

Errata

Title & Document Type: 8340A Option H02 Synthesized Sweeper Manual Supplement

Manual Part Number: 08340-90384

Revision Date: July 1988

HP References in this Manual

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

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**HP 8340A OPTION H02
SYNTHESIZED
SWEEPER
10 MHz to 20 GHz**

HP 8340A OPTION HO2 SYNTHESIZED SWEEPER

Use this supplement with the following manuals and related manual change supplements:

Manual Name	Manual Part Number	Date Printed
HP 8341B Option 003 Operating and Service Manual	08341-90063	November 1987 or December 1988, Edition 2

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1400 FOUNTAINGROVE PARKWAY, SANTA ROSA, CA 95403 U.S.A.

SUPPLEMENT PART NUMBER: 08340-90384
Microfiche Part Number: 08340-90385

Printed: July, 1988



**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 Bureau of Standards, to the extent allowed by the Bureau'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, or, in the case of certain major components listed in section six of this Operating and Service manual, for the specified period. 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.

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ASSISTANCE

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

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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 HP 8340A Option H02

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.

HP 8340A Option H02

INTRODUCTION

This *HP 8340A Option H02 Supplement* documents the changes required to adapt the *HP 8341B Option 003 Operating and Service Manual*, HP Part Number 08341-90063, for use with the HP 8340A Option H02.

DESCRIPTION OF THE 8340A OPTION H02

The 8340A Option H02 synthesized sweeper differs from the standard HP 8340A in three ways. The addition of a two ball SYTM lowers the harmonic content of the RF output. In addition there are two operational differences.

Operational Differences

An FM modulation input is added to the HP 8340A Option H02. The front panel key, [FM] MODULATION, activates the frequency modulation function.

On the standard HP 8340A slow pulse modulation is input through the AM jack. On the HP 8340A Option H02 slow pulse modulation is input through the PULSE jack.

NOTE: There are no operational differences between the HP 8341B Option 003 and the HP 8340A Option H02 other than the 1 volt/GHz output noted on page 1-16 of this supplement.

OVERALL

The following changes apply to the *HP 8341B Option 003 Operating and Service Manual*, HP Part Number 08341-90063.

Change all occurrences of "HP 8341B Option 003" to "HP 8340A Option H02", except required test equipment.

Ignore all references to HP 8341B Options 004 and 005. These options are not available on the HP 8340A Option H02.

CHANGING THE HP 8341B OPTION 003 MANUAL TO AN HP 8340A OPTION H02 MANUAL

To use this supplement, first incorporate the standard *HP 8341B Option 003 Manual Changes Supplement* (yellow sheets) into the HP 8341B Option 003 manual. Then incorporate the changes in this supplement as follows:

Replace the original HP 8341B Option 003 manual pages, with the pages contained in this supplement:

Volume 1

Table of Contents

1-0 through 1-22
with 1-0 through 1-18

3i, 3ii

Manufacturer's Declaration (after title
page) with supplement Manufacturer's
Declaration

Volume 2

Table of Contents

4-1 through 4-110
with 4-1 through 4-136

5-75, 5-76

Add the following pages to the HP 8341B Option 003 manual:

- Blue page at the beginning of Volume 1 (indicating modified manual)
- Blue page at the beginning of Volume 2 (indicating modified manual)
- Blue page at the beginning of Volume 3 (indicating modified manual)
- Blue page (G-24a/G-24b) behind page G-24 (parts cross reference table)

Discard all instruction pages after modification of the HP 8341B Option 003 manual is complete.

INSTRUCTION PAGE

REPLACE THE ORIGINAL HP 8341B OPTION 003 OPERATING AND SERVICE MANUAL PAGES, WITH THE PAGES CONTAINED IN THIS PART OF THE SUPPLEMENT:

Volume 1

Table of Contents

1-0 through 1-22
with 1-0 through 1-18

3i, 3ii

Manufacturer's Declaration (after title
page) with supplement Manufacturer's
Declaration

Volume 2

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4-1 through 4-110
with 4-1 through 4-136

5-75, 5-76

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Externally Leveling the HP 8340B/41B Synthesized Sweepers
Using the HP 8340A Synthesized Sweeper with X-Y Recorders.
Using the HP 8340A Synthesized Sweeper with the HP 8410B/C Network Analyzer

PRODUCT NOTES

Increasing the Frequency Switching Speed on the HP 8340A Synthesized Sweeper.
List of other Product Notes

PROGRAMMING NOTES

Introductory Operating Guide (HP-IB) for the HP 8340A/8341A Synthesized Sweepers with the HP 9000 Series
200/300 Desktop Computers (BASIC)
Quick Reference Guide (HP-IB) for the HP 8340B/41B Synthesized Sweepers

IN CASE OF DIFFICULTY

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.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power, cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

BEFORE APPLYING POWER

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

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

SERVICING

WARNING

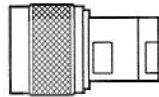
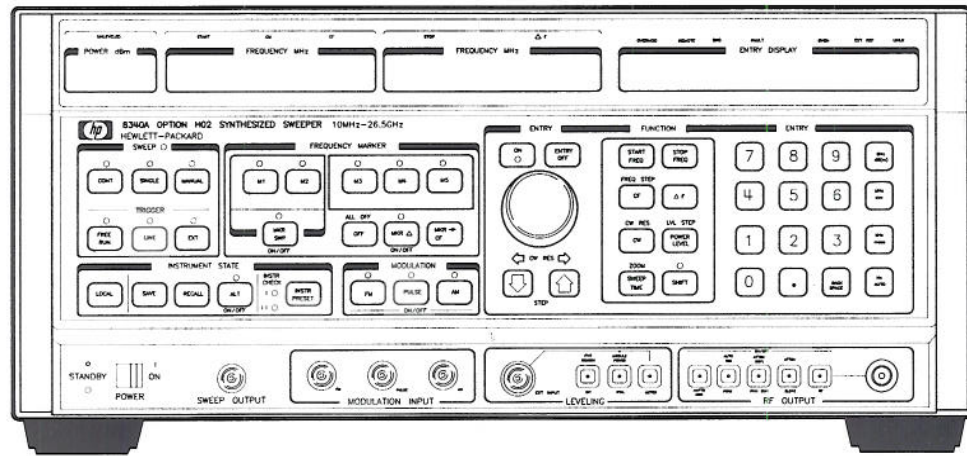
Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

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

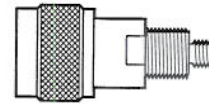
Capacitors inside this product may still be charged even when disconnected from their power source.

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

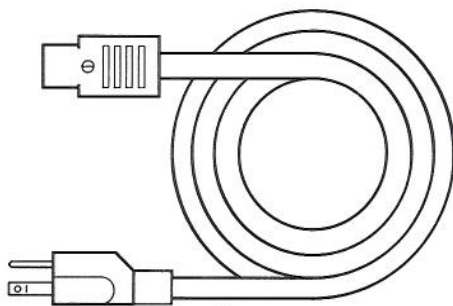
HP 8340A OPTION H02 SYNTHESIZED SWEEPER WITH ACCESSORIES SUPPLIED



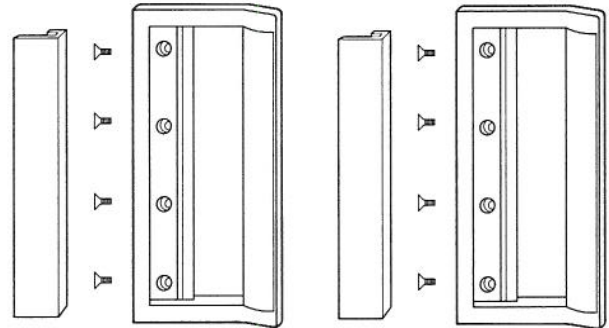
HP Part Number 1250-1854
50Ω TERMINATION
(For AUX OUTPUT)



HP Part Number 1250-1744
TYPE-N (M) TO
3.5 mm



POWER CABLE*



HP Part Number 5061-9690
HANDLES KIT

* POWER CABLE/PLUG SUPPLIED DEPENDS ON COUNTRY OF SHIPMENT DESTINATION. REFER TO SECTION 2, INSTALLATION, FOR PART NUMBER INFORMATION.

Figure 1-1. HP 8340A Option H02 with Accessories Supplied

Section 1. General Information

INTRODUCTION

This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8340A Option H02 Synthesized Sweeper. Figure 1-1 shows the HP 8340A H02 with accessories supplied.

The complete HP 8340A H02 manual set consists of three volumes, divided into eight major sections, which provide the following information:

Volume 1

- SECTION 1, GENERAL INFORMATION, includes a brief description of the instrument and its documentation layout, safety considerations, specifications and supplemental performance characteristics, instrument identification, options available, accessories available, and a list of recommended test equipment.
- SECTION 2, INSTALLATION, provides information for initial inspection, preparation for use, storage, and shipment.
- SECTION 3, OPERATION, is subdivided into five sections that describe the instruments features, how to manually and remotely control instrument operation, and how to interface the HP 8340A H02 with other compatible instruments.

Volume 2

- SECTION 4, PERFORMANCE TESTS, presents procedures required to verify that the performance of the instrument is in accordance with published specifications. An HP-IB Operation Verification procedure is also included to test the ability of the HP 8340A H02 to properly communicate on the HP-IB bus. A section is provided for Automated Test Procedures using a computing controller. These are additional or duplicate tests of the Performance Tests and/or Adjustment procedures.
- AUTOMATED TEST PROCEDURE, provides the procedure for performing automated Frequency Switching and RF attenuator performance tests. The Automated Test Procedure software is supplied with this supplement. An HP 9826A or HP 9836A controller is required for these tests. Refer to Table 4-2 or the Automated Test Procedure document for further information.
- SECTION 5, ADJUSTMENTS, presents procedures required to properly adjust and align the HP 8340A H02 after repair.
- SECTION 6, REPLACEABLE PARTS, provides information required to order all parts and assemblies contained in the HP 8340A H02.

Volume 3

- SECTION 7, MANUAL BACKDATING CHANGES, provides backdating information required to make this manual compatible earlier shipment configurations.

- SECTION 8, SERVICE, includes information to troubleshoot and repair instrument problems.

The Service Section begins with a Service Introduction that describes the section layout and overall instrument theory and troubleshooting concepts. The Service Introduction section then leads the troubleshooter into one of eight Functional Groups, each describing a set of assemblies that serve as a functional unit.

Each Functional Group area includes more detailed information that will lead the troubleshooter to a specific assembly within that group.

Each assembly is then supported with its own separate circuit description, schematic diagram, component location diagram, and troubleshooting information to lead the troubleshooter to the specific circuit or component at fault.

Additional copies of the Operating and Service Manual are available; refer to HP Part Number information of the manuals on the title page of this volume.

On the title page of this volume is a "Microfiche" part number. This number may be used to order 10- by 15-centimeter (4- by 6-inch) microfilm transparencies of the complete manual. Each microfiche page contains up to 60 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Changes sheet as well as all pertinent Service Notes.

Refer any questions regarding this manual, the Manual Changes Supplement, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the last tab section in Volume 3 for a worldwide listing of HP Sales/Service Offices.

SPECIFICATIONS

Listed in Table 1-1 are the specifications for the HP 8340A H02. These specifications are the performance standards, or limits, against which the instrument may be tested. Also listed in Table 1-1 are the supplemental performance characteristics (*in italics*). Supplemental performance characteristics are not specifications but are typical characteristics included as additional information for the user.

SAFETY CONSIDERATIONS

This product has been manufactured and tested in accordance with international safety standards. Before operation, this product and related documentation must be reviewed for familiarization with safety markings and instructions. A complete listing of Safety Considerations precedes Section 1 of this manual.

INSTRUMENTS COVERED BY MANUAL

Attached to the rear panel of the instrument is a serial number plate. A typical serial number plate is shown in Figure 1-2. 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 those listed on the title page of this manual under SERIAL NUMBER.

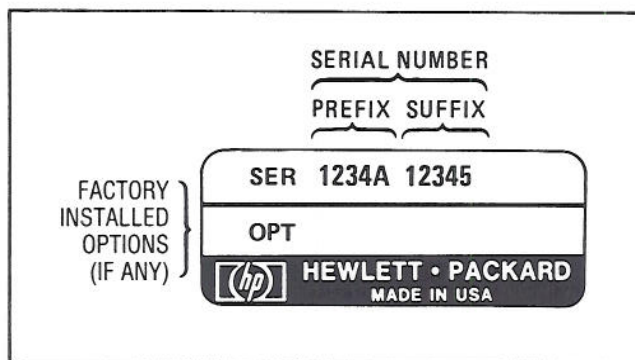


Figure 1-2. Typical Serial Number Plate

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. An unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for the instrument is then supplied with a Manual Changes Supplement that documents the differences.

In addition to change information, the Manual Changes Supplement contains information for correcting errors in the manual. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes Supplement. The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the title page. Complimentary copies of the Manual Changes Supplement are available on request from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes Supplement, contact your nearest Hewlett-Packard Sales/Service Office.

DESCRIPTION

The HP Model 8340A H02 Synthesized Sweeper is a broadband, analog sweep, frequency synthesizer with versatile modulation and output power control.

The HP 8340A H02 generates synthesized output frequencies from 10 MHz to 20.0 GHz. Frequency resolution from 1 Hz at 10 MHz to 3 Hz at 20.0 GHz is available. Frequency accuracy is a function of the internal time base accuracy or an external frequency standard.

The HP 8340A H02 features amplitude modulation, pulse modulation, and frequency modulation.

The HP 8340A H02 is capable of generating a true analog sweep across its entire 10 MHz to 20.0 GHz frequency range. Additionally, a synthesized sweep mode allows precision analog sweeps as narrow as 100 Hz.

Additional features include five calibrated frequency markers and various sweep modes oriented around stored marker positions. The ability to Save and Recall up to 9 front panel settings also allows an Alternate Sweep function.

The front panel ENTRY DISPLAY shows the current active function and its appropriate values. Data entry is quickly accomplished through the use of the numeric keyboard, step keys, or rotary knob control. All front panel functions, except the line switch, are programmable through the HP-IB bus.

Many serviceability features have also been incorporated in the HP 8340A H02. An internal SELF TEST is run each time the instrument is turned on or when the front panel INSTR PRESET key is pressed. Front panel diagnostic routines are accessible to aid in fault detection and isolation. Additional information on troubleshooting and repair procedures is included in the section In Case of Difficulty, in this volume. This information is also included in the Service section in Volume 3.

EQUIPMENT AVAILABLE

Service Accessories

A Service Accessory Kit is available as HP Part Number 08340-60134. This kit includes a variety of extender boards, cables, and adapters that will aid in servicing the HP 8340A H02.

RECOMMENDED TEST EQUIPMENT

Table 4-2 contains a complete list of all required equipment for the tests and adjustments supplied in Section 4, Performance Tests and Section 5, Adjustments. Test equipment other than that noted in the table may be substituted if it meets or exceeds the critical specifications indicated in the table.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (1 of 14)

NOTE HP 8340A Option H02 Specifications are the performance standards, or limits, against which the instrument may be tested. The following Specifications apply for temperatures between 0 and +55°C except where noted. Specifications apply with periodic use of AUTO TRACKING CALIBRATION in swept operation. Supplemental Performance Characteristics are in <i>italics</i> in this table and are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. These are denoted as "typical," "nominal," or "approximate."
FREQUENCY
CW MODE Range: 0.01 to 20.0 GHz Resolution: $n \times 1$ Hz Where N = harmonic multiplication (1 to 3). Refer to Frequency ranges and Bandswitch Points description below. Accuracy: Same as Time Base Accuracy Time Base Frequency: 10 MHz Aging Rate: 1×10^{-9} per day, 2.5×10^{-7} per year after 72 hour warm up if HP 8340A Option H02 has been disconnected from ac power for less than 24 hours. Aging rate is achieved after 7 to 30 days warm up if HP 8340A Option H02 has been disconnected from ac power for greater than 24 hours. Temperature Coefficient: Typically $< 1 \times 10^{-10}$ per °C Change due to 10% line voltage change: Typically $< 1 \times 10^{-11}$ Accuracy: Overall accuracy of internal time base is a function of time base calibration $\pm$ aging rate $\pm$ temperature effects $\pm$ line effects. Switching Time: <50 msec (PEAK function off) Fast Phase Lock Mode reduces typical switching time to <20 msec.
CENTER FREQUENCY/SWEEP WIDTH MODE (CF/ΔF) Range: 10.00005 MHz to 19.99999995 GHz (center frequency) 100 Hz to 19.99 GHz (sweep width) Resolution: Approximately 0.1% of sweep width (ΔF) Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec): $\Delta \leq n \times 5$ MHz: $\pm 1\%$ of indicated sweep width (ΔF) $\pm$ time base accuracy* $\Delta > n \times 5$ MHz to < 100 MHz: $\pm 2\%$ of indicated sweep width (ΔF) $\Delta \geq 100$ MHz: $\pm 1\%$ of indicated sweep width (ΔF), or ± 50 MHz, whichever is less. Where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points description below. *Time Base effects Center Frequency accuracy only, not sweep width accuracy.

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (2 of 14)

FREQUENCY (Cont'd)
START/STOP MODE Range Start: 10 MHz to 19.9999999 MHz Stop: 10.0001 MHz to 20.0 GHz Resolution: Typically, the same as Center Frequency/Sweep Width mode: Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec): Same as Center Frequency/Sweep Width Mode.
FREQUENCY MARKERS All 5 markers are independently variable and have the same specifications. Range: 10 MHz to 20.0 GHz Resolution: Approximately 0.1% of sweep width (ΔF) Readout Accuracy (sweep time > 100 msec): $\Delta \leq n \times 5 \text{ MHz}$: $\pm 1\%$ of indicated sweep width (ΔF) $\pm$ time base accuracy*. $\Delta > n \times 5 \text{ MHz}$ to $< n \times 100 \text{ MHz}$: $\pm 2\%$ of indicated sweep width (Δ). $\Delta \geq n \times 100 \text{ MHz}$: $\pm 1\%$ of indicated sweep width (ΔF) or $\pm 50 \text{ MHz}$, whichever is less. Where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points Description below. *Time base accuracy is not a factor in MKRΔ Mode.
TYPICAL FREQUENCY RANGES AND BANDSWITCH POINTS For bands 0 and 1, the HP 8340A Option H02's output is derived from the fundamental frequency of its internal 2.3 to 7.0 GHz YIG-tuned oscillator ($n=1$). For bands 2 and 3, the output is derived from the 2nd or 3rd harmonic of the oscillator ($n = 2$ or 3). Bandswitch points in CW Mode (only) always occur at the following points: Band 0 to 1: 2.3 GHz Band 1 to 2: 7.0 GHz Band 2 to 3: 13.5 GHz Bandswitch points in each of the swept modes (CF/ΔF, START/STOP) and the MANUAL SWEEP mode normally occur at the following points (with the exception listed below): Band 0 to 1: 2.4 GHz Band 1 to 2: 7.0 GHz Band 2 to 3: 13.5 GHz The swept mode bandswitch points are illustrated in Figure 1.

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8341A Option H02 Specifications and Supplemental Performance Characteristics (3 of 14)

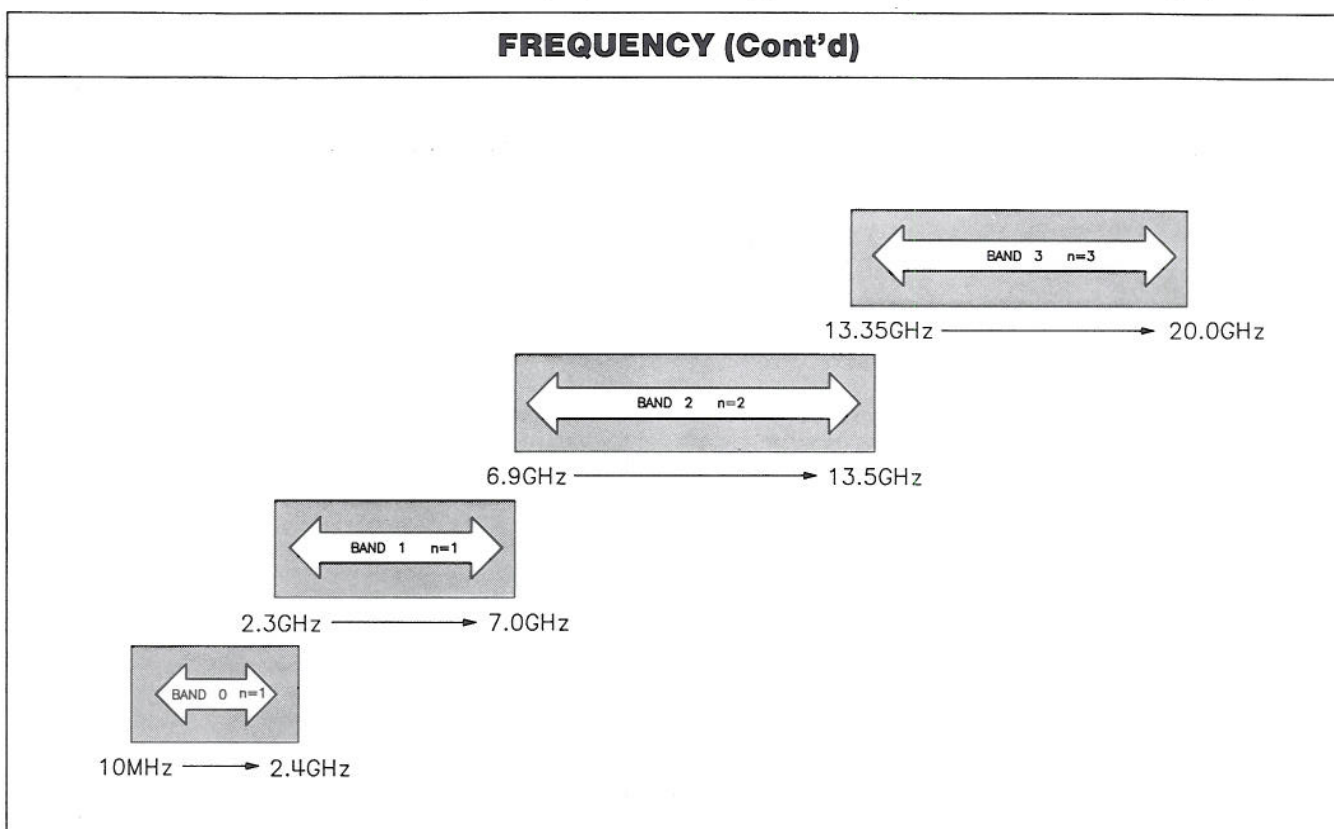


Figure 1. Typical Frequency Ranges and Bandswitch Points in Swept Modes

Note that the bands overlap. However, any sweep will be executed with the minimum number of bandswitch points. If the start frequency is above the lower limit for a given band, the sweep will start in that band and not the next lower one. If the stop frequency exceeds the upper limit of a given band by an amount greater than $0.004 \times \Delta F$, a bandswitch will occur at that band's upper limit.

SPECTRAL PURITY					
(Spectral Purity specifications apply for CW mode and all swept modes, unless otherwise stated.)					
SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)				
	Band 0		Band 1	Band 2	Band 3
	0.01 to <1.4	1.4 to <2.3	2.3 to <7.0	7.0 to <13.5	13.5 to 20.0
Harmonics (only up to 20.0 GHz)	< -30	< -50	< -50	< -50	< -50
Subharmonics and multiples thereof (up to 20.0 GHz)	—	—	—	< -50	< -50
Non-harmonically related spurious (CW and Manual Sweep mode only)	< -50	< -50	< -70	< -64	< -60

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (4 of 14)

SPECTRAL PURITY (Cont'd)				
SPURIOUS SIGNALS (Cont'd)				
Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples thereof				
(CW mode only, all power levels)	Band 0 0.0001 to <2.3	Band 1 2.3 to <7.0	Band 2 7.0 to <13.5	Band 3 13.5 to 20.0
Offset <300 Hz from carrier	<-50	<-40	<-40	<-40
Offset 300 Hz to 1 kHz from carrier	<-60	<-60	<-54	<-50
Offset >1 kHz from carrier	<-65	<-65	<-59	<-55
SINGLE-SIDEBAND PHASE NOISE (dBc/1 Hz BW, CW Mode, all power levels)				
Offset 30 Hz from carrier	<-64	<-64	<-58	<-54
Offset 100 Hz from carrier	<-70	<-70	<-64	<-60
Offset 1 kHz from carrier	<-78	<-78	<-72	<-68
Offset 10 kHz from carrier	<-86	<-86	<-80	<-76
Offset 100 kHz from carrier	<-107	<-107	<-101	<-97
TYPICAL FREQUENCY STABILITY , 50 Hz - 15 kHz post detection bandwidth				
Typical Residual FM in CW Mode: $<n \times 60 \text{ Hz rms}$				
Typical Residual FM in Swept Mode:				
$\Delta F > n \times 5 \text{ MHz: } <n \times 25 \text{ kHz rms}$				
$\Delta F \leq n \times 5 \text{ MHz: Same as CW mode}$				
Where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points description above.				

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (6 of 14)

RF OUTPUT (Cont'd)

TYPICAL ALC INCREMENTAL ACCURACY

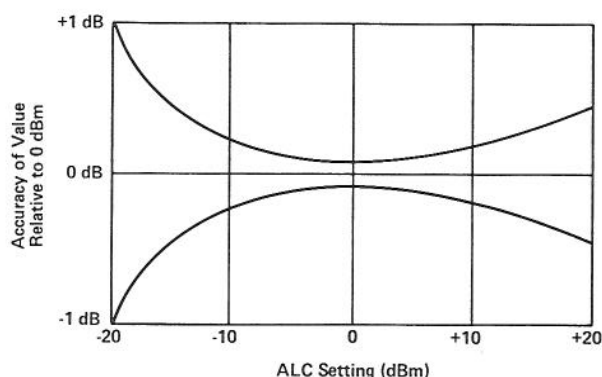


Figure 2. Typical ALC Incremental Accuracy

In normal operation, the ALC does not operate below -4.95 dBm because the instrument automatically increments the step attenuator at that point. However, when the ALC and step attenuator are independently controlled (DECOUPLED mode), the ALC may be operated over its full $+20$ dBm to -20 dBm range. Refer to Section III, Operation for a more detailed description. Pressing [SHIFT] [PWR SWP] places the instrument in the Decoupled Mode. In this mode the Data Entry keyboard and the RPG control the ALC level, and the step up and step down keys control the attenuator.

RF OUTPUT CONNECTOR

Output Impedance: *Nominally 50 Ohms*

Typical Source SWR (Internally leveled only):

0.1 to <2.3 GHz: *Typically $<1.6:1$*

2.3 to 20.0 GHz: *Typically $<1.9:1$*

STABILITY WITH TEMPERATURE: *Typically ± 0.01 dB/ $^{\circ}$ C*

OUTPUT LEVEL SWITCHING TIME:

Typically <10 ms to be within 0.1 dB of final value with no attenuator range change (internally leveled only).

POWER SWEEP

Range:

Calibrated Range: At least 20 dB in DECOUPLED mode: see Figure 3 below. Actual available range is determined by the difference of maximum leveled power available at the frequency of interest and -20 dBm.

Resolution: 0.05 dB/sweep

Accuracy:

Starting Power Level: Same as Output Power Accuracy

Power Sweep Width and Linearity: See Figure 2

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (7 of 14)

RF OUTPUT (Cont'd)	
(A) COUPLED MODE (NON-SWEPT OPERATION, PEAKED) ALC VALUE (DBM) FREQUENCY RANGE (GHZ)	(B) DECOUPLED MODE (NON-SWEPT OPERATION, PEAKED) ALC VALUE (DBM) FREQUENCY RANGE (GHZ)
Figure 3. Typical Power Sweep Range In normal operation (a), the ALC does not operate below -4.95 dBm (unless the instrument is placed in the Decoupled Mode by pressing [SHIFT][PWR SWP]. See (b), and so the maximum power sweep range is the difference of -4.95 dBm and the maximum leveled power available at the frequency of interest (specified leveled power shown in the diagram). In the DECOUPLED mode (b), the power sweep range is extended because the ALC can operate down to -20 dBm.	
SLOPE COMPENSATION Calibrated Range: 0 to 1.5 dB/GHz Resolution: 0.0001 dB/GHz	
EXTERNAL LEVELING XTAL: Allows the instrument to be externally leveled by crystal detectors of positive or negative polarity. METER: Allows power meter leveling with any HP power meter. Range (XTAL or METER): 500 microvolts (-66 dBV) to 2.0 volts (± 6 dBV) Accuracy of voltage at EXT INPUT connector relative to the displayed level (leveling voltage is shown in ENTRY DISPLAY in dBV): ± 0.5 dB ± 0.2 mV typically. Loop Bandwidth: XTAL Mode: Nominally 70 kHz METER Mode: Nominally 0.7 Hz Input Impedance: Nominally 1 M Ohm.	

Supplemental Performance Characteristics are in italics.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (9 of 14)

PULSE MODULATION (Cont'd)	
SETTLING TIME OF PULSES	
OVERSHOOT, RINGING (V_{OR}/V_P): <i><15% typically</i>	
PULSE WIDTH COMPRESSION ($T_V - T_{RF}$): <i>± 5 nanoseconds typically</i>	
DELAY TIME (T_D): <i>50 nanoseconds typically</i>	
VIDEO FEEDTHROUGH (V_F/V_P): 0.01 to <0.4 GHz (Band 0): <i><10% (at 0 dBm)</i> 0.4 to <2.3 GHz (Band 0): <i>$\leq 5\%$ (for output power levels $\leq +8$ dBm)</i> 2.3 to 20.0 GHz (Bands 1 - 3): <i>$\leq 0.2\%$</i>	
SIDEBANDS (caused by a pulse input when PULSE is OFF): <i>Typically -50 dBc with a 30 kHz squarewave input from 0.01 to 7.0 GHz.</i>	
PULSE INPUT CONNECTOR: TTL compatible. (Open circuit is TTL high level and keeps RF on.) <i>Damage level is $+12$ Vdc, -20 Vdc. Refer to Section 3, Operation, for input circuit diagram.</i>	
PULSE DEFINITIONS: T_{RF} -RF Pulse Length T_V -Input Pulse Length T_D -Delay Time V_P -RF Pulse Amplitude T_R -RF Pulse Rise Time T_F -RF Pulse Fall Time V_{OR} -Overshoot and Ringing V_F -Video Feedthrough	

Figure 4. Pulse Definitions

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (10 of 14)

AMPLITUDE MODULATION									
(The following specifications apply when the instrument is internally leveled, for waveforms whose envelope peak is at least 1 dB below maximum specified power. Unless noted, pulse modulation must be OFF.									
FREQUENCY RANGE: 0.01 to 18.0 GHz									
AM DEPTH: 0 to 90% Actual available depth will be greater than this in many cases and is determined by the difference of the maximum leveled power available (at the frequency of interest) and -30 dBm.									
AM SENSITIVITY (at 1 kHz rate and 30% Depth): 100%/V $\pm 5\%$. AM Depth is linearly controlled by varying the input between 0 and ± 1 V peak. Nominal input impedance is 600 Ohms.									
AM BANDWIDTH (relative to 1 kHz rate): DC coupled, 3 dB point ≥ 100 kHz, Depth = 90%									
AM FREQUENCY RESPONSE (FLATNESS) (relative to a 1 kHz rate at 30% depth, DC to 10 kHz): ± 0.20 dB									
DISTORTION (at 50% modulation depth): <table border="1" data-bbox="305 884 1253 1106"> <thead> <tr> <th>Modulation Rate</th><th>Maximum Distortion</th></tr> </thead> <tbody> <tr> <td>≤ 20 KHz</td><td>4%</td></tr> <tr> <td>20 KHz to ≤ 50 KHz</td><td>10%</td></tr> <tr> <td>50 KHz to ≤ 100 KHz</td><td>35%</td></tr> </tbody> </table>		Modulation Rate	Maximum Distortion	≤ 20 KHz	4%	20 KHz to ≤ 50 KHz	10%	50 KHz to ≤ 100 KHz	35%
Modulation Rate	Maximum Distortion								
≤ 20 KHz	4%								
20 KHz to ≤ 50 KHz	10%								
50 KHz to ≤ 100 KHz	35%								
INCIDENTAL PHASE MODULATION (in peak radians) (Rates ≤ 10 kHz, 30% Depth): < 0.4 typically									
INCIDENTAL FM: <i>Incidental Phase Modulation $\times$ Modulation Frequency</i>									
AM INPUT IMPEDANCE: <i>Nominally 600 Ohms.</i>									

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (11 of 14)

PULSE AMPLITUDE MODULATION	
UNLEVELED ("SHIFT RF" mode) RF FREQUENCY: 0.01 to 18 GHz PULSE REPETITION RATE: DC to 5.0 MHz PULSE WIDTH: 50 ns to CW AMPLITUDE MOD RATE (3dB BW): DC to 50 kHz MODULATION DEPTH: 35 dB minimum AM DISTORTION (at 50% MODULATION DEPTH): 25% Maximum at ≤ 50 kHz Modulation Rate	
INTERNALLY LEVELED RF FREQUENCY: 0.4 to 18 GHz PULSE REPETITION RATE: 10 Hz to 5.0 MHz PULSE WIDTH: 200 ns to CW AMPLITUDE MOD. RATE (DC Coupled, 3 dB BW): $\geq \text{PRF}/20$ or 5 kHz (whichever is less) MODULATION DEPTH: Envelope trough ≥ -30 dBm, ALC Level	
FREQUENCY MODULATION	
MODULATION RATE (3 dB Bandwidth): 50 kHz to 10 MHz	
PEAK DEVIATION: The lesser of 10 MHz or: $5 \times \text{Mod Rate Band 0,1}$ $10 \times \text{Mod Rate Band 2}$ $15 \times \text{Mod Rate Band 3}$	
DEVIATION ACCURACY (at 100 kHz Rate): $\pm 10\%$	
FM SENSITIVITY: 1 MHz/Volt or 10 MHz/Volt	
SWEEP TIME	
RANGE: 10 milliseconds to 200 seconds forward sweep times <i>Fastest possible sweep typically cycles once every 40 ms; fastest possible full band sweep typically cycles once every 150 ms.</i>	
MAXIMUM SWEEP RATE: 100 MHz/ms	
RESOLUTION: <i>Approximately 0.1% of current sweep time value.</i>	
ACCURACY: $\pm 5\%$ (sweeptimes ≤ 50 seconds)	

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (12 of 14)

INPUTS
FREQUENCY MODULATION INPUT Front panel BNC female connector. Nominal input impedance is 50 Ohms. Maximum input voltage = ± 1 vac (50 KHz to 10 MHz, 3 dB bandwidth). Damage to internal circuitry will result if a signal with a peak voltage of ± 8 vac or greater is input.
PULSE MODULATION INPUT Front panel BNC female input connector. TTL compatible (open circuit is TTL high level and keeps RF on). <i>Damage level is +12 Vdc, -20 Vdc.</i>
AM MODULATION INPUT Front panel BNC female input connector. <i>Nominal input impedance is 600 Ohms.</i>
LEVELING EXT INPUT Front panel BNC female input connector. Used for power meter leveling or crystal detector leveling. Input impedance in XTAL or METER modes is <i>nominally 1 MOhm</i>. Refer to EXTERNAL LEVELING specifications.
FREQUENCY STANDARD EXT Rear panel BNC female connector. Accepts 5 or 10 MHz signal from internal or external timebase. A BNC jumper connects this input to the HP 8340A H02's FREQUENCY STANDARD INT output for operation from HP 8340A H02's internal timebase. External signal input must be 5 MHz ± 50 Hz or 10 MHz ± 100 Hz, 0 to +10 dBm. <i>Nominal input impedance is 50 ohms.</i>
EXT TRIGGER INPUT Rear panel BNC female connector. Triggers single sweep. Trigger signal must be >2 Vdc (10 Vdc max) and wider than 0.5 microseconds. <i>Nominal input impedance is 2 kOhms.</i>
STOP SWP IN/OUT: Rear panel BNC female connector. TTL high while sweeping, stops sweep when grounded externally. TTL low when HP 8341A stops sweep.
HP 8755C INTERFACE Rear panel. Connects via cable (HP Part No. 8120-3174) to HP 8755C Scalar Network Analyzer to provide Alternate Sweep function.
HP 8410B INTERFACE Rear panel 25-pin D-type connector. Permits multi-octave operation of HP 8410B/C Network Analyzer with HP 8340A H02 via interface cable (HP Part No. 08410-60146). Also provides duplicates of these functions: Ext Trigger Input, Mute Output, Penlift Output, Neg Blank, and Z-Axis Blank/Mkrs. Also provides an input for a switch closure to execute the UP key function.
OUTPUTS
RF OUTPUT Front panel Type N Female connector. Frequency output range is 10 MHz to 20.0 GHz. <i>Nominal output impedance is 50 Ohms.</i> SWR is shown in RF OUTPUT characteristics.
SWEEP OUTPUT Front and rear panel BNC female connectors. Supplies a voltage proportional to the sweep that ranges from <i>approximately 0 Vdc</i> (at start of sweep) to <i>approximately +10 Vdc</i> (at end of sweep), regardless of sweep width. In CW mode, the dc voltage is proportional to percentage of full 10 MHz to 20.0 GHz range.
1 V/GHz (19V Max) Rear panel BNC female connector. Outputs a voltage proportional to output frequency at 1V/GHz, up to a maximum of 19 Vdc. <i>Nominal load impedance should be ≥ 4 KOhms.</i> Accuracy of 1V/GHz is $\pm 1\% \pm 2$mV.

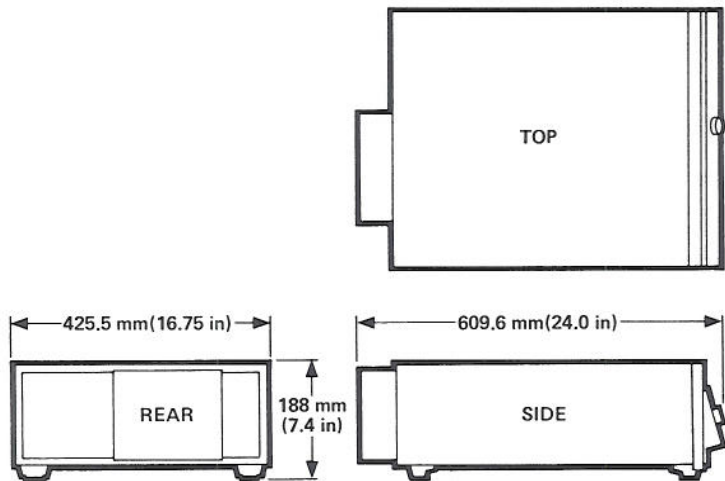
Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (13 of 14)

OUTPUTS (Cont'd)	
10 MHz REF OUTPUT	Rear panel BNC female connector. Output power level is <i>nominally 0 dBm</i> , Output impedance is <i>nominally 50 Ohms</i> .
FREQUENCY STANDARD INT	Rear panel BNC connector. Output frequency 10 MHz, output power <i>nominally 3 dBm</i> , 50 Ohm nominal output impedance. Jumpered to FREQUENCY STANDARD EXT for operation from HP 8340A H02's internal timebase.
MUTE OUTPUT	Rear panel BNC female connector. Mutes servo motor of X-Y recorder when the HP 8340A H02 crosses a band switchpoint.
PENLIFT OUTPUT J13	For operation with X-Y recorders. PENLIFT disables an X-Y recorder's ability to lower its pen during sweep retrace. If [SHIFT] [LINE] is pressed on the front panel, PENLIFT will also disable the pen during forward sweep band switchpoints. Because of X-Y recorder limitations PENLIFT will always disable the X-Y recorder's pen at sweep times under 5 seconds. PENLIFT enables pen operation by providing a current path to ground for the X-Y recorder's pen solenoid. The voltage at the PENLIFT output in this state will be <i>approximately 0 Vdc</i> . Circuit impedance in this state is <i>approximately .5 Ohms</i> . PENLIFT disables pen operation by not providing a current path to ground for the X-Y recorder's pen solenoid. The voltage on the PENLIFT output will be equal to the X-Y recorder's pen solenoid supply voltage. Circuit impedance in this state is very high.
NEG BLANK	Rear panel BNC female connector. Supplies negative rectangular pulse (<i>approximately -5 Vdc into 2 kOhm load</i>) during the retrace and band switchpoints of the RF output.
Z-AXIS BLANK/MKRS	Rear panel BNC female connector. Supplies positive rectangular pulse (<i>approximately +5 Vdc into 2 kOhms</i>) during the retrace and band switchpoints of the RF output. Also, supplies a -5 Vdc pulse when the RF is coincident with a marker frequency (intensity markers only).
AUX OUT	Rear panel Type-N female connector. Provides a 2.3 to 7.0 GHz fundamental oscillator output, <i>nominally 0 dBm and 50 Ohm output impedance</i> .
REMOTE OPERATION	
All functions (except line power) may be programmed via the Hewlett-Packard Interface Bus (HP-IB). Detailed Remote operation information is included in Section 3, Operation.	
GENERAL	
ENVIRONMENTAL	
Temperature: Operation at 0 to +55°C, except as noted in electrical specifications.	
Humidity: Passes 5 day cycling, +40°C, 95% relative humidity.	
EMI: Controlled and radiated interference is within the requirements of CE03 and RE02 (relaxed by 10 dB) of MIL STD 461A, and within the requirements of VDE 0871/1978, Level B and CISPR publication 11 (1975).	

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340A Option H02 Specifications and Supplemental Performance Characteristics (14 of 14)

GENERAL (Cont'd)	
WARM-UP TIME Operation: Requires 30-minute warmup from cold start, 0 to +55°C. Internal temperature equilibrium is reached after 2-hour warmup at stable outside temperature. Frequency Reference: Reference time base is kept at operating temperature in STANDBY mode with the instrument connected to the ac power. For instruments disconnected from ac power for less than 24 hours, the aging rate is $<1 \times 10^{-9}$ /day after a 72-hour warmup.	
POWER REQUIREMENTS 47.5 to 66 Hz; 100, 120, 220, or 240 volts ($\pm 10\%$); <i>Typically, 500 VA maximum (40 VA in STANDBY).</i>	
WEIGHT Net Weight: 34 kg (75 lb) Shipping Weight: 52 kg (112 lb)	
DIMENSIONS  The diagram shows three views of the instrument: a top view, a rear view, and a side view. The top view is a rectangle with a handle on the left side. The rear view shows the back of the instrument with a width of 425.5 mm (16.75 in) and a height of 188 mm (7.4 in). The side view shows the right side of the instrument with a depth of 609.6 mm (24.0 in).	
NOTES	
- Maximum leveled power from 35°C to 55°C will typically be degraded from these specifications by <i>no more than 2 dB</i>. - Internally leveled, AM off. The POWER dBm display monitors that actual output power, giving accurate readings when unleveled, externally leveled, or when amplitude modulating with a signal that has a dc component. In these modes, the accuracy <i>typically degrades by ± 0.1 dB</i> over the tabulated values. The ENTRY DISPLAY shows the desired power level, or the desired external detector output voltage, exclusive of modulation. - The ALC loop <i>typically operates up to +20 dBm</i> to enhance usability at those frequencies where leveled power greater than the maximum specified is available. - Typical.	

Supplemental Performance Characteristics are in *italics*.

Section 3. Operation

INTRODUCTION

NOTE

The information contained in this section applies to the HP 8340A Option H02 instruments even though the titles of the documents do not mention the HP 8340A Option H02 specifically.

The Operation section of this manual consists of the following subsections:

GETTING ACQUAINTED GUIDE describes the basic features and essential operating procedures for local (front panel) and remote (HP-IB) operation of the HP 8341B Option 003 (to be known as the SOURCE). Personnel using the SOURCE for the first time should begin with this Guide.

OPERATION: FRONT/REAR PANEL DESCRIPTIONS, HP-IB PROGRAMMING INFORMATION, and POWER CONTROL/MODULATION FEATURES explains the functions of all front and rear panel keys, switches, connectors, indicators and displays, all HP-IB codes and programming procedures, and all the special features associated with power control and modulation. The front/rear panel information is grouped according to the physical layout of the HP 8341B Option 003: Figure 3-1 provides a visual index to the front panel functions, Figure 3-2 is an index to the rear panel functions, and Table 3-1 provides a cross reference between functions/modes and the front panel keys. **NOTE:** Figure 3-2 shows a 0.5V/GHz output. The HP 8340A Option H02 has a 1.0 V/GHz output.

The HP-IB programming information begins with Table 3-2, which lists all code mnemonics, and the codes and procedures are explained in the subsequent text. The power control and modulation information describes the special procedures that can be used to enhance the performance of these functions.

PROGRAMMING NOTES contain supplemental HP-IB programming information. Two Programming Notes are included:

Quick Reference Guide for the HP 8341B Option 003 Synthesized Sweeper succinctly lists the input programming codes, and was written for the experienced operator.

Introductory Operating Guide for use with the HP 9826A or HP 9836A BASIC-language computers provides a detailed explanation of HP-IB programming.

OPERATING GUIDES contain specialized application information. This section contains four Operating Guides (in addition to the Getting Acquainted Guide):

Use with X-Y Recorders explains interfacing of the SOURCE to HP X-Y recorders.

External Leveling of the HP 8340B/8341B describes using crystal detectors or power meters.

Use with the HP 8410B/C Network Analyzer shows interconnections between the HP 8340B/41B, the Network Analyzer, polar and rectangular displays, and transmission/reflection test sets.

Use with the HP 8755 Frequency Response Test Set describes interfacing procedures for the SOURCE and this scalar network analyzer system.

Contact the nearest HP Sales and Service Office for copies of other Programming Notes and Operating Guides as they become available.

SAFETY

Before applying power, refer to SAFETY CONSIDERATIONS in Section 1 of this manual. The information, cautions, and warnings in this manual must be followed to ensure safe operating conditions for the instrument and the operator.

WARNING

Before the instrument's line power cord is plugged in, all protective earth terminals ("ground" connections), extension cords, auto-transformers and other devices that are connected to the HP 8340A Option H02 should be connected to a protective earth-grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only fuses with the required current rating and specific type should be used. Do not use repaired fuses or short circuit the fuse holder; to do so could cause a shock or fire hazard.

CAUTION

Before the instrument's line power cord is plugged in, the line power module must be set to the voltage of the power source or damage to the instrument may result.

ADDITIONAL OPERATING INFORMATION

Located underneath the SOURCE is a pullout information card that summarizes the operating procedures and programming codes for the instrument.

If further information is necessary, contact the nearest Hewlett-Packard Sales and Service Office. The world-wide locations of HP offices are listed inside of the back cover of this manual.

VOLUME 2

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Section 4: Performance Tests

INTRODUCTION

The procedures in this section test the HP 8340A Option H02's electrical performance using the specifications given in Section 1 as the performance standards. These tests are intended for use in incoming inspection, calibration verification, and post-repair performance verification. All tests can be performed without access to the interior of the instrument. An HP-IB Operation Verification procedure is also provided at the end of this section to verify proper HP-IB operation of the instrument.

RECOMMENDED TEST EQUIPMENT

Table 4-2 is a complete list of all required equipment for the tests and adjustments supplied in Section 4, Performance Tests. Test equipment other than that noted in the table may be substituted if it meets or exceeds the critical specifications indicated in the table.

TEST RECORD

Results of the Performance Test procedures may be tabulated on the test record card located at the end of this section. Each test lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments have been made.

CALIBRATION CYCLE

This instrument requires periodic verification of performance. The instrument should be checked using the following performance tests at least once every year.

TEST FAILURE – SERVICE MANUAL

If any test fails, one may be referred to the service and/or adjustment sections of the this manual.

NOTE

The acronym "DUT" (Device Under Test) is used to describe the HP 8340A Option H02 under test. The acronym "LO" is used to describe the Local Oscillator.

Table 4-1. List of Manual Performance Tests¹

Test Number	Performance Test Title	Page
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Table 4-2. Recommended Test Equipment (1 of 6)

Instrument	Critical Specifications	Recommended Model	Use ¹
Oscilloscope	Dual Channel Bandwidth: dc to 100 MHz Vertical Sensitivity: ≤ 5 mV/Div Horizontal Sensitivity: 50 ns/Div 10 Magnifier External Sweep Capability 50 Ohm Vertical Input	HP 1741A	P, A, T
Oscilloscope Probe	10:1 Divider Probe	HP 10004D	T, A
Digital Voltmeter (DVM)	Range: -50 to $+50$ Vdc Accuracy: $\pm 0.01\%$ Input Impedance: ≥ 10 MOhms	HP 3455A or HP 3456A	P, A, T
Power Meter	Power Range: 1μ W to 100 mW Accuracy: ± 0.02 dB	HP 436A Option 022	P, A, T
Power Sensors	Frequency Range: 10 to 50 MHz Power Range: 1μ W to 100mW	HP 8481A	P, A, T
	Frequency Range: 50 MHz to maximum Frequency of DUT Power Range: 1μ W to 100 mW	HP 8485A	P, A, T
Frequency Counter	Frequency Range: Same as DUT Input Impedance: 50 Ohms Frequency Accuracy: time Base Accuracy ± 1 count	HP 5343A Option 011	P, A, T
Universal Counter	Time Interval Range: 100 ns to 200 s	HP 5316A	P, A, T
Spectrum Analyzers	Frequency Range: HP 8340B DUT: 0.01 to 22 GHz HP 8341B DUT: 0.01 to 20 GHz Must have External Time Base Input Center Frequency Accuracy in 0 Hz Span: Same as Time Base Accuracy Minimum Resolution Bandwidth: ≤ 300 Hz Residual FM: < 100 Hz Log Fidelity: ≤ 1 dB Must have Video Output	HP 8566A or HP 8566B	P, A, T
	Frequency Range: 20 Hz to 40 MHz Resolution Bandwidth: ≤ 3 Hz	HP 3585A	P, T
Frequency Standard	Frequency: 10 MHz Stability: $> 1 \times 10^{-10}/\text{yr}$	HP 5061A	P, A
Synthesized Sweeper (used as Local Oscillator in P ¹ and A ¹ , and Sweep Generator in A ¹)	Frequency Range: Same as DUT Must have External Time Base Input Frequency Accuracy: Same as Time Base Accuracy RF Power Output: $\geq +4$ dBm ³ Phase Noise: Must meet or exceed HP 8340A or HP 8341A Line Related Spurious Signals: Must meet or exceed HP 8340A Option H02	HP 8340A/B or HP 8341A/B	P, A

Table 4-2. Recommended Test Equipment (2 of 6)

Instrument	Critical Specifications	Recommended Model	Use ¹
Signal Generator	Frequency: 300 to 400 MHz RF Output Power: ≥ 0 dBm Settability: to within ± 50 kHz	HP 8654A (or HP 8340A/B or HP 8341A/B)	A
Desktop Computer	HP 236, 226, and 216 are equivalent to the HP 9836, 9826, and 9816 respectively. Of the three, the HP 236 (9836) is suggested. HP 85F includes HP 83936A ROM Drawer, HP 82937A HP-IB Interface, and I/O ROM HP Part No. 00085-15003.	HP 236 HP 226 HP 216 HP 85F	HP-IB
Plotter/Printer ROM	For HP 85F, no substitute.	HP Part No. 00085-10052	HP-IB
Modulation Analyzer	No Substitute	HP 8901A or HP 8902A	P
Pulse Generator	Pulse Width: ≤ 100 nS Rise Time: ≤ 10 ns Frequency: 20 Hz to 50 kHz	HP 8012B	P, A, T
Function Generator	Sinewave Amplitude: ≥ 1 Vrms Sinewave Frequency: dc to 100 kHz	HP 3325A	P, A, T
Amplifier	Frequency Range: 100 kHz to 1.3 GHz Gain: > 20 dB	HP 8447F	P, A
	Frequency Range: 2 to 20 GHz Gain: 15 dB	HP 8349B	P
Power Supply	0 to 50 Vdc Voltage Drift (in 1 hour): $\leq 0.1\% + 2.5$ mV	HP 6294A	P, A
Mixer	Frequency Range: 1 GHz to maximum frequency of DUT	HP Part Number 0955-0307	P, A
Feedthrough Termination	50 Ohm feedthrough	HP 10100C	P
Attenuators	Frequency Range: same as DUT Maximum Input Power: $> +20$ dBm Attenuation: 10 dB Connectors: 3.5 mm	HP 8493C Opt. 010	P, A
	Frequency Range: same as DUT Maximum Input Power: $> +20$ dBm Attenuation: 20 dB Connectors: 3.5 mm	HP 8493C Opt. 020	P A
Step Attenuator	Frequency Range: DC to 100 MHz Maximum Input Power: ≥ 200 mW avg. Attenuation 0 to 70 dB, settable in 10 dB steps	HP 355D	P
Power Splitter	Frequency Range: 10 MHz to 26.5 GHz Maximum Input Power: $\geq +20$ dBm Input SWR ≤ 1.3 Output SWR ≤ 1.22 Output tracking ≤ 0.25 dB	HP 11667B	P

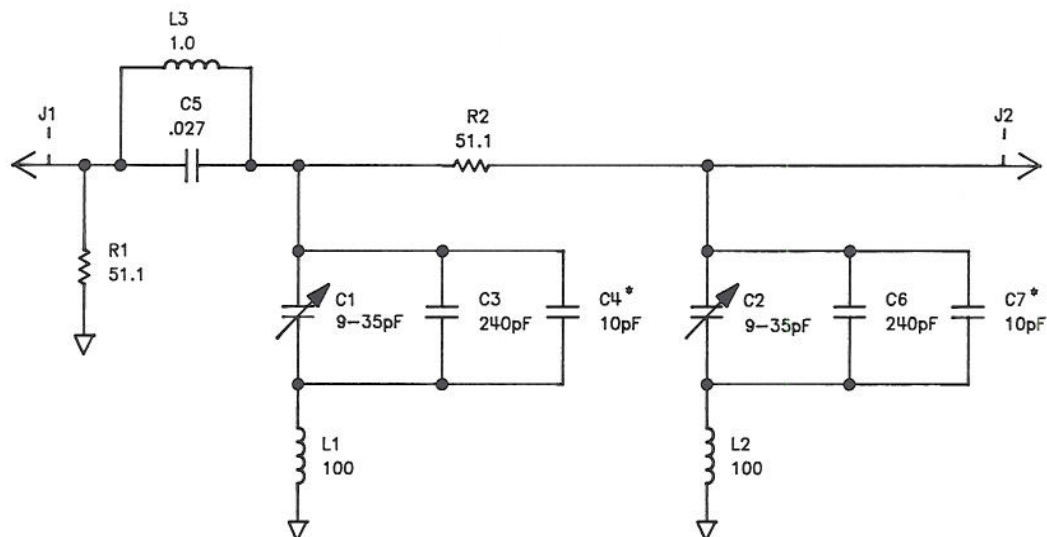
Table 4-2. Recommended Test Equipment (3 of 6)

Instrument	Critical Specifications	Recommended Model	Use ¹
Adapters	3.5 mm (f) to Type-N (m) (3 required)	HP Part No. 1250-1744	P, A, T
	3.5 mm (f) to 3.5 mm (f) (1 required)	5061-5311	P, A, T
	3.5 mm (m) to 3.5 mm (m) (2 required)	1250-1748	P, A, T
	3.5 mm (m) to Type-N (m) (1 required for HP 8341A LO)	1250-1743	P, A
	SMC (f) to BNC (f)	1250-0832	P
	SMA Male to BNC Female	1250-1200	P, A
	SMA Female to SMA Female	1250-1159	P
	Type-N Male to BNC Female	1250-1476	P
	BNC Female to Dual Banana	1251-2277	P, A
	SMB (m) to SMB (m)	1250-0669	A, T
Adapter Tees	BNC (f) to Clip Lead (2 required)	8120-1292	A, T
	BNC Male-Female-Female SMB Male-Male-Male	1250-0781 1250-0670 ²	P, A T
Active Probe	Input Impedance: 100 KOhms Output Impedance: 50 Ohms	HP 1121A	T, A
Probe Power Supply	For HP 1121A	HP 1122A	T, A
High Pass Filter (1 each required; use only if DUT is HP 8340B)	Frequency Range: 18.0 to 26.5 GHz Connectors: 3.5 mm Female 3.5 mm Male	HP K281C	P
		HP K281C Opt. 012	P
Low Pass Filter	Pass 100 MHz and below Reject 150 MHz and above	9135-0260	P, A
Crystal Detector	Negative Frequency Range: Same as DUT	HP 8473C	P, T, A
Diode (2 required)	Peak Inverse Voltage: 400V Average Forward Current: 750 mA	1901-0028	P
Capacitors	1000 pF ($\pm 10\%$), 100 VDC	0160-4574	P
	0.1 μ F ($\pm 10\%$), 200 VDC	0160-0168	A
Resistor	1 MOhm, 1%, 0.5 Watt	0757-0059	A
	1 KOhm, 1%, 0.125 Watt	0757-0280	P
50 Ohm Termination	SMB (f)	1250-0676	A

Table 4-2. Recommended Test Equipment (4 of 6)

Instrument	Critical Specifications	Recommended Model	Use ¹
PC Board Extenders	24-pin 30-pin 36-pin 44-pin 48-pin 62-pin 110-pin	HP Part No. 08340-60095 ² 08505-60041 ² 08505-60042 ² 08350-60031 ² 08340-60050 ² 08340-60096 ² 08340-60033 ²	T T T T T T T
IC Test Clip	16-pin 20-pin	1400-0734 ² 1400-0979 ²	T T
Adjustment Tool	Fits adjustment slot on components	8830-0024 ²	T
Service Cables	BNC (m) to SMB (f) (2 required) SMA (m) to SMA (m) Semi-Rigid 61mm ($\cong$ 2 ft) 2 required SMB (f) to SMB (f) Delay Line — SMA (m) to SMA (m) $\geq$ 1 meter (3 ft) BNC (m) to BNC (m) (4 required)	85680-60093 ² 08340-20124 ² 5061-1022 ² 08503-20038 ² HP 10503A	T P, A, T T P P, A, T
Nut Driver	9/16-inch, to replace front panel BNC nuts	08340-20099 ²	T
Wrench	5/16-inch slotted box/open end	08555-20097 ²	T
Notch Filter	At least 35 dB rejection at 1 MHz Construct as shown below. The filter rejection should be: $\geq$ 35 dB at 1 MHz $<$ 26 dB at 1.01 MHz	Locally Fabricate	P
Test Jumper	Clip lead (IC or small alligator)	Purchase locally	T
YO Special Test Fixture	Refer to Section 5, Adjustments, 5-8. YO Loop Adjustments	Locally Fabricate	A

Table 4-2. Recommended Test Equipment (5 of 6)



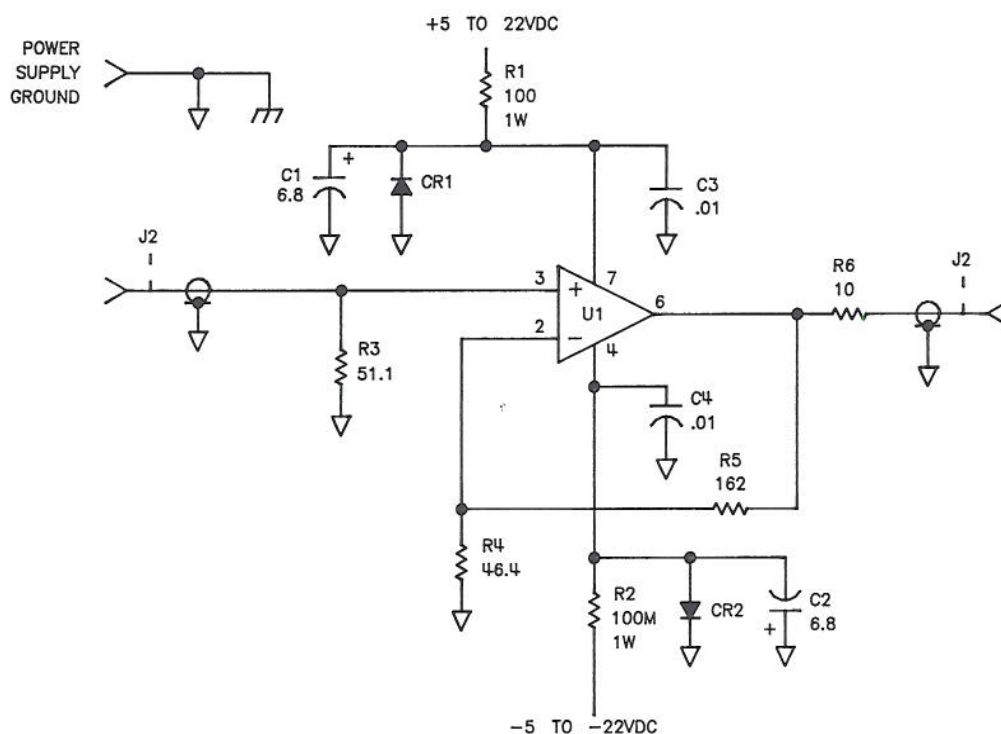
* Nominal value

Reference Designator	Description	HP Part No.	Qty.
C1,2	CAPACITOR-VAR CER 9-35PF	0121-0046	2
C3,6	CAPACITOR-MICA 240PF 300V	0140-0199	2
C4,7	CAPACITOR-CERAMIC 10PF 100V	0160-4791	2
C5	CAPACITOR-PE .027 μ F 200V	0170-0066	1
J1,2	CONNECTOR RF MALE SMB	1250-0257	2
L1,2	COIL 100 μ H 5%	9140-0210	2
L3	COIL 1.0 μ H 5%	9100-3551	1
R1,2	RESISTOR 51.1 1% .125W	0757-0394	2

1. P=Performance Tests, HP-IB=HP-IB Operation Verification Test, A=Adjustments, T=Troubleshooting.
2. These parts are included in Service Kit HP Part Number 08340-60134.
3. For best accuracy in the Pulse Modulation Rise and Fall Time and the Amplitude Modulation Performance Tests, the local oscillator drive to the mixer should be $\geq +4$ dBm. The HP 8340A Option H02, used as the LO will produce at least +5 dBm at any frequency.

Table 4-2. Recommended Test Equipment (6 of 6)

**AM Amplifier Schematic and Parts List
(For Simultaneous AM and Pulse Test)**



Reference Designator	Description	HP Part No.	Qty.
C1, C2	CAPACITOR 6.8 μ F 35V TA	0180-0116	2
C3, C4	CAPACITOR .01 μ F 100V CER	0160-4832	2
CR1, CR2	DIODE POWER 400V 1A (IN4004)	1901-0743	2
J1	CONNECTOR RF FEMALE BNC	1250-0045	1
J2	CONNECTOR RF MALE BNC	1250-0118	1
MP1, 2	NUT HEX 3/8-32	2950-0001	2
MP3, 4	WASHER LOCK .377 ID	2190-0016	2
R1, R2	RESISTOR 100 Ω 5% 2W	0698-3620	2
R3	RESISTOR 51.1 Ω 1% .125W	0757-0394	1
R4	RESISTOR 46.4 Ω 1% .125W	0698-4037	1
R5	RESISTOR 162 Ω 1% .125W	0757-0405	1
R6	RESISTOR 10 Ω 1% .125W	0757-0346	1
U1	IC OP AMP 8-PIN DIP (OP-27)	1826-0932	1

4-1. INTERNAL TIME BASE AGING RATE

NOTE

The overall accuracy of the HP 8340A Option H02 10 MHz internal time base is a function of time base calibration $\pm$ aging rate $\pm$ temperature effects $\pm$ line effects.

For greatest frequency accuracy, the time base should be allowed to warm up until the output frequency has stabilized (usually 7 to 30 days) before calibrating (adjusting the time base frequency to a known standard). After calibration, the change in time base frequency should remain within the aging rate if: the time base oven is not allowed to cool down, the instrument orientation with respect to the earth's magnetic field is maintained, and the instrument does not sustain any mechanical shock. Frequency changes due to orientation with respect to the earth's magnetic field and altitude changes will usually be nullified when the instrument is returned to its original position. Frequency changes due to mechanical shock will usually appear as a fixed frequency error.

If the instrument is disconnected from ac power allowing the time base oven to cool down, it may be necessary to readjust the time base frequency after a new warmup cycle; however, in most cases, the time base frequency will return to within ± 1 Hz of the original frequency.

Specification

Table 4-3. Internal Time Base Aging Rate Specifications

Aging Rate:

1×10^{-9} per day, 2.5×10^{-7} per year after 72-hour warm up if the instrument has been disconnected from ac power for less than 24 hours. Aging rate is achieved after 7 to 30 days warm-up if the instrument has been disconnected from ac power for greater than 24 hours.

Accuracy:

Overall accuracy of internal time base is a function of time base calibration $\pm$ aging rate $\pm$ temperature effects $\pm$ line effects.

Description

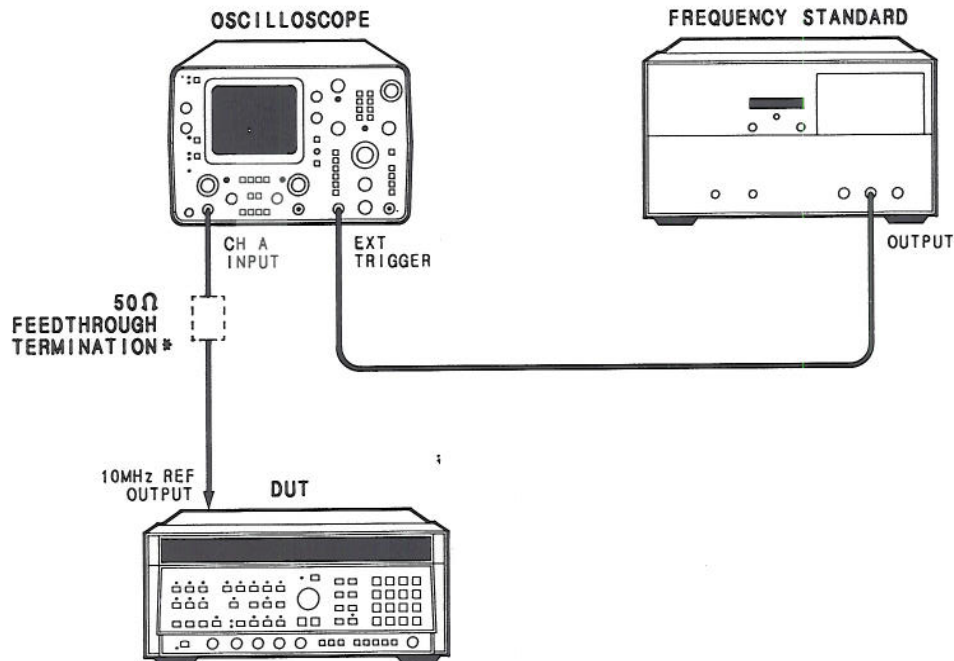
A reference signal from the DUT under test is connected to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the oscilloscope trigger input. The time required for a specific phase change is measured immediately and after a period of time. The aging rate is inversely proportional to the absolute value of the difference in the measured times.

Equipment

Frequency Standard	HP 5061A
Oscilloscope ¹	HP 1741A

1. A 50 Ohm Feedthrough Termination (such as the HP 10100C) is required when using an oscilloscope without a 50 Ohm input. It is not required with the HP 1741A.

4-1. INTERNAL TIME BASE AGING RATE (Cont'd)



*REQUIRED ONLY FOR OSCILLOSCOPES NOT HAVING
50 OHMS INPUT CAPABILITY

Figure 4-1. Internal Time Base Aging Rate Test Setup

NOTE

Be sure the DUT has been connected to the AC power line for 30 days before beginning this test. If the instrument was disconnected from the ac power line for less than 24 hours, it only has to be connected to AC power for 24 hours before proceeding.

Procedure

1. Connect the equipment as shown in Figure 4-1.
2. Adjust the oscilloscope external triggering controls for a stable display of the DUT 10 MHz REF OUTPUT signal.
3. Measure the time required for a phase change of 360 degrees. Record the time (T1) in seconds.

T1 = _____ second(s)

4-1. INTERNAL TIME BASE AGING RATE (Cont'd)

4. Wait for a period of time (from 3 to 24 hours) and remeasure the phase change time (repeat step 3). Record the period of time between measurements (T2) in hours and the new phase change time (T3) in seconds.

T2 = _____ hours (h)

T3 = _____ seconds (s)

5. Calculate the aging rate from the following equation:

$$\text{Aging Rate} = (1 \text{ cycle}/f) (1/T1 - 1/T3) (T/T2)$$

Where: 1 cycle = the phase change reference for the time measurement. (In this case, 360 degrees)

f = DUT time base output frequency (10 MHz)

T = specified time for aging rate (24 hours)

T1 = initial time measurement (s) for 360 degree (1 cycle change)

T2 = time between measurements (h)

T3 = final time measurement (s) for a 360 degree (1 cycle) change

For example, if:

T1 = 351s

T2 = 3h

T3 = 349s

Then:

$$\begin{aligned} \text{Aging Rate} &= (1 \text{ cycle}/10 \text{ MHz}) (1/351\text{s} - 1/349\text{s}) (24\text{h}/3\text{h}) \\ &= 1.306 \times 10^{-11} \text{ per day} \end{aligned}$$

6. Verify that the aging rate is less than 10^{-9} per day.

NOTE

If the absolute frequencies of the frequency standard and the DUT's time base oscillator are extremely close, the measurement time in steps 3 and 4 (T1 and T3) can be reduced by measuring the time required for a phase change of less than 360 degrees. change "1 cycle" in the equation accordingly (i.e., 180 degrees = 1/2 cycle, or 90 degrees = 1/4 cycle).

7. If the aging rate is not within the required tolerance, be sure sufficient warmup time has been allowed and that the environmental conditions have not changed throughout the test, then check the time base heater circuit and, if necessary, replace the time base. Refer to service and repair information for the A51 10 MHz reference oscillator in the reference loop — M/N Loop portion in Section 8 of the Service Manual.

4-2. FREQUENCY RANGE AND CW MODE ACCURACY

Specification

Table 4-4. Frequency Range and CW Mode Accuracy Specifications

Range:
0.01 to 20.00 GHz
Resolution: $n \times 1$ Hz
Where N = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points description in the specifications portion of Section 1.
Accuracy: Same as Time Base Accuracy in the specifications portion of Section 1.

Description

The HP 8340A Option H02 RF output is supplied to a frequency counter. The frequency counter internal time base is used as the reference for the DUT to eliminate time base error from the measurement. The DUT frequency display and the counter display should agree, within the resolution of each instrument. This procedure does not test for CW mode accuracy as a function of the time base accuracy.

NOTE

A fault in the DUT could cause the two displays to be different. Any fault that would cause one of the phase lock loops to be unlocked would be indicated by a front-panel UNLK indication; however, all HP 8340A Option H02 internal phase lock loops could be locked and the DUT output frequency could be in error (i.e., a phase lock loop frequency divider bit could be bad). If all the dividers work normally, then CW mode frequency accuracy is essentially guaranteed.

In the following procedure, the test frequencies are selected first to test the maximum frequency range and then to exercise each frequency related circuit throughout its CW range while holding all remaining circuits constant. The test frequencies are grouped so that an abnormal indication would point to the circuit most likely causing the problem.

Equipment

Frequency Counter	HP 5343A Option 011
Adapters	
SMA (m) to BNC (f)	HP P/N 1250-1200
3.5 mm (f) to 3.5 mm (f)	HP P/N 5061-5311
(1 required)	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
(1 required)	
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

Procedure

1. Connect the equipment as shown in Figure 4-2. Connect the DUT RF Output to the 10 MHz-500 MHz counter input. Allow the equipment to warm up for one hour. The DUT and the frequency counter use the same frequency standard to eliminate time base error from the measurement. Set the DUT's rear panel FREQUENCY STANDARD switch to EXT.

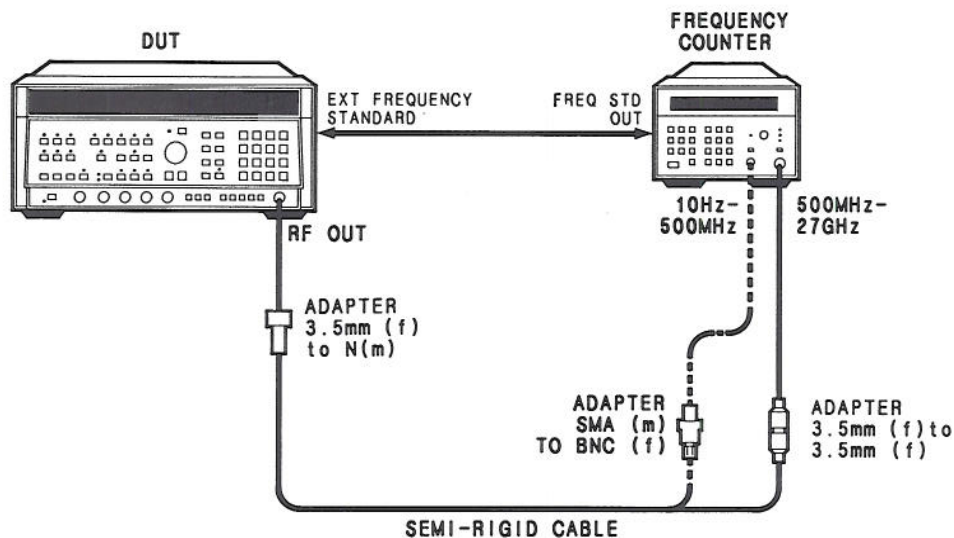


Figure 4-2. Frequency Range Test Setup

2. Press DUT [INSTR PRESET], then [CW] and enter [1] [0] [MHz]. Press [POWER LEVEL] and enter [+] [1] [0] [dBm]. the counter should indicate 10 MHz $\pm$ 1 Hz $\pm$ the resolution of the counter.
3. Connect the DUT's RF output to the 500 MHz-26.5 GHz counter input. Press the DUT's [CW] key and enter [2] [0] [GHz]. Press [POWER LEVEL] [0] [dBm]. The counter should indicate 20.0 GHz $\pm$ 3 Hz $\pm$ the resolution of the counter.

NOTE

Since the same time base is used for both the DUT and the frequency counter, only the displayed frequency is checked. The actual frequency error is $\pm$ (DUT output frequency/10 MHz) X time base error $\pm$ 3 Hz.

4. Check the M/N M Divider frequencies as follows:

NOTE

Pressing [SHIFT] [M1] displays, from left to right, the:

- M divide number,
- N divide number,
- M/N Loop output frequency,
- 20/30 Loop output frequency.

Press [SHIFT] [M5] to exit this diagnostic mode. The instrument continues to operate normally while in the diagnostic mode.

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

- a. Press **[CW]** key and enter **[2] [4] [9] [0] [MHz]**. Select a step size of 10 MHz by pressing **[SHIFT] [CF] [1] [0] [MHz]**. Press **[SHIFT] [M1]** to display, from left to right, the M divide number, the N divide number, the M/N Loop output frequency, and the 20/30 Loop output frequency. Press the **[CW]** key to display the CW frequency in the **[ENTRY DISPLAY]**.
- b. Using the down arrow key, step down to 2 300.000000 MHz. Check the counter indication at each step. The counter should indicate the DUT's frequency $\pm 1 \text{ Hz} \pm$ the resolution of the counter at each step.

NOTE

The above step sets and holds the N Divider to 13 and programs the M Divider through its full range of 8 to 27. Any frequency error as a result of a problem in the M Divider will probably be a multiple of 10 MHz.

- c. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.
5. Check the M/N N Divider frequencies as follows:
- a. Select a step size of 200 MHz by pressing **[SHIFT] [CF] [2] [0] [0] [MHz]**. Press **[CW]** to display the CW frequency in the **[ENTRY DISPLAY]**. The CW frequency should be 2 300.000000 MHz.
 - b. Using the up arrow key, step to 6 900.000000 MHz. Check the counter indication at each step. The counter should indicate the DUT's frequency $\pm 1 \text{ Hz} \pm$ the resolution of the counter.

NOTE

The above step sets and holds the M Divider to 27 and programs the N Divider through its full range of 13 to 36. Any frequency error as a result of a problem in the M Divider will probably be a multiple of 10 MHz.

- c. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.
6. Check the 20/30 MHz N2 loop frequencies as follows:
- a. Press **[INSTR PRESET]**. Press **[CF]** key and enter **[2] [3] [1] [0] [.] [5] [MHz]**. Press the **[ΔF]** key and enter **[1] [MHz]**. Select a step size of 1 kHz by pressing **[SHIFT] [CF] [1] [kHz]**.
 - b. Press **[SINGLE]** sweep key to set the DUT to be phase-locked at the start of sweep (2.310 GHz). Press **[SHIFT] [M1]** to enter the diagnostic display mode. Press **[CF]** to display the center frequency in the **[ENTRY DISPLAY]**. The center frequency should be 2.310500 GHz.
 - c. Using the up arrow key, step the center frequency up to 2.310510 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF — 0.0005 GHz) $\pm 1 \text{ Hz} \pm$ the resolution of the counter.

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

NOTE

The above steps set the output of the M/N loop to 180 MHz where $M=26$ and $N=13$. The YO start frequency (2310 MHz) is then 20 to 30 MHz below the Nth harmonic ($N=13$) of 180 MHz ($180 \times 13 = 2340$). The 20/30 MHz output is then 30 MHz. since the ΔF frequency (1 MHz) is between 0.1 to 5 MHz, the 20/30 MHz frequency is derived from the PLL2 75 to 150 MHz VCO output divided by 5 ($150 \text{ MHz} / 5 = 30 \text{ MHz}$). The PLL2 VCO frequency is stepped down in 5 kHz steps which steps the 20/30 frequency from 30 MHz down to 29.990 MHz in 1 kHz steps. Since the M/N frequency remains constant and the DUT's output frequency is mixed with a harmonic (13th) of the M/N signal and the resultant output is phase compared to the 20/30 output, the DUT output frequency must increase by 1 kHz/step to satisfy the 20/30 phase lock loop. This checks the least significant (BCD) N2 programming bits.

To observe the N2 PLL2 VCO frequency changes, repeat the N2 loop frequency check (Step 6a through 6c) pressing [SHIFT] [M3] in step 6b rather than [SHIFT] [M1]. [SHIFT] [M3] will display, from left to right, the PLL2 VCO frequency and the PLL3 Up Converter frequency (the PLL3 UP Converter frequency display will be 0 since the PLL3 is not used in the swept mode).

- d. Select a step size of 10 kHz by pressing [SHIFT] [CF] [1] [0] [kHz]. Press [CF] to display the center frequency in the [ENTRY DISPLAY]; the display should indicate 2.310510 GHz.
- e. Using the up arrow key, step the center frequency up to 2.310600 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency ($CF - 0.005 \text{ GHz}$) $\pm 1 \text{ Hz} \pm$ the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.99 MHz to 29.90 MHz in 0.01 MHz steps and checks additional N2 Divider programming bits.

- f. Select a step size of 100 kHz by pressing [SHIFT] [CF] [1] [0] [0] [kHz]. Press [CF] to display the center frequency in the [ENTRY DISPLAY]. The CF should be at 2.310600 GHz.
- g. Using the up arrow key, step the center frequency up to 2.311500 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency ($CF - 0.0005 \text{ GHz}$) $\pm 1 \text{ Hz} \pm$ the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.9 to 29.0 in 0.1 MHz steps and check additional N2 Divider programming bits.

- h. Select a step size of 1 MHz (press [SHIFT] [CF] and enter [1] [MHz]). Press [CF] to display the center frequency in the [ENTRY DISPLAY]. The CF should be at 2.311500 GHz.

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

- i. Using the up arrow key, step the center frequency up to 2.320500 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF – 0.0005 GHz) ± 1 Hz $\pm$ the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.0 MHz to 21.0 MHz in 1 MHz steps. The last CF step programs the 20/30 to 30 MHz and the M/N frequency to 180.769231 MHz. This checks the remaining N2 Divider programming bits.

- j. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.
7. Check the 20/30 MHz N1 loop frequencies as follows:
- a. Press [INSTR PRESET]. Select a step size of 10 kHz by pressing [SHIFT] [CF] [1] [0] [kHz]. Press [CW] and enter [2] [3] [1] [9] [.] [9] [7] [MHz].
 - b. Press [SHIFT] [M1] to display, from left to right, the M divide number, the N divide number, the M/N Output frequency, and the 20/30 Output frequency.
 - c. Using the down arrow key, step the CW frequency down to 2 319.870000 MHz. Check the counter indication at each step. The counter should indicate the DUT CW frequency ± 1 Hz $\pm$ the resolution of the counter.

NOTE

The above steps set the output of the M/N loop to 180 MHz where M=26 and N=13. The PLL1 VCO frequency is stepped up in 100 kHz steps. This steps the 20/30 frequency up from 20.03 MHz in 10 kHz steps to 20.13 MHz. The M/N frequency remains constant and the YO frequency is mixed with a harmonic (13th) of the M/N signal. The resultant output is phase compared to the 20/30 output. The DUT output frequency must decrease by 10 kHz/step to satisfy the YO phase lock loop. This checks the least significant N1 programming bits.

- d. Select a step size of 100 kHz by pressing [SHIFT] [CF] [1] [0] [0] [kHz]. Press the [CW] key to view the CW frequency in the [ENTRY DISPLAY]. The CW frequency should be at 2 319.870000 MHz.
- e. Using the down arrow key, step the CW frequency down to 2 318.970000 MHz. Check the counter indication at each step. The counter should indicate the DUT CW frequency ± 1 Hz $\pm$ the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 20.13 up to 21.03 in 0.1 MHz steps and checks additional N1 Divider programming bits.

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

- f. Select a step size of 1 MHz by pressing **[SHIFT] [CF] [1] [MHz]**. Press the **[CW]** key to view the CW frequency in the **[ENTRY DISPLAY]**. The CW frequency should be at 2318.97000 MHz.
- g. Using the down arrow key, step the CW frequency down to 2310.970000 MHz. Check the counter indication at each step. The counter should indicate the DUT CW frequency $\pm 1 \text{ Hz} \pm$ the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 21.03 MHz to 29.03 MHz in 1 MHz steps and check the remaining N1 Divider programming bits.

- 8. If frequency errors occurred, the instrument requires service. To troubleshoot the instrument, determine what frequency related circuit is most likely to have caused the symptom (i.e., M/N Loop or 20/30 Loop) then refer to Section VIII of the Service Manual (may be ordered separately).

4-3. SWEEP TIME ACCURACY

Specification

Table 4-5. Sweep Time Accuracy Specifications

Range: 10 milliseconds to 200 seconds forward sweep times.

Accuracy: $\pm 5\%$ (sweptimes ≤ 50 seconds).

Maximum Sweep Rate: 100 MHz/ms.

Description

The DUT is swept at 5 different sweep times, ranging from 10 ms to 50 sec. The rear panel STOP SWEEP IN/OUT signal of the DUT is used to trigger INPUT A and B on a universal counter used in the time interval mode. At the start of a sweep, the STOP SWEEP IN/OUT signal changes from TTL low to TTL high. This pulse triggers INPUT A on the universal counter (selected for leading edge triggering) and the count begins. At the end of a sweep, the STOP SWEEP IN/OUT signal changes from TTL high to TTL low. At this point, INPUT B is triggered (selected for trailing edge triggering) and the count is complete. After the universal counter has made several counts, an accurate reading of the DUT sweep time is indicated on its display.

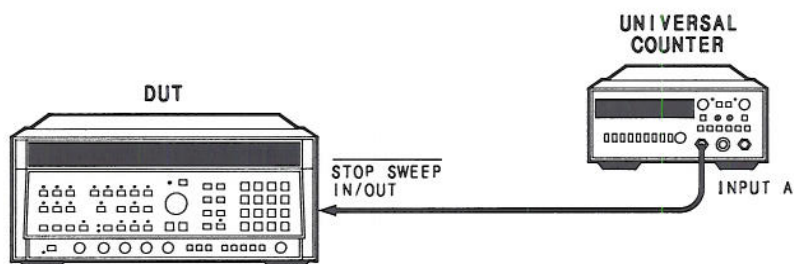


Figure 4-3. Sweep Time Accuracy Test Setup

Equipment

Universal Counter HP 5316A

Procedure

1. Connect equipment as shown in Figure 4-3. Switch the DUT POWER to ON. Allow the equipment to warm up for one hour.
2. On the DUT, press [INSTR PRESET] [START FREQ] [3] [GHz] [STOP FREQ] [4] [GHz] [POWER LEVEL] [0] [dBm].

4-3. SWEEP TIME ACCURACY (Cont'd)

- Set up the universal counter as follows:

TI A→B IN
 GATE TIME MIN
 LEVEL/SENSE (CHANNEL A and B) +MAX
 TRIGGER (CHANNEL A and B) LEVEL
 AC/DC (CHANNEL A and B) DC
 ATTN (CHANNEL A and B) X1
 FILTER NORM
 SEP/COM A COM A
 Channel A Triggering Leading Edge
 Channel B Triggering Trailing Edge

NOTE

To ensure that an accurate sweep time indication is obtained from the universal counter in step 4, allow the DUT to complete at least three sweeps.

- On the DUT, press **[SWEEP TIME] [1] [0] [msec]**. Verify that the sweep time displayed by the universal counter is within the limits shown in Table 4-6.
- Repeat step 4 for values shown in Table 4-6.

Table 4-6. Sweep Time Accuracy Limits

Selected	Lower Limit	Upper Limit
10 ms ¹	9.5 ms	10.5 ms
100 ms	95 ms	105 ms
1 s	.95 s	1.05 s
10 s	9.5 s	10.5 s
50 s	47.5 s	52.5 s

1. This step verifies Maximum Sweep Rate. 10ms sweep time across a frequency span of 1 GHz (1000 MHz) : $\frac{1000 \text{ MHz}}{10 \text{ ms}} = 100 \text{ MHz/ms}$

4-4. SWEPT FREQUENCY ACCURACY

Specification

Table 4-7. Swept Frequency Accuracy Specifications

Center Frequency/Sweep Width Mode (CF/ ΔF)

Readout Accuracy with respect to sweep out voltage (sweep time > 100 milliseconds):

$\Delta F \leq n \times 5 \text{ MHz}$: $\pm 1\%$ of indicated sweep width (ΔF) $\pm$ time base accuracy*

$\Delta F > n \times 5 \text{ MHz}$ to $< 300 \text{ MHz}$: $\pm 2\%$ of indicated sweep width (ΔF)

$\Delta F \geq 300 \text{ MHz}$: $\pm 1\%$ of indicated sweep width (ΔF), or $\pm 50 \text{ MHz}$, whichever is less

Where n = harmonic multiplication number. Refer to Frequency Ranges and Bandswitch Points description in the specifications table in Section 1.

* Time Base affects Center Frequency accuracy only, not Sweep Width Accuracy.

Start/Stop Mode

Readout Accuracy with respect to sweep out voltage (sweep time > 100 milliseconds):

Same as Center Frequency/Sweep Width Mode.

Description

The DUT's RF output is connected to the spectrum analyzer input. The spectrum analyzer is set for zero Hz span at a CW frequency within the DUT swept frequency range. The spectrum analyzer VIDEO OUT (applied to the oscilloscope vertical input) will have a response as the DUT output passes through the frequency that the spectrum analyzer is tuned to. The selected spectrum analyzer bandwidth filter will determine the shape of the response.

The DUT's SWEEP OUT, in series with a power supply, is applied to an oscilloscope's horizontal input. The input to the oscilloscope is clamped at $\pm 0.7\text{V}$ by two diodes to prevent overdriving the oscilloscope's input. The oscilloscope is calibrated by setting the DUT and the spectrum analyzer to the same CW frequency (e.g., 20% of Band). To set the DUT to have a SWEEP OUT voltage and at the same time a phase locked CW frequency that is proportional to a percentage of a swept frequency band, the START and STOP frequencies are selected, MANUAL SWEEP is selected, and a frequency equivalent to the desired percentage of band is selected (e.g., START 3 GHz, STOP 5 GHz, MANUAL 3.4 GHz, for 20%). The power supply is adjusted for a DVM indication of zero volts and the oscilloscope horizontal position control is used to position the dot to the center graticule line. With the oscilloscope horizontal sensitivity set to 0.05 V/Division, the CRT horizontal axis is now calibrated to approximately 0.5% of the swept frequency range per division. The spectrum analyzer VIDEO OUT voltage to the oscilloscope is then maximum and the scope vertical position is adjusted to place the dot near the top of the CRT.

The DUT's can now be set to sweep any frequency range and the oscilloscope center graticule line will represent the calibrated percentage (e.g., 20%) of the sweep range. The spectrum analyzer center frequency is set to a frequency that is the desired percentage (e.g., 20%) of the DUT swept frequency range. If the DUT swept frequency accuracy is perfect, the oscilloscope trace will be the response of the spectrum analyzer's bandwidth filter, centered on the CRT. If the trace is not centered, the spectrum analyzer center frequency is adjusted to position the response to the center of the oscilloscope CRT. The amount of spectrum analyzer frequency change is the DUT Swept Frequency Accuracy error.

4-4. SWEPT FREQUENCY ACCURACY (Cont'd)

Since the circuitry that determines swept frequency accuracy is the same for both ΔF Mode and Start/Stop Mode, only Start/Stop Mode swept frequency accuracy is tested.

NOTE

The spectrum analyzer resolution bandwidth and DUT sweep time must be compatible to obtain the desired oscilloscope response.

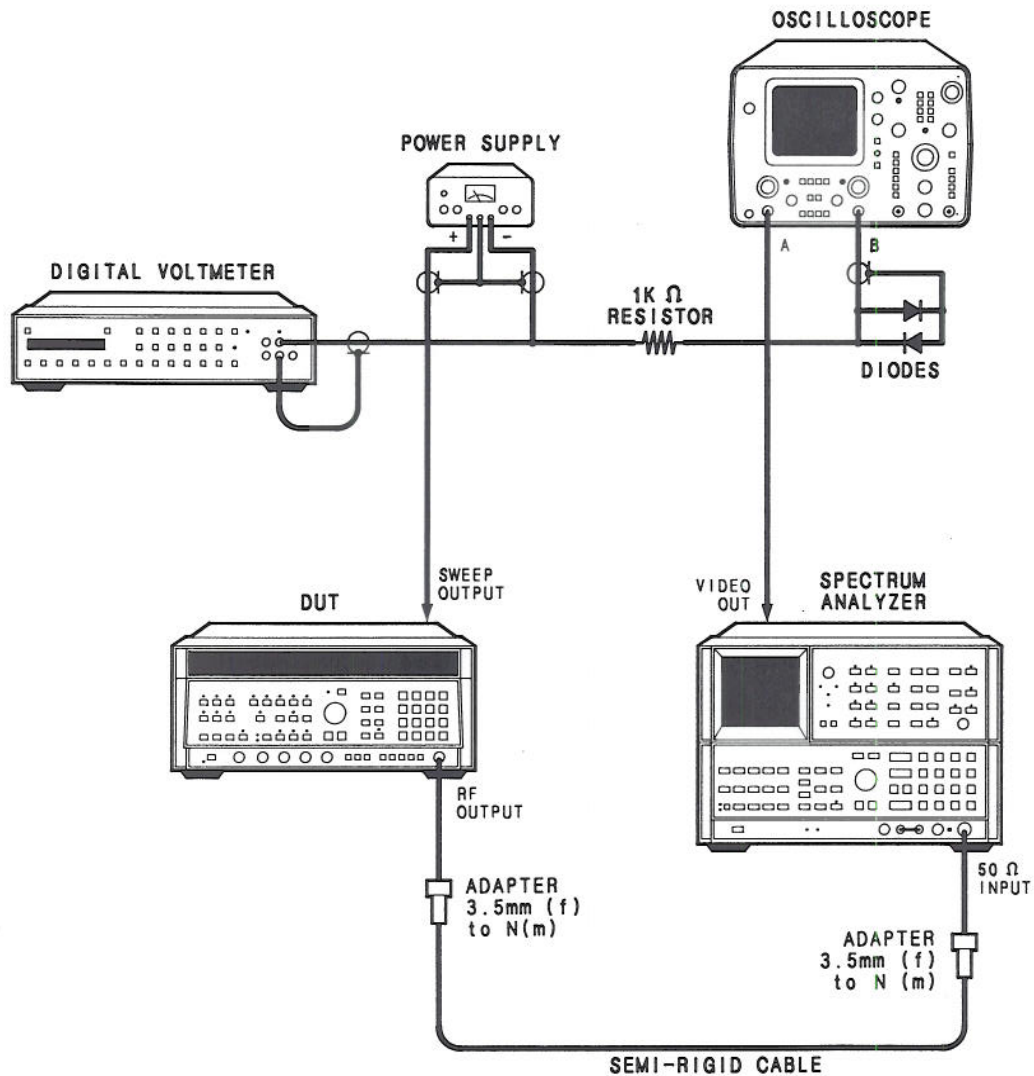


Figure 4-4. Swept Frequency Accuracy Test Setup

4-4. SWEPT FREQUENCY ACCURACY (Cont'd)

Equipment

Spectrum Analyzer	HP 8566B
Oscilloscope	HP 1741A
Power Supply	HP 6294A
Adapters	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
(2 required)	
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
Diode (2 required)	HP P/N 1901-0028
Digital Voltmeter	HP 3456A
1 KOhm Resistor	HP P/N 0757-0280

Procedure

1. Connect the equipment as shown in Figure 4-4 (with the power supply output set to 0 Vdc). Allow the equipment to warm up for one hour.
2. Press **[INSTR PRESET]** on the DUT. Set the oscilloscope to display amplitude versus sweep out voltage (A vs B). Set channel A sensitivity to 0.2V/Div.
3. Set the spectrum analyzer REFERENCE LEVEL to 20 dBm. Set CENTER FREQUENCY to 3.4 GHz for 20% (4 GHz for 50%, or 4.6 GHz for 80%). Set FREQUENCY SPAN to zero. Set RES BW (resolution bandwidth) to 3 MHz.
4. Set the DUT to have a sweep out voltage and at the same time, a phase locked CW frequency that is proportional to a percentage of band as follows:
 - a. Press **[START]** and enter **[3] [GHz]**
 - b. Press **[STOP]** and enter **[5] [GHz]**
 - c. Press **[MANUAL] SWEEP** and enter **[3] [.] [4] [GHz]** for 20% (4 GHz for 50%, or 4.6 GHz for 80%).



Do not adjust the power supply for greater than ± 10 Vdc in this procedure.

5. Adjust the oscilloscope's Channel B sensitivity for 0.05 V/DIV and the horizontal position control for midrange. Adjust the power supply voltage for a DVM indication of 0 ± 10 mVdc.
6. Adjust oscilloscope horizontal position control to position the dot on the center graticule. Adjust the oscilloscope vertical position to place the dot near the top of the CRT.

NOTE

The oscilloscope is now calibrated for 0.5%/Division and for the desired percentage of band (i.e., 20%, 50%, or 80%). Measurements can now be made at this percentage of band for any Start/Stop frequency and any frequency span.

4-4. SWEPT FREQUENCY ACCURACY (Cont'd)

7. Refer to Table 4-8, press the DUT's [START FREQ] key and enter the start frequency shown in Table 4-8. Press the [STOP FREQ] key and enter the appropriate stop frequency. Press the [SWEEP TIME] key and enter the appropriate sweep time. Select the appropriate spectrum analyzer resolution bandwidth. Set the spectrum analyzer center frequency to the appropriate frequency for the percentage of band being tested. Press the DUT's [CONT] key to return to the swept mode.
8. Ideally, the oscilloscope response will be at the center graticule line, if not, adjust the spectrum analyzer center frequency to bring the oscilloscope response to the center graticule line. The difference between the original center frequency setting and present center frequency is the DUT's swept frequency error. This error should be within the test limit shown in Table 4-8.
9. Repeat steps 3 through 8 to test at 50% and 80% of band.

NOTE

If the swept frequency accuracy error exceeds the test limit, refer to the Sweep Gain and Delay Adjustments, in Section 5, Adjustments in the Calibration Manual.

Table 4-8. Swept Frequency Accuracy Test Frequencies

DUT			Spectrum Analyzer				Test Limit (kHz)
Start Freq (GHz)	Stop Freq (GHz)	Sweep Time (ms)	Center Frequency (GHz)			Res BW (kHz)	
			20% of Band	50% of Band	80% of Band		
2.3	2.300099	3000	2.3000198	2.3000495	2.300792	0.3	± 0.99
2.3	2.300101	3000	2.3000202	2.3000505	2.300808	0.3	± 1.01
2.3	2.300499	1000	2.3000998	2.3002495	2.3003992	1.0	± 4.99
2.3	2.300501	1000	2.3001002	2.3002505	2.3004008	1.0	± 5.01
2.3	2.30499	300	2.300998	2.302495	2.303992	3.0	± 49.9
2.3	2.30501	300	2.301002	2.302505	2.304008	3.0	± 100.02
2.3	2.31	300	2.302	2.305	2.308	3.0	± 200
2.3	2.32	100	2.304	2.310	2.316	10	± 400
2.3	2.33	100	2.306	2.315	2.324	10	± 600
2.3	2.34	100	2.308	2.320	2.332	30	± 800
2.3	2.349	100	2.3098	2.3245	2.3392	30	± 998
2.3	2.3501	100	2.31002	2.32505	2.34008	30	± 1020
2.3	2.36	100	2.312	2.33	2.348	30	± 1200
2.3	2.37	100	2.314	2.335	2.356	30	± 1400
2.3	2.38	100	2.316	2.34	2.364	30	± 1600
2.3	2.39	100	2.318	2.345	2.372	30	± 1800
2.3	2.3999	100	2.31998	2.34995	2.37992	30	± 1980
2.3	2.4001	100	2.32002	2.35005	2.38008	100	± 2002
2.3	2.799	100	2.3998	2.5495	2.6992	1000	± 4990
2.3	2.801	100	2.4002	2.5505	2.7008	1000	± 5010
2.3	7.29	100	3.298	4.795	6.292	3000	± 49900
2.3	7.31	100	3.302	4.805	6.308	3000	± 50000
2.3	8.3	100	3.500	5.300	7.100	3000	± 50000
2.3	16.452	200	5.1304	9.376	13.6216	3000	± 50000
2.3	20.0	200	5.84	11.15	16.46	3000	± 50000

4-5. MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST

Specification

Table 4-9. Maximum Leveled Output Power and Power Accuracy Specifications

RF OUTPUT					
MAXIMUM LEVELED POWER Non-Swept Operation (0°C to +35°C) ¹	Bands and Approximate Frequency Ranges (GHz) (see Frequency Ranges and Bandswitch Points for complete description)				
	Band 0 0.01 to <2.3	Band 1 2.3 to <7.0	Band 2 7.0 to <13.5	Band 3	
				13.5 to <18.6	18.6 to 20.0
PEAKED	+10.0 dBm	+10.0 dBm	+ 10.0 dBm	+10.0 dBm	+7.0 dBm
NON-PEAKED	+9.0 dBm	+9.0 dBm	+9.0 dBm	+9.0 dBm	+6.0 dBm
MAXIMUM LEVELED POWER Swept Operation (0°C to +35°C) Sweep Rate: ≤100 MHz/ms Deviation: 100 Hz to 19.99 GHz Applies to all sweep modes	Bands and Approximate Frequency Ranges (GHz) (see Frequency Ranges and Bandswitch Points for complete description)				
	Band 0 0.01 to <2.3	Band 1 2.3 to <7.0	Band 2 7.0 to <13.5	Band 3	
				13.5 to <18.6	18.6 to 20.0
Deviation: 100 Hz to ≤100 MHz	+9.0 dBm	+9.0 dBm	+9.0 dBm	+9.0 dBm	+6.0 dBm
Deviation: >100 MHz	+8.0 dBm	+8.0 dBm	+8.0 dBm	+8.0 dBm	+5.0 dBm
OUTPUT POWER ACCURACY ¹	Bands and Approximate Frequency Ranges (GHz) (see Frequency Ranges and Bandswitch Points for complete description)				
	Band 0 0.01 to <2.3		Bands 1-3 2.3 to 20		
	+18 to +10 dBm ² +10 to -4.95 dBm -5 to -14.95 dBm -15 to -44.95 dBm -45 to -74.95 dBm -75 to -100 dBm		±1.8 dB ±1.5 dB ±2.0 dB ±2.3 dB ±2.6 dB ±2.9 dB		
FLATNESS (Internally Leveled)					
	Band 0 0.01 to <2.3		Bands 1 – 3 2.3 to 20		
+18 to +10 dBm ² +10 to -4.95 dBm -5 to -14.95 -15 to -44.95 dBm -45 to -74.95 dBm -75 to -100 dBm	— ±0.6 dB ±0.9 dB ±1.2 dB ±1.4 dB ±1.7 dB		±1.2 dB ±1.1 dB ±1.6 dB ±1.9 dB ±2.2 dB ±2.5 dB		

4-5. MAXIMUM LEVELED POWER AND POWER ACCURACY TEST (Cont'd)

Table 4-9. Maximum Leveled Output Power and Power Accuracy Specifications (Cont'd)

NOTES

1. Internally leveled, AM off. The POWER dBm display monitors the actual output power, giving accurate readings when unleveled, externally leveled, or when amplitude modulating with a signal that has a dc component. The ENTRY DISPLAY shows the desired power level, or the desired external detector output voltage, exclusive of modulation.
2. The ALC loop typically operates up to +20 dB to enhance usability at those frequencies where leveled power greater than the maximum specified is available.

Description

MAXIMUM LEVELED POWER

Maximum leveled power is tested under two conditions, Manual (CW) mode, and swept mode.

Manual Mode

In Manual mode, The DUT is set to sweep across a given frequency band. The CW frequency is initially at the highest frequency in the band. The power level is increased until the UNLEVELED indicator comes on, then decreased until it just goes out. The manual (CW) frequency is then decreased with the front panel rotary knob. The operator must lower the power level if the UNLEVELED indicator comes on while the frequency is decreased. The power level may need to be reduced several times before the lowest frequency in the band is reached. Now the operator increases the frequency while watching the power meter and notes the lowest power meter reading. This test is performed once with the instrument **PEAK** function ON and once with **PEAK** OFF.

Swept Mode

A crystal detector and an oscilloscope are used to monitor the swept response. The DUT is set to sweep a given frequency band. The power level is increased until the DUT's UNLEVELED indicator comes on, then decreased until it just goes out. The maximum leveled power may vary with sweep mode and sweep time. To find the worst case, the instrument is checked in SINGLE SWEEP (.5 Seconds) and in CONTINUOUS SWEEP (AUTO) in each band. The worst case mode and frequency band is selected, and a frequency marker is positioned at the minimum power point on the swept display. The DUT is set to CW at the marker frequency and the measured power is compared to the narrow sweep (< 100 MHz) power specification. If this test fails the power is compared to the wide sweep (> 100 MHz) power specification. The frequency band is then checked at 100 MHz intervals against the narrow sweep specification.

FLATNESS

Flatness is measured with the RF output level at 0 dBm. Flatness is primarily a function of the RF path; therefore, the response will be essentially the same at all ALC levels. However, the response will most likely change when the RF Attenuator is stepped to a different attenuation level.

A power meter is used to measure the RF signal level. An oscilloscope, connected to the power meter recorder output, is used to find the frequencies where the maximum and minimum points of the response occur. The DUT is set to a slow sweep to allow the power meter to respond to any power variations. A marker is positioned at the maximum and minimum points on the oscilloscope display. The DUT is then set to CW at each of the marker frequencies and the power indication are recorded. The maximum power level minus the minimum power level should be within the flatness specification.

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

ACCURACY

The absolute power level at the maximum and minimum points should be within the accuracy specification.

Two different power sensors may be required to cover the complete frequency range. The HP 8481A power sensor is used from 10 MHz to 50 MHz and the HP 8485A power sensor is used for the other frequency bands covering 50 MHz to 20 GHz. The 8485A power sensor can be used down to 10 MHz, but if a minimum or maximum that is close to the test limits occurs in this frequency range, the HP 8481A power sensor should be used.

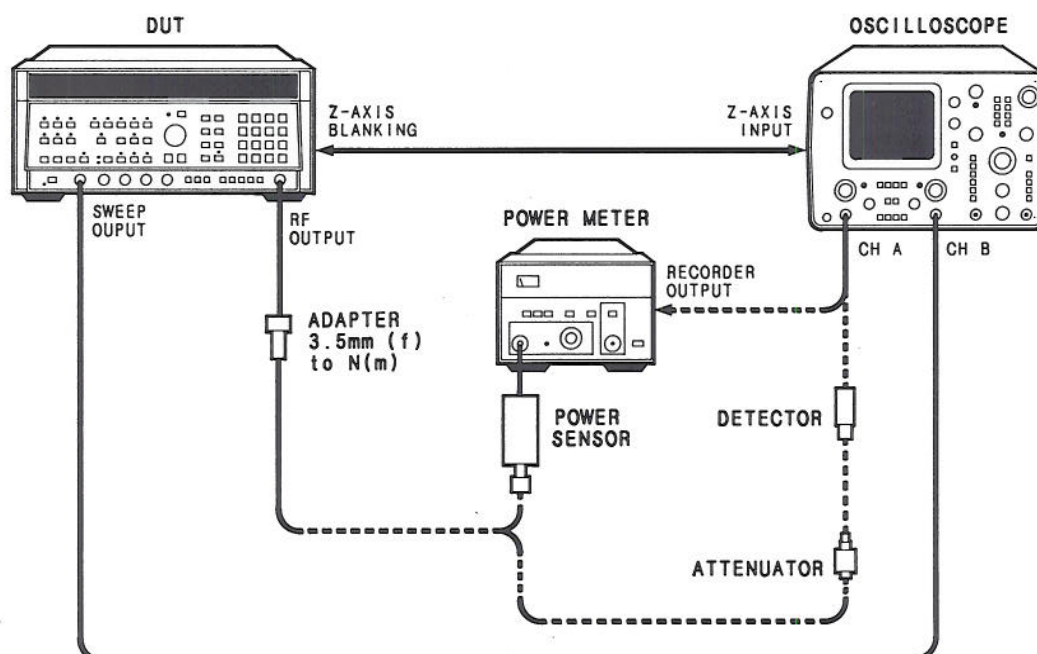


Figure 4-5. Maximum Leveled Output Power and Power Accuracy Test Setup

Equipment

Oscilloscope	HP 1741A
Attenuator	HP 8493C Opt. 010
Crystal Detector	HP 8473C
Power Meter	HP 436A Option 022
Power Sensor	HP 8481A
Power Sensor	HP 8485A
Adapters	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
SMC (f) to BNC (f)	HP P/N 1250-0832

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

Procedure

MAXIMUM LEVELED POWER

Non-swept Operation

1. Connect the equipment as shown in Figure 4-5. Connect the HP 8481A power sensor to the DUT RF output. Allow the equipment to warm up for one hour. Set the cal factor % dial to the average value for the band being tested. Zero the power meter (turn DUT's RF power off, zero the power meter, turn the DUT's RF power back on).
2. Press **[INSTR PRESET]**. Press **[PEAK]** on. Press **[STOP FREQUENCY] [2] [.] [3] [GHz] [MANUAL]**.
3. Press the **[POWER LEVEL]** key and, using the front panel rotary knob, increase the power level until the the UNLEVELED indicator comes on. Decrease the power level until the UNLEVELED light just goes off. Press **[MANUAL]** again and slowly turn the rotary knob counter-clockwise. if the UNLEVELED indicator comes on before reaching the beginning of the band, press **[POWER LEVEL]** and decrease the power until the UNLEVELED indicator just goes out. Press **[MANUAL]** and continue decreasing the frequency. Lower the power level as required until the beginning of the band is reached. One will probably have to lower the power level several times.
4. Turn the rotary knob clockwise and note the lowest power level in the band. Set the instrument to this lowest power frequency. Adjust the power meter cal factor % dial to the appropriate setting. Record the DUT's output power.
5. Replace the HP 8481A power sensor with an HP 8485A. Repeat steps 3 and 4 with the start and stop frequencies shown below:

Start Frequency	Stop Frequency	Band
2.3 GHz	7.0 GHz	1
7.0 GHz	13.5 GHz	2
13.5 GHz	18.6 GHz	3
18.6 GHz	20.0 GHz	3

6. Press **[SHIFT] [PEAK]**. Repeat steps 2 through 5 with **PEAK** turned OFF.

Swept Operation

In the following steps, the DUT is tested while being swept across one entire band at a time. The worst case power level is found, and is then measured with a power meter. Most HP 8340A Option HO2's will pass the <100 MHz deviation specification even when sweeping > 100 MHz. When performing the following test, check instrument broad band performance against the < 100 MHz specification. If the instrument passes, steps 14 through 19 need not be performed.

7. Connect the equipment as shown in Figure 4-5. Connect the 10 dB pad and crystal detector to the DUT RF output and connect the detector output to the oscilloscope channel A input. Allow the equipment to warm up for one hour. Set oscilloscope controls as follows: channel A to 0.05 V/div channel B to 1V/div. Trigger on B. A vs B mode.

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

8. Press **[INSTR PRESET]**. Press **[PEAK]** on. Press **[STOP FREQUENCY]** and enter **[2] [.] [3] [GHz]**. Adjust the oscilloscope to view the swept output of the crystal detector.

In Band 0 (10 MHz to 2.3 GHz, the crystal detector may pass a portion of the RF signal. This RF feedthrough may be visible on the low frequency portion of the oscilloscope trace.

Also, as the power in band 0 is increased toward maximum leveled, the level of the harmonics may increase and cause a perturbation in the swept response. This will cause the maximum power indication on the oscilloscope to increase without causing the UNLEVELED indicator to light. Therefore, flatness is only specified at $\leq +10$ dBm in Band 0.

9. Press the **[POWER LEVEL]** key and, using the front panel rotary knob, increase the power level until the UNLEVELED indicator comes on. Slowly decrease the power level until the UNLEVELED indicator just goes off. Note the ENTRY DISPLAY power indication.

NOTE

The maximum leveled power indication may differ with sweep mode and sweep time. To find the worst case, the maximum leveled power is checked in continuous sweep with auto sweep time (step 9), and single sweep with a .5 second sweep time (step 10).

10. Press **[SINGLE]**. Press **[SWEEP TIME]** and enter **[.] [5] [sec]**. Repeat step 9 while repeatedly pressing the **[SINGLE]** sweep key.
11. Select the mode that gave the worst case maximum leveled power indication (lowest ENTRY DISPLAY indication). Press **[AMTD MKR]** and use the rotary knob to position the amplitude marker to the minimum power level point on the oscilloscope trace (for a negative polarity crystal detector, this is the highest point on the display, for a positive polarity detector, this is the lowest point on the display). Using the oscilloscope vertical position control, position the lowest power point on a horizontal graticule line. Note the marker frequency. Press **[MANUAL]** and enter the frequency noted for the amplitude marker. Due to SYTM tracking, the RF output level at a single frequency may be greater than in a swept mode. Therefore, if the oscilloscope now indicates a higher power level than the swept response (for a positive polarity detector, the trace moves down), press **[POWER LEVEL]** and (using the rotary knob) adjust the power level to return the dot on the oscilloscope to the horizontal reference line.
12. Disconnect the 10 dB pad and crystal detector and connect the power sensor to the DUT RF output. Set the power meter's calibration factor switch to include the frequency noted for the amplitude marker.

Turn the amplitude marker off. To obtain power meter reading, zero the power meter on the range being used. To zero the power meter, press the power meter RANGE HOLD, press DUT **[RF]** off, zero the power meter, and press **[RF]** on.

The power meter indication should be equal to or greater than the maximum leveled power specification. If the DUT does not meet its maximum leveled power specification, the instrument must be returned to Hewlett-Packard for adjustment or repair.
13. Press the **[START FREQ]** key and enter the start frequency for the next band. press the **[STOP FREQUENCY]** key and enter the stop frequency for the next band. Repeat steps 9 through 12 until all frequency bands have been checked.

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

14. If the DUT passed the maximum leveled power (< 100 MHz deviation) specification when sweeping > 100 MHz, proceed to the Flatness test, step 20. If the DUT failed the < 100 MHz specification in any band, the whole band has to be checked in 100 MHz sweepwidths. For convenience, this test is only performed when necessary, and then only in the required band.

Press **[INSTR PRESET] [CF]**. Enter the start of band frequency + 50 MHz i.e. if testing band 3 from 18.6 to 20 GHz (this is the most likely frequency range to require narrow deviation testing) enter 18.6 GHz + 50 MHz (18.650 GHz). Press **[Δ F] [1] [0] [0] [MHz]**.

15. Press **[POWER LEVEL]** and increase the power level (with the rotary knob) until the UNLEVELED indicator comes on, decrease the power level until the indicator just goes off.
16. Press **[SHIFT] [CF] [1] [0] [0] [MHz]**, this programs the step up and step down keys to a step size of 100 MHz.
17. Press **[CF]** and the step up key, (increase the center frequency value by 100 MHz). If the UNLEVELED indicator comes on, press **[POWER LEVEL]** and decrease the power until the indicator just goes out. Repeat this step until the entire band has been covered. Take note of the center frequency that had the lowest leveled power.
18. Place the DUT in CW mode and set it to the frequency where the lowest leveled power was encountered in step 17. Set the power meter's calibration factor for this frequency. Zero the power meter. Refer to the specifications in the beginning of this test. Determine the specified maximum leveled power (100 Hz to < 100 MHz) for the band the DUT is in. For example, if the DUT is set to a CW frequency of 19.05 GHz, the specified maximum leveled power with sweep widths from 100 Hz to < 100 MHz is 6 dBm. While monitoring the power meter, set the DUT to produce precisely that amount of power.
19. Disconnect the power sensor and attach the 10 dB pad and crystal detector. Use the oscilloscope's vertical position control to set the RF output power response trace to a reference graticule. Press **[CF]** and enter the existing CW frequency (the one at which leveled power output was lowest). Press **[Δ F]** and enter 100 MHz. Press **[POWER LEVEL]** and increase the power until the unleveled indicator comes on. Decrease the power until the indicator just goes off. If using a negative polarity detector, the resultant power response trace should be on or below the reference graticule. If using a positive polarity detector, the trace should be at or above the reference graticule. This shows that the DUT meets the specified maximum power output for the band in question.

FLATNESS

Flatness is measured with the RF output level at 0 dBm. Flatness is primarily a function of the RF path; therefore, the response will be essentially the same at all ALC levels. Although the ALC accuracy is not specified separately, the ALC accuracy is typically < 0.15 dB for RF output levels from +10 to -4.95 dBm.

To verify that the ALC is not adding undesired errors, perform the following ALC test. Note that this is not a performance test, and there are no test record card entry locations for the results.

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

20. Connect the power sensor to the RF output of the DUT. Press **[INSTR PRESET]**. Set the DUT to a CW frequency of 4 GHz at 0 dBm. Press the power meter's dB relative button. Check the RF output in 1 dB steps from +10 to -4.95 dBm. The power meter should indicate an the chosen power level + 0.15 dB (ALC error). If the instrument fails this test, refer to the ALC adjustments procedure in Section 5, Adjustments.

Zero the power meter. Connect the oscilloscope channel A to the power meter's RECORDER OUTPUT. Refer to figure 4-5, Maximum Leveled Output Power and Power Accuracy Test Setup.
21. Press **[INSTR PRESET]**. Press **[PEAK]** on. Press **[STOP FREQUENCY]** and enter **[2] [.] [3] [GHz]**. Press **[POWER LEVEL]** and enter **[0] [dBm]**.
22. Press the **[SWEEP TIME]** key and enter **[2] [sec]**.
23. Adjust the oscilloscope controls to view the power meter RECORDER OUTPUT voltage versus the DUT's SWEEP OUTPUT voltage (A versus B). The oscilloscope vertical gain and position must be changed as a function of the power meter range and RECORDER OUTPUT voltage.
24. Press Frequency Marker key **[M2]** and, using the rotary knob, change the marker frequency to position the (intensified) marker on the lowest point on the oscilloscope trace. It may be necessary to adjust the oscilloscope INTENSITY to view the marker dot. Note the low power frequency on the test record card.
25. Note the marker frequency. Press the **[MANUAL]** key and enter the frequency noted for M2. Reset the power meter calibration factor switch to include this frequency. The power meter indication is the minimum power point. Record the power meter indication on the work sheet provided in Table 4-10. Note the minimum power level on the test record card as well.

NOTE

For Band 0 (10 MHz to 2.3 GHz), if the minimum or maximum power occurred below 50 MHz, use the HP 8481A power sensor to measure the power level.

26. Press the **[CONT]** key to return the sweep mode. Press **[M1]** and, using the rotary knob, change the marker frequency to position the marker on the highest point on the oscilloscope trace. Note the marker frequency. Press the **[MANUAL]** key and enter the frequency noted for M1. Reset the power meter calibration factor switch to include this frequency. The power meter indication is the maximum power point. Record the power meter indication on the work sheet. Record these values on the test record card as well.
27. Press the **[CONT]** key to return to the swept mode. Press the **[START FREQ]** key and enter the start frequency for the next frequency band. Press the **[STOP FREQ]** key and enter the stop frequency for the next frequency band.
28. Repeat steps 23 through 27 to measure the flatness until all frequency bands have been checked.
29. The maximum minus the minimum power meter indications should be within the flatness specifications. Record the flatness performance data on the test record card. If the DUT does not meet its flatness specification, refer to Flatness Adjustments in Section 5 of the Calibration Manual.

4.5 MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

ACCURACY

30. The absolute power level at the maximum and minimum points should be within the accuracy specification. This test may be repeated at other ALC power levels (+10 dBm to -4.95 dBm) to verify flatness and accuracy specifications over the ALC range.

Table 4-10. Maximum Leveled Output Power Test Work Sheet

Frequency Range: 10 MHz to 2.3 GHz		
	Power Meter Indication	HP 8340A Entry Display
Steps 24, 25	Minimum _____	_____
Step 26	Maximum _____	_____
Step 29	Flatness:	
	Maximum - Minimum _____	(≤ 1.2 dB)

Frequency Range: 2.3 GHz to 7.0 GHz		
	Power Meter Indication	HP 8340A Entry Display
Steps 24, 25	Minimum _____	_____
Step 26	Maximum _____	_____
Step 29	Flatness:	
	Maximum - Minimum _____	(≤ 2.2 dB)

Frequency Range: 7.0 GHz to 13.5 GHz		
	Power Meter Indication	HP 8340A Entry Display
Steps 24, 25	Minimum _____	_____
Step 26	Maximum _____	_____
Step 29	Flatness:	
	Maximum - Minimum _____	(≤ 2.2 dB)

Frequency Range: 13.5 GHz to 20.0 GHz		
	Power Meter Indication	HP 8340A Entry Display
Steps 24, 25	Minimum _____	_____
Step 26	Maximum _____	_____
Step 29	Flatness:	
	Maximum - Minimum _____	(≤ 2.2 dB)

4-6. EXTERNAL LEVELING

Specification

Table 4-11. External Leveling Specifications

XTAL: Allows the DUT to be externally leveled by crystal detectors of positive or negative polarity.

METER: Allows power meter leveling with any HP power meter.

Range (XTAL or METER): 500 microvolts (−66 dBV) to 2.0 volts (+6 dBV)

Accuracy of voltage at EXT INPUT connector relative to the displayed level (leveling voltage is shown in ENTRY DISPLAY in dBV): $\pm 0.5 \text{ dB} \pm 200 \text{ microvolts}$.

Description

The DUT's external leveling circuit is designed to maintain a constant voltage at the EXT INPUT BNC. This is achieved by first selecting a voltage (in dBV) to which the EXT INPUT will be leveled. This establishes a reference voltage for the ALC. The voltage at the EXT INPUT is then routed through the external leveling circuitry to the ALC and compared to the reference. If a difference between the two voltages exist, the DUT's RF OUTPUT power will be adjusted to compensate for the difference.

The DUT's external leveling circuit allows a positive or negative crystal detector to be used in the external leveling loop. A negative crystal detector (HP 8473C) is used in this test but a positive crystal detector may be substituted.

The XTAL Leveling mode is selected to verify the instrument's external leveling specification. Nine different dBV values, ranging from +6 dBV to −66 dBV, are selected and the voltage accuracy at the EXT INPUT is checked with a DVM.

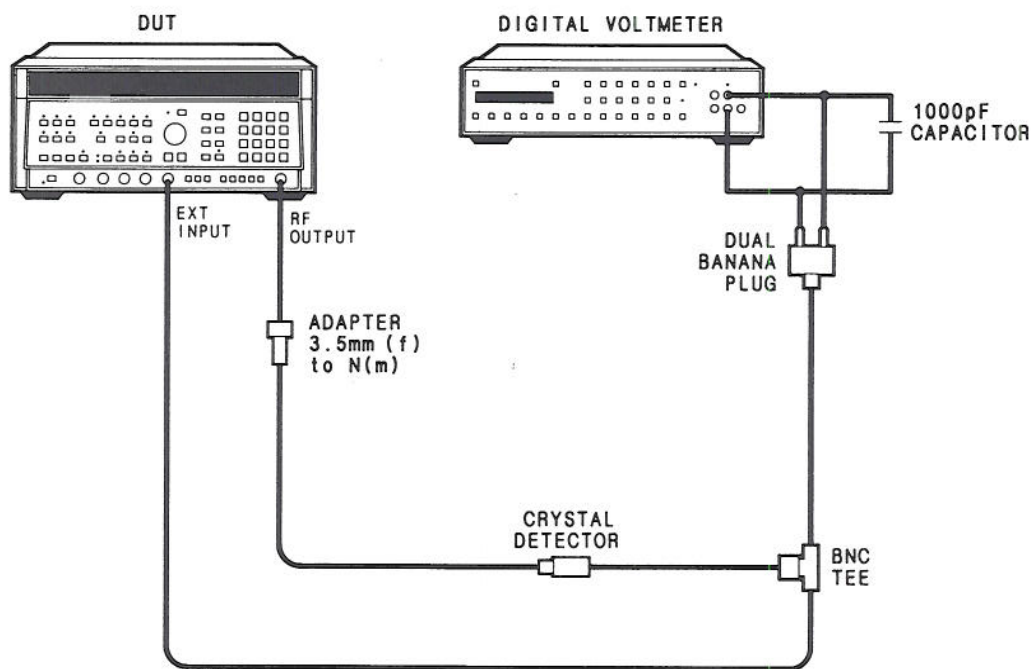


Figure 4-6. External Leveling Test Setup

4-6. EXTERNAL LEVELING (Cont'd)

Equipment

Digital Voltmeter (DVM)	HP 3456A
Crystal Detector	HP 8473C
Capacitor (1000 pF)	HP P/N 0160-4574
Adapters	
Type-N (m) to 3.5 mm (f) (1 required)	HP P/N 1250-1744
BNC (f) to Dual Banana	HP P/N 1251-2277
BNC Tee (m) (f) (f)	HP P/N 1250-0781

Procedure

1. Turn DUTs LINE switch ON. Press [INSTR PRESET] [CW] [4] [.] [5] [GHz] [POWER LEVEL] [0] [dB(m)].
2. Connect equipment as shown in Figure 4-6 (note 1000 pF capacitor shunting DVM input). Allow the equipment to warm up for one hour.

NOTE

In step 3, XTAL mode is selected. In this mode the [dB(m)] terminator key selects dBV. The dBV value selected corresponds to a voltage at which the DUT's EXT INPUT will be leveled (see Table 4-14). The selected dBV is displayed in the ENTRY DISPLAY.

NOTE

If a positive polarity crystal detector is being used for this test, the voltages given in Tables 4-12, 4-13, 4-14, and 4-15 will all be positive.

3. Press [XTAL] [6] [dB(m)]. DVM reading should be within the values shown on the first line in Table 4-12.

Table 4-12. External Leveling Limits (With No Attenuator)

dBV Selected	DVM Indication (V)		
	Lower Limit	Ideal	Upper Limit
+6	-1.883	-1.995	-2.114
0	-0.944	-1.000	-1.059
-10	-0.2983	-0.3162	-0.3352
-20	-0.0942	-0.01000	-0.1061

4-6. EXTERNAL LEVELING (Cont'd)

4. Repeat Step 3 for the remaining dBV values shown in Table 4-12.
5. Press the down step key to select 10 dB of attenuation.
6. Repeat Step 3 for values shown in Table 4-13.
7. Press the down step key to select 20 dB of attenuation.
8. Repeat Step 3 for values shown in Table 4-14.

Table 4-13. External Leveling Limits (With 10 dB Attenuation)

dBV Selected	DVM Indication (mV)		
	Lower Limit	Ideal	Upper Limit
-30	-29.65	-31.62	-33.70
-40	-9.24	-10.00	-10.79

Table 4-14. External Leveling Limits (With 20 dB Attenuation)

dBV Selected	DVM Indication (mV)		
	Lower Limit	Ideal	Upper Limit
-50	-2.785	-3.162	-3.550
-60	-0.744	-1.000	-1.259
-66	-0.273	-0.501	-0.731

4-6. EXTERNAL LEVELING (Cont'd)

Table 4-15. dBV vs. Voltage Reference Table

dBV	Voltage	dBV	Voltage
7	-2.239V	-12	-0.2512V
6	-1.995V	-19	-0.1122V
5	-1.778V	-20	-0.1000V
4	-1.585V	-21	-89.13mV
3	-1.413V	-29	-35.48mV
2	-1.259V	-30	-31.62mV
1	-1.122V	-31	-28.18mV
0	-1.000V	-39	-11.22mV
-1	-0.8913V	-40	-10.00mV
-2	-0.7943V	-41	-8.913mV
-3	-0.7079V	-49	-3.548mV
-4	-0.6310V	-50	-3.162mV
-5	-0.5623V	-51	-2.818mV
-6	-0.5012V	-59	-1.122mV
-7	-0.4467V	-60	-1.000mV
-8	-0.3981V	-61	-0.8913mV
-9	-0.3548V	-65	-0.5623mV
-10	-0.3162V	-66	-0.5012mV
-11	-0.2818V	-67	-0.4467mV

4-7. SPURIOUS SIGNALS TEST

Specification

Table 4-16. Spurious Signals Test Specifications

SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)				
	Band 0		Band 1	Band 2	Band 3
	0.04 to <1.4	1.4 to <2.3	2.3 to <7.0	7.0 to <13.5	13.5 to 20.0
Harmonics (up to max. output freq.)	< -30	< -50	< -50	< -50	—
Subharmonics and multiples thereof (up to max. output freq.)	—	—	—	< -50	< -50
Non-harmonically related spurious (CW and Manual Sweep mode only)	< -50	< -50	< -70	< -64	< -60
Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples thereof (CW mode only, all power levels)					
STANDARD INSTRUMENT					
Offset <300 Hz from carrier	< -50		< -40	< -40	< -40
Offset 300 Hz to 1 kHz from carrier	< -60		< -60	< -54	< -50
Offset > 1 kHz from carrier	< -65		< -65	< -59	< -55

Description

The DUT's RF output signal is displayed on a spectrum analyzer to verify that the harmonic and non-harmonic spurious signals are at or below the specified level.

Equipment

Spectrum Analyzer	HP 8566B
Adapters	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
(2 required)	
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124

4-7. SPURIOUS SIGNALS TEST (Cont'd)

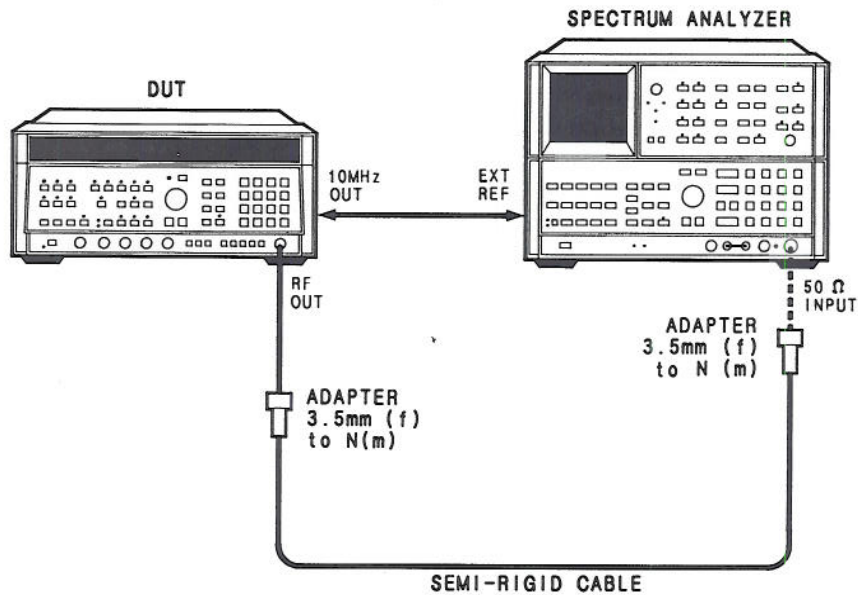


Figure 4-7. Spurious Signals Test Setup

Procedure

1. Connect equipment as shown in Figure 4-7. The position of the DUT can affect spurious responses; therefore, place the DUT in its normal operating position (i.e., flat on its feet) for this test. Allow the instruments to warm up for one hour.
2. Press **[INSTR PRESET]** on the DUT. Press the **[STOP FREQ]** key and enter **[2] [.] [3] [GHz]**.
3. Press the DUT's **[POWER LEVEL]** key and enter **[0] [dBm]**.
4. Press the **[CW]** key and enter any frequency of interest within the selected frequency range.
5. Set up the spectrum analyzer to view the DUT's RF output signal. Set the reference level to place the peak of the DUT's RF output signal on the reference level at the top graticule line.

4-7. SPURIOUS SIGNALS TEST (Cont'd)

NOTE

When using a spectrum analyzer other than the HP 8566A/B, the spectrum analyzer may generate some mixing products that could appear on the display. If a signal is in question, increase the spectrum analyzer input attenuation by 10 dB, note if signal decreases in amplitude by 10 dB, then return the attenuator to its original position. If the signal in question comes from an external source, it will change by exactly 10 dB. If the signal in question originates in the spectrum analyzer, the level will either change by greater or less than 10 dB or may not change at all.

The DUT's rotary knob circuit may generate some noise spikes when the knob is rotated. These signals should disappear when rotation is stopped.

If a spurious signal is found and it appears out of specification, check the fundamental signal amplitude to ensure it is at 0 dBm. Then check spurious level by substituting a known amplitude signal on the spectrum analyzer.

6. Tune the spectrum analyzer across its full frequency range. Look for any spurious signals. For each spurious response determine what mechanism generated the spurious response and what specification applies.
 - a. Is the spurious response in question an integer multiple of the DUT's RF output signal? If it is, the "harmonic" specification applies.
 - b. Press the DUT's **[SHIFT]** key and then **[M2]** to display, from left to right, the YO harmonic number and the YO frequency. Is the spurious response in question an integer multiple of the YO frequency (and not a harmonic of the RF signal)? If it is the "subharmonic and multiples thereof" specification applies.

NOTE

Press the **[CW]** key to view the CW frequency in the ENTRY DISPLAY.

- c. If the spurious response in question does not meet one of the above criteria, the "non-harmonically related" specification applies.
7. Repeat steps 4 through 7 at any frequency of interest within this frequency band.
8. Press the DUT's **[STOP FREQ]** key and enter the stop frequency for the next frequency band. Press the **[START FREQ]** key and enter the start frequency for the next frequency band. Repeat steps 3 through 8 until all DUT frequency bands have been tested up to 20 GHz.

4-9. SINGLE SIDEBAND PHASE NOISE

Specification

Table 4-18. Single-sideband Phase Noise Specifications

SPURIOUS SIGNALS [Expressed in dB relative to the carrier level (dBc)]	Bands and Approximate Frequency Ranges (GHz) (see Frequency Ranges and Bandswitch Points for complete description)			
Single-sideband Phase Noise (dBc/1 Hz BW, CW Mode, all power levels)	Band 0 0.01 to <2.3	Band 1 2.3 to <7.0	Band 2 7.0 to <13.5	Band 3 13.5 to 20.0
Offset 30 Hz from carrier	< -64	< -64	< -58	< -54
Offset 100 Hz from carrier	< -70	< -70	< -64	< -60
Offset 1 kHz from carrier	< -78	< -78	< -72	< -68
Offset 10 kHz from carrier	< -86	< -86	< -80	< -76
Offset 100 kHz from carrier	< -107	< -107	< -101	< -97

Description

This test is performed in three steps: SYSTEM CALIBRATION, PHASE NOISE MEASUREMENT, and PHASE NOISE CALCULATION. A second HP 8340A Option H02 is used as a local oscillator (LO) to mix down the microwave frequency from the DUT to a 1 MHz IF. The IF signal is amplified and, for 30 Hz, 100 Hz and 1 kHz offsets, sent directly to a low frequency spectrum analyzer. For 10 kHz and 100 kHz offsets, a 1 MHz notch filter is inserted between the amplifier and the spectrum analyzer to attenuate IF signal and obtain increased dynamic range on the spectrum analyzer. Phase noise is measured using the OFFSET and NOISE LVL functions of the spectrum analyzer.

SYSTEM CALIBRATION obtains the system's frequency response data (Cal Data (CD) and IF Cal Data (IFCD), measured in dBc). A zero dBm, 1 MHz IF is established and then the LO frequency is reduced to obtain 1.00003, 1.0001, and 1.001 MHz IFs. At each point, the power level at the peak of the IF is recorded as the Cal Data (CD). A 1 MHz notch filter is then inserted between the amplifier and the spectrum analyzer. The LO frequency is again reduced to obtain 1.01 and 1.1 MHz IFs, and the Cal Data for these points is recorded. The LO frequency is then increased to obtain a 1 MHz IF and the response due to the 1 MHz notch filter is recorded as the IF Cal Data (IFCD). This data is required for calculating the actual phase noise for the 10 kHz and 100 kHz offsets. Since it is not required for the 30 Hz, 100 Hz and 1 kHz offsets, IFCD is defined as zero at these points.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

PHASE NOISE MEASUREMENT obtains phase noise data for DUT frequencies of 2.202, 6.902, 13.402, and 19.502. These specific frequencies typically have the worst case phase noise. The DUT is adjusted for the test frequency and then the LO frequency is adjusted to obtain a $1 \text{ MHz} \pm 0.9 \text{ Hz}$ IF. A signal to noise level (IF to phase noise level at 30 Hz, 100 Hz, 1 kHz, 10 kHz, and 100 kHz offsets from IF) measurement is performed using the OFFSET and NOISE LVL functions of the spectrum analyzer and the results are recorded as the Measured Noise Level (MNL, measured in dBc).

PHASE NOISE CALCULATION takes the data obtained for MNL and adds and subtracts the calibration data and a 3 dB correction factor to obtain the actual phase noise. The formula that is used is:

$$\text{Actual Phase Noise} = \text{MNL} + \text{IFCD} - \text{CD} - 3 \text{ dB}$$

IFCD is the response of the 1 MHz notch filter at 1 MHz. Since the filter is not installed during the 10 Hz, 100 Hz and 1 kHz measurements, IFCD = 0. During the 10 kHz and 100 kHz offset measurements, the notch filter attenuates the IF causing the power difference between the IF and the phase noise to be smaller than it actually is, therefore IFCD must be added to MNL to correct this. The system's frequency response (LCD) causes the difference between the IF level and the phase noise level to be greater than it actually is, therefore CD must be subtracted from MNL. A factor of 3 dB is subtracted from MNL to correct for the LO's phase noise contribution.

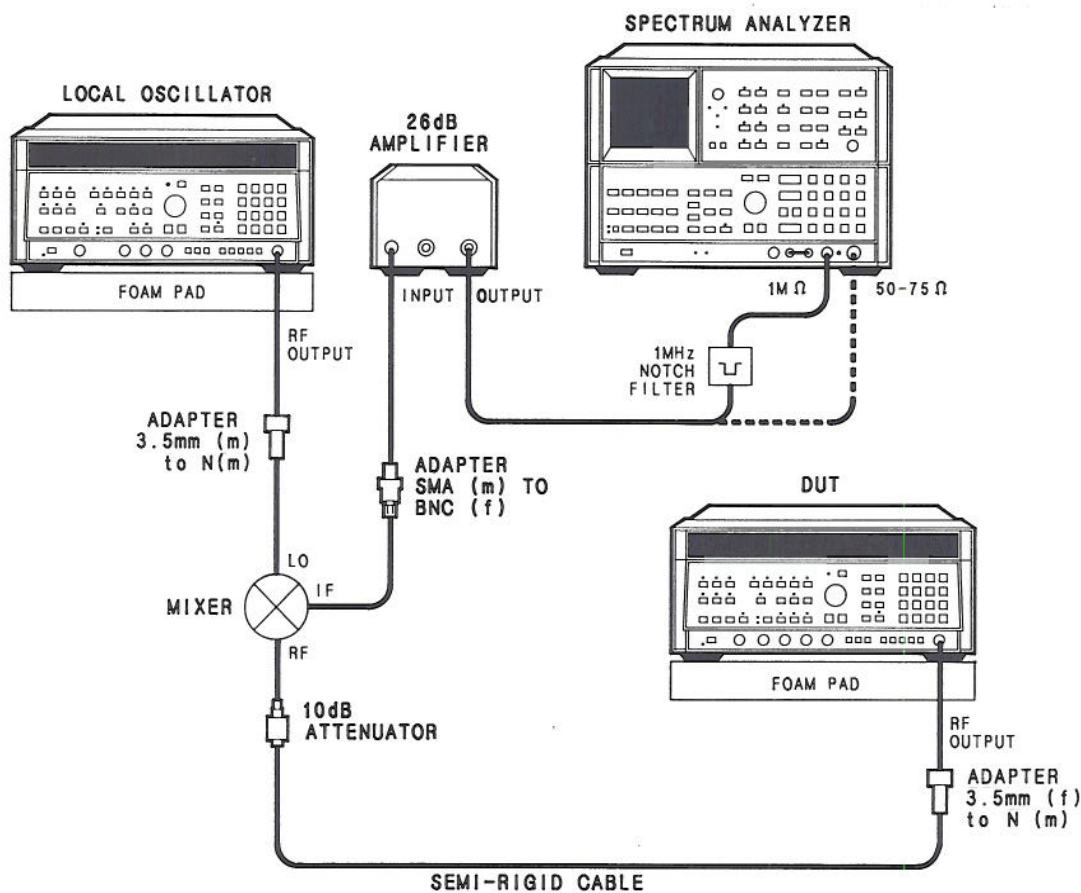


Figure 4-9. Single Sideband Phase Noise Test Setup

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

Equipment

Synthesized Sweeper (Local Oscillator)	HP 8340A or HP 8341A
Spectrum Analyzer	HP HP 3585A
Power Amplifier	HP 8447F
Attenuator	HP 8493C Opt. 010
Mixer	HP P/N 0955-0307
Adapters	
Type-N (m) to 3.5 mm (f) (1 required)	HP P/N 1250-1744
Type-N (m) to 3.5 mm (m) (1 required if LO is HP 8341A)	HP P/N 1250-1743
SMA (m) to BNC (f)	HP P/N 1250-1200
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
Foam Pads	(Refer to note following step 1)
1 MHz Notch Filter	(See schematic in Recommended Test Equipment list, at the beginning of this section)

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

Procedure

1. Connect equipment as shown in Figure 4-9 with the amplifier connected directly to the spectrum analyzer 50 Ohm input.

NOTE

The foam pads shown in Figure 4-9 are required to isolate the DUT and LO from mechanical vibrations which could induce phase noise.

NOTE

In this procedure, the LO is programmed for +10 dBm. At some points the LO may indicate an unlevelled condition. This is to be expected and does not affect the phase noise measurement.

2. On the LO, press [INSTR PRESET] [CW] [2] [.] [2] [0] [1] [GHz] [POWER LEVEL] [1] [0] [dB(m)] [PEAK].
3. On the DUT, press [INSTR PRESET] [CW][2] [.] [2] [0] [2] [GHz] [POWER LEVEL] [0] [dB(m)] [PEAK].
4. On the spectrum analyzer, press INSTR PRESET, CENTER FREQUENCY, 1 MHz, FREQUENCY SPAN, 1 MHz.
5. Switch the spectrum analyzer AUTO RANGE and REF LVL TRACK off.
6. Allow the equipment to warm up for 1 hour.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

7. Adjust the spectrum analyzer marker to the peak of the IF.
8. On the spectrum analyzer, press COUNTER.
9. Adjust the frequency of the LO for an spectrum analyzer COUNTER reading of $1 \text{ MHz} \pm 0.9 \text{ Hz}$. This removes any frequency offsets between the DUT and LO.
10. Adjust the output power of the DUT for 0 dBm at the peak of the IF. Select a REFERENCE LEVEL of 0 dBm on the spectrum analyzer.

SYSTEM CALIBRATION

30 Hz Offset Calibration

(not applicable to units equipped with Option 007, Relaxed Phase Noise specifications)

11. On the spectrum analyzer, press FREQUENCY SPAN, 250 Hz, RES BW, 3 Hz. Allow one sweep to occur. Ensure power at peak if IF is still 0 dBm.
12. Reduce LO frequency by 30 Hz ($\text{IF} = 1.00003 \text{ MHz} \pm 0.9 \text{ Hz}$).
13. Allow one sweep of the spectrum analyzer to occur. Adjust the spectrum analyzer marker to the peak of the IF. Record the marker power level (Cal Data) into Table 4-19.

Table 4-19. Phase Noise Calibration Data

Step	Offset (Hz)	Cal Data (dB)
13	30	CD =
14	100	CD =
16	1K	CD =
19	10K	CD =
21	100K	CD =
22	0	IFDC =

100 Hz Offset Calibration

14. Reduce the LO frequency by 70 Hz ($\text{IF} = 1.0001 \text{ MHz} \pm 0.9 \text{ Hz}$) Repeat step 13.

1 kHz Offset Calibration

15. On the spectrum analyzer, press FREQUENCY SPAN, 2500 Hz, RES BW, 30 Hz.
16. Reduce LO frequency by 900 Hz ($\text{IF} = 1.001 \text{ MHz} \pm 0.9 \text{ Hz}$). Repeat step 13.

10 kHz Offset Calibration

17. Connect 1 MHz notch filter as shown in Figure 4-9. Select 1 MOhm input impedance on the spectrum analyzer.
18. On the spectrum analyzer, press FREQUENCY SPAN, 25 kHz, RES BW, 100 Hz.
19. Reduce LO frequency by 9 kHz ($\text{IF} = 1.01 \text{ MHz} \pm 0.9 \text{ Hz}$). Repeat step 13.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

100 kHz Offset Calibration

20. On the spectrum analyzer, press FREQUENCY SPAN, 250 kHz, RES BW, 1 kHz.
21. Reduce LO frequency by 90 kHz ($IF = 1.1 \text{ MHz} \pm 0.9 \text{ Hz}$). Repeat step 13.

IF Cal Data

22. Increase the LO frequency by 100 kHz ($IF = 1 \text{ MHz} \pm 0.9 \text{ Hz}$). Repeat step 13.

PHASE NOISE MEASUREMENT

23. Connect equipment as shown in Figure 4-9 with the amplifier connected directly to the spectrum analyzer 50 Ohm input. Return the spectrum analyzer to 50 Ohm input impedance.
24. On the DUT, press **[POWER LEVEL] [0] [dB(m)]**. Select the spectrum analyzer REFERENCE LEVEL to place the peak of the IF at the top graticule of the display. Ensure $IF = 1 \text{ MHz} \pm 0.9 \text{ Hz}$. If necessary, adjust LO for an spectrum analyzer COUNTER reading of $1 \text{ MHz} \pm 0.9 \text{ Hz}$.
25. On the spectrum analyzer, press FREQUENCY SPAN, 250 Hz, RES BW, 3 Hz. Step the RANGE until the overload light just turns on and then increment it one step. Allow one sweep to occur.

30 Hz Offset

(not applicable to units equipped with Option 007, Relaxed Phase Noise Specifications)

26. On the spectrum analyzer, press MANUAL, CLEAR A, MKR → CF, COUNTER.
27. On the spectrum analyzer, press OFFSET, ENTER OFFSET, CF STEP SIZE, 30 Hz, MANUAL, STEP UP (key), NOISE LVL. The noise level measurement takes approximately 30 seconds. For an accurate reading, allow at least 2 measurements to be made before recording value. Record Measured Noise Level (MNL) into Table 4-20.

Table 4-20. Phase Noise Measurement Data

Step	Offset	Measured Noise Level [MNL, dBc (1 Hz)]			
		2.202 GHz	6.902 GHz	13.402 GHz	19.502 GHz
27	30				
29	100				
31	1K				
34	10K				
36	100K				

28. On the spectrum analyzer, press COUNTER, NOISE LVL, OFFSET, CONT. Return marker to peak of IF and ensure COUNTER reading is $1 \text{ MHz} \pm 0.9 \text{ Hz}$. If necessary, adjust LO for a 1 MHz IF. If the IF drifted more than 6 Hz, steps 26 through 28 must be repeated.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

100 Hz Offset

29. Repeat steps 26 through 28 with a CF STEP SIZE of 100 Hz substituted in step 27.

1 kHz Offset

30. On the spectrum analyzer, press FREQUENCY SPAN, 2.5 kHz, RES BW, 30 Hz.

31. Repeat steps 26 through 28 with a CF STEP SIZE of 1 kHz substituted in step 27.

10 kHz Offset

32. Connect the equipment in Figure 4-9 with the 1 MHz Notch Filter connected. Select the 1 MOhm input impedance on the spectrum analyzer.

33. On the spectrum analyzer, press FREQUENCY SPAN, 25 kHz, RES BW, 100 Hz. Decrement the RANGE until the overload light just turns on and then increment it one step.

34. Repeat steps 26 through 28 with a CF STEP SIZE of 10 kHz substituted in step 27.

100 kHz Offset

35. On the spectrum analyzer, press FREQUENCY SPAN, 250 kHz, RES BW, 1 kHz.

36. Repeat steps 26 through 28 with a CF STEP SIZE of 100 kHz substituted in step 27.

37. Repeat steps 23 through 36 for the CW frequencies shown in Table 4-21.

Table 4-21. Phase Noise Test Frequencies

CW Frequency (GHz)	
DUT	LO
6.902	6.901
13.402	13.401
19.502	19.501

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

PHASE NOISE CALCULATION

38. Using the data obtained in Table 4-19 and Table 4-20, calculate and enter the Actual Phase Noise into Table 4-21.

For example: Assume the following data was obtained for the 30 Hz offset at 26.032 GHz

CD = 0 dB (obtained in step 13)

MNL = -50.8 dB (obtained in step 27)

IFCD is defined to be 0 for a 30 Hz offset (also for 100 Hz and 1 kHz)

Therefore

$$\begin{aligned}\text{Actual Phase Noise} &= \text{MNL} + \text{IFCD} - \text{CD} - 3 \text{ dB} \\ &= -50.8 + 0 - 0 - 3 \\ &= -53.8\end{aligned}$$

The value -53.8 would be entered into Table 4-22.

For example: Assume the following data was obtained for the 10 kHz offset at 2.202 GHz

CD = -25.6 dB (obtained in step 19)

IFCD = -44.2 dB (obtained in step 22)

MNL = -66.0 dB (obtained in step 34)

Therefore

$$\begin{aligned}\text{Actual Phase Noise} &= \text{MNL} + \text{IFCD} - \text{CD} - 3 \text{ dB} \\ &= -66.0 + (-44.2) - (-25.6) - 3 \\ &= -87.6\end{aligned}$$

The value -87.6 would be entered into Table 4-22.

Table 4-22. Phase Noise Test Results

Actual Single Sideband Phase Noise (dBc/1 Hz)				
Offset (Hz)	2.202 GHz	6.902 GHz	13.402 GHz	19.502 GHz
30 ¹				
100				
1K				
10K				
100K				

1. Actual = MNL + IFCD - CD - 3 dB where IFCD = 0 for 30 Hz, 100 Hz, and 1 kHz offsets = value measured in step 22 (see Table 4-19) for 10K and 100 kHz offsets

4-10. POWER SWEEP TEST

Specification

Table 4-23. Power Sweep Test Specifications

Power Sweep

Range

Displayed: 0 to 40 dB/sweep

Actual: At least 10 dB at any given frequency (at least 20 dB in DECOUPLED mode); see Figure 2 in Table 1-1, specification table.

Accuracy

Starting Power Level: Same as Output Power Accuracy

Power Sweep Width and Linearity: See Figure 2 in Table 1-1, specification table.

In normal operation (a), the ALC does not operate below -9.95 dBm (see Figure 3 in Table 1-1, specification table), and so the maximum power sweep range is the difference of -9.95 dBm and the maximum leveled power available at the frequency range of interest (specified leveled power shown in diagram). In the DECOUPLED mode (b), the power sweep range is extended because the ALC can operate down to -20 dBm.

Description

The DUT is set to allow the ALC and the step attenuator to be operated independently ([SHIFT] [PWR SWP]). The DUT is then set to do a 20 dB power sweep from -20 dBm to 0 dBm at a CW frequency. The DUT is set to do a manual sweep while its output power is measured at the two end points, -20 dBm and 0 dBm, using a power meter.

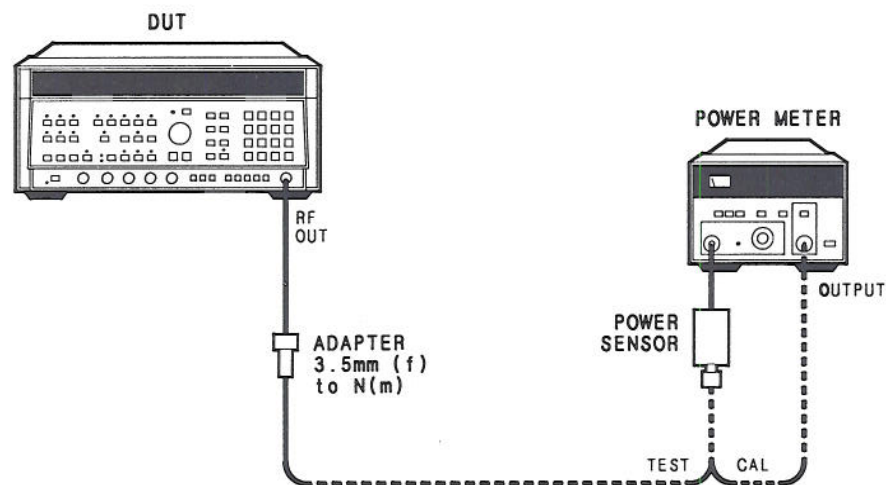


Figure 4-10. Power Sweep Test Setup

4-10. POWER SWEEP TEST (Cont'd)

Equipment

Power Meter	HP 436A Option 022
Power Sensor	HP 8485A
Adapters	
Type N (m) to 3.5 mm (f)	HP P/N 1250-1744
(1 required)	

Procedure

1. Connect equipment as shown in Figure 4-10. Connect the HP 8485A power sensor to the power meter. Allow a one hour warm up time. Set the power meter's calibration switch to include 1 GHz, then zero and calibrate the power meter before connecting the power sensor to the DUT.
2. Press the DUT's [INSTR PRESET]. Press the [CW] key and enter [1] [GHz].
3. Press [SHIFT] [PWR SWP] to allow the ALC and RF step attenuator to be independently controlled.

NOTE

The step up and step down keys control the RF attenuator. The numeric key pad and rotary knob control the ALC power level.

4. Enter [–] [2] [0] [dBm] ALC power level to set the start of the power sweep at –20 dBm. Press [PWR SWP] and enter [2] [1] [dBm] to set the power sweep range to >20 dB (The maximum power sweep range is from –20 dBm to maximum power).
5. Press the [MANUAL] key. Turn the rotary knob counterclockwise to find the beginning of the power sweep (i.e., the power meter indication is at maximum and no longer changing). Record the power meter indication.

NOTE

The POWER dBm display will indicate the approximate output power during a very slow or manual sweep.

6. Rotate the rotary knob clockwise to find the end of the power sweep (i.e., the power meter indication is at maximum and no longer changing). Record the power meter indication.
7. The difference between the power meter indications recorded in step 5 and step 6 must be ≥ 20 dB.
8. Press the [CW] key and enter [5] [GHz]. Set the power meter's calibration factor switch to include this frequency. Repeat steps 5 through 7 at CW frequencies of 10, and 15 GHz.

4-11. PULSE MODULATION ON/OFF RATIO TEST

Specification

Table 4-24. Pulse Modulation ON/OFF Ratio Test Specifications

For CW mode:

On/Off Ratio: > 80 dB

Description

The DUT under test is set to a CW frequency at 0 dBm. The RF output level is viewed on a spectrum analyzer. A reference level is set on the spectrum analyzer display, the PULSE key is pressed (ON).

NOTE

The 50 ohm termination on the DUT's PULSE input simulates the RF OFF state when PULSE is selected (ON).

The difference between the two spectrum analyzer displayed levels is the pulse ON/OFF ratio.

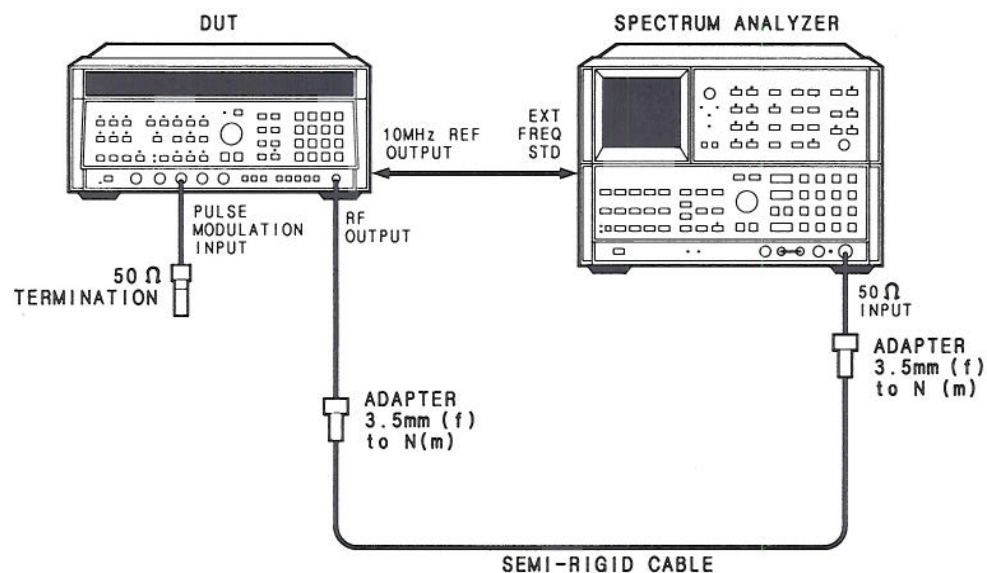


Figure 4-11. Pulse Modulation ON/OFF Ratio Test Setup

4-11. PULSE MODULATION ON / OFF RATIO TEST (Cont'd)

Equipment

Spectrum Analyzer	HP 8566B
50 Ohm Termination	HP 10100C
Adapters	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
(2 required)	
Cable SMA (m) to SMA (m)	HP P/N 08340-20124

Procedure

1. Connect equipment as shown in Figure 4-11. Allow a one hour warm up time.
2. On the DUT, press **[INSTR PRESET]** then **[CW] [1] [GHz]**. The RF power level should be 0 dBm.
3. Set the spectrum analyzer CENTER FREQUENCY to equal the DUT's CW frequency, FREQUENCY SPAN 200 Hz, RES BW 30 Hz, PEAK SEARCH, MKR → CF, MKR → REF LVL, MKRΔ.
4. Press the DUT's **[PULSE]** key (ON). The spectrum analyzer marker delta amplitude level should be greater than 80 dB.
5. Repeat steps 2 through 4 at CW frequencies of 3, 9, and 15 GHz.

NOTE

For further verification of the ON/OFF Ratio, steps 2 through 4 may be repeated for other frequencies of interest.

4-12. PULSE MODULATION RISE AND FALL TIME TEST

Specification

Table 4-25. Pulse Modulation Rise and Fall Time Test Specification

For CW mode:
Rise Time (T_R): <35 ns
Fall Time (T_F) 10 MHz to <13.5 GHz = <35 ns
13.5 to 18 GHz = <50 ns

Description

The DUT's RF output frequency is down converted to 50 MHz using a mixer and a local oscillator. The 50 MHz IF signal is amplified and applied to an oscilloscope. The DUT is pulsed using a pulse generator. The pulse generator output is also applied to the oscilloscope. The oscilloscope is used to measure the pulse envelope rise and fall times. Refer to Figure 4-12 Pulse Definitions.

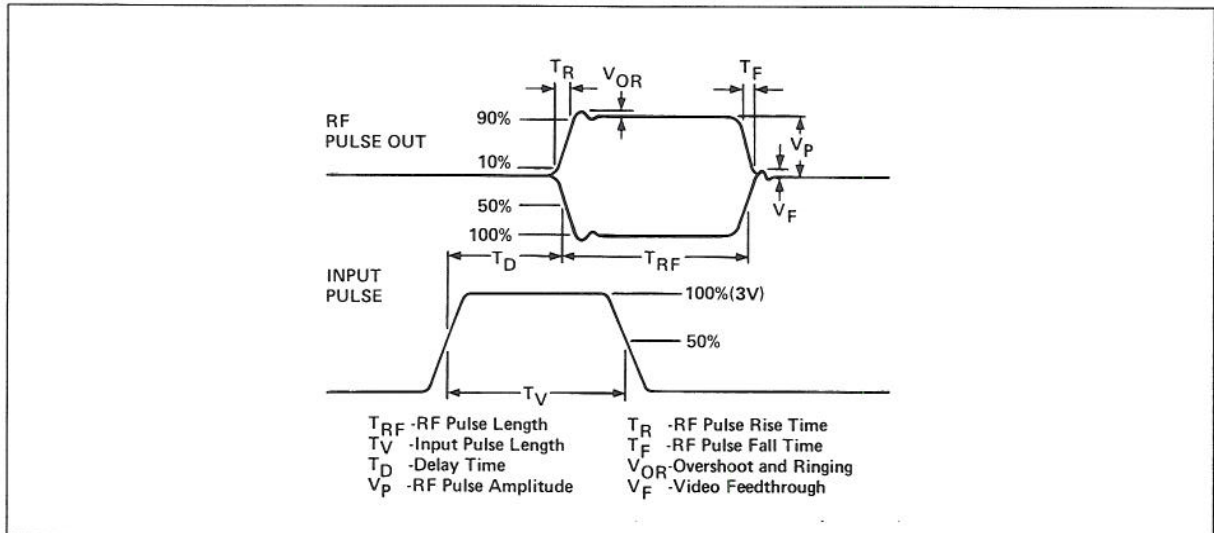


Figure 4-12. Pulse Definitions

4-12. PULSE MODULATION RISE AND FALL TIME TEST (Cont'd)

Equipment

Local Oscillator	HP 8340A/B or HP 8341A/B
Pulse Generator	HP 8012B
Amplifier	HP 8447F
Oscilloscope	HP 1741A
Adapters	
Type-N (m) to 3.5 mm (f)	HP P/N 1250-1744
(1 required)	
Type-N (m) to 3.5 mm (m)	HP P/N 1250-1743
(1 required if LO is HP 8341A)	
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
10 dB Attenuator	HP 8493C Opt. 010
Mixer	HP P/N 0955-0307
Low Pass Filter (LPF)	HP P/N 9135-0260

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

4-12. PULSE MODULATION RISE AND FALL TIME TEST (Cont'd)

Procedure

1. Connect equipment as shown in Figure 4-13. Connect the mixer directly to the local oscillator RF output to obtain maximum LO drive to the mixer. Connect the BNC tee directly to the DUT's PULSE IN connector. Allow a one hour warm up time.

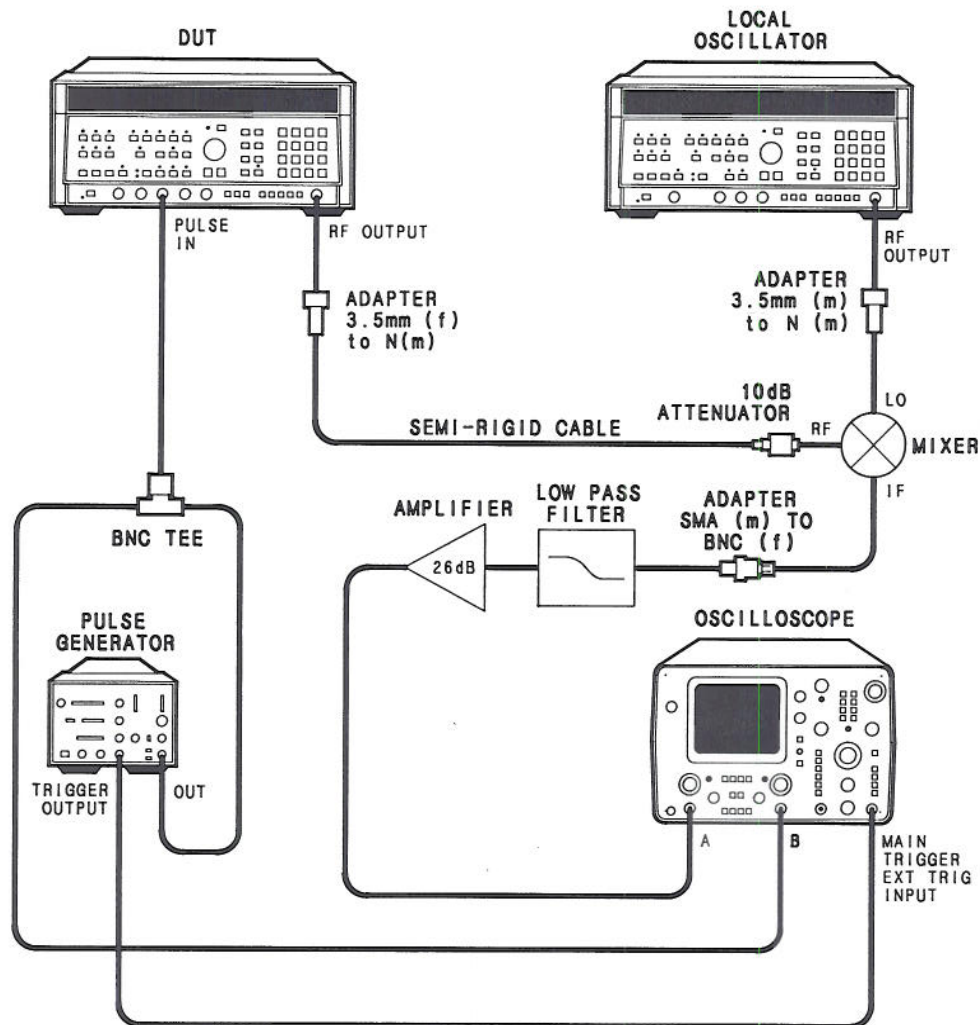


Figure 4-13. Pulse Modulation Rise and Fall Time Test Setup

4-12. PULSE MODULATION RISE AND FALL TIME (Cont'd)

2. Set up the HP 8012B Pulse Generator as follows:

OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN
PULSE PERIOD slide switch	1 μ –0.1m
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5.0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER	fully CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	10n–1 μ
TRAILING EDGE control	fully CCW

3. Set both oscilloscope channels A and B for 50 ohm input. Set the oscilloscope to view the pulse generator output waveform. Adjust the pulse generator's pulse width VERNIER for a 100 nanosecond pulse. Adjust the pulse period VERNIER for a 10 microsecond period.

Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level). Set the oscilloscope to trigger on this pulse (trigger on channel B).

4. Press **[INSTR PRESET]** on both the DUT and the LO. On the DUT, press **[CW] [1] [GHz]** and the **[PULSE]** modulation key. On the LO, press **[CW] [.] [9] [5] [GHz]**. The IF frequency is then 50 MHz. Set the LO for +10 dBm or maximum leveled output. The DUT's RF power should be 0 dBm.

NOTE

For best accuracy in this test, the Local Oscillator drive to the mixer should be $\geq +4$ dBm.

5. Set the oscilloscope horizontal sweep to 50 nanoseconds/division and select channel A input only. Adjust the channel A (pulsed IF input signal) vertical gain and position so that the pulse OFF is at the 0% graticule line and the pulse ON is at 100% graticule line. Select the horizontal MAG X10. The oscilloscope is now calibrated for 5 nanoseconds/division. Adjust the horizontal position control to position the modulation envelope so that the 10% point of the envelope rise time is at the center vertical graticule line similar to Figure 4-14.

4-12. PULSE MODULATION RISE AND FALL TIME (Cont'd)

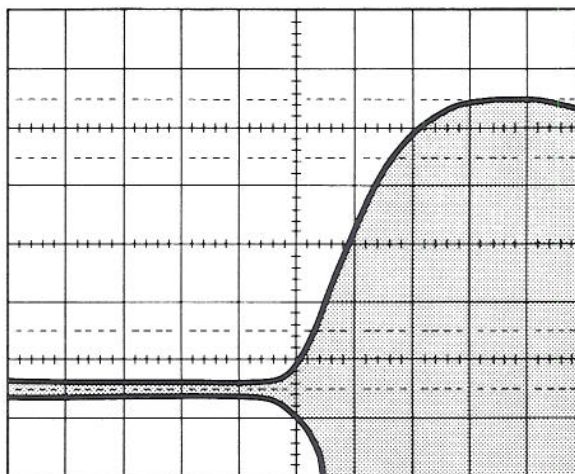


Figure 4-14. Pulse Modulation Rise Time Waveform

6. The 90% point of the envelope rise time should be less than 35 nanoseconds (7 horizontal divisions) from the 10% point.
7. Adjust the oscilloscope horizontal position control to view the modulation envelope fall time. Position the waveform so that the modulation envelope crosses the 90% graticule at a vertical graticule line similar to Figure 4-15.

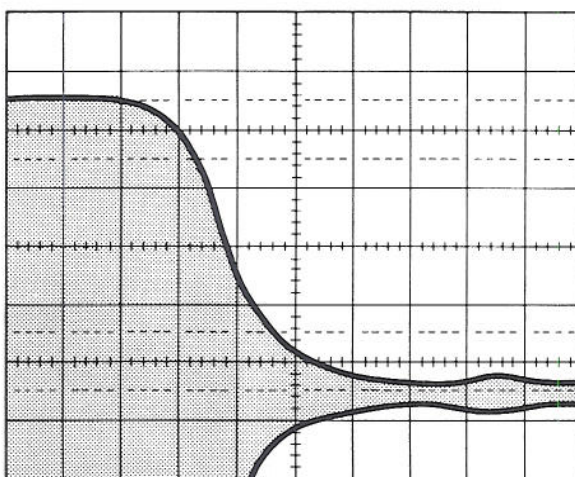


Figure 4-15. Pulse Modulation Fall Time Waveform

8. At 1, 3, and 9 GHz the 10% point should be <35 nanoseconds (7 divisions) from the 90% point. At 15 GHz, the 10% point should be <50 nanoseconds (10 divisions) from the 90% point.
9. Repeat steps 5 through 8 at CW frequencies of 3, 9, and 15 GHz. Set the LO CW frequency to be 50 MHz below the DUT's frequency.

4-13. PULSE MODULATION ACCURACY TEST (Cont'd)

Equipment

Local Oscillator	HP 8340A or HP 8341A
Pulse Generator	HP 8012B
Amplifier	HP 8447F
Oscilloscope	HP 1741A
Adapters	
Type-N (m) to 3.5 mm (f) (1 required)	HP P/N 1250-1744
Type-N (m) to 3.5 mm (m) (1 required if LO is HP 8341A)	HP P/N 1250-1743
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
10 dB Attenuator	HP 8493C Opt. 010
Mixer	HP P/N 0955-0307
Low Pass Filter (LPF)	HP P/N 9135-0260

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector. For best accuracy in this test, the local oscillator drive to the mixer should be ≥ 4 dBm.

1. Connect equipment as shown in Figure 4-16. Connect the output of the DUT directly into channel A of the oscilloscope. Connect the BNC tee directly to the DUT's PULSE IN connector. Allow a one hour warm up.
2. Set up the pulse generator as follows:

PULSE PERIOD slide switch	1 μ – 0.1m
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5.0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER	fully CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	10n-1 μ
TRAILING EDGE control	fully CCW
OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN

3. Set both oscilloscope channels (A and B) for 50 Ohm input. Set the oscilloscope to view the pulse generator output waveform. Adjust the pulse generator's pulse width VERNIER for a 700 nanosecond pulse. Adjust the pulse period VERNIER for a 10 microsecond period. Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level).
4. Press [INSTR PRESET] on both the DUT and the LO. On the DUT, press [CW] [5] [0] [MHz] [POWER LEVEL] [-] [1] [0] [dBm].
5. Set the oscilloscope horizontal for 100 nanoseconds/division and select channel A input only. Adjust the channel A vertical sensitivity to view the entire RF envelope.

4-13. PULSE MODULATION ACCURACY TEST (Cont'd)

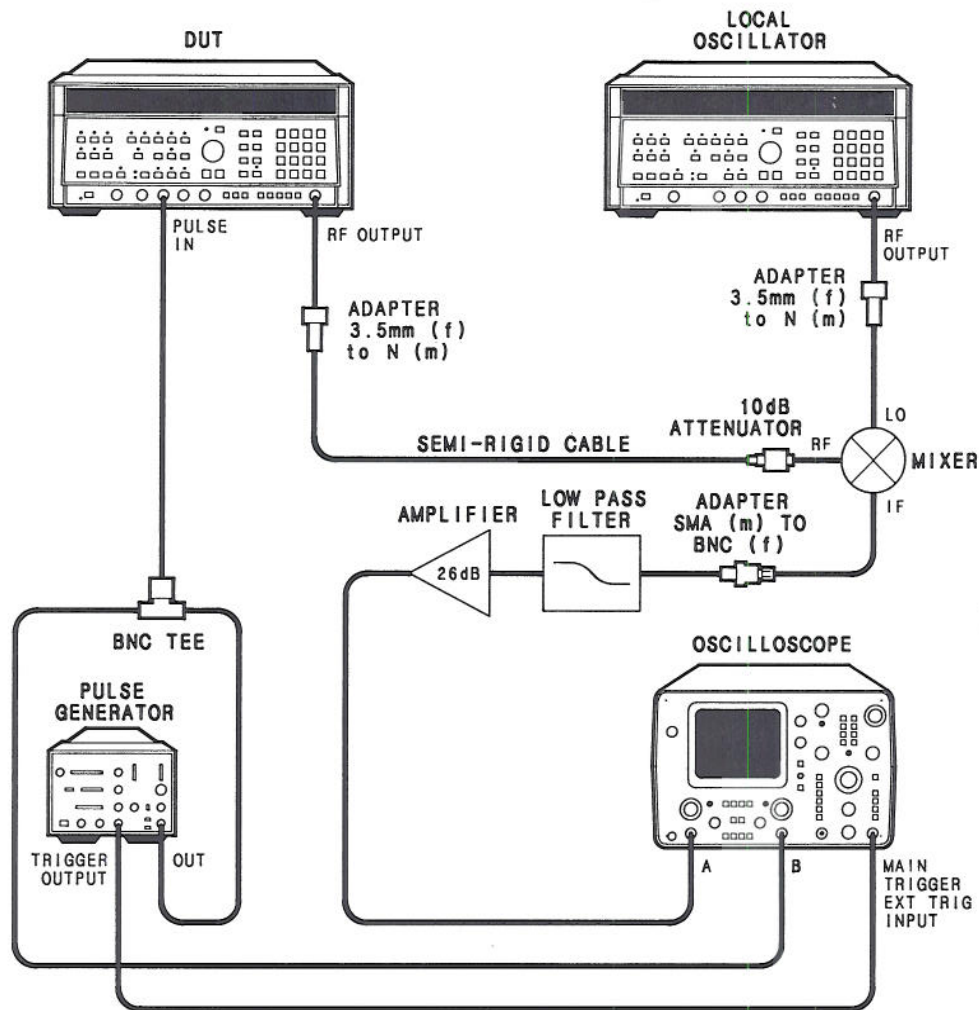


Figure 4-16. Pulse Modulation Accuracy Test

NOTE

It may be necessary to reduce the vertical sensitivity and/or adjust the DUT's RF output level at some frequencies.

6. Press the [PULSE] key on the DUT (pulse ON). Adjust the oscilloscope vertical position and sensitivity to place the modulation envelope on convenient horizontal graticule lines. Press the [PULSE] key to turn pulse OFF. Press the [POWER LEVEL] key on the DUT. Note the power level in the ENTRY DISPLAY.
7. Adjust the DUT's power level using the rotary knob so that the signal aligns with the horizontal graticule lines established in step 6 for the modulation envelope. Note the ENTRY DISPLAY power level.

4-13. PULSE MODULATION ACCURACY TEST (Cont'd)

8. The difference between the power levels noted in step 6 and 7 should be less than the specification for this pulse width and RF frequency.
9. Repeat steps 5 through 8 for pulse widths of 2, 5, and 10 μ s.
10. To test the pulse repetition frequency range, set the pulse generator period to 10 milliseconds (100 Hz) and pulse width to 1 microsecond (duty cycle of 0.01%). Repeat steps 5 through 8. Set the pulse generator period to 2 μ s (500 kHz) and pulse width to 700 nanoseconds (minimum specified PW). Repeat steps 5 through 8.
11. Connect the local oscillator as shown in Figure 4-16.
12. Adjust the pulse generator pulse width VERNIER for a 100 nanosecond pulse. Adjust the pulse period VERNIER for a 10 microsecond period. Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level).
13. Press **[INSTR PRESET]** on both the DUT and the LO. On the DUT, press **[CW] [1] [GHz] [POWER LEVEL] [-] [1] [0] [dBm]**. On the LO, press **[CW] [.] [9] [5] [GHz]**. The IF frequency is then 50 MHz. Set the LO for +10 dBm or maximum leveled output.
14. Set the oscilloscope horizontal for 50 nanoseconds/division and select channel A input only. Adjust the channel A vertical sensitivity to view the entire RF envelope.

NOTE

It may be necessary to reduce the vertical sensitivity and/or adjust the DUT's RF output level at some frequencies.

15. Press the **[PULSE]** key on the DUT (pulse ON). Adjust the oscilloscope vertical position and sensitivity to place the modulation envelope on convenient horizontal graticule lines. Press the **[PULSE]** key to turn pulse OFF. Press the **[POWER LEVEL]** key on the DUT. Note the power level in the **ENTRY DISPLAY**.
16. Adjust the DUT's power level using the rotary knob so that the IF carrier signal aligns with the horizontal graticule lines established in step 15 for the modulation envelope. Note the **ENTRY DISPLAY** power level.
17. The difference between the power levels noted in step 15 and 16 should be less than the specification for this pulse width and RF frequency.
18. Repeat steps 14 through 17 for pulse widths of 200, 500, and 1000 nanoseconds.
19. To test the Pulse Repetition Frequency range (10 Hz to 5 MHz), set the pulse generator period to 100 milliseconds (10 Hz) and pulse width to 10 microseconds (duty cycle of 0.01%). Repeat steps 14 through 17. Set the pulse generator period to 200 nanoseconds (5 MHz) and pulse width to 100 nanoseconds (minimum specified PW). Repeat steps 14 through 17.
20. Set the pulse generator period to 10 microseconds and pulse width to 100 nanoseconds. Repeat steps 14 through 19 at CW frequencies of 3, 9, and 15 GHz. Set the LO's CW frequency to be 50 MHz below the DUT's frequency. For the 15 GHz test frequency, press **[PEAK]** to (ON).

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST

Specification

Table 4-27. Pulse Modulation Video Feedthrough Test Specification

For CW mode and frequencies only:

Video Feedthrough (V_F/V_P):

0.01 to <0.4 GHz (Band 0): <10% for output power level = 0 dBm

0.4 <2.3 GHz (Band 0): <5% for output power levels $\leq +8$ dBm

2.3 to 20.0 GHz (Bands 1-3): <0.2%

Description

NOTE

Video feedthrough is any component of the pulse generator signal that appears at the DUT's RF output connector.

The DUT is set to a CW frequency at 0 dBm and is pulsed using a pulse generator. The pulsed RF output signal is fed through a 10 dB attenuator and a low pass filter that will pass only the low frequency (video feedthrough) component of the modulation envelope. The video feedthrough is measured using an oscilloscope. The measured voltage is related to the RF power by:

$$P = 10 \log (V^2/R/1 \text{ mW})$$

Where:

P = DUT RF output level minus 10 dB, and

R = 50 Ohms.

Equipment

Pulse Generator	HP 8012B
Oscilloscope	HP 1741A
Adapters	
Type-N (m) to 3.5 mm (f) (1 required)	HP P/N 1250-1744
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
10 dB Attenuator	HP 8493C Opt. 010
Low Pass Filter (LPF)	HP P/N 9135-0260

Procedure

1. Connect equipment as shown in Figure 4-17. Attach the BNC tee directly to the DUT's PULSE input connector. Allow a one hour warm up time.

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST (Cont'd)

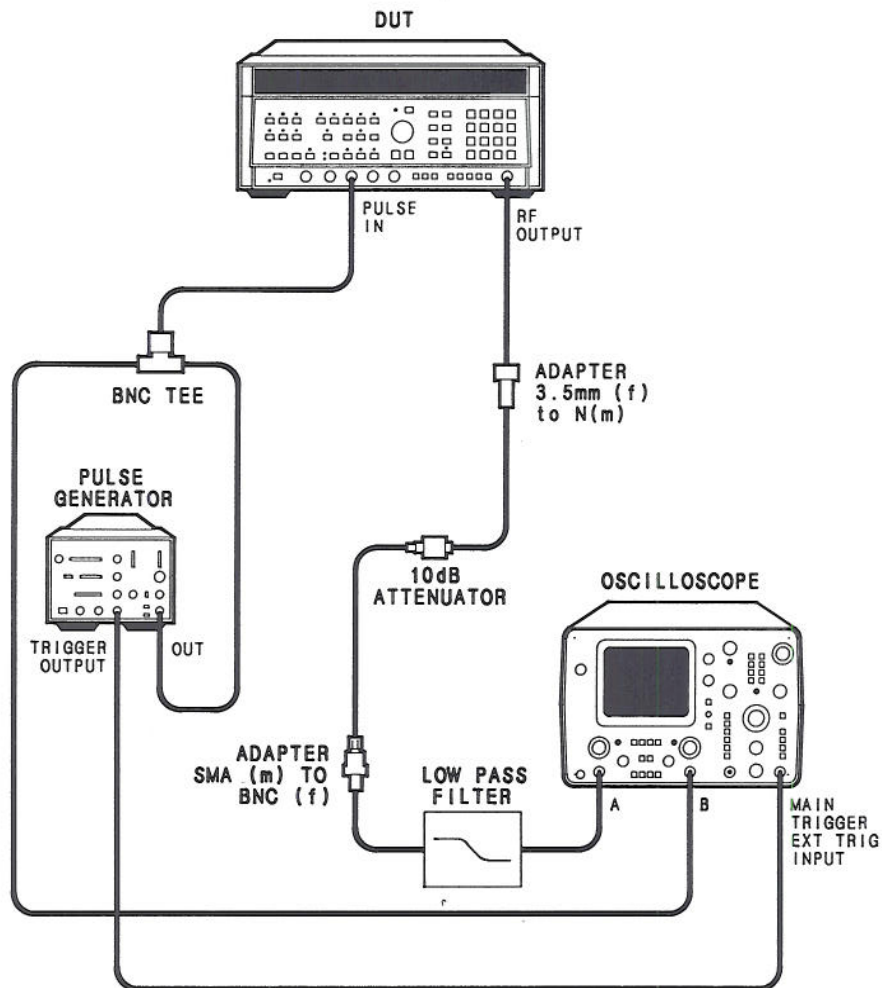


Figure 4-17. Pulse Modulation Video Feedthrough Test Setup

2. Set up the pulse generator at follows:

PULSE PERIOD slide switch	 $1\mu - 0.1m$
TRANSITION TIME slide switch	 minimum (5n)
AMPLITUDE slide switch	 top position (5.0)
PULSE DOUBLE/NORMAL	 NORMAL
PULSE DELAY slide switch	 minimum
Pulse Delay VERNIER fully	 CCW
LEADING EDGE control	 fully CCW
PULSE WIDTH slide switch	 $10n - 1\mu$
TRAILING EDGE control	 fully CCW
OFFSET	 OFF
POLARITY	 +
OUTPUT	 NORMAL
INT LOAD	 IN

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST (Cont'd)

- Set both oscilloscope channels (A and B) to 50 Ohm input. Set the oscilloscope to view the pulse generator output waveform. Adjust the pulse generator pulse width VERNIER for a 100 nanosecond pulse. Adjust the pulse period VERNIER for a 100 microsecond period. Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level). Set the oscilloscope horizontal sweep to 50 nanoseconds/division and select channel A input only.
- On the DUT, press **[INSTR PRESET]** followed by **[CW] [.] [4] [GHz]**. Press the **[PULSE]** key (pulse ON).
- Press the **[POWER LEVEL]** key and enter the first power level, **[0] [dBm]**.
- Adjust the oscilloscope channel A vertical sensitivity and vertical position to view the video feedthrough signal similar to Figure 4-18. Verify that the video feedthrough is less than 10mV.

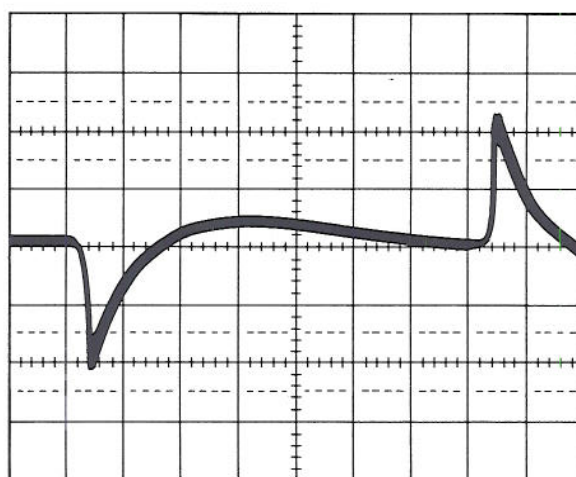


Figure 4-18. Pulse Modulation Video Feedthrough Waveform

- Press **[CW] [.] [5] [GHz]**, **[POWER LEVEL] [8] [dBm]**. The test limits for the three power levels are shown in Table 4-28. (Note that the test limit is 5% of Vpk.)
- Adjust the oscilloscope channel A vertical sensitivity and vertical position to view the video feedthrough signal similar to Figure 4-18. Verify that the video feedthrough is less than 10mV.

Table 4-28. Pulse Modulation Video Feedthrough Test Limits

DUT RF Output Level (dBm)	P = (dBm)	Vpk	TEST LIMIT (pk voltage)
+8	-2	0.2511	12 mV
0	-10	0.0999	5 mV
-10	-20	0.03162	1.6 mV

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST (Cont'd)

The test limits are derived using the following equation:

$$P = 10 \log (V_{rms}^2/R/1 \text{ mW})$$

Where:

P = DUT RF output level -10 dBm, and,

R = 50 Ohms.

Example:

For a DUT set to 0 dBm, the output of the 10 dB pad is -10 dBm.

$$P = 10 \log (V_{rms}^2/R/1 \text{ mW})$$

$$-10 = 10 \log (V^2/50/0.001) \quad (\text{divide through by 10})$$

$$-1 = \log (V^2/50/0.001) \quad (\text{take antilog of both sides})$$

$$10^{-1} = 0.1 = (V^2/50/0.001) \quad (\text{cross multiply})$$

$$0.0001 = V^2/50 \quad (\text{cross multiply again})$$

$$\sqrt{0.005} = V = 0.0707 \text{ rms}$$

$$\text{Test Limit} = V_{pk} \times 5\% = 0.0707 \times 1.414 \times 5\% = 5 \text{ mV}$$

9. Repeat steps 7 and 8 for DUT output power levels of 0 and -10 dBm.
10. Repeat steps 7 through 9 at CW frequencies of 1, 1.5, and 2 GHz.

NOTE

For DUT frequencies above 2.3 GHz the video feedthrough is typically so small that it is difficult to measure. The following steps provide a means to verify that the video feedthrough is negligible.

11. Remove the 10 dB pad between the DUT and the low pass filter. Press the [CW] key and enter any frequency from >2.3 GHz to the DUT's maximum frequency. Press the [POWER LEVEL] key and enter [-] [1] [0] [dBm].
12. Select the oscilloscope X5 vertical magnifier. The test limit is now 0.2 mV or 1 minor division on the oscilloscope.
13. Select several CW frequencies >2.3 GHz. and verify that the video feedthrough is less than 1 minor division on the oscilloscope.

4-15. AMPLITUDE MODULATION TEST

Specification

Table 4-29. Amplitude Modulation Test Specifications

The following specifications apply when the DUT is internally leveled, for waveforms whose envelope peak is at least 1 dB below maximum specified power. Unless noted, pulse modulation must be OFF; however, the HP 8340A Option H02 is capable of simultaneous amplitude and pulse modulation. See Section 3, Operation.

Frequency Range: 0.01 to 18 GHz

AM Depth: 0 to 90%

AM Sensitivity at 1 kHz rate and 30% depth: 100%/Volt $\pm$ 5%

AM Bandwidth relative to a 1 kHz rate at 90% depth: DC coupled, 3 dB point $\geq$ 100 kHz

AM Frequency Response (Flatness) Relative to a 1 kHz rate at 30% depth, DC to 10 kHz:
 ± 0.20 dB

Description

AM sensitivity and accuracy is determined by simulating a modulation signal (i.e., setting the function generator to a dc voltage). The unmodulated DUT RF output is measured using a power meter. A dc voltage representing the percentage of modulation is applied to the DUT's AM input. The power meter indication should change by:

$$20 \log (1 + (\text{dc voltage} \pm (0.05 \text{ times the dc voltage})))$$

The sensitivity and accuracy is tested at several CW frequencies.

The AM frequency response and bandwidth is measured by down converting the DUT's RF frequency to an IF frequency within the range of the modulation analyzer. The DUT is amplitude modulated using a function generator. The modulation analyzer is set to indicate 0 dB at the reference modulation frequency of 1 kHz. The modulation frequency is varied and the flatness is indicated on the modulation analyzer. The modulating frequency is then set to the bandwidth specification (100 kHz) and the modulation analyzer should indicate > -3 dB.

Finally, the function generator output level is increased to obtain $>90\%$ modulation depth.

Equipment

Local Oscillator	HP 8340A or HP 8341A
Modulation Analyzer	HP 8901A
Function Generator	HP 3325A
Digital Voltmeter	HP 3455A
Amplifier	HP 8447F
Power Meter	HP 436A
Power Sensor	HP 8485A
Adapters	
Type-N (m) to 3.5 mm (f) (1 required)	HP P/N 1250-1744
Type-N (m) to 3.5 mm (m) (1 required if LO is HP 8341A)	HP P/N 1250-1743
Type-N (m) to BNC (f)	HP P/N 1250-1476
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781

4-15. AMPLITUDE MODULATION TEST (Cont'd)

Equipment, Cont'd

Cable (Semi-Rigid SMA male to SMA male) HP P/N 08340-20124
 20 dB Attenuator HP 8493C Opt. 020
 Mixer HP P/N 0955-0307

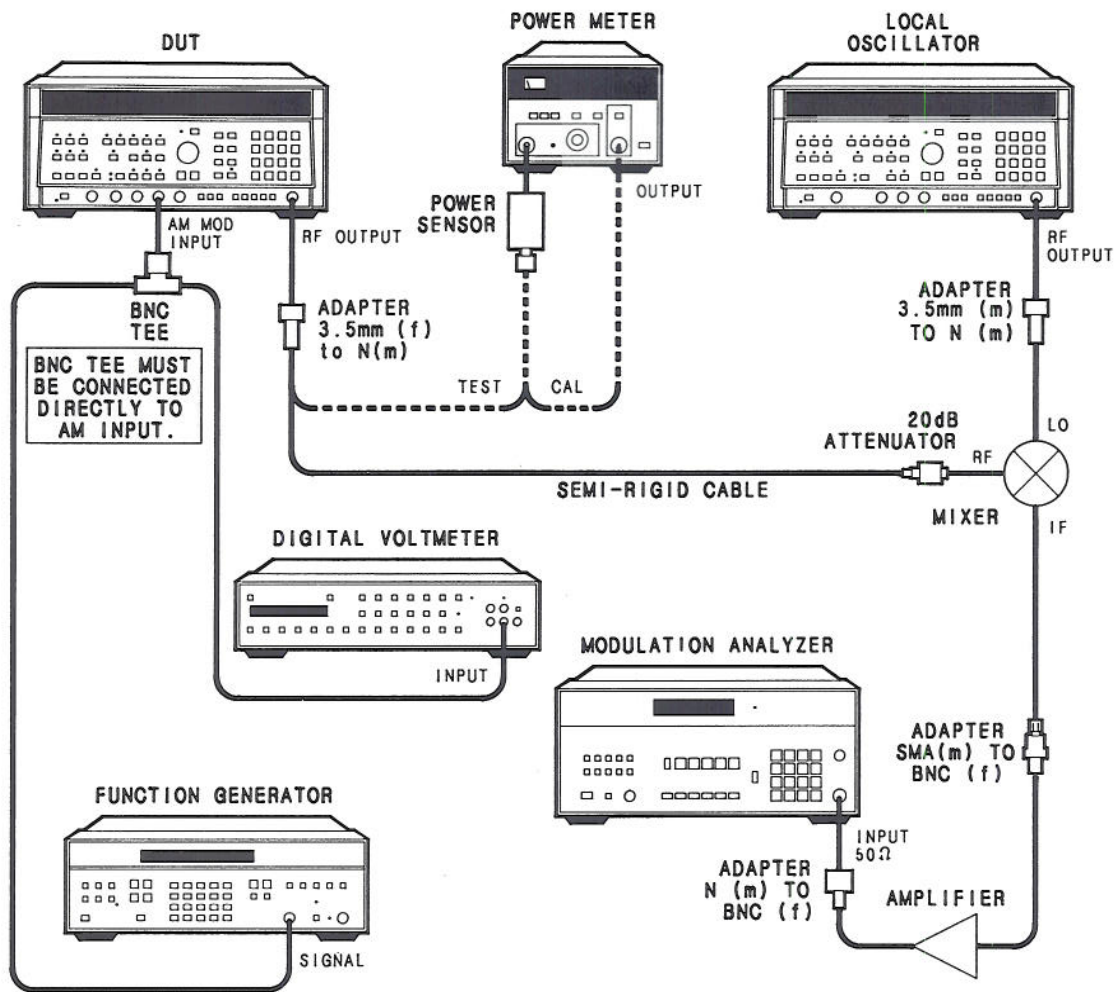


Figure 4-19. Amplitude Modulation Test Setup

4-15. AMPLITUDE MODULATION TEST (Cont'd)

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

Procedure

AM SENSITIVITY AND ACCURACY

1. Connect equipment as shown in Figure 4-19. Connect the mixer LO port at the LO's RF output. Connect the power sensor to the power meter. Allow a one hour warm up time. Set the power meter's calibration factor switch to include 1.5 GHz, then zero and calibrate the power meter. Connect the power sensor to the DUT's RF output.
2. On the DUT, press [INSTR PRESET] [CW] [1] [.] [5] [GHz]. Press the [POWER LEVEL] key and enter [−] [5] [dBm].

NOTE

The function generator output impedance is 50 Ohms and its output indication accuracy assumes a 50 Ohm load. The DUT's AM input impedance is 600 Ohms; therefore, a high impedance DVM is used to measure and set the function generator output level.

3. Zero the power meter as follows:
With power applied to the sensor, press the power meter RANGE HOLD. Press the DUT's [RF] key to turn the RF OFF. Zero the power meter. Press the [RF] key to turn the RF ON.
4. Using the DVM as an indicator, set the function generator to output 0 Vdc (If the function generator being used does not have this feature, use a dc power supply). Press the DUT's [AM] key (AM ON). Note the power meter indication.
5. Simulate +30% modulation by setting the function generator output to +0.3 volts dc as indicated on the DVM. The power meter indication should increase by 2.18 to 2.38 dB from the value noted in step 4.
$$20 \log (1 + (0.3 - (0.05 \text{ times } 0.3))) = 2.18 \text{ dB}$$

to

$$20 \log (1 + (0.3 + (0.05 \text{ times } 0.3))) = 2.38 \text{ dB}$$
6. Simulate −30% modulation by setting the function generator output to −0.3 volts dc as indicated on the DVM. The power meter should decrease by 2.91 to 3.29 dB from the value noted in step 4.
$$20 \log (1 + (-0.3 - (0.05 \text{ times } -0.3))) = -2.91 \text{ dB}$$

to

$$20 \log (1 + (-0.3 + (0.05 \text{ times } -0.3))) = -3.29 \text{ dB}$$

NOTE

The DUT's test power levels are selected to avoid power meter range changes at the +30 and −30% modulation settings.

4-15. AMPLITUDE MODULATION TEST (Cont'd)

7. Press the DUT's [POWER LEVEL] key and enter [+] [5] [dBm]. Press the [AM] key to turn AM OFF. Repeat steps 3 through 6 for this power setting.
8. Press the DUT's [CW] key and enter [4] [.] [5] [GHz]. Press the [AM] key to turn AM OFF. Set the power meter's calibration factor switch to include 4.5 GHz. Repeat steps 3 through 6 for DUT power settings of -5 and +5 dBm.

AM FREQUENCY RESPONSE AND BANDWIDTH

9. Disconnect the power sensor and connect the DUT's RF output to the 20 dB attenuator.
10. On the DUT, press [CW] [1] [.] [5] [GHz], [POWER LEVEL] [0] [dBm]. On the LO, press [INSTR PRESET] [CW] [1] [.] [4] [5] [GHz], [POWER LEVEL] [1] [0] [dBm]. Press PEAK (ON). (The output may be unlevelled; this will not affect the test.) The IF frequency is now 50 MHz.

NOTE

For best accuracy in the amplitude modulation test, the local oscillator drive to the mixer should be $> +4$ dBm.

11. Set the function generator for a sine wave at a reference frequency of 1 kHz at 0.6363 Vrms (0.9 times 0.707) ± 0.05 Vrms. For example: 0.65 Vrms, as indicated on the DVM, would fall in this range. Set the modulation analyzer input frequency to 50 MHz (by pressing FREQ 50 MHz), then press AM and AVE. The modulation analyzer should indicate about 63%. Note the DVM indication.
12. Press the dB key. As the modulating frequency is changed, the modulation analyzer will indicate the flatness in dB relative to the 1 kHz reference.
13. Set the function generator to 100, 200, 500 Hz, then 1, 2, 5, and 10 kHz. Check the DVM indication and adjust the level of the modulating signal at each frequency to eliminate any flatness error of the function generator. Observe the flatness indication on the modulation analyzer. The flatness indication should be $\leq \pm 0.20$ dB.
14. Check the AM bandwidth by setting the function generator to 100 kHz. Adjust the function generator output level to the value noted in step 11. The modulation analyzer should indicate ≥ -3 dB.

AM DEPTH

15. Set the function generator to 1 kHz. Set the modulation analyzer to indicate percent modulation by setting the controls as follows:

AUTOMATIC OPERATION	ON
AM	ON
RATIO %	OFF
RATIO dB	OFF
PEAK	+

Increase the function generator output amplitude to obtain $> 90\%$ modulation depth.

16. Repeat steps 11 through 15 at DUT RF frequencies of 3, 9, and 15 GHz. Make sure LO CW frequency is always 50 MHz below the DUT frequency.

4-16. AM DISTORTION

Specification

Table 4-30. AM Distortion Specifications

AM Distortion is specified at ALC levels from -4.95 to $+5$ dBm	
SHIFT POWER SWEEP mode, Internally Leveled at 50% Depth:	
Up to 20 kHz rate	< 4%
>20 to 50 kHz rate	<10%
>50 to 100 kHz rate	<35%
SHIFT RF mode at 50% depth:	
50 kHz rate:	<25%

AM Distortion Description

TEST CONDITIONS

AM distortion is measured under two conditions. The first condition places the DUT into internally leveled mode. The SHIFT POWER SWEEP mode is engaged, allowing the operator to independently control the ALC level and step attenuator. This test is performed at 50% depth, at AM rates of 20 kHz, 50 kHz, and 100 kHz. In the second condition, the DUT is placed into the SHIFT RF mode (which disables the ALC). This test is performed with an AM depth of 50% at a 50 kHz rate.

TEST SETUP

This test uses a function generator to amplitude modulate the DUT. The output of the DUT is down converted to an IF frequency within the range of the modulation analyzer.

CAUSES OF AM DISTORTION

AM distortion is a function of SRD biasing in the two-sphere SYTM. If the conversion efficiency of the SYTM varies non-linearly with power level, AM distortion will be generated. The step recovery diode (SRD) is only used in bands 2 and 3. Because of this, AM distortion need only be verified in bands 2 and 3 (7.0 to 20.0 GHz).

FREQUENCIES TO BE TESTED

There are no set guidelines as to what specific frequencies should be checked for AM distortion, which can occur anywhere in bands 2 or 3. The instrument is checked at the factory at 200 MHz intervals from 1.0 to 20.0 GHz using automated test stations. Performing this same test manually would be very time consuming. Therefore, this test does not document any specific frequencies to test, but instructs the operator to test any desired number of frequency points.

4-16. AM DISTORTION (Cont'd)

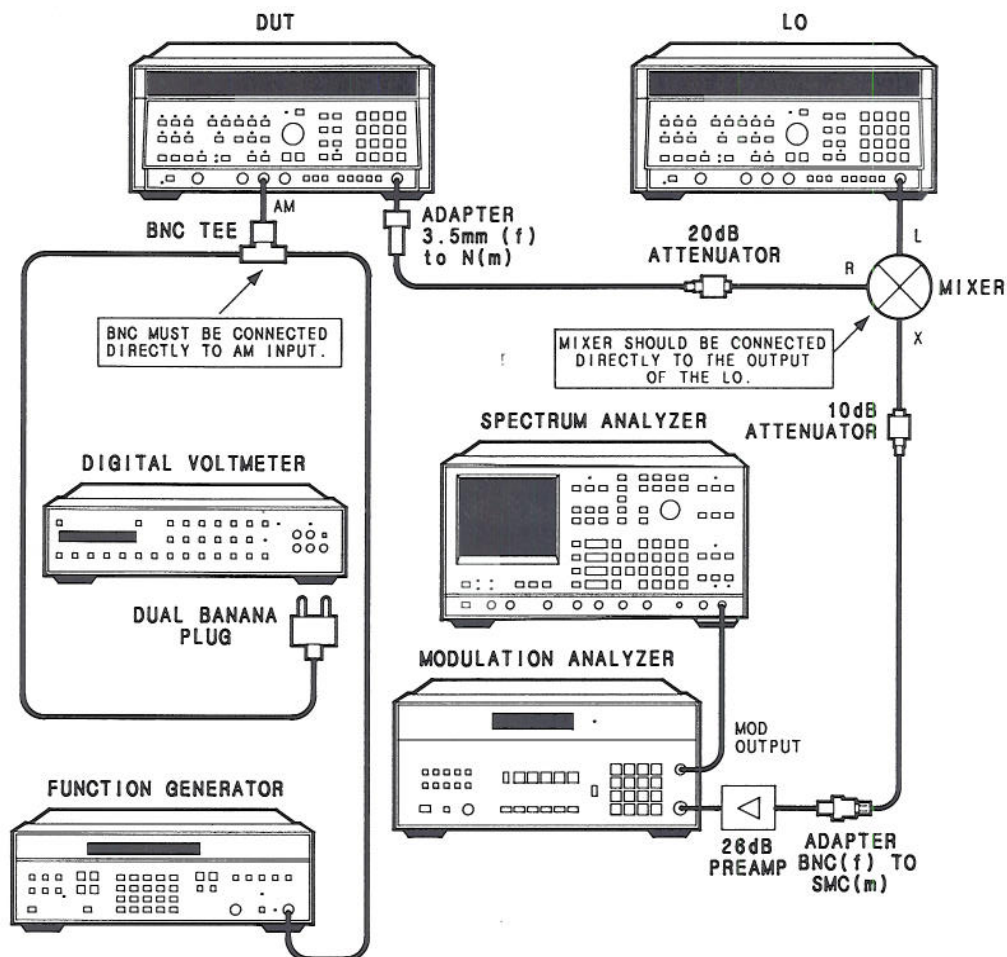


Figure 4-20. AM Distortion Test Setup

Equipment

Local Oscillator	HP 8340A/B
Modulation Analyzer	HP 8901A
Spectrum Analyzer	HP 3585A
Function Generator	HP 3325A
Amplifier	HP 8447F
Mixer	HP P/N 0955-0307
10 dB Attenuator	HP 8493C Opt. 010
20 dB Attenuator	HP 8493C Opt. 020
Adapters:	
3.5 mm (f) to Type-N(m)	HP P/N 1250-1744
(2 required)	
3.5 mm (m) to 3.5 mm (m)	HP P/N 1250-1748
SMC(m) to BNC(f)	HP P/N 1250-1200

4-16. AM DISTORTION (Cont'd)

Procedure

1. Press **[INSTR PRESET]** on the DUT. Set the DUT to the desired CW frequency. Press **[SHIFT] [PWR SWP] [-] [4] [.] [9] [5] [dBm]**. Turn **AM modulation ON**.
2. Press **[INSTR PRESET]** on the local oscillator. Set the local oscillator to a CW frequency 70 MHz away from the DUT's carrier frequency. This will produce a 70 MHz IF frequency out of the mixer. Set the local oscillator output power to +10 dBm and press **[PEAK]**.

NOTE

The mixer will not operate with input frequencies below 1 GHz.

3. On the modulation analyzer, press the green "AUTOMATIC OPERATION" key. Also press the **[AM]** and **[PEAK-]** keys.
4. Set the function generator for a 20 kHz output (sine wave).
5. Set the modulation depth to 50% by adjusting the function generator output level until the modulation analyzer reads 50.0% (start with a function generator output of 535 mV, adjust from there).
6. Press **[INSTR PRESET]** on the spectrum analyzer and set up as follows:

Start Frequency	1 kHz
Stop Frequency	400 kHz
Resolution Bandwidth	1 kHz
Marker Offset	ON

Turn off **AUTORANGE** and **REF LVL TRACK** functions.
7. Set the spectrum analyzer to **MANUAL** sweep with the modulation rate frequency selected. For example, if the modulation rate is 20 kHz, press **[MANUAL] [2] [0] [kHz]**.
8. Press **[ENTER OFFSET]**. Look at the offset value in the upper right-hand corner of the CRT. It should read 0.
9. Calculate the frequency of the second harmonic of the modulation frequency by multiplying the modulation rate by 2. For example, with a modulation rate of 20 kHz, the second harmonic would be at 40 kHz.

In this case, **[MANUAL] [4] [0] [kHz]** would be pressed.
10. Read the relative amplitude in dB from the marker offset portion of the CRT (upper right-hand corner). This value is relative to the carrier power level. For this reason, future references to this value will be expressed in dBc (db relative to the carrier). Call this value dBc1 and enter it into the test record card.
11. Repeat steps 9 and 10 (if necessary), reading successive harmonics until the amplitude of the harmonic is -40 dBc or less. If the second harmonic is already less than -40 dB, AM distortion is negligible. Note this in the test record card (under step 12) and proceed to step 13.

4-16. AM DISTORTION (Cont'd)

HOW TO DETERMINE THE FREQUENCY OF HARMONICS

The frequency of the third harmonic is equal to the modulation rate multiplied by 3. The frequency of the fourth harmonic is equal to the modulation rate multiplied by 4, etc.) Call these successive values dBc2, dBc3, dBc4, etc.

12. Calculate the total harmonic distortion:

Total Harmonic Distortion (THD, %) =

$$100 \times \text{Square Root of } [10^{(\text{dBc1}/10)} + 10^{(\text{dBc2}/10)} + 10^{(\text{dBc3}/10)} \dots]$$

EXAMPLE

$$\text{dBc1} = -35 \text{ dBc} \quad \text{dBc2} = -39 \text{ dBc} \quad \text{dBc3} = -46 \text{ dBc}$$

Ignore dBc3 because it is less than -40 dBc.

$$\begin{aligned} \text{THD (\%)} &= 100 \times \text{Square Root of } [10^{(-35/10)} + 10^{(-39/10)}] \\ &= 100 \times \text{Square Root of } [10^{(-3.5)} + 10^{(-3.9)}] \\ &= 100 \times \text{Square Root of } [316.2 \times 10^{-6} + 125.9 \times 10^{-6}] \\ &= 100 \times \text{Square Root of } 442.1 \times 10^{-6} \\ &= 100 \times .021 \\ &= 2.1\% \end{aligned}$$

Record this value in the test record card.

13. Set the DUT to a new CW frequency. Make sure the local oscillator is 70 mHz offset from the carrier. Press **[CONT]** on the spectrum analyzer. Readjust the function generator signal amplitude if necessary to maintain 50% depth.
14. Repeat steps 7 through 13 for all desired CW frequencies.
15. Select the first CW frequency tested. Press **[CONT]** on the spectrum analyzer Repeat steps 7 through 14 with the function generator output (modulation rates) set to 50 and 100 kHz. Readjust the signal amplitude out of the function generator as necessary to maintain 50% depth.
16. Select the first CW frequency tested. Press **[CONT]** on the spectrum analyzer Set the output of the function generator (modulation rate) to 20 kHz. Adjust the signal amplitude out of the function generator as necessary to maintain 50% depth. On the DUT press **[SHIFT] [PWR SWP]**, press the DOWN ARROW once, then press **[5] [dBm]**. Repeat steps 7 through 15.
17. Select the first CW frequency tested. Press **[CONT]** on the spectrum analyzer On the DUT, press **[SHIFT RF]**. Set the output of the function generator (modulation rate) to 50 kHz. Adjust the signal amplitude out of the function generator as necessary to maintain 50% depth. Repeat steps 7 through 14.

4-17. SIMULTANEOUS AM AND PULSE

Specification

Table 4-31. Simultaneous AM and Pulse Specifications

UNLEVELED ("SHIFT RF" mode)
RF Frequency: 0.01 to 18 GHz
Pulse Repetition Rate: DC to 5.0 MHz
Pulse Width: 50 ns to CW
Amplitude Mod Rate (3 dB BW): DC to 50 kHz
Modulation Depth: 35 dB minimum
AM Distortion (at 50% Modulation Depth): 25% Maximum at ≤ 50 kHz Modulation Rate
INTERNALLY LEVELED
RF Frequency: 0.4 to 18 GHz
Pulse Repetition Rate: 10 Hz to 5.0 MHz
Pulse Width: 200 ns to CW
Amplitude Mod. Rate (DC Coupled 3 dB BW): $\geq \text{PRF}/20$ or 5 kHz (whichever is less)
Modulation Depth: Envelope trough ≥ -30 dBm, ALC Level

NOTE

THE ACRONYM "PRF" WILL BE USED INSTEAD OF "PULSE REPETITION FREQUENCY" THROUGHOUT THE REST OF THIS PROCEDURE.

Simultaneous AM and Pulse Description

PURPOSE

This test checks the DUT's AM flatness at various combination of pulse repetition frequencies (PRF), pulse widths, and carrier frequencies. The instrument is tested in two modes, internally leveled mode and SHIFT RF mode (which disables the automatic leveling control circuitry).

TEST SETUP

This test is performed by attaching a microwave detector to the RF output of the DUT and then monitoring the voltage out of the detector while the AM frequency is changed. The detector output is monitored on a low frequency spectrum analyzer equipped with a tracking generator. When the spectrum analyzer's tracking generator is used as the amplitude modulating signal, swept flatness can be displayed on the analyzer.

DUT CARRIER FREQUENCY, PULSE REPETITION FREQUENCIES, AND PULSE WIDTHS TO BE TESTED

There are no set guidelines as to what specific pulse repetition frequencies or pulse widths to use in verifying performance. The operator should verify performance with any desired combinations of PRFs and Pulse widths. PRFs and pulse widths of interest should be checked at carrier frequencies of 1 and 4.5 GHz.

4-17. SIMULTANEOUS AM AND PULSE (Cont'd)

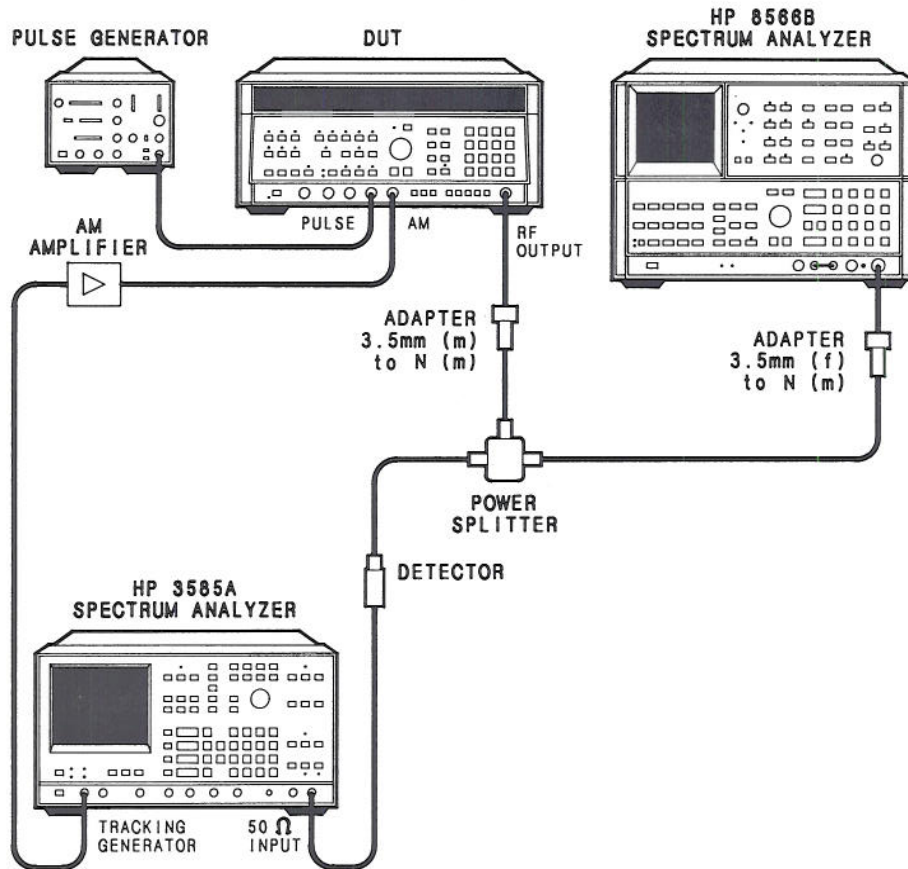


Figure 4-21. Simultaneous AM and Pulse Test Setup

Equipment

Spectrum Analyzer	HP 8566B
Spectrum Analyzer	HP 3585A
Pulse Generator	HP 8012B
Power Splitter	HP 11667A
Detector	HP 8473C
Adapters:	
3.5 mm (f) to Type-N(m)	HP P/N 1250-1744
(2 required)	
SMC(m) to BNC(f)	HP P/N 1250-1200
3.5 mm (m) to 3.5 mm (m)	HP P/N 1250-1748
AM Amplifier	Fabricate, see Table 4-2 (6 of 6)

4-17. SIMULTANEOUS AM AND PULSE (Cont'd)

Procedure

INTERNALLY LEVELED

Steps 1 Through 5 Set The AM Modulation Index To 95%

1. On the HP 3585A, press [INSTR PRESET] [MANUAL] [1] [kHz]. Set the **tracking generator amplitude** knob fully counter-clockwise.
2. On the DUT:
Press [INSTR PRESET]; [PEAK]
[CW] [1] [GHz]
[POWER LEVEL] [1] [0] [dB(m)]
3. On the HP 8566B:
Press [INSTR PRESET]
[CENTER FREQUENCY] [1] [GHz]
[RES BW] [3] [0] [0] [kHz]
[ENTER dB/DIV] [5] [dB]
[PEAK SEARCH] [MKR→REF LVL]
[FREQUENCY SPAN] [0] [Hz]
[SWEEP TIME] [1] [0] [ms]
4. On the DUT, turn **AM ON**. On the HP 8566B, press [VIDEO] and turn the **LEVEL** knob until the waveform on the display synchronizes.

NOTE

Excessive modulation depth may cause the DUT to squegg (the power output of the DUT will drop). To eliminate this power drop, turn the DUT's RF power OFF and then back ON.

5. Adjust the HP 3585A **TRACKING GENERATOR** to place the lowest part of the waveform 26 dB below the HP 8566B's top horizontal graticule (26 dB below the reference). The AM depth is now set to 95%. The **TRACKING GENERATOR** should not be adjusted again.
6. On the HP 3585A, turn off **AUTORANGE** and **REF LVL TRACK** and activate continuous sweep by pressing [CONT].

7. Set up the pulse generator as follows:

PULSE PERIOD slide switch	as desired
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5.0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER	fully CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	as desired
TRAILING EDGE control	fully CCW
OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN

4-17. SIMULTANEOUS AM AND PULSE (Cont'd)

8. Set the pulse generator to the desired PRF and pulse width. Set up the HP 3585A as follows:

[STOP FREQUENCY]	PRF/20 (not to exceed 5 kHz)
[START FREQUENCY]	Stop Frequency/10
[RES BW]	Less than or equal to Start frequency/10

NOTE

In the following test, the operator is instructed to press the HP 3585A's **REF LVL** key. This key is actually marked **REF LVL**. Do not press the **REFERENCE LEVEL**, **REF LEVEL VOLT**, or **MKR/REF LVL** keys!

9. On the DUT, turn **PULSE ON**. On the HP 3585A, press **[dB/DIV] [2] [dB]**. Press **[REF LVL]** and adjust the rotary knob until the trace begins on a convenient horizontal graticule. If the **OVERLOAD** light comes on, press **[RANGE]** and the **UP ARROW** key until it goes off.

The HP 3585A marker feature can be used to display a digital readout of the signal's power level at any point on the trace. This power level will be expressed relative to the level at the start frequency.

To do this, press **[MANUAL]**, enter the start frequency (i.e. **[MANUAL] [1] [kHz]**, etc.). Turn **OFFSET** on (if it was already turned on, don't press it again) press **[ENTER OFFSET]** and **[MARKER]**.

Turn the rotary knob. The marker will move along the trace, displaying the relative power level in the upper right-hand corner of the CRT.

10. Press **[CONT]** on the HP 3585A. Select the next PRF and pulse width combination, keeping the **START** sweep, **STOP** sweep, and **RES BW** within the parameters set forth in step 8. Adjust the **REF LVL** as needed so the displayed data is easy to interpret. Adjust **RANGE** if the **OVERLOAD** light comes on.

Repeat this step for all desired PRFs and pulse widths.

NOTE

The HP 3585A's **START** frequency, **STOP** frequency, and **RES BW** does not need to be changed when testing PRFs of 100 kHz and above. One set up for 100 KHz, higher PRFs (at any valid pulse width) may be tested by simply changing the PRF and/or pulse width on the pulse generator while monitoring the flatness of the displayed trace.

SHIFT RF MODE

Steps 11 Through 14 Set The AM Modulation Index To 95%

11. On the HP 3585A, press **[INSTR PRESET] [MANUAL] [1] [kHz]**. Set the **tracking generator amplitude** knob fully counter-clockwise.
12. On the DUT, press **[SHIFT] [RF]**, turn **PULSE OFF**.
13. On the DUT, make sure that **AM** is ON.

4-17. SIMULTANEOUS AM AND PULSE (Cont'd)

NOTE

Excessive modulation depth may cause the DUT to squegg (the power output of the DUT will drop). To eliminate this power drop, turn the DUT's RF power OFF and then back ON.

14. Adjust the HP 3585A **TRACKING GENERATOR** to place the lowest part of the waveform 26 dB below the HP 8566B's top horizontal graticule (26 dB below the reference). The AM depth is now set to 95%. The **TRACKING GENERATOR** should not be adjusted again.
15. On the HP 3585A, turn off **AUTORANGE** and **REF LVL TRACK** and activate continuous sweep by pressing **[CONT]**.

NOTE

When testing amplitude bandwidth in **SHIFT RF** mode, pulse modulation is not necessary. This is because the ALC is in an open loop mode. This lack of feedback makes the amplitude bandwidth a simple function of internal microcircuits' characteristics.

16. Set the HP 3585A up as follows:

Press **[START FREQ] [4] [0] [0] [Hz]**

[STOP FREQ] [5] [0] [kHz]

[dB/DIV] [2] [dB]

[REF LVL] Turn the rotary knob until the trace is on a horizontal graticule.

If the **OVERLOAD** light comes on, press **[RANGE]** and the **UP ARROW** key until it goes off.

The HP 3585A marker feature can be used to display a digital readout of the signal's power level at any point on the trace. This power level will be expressed relative to the level at the start frequency.

To do this, press **[MANUAL] [4] [0] [0] [Hz]**. Turn **OFFSET** on (if it was already turned on, don't press it again) press **[ENTER OFFSET]** and **[MARKER]**.

Turn the rotary knob. The marker will move along the trace, displaying the power level (relative to 400 Hz) in the upper right-hand corner of the CRT. No part of the trace should exceed + 3 dB relative to the level at 400 Hz.

17. Press **[CONT]** on the HP 3585A. Select the next PRF and pulse width combination. Adjust the **REF LVL**, if necessary, so the trace is on a horizontal graticule. Adjust **RANGE** if the **OVERLOAD** light comes on.

Repeat this step for all desired PRFs and pulse widths.

18. Repeat steps 1 through 17 with a carrier frequency of 4.5 GHz.

NOTE

In **SHIFT RF** mode it is very important to readjust the tracking generator output when the carrier frequency is changed. In internally leveled mode, there is little difference in AM depth from one carrier frequency to another. This is not the case in **SHIFT RF** mode, where significant changes in AM depth will occur.

4-18. FM ACCURACY AND FLATNESS

Specification

Table 4-32. Frequency Modulation Specifications

FREQUENCY MODULATION	
Modulation Rate: 50 kHz to 10 MHz (3 dB Bandwidth)	
Peak Deviation:	
Bands 0,1:	The lesser of 10 MHz or 5 x modulation rate
Band 2:	The lesser of 10 MHz or 10 x modulation rate
Band 3:	The lesser of 10 MHz or 15 x modulation rate
Deviation Accuracy (at 100 kHz rate): $\pm 10\%$	
Sensitivity: 1 MHz/V and 10 MHz/V	

FM Accuracy Description

FM accuracy is measured by observing the modulated RF carrier on a spectrum analyzer. When the modulation index (peak deviation divided by modulation rate) is set to exactly 2.404, the power in the carrier will be at zero. This is called a Bessel Null.

Once the carrier has been nulled, the peak deviation is known precisely since the modulation rate is synthesized. Since the peak deviation is known, the FM input voltage can be measured to calculate the FM input sensitivity (1 or 10 MHz/V nominally). The error from nominal is expressed as a percent and is the FM accuracy. This is measured at a 100 kHz rate.

Equipment

Spectrum Analyzer	HP 8566B
Digital Voltmeter	HP 3456A
Function Generator	HP 3325A
Adapters:	
3.5 mm (f) to Type-N(m)	HP P/N 1250-1744
BNC(f) to dual banana	HP P/N 1251-2277
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cables:	
Semi-Rigid, (SMA male to SMA male)	HP P/N 08340-20124
BNC (m) to BNC (m) (2 required)	HP P/N 8120-8140

4-18. FM ACCURACY AND FLATNESS (Cont'd)

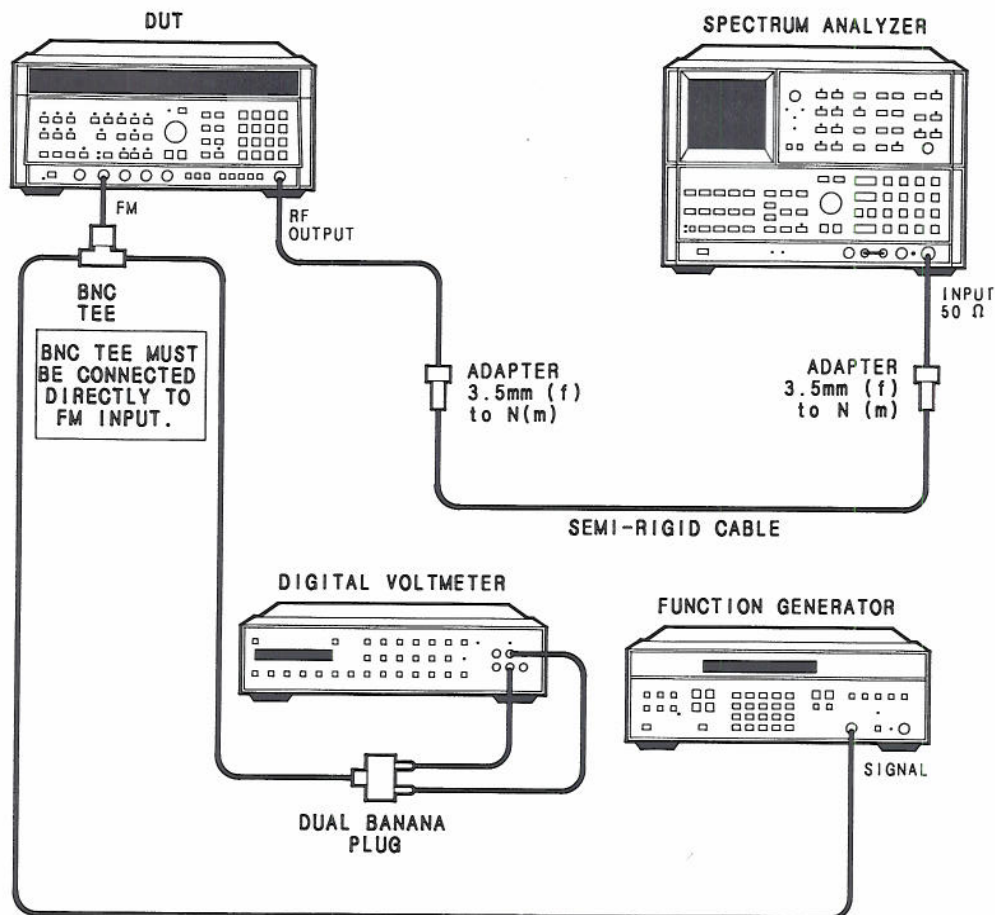


Figure 4-22. FM Accuracy Setup

Procedure

1. Connect the equipment as shown in Figure 4-22, FM Accuracy Setup. The BNC Tee should be connected directly to the DUT's FM input BNC.
2. Set the function generator to a 100 kHz sine wave. Set the DVM to ac volts.
3. Press **[INSTR PRESET]** on the DUT and set up the following conditions:

Sweep Mode:	CW
Frequency out:	2.2 GHz
Leveling:	INT
RF Output:	0 dBm
RF Peaking (PEAK):	ON
FM	ON
FM Sensitivity:	1 MHz/V (default condition)

4-18. FM ACCURACY AND FLATNESS (Cont'd)

4. On the function generator, press AMPTD 450 mV (p-p). Then press the **LEFT ARROW** key until the first digit on the left side of the decimal point is flashing.
5. Set the spectrum analyzer's center frequency to that of the DUT. Choose a frequency span of 2 MHz. Observe the carrier on the display of the spectrum analyzer while performing step 6.
6. Press the function generator's **UP ARROW** or **DOWN ARROW** keys until the carrier is nulled (minimum amplitude). The function generator's **LEFT ARROW** and **RIGHT ARROW** keys will change the resolution of the **UP ARROW** and **DOWN ARROW** keys for a finer or coarser amplitude adjustment.

7. Measure the rms amplitude of the FM input with the DVM. Note this value on the test record card as V_{in} .

Calculate the actual FM sensitivity and then the percent error. Actual deviation is equal to 2.404 times 100 kHz (since the modulation index is at the first Bessel Null). The actual FM sensitivity is then:

$$\text{Actual FM Sensitivity} = (.2404)/(V_{in} \times 1.414)$$

$$\% \text{ Error} = 100 \times (\text{Actual FM Sensitivity} - \text{Range})/\text{Range}$$

Where "Range" = 1 (for 1 MHz/V), or 10 (for 10 MHz/V).

8. Set the function generator's amplitude to 45 mV p-p. Press the DUT's the **UP ARROW** key to select an FM sensitivity of 10 MHz/V. Repeat steps 6 and 7.
9. Repeat steps 4 through 8 at CW frequencies of 2.5, 6.9, 13.4, and 18 GHz. After entering a new CW frequency, press the FM key twice to display the FM sensitivity in the DUT's ENTRY DISPLAY and then press the DUT's **DOWN ARROW** key to select an FM sensitivity of 1 MHz/V.

4-18. FM ACCURACY AND FLATNESS (Cont'd)

FM Flatness Description

The FM Flatness test uses a delay line discriminator. The discriminator is formed by driving a mixer with a modulated carrier into the LO port, and a delayed carrier into the RF port. The delay is produced with a 3 foot length of cable (the length does not have to be precise). When connected like this, the mixer responds to phase differences between its two inputs. The cable exhibits a constant time delay. As the carrier frequency changes, the cable causes a phase shift at the mixer inputs. This phase shift varies linearly with frequency. The mixer only operates as a phase detector when its inputs are 90° out of phase relative to one another (quadrature). A carrier frequency must be chosen such that the cable delay causes a phase shift of 90° (this will be explained in the procedure).

The output of the discriminator is fed to the 50 Ohm input of a spectrum analyzer. By using the tracking generator output to drive the FM input of the DUT, a swept response of FM Flatness will be seen on the spectrum analyzer CRT. The response relative to 100 kHz is verified against the specification.

This test also checks control circuitry on the A23 FM Driver assembly. (That is why FM is checked in bands other than the fundamental band of the YIG oscillator).

Equipment

Spectrum Analyzer	HP 3585A
Mixer	HP P/N 0955-0307
Power Amplifier	HP 8447F
Power Splitter	HP 11667B
Step Attenuator	HP 355D
Delay Line	HP P/N 08503-20038
(> 1 meter in length)	
Adapters:	
3.5 mm (m) to Type-N (m)	HP P/N 1250-1743
3.5 mm (m) to 3.5 mm (m)	HP P/N 1250-1748
SMA (m) to BNC (f)	HP P/N 1250-1200
Cables:	
Semi-Rigid, SMA (m) to SMA (m)	HP P/N 08340-20124
BNC (m) to BNC (m)	HP P/N 8120-8140
(4 required)	

4-18. FM ACCURACY AND FLATNESS (Cont'd)

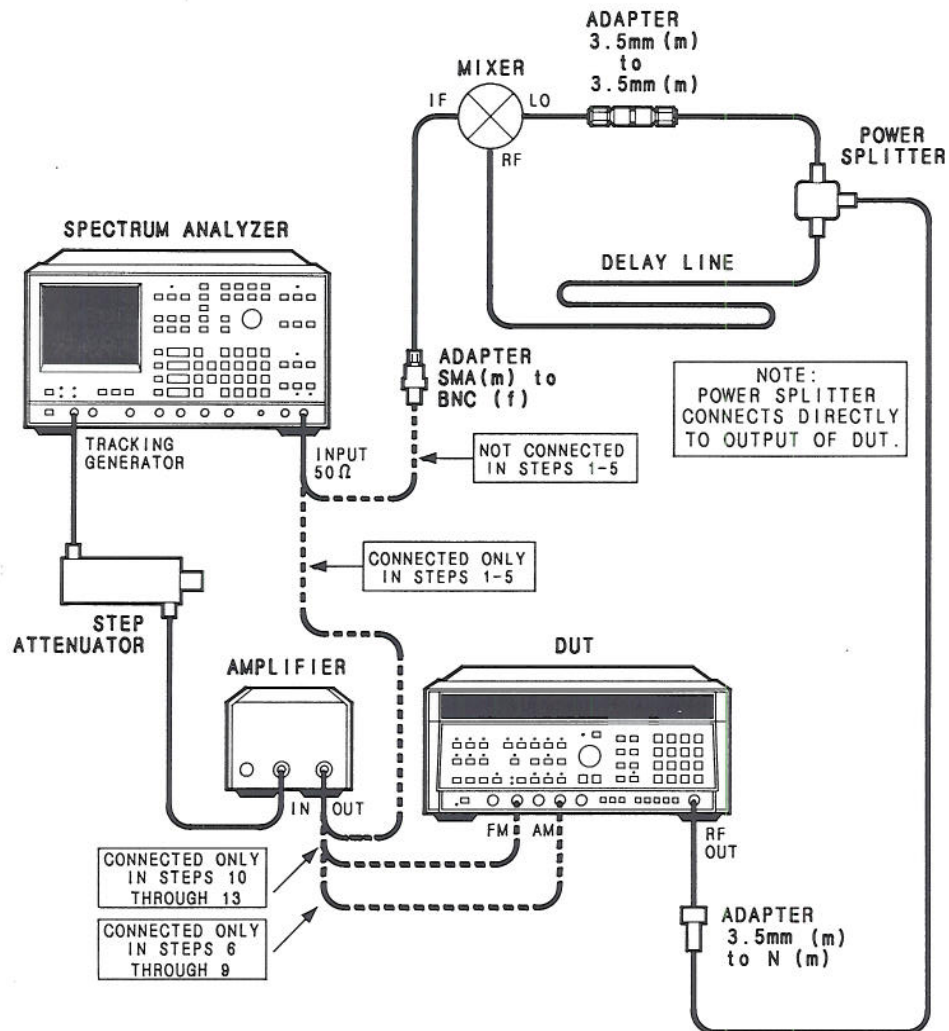


Figure 4-23. FM Flatness Setup

Procedure

1. Refer to Figure 4-23, FM Flatness Setup. Connect the test equipment as shown. Connect the output of the amplifier to the 50 Ohm input of the spectrum analyzer. The spectrum analyzer should not be connected to the mixer at this time.

2. Press **[INSTR PRESET]** on the DUT and set up as follows:

Sweep Mode:	CW
Frequency:	2.2 GHz
PEAK	ON
Leveling:	INT
Power Out:	+6 dBm

Set the step attenuator to 30 dB.

4-18. FM ACCURACY AND FLATNESS (Cont'd)

3. Press **[INSTR PRESET]** on the spectrum analyzer and set up as follows:

Start Frequency:	50 kHz
Stop Frequency:	10 MHz
Resolution BW:	10 kHz (default condition)
Video BW:	1 kHz

Turn the spectrum analyzer's TRACKING GENERATOR knob fully clockwise.

NOTE

Steps 4 and 5 normalize the frequency response variations due to the spectrum analyzer's tracking generator, step attenuator, amplifier, and cables.

4. Set up the spectrum analyzer as follows:

NOTE

In the following text, the operator is instructed to press the **REF LVL** key. This key is actually marked **REF LVL**. Do not press the **REFERENCE LEVEL**, **REF LEVEL VOLT**, or **MKR→REF LVL** keys.

Press **[MANUAL] [1] [MHz] [dB/DIV] [2] [dB]**.

Press **[REF LVL]**. The **[REF LVL]** key is to the left of the rotary knob, in the **MARKER/CONTINUOUS ENTRY** section of the front panel.

Press **[CLEAR A]** and turn the rotary knob until the marker is 5 divisions up from the bottom horizontal graticule.

Make sure the **OVER RANGE** message does not come on. **Turn off the Autorange function.** Adjust the **RANGE** if the **OVER RANGE** message comes on.

5. Press **[CONT]** sweep to take a swept response of the signal path. When a full sweep is completed, press **[STORE A→B]** and **[A-B]**. Turn **VIEW B OFF**.

A straight line should be displayed across the center of the spectrum analyzer CRT.

Press **[SAVE] [1]** on the spectrum analyzer.

NOTE

Steps 6 through 9 find the DUT output frequency that places the mixer inputs in quadrature (90° out of phase).

6. Press **[RECALL] [1]** on the spectrum analyzer. Make sure the DUT is set to the desired CW frequency. Move the output of the HP 8447F to the DUT's AM input. Connect the output of the mixer to the spectrum analyzer 50 Ohm input.

7. AM is used to find a quadrature frequency that is close to the desired FM flatness test frequency. This is done because at quadrature, AM is rejected and FM response is maximized.

On the DUT, turn **AM ON**. Make sure **FM** is turned **OFF**.

8. Set up the spectrum analyzer as follows:

Turn **A-B OFF**. Press **[dB/DIV] [1] [0] [dB] [MANUAL] [1] [0] [0] [kHz]**. Press **[CLEAR A]**.

4-18. FM ACCURACY AND FLATNESS (Cont'd)

9. Press **[SHIFT] [CW]** on the DUT. Note the CW frequency shown in the **ENTRY DISPLAY**. This activates the fine tuning feature on the DUT. The CW frequency will be displayed in the DUT's **ENTRY DISPLAY**. Take note of the flashing cursor in the **ENTRY DISPLAY**. Press the **STEP UP** or **STEP DOWN** keys to place the flashing cursor just to the left of the decimal point. Turn the DUT's rotary knob (changing the CW frequency) until the marker on the spectrum analyzer's CRT dips. (It is normal for a spurious signal to be displayed below the actual marker. Keep turning the DUT's knob until the **marker** dips.)

Press the **STEP UP** key twice. Turn the DUT's rotary knob until the marker on the spectrum analyzer reaches minimum amplitude. This should be possible every 75 MHz or so due to the length of the delay line.

NOTE

Step 15 will instruct the operator to set the DUT's FM sensitivity to 10 MHz/V when performing step 10. If the step attenuator has not been set to 50 dB, the DUT's OVERMOD light will come on.

10. Move the output of the amplifier to the DUT's FM input. Turn **FM ON** and **AM OFF**. Verify that the DUT's FM sensitivity is set to 1 MHz/V (default condition).
11. Set the spectrum analyzer to 2 dB/DIV and turn **A-B** back ON. Press **[CLEAR A]**. Press **[REF LVL]** and turn the spectrum analyzer's rotary knob (usually counter-clockwise) until the marker is on the center horizontal graticule. **If the OVER RANGE beep and message occur, turn the rotary knob in the opposite direction.** Don't be concerned if the marker does not move at first, it may take several complete turns of the rotary knob before any change is noticed on the CRT.
12. Press **[CONT]** sweep on the spectrum analyzer. **The spectrum analyzer will now display the FM flatness from 50 kHz to 10 MHz.**

The spectrum analyzer's marker offset feature can be used to display a digital readout of the signal power level. The readout will be expressed relative to the power level at 100 kHz. To activate this feature, press the following keys on the spectrum analyzer:

[MANUAL] [1] [0] [0] [kHz] [OFFSET] [ENTER OFFSET] [MARKER]

The power level at any chosen frequency between 50 kHz and 10 MHz (relative to the 100 kHz power level) will be displayed in the upper right hand corner of the CRT. Turn the spectrum analyzer's rotary knob to change the measurement frequency.

13. Determine the maximum and minimum deviation points from the 100 kHz reference. The difference between these points should be ≤ 3 dB. Record the worst case power level on the Test Record Card.
14. Repeat Steps 6 through 13 for frequencies of 2.5, 6.9, 13.4, and 18 GHz.
15. Repeat Steps 6 through 14 with the step attenuator set to 50 dB. When repeating step 10, set the FM sensitivity to 10 MHz/V, not 1 MHz/V.

4-19. HP-IB OPERATION VERIFICATION TEST

NOTE

This HP-IB test is an automated test; a Desktop Computer is required.

Two software listings are supplied. Table 4-34 gives a BASIC program listing for the HP 85F; Table 4-35 gives a BASIC program listing for the HP 9826A (HP 226) or 9836A (HP 236). The test procedure applies to either test program used.

Description

The test program given in Table 4-34 is written to verify the HP 8340A HP-IB interface by writing to and reading from the instrument. The program also displays the DUT's status bytes similar to the format shown in Table 4-33, HP 8340A Status Byte Descriptions. Upon running the program the status bits displayed will change initially as the program outputs an IP (INSTR PRESET), S2 (Single sweep), and two TS (Take Sweep) commands. After about two passes through the output loop (program lines 120 to 300 for the HP 85F, program lines 130 to 350 for the HP 9826A/9836A), the status bits should all be zeros and the DUT should be in LOCAL mode. The procedure instructs the operator to press specific DUT front panel keys and perform certain functions which should set specific bits of the status bytes. This procedure will test most of the bits in the two status bytes. However, if the instrument is working properly, the status bit for the Fault Indicator On, the Oven Cold, and the Self Test Failed will not be tested for the set state. By pressing a controller soft key, the program will test the data bits by outputting a series of binary numbers to the DUT and reading back each number that it outputs. If a bit is held HIGH or LOW, the number read will not agree with the number written and the program will display an error message. This procedure does not test all of the HP-IB control lines.

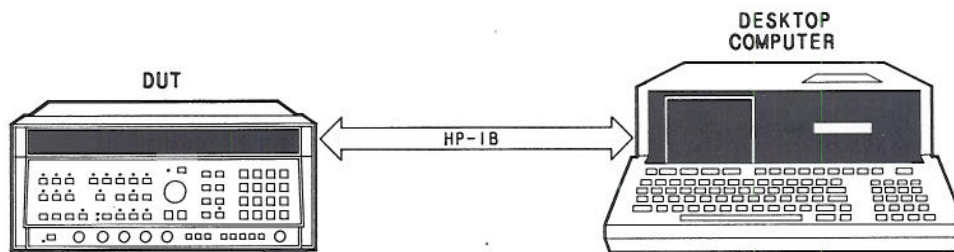


Figure 4-24. HP 8340A Option H02 HP-IB Operation and Verification Test Setup

Equipment

Desktop Computer	HP 85F
(Includes HP 82937A HP-IB Interface and	
I/O ROM HP P/N 00085-15002 and	
HP 82936 ROM Drawer)	
Plotter/Printer ROM	HP P/N 00085-15002
or	
Desktop Computer	HP 9826A(HP 226)/9836A(HP 236)
(With BASIC language and 512K byte memory)	

4-19. HP-IB OPERATION VERIFICATION TEST (Cont'd)

Procedure

1. Connect the equipment as shown in Figure 4-24. Enter the program shown in Table 4-34 if the HP 85F is used, or the program in Table 4-35 if the HP 9826A or 9836A is used. Press the RUN key. The program will display the DUT's status bytes similar to Table 4-33. After the program goes through the output loop routine about two times, all status bits should be "0" and the DUT should be in LOCAL mode (front panel REMOTE indicator not ON).
2. Press the DUT's **[INSTR PRESET]** key. After going through the output loop about three times, status byte 1 decimal value should be 24 (bits 4 and 3 set).

NOTE

After pressing a DUT front panel key, watch the displayed decimal value. When the decimal value changes, press the controller PAUSE key. Note the status bits that are set and press CONT.

3. Press the DUT's **[CW]** key. After the program goes through the output loop about three times all status bits should be "0"; however, status byte 1, bit 1, should have been set during one of the output loop passes. Enter **[1] [5] [GHz]** and the byte 1 status bits will change, but after about 2 passes all status bits should be "0".
5. Switch the DUT's rear panel FREQUENCY REFERENCE switch to EXT. Status byte 2 value should be 24 (bits 4 and 3 set). Return the switch to INT.
6. Press the controller softkey K1 (SYNTAX).

NOTE

There will be about a 6 second delay before the status bits change.

The program will output the character string "XYZ" to the DUT. The DUT should not recognize this string and should set status byte 1, bit 5 (SRQ on HP-IB Syntax Error).

7. Press the controller softkey K4 (DATA BIT). The program will test all data bits and display an error message if any bits fail the test, or if all bits pass the test, the program will display "ALL DATA BITS WORKING."

4-19. HP 8340A Option H02 HP-IB OPERATION VERIFICATION TEST (Cont'd)

Table 4-33. Status Byte Description

STATUS BYTE (#1)								
BIT #	7	6	5	4	3	2	1	0
DECIMAL VALUE	128	64	32	16	8	4	2	1
FUNCTION	SRQ on New frequencies or Sweep Time in Effect	REQUEST SERVICE (RQS)	SRQ on HP-IB Syntax Error	SRQ on End of Sweep	SRQ on RF Settled	SRQ on Changed in Extended Status Byte	SRQ on Numeric Entry Completed (HP-IB or Front Panel)	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	7	6	5	4	3	2	1	0
DECIMAL VALUE	128	64 (L)	32 (L)	16 (L)	8	4	2 (L)	1
FUNCTION	Fault Indicator On	RF Unleveled	Power Failure	RF Unlocked	External Freq. Ref. Selected	Oven Cold	Over Modulation	Self Test Failed
(L) See Note 1								

1. When an interruption occurs, this information is sent to the controller. With a priority pre-determined in the software, the controller will read the Status of the HP 8340/41. Thus the controller does respond instantaneously to the Service Request. During this delay, the cause of the SRQ may have disappeared. To avoid having the controller get an SRQ with "no information" on some functions of the extended status byte, the bit corresponding to the function requiring the service is latched, even if the cause of the SRQ disappears before the controller has read the extended status byte. These functions are: overmodulation (bit 1), RF unlocked (bit 4), power failure (bit 5) and RF unleveled (bit 6). Refer to *HP-IB Programming Note, Introductory Operating Guide*, found in Volume 1 of this manual, for a complete explanation.

Table 4-34. HP 8340A Option H02 HP-IB Operation Verification Programming Listing (For Use with HP 85F)

```

10  ! HP 8340A HP-IB OPERATION VERIFICATION
20  !   VERIFICATION TEST
30  !
40  !       15 MARCH 86
50  !
60  I1=719
70  OUTPUT I1;"IP S2 TSTS"
80  !
90  ON KEY# 1,"SYNTAX" GOSUB 370
100 ON KEY# 4,DATA BIT GOSUB 400
110 LOCAL 7
120 OUTPUT I1;"DS"
130 DISP "HP 8340A STATUS BYTE 1 AND 2"
140 DISP
150 DISP "BYTE-----BIT-----"
160 DISP "# 7 6 5 4 3 2 1 0 VALUE"
170 DISP "-----"
180 DISP
190 ENTER I1 USING "#,B" ; E,F
200 FOR I=1 TO 2
210 DISP I;
220 IF I=1 THEN N=E
230 IF I=2 THEN N=F
240 FOR J=7 TO 0 STEP -1
250 A=BIT(N,J)
260 DISP A;
270 NEXT J
280 DISP N
290 DISP
300 NEXT I
310 DISP USING "4/,A" ; " "
320 KEY LABEL
330 GOTO 120
340 !
350 !   Syntax Test
360 !
370 OUTPUT I1;"XYZ"
380 RETURN
390 !
400 !   Test Data Bits
410 !
420 CLEAR
430 DSP USNG "/",K" ; "TEST DATA BITS"
440 FOR C=0 TO 7
450 B=2^C
460 OUTPUT I1 USING "K,B" , "TI",B
470 WAIT 100
480 ENTER I1 USING "#,B" , D
490 IFB#D THEN DISP " DATA BIT";C;"NOT WORKING"
500 NEXT C
510 DISP "ALL DATA BITS WORKING"
520 DISP "PRESS CONT"
530 PAUSE
540 RETURN
550 END

```


Table 4-35. HP-IB Operation Verification Programming Listing (For Use with HP 9826A/36A)

```

10      ! HP 8340A HP-IB OPERATION
20      !   VERIFICATION TEST
30      !
40      !       15 MARCH 86
50      !
60      I1=719
70      OUTPUT I1;"IP S2 TSTS"
80      !
90      OFF KEY
100     ON KEY 1 LABEL "SYNTAX" GOTO Syntax
110     ON KEY 4 LABEL "DATA BIT" GOTO Data__bit
120     LOCAL 7
130     OUTPUT 1; CHR$(12);
140     !
150 Read__status: !
160     OUTPUT I1;"OS"
170     !
180     PRINT TABXY(1,1);"HP 8340A STATUS BYTE 1 AND 2"
190     PRINT
200     PRINT "BYTE_____BIT_____ "
210     PRINT "# 7 6 5 4 3 2 1 0 VALUE"
220     PRINT "-----"
230     PRINT
240     ENTER I1 USING "#,B";E,F
250     FOR I=1 TO 2
260         PRINT I;
270         IF I=1 THEN N=E
280         IF I=2 THEN N=F
290         FOR J=7 TO 0 STEP -1
300             A=BIT(N,J)
310             PRINT A;
320         NEXT J
330         PRINT USING "X,5D";N
340         PRINT
350     NEXT I
360     BEEP 200,.01
370     GOTO Read__status
380     !
390 Syntax: !
400     !
410     OUTPUT I1;"XYZ"
420     GOTO Read__status
430     !
440 Data__bit: !
450     !
460     OUTPUT 1; CHR$(12); ! Clear screen
470     DISP USING "/,K";   TEST DATA BITS"
480     FOR C=0 TO 7
490         B=2^C
500         OUTPUT I1 USING "K,B";"TI",B
510         WAIT .1
520         ENTER I1 USING "#,B";D
530         IF B-D<1 THEN GOTO 550
540         IF B<>D THEN DISP " DATA BIT  ";C;;NOT WORKING"
550     NEXT C
560     !
570     PRINT "ALL DATA BITS WORKING"
580     DISP "PRESS CONTINUE"
590     PAUSE
600     DISP
610     GOTO Read__status
620     END

```

HP 8340A Option H02 Test Record Card (1 of 41)

**Hewlett-Packard Model 8340A Option H02
Synthesized Sweepers**

Date: _____

Model Number: _____

Serial Number: _____

Tested By: _____

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-1. Internal Time Base Aging Rate					
T_1 = Time for 360 degree phase change	3			_____ seconds	
T_2 = Time between T_1 and T_3	4			_____ hours	
T_3 = Time for 360 degree phase change				_____ seconds	
Calculated Aging Rate	5			_____ per day	

HP 8340A Option H02 Test Record Card (2 of 41)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy					
Frequency Range Check					
10 MHz	2	Freq. ± 1 Hz $\pm$ Counter Resolution		_____ MHz	
20.0 GHz	3	Freq. ± 3 Hz $\pm$ Counter Resolution		_____ GHz	
M/N Divider Check (M Divider)	4b	Freq. ± 1 Hz $\pm$ Counter Resolution			
M = 8 N = 13		2490 MHz		_____ MHz	
9		2480 MHz		_____ MHz	
10		2470 MHz		_____ MHz	
11		2460 MHz		_____ MHz	
12		2450 MHz		_____ MHz	
13		2440 MHz		_____ MHz	
14		2430 MHz		_____ MHz	
15		2420 MHz		_____ MHz	
16		2410 MHz		_____ MHz	
17		2400 MHz		_____ MHz	
18		2390 MHz		_____ MHz	
19		2380 MHz		_____ MHz	
20		2370 MHz		_____ MHz	
21		2360 MHz		_____ MHz	
22		2350 MHz		_____ MHz	
23		2340 MHz		_____ MHz	
24		2330 MHz		_____ MHz	
25		2320 MHz		_____ MHz	
26		2310 MHz		_____ MHz	
27		2300 MHz		_____ MHz	

HP 8340A Option H02 Test Record Card (3 of 41)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd)					
M/N Divider Check (N Divider)	5b	Freq. ± 1 Hz $\pm$ Counter Resolution			
M = 27 N = 13		2300 MHz		_____ MHz	
14		2500 MHz		_____ MHz	
15		2700 MHz		_____ MHz	
16		2900 MHz		_____ MHz	
17		3100 MHz		_____ MHz	
18		3300 MHz		_____ MHz	
19		3500 MHz		_____ MHz	
20		3700 MHz		_____ MHz	
21		3900 MHz		_____ MHz	
22		4100 MHz		_____ MHz	
23		4300 MHz		_____ MHz	
24		4500 MHz		_____ MHz	
25		4700 MHz		_____ MHz	
26		4900 MHz		_____ MHz	
27		5100 MHz		_____ MHz	
28		5300 MHz		_____ MHz	
29		5500 MHz		_____ MHz	
30		5700 MHz		_____ MHz	
31		5900 MHz		_____ MHz	
32		6100 MHz		_____ MHz	
33		6300 MHz		_____ MHz	
34		6500 MHz		_____ MHz	
35		6700 MHz		_____ MHz	
36		6900 MHz		_____ MHz	

HP 8340A Option H02 Test Record Card (4 of 41)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd)					
20-30 Loop Check (N2 Divider)					
DUT ENTRY DISPLAY		DUT START Frequency			
CF Frequency:		Freq. ± 1 Hz $\pm$ Counter			
		Resolution			
2.310500 GHz	6b	2.310000 GHz		_____ GHz	
2.310501	6c	2.310001		_____ GHz	
2.310502		2.310002		_____ GHz	
2.310503		2.310003		_____ GHz	
2.310504		2.310004		_____ GHz	
2.310505		2.310005		_____ GHz	
2.310506		2.310006		_____ GHz	
2.310507		2.310007		_____ GHz	
2.310508		2.310008		_____ GHz	
2.310509		2.310009		_____ GHz	
2.310510		2.310010		_____ GHz	
2.310510	6d	2.310010		_____ GHz	
2.310520	6e	2.310020		_____ GHz	
2.310530		2.310030		_____ GHz	
2.310540		2.310040		_____ GHz	
2.310550		2.310050		_____ GHz	
2.310560		2.310060		_____ GHz	
2.310570		2.310070		_____ GHz	
2.310580		2.310080		_____ GHz	
2.310590		2.310090		_____ GHz	
2.310600		2.310100		_____ GHz	
2.310600	6f	2.310100		_____ GHz	
2.310700	6g	2.310200		_____ GHz	
2.310800		2.310300		_____ GHz	
2.310900		2.310400		_____ GHz	
2.311000		2.310500		_____ GHz	
2.311100		2.310600		_____ GHz	
2.311200		2.310700		_____ GHz	
2.311300		2.310800		_____ GHz	
2.311400		2.310900		_____ GHz	
2.311500		2.311000		_____ GHz	
2.311500	6h	2.311000		_____ GHz	
2.312500	6i	2.312000		_____ GHz	
2.313500		2.313000		_____ GHz	
2.314500		2.314000		_____ GHz	
2.315500		2.315000		_____ GHz	
2.316500		2.316000		_____ GHz	
2.317500		2.317000		_____ GHz	
2.318500		2.318000		_____ GHz	
2.319500		2.319000		_____ GHz	
2.320500		2.320000		_____ GHz	

HP 8340A Option H02 Test Record Card (5 of 41)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd) 20-30 Loop Check (N1 Divider) DUT ENTRY DISPLAY CW Frequency:					
2319.97 MHz	7a	Frequency Counter Indicator		_____ MHz	
2319.96	7c	Freq. ± 1 Hz $\pm$ Counter		_____ MHz	
2319.95		Resolution		_____ MHz	
2319.94				_____ MHz	
2319.93				_____ MHz	
2319.92				_____ MHz	
2319.91				_____ MHz	
2319.90				_____ GHz	
2319.89				_____ MHz	
2319.88				_____ MHz	
2319.87				_____ MHz	
2319.87	7d			_____ MHz	
2319.77	7e			_____ MHz	
2319.67				_____ MHz	
2319.57				_____ MHz	
2319.47				_____ MHz	
2319.37				_____ MHz	
2319.27				_____ MHz	
2319.17				_____ MHz	
2319.07				_____ MHz	
2318.97				_____ MHz	
2318.97	7f			_____ MHz	
2317.97	7g			_____ MHz	
2316.97				_____ MHz	
2315.97				_____ MHz	
2314.97				_____ MHz	
2313.97				_____ MHz	
2312.97				_____ MHz	
2311.97				_____ MHz	
2310.97				_____ MHz	

HP 8340A Option H02 Test Record Card (6 of 41)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-3. Sweep Time Accuracy 10 milliseconds 100 milliseconds 1 second 10 seconds 50 seconds	4		9.5 ms 95 ms 0.95 s 9.5 s 47.5 s	_____ ms _____ ms _____ s _____ s _____ s	10.5 ms 105 ms 1.05 s 10.5 s 52.5 s

HP 8340A Option H02 Test Record Card (7 of 41)

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy 20% of Band Accuracy		8					
DUT Start Freq. (GHz)	DUT Stop Freq. (GHz)		20% of Band	Test Limit (kHz)	Spectrum Analyzer Center Freq. (GHz)	Spectrum Analyzer Center Freq. GHz	Spectrum Analyzer Center Freq. (GHz)
2.3	2.300099		2.3000198	± 0.99	2.30001881	_____	2.30002079
2.3	2.300101		2.3000202	± 1.01	2.30001919	_____	2.30002121
2.3	2.300499		2.3000998	± 4.99	2.30009481	_____	2.30010479
2.3	2.300501		2.3001002	± 5.01	2.30009519	_____	2.30010521
2.3	2.30499		2.300998	± 49.9	2.3009481	_____	2.3010479
2.3	2.30501		2.301002	± 100.02	2.30090198	_____	2.30110202
2.3	2.31		2.302	± 200	2.3018	_____	2.3022
2.3	2.32		2.304	± 400	2.3036	_____	2.3044
2.3	2.33		2.306	± 600	2.3054	_____	2.3066
2.3	2.34		2.308	± 800	2.3072	_____	2.3088
2.3	2.349		2.3098	± 998	2.308802	_____	2.310798
2.3	2.3501		2.31002	± 1020	2.309	_____	2.31104
2.3	2.36		2.312	± 1200	2.3108	_____	2.3132
2.3	2.37		2.314	± 1400	2.3126	_____	2.3154
2.3	2.38		2.316	± 1600	2.3144	_____	2.3176
2.3	2.39		2.318	± 1800	2.3162	_____	2.3198
2.3	2.3999		2.31998	± 1980	2.318	_____	2.32196
2.3	2.4001		2.32002	± 2002	2.318018	_____	2.322022
2.3	2.799		2.3998	± 4990	2.39481	_____	2.40479
2.3	2.801		2.4002	± 5010	2.39519	_____	2.40521
2.3	7.29		3.298	± 49900	3.2481	_____	3.3479
2.3	7.31		3.302	± 50000	3.352	_____	3.352
2.3	8.3		3.500	± 50000	3.45	_____	3.55
2.3	16.452		5.1304	± 50000	5.0804	_____	5.1804
2.3	20.0		5.84	± 50000	5.79	_____	5.89

HP 8340A Option H02 Test Record Card (8 of 41)

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy (Cont'd) 50% of Band Accuracy		8					
DUT Start Freq. (GHz)	DUT Stop Freq. (GHz)		50% of Band	Test Limit (kHz)	Spectrum Analyzer Center Freq. (GHz)	Spectrum Analyzer Center Freq. GHz	Spectrum Analyzer Center Freq. (GHz)
2.3	2.300099		2.3000495	± 0.99	2.30004851	_____	2.30005049
2.3	2.300101		2.3000505	± 1.01	2.30004949	_____	2.30005151
2.3	2.300499		2.3002495	± 4.99	2.30024451	_____	2.30025449
2.3	2.300501		2.3002505	± 5.01	2.30024549	_____	2.30025551
2.3	2.30499		2.302495	± 49.9	2.3024451	_____	2.3025449
2.3	2.30501		2.302505	± 100.02	2.30240498	_____	2.30260502
2.3	2.31		2.305	± 200	2.3048	_____	2.3052
2.3	2.32		2.310	± 400	2.3096	_____	2.3104
2.3	2.33		2.315	± 600	2.3144	_____	2.3156
2.3	2.34		2.320	± 800	2.3192	_____	2.3208
2.3	2.349		2.3245	± 998	2.323502	_____	2.325498
2.3	2.3501		2.32505	± 1020	2.32403	_____	2.32607
2.3	2.36		2.33	± 1200	2.3288	_____	2.3312
2.3	2.37		2.335	± 1400	2.3336	_____	2.3364
2.3	2.38		2.34	± 1600	2.3384	_____	2.3416
2.3	2.39		2.345	± 1800	2.3432	_____	2.3468
2.3	2.3999		2.34995	± 1980	2.34797	_____	2.35193
2.3	2.4001		2.35005	± 2002	2.348048	_____	2.352052
2.3	2.799		2.5495	± 4990	2.54451	_____	2.55449
2.3	2.801		2.5505	± 5010	2.54549	_____	2.55551
2.3	7.29		4.795	± 49900	4.7451	_____	4.8449
2.3	7.31		4.805	± 50000	4.755	_____	4.855
2.3	8.3		5.300	± 50000	5.250	_____	5.350
2.3	16.452		9.376	± 50000	9.326	_____	9.426
2.3	20.0		11.15	± 50000	11.1	_____	11.2

HP 8340A Option H02 Test Record Card (9 of 41)

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy (Cont'd) 80% of Band Accuracy		8					
DUT Start Freq. (GHz)	DUT Stop Freq. (GHz)		80% of Band	Test Limit (kHz)	Spectrum Analyzer Center Freq. (GHz)	Spectrum Analyzer Center Freq. GHz	Spectrum Analyzer Center Freq. (GHz)
2.3	2.300099		2.3000792	± 0.99	2.30007821	_____	2.30008019
2.3	2.300101		2.300808	± 1.01	2.30007979	_____	2.30008181
2.3	2.300499		2.3003992	± 4.99	2.30039421	_____	2.30040419
2.3	2.300501		2.3004008	± 5.01	2.30039579	_____	2.30040581
2.3	2.30499		2.303992	± 49.9	2.3039421	_____	2.3040419
2.3	2.30501		2.304008	± 100.02	2.30390798	_____	2.3041802
2.3	2.31		2.308	± 200	2.3078	_____	2.3082
2.3	2.32		2.316	± 400	2.3156	_____	2.3164
2.3	2.33		2.324	± 600	2.3234	_____	2.3246
2.3	2.34		2.332	± 800	2.3312	_____	2.3328
2.3	2.349		2.3392	± 998	2.338202	_____	2.340198
2.3	2.3501		2.34008	± 1020	2.33906	_____	2.3411
2.3	2.36		2.348	± 1200	2.3468	_____	2.3492
2.3	2.37		2.356	± 1400	2.3546	_____	2.3574
2.3	2.38		2.364	± 1600	2.3624	_____	2.3656
2.3	2.39		2.372	± 1800	2.3702	_____	2.3738
2.3	2.3999		2.37992	± 1980	2.37794	_____	2.3819
2.3	2.4001		2.38008	± 2002	2.378078	_____	2.382082
2.3	2.799		2.6992	± 4990	2.69421	_____	2.70419
2.3	2.801		2.7008	± 5010	2.69579	_____	2.70581
2.3	7.29		6.292	± 49900	6.2421	_____	6.3419
2.3	7.31		6.308	± 50000	6.258	_____	6.358
2.3	8.3		7.1	± 50000	7.05	_____	7.15
2.3	16.452		13.6216	± 50000	13.5716	_____	13.6716
2.3	20.0		14.16	± 50000	14.11	_____	14.21

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy					
Maximum Leveled Power					
NON-Swept Operation					
PEAK ON					
Band 0	4	MANUAL Mode	+ 10 dBm	_____ dBm	
Band 1	4		+ 10 dBm	_____ dBm	
Band 2	4		+ 10 dBm	_____ dBm	
Band 3 (<18.6 GHz)	4		+ 10 dBm	_____ dBm	
Band 3 ($\geq$ 18.6 GHz)	4		+ 7 dBm	_____ dBm	
PEAK OFF					
Band 0	4	MANUAL Mode	+ 9 dBm	_____ dBm	
Band 1	4		+ 9 dBm	_____ dBm	
Band 2	4		+ 9 dBm	_____ dBm	
Band 3 (<18.6 GHz)	4		+ 9 dBm	_____ dBm	
Band 3 ($\geq$ 18.6 GHz)	4		+ 6 dBm	_____ dBm	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd) Maximum Leveled Power Broad Band Swept Operation Deviation > 100 MHz Band 0 ENTRY DISPLAY Power Indication Lowest power level recorded in step 9 or 10 Minimum Power Frequency Power Meter Indication Maximum Leveled Power Band 1 ENTRY DISPLAY Power Indication Lowest power level recorded in step 9 or 10 Minimum Power Frequency Power Meter Indication	9	Continuous Sweep, Auto Sweep Time		_____ dBm	
	10	Single Sweep, 0.5 Second Sweep Time		_____ dBm	
	11			_____ dBm	
		Amplitude Marker Frequency		_____ GHz	
	12	Standard Instrument	+ 8 dBm ¹	_____ dBm	
	9	Continuous Sweep, Auto Sweep Time		_____ dBm	
	10	Single Sweep, 0.5 Second Sweep Time		_____ dBm	
	11			_____ dBm	
		Amplitude Marker Frequency		_____ GHz	
	12	Standard Instrument	+ 8 dBm ¹	_____ dBm	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Maximum Leveled Power Broad Band Swept Operation Deviation > 100 MHz					
Band 2					
ENTRY DISPLAY Power Indication	9	Continuous Sweep, Auto Sweep Time		_____ dBm	
	10	Single Sweep, 0.5 Second Sweep Time		_____ dBm	
Lowest power level recorded in step 9 or 10	11			_____ dBm	
Minimum Power Frequency		Amplitude Marker Frequency		_____ GHz	
Power Meter Indication	12	Standard Instrument	+ 8 dBm ¹	_____ dBm	
Maximum Leveled Power Band 3 (up to 18.6 GHz)					
ENTRY DISPLAY Power Indication	9	Continuous Sweep, Auto Sweep Time		_____ dBm	
	10	Single Sweep, 0.5 Second Sweep Time		_____ dBm	
Lowest power level recorded in step 9 or 10	11			_____ dBm	
Minimum Power Frequency		Amplitude Marker Frequency		_____ GHz	
Power Meter Indication	12	Standard Instrument	+ 8 dBm ¹	_____ dBm	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Maximum Leveled Power Broad Band Swept Operation Deviation > 100 MHz Band 3 (18.6 GHz and above) ENTRY DISPLAY Power Indication	9	Continuous Sweep, Auto Sweep Time		_____ dBm	
	10	Single Sweep, 0.5 Second Sweep Time		_____ dBm	
Lower power level recorded in step 9 or 10	11			_____ dBm	
Minimum Power Frequency		Amplitude Marker Frequency		_____ GHz	
Power Meter Indication	12	Standard Instrument	+5 dBm ²	_____ dBm	

1. If the DUT's maximum leveled power is greater than or equal to + 9 dBm, then it has met narrow deviation specifications. Steps 14 through 19 may be ignored for the band tested.
2. If the DUT's maximum leveled power is greater than or equal to +6 dBm, then it has met narrow deviation specifications. Steps 14 through 19 may be ignored for the band tested.

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd) Maximum Leveled Power Swept Operation Deviation ≤ 100 MHz Band _____ Minimum Power Frequency	17	NOTE This test record page need not be completed if DUT passed narrow band (≤ 100 MHz) performance specifications when in broad band (> 100 MHz) sweeps (steps 7 through 13). Center Frequency Maximum Leveled Power Specification (Refer to Table 1-1 or 1-2) Pass/Fail	_____ ✓	_____ GHz _____ dBm	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Flatness					
Band 0 Measurement					
Minimum Power Frequency	24	M2 Frequency		_____ GHz	
Minimum Power Level	25	M2 Power Level		_____ dBm	
Maximum Power Frequency	26	M1 Frequency		_____ GHz	
Maximum Power Level		M1 Power Level		_____ dBm	
Band 1 Measurement					
Minimum Power Frequency	24	M2 Frequency		_____ GHz	
Minimum Power Level	25	M2 Power Level		_____ dBm	
Maximum Power Frequency	26	M1 Frequency		_____ GHz	
Maximum Power Level		M1 Power Level		_____ dBm	
Band 2 Measurement					
Minimum Power Frequency	24	M2 Frequency		_____ GHz	
Minimum Power Level	25	M2 Power Level		_____ dBm	
Maximum Power Frequency	26	M1 Frequency		_____ GHz	
Maximum Power Level		M1 Power Level		_____ dBm	
Band 3 Measurement					
Minimum Power Frequency	24	M2 Frequency		_____ GHz	
Minimum Power Level	25	M2 Power Level		_____ dBm	
Maximum Power Frequency	26	M1 Frequency		_____ GHz	
Maximum Power Level		M1 Power Level		_____ dBm	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)	29				
Flatness (Maximum minus Minimum Calculations)					
Band 0 Calculation		≤ 1.2 dB		_____ dB	
Band 1 Calculation		≤ 2.2 dB		_____ dB	
Band 2 Calculation		≤ 2.2 dB		_____ dB	
Band 3 Calculation		≤ 2.2 dB		_____ dB	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-6. External Leveling		(Using Negative Crystal Detector)			
Leveling Voltage (dBv)					
+6	3		-1.883 V	_____ V	-2.114 V
0			-0.944 V	_____ V	-1.059 V
-10			-0.2983 V	_____ V	-0.3352 V
-20			-0.0942 V	_____ V	-0.1061 V
-30			-29.65 mV	_____ mV	-33.70 mV
-40			-9.24 mV	_____ mV	-10.79 mV
-50			-2.785 mV	_____ mV	-3.550 mV
-60			-0.744 mV	_____ mV	-1.259 mV
-66			-0.273 mV	_____ mV	-0.731 mV

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-7. Spurious Signals 10 MHz to 20 GHz Frequency of Interest Selected	4	Refer to Table 4-16 for Specifications			
	6				

NOTE

Test 4-8 has been omitted.

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-9. Single Sideband Phase Noise from Steps 11 through 38 (Using Tables 4-19, 4-20, and 4-22)	38				
2.202 GHz					
Offset = 30 Hz				_____ dBc	< -64 dBc
100 Hz				_____ dBc	< -70 dBc
1 kHz				_____ dBc	< -78 dBc
10 kHz				_____ dBc	< -86 dBc
100 kHz				_____ dBc	< -107 dBc
6.902 GHz					
Offset = 30 Hz				_____ dBc	< -64 dBc
100 Hz				_____ dBc	< -70 dBc
1 kHz				_____ dBc	< -78 dBc
10 kHz				_____ dBc	< -86 dBc
100 kHz				_____ dBc	< -107 dBc
13.402 GHz					
Offset = 30 Hz				_____ dBc	< -58 dBc
100 Hz				_____ dBc	< -64 dBc
1 kHz				_____ dBc	< -72 dBc
10 kHz				_____ dBc	< -80 dBc
100 kHz				_____ dBc	< -101 dBc
19.502 GHz					
Offset = 30 Hz				_____ dBc	< -54 dBc
100 Hz				_____ dBc	< -60 dBc
1 kHz				_____ dBc	< -68 dBc
10 kHz				_____ dBc	< -76 dBc
100 kHz				_____ dBc	< -97 dBc

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-10. Power Sweep					
1 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥ 20 dB difference	20 dB	_____ dB	
5 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥ 20 dB difference	20 dB	_____ dB	
10 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥ 20 dB difference	20 dB	_____ dB	
15 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥ 20 dB difference	20 dB	_____ dB	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-11. Pulse Modulation ON/ OFF Ratio 1 GHz 3 GHz 9 GHz 15 GHz	4	Δ Amplitude must be > 80 dB	80 dB 80 dB 80 dB 80 dB	_____ dB _____ dB _____ dB _____ dB	
4-12. Pulse Modulation Rise and Fall Time 1 GHz Rise Time Fall Time 3 GHz Rise Time Fall Time 9 GHz Rise Time Fall Time 15 GHz Rise Time Fall Time	6 8 6 8 6 8 6 8			_____ nsec _____ nsec _____ nsec _____ nsec _____ nsec _____ nsec _____ nsec _____ nsec	35 ns 35 ns 35 ns 35 ns 35 ns 25nsec 35 ns 50 ns

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy					
DUT CW Freq. = 50 MHz PRF = 100 kHz					
Pulse Width = 700 ns	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	> -0.3 dB	_____ dB	< +4 dB
Pulse Width = 2 μ s	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	> -0.3 dB	_____ dB	< +1.5 dB
Pulse Width = 5 μ s	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 10 μ s	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Repetition Freq. Range DUT CW Freq. = 50 MHz	10				
Minimum PRF PRF = 100 Hz PW = 1 microsecond	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	> -0.3 dB	_____ dB	< +4 dB
Maximum PRF PRF = 500 kHz PW = 700 nanoseconds	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +4 dB
DUT CW Freq. = 1 GHz PRF = 100 kHz					
Pulse Width = 100 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +3 dB
Pulse Width = 200 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +1.5 dB
Pulse Width = 500 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 1000 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy					
Pulse Repetition Freq. Range DUT CW Freq. = 1 GHz	19				
Minimum PRF PRF = 10 Hz PW = 10 microseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +3 dB
DUT CW Freq. = 3 GHz PRF = 100 kHz					
Pulse Width = 100 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +1.5 dB
Pulse Width = 200 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 500 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 1000 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy (Cont'd)					
Pulse Repetition Freq. Range DUT CW Freq. = 3 GHz	19				
Minimum PRF PRF = 10 Hz PW = 10 microseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +1.5 dB
DUT CW Freq. = 9 GHz PRF = 100 kHz					
Pulse Width = 100 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +1.5 dB
Pulse Width = 200 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 500 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Width = 1000 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Pulse Repetition Freq. Range DUT CW Freq. = 9 GHz	19				
Minimum PRF PRF = 10 Hz PW = 10 microseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	< +1.5 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy (Cont'd)					
DUT CW Freq. = 15 GHz					
PRF = 100 kHz					
Pulse Width = 100 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +1.5$ dB
Pulse Width = 200 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +0.3$ dB
Pulse Width = 500 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +0.3$ dB
Pulse Width = 1000 ns	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +0.3$ dB
Pulse Repetition Freq. Range	10				
DUT CW Freq. = 15 GHz					
Minimum PRF					
PRF = 10 Hz					
PW = 10 microseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +0.3$ dB
Maximum PRF					
PRF = 5 MHz					
PW = 100 nanoseconds	15	ENTRY DISPLAY Power Level		_____ dBm	
	16	ENTRY DISPLAY Power Level		_____ dBm	
	17	Δ Power between steps 15 and 16	> -0.3 dB	_____ dB	$< +1.5$ dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-14. Pulse Modulation Video Feedthrough					
DUT CW Freq. = 0.3 GHz Power Level = 0 dBm	6	Oscilloscope peak voltage		_____ mV	<10mV
DUT CW Freq. = 0.5 GHz Power Level = +8 dBm	7			_____ mV	< 12 mV
0 dBm				_____ mV	<5 mV
-10 dBm				_____ mV	<1.6 mV
DUT CW Freq. = 1 GHz Power Level = +8 dBm	7			_____ mV	<12 mV
0 dBm				_____ mV	<5 mV
-10 dBm				_____ mV	<1.6 mV
DUT CW Freq. = 1.5 GHz Power Level = +8 dBm	7			_____ mV	<12 mV
0 dBm				_____ mV	<5 mV
-10 dBm				_____ mV	<1.6 mV
DUT CW Freq. = 2 GHz Power Level = +8 dBm	7			_____ mV	<12 mV
0 dBm				_____ mV	<5 mV
-10 dBm				_____ mV	<1.6 mV
DUT CW Freq. = >2.3 GHz Power Level = -10 dBm (Any Frequency Selected)	10			_____ mV	<0.2 mV

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-15. Amplitude Modulation					
AM Sensitivity					
DUT Freq. = 1.5 GHz	2				
Power = -5 dBm					
	4	Power Meter Indication		_____ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	_____ dB	<2.38 dB
-30% Modulation	6	Power Meter Change	>2.91 dB	_____ dB	<3.29 dB
DUT Freq. = 1.5 GHz	7				
Power = +5 dBm					
	4	Power Meter Indication		_____ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	_____ dB	<2.38 dB
-30% Modulation	6	Power Meter Change	>2.91 dB	_____ dB	<3.29 dB
DUT Freq. = 4.5 GHz	8				
Power = -5 dBm					
	4	Power Meter Indication		_____ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	_____ dB	<2.38 dB
-30% Modulation	6	Power Meter Change	>2.91 dB	_____ dB	<3.29 dB
DUT Freq. = 4.5 GHz	8				
Power = +5 dBm					
	4	Power Meter Indication		_____ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	_____ dB	<2.38 dB
-30% Modulation	6	Power Meter Change	>2.91 dB	_____ dB	<3.29 dB
DUT Freq. = 1.5 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		_____ dB	$\leq \pm 0.2$ dB
100 Hz	13	Analyzer)		_____ dB	$\leq \pm 0.2$ dB
200 Hz				_____ dB	$\leq \pm 0.2$ dB
500 Hz				_____ dB	$\leq \pm 0.2$ dB
1 kHz				_____ dB	$\leq \pm 0.2$ dB
2 kHz				_____ dB	$\leq \pm 0.2$ dB
5 kHz				_____ dB	$\leq \pm 0.2$ dB
10 kHz				_____ dB	$\leq \pm 0.2$ dB
AM Bandwidth	14	Modulation Analyzer	≥ -3 dB	_____ dB	
Funct. Gen. = 100 kHz		Indication			
Adjust output level to that noted in Step 11					
AM Depth					
Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	_____ %	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-15. Amplitude Modulation (Cont'd)					
DUT Freq. = 3 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		_____ dB	$\leq \pm 0.2$ dB
100 Hz	13	Analyzer)		_____ dB	$\leq \pm 0.2$ dB
200 Hz				_____ dB	$\leq \pm 0.2$ dB
500 Hz				_____ dB	$\leq \pm 0.2$ dB
1 kHz				_____ dB	$\leq \pm 0.2$ dB
2 kHz				_____ dB	$\leq \pm 0.2$ dB
5 kHz				_____ dB	$\leq \pm 0.2$ dB
10 kHz				_____ dB	$\leq \pm 0.2$ dB
AM Bandwidth	14	Modulation Analyzer	≥ -3 dB	_____ dB	
Funct. Gen. = 100 kHz		Indication			
Adjust output level to that noted in Step 11					
AM Depth					
Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	$>90\%$	_____ %	
DUT Freq. = 9 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		_____ dB	$\leq \pm 0.2$ dB
100 Hz	13	Analyzer)		_____ dB	$\leq \pm 0.2$ dB
200 Hz				_____ dB	$\leq \pm 0.2$ dB
500 Hz				_____ dB	$\leq \pm 0.2$ dB
1 kHz				_____ dB	$\leq \pm 0.2$ dB
2 kHz				_____ dB	$\leq \pm 0.2$ dB
5 kHz				_____ dB	$\leq \pm 0.2$ dB
10 kHz				_____ dB	$\leq \pm 0.2$ dB
AM Bandwidth	14	Modulation Analyzer	≥ -3 dB	_____ dB	
Funct. Gen. = 100 kHz		Indication			
Adjust output level to that noted in Step 11					
AM Depth					
Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	$>90\%$	_____ %	
DUT Freq. = 15 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		_____ dB	$\leq \pm 0.2$ dB
100 Hz	13	Analyzer)		_____ dB	$\leq \pm 0.2$ dB
200 Hz				_____ dB	$\leq \pm 0.2$ dB
500 Hz				_____ dB	$\leq \pm 0.2$ dB
1 kHz				_____ dB	$\leq \pm 0.2$ dB
2 kHz				_____ dB	$\leq \pm 0.2$ dB
5 kHz				_____ dB	$\leq \pm 0.2$ dB
10 kHz				_____ dB	$\leq \pm 0.2$ dB
AM Bandwidth	14	Modulation Analyzer	≥ -3 dB	_____ dB	
Funct. Gen. = 100 kHz		Indication			
Adjust output level to that noted in Step 11					
AM Depth					
Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	$>90\%$	_____ %	

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion					
ALC = -4.95 dBm					
AM Depth = 50%					
AM Rate = 20 kHz					
		SHIFT POWER SWEEP Mode			
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion (Cont'd)					
ALC = -4.95 dBm					
AM Depth = 50%					
AM Rate = 50 kHz					
		SHIFT POWER SWEEP Mode			
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion (Cont'd)					
ALC = -4.95 dBm					
AM Depth = 50%					
AM Rate = 100 kHz					
		SHIFT POWER SWEEP Mode			
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion ALC = +5 dBm AM Depth = 50% AM Rate = 20 kHz Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____		SHIFT POWER SWEEP Mode			
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 4%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion (Cont'd) ALC = +5 dBm AM Depth = 50% AM Rate = 50 kHz Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____ Selected CW Freq: = _____		SHIFT POWER SWEEP Mode			
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%
	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 10%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion (Cont'd)					
ALC = +5 dBm					
AM Depth = 50%					
AM Rate = 100 kHz					
		SHIFT POWER SWEEP Mode			
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%
Selected CW Freq: = _____	10	Second Harmonic (dBc1)		_____ dBc	
	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 35%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. AM Distortion (Cont'd)					
AM Depth = 50%					
AM Rate = 50 kHz					
		SHIFT POWER SWEEP Mode			
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%
Selected CW Freq:	10	Second Harmonic (dBc1)		_____ dBc	
= _____	11	Third Harmonic (dBc2)		_____ dBc	
	11	Fourth Harmonic (dBc3)		_____ dBc	
	11	Fifth Harmonic (dBc4)		_____ dBc	
	12	Total Harmonic Distortion		_____ %	< 25%

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-17. Simultaneous Pulse and AM					
AM Index = 95%					
CW Freq. = 1 GHz					
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	Internally Leveled = PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-17. Simultaneous Pulse and AM (Cont'd) AM Index = 95% CW Freq. = 1 GHz		SHIFT RF Mode Start Freq. = 400 Hz Stop Freq. = 50 kHz			
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-17. Simultaneous Pulse and AM (Cont'd)					
AM Index = 95%					
CW Freq. = 4.5 GHz					
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	Internally Leveled = PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB
PRF _____					
PW _____					
Stop Freq. _____					
Start Freq. _____					
Res. BW _____	8	= PRF/20 (up to 5 kHz) = Stop Freq./10 ≤ Start Freq./10	-3 dB	_____	+3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-17. Simultaneous Pulse and AM (Cont'd) AM Index = 95% CW Freq. = 4.5 GHz		SHIFT RF Mode Start Freq. = 400 Hz Stop Freq. = 50 kHz			
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB
PRF _____					
PW _____	16		-3 dB	_____	+3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-18. Frequency Modulation					
ACCURACY					
CW Freq. = 2.2 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
CW Freq. = 2.5 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
CW Freq. = 6.9 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
CW Freq. = 13.4 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
CW Freq. = 18 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_____ V _____ %	10%
FLATNESS					
FM Sensitivity = 1 MHz/V					
CW Freq. = 2.2 GHz	13	Worst Case Power Level		_____ dB	3 dB
CW Freq. = 2.5 GHz	13	Worst Case Power Level		_____ dB	3 dB
CW Freq. = 6.9 GHz	13	Worst Case Power Level		_____ dB	3 dB
CW Freq. = 13.4 GHz	13	Worst Case Power Level		_____ dB	3 dB
CW Freq. = 18 GHz	13	Worst Case Power Level		_____ dB	3 dB

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SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-18. Frequency Modulation (Cont'd) FM Sensitivity = 10 MHz/V CW Freq. = 2.2 GHz CW Freq. = 2.5 GHz CW Freq. = 6.9 GHz CW Freq. = 13.4 GHz CW Freq. = 18 GHz					
	13	Worst Case Power Level		_____ dB	3 dB
	13	Worst Case Power Level		_____ dB	3 dB
	13	Worst Case Power Level		_____ dB	3 dB
	13	Worst Case Power Level		_____ dB	3 dB
	13	Worst Case Power Level		_____ dB	3 dB

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

3. Press the **UP ARROW** [$\blacktriangle$] step key to access each Cal Constant listed in the table below and preset the Cal Constants to the value provided in the table. Be sure to terminate each entry by pressing [Hz].

Cal Constant	Value	Cal Constant	Value
2	100	53	0
3	100	56	****
5	100	58	1
6	100	71	1024
7	100	72	1024
9	1024	73	1024
10	1024	74	1024
11	1024	75	25
41	300	76	1000
50	0	77	-25
51	0	78	25
52	0	80	-17

4. If the A13 SYTM or the A22 RF clamp/SRD bias assembly has been replaced, preset the following potentiometers (pots) to the position stated (see Figure 5-41):

Center the following:

A22R55 (MIN)	A22R45 (2A)	A22R46 (3A)	A22R47 (4A)
	A22R42 (2B)	A22R43 (3B)	A22R44 (4B)

Set the following fully clockwise:

A22R12 (CLAMP 1)	A22R11 (CLAMP 2)	A22R10 (CLAMP 3)
A22R50 (C)		

5. If the A13 SYTM or the A28 SYTM Driver assembly has been replaced, preset the following pots to the position stated (see Figure 5-41):

Center:

A28R6 (OFST)

Set the following fully clockwise:

A28R24 (BP2 FREQ)	A28R25 (BP3 FREQ)	A28R88 (KICK)
-------------------	-------------------	---------------

Set the following fully counter-clockwise:

A28R19 (DYS)	A28R22 (DYO)	A28R27 (BP2)	A28R13 (DRP)
A28R28 (BP3)	A28R82 (GAIN)	A28R99 (BP1)	

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

1.0 V/GHZ ADJUSTMENT

6. If the A26 assembly has been replaced, preset the following pots to the position stated (see Figure 5-41):

Set the following fully clockwise:

A26R88 (MO)

Center the following:

A26R7 (BAL)

A26R43 (HET)

A26R45 (X1)

A26R47 (X2)

A26R49 (X3)

A26R51 (X4)

A26R91 (GAIN)

7. On the DUT, press **[CW] [1] [0] [MHz]**. Adjust A28R67 (V/GHz) for a DVM indication of +10 mV +1.0 mV.

RESET ERROR ADJUSTMENT

8. Connect the oscilloscope to A58TP14 (ERROR).
9. Press **[INSTR PRESET]** on the DUT.
10. Adjust A58R1 (RESET, Figure 5-41, 2 of 2) for as close as possible to zero volt average on the oscilloscope. (See Figure 5-42.)
11. On the DUT, press **[CW] [1] [0] [GHz]** and **[RF]** (RF power indicator off).
12. Connect DVM LO to A22TP1 (GND) and DVM HI to A22TP2 (S/H). Adjust A22R37 (OS) for a 0 ± 1 mV indication.
13. On the DUT, press **[RF]** (RF indicator on) to turn RF power on.

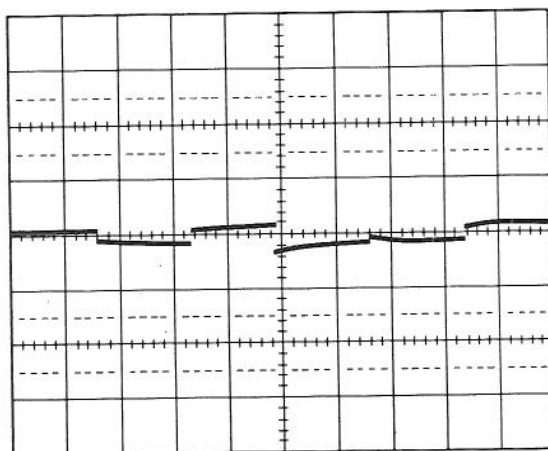


Figure 5-42. Reset Pulse to Zero Voltage Average

INSTRUCTION PAGE

ADD THESE PAGES TO YOUR HP 8341B OPTION 003 OPERATING AND SERVICE MANUAL AS INDICATED. DO NOT REMOVE ANY PAGES

Blue page at the beginning of Volume 1 (indicating modified manual)
Blue page at the beginning of Volume 2 (indicating modified manual)
Blue page at the beginning of Volume 3 (indicating modified manual)
Blue page (G-24a/G-24b) behind page G-24 (parts cross reference table)

Parts-Cross Reference Table

When replacing a part, cross-reference it to the following table. If the part does not appear in this table, use the original part number in Tables G-1 and J-1.

Ref. Desig.	HP Part Number	Replace with HP Part Number	New Description	Page Number
12	08340-00085	08340-00071	DRESS PANEL-LOWER	G-26
11	08340-00004	08340-00072	DRESS PANEL-KEYBOARD	G-26
140	08340-00100	08340-00098	PANEL-REAR	J-12

