3048MS

HP 3048A OPTION 301
PHASE NOISE MEASUREMENT SYSTEM
(Including Options 001, 002, 003, 004, 005, and 006)

Calibration Manual

SERIAL NUMBERS

This manual applies directly to software version number:

HP 3048A Option 301 Software Version: REV:A.00.00

First Edition

Calibration Manual HP Part 03048-90041

Other Documents Availiable:
Microfiche Calibration Manual HP Part 03048-90045
Operation Manual HP Part 03048-90042
Microfiche Operation Manual HP Part 03048-90046
Reference Manual HP Part 03048-90040
Microfiche Reference Manual HP Part 03048-90047
HP 11848A Service Manual HP Part 11848-90004
Microfiche HP 11848A Service Manual HP Part 11848-90012
HP 3048A Quick Reference Guide 03048-90019

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HEWLETT PACKARD

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HP 3048A Opt 301 Key map **Release: A.00.02**

Dear Customer,

There are several areas in the HP 3048A Opt 301 that have some hidden function keys that you will find necessary. The following list describes these keys, their function, and in which areas of the software they are active.

"Escape" - Back out of imbedded menus

"Control-Break" - Stops measurement and returns to main menu

In "Graph of Results" screen:

F4 - sends result graph to printer if GRAFPLUS loaded
"Shift" F4 - sends result graph and parameter summary to printer if GRAFPLUS loaded
"M" - a menu will appear in the top right corner of the graph. Press the first letter of each option or highlight and "enter" to activate.

Marker - displays a marker on the graph. Move the marker with the arrow keys (UP and DOWN - Coarse movement, LEFT and RIGHT - fine movement)
New Graticule - redraws graticule (no data will appear)

Plot data - plots current data or adds data to current graph

Omit spurs - plots data without spurs

Escape - removes menu from screen (for printing graph, etc.)

In "Instrument Control" screen:

Type the first letter of each description to highlight the box. Repeated input of the first letter scrolls through the choices available. These descriptions change depending on the measurement type.

In "Sigma vs Tau" screen (from "Manipulate Results):

Type F7 once - Plots Sigma vs Tau(sec)
Type F7 twice - Plots Jitter(sec) vs Tau(sec)

During measurement at connect diagram:

Arrow keys manipulate spans on RF analyzer and HP 3561A

RF analyzer
UP arrow - Increase RF analyzer Span (40 MHz max.)
DOWN arrow - Decrease RF analyzer span

HP 3561A
LEFT arrow - Decrease HP 3561A span
RIGHT arrow - Increase HP 3561A span

In many screens, a "Shift" function key decrements the value that the listed function key increments. For example, see Trace Integration - Shift F7.

HP 3048MS Phase Noise Measurement System Software Update Procedure

This update kit is to be used to update your HP 3048MS Phase Noise Measurement System software currently residing on the hard drive of your computer. If your HP 3048MS software displays **HP 11838A Rev A.00.01** in the lower left hand corner of the main menu, you must complete this procedure.

This update kit includes the following:

1. Three software diskettes:
   a. **HP 3048A Option 301 Rev A.00.02** (PN 03048-10015)
   b. **Update**
   c. **GRAFPLUS** - This disk will not be used in this update procedure. Rather, it is a back-up copy of an application currently installed on your hard disk drive. You should store it properly.
2. New manauls.
2. Update pages for the new manuals.

Currently, the HP 3048MS system software resides in a directory named **\phase**. The executable, .EXE, file is called **11838**. This update procedure will create a new **\3048** directory and copy to it, among other files, two new executable files, **PN.EXE** and **CAL.EXE**. PN.EXE is the updated version of 11838.EXE and CAL.EXE is new calibration software that you do not currently have. Some files from the old \PHASE directory will be copied to the new \3048 directory.

To update your system with the new software, do the following:

1. Exit any application programs, if any, that are currently running on the computer.

2. Insert the **HP 3048A Option 301 Rev A.00.02** diskette into the 'A' drive of your Vectra computer.

3. Be sure the MS-DOS prompt is **A:\>**. At this prompt, enter the following: **INSTALL C**
   This will install the new HP 3048A Option 301 software onto the 'C' drive in a new \3048 directory.

4. When the computer has completed step 3, remove the **HP 3048A Option 301** disk from the 'A' drive and insert the **Update** disk into the 'A' drive.

5. At the MS-DOS prompt **A:\>**, enter the following: **UPDATE A C**
   This program will perform two tasks:

   1. It stores duplicate copies of the Result (.RES), Parameter (.PRM), Calibration (.CAL) and Configuration (.CFG) files that exist in the old \PHASE directory in the new \3048 directory.

   2. It will overwrite the current AUTOEXEC.BAT file in the root directory with a new AUTOEXEC.BAT that reflects the new \3048 directory and new executable file name **PN.EXE**. You can either let the Update program overwrite the AUTOEXEC.BAT or you can update it yourself to reflect the new changes. However, this .BAT file must be updated with the new changes.

6. When the computer has completed step 5, remove the **Update** disk from the 'A' drive.

7. Re-boot your computer by either of the following:

   1. Simultaneously pressing [Ctrl] [Alt] [Del].
   2. Cycle the power to your computer.

8. The new software you have just installed (HP 3048A Rev. A.00.02) will automatically load into the computer and run. **HP 3048A A.00.02** should be displayed in the lower left hand part of the screen.

TABLE OF CONTENTS

General Information

INTRODUCTION

This manual documents the procedures which calibrate the HP 3048A Phase Noise Measurement System. System calibration assures that the System meets its published specifications. The procedures consist of system checks, functional tests, adjustments, signal path characterization, and performance tests. Calibration of the HP 11848A Phase Noise Measurement Interface results from calibration of the System.

NOTE

"Calibration" as referred to in this manual should not be confused with the measurement calibration referred to in the normal course of making a phase noise measurement. Measurement calibration (especially, a measurement with phase lock) refers to the characterization of such parameters as the detector constant, tuning sensitivity of the signal source's FM input, and determination of the phase lock loop bandwidth.

The need for calibration is governed by the situation. It is usually not necessary nor even desirable to recalibrate the System frequently. Testing guidelines are summarized below.

Most tests are automatic. Operator intervention is documented in the System's test software. It is recommended, however, that the user follow along in this manual as the tests are running.

EQUIPMENT REQUIRED

Equipment required, but not part of the System, is minimal. A feature of the System is the four sources built into the Interface which substitute for external sources in many cases.

Extensive use is made of the HP 3561A Dynamic Signal Analyzer both as a signal source (using its built-in noise source) and as a signal analyzer. Any calibrated HP 3561A can be used in calibrating the System; it does not need to be the specific HP 3561A in the System.

The external test equipment requirements are given in Table 1.

PERFORMANCE TEST RECORD

Most test results can be hardcopied to a printer. This practice is recommended. It is also recommended that the serial number of the Interface under test be recorded in the System Configuration Table so that it will appear on the printouts.

SYSTEM CALIBRATION TRACEABILITY

The measurement of phase noise, as implemented in the HP 3048A, is a ratio measurement where both the numerator (the noise power) and the denominator (the carrier's power) are measured by the same system spectrum analyzer(s). The accuracy of the measured ratio depends on the amplitude linearity of the spectrum analyzer. The amplitude linearity calibration of the spectrum analyzer will be traceable to the U.S. National Institute of Standards (NIST) if the instrumentation used to perform the spectrum analyzer's calibration is traceable to NIST.

Table 1. Recommended Test Equipment

Instrument Type	Critical Specifications	Suggested Model
Audio Source	Supported by HP 3048A Option 301 software	See Note (1)
Frequency Counter	Frequency Range: 10 to 550 MHz	HP 5315A
Microwave Sources	For systems with Option 201 only(2); 2 required Frequency Range: 1.2 to 18 GHz Maximum Level: >+7 dBm (source 1), >0 dBm (source 2) Stability: drift small compared to 100 kHz	See note (3).
Noise Floor Test Fixture	Supplied with system. No substitute recommended.	HP 11848-61032
Power Meter and Sensor	For systems with Option 201 only(1) Frequency Range: 1.2 to 18 GHz Level Range: >+7 dBm	HP 435B HP 8481A
Printer	Supported by GRAFPLUS™	HP ThinkJet Printer HP PaintJet Printer HP QuietJet Printer
RF Spectrum Analyzer	Supported by HP 3048A Option 301 software	See Table 2 (4)

(1) The HP 3325A/B and HP 8904A are the only audio sources supported by the HP 3048A Option 301 software.

(2) Option 201 adds the 1.2 to 18 GHz input.

(3) A variety of combinations of sources with adequate output and frequency range can be used for this test.

(4) Not needed unless the system is used with an RF spectrum analyzer.

Table 2. Supported RF Analyzers

Model	Frequency Range	Other Considerations
HP 3585A/B	20 Hz to 40 MHz	Allows complete generation of calibration files. Synthesized LO, Tracking Generator
HP 8566A/B HP 8567A HP 8568A/B HP 71000	Varies with model	Must verify calibration data by performing the Noise Flatness Performance Test. Synthesized LOs. Although these analyzers cannot generate New HIGHDATA.CAL > 100 kHz, the Cal Data is verified and/or corrected by performing the Noise Flatness Test.

Table 3. Performance Verification Guideline

Situation[1]	Check or Test to Run						
	Quick Check	Performance Tests	Functional Tests	DAC Tests	Calibration		
					Option 1	Option 2	Sources
New Installation	X	X[2]					
Annual Calibration		X[3]	X[3]	X[3]		X[3]	X[3]
Ambient Change					X		
Confidence Check	X	X[2]					
HP 11848A Repair		X[3]	X[3]	X[3]		X[3]	X[3]
HP 3561A Repair	X						

(1) Perform the Adjustments when recommended by the other tests.

(2) Run the Performance Tests when it is desired to ensure that the System meets its published specifications.

(3) Perform these in the following order: Functional Tests, DAC Tests, Option 2 Calibration, Internal Sources Calibration, then Performance Tests.

WHEN AND WHAT TO TEST

Use Table 3 as a guideline for verifying the performance of the System.

The checks and tests are summarized below. The procedures are listed in the order in which they are described except for the *Source Options Spectral Purity Tests* which follow the Adjustments.

Quick Check is a confidence check which performs a complete phase-locked measurement of the phase noise of the 10 MHz A vs. B internal sources.

Performance Tests verify that the System meets its published specifications. The tests are as follows:

Spur Accuracy Test verifies the accuracy of noise measurements by measuring the level of phase modulation on a carrier with a known discrete sideband level. (In the context of phase noise measurements, discrete sidebands are often referred to as spurious signals or "spurs".)

Noise Flatness Test measures the unflatness of noise signals at offsets greater than 500 kHz. This test needs to be performed only when an RF spectrum analyzer is in the System's Configuration Table.

Noise Floor Test verifies the measurement sensitivity.

Microwave Phase Detector Conversion Loss (Option 201) Test measures the conversion loss of the 1.2 to 18 GHz phase detector. If the detector is not within specification, the noise floor will be degraded when the detector is used. (Option 201 adds the 1.2 to 18 GHz input to the Interface.)

Source Options Spectral Purity Tests verify the contribution of optional sources to the noise floor. (The procedures for these tests follow the Adjustments.)

Functional Tests verify the functionality of the HP 11848A Phase Noise Interface. The tests measure the paths for proper switching, DC offsets, amplifier gains, filter responses, etc. (Adjustments to the HP 11848A can be made when Functional Tests show a problem.)

DAC Tests verify the accuracy of the three DACs in the HP 11848A Phase Noise Interface. (Adjustments to the DACs should be made if a DAC is out of limits.) The DAC Tests require accessing the interior of the Interface.

Option 1 Calibration totally characterizes the HP 11848A measurement paths and generates new calibration data. The data collected replaces the data generated during the previous calibration. The new data may be stored in mass storage. (However, it does not replace the extra data obtained from the Option 2 Calibration.)

Option 2 Calibration is the same as Option 1 Calibration but includes the characterization of two additional reference paths.

Internal Sources Calibration determines and records as data the nominal DAC 2 and DAC 3 voltages required to set the three tuneable, internal sources (VCOs) to their center frequencies.

Adjustments are made when other tests or checks indicate the need. Adjustments require accessing the interior of the Interface.

A3 Adjustments are made to the A3 Analyzer Interface Assembly.

A4 Adjustments are made to the A4 Phase Detector Assembly.

THE IMPORTANCE OF SYSTEM CALIBRATION DATA

Phase noise measurements are ultimately made by the HP 3561A Dynamic Signal Analyzer after the demodulated "noise signal" has passed through the HP 11848A Phase Noise Interface. Phase lock loop control signals also pass through the Interface. The Interface conditions the signals for best measurement sensitivity and accuracy. It is therefore important to know the characteristics of the circuits in the Interface.

The Interface's characteristics are acquired during the Option 1, Option 2, and Internal Sources Calibrations that are described above. The acquired data is stored on the mass-storage media (hard or floppy disc). During the normal course of operation, the System loads the data into the computer's memory (RAM) where it is accessed by the program as needed to correct the raw measurement data. Therefore, the stored data must match the specific Interface being used. It is a good practice to keep the Interface's serial number in the System's Configuration Table which will then appear on data printouts.

The calibration data is stored in two data files: "LOWDATA.CAL" and "HIGHDATA.CAL". LOWDATA.CAL is used for signal-path circuits through 100 kHz. HIGHDATA.CAL is used for signal paths above 100 kHz plus the nominal tuning voltage of the tunable, internal sources and noise-flatness data.

HP 3048A Option 301 Software Information

NOTE

If hardcopies of the test results are desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

LOADING THE SOFTWARE

To load the HP 3048A Option 301 software:

1. If the software will be run from a flexible disk, insert the disk into the disk drive.

   The disk must be left in the drive for the programs to have access to it.

2. Select the drive for the software by typing `<drive>:` (for example `C:`) and then pressing ENTER.

3. Set the directory path to **3048** by typing `CD \3048` and then pressing ENTER.

NOTE

The HP 3048A Option 301 Software disk has two executable programs used to calibrate the System.

- *"PN.EXE" (referred to as the Phase Noise program)*
- *"CAL.EXE" (referred to as the Calibration program)*

4. To load and run the Phase Noise program, type `PN` and then press ENTER.

5. To load and run the Calibration program, type `CAL` and then press ENTER.

NOTE

If a National GPIB interface card is used in place of an HP-IB interface card, type `PN /N` *to load the Phase Noise program, or* `CAL /N` *to load the Calibration program.*

The instructions at the beginning of each procedure states which one of the above programs is used to perform a particular test.

For more information about hardware or software installation or use, refer to appendix A in the HP 3048A Option 301 Operating Manual.

SOFTWARE OPERATION

With either the Phase Noise Main Menu, or the Calibration Main Menu is displayed on your computer, use the following operating instructions.

1. Select a Main Menu item using one of two methods:
   a. Press the first capitalized letter of the item you want.
   b. Use the up [△] or down [▽] keys to move the inverse video box over the item you want, then press the [ENTER] key.
2. When a Main Menu item is selected, a pop-up window or diagram is superimposed over the Main Menu to provide you with further selections, or with entry fields or diagrams for input.
3. More pop-up windows may appear as you make selections. Press the [ESC] (escape) key to return to the previous window.

   To reduce keystrokes as you move between windows or diagrams, press and hold the [Alt] key, and then the first capitalized letter of the Main Menu item that you want.
4. To abort a measurement, press the [CNTL] and [BREAK] keys simultaneously. The measurement will stop and the software will return to the Main Menu.
5. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.

   If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)
6. At the Main Menu level, you may press the [Q] key to exit the HP 3048A Option 301 software.

Quick Check

DESCRIPTION

The Quick Check is a straight-forward, phase-lock-loop measurement of the phase noise of the two internal 10 MHz sources (A vs. B). Though the check is easy to run, a large portion of the circuitry in the HP 11848A Phase Noise Interface is exercised. A completed measurement with good results verifies that the System is operating correctly but does not verify its accuracy.

The check uses only equipment that is part of the System. Measurement definition parameters for this test are retrieved from a Test File named "DEFAULT.PRM".

NOTE

This check duplicates some of the guided tour in the Getting Started *section of the* Operating Manual. *The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.*

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

PROCEDURE

1. From the Phase Noise Main Menu, select **File System**.
2. Select **Directory**.
3. Type `*.PRM` and press [ENTER].
4. Using the [△] [▽] keys, select **DEFAULT.PRM** and press [ENTER].
5. Select **Load File**.

   `DEFAULT.PRM` should be displayed as the path.
6. Press [ENTER] to load the file.
7. Press [ESC] to return to the Main Menu.
8. Select **New Measurement**.

9. Press [Y] to indicate that new measurement data is desired. The System now addresses each instrument listed in the System's Configuration Table. If an instrument does not respond to the HP-IB address listed for it, the System will inform you with a display message. (For details on adding an instrument to the System's Configuration Table or verifying an HP-IB address, refer to appendix A in the HP 3048A Option 301 Operating Manual.)
10. Connect the HP 3561A input and the two 10 MHz source outputs to the HP 11848A as shown in the connect diagram on the computer display and in Figure 1. Note especially the rear-panel connections.

NOTE

The Interface's SPECTRUM ANALYZER *output should either be terminated in 50Ω or an RF spectrum analyzer should be connected to it.*

11. Press the **F1** to run the test. The measurement should proceed without error messages, and the measured noise results should be within 10 dB of that in Figure 2. (The plot in Figure 2 is typical for a System without an RF spectrum analyzer. The measurement takes about 5 minutes depending on the controller and the presence of the RF spectrum analyzer.)

NOTE

A graph of the loop suppression curve will be displayed before the actual measurement begins. This is normal for this measurement. Press [F1] *to proceed.*

12. When the test is done, the computer will sound a short beep and display the message `MEASUREMENT COMPLETE` for approximately 5 seconds.
13. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
14. Press [ESC] to return to the Main Menu.

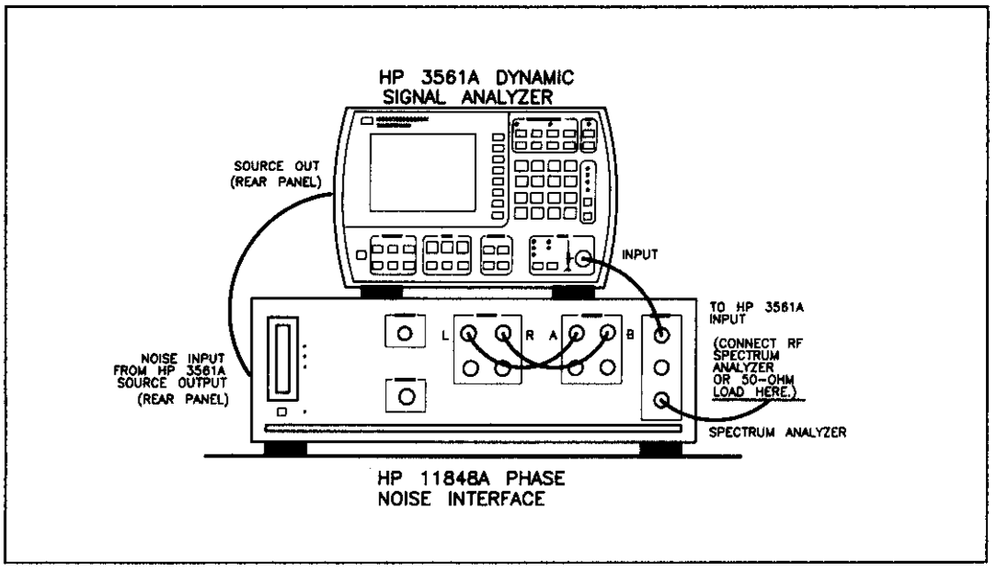


Figure 1. Quick Check Setup

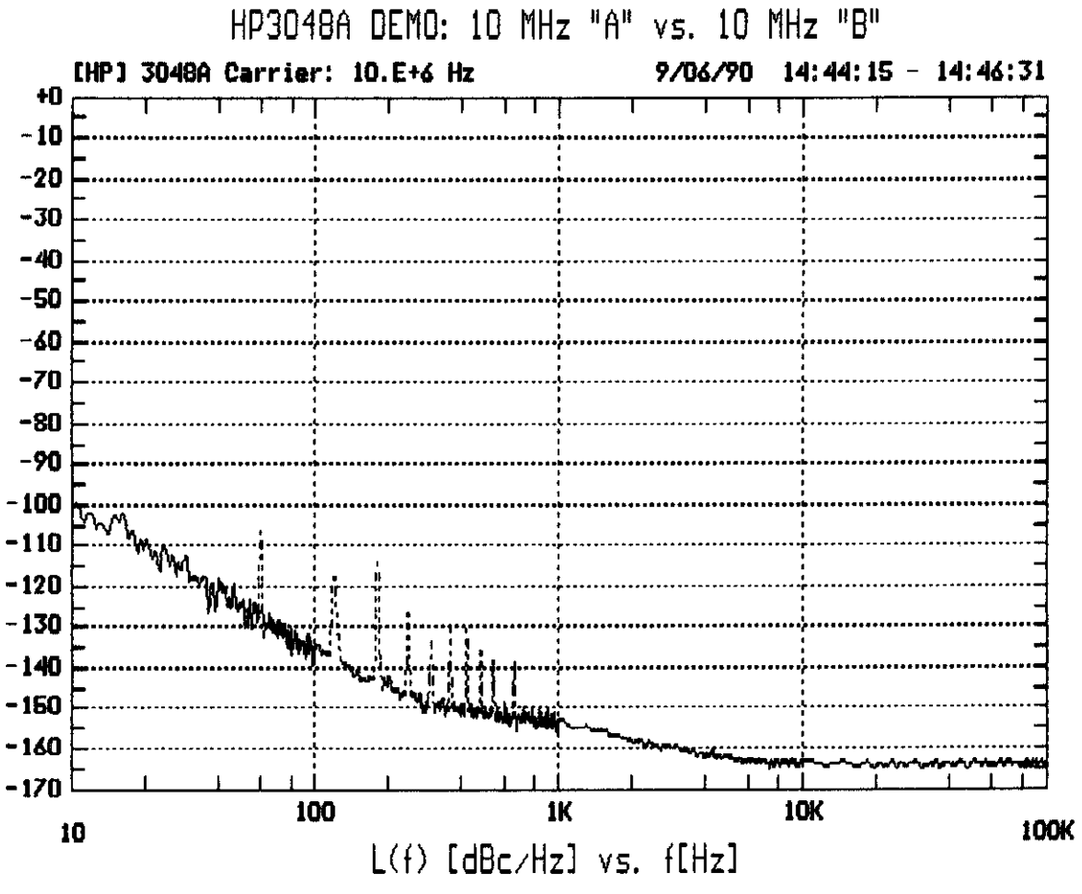


Figure 2. Typical Noise Plot for the System Quick Check

Spur Accuracy Test

DESCRIPTION

In this test an external audio tone is input to the phase modulator of the internal 10 MHz B Oscillator to generate a 10 MHz carrier with discrete, phase-modulation sidebands. The sideband level (relative to the carrier) is calibrated with the HP 3561A Dynamic Signal Analyzer and then measured as a normal phase noise measurement (with the 10 MHz A Oscillator phase locked to 10 MHz B Oscillator). The measurements are made with audio tones of 5.5, 55, 550, 5500, 55 000, and (if an RF spectrum analyzer is present) 550 000 Hz.

To calibrate the sideband level (relative to the carrier), the two 10 MHz Oscillators (A and B) are set 785 Hz apart and fed into the RF Phase Detector. The amplitude of the 785 Hz beatnote is measured by the HP 3561A. This level is the carrier reference level. Then the phase modulation sidebands for each modulation rate are measured with the HP 3561A and the relative sideband level is computed as the ratio of the two measurements.

The RF signal simulates the spurious discrete phase modulation (often called "spurs") frequently appearing in phase noise measurements. Although testing is done on discrete tone sidebands, the general accuracy of the noise sideband measurement is verified.

If an RF spectrum analyzer is not present, the test covers offsets of 1 Hz to 100 kHz. If an RF analyzer is present the range is 1 Hz to 1 MHz.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

Audio Source. An HP 3325A/B or HP 8904A is required for this test and must be entered in the System's Configuration Table. (For details on how to add an instrument to the Configuration Table, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

PROCEDURE

1. From the Phase Noise Main Menu, select **Advanced Functions.**
2. Select **Spur Accuracy Test.**
3. Select **Perform Test.**
4. Connect the instruments as shown on the display and in figure 3.

NOTE

The Interface's SPECTRUM ANALYZER *output should either be terminated in 50Ω or an RF spectrum analyzer should be connected to it.*

5. Press [F1]. The measurement should proceed without error messages, and the measured spurs should be similar to the ones shown in figure 4 with no failures listed. (The measurement takes about 10 minutes depending on controller and the presence of the RF spectrum analyzer.)

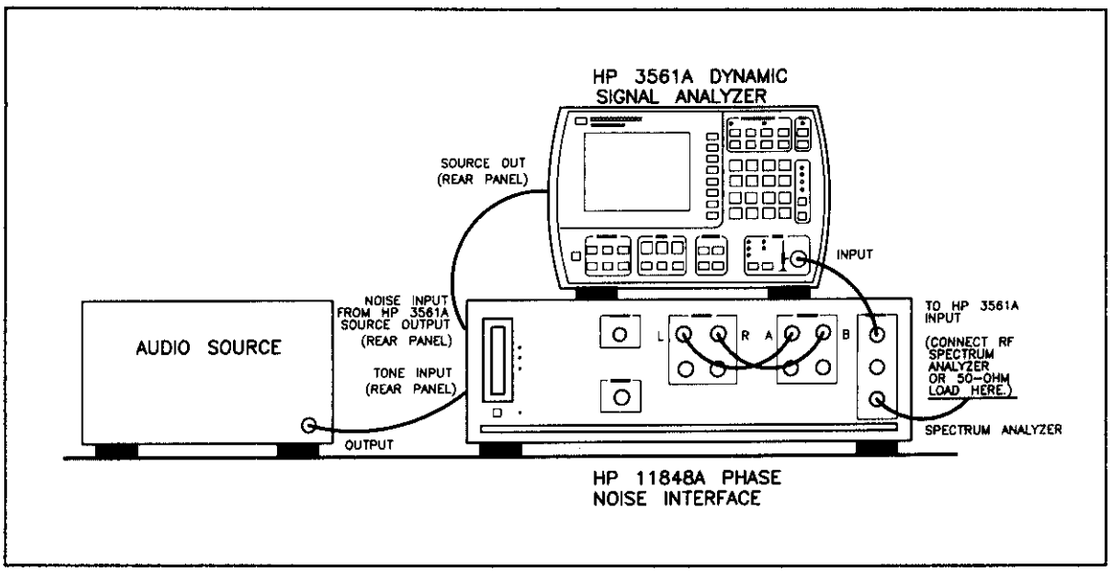


Figure 3. Spur Accuracy Test Setup

NOTE

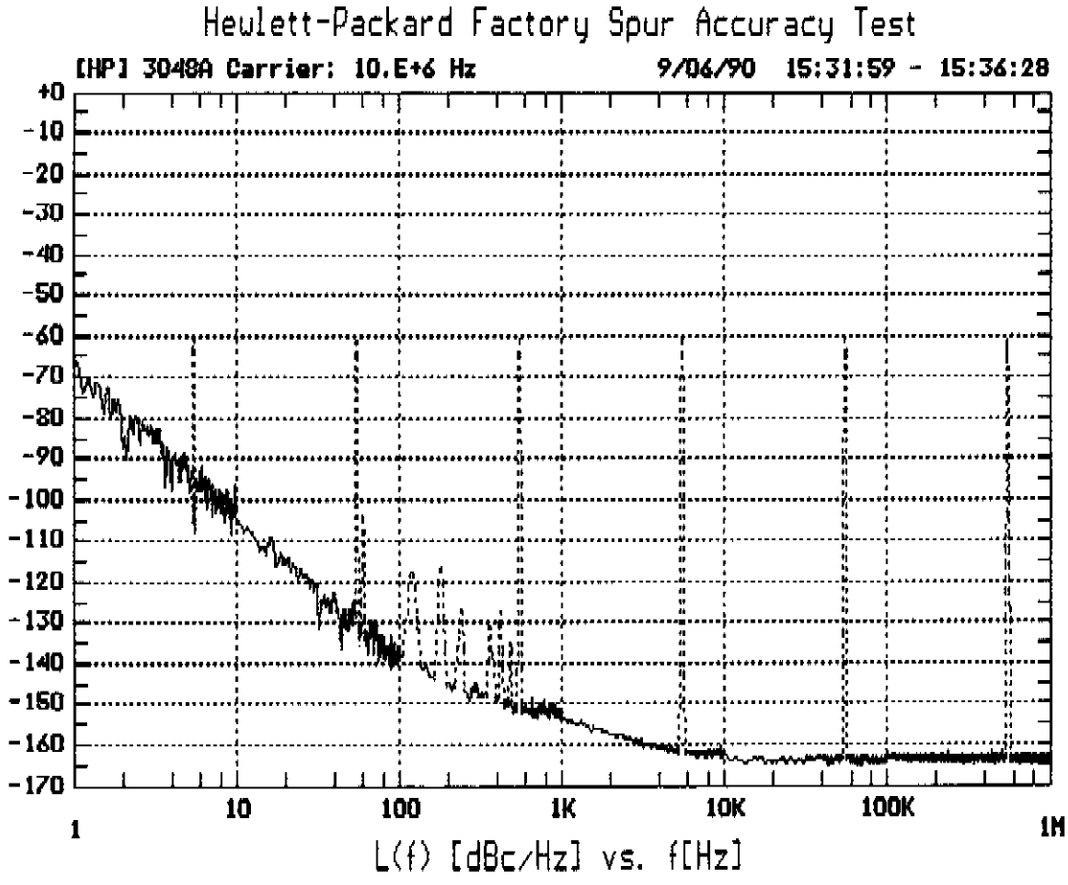
If an RF spectrum analyzer is not present, the test covers offsets of 1 Hz to 100 kHz. If an RF analyzer is present the range is 1 Hz to 1 MHz.

6. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
7. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
8. Press [ESC] to return to the previous menu.
9. To view the test results, select **Test Results**.
10. To print a hard copy of the test results table, press [F1].

NOTE

Failures are indicated by an F *in the error column of the failed data. If this test fails, check the level of the calibration spur versus the measured spurs in the printed results to help determine what caused the failure.*

11. Press [ESC] three times return to the Main Menu.



Hewlett-Packard Factory Spur Accuracy Test 9/06/90 [15:31:59 - 15:36:28]
HP 11848A SN: 2924A00450

	Spur Freq (Hz)	Calibratd (dBc)	Measured (dBc)	Error (dB)
1.	5.5	-60.47	-60.24	0.23
2.	55	-60.92	-61.36	0.44
3.	550	-60.30	-61.18	0.88
4.	5.5E+3	-60.95	-61.16	0.20
5.	55.E+3	-60.79	-60.90	0.11
6.	550.E+3	-61.54	-61.40	0.14

Figure 4. Typical Spur Accuracy Test Results

Noise Flatness Test

DESCRIPTION

This test verifies that the calibration data used for phase noise measurements above 500 kHz offsets is accurate.

The test requires an RF spectrum analyzer in the System's Configuration Table and needs to be run only when an RF analyzer is used while making measurements. (An HP 3585A/B Spectrum Analyzer is supplied with Systems having Option 101.) The test is a standard phase-lock-loop measurement of the phase noise of the internal 400 MHz and 350–500 MHz Oscillators. The frequency offset range of the measurement is 500 kHz to 40 MHz. The 400 MHz Oscillator has a flat or white phase noise distribution from 500 kHz to 40 MHz.

This test measures the maximum unflatness above 500 kHz relative to the measured noise value at a 500 kHz offset.

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

PROCEDURE

1. From the Phase Noise Main Menu, select **Advanced Functions.**
2. Select **Noise Flatness Test.**
3. Press [Y] to indicated that new measurement data is desired.
4. Connect the instruments as shown on the display and in figure 5.
5. Press the [F1]. The measurement should proceed automatically without error messages (but see the following note) and the measured noise should be similar to that shown in figure 6. (The measurement takes about 5 minutes depending on the controller.)
6. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
7. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
8. Press [ESC] twice to return to the Main Menu.

NOTE

It is permissible to proceed with the test if an accuracy specification degradation message is displayed if the degradation is 1 dB or less.

If the test results indicate an unflatness > 2 dB, correction data is automatically stored in the file HIGHDATA.CAL to compensate for the unflatness.

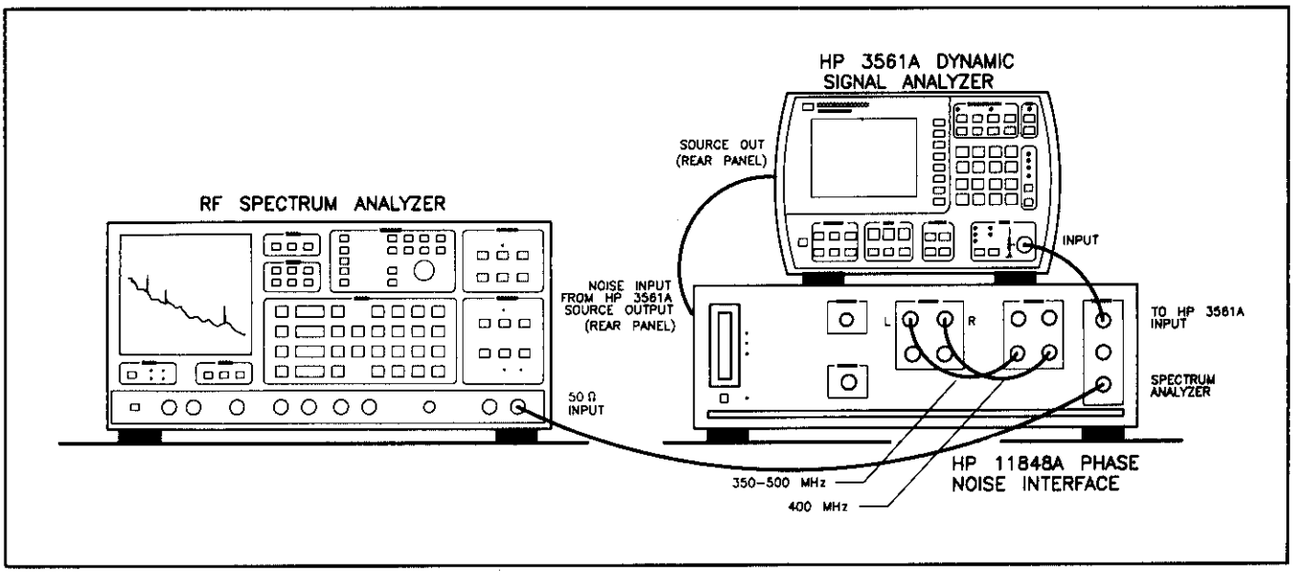


Figure 5. Noise Flatness Test Setup

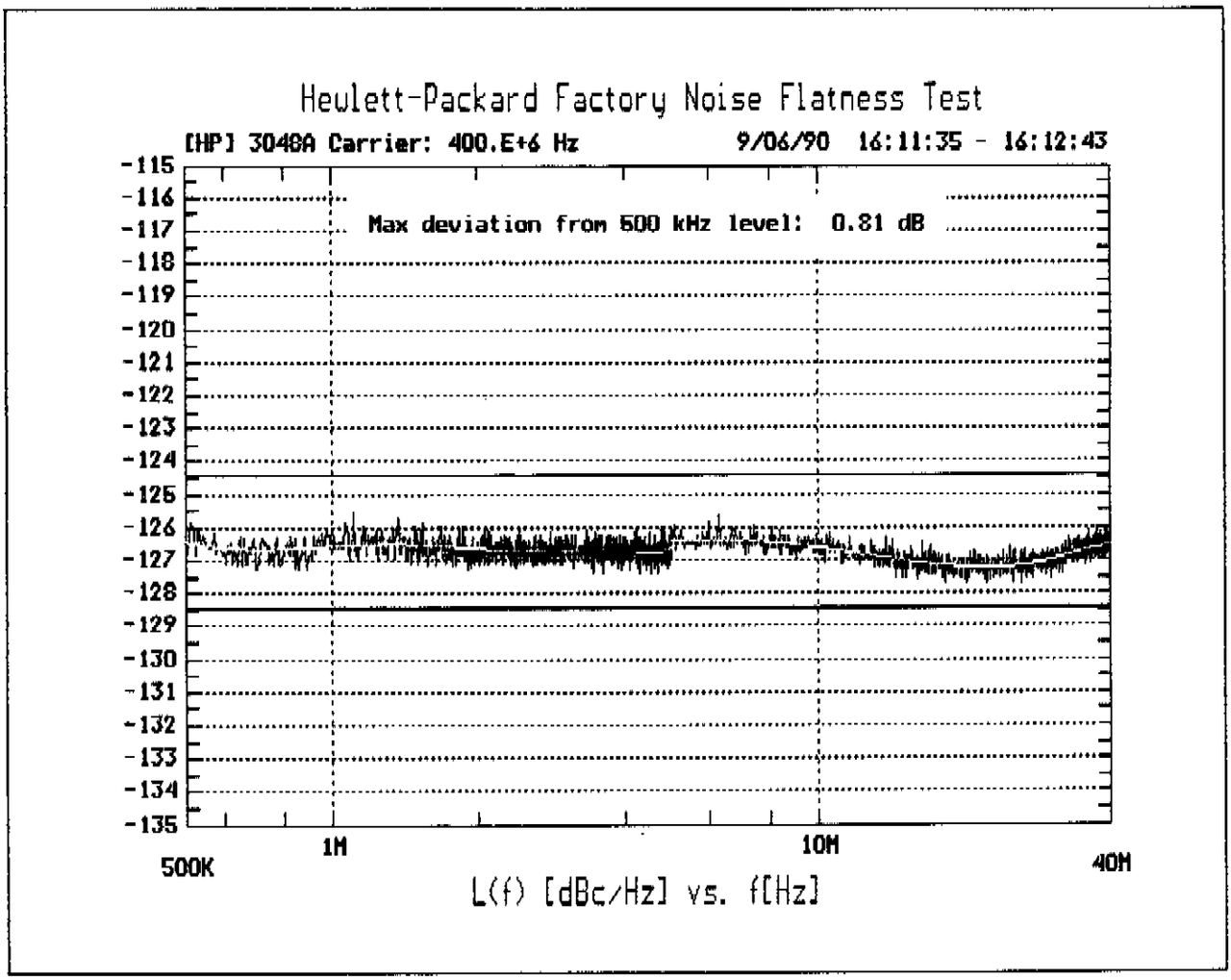


Figure 6. Typical Noise Flatness Test Results

Noise Floor Test

DESCRIPTION

This test measures the noise of the System apart from the phase noise contribution of the external reference sources. Thus this test measures the absolute sensitivity (the noise floor) of the System.

The output of the internal 350–500 MHz Oscillator is split and applied to both inputs of the 5 MHz to 1.6 GHz Phase Detector. However, one path to the phase detector is delayed one-quarter wavelength to establish phase quadrature of the split signals. Fine adjustment of quadrature is made by tuning the oscillator until the dc output of the detector is 0V. The phase noise of the oscillator cancels itself out because the phase fluctuations of the split signals are correlated.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

Noise Floor Test Fixture. A power splitter with delay line is required for this test. This device is supplied with the System (HP 11848-61032).

PROCEDURE

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. From the Phase Noise Main Menu, select **Advanced Functions.**
2. Select **Internal Noise Test.**
3. Press [Y] to indicated that new measurement data is desired.
4. Connect the instruments as shown on the display and in figure 7.

NOTE

The Interface's SPECTRUM ANALYZER *output should either be terminated in 50Ω or an RF spectrum analyzer should be connected to it.*

Connect the Noise Floor Test Fixture directly to the L *and* R *ports of the* PHASE DETECTOR INPUTS. *Line length is critical; do not connect intervening cables.*

Tighten all connections securely as the Noise Floor test results may be affected by loose connections. Also, do not mechanically disturb the System while the test is running.

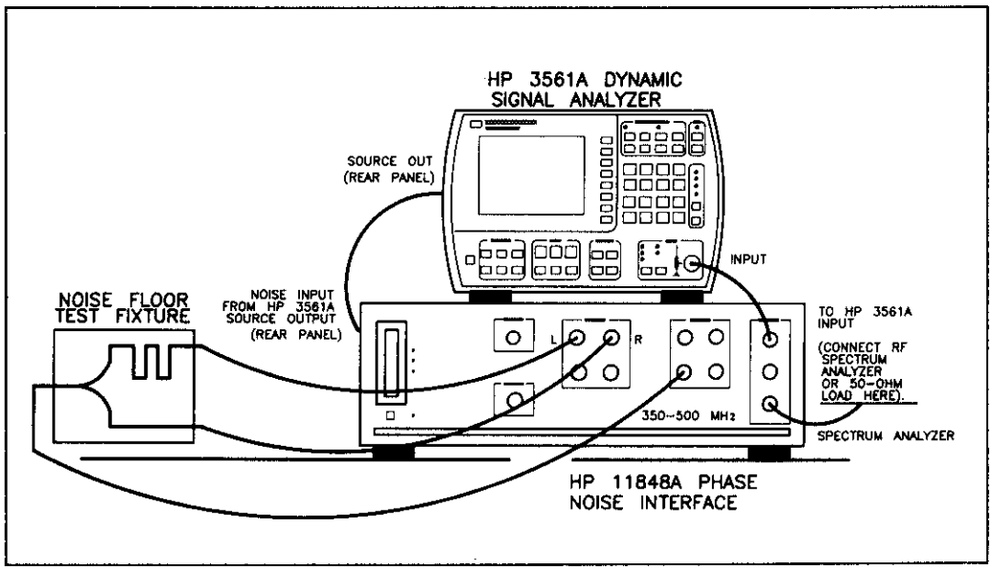


Figure 7. *Noise Floor Test Setup*

5. Press [F1]. The measurement should proceed automatically without error messages and the measured noise should be similar to that shown in Figure 8. (The measurement takes about 30 minutes depending on the controller and the presence of the RF spectrum analyzer.)

NOTE

If no RF spectrum analyzer is present, the test covers offsets of 0.01 Hz to 100 kHz. If an RF analyzer is present the range is 0.01 Hz to 40 MHz.

The phase detector constant is not measured for this test. A phase detector constant of 0.6 V/radian is used for the Noise Floor Test because at the specified R-port power level, the phase detector constant is typically 0.6 V/radian.

6. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
7. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
8. Press [ESC] twice to return to the Main Menu.

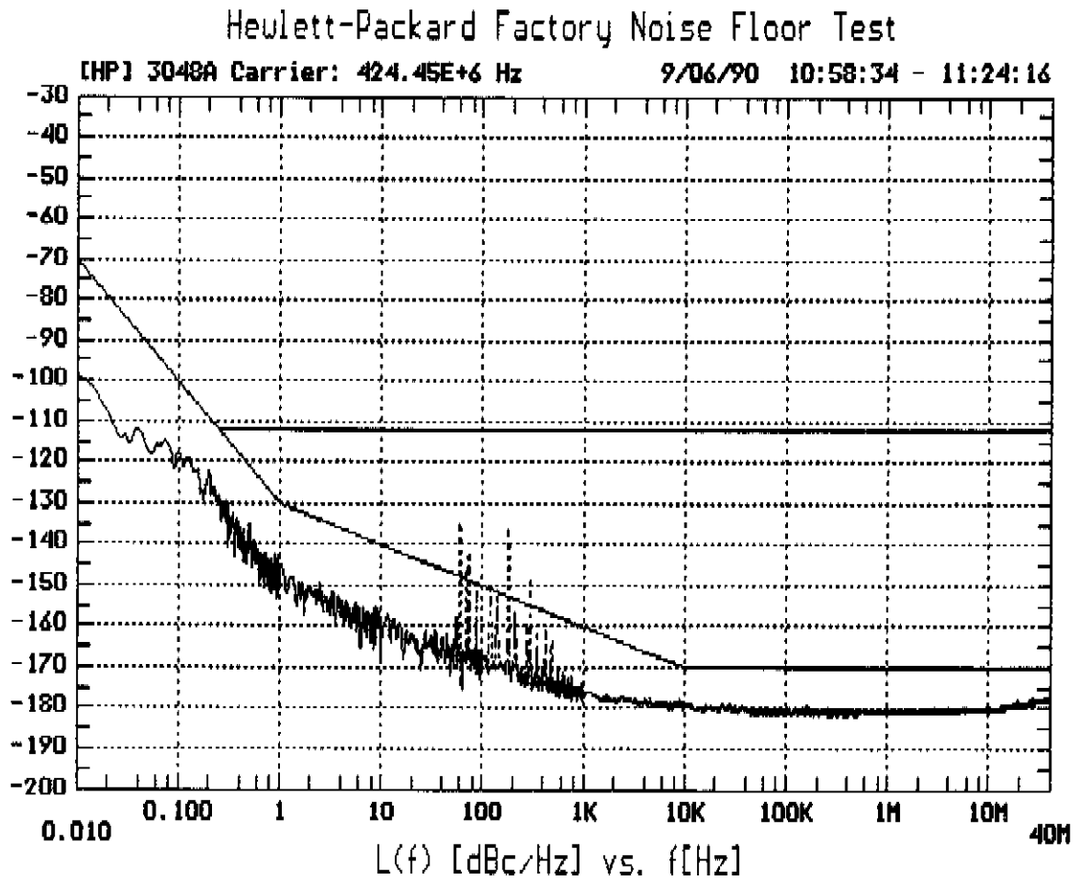


Figure 8. Typical Noise Floor Test Results

Microwave Phase Detector Conversion Loss (Opt. 201) Test

DESCRIPTION

Two microwave sources are set 50 kHz apart. One is connected to the R port of the Interface's 1.2 GHz to 18 GHz (microwave) phase detector; the other is connected to the L port. The phase detector generates a 50 kHz IF beatnote at its output which is measured by the HP 3561A. The conversion loss of the phase detector is the ratio of the level of the beatnote to the level of the signal at the R port. This procedure is repeated for several carrier frequencies. Because of the high frequencies involved, the power of the two sources is measured by a power meter for each frequency.

The signal path within the Interface is controlled manually using the 11848A Control feature. The microwave sources are operated manually.

Conversion loss is not an explicitly specified parameter but must be within the limits given in this procedure to assure specified sensitivity (that is, noise floor) for the stated carrier frequency. Excessive conversion loss is usually caused by a defective phase detector (mixer) itself or by interconnecting cables or relays.

EQUIPMENT

Microwave Sources. Two microwave sources are required. If the full range of the microwave phase detector is to be tested, both sources must cover 1.2 to 18 GHz. The drift and short-term instability of both sources must be less than 100 kHz. One source must output at least +7 dBm, the other at least 0 dBm. If the required stability is unobtainable, the test can be run with an RF spectrum analyzer (such as the HP 3585A/B) used in place of the HP 3561A; the source instability must be less than 10 kHz. If any other RF spectrum analyzer is used, the output power of the Option 201 Phase Detector at the Spectrum Analyzer port should be measured with the power meter.

Power Meter and Sensor. A power meter with sensor is required for this test to check the power into the L and R ports of the microwave phase detector. The power meter must be able to measure up to +10 dBm from 1.2 to 18 GHz.

Spectrum Analyzer. The HP 3561A Dynamic Signal Analyzer or the HP 3585A/B Spectrum Analyzer is recommended but other RF spectrum analyzers can be used. If any other spectrum analyzer is used, the output power of Option 201 Phase Detector at the Spectrum Analyzer port should be measured with a power meter.

PROCEDURE

CAUTION

The microwave phase detector is more susceptible to burnout than the RF phase detector. Levels greater than +10 dBm may cause damage. Measure the power levels with a power meter before connecting the sources to the phase detector. Also, disconnect the sources from the phase detector before changing frequency.

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. Two signal sources and the spectrum analyzer are connected to the Interface as follows. (Refer to Figure 9.)
   a. Set one microwave source to 1.2 GHz. Measure the power with a power meter and set the level to 0 dBm. Connect it to the front-panel R input of the 1.2 GHz TO 18 GHz phase detector.
   b. Set the other microwave source 50 kHz above or below 1.2 GHz. Measure the power with a power meter and set the level to +7 dBm. Connect it to the front-panel L input of the phase detector. (If an RF spectrum analyzer is to be used, a 1 MHz beatnote is suggested.)
   c. Preset the HP 3561A for a 0 to 100 kHz frequency span. Connect the HP 3561A's input to the Interface's front-panel TO HP 3561A INPUT output. (If an RF spectrum analyzer is used, set it to view a 1 MHz signal.)

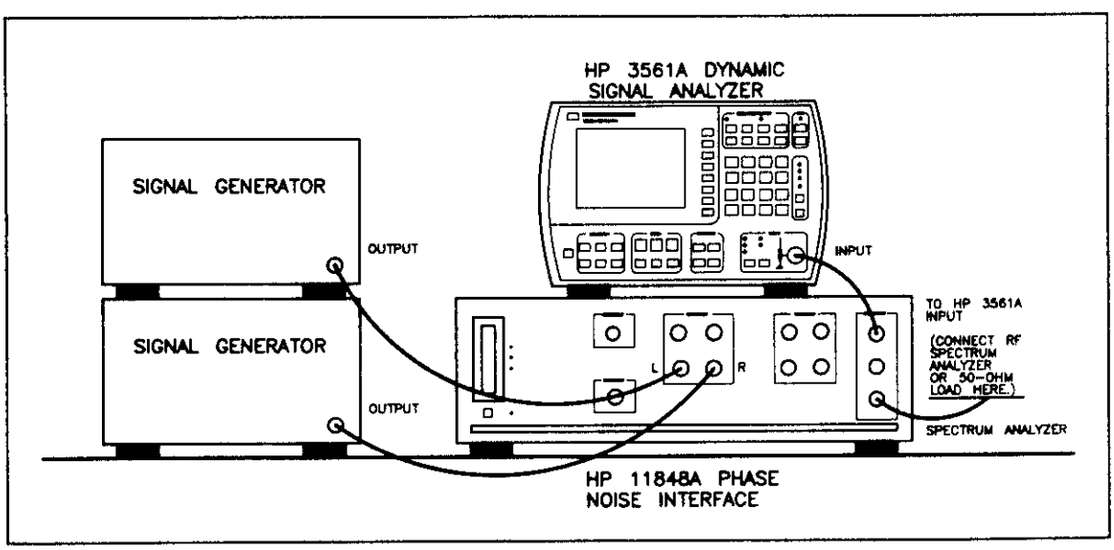


Figure 9. Microwave Phase Detector Conversion Loss Test Setup

2. From the Phase Noise Main Menu, select **Advanced Functions**.

3. Select **11848A Control.**
4. Set up the HP 11848A internal configuration as follows.
   a. Select **Preset.**
   b. Select **DAC/GAINS, etc.**
   c. Using the [△] [▽] keys, select the line labeled **HPF(H):**, press [6], then press [ENTER].
   d. Press [ESC].
   e. Select **K/L/S SWITCHES.**
   f. Using the [△], [▽], [◁], [▷], keys select the line labeled **K12:**, press [1], then press [ENTER].
   g. Using the [△], [▽], [◁], [▷], keys select the line labeled **K13:**, press [1], then press [ENTER].
5. Set one of the microwave sources to the frequencies indicated in table 3 below. Set the other source 50 kHz above or below the frequency of the first source. (If an RF spectrum analyzer is being used, set the other source 1 MHz above or below the first source.) For each pair of frequencies, remeasure the power of both sources, reconnect the sources to the phase detector, and read the level of the 50 kHz (or 1 MHz) signal from the spectrum analyzer. The level should be −25 dBV (−12 dBm) or higher.

Table 3. Conversion Loss Test Results

Microwave Source Frequency (GHz)	Limits of Beatnote Signal (dBV)	
	Lower	Actual
1.2	−25	_____
2	−25	_____
4	−25	_____
8	−25	_____
12	−25	_____
18	−25	_____

5. Press [ESC] three times to return to the Main Menu.

Functional Tests

DESCRIPTION

The Functional Tests exercise the hardware in the Interface and check for proper functioning. Examples of the hardware checked are switches, amplifiers, attenuators, DACs, filters, etc. The program permits a run-through of all checks or in some cases a single function can be individually tested.

In a typical test such as the testing of a filter, the program routes the noise source of the HP 3561A Dynamic Signal Analyzer through a reference path to the input of the HP 3561A and measures the signal level at several frequencies. The program then inserts the filter in the path and remeasures the levels.

Except for checks of dc offset and VCO control path, test limits are loose because only the general functioning of the filter is checked. (Measurement path filters are tightly characterized by the Option 1 or Option 2 Calibration program.)

EQUIPMENT

Printer. To perform all tests sequentially using **All Tests (w/Hardcopy)**, a printer must be connected to the computer and the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

A specific test can be performed without a printer. However, it is not recommended.

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. From the Calibration Main Menu, select **Functional Tests.**

NOTE

The tests may be run as an entire sequence or tests may be run individually as outlined in the following steps. Before proceeding with the tests, you should read the Comments *section below.*

2. To perform all tests sequentially, select **All Tests w/Hardcopy.**

   To perform a specific test, select the desired test, and then follow the instructions on the display. An * (asterisk) will flash in the lower right portion of the window border to indicate the test is running.

3. When the test is done, use the [△] [▽] keys to view the test results or press [F1] to print a hard copy.
4. Press [ESC] to return to the Main Menu.

Comments

If it is desired to have the Interface's serial number appear on the printout, the serial number must appear in the System's Configuration Table. This practice is recommended.

Runtime. The full functional test takes about 25 minutes to run. Some manual reconnection of cables is required.

Connections. Signal connect diagrams or instructions appear on the display as the test or tests proceed. However, two connections are assumed that are not shown. (1) The rear-panel SOURCE OUT connector of the HP 3561A must be connected to the rear-panel NOISE INPUT FROM HP 3561A SOURCE OUTPUT connector of the Interface. (2) The Interface's SPECTRUM ANALYZER output should either be terminated in 50Ω or an RF spectrum analyzer should be connected to it. In either case the spectrum analyzer port must be terminated in 50Ω.

Tests. A brief description of the ten Functional Tests follows. Referring to the Block Diagram foldout at the end of this manual will help in understanding the descriptions.

0 – Flip-Flop Test. The out-of-lock and overload flip-flops are tested when set and cleared.

1 – Rear Panel Tune Voltage Output Test. The transfer function of ATTEN 1 is measured by a method similar to A – A3/A4 Transfer Functions Test.

2 – Front Panel Tune Voltage Output Test. The transfer function of ATTEN 3 is measured by a method similar to A – A3/A4 Transfer Functions Test.

3 – RF Phase Detector Beatnote Test. The (A6) 10 MHz VCXO A and (A7) 10 MHz VCXO B are fed into the RF Phase Detector. A beatnote of 500 Hz is generated and the amplitude measured. This test checks the functioning of both oscillators and the RF Phase Detector.

4 – Beatnote Pull Test (DACs 1, 2, & 3). This is similar to Test 06, but the oscillators are individually tuned by each of the three DACs to test their tuning sensitivity.

5 – Peak Detector & Switched HPF Test. An 800 Hz beatnote is generated by the method described in Test 06. The beatnote is fed into the Peak Detector following the 10 Hz/50 kHz High-Pass Filter. The dc output from the Peak Detector is measured with the 10 Hz then the 50 kHz filter switched in.

6 – Oscillator Test. The absolute level and frequency of the 100 kHz Calibration Oscillator and the Search Oscillator are measured.

7 – DC Offsets Test. The HP 3561A is used as a dc voltmeter to measure the dc level at the front-panel TO HP 3561A INPUT connector. The voltage is measured with many different circuits in the measurement path. The circuits are labeled for each result. If the voltage is slightly out of limits, in most cases they can be adjusted. (Refer to the *Adjustments* further on in this manual.)

8 – Lag/Lead Transfer Functions Test. Lag-Lead Network 1 is measured at 8 different settings.

9 – PLL Paths Transfer Functions Test. This check is similar to A – A3/A4 Transfer Functions Test except that the paths are through the circuits labeled GAIN 1, GAIN 2, and ATTEN 2 on the Block Diagram.

A – A3/A4 Transfer Functions Test. A3 is the Analyzer Interface Assembly; A4 is the Phase Detector Assembly. The circuit paths checked are between the rear-panel NOISE INPUT FROM HP 3561A SOURCE OUTPUT connector (J14) to the front-panel TO HP 3561A INPUT connector (J11). The print out path descriptions give some idea of the signal flow. A measurement of the simplest path is made first; this becomes a reference for the tests. Measurements are made at several frequencies.

DAC Tests

DESCRIPTION

The output of the three Digital-to-Analog Converters (DACs) is measured with each input bit individually set high. DAC 1 can be tested via a front-panel output. DACs 2 and 3 can only be tested at internal test points. This requires removal of the top cover of the HP 11848A Phase Noise Interface. The HP 3561A Dynamic Signal Analyzer is used as a dc voltmeter in this test.

Since this test requires accessing the interior of the Interface, precautions should be taken to prevent electrical shock. Care should also be taken to minimize electro-static discharge that could damage sensitive electrical devices.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. The testing of DACs 2 and 3 requires removal of the top cover of the Interface. To do this:
   a. Switch LINE to OFF.
   b. Remove the line cord.
   c. If the rear panel of the Interface has two feet in the upper corners, remove them.
   d. Unscrew the screw in the middle of the rear edge of the top cover. This is a captive screw and will cause the top cover to push away from the frame. (A slight tapping on the top cover will aid in removal.) Slide the cover back about 6.5 mm (0.25 inch) and lift it off.
   e. Re-insert the line cord and switch LINE back to ON.
2. From the Calibration Main Menu, select **Test DACS**.

NOTE

Before proceeding with the tests, you should read the Comments *section below.*

3. Connect the instruments as shown on the display.
4. Press [F1] to proceed.

NOTE

*An * (asterisk) will flash in the lower right portion of the window border to indicate the test is running.*

5. When the test is done, use the [△] [▽] keys to view the test results or press [F1] to print a hard copy.
6. Press [ESC] to return to the Main Menu.

Comments

If it is desired to have the Interface's serial number appear on the printout, the serial number must appear in the System's Configuration Table. This practice is recommended.

Connections. To test DACs 2 and 3, you will be prompted to connect the HP 3561A input to testpoints on the A3 Analyzer Interface Assembly. A3 is the large printed circuit board under the top cover. (Refer to the HP 11848A *Service Manual* for details.) The testpoint locations are shown in Figure 11.

The specific connections are:

DAC 2: Connect the negative (–) lead (the outer conductor) to A3 TP207 (ground). Connect the positive (+) lead (the inner conductor) to A3 TP202.

DAC 3: Connect the negative (–) lead (the outer conductor) to A3 TP207 (ground). Connect the positive (+) lead (the inner conductor) to A3 TP201.

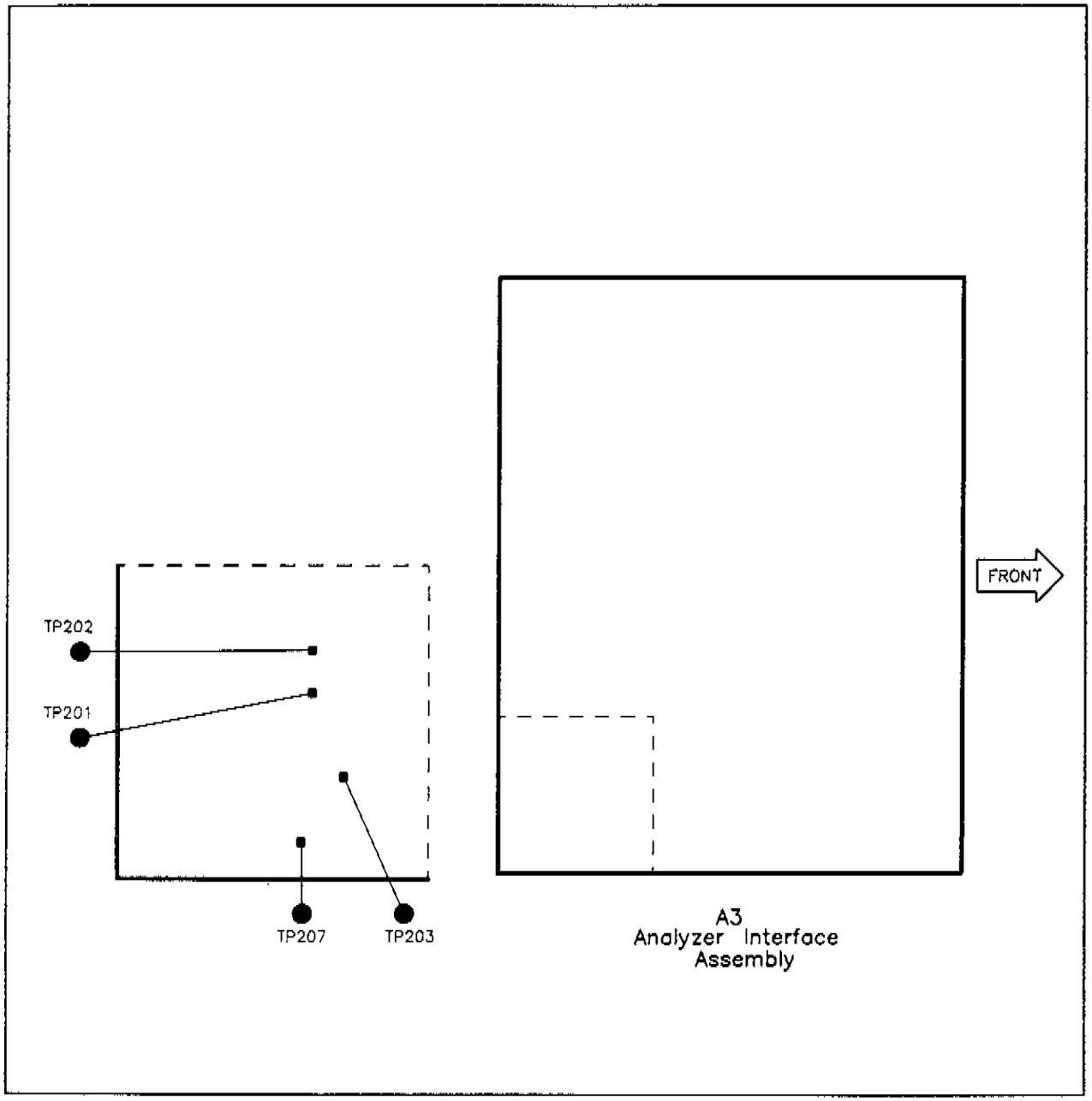


Figure 11. A3 Testpoint Locations

A3 Adjustments

DESCRIPTION

The A3 Analyzer Interface Assembly in the HP 11848A has ten adjustments. The adjustments are guided by the system software but the software neither displays the actual measurement values nor indicates whether the adjustment is within the proper limits; rather, the operator simply reads the value from the HP 3561A and adjusts the specified component until the reading is within limits.

The following adjustments are made:

Component	Circuit	Purpose
A3R68	AC/DC Adaptive Coupler	Minimize dc offset
A3R74	1 Hz High-Pass Filter	Minimize dc offset
A3R80	10 Hz High-Pass Filter	Minimize dc offset
A3R86	100 Hz High-Pass Filter	Minimize dc offset
A3R92	1 kHz High-Pass Filter	Minimize dc offset
A3R98	10 kHz High-Pass Filter	Minimize dc offset
A3R132	Floating Amplifier 2	Maximize ground isolation
A3R134	Floating Amplifier 1	Maximize ground isolation
A3R210	DAC 2	Set reference level
A3R206	DAC 3	Set reference level

Since these procedures require accessing the interior of the Interface, precautions should be taken to prevent electrical shock. Care should also be taken to minimize electrostatic discharge that could damage sensitive electrical devices.

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

Initial Setup

1. The adjustments to the A3 Analyzer Interface Assembly require removal of the top cover of the Interface. To do this:
   a. Switch LINE to OFF.
   b. Remove the line cord.
   c. If the rear panel of the Interface has two feet in the upper corners, remove them.
   d. Unscrew the screw in the middle of the rear edge of the top cover. This is a captive screw and will cause the top cover to push away from the frame. Slide the cover back about 6.5 mm (0.25 inch) and lift it off.

e. Re-insert the power cord and switch LINE back to ON.

2. Set the HP 3561A input switch to the FLOAT position.
3. From the HP 11838A Calibration Main Menu, select **Internal Adjustments.**
4. Select **3 – A3 Adjustment.**

NOTE

The physical location of testpoints and adjustable components is shown in Figure 16.

DC Offset Adjustments

5. Connect the instruments as shown on the display and in figure 12.
6. Make the adjustments for A3R68, A3R74, A3R80, A3R86, A3R92, and A3R98 as instructed. Press [F1] when done with each adjustment.

NOTE

The adjustment limit prompt "0 VDC +/- 300 uV" means that the adjusted value should be between −300 and +300 microvolts dc.

The values you are monitoring and adjusting appear as the value for "Y:" or "Yr:" at the bottom center of the HP 3561A display.

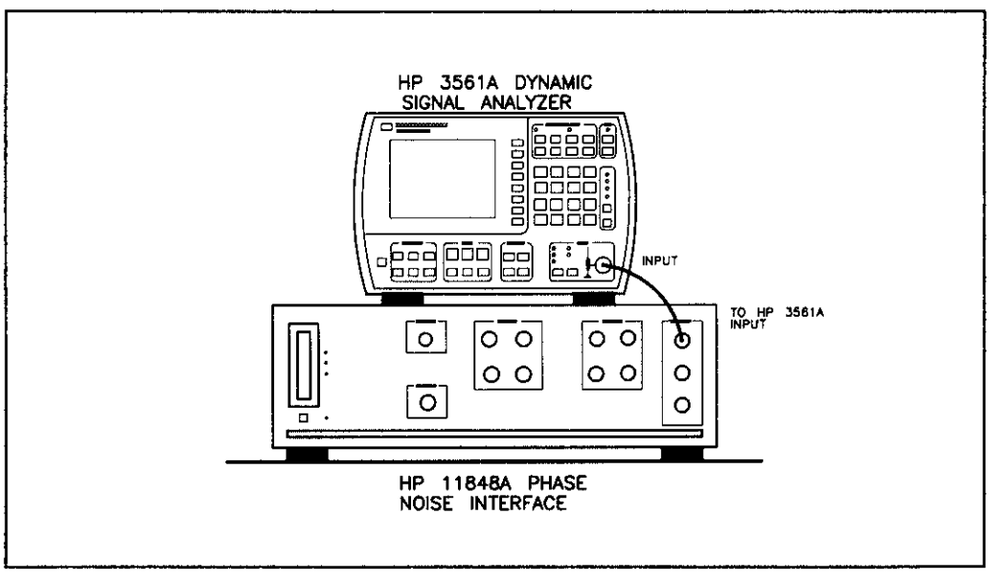


Figure 12. A3 DC Offset Adjustments Setup

Ground Isolation Adjustments

7. Connect the instruments as shown on the display and in figure 13. This sets up a reference for the following measurements.
8. Press [F1] to proceed.
9. Using a BNC-to-clip lead adapter of the cable from the HP 3561A noise source, connect the instruments as shown on the display and in figure 14.

NOTE

Connect the ground (outer conductor) lead of the clip-lead adapter to chassis ground in the HP 11848A. (Testpoint A3 TP46 is a convenient ground connection point.)

Connect the other lead (the signal lead or inner conductor) of the clip-lead adapter to the outer conductor of the BNC tee. Note that the outer conductor of the tee is not chassis ground; it is an isolated, floating ground.

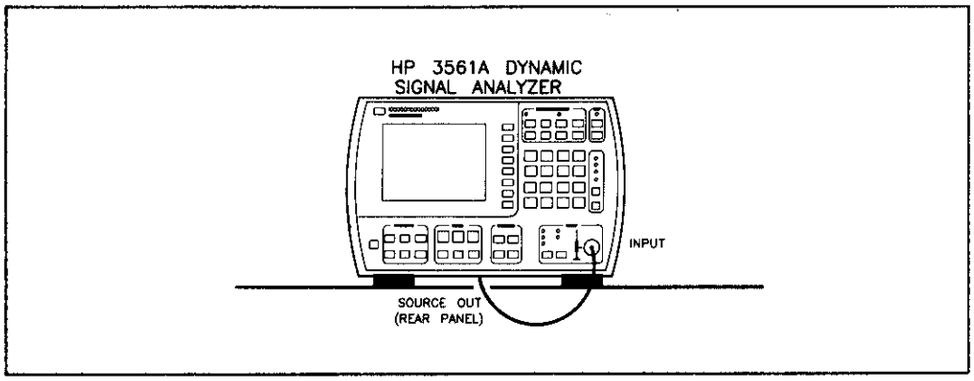


Figure 13. A3 Ground Isolation Reference Setup

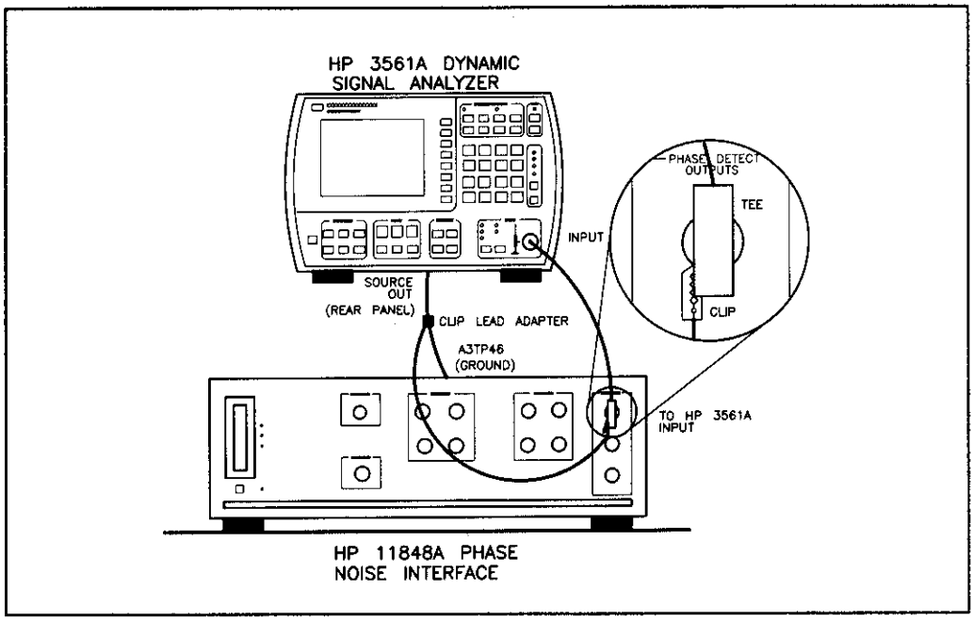


Figure 14. A3 Ground Isolation Setup

10. Adjust A3R132 as instructed. Refer to Figure 15 which shows a typical result after adjustment.
11. Press [F1] to proceed.
12. The next prompts instruct you to simply move the BNC tee (with cables and adapters attached) from its present connection to the HP 11848A front-panel connector labeled TUNE VOLTAGE OUTPUT. Then adjust A3R134 in a manner similar to A3R132 above. (It may also be necessary to use a different ground connection.)
13. Press [F1] to proceed.

DAC Reference Adjustments

14. Connect the instruments as shown on the display.

NOTE

Connect the ground (outer conductor) lead of the clip lead-adapter to TP207. Connect the other lead (inner conductor) of the clip lead-adapter to either TP 203 or TP 201 as requested.

The adjustment limit prompt "`-10 VOLTS +/- 50 mV`*" means that the adjusted value should be between –10.05 and –9.95 volts.*

The adjustment limit prompt "`-.323 VOLTS +/- 1 mV`*" means that the adjusted value should be between –324 and –322 millivolts.*

15. Press [F1] to proceed.
16. Adjust A3R210 as instructed.
17. Press [F1] to proceed.

18. Connect the instruments as shown on the display.
19. Press [F1] to proceed.
20. Adjust A3R206 as instructed.
21. Press [ESC] to return to the Main Menu.

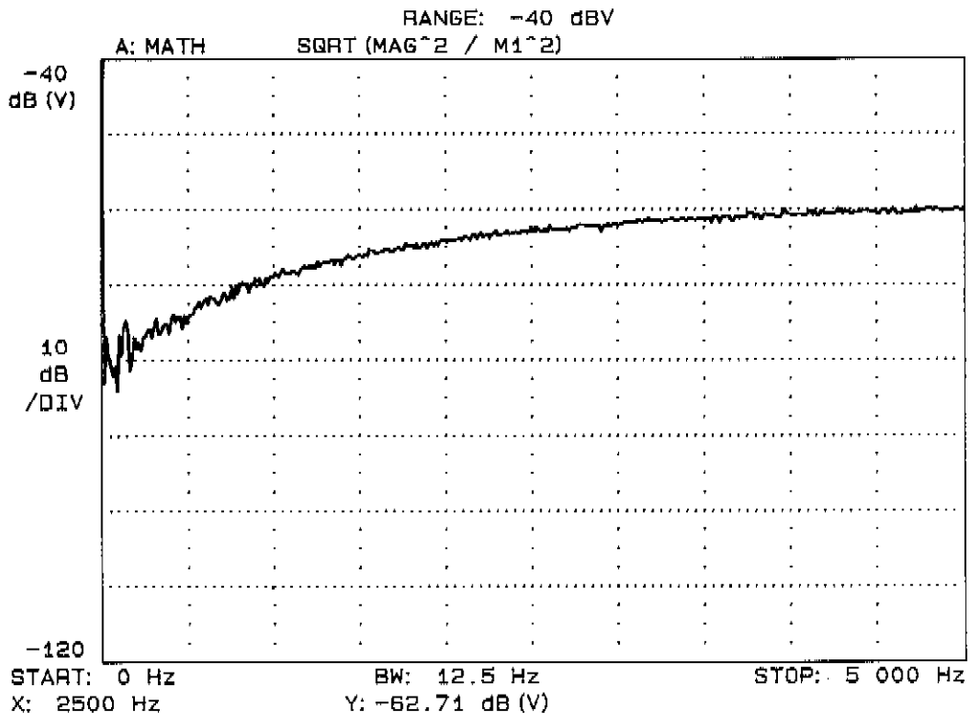


Figure 15. Typical Ground Isolation Adjustment

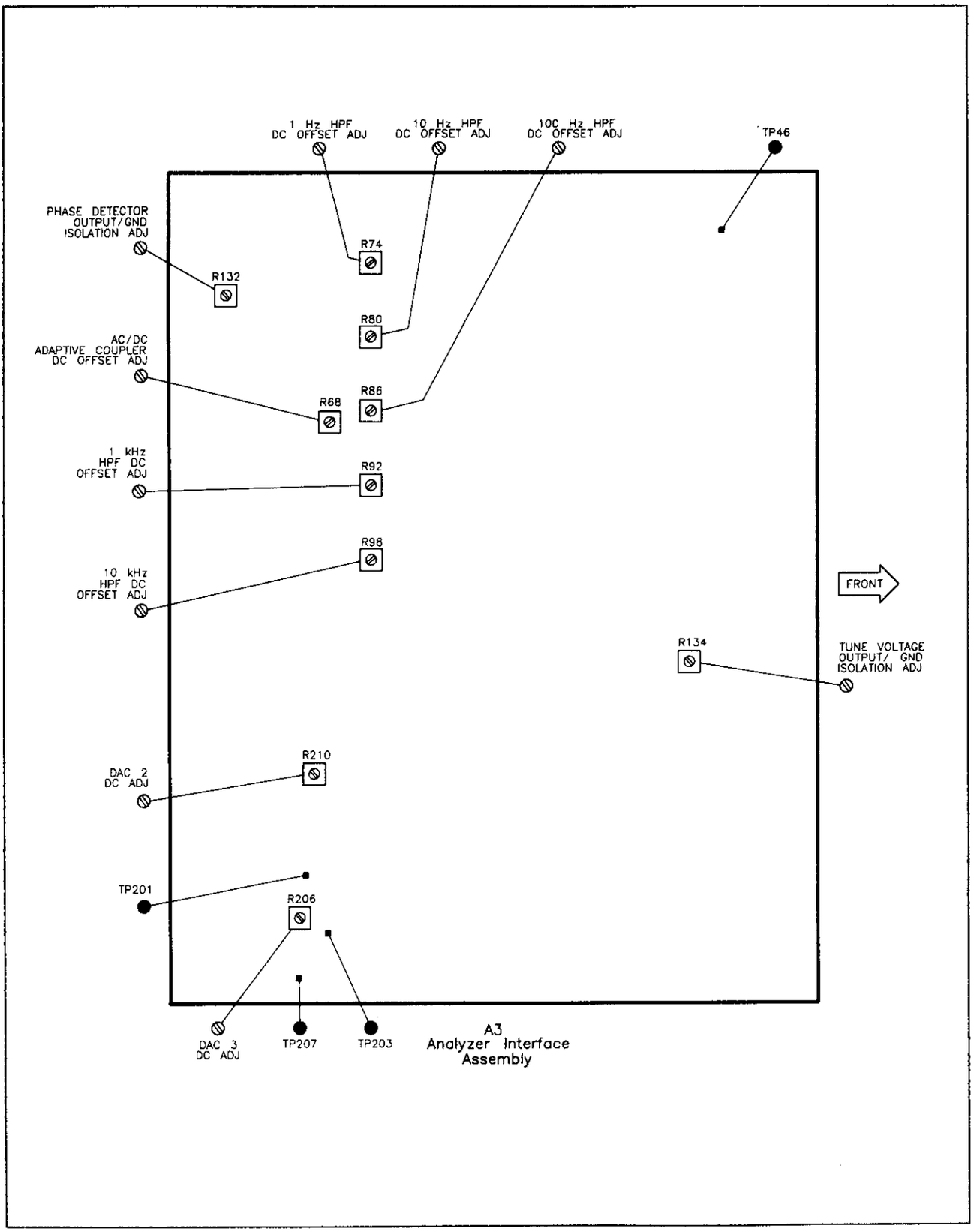


Figure 16. A3 Testpoint and Adjustment Locations

A4 Adjustments

DESCRIPTION

The A4 Phase Detector Assembly in the HP 11848A has six adjustments. The adjustments are guided by the system software but the software neither displays the actual measurement values nor indicates whether the adjustment is within the proper limits; rather, the operator simply reads the value from the measuring instrument (usually the HP 3561A) and adjusts the specified component until the reading is within limits.

The following adjustments are made:

Component	Circuit	Purpose
A4R67	Low-Noise Amplifier	Minimize dc offset
A4R51	Low-Noise Amplifier	Match input impedance (50Ω)
A4R70	Low-Noise Amplifier	Match low/high frequency gains
A4R38	PLL 12 dB Amplifier	Zeros panel meter at maximum sensitivity
A4R278	DAC 1	Set reference level
A4C32	Low-Noise Amplifier	High-frequency peaking(1)

(1) This adjustment can be done only with the HP 3585A/B Spectrum Analyzer in the System's Configuration Table.

Since these procedures require accessing the interior of the Interface, precautions should be taken to prevent electrical shock. Care should also be taken to minimize electrostatic discharge that could damage sensitive electrical devices.

EQUIPMENT

RF Spectrum Analyzer. The adjustment of A4C32 requires an HP 3585A/B Spectrum Analyzer. This adjustment is necessary only if phase noise measurements to 40 MHz offsets are made. Since an RF spectrum analyzer with a tracking generator must be used and since the program software controls only the HP 3585A/B, no substitution of equipment is possible. (The software will not run the A4C32 adjustment if an HP 3585A/B is not in the System's Configuration Table.)

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

Initial Setup

1. The adjustments to the A4 Phase Detector Assembly require that the assembly be pulled out from the front panel. (It will be helpful to refer to the figure and procedure for accessing the A4 assembly in the HP 11848A *Service Manual.*) To do this:
   a. Switch LINE to OFF.
   b. Remove the line cord.
   c. Remove the plastic trim strip from the top of the front frame.
   d. Remove the three Torx screws in the top of the front frame.
   e. Remove the three Torx screws in the bottom of the front frame.
   f. Carefully pull the front panel out far enough to access the six adjustment holes in the shield covering the A4 assembly. Note that it is not necessary to remove the shield from the A4 assembly to make the adjustments.
   g. Re-insert the line cord and switch LINE back to ON.
2. Set the HP 3561A input switch to the FLOAT position.
3. From the Calibration Main Menu, select **Internal Adjustments.**
4. Select **4 – A4 Adjustments.**

NOTE

The physical location of testpoints and adjustable components is shown in Figure 24.

Low-Noise Amplifier Adjustments

5. Connect the instruments as shown on the display and in figure 17.

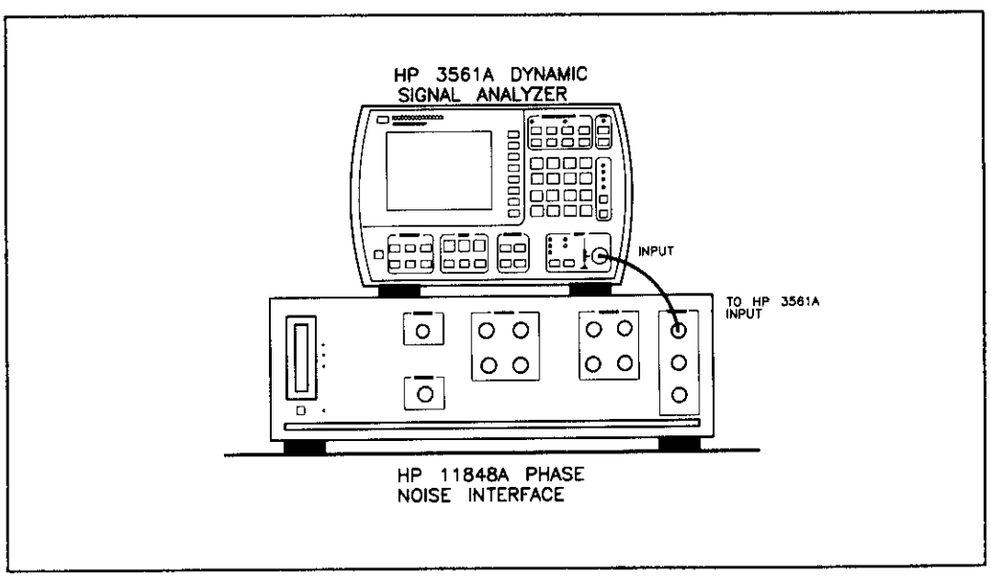


Figure 17. A4 Low-Noise Amplifier Adjustment Setup

6. Make the adjustment for A4R67 as instructed.

NOTE

The adjustment limit prompt "0 VDC +/- 20 mV" means that the adjusted value should be between –20 and +20 millivolts dc.

The value you are monitoring and adjusting appear as the value for "Y:" at the bottom center of the HP 3561A display.

7. Press [F1] to proceed.
8. Connect the instruments as shown on the display and in figure 18. This sets up a 50Ω reference for the following measurements.
9. Press [F1] to proceed.

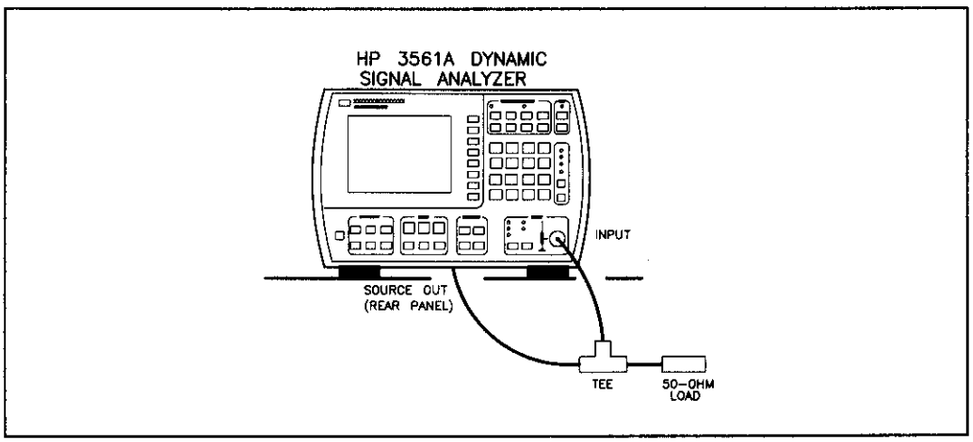


Figure 18. A4 Low-Noise Amplifier Impedance Match Reference Setup

10. Connect the instruments as shown on the display and in figure 19. This allows the HP 3561A to compare the loading of the noise input port to the loading of a 50Ω termination.

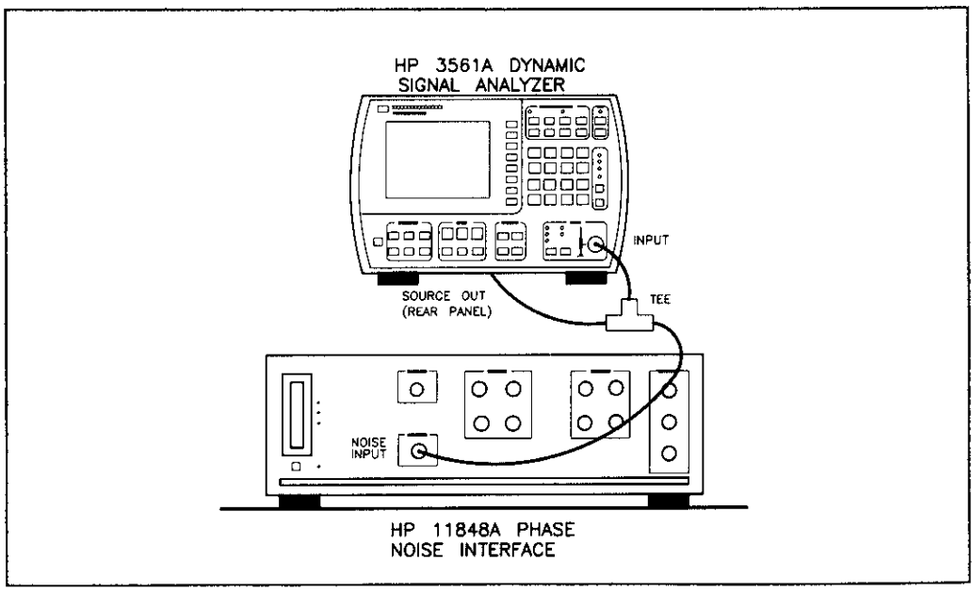


Figure 19. A4 Low-Noise Amplifier Impedance Match Adjustment Setup

11. Adjust A4R51 as instructed. Refer to Figure 20 which shows a typical result after adjustment.
12. Press [F1] to proceed.

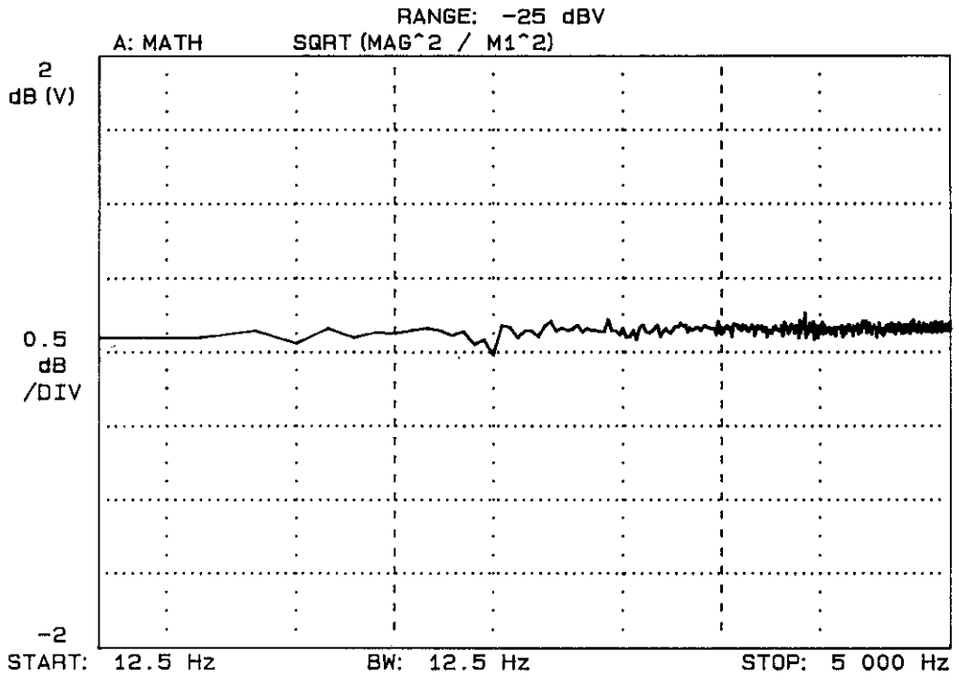


Figure 20. Typical Low-Noise Amplifier Impedance Match Adjustment

13. Connect the instruments as shown on the display and in figure 21.

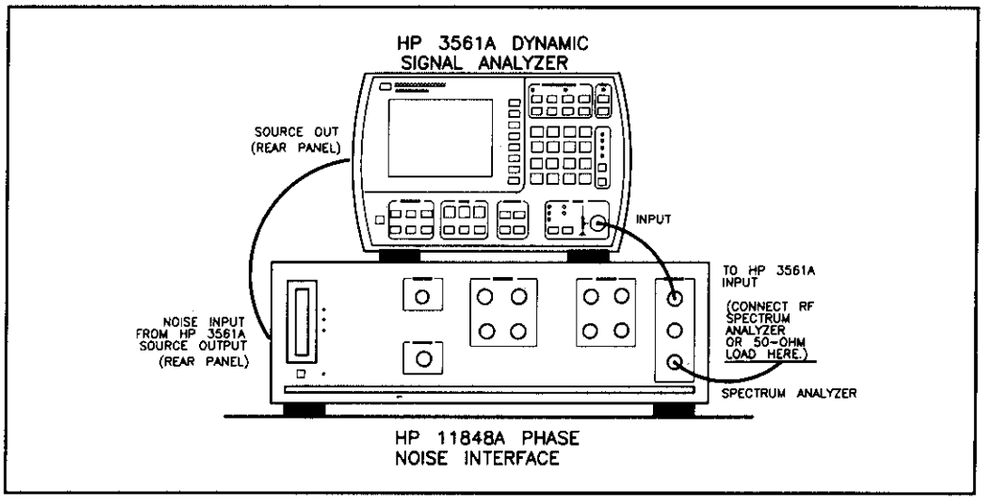


Figure 21. A4 Low-Noise Amplifier Gain Adjustment Setup

14. Press [F1] to proceed.
15. Adjust A4R70 as instructed. The result should be similar to the one in figure 20.
16. Press [F1] to proceed.

Phase Lock Loop 12 dB Amplifier Adjustment

17. Adjust A4R38 to zero the panel meter as instructed.
18. Press [F1] to proceed.

DAC 1 Adjustment

19. Adjust A4R278 as instructed.
20. Press [F1] to proceed.

NOTE

The adjustment limit prompt "+10 VOLTS +/- .05 VOLTS" means that the adjusted value should be between +9.95 and +10.05 volts.

Low-Noise Amplifier Peaking Adjustment

NOTE

If an HP 3585A/B RF Spectrum Analyzer is not in the System Configuration Table, this adjustment cannot be made, and the software will return to the Internal Adjustments menu.

21. Connect the instruments as shown on the display and in figure 22. Also, check that the tracking generator is set for maximum output level.

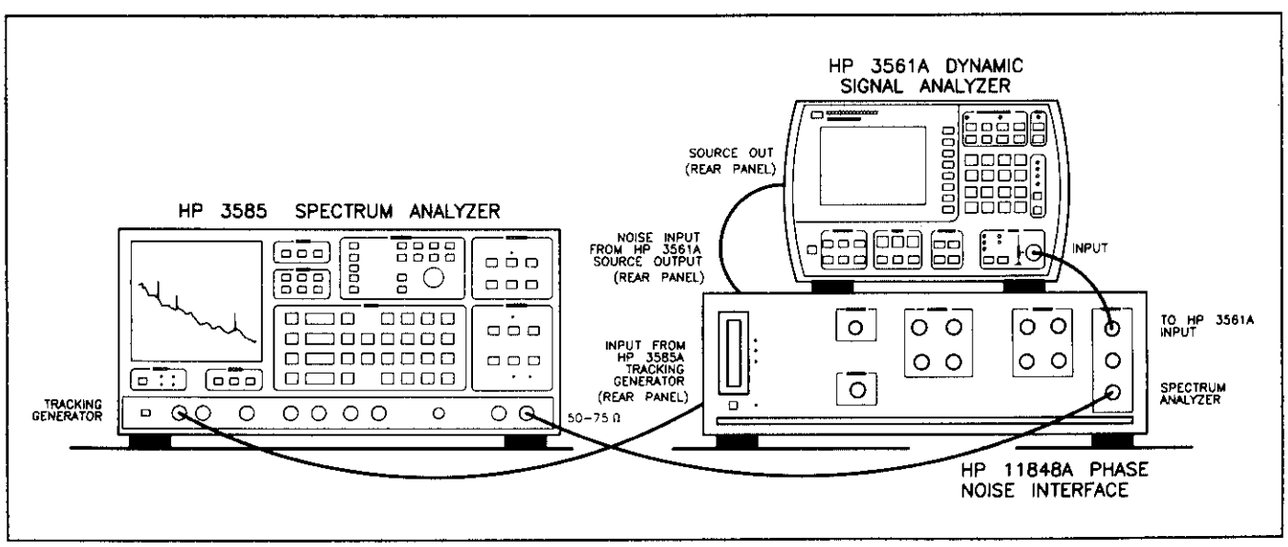


Figure 22. A4 Low-Noise Amplifier Peaking Adjustment Setup

22. Press [F1] to proceed.
23. Adjust A4C32 using a non-metallic tuning tool. The adjustment is most easily done by setting the RF spectrum analyzer to local (press the LOCAL key) then moving the marker with the knob. The adjustment is correct when the level of the highest point on the trace is opposite and equal to the lowest point (usually 40 MHz). A typical adjustment is shown in figure 23.
24. Press [F1] to proceed.
25. The computer will display a message to disconnect the cable from the HP 3585A/B tracking generator. Remove the cable and press any key to continue.
26. Press [ESC] to return to the Main Menu.

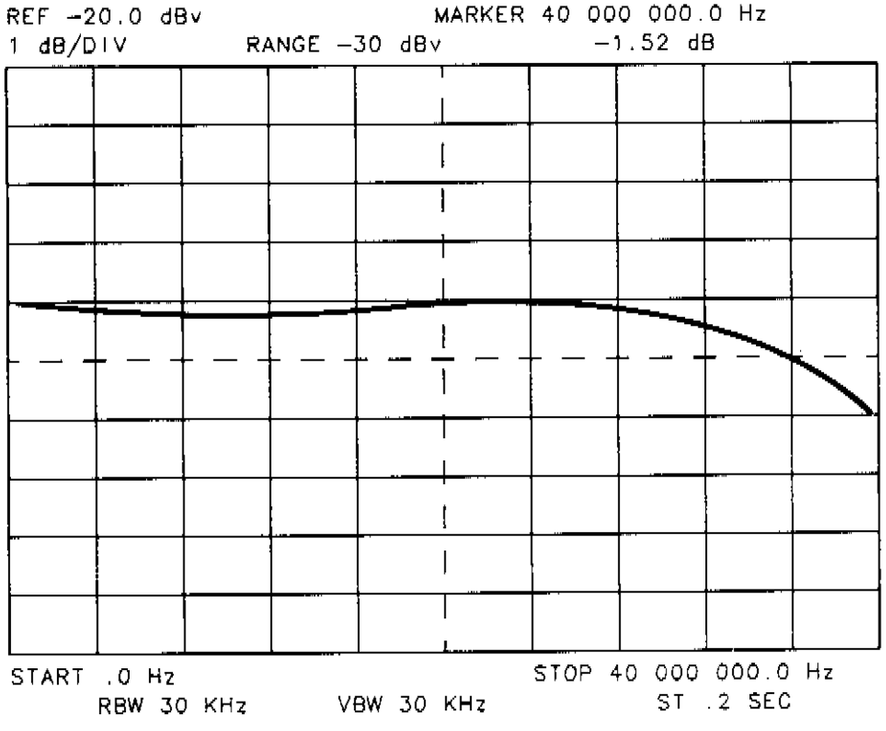


Figure 23. Typical Low-Noise Amplifier Peaking Adjustment

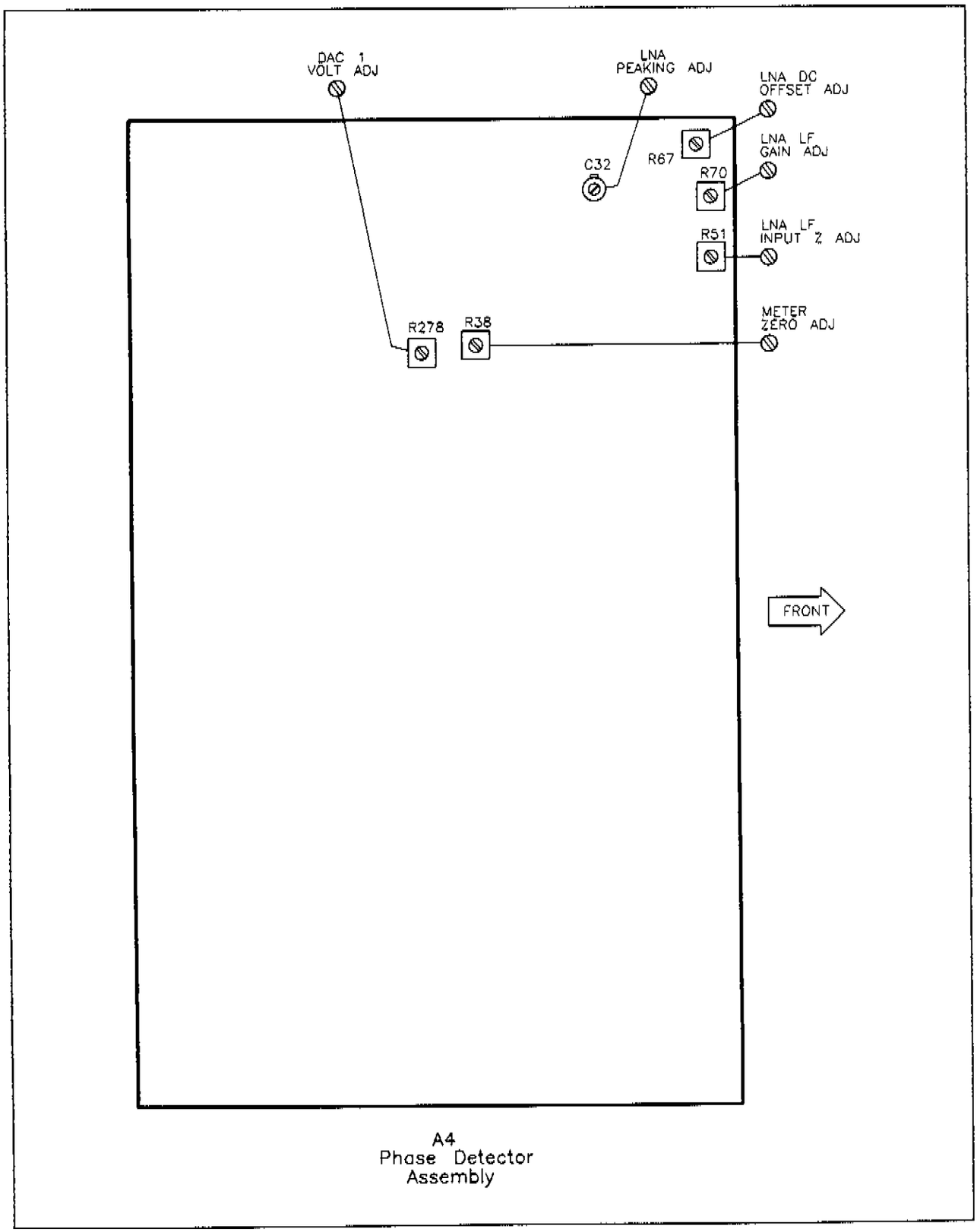


Figure 24. A4 Testpoint and Adjustment Locations

Option 1 Calibration

DESCRIPTION

The Option 1 Calibration program characterizes the gain and flatness of signal paths internal to the HP 11848A Phase Noise Interface. These unique characteristics are calibration factors which scale the measurement results for best noise measurement accuracy.

NOTE

Option 1 Calibration is similar to Option 2 Calibration. However, Option 2 Calibration collects data to characterize two additional reference paths. Perform Option 2 Calibration annually. Perform Option 1 Calibration when significant ambient changes occur.

For frequencies of 100 kHz and below, the calibration program sets up the HP 3561A as a scalar network analyzer. The internal noise source of the HP 3561A is the input signal to the network under test and the spectrum analyzer function measures the magnitude of the output from the network. For frequencies of 100 kHz through 40 MHz, the HP 3585A/B (which is required for this frequency range) is used with its internal tracking generator used as the stimulus.

The collected data is stored in two files in mass media storage titled "LOWDATA.CAL" and "HIGHDATA.CAL". Since the data is unique to each individual HP 11848A, it is important that the two files be transferred along with the Interface should the Interface be moved to another System. The data should be tagged to the serial number of the Interface it represents. (The Interface's serial number is logged in the System's Configuration Table.) Note, however, that the data is not unique to the HP 3561A (or HP 3585A/B) spectrum analyzer.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the calibration data is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

RF Spectrum Analyzer. The System collects data through offsets of 100 kHz with the HP 3561A. Data through 40 MHz offsets requires, in addition, an HP 3585A/B Spectrum Analyzer. Since an RF spectrum analyzer with a tracking generator must be used and since the program software controls only the HP 3585A/B, no substitution of equipment is possible.

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

Initial Setup

1. Set the HP 3561A input switch to the FLOAT position.
2. From the Calibration Main Menu, select **Calibration.**

Calibration to 100 kHz Offsets

3. Select **DC to 100 kHz Calibration.**
4. Press [N] to indicate measurement of external path is not desired.
5. Connect the instruments as shown on the display and in figure 25.

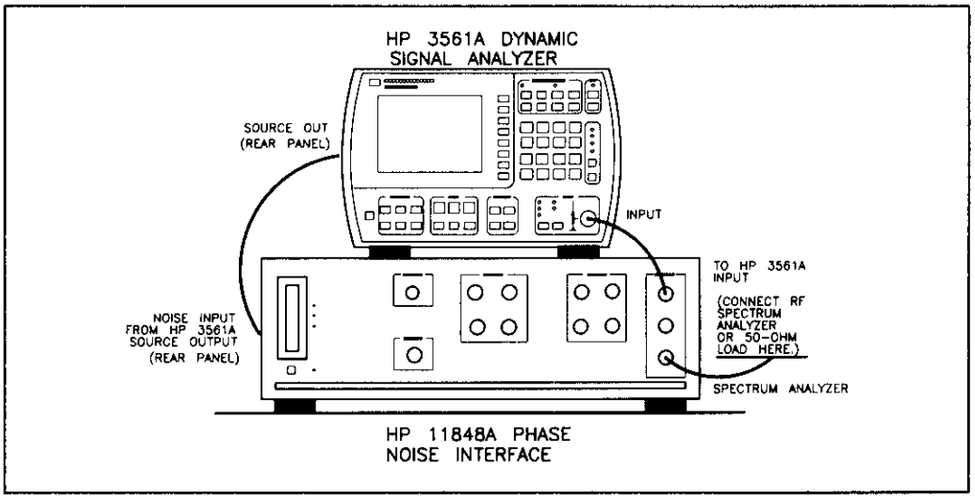


Figure 25. First Option 1 Calibration Setup

6. Press [F1] to proceed.
7. When the calibration is done, the computer will display the message `Calibration from DC to 100 kHz Complete`.
8. Press [ESC] to return to the Calibration Menu.

NOTE

This is the end of Option 1 Calibration if no HP 3585A/B Spectrum Analyzer is present, continue with step 16.

Calibration 100 kHz through 40 MHz Offsets

9. Select **100 kHz – 40 MHz Calibration.**
10. Press [N] to indicate measurement of external path is not desired.
11. Connect the instruments as shown on the diagram and in figure 26.

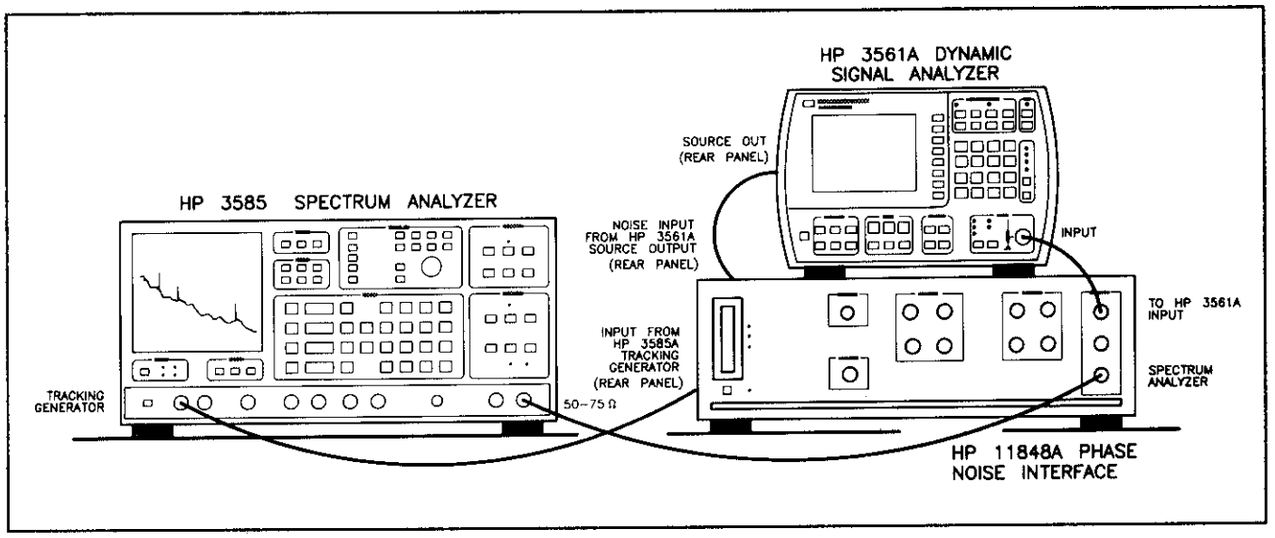


Figure 26. Second Option 1 Calibration Setup

12. Set the HP 3585A/B Tracking Generator for maximum output level.
13. Press [F1] to proceed.
14. When the calibration is done, the computer will display the message `Disconnect cable from 3585A Tracking Generator.` Disconnect the cable.
15. Press [ESC] to return to the Calibration Menu.

Evaluating Calibration Data

16. To evaluate the calibration data:
    a. Select **Evaluate Cal. Data.**
    b. Select the calibration data to be evaluated from the displayed menu.
    c. The graphed results will now be displayed. To print a hard copy, press [F4].
    d. Repeat the above steps for all calibration data to be evaluated.
    e. Press [ESC] to return to the Calibration Main Menu.

Storing Calibration Data

17. Once the calibration data has been taken, and evaluated, the following choices are available.
    - To store the new calibration data, select **Store Cal. Data to Disk.** This will update the files LOWDATA.CAL and HIGHDATA.CAL on the disk being used.
    - To load calibration data previously stored to the disk, select **Load Cal. Data from Disk.**
    - To clear all calibration data from memory, select **Wipe Cal. Data from Memory.**

NOTE

If none of the above steps are selected, the latest calibration data taken will remain in memory but will not be stored on disk. If the calibration program is exited, the latest calibration data will be lost.

18. Press [ESC] to return to the Main Menu.

Option 2 Calibration

DESCRIPTION

The Option 2 Calibration program characterizes the gain and flatness of signal paths internal to the HP 11848A Phase Noise Interface. These unique characteristics are calibration factors which scale the measurement results for best noise measurement accuracy. Option 2 Calibration is similar to Option 1 Calibration. However, Option 2 Calibration collects data to characterize two additional reference paths. Perform Option 2 Calibration annually.

For frequencies of 100 kHz and below, the calibration program sets up the HP 3561A as a scalar network analyzer. The internal noise source of the HP 3561A is the input signal to the network under test and the spectrum analyzer function measures the magnitude of the output from the network. For frequencies of 100 kHz through 40 MHz, the HP 3585A/B (which is required for this frequency range) is used with its internal tracking generator used as the stimulus.

The collected data is stored in two files in mass media storage titled "LOWDATA.CAL" and "HIGHDATA.CAL". Since the data is unique to each individual HP 11848A, it is important that the two files be transferred along with the Interface should the Interface be moved to another System. The data should be tagged to the serial number of the Interface it represents. (The Interface's serial number is logged in the System's Configuration Table.) Note, however, that the data is not unique to the HP 3561A (or HP 3585A/B) spectrum analyzer.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the calibration data is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

RF Spectrum Analyzer. The System collects data through offsets of 100 kHz with the HP 3561A. Data through 40 MHz offsets requires, in addition, an HP 3585A/B Spectrum Analyzer. Since an RF spectrum analyzer with a tracking generator must be used and since the program software controls only the HP 3585A/B, no substitution of equipment is possible.

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

Initial Setup

1. Set the HP 3561A input switch to the FLOAT position.
2. From the Calibration Main Menu, select **CALIBRATION**.

Calibration to 100 kHz Offsets

3. Select **DC to 100 kHz Calibration.**
4. Press [Y] to indicate measurement of external path is desired.
5. Connect the instruments as shown on the display and in figure 27. This sets up a 50Ω reference for the following measurements.

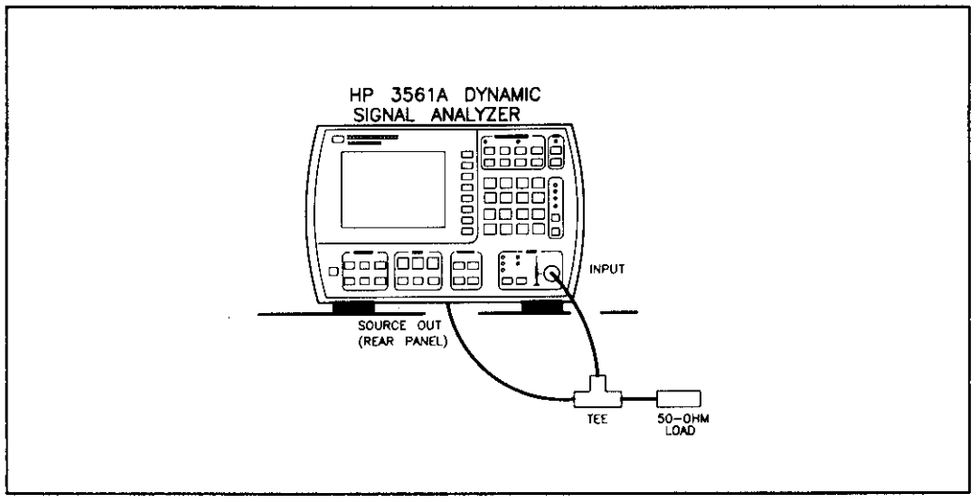


Figure 27. First Option 2 Calibration Setup

6. Press [F1] to proceed.
7. Connect the instruments as shown on the display and in figure 28.

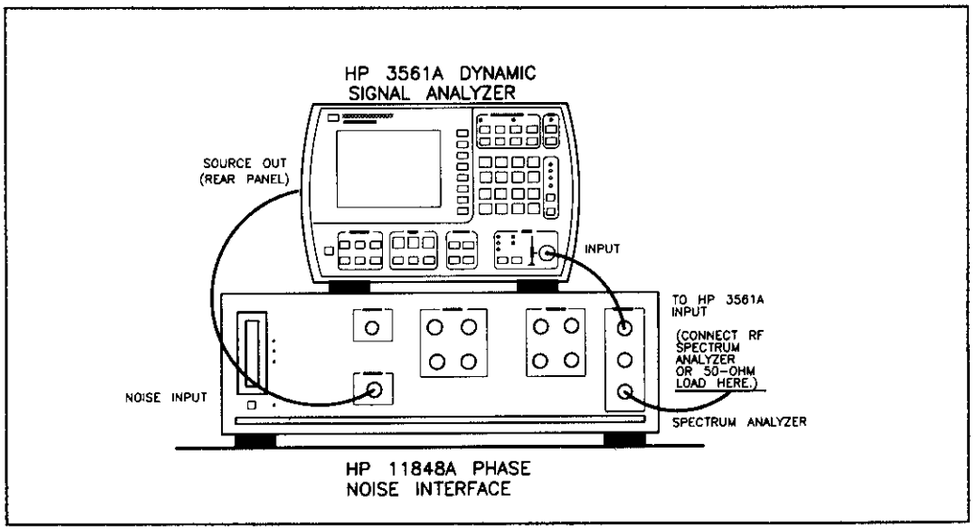


Figure 28. Second Option 2 Calibration Setup

8. Press [F1] to proceed.
9. Connect the instruments as shown on the display and in figure 29.

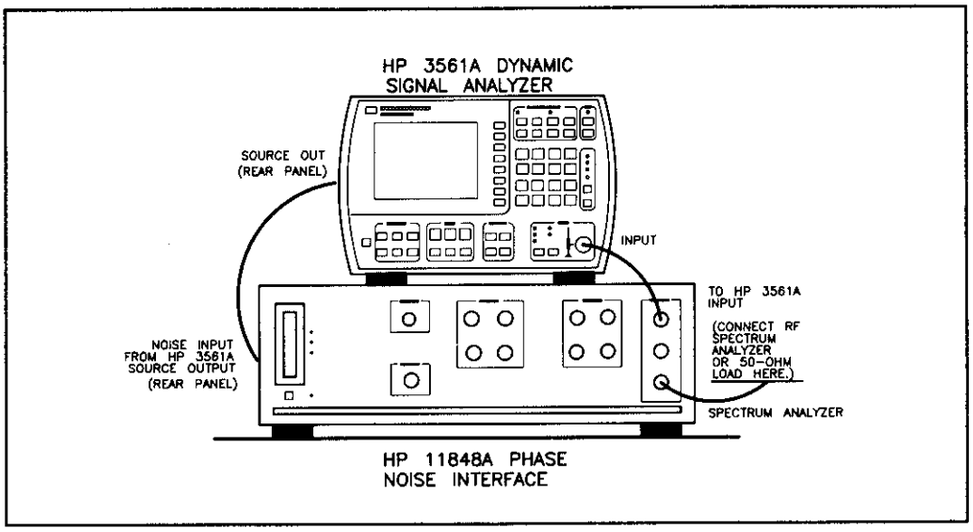


Figure 29. Third Option 2 Calibration Setup

10. Press [F1] to proceed.
11. When the calibration is done, the computer will display the message `Calibration from DC to 100 kHz Complete`.
12. Press [ESC] to return to the Calibration Menu.

If no HP 3585A/B Spectrum Analyzer is present, this is the end of Option 2 Calibration. Continue with step 24.

Calibration 100 kHz through 40 MHz Offsets

13. Select **100 kHz – 40 MHz Calibration.**
14. Press [Y] to indicate measurement of external path is desired.
15. Connect the instruments as shown on the display and in figure 30. This sets up a 50Ω reference for the following measurements.

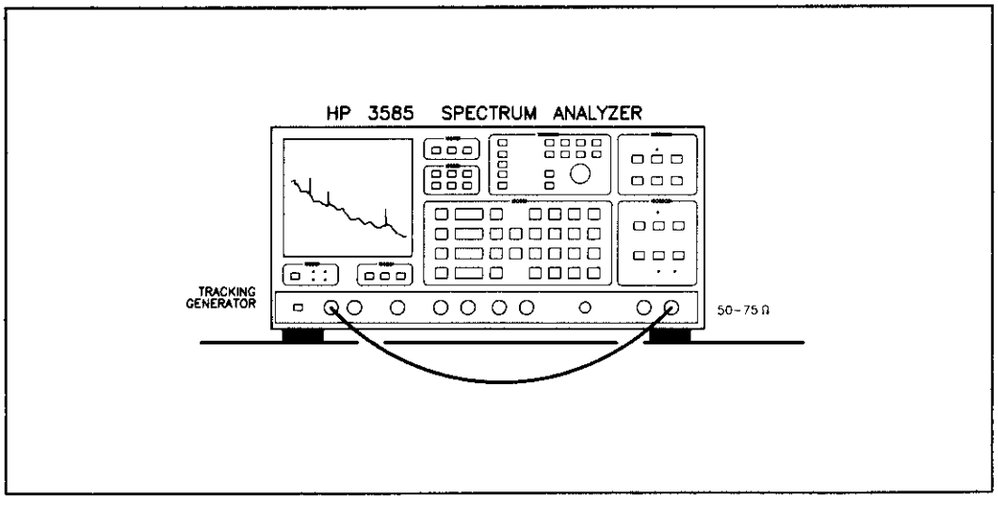


Figure 30. Fourth Option 2 Calibration Setup

16. Set the HP 3585A/B Tracking Generator for maximum output.
17. Press [F1] to proceed.
18. Connect the instruments as shown on the display and in figure 31.

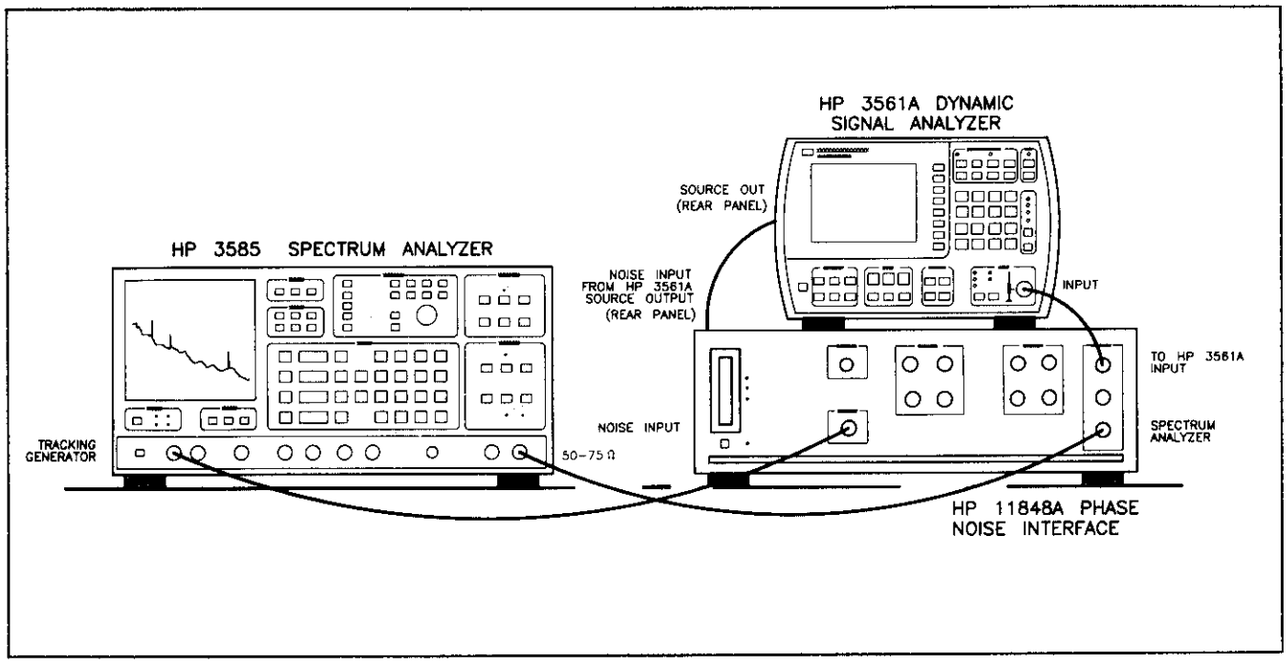


Figure 31. Fifth Option 2 Calibration Setup

19. Press [F1] to proceed.
20. Connect the instruments as shown on the display and in figure 32.

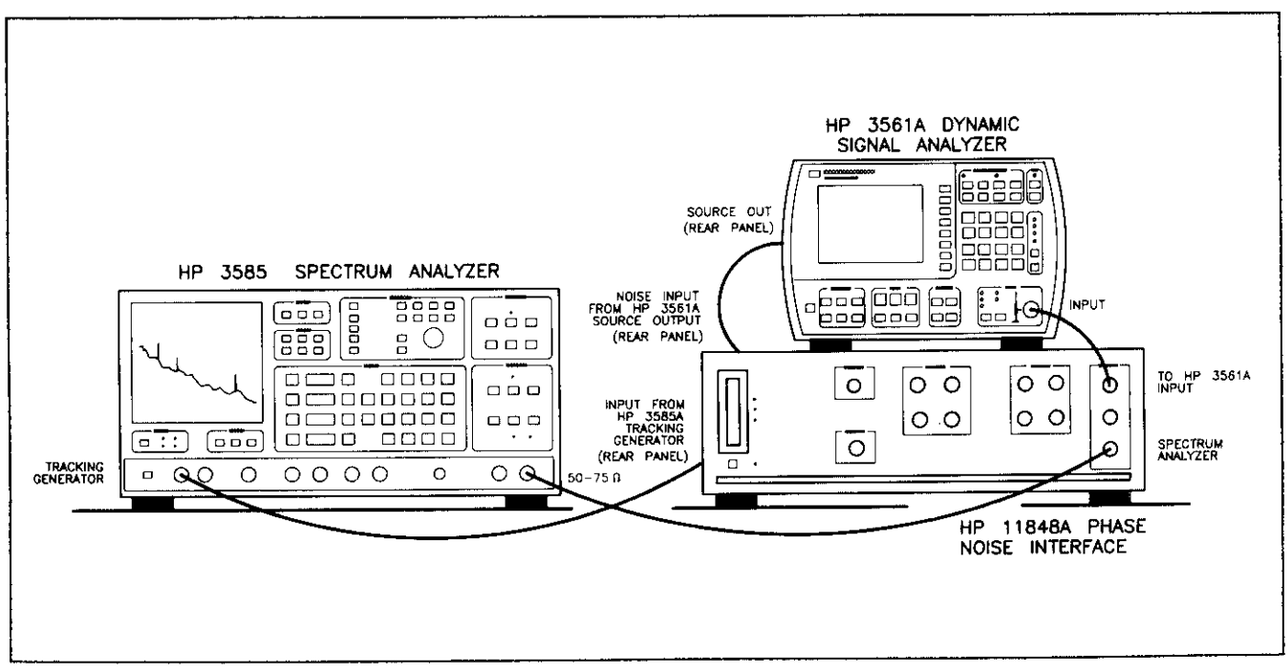


Figure 32. Sixth Option 2 Calibration Setup

21. Press [F1] to proceed.
22. When the calibration is done, the computer will display the message `DISCONNECT CABLE FROM 3585A TRACKING GENERATOR`. Disconnect the cable.
23. Press [ESC] to return to the Calibration Main Menu.

Evaluating Calibration Data

24. To evaluate the calibration data:
    a. Select **Evaluate Cal. Data.**
    b. Select the calibration data to be evaluated from the displayed menu.
    c. The graphed results will now be displayed. To print a hard copy, press [F4].
    d. Repeat the above steps for all calibration data to be evaluated.
    e. Press [ESC] to return to the Calibration Main Menu.

Storing Calibration Data

25. Once the calibration data has been taken, and evaluated, the following choices are available.
    - To store the new calibration data, select **Store Cal. Data to Disk.** This will update the files LOWDATA.CAL and HIGHDATA.CAL on the disk being used.
    - To load calibration data previously stored to the disk, select **Load Cal. Data from Disk.**
    - To clear all calibration data from memory, select **Wipe Cal. Data from Memory.**

NOTE

If none of the above steps are selected, the latest calibration data taken will remain in memory but will not be stored on disk. If the calibration program is exited, the latest calibration data will be lost.

26. Press [ESC] to return to the Main Menu.

Internal Sources Calibration

DESCRIPTION

The Internal Sources Calibration program determines the settings of DACs 2 and 3 which tune three of the four internal Oscillators to their nominal frequencies. This is a software controlled adjustment. (The three oscillators are 10 MHz A, 10 MHz B, and 350–500 MHz.) The tuning (or frequency set) data is then recorded on the System's mass storage medium in the HIGHDATA.CAL file. As with the Option 1 and Option 2 Calibration, this data must be used only with the HP 11848A for which the data was taken.

EQUIPMENT

Frequency Counter. A general purpose 550 MHz counter is required. It does not need to be programmable.

PROCEDURE

NOTE

The program used for this procedure is CAL.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

Initial Setup

1. From the Calibration Main Menu, select **Calibration.**
2. Select **Center V. of Internal Sources.**

NOTE

For all oscillators increasing the voltage decreases the frequency.

The DACs can be set in 1 mV increments. If an unacceptable value is entered, a prompt will indicate that the entry needs modification.

Calibration of the 10 MHz A Oscillator

3. Connect the cable from the HP 11848A front-panel 10 MHz A source output to the counter's input.
4. To adjust the DACs:
   a. Use the [△] [▽] keys to select the center voltage corresponding to 10 MHz A, and press [ENTER] to turn on the oscillator.
   b. Note the frequency on the counter. If it is within ±10 Hz of 10 MHz, continue on to step 5.
   c. If the frequency is out of limits, change the voltage of DAC2 by keying in a new voltage within the cursor field then press [ENTER]. If the voltage does not bring the frequency within limits, key in another voltage. (The tuning sensitivity is about 20 Hz/V.)

Calibration of the 10 MHz B Oscillator

5. Connect the cable from the HP 11848A front-panel 10 MHz B source output to the counter's input as prompted.
6. To adjust the DACs, proceed as in step 4 to bring the frequency within ±50 Hz of 10 MHz, then continue on to step 7. (The tuning sensitivity is about 200 Hz/V.)

Calibration of the 350–500 MHz Oscillator

7. Connect the cable from the HP 11848A front-panel 350–500 MHz source output to the counter's input as prompted.
8. To adjust the DACs, proceed as in step 4 to bring the frequency between 399 and 401 MHz, then press [ESC] to return to the Calibration Menu. (The tuning sensitivity is about 20 MHz/V.)

Storing Calibration Data

9. Once the DACs have been adjusted, the following choices are available.
   - To store the new DAC values, select **Store Cal. Data to Disk**. This will update the files LOWDATA.CAL and HIGHDATA.CAL on the disk being used.
   - To load DAC values previously stored to the disk, select **Load Cal. Data from Disk.**
   - To clear all calibration data from memory, select **Wipe Cal. Data from Memory.**

NOTE

If none of the above steps are selected, the latest calibration data taken will remain in memory but will not be stored on disk. If the calibration program is exited, the latest calibration data will be lost.

10. Press [ESC] to return to the Main Menu.

Spectral Purity Test for Options 001 and 002

DESCRIPTION

Option 001 adds an HP 8662A Synthesized Signal Generator as a System reference source. Option 002 adds an HP 8663A Synthesized Signal Generator as a System reference source. To test the spectral purity of these options, an absolute, phase-lock-loop, phase-noise measurement is made with the signal generator in the System vs. another signal generator of the same type. The test is run only for a carrier of 1270 MHz.

NOTE

The phase noise measurement result is the combined noise of both signal generators. Both generators together must meet the specified noise level. If one or both generators do not meet the specification, a third generator must be measured vs. each of the other two generators to determine which generator is not within specification. This procedure is known as a three-oscillator comparison test.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

Reference Signal Generator. The reference generator can be either an HP 8662A Option 003 or an HP 8663A Option 003 Synthesized Signal Generator.

RF Spectrum Analyzer. The System collects data to 100 kHz offsets with the HP 3561A. Data to 40 MHz offsets requires, in addition, an RF spectrum analyzer. Any supported RF spectrum analyzer can be used in this test. However, all specified offsets are covered with the HP 3561A. An RF analyzer is needed only if informational data beyond 100 kHz is desired.

PROCEDURE

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. From the Phase Noise Main Menu, select **File System**.
2. Select **Directory**.
3. Type `*.PRM` and press ENTER.

4. Using the [△] [▽] keys select **HPTEST21.PRM** and press [ENTER].
5. Select **Load File.**
6. HPTEST21.PRM should be displayed as the path. Press [ENTER] to load the file.

NOTE

This file has been set up specifically to measure the HP 8662A and HP 8663A Synthesized Signal Generators and all entries in the Define Measurement Parameter Table have been set for best measurement accuracy for these sources. It is assumed that the System's HP 8662A or HP 8663A is in the System's Configuration Table.

7. Press [ESC] to return to the Main Menu.
8. Select **New Measurement.**
9. Press [Y] to indicate the new measurement data is desired.
10. Connect the instrument as shown on the display and in figure 33.

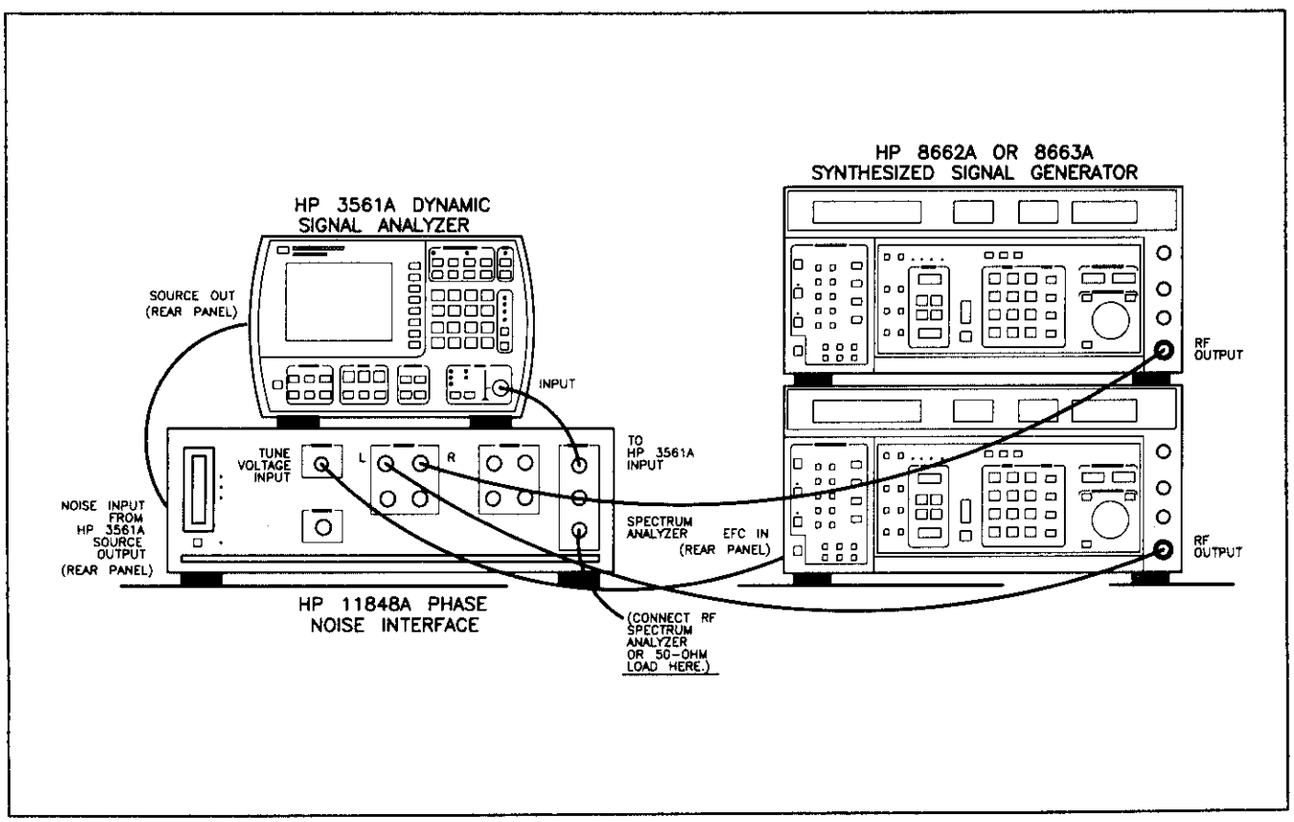


Figure 33. *Spectral Purity Test Setup for Options 001 and 002*

11. Set the reference HP 8662/8663 to 1270 MHz and +16 dBm. All other functions should be turned off.

12. Press [F1]. The measurement should proceed automatically without error messages. The measured spurious signals, as read from the measurement results plot, should be less than −70 dBc for frequency offsets less than 300 Hz and less than −84 dBc for offsets greater than 300 Hz. The measured noise should be with the limits given in the following table.

Spurious Signal Limit for Offsets <300 Hz: _____ −70 dBc

Spurious Signal Limit for Offsets >300 Hz: _____ −84 dBc

Offset Frequency (Hz)	Noise Level (dBc)	
	Actual	Maximum
1	_____	−48
10	_____	−78
100	_____	−97
1 000	_____	−112
3 000	_____	−112
5 000	_____	−114
10 000	_____	−124
100 000	_____	−124

13. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
14. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
15. Press [ESC] to return to the Main Menu.

Spectral Purity Test for Options 003 and 004

DESCRIPTION

Option 003 adds an HP 11729C Carrier Noise Test Set as a down-converter to the System reference source. Option 004 adds an HP 11729C Option 130 Carrier Noise Test Set (with an AM detector) as a down-converter to the System reference source. The reference source can be either an HP 8662A Option 003 or an HP 8663A Option 003.

This test measures the absolute noise floor of the System including the contributions of two reference sources and two down-converters. (Refer to the functional diagram of Figure 34.) The test method measures the sum of the noise of two down-converters (including the noise of their respective 640 MHz reference sources—Source 2 and Source 3) by having each one down-convert a common source (Source 1). The noise of the common source is then cancelled in the phase detector. Quadrature is maintained by phase locking.

Tuning is through the electronic frequency control (EFC) port of one of the 640 MHz sources. Source 1 is an independent microwave signal generator or simply the main RF output of one of the HP 8662As or HP 8663As (which, by multiplying up its time base reference, supplies the 640 MHz Source 2 or Source 3).

NOTE

Since the noise floor measurement results include the combined noise of both downconverters and signal generators, all sources (except Source 1) together must be better than the specified noise level. If the test results do not meet specification, the 640 MHz references from the HP 8662As or HP 8663As should be tested. The test procedure is found in Appendix B.

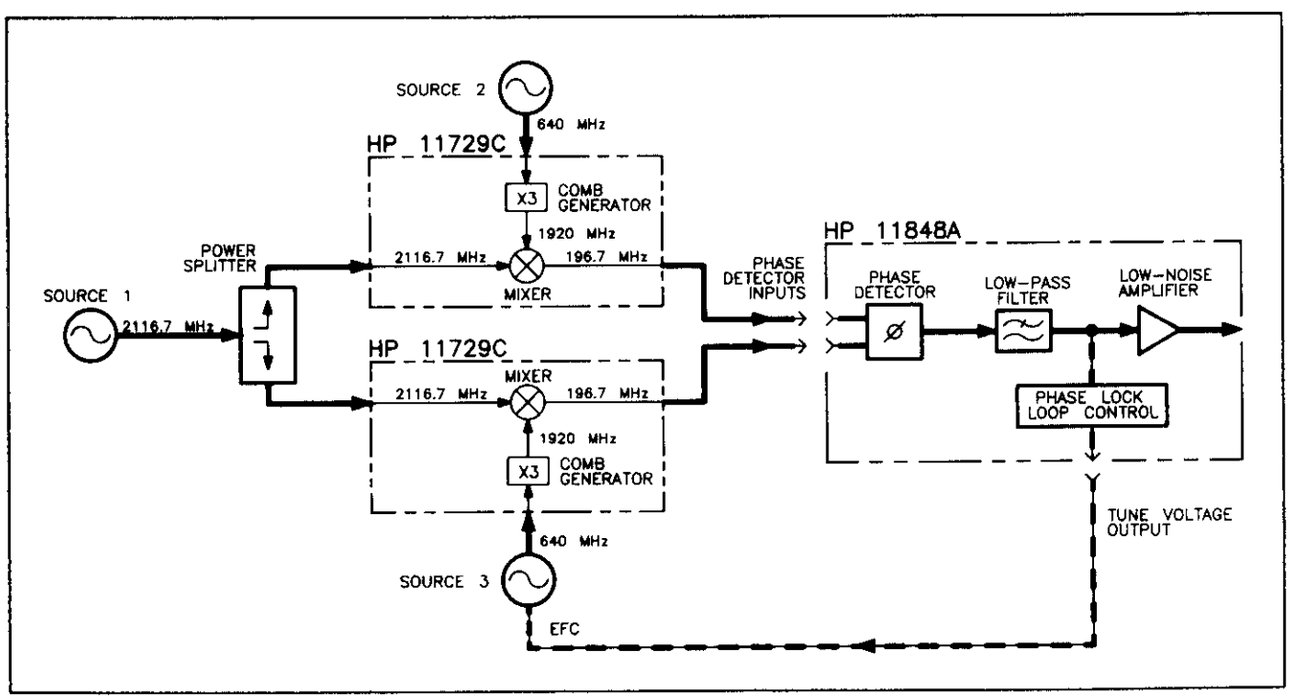


Figure 34. Functional Diagram of the Spectral Purity Tests

EQUIPMENT

Carrier Noise Test Set. A second HP 11729C is required in addition to the one in the System.

Reference Signal Generator. A second HP 8662A Option 003 or HP 8663A Option 003 Synthesized Signal Generator is required in addition to the one in the System.

Frequency Doubler. If two HP 8662As are used, a frequency doubler is required. The recommended model is HP 11721A.

Power Splitter. The generally recommended model is HP 11667A; it has a very wide frequency range but 6 dB loss. Other splitters such as Mini-Circuits ZAPD-4 have typically 3 dB loss but the frequency range is restricted.

Printer. This test will run without a printer connected to the computer; however, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

RF Spectrum Analyzer. The System collects data to 100 kHz offsets with the HP 3561A. Data to 40 MHz offsets requires, in addition, an RF spectrum analyzer. Any supported RF spectrum analyzer can be used in this test. However, all specified offsets are covered with the HP 3561A. An RF analyzer is needed only if informational data beyond 100 kHz is desired.

PROCEDURE

NOTE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. The HP 3048A *Noise Floor Test* should be run before running this test.
2. From the Phase Noise Main Menu, select **File System.**
3. Select **Directory.**
4. Type `*.PRM` and press [ENTER].
5. Using the [△] [▽] keys, select **HPTEST17.PRM** and press [ENTER].
6. Select **Load File.**
7. `HPTEST17.PRM` should be displayed as the path. Press [ENTER] to load the file.

NOTE

This file has been set up specifically to measure the HP 8662A and HP 8663A Synthesized Signal Generators and the HP 11729C Carrier Noise Test Sets. All entries in the Define Measurement Parameter Table have been set for best measurement accuracy for these sources. However, only the first HP 11729C actually needs to be entered in System's Configuration Table (which allows the System to select its center band).

8. Press [ESC] to return to the Main Menu.
9. Select **New Measurement.**
10. Press [Y] to indicate that new measurement data is desired.
11. Connect the instruments as shown in figure 35 and set the non-controlled instruments as instructed in the following steps a and b. However, before connecting and setting the instruments, read the following notes.
    a. Normally, you will set the level of the second source (driving the power splitter) to +13 dBm, and set its frequency to 2116.7 MHz (into the splitter). (But see the following notes.)
    b. Set the second HP 11729C FILTER RANGE CENTER BAND to 1.92 GHz. (Or, in general, set the center band to frequency that matches the RF or microwave input frequency.)

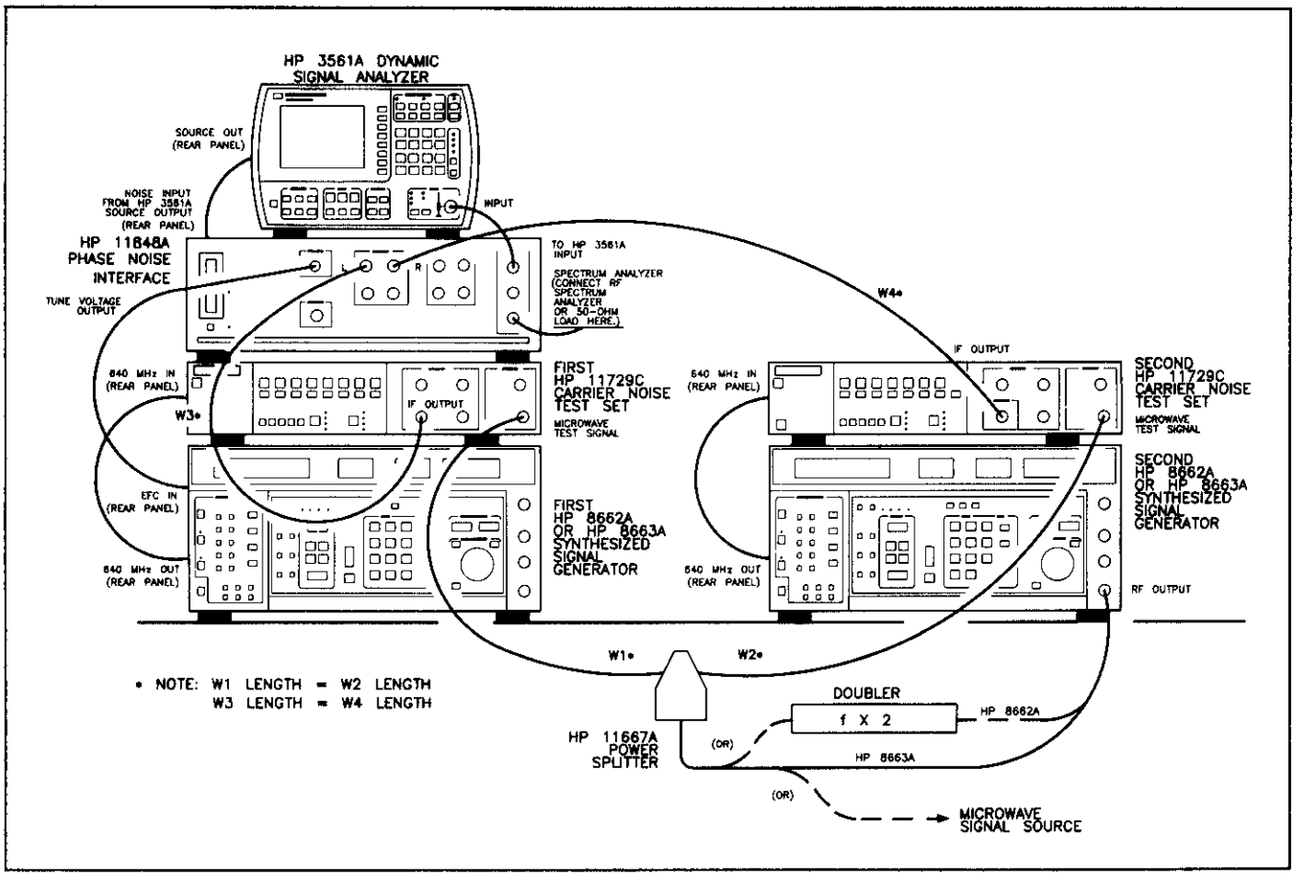


Figure 35. Spectral Purity Tests for Options 003 and 004 Setup

12. Using the [F8] or [SHIFT] [F8] keys, set the lowest possible beatnote as measured on the HP 3561A display. **Do not exceed ±5 volts as the specified center voltage.** (Use the [△] [▽] keys to change the HP 3561A frequency span.)

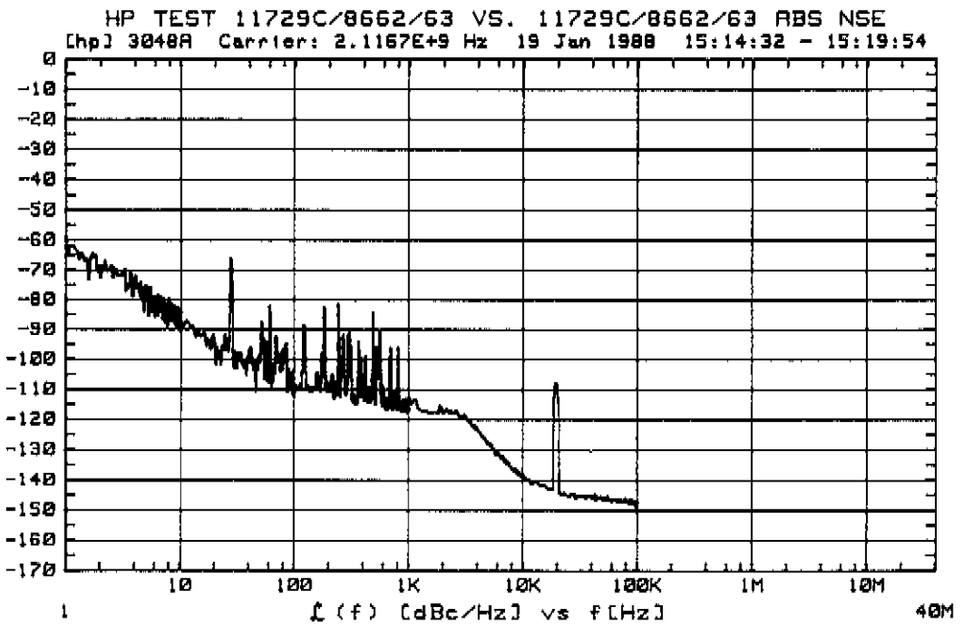


Figure 36. Typical Spectral Purity Tests Results

NOTE

1. The on-screen connection diagram, while showing the general measurement technique, is incomplete. Also note that neither of the HP 8662As or HP 8663As nor the second HP 11729C in figure 35 are under HP-IB control.

2. Either the first source, the second source, or an independent third source can be used to drive the power splitter.

3. The recommended input drive level to each of the two HP 11729Cs is +7 dBm; although, for the 1.28 and 3.20 GHz frequency band, 0 dBm is adequate. Thus, if an HP 11667A Power Splitter (with a nominal 6 dB loss) is used, the source driving the power splitter optimally should be set to 2116.7 MHz at +13 dBm, but a level as low as +6 dBm is adequate.

4. If the source driving the power splitter (such as the HP 8662A) requires a doubler, set the source's frequency to 1058.35 MHz and set its level as high as possible (+16 to +20 dBm) to generate at least 0 dBm at the output of the doubler.

5. The frequency of 2116.7 MHz was chosen to minimize the number of significant spurious signals.

6. Other sources can be used to perform this test at higher frequencies. It is important to observe the power requirements stated above and to set the center bands of the HP 11729Cs to match the carrier frequency. For the spectral purity specifications at other frequencies, refer to the Specifications section of the Reference Manual.

13. Press [F1]. The measurement should proceed automatically. The measured noise should be similar to that shown in Figure 36 and should be within the limits given in the following table.

NOTE

If the beatnote frequency is too high, the System cannot tune the (EFC) source close enough to acquire phase lock. Various error messages on the display warn of this condition. You must then manually adjust the frequency of one of the 640 MHz sources (in the HP 8662As or HP 8663As) to bring the difference frequency of the sources within the loop's capture range. (For the HP 8662A and HP 8663A, the adjustment is located on the rear panel and is labeled "FINE FREQUENCY ADJUST".)

If this test fails, perform the HP 8662A or HP 8663A 640 MHz Spectral Purity Test *in* Appendix B.

Offset Frequency (Hz)	Noise Level (dBc)	
	Actual	Maximum
1	_____	−44
10	_____	−74
100	_____	−94
1 000	_____	−110
3 000	_____	−110
5 000	_____	−120
10 000	_____	−130
100 000	_____	−140

14. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
15. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
16. Press [ESC] to return to the Main Menu.

Spectral Purity Tests for Options 005 and 006

DESCRIPTION

Option 005 adds an HP 8642A Signal Generator Option 001 as a System reference source. Option 006 adds an HP 8642B Signal Generator Option 001 as a System reference source. (Option 001 in the HP 8642A or HP 8642B adds a high-stability timebase reference.) To test the spectral purity of these options, an absolute, phase-lock-loop, phase-noise measurement is made with the signal generator in the System vs. another signal generator of the same performance or better. The test is run only for a carrier of 640 MHz.

NOTE

The phase noise measurement result is the combined noise of both signal generators. If a second HP 8642A or HP 8642B Signal Generator is used, the specified noise level should be raised 3 dB. Then, if one or both generators do not meet the specification, a third generator must be measured vs. each of the other two generators to determine which generator is not within specification. This procedure is known as a three-oscillator comparison test.

EQUIPMENT

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

Reference Signal Generator. The reference signal generator must have phase noise performance that equals or exceeds the specifications for the HP 8642A or HP 8642B under test. Possible reference sources include the 640 MHz reference from an HP 8662A Option 003 or HP 8663A Option 003 Synthesized Signal Generator or a second HP 8642A or HP 8642B Signal Generator (which need not have Option 001). None of the sources need to be in the System's Configuration Table, but one may be. Having the System's HP 8642A or HP 8642B in the table will put it under automatic control.

RF Spectrum Analyzer. The System collects data to 100 kHz offsets with the HP 3561A. Although the System has a specification at 200 kHz offsets, data taken at 100 kHz offsets is adequate and thus eliminates the need for an RF spectrum analyzer. However, any supported RF spectrum analyzer, such as the HP 3585A/B Spectrum Analyzer, can be used in this test. With an RF spectrum analyzer connected, data to 40 MHz offsets will be displayed.

PROCEDURE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. From the Phase Noise Main Menu, select **File System.**
2. Select **Directory.**
3. Type `*.PRM` and press [ENTER].
4. Using the [△] [▽] keys, select **HPTEST18.PRM** and press [ENTER].
5. Select **Load File.**
6. `HPTEST18.PRM` should be displayed as the path. Press [ENTER] to load the file.

NOTE

This file has been set up specifically to measure the HP 8642A and HP 8642B Signal Generators and all entries in the Define Measurement Parameter Table have been set for best measurement accuracy for these sources. It is assumed that the System's HP 8642A or HP 8642B is in the System's Configuration Table.

7. Press [ESC] to return to the Main Menu.
8. Select **New Measurement.**
9. Press [Y] to indicate that new measurement data is desired.
10. Connect the instruments as shown on the display and in figure 37. If an HP 8642A or 8642B Signal Generator is used as the second RF source, set its RF output for 640 MHz CW at +6 dBm.

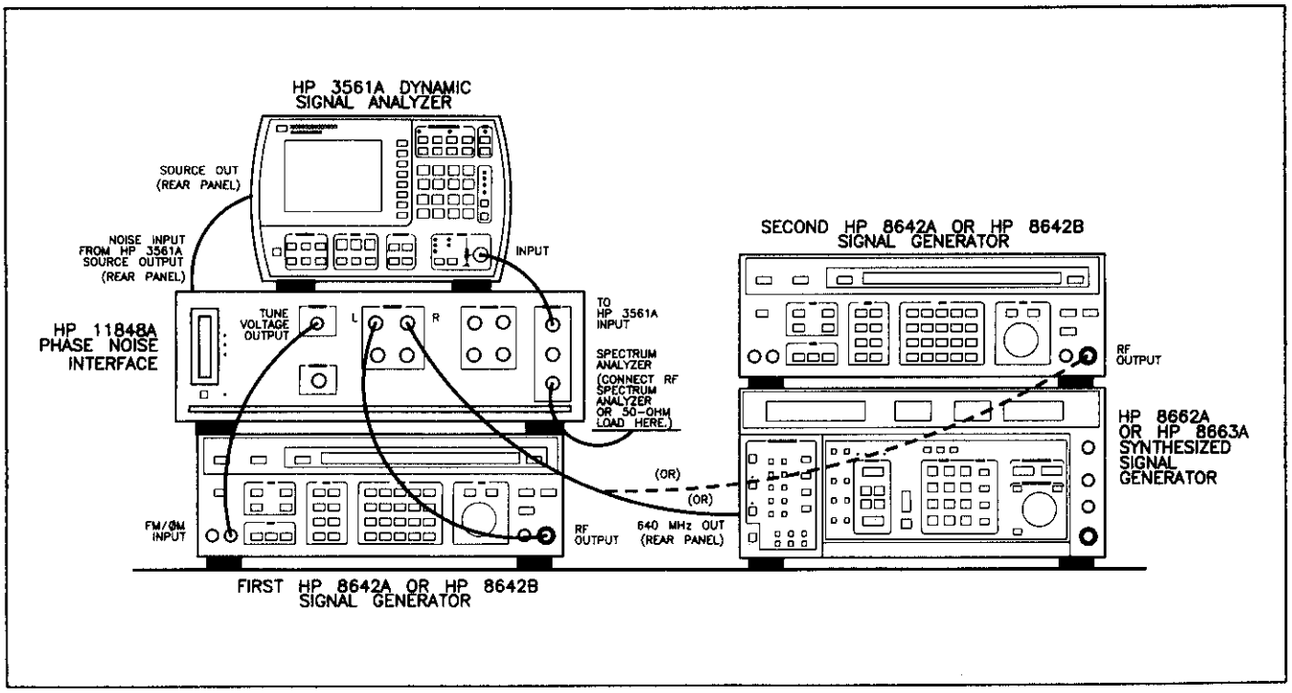


Figure 37. Spectral Purity Tests for Options 005 and 006 Setup

11. Press [F1] softkey. The measurement should proceed automatically without error messages. If the reference source is an HP 8662A Option 003 or HP 8663A Option 003, the measured noise should be similar to that shown in Figure 38 and should be less than −134 dBc at 20 kHz offset or −144 dBc at 100 or 200 kHz offset. If the reference source is an HP 8642A or HP 8642B, subtract 3 dB from the measurement results; the limits should then be as previously stated.

Noise Limit for 20 kHz Offset: _____ −134 dBc

Noise Limit for 100 or 200 kHz Offset: _____ −144 dBc

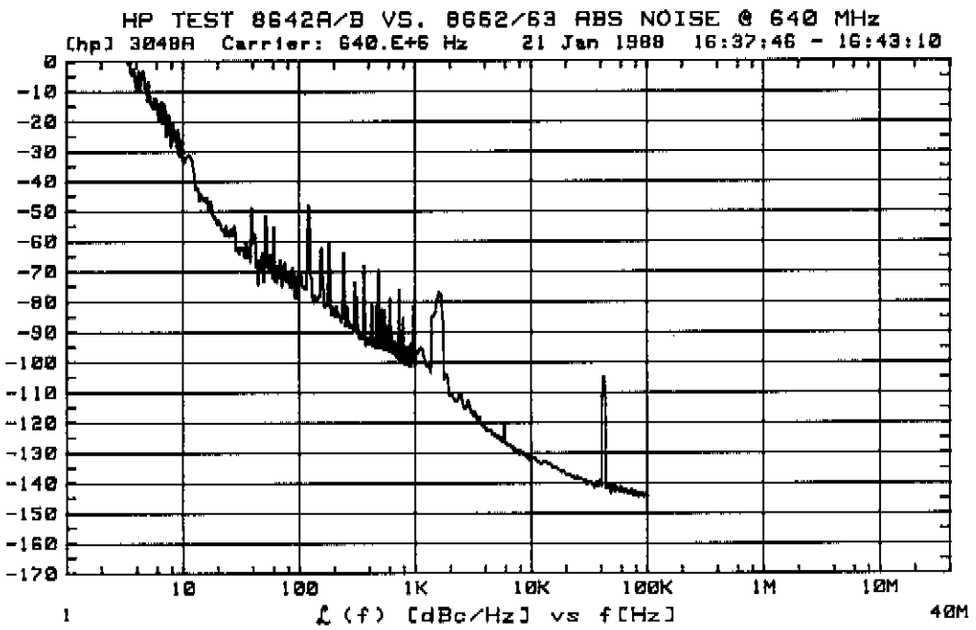


Figure 38. Typical Spectral Purity Tests Results with HP 8662A Reference Source

12. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
13. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
14. Press [ESC] to return to the Main Menu.

Appendix A: Block Diagram and System Troubleshooting

BLOCK DIAGRAM

The foldout **BD** is a block diagram of the HP 11848A Phase Noise Interface. When calibrating the System, the diagram helps to visualize what circuit functions are being tested. It is also very useful when running the HP 11848A Control feature which is required in several of the tests. The HP 11848A Control feature permits arbitrary control over all programmable circuits; the Block Diagram documents those circuits. For more information about the Block Diagram (such as theory of operation), refer to the *HP 11848A Service Manual.*

SYSTEM TROUBLESHOOTING

The tests described in this manual can often assist in isolating System faults down to a System device. Some aspects of the main software tests as they apply to isolating faulty System devices are described in the following list.

Calibrate System. A series of transfer function measurements are made on various signal paths in the Interface. The measurement data is stored as calibration factors which the controller uses (either directly or in more involved calculations) to correct the measured phase noise data whenever that signal path is used. Normally the Calibrate System program is invoked only for the annual System calibration or when the Interface has been repaired. Any difficulties encountered when the calibration program is being run may point to the Interface. For example, a catastrophic failure of a high-pass filter in the Interface will generate data that is too far out of limits to be accepted as a legitimate transfer function; the program will then abort the measurement.

Performance Tests. To verify that the system meets its published specifications, a series of Performance Tests can be run. The failure of a test may contain enough clues to point to a failure in the Interface.

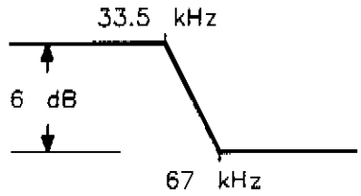
Internal Adjustments. Often small out-of-specification results of the Performance Tests or Functional Checks can be corrected by means of adjustments, particularly if the condition is due to a dc offset voltage that is out of limits.

Functional Checks. These tests are an extension of the Performance Tests that test the general operational integrity of the Interface itself. The test limits are generally loose.

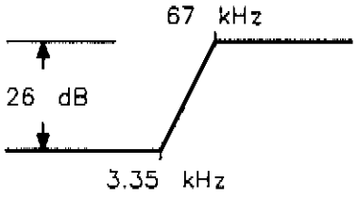
HP 11848A Control. Arbitrary and complete control of the programmable functions of the Interface from the controller keyboard is provided by the HP 11848A Control program. A single display contains all the Interface state information. Because of the compactness of the state information, you should consult the *HP 3048A Option 301 Reference Manual* when running the program.

1. Switches on the Block Diagram are shown in their HP-IB preset state. At interface turn-on with no controller connected, the power-up state is the same as the HP-IB preset state except:
   a. ATTEN 1 is set to an open-circuit (non-programmable) state, and
   b. the switches of cluster S5 through S8 are all open.

2. The transfer function of GAIN 2 also has a lead-lag response as follows:



3. The transfer function of Lag-Lead Network 1 is as follows:



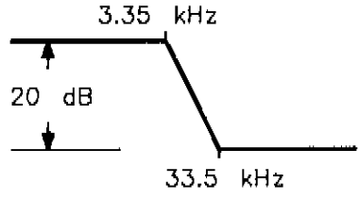
   To this transfer function is added a programmable lag-lead with the following poles and zeros:

Lag-Lead Number	Pole Frequency	Zero Frequency	Attenuation
0	4.82 Hz	9.95 Hz	6 dB
1	8.01 Hz	40.1 Hz	14 dB
2	9.17 Hz	115.9 Hz	22 dB
3	9.68 Hz	306 Hz	30 dB
4	9.95 Hz	784 Hz	38 dB
5	9.95 Hz	1.985 kHz	46 dB
6	9.95 Hz	5.00 kHz	54 dB
7	9.95 Hz	12.58 kHz	62 dB

4. Assemblies A6, A8, and A9 are controlled as follows:

Control Line	State		
	A6	A8	A9
L17	Off	On	On
L18	Off	On	Off
L17, L18	On	Off	Off

5. The transfer functions of Lag-Lead Network 2 on A4 and the Lag-Lead Network on A3 are both as follows:

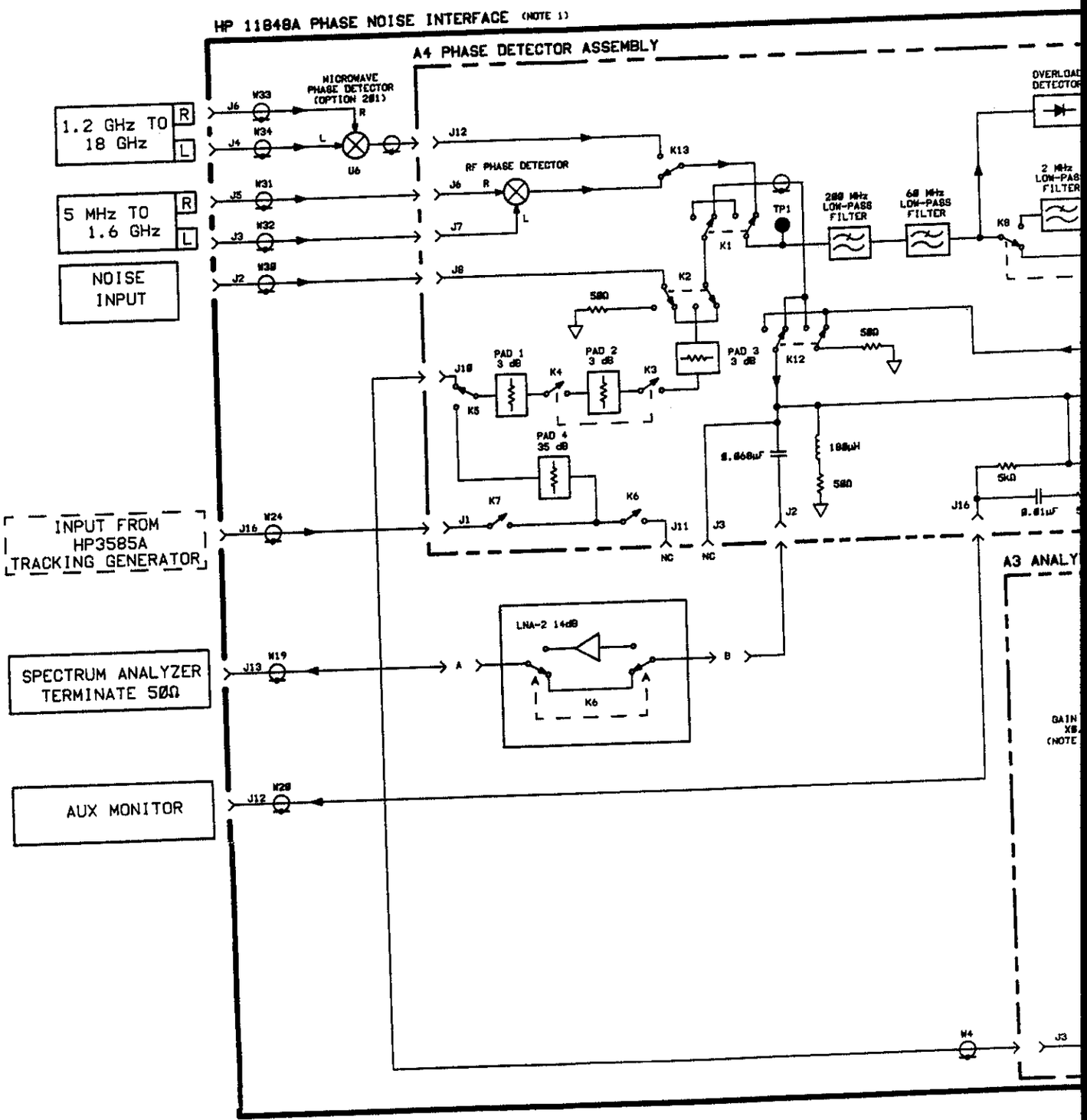


6. The passband gain of the High-Pass Filters is 2 (as measured from TP17 to the respective filter output). The gain settings of the GAIN 3 amplifier and attenuator include the passband gain of the High-Pass Filters.

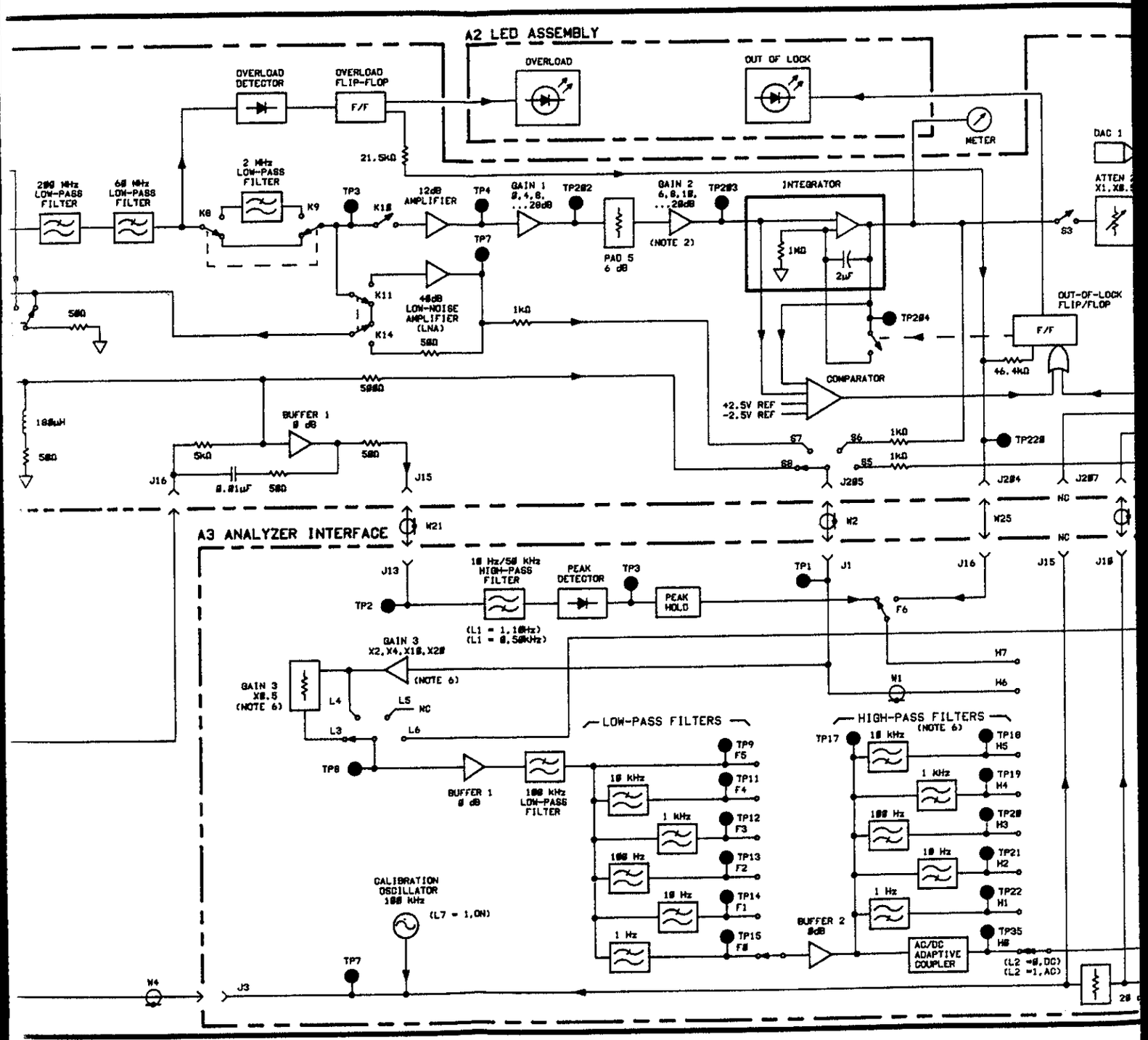
Block Diagram Notes

Block Diag.

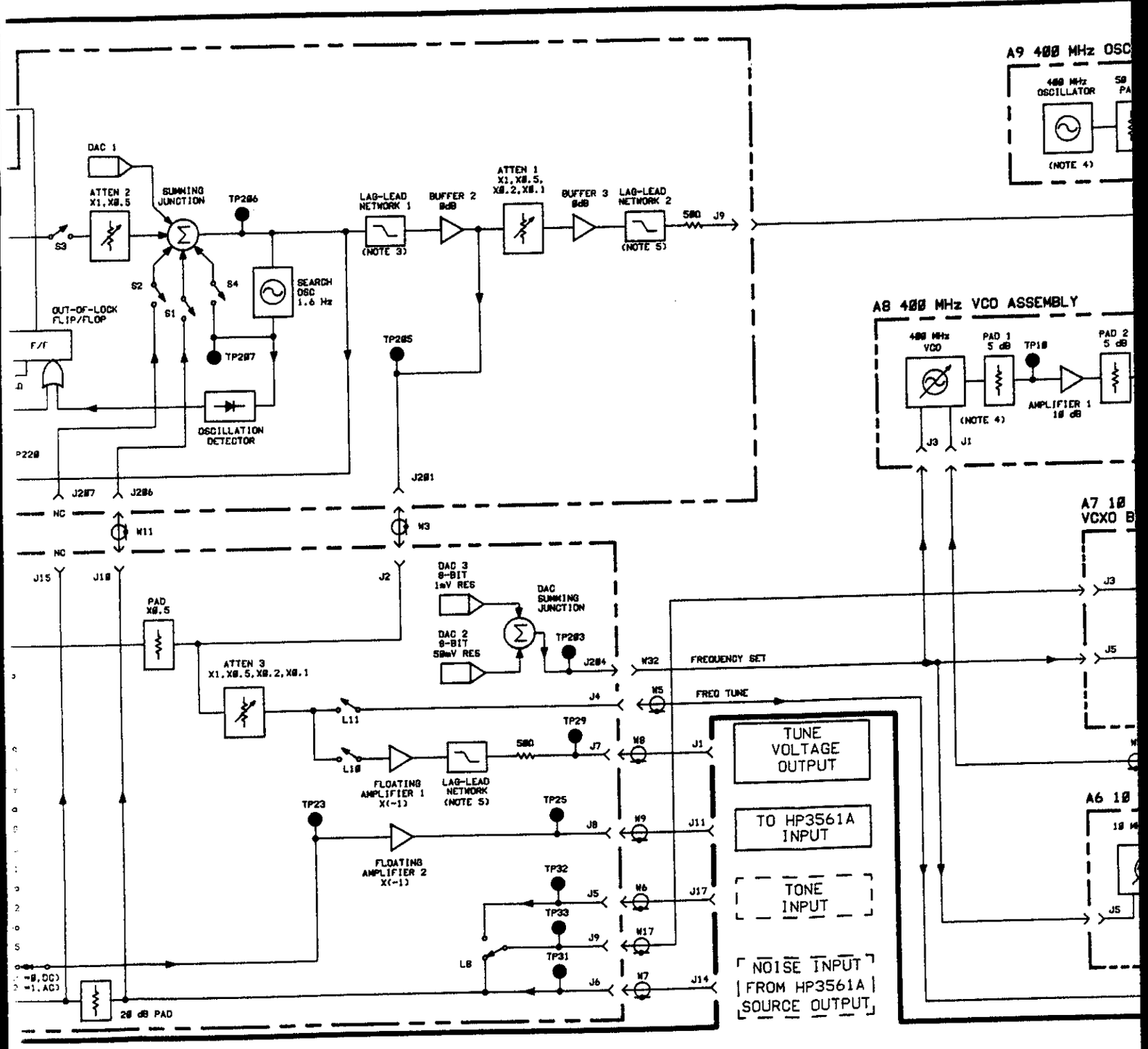
Sht 1 of 4



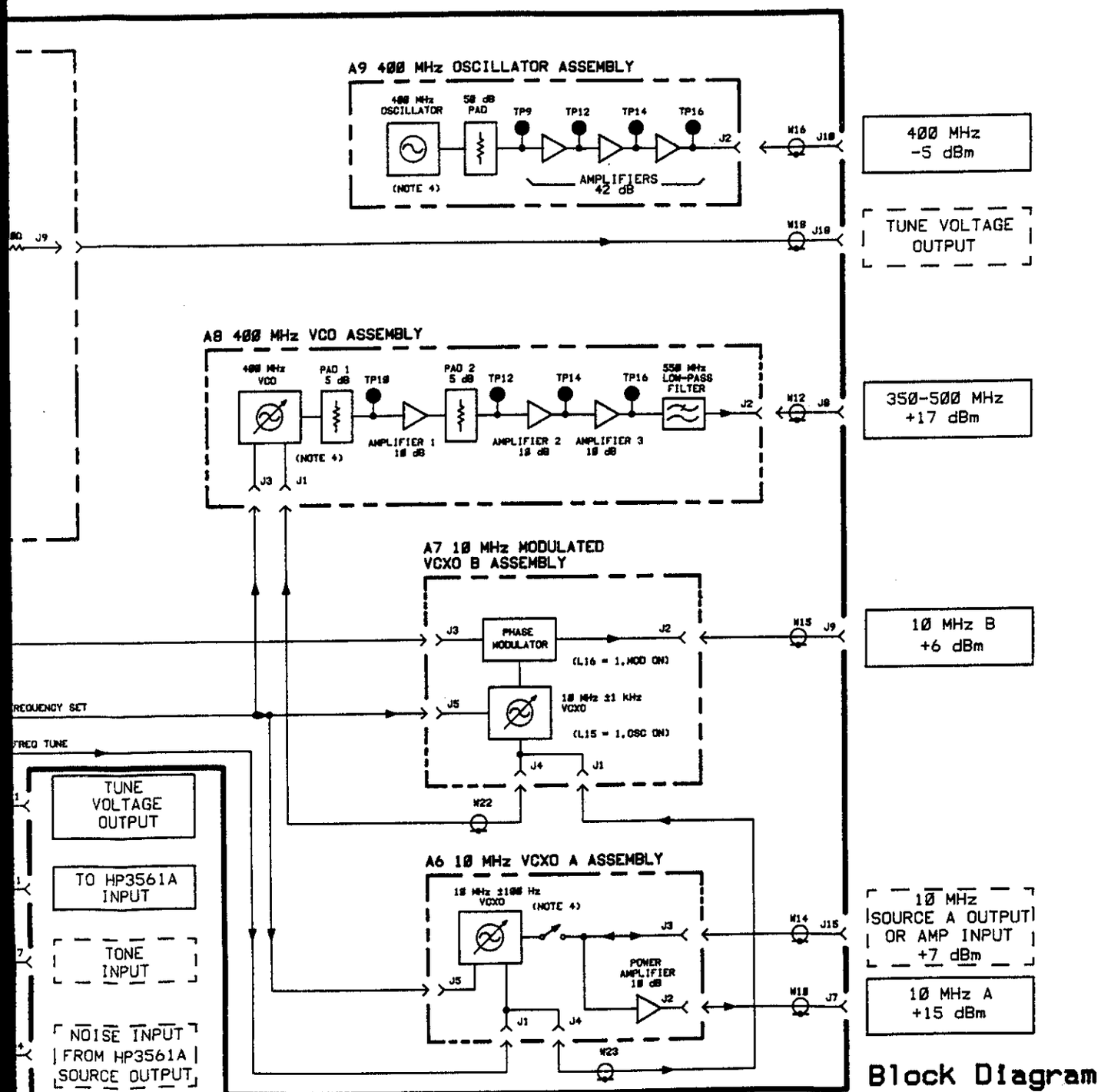
Block Diag.
Sht 2 of 4



Block Diag.
Sht 3 of 4



Block Diag.
SH 4 of 4



Block Diagram

Appendix B: HP 8662A or HP 8663A 640 MHz Spectral Purity Test

DESCRIPTION

This test measures the absolute noise floor of the System including the contributions of two 640 MHz reference sources (a combination of HP 8662A Option 003 and/or HP 8663A Option 003) in a normal phase-lock-loop, phase-noise measurement. Tuning is through the electronic frequency control (EFC) port of one of the 640 MHz sources.

This test should not be confused with the Spectral Purity Tests for Options 001 and 002. That test measures the absolute phase noise on the front-panel RF output. This test measures the absolute phase noise on the low-phase-noise, rear-panel 640 MHz reference output. Also note that the two sources (HP 8662A or HP 8663A) must have the low phase-noise option (Option 003).

This test is intended to be run when the Spectral Purity Test for Options 003 and 004 fails. If that test fails but this test passes, the failure is in one of the HP 11729C Carrier Noise Test Sets. If this test also fails, the failure is in one of the HP 8662As or HP 8663As.

EQUIPMENT

Carrier Noise Test Set. This test requires a low-noise amplifier to increase the power level of one of the 640 MHz sources enough to adequately drive the L port of the RF phase detector in the Interface. An amplifier in the HP 11729C Carrier Noise Test Set ideally fills this need.

Printer. This test will run without a printer connected to the computer. However, connecting a printer is recommended.

If a hardcopy of the test results is desired, the GRAFPLUS software must be executed prior to loading the HP 3048A Option 301 software. (For detailed information on GRAFPLUS, refer to appendix A in the HP 3048A Option 301 Operating Manual.)

Reference Signal Generator. A second HP 8662A Option 003 or HP 8663A Option 003 Synthesized Signal Generator is required in addition to the one in the System.

RF Spectrum Analyzer. The System collects data to 100 kHz offsets with the HP 3561A. Data to 40 MHz offsets requires, in addition, an RF spectrum analyzer. Any supported RF spectrum analyzer can be used in this test. However, all specified effects are covered with the HP 3561A. An RF analyzer is needed only if informational data beyond 100 kHz is desired.

PROCEDURE

The program used for this procedure is PN.EXE. For more information, refer to Loading the HP 3048A Option 301 software on page 5.

1. The *Noise Floor Test* should be run before running this test.
2. From the Phase Noise Main Menu, select **File System**.
3. Select **Directory**.
4. Type *.PRM and press [ENTER].
5. Using the [△] [▽] keys, select **HPTEST20.PRM** and press [ENTER].
6. Select **Load File**.

NOTE

This file has been set up specifically to measure the HP 8662A and HP 8663A Synthesized Signal Generators. All entries in the Define Measurement Parameter Table have been set for best measurement accuracy for these sources.

7. HPTEST20.PRM should be displayed as the path. Press [ENTER] to load the file.
8. Press [ESC] to return to the Main Menu.
9. Select **New Measurement**.
10. Press [Y] to indicate that new measurement data is desired.
11. Connect the instruments as shown in Figure B–1.

NOTE

The on-screen connection diagram, while showing the general measurement technique, is incomplete. Also note that neither of the HP 8662As or HP 8663As in Figure B–1 are under HP-IB control.

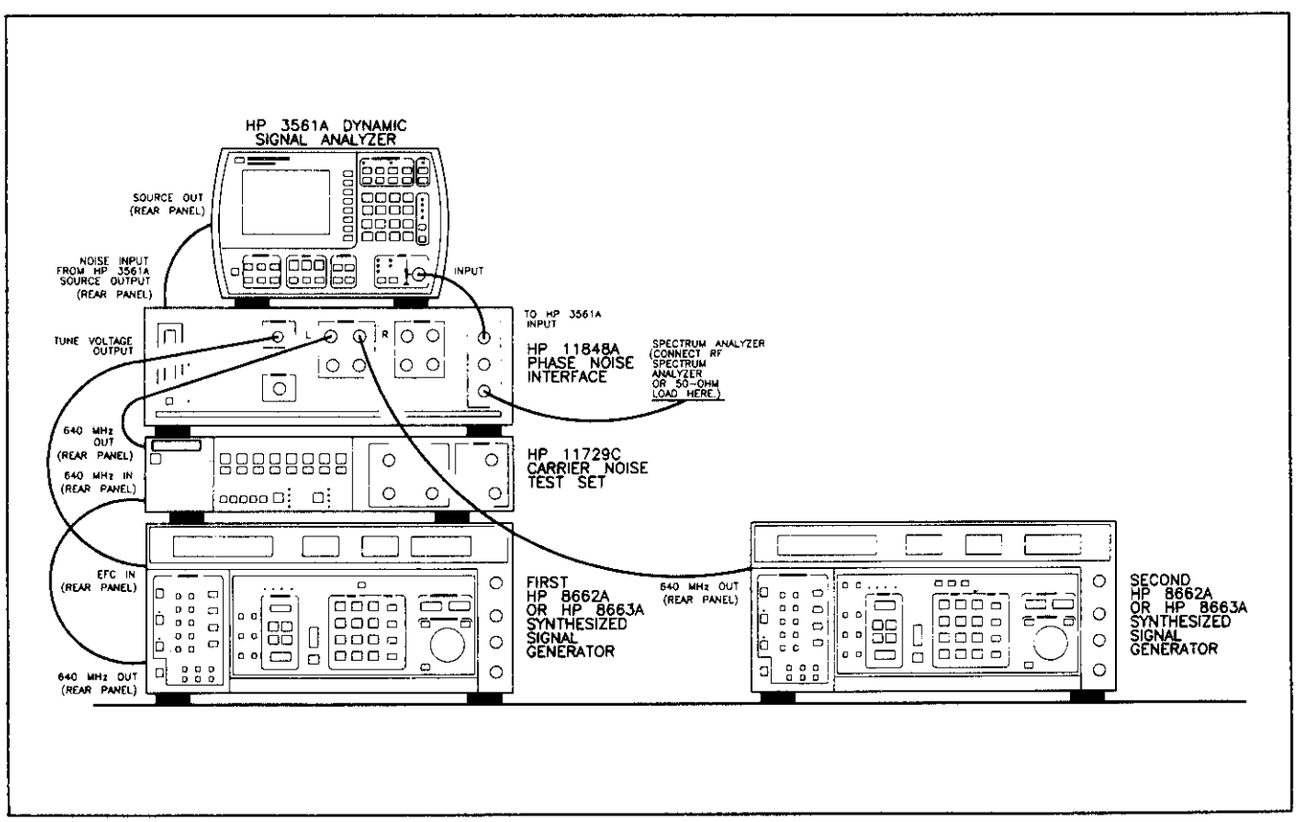


Figure B–1. HP 8662A or HP 8663A 640 MHz Spectral Purity Test

12. Using the [F8] or [SHIFT] [F8] keys, set the lowest possible beatnote as measured on the HP 3561A display. **Do not exceed ±5 volts as the specified center voltage.** (Use the [△] [▽] keys to change the HP 3561A frequency span.)

13. Press [F1]. The measurement should proceed automatically. The measured noise should be similar to that shown in Figure B–2 and should be within the limits given in the following table.

NOTE

If the beatnote frequency is too high, the System cannot tune the (EFC) source close enough to acquire phase lock. Various error messages on the display warn of this condition. You must then manually adjust the frequency of one of the 640 MHz sources (in the HP 8662As or HP 8663As) to bring the difference frequency of the sources within the loop's capture range. (For the HP 8662A and HP 8663A, the adjustment is located on the rear panel and is labeled "FINE FREQUENCY ADJUST".)

Offset Frequency (Hz)	Noise Level (dBc)	
	Actual	Maximum
1	_____	−54
10	_____	−84
100	_____	−104
1 000	_____	−118
3 000	_____	−118
5 000	_____	−126
10 000	_____	−142
100 000	_____	−154

NOTE

At some frequency offsets, phase noise levels may be obscured by spurious signals. When this is the case, estimate the phase noise level by averaging the levels at the bases of the spurious signals.

In the table above the noise level limits for offsets of 1000, 3000, 5000, 10 000, and 100 000 Hz are 3 dB higher than the published specification for the HP 8662A Option 003 or HP 8663A Option 003. This is because of the increased likelihood that the noise level of each source is similar and close to the specification. In that case, the combined noise is 3 dB higher than either source alone.

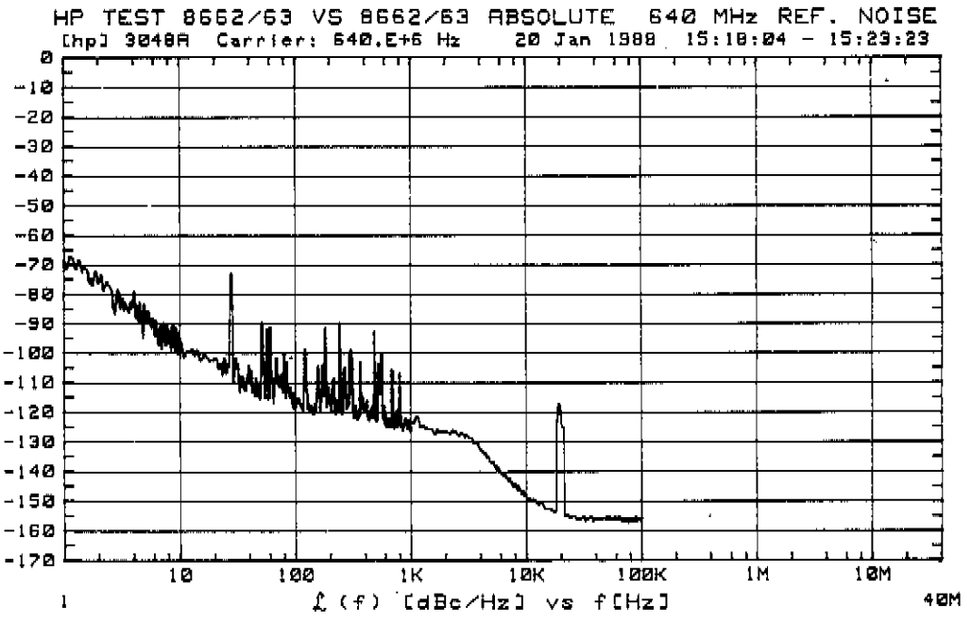


Figure B-2. Typical Spectral Purity Tests Results

14. When the test is done, the computer will sound a short beep and display the message `Measurement Complete` for approximately 5 seconds.
15. To print a hardcopy of a phase noise graph, press [SHIFT] and [F4] simultaneously.
16. Press [ESC] to return to the Main Menu.