ and Ⓑ)

The controller on the A4 board assembly sends a command over the 321.4 MHz SELECT line instructing the A2 board assembly to switch either the calibration signal or the IF input signal into the module's RF path. At the same time that the calibration signal is switched into the RF path by the IF relay (function block Ⓐ), the relay-control circuit (function block Ⓑ) turns on the power supplies for the divide-by-16 microcircuit, A2U2.

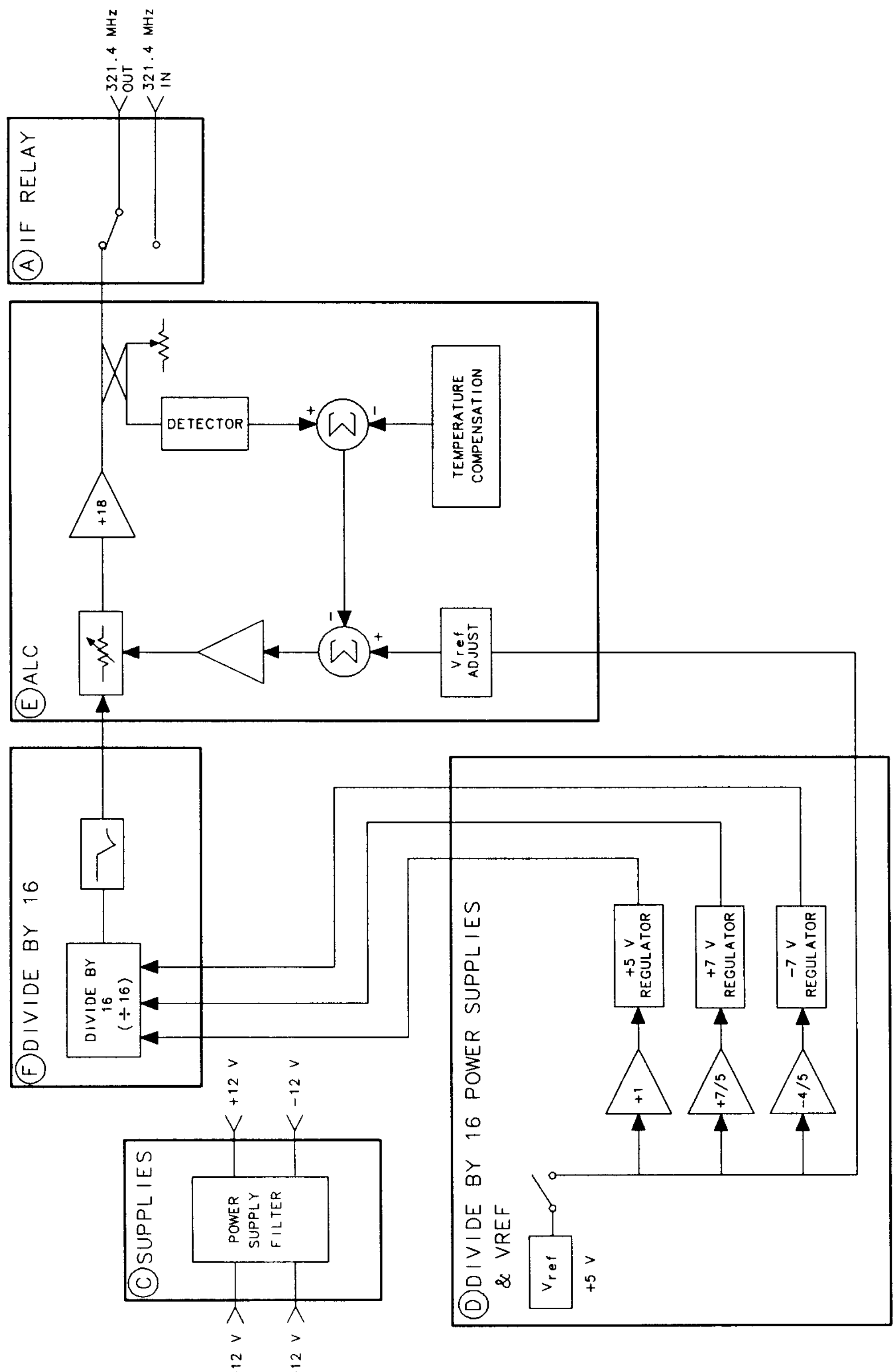


Figure 5-6. HP 70907B: A2 Calibration Source Simplified Block Diagram

A3 Last Converter Assembly

While troubleshooting the A3 board assembly, refer to the A3 schematic in the *HP 70907A/B Component-Level Information* binder.

A3 Last Converter Assembly Circuit Descriptions

The A3 Last Converter board assembly mixes the 321.4 MHz IF signal from the external first converter with the 300 MHz LO signal from the local oscillator module. The 21.4 MHz IF signal produced by the mixing is then amplified and passed through a 100 MHz low-pass filter (LPF). The resultant 21.4 MHz IF signal can be switched to the module's rear-panel 21.4 MHz output, where it is available to for use by modular measurement system IF modules.

Note The third-order intermodulation (TOI) and noise figure of the A3 board assembly are affected by several circuits: the 300 MHz LO, the 321.4 MHz amplifiers, the mixer, and the 21.4 MHz amplifiers. The 321.4 MHz amplifiers are the circuits primarily responsible for setting the A3 board assembly's TOI and noise figure. To maintain the TOI performance level, the 300 MHz LO circuit must deliver a LO power level of approximately +19 dBm to the mixer.

The A3 assembly has the following types of circuits:

- 300 MHz second LO.
- 321.4 MHz IF amplifiers and band-pass filter (BPF).
- 21.4 MHz IF amplifiers.
- Service detectors.

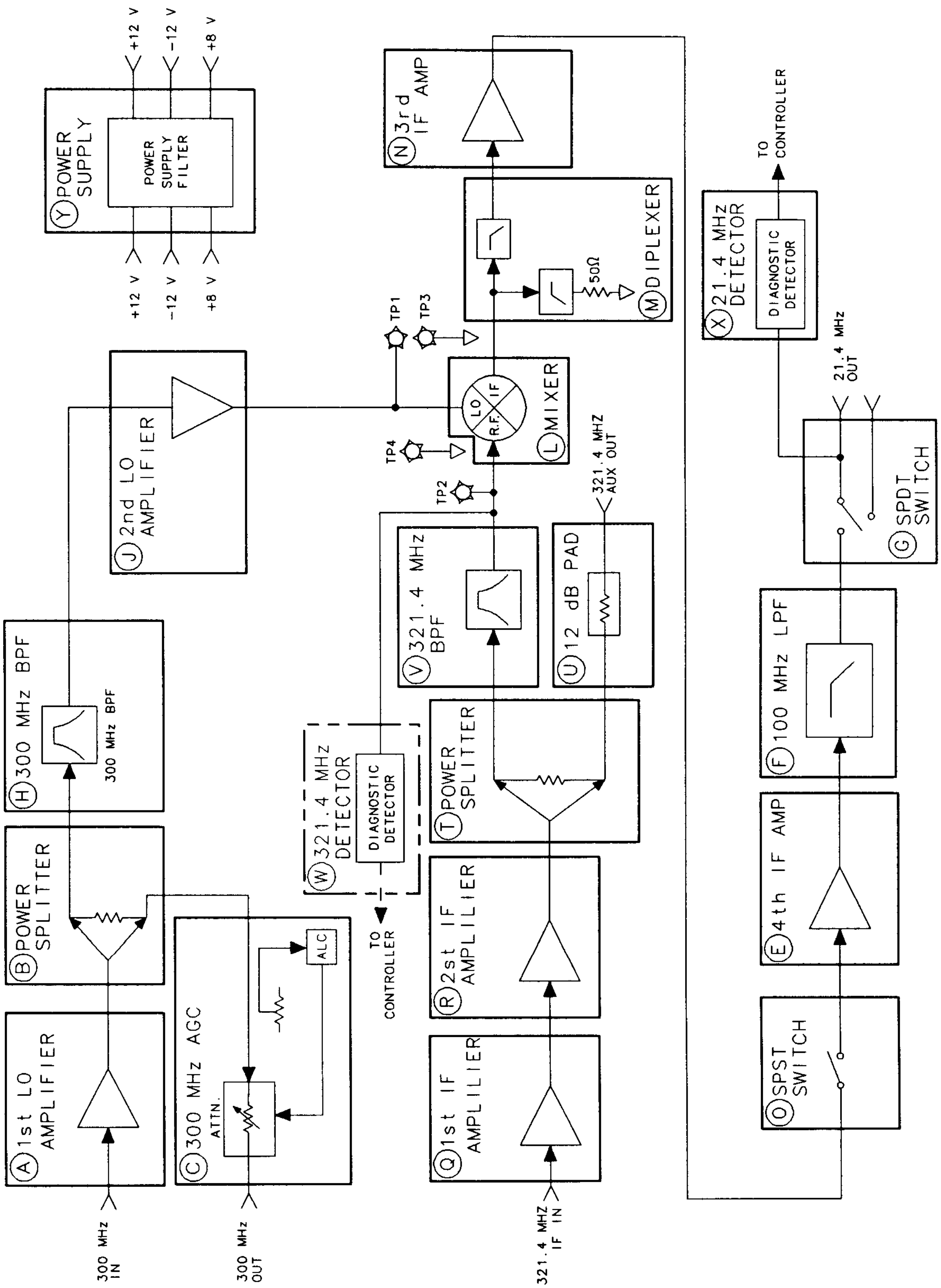


Figure 5-7. A3 Last Converter Simplified Block Diagram

300 MHz Reference Circuit (Function Blocks Ⓐ, Ⓑ, Ⓒ, Ⓗ, Ⓘ, Ⓙ, Ⓚ, and Ⓛ)

The primary responsibility of the 300 MHz second LO circuit is to deliver a LO signal of approximately +19 dBm to the mixer. This circuit's secondary responsibility is to provide an auxiliary 300 MHz that can be used by other modular measurement system modules.

Input-Matching Circuit and 1st LO Amplifier (Function Block Ⓐ). The 300 MHz LO input signal comes onto the board at A3J2 and is fed through a input-matching circuit consisting of resistor A3R24 and capacitor A3C20. The signal then goes directly into the 1st LO amplifier circuit.

The 1st LO amplifier is an active bias type amplifier. The voltage at the base of A3Q6, which is developed by a divider network consisting of A3R23 and A3VR2, is translated up by the V_{be} of A3Q6.

The base current and collector current for A3Q5 are both supplied through A3R25: The base current is supplied by the collector of A3Q6; the collector current is set by the voltage drop across A3VR2. Because zener diode A3VR2 sets the voltage drop across A3R25 to a specific value regardless of the supply voltage, the dc collector-bias current of A3Q5 is independent of the device β and even less sensitive to supply variations than the bias currents in the 321.4 MHz amplifiers. (Because the base current is such a small fraction of collector current, it is acceptable to represent the current through A3R25 as the collector current of A3Q5.)

Inductor A3L10, at the emitter of A3Q5, is formed by a trace on the PC board. The value of A3L10 was chosen so that at 300 MHz the impedance, seen as though looking into the base of A3Q5, is approximately 50Ω.

The output impedance of the 1st LO amplifier is comprised of high-impedance inductor A3L11 in parallel with the input impedance of the power splitter (function block Ⓑ). The output impedance is approximately 50Ω.

Power Splitter (Function Block Ⓑ). The output of the 1st LO amplifier is fed into power splitter A3U1. One output of the splitter goes into the temperature-compensated 300 MHz AGC loop (function block Ⓒ). The other output of the splitter goes to the 300 MHz BPF (function block Ⓗ).

300 MHz AGC (Function Block Ⓒ). The signal received from the power splitter is attenuated by a resistive divider that is formed by the combined resistance of the PIN modulating diode A3CR15 and the 50Ω input impedance of the discrete 350 MHz low-pass filter that is connected to the cathode of A3CR15. The output of the 350 MHz low-pass filter is fed into a discrete directional coupler formed by Schottky diode A3CR13 and peak-hold capacitor A3C41. The detected voltage is divided by two, then the reduced voltage is fed into the inverting terminal of the loop-integrating amplifier A3U7.

The reference voltage applied to the non-inverting terminal of A3U7 is derived from stabilized zener diode A3VR1 and adjusted by variable resistor A3R49. Schottky diode A3CR14 in the reference-voltage circuit is identical to detector diode A3CR13. The diodes have the same bias level, and the net impedance presented to the diodes has been matched as much as possible. The series combination of A3R69 and A3C44 (between the A3U7 inverting terminal and output terminal) provides a transmission zero at 15.9 kHz that compensates the AGC loop. The voltage difference between the A3U7 inputs is amplified, then the output of A3U7 is used to drive current buffer A3Q9. The output of A3Q9 is then used to drive PIN diode A3CR15, thus closing the loop.

The output of the AGC circuit is a 300 MHz signal of approximately 0 dBm ±1 dBm which is delivered to the rear-panel 300 MHz auxiliary output.

300 MHz BPF and 1 dB Pad (Function Blocks Ⓗ and Ⓘ). The 300 MHz BPF provides about 20 dB of rejection at 321.4 MHz. This rejection keeps the 300 MHz LO signal from being contaminated by any 321.4 MHz signal that might feedback through mixer A3U3.

The 300 MHz BPF consists of two capacitively-coupled resonators. Each shunt resonator consists of a 39 nH discrete inductor and a 3.0 nH inductance formed by a trace on the PC board. Capacitor A3C26, which couples the two resonators, is formed by an interdigitated PC board trace. The series inductors also function as a tapped inductance, providing an impedance transformation that prevents the Q of the resonators from degrading.

The output of the 300 MHz BPF goes through a 1 db pad (function block Ⓘ) and then to the 2nd LO amplifier.

2nd LO Amplifier (Function Block Ⓙ). The 2nd LO amplifier is almost identical to the 1st LO amplifier (function block Ⓐ). The bias current of the 2nd LO amplifier has been increased to 60 mA to enable higher power delivery into the A3U3 mixer. The 2nd LO amplifier provides approximately 30 dB of rejection at 321.4 MHz to help keep the 300 MHz LO signal from being contaminated by any 321.4 MHz signal that might feed back through the mixer. The output of this amplifier is fed into the 350 MHz LPF.

350 MHz LPF (Function Block Ⓚ). The 350 MHz LPF reduces the harmonic content of the signal before it reaches the mixer. This filtering helps improve the mixer TOI and reduces harmonic feedthrough. The final element in the LPF is a matching network that provides a 50Ω output source impedance for the mixer. The matching network is comprised of a shunt capacitor (A3C690) sandwiched between two resistors (A3R33 and A3R34) which act like small series inductances. The output signal (300 MHz at approximately +19 dBm) from function block Ⓚ goes to the mixer (function block Ⓛ).

321.4 MHz Amplifiers and Band-Pass Filter Circuit (Function Blocks Ⓠ, Ⓡ, Ⓢ, Ⓣ, Ⓤ, and Ⓥ)

High-Pass Filter/Matching Network and IF Amplifiers (Function Block Ⓠ). The 321.4 MHz IF input comes onto the board at A3J1 and is fed into the high-pass filter/matching network which precedes the 1st IF amplifier. This filter/matching network has the following characteristics:

- Input impedance of 50Ω.
- High-pass filter cutoff of approximately 300 MHz to reduce the last converters susceptibility to IF subharmonics and improve the image rejection at 278.6 MHz.
- Notch at 160.7 MHz, provided by a series-shunt circuit consisting of A3L28 and A3C86, to improve the IF subharmonic performance at 160.7 MHz.

The output of the high-pass filter/matching network drives the 1st IF amplifier, which is an active bias type. The voltage at the base of A3Q3, which is developed by a resistor-divider network consisting of A3R2 and A3R3, is translated up by the V_{be} of A3Q3.

To make the dc collector-bias current of A3Q1 independent of the device β and less sensitive to supply variations, both the base current and the collector current for A3Q1 are supplied through A3R4. The base current is supplied by the collector of A3Q3; the collector current is set by the voltage drop across A3R4 (the difference between the voltage at the emitter of A3Q3 and the +8 V supply voltage). Because the base current is such a small fraction of collector current, it is acceptable to represent the current through A3R4 as the collector current of A3Q1.

Inductor A3L1, at the emitter of A3Q1, is formed by a trace on the PC board. The value of A3L1 was chosen so that at 321.4 MHz the impedance, seen as though looking into the base of A3Q1, is approximately 50Ω. The output impedance of the first amplifier is comprised of high-impedance inductor A3L2 in parallel with the input impedance of the 2nd IF amplifier (function block Ⓡ).

Because the 2nd IF amplifier is nearly identical to the 1st IF amplifier, the 1st IF amplifier drives a net output impedance of approximately 50Ω. The gain of the 1st IF amplifier can be determined using the formula below. Note that there is an inherent 20 dB-per-decade gain slope due to the 4.0 nH inductor A3L1 at emitter.

$$G = -(gm \times 50) / [1 + gm\left(1 + \frac{1}{\beta}\right)(2 \times \pi \times freq \times 4\ nH)]$$

Since the output impedance of the 2nd IF amplifier is also 50Ω, the gain of the 2nd IF amplifier is identical to the gain of the 1st IF amplifier.

Due to emitter degeneration introduced into the circuit by A3L3, the gain of each amplifier is independent of the device transconductance to a first-order approximation. Each amplifier delivers approximately 15 dB of power gain at 321.4 MHz. The 1st IF amplifier is biased at 17 mA and the 2nd IF amplifier is biased at 34 mA. These bias levels are set to facilitate a reasonable noise figure (approximately 1.5 dB) in the 1st IF amplifier and an improved TOI performance in the 2nd IF amplifier. (Because of the gain achieved by the 1st IF amplifier, the 2nd IF amplifier's TOI performance is more critical than its noise figure.)

The 321.4 MHz BPF (function block Ⓥ) can be adjusted to compensate for total amplifier gain slope.

Variable Pad (Function Block Ⓢ). The output of the 2nd IF amplifier is fed into a variable attenuator (pad). This attenuator is used to make minor converter-gain adjustments, such as setting the gain during module alignment. After going through the variable pad, the IF signal goes to a power splitter.

Power Splitter and 12 dB Pad (Function Blocks Ⓣ and Ⓤ). The 321.4 MHz IF signal is split by the A3U2 power splitter. One output of the splitter is fed into a 12 dB pad and then routed to the unfiltered wide-band auxiliary 321.4 MHz output on the module rear panel. The other output of the splitter is fed into the 321.4 MHz BPF.

321.4 MHz BPF (Function Block Ⓥ). The 321.4 MHz BPF consists of a four-element coupled-shunt resonator filter in series with a fifth resonator that provides a transmission zero at 278.6 MHz (the image frequency of 321.4 MHz when the final IF is 21.4 MHz). The coupling elements in the four-element filter are capacitors formed by traces printed on the PC board.

The filter bandwidth is approximately 10 MHz with an insertion loss of about 4 dB. This results in a 321.4 MHz signal with a bandwidth of 10 MHz and approximately 20 dB of total gain being fed into the RF port of mixer A3U3 (function block Ⓛ).

21.4 MHz Amplifier Circuit (Function Blocks Ⓛ, Ⓜ, Ⓝ, Ⓞ, Ⓔ, Ⓕ, Ⓖ, and Ⓟ)

The 21.4 MHz amplifier circuit mixes the 300 MHz and 321.4 MHz signals, and then amplifies and filters the resulting 21.4 MHz signal. The 21.4 MHz IF circuit gain of approximately 10 dB is added to the 321.4 MHz IF circuit gain of approximately 20 dB, resulting in a total module gain of approximately 30.5 dB. Variable attenuator A3R18 (function block Ⓢ) is used to make any minor module-gain corrections needed.

Mixer (Function Block Ⓛ). The LO port of mixer A3U3 receives a 300 MHz signal of approximately +19 dBm. The RF port of the mixer receives a 321.4 MHz signal with a bandwidth of 10 MHz and a signal level that is approximately 16.5 dB higher than the signal level at A3J1. Mixer A3U3 has a conversion efficiency of 6 dB. The 21.4 MHz IF signal that results from the mixing is fed into the diplexer.

Diplexer (Function Block Ⓜ). All of the unwanted higher-order mixing terms are terminated in 50Ω by the diplexer. The transition frequency between the high-pass and low-pass signal paths is approximately 50 MHz. The diplexer helps keep higher-order mixing products from reflecting back into the mixer, where they would cause added distortion. The diplexer also helps maintain the reasonable

port-to-port isolation performance of the mixer.

3rd IF Amplifier (Function Block Ⓝ). The diplexer output drives the 3rd IF amplifier, which is the first 21.4 MHz IF amplifier. The 3rd IF amplifier is a transformer-feedback amplifier with the active device (A3Q10) in a common-base configuration.

To achieve an amplifier noise figure of approximately 1 dB, the bias level of A3Q10 is set to about 1 mA. The noise figure of the A3 Last Converter board is somewhat dependent on the noise figure of the 21.4 MHz amplifiers. Moderate changes, such as the noise figure of the 21.4 MHz amplifiers increasing to 3.0 dB, will cause a few tenths of a dB change in the overall noise figure. Resistor A3R70 at the base of A3Q10 prevents undesired oscillations in the circuit and keeps the net input impedance (looking into the emitter) positive. This resistor does degrade the noise performance by about a tenth of a dB.

The 3rd IF amplifier provides about 10 dB of gain. The theoretical circuit gain is 12 dB. However, parasitic effects reduce the circuit gain by approximately 2 db. The theoretical gain is set by the transformer turns ratio: The transformer turns ratio is 1:11 with the secondary tapped at 7:4. There are four turns between ground and the secondary tap that provides the output signal. This results in the theoretical voltage gain of 12 dB (20 log(4) = 12 dB). The transformer design and connections result in the load and source impedances being translated through the amplifier. Therefore, as long as the load and source impedances are 50Ω, the voltage and power gains in this circuit will be identical.

This circuit has extremely good distortion performance. The TOI of approximately +25 dBm is important in maintaining the TOI performance of the module. However, as a result of this circuit's relatively large bandwidth (approximately 200 MHz), an additional isolation switch is needed. The SPST switch (function block Ⓞ) provides the isolation needed to prevent unwanted signals from reaching the 21.4 MHz IF output when the module is in bypass mode.

SPST Switch (Function Block Ⓞ). The SPST switch, located at the output of the 3rd IF amplifier, provides isolation between the 3rd and 4th IF amplifiers to prevent unwanted signals from reaching the 21.4 MHz IF output when the module is in bypass mode.

The switch is a SPST comprised of two PIN diodes which are driven by A3U6 (function block Ⓟ). The output of the SPST switch drives the 4th IF amplifier.

4th IF Amplifier (Function Block Ⓔ). The 4th IF amplifier is identical to the 3rd IF amplifier. The output of this amplifier is fed into the 100 MHz LPF.

100 MHz LPF (Function Block Ⓕ). The 100 MHz LPF is a 5-element low-pass filter. Between the 4th IF amplifier output and the filter input there is a coupling/matching inductor (A3L27) that is critical in maintaining a 50Ω output impedance (seen as though looking into the module's rear-panel 21.4 MHz IF output port). However, because the output impedance is sensitive to parasitics, the value of this inductor may not be ideal in providing an exact 50Ω output impedance.

The primary task of the 100 MHz LPF is to reduce 300 MHz LO harmonic feedthrough. The IF harmonic performance of this port is good because the 21.4 MHz IF amplifiers are fairly linear. The output of the filter is fed into a SPDT switch.

SPDT Switch (Function Block Ⓖ). The SPDT switch is used to select the 21.4 MHz IF signal that will be directed to the module's rear-panel 21.4 MHz output. The switch selects between the following signals:

- The 21.4 MHz IF signal produced by the A3 board's mixing process.
- The external 21.4 MHz IF from the module's rear-panel 21.4 MHz auxiliary input.

The switch is comprised of four PIN diodes which are driven by switch driver A3U6 (function block Ⓟ). The insertion loss of the switch is approximately 1.5 dB in either position. The on position puts the A3 board's IF signal at the rear-panel output. (The on position is the default.) The switch's isolation is approximately 65 dB between the input of the disabled output. (The isolation is a function of the impedance of CR10 being low and CR11 being high.)

Service Detectors (Function Blocks Ⓓ, Ⓦ, and Ⓧ)

Service detectors are used to check for the presence of specific signals during self-test or when the system is turned on. The A3 board assembly may have the following service detectors:

- The 300 MHz detector (function block Ⓓ) is present in both HP 70907A and HP 70907B modules.
- The 321.4 MHz detector (function block Ⓓ) is only functional in HP 70907A modules that have serial numbers earlier than 2638A00275.
- The 21.4 MHz detector (function block Ⓧ) is present in both HP 70907A and HP 70907B modules.

300 MHz Detector (Function Block Ⓓ). A sample of the 300 MHz signal power is taken from a point between the filtering and matching-network components in the 350 MHz LPF (function block Ⓚ). This sample is used as the input to the 300 MHz detector. The 300 MHz detector consists of a high-impedance AM detector (comprised of Schottky detector-diode A3CR12 and peak-hold capacitor A3C35) and

open-collector comparator A3U5.

The output of A3U5 goes via A3J8-4 to the A4 Power Supply/Controller assembly, where pull-up resistor A4R15 monitors the condition of the 300 MHz detector:

TTL high	When a 300 MHz signal is not present, the bias level of A3CR12 causes the voltage fed into the inverting terminal of A3U5 to be slightly lower than the reference voltage fed into the non-inverting terminal of A3U5. This causes the output of A3U5 to be open (TTL high = error condition).
TTL low	When a 300 MHz signal of sufficient amplitude is present, the voltage fed into the inverting terminal of A3U5 is higher than the reference voltage fed into the non-inverting terminal of A3U5. This causes the output of A3U5 to be shorted (TTL low).

321.4 MHz Detector.

Note Because of problems with circuit stability, the 321.4 MHz detector is disabled in newer board versions. Some of the components associated with the detector may be physically present on newer versions of the board even though the detector is not functional. If you want to remove this detector from an older board, refer to the Diagnostics Test information in the "Verification Test Failures" section of this chapter.

The following information applies only to older boards with functional 321.4 MHz detectors.

The 321.4 MHz IF power is sampled at the output of function block Ⓥ by a buffer amplifier that has a high input impedance. The amplifier's load impedance consists of inductor A3L42 in parallel with detector-diode A3CR1 which is in series with peak-hold capacitor A3C18.

The detected voltage is fed into the inverting terminal of open-collector comparator A3U4, and the reference voltage is fed into the non-inverting terminal of A3U4. The output of A3U4 goes via A3J7-2 to the A4 Power Supply/Controller assembly where pull-up resistor A4R14 monitors the condition of the 321.4 MHz detector:

TTL high — When a 321.4 MHz signal is not present, the voltage fed into the inverting terminal of A3U4 is lower than the reference voltage fed into the non-inverting terminal. This causes the output of A3U4 to be open (TTL high = error condition).

TTL low — When a 321.4 MHz signal of sufficient amplitude is present, the voltage fed into the inverting terminal of A3U4 is higher than the reference voltage fed into the non-inverting terminal. This causes the output of A3U4 to be shorted (TTL low).

21.4 MHz Detector. The 21.4 MHz IF power is sampled between A3C58 and A3J5 in function block Ⓖ by a buffer amplifier that has a high input impedance. The amplifier's load impedance consists of inductor A3L38 in parallel with detector-diode A3CR3 which is in series with peak-hold capacitor A3C59.

The detected voltage is fed into the inverting terminal of open-collector comparator A3U8, and the reference voltage is fed into the non-inverting terminal of A3U8. The output of A3U8 goes via A3J7-3 to the A4 Power Supply/Controller assembly where pull-up resistor A4R18 monitors the condition of the 21.4 MHz detector:

TTL high — When a 21.4 MHz signal is not present, the voltage fed into the inverting terminal of A3U8 is lower than the reference voltage fed into the non-inverting terminal. This causes the output of A3U8 to be open (TTL high = error condition).

TTL low — When a 21.4 MHz signal of sufficient amplitude is present, the voltage fed into the inverting terminal of A3U8 is higher than the reference voltage fed into the non-inverting terminal. This causes the output of A3U8 to be shorted (TTL low).

A4 Power Supply/Control Board Assembly

While troubleshooting the A4 board assembly, refer to the A4 schematic in the *HP 70907A/B Component-Level Information* binder.

A4 Power Supply/Control Board Assembly Circuit Descriptions

The A4 Power Supply/Control board assembly does the following things:

- Converts the 27 V ac, 40 kHz switching power signal to dc voltages that can be used to operate the various module circuits.
- Provides the digital interface to the Modular System Interface Bus (MSIB).
- Executes a variety of module-level commands and functions using its slave microprocessor and the slave firmware stored in EAROM.
- Uses an 8-bit DAC to provide the preselector-peak voltage to the A7 Front Panel board assembly. (Preselector DAC circuits are functional in HP 70907B modules only.)

Power Supply (Function Blocks Ⓐ and Ⓒ)

The HP 70000 series mainframe has a switching power supply that delivers 27 V ac at 40 KHz to each module in the mainframe. In the HP 70907A/B, this signal is applied through W15 to the input power transformer A4T1.

The ferrite choke around W15 helps contain MSIB digital noise by forcing a specific signal-return path for the MSIB traffic. Balun A4T2 and capacitors A4C1 and A4C2 act as a filter to keep any common-mode noise that is in the module from getting back onto the mainframe power bus.

Transformer A4T1 has three secondaries, each using full-wave rectifiers. Large voltage spikes normally occur at the input of A4T1 when the rectifying diodes are off. To reduce these spikes, a common series RC circuit is connected to the output of each full-wave rectifier. Also connected to the outputs of the full-wave rectifiers are common-mode filters (A4L1 and A4C7, A4L2 and A4C8, A4L3 and A4C9, and A4L4 and A4C10). The outputs of the common-mode filters are fed into four three-terminal regulators (A4U1, A4U2, A4U10, and A4U11).

The following module supply voltages are available. Some are obtained from the voltage at a regulator input and some are obtained from a regulator output.

- +5 V regulated (A4J5-6 and A4J5-9) is used for digital circuits.
- +7.5 V unregulated (A4J2-1) is first regulated to +5 V on the A1 board assembly, then used to supply the A5 Leveling Amplifier.
- +8 V regulated (A4J4-3) is used for the A3 Last Converter assembly.
- +11 V unregulated (A4J2-22) is first regulated to +7 V on the A1 assembly, then used to supply the last stage of the A5 Leveling Amplifier.
- ±12 V regulated (A4J2-8, A4J3-5, A4J2-6, and A4J3-3) is used for the A3 Last Converter and the A1 Miscellaneous Bias assemblies.
- ±15 V unregulated (A4J2-2 and A4J2-4) is used for the A8 Attenuator drive circuitry.

MSIB Interface Circuit (Function Block Ⓑ)

Bus transceiver chip A4U3 receives information over the MSIB through W15, and then transmits commands to the MSIB-control IC A4U5. The MSIB-control IC is the interface between the module-controller microprocessor A4U15 (function block Ⓓ) and the external MSIB communication system.

Controller Circuit (Function Block Ⓓ)

The module controller receives commands through the MSIB interface circuits, and then executes specific module functions based on the commands received. For example, it may switch the module to a desired measurement or response state. The controller also receives information from the fault detector (function block Ⓒ) about the existence of certain error conditions (for example, LO unleveled and bias error).

The module-controller microprocessor A4U15 receives MSIB commands from A4U5 via the data bus (D0-7), and writes corresponding bit patterns into latches that set the module functions. The module's EAROM A4U9 (HP 70907A: A4U9 and A4U16) contains tables that convert MSIB commands to latch-bit patterns and data.

The output of address latch A4U8 connects to the address ports of EAROM A4U9 (HP 70907A: A4U9 and A4U16), MSIB-interface IC A4U5, and control-signals latch A4U7. Because A4U15 does not have any address ports, it must write via the data bus into A4U8 to address these components. When A4U15 needs to receive data or write data to one of these components, it addresses the component and then activates it via the LWR control line (A4J2-5) or some logic function that is based on this signal.

The data and address lines are also routed over W13 to the A1 Miscellaneous Bias board assembly to control the attenuator latch and the mixer-bias DAC.

Module-address switch A4S2 is used to set the MSIB address for the module. Write/protect switch A4S1 is normally set to protect EAROM A4U9 (HP 70907A: A4U9 and A4U16) from having data overwritten. To allow EAROM data to be changed, the switch must be set to the write position.

Fault Detector Circuit (Function Block Ⓒ)

Error-condition information comes into the fault detector circuit and is passed on by A4U14 to the controller circuit (function block Ⓓ).

Control Signals Latch Circuit (Function Block Ⓕ)

The microprocessor A4U15 uses data latch A4U7 to control the following circuits.

- SPDT Switch (function block Ⓖ on the A3 board assembly) controls the 21.4 MHz IF daisy-chain path.
- IF Relay (function block Ⓐ on the A2 board assembly) determines whether the 321.4 MHz IF signal or the 321.4 MHz calibrator signal will be inserted into the IF path of the module.
- Mixer-bias enable (function block Ⓑ on the A1 board assembly) grounds the mixer-bias output when a self-biased mixer is being used.

Preselector DAC Circuit (Function Block Ⓗ)

Note

The preselector DAC circuity is functional only in HP 70907B modules. Newer HP 70907A modules may have the components for the preselector-DAC circuit physically present on the board, but they are not used.

Preselector DAC A4U16 provides ±5 V to the voltage-summer circuit on the A7 Front Panel board assembly. A4R27 and A4R29 are used to adjust the DAC reference voltage.

On the A7 board assembly, the preselector-peak DAC voltage is scaled down by a factor of 100 and then summed with the rear-panel TUNE SPAN voltage to provide preselector tuning for HP 11974 series preselected mixers.

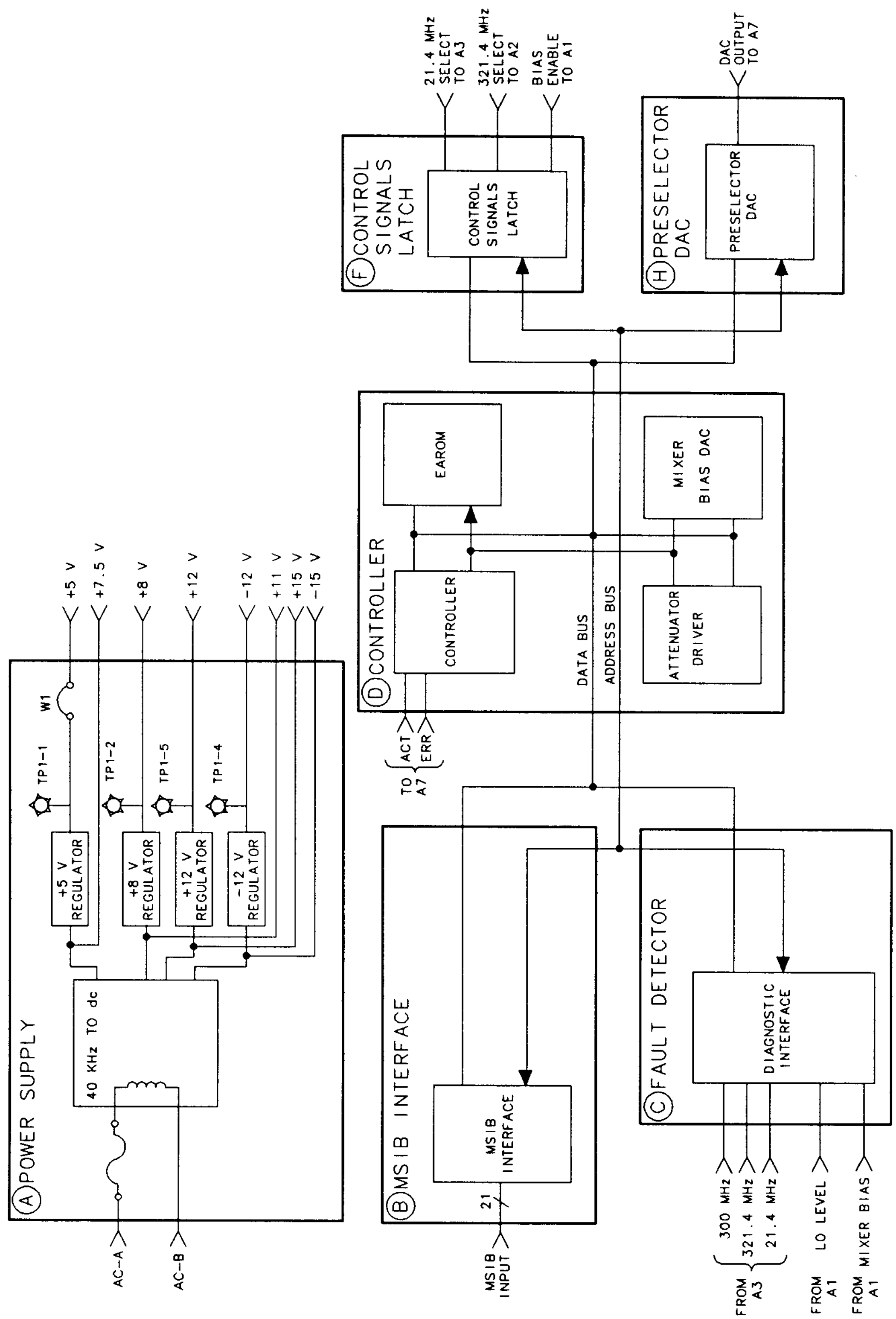


Figure 5-8. A4 Power Supply/Control Board Assembly Simplified Block Diagram

A7 Front Panel Board Assembly

While troubleshooting the A7 board assembly, refer to the A7 schematic in the *HP 70907A/B Component-Level Information* binder.

A7 Front Panel Board Assembly Circuit Descriptions (HP 70907A)

The A7 Front Panel board assembly contains the front-panel active (ACT) and error (ERR) LEDs, which indicate the status of the module.

Front Panel (Function Block Ⓐ)

The A7 Front Panel board assembly contains the LEDs and their respective current-limiting resistors. The actual LED-drive circuitry, a pair of open collector current buffers/switches, is on the A4 Power Supply/Control board assembly.

The LEDs are activated when the LED control lines (A7J1-10 and A7J1-8) are pulled to a TTL low. The ACT LED is controlled by A7J1-10; the ERR LED is controlled by A7J1-8.

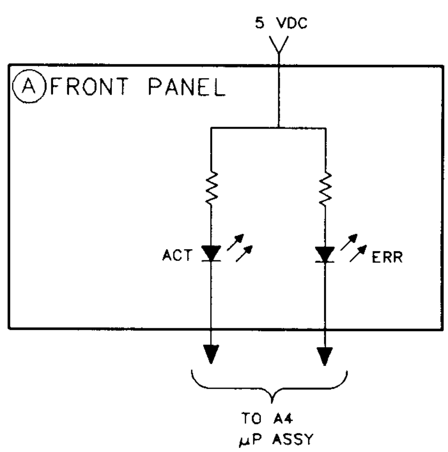


Figure 5-9. HP 70907A: A7 Front Panel Board Simplified Block Diagram

A7 Front Panel Board Assembly Circuit Descriptions (HP 70907B)

The A7 Front Panel board assembly contains the front-panel active (ACT) and error (ERR) LEDs, which indicate the status of the module. The A7 assembly also provides the summed voltage for the front-panel PRESEL TUNE/SPAN output.

Voltage Summer (Function Block Ⓐ)

This circuit scales down, by a factor of 100, the preselector-peak voltage generated by the 8-bit DAC located on the A4 Power Supply/Control assembly. Then, the scaled-down voltage is summed with the voltage from the

rear-panel TUNE SPAN input and the combined signal is sent to the

front-panel BNC connector.

The input impedance of A7J2 must be greater than 100 kΩ. This is accomplished through the use of a unity-gain inverting amplifier (A7U1B) that provides a 2:1 isolation factor from ground potential variations (in other words, potential variations between the front casting of the HP 70907B and the reference on the frequency control assembly of the HP 70900 LO module).

Unity-gain inverting amplifier A7U1A buffers the preselector-peak DAC input voltage, which comes in on A7J1-2.

The output of these two buffer stages (A7U1A and A7U1B) is fed into a voltage-summer circuit that includes A7U2. The DAC voltage comes from the A4 assembly with a range of ±5 V. To allow sufficient tuning range during peaking for HP 11974 series preselected mixers, the DAC voltage is scaled (by a factor of 100) by the resistive feedback combination of A7R6 and A7R8. The scaled-down DAC voltage is now able to modify the TUNE SPAN voltage by ±50 mV, preserving the necessary tuning range. The output of A7U2 is fed to the BNC connector on the front panel.

LED Drive (Function Block Ⓑ)

The A7 Front Panel board assembly contains the LEDs and their respective current-limiting resistors. The actual LED-drive circuitry, a pair of open collector current buffers/switches, is on the A4 Power Supply/Control board assembly.

The LEDs are activated when the LED control lines (A7J1-10 and A7J1-8) are pulled to a TTL low. The ACT LED is controlled by A7J1-10; the ERR LED is controlled by A7J1-8.

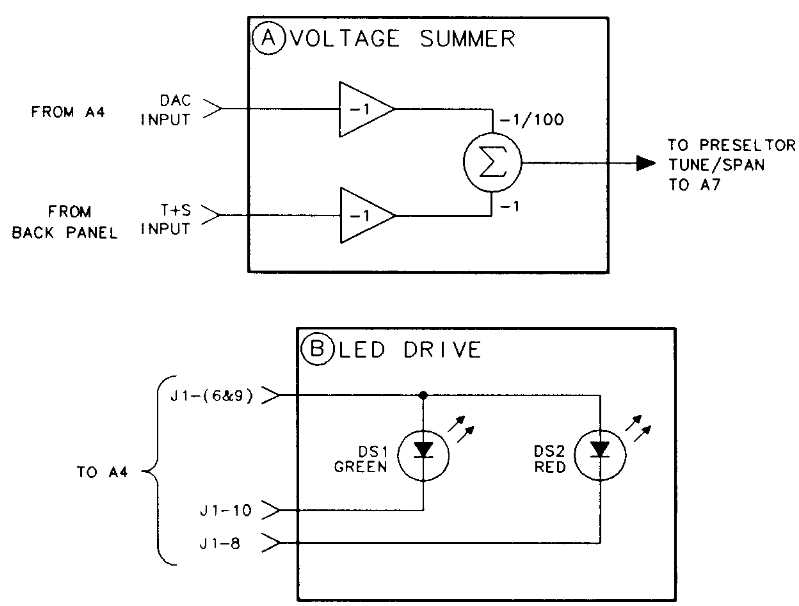


Figure 5-10. HP 70907B: A7 Front Panel Board Simplified Block Diagram

7

Replaceable Parts

Introduction

This chapter contains information for identifying and ordering replacement assemblies and mechanical parts for the HP 70907A/B External Mixer Interface module. (Assembly location information is given in Chapter 8.) Included in this chapter are the following tables and figures:

- Table 7-1 lists reference designations, abbreviations, and value multipliers used in the parts lists.
- Tables 7-2 and 7-3 list all major and cable assemblies by reference designation. Table 7-2 identifies HP 70907A assemblies; Table 7-3 identifies HP 70907B assemblies.
- Figures 7-1 through 7-8 contain illustrations of the module with a listing of the chassis mechanical parts that are identified in each figure.

Note

Parts lists, component-location diagrams, and schematics for the board assemblies that have field-replaceable lower level parts are available in the *HP 70907A/B Component-Level Information* binder. This set contains a separate CLIP for each board assembly or board assembly version. Each individual CLIP can be ordered separately, or as part of the CLIP set. Refer to Appendix A for the CLIP part numbers.

Exchange Assemblies

The part numbers for any available rebuilt assemblies that may be replaced on an exchange basis are included in Tables 7-2 and 7-3. Exchange assemblies (factory repaired and tested) are available only on a trade-in basis when the defective assemblies are returned for credit. User spare-parts stock must be ordered by the new assembly part number.

Table and Parts Identification Formats

Major and Cable Assembly Table Format

Tables 7-2 and 7-3 give the following information for each assembly:

1. Assembly reference designation.
2. Hewlett-Packard part number for the assembly.
3. Description of the part.

Parts Identification Format

Figures 7-1 through 7-8 give the following information for the parts identified in each figure:

1. Item number of callout in figure.
2. Hewlett-Packard part number.
3. Total quantity (Qty) in the view shown.
4. Description of the part.

Ordering Information

To order an assembly or mechanical part listed in this chapter, quote the Hewlett-Packard part number and indicate the quantity required.

To order a part that is *not* listed, include the following information with the order:

- Module model number.
- Module serial number.
- Part description, including the following information:
  - where part is located.
  - what part looks like.
  - what function part serves (if known).
- Quantity needed.

Parts can be ordered by addressing the order to the nearest Hewlett-Packard office. Customers within the USA can also use either the direct mail-order system, or the direct phone-order system described below. The direct phone-order system has a toll-free phone number available.

Direct Mail-Order System

Within the USA, Hewlett-Packard can supply parts through a direct mail-order system. Advantages of using the system are as follows:

- Direct ordering and shipment from Hewlett-Packard.
- No maximum or minimum on any mail order. (There is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing.)
- Prepaid transportation. (There is a small handling charge for each order.)
- No invoices.

To provide these advantages, a check or money order must accompany each order. Mail-order forms and specific ordering information are available through your local HP office.

Direct Phone-Order System

Within the USA, a phone order system is available for regular and hotline replacement parts service. Mastercard and Visa are accepted.

Regular Orders

The toll-free phone number, (800) 227-8164, is available Monday through Friday, 6 AM to 5 PM (Pacific time). Regular orders have a 4-day delivery time.

Hotline Orders

Hotline service is available 24 hours a day, 365 days a year, for emergency parts ordering. The toll-free phone number, (800) 227-8164, is available Monday through Friday, 6 AM to 5 PM (Pacific time). After-hours and on holidays, call (415) 968-2347.

To cover the cost of freight and special handing, there is an additional hotline charge on each order (three line items maximum per order). Hotline orders are normally delivered the next business day after they are ordered.

Table 7-1. Reference Designations, Abbreviations and Multipliers (1 of 4)

REFERENCE DESIGNATIONS					
A	Assembly	F	Fuse	RT	Thermistor
AT	Attenuator, Isolator, Limiter, Termination	FL	Filter	S	Switch
B	Fan, Motor	HY	Circulator	T	Transformer
BT	Battery	J	Electrical Connector (Stationary Portion), Jack	TB	Terminal Board
C	Capacitor	K	Relay	TC	Thermocouple
CP	Coupler	L	Coil, Inductor	TP	Test Point
CR	Diode, Diode Thyristor, Step Recovery Diode, Varactor	M	Meter	U	Integrated Circuit, Microcircuit
DC	Directional Coupler	MP	Miscellaneous Mechanical Part	V	Electron Tube
DL	Delay Line	P	Electrical Connector (Movable Portion), Plug	VR	Breakdown Diode (Zener), Voltage Regulator
DS	Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Visible)	Q	Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor	W	Cable, Wire, Jumper
E	Miscellaneous Electrical Part	R	Resistor	X	Socket
				Y	Crystal Unit (Piezoelectric, Quartz)
				Z	Tuned Cavity, Tuned Circuit

ABBREVIATIONS	
A	
A	Across Flats, Acrylic, Air (Dry Method), Ampere
ADJ	Adjust, Adjustment
ANSI	American National Standards Institute (formerly USASI-ASA)
ASSY	Assembly
AWG	American Wire Gage
B	
BCD	Binary Coded Decimal
BD	Board, Bundle
BE-CU	Beryllium Copper
BNC	Type of Connector
BRG	Bearing, Boring
BRS	Brass
BSC	Basic
BTN	Button
C	
C	Capacitance, Capacitor, Center Tapped, Cermet, Cold, Compression
CCP	Carbon Composition Plastic
CD	Cadmium, Card, Cord
CER	Ceramic
CHAM	Chamfer
CHAR	Character, Characteristic, Charcoal
CMOS	Complementary Metal Oxide Semiconductor
CNDCT	Conducting, Conductive, Conductivity, Conductor
CONT	Contact, Continuous, Control, Controller
CONV	Converter
CPRSN	Compression
CUP-PT	Cup Point
CW	Clockwise, Continuous Wave
D	
D	Deep, Depletion, Depth, Diameter, Direct Current
DA	Darlington

Table 7-1. Reference Designations, Abbreviations, and Multipliers (2 of 4)

ABBREVIATIONS					
DAP-GL	Diallyl Phthalate Glass	FT	Current Gain Bandwidth Product (Transition Frequency), Feet, Foot	JFET	Junction Field Effect Transistor
DBL	Double				
DCDR	Decoder				**K**
DEG	Degree				
D-HOLE	D-Shaped Hole	FXD	Fixed	K	Kelvin, Key, Kilo, Potassium
DIA	Diameter				
DIP	Dual In-Line Package		**G**	KNRLD	Knurled
DIP-SLDR	Dip Solder			KVDC	Kilovolts Direct Current
D-MODE	Depletion Mode	GEN	General, Generator		
DO	Package Type Designation	GND	Ground		
		GP	General Purpose, Group		**L**
DP	Deep, Depth, Diametric Pitch, Dip			LED	Light Emitting Diode
DP3T	Double Pole Three Throw		**H**		
				LG	Length, Long
DPDT	Double Pole Double Throw	H	Henry, High	LIN	Linear, Linearity
		HDW	Hardware	LK	Link, Lock
DWL	Dowell	HEX	Hexadecimal, Hexagon, Hexagonal	LKG	Leakage, Locking
				LUM	Luminous
	E				
		HLCL	Helical		
E-R	E-Ring	HP	Hewlett-Packard Company, High Pass		**M**
EXT	Extended, Extension, External, Extinguish			M	Male, Maximum, Mega, Mil, Milli, Mode
			I		
	F				
		IC	Collector Current, Integrated Circuit	MA	Milliampere
F	Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Frequency			MACH	Machined
		ID	Identification, Inside Diameter	MAX	Maximum
				MC	Molded Carbon Composition
		IF	Forward Current, Intermediate Frequency		
FC	Carbon Film/ Composition, Edge of Cutoff Frequency, Face			MET	Metal, Metallized
				MHZ	Megahertz
		IN	Inch	MINTR	Miniature
		INCL	Including	MIT	Miter
FDTHRU	Feedthrough	INT	Integral, Intensity, Internal	MLD	Mold, Molded
FEM	Female			MM	Magnetized Material, Millimeter
FIL-HD	Fillister Head				
FL	Flash, Flat, Fluid		**J**	MOM	Momentary
FLAT-PT	Flat Point			MTG	Mounting
FR	Front	J-FET	Junction Field Effect Transistor	MTLC	Metallic
FREQ	Frequency			MW	Milliwatt

Table 7-1. Reference Designations, Abbreviations, and Multipliers (3 of 4)

ABBREVIATIONS					
	N	PLSTC	Plastic	SMA	Subminiature, A Type (Threaded Connector)
		PNL	Panel		
N	Nano, None	PNP	Positive Negative Positive (Transistor)	SMB	Subminiature, B Type (Slip-on Connector)
N-CHAN	N-Channel	POLYC	Polycarbonate		
NH	Nanohenry	POLYE	Polyester		
NM	Nanometer, Nonmetallic	POT	Potentiometer	SMC	Subminiature, C-Type (Threaded Connector)
NO	Normally Open, Number	POZI	Pozidriv Recess		
		PREC	Precision		
NOM	Nominal	PRP	Purple, Purpose	SPCG	Spacing
NPN	Negative Positive Negative (Transistor)	PSTN	Piston	SPDT	Single Pole Double Throw
		PT	Part, Point, Pulse Time		
NS	Nanosecond, Non-Shorting, Nose			SPST	Single Pole Single Throw
		PW	Pulse Width		
NUM	Numeric			SQ	Square
NYL	Nylon (Polyamide)			SST	Stainless Steel
			Q	STL	Steel
	O			SUBMIN	Subminiature
		Q	Figure of Merit	SZ	Size
OA	Over-All				
OD	Outside Diameter		**R**		
OP AMP	Operational Amplifier	R	Range, Red, Resistance, Resistor, Right, Ring		**T**
OPT	Optional, Option, Optional			T	Teeth, Temperature, Thickness, Time, Timed, Tooth, Typical
		REF	Reference		
	P	RES	Resistance, Resistor		
		RF	Radio Frequency		
PA	Picoampere, Power Amplifier	RGD	Rigid		
		RND	Round	TA	Ambient Temperature, Tantalum
PAN-HD	Pan Head	RR	Rear		
PAR	Parallel, Parity	RVT	Rivet, Riveted		
PB	Lead (Metal), Pushbutton			TC	Temperature Coefficient
			S		
PC	Printed Circuit			THD	Thread, Threaded
PCB	Printed Circuit Board	SAWR	Surface Acoustic Wave Resonator	THK	Thick
				TO	Package Type Designation
P-CHAN	P-Channel	SEG	Segment		
PD	Pad, Power Dissipation	SGL	Single	TPG	Tapping
		SI	Silicon, Square Inch	TR-HD	Truss Head
PF	Picofarad, Power Factor			TRMR	Trimmer
		SL	Slide, Slow	TRN	Turn, Turns
PKG	Package	SLT	Slot, Slotted	TRSN	Torsion

Table 7-1. Reference Designations, Abbreviations, and Multipliers (4 of 4)

ABBREVIATIONS					
	U	VAR	Variable		**Y**
		VDC	Volts—Direct Current		
UCD	Microcandela			YIG	Yttrium-Iron-
UF	Microfarad				Garnet
UH	Microhenry		**W**		
UL	Microliter,				
	Underwriters'	W	Watt, Wattage,		**Z**
	Laboratories, Inc.		White, Wide, Width		
UNHDND	Unhardened	W/SW	With Switch	ZNR	Zener
		WW	Wire Wound		
	V				
			X		
V	Variable, Violet,				
	Volt, Voltage	X	By (Used with		
VAC	Vacuum, Volts—		Dimensions),		
	Alternating Current		Reactance		

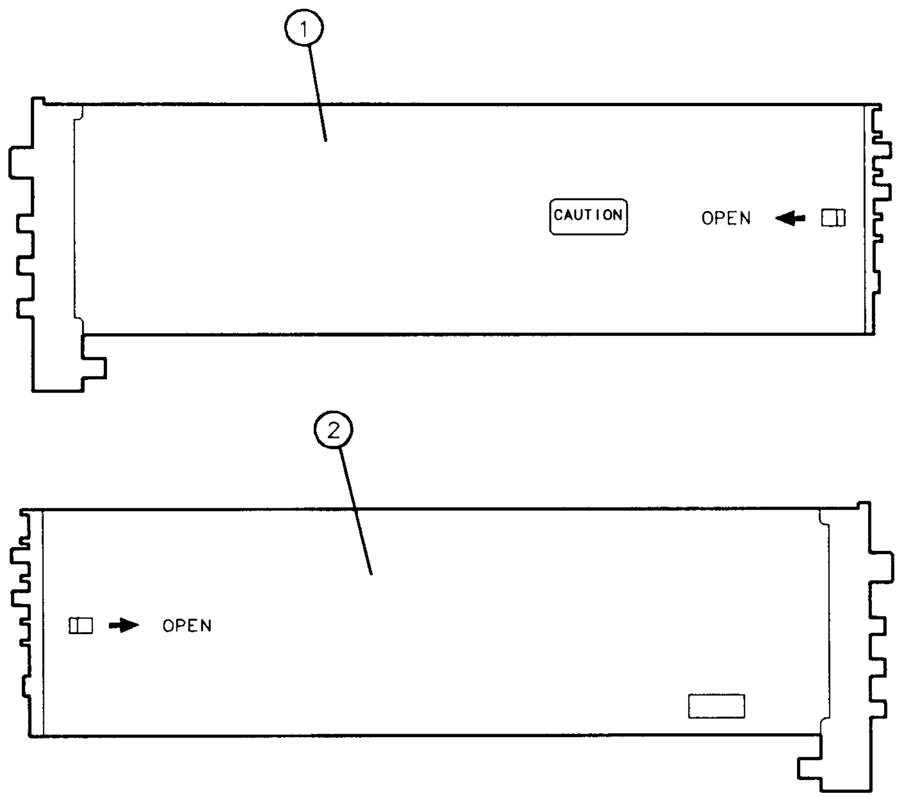
MULTIPLIERS					
Abbreviation	**Prefix**	**Multiple**	**Abbreviation**	**Prefix**	**M- ultiple**
T	tera	10^{12}	m	milli	10& minus;3
G	giga	10^{9}	μ	micro	10−;6
M	mega	10^{6}	n	nano	10^{-9}
k	kilo	10^{3}	p	pico	10^{-12}
da	deka	10	f	femto	10^{-15}
d	deci	10^{-1}	a	atto	10^{-18}
c	centi	10^{-2}			

Table 7-2. HP 70907A Major Assemblies and Cables

Reference Designation	Assembly HP Part Number	Description
A1	70907-60036	Miscellaneous Bias Board Assembly
A1	70907-69036	Miscellaneous Bias Board Assembly (rebuilt)
A2	70907-60038	Calibration Source Board Assembly
A3	70907-60004	Last Converter Board Assembly
A3	70907-69004	Last Converter Board Assembly (rebuilt)
A4	70907-60047	Power Supply/Control Board Assembly
A4F1	2110-0695	Fuse 1.5 A 125 V
A4U9	70907-80008	EPROM
A4U16	70907-80009	EPROM
A5	5086-7754	Leveling Amplifier Assembly
A6	0955-0204	Isolator Assembly
A7	70907-60039	Front Panel Board Assembly
A8	5086-7753	Attenuator Assembly
K2	3106-0029	RF Switch Assembly
W1	70907-60030	IF Input Cable Assembly
W2	70907-60013	Last Converter Cable Assembly
W3	70907-60031	Attenuator Out Cable Assembly
W4	70907-60015	21.4 Out Cable Assembly
W5	70907-60014	21.4 In Cable Assembly
W6	70907-60017	321.4 Out Cable Assembly
W7	70907-20017	RF LO IN Cable Assembly
W8	70907-20019	RF LO OUT Cable Assembly
W9	70907-20018	RF LO AUX Cable Assembly
W10	70907-60026	Calibration Source Cable Assembly
W11	70904-60017	Front Panel Cable Assembly
W12	70907-60025	Converter Rear Cable Assembly
W13	70907-60023	ALC Control Cable Assembly
W14	70907-60024	Converter Front Cable Assembly
W15	70904-60040	HP-MSIB Flex Assembly
W16	70907-60020	Mixer Bias Cable Assembly
W17	70907-60019	Tune Span Cable Assembly
W18	1250-1741	Adapter M SMA F SMA
W19	1250-1159	Adapter M SMA M SMA
W20	70907-20021	Attenuator In Cable Assembly
W24	70907-60035	K2 Wire Harness Assembly
W25	70907-60041	LO Amplifier Wire Harness Assembly

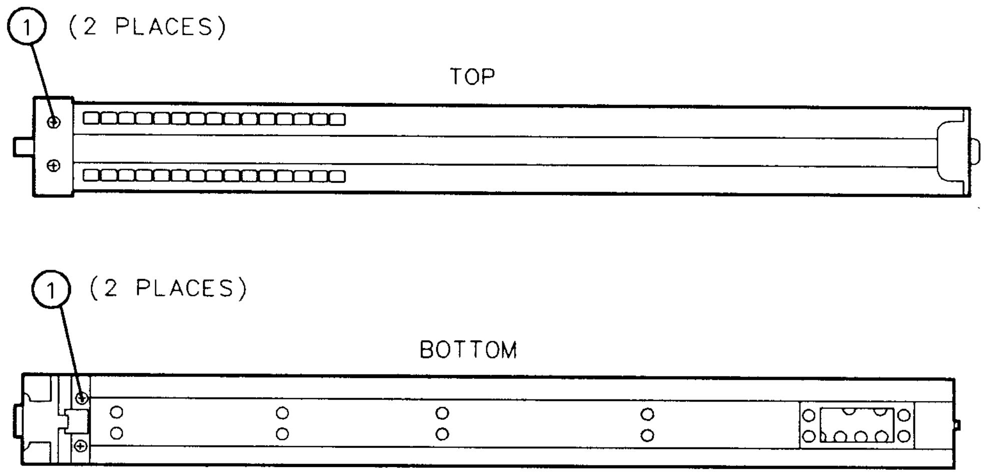
Table 7-3. HP 70907B Major Assemblies and Cables

Reference Designation	Major Assembly HP Part Number	Description
A1	70907-60036	Miscellaneous Bias Board Assembly
A1	70907-69036	Miscellaneous Bias Board Assembly (rebuilt)
A2	70907-60040	Calibration Source Board Assembly
A3	70907-60004	Last Converter Board Assembly
A3	70907-69004	Last Converter Board Assembly (rebuilt)
A4	70907-60045	Power Supply/Control Board Assembly
A4F1	2110-0695	Fuse 1.5 A 125 V
A4U9	70907-80018	EPROM
A4U15	5181-5039	EPROM
A5	5086-7754	Leveling Amplifier Assembly
A6	0955-0204	Isolator Assembly
A7	70907-60059	Front Panel Board Assembly
A8	5086-7844	Attenuator Assembly
A8	5086-6844	Attenuator Assembly (rebuilt)
K2	3106-0029	RF Switch Assembly
W1	70907-60051	IF Input Cable Assembly
W2	70907-60052	Attenuator In Cable Assembly
W3	70907-60031	Attenuator Out Cable Assembly
W4	70907-60015	21.4 Out Cable Assembly
W5	70907-60014	21.4 In Cable Assembly
W6	70907-60017	321.4 Out Cable Assembly
W7	70907-20017	RF LO IN Cable Assembly
W8	70907-20049	Leveling Amplifier LO OUT Cable Assembly
W9	70907-20018	RF LO AUX Cable Assembly
W10	70907-60055	Calibration Source Cable Assembly
W11	70904-60017	Front Panel Cable Assembly
W12	70907-60025	Converter Rear Cable Assembly
W13	70907-60023	ALC Control Cable Assembly
W14	70907-60024	Converter Front Cable Assembly
W15	70904-60040	HP-MSIB Flex Assembly
W16	70907-60020	Mixer Bias Cable Assembly
W17	70907-60054	Tune Span Cable Assembly
W18	5062-4829	Preselected Tune Span Wire Harness Assembly
W19	1250-1159	Adapter M SMA M SMA
W20	70907-20051	Calibration Source LO Input Cable Assembly
W21	70907-20050	LO OUTPUT Cable Assembly
W22	5062-0703	ATTEN DRIVE IN Ribbon Cable Assembly
W23	70907-60035	K2 Wire Harness Assembly
W24	70907-60041	LO Amplifier Wire Harness Assembly



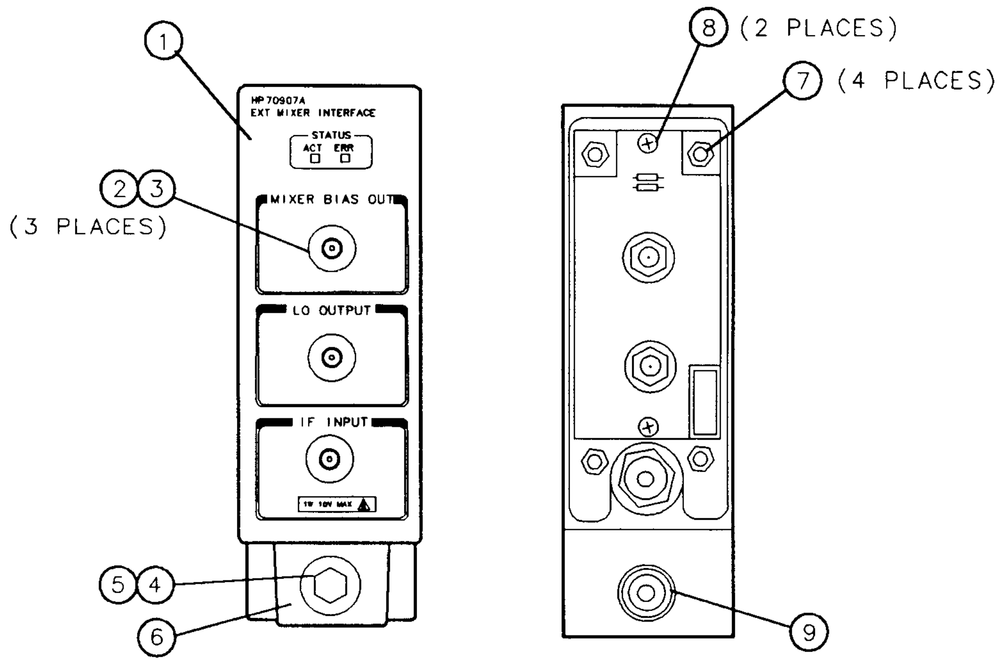
Item	HP Part Number	Qty	Description
1	5001-5839	1	Cover-Right
2	5001-5838	1	Cover-Left

Figure 7-1. HP 70907A and HP 70907B Module Parts ID, Side Covers



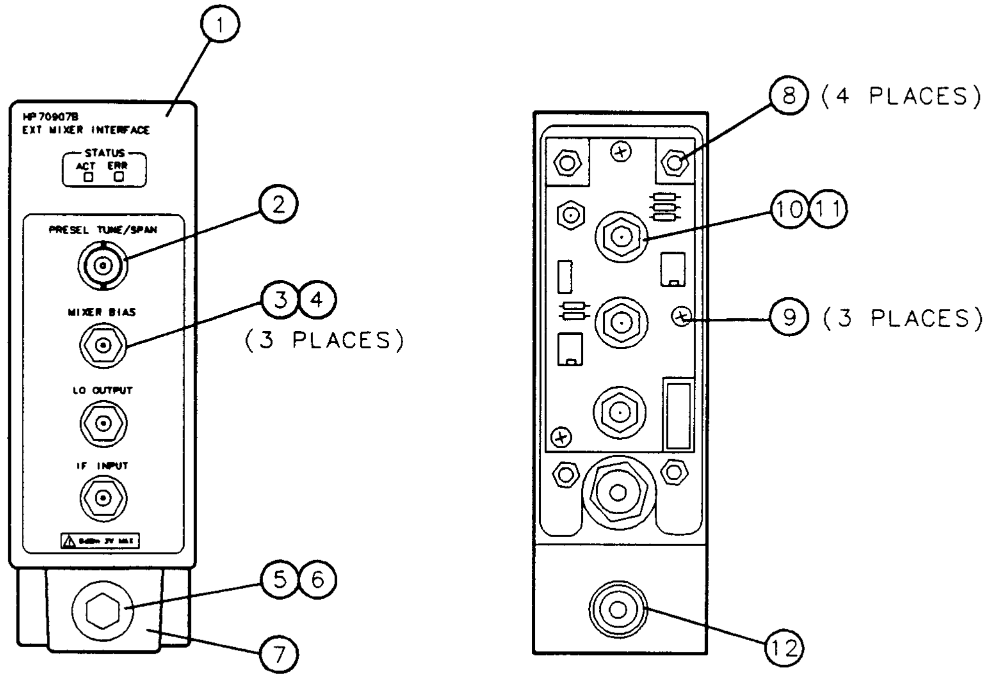
Item	HP Part Number	Qty	Description
1	0515-1054	4	Screw M3.0 9PCFLPDS

Figure 7-2.
HP 70907A and HP 70907B Module Parts ID, Top and Bottom Views



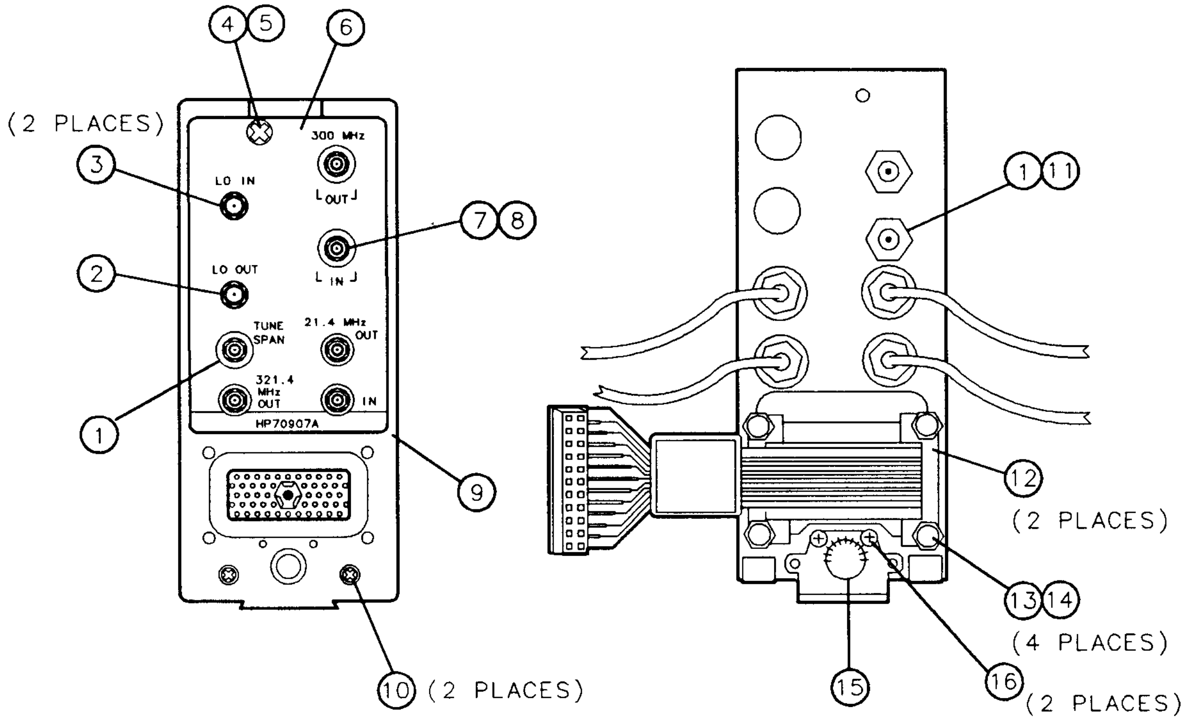
Item	HP Part Number	Qty	Description
1	70907-00005	1	Panel-Front
2	2190-0761	3	Washer-Flat 0.250OD12
3	1250-1666	3	Adapter-F SMA F SMA
4	~~5021-3290~~	1	Latch
5	0900-0012	1	O Ring 0.364ID
6	70904-20029	1	Frame-Front
7	0535-0082	4	Nut-Hex LKWR M4
8	0515-0886	2	Screw-M3.0 6PCPNPDS
9	0510-1244	1	Retainer Ring 10.5MMOD

Figure 7-3. HP 70907A Module Parts ID, Front View



Item	HP Part Number	Qty	Description
1	70907-00006	1	Panel-Front
2	1250-0118	1	Connector-RF BNC F
3	2190-0761	3	Washer-Flat 0.250OD12
4	1250-1666	3	Adapter-F SMA F SMA
5	5021-3290	1	Latch
6	0900-0012	1	O Ring 0.364ID
7	70904-20029	1	Frame-Front
8	0535-0082	4	Nut-Hex LKWR M4
9	0515-0886	3	Screw-M3.0 6PCPNPDS
10	2190-0016	1	Star washer on fr. panel BNC conn
11	2950-0001	1	Hex nut on fr. panel BNC conn
12	0510-1244	1	Retainer Ring 10.5MMOD

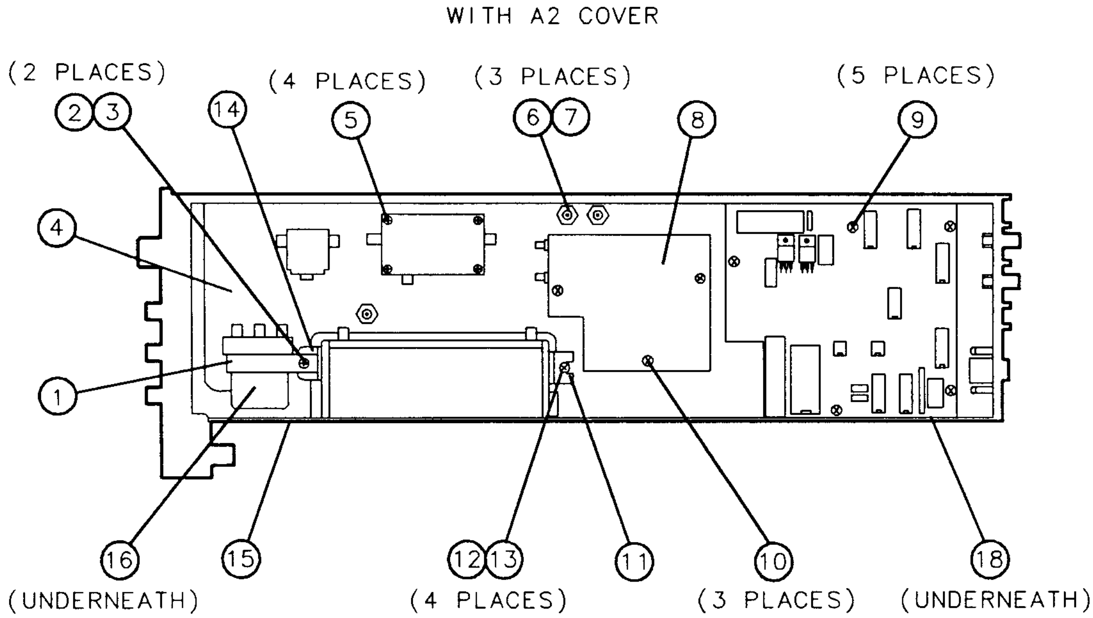
Figure 7-4. HP 70907B Module Parts ID, Front View



Item	HP Part Number	Qty	Description
1	1250-1968	1	Washer Kit-RF Connector
2	0960-0053	1	Termination-Male SMA 50Ω
3	1250-1957	2	Adapter-F SMA F SMA
4	3050-0893	1	Washer-Flat M4.0ID
5	0515-1583	1	Screw-M4.0 12SEMPNPD
6	70907-80004*	1	Label-Rear Panel
	70907-80016†	1	Label-Rear Panel
7	2190-0124	2	Washer-Lock 0.195ID10
8	2950-0078	2	Nut-Hex 10-32
9	70907-20012	1	Frame-Rear
10	0515-1105	2	Screw-M3.0 10PCPNPDS
11	3050-0021	1	Washer-Flat 0.188ID 8
12	5001-5835	2	Bar-Connector
13	1460-2095	4	Spring-CPR 5.49MMOD
14	0535-0042	4	Nut-Plastic Lock M3.0S
15	5001-5840	1	Spring-Grounding
16	0515-1717	2	Screw-M2.5 6SEMPNPD

*Used for HP 70907A only.
†Used for HP 70907B only.

Figure 7-5. HP 70907A and HP 70907B Module Parts ID, Rear View



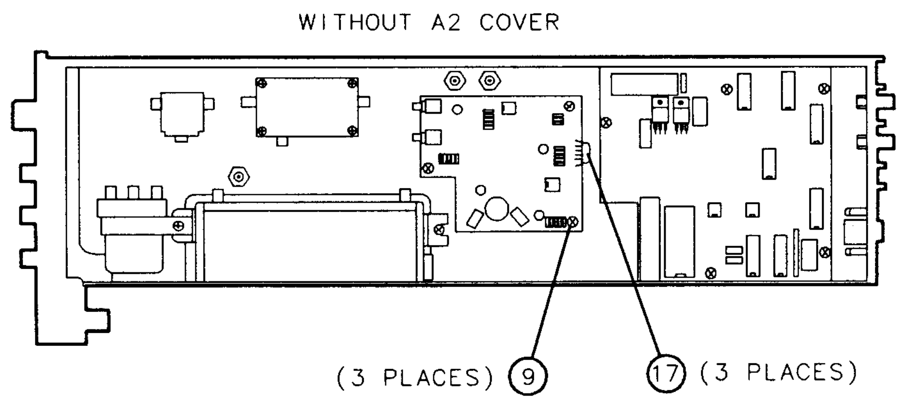
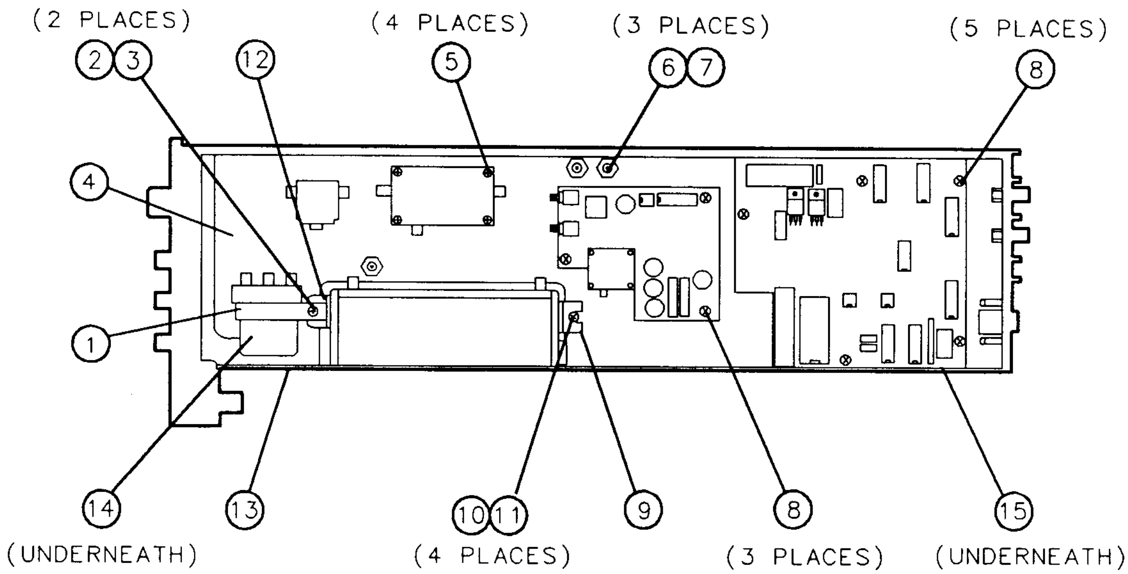


Figure 7-6. HP 70907A Module Parts ID, Right-Side Views (1 of 2)

Item	HP Part Number	Qty	Description
1	70907-00003	1	Clamp-Switch
2	3050-0893	2	Washer-Flat M4.0ID
3	0515-1583	2	Screw-M4.0 12SEMPNPD
4	70907-20047*	1	Center Body
5	0515-1057	4	Screw-M2.5 18PCPNPDS
6	2190-0124	3	Washer-Lock 0.195ID10
7	2950-0078	3	Nut-Hex 10-32
8	70907-20016	1	Cover-321 Cal†
9	0515-0886	8	Screw-M3.0 6PCPNPDS
10	0515-1111	3	Screw-M3.0 16PCPNPDS
11	5021-3297	1	Bracket-Attenuator Front
12	2190-0654	4	Washer-Lock M2.0ID
13	3030-0638	4	Screw-Hex SKT 256 0.375HXS
14	5021-9372	1	Bracket-Attenuator Rear
15	0460-0042	30 mm	Tape-Mylar
16	0460-1460	51 mm	Tape-Double Sided
17	8160-0494	3	Gasket-D Strip Hol
18	70907-00007	1	Insulator-Misc. Bias Board

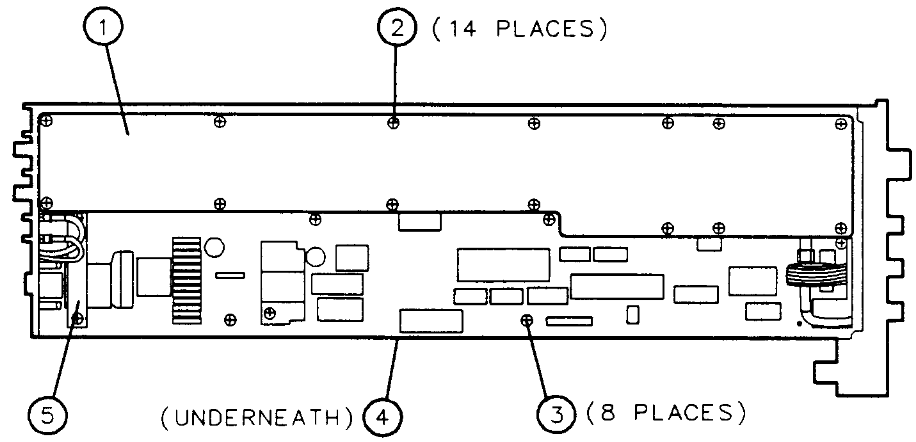
*This part number replaces HP part number 70907-20013.
†Gasket material (HP part number 8160-0495) must be inserted into slots in the 321 Cal Cover.

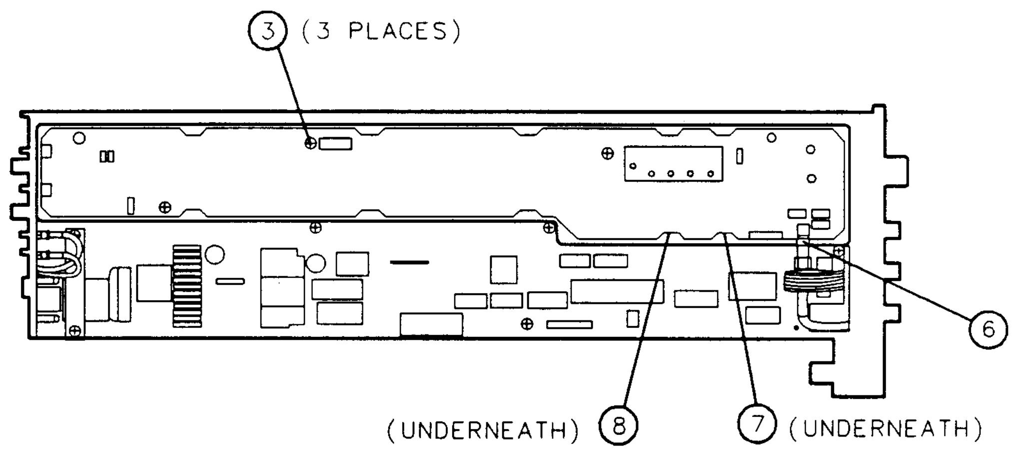
Figure 7-6. HP 70907A Module Parts ID, Right-Side Views (2 of 2)



Item	HP Part Number	Qty	Description
1	70907-00003	1	Clamp-Switch
2	3050-0893	2	Washer-Flat M4.0ID
3	0515-1583	2	Screw-M4.0 12SEMPNPD
4	70907-20047	1	Center Body
5	0515-1057	4	Screw-M2.5 18PCPNPDS
6	2190-0124	3	Washer-Lock 0.195ID10
7	2950-0078	3	Nut-Hex 10-32
8	0515-0886	8	Screw-M3.0 6PCPNPDS
9	5021-3297	1	Bracket-Attenuator Front
10	2190-0654	4	Washer-Lock M2.0ID
11	3030-0638	4	Screw-Hex SKT 256 0.375HXS
12	5021-9372	1	Bracket-Attenuator Rear
13	0460-0042	30 mm	Tape-Mylar
14	0460-1460	51 mm	Tape-Double Sided
15	70907-00007	1	Insulator-Misc. Bias Board

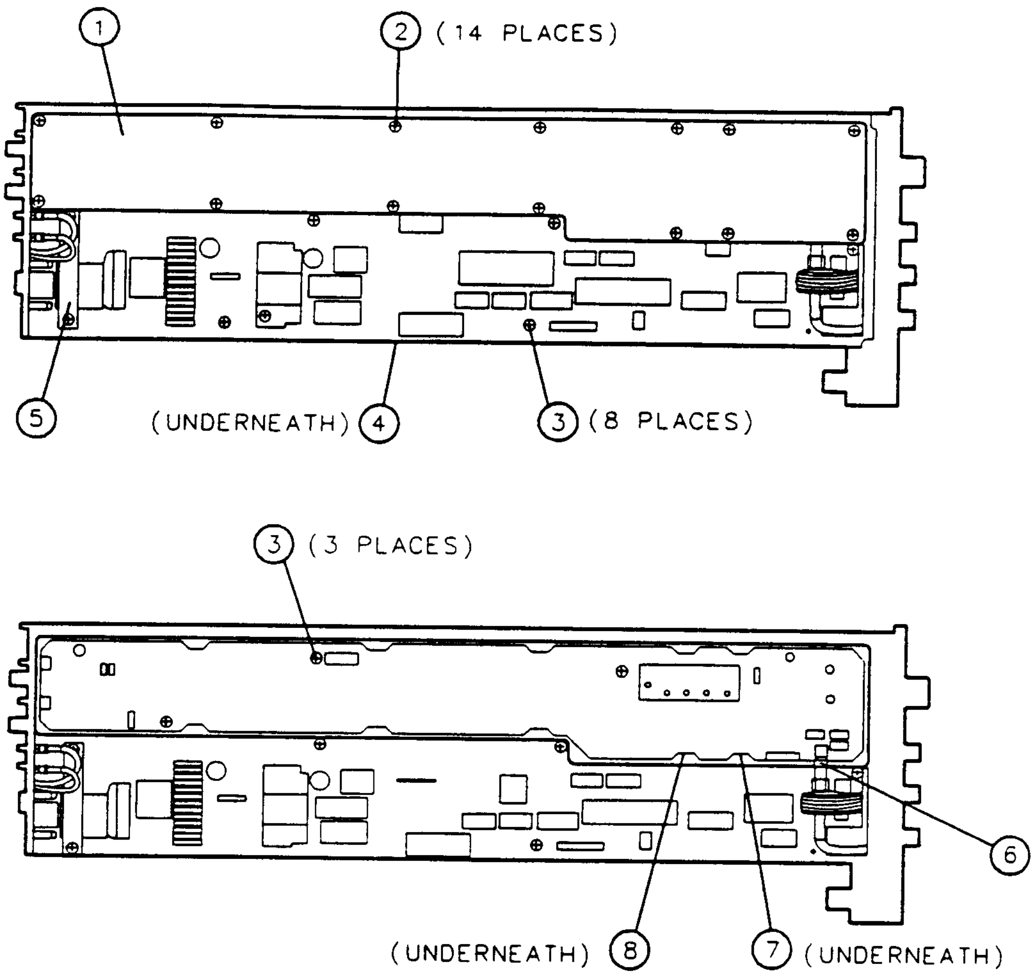
Figure 7-7. HP 70907B Module Parts ID, Right-Side View





Item	HP Part Number	Qty	Description
1	70907-20015	1	Cover-Converter*
2	0515-1079	14	Screws
3	0515-0886	11	Screw-M3.0 6PCPNPDS
4	5001-5875	1	Insulator-Power Control Bd
5	70904-00008	1	Bracket-Core
6	8160-0494	1	Gasket-D Strip Hol
7	70907-20037	1	Residual Suppressor
8	3050-0894	1	Washer-Flat M5.0ID
*Gasket material (HP part number 8160-0495) must be inserted into slots in the Converter Cover.			

Figure 7-8. HP 70907A and HP 70907B Module Parts ID, Left-Side Views



Item	HP Part Number	Qty	Description
1	70907-20015	1	Cover-Converter*
2	0515-1079	14	Screws
3	0515-0886	11	Screw-M3.0 6PCPNPDS
4	5001-5875	1	Insulator-Power Control Bd
5	70904-00008	1	Bracket-Core
6	8160-0494	1	Gasket-D Strip Hol
7	70907-20037	1	Residual Suppressor
8	3050-0894	1	Washer-Flat M5.0ID

*Gasket material (HP part number 8160-0495) must be inserted into slots in the Converter Cover.

Figure 7-8. HP 70907A and HP 70907B Module Parts ID, Left-Side Views

8

Major Assembly and Cable Locations

Introduction

This chapter is divided into two separate sections: one for the HP 70907A and one for the HP 70907B. Each section contains the following module-specific information:

- A table identifying the module's assemblies and cables.
- A figure showing the locations of the module's major assemblies and cables.
- A figure showing the module's front- and rear-panel "J" designations (as identified on the overall block diagram or schematics).

Caution The HP 70907A/B module contains assemblies that can be damaged by electrostatic discharge. All work performed on the HP 70907A/B should be done at a static-safe work station. Refer to "Electrostatic Discharge Information" in Chapter 1.

HP 70907A Information

Table 8-1. HP 70907A Assemblies

Reference Designation	Assembly
A1	Miscellaneous Bias Board Assembly
A2	Calibration Source Board Assembly
A3	Last Converter Board Assembly
A4	Power Supply/Control Board Assembly
A5	Leveling Amplifier Assembly
A6	Isolator Assembly
A7	Front Panel Board Assembly
A8	Attenuator Assembly
K2	RF Switch Assembly
W1	IF Input Cable Assembly
W2	Last Converter Cable Assembly
W3	Attenuator Out Cable Assembly
W4	21.4 Out Cable Assembly
W5	21.4 In Cable Assembly
W6	321.4 Out Cable Assembly
W7	RF LO IN Cable Assembly
W8	RF LO OUT Cable Assembly
W9	RF LO AUX Cable Assembly
W10	Calibration Source Cable Assembly
W11	Front Panel Cable Assembly
W12	Converter Rear Cable Assembly
W13	ALC Control Cable Assembly
W14	Converter Front Cable Assembly
W15	HP-MSIB Flex assembly
W16	Mixer Bias Cable Assembly
W17	Tune Span Cable Assembly
W18	Adapter M SMA F SMA
W19	Adapter M SMA M SMA
W20	Attenuator In Cable Assembly
W24	K2 Wire Harness Assembly
W25	LO Amplifier Cable Assembly

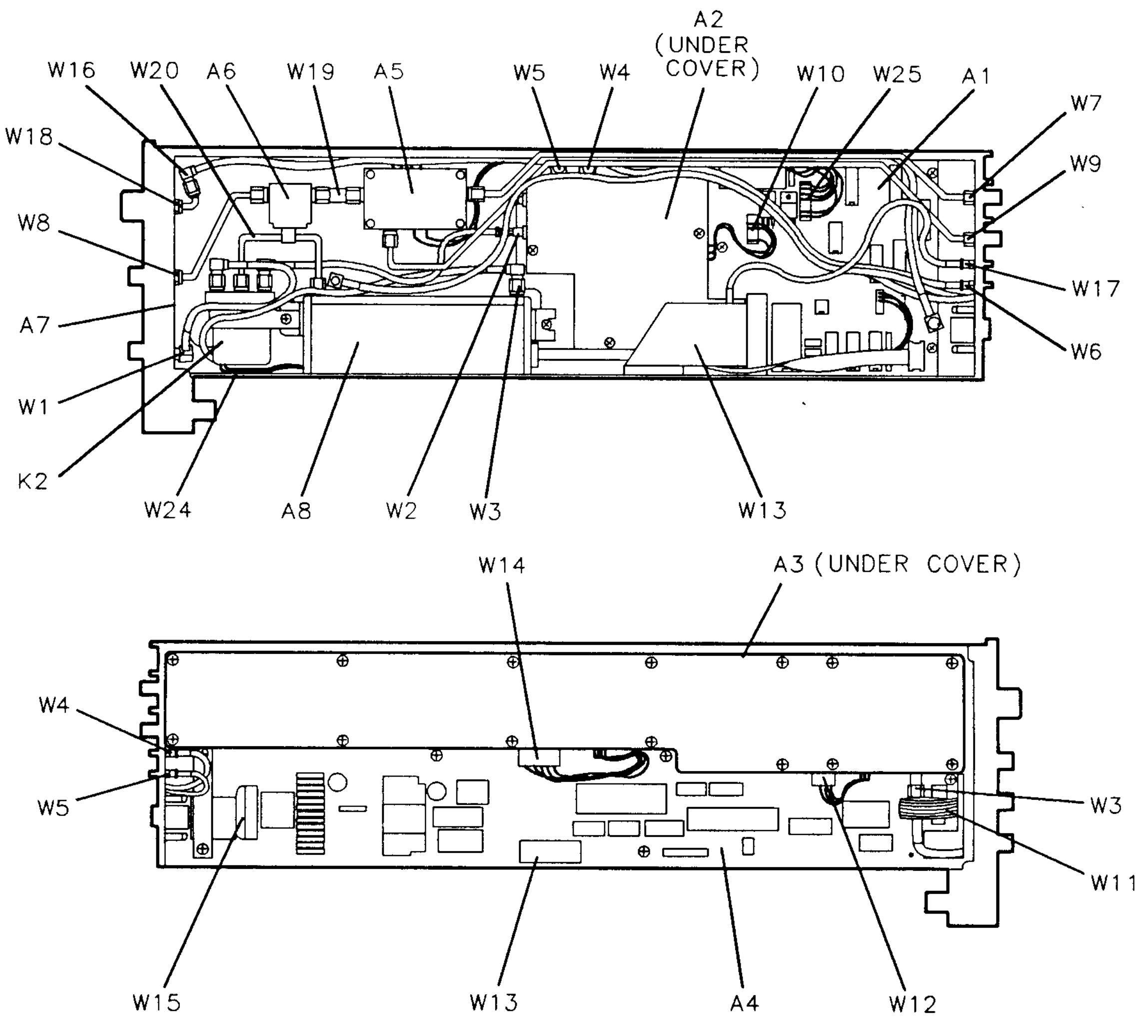


Figure 8-1. HP 70907A Major Assembly and Cable Locations

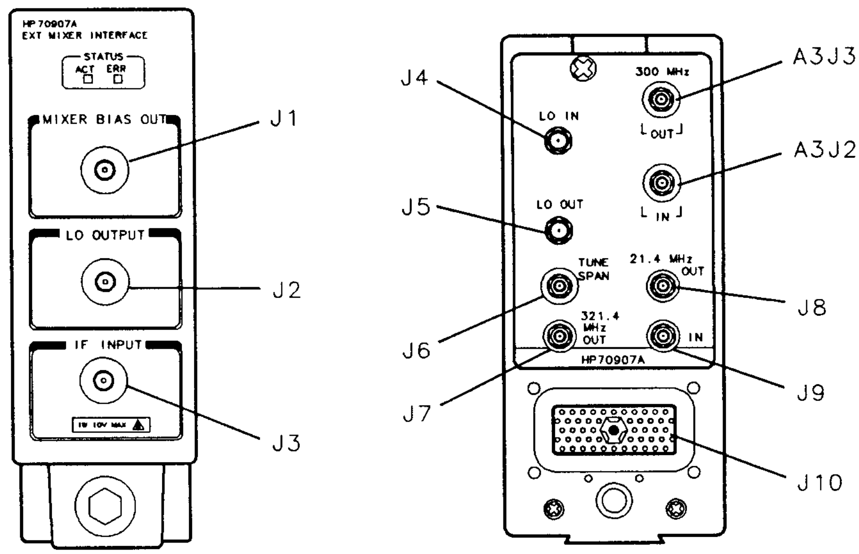


Figure 8-2. HP 70907A Front- and Rear-Panel Connector "J" Designations

HP 70907B Information

Table 8-2. HP 70907B Assemblies

Reference Designation	Assembly
A1	Miscellaneous Bias Board Assembly
A2	Calibration Source Board Assembly
A3	Last Converter Board Assembly
A4	Power Supply/Control Board Assembly
A5	Leveling Amplifier Assembly
A6	Isolator Assembly
A7	Front Panel Board Assembly
A8	Attenuator Assembly
K2	RF Switch Assembly
W1	IF Input Cable Assembly
W2	Attenuator In Cable Assembly
W3	Attenuator Out Cable Assembly
W4	21.4 Out Cable Assembly
W5	21.4 In Cable Assembly
W6	321.4 Out Cable Assembly
W7	RF LO IN Cable Assembly
W8	Leveling Amplifier LO OUT Cable Assembly
W9	RF LO AUX Cable Assembly
W10	Calibration Source Cable Assembly
W11	Front Panel Cable Assembly
W12	Converter Rear Cable Assembly
W13	ALC Control Cable Assembly
W14	Converter Front Cable Assembly
W15	HP-MSIB Flex assembly
W16	Mixer Bias Cable Assembly
W17	Tune Span Cable Assembly
W18	Preselected Tune Span Wire Harness Assembly
W19	Adapter M SMA M SMA
W20	Calibration Source LO Input Cable Assembly
W21	LO OUTPUT Cable Assembly
W22	ATTEN DRIVE IN Ribbon Cable Assembly
W23	K2 Wire Harness Assembly
W24	LO Amplifier Cable Assembly

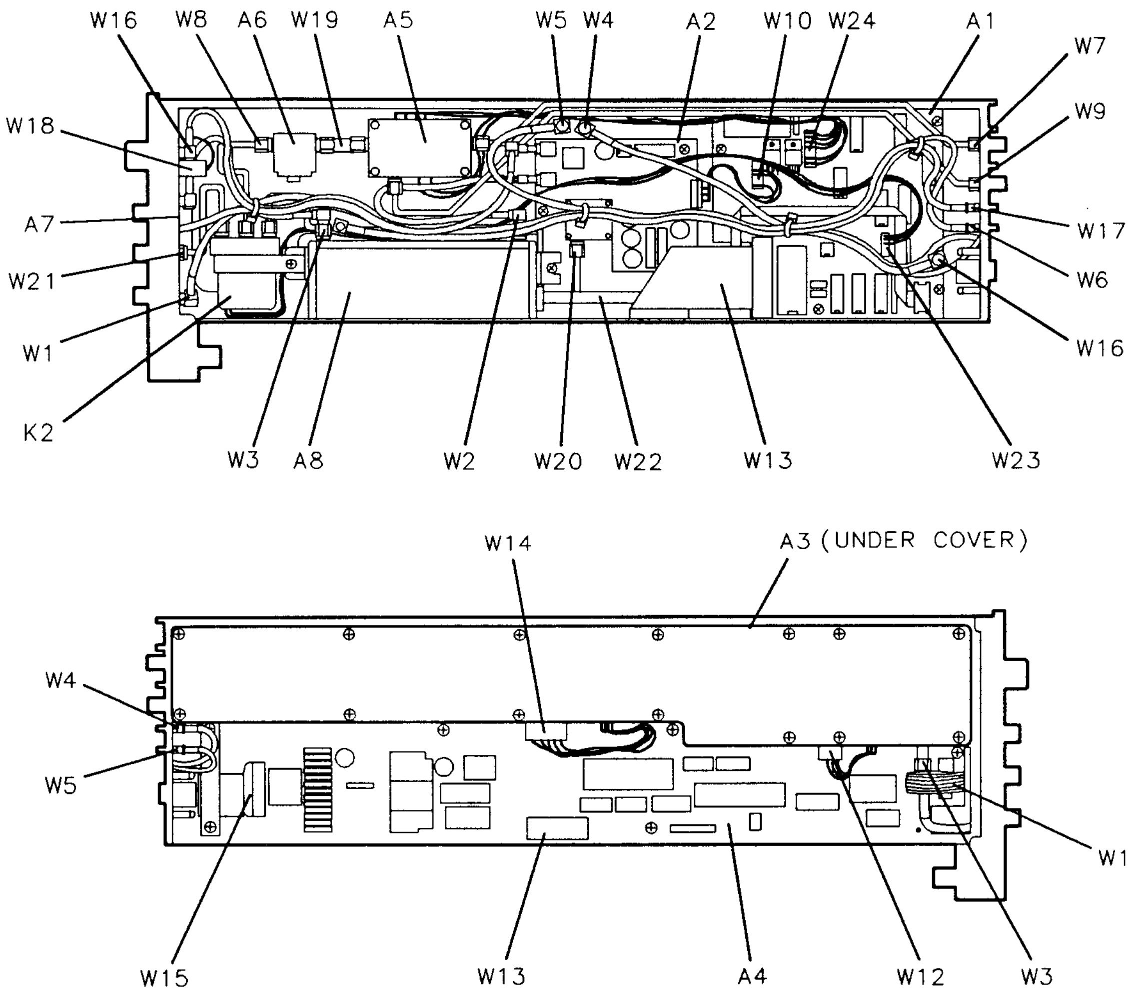


Figure 8-3. HP 70907B Major Assembly and Cable Locations

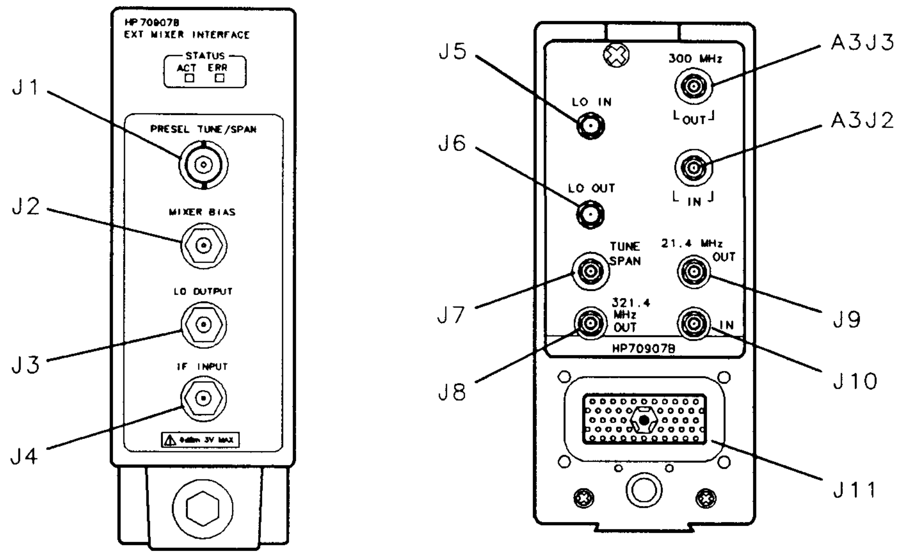


Figure 8-4. HP 70907B Front- and Rear-Panel Connector "J" Designations

A

Component-Level Information Packets

Component-level information is available for selected repairable instrument assemblies. The information for each repairable assembly is provided in the form of Component-Level Information Packets (CLIPs). Each CLIP contains a parts list, component-location diagram, and schematic diagram. Tables A-1 and A-2 identify which instrument assemblies have CLIPs and give the HP part numbers for the CLIPs. The HP part number of a CLIP is changed whenever the HP part number for its related instrument assembly is changed.

Updated or replacement CLIPs may be ordered through your local Hewlett-Packard Sales or Service office using the CLIP part number.

A complete, current set of CLIPs can be obtained by ordering the *HP 70907A/B Component-Level Information* set, HP part number 70907-90033. The current set of CLIPs contains only those CLIPs that support the latest version of instrument assemblies.

Note

CLIPs may not be available for recently introduced assemblies.

CLIPs are packaged in protective plastic envelopes. To use and store your CLIPs effectively, the following accessories are available:

1-1/2 inch CLIP binder (for fewer than 15 packets) .... HP part number 9282-1132
2 inch CLIP binder (for 15 to 25 packets) .... HP part number 9282-1133
2-1/2 inch CLIP binder (for 25 to 30 packets) .... HP part number 9282-1134

Table A-1.
HP 70907A Board Assembly, Serial Number, and CLIP Part Number Cross-Reference

Assembly	Module Serial Prefix	Board Assembly Part Number	CLIP Part Number
A1 Miscellaneous Bias Board Assembly	2932A	70907-60036	70907-90036
A2 Calibration Source Board Assembly	2932A	70907-60038	70907-90037
A3 Last Converter Board Assembly	2932A	70907-60004	70907-90035
A4 Power Supply/Control Board Assembly	2932A	70907-60047	70907-90042
A7 Front Panel Board Assembly	2932A	70907-60039	70907-90038

Table A-2.
HP 70907B Board Assembly, Serial Number, and CLIP Part Number Cross-Reference

Assembly	Module Serial Prefix	Board Assembly Part Number	CLIP Part Number
A1 Miscellaneous Bias Board Assembly	2945A	70907-60036	70907-90036
A2 Calibration Source Board Assembly	2945A	70907-60040	70907-90039
A3 Last Converter Board Assembly	2945A	70907-60004	70907-90035
A4 Power Supply/Control Board Assembly	2945A	70907-60045	70907-90040
A7 Front Panel Board Assembly*	2945A	70907-60046	70907-90041
A7 Front Panel Board Assembly	3018A	70907-60059	70907-90047
* Not included when ordering complete CLIP set (70907-90033).			

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