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HP References in this Manual

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User's Guide

HP 11990A Option 001 for the HP 70900 System Performance Tests

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Warranty service may be obtained from the nearest Hewlett-Packard sales office or other location indicated in the owner's manual or service booklet.

Safety Notes

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

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

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

Instruction Manual

The **instruction manual** symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the manual.

General Safety Considerations

Warning

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

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

Warning

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

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

Caution

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

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

How to Use This Guide

This guide uses the following conventions:

Front-Panel Key	This represents a key physically located on the instrument.
`Softkey`	This indicates a "softkey," a key whose label is determined by the instrument's firmware.
`Screen Text`	This indicates text displayed on the instrument's screen.

HP 70000 Modular Measurement System Documentation Outline

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

Manuals Supplied with Module

Installation and Verification Manual

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

Operation Manual

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

Programming Manual

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

Service Manual, Available Separately

When available, this manual provides service information for a module, including module verification tests, adjustments, troubleshooting, replaceable parts lists, and replacement procedures. For ordering information, contact an HP Sales and Service Office. (NOTE: Some versions of this manual are titled *Technical Reference*.)

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1

General Information

Introduction

This manual documents the user-interface program of the HP 11990A System Performance Test software and describes the performance tests available for each of the individual options. The user-interface program automates the test process. Refer to "Shipment Contents" for more information about what is included with the system performance test programs.

This chapter contains general information. Chapter 2 contains procedures to configure the hardware and install the test software. Chapter 3 contains detailed information about the user-interface menus. Chapters 4 through 9 describe the performance tests for each of the different options.

The information in this chapter is divided into the following sections:

Notes

Before you can use the start-up procedure in Chapter 2 to install the user interface, you must have a system software package. The user interface start-up procedure requires the Executive Disk from a system software package.

The HP 11990A System Performance Test software automates the electrical performance verification of a single RF input of an HP 70000 Series modular spectrum analyzer whose master module is an HP 70900 local oscillator. If your system has more than one RF input, refer to "Testing Multiple Systems" under "System Performance Test Software Overview" in this chapter.

Shipment Contents

This documentation supports HP 11990A System Performance Test software, Revision B.03.00 or greater. The system performance test software consists of three types of packages:

- User Interface package, which is used to automate the test process.
- System Software package, which contain tests for specific predefined systems.
- System Add-On package, which contains additional tests that may be needed to test modules that are not part of a predefined system.

Note HP 70900 system performance tests require both the User Interface package and a system software package. If you are testing a system that includes modules that are not part of a predefined system, a System Add-On package may be needed to test the additional modules. Refer to Table 1-1 below.

Table 1-1. HP 11990A Options

Option Number	Package Type	System or Module Supported	Shipment Contents
001	User Interface	Required for **all** HP 70900 system performance tests	This manual Executive Disk Operating Disk
033	System Add-On	HP 70300A or HP 70301A tracking generators	Manual describing individual tests Test Disk 3
100	System Software	HP 71100A/C	Manual describing individual tests Test Disk 1
200	System Software	HP 71200A/C, HP 71201A	Manual describing individual tests Test Disk 1
209	System Software	HP 71209A/C	Manual describing individual tests Test Disk 1
210	System Software	HP 71210A/C	Manual describing individual tests Test Disk 1
300	System Software	HP 71300A system, or HP 70907A module when used with HP 71100C, HP 71200C, or HP 71210C systems	Manual describing individual tests Test Disk 1

Note Make a working copy of each disk before installing any of the software, then store the master disks in a safe place.

Software Version

The program software version and the program part number will be needed if you contact Hewlett-Packard about this software. The program part number is printed on the disk labels. The software version of the program is visible on the right-hand side of the display that appears after the first program disk is loaded. It is also visible in the Main Menu and the Test Menu. Specific numbers vary, but the version number looks like this: `Rev. A.02.00`. Refer to "Installing System Performance Test Software" in Chapter 2.

Software/Hardware Compatibility

Computer Hardware Compatibility

System Performance Test software is written in HP 9000 Series BASIC 4.0. There is no copy protection. The software can run on the following HP 9000 Series 200/300 computers. Minimum RAM requirement is 2.0 megabytes.

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

When using an HP 9000 Series 300 computer, a medium-resolution monitor and either an HP 98203C or an HP 46020A keyboard are required. If printed results are not needed, a high-resolution monitor can be used.

Due to the various keyboards supported, some minor text differences appear in the menus and softkeys displayed on-screen. Refer to "Typographic Conventions," later in this chapter.

Computer Language Compatibility

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

The software program runs on HP BASIC 4.0, or later, with the following BIN files in RAM.

CLOCK
CS80 (optional – supports newer Winchester disk drives)
DISC (optional – supports microfloppies and older Winchester disk drives)
ERR
GRAPH
GRAPHX
CRTA or CRTB
HPIB
IO
KBD
MAT
MS
PDEV (optional – provides debugging features for program development)

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

DCOMM
SRM

In an HFS (hierarchical file structure) environment, the following BIN file is also required:

HFS

Printer Compatibility

System Performance Test software supports any HP-IB printer; however, many of the printed test results require a graphics printer. Graphical test results are not output to a non-graphics printer.

Note It is not possible to print graphical test results when an HP 9000 Series 300 computer is used with a high-resolution monitor. Refer to "Computer Hardware Compatibility" above for more information.

Typographic Conventions

This manual uses the following conventions:

(KEY) Text that looks like this represents the key label of a key physically located on the analyzer or computer.

`softkey` Text that looks like this represents a "softkey," a key whose label is determined by the instrument's firmware. When softkey labels are written in lowercase letters, a sub-level softkey menu exists for that particular softkey. Softkey labels written in uppercase letters indicate that no further sub-level softkey menus exist for that softkey.

`Text` Text that looks like this represents messages displayed on the CRT, or text that the user enters via the keyboard.

For simplicity in this document, we assume that you are using either an HP 9000 Series 200 keyboard, or an HP 98203C keyboard. Refer to the table below if your keyboard key labels do not match the ones used in text.

Key Labels Shown in This Document	Alternate Key Labels
(EXECUTE)	(RETURN)
(ENTER)	(RETURN)
(RUN)	press (SYSTEM), then press `RUN`
(CONTINUE)	press (SYSTEM), then press `CONTINUE`

Required Test Equipment

Standard Test Equipment

The Equipment Menu lists preferred test equipment models supported by the software. Substitute equipment is acceptable if it meets or exceeds minimum critical specifications for a particular HP 70000 Series modular spectrum analyzer. The user must supply and install the instrument software for unlisted equipment.

The manual in each system software package lists required test equipment types for each test. One appendix in that manual provides a list of test equipment types and the minimum critical specifications for each. Another appendix lists equipment that meets these specifications.

The performance tests also require a technical computer. Refer to "Computer Hardware Compatibility" in this chapter.

Specialized Test Equipment

Some performance tests require specialized test equipment (for example, filters). Construction information appears in an appendix in the appropriate system software package manual.

System Performance Test Software Overview

Testing Multiple Systems

System performance test software tests only one system at a time. If you have more than one RF section module to test in your configuration, test them separately. If you have tested a RF section module and want to select another RF section module to test without turning off the controller, follow the steps below.

Note The program erases test results stored on disk the first time it enters the Test Menu. Therefore, if you want a printed copy of the previously run test results, you must print them before pressing `test menu`. Refer to the Chapter 3 "Parameter Menu" and "Main Menu" sections. "Parameter Menu" contains information on configuring the software to save test results to disk. "Main Menu" contains information about the `REPRINT` softkey.

1. Get to the Main Menu.
2. Press `RESTART`, then press `HP-MSIB map`.
3. Press `SELECT MODULE` to select the desired RF section module. (The `SELECT MODULE` softkey is only present when more than one RF section module is present.)
4. Press `main menu`.
5. From the Main Menu, press `test menu`. If `ERROR MESSAGE: Selected system under test is ; but the software supports the - system` appears, either press `RELOAD` and follow

the on-screen prompts to load different test software, press CHANGE DUT to gain access to either the HP-MSIB Address Menu or the Equipment Menu, or press ABORT to return to the Main Menu. From the HP-MSIB Address Menu, select the RF section module to test that matches the software you already have loaded. From the Equipment Menu, change the HP-IB address of the HP 70000 system's master module.

Types of Error Messages or Warnings Defined

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

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

Appendix B in this manual gives detailed error and status message information.

Limited Cal Defined

Limited Cal is a subset of the system performance tests and is used to verify system operation or check the system after any repair. Press QUICK TEST in the Main Menu or LIMITED CAL in the Test Menu to start the Limited Cal routine.

Single Tests Defined

You may select individual system performance tests with this program. Refer to "Test Menu" in Chapter 3, "Menus."

Test Results

For each performance test, the program indicates whether the system passed or requires adjustment. The program's measurement uncertainty calculations for each test assume that you are using a preferred set of test equipment; substituting equipment can affect result validity. Refer to "Required Test Equipment" in this chapter for further information. Appendix A describes measurement uncertainty.

Printing Test Results

You can use the Parameter Menu to configure the program to format and print test results. Test results will be automatically printed if the program is correctly configured, an HP-IB printer is on the bus, and the printer address is provided in the Equipment Menu. The printout includes title and summary pages. The summary page will be printed at the completion of the Limited Cal or All Test modes of operation if the printer is selected for Results sent to: in the Parameter Menu. The summary page will also be printed when the Test Menu SUMMARY softkey is pressed.

The title page lists the following data:

- System performance test software used, version code for the user interface software, and the test date.
- Model number, serial number, and firmware version of the modules tested.
- Test person's identification.
- Customer's name.
- Repair number.
- Power line frequency.
- Elapsed time since test equipment was calibrated.
- Ambient temperature.
- Ambient humidity.
- Test equipment names, model numbers, addresses, and ID or serial number.

The Summary Page contains the following information:

- System performance test software used, version codes for user interface and test package software, and the test date.
- Model number, serial number, and firmware version of the modules tested.
- Text indicating that the instrument passed, or that it requires adjustment or repair to meet specifications.
- There may also be listings of tests under one or more of the following categories:

  The following tests showed insufficient performance.
  The following tests gave ambiguous results.
  The following tests were not completed due to setup errors.
  The following tests met the appropriate specifications.
  The following tests were not completed.

2

Start-Up Procedures

This chapter contains procedures for installation and use of the HP 11990A System Performance Test software with either an HP 9133 or HP 9122. Both the HP 11990A System Performance Test Option 001 user-interface software and a test option (that is, Option 100, 200, 209, 210, or 300) are required before the program can be installed. If you are testing a system that includes modules that are not part of a predefined system, a System Add-on package may also be needed to test the additional modules.

Note Refer to the Installation and Verification Manual for the HP 70900 local oscillator for information about the configuration of various predefined HP 70000 Series modular spectrum analyzers.

Configuring the Hardware

1. Connect the HP 70000 Series modular spectrum analyzer to the computer port determined by the following criteria:

   a. For computers with an additional HP 98624A HP-IB Interface, connect your spectrum analyzer to the port labeled `HP-IB SELECT CODE 8`. Check that the address switch on the HP 98624A HP-IB Interface board assembly matches the HP-IB controller device address. If needed, refer to the *HP 9000 Series 200/300 Peripheral Installation Guide, Volume 1*.

   b. For computers without an HP 98624A HP-IB Interface, connect the HP 70000 Series modular spectrum analyzer to the port labeled `HP-IB SELECT CODE 7`.

2. Connect the HP-IB cables from the test equipment to the computer's HP-IB SELECT CODE 7 port.

3. Use a 0.5 meter HP-IB cable (HP 10833D, or similar cable) to connect the external disk drive's HP-IB to the HP-IB SELECT CODE 7 port.

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

4. Set the external test equipment and the HP 70000 Series modular spectrum analyzer line switches to ON. Allow the equipment to warm up at least 1 hour for the system performance tests.

5. Turn on the disk drive and computer.

System Performance Test Software

This section contains a procedure for installing the program. More specific program-operation information is contained in Chapter 3, "Menus."

Two assumptions are made with the System Performance Test software: that you are using standard HP-IB addresses for the test equipment, and that all passive devices are available. If either of these assumptions is incorrect, you must use the "Equipment Menu Edit Screen" to correctly configure your test equipment.

Note The program software version and the program part number will be needed if you contact Hewlett-Packard about this software. The software version of the program is visible on the right-hand side of the display that appears after the first program disk is loaded. It is also visible in the Main Menu and the Test Menu. Specific numbers vary, but the version number looks like this: `Rev. A.02.00`. The program part number is printed on the disk labels.

Installing System Performance Test Software onto an HP 9133

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

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

2. Assign the MSI (mass storage is) to the floppy drive of the HP 9133. As an example, assigning the MSI to the floppy disk drive should be similar to the following:
   `MSI ":,700,1"`
3. Insert the Executive disk into the default floppy drive and type in the following:

   `LOAD"INSTAL_HFS",1` (Return)

   A screen prompt titled "PROCESS OVERVIEW" will appear. Please read the entire prompt, make any decisions that pertain to your equipment setup, then press `CONTINUE`.
4. Enter the MSUS of the source and destination disks by following the screen prompts.

   If desired, an additional directory path for the destination disk can be entered at this time, otherwise press (Return) to continue.

   Your source and destination entries will now be confirmed and the program will continue with Creating Directory Structure.
5. Insert the Executive disk into the default floppy drive as indicated by the screen prompt and press `CONTINUE`. Executive disk files will be copied to destination directories created on the hard drive in the previous step.

   Remove the Executive disk from the floppy drive when prompted.

6. Insert the Operating disk into the default floppy drive as indicated by the screen prompt and press CONTINUE. Operating disk files will be copied to destination directories previously created on the hard drive. Remove the Operating disk from the floppy drive when prompted.
7. To copy option performance tests to the hard drive at this time, you must answer Yes to the following screen prompt:

```
Do you want to copy any OPTION discs? (Y or N)
```

Note It is important at this time to decide whether you would like to copy your option performance tests to the hard drive. When the display screen prompts you to copy disks for your option software, this will be the only opportunity to copy your option performance tests to the hard drive.

If you do not want to copy the performance tests for your option to the hard drive, answering No to the above prompt completes the installation procedure. Otherwise, a screen prompt for each available option (in numerical order) will appear allowing you to copy performance tests to the hard drive.

8. Insert the Test disk for your option making sure to select the correct screen prompt that matches your option, then press CONTINUE.

   After you have completed copying your option(s) performance tests onto the hard drive, the installation procedure is complete.

Running the System Performance Test Software from an HP 9133

Note The user-interface software automatically reads system configuration data from the Hewlett-Packard Modular System Interface Bus (HP-MSIB). This data is then written to the HP-MSIB Address Menu command screen as a list of the modules in the current system. The configuration of the current system is easily verified on the HP-MSIB Address Menu command screen.

9. Change to the hard drive directory where the executive files reside by typing the following command line:

```
MSI"/MMS_SYS_TEST/900_SPT/EXEC:,700,0" Return
```

Note The MSUS could be different depending on the HP-IB address of the HP 9133.

If an additional directory path was assigned during the installation procedure, this path *must precede* the assigned directory path (/MMS_SYS_TEST/) shown above.

10. To run the System Performance Test software, type the following command line:

```
LOAD "900_SPT",1 Return
```

11. When the "Test Disk" prompt appears, press the `mass storage` (F4) key.

    The "Mass Storage Menu Edit Screen" will appear with the three following categories:

    - Volume Label
    - MSUS
    - DIRECTORY PATH

12. Using the cursor keys, place the arrow pointing to the DIRECTORY PATH and press `SELECT` (F1).

13. Enter one of the directory paths as listed below for the system being tested and then press Return.

    ../71100C_TESTS
    ../71200C_TESTS
    ../71209A_TESTS
    ../71210C_TESTS
    ../71300A_TESTS

14. Press `DONE` (F8), then `PROCEED` (F6).

15. Enter any serial numbers for sensors as prompted by the program.

16. Press `test menu` to access the performance tests for your system and the following softkeys will be displayed for use with your performance tests.

    `ALL TESTS` (F1)

    `LIMITED CAL` (F2)

    `SUMMARY` (F4)

    `main menu` (F6)

    `HELP` (F7)

    `quit` (F8)

    Refer to the display screen for more information and further instructions regarding the performance tests.

    In order to access the `SINGLE TEST` softkey, press the Next key on the computer keyboard.

Running System Performance Test Software from an HP 9122

Note The user-interface software automatically reads system configuration data from the Hewlett-Packard Modular System Interface Bus (HP-MSIB). This data is then written to the HP-MSIB Address Menu command screen as a list of the modules in the current system. The configuration of the current system is easily verified on the HP-MSIB Address Menu command screen.

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

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

2. Assign the MSI (mass storage is) to the drive you will use as the default drive. As an example, assigning the MSI to a disk drive should be similar to the following:
   `MSI ":,700,0"`
3. Insert the Executive disk into the default floppy drive and type in the following to run the System Performance Test software:

   `LOAD "900_SPT",1` (Return)

   Messages regarding the load sequence for the Executive disk will appear.
4. When prompted to `insert Test Disk in default drive`, insert the Test disk for the option that you want to run system performance tests on, then press `PROCEED`.
5. When the next screen prompt reads `Mass Storage data is needed`, then press `PROCEED`.
6. Insert the Operating disk as instructed by the Disk Prompt Screen, then press `PROCEED`.
7. Enter any serial numbers for sensors as prompted by the program.
8. Press `test menu` (F6) to build the list of performance tests.
9. The up and down cursor keys can be used to identify a specific performance test and the following softkeys will be displayed for use with your performance tests.

   `ALL TESTS` (F1)
   `LIMITED CAL` (F2)
   `SUMMARY` (F4)
   `main menu` (F6)
   `HELP` (F7)
   `quit` (F8)

   Refer to the display screen for more information and further instructions regarding the performance tests.

   In order to access the `SINGLE TEST` softkey, press the (Next) key on the computer keyboard.

3

Menus

This chapter contains information about the user interface menus. The information is divided into the following sections:

Menu Structure

The first menu presented allows you to go to the Main Menu, to begin Limited Cal (Quick Test), or to return to the Equipment Menu. From the Main Menu you can access all of the other menus. Figures 3-1 through 3-4 at the end of this chapter show the menu structure.

The Mass Storage Menu, Parameter Menu, Equipment Menu, and HP-MSIB Address Menu are **configuration** menus; they are used to initialize the software for operation. In these menus you can enter information about disk drives, environment conditions, test equipment, the system under test, and so on.

The Test Menu allows the selection and execution of specific tests, or sets of tests, that are present in the current system software package.

Note When a cursor is present, you may use either the cursor arrow-keys or the rotary pulse generator (RPG) knob to position the cursor at the column item you wish to edit. In most cases, there are more selections available than are displayed on-screen. Be sure to move the cursor to the right and down as far as you can. `NEXT PAGE` and `PREVIOUS PAGE` softkeys are provided to speed your vertical searches.

Common Edit and Command Screen Softkeys

Not all of the menus have edit screens, but all have command screens. This section describes the edit and command screen softkeys that are common to most menus. Softkeys that are unique to a single menu are described in the section for that menu.

Edit Screen Softkeys

The following softkeys are present for edit screens:

`SELECT` or `SELECT/TOGGLE` — either one of these softkeys can appear in the edit screen. `SELECT` activates the column item where the cursor is located, while `SELECT/TOGGLE` activates predefined choices.

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

Command Screen Softkeys

The following softkeys are present for most command screens:

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

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

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

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

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

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

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

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

`YES`	stops the program, retains any data files you stored before pressing `quit`, and returns you to the BASIC operating system. (You can press RUN to restart the program and return to the Main Menu. The program retains all previously entered and stored data.)
`NO`	displays the edit screen of the previous menu, or the command screen if there is no edit screen.

Main Menu

From the Main Menu screen you can access all other menus. There is no edit screen for this menu. Figure 3-1 illustrates the Main Menu softkey organization.

In addition to the five menu selection softkeys and two common softkeys `HELP` and `quit`, the following three softkeys are present in the Main Menu.

`QUICK TEST` runs Limited Cal, a subset of the system performance tests. In this mode, some tests are omitted, others are modified, still others are unmodified. Quick Test does *not* provide a full calibration routine. The test descriptions in the system software package and System Add-On package include test mode information.

`REPRINT` initiates the reprinting of test data from disk to a selected printer. Test results are stored on disk if the Parameter Menu was set up appropriately. Note that the program erases test results stored on disk the first time it enters the Test Menu. Therefore, if a printed copy of the results of the previously run test is desired, it must be printed before pressing `test menu`.

If test results exceed available disk space, only the results that were stored on disk may be reprinted. In most cases, the test results of a Limited Cal test will fit on disk, however, the results of an All Tests will not. If you want to have the results of an All Tests sequence printed, select `printer` for the Parameter Menu selection `Results sent to:` and the test results will be printed during the test.

If no printer is present on the HP-IB, the program omits this softkey. Refer to "Parameter Menu" for more information.

`RESTART` is used to reconfigure the program and retest a system, or to test a different system. Pressing this softkey affects the Status column of the Test Menu command screen, and the RF section selected in the HP-MSIB Address Menu command screen. Pressing `RESTART` also forces the software to reload the Equipment Menu and Parameter Menu files from the Operating Disk.

Mass Storage Menu

The Mass Storage Menu has both an edit screen and a command screen. The edit screen displays a list of mass storage information and allows you to assign the areas where the program stores system and operation data. This is done by assigning volume labels to a mass storage unit specifier (msus). An msus is a string expression that points to a mass storage location. The command screen allows you to save the mass storage information after it is entered. Refer to "Mass Storage Menu Volume Labels" and "Editing Mass Storage Menu Information" below. Figure 3-2 illustrates the Mass Storage Menu softkey organization.

Mass Storage Menu Volume Labels

The BASIC operating system can use a number of mass storage devices. These include internal disk drives, external disk drives, and SRM systems. A mass storage Volume is composed of one or more files. Files are data items or subprograms. A Volume might consist entirely of files on a floppy disk, or some number of files on a small portion of a hard disk.

The Mass Storage Menu lists volume labels, which show the location of certain types of program information. Volume labels each have a default msus. From the Mass Storage Menu, you can reassign the current msus or directory path designation to another designation. You cannot edit volume labels, but you may edit their msus designations and directory path data fields.

The volume labels are explained below.

`SYSTEM` contains the Executive Disk 3 program code. There must be an msus assigned to this volume label.

`DATA` is where the test results (including header and summary information) are temporarily stored.

`ERROR LOG` is where unanticipated errors are recorded for possible future use.

`OPERATING` is where all the program data, including menu configuration files and calibration data, is stored.

`DRIVER DISK` contains the driver instrument control program code. There must be an msus assigned to this volume label. (There may be more than one `DRIVER DISK` Volume.)

`TEST DISK` contains the system performance tests programs. (There may be more than one `TEST DISK` Volume.)

`TEMP` is where temporary instrument-calibration files are kept. (This is usually initialized as a RAM disk.)

Editing Mass Storage Menu Information

Use the following procedure to edit Mass Storage Menu information:

1. Use either the keyboard arrow keys or the RPG knob to position the cursor next to the msus or directory path you wish to edit. The annotations `<=more` and `more=>` indicate that you must scroll the screen left or right to view off-screen column items.
2. Press `SELECT`. Key in the new location (msus or Directory Path), then press ENTER.

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

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3. Repeat steps 1 and 2 until you have finished editing, then press `DONE`.
4. Press `STORE` to save the edited data. Saving Mass Storage Menu data for the first time causes an error message prompting you to create a file. Do this simply by pressing `CREATE`.
5. Press `main menu` to return to the Main Menu screen, or press `EDIT` to continue editing Mass Storage Menu information.

Parameter Menu

The Parameter Menu has both an edit and a command screen. The edit screen displays a list of parameter items and allows you to determine some of the operating conditions of the software program.

Use SELECT/TOGGLE to select the parameter item and enter data, or to toggle to a predefined state. After you have finished editing the Parameter Menu items, press DONE to display the command screen. Then press STORE to save any edited Parameter Menu data, EDIT to return to the edit screen, or main menu to return to the Main Menu screen.

Figure 3-2 illustrates the Parameter Menu softkey organization.

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

The parameter items and their appropriate selections are defined below.

Results sent to:	Your choices are Screen, Printer, or None. Press SELECT/TOGGLE. When Screen is displayed, test results appear on the CRT. When Printer is displayed, test results are displayed on-screen and printed out. When None is displayed, simple pass/fail indications are listed next to the test name in the Test Menu.
Output format:	Your choices are Graph, Table, or Short Table. Press SELECT/TOGGLE. When Graph is displayed, test results are generated in a graph format if appropriate for the particular test results (a graphics printer is required if Printer and Graph are both selected). When Table is displayed, test results are output in a table format. When Short Table is displayed, test results are also output in a table format; however, less critical data points may be eliminated to limit the table length.
Save for reprinting:	Your choices are Yes or No. Press SELECT/TOGGLE. If Yes is displayed, test results are saved on disk for later reprinting using the REPRINT softkey in the Main Menu. If No is displayed, test results are not saved.
Printer lines:	Lines allowed are from 50 to 70. Press SELECT/TOGGLE. Type a number from 50 to 70 to set the number of lines per printed page, then press (ENTER).
Begin each test on a new page:	Your choices are Yes or No. Press SELECT/TOGGLE. If Yes is displayed, the printer form-feeds after each test. If No is displayed, there is no form-feed between tests.
Line frequency:	Valid frequency selections are 50, 60, and 400 Hz. Press SELECT/TOGGLE until the power line frequency for your system is displayed. The line frequency value affects some test results.

`Ambient temperature:` Valid Celsius temperature entries are 0 to 55. Press `SELECT/TOGGLE`. Type a number from 0 to 55, then press (ENTER), This provides the program with the test environment temperature in Celsius, allowing the test limits to reflect temperature-drift guard-bands, if necessary.

`Ambient humidity:` Valid entries for ambient humidity are 0% to 105%. Press `SELECT/TOGGLE`. Type a number from 0 to 105, then press (ENTER).

`Equip. cal period:` Press `SELECT/TOGGLE`. Type a number representing the number of months since the last ETE calibration, then press (ENTER). This information is used by some of the uncertainty calculations. The number of months will appear at the top of the results output.

`Beeper to be activated:` Your choices are `Yes` or `No`. Press `SELECT/TOGGLE`. When `Yes` is displayed, the warning and time-lapse reminder beeps are activated. When `No` is displayed, the program's beep feature is disabled.

`Verify equipment on HP-IB:` Your choices are `Yes` or `No`. Press `SELECT/TOGGLE` to indicate your choice. `Yes` causes the program to verify the presence of an instrument on HP-IB at the address shown in the Equipment Menu. Select `No` to bypass this feature.

`Customer:` Press `SELECT/TOGGLE`, type the customer's name or ID number, then press (ENTER). This allows the name or ID number to be included on the output report. There is a 30 character limit.

`Repair number:` Press `SELECT/TOGGLE`, type the repair number, then press (ENTER). This allows the repair number to be included on the output report. There is a 30 character limit.

`Test person's ID:` Press `SELECT/TOGGLE`, type your name or ID number, then press (ENTER). This allows your name or ID number to be included on the output report. There is a 30 character limit.

`Number lines added:` Lets you include a printed message with the test results. Depending on the program, you can enter up to 30 lines, with no more than 30 characters per line. (Select `User Line:` to enter the message you wish to have printed in this screen.)

`User Lines:`

1. Position the cursor to the left-hand side of a User Line in the menu. Press `SELECT/TOGGLE`.
2. The prompt, `Enter additional information`, appears. Type in your message (up to 30 characters per line), then press (ENTER).
3. After you have entered your message, reposition the cursor at `Number lines added:`. Enter the number of user lines your message occupies, then press (ENTER).

Equipment Menu

The Equipment Menu has both an edit screen and a command screen. The edit screen displays a list of all the equipment required to test your device under test (DUT) completely, and allows you to enter device model numbers, addresses, serial numbers, and information about the availability of passive devices. "Equipment Menu Edit Screen," below, gives more information about entering test equipment data. After you have finished editing the Equipment Menu, press `DONE` to enter the command screen. Press `STORE` in the command screen to save the edited data.

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

The command screen also provides a softkey, `edit cal data`, that provides access to a calibration-data screen. This calibration-data screen lists those passive devices that are labeled `Available` and require calibration data. Refer to "Equipment Menu Command Screen" and "Editing Calibration Data" below for more information. Figure 3-3 illustrates the Equipment Menu softkey organization.

Note An appendix in the system software package manual lists all required test equipment. Using the preferred test equipment (identified by *) ensures the most complete testing capability. Using the models listed as "acceptable" may affect measurement uncertainty. Individual test descriptions provide an equipment list and the test setup for that particular test.

Equipment Menu Edit Screen

From the Equipment Menu edit screen you can enter data about your test equipment. Next to each `DEVICE TYPE` in the equipment list there are columns labeled `DEVICE MODEL` for the model number, `ADDRESS` for the HP-IB address, and `SERIAL` or `ID NO.` (for example, calibration lab number). You may use either the cursor arrow keys or the RPG knob to position the cursor at the column item you wish to edit. Use the following information to edit information in the different columns. You cannot edit the `DEVICE TYPE` column.

`DEVICE MODEL` Locate the cursor beside the model number you wish to edit. Press `SELECT`, type the model number, then press ENTER.

`ADDRESS` Locate the cursor beside the address you want to edit. Press `SELECT`, edit the address, then press ENTER.

If a device does not have an address listed in the address column, `Missing ETE` is included in the Status column next to the tests that required the device. Tests tagged with `Missing ETE` are not performed.

Active devices should be given a three-digit HP-IB address. The three-digit address includes the HP-IB select code and the actual HP-IB address. For example, an HP 70000 Modular Spectrum Analyzer HP-IB select code of 8 and an HP-IB address of 18 yields an address of 818. Valid addresses for active devices are listed below:

- 700 to 730 and 800 to 830 for an HP 70000 Modular Spectrum Analyzer master module. (The addresses of DUTs that function as slaves should match their master's address.)
- 700 to 730 for any other device type.

Passive devices (nonprogrammable devices such as sensors, directional bridges, and detectors) should be addressed as either `Available` or `Not Available`. When certain passive devices are addressed as `Available`, you will also be required to enter a serial number and calibration data for the device. To enter calibration data, press `edit cal data` to access the Calibration Data edit screen. (The calibration data for a passive device is stored on Operating Disk.) If a passive device has `Not Available` in the address column, any tests that require that passive device will not be performed. `Missing ETE` will be printed next to the test names on the test results for any procedures that require a device listed as `Not Available`.

`SERIAL OR ID NO.` Locate the cursor beside the serial or ID number that you want to edit. Press `SELECT`, enter the new serial or ID number (10 digits or less), then press (ENTER). Some passive devices that have `Available` displayed in the address column must also have a serial- or ID-number entry.

Equipment Menu Command Screen

In addition to the common softkeys `EDIT`, `STORE`, `main menu`, `HELP`, and `quit`, this command screen displays the following additional softkeys:

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

`NO ADDRESS` appears only if the program cannot find an instrument at a specified HP-IB address. Either press `NO ADDRESS` to delete all faulty addresses from the edit menu, or use the steps below to find out which instruments are not responding and correct their addresses.

1. Press `EDIT` to access the Equipment Menu edit screen.
2. Scroll the `ADDRESS` column for flashing addresses, then be sure that the instrument is on.
3. `SELECT` the flashing address, correct it, and then press `DONE`.

   If you do not want correct all of the incorrect addresses, press `DONE` to return to the Equipment Menu command screen, then press `NO ADDRESS` to delete the remaining faulty addresses.

Note If the `Verify equipment on HP-IB:` feature is selected in the Parameter Menu, when you exit the Equipment Menu or enter the Test Menu the program will search the addresses in the Equipment Menu for instruments assigned to HP-IB.

Editing Calibration Data

The program requires calibration data for some of the passive devices listed in the Equipment Menu edit screen. The Select Passive Device screen of the Equipment Menu displays all passive devices that need calibration data entered. To reach the Select Passive Device screen, press `edit cal data` in the Equipment Menu.

Note If you are in the Select Passive Device screen and select a passive device that needs a serial number entered, you will be prompted to return to the Equipment Menu and enter the number. If you have formerly entered calibration data for a passive device of a given serial number and you would rather not reenter the data, replace your current Operating Disk with one containing data for passive devices from previous testing. Press `REPEAT` to access the calibration data from that disk. If you only need to enter the passive device's calibration data, press `CREATE`, then use the procedure given later in this section to enter the appropriate information.

If you edit the factory default frequency or calibration factor values, you *must* enter valid calibration factors for each frequency edited. For power sensors, you must enter a frequency and calibration factor for 300 MHz even if the device has no factor listed at 300 MHz. Not all frequencies are listed on the screen at once. Be sure to enter calibration data for frequencies listed on all pages of the display.

Enter the values from the valid calibration factors given below. Other frequencies outside the normal range of the device may also be required. Prior to using your device, you may need to calibrate it at these frequencies to ensure accurate measurement results.

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

Use the procedure below to edit calibration data:

1. While in the Equipment Menu command screen, press `edit cal data` to access the Select Passive Device screen.

2. Locate the cursor beside the device and press SELECT.

   a. To change a frequency or calibration factor, move the cursor next to the one you want to change, enter the new value, then press (ENTER). (It is not necessary to enter new frequency values in numeric order; the program sorts them before storing them on the Operating Disk.)

   b. To delete a frequency or calibration factor, select the frequency or cal factor you want to delete, then clear the line by typing spaces and pressing (ENTER).

3. After you have deleted or entered the necessary data, press DONE to return to the Select Passive Device screen. If you do not want to edit any more data, press DONE to return to the Equipment Menu command screen. Press main menu to continue with the program.

HP-MSIB Address Menu

The HP-MSIB Address Menu lists the model numbers and HP-MSIB addresses of the modules in the HP 70000 Modular Spectrum Analyzer that you may wish to test. The HP-MSIB address of the master and the system are the same. In other words, the address of the master module determines the address of the system.

Figure 3-3 illustrates the HP-MSIB Address Map Menu softkey organization. There is no edit screen for this menu. The command screen may have the following additional softkey.

SELECT MODULE — appears when there is more than one system input (RF section module) available to test. Locate the cursor next to the RF section module that you wish to test. Press SELECT MODULE.

Test Menu

The Test Menu does not have an edit screen. The command screen allows you to select and run system performance tests. Refer to the system software package and system add-on package manuals for information about the specific tests for your system.

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

Missing calibration data for a passive device causes display of an error screen informing you that no file exists for the device serial number. If the correct Operating Disk is in the default drive, press `CREATE` to build the data file. The Test Menu reappears after calibration data has been entered for all passive devices that require it. Refer to "Editing Calibration Data" under "Equipment Menu" in the previous pages for more information.

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

Figure 3-4 illustrates the Test Menu softkey organization. The Test Menu command screen is different from the command screen formats previously described. The softkeys available in this menu are described below.

`LIMITED CAL` begins a factory-defined sequence of the Limited Cal mode tests. During the test sequence, the softkeys listed below are also available.

- `END SEQUENCE` interrupts the test sequence at the end of the test in progress. The Test Menu is displayed with an additional softkey labeled `RESUME TESTING`. Press this softkey to resume the test sequence where the program left off.
- `ABORT` ends the testing process and displays the Test Menu. From there you may choose some other action.

`ALL TESTS` begins a factory-defined sequence that includes all of the tests displayed in the Test Menu. During the test sequence, the softkeys listed below are also available.

- `END SEQUENCE` interrupts the test sequence at the end of the test in progress. The Test Menu is displayed with an additional softkey labeled `RESUME TESTING`. Press this softkey to resume the test sequence where the program left off.
- `ABORT` ends the testing process and displays the Test Menu. From there you may choose some other action.

`REPEAT TEST` runs the selected test and repeats it until you press `END SEQUENCE`. During the test sequence, the softkeys listed below are also available.

- `END SEQUENCE` interrupts the test sequence at the end of the test in progress. The Test Menu is displayed with an additional softkey labeled `RESUME TESTING`. Press this softkey to resume the test sequence where the program left off.
- `ABORT` ends the testing process and displays the Test Menu. From there you may choose some other action.

`RESUME TESTING` allows you to continue the test sequence after you have pressed either `LIMITED CAL` or `ALL TESTS`, and then pressed `END SEQUENCE` or `ABORT`.

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

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

- `END SEQUENCE` interrupts the test sequence at the end of the test in progress, then displays the Test Menu.
- `ABORT` ends the testing process and displays the Test Menu. From there you may choose some other action.

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

- `END SEQUENCE` interrupts the test sequence at the end of the test in progress, then displays the Test Menu.
- `ABORT` ends the testing process and displays the Test Menu. From there you may choose some other action.

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

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

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

`PURGE DISK` allows you to delete any stored data for the spectrum analyzer system under test. Press `YES` to delete the stored data. Press `NO` to return to the Test Menu command screen.

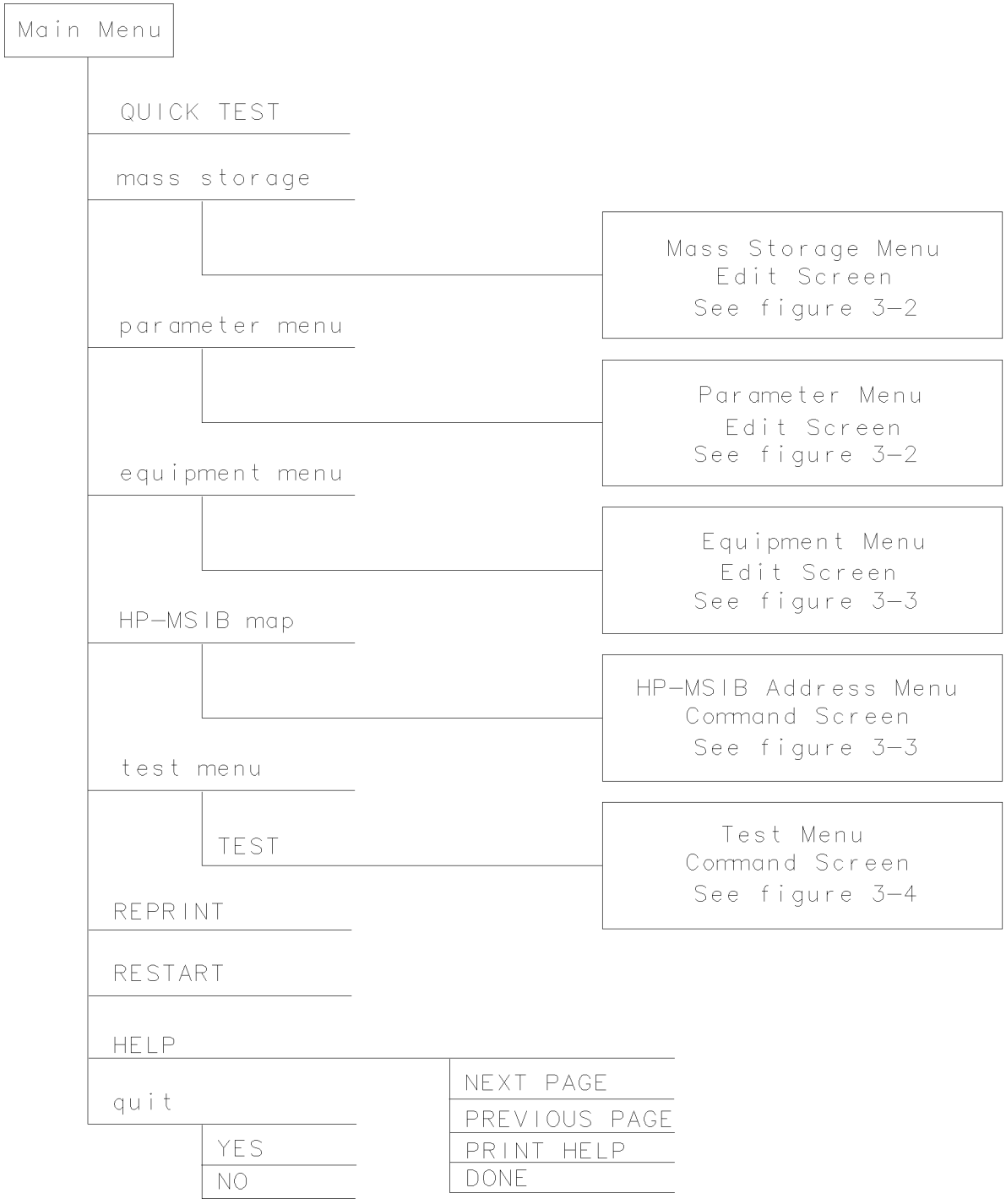
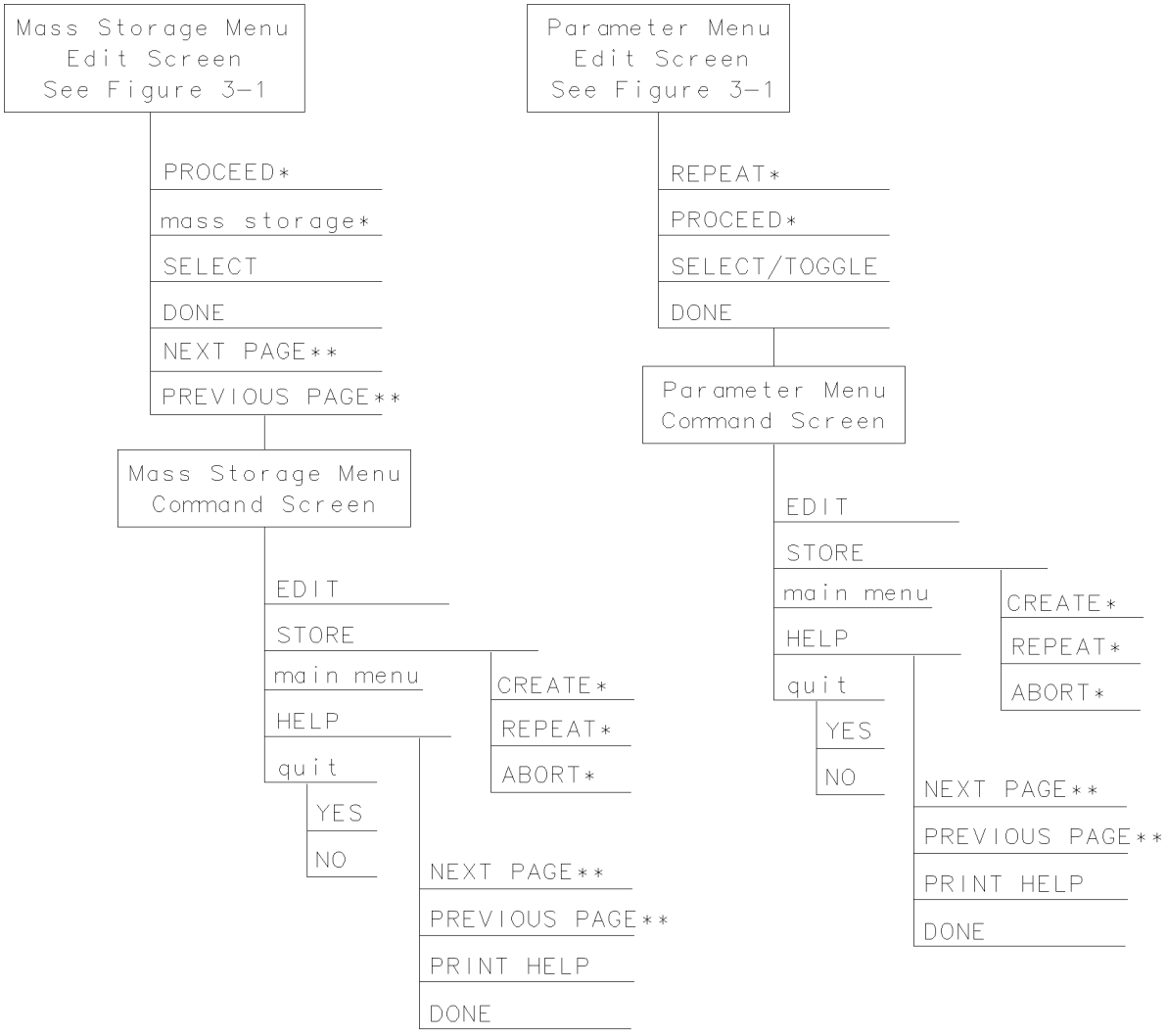


Figure 3-1. Main Menu Softkeys



* Present when the program does not find a file on the Operating Disc.
** Present when more pages of information are available.

Figure 3-2. Mass Storage Menu and Parameter Menu Softkeys

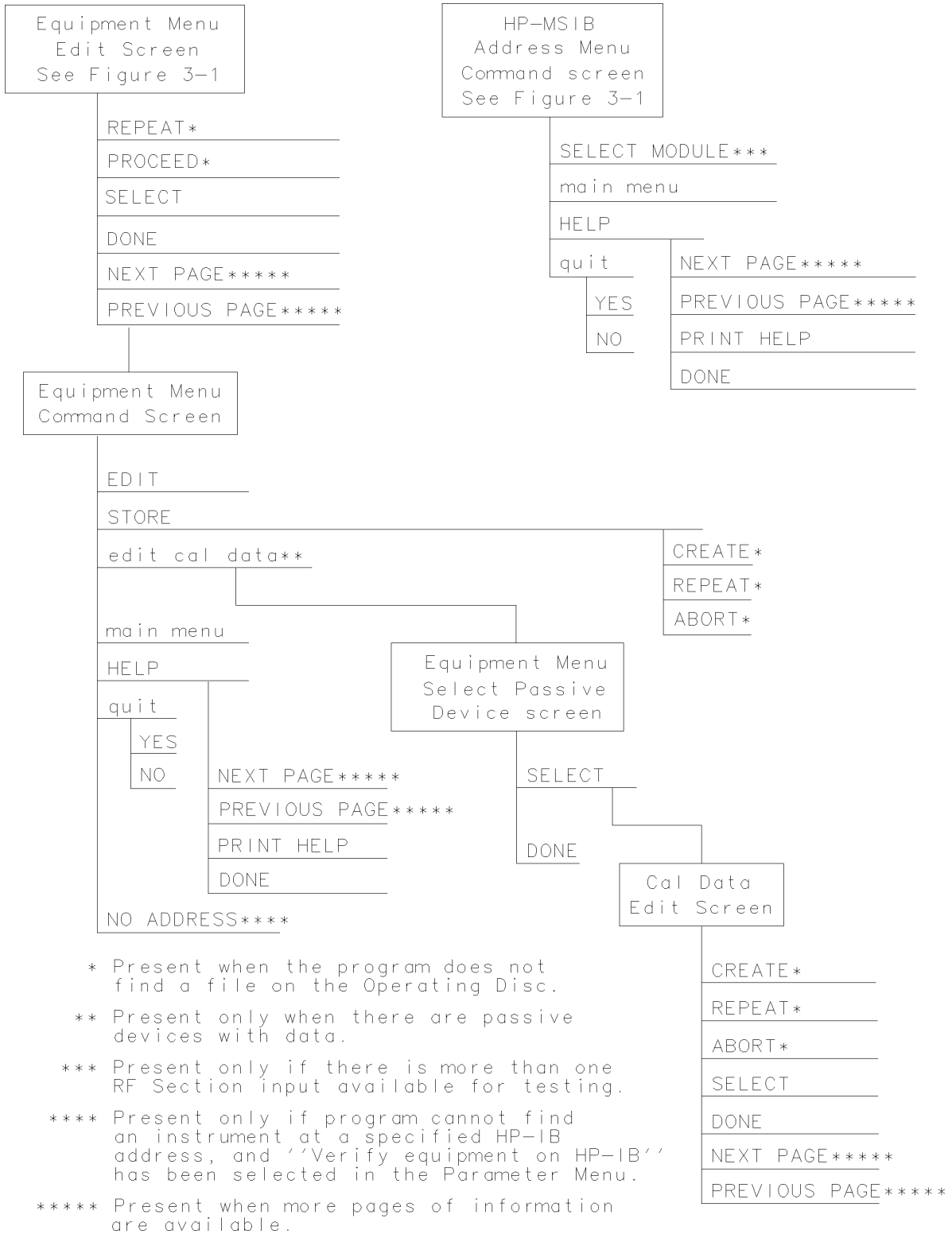
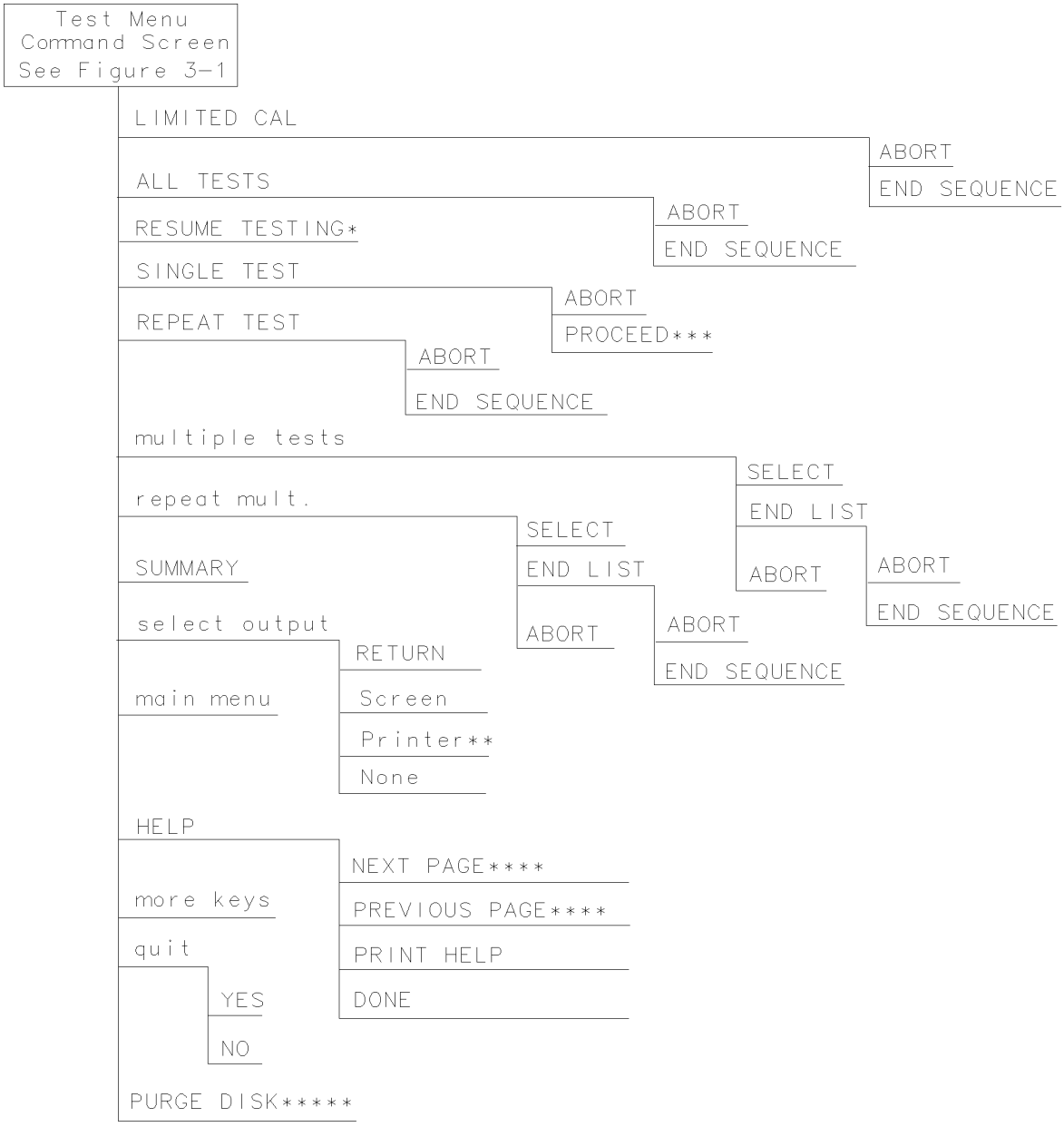


Figure 3-3. Equipment Menu and HP-MSIB Address Menu Softkeys



* Present only if END SEQUENCE was previously selected for LIMITED CAL or ALL TESTS.

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

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

**** Present when more pages of information are available.

***** Present only if ''Save for reprinting:'' was selected in the Parameter Menu.

Figure 3-4. Test Menu Softkeys

4

HP 11990A Option 033 System Add-On Package

Introduction

The HP 11990A Option 033 System Add-On package is used, along with a system software package, to test a tracking generator that is configured with an HP 71100A/C, HP 71200A/C, HP 71201A, HP 71209A/C, or HP 71210A/C spectrum analyzer. This System Add-On package consists of this manual and one test disk (Test Disk 3).

The HP 11990A Option 001 user-interface program and a system software package are required to run the tests in this System Add-On package. This manual includes only test descriptions; information about the test equipment required for these tests is included in the system software package manual. Refer to the *HP 11990A Option 001 User Interface Manual* for instructions to run the test software.

Option 033 Tests

Test Descriptions

This manual lists and describes all of the tests in this System Add-On package. Pressing the softkey `ALL TESTS` invokes the execution of these tests along with the tests listed in the system software package. The tests are run in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the specification as found in the "Specifications" chapter of the tracking generator Installation and Verification manual.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.

- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

The Limited Cal tests are executed in an efficient sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution. These tests, along with any Limited Cal tests in the system software package, are executed when you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu.

TG Absolute Amplitude Accuracy (HP 70300A)
TG Vernier Accuracy (HP 70300A)
TG Frequency Response (HP 70300A)
TG Feedthru (HP 70300A)

TG Absolute Amplitude Accuracy (HP 70301A)
TG Vernier Accuracy (HP 70301A)
TG Frequency Response (HP 70301A)
TG Feedthru (HP 70301A)

TG Absolute Amplitude Accuracy (HP 70300A)

Tested Specification

ABSOLUTE AMPLITUDE ACCURACY
(using the normal and alternate detectors)

Equipment

Power meter
RF power sensor

Equipment Setup

With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the RF OUTPUT amplitude accuracy of the tracking generator. The tracking generator is set to −10 dBm at 300 MHz and the RF OUTPUT is measured for amplitude accuracy with the normal detector enabled. The RF OUTPUT is again measured for amplitude accuracy at −10 dBm at 1 MHz, with the alternate detector enabled. Both frequency measurements are made with a single sweep in zero span.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between RF power sensor and tracking generator RF OUTPUT connector
- Tracking generator RF output harmonic distortion

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Vernier Accuracy (HP 70300A)

Tested Specification

AMPLITUDE ACCURACY: Vernier Accuracy

Equipment

Power meter
RF power sensor

Equipment Setup

With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the incremental RF output amplitude accuracy of the tracking generator over −21 dBm to −10 dBm, the range of the automatic level control (ALC).

The tracking generator frequency is set to 300 MHz, the ALC normal detector is selected, and the tracking generator's attenuator (if present) is set to 0 dB. The tracking generator output power is set to −10 dBm, and a reference reading is taken with the power meter. The output power is then stepped in 1 dB increments over the −21 dBm to −11 dBm range. The absolute error between the programmed amplitude (what was expected) and the power meter reading (what was measured) is stored. The differences in the absolute errors are checked to see if they meet incremental specifications.

The above procedure is repeated at 1 MHz with the ALC alternate detector.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Frequency Response (HP 70300A)

Tested Specification

AMPLITUDE FLATNESS
(using the normal and alternate detectors)

Equipment

Power meter
RF power sensor

Equipment Setup

With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures amplitude variation versus frequency of the tracking generator. The frequency range using the tracking generator normal detector is from 10 MHz to 2.9 GHz. For the alternate detector, the range tested is 100 kHz to 10 MHz.

A reference amplitude of −10 dBm is set at 300 MHz using the normal detector. The amplitude over the frequency range of the normal detector is increased in 60 linear steps from highest to lowest. Each step is measured for any deviation from the reference amplitude.

The same procedure is used to measure the amplitude deviation over the frequency range of the alternate detector, with the −10 dBm reference set at 1 MHz.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between RF power sensor and tracking generator RF OUTPUT connector
- Tracking generator RF output harmonic distortion

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Feedthru (HP 70300A)

(using HP 70902A)

Tested Specification

Tracking Generator Feedthrough

Equipment

Power meter
RF power sensor
50 ohm termination (HP 909D only)

Note The type of 50 Ω termination used can greatly affect the feedthrough level. BNC or Type N terminations have too much leakage, and should not be used. The leakage of the HP 909D termination is low enough not to affect the measurement.

Equipment Setup

Setup A: Connect the RF OUTPUT of the tracking generator to the RF INPUT of the spectrum-analyzer system.

Setup B: With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator. Connect the 50 ohm termination to the RF INPUT of the spectrum analyzer.

Description

The equipment is connected using setup A. The spectrum analyzer system containing the tracking generator is placed in Stimulus Response mode and set to the minimum IF resolution bandwidth, 10 Hz. Source track peaking is then performed to make sure that the source frequency is centered in the IF resolution bandwidth.

The equipment is connected using setup B. The tracking generator feedthrough level is then measured in each band of the spectrum analyzer using the following procedure:

1. The tracking generator is set for an RF output of −10 dBm.
2. The spectrum analyzer is set as follows:

   Reference level of −65 dBm (−75 dBm when HP 70908A is RF section).
   Resolution bandwidth of 10 Hz.
   Attenuator setting of 0 dB.
   Sample detection.
   Stop and start frequencies are set for the band of interest.
3. A sweep is taken.
4. The tracking generator frequency is set to the frequency of the peak response, and a power meter is used to set the output amplitude to −10 dBm ±0.05 dB.

5. The spectrum analyzer settings are changed as follows:

   Span is set to 0 Hz.
   Video bandwidth is set to 3 Hz.
   Sweep time is set to a value which assures that the trace data elements are uncorrelated.

6. A sweep is taken.

The tracking generator feedthrough level is equal to the average of the trace elements. This procedure is repeated for each band of the spectrum analyzer.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between RF power sensor and tracking generator RF OUTPUT connector
- Spectrum analyzer marker resolution
- Spectrum analyzer IF gain accuracy
- Spectrum analyzer log fidelity
- Spectrum analyzer calibration error
- Spectrum analyzer RF attenuator switching

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator
- RF section
- Preselector

TG Harmonics (HP 70300A)

Tested Specification

SPECTRAL PURITY: Harmonic Spurious

Equipment

Microwave source
Microwave spectrum analyzer
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Setup A: Connect the microwave source output to the power splitter input. Connect the microwave power-sensor output to the power meter. Connect the microwave power-sensor input to one of the power splitter's outputs. Connect the RF OUTPUT of the microwave spectrum analyzer through a low-loss cable to the remaining power-splitter output.

Setup B: Connect the RF OUTPUT of the microwave spectrum analyzer through a low-loss cable to the RF OUTPUT of the device under test (DUT).

Description

If it has been longer than 7 days since the frequency response of the microwave spectrum analyzer was characterized, setup A is used while the new calibration data is generated. The calibration is made in 100 MHz increments over the frequency range of 10 MHz to 22 GHz*. The setting of the microwave spectrum analyzer RF attenuator is stored along with the calibration data.

Connect the equipment using setup B. The second through fifth harmonic levels below 2.9 GHz are measured with respect to the maximum leveled output power of the DUT. Measurements are made at nine fundamental frequencies over the 10 MHz to 2.9 GHz range. The DUT is set to an RF output level of −10 dBm, and for zero span operation. The microwave spectrum analyzer RF attenuator is set to the same value that was used during calibration. Resolution bandwidth is set to 30 kHz and the frequency span is set to 1 MHz.

At each fundamental frequency, the amplitude of the fundamental is measured by the microwave spectrum analyzer, and the amplitude is corrected using the flatness calibration data. The second through fifth harmonic levels are then measured, corrected, and compared to specifications.

***Note:** The frequency range is dependent upon the frequency range of the test equipment.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch errors
- Power splitter tracking
- Microwave spectrum analyzer marker resolution
- Microwave spectrum analyzer log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Frequency Accuracy (HP 70300A)

Tested Specification

FREQUENCY ACCURACY

Equipment

Frequency counter

Equipment Setup

The RF OUTPUT of the tracking generator is connected to the high-frequency input of the frequency counter.

Description

This test measures the frequency accuracy of the tracking generator when it is used as a source. The tracking generator is set to a span of 0 Hz and an output of −10 dBm. The frequency counter then measures the tracking generator frequency at 10 points, starting at 500 MHz and ending at 2900 MHz. The frequency error is then determined.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator
- Local oscillator

TG Absolute Amplitude Accuracy (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Absolute Accuracy

Equipment

Power meter
Microwave power sensor

Equipment Setup

With the microwave power-sensor output connected to the power meter, connect the input of the microwave power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the absolute RF output amplitude accuracy of the tracking generator at its maximum specified leveled output power. The tracking generator frequency is set at 2.7 GHz, and the output amplitude is set to −2 dBm. Then the output power is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between microwave power sensor and tracking generator RF OUTPUT connector

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Vernier Accuracy (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Vernier Accuracy

Equipment

Power meter
Microwave power sensor

Equipment Setup

With the microwave power-sensor output connected to the power meter, connect the input of the microwave power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the incremental RF output amplitude accuracy of the tracking generator over −11 dBm to 0 dBm, the range of the automatic level control (ALC).

The tracking generator frequency is set to 2.7 GHz, and the tracking generator's attenuator (if present) is set to 0 dB. The tracking generator output power is then set to 0 dBm, and a reference reading is taken with the power meter. The output power is then stepped in 1 dB increments over the −11 dBm to −1 dBm range. The absolute error between the programmed amplitude (what was expected) and the power meter reading (what was measured) is stored. The differences in the absolute errors are checked to see if they meet incremental specifications.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Frequency Response (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Amplitude Flatness rel. to 2.7 GHz

Equipment

Power meter
Microwave power sensor

Equipment Setup

With the microwave power-sensor output connected to the power meter, connect the input of the microwave power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the RF output amplitude variations of the tracking generator over its complete frequency range.

The tracking generator is set to a frequency of 2.7 GHz, then a power meter is used to set the tracking generator output amplitude to -2 dBm ± 0.15 dB. This establishes the reference amplitude. The tracking generator is then incremented in frequency, the output power is read by the power meter, and the variation from the reference amplitude is stored. Frequency response is measured at a total of 201 points.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between microwave power sensor and tracking generator RF OUTPUT connector

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Feedthru (HP 70301A)

(using HP 70902A)

Tested Specification

Tracking Generator Feedthrough

Equipment

Power meter
RF power sensor
50 ohm termination (HP 909D only)

Note The type of 50 Ω termination used can greatly affect the feedthrough level. BNC or Type N terminations have too much leakage, and should not be used. The leakage of the HP 909D termination is low enough not to affect the measurement.

Equipment Setup

Setup A: Connect the RF OUTPUT of the tracking generator to the RF INPUT of the spectrum-analyzer system.

Setup B: With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator. Connect the 50 ohm termination to the RF INPUT of the spectrum analyzer.

Description

The equipment is connected using setup A. The spectrum analyzer system containing the tracking generator is placed in Stimulus Response mode and set to the minimum IF resolution bandwidth, 10 Hz. Source track peaking is then performed to make sure that the source frequency is centered in the IF resolution bandwidth.

The equipment is connected using setup B. The tracking generator feedthrough level is then measured in each band of the spectrum analyzer using the following procedure:

1. The tracking generator is set for an RF output of −10 dBm.
2. The spectrum analyzer is set as follows:

   Reference level of −65 dBm (−75 dBm when HP 70908A is RF section).
   Resolution bandwidth of 10 Hz.
   Attenuator setting of 0 dB.
   Sample detection.
   Stop and start frequencies are set for the band of interest.
3. A sweep is taken.
4. The tracking generator frequency is set to the frequency of the peak response, and a power meter is used to set the output amplitude to −10 dBm ±0.05 dB.

5. The spectrum analyzer settings are changed as follows:

   Span is set to 0 Hz.
   Video bandwidth is set to 3 Hz.
   Sweep time is set to a value which assures that the trace data elements are uncorrelated.

6. A sweep is taken.

The tracking generator feedthrough level is equal to the average of the trace elements. This procedure is repeated for each band of the spectrum analyzer.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between RF power sensor and tracking generator RF OUTPUT connector
- Spectrum analyzer marker resolution
- Spectrum analyzer IF gain accuracy
- Spectrum analyzer log fidelity
- Spectrum analyzer calibration error
- Spectrum analyzer RF attenuator switching

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator
- RF section
- Preselector

TG Harmonics (HP 70301A)

Tested Specification

SPECTRAL PURITY: Harmonic Spurious

Equipment

Microwave source
Microwave spectrum analyzer
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Setup A: Connect the microwave-source output to the power-splitter input. Connect the microwave power-sensor output to the power meter. Connect the microwave power-sensor input to one of the power splitter's outputs. Connect the RF OUTPUT of the microwave spectrum analyzer through a low-loss cable to the remaining power-splitter output.

Setup B: Connect the RF INPUT of the microwave spectrum analyzer through a low-loss cable to the RF OUTPUT of the device under test (DUT).

Description

If it has been longer than 7 days since the frequency response of the microwave spectrum analyzer was characterized, setup A is used while the new calibration data is generated. The calibration is made in 100 MHz increments over the frequency range of 10 MHz to 22 GHz*. The setting of the microwave spectrum analyzer RF attenuator is stored along with the calibration data.

Connect the equipment using setup B. The second and third harmonic levels below 22 GHz are measured with respect to the maximum leveled output power of the DUT. Measurements are made at nine fundamental frequencies over the 2.7 GHz to 11 GHz range. The DUT is set to an RF output level of −2 dBm, and for zero span operation. The microwave spectrum analyzer RF attenuator is set to the same value that was used during calibration. Resolution bandwidth is set to 30 kHz and the frequency span is set to 1 MHz.

At each fundamental frequency, the amplitude of the fundamental is measured by the microwave spectrum analyzer, and the amplitude is corrected using the flatness calibration data. The second and third harmonic levels are then measured, corrected, and compared to specifications.

***Note:** The frequency range is dependent upon the frequency range of the test equipment.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch errors
- Power splitter tracking
- Microwave spectrum analyzer marker resolution
- Microwave spectrum analyzer log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Low Band Input Insertion Loss (HP 70301A)

Tested Specification

LOW BAND INPUT: Insertion Loss

Equipment

Microwave source
Power meter
Microwave power sensor

Equipment Setup

Setup A: Connect the microwave power-sensor output to the power meter. Connect the microwave source to the microwave power-sensor input through a low-loss cable.

Setup B: Connect the microwave power-sensor output to the power meter. Connect the microwave power-sensor input to the HP 70301A RF OUTPUT. Connect the microwave source to the HP 70301A LOW BAND INPUT through the same low-loss cable that was used in setup A.

Description

If it has been longer than 8 days since the output level of the microwave source was characterized, setup A is used while new calibration data is generated.

The equipment is connected using setup B. After the setup is checked, measurements are made at 21 frequencies over the LOW BAND INPUT range (10 MHz to 2900 MHz). The microwave source amplitude is set to −5 dBm, and the power meter is used to measure the insertion loss from the LOW BAND INPUT to the RF OUTPUT. The measured insertion loss is corrected for the actual power available at the LOW BAND INPUT connector.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between microwave power sensor and microwave source
- Mismatch between microwave power sensor and tracking generator RF OUTPUT connector
- Mismatch between microwave source and tracking generator LOW BAND INPUT connector

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator

TG Frequency Accuracy (HP 70301A)

Tested Specification

FREQUENCY ACCURACY

Equipment

Frequency counter

Equipment Setup

The RF OUTPUT of the tracking generator is connected to the high-frequency input of the frequency counter.

Description

This test measures the frequency accuracy of the tracking generator when it is used as a source. The tracking generator is set to a span of 0 Hz and an output of 0 dBm. The frequency counter then measures the tracking generator frequency at 10 points, starting at the lowest frequency and going to the highest. The frequency error is then determined.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking generator
- Local oscillator

TG RF Off Residuals (HP 70301A)

Tested Specification

RESIDUALS (RF OFF)

Equipment

Microwave source
MW spectrum analyzer
Power meter
MW power sensor
Power splitter

Equipment Setup

Setup A: Connect the microwave-source output to the power-splitter input. Connect the MW power-sensor output to the power meter. Connect the MW power-sensor input to one of the power splitter's outputs. Connect the RF OUTPUT of the MW spectrum analyzer through a low-loss cable to the remaining power-splitter output.

Setup B: Connect the RF OUTPUT of the MW spectrum analyzer through a low-loss cable to the RF OUTPUT of the device under test (DUT).

Description

If it has been longer than seven days since the frequency response of the MW spectrum analyzer was characterized, setup A is used while the new calibration data is generated. The calibration is made in 100 MHz increments over the frequency range of 100 MHz to 22 GHz*. The setting of the MW spectrum analyzer RF attenuator is stored along with the calibration data.

Connect the equipment using setup B. Measurements are made at ten frequencies over the 2.7 GHz to 18 GHz range. Only the local-oscillator signal, and its harmonics that fall below 22 GHz, are measured. The DUT is set to an RF output level of −2 dBm, and for zero span operation. The MW spectrum analyzer RF attenuator is set to the same value that was used during calibration. Resolution bandwidth is chosen to provide at least 10 dB of margin between the specified performance and the displayed average noise level. The frequency span is set to 600 kHz.

At each test frequency, the amplitude of the local oscillator and its harmonics are measured by the MW spectrum analyzer. These amplitudes are then corrected using the flatness calibration data and compared to specifications.

***Note:** The frequency range is dependent upon the frequency range of the test equipment.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch errors
- Power splitter tracking
- MW spectrum analyzer marker resolution
- MW spectrum analyzer log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following module may need repair or adjustment:

- Tracking generator

TG Spurious Outputs (HP 70301A)

Tested Specification

SPECTRAL PURITY: N × 1st LO

Equipment

Microwave source
MW spectrum analyzer
Power meter
MW power sensor
Power splitter
Level generator

Equipment Setup

Setup A: Connect the microwave-source output to the power-splitter input. Connect the MW power-sensor output to the power meter. Connect the MW power-sensor input to one of the power splitter's outputs. Connect the RF OUTPUT of the MW spectrum analyzer through a low-loss cable to the remaining power-splitter output.

Setup B: Connect the RF OUTPUT of the MW spectrum analyzer through a low-loss cable to the RF OUTPUT of the device under test (DUT). Connect the level generator's 50Ω output to the DUT's rear-panel 21.4 MHz IN.

Description

If it has been longer than seven days since the frequency response of the MW spectrum analyzer was characterized, setup A is used while the new calibration data is generated. The calibration is made in 100 MHz increments over the frequency range of 100 MHz to 22 GHz*. The setting of the MW spectrum analyzer RF attenuator is stored along with the calibration data.

Connect the equipment using setup B. Measurements are made at ten frequencies over the 2.7 GHz to 18 GHz range. Only the local-oscillator signal, and its harmonics that fall below 22 GHz, are measured. The DUT is set to an RF output level of 0 dBm, and for zero span operation. The MW spectrum analyzer RF attenuator is set to the same value that was used during calibration. Resolution bandwidth is chosen to provide at least 10 dB of margin between the specified performance and the displayed average noise level. The frequency span is set to 50 kHz.

At each test frequency, the amplitude of the DUT's carrier frequency is measured by the MW spectrum analyzer and then corrected using the flatness calibration data. The spurious signals due to the local oscillator and its harmonics are then measured by the MW spectrum analyzer and corrected using the flatness calibration data. The results are then compared to specifications.

***Note:** The frequency range is dependent upon the frequency range of the test equipment.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch errors
- Power splitter tracking
- MW spectrum analyzer marker resolution
- MW spectrum analyzer log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following module may need repair or adjustment:

- Tracking generator

5

HP 11990A Option 100 System Software Package

Introduction

The HP 11990A Option 100 System Software package provides all test software required to verify that an HP 71100A, HP 71100C, or HP 71150C spectrum analyzer meets all of its major specifications. This system software package consists of this manual and one test disk (Test Disk 1). A System Add-On package may be needed to test modules that are not part of a predefined system. For example, although the tracking generator tests are listed in the Test Menu, these tests are not included in the system software package. The HP 11990A Option 033 System Add-On package contains the tracking generator tests.

Execution of the tests in this system software package is dependent on the HP 11990A Option 001 User Interface program, which automates the test process. Refer to Chapter 2, "Start-Up Procedures," for instructions to run the test software.

Option 100 Tests

Test Descriptions

This manual lists and describes all of the tests in this system software package. Pressing the softkey `ALL TESTS` invokes execution of the tests in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the system specification as found in the "Specifications" chapter of the *HP 70900 Local Oscillator Installation and Verification Manual*.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.
- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

When you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu, the Limited Cal tests are executed in a sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution.

Sweep Time Accuracy
Calibrator Frequency Accuracy
Gain Compression
Calibrator Amplitude Accuracy
Frequency Response
Frequency Span Accuracy
Displayed Average Noise
Residual Responses
Noise Sidebands
Line and System Related Sidebands
Step Gain Accuracy
Log Fidelity
Resolution Bandwidth Tests

Sweep Time Accuracy

(HP 70900A or HP 70900B)

Tested Specification

SWEEP: Sweep Time: Accuracy

Equipment

Universal counter

Equipment Setup

The H SWP output on the rear panel of the HP 70900 local oscillator is connected to the input of the universal counter. If an HP 70700A digitizer is in the system, the H SWP line from the HP 70900 must also be connected to the digitizer rear-panel HI SWP connector.

Description

Several different spectrum-analyzer sweep times are selected to exercise the hardware fully. For each selected sweep time, the DUT is set for a span of 0 Hz and a sweep is triggered. The sweep time is then measured with the universal counter. Sweep times are selected to turn on each of the 12 bits of the sweep DAC. Only one bit is on at a time except when the lower six bits are tested; then bit 6 is also on.

If the HP 70700A digitizer is in the system, then its hardware must also be tested. Several more sweep times are chosen to test: fast sweep times at multiples of the digitizer's clock rate, worst-case resolution errors, and long sample rates.

Uncertainties

The following characteristics contribute to uncertainties:

- Universal counter resolution
- Universal counter accuracy

Test Mode

This test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Calibrator Frequency Accuracy

(HP 70900A or HP 70900B)

Tested Specification

FREQUENCY: Frequency Reference Accuracy: Aging

Equipment

Frequency counter

Equipment Setup

The CALIBRATOR output of the HP 70900 is connected to the input of the frequency counter.

Description

With the spectrum analyzer (DUT) set to its internal frequency reference, the frequency counter is used to measure the 300 MHz CALIBRATOR frequency.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base stability

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Second Harmonic Distortion

(HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Second Harmonic Distortion

Equipment

Level generator
12 MHz low-pass filter

Equipment Setup

Connect the 50 Ω output of the level generator through a 12 MHz low-pass filter to the RF INPUT of the spectrum analyzer (DUT).

Description

The second harmonic distortion of the DUT is measured at 9 and 11 MHz. The DUT auto-zoom function is used to tune the level-generator signal in a 50 Hz span. Carrier amplitude and frequency are measured. The DUT center frequency is then tuned to the second harmonic, and the amplitude of the internally generated second harmonic is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT flatness
- DUT log fidelity
- DUT calibrator amplitude accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Third Order IMD

(HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Spurious Responses: Third-Order Intermodulation Distortion

Equipment

Level generator
General source
50 MHz low-pass filter
Directional bridge

Equipment Setup

Connect the common port of the directional bridge to the RF INPUT of the DUT. Connect the 50 Ω output of the level generator through a 50 MHz low-pass filter to one of the unused directional-bridge connectors. Connect the RF OUTPUT of the general source to another unused directional-bridge connector.

Description

The third-order intermodulation (TOI) of the DUT is measured at approximately 45 MHz using the 3 kHz resolution bandwidth (100 kHz in the HP 70903A). It is tested at several signal separations.

First, the amplitude of the general-source output is measured to establish the TOI reference amplitude level. Then the amplitude of the level-generator output is measured to establish the signal level. The upper third-order-product signal level is then measured, and the equivalent TOI is calculated as follows:

$$[(\text{signal level}) - (\text{DUT input atten. setting})] + \left[\frac{(\text{TOI reference ampl.}) - (\text{third}-\text{order ampl.})}{2}\right]$$

This procedure is repeated for the lower TOI product. The smaller value of the equivalent TOI is retained.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT absolute frequency response referenced to 300 MHz
- DUT marker amplitude resolution
- DUT calibrator amplitude accuracy
- DUT resolution bandwidth amplitude switching
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Gain Compression

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Gain Compression

Equipment

Level generator
Measurement receiver
Sensor module

Equipment Setup

The level generator is connected to the RF INPUT of the spectrum analyzer (DUT). The sensor-module output is connected to the measurement receiver. The sensor-module input is connected to the front-panel IF OUTPUT on the HP 70902A or HP 70903A.

Description

The level generator is set to produce a signal within the range of the DUT. The DUT is tuned to this signal, and the input attenuator is set to 10 dB. The DUT is set to zero span and the level generator is tuned to the center of the DUT passband.

The amplitude of the level generator is adjusted until a signal of −30 dBm or less is at the DUT input mixer. The measurement receiver then measures signal path gain; this value is used as the reference for no gain compression.

The level-generator amplitude is increased to produce a signal of −10 dBm at the DUT input mixer. The measurement receiver again measures signal path gain. The difference between the two gain measurements is the gain compression.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Measurement receiver relative accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Calibrator Amplitude Accuracy

(HP 70900A or HP 70900B)

Tested Specification

AMPLITUDE ACCURACY: Calibrator Uncertainty

Equipment

Power meter
RF power sensor or microwave power sensor

Equipment Setup

Connect the power sensor to the spectrum analyzer (DUT) CALIBRATOR output connector.

Description

After zeroing and calibrating the power meter, the power sensor is connected to the DUT CALIBRATOR output. The calibrator amplitude is measured and corrected using the calibration factor of the power sensor.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between power sensor and CALIBRATOR output connector

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Frequency Response (HP 70904A)

Tested Specification

AMPLITUDE ACCURACY: Frequency Response

Equipment

Microwave source
Level generator (not needed for Limited Cal)
Power meter
RF power sensor or microwave power sensor
Power splitter

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Connect the RF OUTPUT of the microwave source to the input port of the power splitter. Connect one output of the power splitter to the RF INPUT of the DUT. With the power splitter connected to the power meter, connect the other output of the power splitter to the power sensor.

For frequencies less than 50 MHz, connect the OUTPUT of the level generator to the RF INPUT of the DUT.

Description

The power meter is calibrated. The input attenuator of the DUT is set to 10 dB. The microwave source output level is adjusted for a power-meter reading of −10 dBm at 300 MHz. The DUT marker amplitude is read to establish a reference. A minimum of 30 measurements are made in each frequency band above 50 MHz.

For frequencies less than 50 MHz, frequency response is measured with the level generator. The level-generator output level is adjusted to produce the same DUT marker amplitude as that using the previous setup.

The frequency response data is available in graph mode.

Uncertainties

The following characteristics contribute to uncertainties:

All Frequencies

DUT marker amplitude resolution

Frequencies >50 MHz

Power splitter tracking

Power meter accuracy

Mismatch between DUT and power splitter

Mismatch between power sensor and power splitter

Frequencies <50 MHz

Level generator flatness

Mismatch between DUT and level generator

Test Mode

The test is run for frequencies greater than 50 MHz in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Frequency Readout Accuracy

Tested Specification

FREQUENCY: Frequency Readout Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

Frequency readout accuracy is tested at a maximum of eight frequencies and four spans. For each span and source frequency, the frequency readout of the DUT is compared to that of a synthesized source. The source is set to the selected center frequency of the DUT. The signal is marker-peaked. The deviation between the marker frequency readout and the center frequency is the frequency error. This test is performed with the DUT referenced to the internal frequency reference.

If the signal amplitude is close to the noise level due to a cable that has a large amount of signal loss, the measurement is not recorded.

If the HP 70700A digitizer is in the system, the entire test is repeated with the external digitizer selected. In addition, extra frequencies are selected to check the area of band crossings in microwave systems.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

This test is not run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Frequency Span Accuracy

Tested Specification

FREQUENCY: Frequency Span: Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

The DUT center frequency is set to 1.5 GHz, and spans of 10 kHz, 100 kHz, 1 MHz, 10 MHz, 10.01 MHz, 101 MHz, and 1.01 GHz are tested. The synthesizer frequency is adjusted until a signal appears near the left edge of the display. The frequency of this point and several other points in the span are noted by using marker peak. The deviation between the marker frequency and the synthesizer frequency is the absolute error. The maximum frequency span error is calculated by taking the difference between the maximum and minimum absolute errors.

This test is performed with the DUT referenced to the internal frequency reference.

If the HP 70700A digitizer is in the system, the test is repeated with the external digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

A limited version of this test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Image Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the microwave source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source and DUT are tuned to a frequency of 250 MHz. The DUT marker is used to determine carrier amplitude.

The source is then tuned to image frequencies, and image amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- Clean source relative flatness

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Out of Range Responses

Tested Specification

AMPLITUDE: Spurious Responses: Out-of-Range

Equipment

Microwave source

Equipment Setup

The RF output of the microwave source is connected to the RF INPUT of the spectrum analyzer (DUT).

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the RF INPUT of the DUT.

Description

The microwave source is stepped in 100 MHz increments (250 MHz in the All Tests mode) from 4 to 18 GHz. At each signal frequency, the DUT is tuned to the center frequencies that could produce an out-of-range response. The response level is measured at each of these frequencies.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- DUT step gain accuracy
- DUT calibrator amplitude accuracy
- DUT flatness
- Microwave source absolute amplitude accuracy
- Mismatch between microwave source and DUT RF INPUT

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- RF section

Displayed Average Noise

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Displayed Average Noise Level

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the spectrum analyzer (DUT) RF INPUT.

Description

The average displayed noise level is measured at the frequency of the displayed peak in each band, except below 10 MHz where 10 data points are taken.

When the DUT system has an HP 70902A, a resolution bandwidth of 10 Hz and a video bandwidth of 3 Hz are used. When the DUT system has an HP 70903A, a resolution bandwidth of 100 kHz and a video bandwidth of 300 Hz are used. A sweep is taken and trace information is averaged.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- IF section
- RF section

Residual Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Residual Responses

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the RF INPUT of the spectrum analyzer (DUT).

Description

The input attenuator of the DUT is set to 0 dB. The frequencies at which residual responses may occur are calculated and the DUT is tuned to these frequencies. The residual product level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Input Coupling Switching

Tested Specification

AMPLITUDE ACCURACY: Input Coupling Switching Error

Equipment

General source

Equipment Setup

Connect the RF output of the general source to the RF INPUT connector of the spectrum analyzer (DUT).

Description

The input coupling switching is tested at signal frequencies of 500 kHz, 50 MHz, 500 MHz, and 2500 MHz. The DUT is set for dc coupling and signal amplitude is measured. The input coupling is then switched to ac coupling and the difference is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT incremental log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Noise Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Noise Sidebands (dBc/Hz)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

HP 70900A: The noise sidebands are measured at 40 offset frequencies from 100 Hz to 1 MHz.
HP 70900B: The noise sidebands are measured at an offset frequency of 10 kHz.

The DUT is set for 0 dB attenuation and a span of 0 Hz. The signal amplitude is adjusted to the reference level, which is the carrier level. The source carrier frequency is increased by the amount of offset frequency. The resolution bandwidth of the DUT is set to 3% of the offset frequency, and the reference level is reduced by 20 dB. A sweep is taken and the data is averaged. The data is normalized to a 1 Hz bandwidth and corrected for log detection and noise bandwidth.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- DUT resolution bandwidth amplitude correction
- DUT resolution bandwidth 3 dB accuracy
- DUT noise floor error
- Clean source phase-noise level

Test Mode

This test is run in Limited Cal mode at 796.12 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- RF section

Line and System Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Line- and system-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source is set for an amplitude of −10 dBm. Line- and system-related sidebands are tested at frequencies of 15, 1200, and 2500 MHz. The signal is peaked on the DUT and set to the reference level.

The source is then offset by known sideband frequencies, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode at 15 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Synthesis Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Synthesis-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

The RF OUTPUT of the clean source is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

Based on the center frequency tuning equations, the DUT is tuned to frequencies where synthesis-related sidebands may exist. The source carrier level is measured. Then the source frequency is increased to place the sideband on-screen, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Step Gain Accuracy

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: IF Gain Uncertainty

Equipment

Level generator
Voltmeter

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT). Connect the voltmeter to the DUT front-panel VIDEO output.

Description

The spectrum analyzer is set for a reference level and RF attenuator setting that corresponds to 0 dB IF Gain. The level generator is set to +12 dBm and the voltmeter is read to establish a reference voltage.

The reference level is then decreased 10 dB. The level-generator output is adjusted, if necessary, until the reference voltage is reached. The difference between voltage readings is the IF gain error. Repeat this for each IF gain step.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Voltmeter ac measurement accuracy
- DUT marker amplitude resolution
- DUT log scale fidelity incremental accuracy (corrected)

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Log Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Log

Equipment

Level generator

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

This test measures the relative on-screen log scale fidelity (that is, the display CRT's upper eight divisions for the HP 70903A, or upper nine divisions for the HP 70902A).

The DUT is set for a reference level of +10 dBm, span of 0 Hz, and a resolution bandwidth of 100 kHz (HP 70903A) or 100 Hz (HP 70902A). The level-generator frequency is adjusted to peak the detected signal, and the amplitude is adjusted to set the signal at the reference level. The difference between the level generator and marker amplitudes establishes a reference error at this point.

The level generator is stepped down in 1 dB increments (2 dB in Limited Cal and All Tests modes) until the signal is 75 to 90 dB below top-screen. The actual level depends on the IF and RF being tested. In the last 20 dB of the log range, the sweep time is increased to lessen the effects of the reduced signal-to-noise ratio. The amplitude difference between the level generator and the displayed trace average is measured. Once all measurements have been made, the data is normalized to −10 dB of top-screen.

If the HP 70700A digitizer is in the system, the test is repeated with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Resolution Bandwidth Tests

(for HP 70902A or HP 70903A)

Tested Specifications

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
FREQUENCY: Resolution Bandwidths (−3 dB), Accuracy
FREQUENCY: Resolution Bandwidths (−3 dB), Selectivity

Equipment

Level generator

Equipment Setup

Connect the RF OUTPUT of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

Bandwidth switching variation is tested by setting a reference value at the widest resolution bandwidth. The DUT resolution bandwidth is then stepped down in a 1, 3, 10 sequence and the amplitude variation from the widest bandwidth is recorded. The data is then normalized to the reference bandwidth (100 Hz, HP 70902A; 300 kHz, HP 70903A).

The 3 dB (or 60 dB) points of the resolution bandwidth response are tested as follows. The DUT is set to the 0 Hz span and the level-generator frequency is adjusted to peak the response. The level-generator amplitude is then stepped down 3 dB to establish a reference value. The level- generator amplitude is then returned to the original value and the frequency is decreased until the 3 dB reference amplitude is reached. This establishes the lower 3 dB frequency point. The level-generator frequency is then increased until the upper 3 dB point is found. The difference in level-generator frequencies is the 3 dB bandwidth. This procedure may be repeated to determine the 60 dB points of the resolution bandwidth response.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Level generator frequency accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode for some bandwidths.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Linear Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Linear

Equipment

Level generator

Equipment Setup

The 50 Ω output of the level generator is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

The HP 70902A test sets the resolution bandwidth to 30 kHz; the HP 70903A test sets the resolution bandwidth to 1 MHz. The LIN display mode is selected. The level generator is set to provide a signal near the reference level.

The spectrum analyzer marker is peaked. The reference level is set at the peaked value to establish a reference at the top of the display.

The level generator is stepped down in 2 dB increments (4 dB for All Tests mode). The variation between the level-generator amplitude and DUT marker amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

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HP 11990A Option 200 System Software Package

Introduction

The HP 11990A Option 200 System Software package provides all test software required to verify that an HP 71200A, HP 71201A, or HP 71200C spectrum analyzer meets all of its major specifications. This system software package consists of this manual and one test disk (Test Disk 1). A System Add-On package may be needed to test modules that are not part of a predefined system. For example, although the tracking generator tests are listed in the Test Menu, these tests are not included in the system software package. The HP 11990A Option 033 System Add-On package contains the tracking generator tests.

Execution of the tests in this system software package is dependent on the HP 11990A Option 001 User Interface program, which automates the test process. Refer to Chapter 2, "Start-Up Procedures," for instructions to run the test software.

Option 200 Tests

Test Descriptions

This manual lists and describes all of the tests in this system software package. Pressing the softkey `ALL TESTS` invokes execution of the tests in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the system specification as found in the "Specifications" chapter of the *HP 70900 Local Oscillator Installation and Verification Manual*.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.
- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

When you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu, the Limited Cal tests are executed in a sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution.

Sweep Time Accuracy
Calibrator Frequency Accuracy
Gain Compression
Calibrator Amplitude Accuracy
Frequency Response
Frequency Span Accuracy
Image Responses (HP 70600A, HP 70601A)
Multiple Responses (HP 70600A, HP 70601A)
Displayed Average Noise
Residual Responses
Noise Sidebands
Line and System Related Sidebands
Step Gain Accuracy
Log Fidelity
Resolution Bandwidth Test

Sweep Time Accuracy

(HP 70900A or HP 70900B)

Tested Specification

SWEEP: Sweep Time: Accuracy

Equipment

Universal counter

Equipment Setup

The H SWP output on the rear panel of the HP 70900 local oscillator is connected to the input of the universal counter. If an HP 70700A digitizer is in the system, the H SWP line from the HP 70900 must also be connected to the digitizer rear-panel HI SWP connector.

Description

Several different spectrum-analyzer sweep times are selected to exercise the hardware fully. For each selected sweep time, the DUT is set for a span of 0 Hz and a sweep is triggered. The sweep time is then measured with the universal counter. Sweep times are selected to turn on each of the 12 bits of the sweep DAC. Only one bit is on at a time except when the lower six bits are tested; then bit 6 is also on.

If the HP 70700A digitizer is in the system, then its hardware must also be tested. Several more sweep times are chosen to test: fast sweep times at multiples of the digitizer's clock rate, worst-case resolution errors, and long sample rates.

Uncertainties

The following characteristics contribute to uncertainties:

- Universal counter resolution
- Universal counter accuracy

Test Mode

This test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Calibrator Frequency Accuracy

(HP 70900A or HP 70900B)

Tested Specification

FREQUENCY: Frequency Reference Accuracy: Aging

Equipment

Frequency counter

Equipment Setup

The CALIBRATOR output of the HP 70900 is connected to the input of the frequency counter.

Description

With the spectrum analyzer (DUT) set to its internal frequency reference, the frequency counter is used to measure the 300 MHz CALIBRATOR frequency.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base stability

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Second Harmonic Distortion

(HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Second Harmonic Distortion

Equipment

Level generator
12 MHz low-pass filter

Equipment Setup

Connect the 50 Ω output of the level generator through a 12 MHz low-pass filter to the RF INPUT of the spectrum analyzer (DUT).

Description

The second harmonic distortion of the DUT is measured at 9 and 11 MHz. The DUT auto-zoom function is used to tune the level-generator signal in a 50 Hz span. Carrier amplitude and frequency are measured. The DUT center frequency is then tuned to the second harmonic, and the amplitude of the internally generated second harmonic is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT flatness
- DUT log fidelity
- DUT calibrator amplitude accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section
- Preselector

Third Order IMD

(HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Spurious Responses: Third-Order Intermodulation Distortion

Equipment

Level generator
General source
50 MHz low-pass filter
Directional bridge

Equipment Setup

Connect the common port of the directional bridge to the RF INPUT of the DUT. Connect the 50 Ω output of the level generator through a 50 MHz low-pass filter to one of the unused directional-bridge connectors. Connect the RF OUTPUT of the general source to another unused directional-bridge connector.

Description

The third-order intermodulation (TOI) of the DUT is measured at approximately 45 MHz using the 3 kHz resolution bandwidth (100 kHz in the HP 70903A). It is tested at several signal separations.

First, the amplitude of the general-source output is measured to establish the TOI reference amplitude level. Then the amplitude of the level-generator output is measured to establish the signal level. The upper third-order-product signal level is then measured, and the equivalent TOI is calculated as follows:

$$[(\text{signal level}) - (\text{DUT input atten. setting})] + \left[\frac{(\text{TOI reference ampl.}) - (\text{third}-\text{order ampl.})}{2}\right]$$

This procedure is repeated for the lower TOI product. The smaller value of the equivalent TOI is retained.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT absolute frequency response referenced to 300 MHz
- DUT marker amplitude resolution
- DUT calibrator amplitude accuracy
- DUT resolution bandwidth amplitude switching
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section
- Preselector

Gain Compression

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Gain Compression

Equipment

Level generator
Measurement receiver
Sensor module

Equipment Setup

The level generator is connected to the RF INPUT of the spectrum analyzer (DUT). The sensor-module output is connected to the measurement receiver. The sensor-module input is connected to the front-panel IF OUTPUT on the HP 70902A or HP 70903A.

Description

The level generator is set to produce a signal within the range of the DUT. The DUT is tuned to this signal, and the input attenuator is set to 10 dB. The DUT is set to zero span and the level generator is tuned to the center of the DUT passband.

The amplitude of the level generator is adjusted until a signal of −30 dBm or less is at the DUT input mixer. The measurement receiver then measures signal path gain; this value is used as the reference for no gain compression.

The level-generator amplitude is increased to produce a signal of −10 dBm at the DUT input mixer. The measurement receiver again measures signal path gain. The difference between the two gain measurements is the gain compression.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Measurement receiver relative accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section
- Preselector

Calibrator Amplitude Accuracy

(HP 70900A or HP 70900B)

Tested Specification

AMPLITUDE ACCURACY: Calibrator Uncertainty

Equipment

Power meter
RF power sensor or microwave power sensor

Equipment Setup

Connect the power sensor to the spectrum analyzer (DUT) CALIBRATOR output connector.

Description

After zeroing and calibrating the power meter, the power sensor is connected to the DUT CALIBRATOR output. The calibrator amplitude is measured and corrected using the calibration factor of the power sensor.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between power sensor and CALIBRATOR output connector

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Frequency Response (HP 70905A, HP 70906A)

Tested Specification

AMPLITUDE ACCURACY: Frequency Response

Equipment

Microwave source
Level generator (not needed for Limited Cal)
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Connect the RF OUTPUT of the microwave source to the input port of the power splitter. Connect one output of the power splitter to the RF INPUT of the DUT. With the power sensor connected to the power meter, connect the other output of the power splitter to the power sensor.

For frequencies less than 50 MHz, connect the OUTPUT of the level generator to the RF INPUT of the DUT.

Description

The power meter is calibrated. The input attenuator of the DUT is set to 10 dB. The microwave source output level is adjusted for a power-meter reading of −10 dBm at 300 MHz. The DUT marker amplitude is read to establish a reference. A minimum of 30 measurements are made in each frequency band above 50 MHz.

For frequencies less than 50 MHz, frequency response is measured with the level generator. The level-generator output level is adjusted to produce the same DUT marker amplitude as that using the previous setup.

The frequency response data is available in graph mode.

Uncertainties

The following characteristics contribute to uncertainties:

All Frequencies

DUT marker amplitude resolution

Frequencies >50 MHz

Power splitter tracking

Power meter accuracy

Mismatch between DUT and power splitter

Mismatch between power sensor and power splitter

Frequencies <50 MHz

Level generator flatness

Mismatch between DUT and level generator

Test Mode

The test is run for frequencies greater than 50 MHz in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Frequency Response (HP 70600A, HP 70601A)

Tested Specification

AMPLITUDE ACCURACY: Frequency Response
(absolute and relative in all bypassed and preselected bands)

Equipment

Microwave source
Level generator (not needed for Limited Cal)
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70600A or HP 70601A RF INPUT to calibrate the preselected front end.

Setup B: Connect the source output to the input connector of the power splitter. Connect one output of the power splitter to the RF INPUT of the HP 70600A or HP 70601A preselector. Connect the other output from the power splitter to the power sensor, which is connected to the power meter.

Setup C: (For measurements below 50 MHz only) Connect the level-generator output to the RF INPUT of the HP 70600A or HP 70601A Preselector.

Description

The algorithm used in this test is the same as for the HP 70905A and HP 70906A RF section verification tests. The difference is that this test is run twice, once in the preselected mode and once in the bypass mode. In the preselected mode, the preselector is peaked before making each measurement. For both modes, the measurements are made in 3 kHz resolution bandwidth when the HP 70902A IF section is in the system. The purpose of using this bandwidth is to eliminate any local oscillator drift during preselector peaking. If only the wide-band HP 70903A IF section is in the system, the 300 kHz resolution bandwidth is used.

Once the modular spectrum analyzer and power meter have been calibrated, setup B is verified and the HP 70600A or HP 70601A attenuator is set to 10 dB. Then the preselector mode is enabled. Next the source power level is adjusted for a power-meter reading of −10 dBm at 300 MHz. The amplitude of the preselector is then measured to set a reference amplitude.

Starting with the highest band, each band is path-locked while amplitude measurements are taken at various preselector frequencies with the power meter. If the preselected mode is enabled, the preselector is peaked in zero span prior to each measurement, then returned to

the test span. The difference between the power-meter reading and the measured amplitude of the preselector is the amplitude measurement error for the frequency measured.

In all modes except Limited Cal mode, frequencies below 50 MHz are measured using a level generator. Setup C is verified and various frequencies below 50 MHz are measured.

Next, the preselector bypass mode is enabled, and the measurements are repeated once, starting at the −10 dBm, 300 MHz reference amplitude measurement.

Uncertainties

The following characteristics contribute to uncertainties:

All Frequencies

DUT marker amplitude resolution

Frequencies >50 MHz

Power splitter tracking

Power meter accuracy

Mismatch between DUT and power splitter

Mismatch between power sensor and power splitter

Frequencies <50 MHz

Level generator flatness

Mismatch between DUT and level generator

Test Mode

This test is run in Limited Cal mode for frequencies greater than 50 MHz.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Preselector
- RF section

Frequency Readout Accuracy

Tested Specification

FREQUENCY: Frequency Readout Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

Frequency readout accuracy is tested at a maximum of eight frequencies and four spans. For each span and source frequency, the frequency readout of the DUT is compared to that of a synthesized source. The source is set to the selected center frequency of the DUT. The signal is marker-peaked. The deviation between the marker frequency readout and the center frequency is the frequency error. This test is performed with the DUT referenced to the internal frequency reference.

If the signal amplitude is close to the noise level due to a cable that has a large amount of signal loss, the measurement is not recorded.

If the HP 70700A digitizer is in the system, the entire test is repeated with the external digitizer selected. In addition, extra frequencies are selected to check the area of band crossings in microwave systems.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

This test is not run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Frequency Span Accuracy

Tested Specification

FREQUENCY: Frequency Span: Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

The DUT center frequency is set to 1.5 GHz, and spans of 10 kHz, 100 kHz, 1 MHz, 10 MHz, 10.01 MHz, 101 MHz, and 1.01 GHz are tested. The synthesizer frequency is adjusted until a signal appears near the left edge of the display. The frequency of this point and several other points in the span are noted by using marker peak. The deviation between the marker frequency and the synthesizer frequency is the absolute error. The maximum frequency span error is calculated by taking the difference between the maximum and minimum absolute errors.

This test is performed with the DUT referenced to the internal frequency reference.

If the HP 70700A digitizer is in the system, the test is repeated with the external digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

A limited version of this test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Image Responses (HP 70905A or HP 70906A)

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the microwave source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source and DUT are tuned to a frequency of 250 MHz. The DUT marker is used to determine carrier amplitude.

The source is then tuned to image frequencies, and image amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- Clean source relative flatness

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Image Response (HP 70600A, HP 70601A)

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses
(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70600A or HP 70601A RF INPUT, to calibrate the preselected front end.

Setup B: Connect the source output to the RF INPUT of the HP 70600A or HP 70601A preselector.

Description

This test measures image responses for offsets of twice the IF frequency from the center frequency on the spectrum analyzer under test. These offsets are 6 MHz, 42.8 MHz, and 642.8 MHz. The five tuning bands (1H−, 1L−, 2L−, 3L+, 4L+) are tested in the preselected mode only. For bands 0 to 12.7 GHz, attenuation is set to 10 dB; for bands 12.5 to 22 GHz, attenuation is set to 0 dB to maximize dynamic range. In the 12.5 to 22 GHz bands, the preselector is peaked in zero span, then returned to the test span.

An output from the source is applied to the HP 70600A or HP 70601A preselector RF INPUT and a reference amplitude is obtained. The source frequency is then changed to an offset of twice the IF frequency, and the peak amplitude is read. The difference between the reference amplitude and the peak amplitude equals the image amplitude in dBc. If the test frequency fails specifications, it will be retested in a narrower resolution bandwidth and video bandwidth to reduce noise contributions.

In Limited Cal mode, the 6 MHz and 42.8 MHz image frequencies are tested only in the low-pass filter mode, and the 642.8 MHz image frequency is tested in all bands.

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

Test Mode

This test is run in Limited Cal.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Preselector
- RF section

Multiple Responses (HP 70600A, HP 70601A)

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Multiple Responses

(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70600A or HP 70601A RF INPUT to calibrate the preselected front end.

Setup B: Connect the source to the RF INPUT of the HP 70600A or HP 70601A preselector.

Description

This test measures multiple responses of an HP 71201A microwave spectrum analyzer. All five tuning bands (1H−, 1L−, 2L−, 3L+, 4L+) are tested in the preselected mode only. For bands 0 to 12.7 GHz, attenuation is set to 10 dB; for bands 12.5 to 22 GHz, attenuation is set to 0 dB to maximize dynamic range. In the 12.5 to 22 GHz bands, the preselector is peaked in zero span, then is returned to the test span.

A list of source frequencies is generated that should produce a multiple response corresponding to a given center frequency. The source frequency is set to the center frequency and a reference amplitude is obtained. Next, the source frequency is set to frequencies on the list where a response level is obtained for each of the frequencies. The difference between the amplitudes of the reference frequency and the level of each list frequency is the multiple response amplitude in dBc. If the test results plus the maximum amplitude error due to the IF response time is close to specification, the multiple response is measured again at a slower sweep rate to reduce the IF response-time error.

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section
- Preselector

Displayed Average Noise

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Displayed Average Noise Level

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the spectrum analyzer (DUT) RF INPUT.

Description

The average displayed noise level is measured at the frequency of the displayed peak in each band, except below 10 MHz where 10 data points are taken.

When the DUT system has an HP 70902A, a resolution bandwidth of 10 Hz and a video bandwidth of 3 Hz are used. When the DUT system has an HP 70903A, a resolution bandwidth of 100 kHz and a video bandwidth of 300 Hz are used. A sweep is taken and trace information is averaged.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- IF section
- RF section
- Preselector

Residual Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Residual Responses

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the RF INPUT of the spectrum analyzer (DUT).

Description

The input attenuator of the DUT is set to 0 dB. The frequencies at which residual responses may occur are calculated and the DUT is tuned to these frequencies. The residual product level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section
- Preselector

Noise Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Noise Sidebands (dBc/Hz)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

HP 70900A: The noise sidebands are measured at 40 offset frequencies from 100 Hz to 1 MHz.
HP 70900B: The noise sidebands are measured at an offset frequency of 10 kHz.

The DUT is set for 0 dB attenuation and a span of 0 Hz. The signal amplitude is adjusted to the reference level, which is the carrier level. The source carrier frequency is increased by the amount of offset frequency. The resolution bandwidth of the DUT is set to 3% of the offset frequency, and the reference level is reduced by 20 dB. A sweep is taken and the data is averaged. The data is normalized to a 1 Hz bandwidth and corrected for log detection and noise bandwidth.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- DUT resolution bandwidth amplitude correction
- DUT resolution bandwidth 3 dB accuracy
- DUT noise floor error
- Clean source phase-noise level

Test Mode

This test is run in Limited Cal mode at 796.12 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- RF section
- Preselector

Line and System Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Line- and system-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source is set for an amplitude of −10 dBm. Line- and system-related sidebands are tested at frequencies of 15, 1200, and 2500 MHz. The signal is peaked on the DUT and set to the reference level.

The source is then offset by known sideband frequencies, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode at 15 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Synthesis Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Synthesis-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

The RF OUTPUT of the clean source is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

Based on the center frequency tuning equations, the DUT is tuned to frequencies where synthesis-related sidebands may exist. The source carrier level is measured. Then the source frequency is increased to place the sideband on-screen, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Step Gain Accuracy

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: IF Gain Uncertainty

Equipment

Level generator
Voltmeter

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT). Connect the voltmeter to the DUT front-panel VIDEO output.

Description

The spectrum analyzer is set for a reference level and RF attenuator setting that corresponds to 0 dB IF Gain. The level generator is set to +12 dBm and the voltmeter is read to establish a reference voltage.

The reference level is then decreased 10 dB. The level-generator output is adjusted, if necessary, until the reference voltage is reached. The difference between voltage readings is the IF gain error. Repeat this for each IF gain step.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Voltmeter ac measurement accuracy
- DUT marker amplitude resolution
- DUT log scale fidelity incremental accuracy (corrected)

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Log Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Log

Equipment

Level generator

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

This test measures the relative on-screen log scale fidelity (that is, the display CRT's upper eight divisions for the HP 70903A, or upper nine divisions for the HP 70902A).

The DUT is set for a reference level of +10 dBm, span of 0 Hz, and a resolution bandwidth of 100 kHz (HP 70903A) or 100 Hz (HP 70902A). The level-generator frequency is adjusted to peak the detected signal, and the amplitude is adjusted to set the signal at the reference level. The difference between the level generator and marker amplitudes establishes a reference error at this point.

The level generator is stepped down in 1 dB increments (2 dB in Limited Cal and All Tests modes) until the signal is 75 to 90 dB below top-screen. The actual level depends on the IF and RF being tested. In the last 20 dB of the log range, the sweep time is increased to lessen the effects of the reduced signal-to-noise ratio. The amplitude difference between the level generator and the displayed trace average is measured. Once all measurements have been made, the data is normalized to −10 dB of top-screen. If the HP 70700A digitizer is in the system, the test is repeated with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution.

Test Mode

This test is run in Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Resolution Bandwidth Tests

(for HP 70902A or HP 70903A)

Tested Specifications

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
FREQUENCY: Resolution Bandwidths (−3 dB), Accuracy
FREQUENCY: Resolution Bandwidths (−3 dB), Selectivity

Equipment

Level generator

Equipment Setup

Connect the RF OUTPUT of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

Bandwidth switching variation is tested by setting a reference value at the widest resolution bandwidth. The DUT resolution bandwidth is then stepped down in a 1, 3, 10 sequence and the amplitude variation from the widest bandwidth is recorded. The data is then normalized to the reference bandwidth (100 Hz, HP 70902A; 300 kHz, HP 70903A).

The 3 dB (or 60 dB) points of the resolution bandwidth response are tested as follows. The DUT is set to the 0 Hz span and the level-generator frequency is adjusted to peak the response. The level-generator amplitude is then stepped down 3 dB to establish a reference value. The level- generator amplitude is then returned to the original value and the frequency is decreased until the 3 dB reference amplitude is reached. This establishes the lower 3 dB frequency point. The level-generator frequency is then increased until the upper 3 dB point is found. The difference in level-generator frequencies is the 3 dB bandwidth. This procedure may be repeated to determine the 60 dB points of the resolution bandwidth response.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Level generator frequency accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode for some bandwidths.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Linear Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Linear

Equipment

Level generator

Equipment Setup

The 50 Ω output of the level generator is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

The HP 70902A test sets the resolution bandwidth to 30 kHz; the HP 70903A test sets the resolution bandwidth to 1 MHz. The LIN display mode is selected. The level generator is set to provide a signal near the reference level.

The spectrum analyzer marker is peaked. The reference level is set at the peaked value to establish a reference at the top of the display.

The level generator is stepped down in 2 dB increments (4 dB for All Tests mode). The variation between the level-generator amplitude and DUT marker amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

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HP 11990A Option 209 System Software Package

Introduction

The HP 11990A Option 209 System Software package provides all test software required to verify that an HP 71209A, HP 71209C, or HP 71250C spectrum analyzer meets all of its major specifications. This software package consists of this manual and one test disk (Test Disk 1). A System Add-On package may be needed to test modules that are not part of a predefined system. For example, although the tracking generator tests are listed in the Test Menu, these tests are not included in the system software package. The HP 11990A Option 033 System Add-On package contains the tracking generator tests.

Execution of the tests in this system software package is dependent on the HP 11990A Option 001 User Interface program, which automates the test process. Refer to Chapter 2, "Start-Up Procedures," for instructions to run the test software.

Option 209 Tests

Test Descriptions

This manual lists and describes all of the tests in this system software package. Pressing the softkey `ALL TESTS` invokes execution of the tests in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the system specification as found in the "Specifications" chapter of the *HP 70900 Local Oscillator Installation and Verification Manual*.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.
- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

When you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu, the Limited Cal tests are executed in a sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution.

Sweep Time Accuracy
Calibrator Frequency Accuracy
Gain Compression
Calibrator Amplitude Accuracy
Frequency Response
Frequency Span Accuracy
Image Response
Multiple Responses
Displayed Average Noise
Residual Responses
Noise Sidebands
Line and System Related Sidebands
Step Gain Accuracy
Log Fidelity
Resolution Bandwidth Test

Sweep Time Accuracy

(HP 70900A or HP 70900B)

Tested Specification

SWEEP: Sweep Time: Accuracy

Equipment

Universal counter

Equipment Setup

The H SWP output on the rear panel of the HP 70900 local oscillator is connected to the input of the universal counter. If an HP 70700A digitizer is in the system, the H SWP line from the HP 70900 must also be connected to the digitizer rear-panel HI SWP connector.

Description

Several different spectrum-analyzer sweep times are selected to exercise the hardware fully. For each selected sweep time, the DUT is set for a span of 0 Hz and a sweep is triggered. The sweep time is then measured with the universal counter. Sweep times are selected to turn on each of the 12 bits of the sweep DAC. Only one bit is on at a time except when the lower six bits are tested; then bit 6 is also on.

If the HP 70700A digitizer is in the system, then its hardware must also be tested. Several more sweep times are chosen to test: fast sweep times at multiples of the digitizer's clock rate, worst-case resolution errors, and long sample rates.

Uncertainties

The following characteristics contribute to uncertainties:

- Universal counter resolution
- Universal counter accuracy

Test Mode

This test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Calibrator Frequency Accuracy

(HP 70900A or HP 70900B)

Tested Specification

FREQUENCY: Frequency Reference Accuracy: Aging

Equipment

Frequency counter

Equipment Setup

The CALIBRATOR output of the HP 70900 is connected to the input of the frequency counter.

Description

With the spectrum analyzer (DUT) set to its internal frequency reference, the frequency counter is used to measure the 300 MHz CALIBRATOR frequency.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base stability

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Second Harmonic Distortion

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Second Harmonic Distortion

Equipment

Level generator
12 MHz low-pass filter

Equipment Setup

Connect the 50 Ω output of the level generator through a 12 MHz low-pass filter to the RF INPUT of the spectrum analyzer (DUT).

Description

The second harmonic distortion of the DUT is measured at 9 and 11 MHz. The DUT auto-zoom function is used to tune the level-generator signal in a 50 Hz span. Carrier amplitude and frequency are measured. The DUT center frequency is then tuned to the second harmonic, and the amplitude of the internally generated second harmonic is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT flatness
- DUT log fidelity
- DUT calibrator amplitude accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Third Order IMD

(HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Spurious Responses: Third-Order Intermodulation Distortion

Equipment

Level generator
General source
50 MHz low-pass filter
Directional bridge

Equipment Setup

Connect the common port of the directional bridge to the RF INPUT of the DUT. Connect the 50 Ω output of the level generator through a 50 MHz low-pass filter to one of the unused directional-bridge connectors. Connect the RF OUTPUT of the general source to another unused directional-bridge connector.

Description

The third-order intermodulation (TOI) of the DUT is measured at approximately 45 MHz using the 3 kHz resolution bandwidth (100 kHz in the HP 70903A). It is tested at several signal separations.

First, the amplitude of the general-source output is measured to establish the TOI reference amplitude level. Then the amplitude of the level-generator output is measured to establish the signal level. The upper third-order-product signal level is then measured, and the equivalent TOI is calculated as follows:

$$[(\text{signal level}) - (\text{DUT input atten. setting})] + \left[\frac{(\text{TOI reference ampl.}) - (\text{third}-\text{order ampl.})}{2}\right]$$

This procedure is repeated for the lower TOI product. The smaller value of the equivalent TOI is retained.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT absolute frequency response referenced to 300 MHz
- DUT marker amplitude resolution
- DUT calibrator amplitude accuracy
- DUT resolution bandwidth amplitude switching
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Gain Compression

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Gain Compression

Equipment

Level generator
Measurement receiver
Sensor module

Equipment Setup

The level generator is connected to the RF INPUT of the spectrum analyzer (DUT). The sensor-module output is connected to the measurement receiver. The sensor-module input is connected to the front-panel IF OUTPUT on the HP 70902A or HP 70903A.

Description

The level generator is set to produce a signal within the range of the DUT. The DUT is tuned to this signal, and the input attenuator is set to 10 dB. The DUT is set to zero span and the level generator is tuned to the center of the DUT passband.

The amplitude of the level generator is adjusted until a signal of −30 dBm or less is at the DUT input mixer. The measurement receiver then measures signal path gain; this value is used as the reference for no gain compression.

The level-generator amplitude is increased to produce a signal of −10 dBm at the DUT input mixer. The measurement receiver again measures signal path gain. The difference between the two gain measurements is the gain compression.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Measurement receiver relative accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Calibrator Amplitude Accuracy

(HP 70900A or HP 70900B)

Tested Specification

AMPLITUDE ACCURACY: Calibrator Uncertainty

Equipment

Power meter
RF power sensor or microwave power sensor

Equipment Setup

Connect the power sensor to the spectrum analyzer (DUT) CALIBRATOR output connector.

Description

After zeroing and calibrating the power meter, the power sensor is connected to the DUT CALIBRATOR output. The calibrator amplitude is measured and corrected using the calibration factor of the power sensor.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between power sensor and CALIBRATOR output connector

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Frequency Response (HP 70908A)

Tested Specification

AMPLITUDE ACCURACY: Frequency Response

Equipment

Microwave source
Level generator (not needed for Limited Cal)
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Connect the RF OUTPUT of the microwave source to the input port of the power splitter. Connect one output of the power splitter to the RF INPUT of the DUT. With the power splitter connected to the power meter, connect the other output of the power splitter to the power sensor.

For frequencies less than 50 MHz, connect the OUTPUT of the level generator to the RF INPUT of the DUT.

Description

The power meter is calibrated. The input attenuator of the DUT is set to 10 dB. The microwave source output level is adjusted for a power-meter reading of −10 dBm at 300 MHz. The DUT marker amplitude is read to establish a reference. A minimum of 30 measurements are made in each frequency band above 50 MHz.

For frequencies less than 50 MHz, frequency response is measured with the level generator. The level-generator output level is adjusted to produce the same DUT marker amplitude as that using the previous setup.

The frequency response data is available in graph mode.

Uncertainties

The following characteristics contribute to uncertainties:

All Frequencies

DUT marker amplitude resolution

Frequencies >50 MHz

Power splitter tracking

Power meter accuracy

Mismatch between DUT and power splitter

Mismatch between power sensor and power splitter

Frequencies <50 MHz

Level generator flatness

Mismatch between DUT and level generator

Test Mode

This test is run in Limited Cal mode for frequencies greater than 50 MHz.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Frequency Readout Accuracy

Tested Specification

FREQUENCY: Frequency Readout Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

Frequency readout accuracy is tested at a maximum of eight frequencies and four spans. For each span and source frequency, the frequency readout of the DUT is compared to that of a synthesized source. The source is set to the selected center frequency of the DUT. The signal is marker-peaked. The deviation between the marker frequency readout and the center frequency is the frequency error. This test is performed with the DUT referenced to the internal frequency reference.

If the signal amplitude is close to the noise level due to a cable that has a large amount of signal loss, the measurement is not recorded.

If the HP 70700A digitizer is in the system, the entire test is repeated with the external digitizer selected. In addition, extra frequencies are selected to check the area of band crossings in microwave systems.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

This test is not run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Frequency Span Accuracy

Tested Specification

FREQUENCY: Frequency Span: Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

The DUT center frequency is set to 1.5 GHz, and spans of 10 kHz, 100 kHz, 1 MHz, 10 MHz, 10.01 MHz, 101 MHz, and 1.01 GHz are tested. The synthesizer frequency is adjusted until a signal appears near the left edge of the display. The frequency of this point and several other points in the span are noted by using marker peak. The deviation between the marker frequency and the synthesizer frequency is the absolute error. The maximum frequency span error is calculated by taking the difference between the maximum and minimum absolute errors.

This test is performed with the DUT referenced to the internal frequency reference.

If the HP 70700A digitizer is in the system, the test is repeated with the external digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

A limited version of this test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Image Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses
(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70908A RF INPUT, to calibrate the preselected front end.

Setup B: Connect the source output to the RF INPUT of the HP 70908A RF section.

Description

This test measures image responses for offsets of twice the IF frequency from the center frequency on the spectrum analyzer under test. These offsets are 6 MHz, 42.8 MHz, and 642.8 MHz. All four tuning bands (1H−, 1L−, 2L−, 4L−) are tested.

An output from the source is applied to the HP 70908A RF INPUT and a reference amplitude is obtained. The source frequency is then changed to an offset of twice the IF frequency, and the peak amplitude is read. The difference between the reference amplitude and the peak amplitude equals the image amplitude in dBc. If the test frequency fails specifications, it will be retested in a narrower resolution bandwidth and video bandwidth to reduce noise contributions.

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Multiple Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Multiple Responses
(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70908A RF INPUT to calibrate the preselected front end.

Setup B: Connect the source to the RF INPUT of the HP 70908A RF section.

Description

This test measures multiple responses of an HP 71210 spectrum analyzer. All four tuning bands (1H−, 1L−, 2L−, 4L−) are tested.

A list of source frequencies is generated that should produce a multiple response corresponding to a given center frequency. The source frequency is set to the center frequency and a reference amplitude is obtained. Next, the source frequency is set to frequencies on the list where a response level is obtained for each of the frequencies. The difference between the amplitudes of the reference frequency and the level of each listed frequency is the multiple response amplitude in dBc. If the test results plus the maximum amplitude error due to the IF response time are close to specification, the multiple response is measured again at a slower sweep rate to reduce the IF response-time error.

In single mode, the center frequency is stepped up in 500 MHz increments. In all other test modes, it is stepped up in 1 GHz increments (27 measurements).

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Displayed Average Noise

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Displayed Average Noise Level

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the spectrum analyzer (DUT) RF INPUT.

Description

The average displayed noise level is measured at the frequency of the displayed peak in each band, except below 10 MHz where 10 data points are taken.

When the DUT system has an HP 70902A, a resolution bandwidth of 10 Hz and a video bandwidth of 3 Hz are used. When the DUT system has an HP 70903A, a resolution bandwidth of 100 kHz and a video bandwidth of 300 Hz are used. A sweep is taken and trace information is averaged.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- IF section
- RF section

Residual Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Residual Responses

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the RF INPUT of the spectrum analyzer (DUT).

Description

The input attenuator of the DUT is set to 0 dB. The frequencies at which residual responses may occur are calculated and the DUT is tuned to these frequencies. The residual product level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Noise Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Noise Sidebands (dBc/Hz)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

HP 70900A: The noise sidebands are measured at 40 offset frequencies from 100 Hz to 1 MHz.
HP 70900B: The noise sidebands are measured at an offset frequency of 10 kHz.

The DUT is set for 0 dB attenuation and a span of 0 Hz. The signal amplitude is adjusted to the reference level, which is the carrier level. The source carrier frequency is increased by the amount of offset frequency. The resolution bandwidth of the DUT is set to 3% of the offset frequency, and the reference level is reduced by 20 dB. A sweep is taken and the data is averaged. The data is normalized to a 1 Hz bandwidth and corrected for log detection and noise bandwidth.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- DUT resolution bandwidth amplitude correction
- DUT resolution bandwidth 3 dB accuracy
- DUT noise floor error
- Clean source phase-noise level

Test Mode

This test is run in Limited Cal mode at 796.12 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- RF section

Line and System Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Line- and system-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source is set for an amplitude of −10 dBm. Line- and system-related sidebands are tested at frequencies of 15, 1200, and 2500 MHz. The signal is peaked on the DUT and set to the reference level.

The source is then offset by known sideband frequencies, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode at 15 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Synthesis Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Synthesis-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

The RF OUTPUT of the clean source is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

Based on the center frequency tuning equations, the DUT is tuned to frequencies where synthesis-related sidebands may exist. The source carrier level is measured. Then the source frequency is increased to place the sideband on-screen, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Step Gain Accuracy

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: IF Gain Uncertainty

Equipment

Level generator
Voltmeter

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT). Connect the voltmeter to the DUT front-panel VIDEO output.

Description

The spectrum analyzer is set for a reference level and RF attenuator setting that corresponds to 0 dB IF Gain. The level generator is set to +12 dBm and the voltmeter is read to establish a reference voltage.

The reference level is then decreased 10 dB. The level-generator output is adjusted, if necessary, until the reference voltage is reached. The difference between voltage readings is the IF gain error. Repeat this for each IF gain step.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Voltmeter ac measurement accuracy
- DUT marker amplitude resolution
- DUT log scale fidelity incremental accuracy (corrected).

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Log Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Log

Equipment

Level generator

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

This test measures the relative on-screen log scale fidelity (that is, the display CRT's upper eight divisions for the HP 70903A, or upper nine divisions for the HP 70902A).

The DUT is set for a reference level of +10 dBm, span of 0 Hz, and a resolution bandwidth of 100 kHz (HP 70903A) or 100 Hz (HP 70902A). The level-generator frequency is adjusted to peak the detected signal, and the amplitude is adjusted to set the signal at the reference level. The difference between the level generator and marker amplitudes establishes a reference error at this point.

The level generator is stepped down in 1 dB increments (2 dB in Limited Cal and All Tests modes) until the signal is 75 to 90 dB below top-screen. The actual level depends on the IF and RF being tested. In the last 20 dB of the log range, the sweep time is increased to lessen the effects of the reduced signal-to-noise ratio. The amplitude difference between the level generator and the displayed trace average is measured. Once all measurements have been made, the data is normalized to −10 dB of top-screen.

If the HP 70700A digitizer is in the system, the test is repeated with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Resolution Bandwidth Test

(for HP 70902A or HP 70903A)

Tested Specifications

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
FREQUENCY: Resolution Bandwidths (−3 dB), Accuracy
FREQUENCY: Resolution Bandwidths (−3 dB), Selectivity

Equipment

Level generator

Equipment Setup

Connect the RF OUTPUT of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

Bandwidth switching variation is tested by setting a reference value at the widest resolution bandwidth. The DUT resolution bandwidth is then stepped down in a 1, 3, 10 sequence and the amplitude variation from the widest bandwidth is recorded. The data is then normalized to the reference bandwidth (100 Hz, HP 70902A; 300 kHz, HP 70903A).

The 3 dB (or 60 dB) points of the resolution bandwidth response are tested as follows. The DUT is set to the 0 Hz span and the level-generator frequency is adjusted to peak the response. The level-generator amplitude is then stepped down 3 dB to establish a reference value. The level- generator amplitude is then returned to the original value and the frequency is decreased until the 3 dB reference amplitude is reached. This establishes the lower 3 dB frequency point. The level-generator frequency is then increased until the upper 3 dB point is found. The difference in level-generator frequencies is the 3 dB bandwidth. This procedure may be repeated to determine the 60 dB points of the resolution bandwidth response.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Level generator frequency accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode for some bandwidths.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Linear Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Linear

Equipment

Level generator

Equipment Setup

The 50 Ω output of the level generator is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

The HP 70902A test sets the resolution bandwidth to 30 kHz; the HP 70903A test sets the resolution bandwidth to 1 MHz. The LIN display mode is selected. The level generator is set to provide a signal near the reference level.

The spectrum analyzer marker is peaked. The reference level is set at the peaked value to establish a reference at the top of the display.

The level generator is stepped down in 2 dB increments (4 dB for All Tests mode). The variation between the level-generator amplitude and DUT marker amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy.
- DUT marker amplitude resolution

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Bandwidth

(for HP 70910A)

Tested Specification

OUTPUT: 321.4 MHz Output (rear-panel); 3 dB bandwidth

Equipment

Microwave source
Spectrum analyzer
Frequency reference
Power meter
Microwave power sensor

Equipment Setup

The microwave source is connected to the HP 70910A RF INPUT port. The RF or microwave power sensor is connected to the rear-panel 321.4 MHz output port on the HP 70910A. The microwave source and the spectrum analyzer containing the HP 70910A must share a common frequency reference.

Description

The spectrum analyzer is tuned to the test frequency with a span of 0 Hz. The microwave source is tuned to the same CW frequency at a specified amplitude. The preselector filter in the HP 70910A is peaked, then the power at the rear-panel 321.4 MHz output port is measured with the power sensor. The source is tuned to a point on the skirt of the preselector filter defined by the offset frequency. While monitoring the power out the rear-panel 321.4 MHz port with the power sensor, the source is adjusted to the −3 dB point and the source frequency is saved. This routine is repeated for the other side of the filter. The 3 dB bandwidth is calculated by subtracting the frequency of the lower 3 dB point from the upper 3 dB point. The 3 dB bandwidth is checked at ten different center frequencies, then the measurement error is subtracted from the bandwidth and is compared against the module specification.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter error
- Mismatch error

Test Mode

This test is run in Limited Cal mode and should be run after the module has been repaired.

In Case of Failure

Verify the microwave source, spectrum analyzer, and DUT all share a common frequency reference.

Verify alignment of the HP 70910A RF section preselector.

Local Oscillator (LO) Output Amplitude

Tested Specification

OUTPUT: HP 70909A or HP 70910A LO Output (front panel)

Equipment

Power meter
Microwave power sensor

Equipment Setup

Setup A: If necessary, connect the microwave power sensor to the POWER REF OUTPUT of the power meter for calibration.

Setup B: Connect the microwave power sensor to the LO OUTPUT of the HP 70909A or HP 70910A.

Description

This test measures the output power that is available from the LO OUTPUT of the HP 70909A or HP 70910A (front panel) over the full tuning range of the HP 70900A/B local oscillator (3.0 to 6.0 GHz). The measurement is made using the microwave power sensor with the system set to zero span.

Uncertainties

The following characteristics contribute to uncertainties:

- Mismatch error
- Power meter error

Test Mode

This test is performed in Limited Cal mode.

In Case of Failure

Check the test setup. Make sure the appropriate correction factors are applied for the power sensor that is being used.

Check for any errors that are reported by the system. If any errors are reported, determine which module is reporting the error(s). Most probable cause of failure for this test is the HP 70909A or HP 70910A.

8

HP 11990A Option 210 System Software Package

Introduction

The HP 11990A Option 210 System Software package provides all test software required to verify that an HP 71210A, HP 71210C, or HP 71250C spectrum analyzer meets all of its major specifications. This software package consists of this manual and one test disk (Test Disk 1). A System Add-On package may be needed to test modules that are not part of a predefined system. For example, although the tracking generator tests are listed in the Test Menu, these tests are not included in the system software package. The HP 11990A Option 033 System Add-On package contains the tracking generator tests.

Execution of the tests in this system software package is dependent on the HP 11990A Option 001 User Interface program, which automates the test process. Refer to Chapter 2, "Start-Up Procedures," for instructions to run the test software.

Option 210 Tests

Test Descriptions

This manual lists and describes all of the tests in this system software package. Pressing the softkey `ALL TESTS` invokes execution of the tests in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the system specification as found in the "Specifications" chapter of the *HP 70900 Local Oscillator Installation and Verification Manual*.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.
- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

When you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu, the Limited Cal tests are executed in a sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution.

Sweep Time Accuracy
Calibrator Frequency Accuracy
Gain Compression
Calibrator Amplitude Accuracy
Frequency Response
Frequency Span Accuracy
Image Response
Multiple Responses
Displayed Average Noise
Residual Responses
Noise Sidebands
Line and System Related Sidebands
Step Gain Accuracy
Log Fidelity
Resolution Bandwidth Test

Sweep Time Accuracy

(HP 70900A or HP 70900B)

Tested Specification

SWEEP: Sweep Time: Accuracy

Equipment

Universal counter

Equipment Setup

The H SWP output on the rear panel of the HP 70900 local oscillator is connected to the input of the universal counter. If an HP 70700A digitizer is in the system, the H SWP line from the HP 70900 must also be connected to the digitizer rear-panel HI SWP connector.

Description

Several different spectrum-analyzer sweep times are selected to exercise the hardware fully. For each selected sweep time, the DUT is set for a span of 0 Hz and a sweep is triggered. The sweep time is then measured with the universal counter. Sweep times are selected to turn on each of the 12 bits of the sweep DAC. Only one bit is on at a time except when the lower six bits are tested; then bit 6 is also on.

If the HP 70700A digitizer is in the system, then its hardware must also be tested. Several more sweep times are chosen to test: fast sweep times at multiples of the digitizer's clock rate, worst-case resolution errors, and long sample rates.

Uncertainties

The following characteristics contribute to uncertainties:

- Universal counter resolution
- Universal counter accuracy

Test Mode

This test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Calibrator Frequency Accuracy

(HP 70900A or HP 70900B)

Tested Specification

FREQUENCY: Frequency Reference Accuracy: Aging

Equipment

Frequency counter

Equipment Setup

The CALIBRATOR output of the HP 70900 is connected to the input of the frequency counter.

Description

With the spectrum analyzer (DUT) set to its internal frequency reference, the frequency counter is used to measure the 300 MHz CALIBRATOR frequency.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base stability

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Second Harmonic Distortion

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Second Harmonic Distortion

Equipment

Level generator
12 MHz low-pass filter

Equipment Setup

Connect the 50 Ω output of the level generator through a 12 MHz low-pass filter to the RF INPUT of the spectrum analyzer (DUT).

Description

The second harmonic distortion of the DUT is measured at 9 and 11 MHz. The DUT auto-zoom function is used to tune the level-generator signal in a 50 Hz span. Carrier amplitude and frequency are measured. The DUT center frequency is then tuned to the second harmonic, and the amplitude of the internally generated second harmonic is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT flatness
- DUT log fidelity
- DUT calibrator amplitude accuracy

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Third Order IMD

(HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Spurious Responses: Third-Order Intermodulation Distortion

Equipment

Level generator
General source
50 MHz low-pass filter
Directional bridge

Equipment Setup

Connect the common port of the directional bridge to the RF INPUT of the DUT. Connect the 50 Ω output of the level generator through a 50 MHz low-pass filter to one of the unused directional-bridge connectors. Connect the RF OUTPUT of the general source to another unused directional-bridge connector.

Description

The third-order intermodulation (TOI) of the DUT is measured at approximately 45 MHz using the 3 kHz resolution bandwidth (100 kHz in the HP 70903A). It is tested at several signal separations.

First, the amplitude of the general-source output is measured to establish the TOI reference amplitude level. Then the amplitude of the level-generator output is measured to establish the signal level. The upper third-order-product signal level is then measured, and the equivalent TOI is calculated as follows:

$$[(\text{signal level}) - (\text{DUT input atten. setting})] + \left[\frac{(\text{TOI reference ampl.}) - (\text{third}-\text{order ampl.})}{2}\right]$$

This procedure is repeated for the lower TOI product. The smaller value of the equivalent TOI is retained.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT absolute frequency response referenced to 300 MHz
- DUT marker amplitude resolution
- DUT calibrator amplitude accuracy
- DUT resolution bandwidth amplitude switching
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Gain Compression

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Gain Compression

Equipment

Level generator
Measurement receiver
Sensor module

Equipment Setup

The level generator is connected to the RF INPUT of the spectrum analyzer (DUT). The sensor-module output is connected to the measurement receiver. The sensor-module input is connected to the front-panel IF OUTPUT on the HP 70902A or HP 70903A.

Description

The level generator is set to produce a signal within the range of the DUT. The DUT is tuned to this signal, and the input attenuator is set to 10 dB. The DUT is set to zero span and the level generator is tuned to the center of the DUT passband.

The amplitude of the level generator is adjusted until a signal of −30 dBm or less is at the DUT input mixer. The measurement receiver then measures signal path gain; this value is used as the reference for no gain compression.

The level-generator amplitude is increased to produce a signal of −10 dBm at the DUT input mixer. The measurement receiver again measures signal path gain. The difference between the two gain measurements is the gain compression.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Measurement receiver relative accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Calibrator Amplitude Accuracy

(HP 70900A or HP 70900B)

Tested Specification

AMPLITUDE ACCURACY: Calibrator Uncertainty

Equipment

Power meter
RF power sensor or microwave power sensor

Equipment Setup

Connect the power sensor to the spectrum analyzer (DUT) CALIBRATOR output connector.

Description

After zeroing and calibrating the power meter, the power sensor is connected to the DUT CALIBRATOR output. The calibrator amplitude is measured and corrected using the calibration factor of the power sensor.

Uncertainties

The following characteristics contribute to uncertainties:

- Power meter accuracy
- Mismatch between power sensor and CALIBRATOR output connector

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Frequency Response (HP 70908A)

Tested Specification

AMPLITUDE ACCURACY: Frequency Response

Equipment

Microwave source
Level generator (not needed for Limited Cal)
Power meter
Microwave power sensor
Power splitter

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Connect the RF OUTPUT of the microwave source to the input port of the power splitter. Connect one output of the power splitter to the RF INPUT of the DUT. With the power splitter connected to the power meter, connect the other output of the power splitter to the power sensor.

For frequencies less than 50 MHz, connect the OUTPUT of the level generator to the RF INPUT of the DUT.

Description

The power meter is calibrated. The input attenuator of the DUT is set to 10 dB. The microwave source output level is adjusted for a power-meter reading of −10 dBm at 300 MHz. The DUT marker amplitude is read to establish a reference. A minimum of 30 measurements are made in each frequency band above 50 MHz.

For frequencies less than 50 MHz, frequency response is measured with the level generator. The level-generator output level is adjusted to produce the same DUT marker amplitude as that using the previous setup.

The frequency response data is available in graph mode.

Uncertainties

The following characteristics contribute to uncertainties:

All Frequencies

DUT marker amplitude resolution

Frequencies >50 MHz

Power splitter tracking

Power meter accuracy

Mismatch between DUT and power splitter

Mismatch between power sensor and power splitter

Frequencies <50 MHz

Level generator flatness

Mismatch between DUT and level generator

Test Mode

This test is run in Limited Cal mode for frequencies greater than 50 MHz.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Frequency Readout Accuracy

Tested Specification

FREQUENCY: Frequency Readout Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

Frequency readout accuracy is tested at a maximum of eight frequencies and four spans. For each span and source frequency, the frequency readout of the DUT is compared to that of a synthesized source. The source is set to the selected center frequency of the DUT. The signal is marker-peaked. The deviation between the marker frequency readout and the center frequency is the frequency error. This test is performed with the DUT referenced to the internal frequency reference.

If the signal amplitude is close to the noise level due to a cable that has a large amount of signal loss, the measurement is not recorded.

If the HP 70700A digitizer is in the system, the entire test is repeated with the external digitizer selected. In addition, extra frequencies are selected to check the area of band crossings in microwave systems.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

This test is not run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Frequency Span Accuracy

Tested Specification

FREQUENCY: Frequency Span: Accuracy

Equipment

Synthesized source

Equipment Setup

Connect the RF OUTPUT of the synthesized source to the spectrum analyzer (DUT) RF INPUT.

Description

The DUT center frequency is set to 1.5 GHz, and spans of 10 kHz, 100 kHz, 1 MHz, 10 MHz, 10.01 MHz, 101 MHz, and 1.01 GHz are tested. The synthesizer frequency is adjusted until a signal appears near the left edge of the display. The frequency of this point and several other points in the span are noted by using marker peak. The deviation between the marker frequency and the synthesizer frequency is the absolute error. The maximum frequency span error is calculated by taking the difference between the maximum and minimum absolute errors.

This test is performed with the DUT referenced to the internal frequency reference.

If the HP 70700A digitizer is in the system, the test is repeated with the external digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Synthesized source time-base accuracy
- DUT marker frequency accuracy

Test Mode

A limited version of this test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Image Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses
(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70908A RF INPUT, to calibrate the preselected front end.

Setup B: Connect the source output to the RF INPUT of the HP 70908A RF section.

Description

This test measures image responses for offsets of twice the IF frequency from the center frequency on the spectrum analyzer under test. These offsets are 6 MHz, 42.8 MHz, and 642.8 MHz. All four tuning bands (1H−, 1L−, 2L−, 4L−) are tested.

An output from the source is applied to the HP 70908A RF INPUT and a reference amplitude is obtained. The source frequency is then changed to an offset of twice the IF frequency, and the peak amplitude is read. The difference between the reference amplitude and the peak amplitude equals the image amplitude in dBc. If the test frequency fails specifications, it will be retested in a narrower resolution bandwidth and video bandwidth to reduce noise contributions.

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- RF section

Multiple Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Multiple Responses
(in the low and preselected bands)

Equipment

Microwave source

Equipment Setup

Note A low-loss cable such as HP part number 8120-3124 must be used to connect the microwave source to the spectrum analyzer (DUT).

Setup A: Connect the HP 70900 local oscillator CALIBRATOR output to the HP 70908A RF INPUT to calibrate the preselected front end.

Setup B: Connect the source to the RF INPUT of the HP 70908A RF section.

Description

This test measures multiple responses of an HP 71210 spectrum analyzer. All four tuning bands (1H−, 1L−, 2L−, 4L−) are tested.

A list of source frequencies is generated that should produce a multiple response corresponding to a given center frequency. The source frequency is set to the center frequency and a reference amplitude is obtained. Next, the source frequency is set to frequencies on the list where a response level is obtained for each of the frequencies. The difference between the amplitudes of the reference frequency and the level of each listed frequency is the multiple response amplitude in dBc. If the test results plus the maximum amplitude error due to the IF response time are close to specification, the multiple response is measured again at a slower sweep rate to reduce the IF response-time error.

In single mode, the center frequency is stepped up in 500 MHz increments. In all other test modes, it is stepped up in 1 GHz increments (27 measurements).

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source flatness
- DUT marker amplitude resolution
- DUT step gain error
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Displayed Average Noise

(using HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Displayed Average Noise Level

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the spectrum analyzer (DUT) RF INPUT.

Description

The average displayed noise level is measured at the frequency of the displayed peak in each band, except below 10 MHz where 10 data points are taken.

When the DUT system has an HP 70902A, a resolution bandwidth of 10 Hz and a video bandwidth of 3 Hz are used. When the DUT system has an HP 70903A, a resolution bandwidth of 100 kHz and a video bandwidth of 300 Hz are used. A sweep is taken and trace information is averaged.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- IF section
- RF section

Residual Responses

(using HP 70902A)

Tested Specification

AMPLITUDE: Spurious Responses: Residual Responses

Equipment

50 Ω termination

Equipment Setup

Connect the 50 Ω termination to the RF INPUT of the spectrum analyzer (DUT).

Description

The input attenuator of the DUT is set to 0 dB. The frequencies at which residual responses may occur are calculated and the DUT is tuned to these frequencies. The residual product level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT step gain accuracy
- DUT log fidelity
- DUT resolution bandwidth amplitude switching accuracy
- DUT calibrator amplitude accuracy
- DUT RF attenuator switching accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- RF section

Noise Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Noise Sidebands (dBc/Hz)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

HP 70900A: The noise sidebands are measured at 40 offset frequencies from 100 Hz to 1 MHz.
HP 70900B: The noise sidebands are measured at an offset frequency of 10 kHz.

The DUT is set for 0 dB attenuation and a span of 0 Hz. The signal amplitude is adjusted to the reference level, which is the carrier level. The source carrier frequency is increased by the amount of offset frequency. The resolution bandwidth of the DUT is set to 3% of the offset frequency, and the reference level is reduced by 20 dB. A sweep is taken and the data is averaged. The data is normalized to a 1 Hz bandwidth and corrected for log detection and noise bandwidth.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- DUT resolution bandwidth amplitude correction
- DUT resolution bandwidth 3 dB accuracy
- DUT noise floor error
- Clean source phase-noise level

Test Mode

This test is run in Limited Cal mode at 796.12 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- RF section

Line and System Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Line- and system-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

Connect the RF OUTPUT of the clean source to the RF INPUT of the spectrum analyzer (DUT).

Description

The source is set for an amplitude of −10 dBm. Line- and system-related sidebands are tested at frequencies of 15, 1200, and 2500 MHz. The signal is peaked on the DUT and set to the reference level.

The source is then offset by known sideband frequencies, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is run in Limited Cal mode at 15 MHz only.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Synthesis Related Sidebands

(using HP 70902A)

Tested Specification

FREQUENCY: Spectral Purity: Synthesis-related sidebands (dBc)

Equipment

Clean source

Equipment Setup

The RF OUTPUT of the clean source is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

Based on the center frequency tuning equations, the DUT is tuned to frequencies where synthesis-related sidebands may exist. The source carrier level is measured. Then the source frequency is increased to place the sideband on-screen, and the sideband level is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Step Gain Accuracy

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: IF Gain Uncertainty

Equipment

Level generator
Voltmeter

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT). Connect the voltmeter to the DUT front-panel VIDEO output.

Description

The spectrum analyzer is set for a reference level and RF attenuator setting that corresponds to 0 dB IF Gain. The level generator is set to +12 dBm and the voltmeter is read to establish a reference voltage.

The reference level is then decreased 10 dB. The level-generator output is adjusted, if necessary, until the reference voltage is reached. The difference between voltage readings is the IF gain error. Repeat this for each IF gain step.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Voltmeter ac measurement accuracy
- DUT marker amplitude resolution
- DUT log scale fidelity incremental accuracy (corrected).

Test Mode

This test is run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF Section

Log Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Log

Equipment

Level generator

Equipment Setup

Connect the 50 Ω output of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

This test measures the relative on-screen log scale fidelity (that is, the display CRT's upper eight divisions for the HP 70903A, or upper nine divisions for the HP 70902A).

The DUT is set for a reference level of +10 dBm, span of 0 Hz, and a resolution bandwidth of 100 kHz (HP 70903A) or 100 Hz (HP 70902A). The level-generator frequency is adjusted to peak the detected signal, and the amplitude is adjusted to set the signal at the reference level. The difference between the level generator and marker amplitudes establishes a reference error at this point.

The level generator is stepped down in 1 dB increments (2 dB in Limited Cal and All Tests modes) until the signal is 75 to 90 dB below top-screen. The actual level depends on the IF and RF being tested. In the last 20 dB of the log range, the sweep time is increased to lessen the effects of the reduced signal-to-noise ratio. The amplitude difference between the level generator and the displayed trace average is measured. Once all measurements have been made, the data is normalized to −10 dB of top-screen.

If the HP 70700A digitizer is in the system, the test is repeated with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF Section

Resolution Bandwidth Test

(for HP 70902A or HP 70903A)

Tested Specifications

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
FREQUENCY: Resolution Bandwidths (−3 dB), Accuracy
FREQUENCY: Resolution Bandwidths (−3 dB), Selectivity

Equipment

Level generator

Equipment Setup

Connect the RF OUTPUT of the level generator to the RF INPUT of the spectrum analyzer (DUT).

Description

Bandwidth switching variation is tested by setting a reference value at the widest resolution bandwidth. The DUT resolution bandwidth is then stepped down in a 1, 3, 10 sequence and the amplitude variation from the widest bandwidth is recorded. The data is then normalized to the reference bandwidth (100 Hz, HP 70902A; 300 kHz, HP 70903A).

The 3 dB (or 60 dB) points of the resolution bandwidth response are tested as follows. The DUT is set to the 0 Hz span and the level-generator frequency is adjusted to peak the response. The level-generator amplitude is then stepped down 3 dB to establish a reference value. The level- generator amplitude is then returned to the original value and the frequency is decreased until the 3 dB reference amplitude is reached. This establishes the lower 3 dB frequency point. The level-generator frequency is then increased until the upper 3 dB point is found. The difference in level-generator frequencies is the 3 dB bandwidth. This procedure may be repeated to determine the 60 dB points of the resolution bandwidth response.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- Level generator frequency accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode for some bandwidths.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF Section

Linear Fidelity

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Linear

Equipment

Level generator

Equipment Setup

The 50 Ω output of the level generator is connected to the RF INPUT of the spectrum analyzer (DUT).

Description

The HP 70902A test sets the resolution bandwidth to 30 kHz; the HP 70903A test sets the resolution bandwidth to 1 MHz. The LIN display mode is selected. The level generator is set to provide a signal near the reference level.

The spectrum analyzer marker is peaked. The reference level is set at the peaked value to establish a reference at the top of the display.

The level generator is stepped down in 2 dB increments (4 dB for All Tests mode). The variation between the level-generator amplitude and DUT marker amplitude is measured.

Uncertainties

The following characteristics contribute to uncertainties:

- Level generator relative amplitude accuracy
- DUT marker amplitude resolution

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

9

HP 11990A Option 300 System Software Package

Introduction

The HP 11990A Option 300 System Software package provides all test software required to verify that an HP 71300A millimeter spectrum analyzer meets all of its major specifications. This software package can also be used when an HP 70907A is a secondary input of an HP 71100C, HP 71200C, or HP 71210C spectrum analyzer. This software package consists of this manual and one test disk (Test Disk 1). A System Add-On package may be needed to test modules that are not part of a predefined system.

Execution of the tests in this system software package is dependent on the HP 11990A Option 001 User Interface program, which automates the test process. Refer to Chapter 2, "Start-Up Procedures," for instructions to run the test software.

Option 300 Tests

Test Descriptions

This manual lists and describes all of the tests in this system software package. Pressing the softkey `ALL TESTS` invokes execution of the tests in an efficient sequence determined by the software authors.

The following list explains the information found in this manual under the test names:

- "Tested Specification" is the name of the system specification as found in the "Specifications" chapter of the *HP 70900 Local Oscillator Installation and Verification Manual*.
- "Equipment" lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.

- "Equipment Setup" describes equipment interconnections. A setup screen on the computer display will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. Pressing `ABORT` will display the Test Menu. If the setup is wrong, pressing `PROCEED` three times will abort the test and then display the Test Menu.
- "Description" provides a brief description of the test.
- "Uncertainties" tells what characteristics contribute to measurement uncertainties.
- "Test Mode" tells whether the particular test runs in Limited Cal mode and what, if any, parameter is modified. Mode selection is a Test Menu function. There are six major modes: Single, Repeat, Multiple, Repeat Multiple, All Tests, and Limited Cal. In any mode other than Limited Cal, the tests run in their entirety. The following section lists the tests included in Limited Cal.
- "In Case of Failure" tells which modules may need repair or adjustment if the test fails.

Limited Cal Tests

When you press `LIMITED CAL` in the Test Menu or `QUICK TEST` in the Main Menu, the Limited Cal tests are executed in a sequence defined by the software authors. The Limited Cal tests are listed below in the order that they appear in this manual, not in the order of execution.

Sweep Time Accuracy
Calibrator Frequency Accuracy
Calibrator Amplitude Accuracy
LO Output Amplitude
Frequency Span Accuracy
Displayed Average Noise
Residual Responses
Log Fidelity
Resolution Bandwidth
Image Response

Sweep Time Accuracy

(HP 70900A or HP 70900B)

Tested Specification

SWEEP: Sweep Time: Accuracy

Equipment

Universal counter

Equipment Setup

The H SWP output on the rear panel of the HP 70900 local oscillator is connected to the input of the universal counter. If an HP 70700A digitizer is in the system, the H SWP line from the HP 70900 must also be connected to the digitizer rear-panel HI SWP connector.

Description

Several different spectrum-analyzer sweep times are selected to exercise the hardware fully. For each selected sweep time, the DUT is set for a span of 0 Hz and a sweep is triggered. The sweep time is then measured with the universal counter. Sweep times are selected to turn on each of the 12 bits of the sweep DAC. Only one bit is on at a time except when the lower six bits are tested; then bit 6 is also on.

If the HP 70700A digitizer is in the system, then its hardware must also be tested. Several more sweep times are chosen to test: fast sweep times at multiples of the digitizer's clock rate, worst-case resolution errors, and long sample rates.

Uncertainties

The following characteristics contribute to uncertainties:

- Universal counter resolution
- Universal counter accuracy

Test Mode

This test runs in the Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- Digitizer

Calibrator Frequency Accuracy

(HP 70900A or HP 70900B)

Tested Specification

FREQUENCY: Frequency Reference Accuracy: Aging

Equipment

Frequency counter

Equipment Setup

The CALIBRATOR output of the HP 70900 is connected to the input of the frequency counter.

Description

With the spectrum analyzer (DUT) set to its internal frequency reference, the frequency counter is used to measure the 300 MHz CALIBRATOR frequency.

Uncertainties

The following characteristics contribute to uncertainties:

- Frequency counter time-base stability

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Mixer Bias Output Accuracy

Tested Specification

INPUTS AND OUTPUTS: HP 70907A external mixer interface: Mixer Bias Output

Equipment

Voltmeter
50 Ω termination

Equipment Setup

Connect the 50 Ω termination via a tee adapter to the MIXER BIAS OUT of the HP 70907A external mixer interface module (EMIM) and to the voltmeter.

If the 50 Ω termination does not measure 51.1 Ω, return to the "Equipment Menu Edit Screen" and enter the actual resistance in the `SERIAL OR ID NO.` column.

Description

This test measures the accuracy of the EMIM's external bias output current, which is available for externally biasing a microwave mixer. The mixer bias current is measured over its full range by comparing the programmed bias current to the voltage developed across a 50 Ω termination by this current.

Current is stepped in 10 μA increments over the -10 to $+10$ mA range while the actual current is measured by reading the voltage developed across the 50 Ω termination with a voltmeter.

Note Due to the small currents used, the resistance of the termination must be measured using the four-wire ohm technique.

Uncertainties

The following characteristics contribute to uncertainties:

- Voltmeter four-wire Ω accuracy
- Voltmeter voltage accuracy

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- External mixer interface module

Calibrator Amplitude Accuracy

Tested Specification

AMPLITUDE ACCURACY: Calibrator Uncertainty

Equipment

General source
Measuring receiver
Sensor module

Equipment Setup

Setup A: Connect the general source through an appropriate cable to the sensor module of the measuring receiver.

Setup B: Connect the general source output to the IF INPUT of the HP 70907A external mixer interface module (EMIM). Connect the sensor module to the 321.4 MHz OUT of the EMIM.

Description

This test measures the amplitude variation of the internal calibration source over its tuning range referenced to a −35 dBm signal applied to the IF INPUT of the EMIM.

The general source is set to a frequency of 321.4 MHz and an amplitude of −35 dBm. The amplitude of the general source output is measured by the measuring receiver. The cables that are needed to connect the source to the EMIM must be included so that any losses may be accounted for and calibrated out.

The amplitude of the EMIM output is measured to establish its gain. The internal calibration source of the EMIM is then stepped over its frequency range in 5 kHz increments. At each frequency increment, the actual frequency is measured by the measuring receiver; the frequency of the internal calibration source cannot be set directly.

The internal calibration source is tuned over its range while the measuring receiver measures the amplitude of the EMIM 321.4 MHz OUT. This data is then normalized to the −35 dBm level previously set.

Note that the internal calibration source is actually changing frequency. The tuning is not symmetrical about the 321.4 MHz nominal center and requires tuning ±30 kHz of this center.

Uncertainties

The following characteristics contribute to uncertainties:

- Mismatch between sensor module and EMIM output connector
- Measuring receiver tuned RF (absolute) accuracy

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- External mixer interface module

LO Output Amplitude

Tested Specification

INPUTS AND OUTPUTS: HP 70907A external mixer interface: LO Output

Equipment

Power meter
Microwave power sensor

Equipment Setup

Setup A: Connect the power sensor to the power meter POWER REF OUTPUT.

Setup B: Connect the power sensor to the LO OUTPUT of the HP 70907A external mixer interface module (EMIM).

Description

If the power meter needs calibration, connect the equipment using setup A.

Connect the equipment using setup B. This test measures the EMIM LO OUTPUT power over the full tuning range of the HP 70900 local oscillator (3.0 to 6.6 GHz). The EMIM is set to zero span.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT mismatch error
- Power meter error

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- External mixer interface module

Frequency Response

Tested Specification

AMPLITUDE ACCURACY: Frequency Response

Equipment

Microwave source
Power meter
Microwave power sensor
Directional coupler
External mixer (HP 11970K)

Equipment Setup

Connect the source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-1.

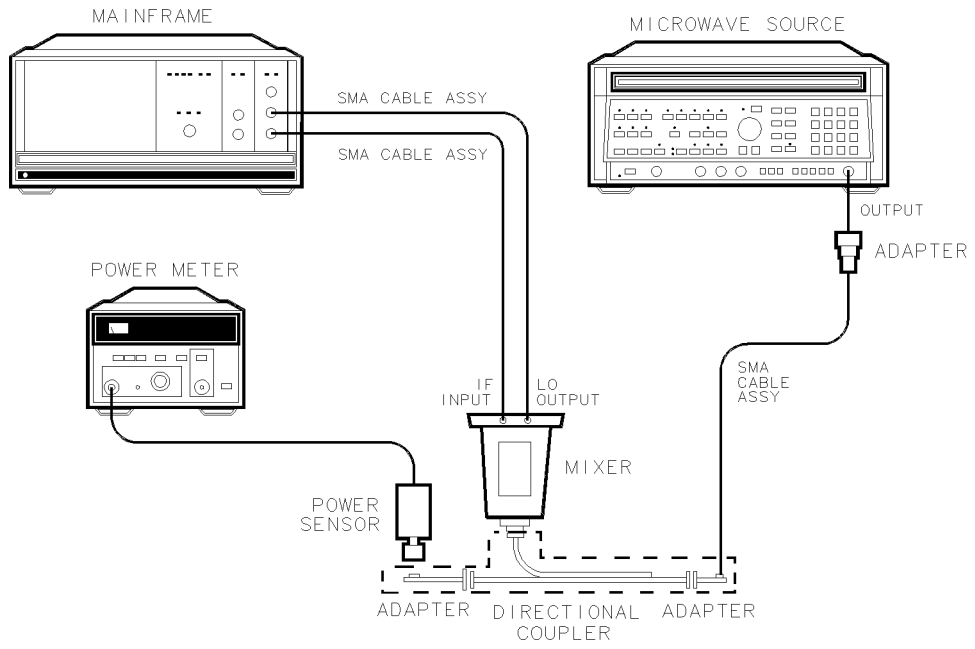


Figure 9-1. Frequency Response Test Setup

Description

This test measures amplitude variation of the HP 71300A millimeter spectrum analyzer from 18 to 26 GHz. The microwave power sensor is selected and the system is interrogated for an IF section. This step allows an optimum resolution bandwidth to be used to minimize measurement errors due to log fidelity. The signal is centered on the display using a span that is five times greater than the resolution bandwidth. Marker amplitude is measured at 100 MHz increments and compared with the power meter measurement, which has been corrected for directional-coupler coupling factor. The system conversion loss is set to 0 dB so that the conversion loss being measured is that of the external mixer when used with the HP 71300A system. The frequency response is then one-half of the difference between the maximum and minimum values measured.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT log fidelity
- Power meter accuracy
- Mismatch error
- Directional coupler accuracy

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- External mixer interface module

Frequency Readout Accuracy

Tested Specification

FREQUENCY: Frequency Readout Accuracy
(using the internal frequency reference)

Equipment

Microwave source
External mixer (HP 11970K only)

Equipment Setup

Setup A: The HP 70907A external mixer interface module (EMIM) LO OUTPUT and RF INPUT are connected to the HP 11970K external mixer through appropriate cables. Then the HP 11970K external mixer input is connected to the microwave source output. See Figure 1-2.

Setup B (alternate): This is the same setup that is used in the Frequency Response test: Connect the microwave source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-3.

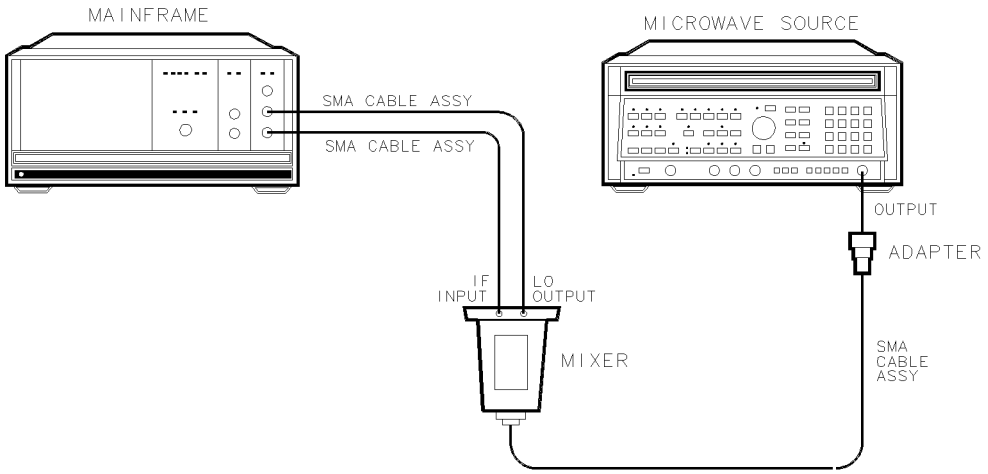


Figure 9-2. Frequency Readout Accuracy Test Setup A

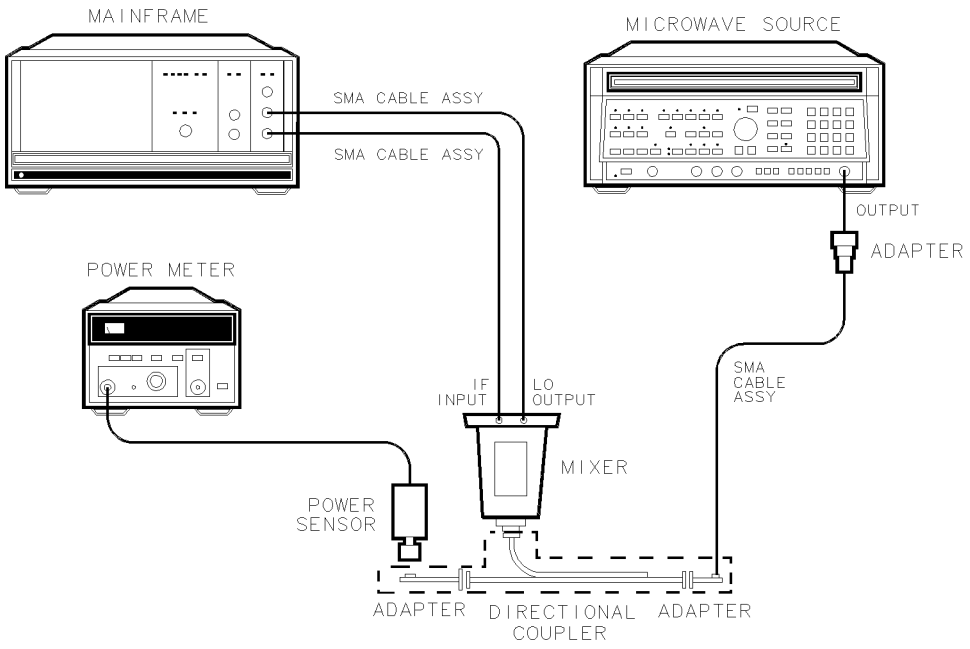


Figure 9-3. Frequency Readout Accuracy Test Setup B (alternate)

Description

Frequency readout accuracy is measured by comparing the marker frequency of the system to the frequency input to the system by the microwave source. A 100:1 span/resolution bandwidth ratio is needed to reduce the errors associated with the marker resolution. The modular system is interrogated for an IF section. If only the HP 70903A IF section is present, the minimum span that can be used is 10 MHz. If an external 100 MHz reference is connected to the HP 70900 local oscillator, the external reference must be disconnected to allow the accuracy of the test to be based only on the accuracy of the internal reference.

The number of frequencies and spans to be used in testing is determined by the test mode. At least one fractional N span and one lock-and-roll span are tested.

If the HP 70700A digitizer is in the system, the entire test is repeated with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Source frequency error
- DUT marker frequency resolution

Test Mode

This test is not run in the Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Frequency Span Accuracy

Tested Specification

FREQUENCY: Frequency Span: Accuracy
(using the internal frequency reference)

Equipment

Microwave source
External mixer (HP 11970K only)

Equipment Setup

Setup A: The HP 70907A external mixer interface module (EMIM) LO OUTPUT and RF INPUT are connected to the HP 11970K external mixer through appropriate cables. Then the HP 11970K external mixer input is connected to the microwave source output. See Figure 1-4.

Setup B (alternate): This is the same setup that is used in the Frequency Response test: Connect the microwave source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-5.

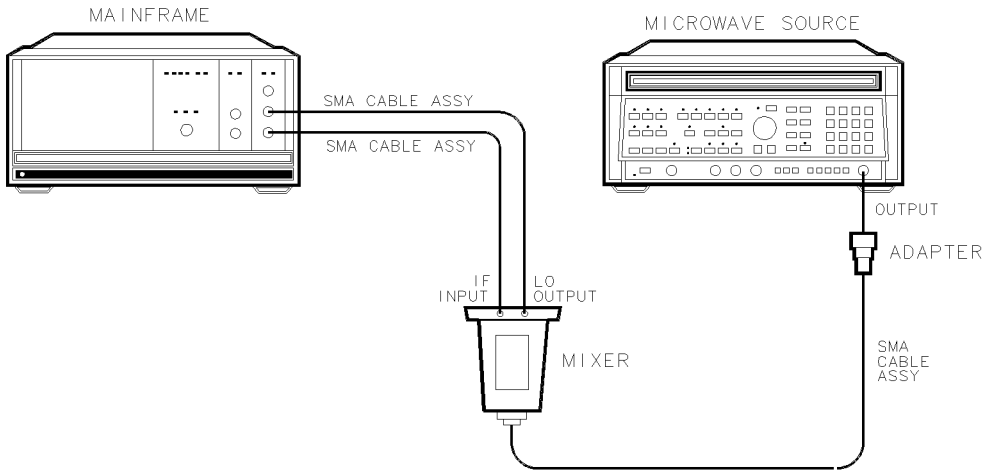


Figure 9-4. Frequency Span Accuracy Test Setup A

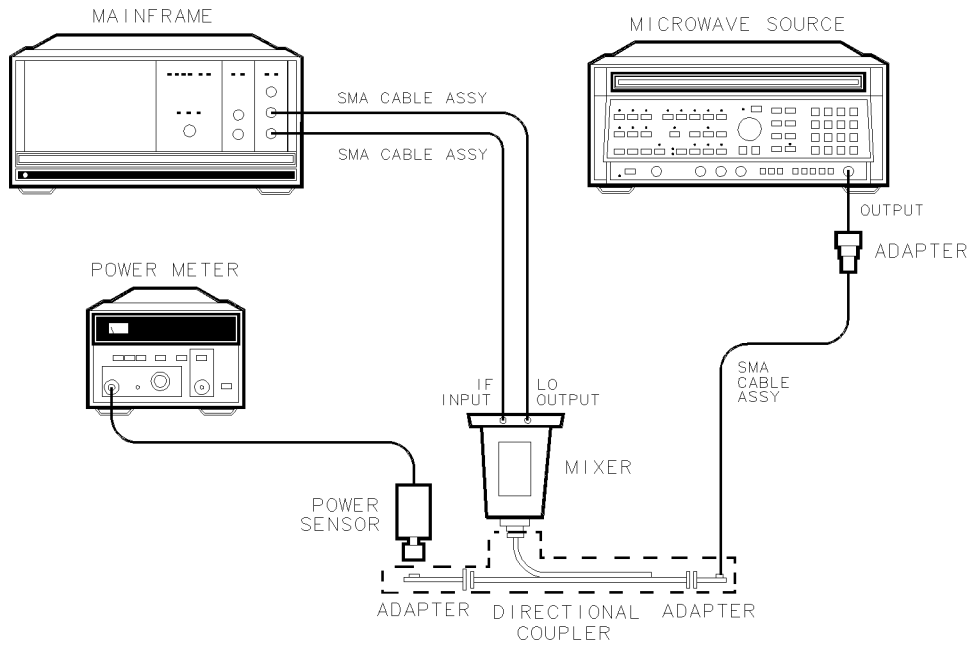


Figure 9-5. Frequency Span Accuracy Test Setup B (alternate)

Description

Frequency span accuracy is measured by comparing the marker frequency of the system at several points on the display to the frequency of the microwave source. The deviation between marker frequency and microwave source frequency is the absolute error. The maximum frequency span error is calculated by taking the difference between the maximum and minimum absolute errors. A 100:1 span/resolution-bandwidth ratio is needed to reduce the errors associated with the marker resolution. The modular system is interrogated for an IF section. If only the HP 70903A IF section is present, the minimum span that can be used is 10 MHz. If an external 100 MHz reference is connected to the HP 70900 local oscillator, the external reference must be disconnected to allow the accuracy of the test to be based only on the accuracy of the internal reference.

If the HP 70700A digitizer is in the system, the entire test is run again with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Microwave source accuracy
- DUT marker resolution

Test Mode

A limited version of this test runs in Limited Cal mode and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator
- External mixer interface module

Gain Calibration Accuracy

(using HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
(reference bandwidth = 300 kHz)

Equipment

Microwave source
External mixer (HP 11970K only)

Equipment Setup

Setup A: The HP 70907A external mixer Interface module (EMIM) LO OUTPUT and RF INPUT are connected to the HP 11970K external mixer through appropriate cables. Then the HP 11970K external mixer input is connected to the microwave source output. See Figure 1-6.

Setup B (alternate): This is the same setup that is used in the Frequency Response test: Connect the microwave source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-7.

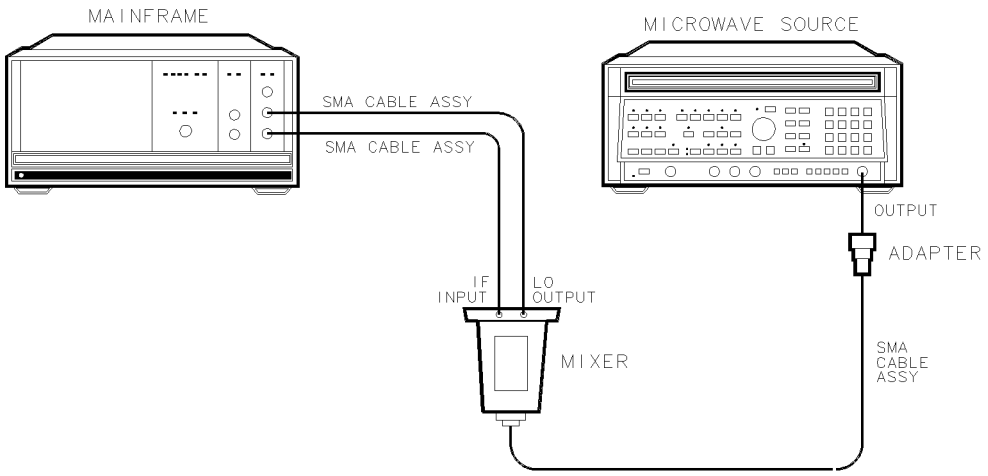


Figure 9-6. Gain Calibration Accuracy Test Setup A

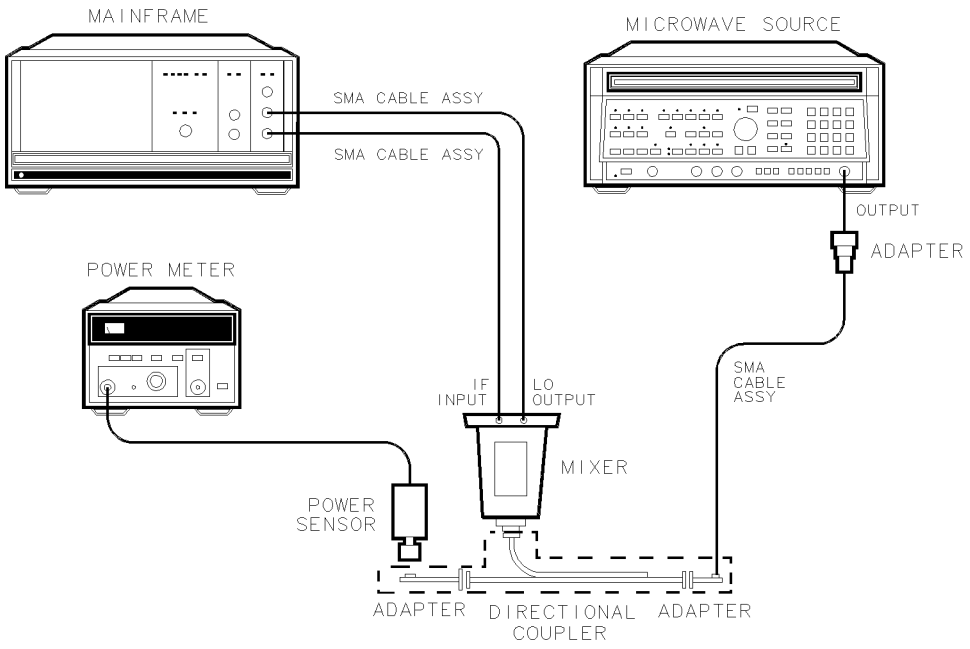


Figure 9-7. Gain Calibration Accuracy Test Setup B (alternate)

Description

To find System Gain Accuracy, the test first sets 300 kHz resolution bandwidth (in HP 70903A), then the test compares the DUT marker amplitude in corrected mode with marker amplitude in uncorrected mode. An error occurs if the tuning range of the internal calibration source cannot tune to the center frequency of the resolution bandwidth filter.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT uncorrected incremental log fidelity

The RSS total of these uncertainties is calculated for each measurement.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Local oscillator

Displayed Average Noise Level

(for HP 70902A or HP 70903A)

Tested Specification

AMPLITUDE: Displayed Average Noise Level

Equipment

External mixer (HP 11970K only)
50 Ω termination

Equipment Setup

Setup A: Connect the HP 11970K external mixer to the LO OUTPUT and IF INPUT of the HP 70907A external mixer interface module (EMIM). Connect a 50 Ω termination to the HP 11970K external mixer INPUT.

Setup B (alternate): This is the same setup that is used in the Frequency Response test: Connect the source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-8.

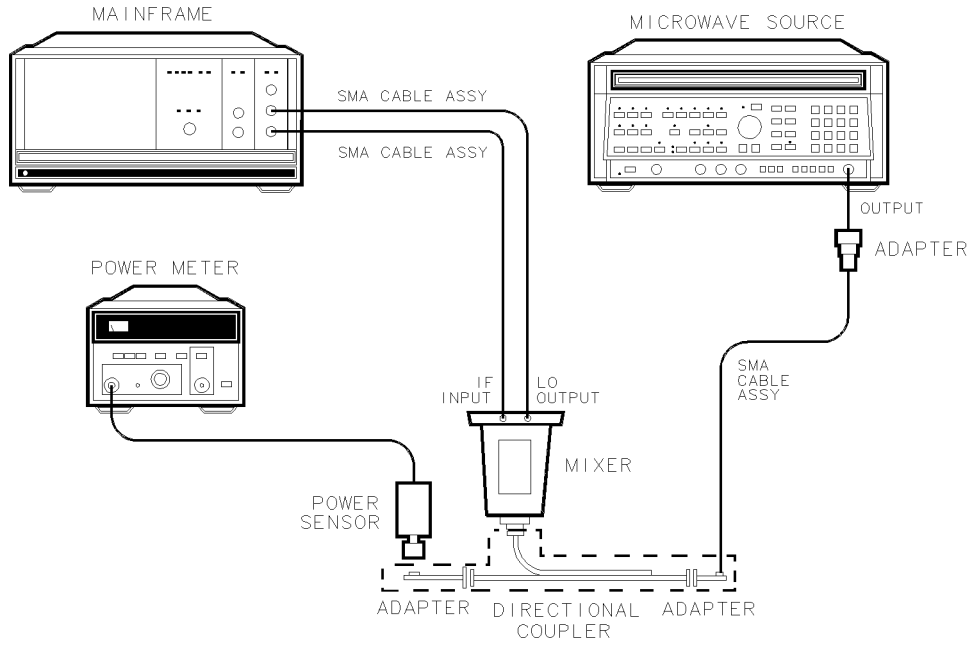


Figure 9-8. Displayed Average Noise Level Test Setup B (alternate)

Description

This test measures the displayed average noise level of the spectrum-analyzer/external-mixer system. The displayed average noise level is closely related to sensitivity, which determines the lowest level signal that may be measured by the IF section.

This measurement is made by sweeping the full 18 GHz to 26 GHz frequency band to determine the frequency with the highest displayed average noise. The spectrum analyzer is set to zero span at this frequency, the resolution bandwidth is set to 1 kHz (100 kHz with HP 70903A IF section), and the sample detector is enabled. Sweep time is determined by auto-correlation, and sweeps are taken until the displayed average noise level is known to be accurate to 0.5 dB. If setup B is used, the source frequency is set to 15 GHz and the amplitude to −120 dBm.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT calibrator error
- DUT marker amplitude resolution
- DUT step gain error
- DUT resolution bandwidth switching
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Residual Responses

Tested Specification

AMPLITUDE: Residual Responses

Equipment

External mixer (HP 11970K only)
50 Ω termination

Equipment Setup

Setup A: Connect a 50 Ω termination to the input port of the HP 11970K external mixer. Connect the HP 11970K external mixer LO OUTPUT and IF INPUT ports to the HP 70907A external mixer interface module (EMIM) LO OUTPUT and IF INPUT ports.

Setup B (alternate): This is the same setup that is used in the Frequency Response test: Connect the source to the input of the directional-coupler main guide. Connect the microwave power sensor to the power meter, then connect the sensor to the output of the directional-coupler main guide. Connect the HP 11970K external mixer to the directional-coupler coupled port. Connect the HP 11970K external mixer to the EMIM IF INPUT and LO OUTPUT through appropriate cables. See Figure 1-9.

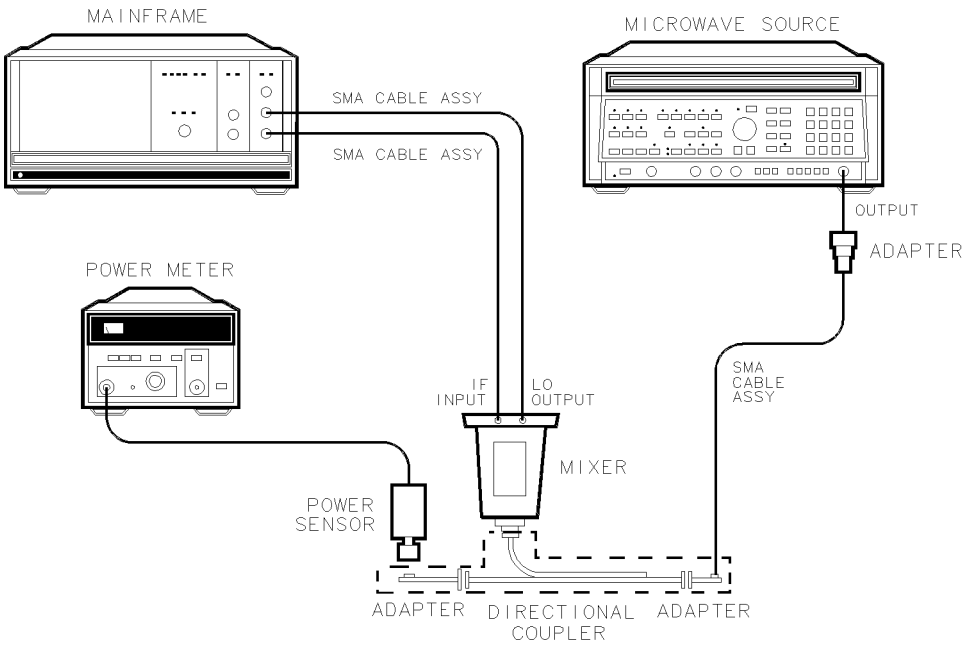


Figure 9-9. Residual Response Test Setup B (alternate)

Description

This test measures residual responses that are on the display when there is no input signal. A residual response results when mixing of at least two of the DUT's internal signals produces a product at one of the DUT's intermediate frequencies.

The DUT is calibrated, if necessary. If setup B is used, the test terminates the external mixer by setting the source to 15 GHz, −120 dBm.

Maximum DUT sensitivity results with the internal attenuator at 0 dB and an IF gain of 50 dB. The test then measures responses at possible residual frequencies. The test frequencies are in-band results of calculations involving up to 50 harmonics of the DUT's fixed LO frequencies (300 MHz and 18.4 MHz) and the intermediate frequencies (321.4 MHz, 21.4 MHz, and 3.0 MHz).

Uncertainties

The following characteristics contribute to uncertainties:

- DUT calibrator error
- DUT marker amplitude resolution
- DUT step gain error
- DUT resolution bandwidth switching
- DUT attenuator switching errors
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- External mixer interface module

Log Fidelity

(for HP 70902A and HP 70903A)

Tested Specification

AMPLITUDE ACCURACY: Scale Fidelity: Log

Equipment

General source
Measuring receiver
Sensor module
Power splitter (or hybrid combiner)

Equipment Setup

Connect the general source to the input of the power splitter. Connect one output of the power splitter to the IF INPUT of the HP 70907A external mixer interface module (EMIM). To the remaining output of the power splitter, connect the sensor module from the measuring receiver.

Description

This test measures the relative on-screen log scale fidelity (that is, the display CRT's upper eight divisions for the HP 70903A, or upper nine divisions for the HP 70902A).

The IF section is set to 100 kHz (HP 70903A) or 1 kHz (HP 70902A) resolution bandwidth, 300 Hz video bandwidth, and sample detection. The HP 71300A millimeter spectrum analyzer acts as a fixed-tuned 321.4 MHz receiver, so the span is set to 0 Hz. The reference is set to provide maximum on-screen dynamic range. The general source frequency is adjusted to center the signal in the IF passband, and the general source amplitude is adjusted to set the signal at the reference level. The measuring receiver measures the general source amplitude. The difference between the measuring receiver reading and marker amplitude readout establishes a top-screen reference.

The general source amplitude is decreased in 1 dB increments (2 dB in Limited Cal and All Tests modes) until the signal is 75 to 90 dB below

top-screen. The actual level depends on the IF being tested and the test mode. In the last 20 dB of the log range, the sweep time is increased to lessen the effects of the reduced signal-to-noise ratio. Once all measurements have been made, the data is normalized to −10 dB of top-screen to account for the small amount of gain compression in the upper 10 dB of display range.

If the HP 70700A digitizer is in the system, the test is run again with the digitizer selected.

Uncertainties

The following characteristics contribute to uncertainties:

- Measuring receiver tuned RF amplitude (relative) accuracy
- DUT marker amplitude resolution

Test Mode

This test is run in Limited Cal mode, and should be run after doing a repair.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Resolution Bandwidth

(HP 70902A or HP 70903A)

Tested Specifications

AMPLITUDE ACCURACY: Resolution Bandwidth Switching Uncertainty
FREQUENCY: Resolution Bandwidths: −3 dB: Selectivity (−60/−3 dB)

Equipment

General source
Measuring receiver
Sensor module
Power splitter (or hybrid cCombiner)

Equipment Setup

Connect the general source to the input of the power splitter. Connect one output connector of the power splitter to the IF INPUT of the HP 70907A external mixer interface module (EMIM). To the remaining output connector of the power splitter, connect the sensor module from the measuring receiver.

Description

This test measures the resolution bandwidth switching variation by taking a reference amplitude reading in 1 kHz (HP 70902A) or 300 kHz (HP 70903A) resolution bandwidth, then comparing the IF section resolution-bandwidth amplitude (from 300 Hz to 300 kHz) to this reference. During this measurement, the video bandwidth is set at 300 Hz (used during the calibration of the IF section) to eliminate any amplitude shift caused by video bandwidth switching.

The 3 dB and 60 dB bandwidths are determined by the following algorithm: The resolution bandwidths are stepped in a 1, 3, 10 sequence from 300 Hz to 300 kHz (HP 70902A) or 100 kHz to 3 MHz (HP 70903A), the general source frequency is adjusted to peak the signal in each bandwidth, and the marker amplitude is read by taking the mean of the trace points. The mean is used as a reference amplitude.

The general source amplitude is stepped down 3 dB (or 60 dB) to establish a reference marker amplitude on the display. The general source amplitude is then returned to the original level and the frequency is adjusted until the lower 3 dB (or 60 dB) point is found. This procedure is repeated for the upper 3 dB (or 60 dB) point. The 3 dB (or 60 dB) bandwidth is the difference between the upper and lower frequencies. The selectivity (shape factor) is the ratio of the 60 dB bandwidth divided by the 3 dB bandwidth.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT marker amplitude resolution
- DUT incremental log fidelity
- Measuring receiver tuned RF (relative) accuracy
- General source frequency

Test Mode

In Limited Cal mode, only the corrected switching specification, and the 3 dB bandwidth and shape factor of the 300 kHz, 10 kHz, 3 kHz and 1 kHz bandwidths (HP 70902A) or 300 kHz and 3 MHz (HP 70903A), are tested.

In Case of Failure

Note The switching specification is primarily determined by the preceding Calibrator Amplitude Accuracy test specification. Should the Resolution Bandwidth test fail, perform the Calibrator Amplitude Accuracy test to verify that it passes before assuming that the resolution bandwidths are out of specification.

If this test fails, the following modules may need repair or adjustment:

- IF section

IF Gain Accuracy

(for HP 70902A or 70903A)

Tested Specification

AMPLITUDE ACCURACY: IF Gain Uncertainty

Equipment

General source
Measuring receiver
Sensor module
Power splitter (or hybrid combiner)
Voltmeter

Equipment Setup

Connect the general source to the input of the power splitter. Connect one output connector of the power splitter to the IF INPUT of the HP 70907A external mixer interface module (EMIM). To the remaining output connector of the power splitter, connect the sensor module from the measuring receiver. Connect the voltmeter to the IF section VIDEO OUTPUT.

Description

This test measures the internal IF step gain of the IF section. The IF step gain is controlled by the reference level, attenuator setting, and calibration amplitude corrections. The IF section is set to zero span and the EMIM attenuator is set to 0 dB. The reference level is adjusted for the highest level that produces an IF gain of 0 dB with an EMIM attenuator setting of 0 dB. The general source frequency is adjusted to center the signal in the IF passband. Reference readings are taken using the measuring receiver and the voltmeter. The reference level and general source amplitude are then decreased in 10 dB increments until 50 dB of IF gain is achieved. The differences between the measuring receiver readings and the voltmeter readings is the IF gain variation.

Uncertainties

The following characteristics contribute to uncertainties:

- Measuring receiver tuned RF (relative) accuracy
- Voltmeter accuracy
- DUT incremental log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is not run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section

Image Response

Tested Specification

AMPLITUDE: Spurious Responses: Image Responses

Equipment

General source

Equipment Setup

Connect the general source output to the IF INPUT of the HP 70907A external mixer interface module (EMIM).

Description

This test measures image responses at offsets of two times the 3 MHz and 21.4 MHz IFs.

The DUT is calibrated, if necessary, and a check is made for proper

test-equipment connections. Because measurements are performed in zero span, the sweep time is set to a minimum value as determined by the autocorrelation theorem. Maximum on-screen dynamic range is found by adjusting the reference level. Adjustment of the general source frequency peaks the signal in the selected resolution bandwidth. Adjustment of the general source amplitude places the signal at the top-line reference level. After the IF has settled, the test measures the image response amplitude.

Uncertainties

The following characteristics contribute to uncertainties:

- DUT resolution bandwidth switching
- DUT log fidelity

The RSS total of these uncertainties is calculated for each measurement.

Test Mode

This test is run in Limited Cal mode.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- IF section
- External mixer interface module

A

Measurement Uncertainty

Introduction

The program combines individual measurement uncertainties to arrive at total uncertainty, and that establishes a range of ambiguous results and a boundary beyond which results are definitely unacceptable. Total uncertainty multiplied by a measurement uncertainty coefficient combines with specification limits to determine the test limits, which determine acceptable system performance. The HP performance tests are shipped with the coefficient set to zero in every test, thus setting test limits at the specification range limits. Figure A-1 illustrates acceptable performance with a zero coefficient. The last section of this appendix tells how to change the measurement uncertainty coefficient on a test-by-test basis.

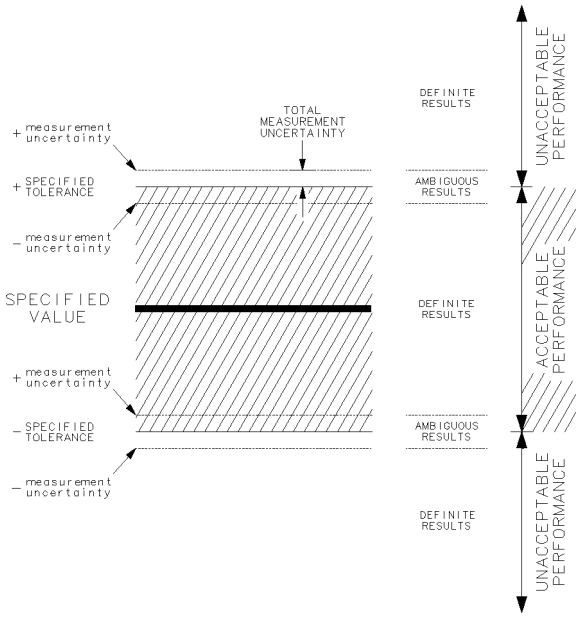


Figure A-1.
Acceptable Measurement Range with Measurement Uncertainty Coefficient Set to Zero

Combining Individual Uncertainties

Individual measurement uncertainties vary with test equipment and measurement techniques. Either of two methods of combining uncertainties produces a total uncertainties figure: Worst-Case Sum, or Root Sum of the Squares (RSS).

Worst-Case Sum defines boundaries of total uncertainty without providing a specific estimate. RSS is an accurate and statistically significant estimate. Where appropriate, the tests use RSS.

- Worst Case analysis sums absolute magnitudes of individual measurement uncertainties to produce the largest possible value.

$$|U_1| + |U_2| + |U_3| + ... + |U_n|$$

- RSS uncertainty utilizes the fact that individual uncertainties are independent of each other and can therefore be combined as random variables.

$$\sqrt{\left(\frac{U_1}{M_1}\right)^2 + \left(\frac{U_2}{M_2}\right)^2 + \left(\frac{U_3}{M_3}\right)^2 + ... + \left(\frac{U_n}{M_n}\right)^2}$$

where

U_i = uncertainties in the particular measurement (linear)
M_i = expected value of the measurement (in linear)

Combining Uncertainty and Specification

Using the instructions in this section, a qualified person can change the measurement uncertainty coefficient on a test-by-test basis.

On Test Disk 1 there is an ASCII file named TEST_LIST, which contains a section for every test applicable to the particular system software package. (Use GET and SAVE to retrieve and store ASCII files.) Each section has a line labeled FLAGS; in other words, there is a FLAGS line for every test. The number after the second comma in the FLAGS line is the measurement uncertainty coefficient. To change the coefficient, modify this number. A negative coefficient tightens the test limit. The absolute coefficient times total measurement uncertainty tightens or loosens test limits. For example, a coefficient of -0.5 tightens the test limit by the uncertainty times 0.5.

Note When the System Performance Test program is verifying warranted performance, the uncertainty coefficient must be zero for all tests.

B

Error and Status Messages

Introduction

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

`<<<<`

The indicated result of the test is outside the test limit.

`<**>`

The indicated result of the test far exceeds the expected result. Suspect a failure of test equipment, accessories, or spectrum analyzer.

`3478A MULTIMETER requires calibration.`

Your HP 3478A is functioning improperly. Either connect a different HP 3478A or display the Equipment Menu and assign a different model number.

`Aborted`

You aborted the test indicated.

`Adjust Inst`

The system under test needs adjustment or repair to pass the indicated test's specification.

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

You have model numbers in the Equipment Menu that are not supported by the software. Ignore this caution if you are sure that the model numbers listed are correct and that program memory contains a driver for these models. Otherwise, press `EDIT` to return to the edit screen, and correct the model number. A driver that is required but missing causes the error message `ERROR MESSAGE: is a undefined subprogram` to appear on-screen. You can return to the Test Menu by pressing `ABORT`.

`Current zero expired.`

The power meter requires rezeroing. Perform the procedure provided on the computer display.

`Disk file is full, no longer duplicating output.`

You attempted to store too much data on a disk.

`Equipment list is not acceptable.`

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

`Equipment list shows no analyzer to test.`

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

`ERROR: Address matches system disk drive.`

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

`Error: Address not in acceptable range.`

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

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

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

`ERROR: Search for volume label unsuccessful.`

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

`ERROR: Some devices listed as "Available" require serial numbers.`

You pressed `DONE` to go to the Equipment Menu command screen, but some devices have not been assigned their required serial numbers. Display the Equipment Menu edit screen and assign the serial numbers.

`ERROR: Address is HP-IB controller address.`

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

`ERROR MESSAGE: Attempt to close file failed.`

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

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

`ERROR MESSAGE: Attempt to create file failed.`

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

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

ERROR MESSAGE: Attempt to Edit Mass Storage failed.

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

ERROR MESSAGE: Attempt to store Mass Storage failed.

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

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

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

ERROR MESSAGE: Calibration data frequency exceed acceptable limits.

Return to the Cal Data edit screen in the Equipment Menu and correct the data entries that are flashing.

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

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

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

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

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

Return to the Cal Data edit screen in the Equipment Menu and enter the calibration data for frequencies indicated with flashing markers.

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

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

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

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

ERROR MESSAGE: Calibration data for with serial number is not found on the current Operating disk.

The data file cannot be found or there is a problem with the data file on the Operating Disk. If you have stored calibration data on another HP 70000 Software Product Operating Disk, replace your current Operating Disk with that one and access the data. Be sure to return the Operating Disk belonging with your system under test to the default drive. After correcting the problem, either press REPEAT to try again or press PROCEED.

ERROR MESSAGE: DUT does not have an address.

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

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

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

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

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

ERROR MESSAGE: Equipment address matches external disk drive.

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

ERROR MESSAGE: Equipment Menu data not found on .

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

ERROR MESSAGE: Equipment does not have an address.

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

ERROR MESSAGE: ERROR XXX in XXXXX .

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

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

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

ERROR MESSAGE: Incorrect disk found. required.

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

ERROR MESSAGE: is a undefined subprogram.

The program has tried to use a model number that is not supported by the current software. If an incorrect model number was entered, return to the Equipment Menu and correct the model number. If the model number is correct, you must load the appropriate instrument driver before you can continue testing. Press ABORT to return to the Test Menu command screen.

ERROR MESSAGE: Parameter Menu data not found on .

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

ERROR MESSAGE: Read data from file failed.

There is a problem with the data file on the Operating Disk. Correct the problem, then either press REPEAT to try again or ABORT to return to Main Menu.

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

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

ERROR MESSAGE: Sensor model # not supported.

Software does not support the sensor model number entered for the Signal Sensor in the Equipment Menu. Return to the Equipment Menu and select a sensor with a model number that is supported. (For a list of supported equipment, refer to Appendix A in the appropriate system software package.)

ERROR MESSAGE: Parameter Menu data file not found on .

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

ERROR MESSAGE: The correct Power Sensor has not been detected. Connect the or Abort the test

The power sensor currently connected to the Measuring Receiver is not the power sensor required for the current test. Connect the required sensor and press PROCEED, or press ABORT to return to the Test Menu command screen.

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

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

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

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

`ERROR MESSAGE: was not located.`

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

`ERROR MESSAGE: Write data to file failed.`

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

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

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

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

`Failed`

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

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

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

`Hdw Broken`

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

`Initializing the HP-IB system per the Equipment Menu.`

The program is attempting to determine if the HP-IB addresses provided in the Equipment Menu can be found. This message only appears if `Verify equipment on HP-IB:` has been selected in the Parameter Menu.

`KEYBOARD SYSTEM CRASH WITH KEYBOARD: .`

The software program does not support the current keyboard. Install a keyboard having one of the part numbers listed in the "Computer Hardware Compatibility" section, then restart the program.

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

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

`Media not initialized.`

You attempted to access a blank disk. Correct the fault, then press CONTINUE.

`NO CASE FOR THE SENSOR IN THE 8902A DRIVER!`

Software does not support the sensor indicated as Signal Sensor in the Equipment Menu. Return to the Equipment Menu and select a supported sensor.

`No disk copy of output found.`

You pressed `REPRINT` in the Main Menu, but the program cannot find a data file in the current `DATA` Volume. If you saved the data, return to the Mass Storage Menu and edit the location of the DATA Volume.

`Passed`

The spectrum analyzer meets the tested specifications.

`PAUSED. PRESS CONTINUE.`

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

`PRGM ERROR`

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

`Reading errors from ERRORLOG failed. Check disk at _.`

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

`Return to Equipment Menu to enter serial number for _.`

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

`Setup Error`

The program aborted the test after attempting to verify the test setup. Make sure that all required test equipment is present, and has been turned on and connected.

`Short Pass`

The spectrum analyzer meets an abbreviated version of the tested specifications. Some external test equipment, or the spectrum analyzer, has insufficient range for a complete test. (For example, Line-Related Sidebands typically passes with a Short Pass.)

`Test can not be done.`

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

`Testing dd_mmm_yyyy.`

The particular test was last modified on the displayed date.

`TEST_LIST is not compatible.`

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

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

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

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

When `Yes` is selected for `Verify equipment on HP-IB:` in the Parameter Menu, this error message displays the ETE with the address that is either missing or not set to ON.

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

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

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

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

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

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

`THIS COLUMN CAN NOT BE EDITED.`

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

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

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

`Timed Out`

The program aborted the test.

`WARNING: Duplicate Address`

You attempted to exit the Equipment Menu after assigning the same HP-IB address to two different model numbers. HP-IB protocol allows only one instrument per address. It is acceptable to assign the same address to identical model numbers, implying multiple use of the same instrument. You may have to scroll through the menu to find the duplication.

`WARNING: Duplication may exclude specific tests.`

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

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

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

`Write protected.`

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

C

Standard Test Equipment

Table C-1 lists adapters and cables. These accessories allow you to interconnect the HP 70000 Modular Measurement System spectrum analyzer and the external test equipment. An asterisk marks the preferred item in each category.

Table C-2 lists external test equipment supported by HP 11990A Performance Test software. You will need an instrument from each category to perform the complete set of performance tests. This list is duplicated in the equipment menu.

Table C-1. Required Accessories

Accessory	HP Part Number or Model Number
Adapters	
Type N (f) to BNC (m)	1250-0077
Type N (m) to BNC (f)	1250-0780*
APC 3.5 (f) to Type N (m)	1250-1744
BNC (f) to dual banana plug	1251-2277
APC 3.5 (f) to APC 3.5 (f)	1250-1749, 5061-5311*
Cables	
BNC (m) to SMB (m), 122 cm (4 ft)	85680-60093*
BNC (m) to BNC (m), 122 cm (4 ft)	HP 10503A
Low Loss, SMA (m) to SMA (m), 61 cm (2 ft)	8120-3124
APC 3.5 (m) to APC 3.5 (m), 99 cm (3.25 ft)	8120-4921
* Indicates the recommended accessory.	

Table C-2. Required External Test Equipment

Category	HP Part Number or Model Number
12 MHz Low-Pass Filter	See Figure E-1.
50 MHz Low-Pass Filter	See Figure E-2.
50 Ohm Terminations	
Type N (m)	HP 908A*
APC 3.5 (m)	HP 909D†
BNC (m)	HP 11593A
SMA (m)	1810-0118
Clean Source‡	HP 8662A, HP 8663A*
Directional Bridge	HP 8721A
Directional Coupler#	HP K752C
External Mixer#	HP 11970K
Frequency Counter	HP 5343A*, HP 5342A
General Source	HP 8662A, HP 8663A*
Hybrid Combiner†,#	Mini-Lab Circuits P/N ZFSC-2-5
Level Generator	HP 3335A
MW Power Sensor	HP 8481A, HP 8485A*, HP 11792A
MW Spectrum Analyzer†,‡	HP 71210A/C*, HP 8566B, HP 71201A, HP 71201A Option 001, HP 71200C Option 002, HP 71200C Option 003
Measurement Receiver	HP 8902A
Microwave Source	HP 8340A*, HP 8340B, HP 8341A, HP 8341B
Power Meter	HP 436A*, HP 70100A, HP 437A, HP 438A, HP 8902A
Power Splitter	
Type N (f) connectors	HP 11667A
APC 3.5 (f) connectors	HP 11667B*
Printer (Any HP-IB Printer)	Graphics/Non-Graphics
RF Power Sensor	HP 8482A*, HP 11722A
Sensor Module#	HP 11722A
Signal Sensor	HP 11722A
Synthesized Source‡	HP 8340A*, HP 8340B, HP 8341A, HP 8341B, HP 8662A, HP 8663A
Technical Computer	See "NOTE," below.
Universal Counter	HP 5316A*, HP 5316B
Voltmeter	HP 3445A, HP 3456A*, HP 3478A

* Indicates the recommended model of test equipment.

† Needed only when the system under test contains a tracking generator module, HP 70601A or HP 70906A.

NOTE: Refer to the "Software/Hardware Compatibility" section in the *HP 11990A Option 001 User Interface Manual.*

‡ Not used when the system under test is a HP 71300A (HP 70907A/B).

Used for testing the HP 70907A/B only.

D

Critical Test Equipment Specifications

Table D-1 lists names and critical specifications for external test equipment which the user may want to substitute.

Table D-1. External Test Equipment Critical Specifications (1 of 3)

Instrument	Critical Specification
Level Generator	Frequency Range: 200 Hz to 50 MHz Stability: $\pm 1 \times 10^{-7}$/month Resolution: $\leq$0.01 Hz Amplitude Range: +12 to −85 dBm Resolution: 0.01 dB Flatness: 200 Hz to 50 MHz, ±0.2 dB Step Attenuator Accuracy +12 to −26 dBm: ±0.025 dB −26 to −46 dBm: ±0.03 dB −46 to −85 dBm: ±0.09 dB Harmonics: <−40 dBc
Synthesized Source	Frequency Range*: 10 MHz to 500 MHz Resolution: $\leq$5 Hz at maximum frequency Stability: 1×10^{-9}/day, 2.5×10^{-7}/year Amplitude Range: +10 to −90 dBm Resolution: 0.1 dB Spurious Signals: <−20 dBc
General Source	Frequency Range: 500 kHz to 500 MHz Resolution: $\leq$0.1 Hz Amplitude Range: +10 to −90 dBm Resolution: 0.1 dB Harmonics: <−30 dBc
*For complete testing, the source should tune to the maximum upper frequency of the modular spectrum analyzer under test. To identify the upper frequency limit of the RF section in the system under test, refer to "Specifications" in the system master's Installation and Verification manual.	

Table D-1. External Test Equipment Critical Specifications (2 of 3)

Instrument	Critical Specification
Microwave Source	Frequency Range*: 50 MHz to 26.5 GHz Resolution: ≤5 Hz Amplitude Range: +10 to −90 dBm Resolution: 0.1 dB Spurious Signals: <−20 dBc
Clean Source	Frequency Range*: 10 MHz to 1.2 GHz (2.55 GHz preferred) Resolution: ≤1 Hz Stability: 2.5×10^{-7}/year Amplitude Range: +10 to −90 dBm Resolution: 0.1 dB Spectral Purity Power Mains Line-Related Sidebands: <−83 dBc Non-Harmonically Related: <−83 dBc Harmonics: <−30 dBc SSB Phase Noise in 1 Hz Bandwidth *Offset from Carrier* — *Phase Noise* 100 Hz — <−75 dBc 1000 Hz — <−91 dBc 10 kHz — <−96 dBc 100 kHz — <−114 dBc
MW Spectrum Analyzer	Frequency Range: 10 MHz to 22 GHz Resolution: 10 Hz Amplitude Range: +5 to −100 dBm Resolution: 0.1 dB
12 MHz Low-Pass Filter	f_c=12 MHz Nine-element Tchebychev, 0.1 dB ripple Rejection at 18 MHz: >45 dB
50 MHz Low-Pass Filter	f_c=52 MHz Nine-element Tchebychev, 0.1 dB ripple Rejection at 80 MHz: >55 dB

* For complete testing, the source should tune to the maximum upper frequency of the modular spectrum analyzer under test. To identify the upper frequency limit of the RF section in the system under test, refer to "Specifications" in the system master's Installation and Verification Manual.

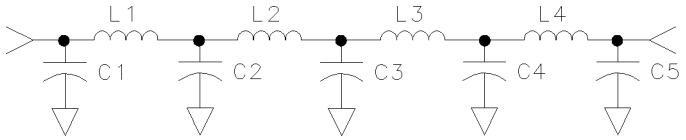
Table D-1. External Test Equipment Critical Specifications (3 of 3)

Instrument	Critical Specification
Directional Bridge	Frequency Range: 100 kHz to 100 MHz Directivity: >40 dB from 1 to 100 MHz Coupling: 6 dB Transmission: 6 dB
Power Splitter	Frequency Range: 50 MHz to 26.5 GHz (or front-end highest frequency) Output Tracking: ≤0.25 dB Equivalent Output VSWR: ≤1.35
RF Power Sensor	VSWR: <1.3 Frequency Range: 100 kHz to 2.9 GHz
MW Power Sensor	VSWR: <1.3 Frequency Range: 50 MHz to 26.5 GHz

E

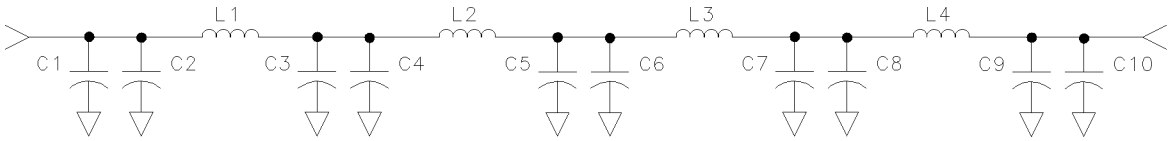
Specialized Test Equipment

This appendix provides the schematics and part descriptions for two filters required in some performance test setups.



Reference Designator	HP Part Number	CD	Qty	Description
C1	0160-5491	7	1	CAPACITOR-FXD 240PF CER
C2	0160-5439	5	1	CAPACITOR-FXD 510PF CER
C3	0160-4825	5	1	CAPACITOR-FXD 560PF CER
C4	0160-5439	5	1	CAPACITOR-FXD 510PF CER
C5	0160-5491	7	1	CAPACITOR-FXD 240PF CER
L1	9100-3551	5	2	COIL-MLD 1 UH
L2	9140-0264	5	2	COIL-MLD 1.2 UH
L3	9140-0264	5		COIL-MLD 1.2 UH
L4	9100-3551	5		COIL-MLD 1 UH
NOTE: Capacitors *must* be ceramic. Small-body inductors must *not* be used.				

Figure E-1. 12 MHz Low-Pass Filter, Schematic Diagram and Parts List



Reference Designator	HP Part Number	CD	Description
C1	0160-4803	9	CAPACITOR-FXD 68PF
C2	0160-4804	0	CAPACITOR-FXD 56PF
C3	0160-4800	6	CAPACITOR-FXD 120PF
C4	0160-4790	3	CAPACITOR-FXD 12PF
C5	0160-4800	6	CAPACITOR-FXD 120PF
C6	0160-4788	9	CAPACITOR-FXD 18PF
C7	0160-4800	6	CAPACITOR-FXD 120PF
C8	0160-4790	3	CAPACITOR-FXD 12PF
C9	0160-4803	9	CAPACITOR-FXD 68PF
C10	0160-4804	0	CAPACITOR-FXD 56PF
L1	9100-3911	1	COIL-MLD 220NH
L2	9140-0450	1	COIL-MLD 270NH
L3	9140-0450	1	COIL-MLD 270NH
L4	9100-3911	1	COIL-MLD 220NH
NOTE: Capacitors *must* be ceramic. Small-body inductors must *not* be used. Parallel capacitors are used to achieve the correct capacitance.			

Figure E-2. 50 MHz Low-Pass Filter, Schematic and Parts List