

Installation and Verification Manual

HP 70310A

Precision Frequency Reference



HP Part No. 70310-90059
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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 product or the user's work. 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 to the user. Do not proceed beyond a *WARNING* sign until the indicated conditions are fully understood and met.

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

General Safety Considerations

- WARNING**
- The instructions in this document are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.
 - The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.
 - The power cord is connected to internal capacitors that may remain live for five seconds after disconnecting the plug from its power supply.
 - This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.
 - For continued protection against fire hazard, replace fuse only with same type and ratings, (type nA/nV). The use of other fuses or materials is prohibited.
-

- 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.
 - 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.
-

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General Information

Introduction

The *HP 70310A Installation and Verification Manual* contains information needed to install and verify the HP 70310A Precision Frequency Reference. For information on installing and verifying HP 70000 Modular Measurement Systems, refer to the Installation and Verification Manual for the system master (for example, HP 70900A Local Oscillator).

This manual contains the following five chapters:

- Chapter 1, “General Information,” describes the module and its accessories, gives electrostatic discharge and packaging information, and lists Hewlett-Packard Sales and Service Offices.
- Chapter 2, “Installation,” provides information for configuring and installing the module in an HP 70000 Modular Measurement System, or as a separate frequency reference.
- Chapter 3, “Specifications,” lists module specifications and characteristics.
- Chapter 4, “Verification,” contains information about the tests needed to verify module specifications, and provides a procedure for adjusting the module’s internal oven/oscillator.
- Chapter 5, “Troubleshooting,” explains the most probable causes of the front-panel status/error LEDs’ lighting, and lists the error codes that can be generated by the HP 70310A module.

Manual Conventions

The following descriptions are used throughout this manual:

Keys physically on an instrument are represented in the following way:

Key **KEY**

Softkeys, keys defined by software or firmware, are represented in the following way:

Softkey **softkey**

Text that appears on the CRT is represented in the following way:

Screen text screen text

Module Description

The HP 70310A Precision Frequency Reference is a 1/8-width module designed to plug into HP 70000 Modular Measurement System mainframes. The HP 70310A module provides 10 MHz and 100 MHz precision reference signals for use by HP 70000 Modular Measurement Systems and other instruments. The HP 70310A functions either by itself, as a separate frequency reference, or as a slave to an HP 70000 Modular Measurement System master element such as the HP 70900A Local Oscillator. When the HP 70310A is configured as a slave, it is controlled by the master element.

Module Options

The HP 70310A Precision Frequency Reference has the following module options:

- Option W30** adds 2 years to the standard 1 year return to Hewlett-Packard service warranty.
- Option 001** adds two distribution amplifiers that accept inputs of 5 MHz to 300 MHz. Each distribution amplifier has one input and three outputs.
- Option 002** deletes the HP 70310A module's internal oven/oscillator and the external power pack accessory. HP 70310A Option 002 modules must be connected to an external-reference signal of 1, 2, 5, or 10 MHz to operate.
- Option 910** adds another set of the manuals that normally ship with the module.
- Option 915** adds the module service documentation and module verification software.

Safety Considerations

Before operating this module, familiarize yourself with any safety markings on the module and the safety instructions in this manual. This module has been manufactured and tested according to international safety standards. However, to ensure safe operation of the module and personal safety of the user and service personnel, the cautions and warnings in this manual must be followed. Refer to the summary of safety considerations at the front of this manual.

Modules Covered by Manual

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 serial number prefix; the last five digits are the suffix. See Figure 1-1. The prefix is the same for all identical modules; it only changes when a change is made to the module. The suffix, however, is assigned sequentially and is different for each module. The contents of this manual apply to modules with the serial number prefixes listed under "Serial Numbers" on the manual title page.



Figure 1-1. Typical Serial Number Label

Manual Updating Supplement

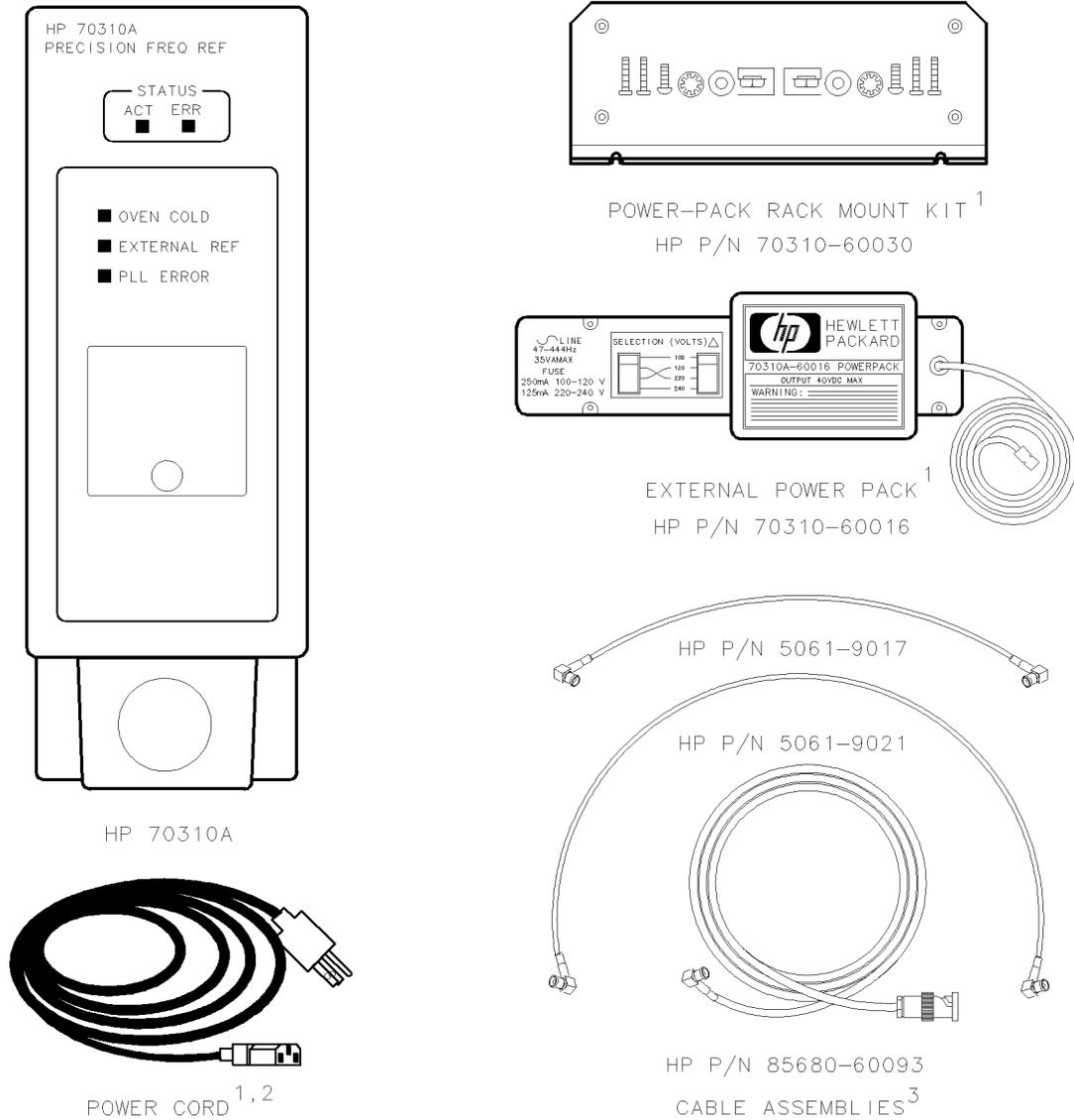
A module manufactured after this manual was printed may have a serial number prefix other than that listed under “Serial Numbers” on the manual title page. This unlisted serial prefix means that changes have been made to the module since the manual was printed.

Any changes that affect this manual are documented in the Manual Updating Supplement for this manual. The Manual Updating Supplement may also contain information for correcting errors in the manual. To keep the manual as current and accurate as possible, periodically request the latest Manual Updating Supplement for this manual from your nearest Hewlett-Packard Sales and Service office.

Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the module has been checked mechanically and electrically. Refer to the accessory information on the following pages to find out what is shipped with the HP 70310A Precision Frequency Reference.

If the shipping contents are not complete, or the module does not pass the procedures in Chapter 4, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier’s inspection. The Hewlett-Packard office will arrange for repair or replacement without waiting for claim settlement.



- 1 These items are not supplied with HP 70310A Option 002 modules.
- 2 The power cord supplied is appropriate for the country that the instrument is shipped to. For the part number of the specific power cord shipped with your instrument, refer to the Installation and Verification Manual for the system master (e.g., HP 70900A).
- 3 These items are not supplied when the module is ordered configured in a system.

Figure 1-2. HP 70310A Module with Accessories

Accessories

The HP 70310A Precision Frequency Reference may be ordered separately or as part of a preconfigured HP 70000 Modular Measurement System. Figure 1-2 shows the HP 70310A module and the accessories that may be shipped with it.

Front and Rear-Panel Features

Figure 1-3 shows the HP 70310A module's front- and rear-panel features.

Front-Panel Status and Error LEDs

All of the front-panel LEDs flash on, then off again, during the module's self-test. Listed below are the other reasons for each LED to light. For troubleshooting information, refer to Chapter 5.

ACT (Active) LED

The ACT LED lights when the module is activated by an HP 70000 Modular Measurement System master (for example, HP 70900A).

ERR (Error) LED

The ERR LED lights when an error condition exists.

OVEN COLD LED

The OVEN COLD LED lights when the internal oven/oscillator assembly is not warmed up to operating temperature. The OVEN COLD LED is not used in HP 70310A Option 002 modules (internal oven/oscillator assembly deleted).

EXTERNAL REF (Reference) LED

The EXTERNAL REF LED lights when an appropriate external-reference signal is being injected into the rear-panel EXT REF input.

PLL ERROR (Phase-Lock-Loop Error) LED

The PLL ERROR LED lights when the (internal or external) reference signal is either absent or incorrect. An external-reference signal *must* be used with HP 70310A Option 002 modules.

Oscillator Adjustment Door

The oscillator adjustment door is removed to allow the internal oven/oscillator to be calibrated.

Module Latch

When the module is being installed in or removed from an HP 70000 Modular Measurement System mainframe, an 8 mm hex-ball driver is used to turn the module latch.

Rear-Panel Inputs and Outputs

A 1 OUT, A 2 OUT, and A 3 OUT

These distribution-amplifier outputs are only present in HP 70310A Option 001 modules. The output signals are approximately 0 dBm, and are leveled and isolated versions of the signal being injected into A IN.

B 1 OUT, B 2 OUT, and B 3 OUT

These distribution-amplifier outputs are only present in HP 70310A Option 001 modules. The output signals are approximately 0 dBm, and are leveled and isolated versions of the signal being injected into B IN.

A IN

This distribution-amplifier input is only present in HP 70310A Option 001 modules. The signal injected at A IN is leveled and distributed to the A outputs (A 1 OUT, A 2 OUT, and A 3 OUT). The input signal must be from 5 to 300 MHz in frequency, with a power level of -4 to $+4$ dBm.

B IN

This distribution-amplifier input is only present in HP 70310A Option 001 modules. The signal injected at B IN is leveled and distributed to the B outputs (B 1 OUT, B 2 OUT, and B 3 OUT). The input signal must be from 5 to 300 MHz in frequency, with a power level of -4 to $+4$ dBm.

100 MHz

This output supplies a stable frequency-reference signal for use by HP 70000 Modular Measurement Systems.

EXT PWR

The external power pack is plugged into this input. The external power pack supplies power for the heater in the internal oven/oscillator while the system power is turned off.

The EXT PWR input is not present on HP 70310A Option 002 modules (no internal oven/oscillator).

10 MHz

This output supplies a stable frequency-reference signal.

EXT REF

This input allows the use of an external-reference signal. The external-reference input signal can have a frequency of 1, 2, 5, or 10 MHz, and a power range of -5 to $+21$ dBm. TTL signal levels are acceptable. Refer to Chapter 3 for external-reference input specifications.

When an acceptable external-reference signal is applied to the EXT REF input, the module automatically switches to the external reference.

HP 70310A Option 002 modules *must* have an external-reference signal supplied. (HP 70310A Option 002 modules do not have an internal oven/oscillator.)

Mainframe/Module Interconnect

This multiple-pin connector plugs into the mainframe and provides the power supplies and Hewlett-Packard Modular System Interface Bus (HP-MSIB) for the module.

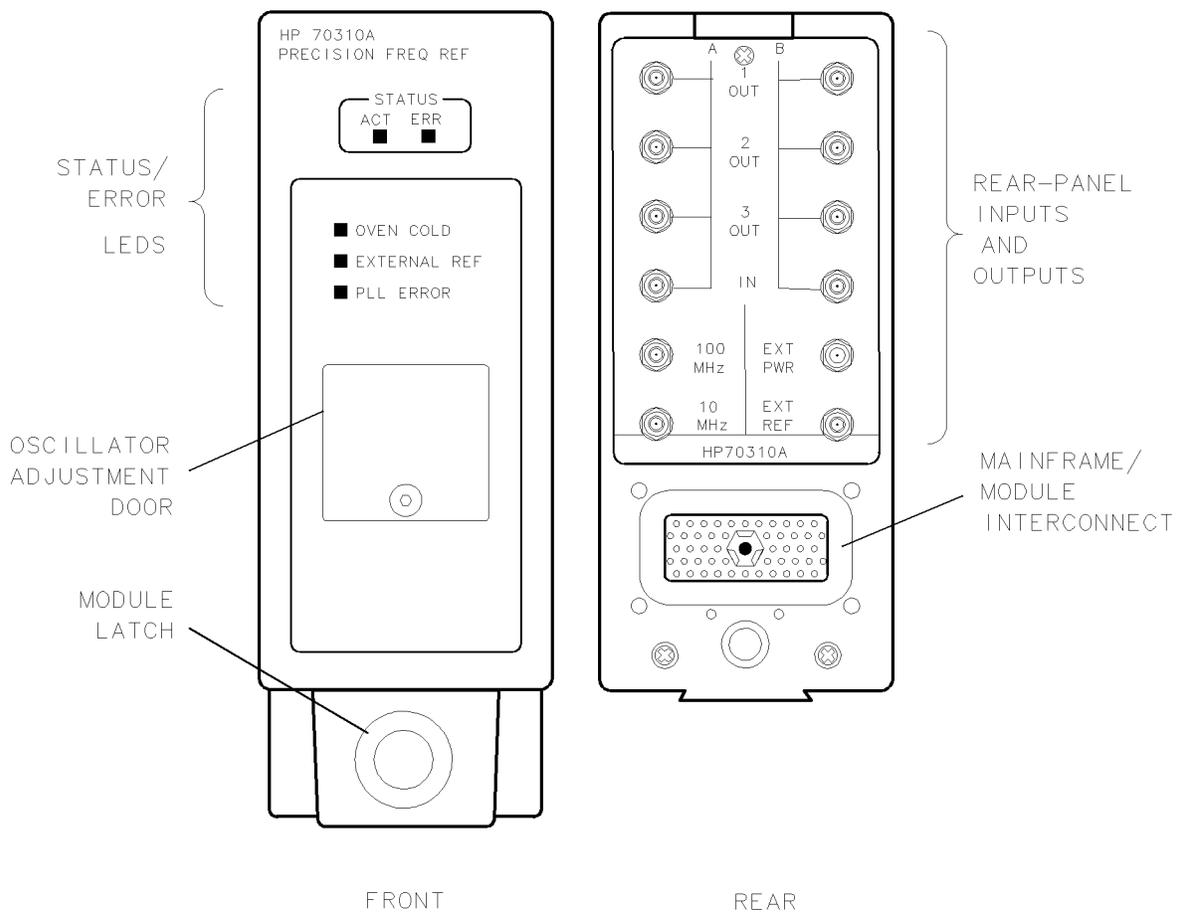


Figure 1-3. HP 70310A Module's Front- and Rear-Panel Features

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 1-4 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 1-1 for a list of static-safe accessories and their part numbers.

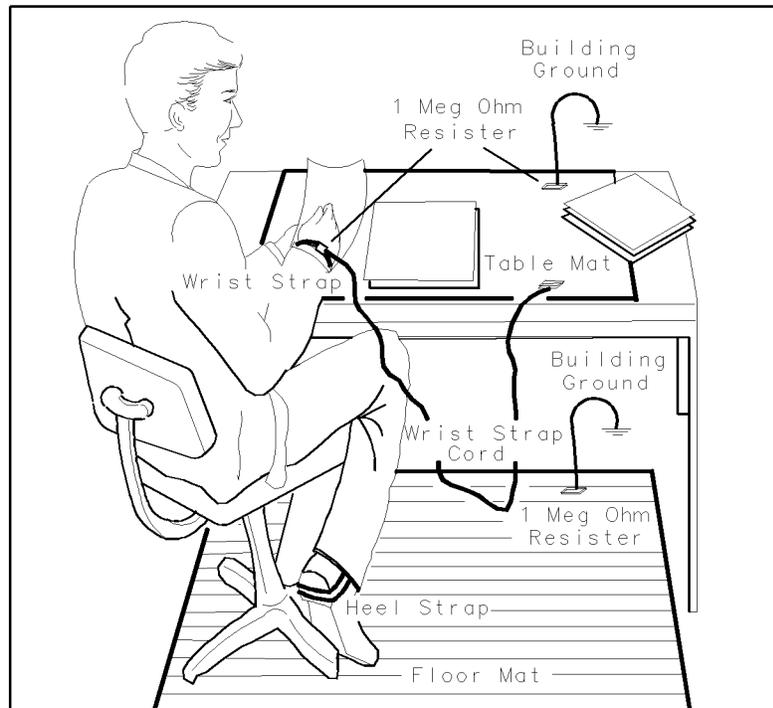


Figure 1-4. Static-Safe Work Station

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.
-

Caution Do *not* short the coaxial cable from the external power pack. Instrument damage can result.

- 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 1-1. 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, 4.6m (15 ft) (The wrist strap and wrist-strap cord are <i>not</i> 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 <i>not</i> 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 russet color	92176A
		92176C
	Large, 1.2m × 2.4m (4 ft × 8 ft) natural color russet color	92176B
		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 sales and service offices provide 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 1-2.

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

**Table 1-2.
Hewlett-Packard Spectrum Analyzer Sales and Service Offices**

IN THE UNITED STATES California	IN AUSTRALIA Hewlett-Packard Australia Ltd.	IN JAPAN Yokogawa-Hewlett-Packard Ltd.
Hewlett-Packard Co. 1421 South Manhattan Ave. P.O. Box 4230 Fullerton, CA 92631 (714) 999-6700	31-41 Joseph Street Blackburn, Victoria 3130 895-2895	29-21 Takaido-Higashi, 3 Chome Suginami-ku Tokyo 168 (03) 331-6111
Hewlett-Packard Co. 301 E. Evelyn Mountain View, CA 94039 (415) 694-2000	IN CANADA Hewlett-Packard (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 (514) 697-4232	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
Colorado Hewlett-Packard Co. 24 Inverness Place, East Englewood, CO 80112 (303) 649-5000	IN FRANCE Hewlett-Packard France F-91947 Les Ulis Cedex Orsay (6) 907-78-25	IN SINGAPORE Hewlett-Packard Singapore Pte. Ltd. 1150 Depot Road Singapore 0410 273 7388 Telex HPSGSO RS34209 Fax (65) 2788990
Georgia Hewlett-Packard Co. 2000 South Park Place P.O. Box 105005 Atlanta, GA 30339 (404) 955-1500	IN GERMAN FEDERAL REPUBLIC Hewlett-Packard GmbH Vertriebszentrale Frankfurt Berner Strasse 117 Postfach 560 140 D-6000 Frankfurt 56 (0611) 50-04-1	IN TAIWAN Hewlett-Packard Taiwan 8th Floor, Hewlett-Packard Building 337 Fu Hsing North Road Taipei (02) 712-0404
Illinois Hewlett-Packard Co. 5201 Tollview Drive Rolling Meadows, IL 60008 (312) 255-9800	IN GREAT BRITAIN Hewlett-Packard Ltd. King Street Lane Winnersh, Wokingham Berkshire RG11 5AR 0734 784774	IN ALL OTHER LOCATIONS Hewlett-Packard Inter-Americas 3495 Deer Creek Rd. Palo Alto, California 94304
New Jersey Hewlett-Packard Co. 120 W. Century Road Paramus, NJ 07653 (201) 265-5000	IN OTHER EUROPEAN COUNTRIES Hewlett-Packard (Schweiz) AG Allmend 2	
Texas Hewlett-Packard Co. 930 E. Campbell Rd. Richardson, TX 75081 (214) 231-6101	CH-8967 Widen (Zurich) (0041) 57 31 21 11	

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 office.

Figures 1-5 and 1-6 show the packaging materials. When ordering packaging materials to ship modules, it is necessary to order the proper number of foam inserts. No foam inserts are required for a 3/8-width module such as the HP 70205A Graphics Display. One foam insert is required for a 2/8-width module such as the HP 70900A Local Oscillator. Two foam inserts are required for a 1/8-width module such as the HP 70902A IF Section.

Caution Instrument damage can result from using packaging materials other than those specified. 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:

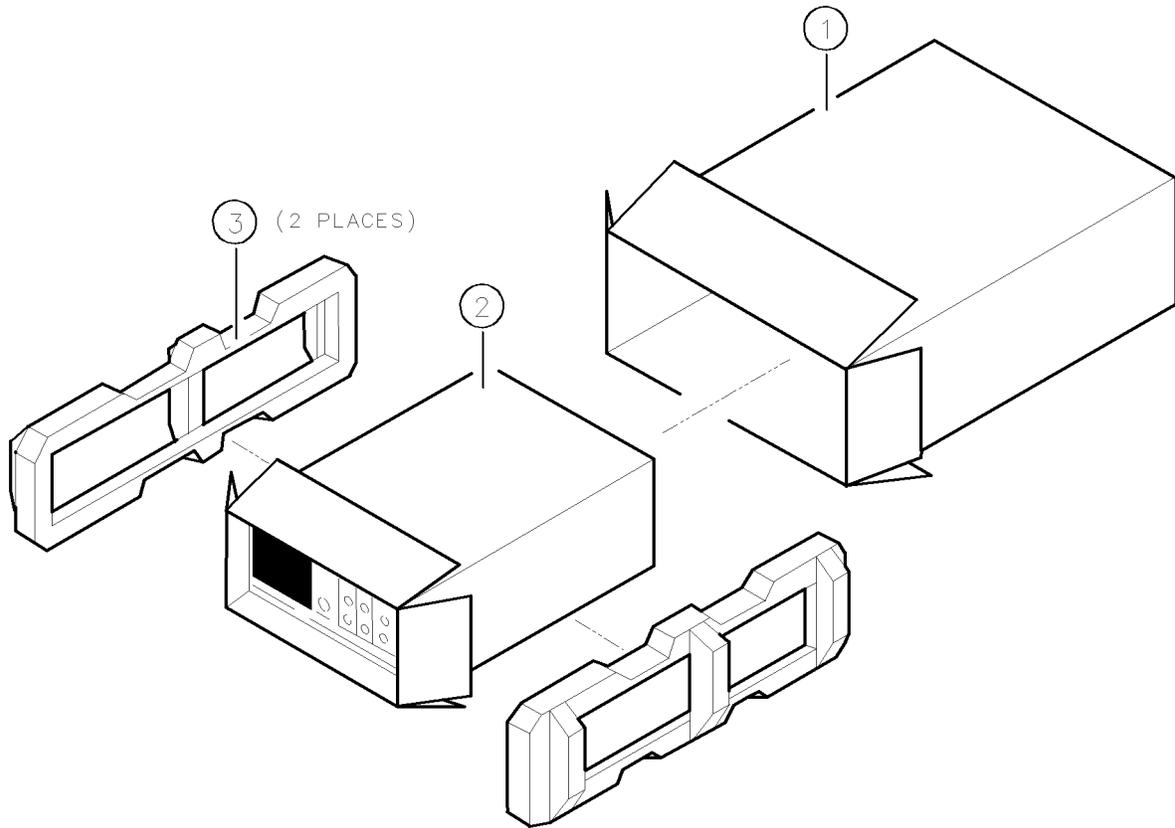
1. Fill out a blue repair card (located at the end of this manual) and attach it to the instrument. If you have recorded any error messages or have any other specific data on the performance of the instrument, also send a copy of this information with the instrument. If a blue repair card is *not* available, make sure the following information is sent 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 appropriate packaging materials. (See Figures 1-5 and 1-6.) Original shipping materials or the equivalent should be used. However, if the original shipping materials are not available and equivalent materials cannot be ordered, instruments can be repackaged for shipment using the following instructions.

Caution Inappropriate packaging of instruments may result in damage to the instruments during transit.

- a. Wrap the instrument in anti-static plastic to reduce the possibility of damage caused by ESD.
- 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 looks like 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.

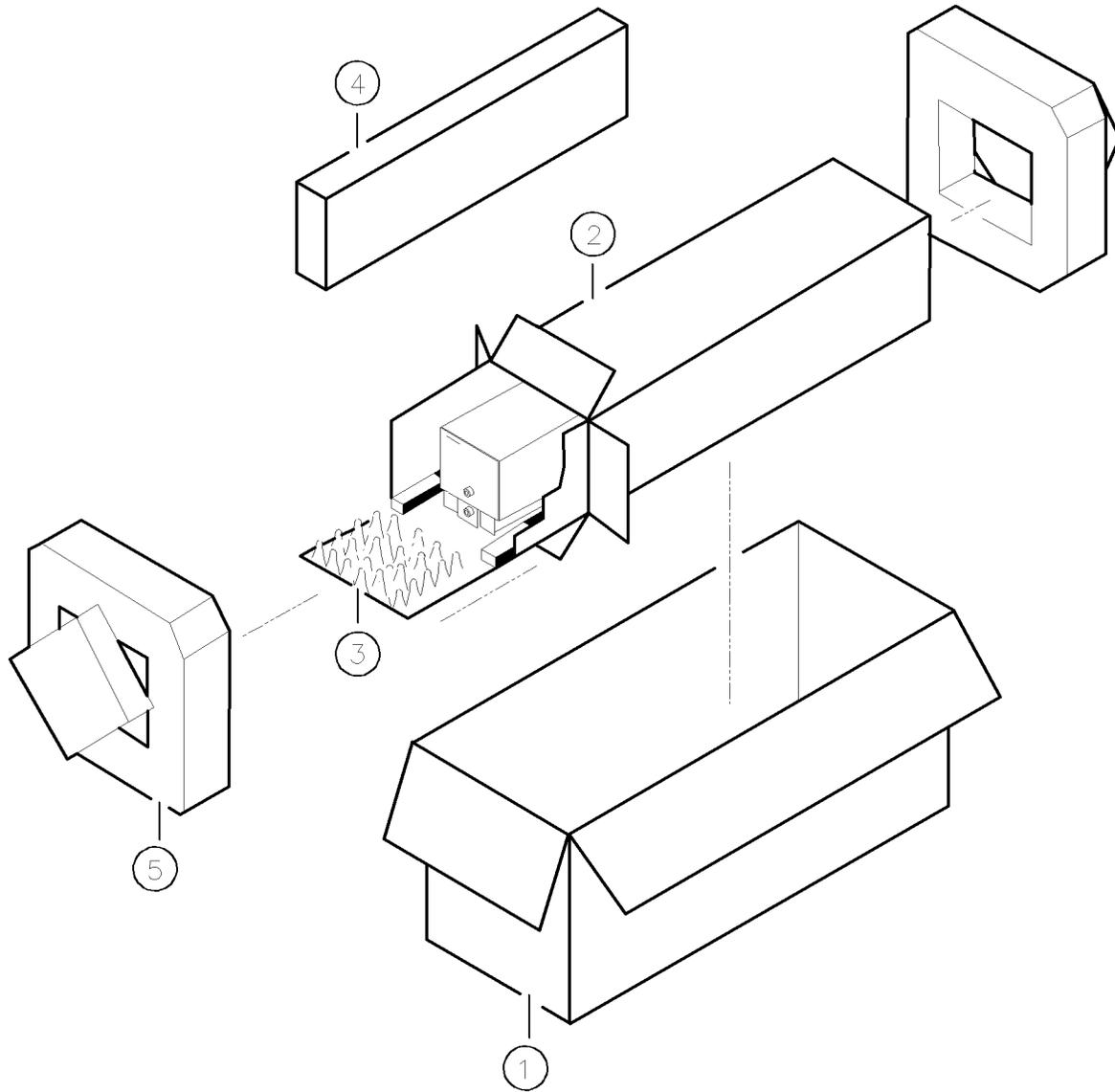


Item	HP Part Number	CD	Qty	Description
1	9211-4487	3	1	Carton-Outer
2	5180-2321	9	1	Carton-Inner
3	5180-2319	5	2	Foam Pad*
	5180-7829	2	2	Foam Pad†

*This is used for packaging the HP 70001A.
 †This is used for packaging the HP 70206A.

&sigspace;

Figure 1-5. Packaging Materials for Mainframe



Item	HP Part Number	CD	Qty	Description
1	9211-5118	9	1	Carton-Outer
2	9211-5119	0	1	Carton-Inner
3	5180-2369	5	1	Carton-Slider
4	4280-0493	3	2	Foam Insert
5	5180-2370	8	2	Foam Pad

&sigspace;

Figure 1-6. Packaging Materials for Modules

Installation

Introduction

This chapter contains information needed to install the HP 70310A Precision Frequency Reference into an HP 70000 Modular Measurement System mainframe, and to check the basic operation of the module. Chapter 4 contains the tests needed to verify that the module meets its specifications.

The examples of addressing and cable connections in this chapter are for an HP 71210A Microwave Spectrum Analyzer system. For more detailed information about HP 70000 Modular Measurement System configuration and addressing, refer to the Installation and Verification Manual for the system master (for example, HP 70900A Local Oscillator).

To use the HP 70310A module as a separate frequency reference, refer to Chapter 1 for general information about the module's inputs and outputs, and to Chapter 3 for information about input requirements and output capabilities.

Installing the module in an HP 70000 Modular Measurement System requires the following steps:

1. Addressing the module.
2. Installing the external power pack (not done for HP 70310A Option 002 modules).
3. Installing the module into the mainframe.
4. Connecting the rear-panel cables.

Installing the module as a separate frequency reference (that is, not part of an HP 70000 Modular Measurement System) requires the following steps:

1. Installing the external power pack (not done for HP 70310A Option 002 modules).
2. Installing the module into the mainframe.
3. Connecting the appropriate rear-panel input and output cables.

When properly installed, the HP 70310A module obtains both power and interface-bus control through the module's rear-panel mainframe/module interconnect. After the module is installed, use the information in "Checking Module Operation" to make sure that the module has been properly installed and is not faulty.

Addressing the Module

The HP 70310A module needs an appropriate Hewlett-Packard Modular System Interface Bus (HP-MSIB) address to be able to communicate with the master of the HP 70000 Modular Measurement System. The HP 70310A module's HP-MSIB address is set using the module's ROW and COLUMN address switches.

Determining the HP-MSIB Address

The HP 70310A module has a factory-preset HP-MSIB address of 7, 19 (row 7, column 19). Figure 2-1 shows the address map for an HP 71210A system. The addresses in this figure are the factory-preset addresses for the modules.

7			70310A PFR	
6		70908A RF SECT		
5				
4		70903A IF SECT		
3				
2		70902A IF SECT		
1				
0		70900A LO/CTLR HP-1B18		
	17	18	19	20

COLUMN

Figure 2-1. Address Map

If the HP 70310A module is going to be used in an HP 70000 Modular Spectrum Analyzer System where the modules all have their factory-preset addresses, the HP 70310A module probably will not need to have its factory-preset address changed. However, if the factory-preset addresses of the modules in the system have been changed, or if the HP 70310A module is being used in another type of HP 70000 Modular Measurement System, the HP 70310A module's factory-preset address may need to be changed.

Changing HP-MSIB addresses requires an understanding of HP-MSIB addressing rules. For information on determining and assigning HP-MSIB addresses, refer to the Installation and Verification Manual for the system master (for example, HP 70900A Local Oscillator).

Setting the HP-MSIB Address Switches

The HP 70310A module's address switches are located on the left side of the module. Table 2-1 gives the decimal value for each address switch when the switch is set to binary 1 (on).

Table 2-1. Decimal Equivalents of Row and Column Address Switches

Address Switch	Decimal Value
Row	
3*	4
2*	2
1*	1
Column	
5*	16
4	8
3	4
2*	2
1*	1
*These switches are factory-preset to binary 1 (on), resulting in an HP-MSIB address of 7, 19 (row 7, column 19).	

Use the procedure below to change the address switches:

1. Set the three ROW switches to the binary value of the module's HP-MSIB row number. For example, if the row number is 7, change the switches to binary 111 as shown in Figure 2-2.
2. Set the five COLUMN switches to the binary value of the module's HP-MSIB column number. For example, if the column number is 19, change the switches to binary 10011 as shown in Figure 2-2.

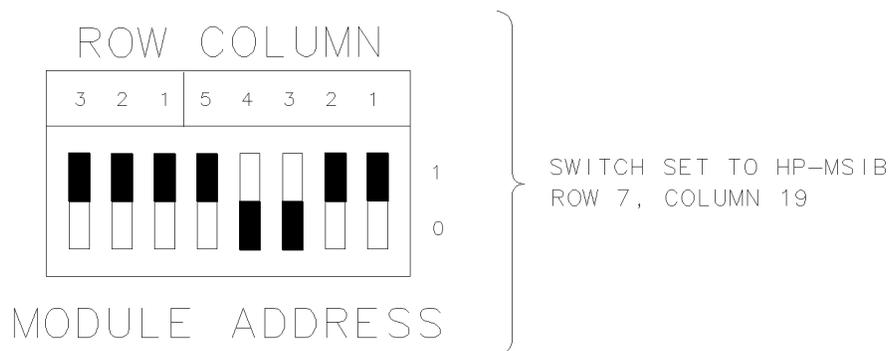
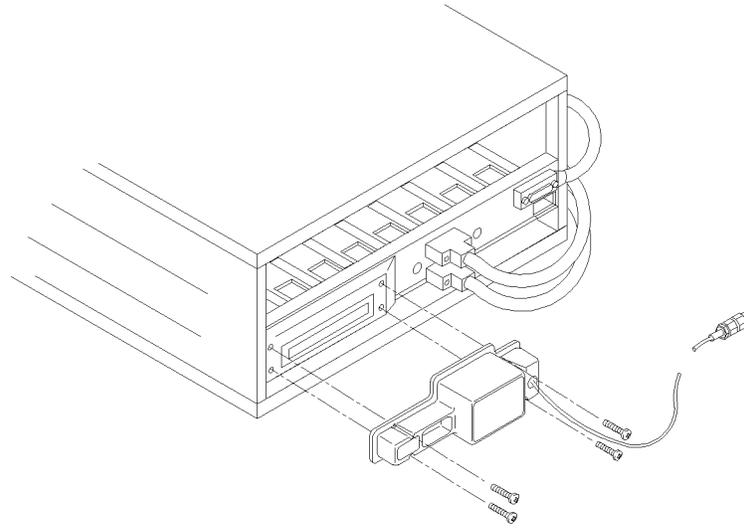
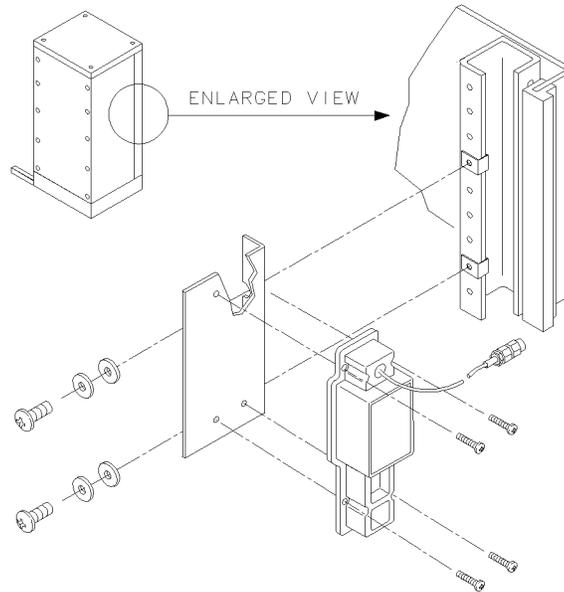


Figure 2-2. Address Switches



INSTALLATION ON A MAINFRAME



INSTALLATION ON AN EQUIPMENT RACK

Figure 2-3. External Power Pack Installation

Installing the External Power Pack

The external power pack provides power to the HP 70310A module to maintain the temperature in the module's internal oven/oscillator when the mainframe is turned off. An HP 70310A Option 002 module does not have an internal oven/oscillator and, therefore, does not need an external power pack.

Caution Install the HP 70310A module into the mainframe and connect the external power pack to the HP 70310A module *before* plugging the external power pack into the ac power source. If the external power pack is incorrectly connected its fuse can open, resulting in a 6015 Oven cold error at power-on. Refer to "Fuse Replacement" in this chapter for fuse location and replacement information.

The external power pack can be installed on the rear of the mainframe or on an equipment rack. For installation information, refer to Figure 2-3 or to the instructions shipped with the power-pack rack-mount kit.

Line Voltage Selector

The line voltage selector on the external power pack must be set to correspond with the voltage of the ac power source. For example, Figure 2-4 shows the line voltage selector set to 100 volts.

Caution The external power pack can be damaged if its line voltage selector is not set correctly *before* the external power pack is plugged into the ac power source.

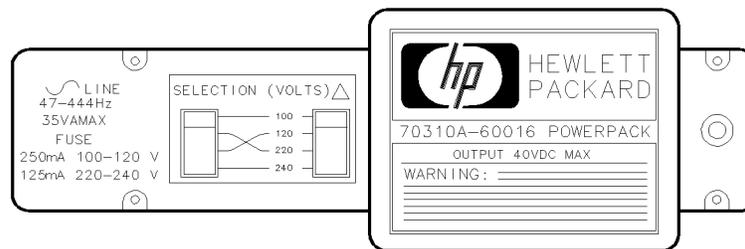


Figure 2-4. External Power Pack Line Voltage Selector

AC Power Source

The external power pack must be plugged into an appropriate ac power source before it will function. However, do not plug the external power pack into the ac power source until the HP 70310A module has been installed in the mainframe and the external power pack cable has been connected to the module's rear-panel EXT PWR connector.

In accordance with international safety standards, the external power pack is equipped with a three-wire ac power cable. When connected to an appropriate ac power receptacle, this cable grounds the external power pack.

The type of power cable shipped with the external power pack depends on the country of destination. If additional or different cables are needed, refer to the Installation and Verification Manual for the system master.

Warning Before plugging the external power pack into the ac power source, verify that the external power pack and the power cable are not damaged, and that the power-source socket outlet is provided with protective earth contact. Any interruption of the protective (grounding) conductor inside or outside of the external power pack, or disconnection of the protective earth terminal, can result in personal injury.

Fuse Replacement

The external power pack's line fuse, and a spare fuse, are located in the line cord receptacle housing on the left side of the external power pack. See Figure 2-5 for fuse removal and replacement information.

The fuse shipped with the external power pack depends on the line voltage used in the country of destination. Table 2-2 shows the fuse value and part number for the different line voltages.

Table 2-2. External Power Pack Fuses

Line Voltage	HP Part Number	CD	Description
100 V to 120 V	2110-0717	3	Fuse—glass 0.250 A 250 V MAX
220 V to 240 V	2110-0718	4	Fuse—glass 0.125 A 250 V MAX

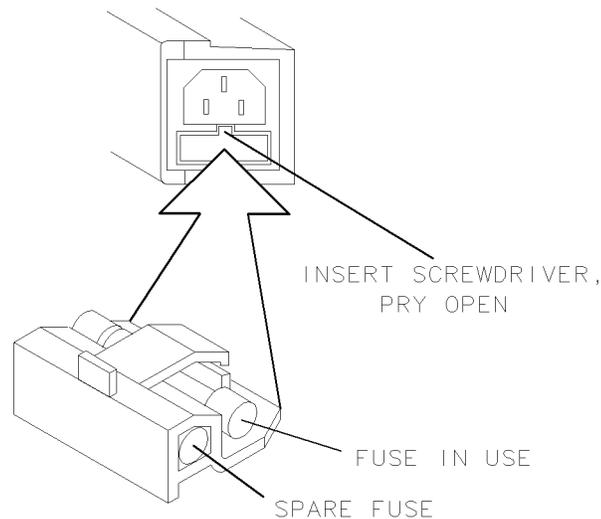


Figure 2-5. External Power Pack Fuse Removal and Replacement

Installing the Module in the Mainframe

The HP 70310A module needs to be installed in an HP 70000 Modular Measurement System mainframe before it will operate. Follow the procedure below to install the module into the mainframe. See Figure 2-6 for identification of the module and mainframe parts called out in the procedure.

1. Turn the mainframe LINE switch off.
2. Open the mainframe front-panel door.
3. Slide the module into the mainframe.
4. Press against the module front panel while tightening the module latch with an 8 mm hex-ball driver.
5. Close the mainframe front-panel door.

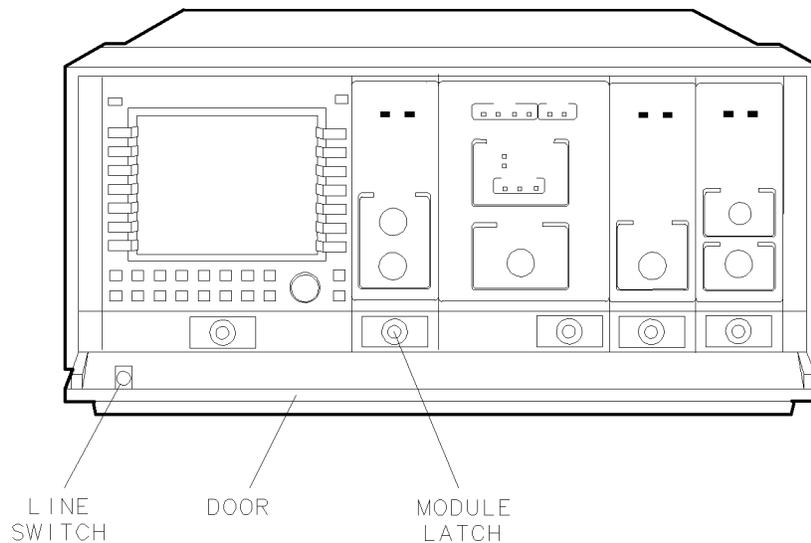


Figure 2-6. Module Installation in Mainframe

Connecting the Rear-Panel Cables

This section contains the following information:

- Instructions for connecting the HP 70310A standard module when it is used in an HP 71210A Microwave Spectrum Analyzer system, and a list of additional connections that are available for a standard module.
- Information about connecting HP 70310A Option 001 modules.
- Information about connecting HP 70310A Option 002 modules.

Refer to Chapter 3 for input and output specifications and characteristics.

HP 70310A Standard

Figure 2-7 shows the rear-panel connections of an HP 71210A system. The HP 70310A module shown in this example is a standard module that is using its internal oven/oscillator as the frequency reference.

HP 71210A System Connections

Follow the steps below to connect the HP 70310A module as shown in Figure 2-7:

1. Connect the external power-pack cable to the HP 70310A module's rear-panel EXT PWR connector.
2. Plug the external power-pack line cord into an appropriate ac power source.
3. Connect the HP 70310A module's 100 MHz output to the HP 70900A module's 100 MHz IN connector.

Other Configurations

In addition to the connections shown in Figure 2-7, a standard HP 70310A module has the following connections available:

- An external frequency-reference signal can be connected to the module's EXT REF input connector. If an external frequency-reference signal is connected, the module's internal frequency reference is automatically switched off.
- The module's 10 MHz output can be used to provide a stable 10 MHz reference frequency to another instrument.

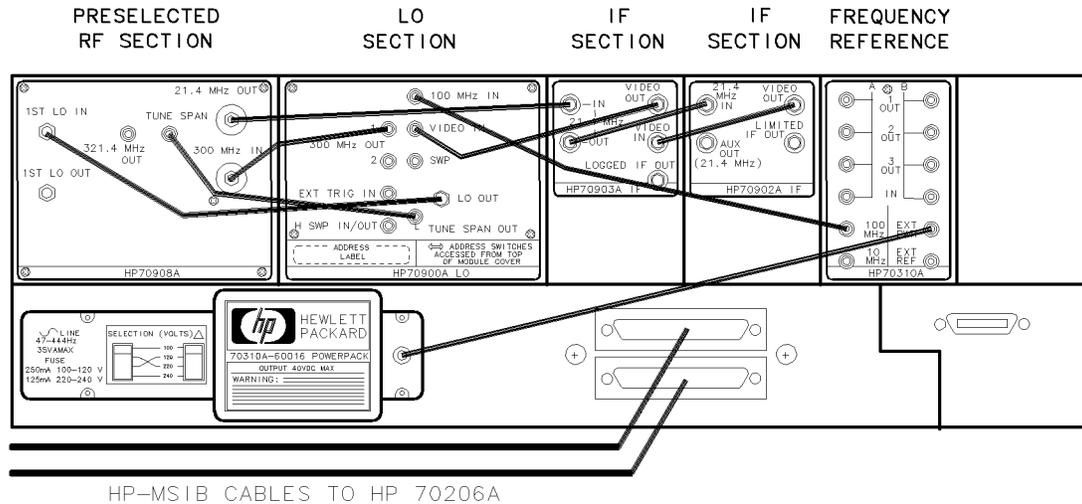


Figure 2-7. Cable Connection Example

HP 70310A Option 001

An HP 70310A Option 001 module has the features of a standard module, plus two distribution amplifiers. Each distribution amplifier has one input and three outputs.

HP 71210A System Connections

To use an HP 70310A Option 001 in an HP 71210A system, use the instructions given above for the standard module.

Other Configurations

The HP 70310A Option 001 module has the following connections available:

- A reference-frequency signal, with a frequency of 5 to 300 MHz, can be connected to the module's A IN connector. This provides three reference-frequency outputs: A 1 OUT, A 2 OUT, and A 3 OUT. These outputs will have the same frequency as the reference-frequency signal at A IN.
- A reference-frequency signal, with a frequency of 5 to 300 MHz, can be connected to the module's B IN connector. This provides three reference-frequency outputs: B 1 OUT, B 2 OUT, and B 3 OUT. These outputs will have the same frequency as the reference-frequency signal at B IN.
- The 100 MHz output supplies a stable frequency-reference signal for use by HP 70000 Modular Measurement Systems and other instruments.
- The external power pack can be connected to the EXT PWR input to maintain the temperature of the module's internal oven/oscillator when the mainframe is turned off.
- The module's 10 MHz output can be used to provide a stable 10 MHz reference frequency to another instrument.
- An external frequency-reference signal can be connected to the module's EXT REF input connector. If an external frequency-reference signal is connected, the module's internal frequency reference is automatically switched off.

HP 70310A Option 002

The HP 70310A Option 002 module does not have an internal oven/oscillator. The other module features are the same as the standard HP 70310A module.

HP 71210A System Connections

Follow the steps below to use an HP 70310A Option 002 module in an HP 71210A system:

1. Connect the HP 70310A module's 100 MHz output to the HP 70900A module's 100 MHz IN connector.
2. Connect an appropriate external frequency reference to the HP 70310A module's EXT REF connector. (Refer to Chapter 3 for external frequency-reference requirements.)

Note If the 6014 PLL error or 6016 No Freq Reference error codes are displayed at instrument power-up, make sure that an appropriate external frequency reference is connected to any HP 70310A Option 002 modules in the system.

Other Configurations

The HP 70310A Option 002 module has the following connections available:

- The module's 100 MHz output supplies a stable frequency-reference signal for use by HP 70000 Modular Measurement Systems and other instruments.
- The module's 10 MHz output can be used to provide a stable 10 MHz reference frequency to another instrument.
- An external frequency reference *must* be connected to the HP 70310A Option 002 module's rear-panel EXT REF connector.

Note HP 70310A Option 002 modules do not have an external power pack connected.

Checking Module Operation

The HP 70310A Precision Frequency Reference can be configured as a separate frequency reference (installed in an HP 70000 Modular Measurement System mainframe) or as a slave in an HP 70000 Modular Measurement System. Module-operation checks are given below for the following configurations:

- HP 70310A module used as a separate frequency reference.
- HP 70310A module used as a slave in an HP 70000 Modular Measurement System that has an HP 70900A Local Oscillator as the system master.

HP 70310A as a Separate Frequency Reference

The operation of the HP 70310A module as a separate frequency reference is verified by checking the results of the module's power-on self-test.

The results of the self-test can be determined by examining the status of the module's LEDs. An HP 70000 Modular Measurement System display can also be used to check for error messages.

Front-Panel LEDs

The power-on self-test runs automatically when power is first applied to the module. The listing below describes what the status of the LEDs should be immediately after the self-test has run.

- The ACT LED should be off.
- The ERR LED should be on if the oven/oscillator is still cold. The ERR LED may stay on when the OVEN COLD LED goes off. If this happens, cycling the power (turning the mainframe off, then quickly turning it on again) should result in the ERR LED going off. HP 70310A Option 002 modules should *not* have the ERR LED go on.
- The OVEN COLD LED should be on if the oven/oscillator is still cold. This LED should go off approximately fifteen minutes after power-on if the module was stored at room temperature. HP 70310A Option 002 modules should *not* have the OVEN COLD LED go on.
- The EXTERNAL REF LED should be off if the internal frequency reference is being used. The EXTERNAL REF LED should go on when an appropriate external reference is connected to the HP 70310A module.
- The PLL ERROR LED should be off.

Checking for Error Messages

If the HP 70310A module's ERR LED remains on, an HP 70000 Modular Measurement System display can be used to determine what error is occurring.

Note	Remove all master elements or systems from the HP-MSIB before using the following troubleshooting procedure. If there are any master elements or systems on the HP-MSIB when this procedure is performed, the system or master may cease communication and the procedure may not work.
-------------	--

Use the following troubleshooting procedure to find out what error conditions exist:

1. Remove the HP 70310A module from the mainframe.
2. Change the ROW address to 0 (binary 000).
3. Reinstall the module into the mainframe.
4. Connect a display to the HP-MSIB by installing a plug-in display into the mainframe or connecting a stand-alone display to the mainframe's HP-MSIB.
5. First press **DISPLAY**, then **REPORT ERRORS**.
6. Note the errors that are listed on the CRT, then refer to Chapter 5, "Troubleshooting," for more information about those errors. Change the ROW address back to 7 (binary 111) before doing more troubleshooting.

HP 70310A as a Slave in an HP 70000 Modular Spectrum Analyzer System

The operation of the HP 70310A module in an HP 70000 Modular Spectrum Analyzer system is verified by checking the results of the module's power-on self-test, and by making sure that the local oscillator in the system is using an external frequency reference.

The results of the self-test are determined by examining the front-panel LEDs and by checking for error messages.

To verify that the local oscillator is using an external frequency reference, the local oscillator is queried using an HP 70000 Modular Measurement System display or an HP 9000 Series 200 controller.

Front-Panel LEDs

The power-on self-test runs automatically when power is first applied to the module. The following listing describes what the status of the LEDs should be immediately after the self-test has run.

- The ACT LED should be on.
- The ERR LED should be on if the oven/oscillator is still cold. The ERR LED should go off when the OVEN COLD LED goes off. HP 70310A Option 002 modules should *not* have the ERR LED go on.
- The OVEN COLD LED should be on if the oven/oscillator is still cold. This LED should go off approximately fifteen minutes after power-on if the module was stored at room temperature. HP 70310A Option 002 modules should *not* have the OVEN COLD LED go on.
- The EXTERNAL REF LED should be off if the internal frequency reference is being used. The EXTERNAL REF LED should go on when an appropriate external reference is connected to the HP 70310A module.
- The PLL ERROR LED should be off.

Refer to Chapter 5, "Troubleshooting," if the LEDs' status is different than that listed above.

Checking for Error Messages: Spectrum Analyzer System with a Display

The procedure below is for use when the HP 70310A module is part of an HP 70000 Modular Measurement system that contains a display and has an HP 70900A Local Oscillator as the system master.

Perform this procedure to display any error messages present for the system, and to determine whether the local oscillator is using an internal or external frequency reference.

1. Press the **MENU** key.
2. The error messages for the system will be visible on the display screen. Note any error messages that have 70310A as part of the error code. While the HP 70310A module is warming up (for approximately fifteen minutes from power-on), the error message `Oven cold ERR 6015 70310A 7,19` may be displayed.

The last two numbers (7,19) are the module's HP-MSIB address, and will be different if the factory-preset address has been changed. With the external power pack installed, the HP 70310A module will not display the `Oven cold` error message after the internal oven/oscillator has warmed up. HP 70310A Option 002 modules will never display this error message.
3. If no other error messages are present for the HP 70310A module, proceed to the next step. If any error message other than the `Oven cold` message is displayed, refer to Chapter 5 for troubleshooting information.
4. If your HP 70900A has a firmware version of 870501 or earlier, press `instr display`, then `EXTEND STATE`.
5. If your HP 70900A has a firmware version of 880314 or later, press `misc`, `catalog`, and then `EXTEND STATE`.
6. Locate the reference to the HP 70900A Local Oscillator on the display's screen. If the reference is not displayed, press `Next Page` until the state screen with the reference to the HP 70900A Local Oscillator is found. If more than one HP 70900A is used, verify that the address displayed matches the address of the HP 70900A being used.
7. Verify that the HP 70900A Local Oscillator is using the HP 70310A module as its frequency standard by verifying that the statement `REF:EXTERNAL` is present.
8. If the above statement is not present, and module installation has been rechecked, refer to the information about addressing and error message reporting in the Installation and Verification Manual for the system master.

Checking for Error Messages: Spectrum Analyzer System with a Controller

The following procedure uses an external controller to query the system master (HP 70900A Local Oscillator) about whether it is using an internal or external frequency reference. An HP 70000 Series display does not have to be present in the system.

1. Connect an HP 9000 Series 200 controller (running HP BASIC 2.0, 3.0, or 4.0) to the system's HP-IB connectors.
2. Execute the following code to display the status of the local oscillator. In line 5 below, the local oscillator's HP-IB address is set to 718. If the factory-preset address has been changed, modify the code to reflect the current address.

```

5 LO_addr=718                !Set LO address
10 CLEAR Lo_addr            !Initialize analyzer HP-IB interface
15 OUTPUT Lo_addr;"IP;";    !Initialize analyzer
20 DIM Answer$(2400)        !Create ANSWER as variable for data
25 OUTPUT Lo_addr;"DSPTEXT EXTEND?;"; !Interrogate LO for extended state
30 ENTER Lo_addr USING "-K";Answers$ !Return data to ANSWER
35 FOR I=1 TO LEN(Answer$)
40 IF Answer$(I,I)=CHR$(10) THEN
45     PRINT""
50 ELSE
55     PRINT Answer$(I,I);      !Display data
60 END IF
65 NEXT I
70 CLEAR Lo_addr
75 OUTPUT Lo_addr;"IP"
80 END

```

3. Verify that the HP 70900A Local Oscillator is using the HP 70310A module as its frequency standard by verifying that the displayed status description includes the statement
REF:EXTERNAL.
4. If the status description of the local oscillator does not indicate the use of an external reference, and the installation has been rechecked, refer to the troubleshooting information in the Installation and Verification Manual for the system master.

Specifications

The following specifications apply to the HP 70310A Precision Frequency Reference. For system specifications, refer to the Installation and Verification Manual for the system master (for example, HP 70900A Local Oscillator).

Note Specifications and characteristics related to the internal oven/oscillator do *not* apply to HP 70310A Option 002 modules. Specifications and characteristics related to the distribution amplifiers apply *only* to HP 70310A Option 001 modules.

The following types of information are provided in this chapter:

- **Specifications** describe the warranted performance over the temperature range 0°C to 55°C (except where noted) after one hour of continuous operation.
- **Typical Performance**, where listed, is *not warranted*, but indicates performance which most units will meet.
- **Characteristics** provide useful information by giving functional, but nonwarranted, performance parameters.

Frequency Reference Error

Time-Dependent Error

per day (7-day average)	$<5 \times 10^{-10}$
per year	$<1 \times 10^{-7}$

Temperature-Dependent Error

0° C to +55° C	$<7 \times 10^{-9}$
----------------------	---------------------

The following warm-up time requirements must be met for the module to meet the frequency reference error specifications:

- >96 hours to meet frequency reference error specification after <24-hour off period.
- >30 days to meet frequency reference error specification after indefinite off period.
- >30 minutes to be within 1×10^{-7} of 24-hour warm-up frequency (at +25° C).

Inputs and Outputs

All connectors are SMB male except for the EXT PWR connector used for dc power input from the external power pack.

100 MHz Output

Power	0 dBm +3 dB, -2 dB
Harmonics (typical)	<-25 dBc
Spurious (typical)	<-115 dBc

10 MHz Output

Power	0 dBm +3 dB, -2 dB
Harmonics	<-20 dBc
Spurious	<-80 dBc

External Reference Input

Frequencies	1, 2, 5, or 10 MHz
Power Range	-5 to +15 dBm
Damage Level	1 watt (+30 dBm)
Impedance (<i>characteristic</i>)	50 Ω

System phase noise specifications can be met if the external-reference signal has the characteristics listed below:

External Reference Input Frequency	10 MHz
Phase Noise:	
10 Hz Offset	<-95 dBc/Hz
100 Hz Offset	<-125 dBc/Hz
1 kHz Offset	<-145 dBc/Hz
Spurious:	
<1 kHz Offset	<-135 dBc
\geq 1 kHz Offset	<-125 dBc

Distribution Amplifier Input

Frequency	10 to 300 MHz
(typical)	5 to 300 MHz
Power Range	\pm 4 dBm
Impedance (<i>characteristic</i>)	50 Ω

Distribution Amplifier Output

Power:	
<300 MHz	0 dBm \pm 2 dB
300 MHz	0 dBm \pm 1 dB
Impedance (<i>characteristic</i>)	50 Ω
VSWR (typical)	<1.5:1

Note The performance of the distribution amplifiers is acceptable to distribute both the 100 MHz and 300 MHz system references without degradation in system performance.

General

Temperature

Operation	0°C to +55°C
Storage	-40°C to +75°C

EMI

Conducted and radiated interference is in compliance with CISPR publication 11 (1975) and Messempfaenger-Postverfuegung 526/527/79 (Kennzeichnung Mit F-Nummer/Funkschutzzeichen). Radiated interference is in compliance with MIL-STD 461B, Part 7, RE02.

Warm-Up Time

This information is listed above under "Frequency Reference Error."

Weight

3.0 kg (6.6 lb) (*characteristic only*)

Dimensions

The HP 70310A is a 1/8-width module.

Power and Cooling Requirements

The power and cooling requirements of the HP 70310A module are provided by the HP 70000 Modular Measurement System mainframe.

An external power pack accessory is included with the HP 70310A module (except HP 70310A Option 002 modules). The external power pack mounts to the rear of the mainframe, and supplies dc power to maintain oven temperature when the mainframe is turned off. The external power pack requires a power source with the following characteristics:

Frequency	47 to 444 Hz
Voltage	100, 120, 220, or 240 V ac

Verification

Introduction

This chapter contains the following verification tests and adjustment procedure for the HP 70310A Precision Frequency Reference.

- External Reference Input Test
- 10 and 100 MHz Output Power Test
- 10 MHz Output Spurs Test
- 10 MHz Output Harmonics Test
- Distribution Amplifier Test
- Oscillator Adjustment

The tests are used to verify the specified performance of the HP 70310A module. The adjustment procedure is for the HP 70310A module's internal oven/oscillator. The adjustment is not used for HP 70310A Option 002 modules because they do not have internal oven/oscillators. Table 4-1 lists the equipment required for the verification tests.

Note To verify the performance of an HP 70000 Modular Measurement System, refer to the Installation and Verification Manual for the system master (for example, HP 70900A Local Oscillator).

Table 4-1. Equipment Required for Verification Tests

Equipment	Model or HP Part Number	Quantity Required
Local Oscillator	HP 70900A/B	1
Mainframe	HP 70001A	1
Spectrum Analyzer	HP 8566B	1
Synthesized Source	HP 8663A	1
Power Meter	HP 436A	1
Power Meter Sensor	HP 8482A	1
Adapters		
Type N (m) to BNC (f)	1250-0780	2
Type N (f) to Type N (f)	1250-1472	1
Type N (m) to SMB (m)	1250-0671	1
SMB (f) to SMB (f)	1250-0672	1
Cables		
BNC (m) to BNC (m)	HP 10503A	1
BNC (m) to SMB (f)	85680-60093	2

External Reference Input Test

Purpose

The purpose of this test is to verify the External Reference Input specifications.

Description

This test verifies that the HP 70310A module's output frequency remains stable for all specified external-reference input frequencies and power levels.

Equipment

Connect the 10 MHz OUTPUT from the rear panel of the synthesized source to the EXT FREQ REFERENCE input on the spectrum analyzer. Calibrate the power meter according to instructions in its Operating Manual. Then connect the calibrated power meter through a BNC to SMB cable to the RF OUTPUT of the synthesized source. Calibrate the spectrum analyzer according to instructions in its Operating Manual. Then connect the RF INPUT of the spectrum analyzer through a BNC to SMB cable to the 100 MHz output of the HP 70310A module (device under test or DUT). See Figure 4-1.

Local Oscillator	HP 70900A/B
Mainframe	HP 70001A
Spectrum Analyzer	HP 8566B
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Meter Sensor	HP 8482A

Adapters

Type N (m) to BNC (f) (<i>2 required</i>)	HP Part Number 1250-0780
Type N (f) to Type N (f)	HP Part Number 1250-1472
Type N (m) to SMB (m)	HP Part Number 1250-0671

Cables

BNC (m) to BNC (m)	HP 10503A
BNC (m) to SMB (f) (<i>2 required</i>)	HP Part Number 85680-60093

External Reference Input Test

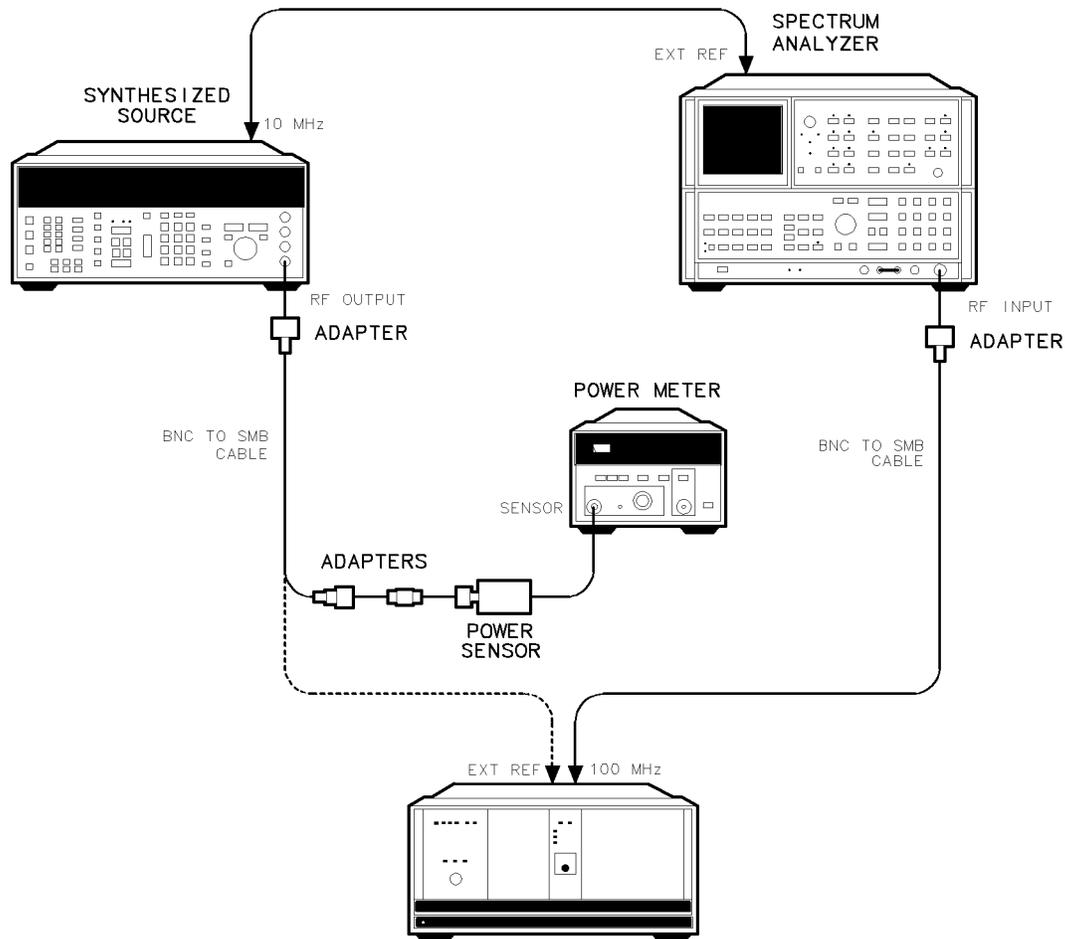


Figure 4-1. External Reference Input Test Setup

Procedure

Note All non-specified spectrum-analyzer settings are left in the AUTO mode.

1. Set the synthesized-source frequency to 1.0 MHz and adjust the amplitude for a -5.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 1 by pressing **(STORE) 1** on front panel of the synthesized source.
2. Set the synthesized-source frequency to 1.0 MHz and adjust the amplitude for a $+15.0$ dBm power reading on the power meter. Save these synthesized-source settings in Register 2 by pressing **(STORE) 2** on the front panel of the synthesized source.
3. Set the synthesized-source frequency to 10.0 MHz and adjust the amplitude for a -5.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 3 by pressing **(STORE) 3** on front panel of the synthesized source.
4. Set the synthesized-source frequency to 10.0 MHz and adjust the amplitude for a $+15.0$ dBm power reading on the power meter. Save these synthesized-source settings in Register 4 by pressing **(STORE) 4** on front panel of the synthesized source.

External Reference Input Test

5. Connect the RF OUTPUT of the synthesized source to the DUT's EXT REF input.
6. Press **(INSTR PRESET)** on the spectrum analyzer and set center frequency to 100 MHz and frequency span to 500 Hz. Press **(RECALL) (1)** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 1.
7. Set the spectrum-analyzer marker to the highest peak and read the marker frequency. The acceptable limits are 100 MHz \pm 20 Hz (99,999,980 Hz to 100,000,020 Hz).
8. Press **(RECALL) (2)** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 2. Repeat step 7.
9. Press **(RECALL) (3)** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 3. Repeat step 7.
10. Press **(RECALL) (4)** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 4. Repeat step 7.

Note The HP 70310A module's front-panel EXTERNAL REF LED should light when the external-reference frequency to the HP 70310A module is within the specified limits. It is normal for the HP 70310A module's front-panel PLL ERROR LED to blink briefly when the input frequency to the HP 70310A module is switched.

10 MHz and 100 MHz Output Power Test

Purpose

The purpose of this test is to verify the HP 70310A module's 10 MHz output power and 100 MHz output power specifications.

Description

This test measures the 10 MHz output power and the 100 MHz output power to assure the levels are within the specified limits.

Equipment

Connect the RF output of the synthesized source to the EXT REF input of the HP 70310A module (device under test or DUT). See Figure 4-2.

Local Oscillator	HP 70900A/B
Mainframe	HP 70001A
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Meter Sensor	HP 8482A

Adapters

Type N (m) to BNC (f)	HP Part Number 1250-0780
Type N (f) to Type N (f)	HP Part Number 1250-1472
Type N (m) to SMB (m)	HP Part Number 1250-0671
SMB (f) to SMB (f)	HP Part Number 1250-0672

Cables

BNC (m) to SMB (f)	HP Part Number 85680-60093
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10 MHz and 100 MHz Output Power Test

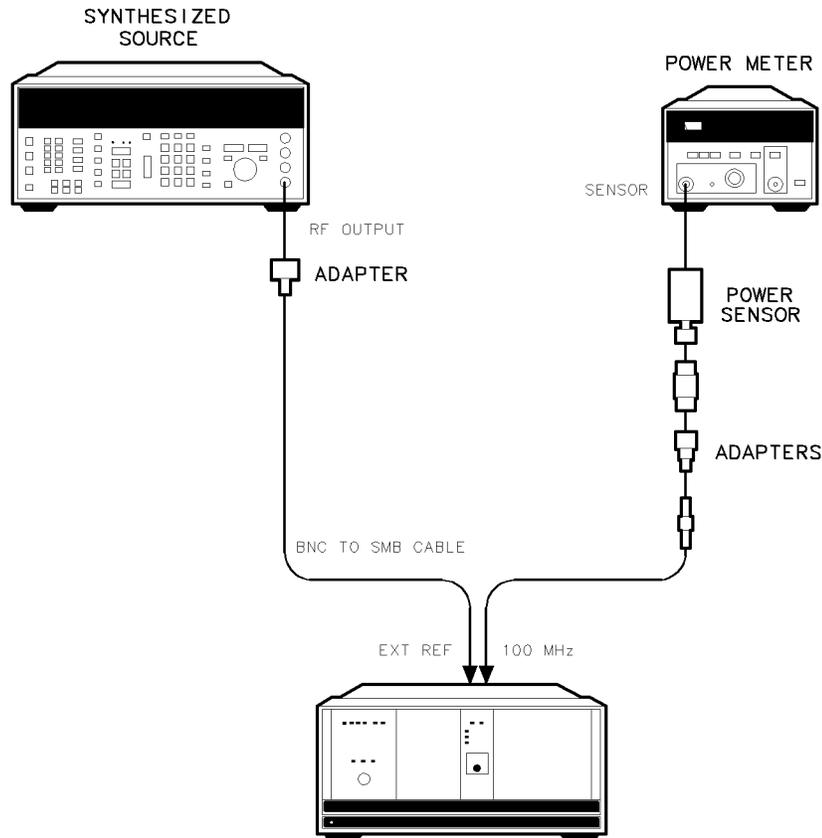


Figure 4-2. 10 MHz and 100 MHz Output Power Test Setup

Procedure

1. Calibrate the power meter and sensor according to instructions in the power meter's Operating Manual.
2. Set the synthesized-source frequency to 10.0 MHz and amplitude to 0 dBm.
3. Connect the power sensor to the DUT's 10 MHz output. The power-meter reading should be 0 dBm -2 dB, $+3$ dB (-2 dBm to $+3$ dBm).
4. Connect the power sensor to the DUT's 100 MHz output. The power-meter reading should be 0 dBm -2 dB, $+3$ dB (-2 dBm to $+3$ dBm).

10 MHz Output Spurs Test

Purpose

The purpose of this test is to verify the HP 70310A module's 10 MHz Output, Spurious Power Level, specification.

Description

This test checks that any reference or power-supply related spurious signals on the module's 10 MHz output are below the specified level.

Equipment

Connect the 10 MHz OUTPUT from the rear panel of the synthesized source to the EXT FREQ REFERENCE input on the spectrum analyzer. Calibrate the power meter according to instructions in its Operating Manual. Then connect the calibrated power meter through a BNC to SMB cable to the RF OUTPUT of the synthesized source. Calibrate the spectrum analyzer according to instructions in its Operating Manual. Then connect the RF INPUT of the spectrum analyzer through a BNC to SMB cable to the 10 MHz output of the HP 70310A module (device under test or DUT). See Figure 4-3.

Local Oscillator	HP 70900A/B
Mainframe	HP 70001A
Spectrum Analyzer	HP 8566B
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Meter Sensor	HP 8482A

Adapters

Type N (m) to BNC (f) (<i>2 required</i>)	HP Part Number 1250-0780
Type N (f) to Type N (f)	HP Part Number 1250-1472
Type N (m) to SMB (m)	HP Part Number 1250-0671

Cables

BNC (m) to BNC (m)	HP 10503A
BNC (m) to SMB (f) (<i>2 required</i>)	HP Part Number 85680-60093

10 MHz Output Spurs Test

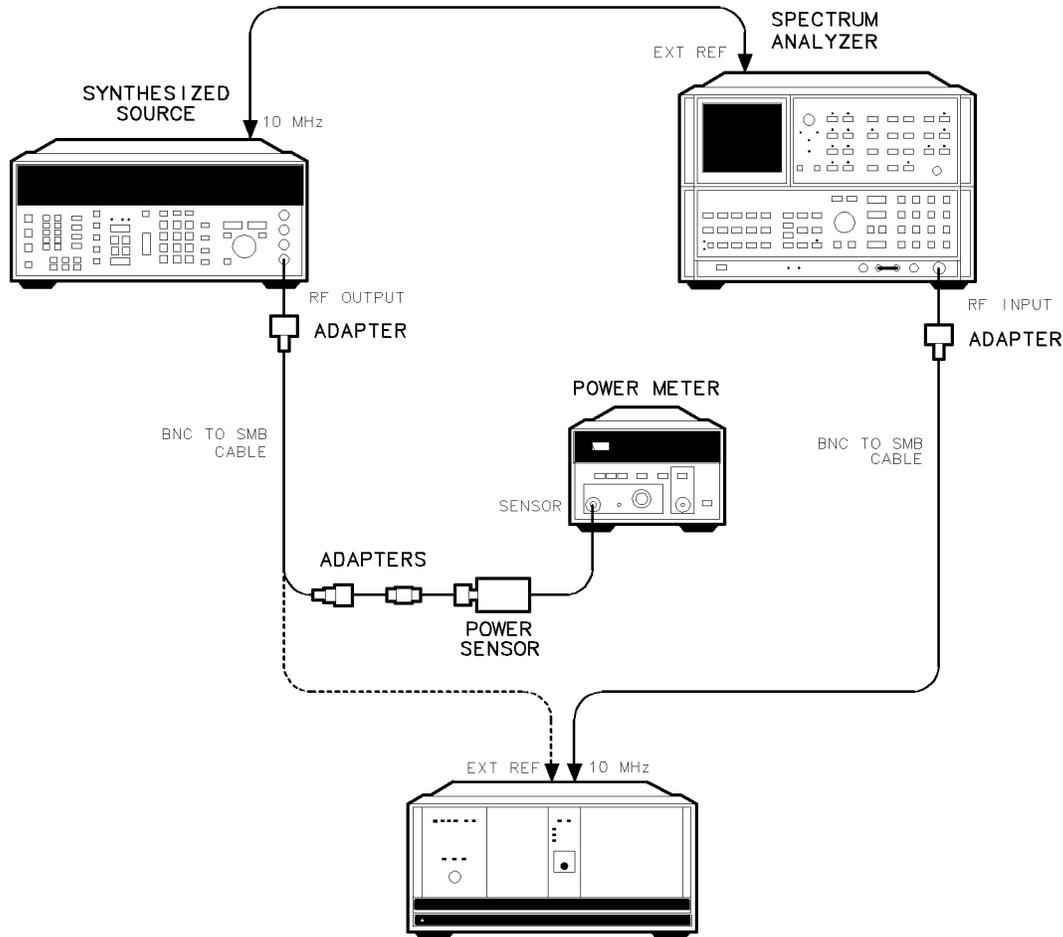


Figure 4-3. 10 MHz Output Spurs Test Setup

Procedure

Note All non-specified spectrum-analyzer settings are left in the AUTO mode.

1. Set the synthesized-source frequency to 1.0 MHz and adjust the amplitude for a +15.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 1 by pressing **(STORE) (1)** on front panel of the synthesized source.
2. Set the synthesized-source frequency to 2.0 MHz and adjust the amplitude for a +15.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 2 by pressing **(STORE) (2)** on the front panel of the synthesized source.
3. Set the synthesized-source frequency to 5.0 MHz and adjust the amplitude for a +15.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 3 by pressing **(STORE) (3)** on front panel of the synthesized source.
4. Set the synthesized-source frequency to 10.0 MHz and adjust the amplitude for a +15.0 dBm power reading on the power meter. Save these synthesized-source settings in Register 4 by pressing **(STORE) (4)** on front panel of the synthesized source.

10 MHz Output Spurs Test

5. Connect the RF OUTPUT of the synthesized source to the DUT's EXT REF input. Press **RECALL** **1** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 1.
6. Set the spectrum-analyzer center frequency to 10 MHz, frequency span to 50 kHz, and reference level to +10 dBm.
7. Set the spectrum-analyzer marker to the highest peak and note the carrier amplitude. It should be approximately 0 dBm.
8. Set the spectrum-analyzer center frequency to 1 MHz, frequency span to 50 kHz, and reference level to -20 dBm. All signals should be at least 80 dB below the carrier level noted in step 7.
9. Change the spectrum-analyzer center frequency setting to 9 MHz. All signals should still be at least 80 dB below the carrier level noted in step 7.
10. Change the spectrum-analyzer center frequency setting to 11 MHz. All signals should still be at least 80 dB below the carrier level noted in step 7.
11. Press **RECALL** **2** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 2.
12. Set the spectrum-analyzer center frequency to 2 MHz, frequency span to 50 kHz, and reference level to -20 dBm. All signals should be at least 80 dB below the carrier level noted in step 7.
13. Change the spectrum-analyzer center frequency setting to 8 MHz. All signals should still be at least 80 dB below the carrier level noted in step 7.
14. Change the spectrum-analyzer center frequency setting to 12 MHz. All signals should still be at least 80 dB below the carrier level noted in step 7.
15. Press **RECALL** **3** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 3.
16. Set the spectrum-analyzer center frequency to 5 MHz, frequency span to 50 kHz, and reference level to -20 dBm. All signals should be at least 80 dB below the carrier level noted in step 7.
17. Change the spectrum-analyzer center frequency to 15 MHz. All signals should still be at least 80 dB below the carrier level noted in step 7.
18. Press **RECALL** **4** on the synthesized-source front panel to set the synthesized-source frequency and amplitude to the settings saved in step 4.
19. Set the spectrum-analyzer center frequency to 10 MHz, frequency span to 5 kHz, RES BW to 30 Hz, VIDEO BW to 10 Hz, and reference level to +10 dBm.
20. Set the spectrum-analyzer marker to the highest peak and note the carrier amplitude. It should be approximately 0 dBm.
21. Set the spectrum-analyzer center frequency to 10.04 MHz, frequency span to 5 kHz, RES BW to 30 Hz, VIDEO BW to 10 Hz, and reference level to -20 dBm. All signals should be at least 80 dB below the carrier level noted in step 20.
22. Change the spectrum-analyzer center frequency setting to 10.08 MHz, frequency span to 10 kHz, and VIDEO BW to 30 Hz. All signals should be at least 80 dB below the carrier level noted in step 20.

10 MHz Output Harmonics Test

Purpose

The purpose of this test is to verify the HP 70310A module's 10 MHz Output, Harmonics Power Level specification.

Description

This test checks the harmonics level of the HP 70310A module's 10 MHz output at frequencies of 20, 30, 40, 50, 60, 70, 80, and 90 MHz.

Equipment

Connect the 10 MHz OUTPUT from the rear panel of the synthesized source to the EXT FREQ REFERENCE input on the spectrum analyzer. Calibrate the power meter according to instructions in its Operating Manual. Then connect the calibrated power meter through a BNC to SMB cable to the RF OUTPUT of the synthesized source. Calibrate the spectrum analyzer according to instructions in its Operating Manual. Then connect the RF INPUT of the spectrum analyzer through a BNC to SMB cable to the 10 MHz output of the HP 70310A module (device under test or DUT). See Figure 4-4.

Local Oscillator	HP 70900A/B
Mainframe	HP 70001A
Spectrum Analyzer	HP 8566B
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Meter Sensor	HP 8482A

Adapters

Type N (m) to BNC (f) (<i>2 required</i>)	HP Part Number 1250-0780
Type N (f) to Type N (f)	HP Part Number 1250-1472
Type N (m) to SMB (m)	HP Part Number 1250-0671

Cables

BNC (m) to BNC (m)	HP 10503A
BNC (m) to SMB (f) (<i>2 required</i>)	HP Part Number 85680-60093

10 MHz Output Harmonics Test

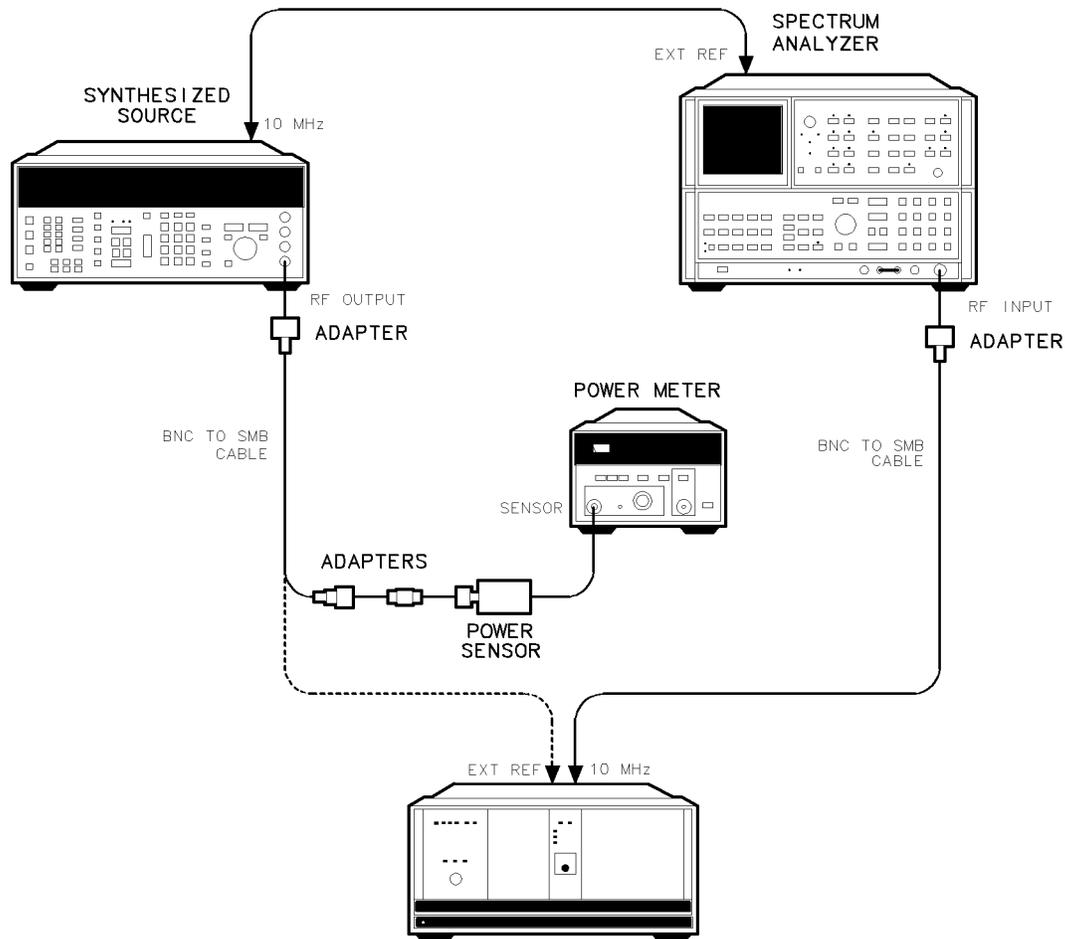


Figure 4-4. 10 MHz Output Harmonics Test Setup

Procedure

Note All non-specified spectrum-analyzer settings are left in the AUTO mode.

1. Set the spectrum-analyzer center frequency to 10 MHz, frequency span to 50 kHz, and reference level to +10 dBm.
2. Set the synthesized-source frequency to 10.0 MHz and adjust the amplitude for a 0 dBm power reading on the power meter. Connect the RF OUTPUT of the synthesized source to the DUT's EXT REF input.
3. Set the spectrum-analyzer marker to the highest peak and note the amplitude of the carrier frequency. It should be approximately 0 dBm.
4. Note the harmonics amplitude as you change the spectrum-analyzer center frequency setting to 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, and 90 MHz. At each frequency, the harmonics amplitude should be 20 dB below the carrier.

Distribution Amplifier Test

Purpose

The purpose of this test is to verify the input frequency range, input power range, and output power specifications of the HP 70310A module's distribution amplifiers. This test is required only for HP 70310A Option 001 modules.

Description

This test measures the output power of each amplifier output while the input power and frequency are varied over the specified limits.

Equipment

Calibrate the power meter according to the instructions in the power meter Operating Manual. Then connect the calibrated power meter through the cable to the RF output of the synthesized source. See Figure 4-5.

Local Oscillator	HP 70900A/B
Mainframe	HP 70001A
Synthesized Source	HP 8663A
Power Meter	HP 436A
Power Meter Sensor	HP 8482A

Adapters

Type N (m) to BNC (f)	HP Part Number 1250-0780
Type N (f) to Type N (f)	HP Part Number 1250-1472
Type N (m) to SMB (m)	HP Part Number 1250-0671
SMB (f) to SMB (f)	HP Part Number 1250-0672

Cables

BNC (m) to SMB (f)	HP Part Number 85680-60093
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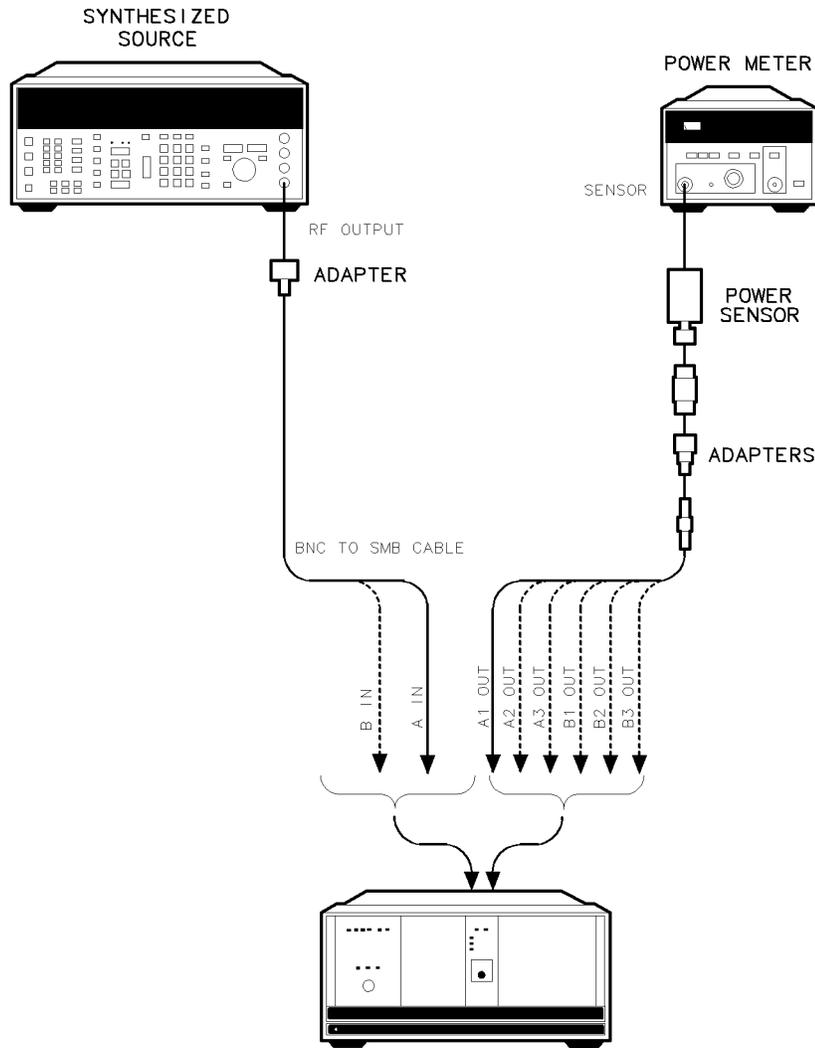


Figure 4-5. Distribution Amplifier Test Setup

Procedure

1. Set the synthesized-source frequency to 10 MHz and adjust its amplitude for a -4.0 dBm reading on the power meter. Save these synthesized-source settings in Register 1 by pressing **(STORE) 1** on the synthesized-source front panel.
2. Set the synthesized-source frequency to 10 MHz and adjust its amplitude for a $+4.0$ dBm reading on the power meter. Save these synthesized-source settings in Register 2 by pressing **(STORE) 2** on the synthesized-source front panel.
3. Set the synthesized-source frequency to 100 MHz and adjust its amplitude for a -4.0 dBm reading on the power meter. Save these synthesized-source settings in Register 3 by pressing **(STORE) 3** on the synthesized-source front panel.
4. Set the synthesized-source frequency to 100 MHz and adjust its amplitude for a $+4.0$ dBm reading on the power meter. Save these synthesized-source settings in Register 4 by pressing **(STORE) 4** on the synthesized-source front panel.

Distribution Amplifier Test

5. Set the synthesized-source frequency to 300 MHz and adjust its amplitude for a -4.0 dBm reading on the power meter. Save these synthesized-source settings in Register 5 by pressing **(STORE) (5)** on the synthesized-source front panel.
6. Set the synthesized-source frequency to 300 MHz and adjust its amplitude for a $+4.0$ dBm reading on the power meter. Save these synthesized-source settings in Register 6 by pressing **(STORE) (6)** on the synthesized-source front panel.
7. Connect the synthesized source to A IN on the device under test (DUT).
8. One by one, connect the power sensor to the DUT's A 1 OUT, A 2 OUT, and A 3 OUT. Each output should have a power level of 0 dBm ± 1.0 dB (-1.0 dBm to $+1.0$ dBm).
9. Press **(RECALL) (5)** to set the synthesized-source frequency and amplitude to the settings given in step 5. Then repeat step 8.
10. Press **(RECALL) (4)** to set the synthesized-source frequency and amplitude to the settings given in step 4.
11. One by one, connect the power sensor to the DUT's A 1 OUT, A 2 OUT, and A 3 OUT. Each output should have a power level of 0 dBm ± 2.0 dB (-2.0 dBm to $+2.0$ dBm).
12. Press **(RECALL) (3)** to set the synthesized-source frequency and amplitude to the settings given in step 3. Repeat step 11.
13. Press **(RECALL) (2)** to set the synthesized-source frequency and amplitude to the settings given in step 2. Repeat step 11.
14. Press **(RECALL) (1)** to set the synthesized-source frequency and amplitude to the settings given in step 1. Repeat step 11.
15. Press **(RECALL) (6)** to set the synthesized-source frequency and amplitude to the settings given in step 6.
16. Repeat steps 7 through 14 for the DUT's distribution amplifier "B".

Oscillator Adjustment

Purpose

This adjustment is used to calibrate the HP 70310A module's internal oscillator. This adjustment is not necessary for HP 70310A Option 002 modules, because they do not have an internal oven/oscillator.

Note The HP 70310A module's oven/oscillator and the other module circuits must be at operating temperature before this adjustment is performed. Mainframe power and/or the external power-pack power must be applied for at least 24 hours for the oven/oscillator to reach operating temperature. Mainframe power must be applied for at least one hour for the other module circuits to reach operating temperature.

Description

The output signal from the HP 70310A module's 10 MHz or 100 MHz rear-panel output is compared to an external frequency-reference standard while the module's internal oscillator is being adjusted. The front-panel oscillator adjustment door is removed to allow access to the internal oven/oscillator adjustments.

Equipment

The HP 70310A module must be installed in an HP 70000 series mainframe such as the HP 70001A. This adjustment also requires a 10 MHz or 100 MHz external frequency-reference standard, a frequency meter, and various cables, adapters, and connectors.

Procedure

Use the following procedure to adjust the HP 70310A module's internal oscillator. Refer to Figure 4-6 for identification of the parts called out in the procedure.

Note When removing the oscillator adjustment door, be careful not to lose the O-ring that is behind it.

1. Remove the socket-head cap-screw **(1)**.
2. Remove the oscillator adjustment door **(2)** and the O-ring behind the door.
3. Remove the cap-screws that cover the FINE **(3)** and the COARSE **(4)** adjustments.
4. Connect the external frequency-reference standard to the frequency meter and note the measured frequency.
5. Disconnect the external frequency-reference standard.
6. Connect the HP 70310A module's rear-panel 10 MHz or 100 MHz output to the frequency meter.
7. While adjusting first the COARSE **(4)** and then the FINE **(3)** adjustments, calibrate the frequency output of the HP 70310A module to match the frequency measured in step 4. If calibration cannot be achieved, the HP 70310A module may need to be serviced.
8. Replace the cap-screws over the FINE **(3)** and the COARSE **(4)** adjustments.
9. Replace the O-ring and the oscillator adjustment door **(2)**.

Oscillator Adjustment

10. Replace the socket-head cap-screw (1) and tighten it to hold the oscillator adjustment door in place.

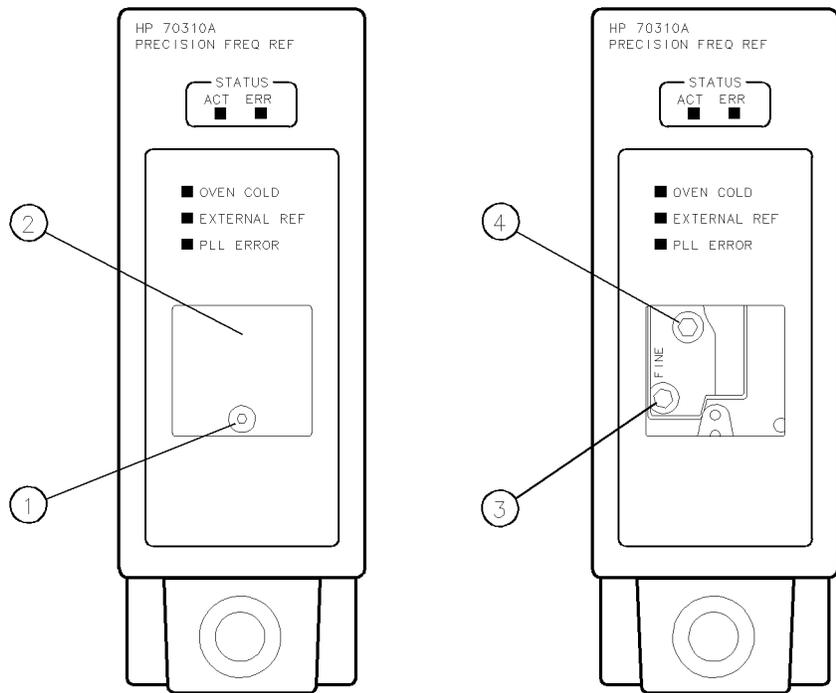


Figure 4-6. Oscillator Adjustment

Troubleshooting

Introduction

This chapter contains information about HP 70310A module front-panel LEDs, and a listing of the error codes for the HP 70310A module. The information in this chapter is designed to help determine whether an error is being caused by the HP 70310A module. For more detailed HP 70310A troubleshooting information, refer to the *HP 70310A Precision Frequency Reference Service Manual*.

If the error is not caused by the HP 70310A module, refer to the Installation and Verification Manual for the system master (for example, HP 70900A) for more troubleshooting information.

Status/Error LEDs

The HP 70310A Precision Frequency Reference has five front-panel LEDs. ACT and EXTERNAL REF are *status* LEDs. ERR, OVEN COLD, and PLL ERROR are *error* LEDs. All of the LEDs light during self-test; other reasons for the LEDs' lighting are given below.

- The ACT (active) LED lights when the module is activated by an HP 70000 Modular Measurement System master.
- The ERR (error) LED lights when there is an error condition.
- The OVEN COLD LED lights when the internal oven/oscillator assembly is not warmed up to operating temperature. The external power pack provides power for the heater in the internal oven/oscillator assembly to help maintain the correct operating temperature when the instrument is turned off. If the external power pack is not plugged in, or if it has an open fuse, the temperature may not be maintained in the internal oven/oscillator assembly and the OVEN COLD LED will light. The OVEN COLD LED should not light in HP 70310A Option 002 modules (internal oven/oscillator assembly deleted).
- The EXTERNAL REF LED lights when an appropriate external reference signal is connected to the rear-panel EXT REF input.
- The PLL ERROR LED lights when the reference signal (internal or external) is either absent or incorrect. An external reference signal *must* be used with HP 70310A Option 002 modules.

Error Messages

The error codes generated by the HP 70310A Precision Frequency Reference are listed below in numerical order.

Types	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.

- 2001 illegal cmd — This is a user-generated system protocol error.
- 2002 illegal parameter — This is a user-generated system protocol error.
- 2006 Param out of range — This is a user-generated system protocol error.
- 2009 Protocol error — This is a user-generated system protocol error.
- 2027 Service mode -- do IP/(For service only) — This is a user-generated system protocol error. The bandwidth or Reference Select are not in their AUTO modes.

Hardware Warning Errors

These error codes report the status of the HP 70310A hardware or indicate that some of the hardware may be broken. These error codes indicate that measurement accuracy may be impaired.

- 6000 EAROM unprotected — The write-protect switch on the A2 Power Supply/Processor board assembly is set to the write position. The correct setting is silk-screened on the left side-cover of the module.
- 6014 PLL error — Either a hardware failure exists, or the frequency reference source (internal or external) is not close enough to 1, 2, 5, or 10 MHz for the module to operate.
- 6015 Oven cold — The A6 Oven/Oscillator assembly has not reached normal operating temperature of approximately 85°C, and there is no external reference applied. If the error appears at power-up when the instrument has been off for more than fifteen minutes and then disappears after the instrument has been on for fifteen to twenty minutes, the most probable causes are: (a) the external power pack has an open fuse, (b) the external power pack is not properly connected, (c) external power pack is faulty, or (d) the HP 70310A module has faulty hardware.

Note At ambient temperatures below the specified operating range of the module, the oven may not be able to generate enough power to keep itself at approximately 85°C.

- 6016 No Freq Reference — No external frequency reference is applied and no internal oven/oscillator is present.

Hardware Broken Errors

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

- 7000 ROM check error — A test of the module ROM has failed. The most probable cause is faulty HP 70310A hardware.
- 7032 Oven RF error — The output level of the A6 Oven/Oscillator assembly is absent or low. The most probable cause is faulty HP 70310A hardware.
- 7033 Power supply error — One or more of the following power supply voltages are out of specification: +5 V, -5 V, or -12 V. The most probable cause is faulty HP 70310A hardware.
- 7034 Dist Amp A error — Either the input to the A4 Distribution Amplifier “A” board assembly is beyond the specified operating range, or a hardware failure exists. The most probable causes are either: (a) one or more outputs that are unlevelled due to faulty HP 70310A hardware, or (b) an input that is too low in power.
- 7035 Dist Amp B error — Either the input to the A3 Distribution Amplifier “B” board assembly is beyond the specified operating range, or a hardware failure exists. The most probable causes are either: (a) one or more outputs that are unlevelled due to faulty HP 70310A hardware, or (b) an input that is too low in power.
- 7045 10 MHz out error — The 10 MHz output is either absent or low. The most probable cause is faulty HP 70310A hardware.

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