HP 83557A
MILLIMETER-WAVE
SOURCE MODULE

SERIAL NUMBERS

This manual applies directly to HP 83557A Millimeter-wave source modules having serial number 2948A00101 and higher.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in System General Information.

MANUAL PART NO. 83557-90001
Microfiche Part Number 83557-90002

Printed: MAY 1990

HEWLETT PACKARD

CERTIFICATION

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

WARRANTY

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

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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

LIMITATION OF WARRANTY

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

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

EXCLUSIVE REMEDIES

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

ASSISTANCE

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

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

BP21.2

TABLE OF CONTENTS

SAFETY CONSIDERATIONS

GENERAL

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

SAFETY SYMBOLS

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

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

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

CAUTION

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

BEFORE APPLYING POWER

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

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

SERVICING

WARNING

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

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

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

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

TABLE of CONTENTS
SYSTEM GENERAL INFORMATION

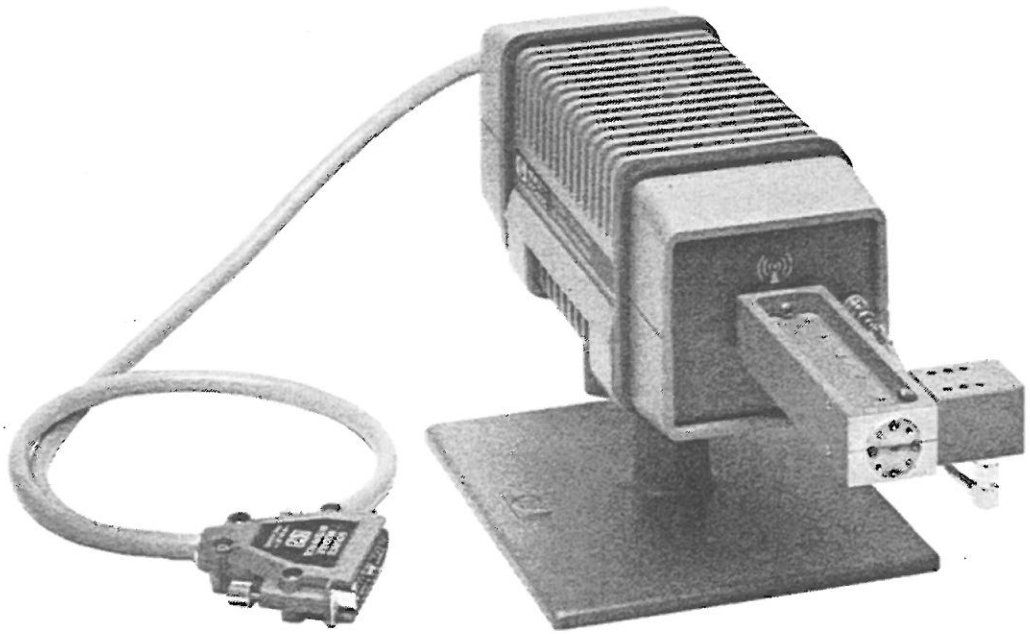


Figure 1-1. HP 83557A Millimeter-wave Source Module

Section 1. System General Information

INTRODUCTION

This manual contains operating and service information for the HP 83557A V-band millimeter-wave source module, shown in Figure 1-1.

Because the HP 83557A source module requires the use of an external signal source to operate, it is necessary to discuss other HP instruments that are compatible with the source module. This manual discusses the operation of these instruments as they affect the use of the source module. For detailed instructions on any of these compatible instruments, refer to the individual instrument's operating and service manual.

This manual is divided into three major headings which provide the following information:

SYSTEM GENERAL INFORMATION provides a brief description of the systems covered by this manual, safety considerations, site preparation, system installation, accessories and operating supplies available. All of the information in this portion of the manual applies to overall maintenance of the V-band source module systems.

SOURCE SYSTEM GUIDES contains the external signal source configurations and the recommended equipment list. This portion is further divided into different source guides. Each source guide contains: connection diagrams, external signal source driven specifications, operating information, performance tests, and system level troubleshooting.

SOURCE MODULE SPECIFICATIONS AND SERVICE provides information that is source module specific, such as the description, specifications, equipment required but not supplied, performance tests and service.

OPTIONS

Option 001. Ordering this option deletes the leveling coupler and detector from the source module.

Option 910. Ordering this option provides an additional operating and service manual for a total of two manuals.

Option W30. Ordering this option adds an additional two years of return to HP service, for a total of three years. This option is available at the time of sale only .

DESCRIPTION

The HP 83557A millimeter-wave source module is a frequency multiplier that provides a means of obtaining leveled high power, high quality signals covering the waveguide band of 50 to 75 GHz (V-band).

SPECIFICATIONS

The HP 83557A source module specifications are divided into two categories:

- External signal source dependent specifications (system specifications).
- Source module specifications independent of signal source.

External signal source dependent specifications are found in each of the source system guides. Refer to the source system guide that describes the source system you are using.

INSTRUMENTS COVERED BY MANUAL

This manual applies specifically to HP 83557A millimeter-wave source modules. A serial number label is attached to the rear panel of the HP 83557A. Figure 1-2 shows a typical serial number label. The serial number is in two parts. The first four digits followed by a letter comprise the serial number prefix; the last five digits form the sequential suffix that is unique to each instrument. The content of this manual applies directly to instruments having the same serial number prefix as listed on the title page of this manual under SERIAL NUMBER.

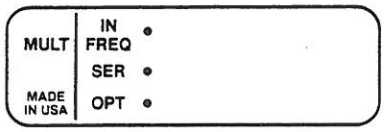


Figure 1-2. Typical Serial Number Label

SYSTEMS COVERED BY MANUAL

Different millimeter-wave (mm-wave) source systems are detailed in this manual under the major heading SOURCE SYSTEM GUIDES. Refer to the source system guide that describes the source system you are using for specific serial number prefix information.

SYSTEM DESCRIPTIONS

The V-band millimeter-wave source system consists of an HP 83557A and a microwave source driver (external signal source) that delivers a minimum of +17 dBm of output power to the RF cable input of the source module at frequencies between 12.5 and 18.75 GHz. Refer to Figure 1-3 for a block diagram of the different configurations.

A source driver can consist of any of the HP models listed in block A together with the HP 8349B, block B. The HP 8349B provides the block A microwave sources with the power amplification, and in some cases the source module interface, needed to drive the HP 83557A.

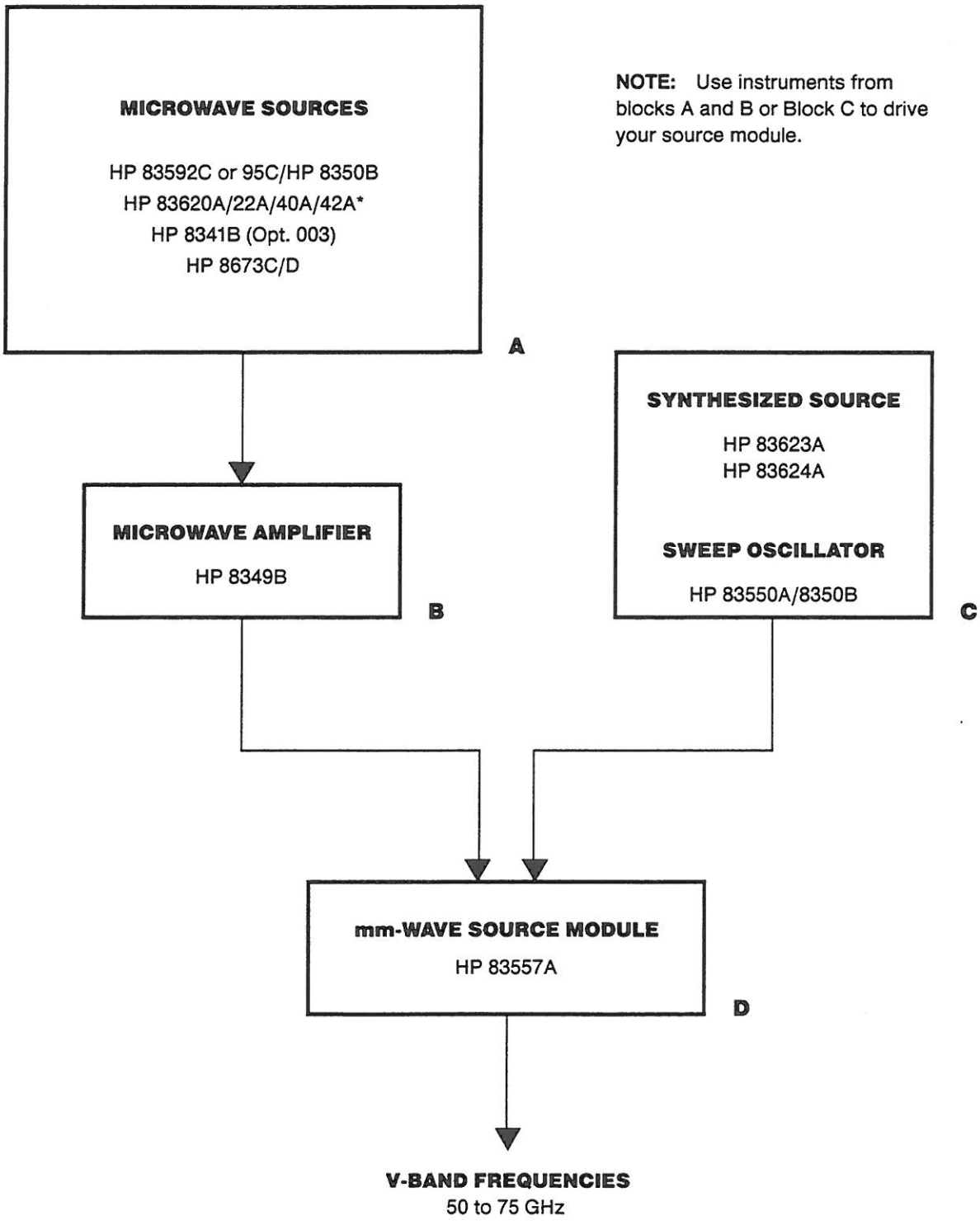
Other mm-wave source system configurations are shown in block C, directly driving the HP 83557A. These are high powered sources with the source module interface designed into the instrument.

SYSTEM COMPONENTS AVAILABLE

A complete V-band mm-wave measurement system is composed of several instruments and accessories called system components. Refer to Table 1-1 for a list of compatible instruments.

ACCESSORIES

Refer to Table 1-2 for a list of compatible accessories.



*Refer to the HP 83623A/24A Source System Guide for configuration information.

Figure 1-3. HP 83557A Source Module Configurations

Table 1-1. Compatible Source System Instruments (Accessories listed are required for mm-wave applications)

Instrument	Frequency Range (GHz)	Model
SCALAR NETWORK ANALYZER	50.0 to 75.0	HP 8757A/C/E with HP 85025C Detector Adapter or HP 11664C Detector Adapter
SPECTRUM ANALYZERS	50.0 to 75.0	HP 8566B with HP 11975A Amplifier and HP 11970V Mixer
	50.0 to 75.0	HP 71300A with HP 11970V Mixer
	50.0 to 75.0	HP 8569B with HP 11975A Amplifier and HP 11970V Mixer
	50.0 to 75.0	HP 8569B Option 003 with HP 11970V Mixer
VECTOR NETWORK ANALYZER	50.0 to 75.0	HP 8510B with HP V11643A Test Set Kit and HP V11644A Calibration Kit and HP 85100A LO/IF Interface Kit
POWER METERS	50.0 to 75.0	Anritsu ML83A with Anritsu MP716A Power Sensor

Table 1-2. Compatible Source System Accessories

Frequency Range (GHz)	Model
*	HP 85025C Detector Adapter
*	HP 11664C Detector Adapter
50.0 to 75.0	HP V752C/D Directional Coupler (10, 20 dB)
50.0 to 75.0	HP V910C Load
50.0 to 75.0	HP 11970V Harmonic Mixer
*	HP 11548A Waveguide Holder
*	HP 11540A Waveguide Stand
50.0 to 75.0	HP V898A E-H Plane Twist
50.0 to 75.0	HP V896B Straight Section
50.0 to 75.0	HP V365A Waveguide Isolator
50.0 to 75.0	HP V373D/G Fixed Attenuator (20, 50 dB)
50.0 to 75.0	HP V894 Waveguide Mismatch

* not frequency dependent

COMPLETE MEASUREMENT SYSTEMS

There are several Hewlett-Packard instruments that can be used as mm-wave receivers. Such receivers include the HP 8510 network analyzer, HP 8757 scalar network analyzer, and the HP 71000 Series spectrum analyzer.

Millimeter-wave Vector Network Analysis

The HP 8510 network analyzer can be configured to make high-speed, wide dynamic range vector measurements at millimeter-wave frequencies. Figure 1-4 shows a simplified block diagram for a generic system, applicable to all waveguide bands.

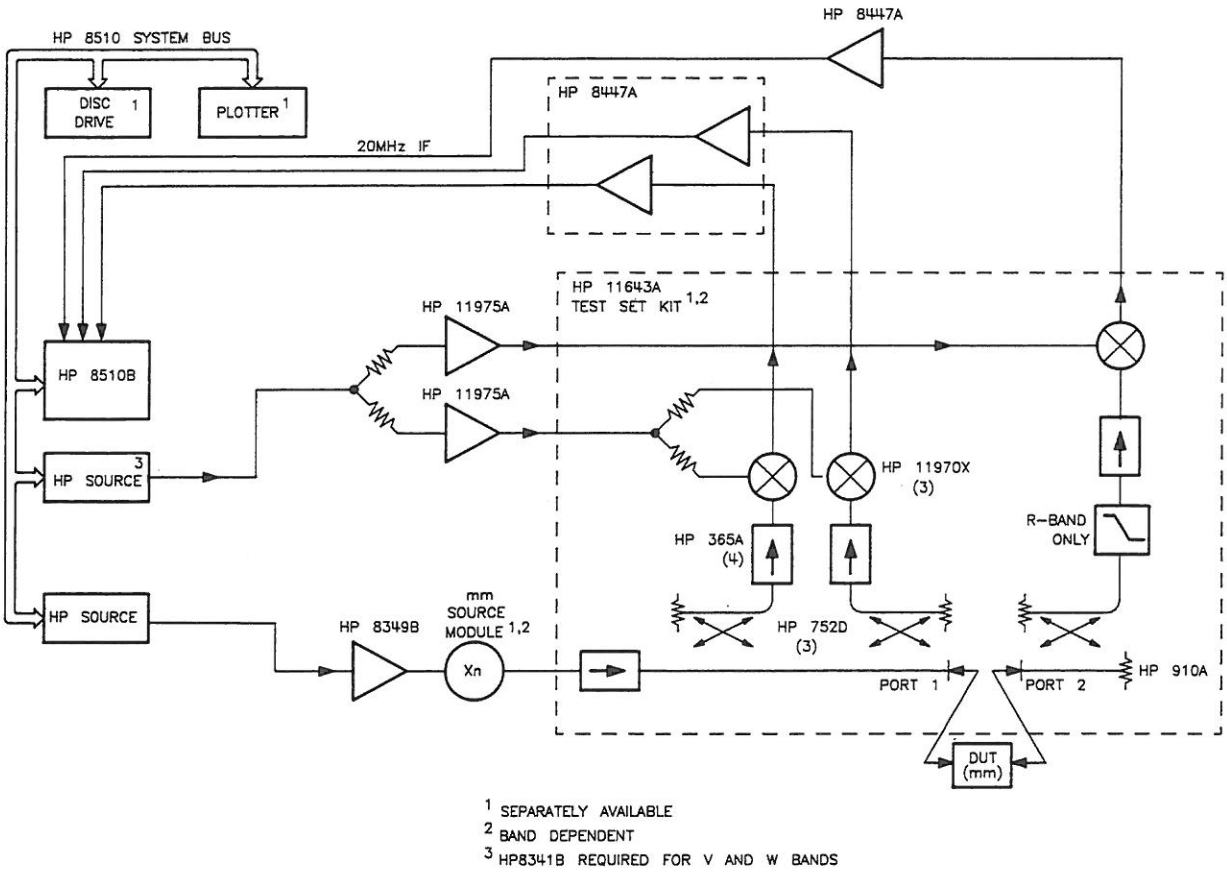


Figure 1-4. Simplified Block Diagram of a Millimeter-wave Vector Network Analyzer System

Millimeter-wave Scalar Network Analysis

HP millimeter-wave source systems can be used for broadband scalar measurements utilizing the HP 8757 scalar network analyzers. Figure 1-5 shows a typical transmission and reflection measurement system.

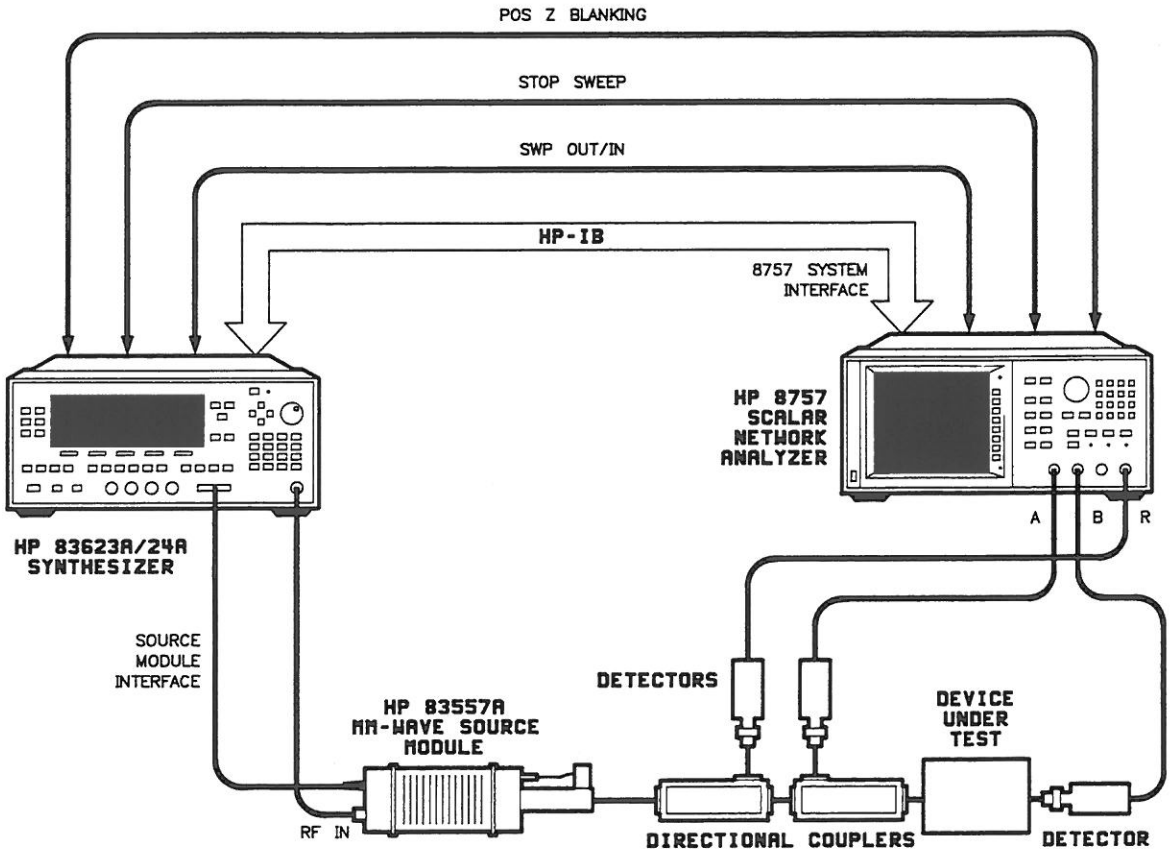


Figure 1-5. Transmission and Reflection Millimeter-wave Measurement System

Signal Analysis

Signal analysis measurements can be made using the HP 11970 Series waveguide harmonic mixers for the HP 8566A/B or the 8569A/B spectrum analyzers, or the HP 71000 Series modular spectrum analyzer to cover waveguide bands from 18 to 110 GHz.

Reference Literature

Data Sheet	*HP 8510 network analyzer*
HP Product Note 8510-12	*Millimeter-wave Measurements Using the HP 8510B Network Analyzer*
Data Sheet	*HP 8757 scalar network analyzer*
Data Sheet	*HP 11664C waveguide detector*
HP Product Note 8756-2	*Using the HP 11664C Detector Adapter to Make Millimeter-wave Scalar Measurements*
HP Product Note 8757-2	*Millimeter-wave Measurements, V and W Band*
Data Sheet	*HP 71000 Series modular spectrum analyzer*
Data Sheet	*HP 8566B spectrum analyzer*
HP Product Note 8569B-1	*Extending the HP 8569B Spectrum Analyzer Above 22 GHz with External Mixers*
HP Product Note 8566A-1	*Using the HP 8566A Spectrum Analyzer for Signal Analysis Above 22 GHz with External Mixers*
HP Product Note 8566A-2	*Extending the HP 8566A Spectrum Analyzer Above 22 GHz with External Mixers*
HP Operating Note	*Operating Guide for the HP 83550 Series Millimeter-wave Source Modules*

SAFETY CONSIDERATIONS

General

Each instrument has been manufactured and tested in accordance with international safety standards. Before operating any instrument, review all documentation to familiarize yourself with safety markings and instructions. For a listing of safety considerations and symbols used in each system component, refer to the individual system component's operating and service manual.

Safety Symbols

A complete listing of the safety symbols used in this manual is given on the page preceding the main Table of Contents.

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publications are available from:

American National Standards Institute
1430 Broadway
New York, NY 10018

SITE PREPARATION

It is the customer's responsibility to select and prepare a site suitable for the mm-wave source system. This includes space, power, and environmental requirements.

Space Requirements

A table must be provided to support the source module and a source driver. The table should be at least 1.8 metres (6 ft) long, 0.9 metres (3 ft) wide and able to support 136 kg (300 lbs). A table with a power distribution strip along the back edge is preferred.

Power Outlets

One power outlet for each instrument in your system is required plus an additional two to three outlets for service. The power line should be capable of providing uninterrupted current. Avoid connecting the mm-wave source system to power lines serving equipment that will disturb the line voltage (e.g. air conditioning equipment, electrical welders, copying machines, large motors, etc.). Refer to the individual instrument manuals for power consumption ratings. Add each rating to figure the total power consumption of the system.

Environmental Requirements

For optimum results, operate the source module within the following limits:

Temperature	+25°C, ±5°C (+77°F, ±9°F)
Humidity	Less than 95%, non-condensing

Operation outside these limits is possible with a chance of performance degradation and a higher risk of failure.

Telephone Considerations

A telephone near the mm-wave source system is recommended, especially if on-site service is desired.

INITIAL INSPECTION

Inspect the shipping container for damage. If it is damaged, keep it until you have checked the contents for completeness.

If the shipping container is damaged, perform the performance tests outlined in this manual. If the source module fails the performance tests, or is damaged or defective, keep the shipping materials and notify both the carrier and the nearest Hewlett-Packard office. Hewlett-Packard will arrange for repair or replacement of the source module without waiting for a settlement from the shipping company.

NOTE: If you already own instruments that will be used in a mm-wave source system, verify the operation and/or calibration before integrating them into the system. Certain instruments require modification before they can be used in a mm-wave source system. Refer to the appropriate source system guide for details.

Site Preparation Checklist
V-Band Millimeter-Wave Source System

Check each item off as it is completed.	
All Components at Installation Site	☐
System Table Support: 135 kg (300 lb) Size: 1.8 m (6 ft) x 0.9 m (3 ft)	☐
Power Outlets System: minimum 2 Service: 3	☐
Temperature +25 ±5°C (+77 ±9°F)	☐
Humidity Less than 95%, non-condensing	
Telephone (useful for on-site service)	☐
Inventory System Components	☐
Perform Incoming Inspection/Calibration	☐
Verify Calibration of Instruments (instruments already owned)	☐

Receiving Checklist

Verify that you have received the following items with your source module.

Item	HP Part/Model Number
Source Module	HP 83557A
Coupler/Detector Assembly (standard instruments only)	Part of HP 83557A
Source Module Stand and Cradle Assembly	83556-60010
RF Cable	5061-5359
Synthesizer Interface Cable (for use with HP 8341B Opt. 003)	5061-5391
Allen Driver (standard instruments only)	8710-1539
Operating and Service Manual	83557-90001

INSTALLATION

Introduction

This section provides instructions for attaching the coupler/detector assembly to the source module, and very general mm-wave source system installation instructions. For specific information on any instrument refer to the individual operating and service manual.

Power Requirements. Most of the instruments obtain power through their own line voltage cord. The two exceptions are:

- The RF plug-in (when applicable), which receives power from the HP 8350 sweep oscillator mainframe.
- The source module, which receives power from the source or the HP 8349B.

To prevent instrument damage, make the correct line voltage and fuse selection for each system component prior to connecting line power to the system.

Line Voltage and Fuse Selection. Each system component must be set to operate with the available AC line voltage, and have the correct line fuse installed. Because system component fuse values for different line voltage settings are not identical, verify that the proper voltage range and corresponding fuse are selected. Line voltage ranges and fuse ratings for system components are given in Section 1 of each component manual, and are often specified on the instrument rear panel. Use the following procedure to determine the correct line voltage setting and fuse value (if necessary):

1. Determine the available line voltage.
2. Refer to the installation section of each instrument manual. Match the correct line voltage and fuse as specified in the manual to the determined AC line voltage. If the measured AC voltage does not fall within the acceptable limits for any range, an auto transformer must be used between the power source and the mm-wave source system.

3. Change the line voltage selector according to the instructions in the installation section of each instrument manual.

4. Insert the proper value fuse for the line voltage range selected.

Power Cables. Each instrument in this mm-wave source system is equipped with a three-wire power cable, in accordance with international safety standards. The cable grounds the instrument system when the cable is connected to an appropriate power line outlet. Table 1-3 shows the plug styles available on power cables supplied with HP instruments. The HP part numbers given for the plugs are the part numbers for complete power cables. The type of power cable/plug shipped with the instrument depends on the country of destination.

System Connections. System connections are discussed in the Source System Guides. Refer to the guide that details the source driver you are using.

Mating Connectors. Refer to the individual instrument's installation section for the type of connector(s) that can be mated with the instrument.

Coupler/Detector Installation

CAUTION

Beware of damage from electro-static discharge (ESD). The coupler/detector assembly and the circuits in the source module are extremely sensitive to electrostatic discharge. Use a grounded wrist strap when you handle these devices.

The coupler/detector assembly is shipped in the same container as the source module but is not attached to the source module. Therefore, you must attach the coupler/detector assembly to the source module upon receipt. Follow the procedure below to do this.

1. Protect yourself from electrostatic discharge (ESD) then remove the coupler/detector assembly and the source module from their packaging.

2. Align the coupler/detector assembly with the source module as shown in Figure 1-6.

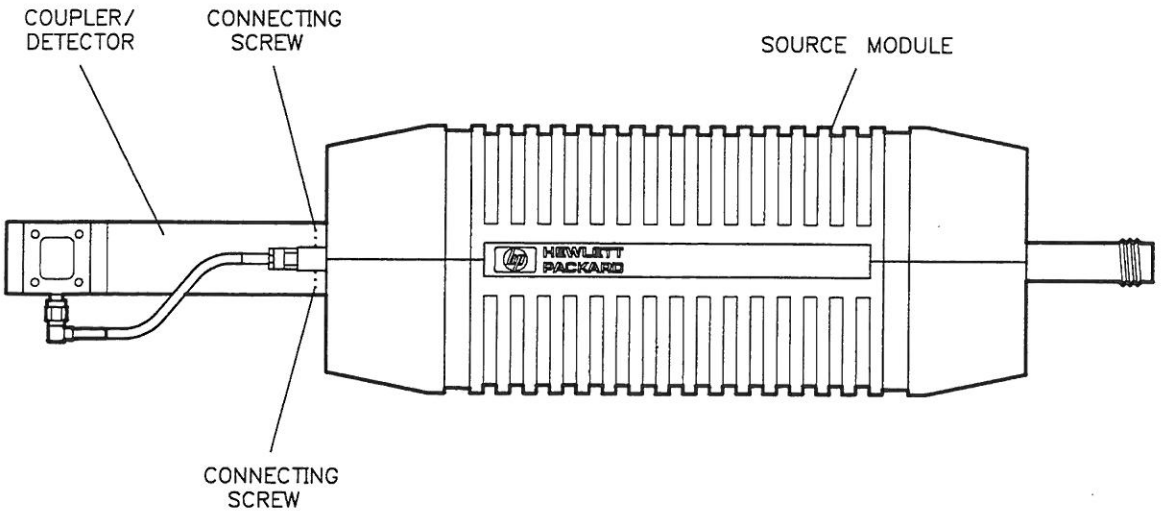


Figure 1-6. Alignment of the Coupler/Detector and Source Module

3. Using an allen driver, tighten the two screws in the coupler at the junction of the coupler and source module.

4. Connect the flexible cable from the detector to the SMC connector on the front panel of the source module.

The coupler/detector assembly installation procedure is complete; the unit should operate as specified.

NOTE: Each coupler/detector assembly is matched to a source module at the factory. The label on the coupler/detector references the serial number of the source module it is matched to and must be used with this source module only. Operation of the source module without the coupler/detector assembly attached is possible, however, the output power of the source module will be unleveled.

System Installation

Refer to the SITE PREPARATION CHECKLIST earlier in this section before continuing with the system installation.

1. Place the source at least six inches back from the front edge of the table (install the plug-in if required).

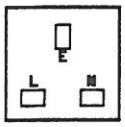
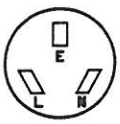
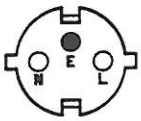
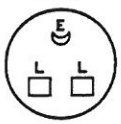
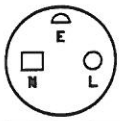
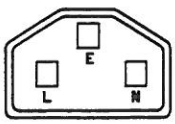
2. Place the source module in its cradle stand. Secure the cradle stand to the source module.

3. Check the voltage/fuse selection of the source.

4. Check the power cables.

5. Refer to the appropriate source system guide for specific source connection diagrams.

Table 1-3. AC Power Cables Available

Plug Type[1]	Cable HP Part Number[2]	Plug Description[2]	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, Republic of So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	Straight SEV1011.1959 24507,Type 12	79	Gray	Switzerland
250V 	8120-0698	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	Straight CEE22-VI (System Cabinet Use)			

1. E = Earth Ground; L = Line; N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

STORAGE AND SHIPMENT

Storage

Store the source modules within the following environmental limits:

Temperature	−25°C to +75°C
Humidity	Up to 95%
Altitude	Up to 4,600 kilometers (15,000 feet)

Shipment

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If you choose to use commercially available materials, follow these instructions:

1. Wrap the component in heavy paper.
2. Use a strong shipping container. A double-wall carton made out of 159-kg (350-lb) test material is adequate.
3. Use shock-absorbing material, 76 to 102 mm (3 to 4 in) thick, around all sides of the instrument to provide a firm cushion and prevent movement inside the container.
4. Seal the container securely.
5. Mark the shipping container **FRAGILE**.

Returning For Service

If you are shipping any component to a Hewlett-Packard office or service center please include the following information (use the service tags at the end of this section):

1. Your company name and address.
2. A technical contact person within your company, and their complete telephone number.
3. The complete model and serial number of the component.
4. The type of service required (calibration vs. repair).
5. Any other information that may expedite service.

When making inquiries, either by correspondence or by telephone, please refer to the instrument by model number and serial number.

Manufacturer's Declaration

NOTE

This is to certify that this product meets the radio frequency interference requirements of Directive FTZ 1046/1984. The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Model 83557A

NOTE

Hiermit wird bescheinigt, dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Mess- und Testgeräte:

Werden Mess- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

ORDERING MANUALS

The manual part number and the microfiche part number are on the title page of this manual. Either number can be used to order extra copies of the manual. Microfiche are 10 x 15 (4 x 6 in) microfilm transparencies. Each microfiche contains reduced photocopies of the manual pages.

Section 2. Source System Guides

INTRODUCTION

The HP 83557A millimeter-wave source module extends the frequency range of 12.5 to 18.75 GHz sources to 50.0 to 75.0 GHz (V-band). This mm-wave source module is enhanced by the performance features of HP microwave source drivers such as the HP 83550A and 83592C/95C RF plug-ins, the HP 8341B (Opt. 003) synthesized sweepers, the HP 8673C/D synthesized signal generators, and the HP 83623A/24A synthesized sweepers.

This section of the manual provides information that will enable you to use the source module in different mm-wave source system configurations. Each system configuration is separately documented in its own Source System Guide (sections 2a through 2e), addressing each according to source driver and applications. The individual guides also provide system specifications, connection diagrams, operating characteristics, performance tests, and troubleshooting sections.

RECOMMENDED TEST EQUIPMENT

Test equipment required for system performance testing is given in Table 2-1. If substitute equipment is used, it must meet the critical specifications shown in the table.

SPECIFICATIONS

The HP 83557A source module uses frequency multiplication to generate mm-wave frequencies. The frequency specifications are directly proportional to those of the external signal source driving the source module. Therefore, those specifications are extensions of the specified signal source and are detailed in each source system guide. The output characteristic specifications are source module specific and are detailed in the Source Module Specifications and Service Section.

OPERATION

The operation portion of the applicable source system guide will enable you to use the HP 83557A source module in a variety of applications. Included are system hookup diagrams that illustrate the source module in a systems environment, test procedures that cover the measurement system, and operational suggestions.

PERFORMANCE TESTS

The test procedures in these sections test the electrical performance of the HP 83557A with a specified source driver in a systems configuration. These tests reference the System Specifications table of each Source System Guide as the performance standards against which the system is tested.

SYSTEM LEVEL TROUBLESHOOTING

Within each Source System Guide is a System Level Troubleshooting section to help isolate system failures to an instrument level. Once an instrument is isolated as the failure, references to the specific Operating and Service manual are made for repair procedures.

Table 2-1. Recommended Test Equipment

Instrument	Critical Specifications	Recommended Model	Use[1]
Spectrum Analyzer	12.5 to 18.75 GHz Coverage	HP 8566B	P
Power Meter	−10 to +20 dBm power coverage	Anritsu ML83A	O,P,T
Power Sensor	−10 to +20 dBm power coverage with 50.0 to 75.0 GHz frequency coverage	Anritsu MP716A	O,P,T
Microwave Amplifier	2.0 to 8.0 GHz Range	HP 11975A	P
Harmonic Mixer	50.0 to 75.0 GHz frequency coverage	HP 11970V	P
Waveguide Directional Coupler, 10 dB	50.0 to 75.0 GHz frequency coverage with >33 dB directivity	HP V752C	O,P
Waveguide Directional Coupler, 20 dB	50.0 to 75.0 GHz frequency coverage with >33 dB directivity	HP V752D	O,P
Detector Adapter	AC Detector Adapter (50.0 to 75.0 GHz)	HP 85025C	O
Detector	50.0 to 75.0 GHz frequency coverage	HP 85025C K57	O
Cables (2)	3.5 mm connectors	HP P/N 5061-5458	O,P,T
Cables (5)	BNC Connectors	HP P/N 8120-1839	
Cables (2)	Type-N male connectors 8 to 20 GHz range, SWR ≤ 1.45 to 1, insertion loss ≤ 2 dB	HP P/N 5061-5359	O,P,T

1. O = Operation; P = Performance Test; T = Troubleshooting

TABLE of CONTENTS
HP 83550A SOURCE SYSTEM GUIDE

Section 2a. HP 83550A Source System Guide

INTRODUCTION

This source system guide provides mm-wave system operating information for the HP 83550A/8350B/83557A system (unless otherwise stated, hereafter referred to as the HP 83550A/83557A system). It contains an operator's check, connection diagrams, system specifications, system performance tests, and system level troubleshooting. For detailed instructions regarding the operation or troubleshooting of the individual instruments, refer to the instrument's operating and service manual.

SYSTEM DESCRIPTION

The HP 83550A is an 8 to 20 GHz RF plug-in used with the HP 8350B sweep oscillator. It provides a minimum of +17 dBm of internally leveled calibrated output power and a built-in mm-wave source module interface to serve as a direct microwave source driver for the HP 83557A source module.

NOTE: With Option 002 (50 dB programmable attenuator), the HP 83550A may not drive the source module to full specified output power. Refer to the HP 83550A Operating and Service Manual for detailed specifications.

For proper display accuracy, leveling flatness, and harmonic suppression, the HP 83550A 1.0/0.5V/GHz frequency reference output switch must be set to 0.5V/GHz. For further information, refer to the HP 83550A Operating and Service Manual.

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

SYSTEM SPECIFICATIONS

Table 2a-1 provides system specifications for the HP 83550A/83557A system configuration. These are the performance standards against which the system is tested.

Table 2a-1. HP 83550A/83557A System Specifications

Frequency Characteristics	**Modulation Characteristics**
Range . . . . . 50.0 to 75.0 GHz	External FM
Accuracy (25°C ±5°C)[1]	Maximum Deviations for Modulation Frequencies
CW Mode . . . . . ±80 MHZ	Crossover Coupled
All Sweep Modes	DC to 100 Hz . . . . . ±300 MHz
(for sweep time > 100 msec) . . . . . ±200 MHz	100 Hz to 6 MHz . . . . . ±54 MHz
CW Resolution . . . . . 104 kHz	Sensitivity
Stability	FM Mode, typically . . . . . −80 MHz/V
With Temperature, typically . . . . . ±4 MHz/°C	Phase-Lock Mode, typically . . . . . −24 MHz/V
With 10% Line Voltage Change . . . . ±600 kHz	External AM
With Time (in a 10-minute period)[1] . . <±4 MHz	Bandwidth, typically . . . . . DC to 100 kHz
Residual FM. Peak (20 Hz to 15 KHz	Sensitivity, typically . . . . . 1 dB/V
bandwidth), (CW mode) . . . . . <100 kHz	External Pulse Modulation
	Rise/Fall Time, typically . . . . . 25 ns
	Minimum RF Pulse Width
	System Leveled, typically . . . . . 1 us
	On/off ratio, typically . . . . . >60 dB
	Pulse Repetition Frequency
	System Leveled . . . . . 10 Hz to 500 kHz
	System Unleveled . . . . . DC Hz to 5 MHz
	HP 8756A, 8757A
	AC Detection Mode Compatibility . . . . . Yes

1. After one hour warmup at selected CW frequency.

OPERATION

INTRODUCTION

This section is intended for operators familiar with the HP 83550A. If you are unfamiliar with this system, refer to the Operator's Check at the end of this section for verification of system operation.

In the operation instructions, instrument settings and function keys are surrounded by the **[ ]** symbols.

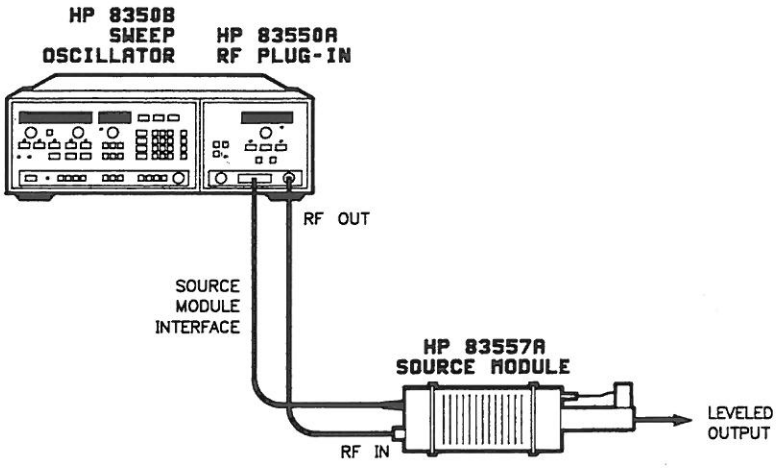


Figure 2a-1. HP 83550A/83557A Source System Configuration

CAUTION

Turn HP 8350B ac power OFF before connecting or disconnecting the source module interface cable.

Connect the system as shown in Figure 2a-1.

FREQUENCY CONTROL

Turn on the HP 8350B and press **[INSTR PRESET]**. The HP 8350B will be automatically initialized to the frequency range of the HP 83557A. You can then choose the appropriate mm-wave frequency you desire from the front panel of the HP 8350B.

Both the HP 8350B and 83550A have built-in self diagnostic and mm-wave source module related error codes to help the user. These error codes will be displayed on the HP 8350B START frequency or RF plug-in POWER level displays should an error occur. For a complete list of these codes, refer to the section titled TROUBLESHOOTING in this guide.

If the HP 83550A is to be used only as an RF plug-in with a frequency range of 8 to 20 GHz, turn off the system, remove the mm-wave source module, then turn the system on again. Otherwise, the HP 83550A will still perform as if connected to the millimeter-wave source module.

POWER LEVEL CONTROL

CAUTION

Before performing any power level calibrations, ensure that the HP 83550A is not at maximum power.

The RF output power of the mm-wave source module is read on the HP 83550A RF plug-in display in this configuration. The output power is controlled by the Power Level Control on the RF plug-in front panel.

When using an HP 83557A (Opt. 001) with an HP 83550A, the output power is unleveled. To provide power control capability with the HP 83557A (Opt. 001), the firmware in the HP 83550A has been upgraded to Revision 6.1. To activate the power control feature, press **[SHIFT] [8] [3]**. To return to leveling with the external signal (standard instrument only), press **[SHIFT] [8] [2]**.

If your HP 83550A does not have firmware revision 6.1 or later, order kit number 83550-90143 to upgrade the firmware.

POWER LEVELING

System Leveling

The HP 83550A/83557A system configuration shown in Figure 2a-1 provides source module leveled output power with corrected power level flatness. When the HP 83550A INT key is active, a portion of the mm-wave power output is sampled using a directional coupler and detector external to the mm-wave source module. This signal is applied to the HP 83550A automatic leveling control circuitry (ALC). The source module output level is displayed on the HP 83550A power display.

External Power Meter Leveling

Output power may also be leveled with a power meter and a directional coupler as shown in Figure 2a-2. Power meter leveling at the mm-wave source module output is possible using the power meters referenced in Table 1-1 (System General Information).

Set the ALC mode to **[MTR]** on the HP 83550A. For best swept accuracy, set the sweep time to 100 seconds when this leveling method is used. A portion of the mm-wave output signal from the source module is coupled/detected and routed to the power meter. The DC voltage from the power meter's recorder output is applied to the HP 83550A ALC input.

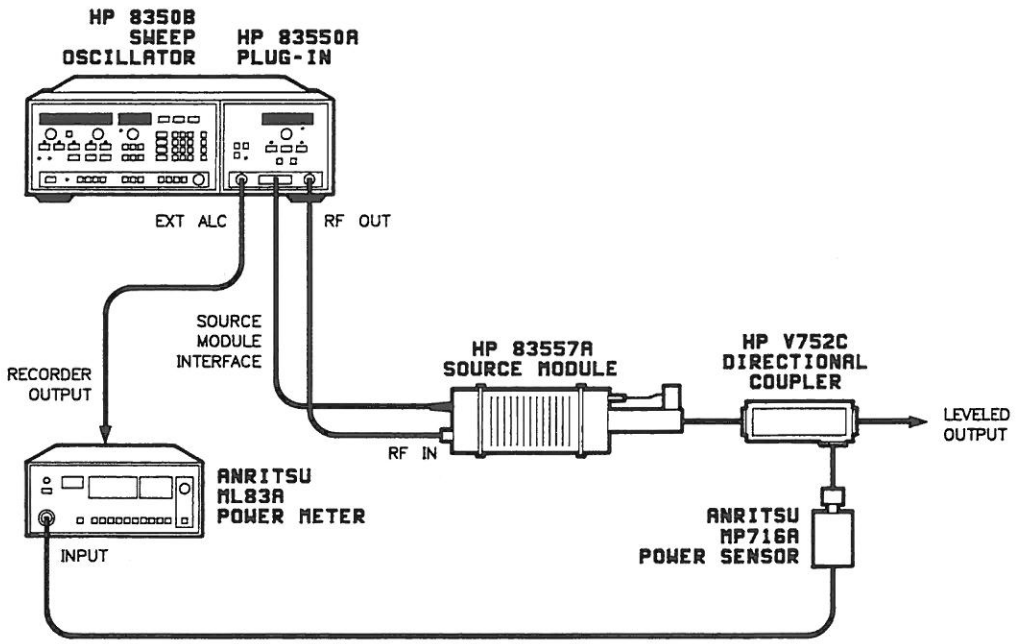


Figure 2a-2. External Power Meter Leveling at the HP 83557A Output

MODULATION

For complete specifications on all three modulation modes described below, refer to Table 2a-1 (HP 83550A/83557A System Specifications).

Frequency Modulation (FM INPUT Connector on HP 8350B)

The HP 83550A/83557A system configuration output signal can be frequency modulated using an external modulating signal applied to the HP 8350 rear panel FM INPUT connector.

The sensitivity and maximum deviations of the HP 83550A are multiplied by a factor of four since the HP 83557A source module is a frequency quadrupler. The sensitivity of the modulating signal may be set via configuration switch A3S1 on the HP 83550A RF plug-in. The following configuration switch settings override HP 8350 non-volatile memory settings at instrument preset. If the configuration switch is changed, you must press Instrument Preset again to load the memory with the new sensitivity settings.

The following is an example of the HP 83550A RF plug-in configuration switch settings. Refer to the HP 83550A Operating and Service manual for further details. The sensitivity setting for the overall system will be multiplied by four, −24 MHz/V and −80 MHz/V.

Description	A3S1 Switch Number 5	6
−6 MHz/V FM Sensitivity	1	1
−20 MHz/V FM Sensitivity	0	X
Cross-over Coupled	X	X

NOTE: 1 = High
0 = Low
X = Don't Care

Amplitude Modulation (AM INPUT Connector on HP 8350B)

The AM INPUT provides amplitude changes (up to approximately 5 dB) proportional to the modulating voltage. The sensitivity is typically 1 dB/V. The AM is typically limited to a frequency response of DC to 100 kHz.

Maximum depth of modulation can be achieved by starting at the maximum power, and decreasing down to the minimum power level possible from the source module. For maximum modulation index, the HP 83557A source module should be set to a power level such that the peak of the modulation waveform does not exceed the maximum specified power level.

Pulse Modulation (PULSE IN Connector)

The application of a pulsed or square wave signal to the PULSE IN connector provides a pulse or square wave modulated signal at the output of the HP 83557A. This input provides an ON/OFF power ratio of typically greater than 60 dB. The PULSE IN input is normally at a TTL HIGH (approximately +3 volts DC). When a TTL LOW signal (approximately 0 volts DC) is applied, the source module output signal is turned off.

With system leveled power, pulse repetition rates from 10 Hz to 500 kHz are achievable.

OPERATOR'S CHECK

DESCRIPTION

The following procedure will enable you to verify the proper operation of your HP 83550A/83557A system by determining the system's output power and flatness performance over the V-band frequency range of 50.0 to 75.0 GHz at the maximum leveled output power of +3 dBm.

EQUIPMENT

Ensure that all the instruments below meet their own performance standards and have been recently calibrated to proper specifications before configuring them into the setup.

RF Signal Source ..... HP 8350B/HP 83550A RF Plug-in
Power Meter ..... Anritsu ML83A
Power Sensor ..... Anritsu MP716A

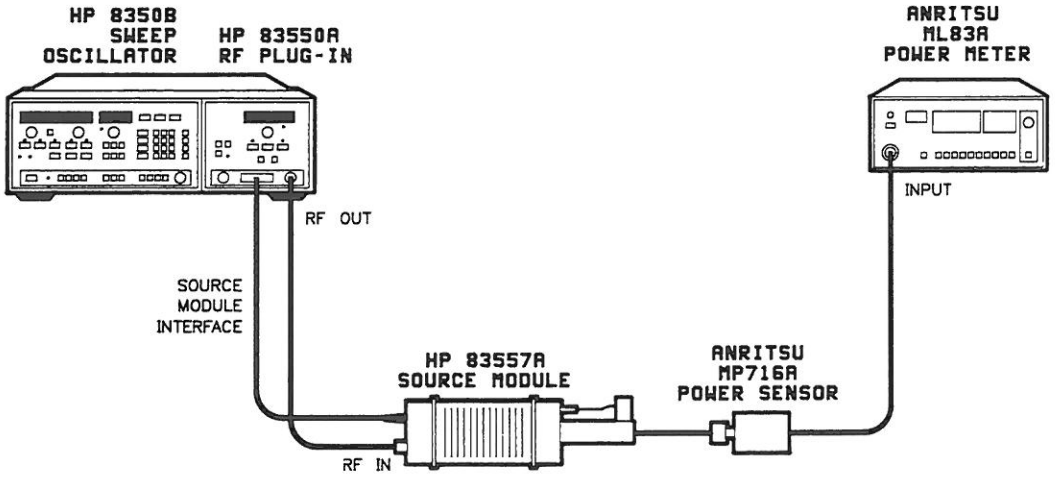


Figure 2a-3. System Configuration

PROCEDURE

1. Connect the equipment as shown in Figure 2a-3. Do not connect the power sensor to the HP 83557A output.

CAUTION

Turn off the ac power on the HP 8350B prior to connecting or disconnecting from the source module interface connector.

2. Turn on all system components.

3. On the power meter:

   Press **[dBm]** mode.

   Zero and calibrate the power meter. Set the CAL FACTOR at 100%. The CAL FACTOR will **not** be changed for the rest of the procedure. By leaving the CAL FACTOR set at 100% it ensures testing for worst case errors.

4. On the HP 8350B:

   Press **[SHIFT] [INSTRUMENT PRESET]**

NOTE: The HP 83550A RF plug-in has built in self diagnostic and source module related error codes to help the user. These error codes are displayed on the HP 8350B START frequency or RF plug-in POWER level displays should an error occur. For a complete list of these codes, refer to the section titled TROUBLESHOOTING in this guide.

   Press **[START] [5] [0] [.] [0] [GHz]**

   Press **[STOP] [7] [5] [.] [0] [GHz]**

   Press **[MAN]** SWEEP and adjust the FREQUENCY/TIME rotary knob for a 50.0 GHz frequency reading.

NOTE: Ensure that the **[⌐¬ MOD]** button is off or it will affect the power level indication on the power meter.

5. On the HP 83550A:

   Press **[INT]** ALC MODE to put the system in the system leveled mode.

   Press **[POWER LEVEL]**

   Adjust the power level rotary knob for a 3.0 dBm reading on the RF plug-in display.

   Connect the Anritsu MP716A power sensor to the HP 83557A output.

   Adjust the power level rotary knob for a 3.0 dBm reading on the power meter display.

6. On the HP 8350B:

   Find the minimum power point between 50.0 GHz and 75.0 GHz by slowly adjusting the FREQUENCY/TIME rotary knob from 50.0 GHz to 75.0 GHz and reading the power meter display. Note at what frequency the minimum power point occurs. See Figure 2a-4.

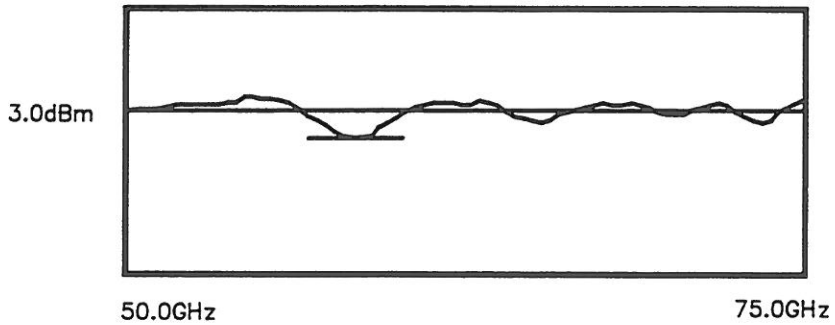


Figure 2a-4. Minimum Power Point (50.0 to 75.0 GHz)

   Enter the frequency of the minimum power point by pressing **[CW] XX.XX [GHz]**.

7. On the HP 83550A:

   Adjust the power level rotary knob until the power meter display reads 3.0 dBm, thus ensuring the minimum power point is at maximum specified output power.

8. On the HP 8350B:

   Press **[START] [5] [0] [.] [0] [GHz]**

   Press **[STOP] [7] [5] [.] [0] [GHz]**

   Slowly adjust the FREQUENCY/TIME rotary knob from 50.0 to 75.0 GHz on the FREQUENCY/TIME display. Observe the power meter display through the entire manual sweep making sure that the power level displayed never exceeds +7.0 dBm. This ensures that from 50.0 to 75.0 GHz, the system's power flatness is within ±2.0 dB of maximum leveled power, 3.0 dBm. See Figure 2a-5.

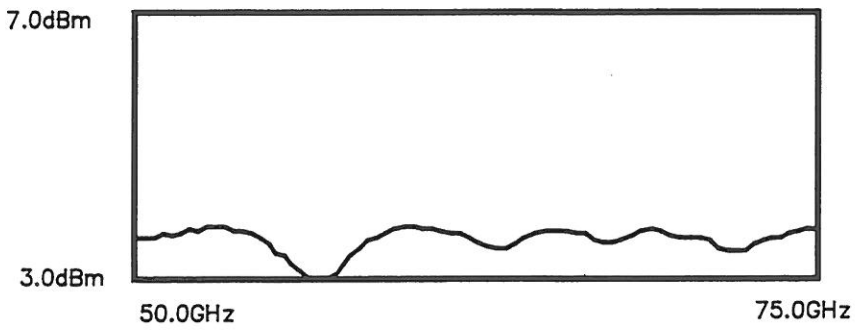


Figure 2a-5. Power Flatness Response (50.0 to 75.0 GHz)

This completes the Operator's Check. If your system fails this functional check refer to the paragraph titled TROUBLESHOOTING.

SYSTEM PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the performance of the HP 83550A/83557A System using the specifications of Table 2a-1 as the performance standards. All tests can be performed without access to the interior of the instrument. The performance test procedures must be performed in the sequence given since some procedures rely on satisfactory test results in the foregoing steps. In order to fully verify the performance specifications of the HP 83557A, the performance tests in the Source Module Specifications and Service section must also be performed. None of the tests require access to the interior of the instrument.

Under the paragraph TROUBLESHOOTING, you will find information on what to do if your system fails to meet specifications.

EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in the Recommended Test Equipment tables in the Source System Guides and the Source Module Specifications and Service Section. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models. Ensure also that the test equipment used is currently calibrated to proper specifications.

NOTE: Use only the connectors and cables that are specified in the following test setups to ensure accurate test results.

OPERATION VERIFICATION

The Operation Verification consists of performing the source module specific performance tests (Source Module Specifications and Service Section) which include, Maximum Leveled Power (verifies frequency range), Power Flatness, and Power Level Accuracy. These tests provide reasonable assurance that the source module is functioning properly and should meet the needs of an incoming inspection (80% verification).

TEST RECORD

Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting or after repairs.

FREQUENCY CHARACTERISTICS

Range
Accuracy
CW Resolution
Stability

MODULATION CHARACTERISTICS

External FM

The performance tests listed above are source dependent and can be found in the Performance Tests of the HP 83550A RF plug-in Operating and Service manual.

NOTE: When specifying the output frequency and modulation characteristics of the HP 83550A/ 83557A system, all specifications will be referenced from the source and must be multiplied by four because the HP 83557A is a frequency quadrupler. For special information about the multipliers, refer to the "Theory of Operation" section found in the "Source Module Specifications and Service" section of this manual.

Table 2a-2. Performance Test Record

HP 83550A System

Serial Number _____ **Date** _____

Humidity* _____ **Tested By** _____

(Optional)** **Temperature _____

Specification Tested	Test Conditions	Specification	Test Results	
			Pass	Fail
FREQUENCY				
Range[1]	_____	50.0 to 75.0 GHz[1]	_____	_____
Accuracy[1]	_____	± 80 MHz[1]	_____	_____
Resolution[1]	_____	104 kHz[1]	_____	_____
Stability[1]				
With Temperature, typically	_____	± 4 MHz/°C[1]	_____	_____
With 10% Line Voltage Change	_____	± 600 kHz[1]	_____	_____
With Time (in a 10 min period)	_____	< ± 4 MHz[1]	_____	_____
Residual FM, Peak (20 Hz to 15 kHz BW, CW Mode)	_____	< 100 kHz[1]	_____	_____
MODULATION				
External FM Maximum Deviations for Modulation				
Frequencies				
Crossover Coupled				
DC to 100 Hz	_____	± 300 MHz[1]	_____	_____
100 Hz to 6 MHz	_____	± 54.0 MHz[1]	_____	_____

1. These specifications are four times those of the HP 83550A specifications because the HP 83557A is a frequency quadrupler.

TROUBLESHOOTING

Specification Failures

Failures are divided into two categories:

Category one describes systems that are meeting specifications in some areas, while failing in others. If this is the case, do the following:

Inspect the connectors and ensure that all connections are making good electrical contact.

Inspect all cabling for breaks.

Test again.

If your system is still failing at the SAME points, your instrument(s) or cable(s) could be defective and should be returned for repair. If, however, your system fails at DIFFERENT points, there is probably a loose connection or a mechanical failure somewhere in the setup.

Remember, it is possible the system may fail the performance test(s) because of measurement uncertainties. If you suspect this to be the case, contact your nearest HP office for more information.

Category two failures are total specification failures. If your system fails any of these tests completely, do the following:

Check the TEST SETUP for correct configuration of the instruments and connections.

Inspect the connectors.

Inspect the cables.

Repeat the failed test(s).

If your system is still failing, the system is probably defective and needs repair.

Also, for the best accuracy in measurement, use only calibrated instruments.

Error Codes

The HP 8350B sweep oscillator and the HP 83550A RF plug-in have a series of internal power-on self tests which will indicate an error code on either the HP 8350B frequency or HP 83550A power displays should a failure occur.

Error codes E001 through E016 are specific to the HP 8350B and indicate a possible failure in the sweep oscillator. Refer to the HP 8350B Operating and Service Manual for information and troubleshooting procedures.

Error codes E050 through E079 are specific to the HP 83550A and indicate a possible failure in the RF plug-in. Refer to the HP 83550A Operating and Service Manual for information and troubleshooting procedures.

Error codes E080 through E086 are specific to the HP 83557A and indicate a possible failure in the source module. Table 2a-3 lists the error codes with descriptions and possible error location.

Table 2a-3. HP 83550A/83557A System Error Codes (1 of 2)

Error Code Displayed	Error Code Description	Possible Location	Cause
E080	Source Module Digital Interface	HP 83557A-A5	On power-up and instrument preset the HP 83550A will attempt to read known constants in predefined source module NOVRAM addresses. If these constants are not returned correctly, the error indicates a problem with the module interface cable or the digital interface assembly in the source module.

This interface error can be isolated to either the HP 83550A RF plug-in or to the HP 83557A source module by initiating a Source Module Digital Interface Cycle Test. This test verifies that the digital signals necessary for proper source module operation are propagating from the HP 83550A RF plug-in source module digital interface connector. This can be performed a follows:

Turn off the HP 8350B ac power and disconnect the source module from the HP 83550A.

On the HP 8350B:
Switch the ac power to on.
Press **[SHIFT] [8] [0]**

Using an oscilloscope, compare the digital interface lines out of the RF plug-in interface connector to the following waveforms. If all the waveforms are present, the error location is either in the source module interface cable or within the source module itself. Should the problem lie in the HP 83550A, refer to the HP 83550A Operating and Service Manual for further troubleshooting information.

Test Pin Location	
HP 83550A A3TP7	
Source Module Interface Connector	Test Trigger
pin 18	MOD D0
pin 19	MOD D1
pin 10	MOD D2
pin 20	MOD D3
pin 8	MOD C0
pin 9	MOD C1

Table 2a-3. HP 83550A/83557A System Error Codes (2 of 2)

Error Code Displayed	Error Code Description	Possible Location	Cause
E081	Source Module NOVRAM Checksum Error	HP 83557A-A5	On power-up and instrument preset, a checksum test is performed on the source module NOVRAM data. If the test fails the error will be displayed.
E082	Source Module +8 VDC Supply Failure	HP 83550A-A3	The +8 VDC power supply is used exclusively for source module operation and this error is indicated when the HP 83550A self-test board measurement of the +8 VDC supply is not within the allowed tolerance.
NOTE: This test is not performed upon power-up or instrument preset unless a source module is connected to the RF plug-in.			
E083	Source Module 0.5 V/GHz Failure	HP 83550A-A5	This error code is indicated when a failure in the 0.5 V/GHz signal has been detected. The test presets the RF plug-in to two known states where the 0.5 V/GHz voltage is at known values. The error is indicated if the measurements do not match the known values.
NOTE: This test is not performed upon power-up or instrument preset unless a source module is connected to the RF plug-in.			
E084	Source Module ALC Failure	HP 83557A-A5	This test measures the logged detector voltage from the source module interface connector. The general integrity of the ALC circuitry and the RF chain is checked when the RF plug-in is in the system leveling mode of operation. This voltage is approximately 0 VDC with the power offset value in the source module memory (0 dBm for the HP 83557A) with a slope of 40 mv/dB. The self test sets the RF plug-in to the minimum settable power for the source module. The power should be leveled at this ALC voltage. The error is indicated if the measured voltage is not within tolerances.
NOTE: This test is not performed upon power-up or instrument preset unless a source module is connected to the RF plug-in. Also, this test is not performed if the RF plug-in is configured for NO RF power at instrument power-up.			

TABLE of CONTENTS
HP 83592C/95C SOURCE SYSTEM GUIDE

Section 2b. HP 83592C/95C Source System Guide

INTRODUCTION

This source system guide is intended to provide you with mm-wave system operating information for the HP 83592C/95C RF plug-ins. It contains an operator's check, connection diagrams, system specifications, system performance tests, and system level troubleshooting. For detailed instructions regarding the operation or troubleshooting of the individual instruments refer to the instrument's operating and service manual.

SYSTEM DESCRIPTION

The HP 83592C/95C RF plug-ins cover the frequency range of 10 MHz to 26.5 GHz. The combination of the HP 83592C/95C RF plug-ins/8350B sweep oscillator with an HP 8349B microwave amplifier delivers the required input power of +17 dBm from 12.5 to 18.75 GHz for the HP 83557A millimeter-wave source module.

For proper display accuracy, leveling flatness, and harmonic suppression, the HP 83592C/95C plug-in's 1V/GHz output will have to be modified for a 0.5V/GHz output. If the serial number prefix of your plug-in matches or exceeds 2602A, the 0.5V, 1.0V/GHz frequency reference output is switch selectable on the A2 interface assembly. Refer to the HP 83592C/95C Operating and Service manuals or the latest manual change sheet.

Also, for best ALC and pulse performance and the ability to externally power meter level with the Anritsu power meter, it is a requirement that the HP 83592C/95C have the latest version of the A4-ALC assembly. Another requirement is the sweep control assembly. It must be the latest revision to allow external leveling at lower RF plug-in output powers when used in millimeter-wave applications. If the serial number prefix of your plug-in matches or exceeds any of the prefixes listed in the box below, the latest version of the A4-ALC and A6-sweep control assemblies are already installed.

RF Plug-in	Lowest Serial Number Prefix with the Required A4 and A6 Assemblies
83592C 83595C	2412A All Prefixes

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

SYSTEM SPECIFICATIONS

Table 2b-1 provides specifications for the HP 83592C/95C RF plug-in/83557A system configuration. These are the performance standards against which the system is tested.

Table 2b-1. HP 83592C/95C/83557A System Specifications

Frequency Characteristics

Range . . . . . 50.0 to 75.0 GHz
Accuracy (25°C ± 5°C)
  CW Mode . . . . . ± 40 MHz
All Sweep Modes
  (for sweep time > 100 msec) . . . . . ± 120 MHz
CW Resolution . . . . . 104 kHz
Stability
  With Temperature, typically . . . . . ± 2.4 MHz/°C
  With 10% Line Voltage Change . . . . . ± 600 kHz
  With Time (in a 10-minute period)[1] . . < ± 1200 kHz
  Residual FM. Peak (20 Hz to 15 kHz bandwidth)
    (CW mode) . . . . . < 36 kHz

Modulation Characteristics

External FM
Maximum Deviations for Modulation Frequencies
  Crossover Coupled
    DC to 100 Hz . . . . . ± 300 MHz
    100 Hz to 1 MHz . . . . . ± 28 MHz
    1 MHz to 2 MHz . . . . . ± 20 MHz
    2 MHz to 10 MHz . . . . . ± 4 MHz

Modulation Characteristics (Cont'd)

  Direct Coupled
    DC to 100 Hz . . . . . ± 48 MHz
    100 Hz to 1 MHz . . . . . ± 28 MHz
    1 MHz to 2 MHz . . . . . ± 20 MHz
    2 MHz to 10 MHz . . . . . ± 4 MHz
Sensitivity
  FM Mode, typically . . . . . − 80 MHz/V
  Phase-Lock Mode, typically . . . . . − 24 MHz/V
External AM
  Bandwidth, typically . . . . . DC to 100 kHz
  Sensitivity, typically . . . . . 1 dB/V
External Pulse Modulation
  Rise/Fall Time, typically . . . . . 10 ns
  Minimum RF Pulse Width
    System Leveled, typically . . . . . 1 µs
  On/Off Ratio, typically . . . . . > 80 dB
  Pulse Repetition Frequency
    System Leveled . . . . . 100 Hz to 500 KHz
    System Unleveled . . . . . 100 Hz to 5 MHz
  HP 8756A, 8757A
    AC Detection Mode Compatability . . . . . Yes

1. After one hour warmup at selected CW frequency.

OPERATION

INTRODUCTION

This section is intended for operators familiar with the HP 8350B/83592C/95C series instruments. If you are unsure, refer to the Operators Check at the end of this section for more specific instructions.

In the operation instructions, any instrument setting or function key is defined by the [ ] symbols around it.

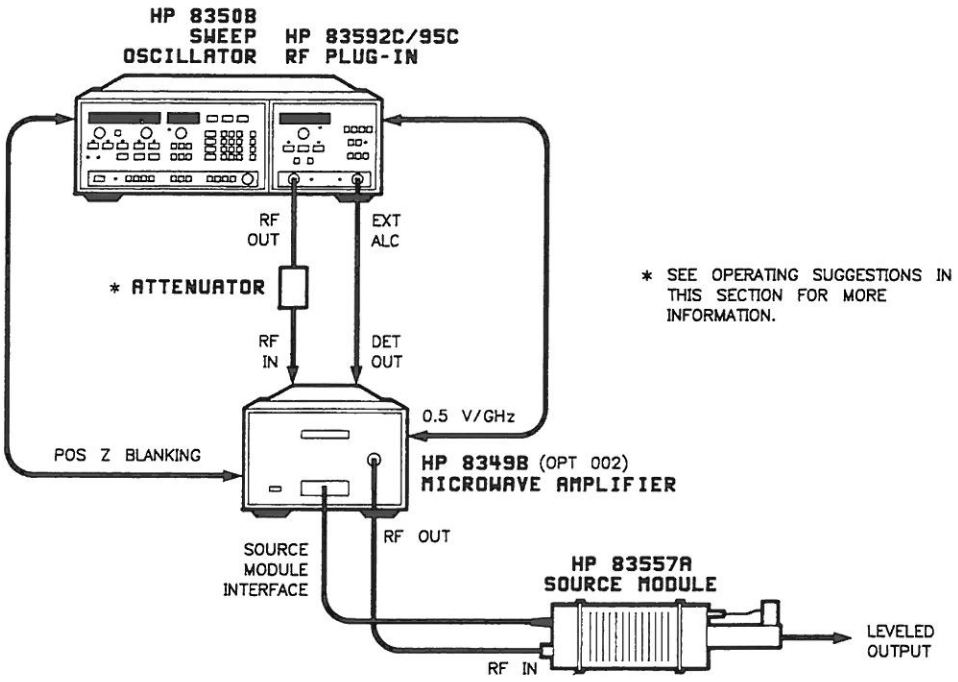


Figure 2b-1. HP 83592C/95C/83557A Source System Configuration

CAUTION

Turn off the ac power on the HP 8349B prior to connecting or disconnecting the source module interface cable.

Connect the system as shown in Figure 2b-1.

FREQUENCY CONTROL

After the connections have been made, turn on the system instruments, and press **[INSTR PRESET]**on the HP 8350B. Allow the instruments to warm-up for 30 minutes. Next, enter a display multiplier on the HP 8350B so that the multiplied output frequency will be correctly displayed. A multiplication factor of four is entered by pressing:

[SHIFT] [START] [4] [MHz]

Once the multiplication factor is entered, you can now directly set the frequency range of interest on the HP 8350B front panel.

NOTE: Entering frequencies outside the 50.0 to 75.0 GHz (12.5 to 18.75 GHz) are invalid and the system will not work properly.

The multiplication factor may be reset to one by pressing:

[INSTR PRESET]

or by entering a multiplication factor of one by pressing:

[SHIFT] [START] [1] [MHz]

The multiplication factor may be "locked" by pressing:

[SHIFT] [ALT]

This eliminates having to re-enter the multiplication factor each time INSTR PRESET is pressed.

The lock may be removed and the multiplication factor may be reset to one by pressing:

[SHIFT] [INSTR PRESET]

POWER LEVEL CONTROL

Before performing any power level calibrations, ensure that the plug-in is not at maximum power.

The RF output power of the mm-wave source module is read on the HP 8349B display in this configuration. However, the output power level is controlled by the Power Level Control on the RF plug-in front panel. The power display of the HP 83592C/95C can be adjusted to match the display on the HP 8349B with the following steps:

Activate the **[EXT]** leveling key on the RF plug-in.

Set the power level of the HP 83592C/95C to 3.0 dBm using the rotary knob (plug-in) or keypad of the HP 8350B.

Set the frequency of the HP 8350B to a CW frequency within the desired frequency range.

Turn the CAL (Calibration adjustment) shown in Figure 2b-2 until the power output display of the HP 8349B reads 3.0 dBm.

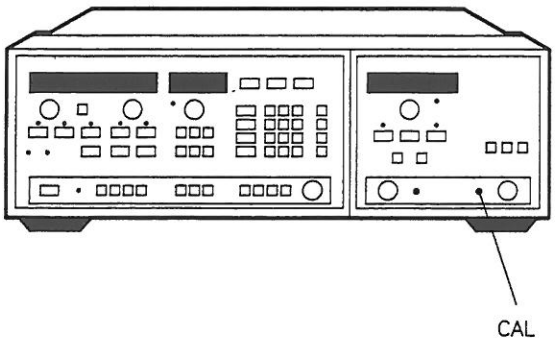


Figure 2b-2. HP 83592C/95C CAL Adjustment Location

POWER LEVELING

System Leveling

The source system configuration shown in Figure 2b-1, provides leveled source module output power with corrected power level flatness. With the EXT key on the RF plug-in active, a portion of the source module output power is coupled out of a directional coupler and detector internal to the source module. This signal is processed and fed through the HP 8349B DET OUT and connected to the RF plug-in external ALC input.

External Power Meter Leveling

Output power may also be leveled with a power meter and a directional coupler as shown in Figure 2b-3. Power meter leveling at the mm-wave source module output is possible using the power meters referenced in Table 1 (System General Information).

Set the plug-in ALC mode to **[MTR]**. For best accuracy, limit the sweep time to 100 seconds when this leveling method is used. A portion of the output power from the source module is coupled/detected and routed to the power meter. The DC voltage from the power meter recorder output is then applied to the RF plug-in external ALC input.

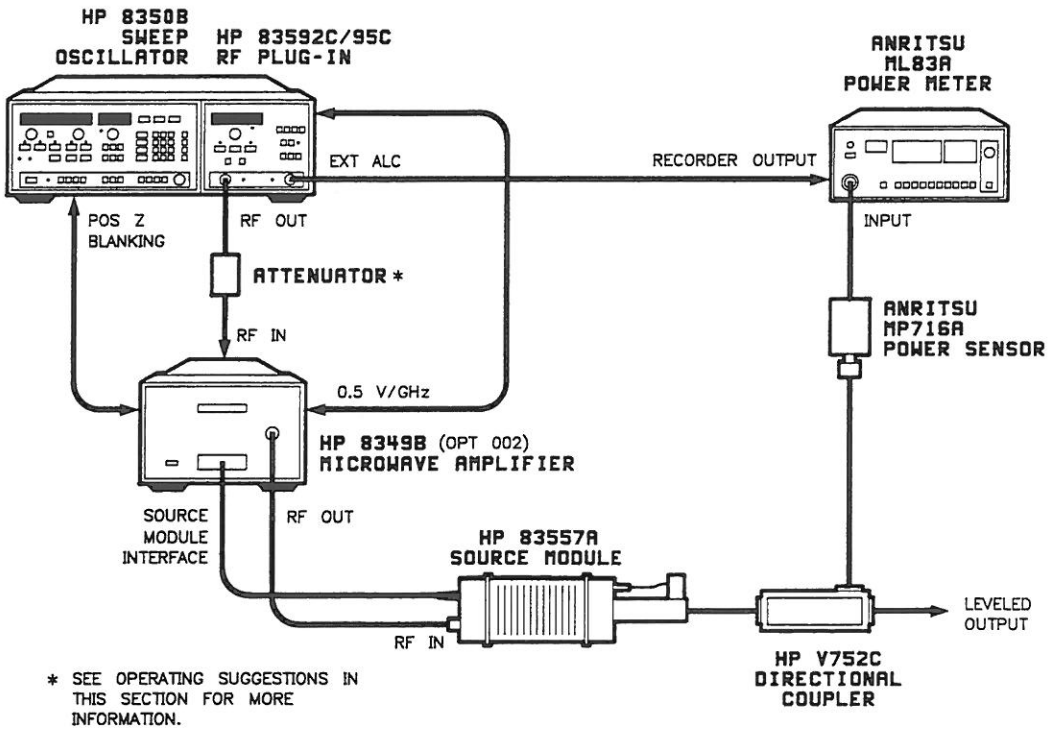


Figure 2b-3. External Power Meter Leveling at the HP 83557A Output

MODULATION

For complete specifications on all modulation modes described below, refer to Table 2b-1 (HP 83592C/95C/83557A System Specifications).

Frequency Modulation (FM INPUT Connector on HP 8350B)

The HP 83592C/95C/83557A system output signal can be frequency modulated using an external modulating signal applied to the HP 8350B rear panel FM INPUT connector.

The sensitivity and maximum deviations of the RF plug-in are multiplied by a factor of four because the HP 83557A source module is a frequency quadrupler. On the HP 83592C/95C, the sensitivity and coupling may be set via a configuration switch A3S1. The following configuration switch settings override the HP 8350 non-volatile memory settings at instrument preset. If the configuration switch settings are changed, you must press Instrument Preset again to load the memory with the new sensitivity and coupling settings.

The following is an example of the HP 83592C RF plug-in configuration switch settings. Refer to the specific RF plug-in operating and service manual for further details. The sensitivity setting for the overall system will be multiplied by four, −24MHz/V and −80 MHz/V.

Description	A3S1 Switch Number 5	6
−6 MHz/V FM Sensitivity	1	1
−20 MHz/V FM Sensitivity	0	X
Direct-Coupled	*	0
Cross-over Coupled	X	1

NOTE: 1 = High
0 = Low
X = Don't Care
When direct-coupled FM is selected (switch number 6), −20MHz/V is automatically selected.

Amplitude Modulation (AM INPUT Connector on HP 8350B)

On this source system configuration, the AM INPUT provides amplitude changes (up to approximately 5 dB) proportional to the modulating voltage. The sensitivity is typically 1 dB/V. The AM is typically limited to a frequency response of DC to 100 kHz.

Maximum depth of modulation can be achieved by starting at the maximum power and decreasing down to the minimum power level possible from the source module. For maximum modulation index, the HP 83557A source module should be set to a power level such that the peak of the modulation waveform does not exceed the maximum specified power level.

Pulse Modulation (PULSE IN Connector)

The application of a pulse or square wave signal to the PULSE IN connector provides a pulse or square wave modulated signal at the output of the HP 83557A. This input provides an ON/OFF power ratio of typically greater than 80 dB. The PULSE IN input is normally at a TTL HIGH (approximately +3 volts DC). When a TTL LOW signal (approximately 0 volts DC) is applied, the source module output signal is turned off.

With system leveled power, pulse repetition rates from 100 Hz to 500 kHz are achievable.

OPERATING SUGGESTIONS

When using an HP 83592C/95C as the source driver, you can optimize the ALC loop performance by using fixed attenuator(s). For example, typical HP 83592C/95C/83557A system power levels (not optimized) over the specified range, are as follows:

RF Plug-in (dBm)		HP 8349B (dBm)		HP 83557A (dBm)
Display	**Output**	**Display**	**Output**	**Output**
+3.0 −2.0	−10.0 −26.0	+3.0 −2.0	+12.0 −4.0	+3.0 −2.0

The RF plug-in power output levels are quite low and can possibly reach the lower limit of the ALC modulator range. By adding a fixed attenuator(s) between the RF plug-in and the HP 8349B amplifier the overall system power level will decrease. A corresponding change in ALC drive signal will cause the RF plug-in to increase output power to correct for the apparent power loss. Thereby, avoiding ALC loop performance problems without overall system performance degradation.

Optimization of the system leveling loop is especially important in scalar network applications when square wave modulation is used. The square wave modulation performance of the RF plug-in is significantly better between maximum output power (depends upon which plug-in) and 15 db lower. By forcing an increase in power with an attenuator(s) the performance improvement is noticeable.

OPERATOR'S CHECK

DESCRIPTION

The following procedure will enable you to verify the proper operation of your HP 83592C/95C/83557A system by determining the system's output power and flatness performance over the V-band frequency range of 50.0 to 75.0 GHz at maximum leveled output power.

EQUIPMENT

Ensure that all the instruments below meet their own performance standards and have been recently calibrated to proper specifications before configuring them into the setup.

RF Signal Source ..... HP 8350B/HP 83592C/95C
Microwave Amplifier ..... HP 8349B
Power Meter ..... Anritsu ML83A
Power Sensor ..... Anritsu MP716A

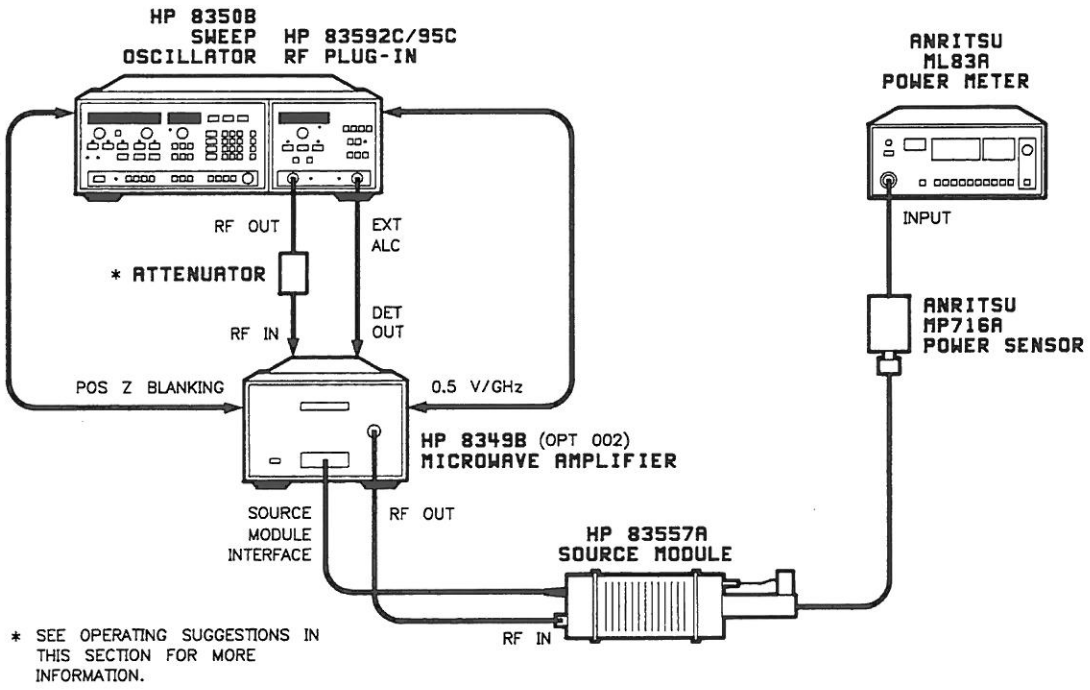


Figure 2b-4. System Configuration

PROCEDURE

1. Connect the equipment as shown in Figure 2b-4. Do not connect the power sensor to the HP 83557A output.

CAUTION

Turn off the AC power on the HP 8349B prior to connecting or disconnecting from the source module interface connector.

2. Turn on all system components.

3. On the power meter:

   Press **[dBm]** mode.

   Zero and calibrate the power meter. Set the CAL FACTOR at 100%. The CAL FACTOR will **not** be changed for the rest of the procedure. By leaving the CAL FACTOR set at 100% it ensures minimum specifications will be met.

4. On the HP 8350:

   Press **[SHIFT] [INSTRUMENT PRESET]**

   Press **[SHIFT] [START] [4] [MHz]**

   Press **[SHIFT] [ALTn]**

   Press **[START] [5] [0] [GHz]**

   Press **[STOP] [7] [5] [GHz]**

   Press **[MAN]** SWEEP and adjust the FREQUENCY/TIME rotary knob for a 50.0 GHz frequency reading.

NOTE: Ensure that the **[⌐¬ MOD]** button is off or it will affect the power level indication on the power meter.

5. On the RF Plug-in:

   Press **[EXT]** ALC MODE to put the system in the system leveled mode.

   Press **[POWER LEVEL]**

   Adjust the power level rotary knob for a 3.0 dBm reading on the RF plug-in display.

   Connect the Anritsu MP716A power sensor to the HP 83557A output.

   Adjust the RF plug-in EXT ALC CAL potentiometer for a 3.0 dBm reading on the power meter display. The displays of the RF plug-in, amplifier and power meter should all read 3.0 dBm (within the display tolerances).

6. On the HP 8350:

   Find the minimum power point between 50.0 GHz and 75.0 GHz by slowly adjusting the FREQUENCY/TIME rotary knob from 50.0 GHz to 75.0 GHz and reading the power meter display. Note at what frequency the minimum power point occurs. See Figure 2b-5.

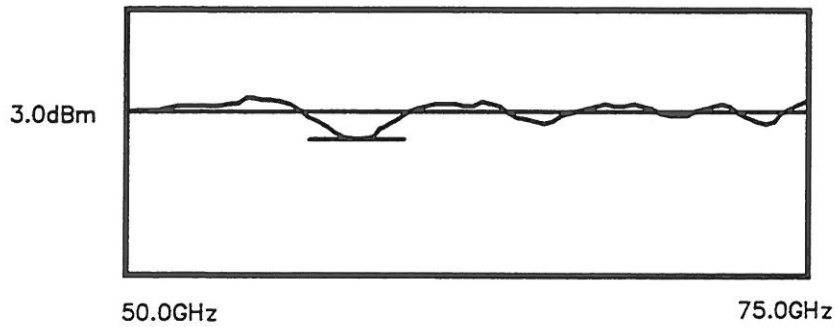


Figure 2b-5. Minimum Power Point (50.0 to 75.0 GHz)

Enter the frequency of the minimum power point by pressing **[CW] XX.XX [GHz]**

7. On the RF Plug-in:

   Adjust the EXT ALC CAL potentiometer until the power meter display reads 3.0 dBm, thus ensuring the minimum power point is at maximum specified output power.

8. On the HP 8350:

   Press **[RECALL] [1]**

   Slowly adjust the FREQUENCY/TIME rotary knob from 50.0 to 75.0 GHz on the FREQUENCY/TIME display. Observe the power meter display through the entire manual sweep making sure that the power level displayed never exceeds 7.0 dBm. This ensures that from 50.0 to 75.0 GHz, the system's power flatness is within ±2.0 dB of maximum leveled power, 3.0 dBm. See Figure 2b-6.

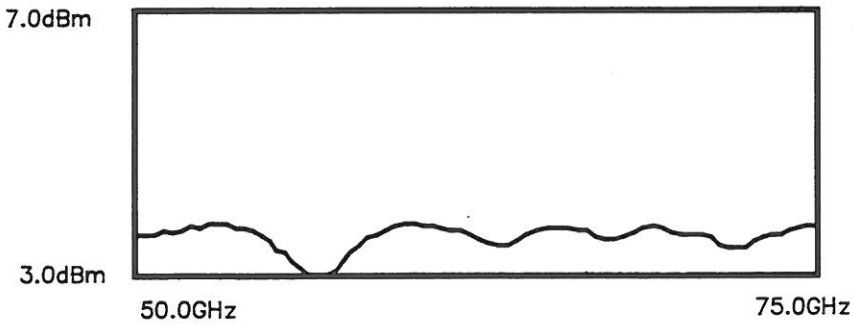


Figure 2b-6. Power Flatness Response (50.0 to 75.0 GHz)

NOTE: Ensure that the **[⌐¬ MOD]** button is off or it will affect the power level indication on the power meter.

This completes the Operator's Check. If your system fails this functional check refer to the paragraph titled TROUBLESHOOTING.

SYSTEM PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the performance of the HP 83592C/95C/83557A System using the specifications of Table 2b-1 as the performance standards. All tests can be performed without access to the interior of the instrument. The performance test procedures must be performed in the sequence given since some procedures rely on satisfactory test results in the foregoing steps. In order to fully verify the performance specifications of the HP 83557A, the performance tests in the Source Module Specifications and Service section must also be performed. None of the tests require access to the interior of the instrument.

Under the paragraph, TROUBLESHOOTING, you will find information on what to do if your system fails to meet specifications.

EQUIPMENT REQUIRED

Equipment required for the performance tests are listed in the Recommended Test Equipment tables under the tab Source System Guides, and Specifications and Service section of the manual. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models. Ensure also that the test equipment used is currently calibrated to proper specifications.

NOTE: Use only the connectors and cables that are specified in the following test setups to ensure accurate test results.

OPERATION VERIFICATION

The Operation Verification consists of performing the source module specific performance tests (Source Module Specifications and Service Section) which include, Maximum Leveled Power (verifies frequency range), Power Flatness, and Power Level Accuracy. These tests provide reasonable assurance that the source module is functioning properly and will meet the needs of an incoming inspection (80% verification).

TEST RECORD

Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting or after repairs.

FREQUENCY CHARACTERISTICS

Range
Accuracy
CW Resolution
Stability

MODULATION CHARACTERISTICS

External FM

The performance tests listed above are source dependent and can be found in the Performance Tests of the HP83592C/95C Operating and Service manuals.

NOTE: When specifying the output frequency and modulation characteristics of the HP 83592C/95C/83557A system, all frequency specifications will be referenced from the sources used and must be multipled by four because the HP 83557A is a frequency quadrupler. For special information about the quadrupler, refer to the "Theory of Operation" section found in the "Source Module Specifications and Service" section of this manual.

Table 2b-2. Performance Test Record Card

HP 83592C/95C

Serial Number _____ **Date** _____

Humidity* _____ **Tested By** _____

(Optional)** **Temperature _____

Specification Tested	Test Conditions	Specification	Test Results	
			Pass	Fail
FREQUENCY				
Range[1]	_____	50.0 to 75.0 GHz[1]	_____	_____
Accuracy[1]	_____	± 40 MHz[1]	_____	_____
Resolution[1]	_____	104 kHz[1]	_____	_____
Stability[1]				
With Temperature, typically	_____	± 2.4 MHz/°C[1]	_____	_____
With 10% Line Voltage Change	_____	± 600 kHz[1]	_____	_____
With Time (in a 10 min period)	_____	< ± 1.2 GHz[1]	_____	_____
Residual FM, Peak (20 Hz to 15 kHz BW, CW Mode)	_____	< 36 kHz[1]	_____	_____
MODULATION				
External FM Maximum Deviations for Modulation				
Frequencies				
Crossover Coupled				
DC to 100 Hz	_____	± 300 MHz[1]	_____	_____
100 Hz to 1 MHz	_____	± 28 MHz[1]	_____	_____
1 MHz to 2 MHz	_____	± 20 MHz[1]	_____	_____
2 MHz to 10 MHz	_____	± 4 MHz[1]	_____	_____
Direct Coupled (− 80 MHz/V only)				
DC to 100 Hz	_____	± 48 MHz[1]	_____	_____
100 Hz to 1 MHz	_____	± 28 MHz[1]	_____	_____
1 MHz to 2 MHz	_____	± 20 MHz[1]	_____	_____
2 MHz to 10 MHz	_____	± 4 MHz[1]	_____	_____

1. These specifications are referenced from the appropriate HP 83590 Series RF plug-in manuals and have been multiplied by a factor of 4 because the HP 83557A is a frequency quadrupler.

Specification Failures

Failures are divided into two categories:

Category one describes systems that are meeting specifications in some areas, while failing others. If this is the case, do the following:

Inspect the connectors and ensure that all connections are making good electrical contact.

Inspect all cabling for breaks.

Test again.

If your system is still failing at the SAME points, your instrument(s) or cable(s) could be defective and should be returned for repair. If, however, your system fails at DIFFERENT points, there is probably a loose connection or a mechanical failure somewhere in the setup.

Remember, it is possible the system may fail the test(s) because of measurement uncertainties. If you suspect this to be the case contact your nearest HP office for more information.

Category two failures are total specification failures. If your system fails any of these tests completely, do the following:

Check the TEST SETUP for correct configuration of the instruments and connections.

Inspect the connectors.

Inspect the cables.

Repeat the failed test(s).

If your system is still failing, the system is probably defective and needs repair.

Remember for the best accuracy in measurement, use only calibrated instruments.

TABLE of CONTENTS
HP 8341B (Opt. 003) SOURCE SYSTEM GUIDE

Section 2c. HP 8341B (Opt. 003) Source System Guide

INTRODUCTION

This source system guide is intended to provide you with mm-wave system operating information for the HP 8341B (Opt. 003) synthesizer. It contains an operator's check, connection diagrams, system specifications, system performance tests, and system level troubleshooting. For detailed instructions regarding the operation or troubleshooting of the individual instruments, refer to the instrument's operating and service manual.

SYSTEM DESCRIPTION

The HP 8341B (Opt. 003) (10 MHz to 20 GHz) synthesized sweeper (hereafter referred to as HP 8341B) operates over the frequency range required by the HP 83557A millimeter-wave source module.

The HP 8341B synthesized sweeper combines with an HP 8349B microwave amplifier (with the built-in source module interface) to deliver the required 12.5 to 18.75 GHz input frequency and +17 dBm of output power for driving the HP 83557A source module.

NOTE: The HP 8341B synthesized sweeper requires a synthesizer interface cable for operation in a mm-wave system. This cable is included with the HP 83557A Source Module.

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

SYSTEM SPECIFICATIONS

Table 2c-1 provides specifications for the HP 8341B synthesized sweeper/83557A system configuration. These are the performance standards against which the system is tested.

Table 2c-1. HP 8341B/83557A System Specifications

Frequency Characteristics	**Modulation Characteristics**
Range .....50.0 to 75.0 GHz	External FM
Accuracy[1] (25°C ±5°C)	Bandwidth .....50 kHz to 10 MHz
CW Mode .....Same as time base	Deviaiton .....the lesser of 40 MHz
Time Base[2] .....Internal 10 MHz time base	or 40 x fmod from 50.0 to 75.0 GHz
Aging rate: less than 1 x 10^{-9}/day and	Sensitivity .....4 MHz/V or 40 MHz/V
2 x 10^{-7}/year after 30-day warmup.	External AM
Temperature Effect: <1 x 10^{-10}/°C	Bandwidth, typically .....DC to 100 kHz
Line Voltage Effect: <1 x 10^{-11}/±10%.	Sensitivity, typically 100%/V
All Sweep Modes	External Pulse Modulation
(for sweep time >100 msec)[3]	Rise/Fall Time, typically .....50 ns
ΔF ≤ (n) 20 MHz .....+1% of ΔF	Minimum RF Pulse Width
± time base accuracy	System Leveled .....1 us
(n) 20 MHz ≥ΔF ≤1200 MHz .....±2% of ΔF	On/off ratio, typically .....>80 dB
ΔF ≥1200 MHz .....±1% of ΔF	Pulse Repetition Frequency
or ±200 MHz, whichever is less	System Leveled .....100 Hz to 500 kHz
n = harmonic band (1−4) of the HP 8341B	System Unleveled .....100 Hz to 5 MHz
CW Resolution .....12 Hz	HP 8756A and 8757A
	AC Detection Mode Compatibility .....Yes

1. Specifications referenced are source driver specific (HP 8341B) and do not indicate the quadrupling effect of the source module.
2. Overall accuracy of internal timebase is a function of timebase calibration ± aging rate ± temperature effects ± line effects.
3. After one hour warmup at selected CW frequency.

OPERATION

INTRODUCTION

This section is intended for operators familiar with the HP 8341B instruments. If you are unfamiliar with this system, refer to the Operator's check at the end of this section for more specific instructions.

In the operation instructions, any instrument setting or function key is defined by [ ] symbols around it.

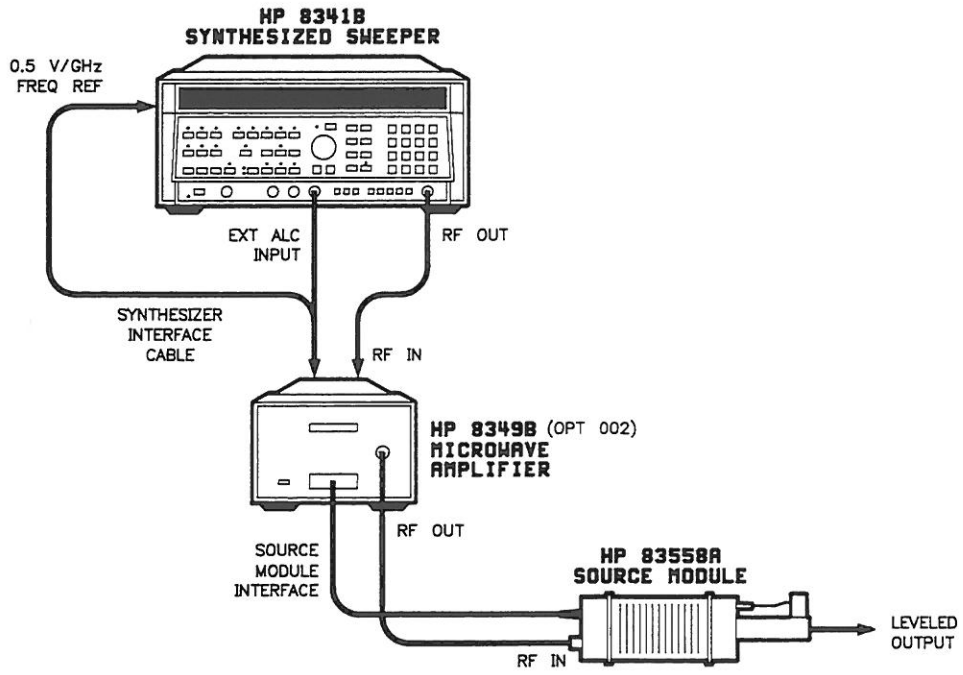


Figure 2c-1. HP 8341B/83557A Source System Configuration

CAUTION

Turn off the ac power on the HP 8349B prior to connecting or disconnecting the source module interface cable.

Connect the system as shown in Figure 2c-1.

FREQUENCY CONTROL

After the connections have been made, turn on the system, and press **[INSTR PRESET]** on the HP 8341B. Allow instruments to warm-up 30 minutes. Enter a display multiplier on the HP 8341B so that the multiplied output frequency will be correctly displayed. A multiplication factor of four should be entered by pressing:

[SHIFT] [START] [4] [Hz]

Once the multiplication factor is entered you can directly set the frequency range of interest on the HP 8341B front panel.

NOTE: Entering frequencies outside 50.0 to 75.0 GHz (12.5 to 18.75 GHz) are invalid and the system will not work properly.

The multiplication factor may be reset to one by pressing:

[INSTR PRESET]

or by entering a multiplication factor of one by pressing:

[SHIFT] [START] [1] [Hz]

The multiplication factor may be "locked" by pressing:

[SHIFT] [ALT]

This eliminates having to re-enter the multiplication factor each time INSTR PRESET is pressed.

The lock may be removed and the multiplication factor may be reset to one by pressing:

[SHIFT] [INSTR PRESET]

POWER LEVEL CONTROL

CAUTION

Before performing any power level calibrations, ensure that the HP 8341B synthesizer is not at maximum power.

Power is controlled by pressing **[POWER LEVEL]**. The step keys, rotary knob, or keypad controls the output power from the synthesizer. The actual output power from the mm-wave source module is read on the HP 8341B PWR dBm display in the system leveled mode. To activate system leveling, **[SHIFT] [XTAL]**. Once activated, the display will read **"EXT MODULE POWER: – XX.XX dBm"** and the internal attenuator is automatically set at 0 dB. The HP 8341B internal attenuator is controlled by pressing **[SHIFT] [SLOPE]** and should normally be set to 0 dB.

POWER LEVELING

System Leveling

System leveling provides calibrated, flat power from the output of the mm-wave source module. The HP 8341B/83557A configuration shown in Figure 2c-1 provides leveled source module output power with corrected power level flatness. With the **[SHIFT] [XTAL]** keys on, a portion of the source module power output is coupled out of a directional coupler and detector internal to the source module. This signal is processed and fed through the HP 8349B synthesizer interface and applied to the HP 8341B ALC circuit.

External Power Meter Leveling

Output power may also be leveled with a power meter and a directional coupler as shown in Figure 2c-2. Power meter leveling at the source module output is possible using the power meters referenced in Table 1-1 (System General Information).

Set the ALC mode to **[METER]** on the HP 8341B. The sweep time is limited to 100 seconds when this leveling method is used. A portion of the mm-wave output signal from the source module is coupled/ detected and routed to the power meter. The DC voltage from the power meter recorder output is then applied to the HP 8341B external ALC circuit.

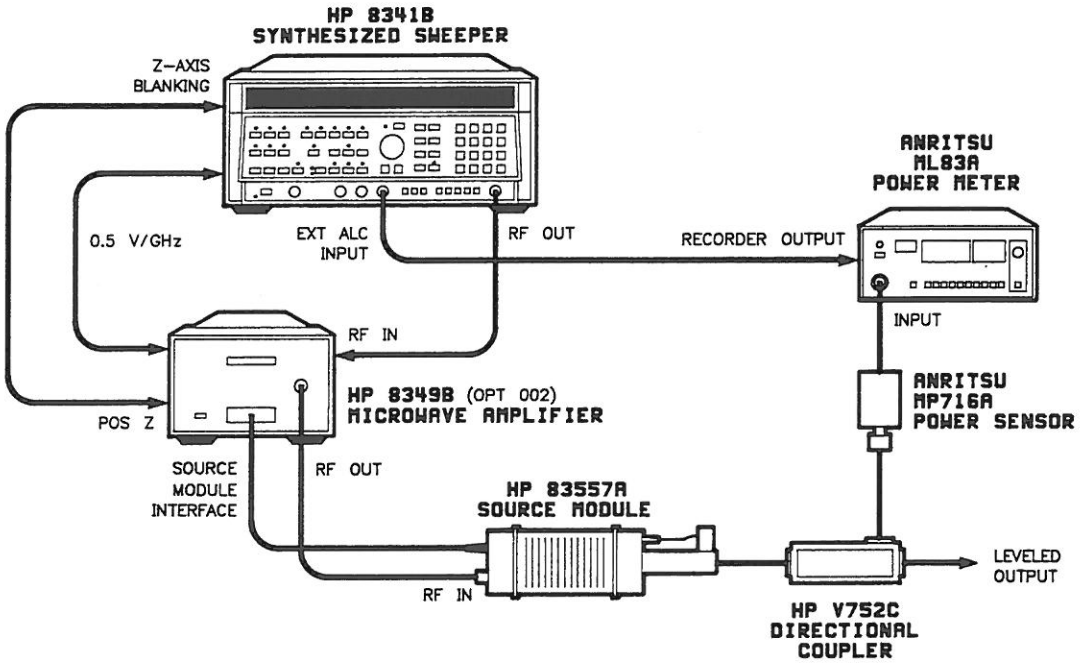


Figure 2c-2. External Power Meter Leveling at the HP 83557A Source Module Output

MODULATION

For complete specifications on all modulation modes described below, refer to Table 2c-1 (HP 8341B/83557A System Specifications).

Frequency Modulation (FM Connector on HP 8341B)

With the FM key activated, the source module may be frequency modulated from an external input signal. The FM deviation is multiplied by four by the HP 83557A source module but the displayed FM sensitivity remains correct as long as the frequency multiplication factor remains at four.

FM sensitivities of 2 MHz/V or 20 MHz/V are available over a bandwidth of 50 Khz to 10 MHz.

Amplitude Modulation (AM Connector on HP 8341B)

When the AM key is activated, the AM input is used for linear, DC-coupled amplitude modulation. The small signal −3 dB bandwidth extends from DC to 100 kHz.

The sensitivity is 100% per volt. This means that +1.0 volt doubles the output voltage (+6 dB), while −1.0 volt shuts the output completely off.

For maximum modulation index, the HP 83557A source module should be set to a power level 3 dB below maximum power (note that 3 dB power is 6 dB volts).

Pulse Modulation (PULSE Connector on HP 8341B)

With the PULSE key activated, and the HP 8341B internally leveled, the application of a pulsed or square wave signal to the PULSE connector provides a pulsed or square wave modulated signal at the output of the HP 83557A. This input provides an ON/OFF power ratio of greater than 80 dB. The PULSE IN input is normally at a TTL HIGH (approximately +3 volts DC). When a TTL LOW signal (approximately 0 volts DC) is applied, the mm-wave output signal is turned off.

OPERATING SUGGESTIONS

When using an HP 8341B synthesizer as the source driver, you can optimize the ALC loop performance by using fixed attenuator(s). For example, typical HP 8341B/83557A system power levels (not optimized) over the specified range, are as follows:

SYNTHESIZER (dBm)		HP 83557A (dBm)
DISPLAY	OUTPUT	OUTPUT
+3.0 −2.0	−10.0 −26.0	+3.0 −2.0

The RF synthesizer power output levels are quite low and can possibly reach the lower limit of the ALC modulator range. By adding a fixed attenuator(s) between the RF synthesizer and the HP 8349B amplifier, the overall system power level will decrease. A corresponding change in ALC drive signal will cause the RF synthesizer to increase output power to correct for the apparent power loss and thereby operate at a more desirable ALC level.

OPERATOR'S CHECK

DESCRIPTION

The following procedure will enable you to verify the proper operation of your HP 8341B/83557A system by determining the system's output power and flatness performance over the V-band frequency range of 50.0 to 75.0 GHz at maximum leveled output power.

EQUIPMENT

Ensure that all the instruments below meet their own performance standards and have been recently calibrated to proper specifications before configuring them into the setup.

RF Signal Source ..... HP 8341B Synthesized Sweeper
Microwave Amplifier ..... HP 8349B
Power Meter ..... Anritsu ML83A
Power Sensor ..... Anritsu MP716A

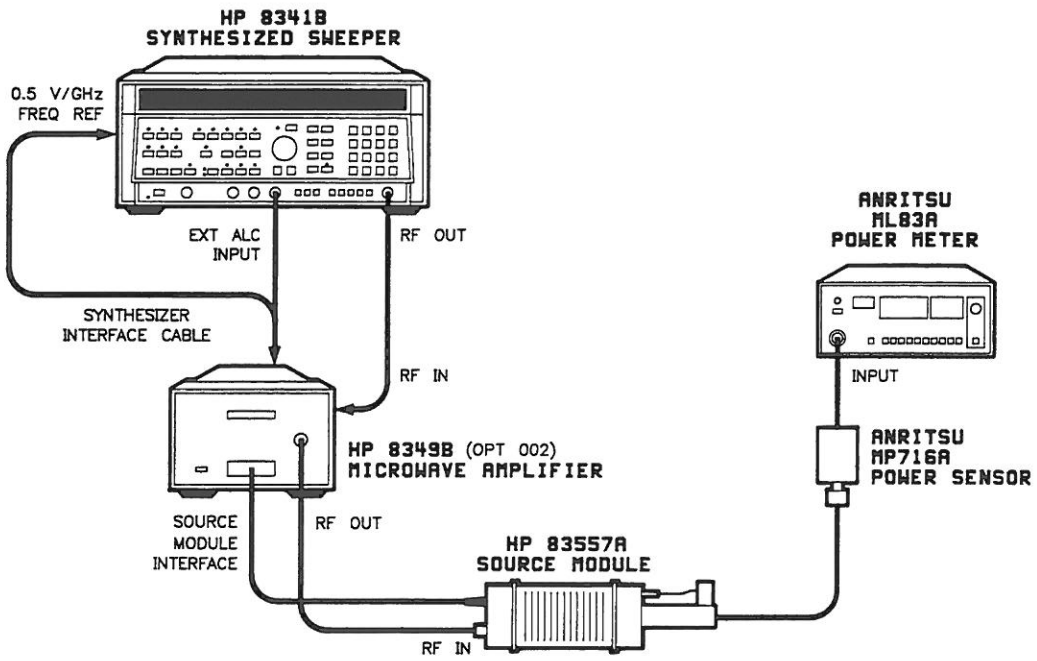


Figure 2c-3. System Configuration

PROCEDURE

1. Connect the equipment as shown in Figure 2c-3. Do not connect the power sensor to the HP 83557A output.

CAUTION

Turn off the AC power on the HP 8349B prior to connecting or disconnecting from the source module interface connector.

2. Turn on all system components.
3. On the power meter:

   Press **[dBm]** mode.

   Zero and calibrate the power meter. Set the CAL FACTOR at 100%. The CAL FACTOR will **not** be changed for the rest of the procedure. By leaving the CAL FACTOR at 100%, it ensures minimum specifications will be met.

4. On the HP 8341B:

   Press **[SHIFT] [INSTR PRESET]**

   Press **[SHIFT] [START] [4] [Hz]**

   Press **[SHIFT] [ALT]**

   Press **[SHIFT] [XTAL]** EXT INPUT leveling

   Press **[CW] [5] [0] [GHz]**

   Connect the power sensor to the HP 83557A output.

   Press **[POWER LEVEL]** and adjust rotary knob for a 3.0 dBm reading on the power meter display. Ensure that the power meter display is within 2.00 dB of the HP 8349B display.

NOTE: Ensure that the **[AM MOD]** button is in the **off** state or it will affect the accuracy of this test.

5. Press **[CW]**

   While observing the power meter display, find the minimum power point between 50.0 to 75.0 GHz by slowly adjusting the rotary knob. Note at what frequency the minimum power point is. See Figure 2c-4.

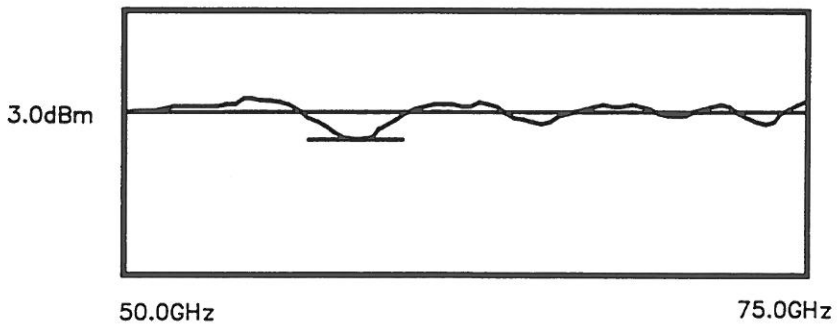


Figure 2c-4. Minimum Power Point (50.0 to 75.0 GHz)

Enter the frequency at the minimum power point by pressing **[CW] XX.XX [GHz]**

6. Press **[POWER LEVEL]** and adjust the rotary knob until you obtain a 3.0 dBm reading on the power meter display.

7. Press **[CW] [5] [0] [GHz]**

   Tune the rotary knob from 50.0 to 75.0 GHz and ensure that the power level displayed on the power meter never exceeds 7.0 dBm. This ensures that from 50.0 to 75.0 GHz, the system's power flatness is within ± 2.0 dB of maximum leveled power, 3.0 dBm. See Figure 2c-5.

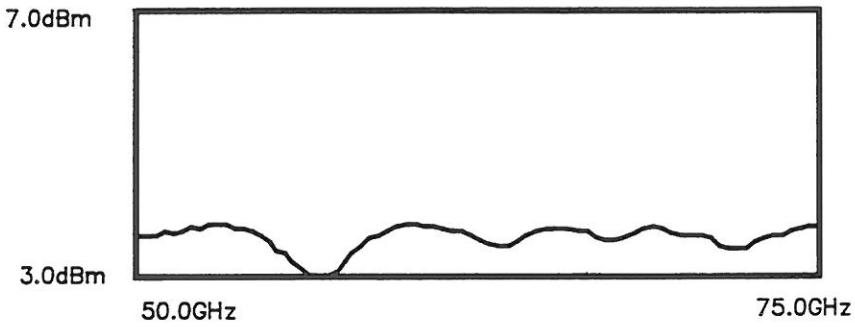


Figure 2c-5. Power Flatness Response (50.0 to 75.0 GHz)

This completes the Operator's Check. If your system fails this functional check, refer to the paragraph titled TROUBLESHOOTING.

SYSTEM PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the performance of the HP 8341B/83557A source system using the specifications of Table 2c-1 as the performance standards. All tests can be performed without access to the interior of the instrument. The performance test procedures must be performed in the sequence given since some procedures rely on satisfactory test results in the foregoing steps. In order to fully verify the performance specifications of the HP 83557A, the performance tests in the Source Module Specifications and Service Section must also be performed. None of the tests require access to the interior of the instrument.

Under the paragraph, TROUBLESHOOTING, you will find information on what to do if your system fails to meet specifications.

EQUIPMENT REQUIRED

Equipment required for the performance tests are listed in the Recommended Test Equipment tables under the tabs Source System Guides, and Source Module Specifications and Service. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models. Ensure also that the test equipment used is currently calibrated to proper specifications.

NOTE: Use only the connectors and cables that are specified in the following test setups to ensure accurate test results.

OPERATION VERIFICATION

The Operation Verification consists of performing the source module specific performance tests (Source Module Specifications and Service Section) which include, Maximum Leveled Power (verifies frequency range), Power Flatness, and Power Level Accuracy. These tests provide reasonable assurance that the source module is functioning properly and should meet the needs of an incoming inspection (80% verification).

TEST RECORD

Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting or after repairs.

FREQUENCY CHARACTERISTICS

Range
Accuracy
Resolution
Stability

The performance tests listed above are source dependent and can be found under the following performance tests in the appropriate HP 8341B synthesized sweeper Operating and Service manual.

NOTE: When specifying the output frequency and modulation characteristics of the HP 8341B/83557A system, all frequency specifications are referenced from the sources used and must be multiplied by four because the HP 83557A is a frequency quadrupler. For special information about the quadrupler, refer to the "Theory of Operation" section found in the "Source Module Specifications and Service" section of this manual.

Table 2c-2. Performance Test Record

HP 8341B (Opt. 003) System

Serial Number _____ **Date** _____

Humidity* _____ **Tested By** _____

(Optional)** **Temperature _____

Specifications Tested	Test Conditions	Specification	Test Results	
			Pass	Fail
FREQUENCY				
Range[1]	_____	50.0 to 75.0 GHz[1]	_____	_____
Accuracy (25°C ±5°C)				
CW Mode		Same as time base		
Time Base	_____	Internal 10 MHz time base Aging rate: less than 1×10^{-9}/day and 2×10^{-7}/year after 30-day warmup.	_____	_____
	_____	Temperature effect $<1 \times 10^{-10}$/°C	_____	_____
	_____	Line Voltage effect $<1 \times 10^{-11}/\pm 10\%$	_____	_____
All Sweep Modes (for sweep time >100 msec)	_____	$\Delta F \leq$(n) 20 MHz ±1% of ΔF ±time base accuracy	_____	_____
		(n) 20 MHz$<\Delta F \leq$(n) 400 MHz: ±2% of ΔF $\Delta F \geq$(n) 400 MHz: ±1% of ΔF or ±200 MHz whichever is less n = harmonic band (1−4) of the HP 8341B		
CW Resolution[1]	_____	12 Hz	_____	_____

1. These specifications are referenced from the HP 8341B synthesized sweeper manuals and have been multiplied by a factor of 4 because the HP 83557A is a frequency quadrupler.

TROUBLESHOOTING

Specification Failures

Failures are divided into two catagories:

Category one describes systems that are meeting specifications in some areas, while failing in others. If this is the case, do the following:

Inspect the connectors and ensure that all connections are making good electrical contact.

Inspect all cabling for breaks.

Test again.

If your system is still failing at the SAME points, your instrument(s) or cable(s) could be defective and should be returned for repair. If, however, your system fails at DIFFERENT points, there is probably a loose connection or a mechanical failure somewhere in the setup.

Remember, it is possible the system may fail the performance test(s) because of measurement uncertainties. If you suspect this to be the case, contact your nearest HP office for more information.

Category two failures are total specification failures. If your system fails any of these tests completely, do the following:

Check the TEST SETUP for correct configuration of the instruments and connections.

Inspect the connectors.

Inspect the cables.

Repeat the failed test(s).

If your system is still failing, the system is probably defective and needs repair.

Also, for the best accuracy in measurement, use only calibrated instruments.

TABLE of CONTENTS
HP 8673C/D SOURCE SYSTEM GUIDE

Section 2d. HP 8673C/D Source System Guide

INTRODUCTION

This source system guide is intended to provide you millimeter-wave system operating information for the HP 8673C/D series synthesized signal generators (unless otherwise stated will be hereafter refered to as the HP 8673C/D). It contains an Operator's Check, connection diagrams, system specifications, system performance tests, and system level troubleshooting. For detailed instruction regarding the operation or troubleshooting of the individual instruments, refer to the instrument's operating and service manual.

SYSTEM DESCRIPTION

HP 8673C/D synthesized signal generators provide direct, factory calibrated control and display of system output frequency and level. HP 8673C/D synthesized signal generators with serial number prefix 2552A are fully compatible for use with a millimeter-wave system consisting of an HP 8349B microwave amplifier and an HP 83557A millimeter-wave source module. For proper display accuracy, leveling flatness, and harmonic suppression, the 1.0V/GHz output on your HP 8673C/D will have to be modified for a 0.5V/GHz output. Serial number prefixes previous to 2552A will require the modification for proper system operation. A retrofit kit may be ordered to implement these modifications. Refer to the table below to determine the retrofit kit number applicable to the system synthesizer. For detailed information concerning synthesizer operation, refer to the HP 8673C/D Operating and Service Manual.

Synthesizer	Retrofit Kit Part Number
HP 8673C	08673-60182
HP 8673D	08673-60183

NOTE: The HP 8673C/D synthesized signal generators require a synthesizer interface cable for operation in a mm-wave system. The cable is available as HP Part No. 5061-5391.

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

SYSTEM SPECIFICATIONS

Table 2d-1 provides specifications for the HP 8673C/D/synthesized signal generator/83557A system configuration. These are the performance standards against which the system is tested.

Table 2d-1. 8673C/D/83557A System Specifications

Frequency Characteristics

Range
- 8673C/D . . . . . 50.0 to 75.0 GHz

Accuracy[1] (25°C ±5°C)
- CW Mode . . . . . Same as time base
- Time Base[2] . . . . . Internal 10 MHz time base
- Aging rate less that $5x10^{-10}$/day after a 24-hour warmup.
- Temperature effect: $<1x10^{-10}$/°C
- Line Voltage effect: $<5x10^{-10}$/+5% to −10%

All Sweep modes[1] (for sweep time >100 ms)[3] . . . . . Same as time base.

CW Resolution . . . . . 12 kHz

Modulation Characteristics

External FM

Maximum Deviations for Modulation Frequencies
- 100 Hz to 10 MHz (60,200 kHz/V ranges)
- 1 kHz to 10 MHz (600 kHz/V,2,6,20 MHz/V ranges) . . . . . The smaller of 40 MHz or fmod x 60

Modulation Characteristics (Cont'd)

Sensitivity
- FM Mode, typically . . . . . 120, 400, 1200 kHz/V and 4, 12, 40 MHz/V

External AM
- Bandwidth, typically . . . . . DC to 80 kHz
- Sensitivity, typically . . . . . 30%/V and 100%/V

External Pulse Modulation
- Rise/Fall Time, typically . . . . . 40 ns
- Minimum RF Pulse Width
- System Leveled, typically . . . . . 1 us
- On/Off Ratio, typically . . . . . >80 dB
- Pulse Repetition Frequency
- System Leveled, typically . . . . . 50 Hz to 100 kHz
- System Unleveled, typically . . . 50 Hz to 500 kHz
- HP 8756A and HP 8757A
- AC Detection Mode Compatibility . . . . . Yes

1. Specifications referenced are source driver specific (HP 8673C/D) and do not indicate the quadrupling effect of the source module.
2. Overall accuracy of internal timebase is a function of timebase calibration ± aging rate ± temperature effects ± line effects.
3. After one hour warmup at selected CW frequency.

OPERATION

INTRODUCTION

This section is intended for operators familiar with the HP 8673C/D instruments. If you are unfamiliar with this system, refer to the Operator's check at the end of this section for more specific instructions.

In the operation instructions, any instrument setting or function key is defined by [ ] symbols around it.

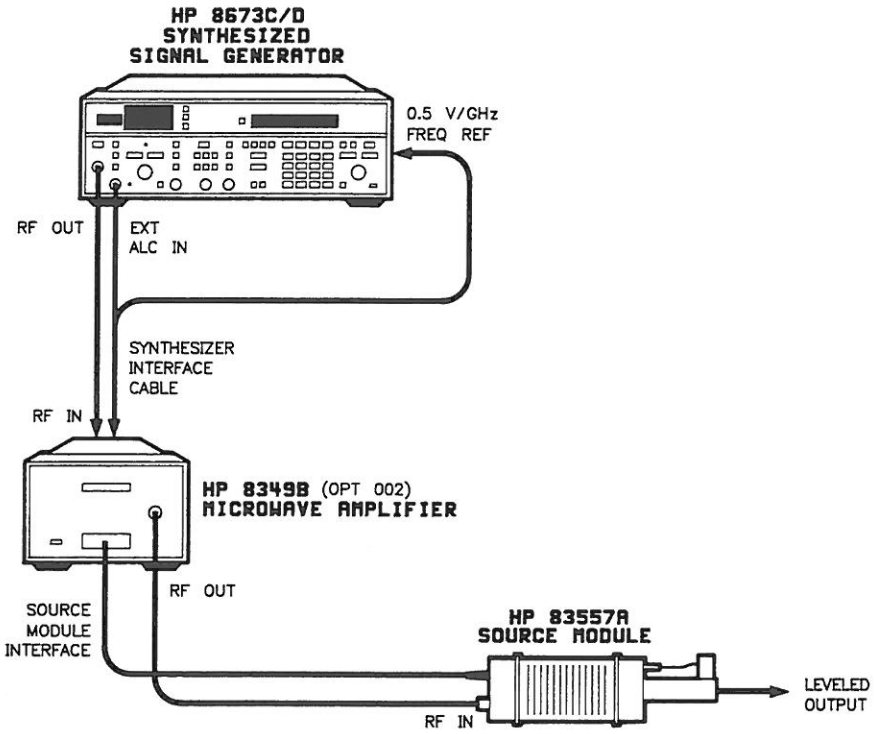


Figure 2d-1. HP 8673C/D/83557A Source System Configuration

CAUTION

Turn off the ac power on the HP 8349B prior to connecting or disconnecting the source module interface cable.

Connect the system as shown in Figure 2d-1.

FREQUENCY CONTROL

After the connections have been made, turn on the system. Allow instruments to warm-up 30 minutes. The synthesizer allows the user to enter and display the actual frequency of the output of the system by entering a multiplication factor into the synthesizer front panel. Preset the synthesizer by pressing:

[RCL] [BACKSPACE]

Enter the multiplication factor by pressing:

[SHIFT] [MULT] [4] [XFREQ]

The actual system output frequency is now shown on the synthesizer display. Once the multiplication factor is entered, the system output frequency can be controlled directly using the synthesizer. The multiplication factor can be reset to one by pressing:

[SHIFT] [MULT] [1] [XFREQ]

POWER LEVEL CONTROL

CAUTION

Before performing any power level calibrations, ensure that the HP 8673C/D synthesizer is not at maximum power.

The system output power can be entered, displayed, and controlled directly with the synthesizer. Power level can be controlled by activating the ALC DIODE key and adjusting the OUTPUT LEVEL VERNIER knob.

POWER LEVELING

System Leveling

To activate system leveling mode, connect the equipment as shown in Figure 2d-1 and press:

[SHIFT] [DIODE/SYS]

NOTE: When using system leveling mode, use only the +20, +10, or 0 dBm range when setting system output level.

When in system leveling mode, both the DIODE/SYS key and the INTERNAL ALC key will light. The power output of the system is detected in the millimeter-wave source module. The detected signal is fed back to the HP 8349B which converts it to a voltage that is proportional to the system output power in volts per dB. This voltage is fed back to the synthesizer through the EXT ALC IN connector. Power level corrections are made by the synthesizer. The actual system output power is shown on the synthesizer display. System output power can also be remotely programmed and read over HP-IB.

External Power Meter Leveling

This power leveling method has a slow settling time but has the advantage of high sensitivity and temperature compensation. Figure 2d-2 illustrates a typical external power meter leveling setup.

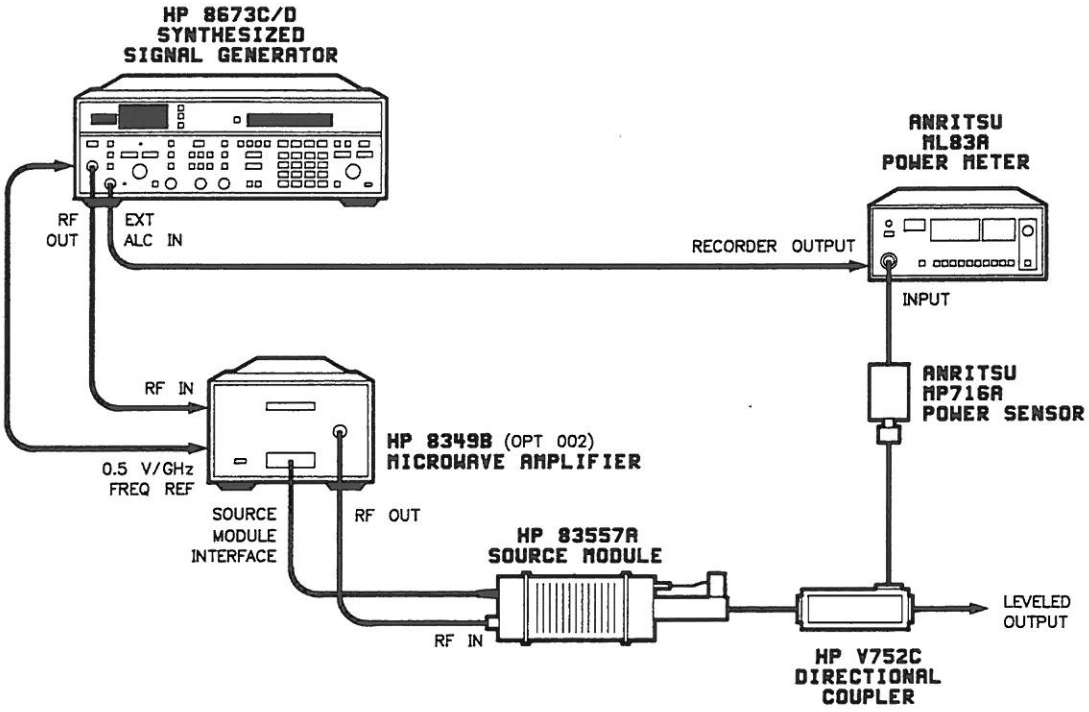


Figure 2d-2. External Power Meter at the HP 83557A Source Module Output.

To activate the external power meter leveling mode, connect the equipment as shown in Figure 2d-2 and press the **[PWR MTR]** key on the HP 8673C/D front panel. The output of the millimeter-wave source module is detected by the power meter. A linearly proportional voltage is fed back to the synthesizer through the EXT ALC IN connector on the front panel. Power level corrections are made by the synthesizer. The actual system output power is shown on the microwave amplifier display. The synthesizer output level meter can be calibrated to the microwave amplifier display by adjusting the CAL control on the synthesizer front panel. Set **[RANGE]** to 0 dBm and the **[VERNIER]** to 0 dBm. Adjust the **[CAL]** control for a system output level of 0 dBm as indicated on the microwave amplifier display.

MODULATION

For complete specifications on all modulation modes described below, refer to Table 2d-1.

Frequency Modulation

The millimeter-wave system's output signal can be frequency modulated by applying an external modulating signal to the synthesizer FM IN connector. FM deviation range is chosen by the FM DEVIATION MHz keys on the synthesizer front panel. The amount of deviation varies linearly with the input signal level; 1 volt peak develops full scale modulation. Due to the frequency quadrupling of the millimeter-wave source module, the sensitivity and maximum deviation of the synthesizer is multiplied by a factor of four. See Table 2d-2.

Table 2d-2. Synthesizer and System Sensitivities

Sensitivity of Synthesizer	Sensitivity of System
30, 100, 300 kHz per volt 1, 3, 10 MHz per volt	120, 400, 1200 kHz per volt 4, 12, 40 MHz per volt

Amplitude Modulation

The millimeter-wave system's output signal can be amplitude modulated by applying an external modulating signal to the synthesizer AM IN connector. The modulation range is selected using the AM keys on the synthesizer front panel. The depth of modulation varies linearly with the input signal; 1 volt peak develops full scale modulation. The AM bandwidth extends from DC to 100 kHz.

Pulse Modulation

The source module's output signal can be pulse modulated by applying a TTL compatible pulse waveform to the PULSE IN connector on the synthesizer front panel. This input provides an on/off power ratio of greater than 80 dB at the system output. The PULSE IN input is normally at a TTL high (approximately +3 volts DC). When a TTL low signal (approximately 0 volts DC) is applied, the source module's output signal is turned off. Leveled pulse repetition rates from 50 Hz to 100 kHz are achievable in system leveling mode with pulse widths as narrow as 1 microsecond. Level accuracy is comparable to CW accuracy down to 5 microsecond pulse widths.

OPERATOR'S CHECK

DESCRIPTION

This procedure allows verification of proper operation of the millimeter-wave system by determining the system's output power and flatness performance at maximum leveled output power over the entire frequency range.

EQUIPMENT

Ensure that all the instruments listed below meet their own performance standards and have recently been calibrated to proper specifications before configuring them into the test setup.

RF Signal Source ..... HP 8673C/D Synthesized Signal Generator
Microwave Amplifier ..... HP 8349B
Power Meter ..... Anritsu ML83A
Power Sensor ..... Anritsu MP716A

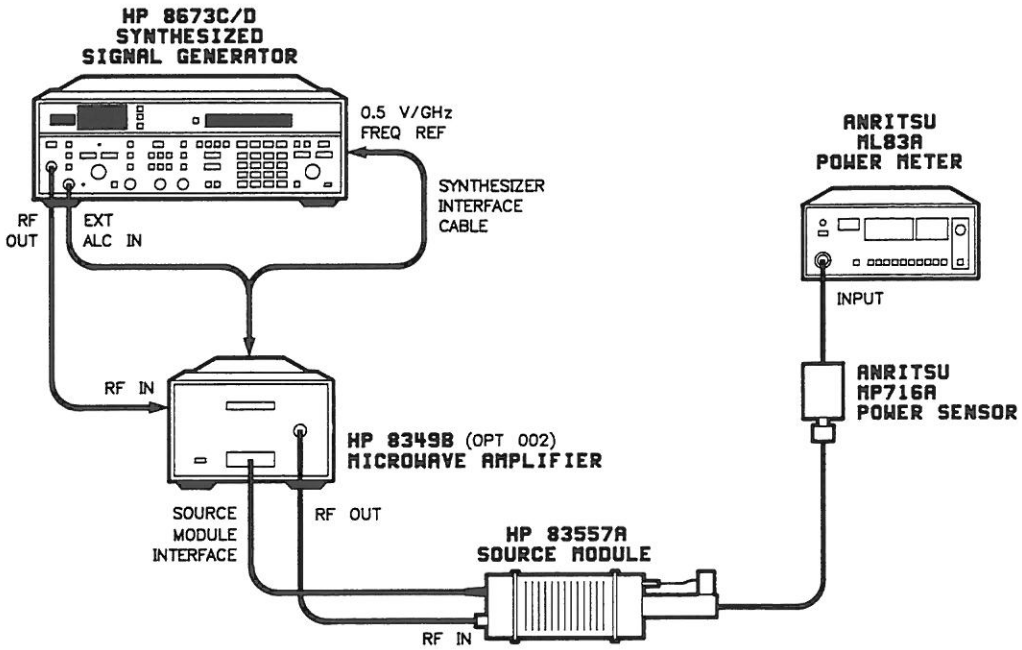


Figure 2d-3. System Configuration

PROCEDURE

1. Connect the equipment as shown in Figure 2d-3. Do not connect the power sensor to the HP 83557A output.

CAUTION

Turn off the ac power on the HP 8349B prior to connecting or disconnecting the source module interface connector. Before performing any power level calibrations, ensure that the HP 8673C/D synthesizer is not at maximum power.

2. Turn on all system components.

3. On the power meter:

   Press **[dBm]** mode.

   Zero and calibrate the power meter. Set the CAL FACTOR at 100%. The CAL FACTOR will not be changed for the rest of the procedure. By leaving the CAL FACTOR at 100%, it ensures minimum specifications will be met.

4. On the HP 8673C/D:

   Press **[SHIFT] [MULT] [4] [xFREQ]**

   Press SWEEP FREQ **[START] [5] [0] [.] [0] [GHz]**

   Press SWEEP FREQ **[STOP] [7] [5] [.] [0] [GHz]**

   Press SWEEP RATE **[STEP] [2] [0] [0] [MHz]**

   Press SWEEP MODE **[MANUAL]**

   Press RANGE [▲] for a +10 dBm reading on the RANGE dBm display.

5. Adjust the synthesizer VERNIER for a reading of +3.0 dBm on the power meter.

6. Find the minimum power point between 50.0 GHz and 75.0 GHz by slowly adjusting the TUNE knob from 50.0 GHz to 75.0 GHz and noting at which frequency minimum power occurs. See Figure 2d-4.

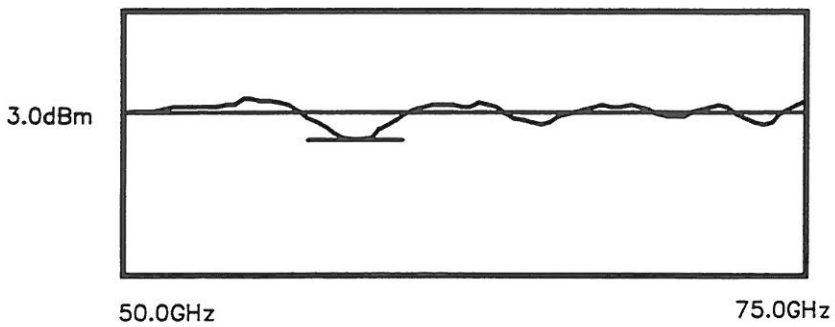


Figure 2d-4. Minimum Power Point (50.0 to 75.0 GHz)

7. Tune the frequency to the minimum power point.
8. Adjust the VERNIER until the power meter display reads +3.0 dBm.
9. Tune the synthesizer frequency to 50.0 GHz.
10. Slowly tune the frequency from 50.0 GHz to 75.0 GHz while watching the power level readings on the power meter. The power level displayed should not exceed +7.0 dBm. See Figure 2d-5.

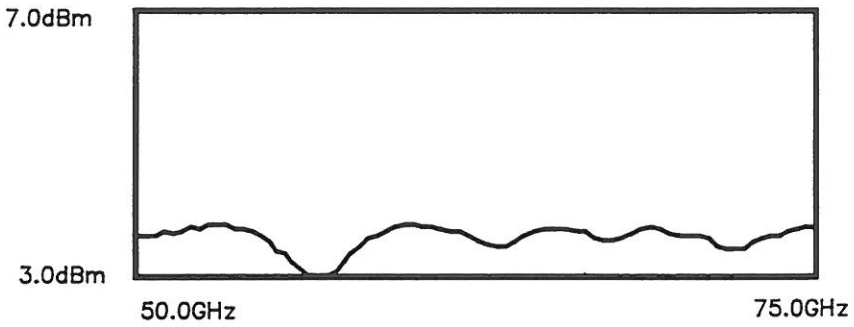


Figure 2d-5. Power Flatness Response (50.0 to 75.0 GHz)

This completes the Operator's Check. If your system fails this functional check, refer to the paragraph titled TROUBLESHOOTING.

SYSTEM PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the performance of the HP 8673C/D/83557A source system using the specifications of Table 2d-1 as the performance standards. All tests can be performed without access to the interior of the instrument. The performance test procedures must be performed in the sequence given since some procedures rely on satisfactory test results in the foregoing steps. In order to fully verify the performance specifications of the HP 83557A, the performance tests in the Source Module Specifications and Service Section must also be performed. None of the tests require access to the interior of the instrument.

Under the paragraph, TROUBLESHOOTING, you will find information on what to do if your system fails to meet specifications.

EQUIPMENT REQUIRED

Equipment required for the performance tests are listed in the Recommended Test Equipment tables in the Source System Guides, and Specifications and Service Sections of the manual. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models. Ensure also that the test equipment used is currently calibrated to proper specifications.

NOTE: Use only the connectors and cables that are specified in the following test setups to ensure accurate test results.

OPERATION VERIFICATION

The Operation Verification consists of performing the source module specific performance tests (Source Module Specifications and Service Section) which include, Maximum Leveled Power (verifies frequency range), Power Flatness, and Power Level Accuracy. These tests provide reasonable assurance that the Source Module is functioning properly and should meet the needs of an incoming inspection (80% verification).

TEST RECORD

Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

FREQUENCY CHARACTERISTICS

Range
Accuracy
Resolution
Stability

MODULATION CHARACTERISTICS

External FM

The performance tests above are source dependent and can be found in the Performance Tests section of the Synthesizer Operating and Service Manual.

NOTE: When specifying the output frequency characteristics of the HP 8673C/D/83557A system, all frequency specifications are referenced from the sources used and must be multiplied by four because the HP 83557A is a frequency quadrupler. For special information about the quadrupler, refer to the "Theory of Operation" section found in the "Source Module Specifications and Service" section of this manual.

Table 2d-2. Performance Test Record

HP 8673C/D System

Serial Number _____ **Date** _____

Humidity* _____ **Tested By** _____

(Optional)** **Temperature _____

Specifications Tested	Test Conditions	Specification	Test Results	
			Pass	Fail
FREQUENCY				
Range[1]	_____	50.0 to 75.0 GHz[1]	_____	_____
Accuracy (25°C ±5°C)				
CW Mode		Same as time base		
Time Base	_____	Internal 10 MHz time base Aging rate: less than 5×10^{-10}/day after 24-hour warmup.	_____	_____
	_____	Temperature effect $<1 \times 10^{-10}$/°C	_____	_____
	_____	Line Voltage effect $<5 \times 10^{-10}$/+5% to −10%	_____	_____
All Sweep Modes (for sweep time >100 msec)		Same as time base	_____	_____
CW Resolution[1]	_____	12 kHz[1]	_____	_____
MODULATION				
External FM				
Maximum Deviations for Modulation Frequencies				
100 Hz to 10 MHz (60,200 kHz/V ranges)	_____	The smaller of 40 MHz or fmod x 80	_____	_____
1 kHz to 10 MHz (2, 6, 20 MHz/V ranges)				

1. These specifications are four times those of the HP 8673C/D specifications because the HP 83557A is a frequency quadrupler.

TROUBLESHOOTING

Specification Failures

Failures are divided into two categories:

Category one describes systems that are meeting specifications in some areas, while failing others. If this is the case, do the following:

Inspect the connectors and ensure that all connections are making good electrical contact.

Inspect all cabling for breaks.

Test again.

If the system fails at DIFFERENT points, there is probably a loose connection or a mechanical failure somewhere in the test setup. If the system fails at the SAME points, the instruments or cables may be defective. Refer to the appropriate operating and service manual for each individual instrument and perform the operator's checks to isolate any possible defective instrument.

Category two describes total specification failures. If the system fails any of the previous tests completely, do the following:

Check the TEST SETUP for correct configuration of the instruments and connections.

Inspect the connectors.

Inspect the cables.

Repeat the failed test.

If the system still fails to meet specifications, the millimeter-wave source module may be defective. However, it is possible that one of the other instruments is defective. Refer to the appropriate operating and service manual for each individual instrument and perform the operator's checks or abbreviated performance tests to ensure that the other instruments are working properly.

Test failures are possible due to measurement uncertainties. Also, for best accuracy in measurement, use only properly calibrated instruments.

TABLE of CONTENTS
HP 83623A/24A SOURCE SYSTEM GUIDE

Section 2e. HP 83623A/24A Source System Guide

INTRODUCTION

This source system guide is intended to provide you with mm-wave system operating information for the HP 83623A/24A synthesizers. It contains an operator's check, connection diagrams, system specifications, system performance tests, and system level troubleshooting. For detailed instructions regarding the operation or troubleshooting of the individual instruments, refer to the instrument's operating and service manual.

SYSTEM DESCRIPTION

The HP 83623A (10 MHz to 20 GHz) and 83624A (2 GHz to 20 GHz) synthesized sweepers (unless otherwise stated, will hereafter be referred to as the HP 83623A/24A) operates over the frequency range required by the HP 83557A millimeter-wave source module.

The HP 83623A/24A delivers the required 12.5 to 18.75 GHz input frequency and +17 dBm of output power for directly driving the HP 83557A source module.

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

SYSTEM SPECIFICATIONS

Table 2e-1 provides specifications for the HP 83623A/24A synthesized sweeper/83557A system configuration. These are the performance standards against which the system is tested.

Table 2e-1. HP 83623A/24A/83557A System Specifications

Frequency Characteristics	**Modulation Characteristics**
Range .....50.0 to 75.0 GHz	External FM
Accuracy[1] (25°C ±5°C)	Bandwidth .....50 kHz to 10 MHz
CW Mode .....Same as time base	Deviation .....the lesser of 8 MHz or 20 x Fmod
Time Base[2] .....Internal 10 MHz time base	Sensitivity .....100 kHz/V, 1 MHz/V or 10 MHz/V
Aging rate: less than 5 x 10^{-10}/day and 1 x 10^{-7}/year after 30-day warmup.	External AM
Temperature Effect: <1 x 10^{-10}/°C	Bandwidth, typically .....DC to 100 kHz
Line Voltage Effect: <5 x 10^{-10}/±10%.	Sensitivity, typically 100%/V
All Sweep Modes	External Pulse Modulation
(for sweep time >100 msec and <5s)[3]	Rise/Fall Time, typically .....50 ns
ΔF ≤ (n) 40 MHz .....+0.1% of ΔF ± time base accuracy	Minimum RF Pulse Width
(n) 40 MHz <ΔF ≤1200 MHz .....±1% of ΔF	System Leveled .....1 us
1200 ≤ΔF <12 GHz:12 MHz	System Unleveled .....100 ns
ΔF >12 GHz:0.1% of ΔF	On/off ratio, typically .....>80 dB
n = harmonic band (1−4) of the HP 83623A/24A	Pulse Repetition Frequency
CW Resolution .....1 Hz	System Leveled .....10 Hz to 500 kHz
	System Unleveled .....DC to 5 MHz
	HP 8756A and 8757A
	AC Detection Mode Compatibility .....Yes

1. Specifications referenced are source driver specific (HP 83623A/24A) and do not indicate the quadrupling effect of the source module.
2. Overall accuracy of internal timebase is a function of timebase calibration ± aging rate ± temperature effects ± line effects.
3. After one hour warmup at selected CW frequency.

OPERATION

INTRODUCTION

This section is intended for operators familiar with the HP 83623A/24A instruments. If you are unfamiliar with this system, refer to the Operator's check at the end of this section for more specific instructions.

In the operation instructions, any instrument setting or function key is defined by [ ] symbols around it.

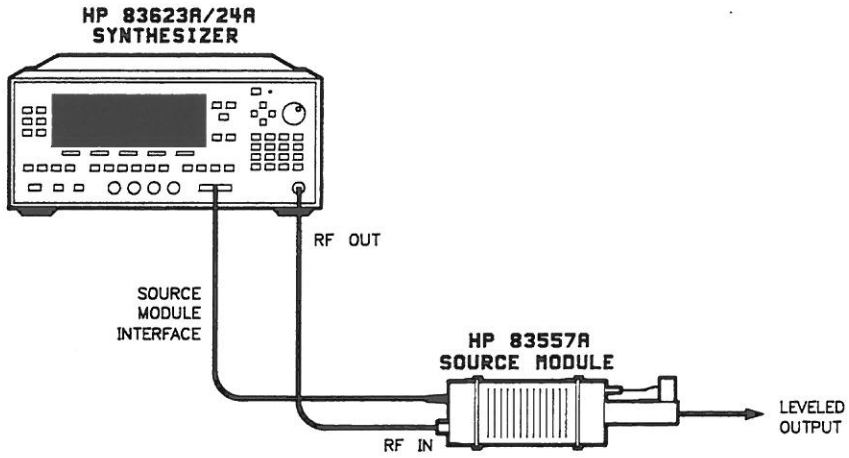


Figure 2e-1. HP 83623A/24A/83557A Source System Configuration

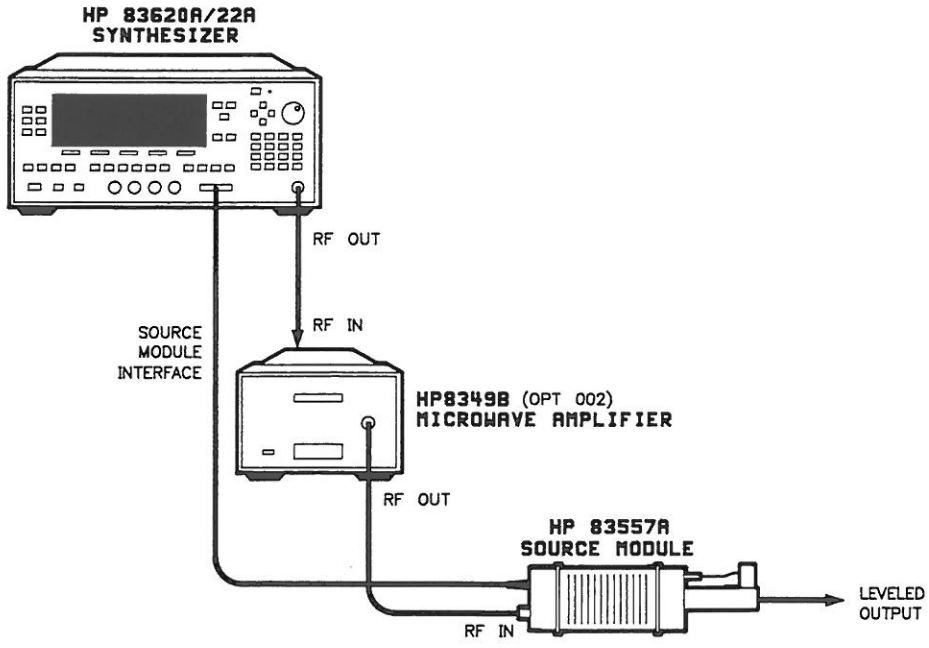


Figure 2e-2. HP 83620A/22A/40A/42A/83557A Source System Configuration

CAUTION

Turn off the ac power on the HP 8349B prior to connecting or disconnecting the source module interface cable.

Connect the system as shown in Figure 2e-1 or Figure 2e-2.

Throughout this Source System Guide, the configuration shown in Figure 2e-2, using the HP 83620A/22A/40A/42A with the HP 8349B, can be substituted for the HP 83623A/24A configuration shown in Figure 2e-1.

FREQUENCY CONTROL

After the connections have been made, turn on the system, and press **[PRESET]** on the HP 83623A/24A. Allow instruments to warm-up 30 minutes. The HP 83623A/24A will automatically read the frequency range of the source module and set the HP 83623A/24A to the appropriate start and stop frequencies.

POWER LEVEL CONTROL

CAUTION

Before performing any power level calibrations, ensure that the HP 83623A/24A synthesizer is not at maximum power.

Power is controlled by pressing **[POWER LEVEL]**. The step keys, rotary knob or keypad controls the output power from the synthesizer. The actual output power from the mm-wave source module is read on the HP 83623A/24A PWR dBm display in the system leveled mode.

POWER LEVELING

System Leveling

System leveling provides calibrated, flat power from the output of the mm-wave source module. The HP 83623A/24A/83557A configuration shown in Figure 2e-1 provides leveled source module output power with corrected power level flatness. With the **[Leveling Point Module]** key on, a portion of the source module power output is coupled out of a directional coupler and detector internal to the source module. This signal is applied to the HP 83623A/24A automatic leveling control circuitry (ALC). The source module output power is displayed on the HP 83623A/24A display.

External Power Meter Leveling

Output power may also be leveled with a power meter and a directional coupler as shown in Figure 2e-3. Power meter leveling at the source module output is possible using the power meters referenced in Table 1-1 (System General Information).

Set the ALC mode to **[Leveling Point PwrMtr]** on the HP 83623A/24A. The sweep time is limited to 100 seconds when this leveling method is used. A portion of the mm-wave output signal from the source module is coupled/detected and routed to the power meter. The DC voltage from the power meter recorder output is then applied to the HP 83623A/24A external ALC circuit.

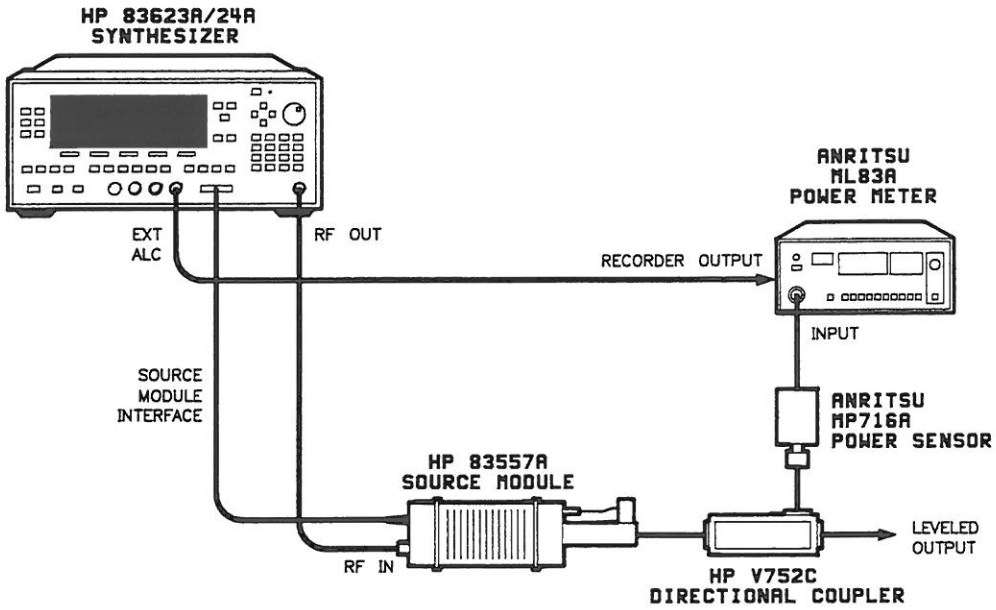


Figure 2e-3. External Power Meter Leveling at the HP 83557A Source Module Output

MODULATION

For complete specifications on all modulation modes described below, refer to Table 2e-1 (HP 83623A/24A/83557A System Specifications).

Frequency Modulation (FM Connector on HP 83623A/24A)

With the **[FM On/Off DC]** key activated, from the **[MOD]** menu, the source module may be frequency modulated from an external input signal. The FM deviation is multiplied by four by the HP 83557A source module but the displayed FM sensitivity remains correct.

FM sensitivities of 100 kHz/V, 1 MHz/V or 10 MHz/V are available over a bandwith of 50 kHz to 10 MHz.

Amplitude Modulation (AM Connector on HP 83623A/24A)

When the **[AM On/Off 100%/V]** key is activated from the **[MOD]** menu, the AM input is used for linear, DC-coupled amplitude modulation. The small signal −3 dB bandwidth extends from DC to 100 kHz.

The sensitivity is 100% per volt. This means that +1.0 volt doubles the output voltage (+6 dB), while −1.0 volt shuts the output completely off.

For maximum modulation index, the HP 83557A source module should be set to a power level 3 dB below maximum power (note that 3 dB power is 6 dB volts).

Pulse Modulation (PULSE Connector on HP 83623A/24A)

With the **[Pulse On/Off Extrnl]** key activated from the **[MOD]** menu, and the HP 83623A/24A system internally leveled, the application of a pulsed or square wave signal to the PULSE connector provides a pulsed or square wave modulated signal at the output of the HP 83557A. This input provides an ON/OFF power ratio of greater than 80 dB. The PULSE IN input is normally at a TTL HIGH (approximately +3 volts DC). When a TTL LOW signal (approximately 0 volts DC) is applied, the mm-wave output signal is turned off.

OPERATOR'S CHECK

DESCRIPTION

The following procedure will enable you to verify the proper operation of your HP 83623A/24A/83557A system by determining the system's output power and flatness performance over the V-band frequency range of 50.0 to 75.0 GHz at maximum leveled output power.

EQUIPMENT

Ensure that all the instruments below meet their own performance standards and have been recently calibrated to proper specifications before configuring them into the setup.

RF Signal Source ..... HP 83623A/24A Synthesized Sweeper
Power Meter ..... Anritsu ML83A
Power Sensor ..... Anritsu MP716A

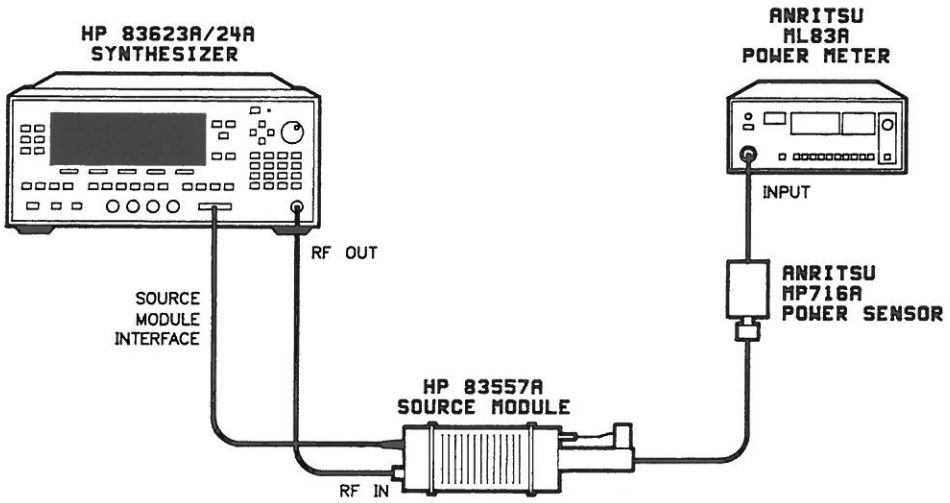


Figure 2e-4. System Configuration

PROCEDURE

1. Connect the equipment as shown in Figure 2e-4. Do not connect the power sensor to the HP 83557A output.

CAUTION

Turn off the AC power on the HP 83623A/24A prior to connecting or disconnecting from the source module interface connector.

2. Turn on all system components.

3. On the HP 83623A/24A:

   Press **[PRESET]**

   Press **[CW] [5] [0] [GHz]**

   Connect the power sensor to the HP 83557A output.

   Press **[POWER LEVEL]** and adjust rotary knob for a 3.0 dBm reading on the power meter display. Ensure that the power meter display is within 2.00 dB of the synthesizer display.

NOTE: Ensure that all modulation is in the **off** state or it will affect the accuracy of this test.

4. Press **[CW]**

   While observing the power meter display, find the minimum power point between 50.0 to 75.0 GHz by slowly adjusting the rotary knob. Note at what frequency the minimum power point is. See Figure 2e-5.

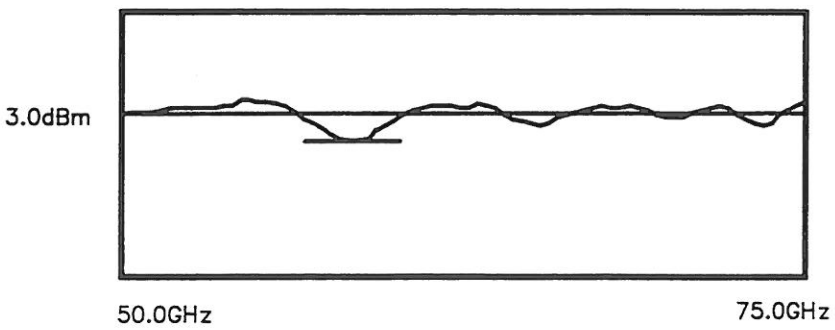


Figure 2e-5. Minimum Power Point (50.0 to 75.0 GHz)

Enter the frequency at the minimum power point by pressing **[CW] XX.XX [GHz]**

5. Press **[POWER LEVEL]** and adjust the rotary knob until you obtain a 3.0 dBm reading on the power meter display.

6. Press **[CW]**

   Tune the rotary knob from 50.0 to 75.0 GHz and ensure that the power level displayed on the power meter never exceeds 6.0 dBm. This ensures that from 50.0 to 75.0 GHz, the system's power flatness is within ±1.5 dB of maximum leveled power, 3.0 dBm. See Figure 2e-6.

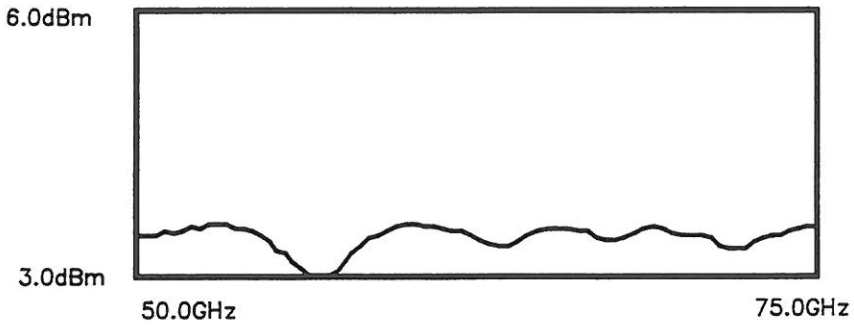


Figure 2e-6. Power Flatness Response (50.0 to 75.0 GHz)

This completes the Operator's Check. If your system fails this functional check, refer to the paragraph titled TROUBLESHOOTING.

SYSTEM PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the performance of the HP 83623A/24A/83557A source system using the specifications of Table 2e-1 as the performance standards. All tests can be performed without access to the interior of the instrument. The performance test procedures must be performed in the sequence given since some procedures rely on satisfactory test results in the foregoing steps. In order to fully verify the performance specifications of the HP 83557A, the performance tests in the Source Module Specifications and Service Section must also be performed. None of the tests require access to the interior of the instrument.

Under the paragraph, TROUBLESHOOTING, you will find information on what to do if your system fails to meet specifications.

EQUIPMENT REQUIRED

Equipment required for the performance tests are listed in the Recommended Test Equipment tables under the tabs Source System Guides, and Source Module Specifications and Service. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models. Ensure also that the test equipment used is currently calibrated to proper specifications.

NOTE: Use only the connectors and cables that are specified in the following test setups to ensure accurate test results.

OPERATION VERIFICATION

The Operation Verification consists of performing the source module specific performance tests (Source Module Specifications and Service Section) which include, Maximum Leveled Power (verifies frequency range), Power Flatness, and Power Level Accuracy. These tests provide reasonable assurance that the source module is functioning properly and should meet the needs of an incoming inspection (80% verification).

TEST RECORD

Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting or after repairs.

FREQUENCY CHARACTERISTICS

Range
Accuracy
Resolution
Stability

The performance tests listed above are source dependent and are found under the following performance tests in the HP 83623A/24A synthesized sweeper Calibration Manual: Internal Time Base Aging Rate, Frequency Range and Swept Frequency Accuracy. The CW Accuracy of the HP 83623A/24A can be verified by the following: if the instrument passes the full self-test, and the instrument is phase-locked, the HP 83623A/24A is as accurate as the timebase. Only by performing these specific tests can the frequency characteristics of the HP 83623A/24A/83557A system be verified.

NOTE: When specifying the output frequency characteristics of the HP 83623A/24A/83557A system, all frequency specifications are referenced from the sources used and must be multiplied by four because the HP 83557A is a frequency quadrupler. For special information about the quadrupler, refer to the "Theory of Operation" section found in the "Source Module Specifications and Service" section of this manual.

Table 2e-2. Performance Test Record

HP 83623A/24A Series System

Serial Number _____ **Date** _____

Humidity* _____ **Tested By** _____

(Optional)** **Temperature _____

Specifications Tested	Test Conditions	Specification	Test Results	
			Pass	Fail
FREQUENCY				
Range[1]	_____	50.0 to 75.0 GHz[1]	_____	_____
Accuracy (25°C ±5°C)				
CW Mode		Same as time base		
Time Base	_____	Internal 10 MHz time base Aging rate: less than 5 x 10^{-10}/day and 1 x 10^{-7}/year after 30-day warmup.	_____	_____
	_____	Temperature effect <1 x 10^{-10}/°C	_____	_____
	_____	Line Voltage effect <5 x 10^{-10}/±10%	_____	_____
All Sweep Modes (for sweep time >100 msec and ≤5S)	_____	ΔF ≤(n) 40 MHz: ±0.1% of ΔF ±time base accuracy (n) 40 MHz<ΔF ≤1200 MHz: ±1% of ΔF 1200 MHz <ΔF ≤ 12 GHz:12MHz ΔF >12 GHz:0.1% of ΔF n = harmonic band (1−4) of the HP 83623A/24A	_____	_____
CW Resolution	_____	1 Hz	_____	_____

TROUBLESHOOTING

Specification Failures

Failures are divided into two catagories:

Category one describes systems that are meeting specifications in some areas, while failing in others. If this is the case, do the following:

Inspect the connectors and ensure that all connections are making good electrical contact.

Inspect all cabling for breaks.

Test again.

If your system is still failing at the SAME points, your instrument(s) or cable(s) could be defective and should be returned for repair. If, however, your system fails at DIFFERENT points, there is probably a loose connection or a mechanical failure somewhere in the setup.

Remember, it is possible the system may fail the performance test(s) because of measurement uncertainties. If you suspect this to be the case, contact your nearest HP office for more information.

Category two failures are total specification failures. If your system fails any of these tests completely, do the following:

Check the TEST SETUP for correct configuration of the instruments and connections.

Inspect the connectors.

Inspect the cables.

Repeat the failed test(s).

If your system is still failing, the system is probably defective and needs repair.

Also, for the best accuracy in measurement, use only calibrated instruments.