HP 3048A
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 Software Version: *REV: A.02.00 and Above*
rev.01NOV90

Third Edition

EAST 24001 MISSION AVENUE, TAF C-34, SPOKANE, WASHINGTON, U.S.A. 99220

Calibration Manual HP Part 03048-90015

Other Documents Availiable:
Microfiche Calibration Manual HP Part 03048-90016
Operation Manual HP Part 03048-90001
Microfiche Operation Manual HP Part 03048-90014
Reference Manual HP Part 03048-90002
Microfiche Reference Manual HP Part 03048-90017
HP 11848A Service Manual HP Part 11848-90004
Microfiche HP 11848A Service Manual HP Part 11848-90012
HP 3048A System Software Discs HP Part 03048-90018
HP 3048A Quick Reference Guide 03048-90019

Printed in U.S.A. : June 1990

HEWLETT PACKARD

Notice

Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product name/number was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648 is now model number Agilent 8648.

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Agilent Technologies

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

SAFETY SYMBOLS

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

 Indicates hazardous voltages.

 Indicates earth (ground) terminal.

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

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

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could resulting personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

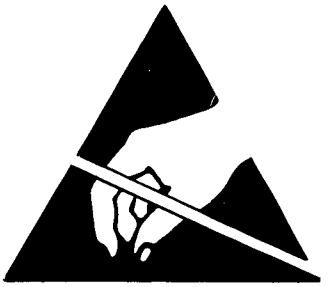
If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Servicing instructions are for use by service trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

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

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source os supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.) Do not use repaired fuses or short circuited fuseholders.



ATTENTION
Static Sensitive Devices

This instrument was constructed in an ESD (electro-static discharge) protected environment. This is because most of the semi-conductor devices used in this instrument are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The results can cause degradation of device performance, early failure, or immediate destruction.

These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

In all instances, measures must be taken to prevent static charge build-up on work surfaces and persons handling the devices.

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, adjustments, performance tests, and signal path characterization. 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 on the System's 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. If a precision attenuator is used to verify the linearity specification of the spectrum analyzer, the accuracy of the ratio is as accurate as the linearity specification of the spectrum analyzer. The amplitude linearity calibration of the spectrum analyzer will be traceable to the U.S. National Bureau of Standards (NBS) if the precision attenuator and other instrumentation used to perform the spectrum analyzer's calibration is traceable to NBS.

Table 1. *Recommended Test Equipment*

Instrument Type	Critical Specifications	Suggested Model
Frequency Counter	Frequency Range: 10 to 550 MHz	HP 5315A
Microwave Sources	For systems with Option 201 only(1); 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 (2).
Noise Floor Test Fixture	Supplied with system. No substitute recommended.	HP 11848-61032
Power Meter and Sensor	For systems with Option 201 only(2) Frequency Range: 1.2 to 18 GHz Level Range: >+7 dBm	HP 435B HP 8481A
Printer	HP-IB; graphics; usually part of the System	HP ThinkJet

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

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

Table 2. *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)		(3)	X(3)
Ambient Change					X		
Confidence Check	X	X(2)					
HP 11848A Repair		X(3)	X(3)	X(3)		(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 2 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 (VNOMs) 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: "CALDATALO" and "CALDATAHI". CALDATALO is used for signal-path circuits through 100 kHz. CALDATAHI is used for signal paths above 100 kHz plus the VNOMs (the nominal tuning voltage of the tuneable, internal sources) and noise-flatness data for flatness variations greater than 2 dB.

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".

NOTE

This check duplicates some of the guided tour in the Getting Started *section of the* Operating Manual.

PROCEDURE

1. Press the [System Preset] softkey. This softkey appears at the Main Software Level menu.
2. Press the [New Msrmnt] softkey to initiate the measurement.
3. Press the [Yes, Proceed] softkey 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 *Setting Up the HP-IB Addresses* in the installation section of the *HP 3048A Operating Manual.*)
4. 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.*

5. Press the [Proceed] softkey 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 10 minutes depending on the controller and the presence of the RF spectrum analyzer.)

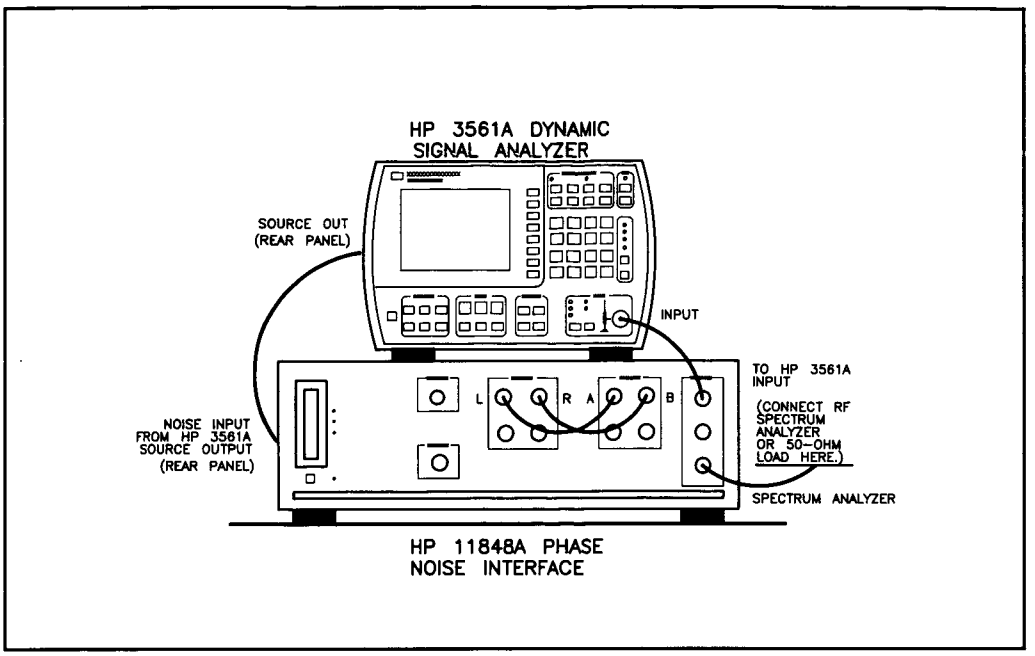


Figure 1. *Quick Check Setup*

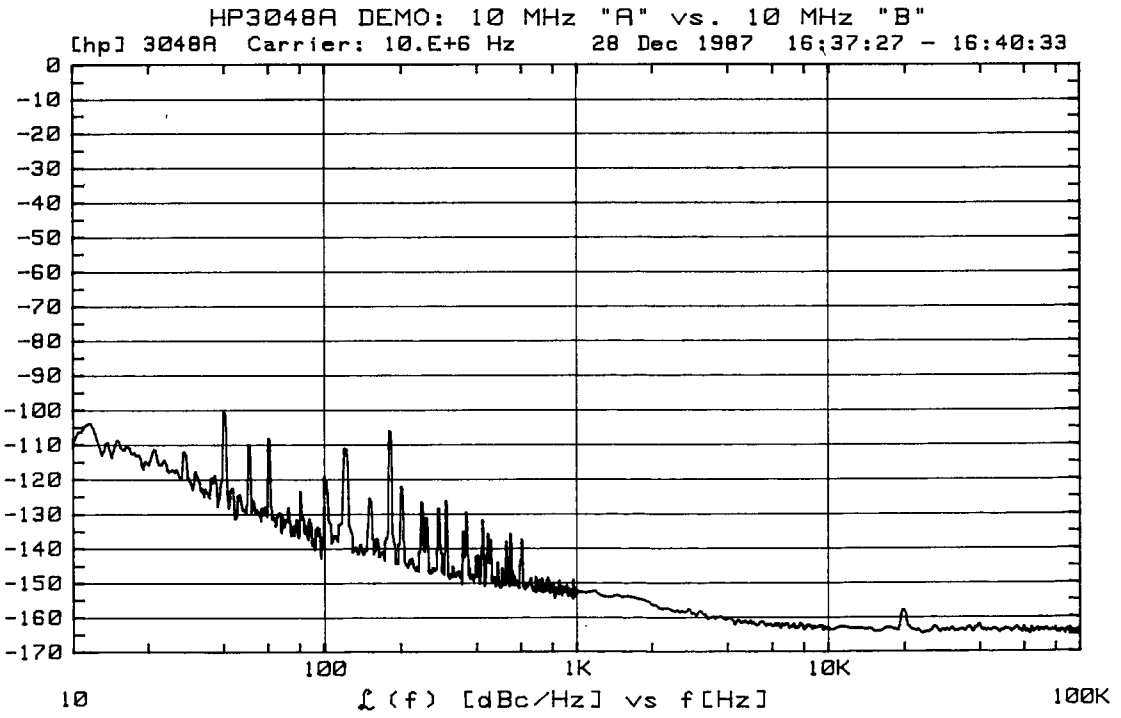


Figure 2. *Typical Noise Plot for the System Quick Check*

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 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. The test requires the presence of a printer in the System's Configuration Table.

Audio Source. The Spur Accuracy Test will run automatically if an HP 3325A Function Generator is in the System's Configuration Table. If this function generator is not available, any manually controlled function generator or audio source having exact decade frequency switching covering 5 Hz to 55 kHz can be used. (The range must be 5 Hz to 550 kHz if an RF spectrum analyzer is configured in the System.) The HP 3312A Function Generator is a typical manual audio source which can be used in this test. If no function generator is found in the system instrument configuration table, the software assumes you have only a manual audio source and you will be prompted for the proper settings.

NOTE

The flatness of the audio source must be better than ±0.3 dB when switching from 55 kHz to 550 kHz. The 550 kHz span is only used when an RF spectrum analyzer is present.

PROCEDURE

1. Press the [Spcl. Funct'n] softkey. This softkey appears at the Main Software Level menu.

NOTE

If troubleshoot mode has been selected (by pressing the Test Mode *softkey), you will be prompted for the setup diagram two times. Press the* Proceed *softkey after the second setup diagram is displayed.*

2. Press the 3048A Sys Chk softkey.
3. Press the Perf. Tests softkey.
4. Press the Spur Accy. softkey. The System will then load the Spur Accuracy Test File.
5. Press the New Msrmnt softkey.
6. Connect the instruments as shown in the on-screen connection diagram and in Figure 3.

NOTE

If a function generator is to be under automatic control, the System's Configuration Table must have the literal name "FUNCT GEN" and model "3325A".

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

7. Press the Proceed softkey. If the function generator is under automatic control, 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.) If the function generator or audio source is under manual control, proceed with step 8.

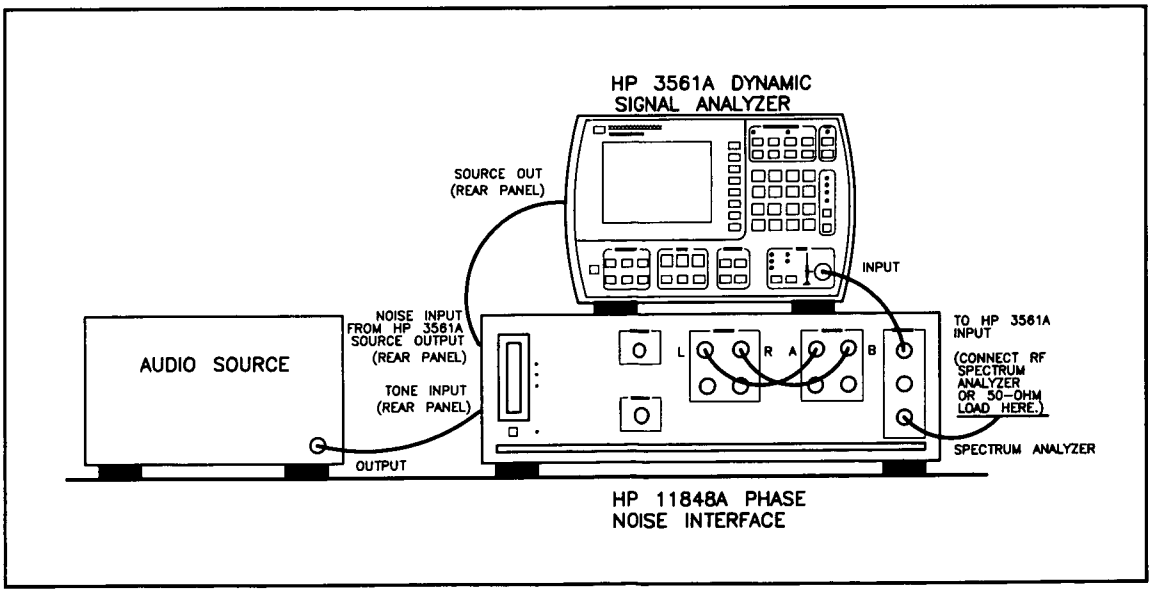


Figure 3. *Spur Accuracy Test Setup*

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.

CAUTION

In the following step, do not apply more than $3V_{peak}$ to the HP 11848A rear-panel TONE INPUT *or the internal protection fuse may blow.*

8. If the function generator or audio source is under manual control, set the initial level to $0.25V_{rms}$ (+1 dBm) into a 50Ω load as prompted by the display. Press the [Proceed] softkey to continue.
9. Set the audio source to the first measurement frequency as prompted on the display and then set the amplitude, as read on the HP 3561A Dynamic Signal Analyzer (FFT Analyzer), as prompted by the display. Press the [Proceed] softkey after completing each setting.

NOTE

Do not change the frequency vernier or amplitude setting *of the audio source after these initial settings have been made. The frequency must be changed only by using decade switching of the audio source.*

10. The test will pause after each frequency is measured and prompt for a new frequency setting. This will be done twice: once for calibrating the phase modulation and once for reading the demodulated phase modulation. Press the [Proceed] softkey after completing each setting. When the measurement is complete, the measured spurs should be similar to the ones shown in Figure 4 with no failures listed.

NOTE

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.

After the Spur Accuracy Test has been run, two additional softkeys ([Recal Spurs] *and* [Repeat Msrmnt]*) are available.*

The [Recal Spurs] *softkey allows you to remeasure all spurs from 5.5 Hz to 55 kHz.*

The [Repeat Msrmnt] *softkey allows you to repeat the measurement without recalibrating the reference spurs.*

These additional softkeys allow you to repeat the measurement with the same data as the original measurement, or to recalibrate the spurs and then repeat the measurement.

29 Dec 1987, 14:17:21
HP11848A S/N 2621A00106

HP11848A SPUR ACCURACY PERFORMANCE TEST

TEST FREQ (Hz.)	CALIBRATED SPUR LVL (DBC)	MEASURED SPUR LVL (DBC)	SPECIFIED ACCURACY (+/-DB)	MEASURED ACCURACY (DB)	PASS/ FAIL
5.5	- 60.3	- 60.46	2.	- 0.16	
55	- 60.19	- 60.68	2.	- 0.49	
550	- 60.29	- 60.96	2.	- 0.67	
5.5E+3	- 60.24	- 60.46	2.	- 0.22	
55.E+3	- 60.08	- 60.58	2.	- 0.5	

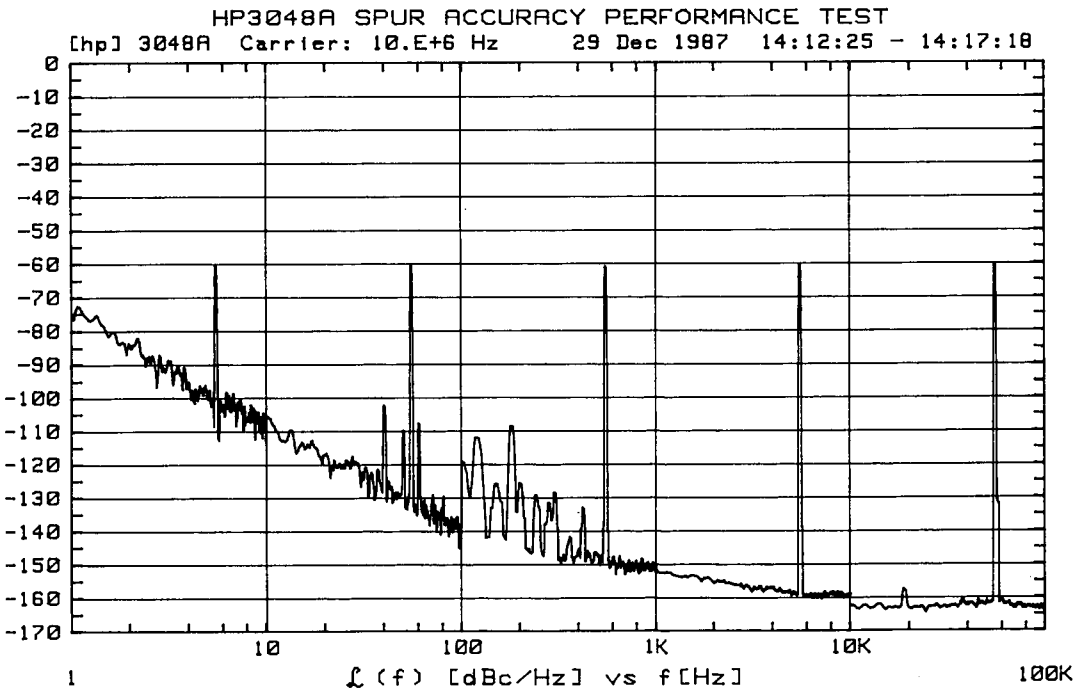


Figure 4. *Typical Spur Accuracy Test Results*

Noise Flatness Test

DESCRIPTION

This test verifies that the calibration data used for phase noise measurements above 500 kHz offsets is accurate. It also provides an opportunity to update the calibration data should the flatness be marginal.

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 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. If the unflatness is equal to or greater than 2 dB, the "CALDATAHI" data file will have supplementary data appended to it to adjust for the unflatness.

EQUIPMENT

Printer. The test requires the presence of a printer in the System's Configuration Table.

PROCEDURE

1. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.

NOTE

If troubleshoot mode has been selected (by pressing the [Test Mode] softkey)you will be prompted for the setup diagram two times. Press the [Proceed] softkey after the second setup diagram is displayed.

2. Press the [3048A Sys Chk] softkey.
3. Press the [Perf. Tests] softkey.
4. Press the [Noise Flat.] softkey. The System will then load the Noise Flatness Test File.
5. Press the [New Msrmnt] softkey.
6. Connect the instruments as shown on the on-screen connection diagram and in Figure 5.
7. Press the [Proceed] softkey. 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.)

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.

After this test completes its measurement, if the measured unflatness is 2 dB or greater, a Store Data *softkey will be displayed. This allows you to store the supplementary data in mass media storage (in the file "CALDATAHI") to correct the calibration data for the paths used by the RF spectrum analyzer.*

If you do not wish to store the supplementary data, you should reload the calibration data from CALDATAHI since the new data remains in computer RAM (random access memory) and will be used in subsequent measurements. Also, if old data is used while the new data has significantly changed, the accuracy of measurements above 500 kHz may not meet the System specifications. If the unflatness is within specifications (less than 2 dB unflatness), the Store Data *softkey will not be displayed.*

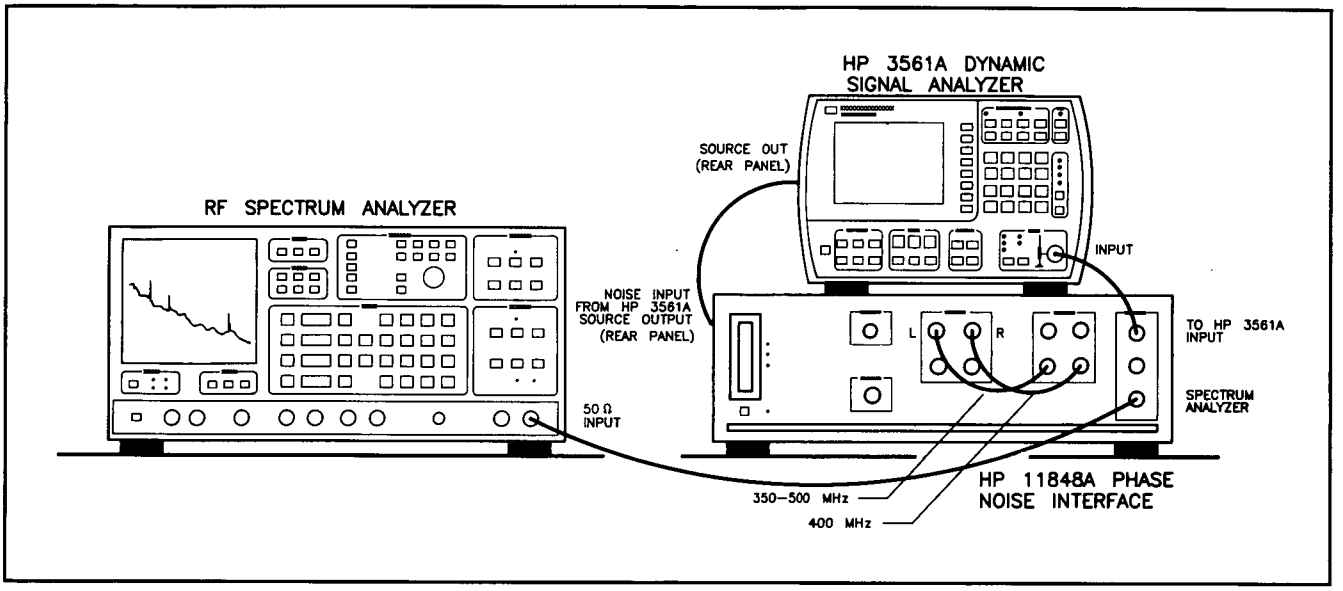


Figure 5. *Noise Flatness Test Setup*

30 Dec 1987, 15:45:23
HP11848A S/N 2621A00106

HP11848A NOISE FLATNESS PERFORMANCE TEST

OFFSET FREQ (Hz.)	MAX UNFLATNESS RELATIVE TO 500 KHz. (+/- dB.)
6.2E+6	0.83

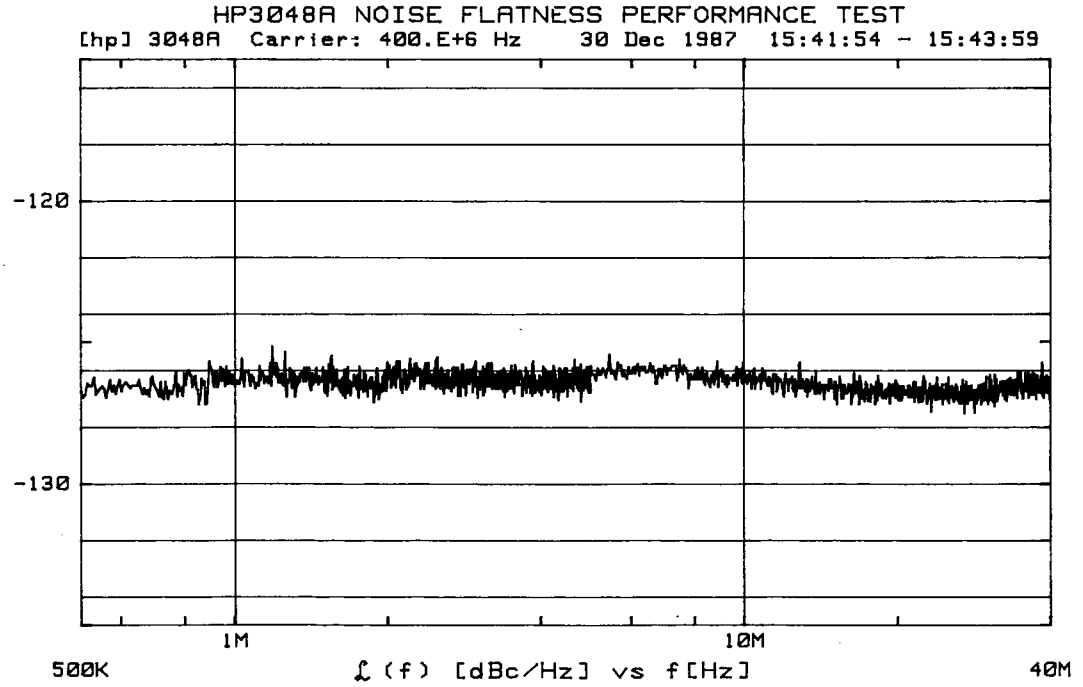


Figure 6. *Typical Noise Flatness Test Results*

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. The test requires the presence of a printer in the System's Configuration Table.

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

1. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.

NOTE

If troubleshoot mode has been selected (by pressing the [Test Mode] softkey), you will be prompted for the setup diagram two times. Press the [Proceed] softkey after the second setup diagram is displayed.

2. Press the [3048A Sys Chk] softkey.
3. Press the [Perf. Tests] softkey.
4. Press the [Noise Floor] softkey. The System will then load the Noise Floor Test File.
5. Press the [New Msrmnt] softkey.
6. Connect the instruments as shown on the on-screen connection diagram and also 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.

7. Press the [Proceed] softkey. 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.

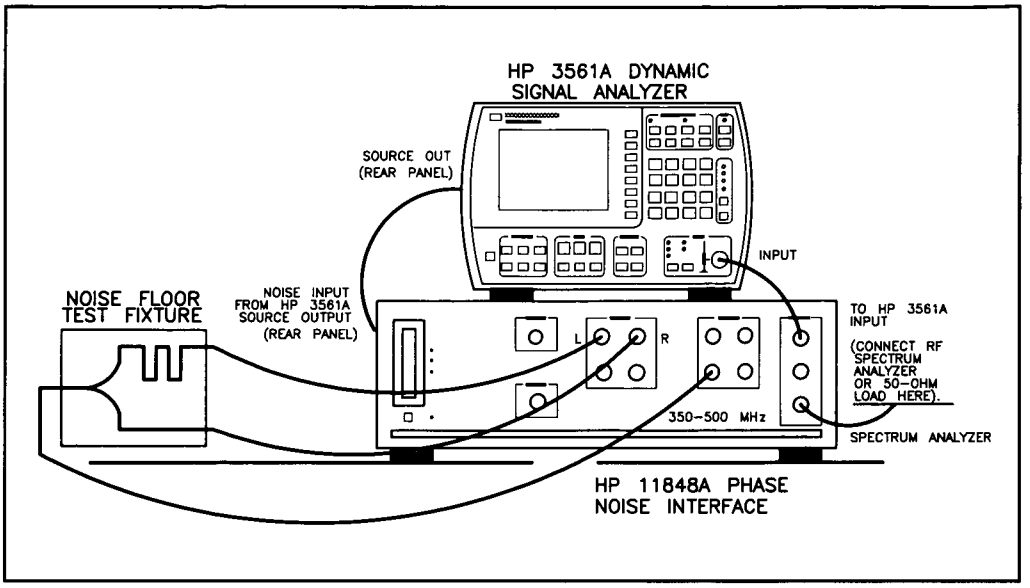


Figure 7. *Noise Floor Test Setup*

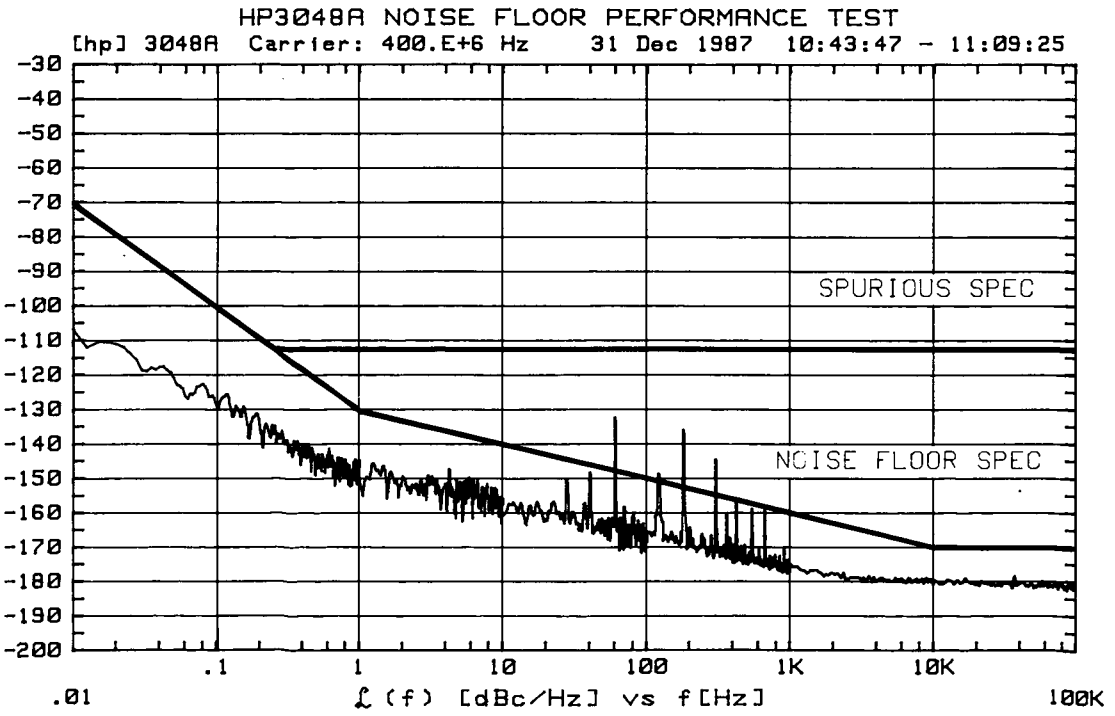


Figure 8. *Typical Noise Floor Test Results*

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 small compared to 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) used in place of the HP 3561A; the source instability must be small compared to 1 MHz. If any other RF spectrum analyzer is used, the output power of the generators 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 Spectrum Analyzer is recommended but other RF spectrum analyzers can be used. If any other spectrum analyzer is used, the output power of the generators should be made 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.

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.)

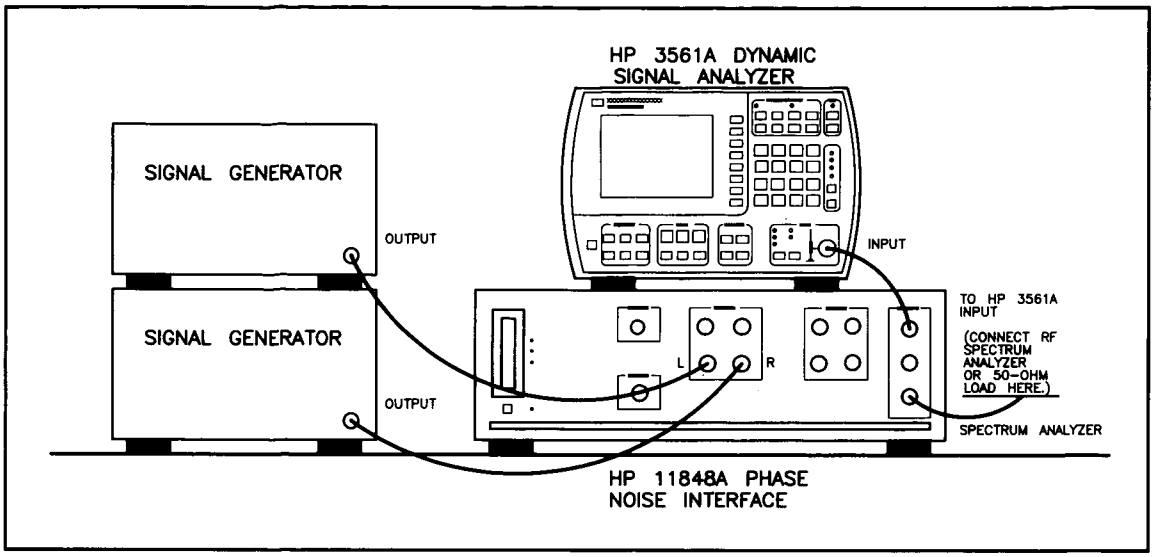


Figure 9. *Microwave Phase Detector Conversion Loss Test Setup*

2. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
3. Press the [11848A Control] softkey.
4. Set up the HP 11848A internal configuration as follows.
   a. Press the [Preset] softkey.
   b. Use the cursor control keys to move the cursor to the "SELECTED 'K' SWITCHES:" line then key in 12 and 13.
   c. Use the cursor control keys to move the cursor to the "H SWITCH NUMBER:" line then key in 6.
   d. Press the [Send Command] softkey. This routes the microwave phase detector output to the front-panel spectrum analyzer output port. The display should appear as in Figure 10. (With 6 showing on the H switch line and 12 and 13 showing on the K switches line, the position of the switch levers of K12 and K13 is in the state opposite that shown on the Block Diagram foldout at the end of this manual.)
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	_____

```
                    HP 11848A CONTROL        Refer to Block Diagram

DAC1:  0          V          GAIN1:   0   dB          ATTEN1:  x1
DAC2:  0          V          GAIN2:   6   dB          ATTEN2:  x1
DAC3:  0          V          GAIN3:  x2               ATTEN3:  x1


H SWITCH NUMBER:> 6  <
F SWITCH NUMBER:  0
LAG-LEAD FILTER:  0


SELECTED 'K' SWITCHES:  12 13
SELECTED 'L' SWITCHES:  3
SELECTED 'S' SWITCHES:  8

Acceptable Values: 0 TO 7
```

Figure 10. *HP 11848A Control Display for Microwave Phase Detector Conversion Loss Test*

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.)

These tests are similar to the tests on the *Diagnostic* disc. The diagnostic program also includes failure analysis information and thus may be more useful in tracking down a fault than the Functional Tests. (Refer to the HP 11848A *Service Manual.*)

EQUIPMENT

Printer. These tests will run without the presence of a printer in the System's Configuration Table. However, the test results in some instances will not remain on the display long enough to be observed; therefore, it is recommended that the tests be run with a printer.

PROCEDURE

1. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
2. Press the [3048A Sys Chk] softkey.
3. Press the [Fnctl. Chk.] softkey.

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.*

4. To perform all tests sequentially, press the [Test All.] softkey and follow the displayed instructions. To perform a specific test, perform the following steps.
   a. Press the [Select Test] softkey.
   b. Move the cursor to the desired test.
   c. With the cursor at Test 01, Test 02, or Test 03, press the [Select Path] softkey then move the cursor to the desired path of the selected test. Press the [Sngl Path] softkey to test a single path of the selected test or press the [Test all] softkey to test all paths. (Refer to *Comments* for a description of the test paths.)
   d. If Test 04 through Test 10 is selected, press the [Run Test] softkey.

Comments

Runtime. With the printer on 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.

Printer On/Off. If a printer is on HP-IB and in the System's Configuration Table, the printout can be inhibited by pressing the [Printer Off] softkey. To re-enable the printer, press the [Printer On] softkey. It is recommended that tests be run with the printer, otherwise the test results in some instances will not remain on the display long enough to be observed.

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

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.

Test 01. **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.)

Test 02. **A3/A4 Signal Paths 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.

Test 03. **Phase-Lock Loop Paths Transfer Functions Test.** This check is similar to Test 02 except that the paths are through the circuits labeled GAIN 1, GAIN 2, and ATTEN 2 on the Block Diagram.

Test 04. **Lag-Lead Transfer Functions Test.** Lag-Lead Network 1 is measured at 8 different settings.

Test 05. **100 kHz Calibrator, Search Oscillator, and Out-of-Lock Flip-Flop Test.** The absolute level and frequency of the 100 kHz Calibration Oscillator and the Search Oscillator are measured. The Out-of-Lock and Overload Flip-Flops are tested when set and cleared.

Test 06. **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.

Test 07. **DAC 1, 2, and 3 Beatnote Pull Test.** This is similar to Test 06, but the oscillators are individually tuned by each of the three DACs to test their tuning sensitivity.

Test 08. **Peak Detector and Switched High-Pass Filter 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.

Test 09. **Rear-Panel Tune Voltage Output Test.** The transfer function of ATTEN 1 is measured by a method similar to Test 02.

Test 10. **Front-Panel Tune Voltage Output Test.** The transfer function of ATTEN 3 is measured by a method similar to Test 02.

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. These tests will run without the presence of a printer in the System's Configuration Table. However, the test results in some instances will not remain on the display long enough to be observed; therefore, it is recommended that the tests be run with a printer.

PROCEDURE

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. Reinsert the line cord and switch LINE back to ON.
2. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
3. Press the [3048A Sys Chk] softkey.

NOTE

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

4. Press the [Dac Tests] softkey and follow the displayed instructions.

Comments

Printer On/Off. If a printer is on HP-IB and in the System's Configuration Table, the printout can be inhibited by pressing the [Printer Off] softkey. To re-enable the printer, press the [Printer On] softkey. This softkey function is not present at all times during the execution of the tests. It is recommended that tests be run with the printer, otherwise the test results in some instances will not remain on the display long enough to be observed.

If it is desired to have the Interface's serial number appear on the printout, the serial number must appear in the appropriate column of 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 positive (+) lead (the inner conductor) to A3 TP202. Connect the negative (–) lead (the outer conductor) to A3 TP207 (ground).

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

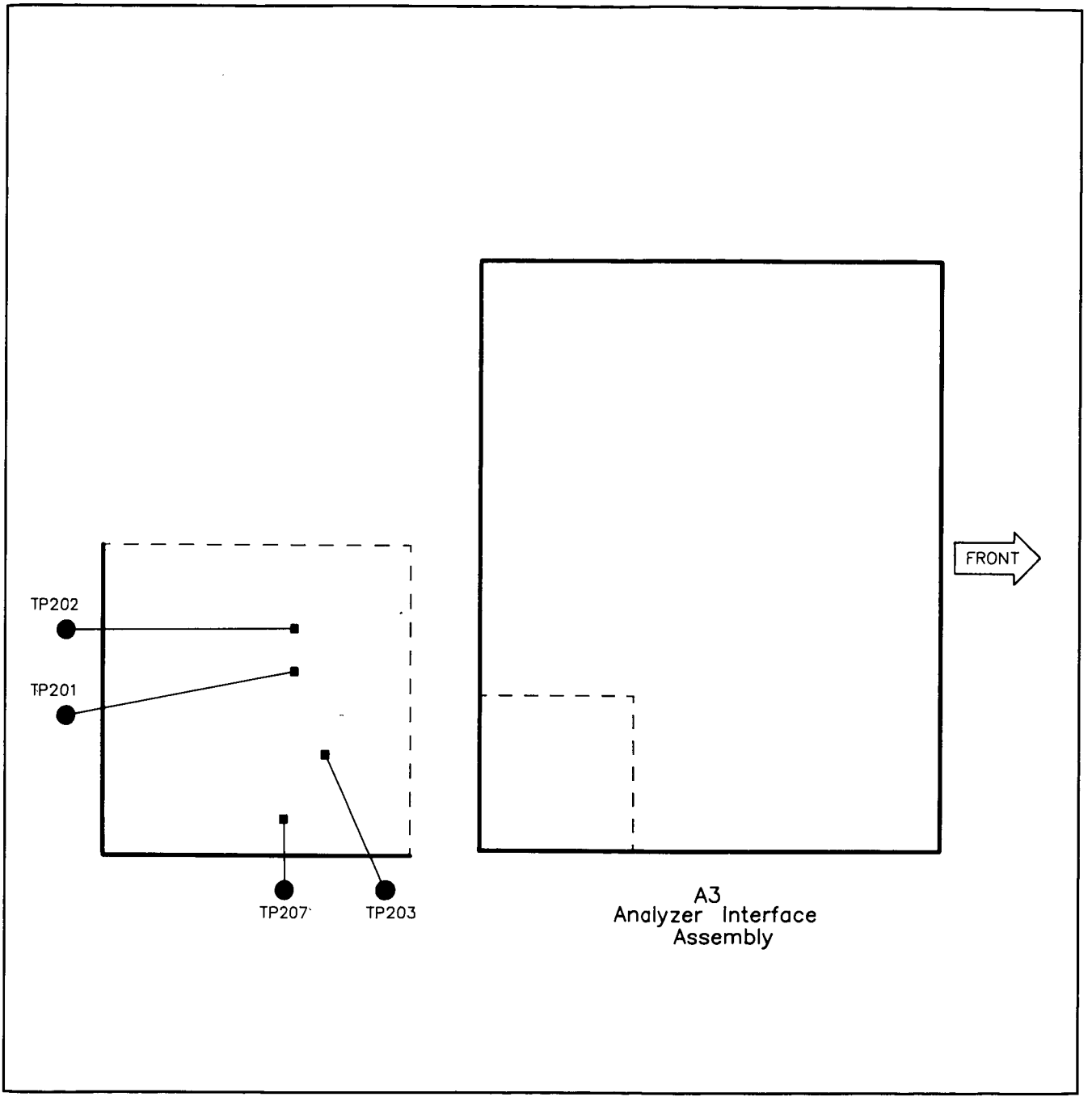


Figure 11. *A3 Testpoint Locations*

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

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. Reinsert the power cord and switch LINE back to ON.
2. Set the HP 3561A input switch to the FLOAT position.
3. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
4. Press the [3048A Sys Chk] softkey.
5. Press the [Int. Adj'mnt] softkey.
6. Press the [Adjust A3] softkey.

NOTE

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

DC Offset Adjustments

7. The prompt

```
CONNECT HP11848A
'PHASE DETECTOR OUTPUTS TO HP3561A INPUT'
TO
HP3561A INPUT
```

instructs you to connect the instruments as shown in Figure 12. After making the connections, press the Proceed softkey.

8. Make the adjustments for A3R68, A3R74, A3R80, A3R86, A3R92, and A3R98 as instructed.

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.

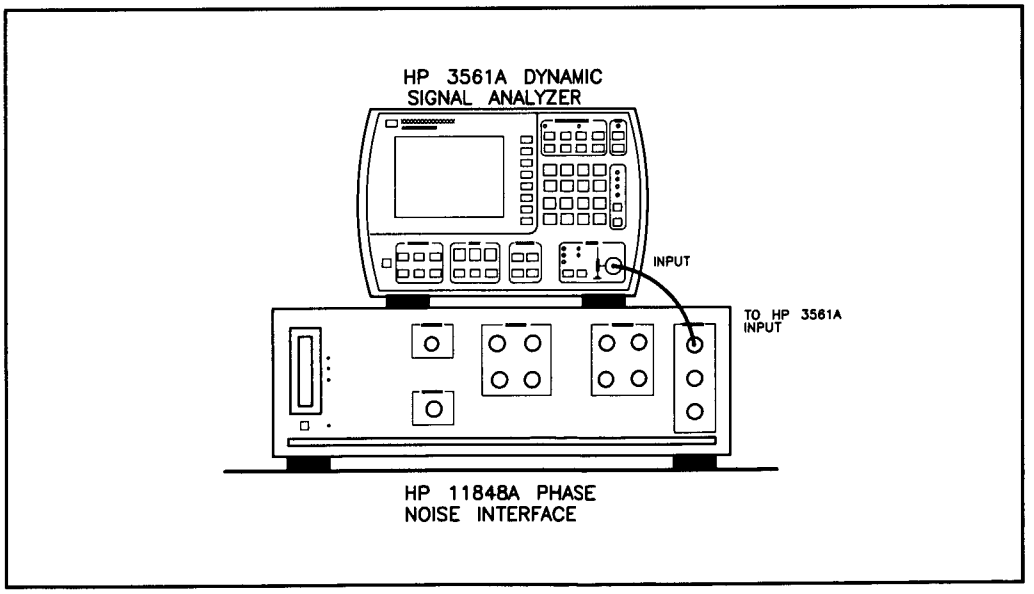


Figure 12. *First A3 Adjustment Setup*

Ground Isolation Adjustments

9. The prompt

```
CONNECT HP3561A NOISE SOURCE (REAR PANEL) TO
HP3561A INPUT.
```

instructs you to connect the HP 3561A as shown in Figure 13. This sets up a reference for the following measurements.

10. The prompt

```
CONNECT A BNC TEE TO THE HP11848A AT
'PHASE DETECTOR OUTPUT TO 3561A INPUT'
          AND
CONNECT CABLE FROM BNC TEE TO HP3561A INPUT
```

followed by

```
USING A BNC TO CLIP LEAD ADAPTER
CONNECT HP3561A NOISE SOURCE AS FOLLOWS:
GROUND LEAD TO HP11848A CHASSIS GROUND
SIGNAL LEAD TO BNC 'TEE' (ISOLATED GROUND)
```

instructs you to connect the instruments as shown in Figure 14.

NOTE

Connect the ground (outer conductor) lead of the cliplead 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 cliplead 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.

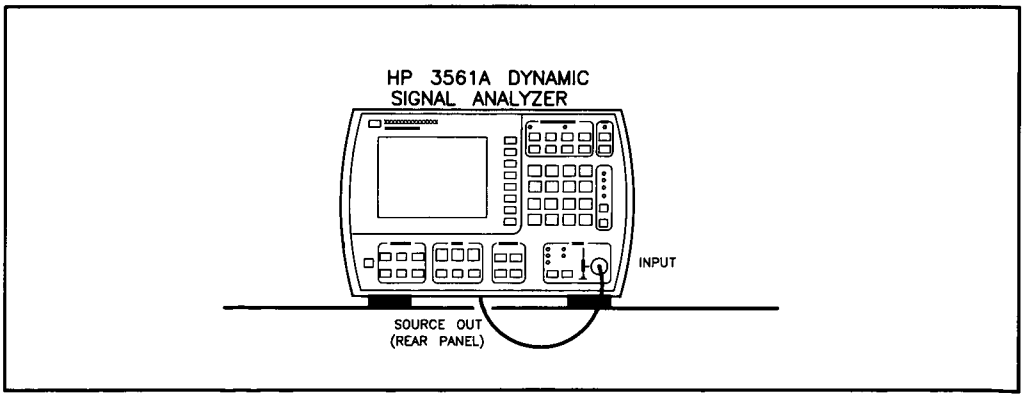


Figure 13. *Second A3 Adjustment Setup*

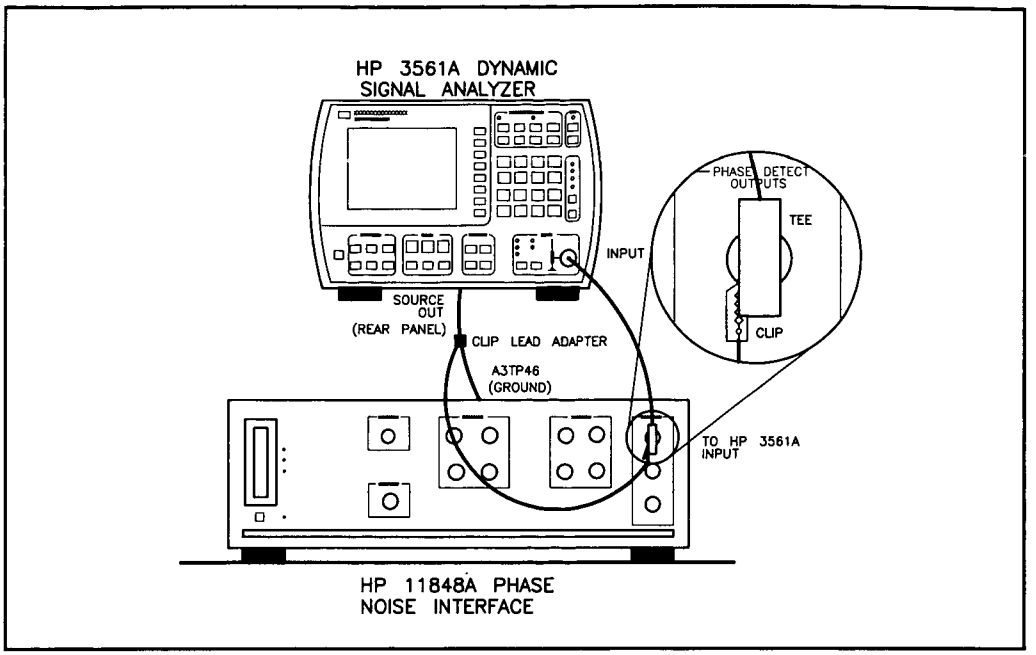


Figure 14. *Third A3 Adjustment Setup*

11. Adjust A3R132 as instructed. Refer to Figure 15 which shows a typical result after adjustment.
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.)

DAC Reference Adjustments

13. Make the connections, measurements, and adjustments of A3R210 and A3R206 as instructed.

NOTE

Note that "+" refers to the cliplead adapter's inner conductor and "–" the outer conductor.

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.*

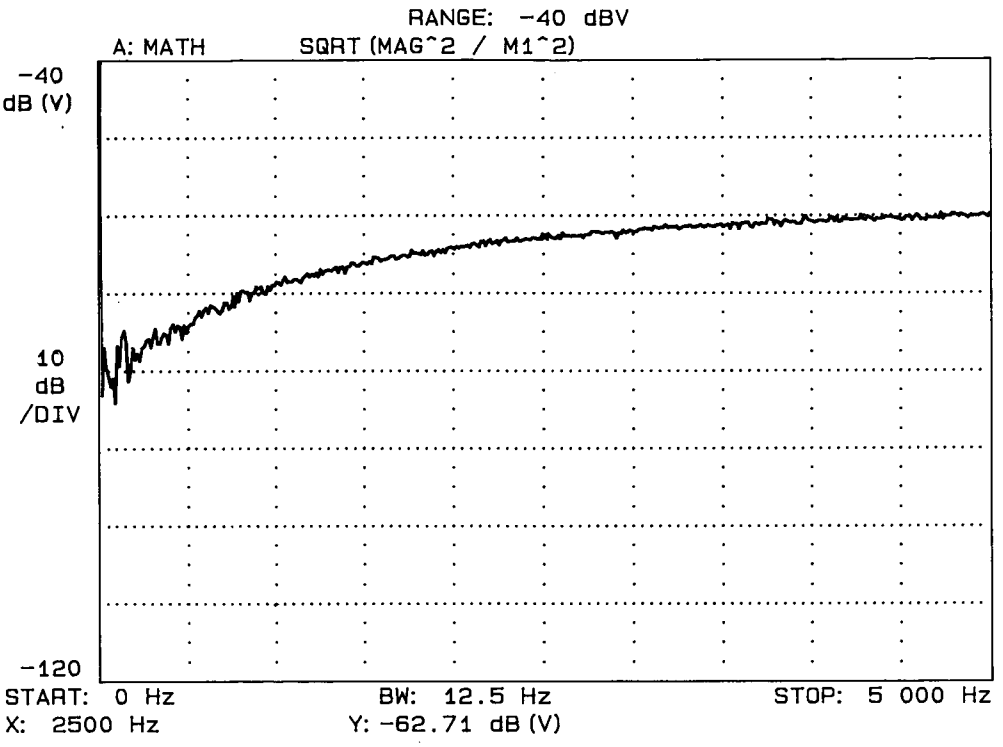


Figure 15. *Typical Ground Isolation Adjustment*

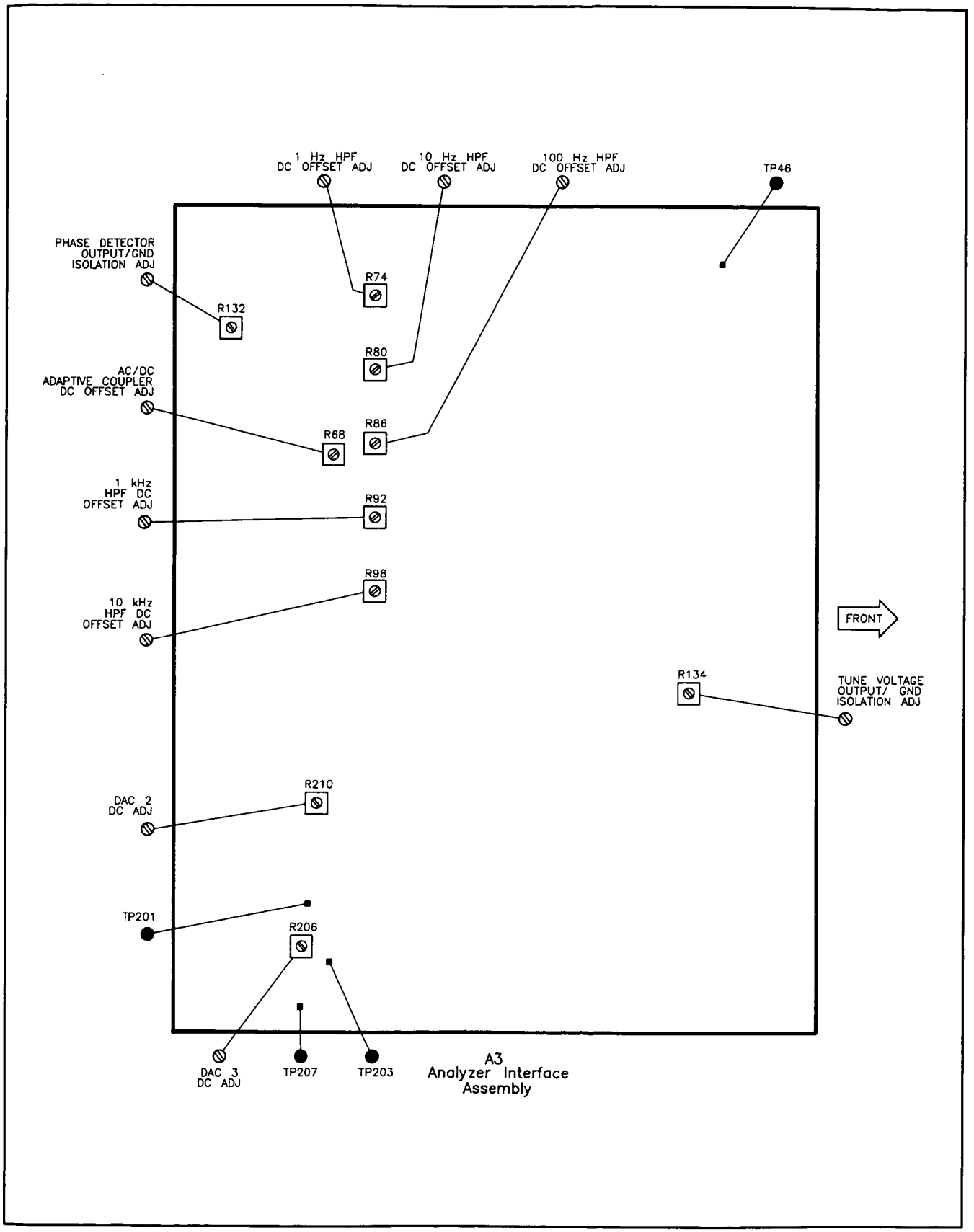


Figure 16. *A3 Testpoint and Adjustment Locations*

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 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 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, no substitution of equipment is possible. (The software will not run the A4C32 adjustment if an HP 3585A is not in the System's Configuration Table.)

PROCEDURE

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. Reinsert the line cord and switch LINE back to ON.

2. Set the HP 3561A input switch to the FLOAT position.

3. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.

4. Press the [3048A Sys Chk] softkey.

5. Press the [Int. Adj'mnt] softkey.

6. Press the [Adjust A4] softkey.

NOTE

If no RF spectrum analyzer is in the System's Configuration Table, you will be informed at this time. Press the [Proceed] *softkey to continue the A4 adjustments minus the A4C32 adjustment.*

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

Low-Noise Amplifier Adjustments

7. The prompt

```
CONNECT HP11848A
'PHASE DETECTOR OUTPUTS TO HP3561A INPUT'
TO
HP3561A INPUT
```

instructs you to connect the instruments as shown in Figure 17. After making the connections, press the [Proceed] softkey.

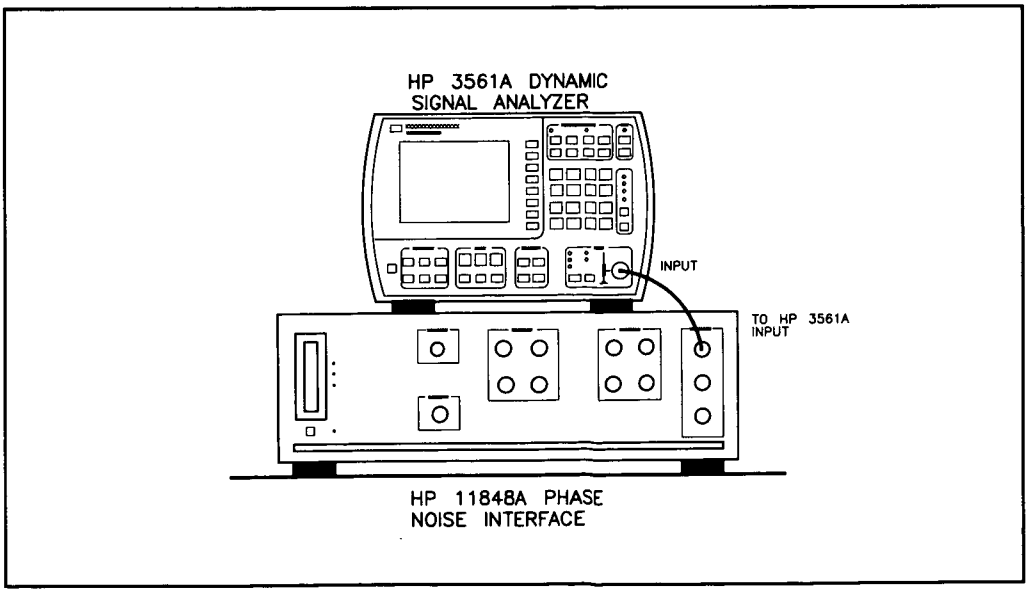


Figure 17. *First A4 Adjustment Setup*

8. 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.

On some A4 adjustments the Next adj. *softkey appears. This key permits you to skip the current adjustment and go on to the next one.*

9. The prompt

```
TERMINATE HP3561A INPUT IN 50 OHMS USING 'BNC TEE'
                    AND
CONNECT HP3561A NOISE SOURCE (REAR PANEL) TO
HP3561A INPUT AT 'BNC TEE'
```

instructs you to connect the instruments as shown in Figure 18. This sets up a 50Ω reference for the following measurements.

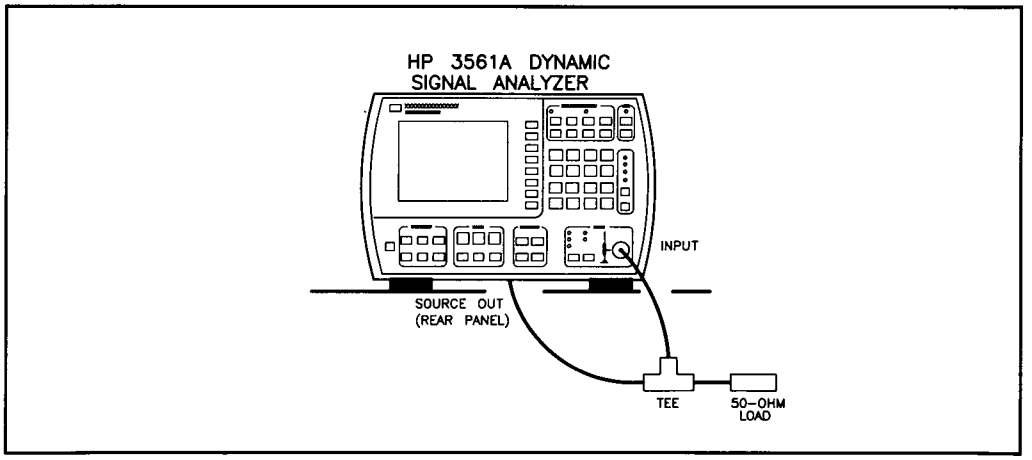


Figure 18. *Second A4 Adjustment Setup*

10. The prompt

```
REMOVE 50 OHM TERMINATION FROM BNC TEE
                    AND
CONNECT CABLE FROM BNC TEE TO HP11848A NOISE INPUT
```

instructs you to remove the 50Ω load from the BNC tee and to connect the instruments as shown in Figure 19. This allows the HP 3561A to compare the loading of the noise input port to the loading of a 50Ω termination.

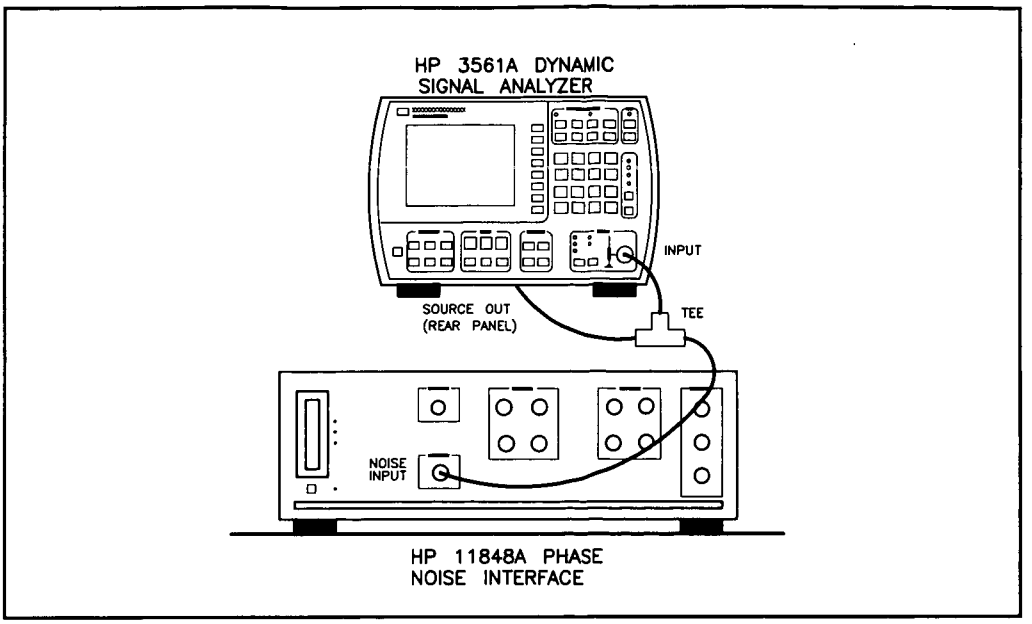


Figure 19. *Third A4 Adjustment Setup*

11. Adjust A4R51 as instructed. Refer to Figure 20 which shows a typical result after adjustment.

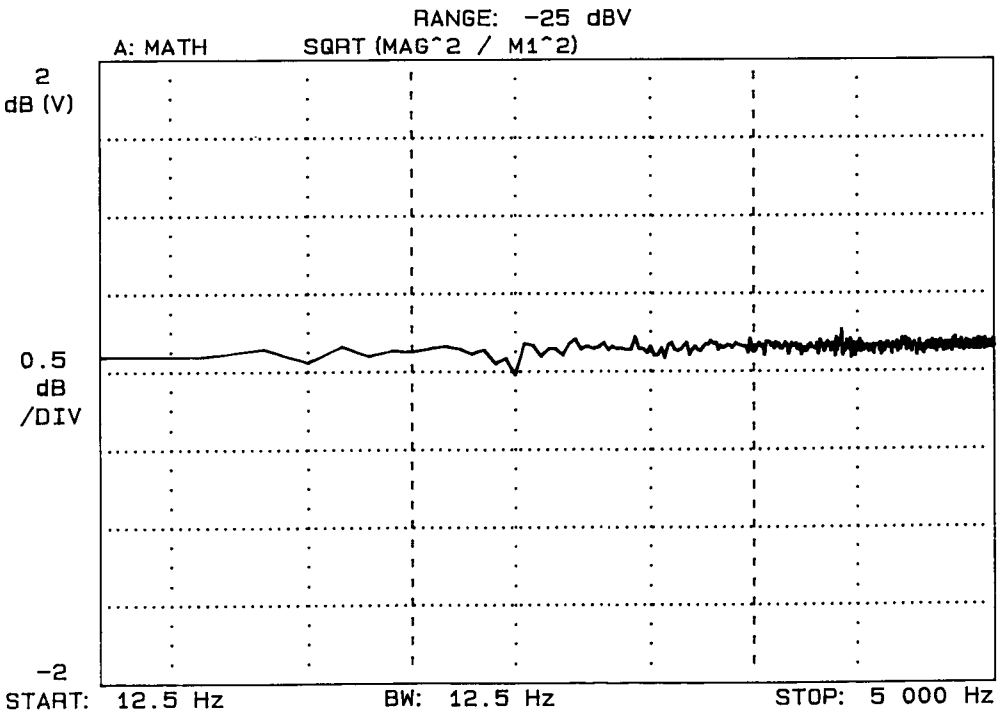


Figure 20. *Typical Low-Noise Amplifier Impedance Match Adjustment*

12. The prompt

```
CONNECT HP11848A
'PHASE DETECTOR OUTPUTS TO HP3561A INPUT'
TO
HP3561A INPUT
```

instructs you to connect the instruments as shown in Figure 17 (the same as in step 7).

13. The prompt

```
CONNECT HP3561A NOISE SOURCE TO HP11848A AT
'NOISE INPUT FROM HP3561A SOURCE OUTPUT'
(REAR PANEL)
```

instructs you to connect the instruments as shown in Figure 21.

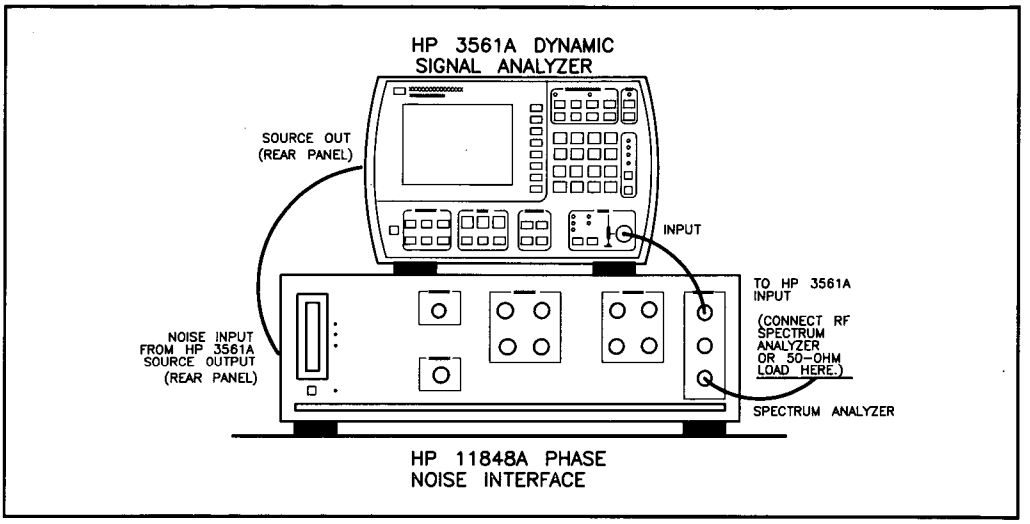


Figure 21. *Fourth A4 Adjustment Setup*

14. Adjust A4R70 as instructed. The result should be similar to the one in Figure 20.

Phase Lock Loop 12 dB Amplifier Adjustment

15. Adjust A4R38 to zero the panel meter as instructed.

DAC 1 Adjustment

16. Adjust A4R278 as instructed.

NOTE

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

If there is no HP 3585A Spectrum Analyzer on HP-IB, the adjustments will end after this adjustment.

Low-Noise Amplifier Peaking Adjustment

17. The prompt

```
CONNECT HP3585A TRACKING GENERATOR OUTPUT TO
HP11848A REAR PANEL AT:
'INPUT FROM HP3585A TRACKING GENERATOR'
```

followed by

```
CONNECT HP3585A 50 OHM INPUT TO HP11848A
PHASE DETECTOR OUTPUT AT 'SPECTRUM ANALYZER'
```

instructs you to connect the instruments as shown in Figure 22. Also, check that the tracking generator level is maximum.

18. 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.

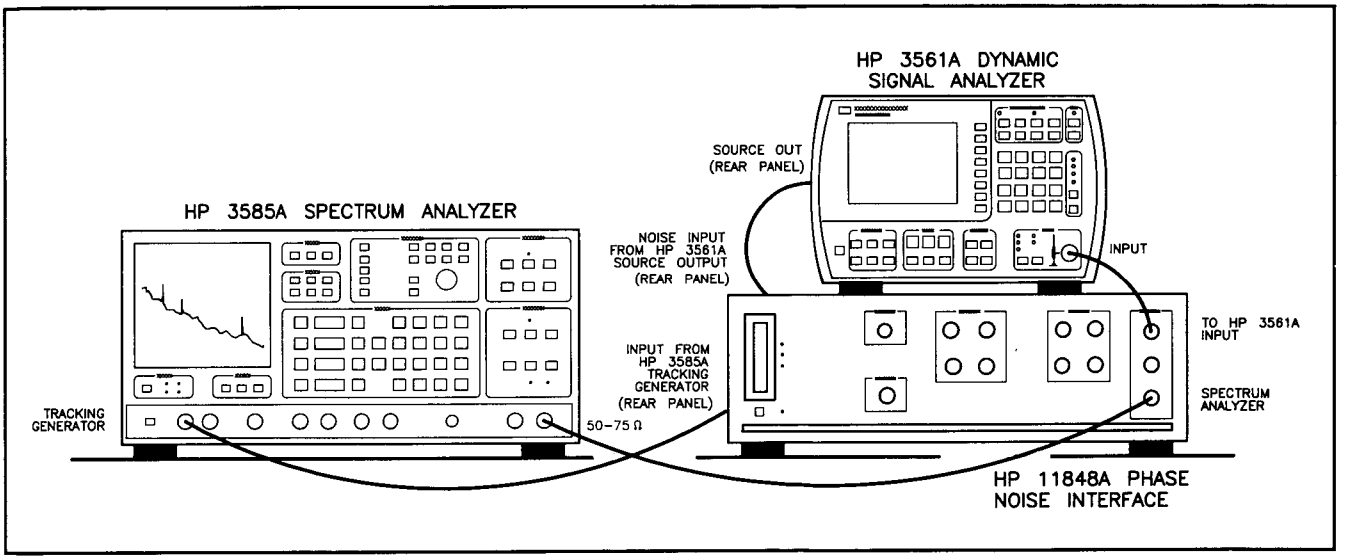


Figure 22. *Fifth A4 Adjustment Setup*

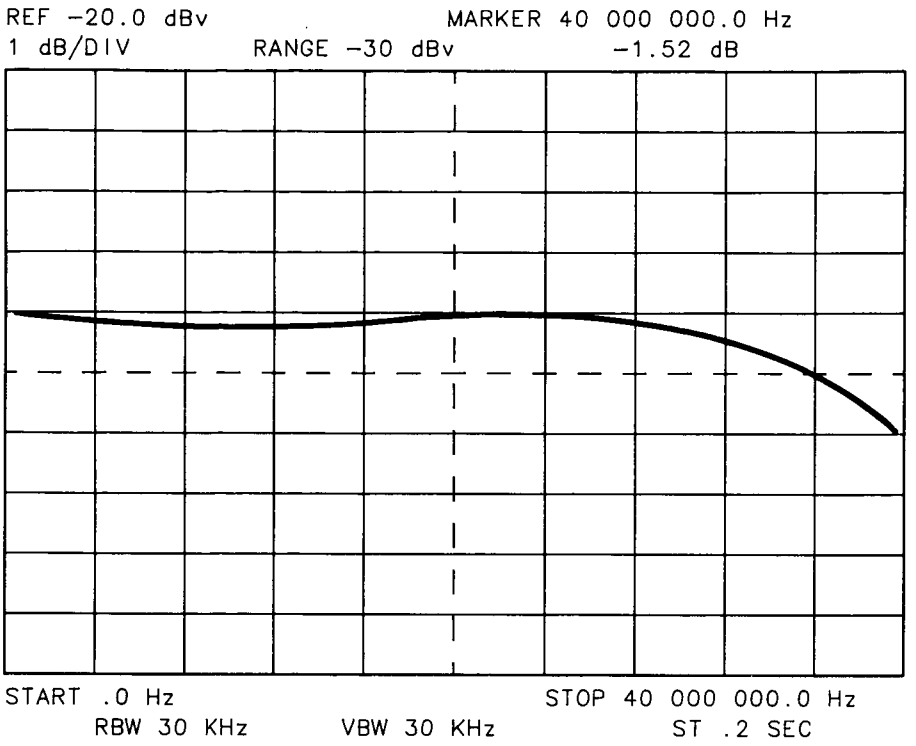


Figure 23. *Typical Low-Noise Amplifier Peaking Adjustment*

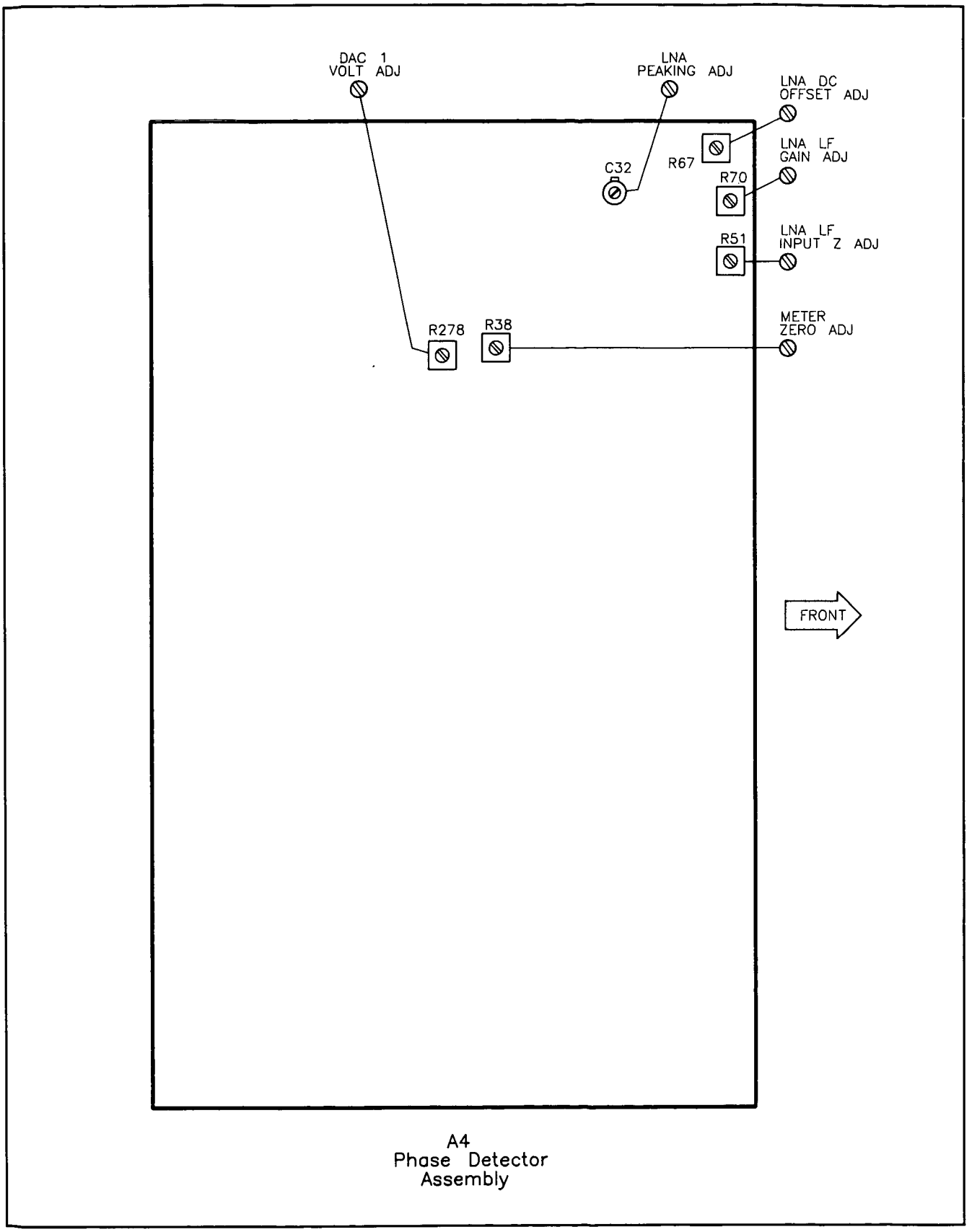


Figure 24. *A4 Testpoint and Adjustment Locations*

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 (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 "CALDATALO" and "CALDATAHI". 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) spectrum analyzer.

EQUIPMENT

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 Spectrum Analyzer. Since an RF spectrum analyzer with a tracking generator must be used and since the program software controls only the HP 3585A, no substitution of equipment is possible.

PROCEDURE

Initial Setup

1. Set the HP 3561A input switch to the FLOAT position.
2. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
3. Press the [3048A Sys Chk] softkey.

NOTE

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

4. Press the [Cal System] softkey.

Calibration to 100 kHz Offsets

5. Press the [Cal to100 kHz] softkey.
6. Press the [Option 1] softkey.
7. Connect the cables as prompted on the display and as shown in Figure 25.

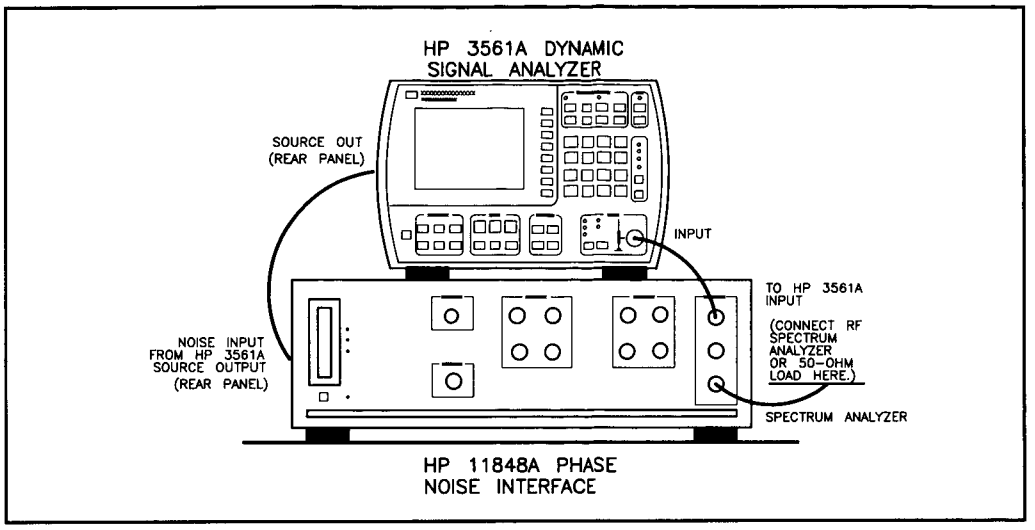


Figure 25. *First Option 1 Calibration Setup*

8. When the prompt appears asking if you want to store the data taken, you have the following choices.
   - If you do not want to store the data, press the [Abort] softkey. This will cause the old data from the mass storage media to be re-loaded in computer RAM (random access memory) and thus destroy the data just collected.
   - If you want simply to replace the old data with the new data on the current mass media storage device, press the [Store Caldata] softkey and overwrite the data in the file. (If you abort at this point, the new data still remains in computer RAM.)
   - If you want to store the new data on a new disc or mass media file location while keeping the old data, place a new disc in place of the old one then press the [Store Caldata] softkey. (If you abort at this point, the new data still remains in computer RAM.)

NOTE

Difficulties encountered in storing calibration data in mass storage generate prompts to assist in clearing the problem. A common example of a problem is a write-protected floppy disc.

This is the end of Option 1 Calibration if no HP 3585A Spectrum Analyzer is present.

Calibration 100 kHz through 40 MHz Offsets

9. Press the [Cal System] softkey.
10. Press the [Cal to 40 MHz] softkey.
11. Make the cable connections as prompted on the display and as shown in part in Figure 26.
12. Press the [Option 1] softkey and continue with the cable connections as show in Figure 26.
13. Store the data as outlined in step 8 above.

Comments

Printer On/Off. If a printer is in the System's Configuration Table, the feature which permits printing of measurement results can be enabled or disabled. When the [Printer On] or [Printer Off] softkey appears, pressing the key will toggle the printout feature. It is recommended that the tests be run with the printer.

Plot On/Off. A feature which permits plotting of the measured transfer functions can be enabled or disabled. When the [Plot On] or [Plot Off] softkey appears, pressing the key will toggle the plot feature.

When plotting is enabled, as measurement of a path is completed, a plot of the transfer function is displayed and the program pauses to permit examination of the plot. The display also shows the insertion loss and frequency of one of two markers. The position of the markers can be moved by the cursor control keys (or knob). If the [Marker 1] softkey is displayed, the marker and displayed values are for unsmoothed ("raw") transfer function data. If the [Marker 2] softkey is displayed (by toggling the marker softkey), the marker and displayed values are for smoothed data (which is actually the data used by the System in making phase-noise measurements).

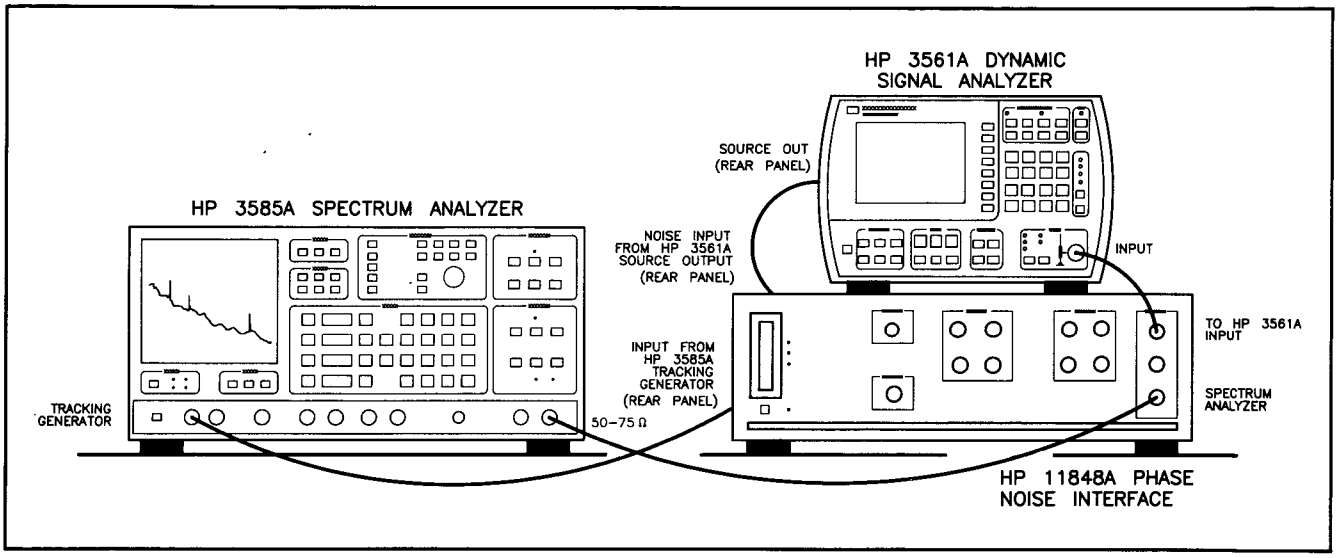


Figure 26. *Second Option 1 Calibration Setup*

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.

NOTE

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 (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 "CALDATALO" and "CALDATAHI". 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) spectrum analyzer.

EQUIPMENT

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 Spectrum Analyzer. Since an RF spectrum analyzer with a tracking generator must be used and since the program software controls only the HP 3585A, no substitution of equipment is possible.

PROCEDURE

Initial Setup

1. Set the HP 3561A input switch to the FLOAT position.
2. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
3. Press the [3048A Sys Chk] softkey.

NOTE

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

4. Press the [Cal System] softkey.

Calibration to 100 kHz Offsets

5. Press the Cal to100 kHz softkey.

6. Press the Option 2 softkey.

7. Connect the cables as prompted on the display and as shown in Figure 27.

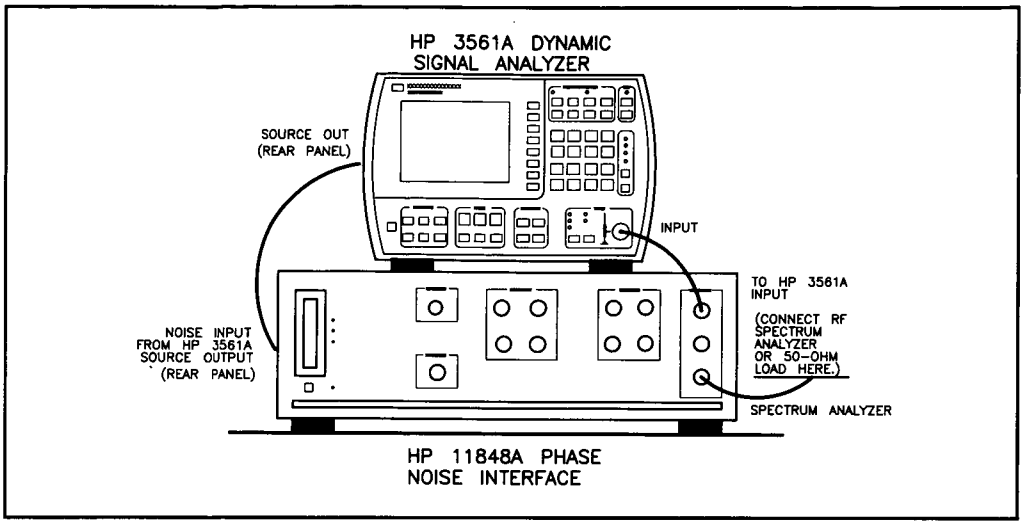


Figure 27. *First Option 2 Calibration Setup*

8. The prompt

```
TERMINATE HP3561A INPUT IN 50 OHMS USING 'BNC TEE'
```

followed by

```
CONNECT HP3561A NOISE SOURCE (REAR PANEL) TO
HP3561A INPUT AT 'BNC TEE'
```

instructs you to connect the instruments as shown in Figure 28. This sets up a 50Ω reference for the following measurements.

9. The prompt

```
CONNECT HP3561A NOISE SOURCE (REAR PANEL) TO
HP11848A NOISE INPUT (FRONT PANEL)
```

followed by

```
REMOVE 50 OHM TERMINATION AND 'BNC TEE' FROM
HP3561A INPUT.
```

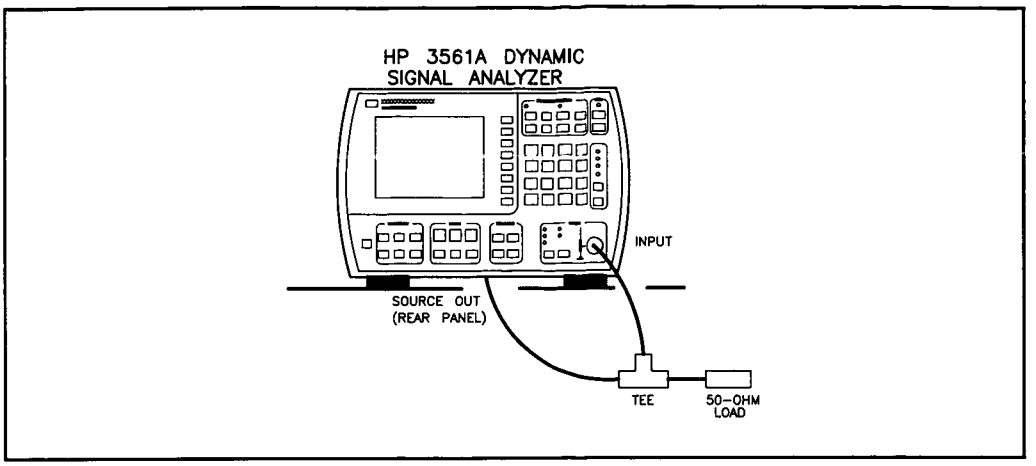


Figure 28. *Second Option 2 Calibration Setup*

followed by

```
CONNECT HP11848A PHASE DETECTOR OUTPUT
LABELED 'TO HP3561A INPUT'   TO
HP3561A INPUT
```

followed by

```
BE SURE THAT HP11848A PHASE DETECTOR OUTPUT
LABELED 'SPECTRUM ANALYZER' IS TERMINATED
IN 50 OHMS.
```

instructs you to connect the instruments as shown in Figure 29.

10. The prompt

```
RE-CONNECT HP3561A NOISE SOURCE (REAR PANEL) TO
HP11848A REAR PANEL AT '3561A NOISE'
```

instructs you to connect the instruments as shown in Figure 27 (the same as in step 7).

11. When the prompt appears asking if you want to store the data taken, you have the following choices.
    - If you do not want to store the data, press the [Abort] softkey. This will cause the old data from the mass storage media to be re-loaded in computer RAM (random access memory) and thus destroy the data just collected.
    - If you want simply to replace the old data with the new data on the current mass media storage device, press the [Store Caldata] softkey and overwrite the data in the file. (If you abort at this point, the new data still remains in computer RAM.)
    - If you want to store the new data on a new disc or mass media file location while keeping the old data, place a new disc in place of the old one then press the [Store Caldata] softkey. (If you abort at this point, the new data still remains in computer RAM.)

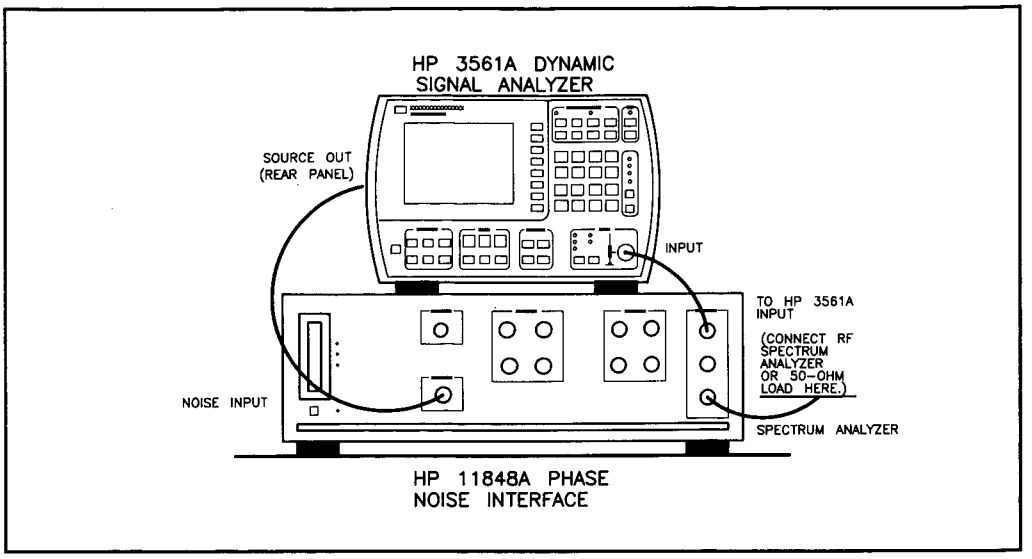


Figure 29. *Third Option 2 Calibration Setup*

NOTE

Difficulties encountered in storing calibration data in mass storage generate prompts to assist in clearing the problem. A common example of a problem is a write-protected floppy disc.

This is the end of Option 2 Calibration if no HP 3585A Spectrum Analyzer is present.

Calibration 100 kHz through 40 MHz Offsets

12. Press the [Cal System] softkey.
13. Press the [Cal to 40 MHz] softkey.
14. Make the cable connections as prompted on the display and as shown in part in Figure 30.
15. Press the [Option 2] softkey and continue with the cable connections as show in Figure 30. Also, check that the tracking generator level is maximum.
16. The prompt

```
CONNECT HP3585A TRACKING GENERATOR TO
HP3585A 50 OHM INPUT
```

instructs you to connect the HP 3585A as shown in Figure 31.

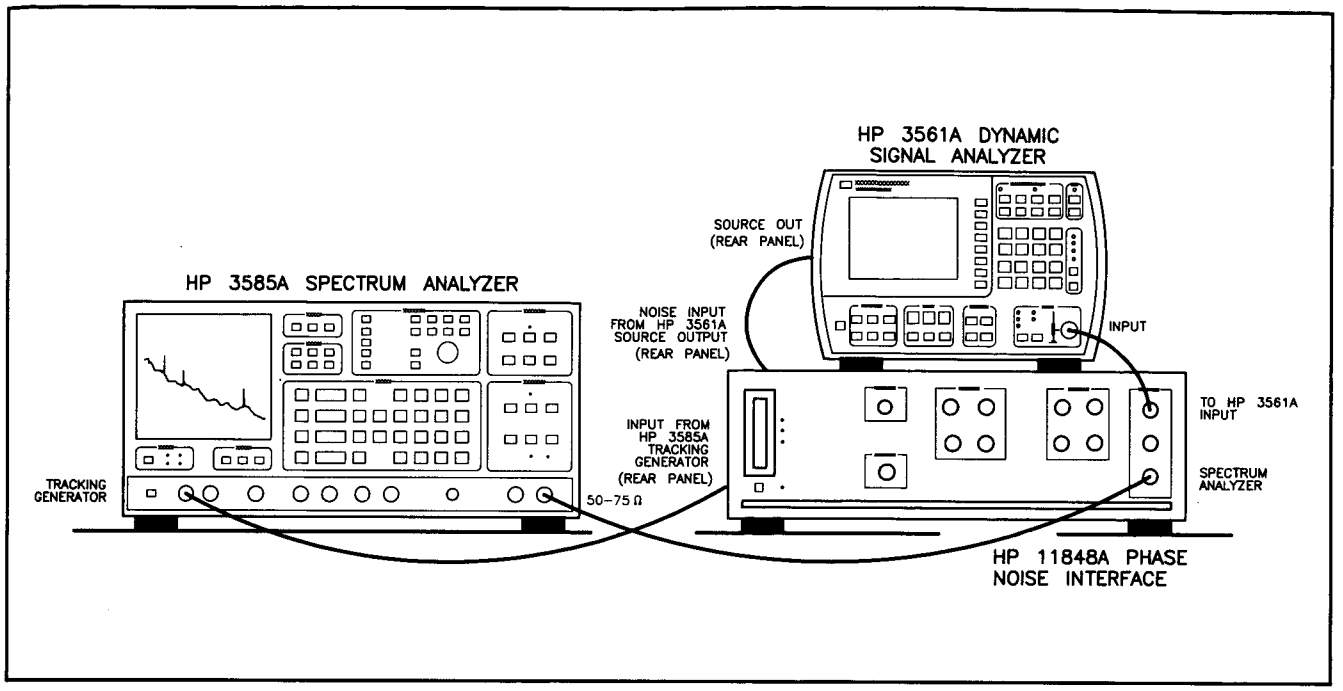


Figure 30. *Fourth Option 2 Calibration Setup*

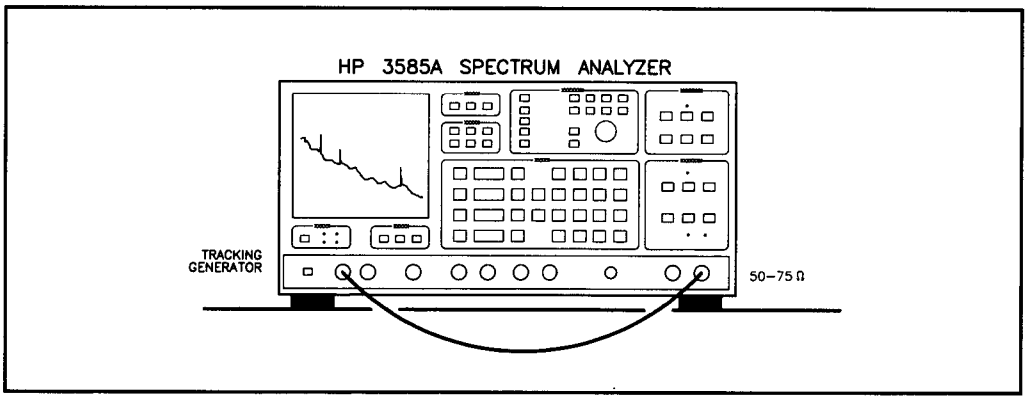


Figure 31. *Fifth Option 2 Calibration Setup*

17. The prompt

```
CONNECT HP3585A TRACKING GENERATOR TO
HP11848A 'NOISE INPUT' (FRONT PANEL)
```

followed by

```
CONNECT HP11848A PHASE DETECTOR OUTPUT LABELLED
'SPECTRUM ANALYZER' TO HP3585A 50 OHM INPUT
```

instructs you to connect the instruments as shown in Figure 32.

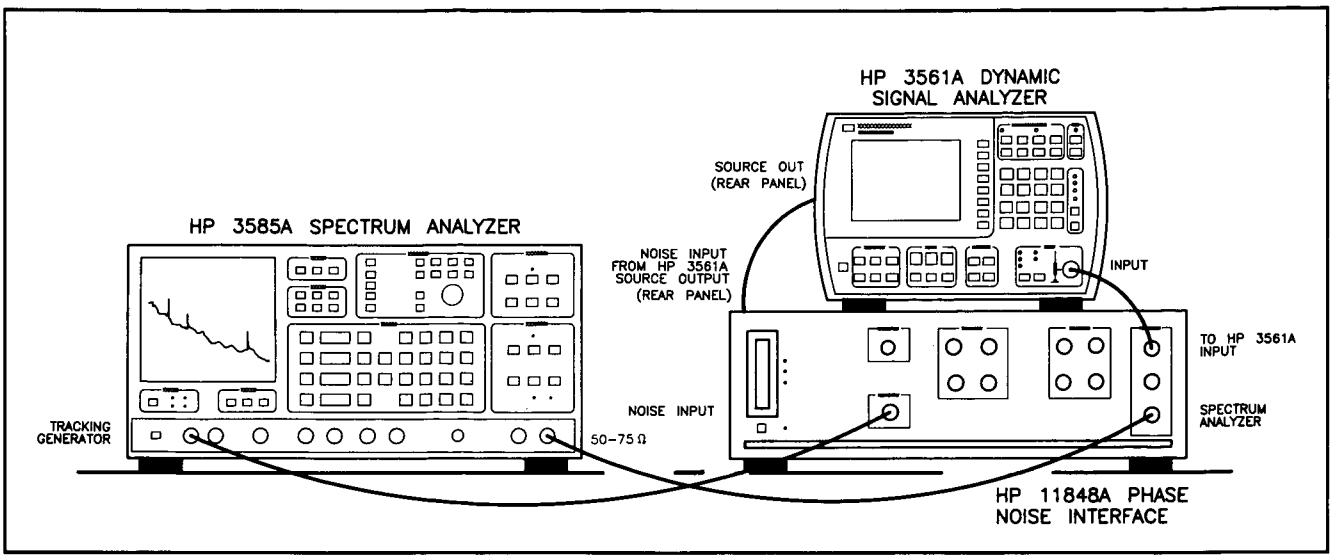


Figure 32. *Sixth Option 2 Calibration Setup*

18. The prompt

```
RE-CONNECT HP3585A TRACKING GENERATOR OUTPUT TO
HP11848A REAR PANEL AT:
'INPUT FROM HP3585A TRACKING GENERATOR
```

instructs you to connect the instruments as shown in Figure 30 (the same as in step 15).

19. Store the data as outlined in step 11 above.

Comments

Printer On/Off. If a printer is in the System's Configuration Table, the feature which permits printing of measurement results can be enabled or disabled. When the [Printer On] or [Printer Off] softkey appears, pressing the key will toggle the printout feature. It is recommended that the tests be run with a printer.

Plot On/Off. A feature which permits plotting of the measured transfer functions can be enabled or disabled. When the [Plot On] or [Plot Off] softkey appears, pressing the key will toggle the plot feature.

When plotting is enabled, as measurement of a path is completed, a plot of the transfer function is displayed and the program pauses to permit examination of the plot. The display also shows the insertion loss and frequency of one of two markers. The position of the markers can be moved by the cursor control keys (or knob). If the [Marker 1] softkey is displayed, the marker and displayed values are for unsmoothed ("raw") transfer function data. If the [Marker 2] softkey is displayed (by toggling the marker softkey), the marker and displayed values are for smoothed data (which is actually the data used by the System in making phase-noise measurements).

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 as VNOMs in the CALDATAHI 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

Initial Setup

1. Press the [Spcl. Funct'n] softkey available at the Main Software Level menu.
2. Press the [3048A Sys Chk] softkey.
3. Press the [Cal System] softkey.
4. Press the [Cal Int Srcs] softkey.
5. Press the [Cal All Srcs] softkey.

NOTE

Step 5 sets up the tests for all three oscillators. The other softkeys allow selection of the individual tests.

Calibration of the 10 MHz A Oscillator

6. Connect the cable from the HP 11848A front-panel 10 MHz A source output to the counter's input as prompted.
8. The prompt

```
Press 'Proceed' TO ACCESS HP11848A FRONT PANEL
Then adjust DAC2 and DAC3 for a frequency reading of
10 MHz +/- 10  Hz.
You may return from 'Front Panel' by pressing 'DONE'
```

readies you for the HP 11848A CONTROL display.

9. To adjust the DACs:
   a. Use the vertical cursor control keys or knob to move the cursor field (" > <") to DAC2.
   b. Note the frequency on the counter. If it is within ±10 Hz of 10 MHz, press the DONE softkey and continue on to step 10.
   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 the [Send Command] softkey. If the voltage does not bring the frequency within limits, key in another voltage. If the voltage settings are too coarse to reach the frequency limits, cursor down to DAC3 and set it in a similar manner.

NOTE

For all oscillators increasing the voltage decreases the frequency.

The 10 MHz A Oscillator has a tuning sensitivity of approximately 20 Hz/V.

DAC2 can be set only in 50 mV increments; DAC3 in 1 mV increments. The acceptable range of voltages are listed below the last entry of the display.

If an unacceptable value is entered, the DAC voltage, after giving the send command, will either be unchanged, rounded off, or a prompt will indicate that the entry needs modification.

Calibration of the 10 MHz B Oscillator

10. Connect the cable from the HP 11848A front-panel **10 MHz B** source output to the counter's input as prompted.

11. The prompt

```
Press 'Proceed' TO ACCESS HP11848A FRONT PANEL
Then adjust DAC2 and DAC3 for a frequency reading of
10 MHz +/- 50  Hz.
You may return from 'Front Panel' by pressing 'DONE'
```

readies you for the HP 11848A CONTROL display.

12. To adjust the DACs, proceed as in step 9 to bring the frequency within ±50 Hz of 10 MHz, then press the [DONE] softkey and continue on to step 13. (The tuning sensitivity is about 200 Hz/V.)

Calibration of the 350–500 MHz Oscillator

13. Connect the cable from the HP 11848A front-panel **350–500 MHz** source output to the counter's input as prompted.

14. The prompt

```
Press 'Proceed' TO ACCESS HP11848A FRONT PANEL
Then adjust DAC2 and DAC3 for a frequency reading of
400 MHz +/- 1 MHz.
You may return from 'Front Panel' by pressing 'DONE'
```

readies you for the HP 11848A CONTROL display.

15. To adjust the DACs, proceed as in step 9 to bring the frequency between 399 and 401 MHz, then press the [DONE] softkey. (The tuning sensitivity is about 20 MHz/V.)

Storing the Data

16. As you are prompted for the 10 MHz A oscillator, press either the [Proceed] softkey to indicate that you want to store the new VNOM in mass storage or the [Abort] softkey to indicate you want to retain the old VNOM. Actual storing of data is in step 19.

17. As you are prompted for the 10 MHz B oscillator, press either the [Proceed] softkey to indicate that you want to store the new VNOM in mass storage or the [Abort] softkey to indicate you want to retain the old VNOM. Actual storing of data is in step 19.

18. As you are prompted for the 350–500 MHz oscillator, press either the [Proceed] softkey to indicate that you want to store the new VNOM in mass storage or the [Abort] softkey to indicate you want to retain the old VNOM. Actual storing of data is in step 19.

19. As you are prompted, press either the [Store Caldata] softkey to permanently store the specified new VNOMs in mass storage or the [Abort] softkey to leave the current VNOMs unchanged. Stored new VNOMs will overwrite the old VNOMs.

20. If you have requested permanent storage of the new VNOMs, the display will prompt you for confirmation of this decision. Press the [Yes, Proceed] softkey to store the new VNOMs.

NOTE

Difficulties encountered in storing the VNOMs in mass storage generate prompts to assist in clearing the problem. A common example of a problem is a write-protected floppy disc.

Press the [View Vnoms] *softkey to confirm the values of the stored VNOMs.*

Spectral Purity Tests 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. These tests will run without the presence of a printer in the System's Configuration Table. It is recommended that the test be run with a printer.

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 effects are covered with the HP 3561A. An RF analyzer is needed only if informational data beyond 100 kHz is desired.

PROCEDURE

1. Press the [Define Msrmnt] softkey. This softkey appears at the Main Software Level Menu.
2. Press the [Test Files] softkey.
3. Press the [Next Page] softkey until the file name "HP TEST HP 8662/63 vs HP 8662/63 ABS @ 1270MHz" appears in the table of file names. Move the cursor until it encompasses the file name and press the [Load File] softkey.
4. When the file has been loaded, press the [DONE] softkey.

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.

5. Press the [DONE] softkey to select the Main Software Level Menu.
6. Press the [New Msrmnt] softkey.
7. Connect the instruments as shown on the on-screen connection diagram and in Figure 33.

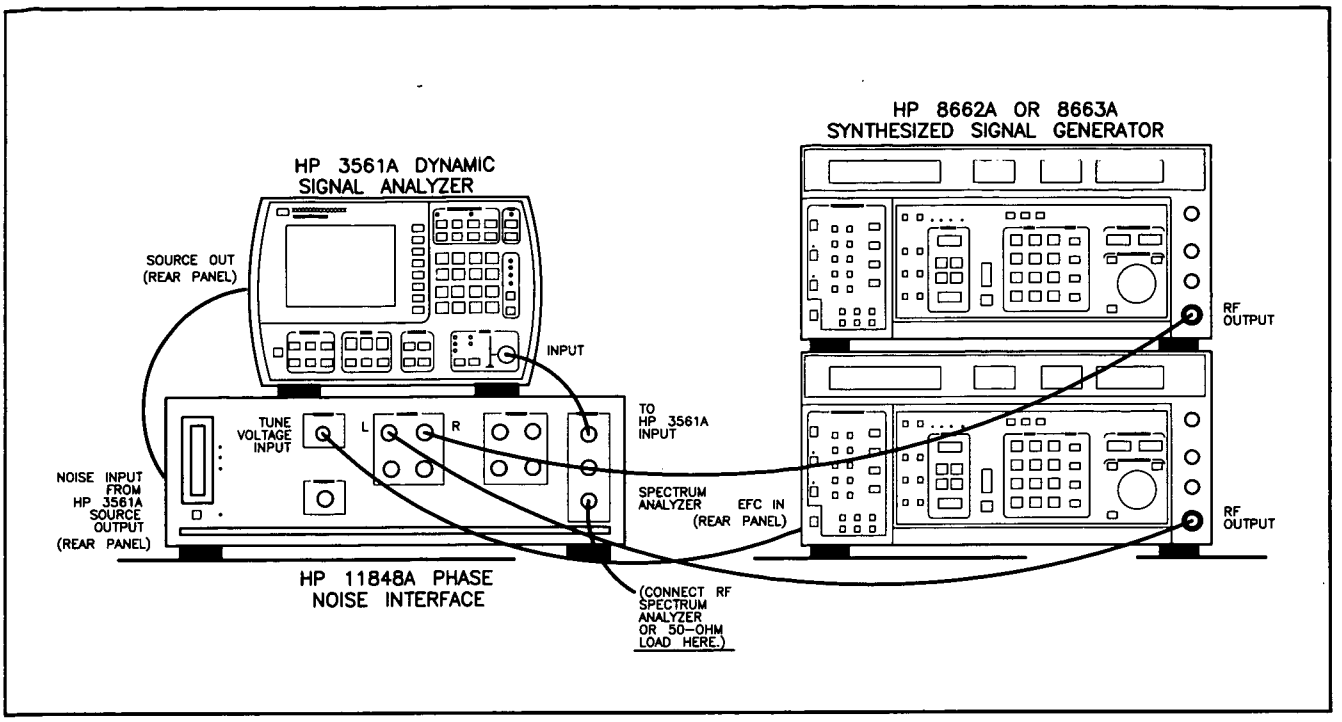


Figure 33. *Spectral Purity Tests for Options 001 and 002 Setup*

8. Press the Proceed softkey. 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
10 000	_____	−124
100 000	_____	−126

Spectral Purity Tests 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 via 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 result includes the combined noise of both down-converters 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 procedure to do this is found in Appendix B.

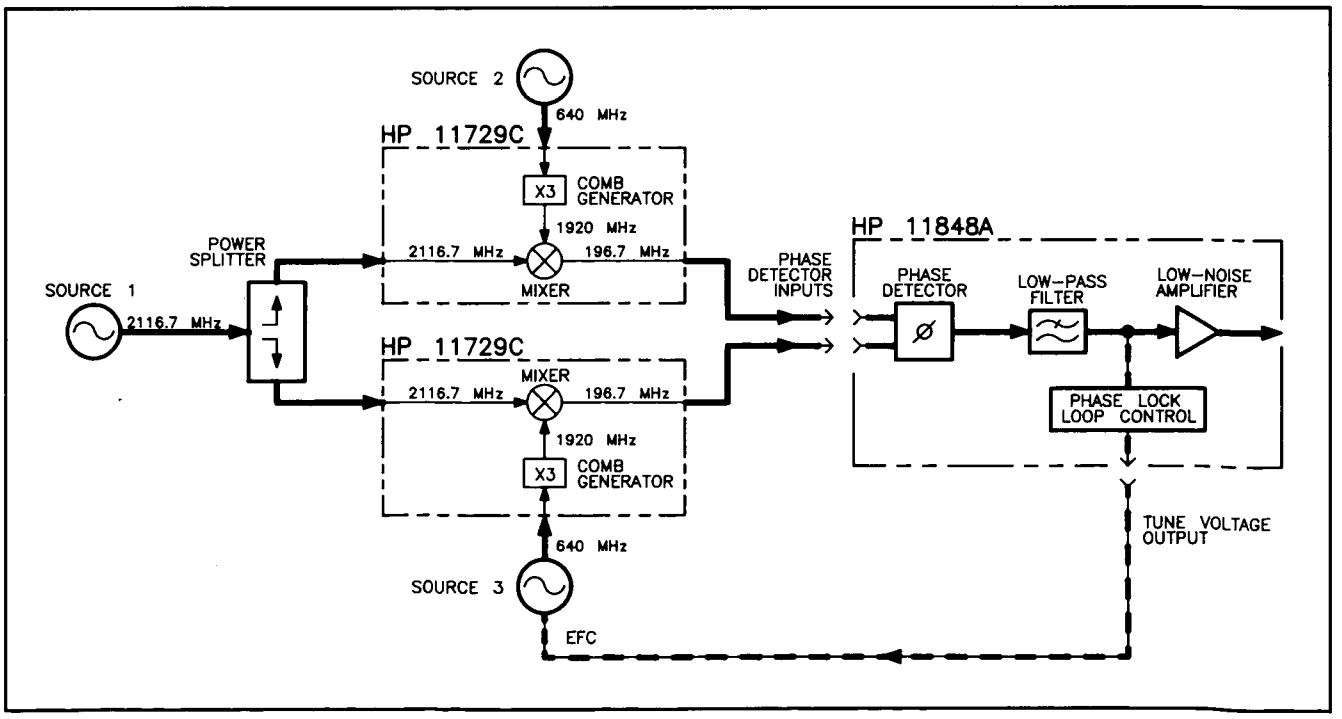


Figure 34. *Functional Diagram of the Spectral Purity Tests*

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 Minicircuits ZAPD-4 have typically 3 dB loss but the frequency range is restricted.

Printer. These tests will run without the presence of a printer in the System's Configuration Table. However, it is recommended that the test be run with a printer.

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

1. The HP 3048A *Noise Floor Test* should be run before running this test.
2. Press the [Define Msrmnt] softkey. This softkey appears at the Main Software Level menu.
3. Press the [Test Files] softkey.
4. Press the [Next Page] softkey until the file name "HP TEST HP 11729C/8662/63 vs HP 11729C/8662/63" appears in the table of file names. Move the cursor until it encompasses the file name and press the [Load File] softkey.

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).

5. When the file has been loaded, press the [DONE] softkey.
6. Press the [DONE] softkey again to select the Main Software Level menu.
7. Press the [New Msrmnt] softkey.
8. 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.)

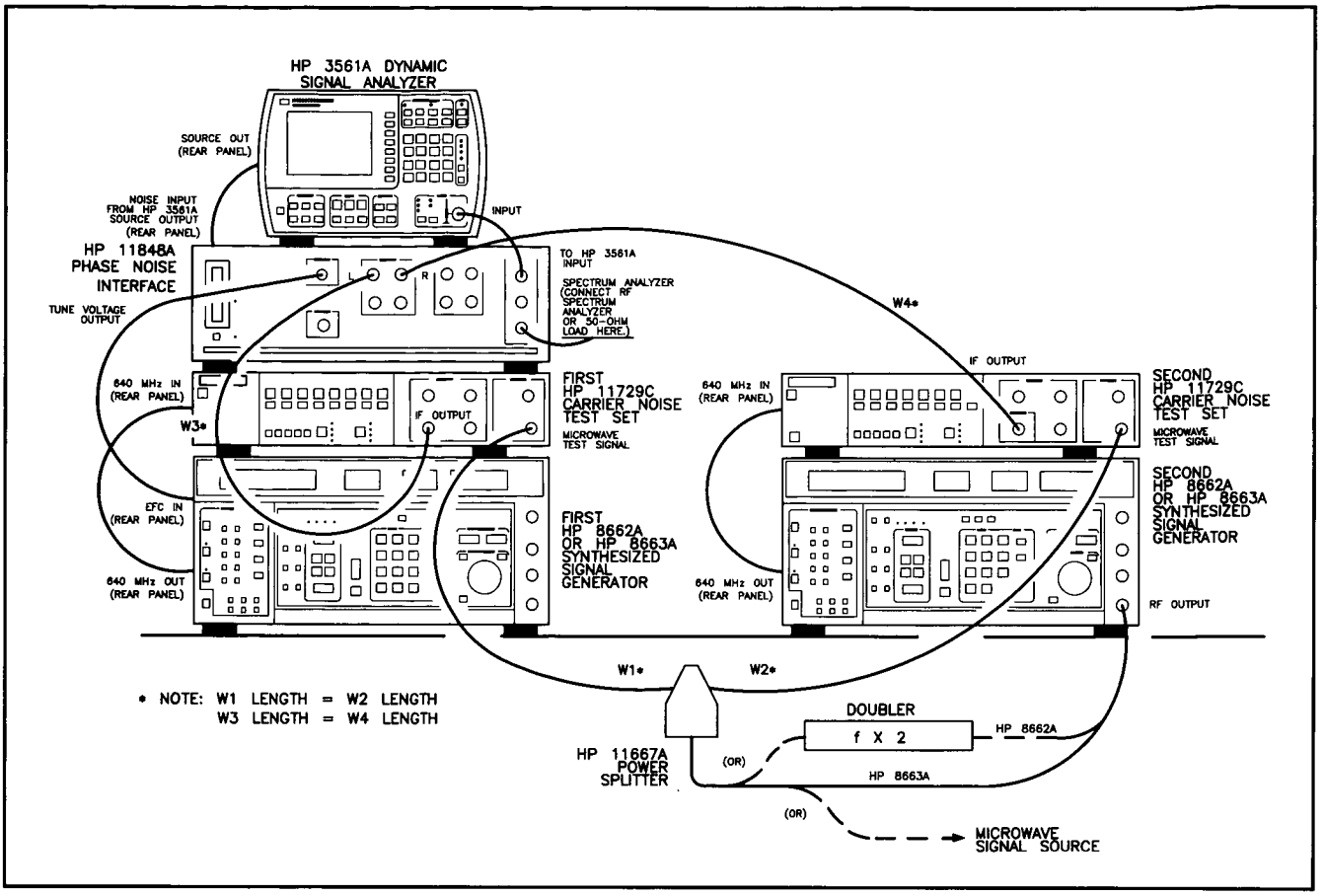


Figure 35. *Spectral Purity Tests for Options 003 and 004 Setup*

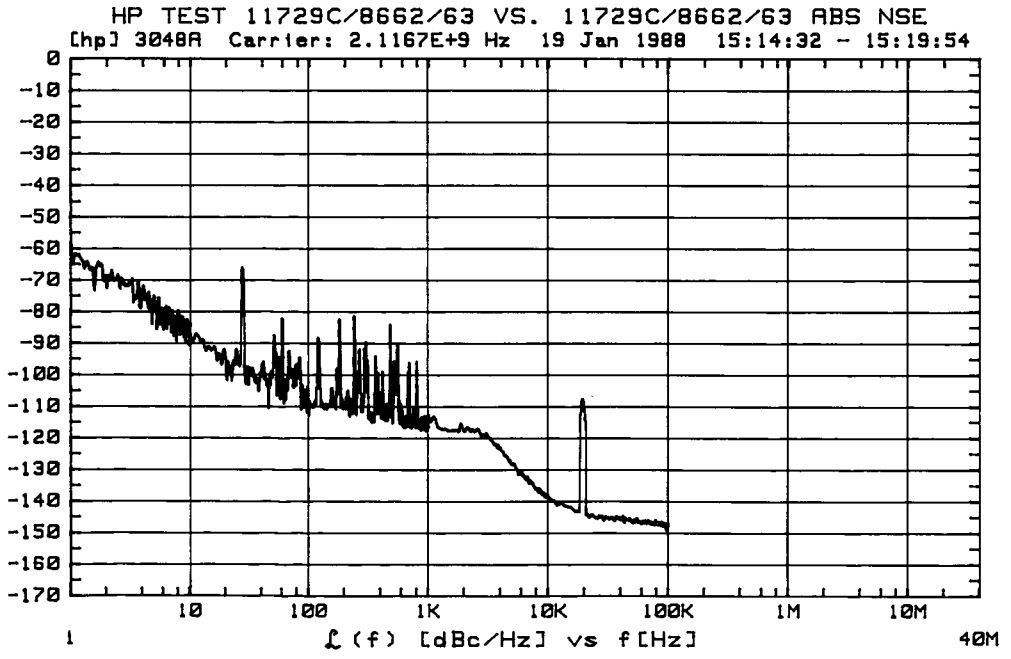


Figure 36. *Typical Spectral Purity Tests Results*

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.

9. Press the Proceed softkey. 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 either 640 MHz source (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
10 000	_____	−130
100 000	_____	−140

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. These tests will run without the presence of a printer in the System's Configuration Table. It is recommended that the test be run with a printer.

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 Spectrum Analyzer, can be used in this test. With an RF spectrum analyzer connected, data to 40 MHz offsets will be displayed.

PROCEDURE

1. Press the [Define Msrmnt] softkey. This softkey appears at the Main Software Level menu.
2. Press the [Test Files] softkey.
3. Press the [Next Page] softkey until the file name "`HP TEST HP 8642A/B vs HP 8662/63 640 MHZ REF`" appears in the table of file names. Move the cursor until it encompasses the file name and press the [Load File] softkey. (This test file allows a reference HP 8642A or HP 8642B even though "HP 8662/63" is in the title.)
4. When the file has been loaded, press the [DONE] softkey.

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.

5. Press the DONE softkey to select the Main Software Level menu.
6. Press the New Msrmnt softkey.
7. Connect the instruments as shown on the on-screen connection diagram 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.

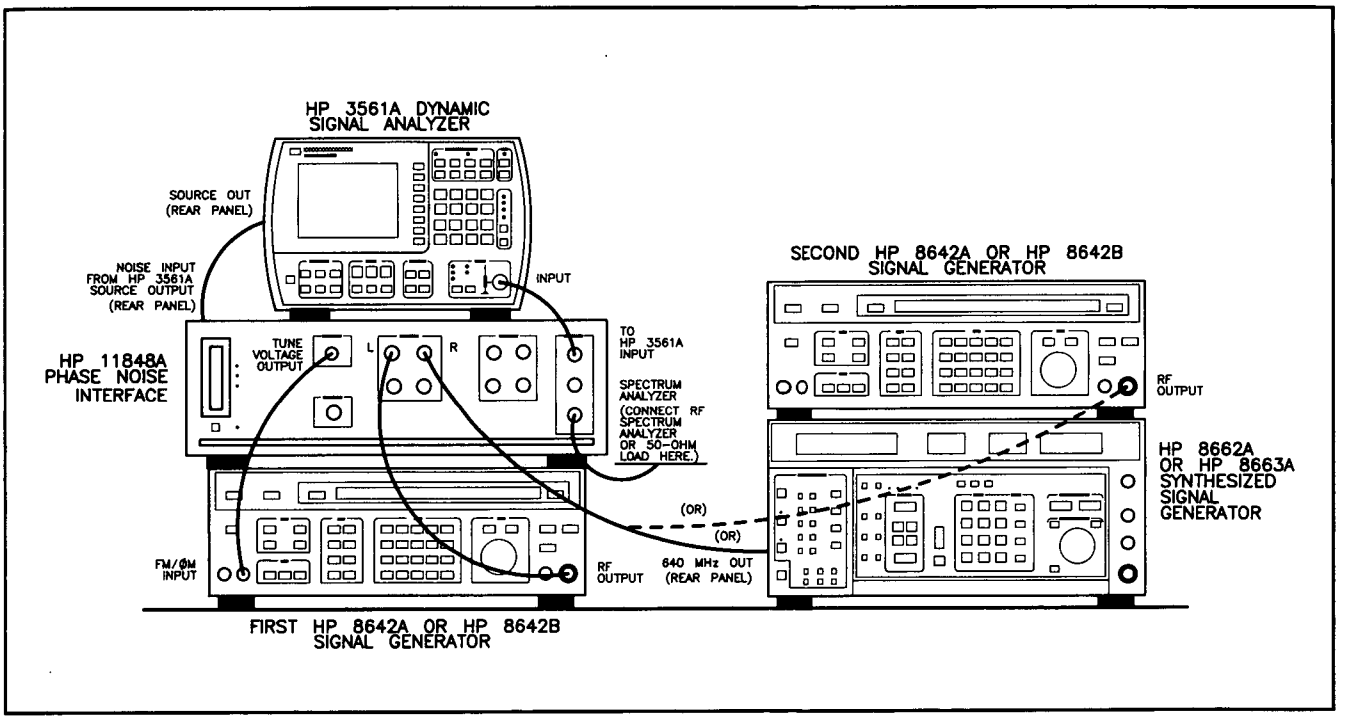


Figure 37. *Spectral Purity Tests for Options 005 and 006 Setup*

8. Press the Proceed 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

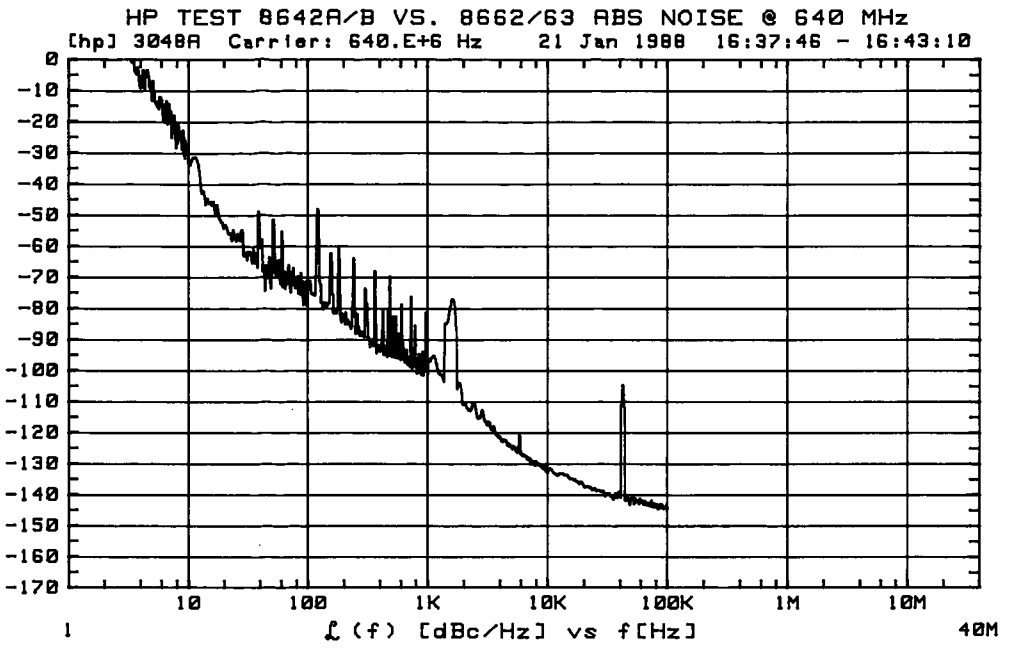


Figure 38. *Typical Spectral Purity Tests Results with HP 8662A Reference Source*

Appendix A: Block Diagram and System Troubleshooting

BLOCK DIAGRAM

The foldout at the back of this manual 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.

NOTE

A Diagnostic program for troubleshooting specifically the HP 11848A Phase Noise Interface is supplied on a separate mass media disc. The Diagnostic program is independent of the main software, and it is usually more efficient to use the main software programs until they point to the Interface as the faulty System device. The Diagnostic program can then be loaded to troubleshoot the Interface itself. Refer to the HP 11848A Service Manual.

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.

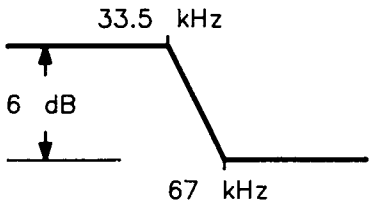
Functional Checks. These tests are an extension of the Performance Tests that test the general operational integrity of the Interface itself. The test limits are generally loose. (The tests in the Diagnostic program are similar to the Functional Checks, but they attempt to diagnose the failure in addition to simply indicating out-of-limits data.)

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 Reference Manual* when running the program. (The keyboard control feature of the Diagnostic program is similar to this program.)

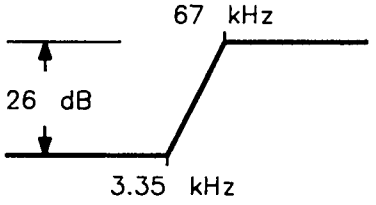
Troubleshoot Mode. When the Troubleshoot Mode (a subset of Test Mode) is enabled, information beyond simple error messages can be invoked. For example, tests can be aborted to the HP 11848A Control mode which shows the Interface state when the abort occurred.

1. Switches on tlhe 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:



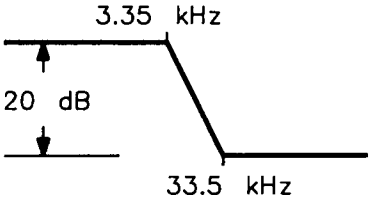
   To this transfer function is added a programmable lag-lead with the following poles and zeros:

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

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 via the electronic frequency control (EFC) port of one of the 640 MHz sources.

NOTE

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 the presence of a printer in the System's Configuration Table. However, it is recommended that the test be run with a printer.

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

1. The *Noise Floor Test* should be run before running this test.
2. Press the [Define Msrmnt] softkey. This softkey appears at the Main Software Level menu.
3. Press the [Test Files] softkey.
4. Press the [Next Page] softkey until the file name "`HP TEST HP 8662/63 vs HP 8662/63 ABS 640Mz REF`" appears in the table of file names. Move the cursor until it encompasses the file name and press the [Load File] softkey.

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.

5. When the file has been loaded, press the DONE softkey.
6. Press the DONE softkey again to select the Main Software Level menu.
7. Press the New Msrmnt softkey.
8. 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.

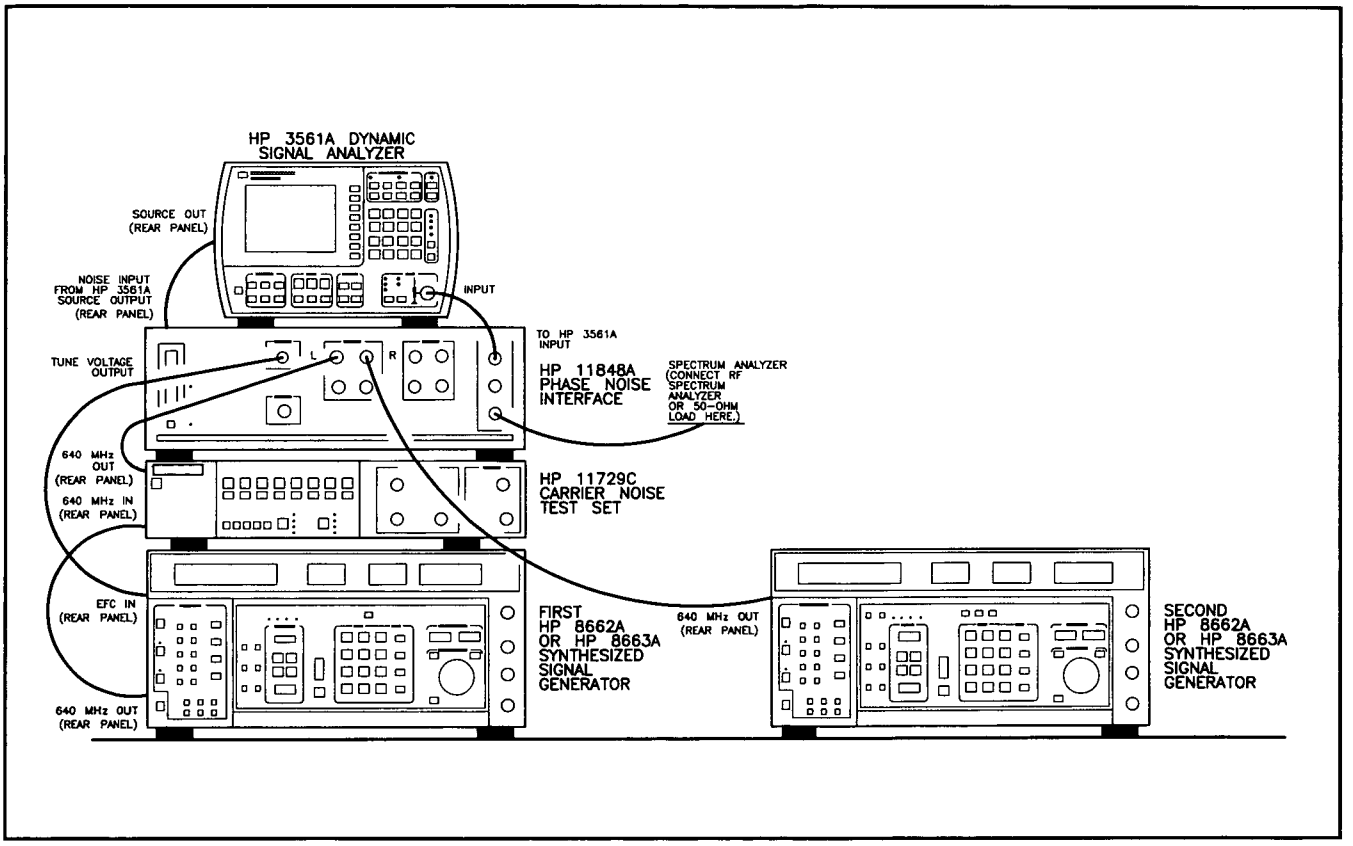


Figure B–1. *HP 8662A or HP 8663A 640 MHz Spectral Purity Test*

9. Press the Proceed softkey. 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 either 640 MHz source (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
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, 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.

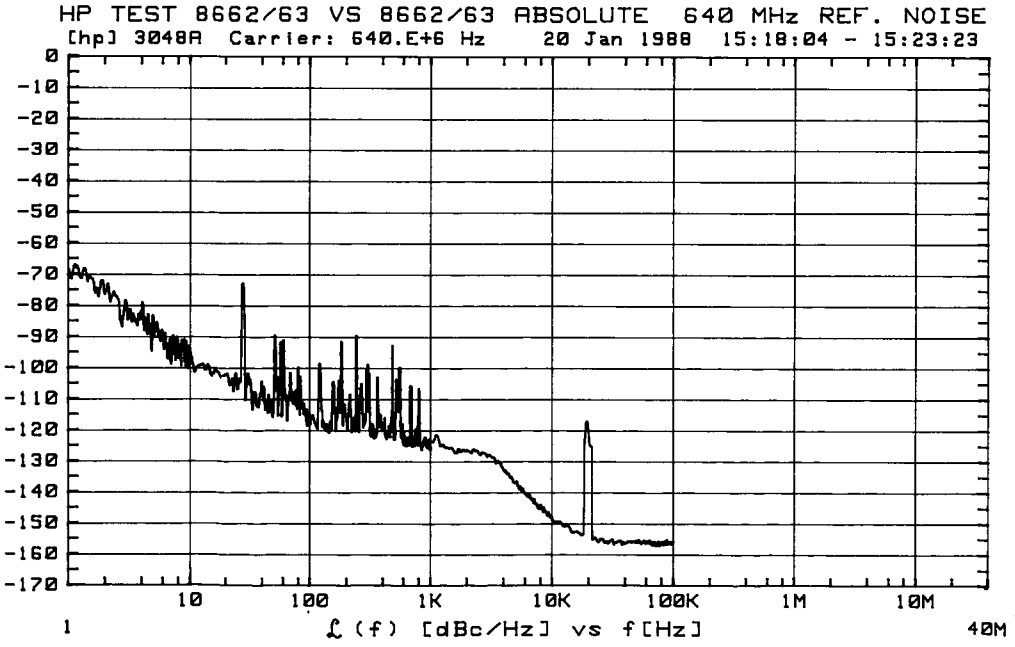


Figure B–2. *Typical Spectral Purity Tests Results*