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User's Guide

HP 85719A
Noise Figure
Measurements Personality

HP part number: 85719-90007
Printed in USA October 1992

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Safety Symbols

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

CAUTION

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

WARNING

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

General Safety Considerations

WARNING

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

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

CAUTION

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

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

An overview of this measurement solution

This quick overview provides basic information about noise figure and gain measurement using the HP 85719A measurement solution.

Some main features of the noise figure and gain measurement personality are listed below:

- User-friendly interface (includes configuration and measurement results displays).
- Storage and edit capability of multiple noise-source ENR data tables.
- Measurement marker functions.
- Single-point test-limit capability.
- Simultaneous display of swept noise figure and gain measurements.
- Variable measurement bandwidth control.
- Calculator for measurement repeatability.
- Mixer test compatibility (such as for frequency converters and receivers).
- Loss-compensation data entry to correct for cables and other losses.

In This Guide . . .

Read the following information to get an idea of what the different chapters of this guide contain.

- Chapter 1, “Getting Started” guides you through setting up the measurement personality (DLP) for use. Instructions for using the self test to verify hardware operation are provided. Also, the differences between spectrum analyzer front-panel key operations and the noise figure measurements personality key operations are explained in this chapter.
- Chapter 2, “Making Measurements” guides you through measurement examples. The recommended test equipment table, methods for optimizing measurements results, and measurement configuration information is located in this chapter. The default-configuration settings are listed here as well.
- Chapter 3, “Menu Key Descriptions” provides the menu map of the DLP and a description of each menu key in alphabetical order.
- Chapter 4, “Specifications, Characteristics, and System Verification” provides the measurement setup specifications and characteristics along with the verification tests. The performance test record is provided at the end of this chapter.
- Chapter 5, “If you Have a Problem ” includes descriptions of measurement error messages. Return-to-factory information is also included in this chapter.
- Chapter 6, “Programming” is the remote command reference. Commands and their descriptions are alphabetically listed in this chapter. A cross-reference table of the personality’s menu keys and their related commands is located in this chapter.

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Getting Started

Getting Started

The noise figure and gain measurements require an HP 859XE Series spectrum analyzer. The information about measurements in this guide assume you are using an HP 87405A probe-powered preamplifier and an HP 346B noise source.

The sections in this chapter provide the following:

- Instructions for installing the HP 85719A Noise Figure Measurements Personality into an Option 119 HP 859XE Series spectrum analyzer
- Instructions for verifying hardware operation using the SELF TEST menu key

After the measurement personality is copied into spectrum analyzer memory, some spectrum analyzer functions change. The notable differences with the measurement personality installed are listed below:

- The following front-panel keys are disabled:

  (FREQUENCY)
  (SPAN)
  (AMPLITUDE)
  (AUX CTRL)
  (MEAS/USER)
  All MARKER and CONTROL keys

- The front-panel [CAL) key function calibrates the instrument for making noise figure and gain measurements, rather than spectrum analysis measurements.
- The front-panel RPG-title mode, bandwidth, and marker key functions are disabled and relocated as menu keys in the measurement personality's menu.
- The front-panel [SAVE) and (RECALL) keys display measurement personality-specific menu operations.
- Several spectrum analyzer remote commands are invalid while you are in noise Egure and gain measurement mode. Use the noise Egure and gain remote commands provided in Chapter 6 of this manual.

Users' Guide Key Conventions

The following key conventions are used throughout this guide:

[FRONT PANEL KEY]	Boxed text indicates a key physically located on the front-panel of the spectrum analyzer or a controller keyboard.
Softkey and SOFTKEY	Shaded text indicates a key label that appears on the display of the spectrum analyzer. The keys that are associated with the labels are physically located on the right-hand side of the spectrum analyzer display. These are frequently referred to in text as the measurement personality's menu keys.
Screen Text	Bold text in this typeface indicates information that you may see displayed on the spectrum analyzer screen. This is often representative of prompts, warnings, and results information.

NOTE

When pressing hardkeys or softkeys, be sure to allow sufficient time for the spectrum analyzer to respond to the command. Fast, consecutive key presses may cause an error in the spectrum analyzer.

Installing the Measurement Personality

To install the noise figure and gain measurement personality, all of the spectrum analyzer user memory needs to be available. Dispose previously installed DLPs, then install the HP 85719A DLP.

You can confirm that the measurement personality and associated hardware are working properly with the self-test function available in the personality's main menu.

To dispose previously installed DLPs

The measurement program requires most of the user memory in the spectrum analyzer. Refer to the steps below to dispose previously installed user programs :

1. Press (PRESET) on the spectrum analyzer.
2. Erase the current user program (DLP) from user memory.
   - Most DLPs include a DLP-dispose menu key. Locate and press the dispose key (often labeled DISPOSE and the DLP name) if a personality is currently installed.
   - If a DLP-dispose key is unavailable, press the front-panel (CONFIG) key. Press More 2 of 3 , then press DISPOSE USER MEM two times.

To load the noise figure and gain measurement DLP

After the memory is cleared, insert the HP 85719A measurement personality card into the spectrum analyzer's card reader slot.

Insert the memory card correctly. The measurement card illustrates correct orientation with an arrow and label.

To load the noise figure and gain DLP, refer to the following steps:

1. Press the spectrum analyzer front-panel (RECALL) key,
2. Underline CARD in the INTERNAL CARD menu key.
3. Press CATALOG CARD , then the CATALOG ALL menu key.
4. If needed, use the (↑) and (↓) keys to highlight the measurement personality file. The label of the file will resemble the following, with different numbers and dates:

   dNF DLP 310 167 20:26:38 12 AUG, 1992

5. Press LOAD FILE and wait about 40 seconds while the highlighted file is installed.
6. Press (MODE) to display the **NF&GAIN** measurement personality softkey.
7. Press the **NF&GAIN** key to enter the measurement personality. After a moment, the main menu is displayed.

To re-enter spectrum analyzer mode press (MODE), then press Spectrum Analyzer

NOTE

Traces A, B, and C are used by the Noise Figure Measurements Personality Any data in these traces will be overwritten when in noise figure mode.
Traces can be saved. Saved traces will not be affected by mode changes.

Using the Self-Test Feature

This section contains procedures to help you verify whether the noise-source drive option card is properly installed and working on the Option 119 spectrum analyzer.

> **NOTE**
>
> If you are verifying a retrofitted HP 859XE spectrum analyzer, refer to the instructions included with the retrofit kit.

Using the self-test function

The self-test function checks that the noise-source drive option card is properly installed and working.

To verify proper hardware function, connect the equipment as illustrated in Figure l-l, then refer to the steps below:

> **NOTE**
>
> Generic 8590E Series spectrum analyzer front and rear panel illustrations are used throughout this guide. Depending on the model number and options, your spectrum analyzer front and rear panels may be different.

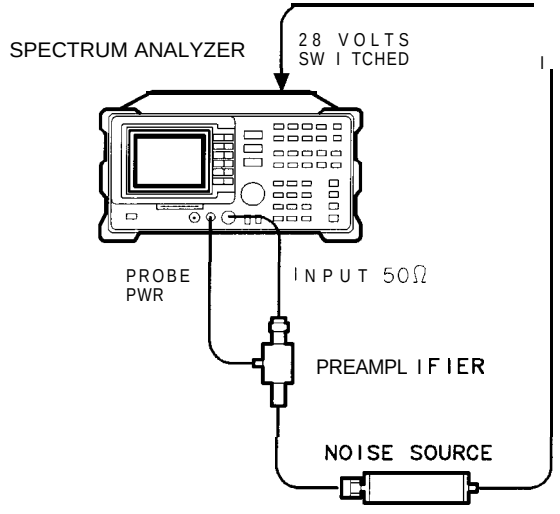


Figure I-I. Self-Test Equipment Connections

1. From the measurement personality's main menu, press SELF TEST
2. Set up the test equipment as described on the display, then press

3. Wait approximately 2 minutes for the system to complete the procedure
4. With PASS status, you can continue with measurement configuration.

If the self-test finds trouble

problem continues, refer to the return-for-service information that follows.

- Make sure the noise-source drive signal from the spectrum analyzer's rear panel "28 VOLTS SWITCHED" is connected to the noise source.
- Make sure the HP 87405A preamplifier probe-power connector is inserted into the spectrum analyzer PROBE PWR connection.
- Check that the noise source and preamplifier are properly connected.

- Check that the Option 119 card is getting recognized by the spectrum analyzer.

  Press the front-panel [MODE) key.
  Press the Spectrum Analyzer softkey
  Press (CONFIG) then More 1 of 3
  Press SHOW OPTIONS 119: NOISE should be displayed.

- Re-run the self-test.

For any error messages generated by the measurement personality, refer to Chapter 5, "If You Have a Problem " in this guide.

If the trouble persists

If the self-test continues to find a problem, and all of the items above are correct, the instrument may need service. Refer to the recommendations below:

- Copy any error messages onto a sheet of paper.
- Contact one of the HP sales and service offices listed in the Table l-l. Describe the trouble to the service office personnel.
- If returning the instrument to the manufacturing factory is required, shipping instructions are located in Chapter 5, "If You Have a Problem . . . " in this guide.

Sales and service offices listing

The HP Sales and Service Office personnel can answer questions for you. Have a copy of the error messages available when you talk to one of the engineers.

Table I-I. Hewlett-Packard Sales and Service Offices

US FIELD OPERATIONS

Headquarters
Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014, USA
(800) 752-0900

California, Northern
Hewlett-Packard Co.
301 E. Evelyn
Mountain View, CA 94041
14151 694-2000

California, Southern
Hewlett-Packard Co.
1421 South Manhattan Ave.
Fullerton, CA 92631
17141 999-6700

Colorado
Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
13031 649-5000

Georgia
Hewlett-Packard Co.
2000 South Park Place
Atlanta, GA 30339
14041 955-1500

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
17081 255-9800

New Jersey
Hewlett-Packard Co.
120 W. Century Road
Paramus, NJ 07653
12011 599-5000

Texas
Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
12141 231-6101

EUROPEAN FIELD OPERATIONS

Headquarters
Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2/Geneva
Switzerland
141 221 780.8111

France
Hewlett-Packard France
1 Avenue Du Canada
Zone D'Activite De Courtaboeuf
F-91947 Las Ulis Cedex
France
(331) 69 82 60

Germany
Hewlett-Packard GmbH
Berner Strasse 117
6000 Frankfurt 56
West Germany
(49 69) 500006-0

Great Britain
Hewlett-Packard Ltd.
Eskdale Road, Winnersh Triangle
Wokingham, Berkshire RF11 502
England
(44 7341 696622

INTERCON FIELD OPERATIONS

Headquarters
Hewlett-Packard Company
3495 Deer Creek Rd.
Palo Alto, California 943041316
14151 857-5027

Australia
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
(61 31 895-2895

Canada
Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans- Canada Highway
Kirkland, Quebec H9J 2X8
Canada
15141 697-4232

China
China Hewlett-Packard Company
38 Bei San Huan XI Road
Shuang Yu Shu
Hai Dian District
Beijing, China
(86 II 256-6888

Japan
Yokogawa-Hewlett-Packard Ltd.
1-27-15 Yabe, Sagamihara
Kanagawa 229, Japan
(81 427) 59-1311

Singapore
Hewlett-Packard Singapore (Pte.) Ltd
1150 Depot Road
Singapore 0410
(65) 273-7388

Taiwan
Hewlett-Packard Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
1886 21 712-0404

2

Making Measurements

Making Measurements

This chapter contains instructions for using the measurement personality. The descriptions of the menu keys are located in Chapter 3, "Menu Key Descriptions."

"Making Measurements" is organized into the following sections:

- Improving Noise Figure Measurement Accuracy
- Configuring for Measurements

  Entering measurement frequencies
  Entering points to be measured
  Entering tune and BW parameters
  Entering preamplifier gain
  Entering noise source case temperature
  Editing noise source ENR data
- Calibrating for Measurements
- Making Measurements on an Amplifier
- Making Measurements on a Frequency Converter
- Making Measurements on a Mixer

The measurement examples provided here use the equipment listed in Table 2-1 on the following page. Other equipment can be substituted if the critical specifications are accommodated.

Table 2-1. Equipment Requirements

Instrument	Model Number	**Specifications**
HP 859XE Series Spectrum Analyzer	HP 8591E, HP 8593E, HP 8594E, HP 8595E, or HP 8596E	859XE-series firmware and hardware
Noise Source	HP 346B Noise Source [Option 0011	Frequency range: 10 MHz to 2.9 GHz ENR: 14 to 16 dB 10 MHz to 30 MHz, SWR: 1.3 30 MHz to 2.9 GHz, SWR: 1.15 Power raouiramant: 28 Vdc (±1 Vdcl
System Preamplifier	HP 87405A Probe-Powered Preamplifier	Frequency Range: 10 MHz to 2.9 GHz Noise Figure: 7.5 dB Input SWR: 2:1(maximum) Probe-power bias connector

Improving Noise Figure Measurement Accuracy

You can improve the accuracy of a noise figure measurement by following the suggestions listed below:

- Use RF precautions with the equipment setup. Some of these are listed below:

  Tighten measurement connections and avoid using non-threaded connectors such as the BNC-style connectors.

  Use only cables that are in good condition.

  Make measurements away from potentially interfering signals.

- "Increase" device gain, if possible.

  Higher device gain minimizes many errors related to the measurement system.

- Reduce the measurement system noise.

  Reduce the effects of measurement system noise by using a low-noise, system preamplifier whenever possible.

- Reduce known error sources such as SWR and ENR uncertainty.

- Use a narrower measurement bandwidth than the bandwidth of the device under test.

Refer also to product note 85719A-1 for additional information.

The Conf ig menu provides the parameters whose values and states need to be determined, if they are to be changed from default values, before you begin making measurements.

Table 2-2 lists the configuration menu keys and some brief descriptions of the parameters. Refer to Chapter 3, “Menu Key Descriptions” for more thorough information.

Table 2-2. Configuration Selections

Menu Key	Selections	Use	Parameter Range
Freq Menu	Start and stop frequencies or with frequency conversion, RF and IF start and stop frequencies	Sat measurement frequenc range	Frequency range of the spectrum analyzer in non-conversion mode; In conversion mode, the RF-start and RF-stop frequency ranges are 0.00 Hz to 999.9 GHz
POINTS	Points to measure	Set the number of equally spaced frequency points over the measurement frequency range	1 point to 401 points
Test Limits [appears if number of points = 1]	Measurement limit settings for minimum and maximum noise figure and gain	Sat minimum- and maximum-power limits for noise figure and gain pass/fail testing	NF: 0.00 dB to 99.90 dB Gain: -99.90 to +99.90 dB
Ref Lvl & Scale	Measurement reference levels and scales	Set the measurement reference levels and scales	Noise figure reference level range is —99.9to +99.90 dB Noise figure scale range is 0.10 dB to 99.90 dB Gain reference level range is -99.9 dB to +99.90 dB Gain scale range is 0.10 dB to 99.90 dB
More 1 of 2 key yields these menu keys:			
Time-BW Menu External Losses PREAMP GAIN SOURCE TEMP Edit ENR Data	Enter additional neasuramant parameters to customize naasuramant ·equirements	Specific uses provided alphabetically in Chapter 3, 'Menu Kay Descriptions"	Ranges listed in Chapter 3, "Menu Kay Descriptions'

To enter measurement frequencies

The frequency range of the noise figure measurement setup with the HP 87405A preamplifier is from 10 MHz to 2.9 GHz, unless the HP 85913 spectrum analyzer is used, then the maximum frequency is 1.8 GHz. You can easily measure a device whose output frequency range falls within this span without additional hardware.

To measure above 2.9 GHz To measure a device having an output frequency above 2.9 GHz, but an overall frequency span within that of the spectrum analyzer, you need to supply a system preamplifier that extends to the output frequency of the device tested. Also, the specifications in Table 4-1 may not apply when other than an HP 87405A preamplifier is used.

To measure below 10 MHz To measure a device having a frequency range below the 10 MHz specification of the HP 85719A measurement personality, you need to provide a low-frequency system preamplifier (such as the HP 8447) and a low frequency calibrated noise source. Also, the specifications in Table 4-1 may not apply when other than an HP 87405A preamplifier is used.

To measure non-frequency converting devices To enter the RF frequency range of the non-frequency converting device under test, refer to the following steps:

1. Press Conf ig in the main menu.
2. Press Freq Menu in the configuration menu.
3. Press Conversion YES NO to underline NO (the default setting) when you are measuring a device other than a frequency converter.
4. Press START FREQ and STOP FREQ to enter the start and stop frequencies of the DUT.
5. Press Previous Menu to return to the configuration menu.
6. Continue configuration, or return to the main menu.

To measure frequency converting devices

The measurement personality frequency menu supports two modes. The Erst mode described below is for frequency converting devices. The second mode is for non-frequency converting devices.

When the DUT (device-under-test) is a frequency converter, the RF and IF frequency values need to be entered. The RF frequency values are used in the personality to select the appropriate ENR data. The IF frequencies are those of the DUT output.

To set the measurement frequency range for frequency converters, refer to the following steps:

1. Press Conf ig in the main menu.
2. Press Freq Menu in the configuration menu.
3. Press Conversion YES NO to underline YES when you are measuring a frequency conversion device.
4. Enter the IF and RF start and stop frequencies of the DUT.

NOTE

Be sure to enter an RF frequency span equal to the IF frequency span.

The RF start frequency must correspond with the IF start frequency even if it results in a "backwards" sweep condition.

- Press RF START FREQ and RF STOP FREQ to enter the RF frequency values of the DUT.
- Press IF START FREQ and IF STOP FREQ to enter the IF frequency values of the DUT.

To enter the number of measurements points

Enter the number of measurement points you want to use. The larger the number of points, the longer the measurement. As few as 1 point or as many as 401 points can be measured, as listed in Table 2-3 below. You can modify the speed of measurements via the time-BW menu keys.

To enter the number of points to measure, refer to the following steps:

1. Press `Config` in the main menu.
2. Press `POINTS` in the configuration menu.
3. Enter the number of points, from 1 to 401, you want to measure.
4. Press the front-panel ENTER key to complete data entry.

If you choose to enter one point, an additional key is displayed. The key label is `Test Limits`. Use the test limits feature to enter pass/fail criteria. The minimum and maximum values for test limits key are described more thoroughly in Chapter 3, "Menu Key Descriptions."

The frequency point is centered between the RF start and stop values you entered. Refer to Figure 2-1 for an example of a single-point measurement.

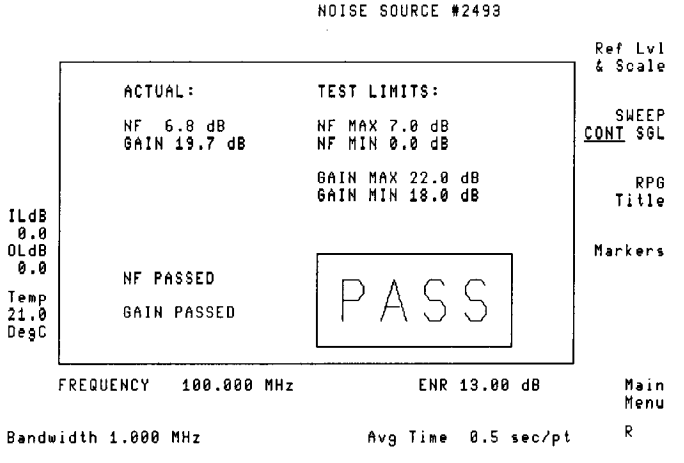


Figure 2-1. Single-Point Measurement Results

Table 2.3. Points Entered vs Points Measured

lumber Entered	Actual Number of Points Measured
1	1 point
2	2 points
3	3 points
4 to 5	5 points
6 to 7	6 points
8 to 9	9 paints
10 to 13	11 points
14 to 16	17 points
19 to 23	21 points
24 to 34	26 points
34 to 45	41 points
46 to 65	51 points
66 to 90	81 points
91 to 150	101 points
151 to 300	201 points
301 to 401	401 points

To enter time-BW parameters

Enter time-bandwidth measurement parameters via the Time-BW Menu key, following the steps below:

1. Press Conf ig in the main menu.
2. Press More 1 of 2 , then Time-BW Menu
3. Press BANDWDTH and use the front-panel data keys, enter a measurement bandwidth.
   - Use 1 MHz measurement bandwidth, except when measuring narrow band devices.
   - For narrow band devices, use a bandwidth narrower than the device bandwidth.
4. Terminate data entry by pressing a frequency units key.

Determine the time-bandwidth product

To set the time-bandwidth product in kHz-seconds, multiply the desired averaging time in seconds by the measurement bandwidth in kHz. Increasing the time-bandwidth value can reduce the measurement's repeatability error. Use the Help Time-BW key to understand more about controlling measurement error. Refer also to the product note 85719A-1. The following steps guide you through data entry.

1. Press TIME-BW PRODUCT key.
   - Enter a larger value to reduce repeatability error (jitter), but increase measurement time.
   - Enter a smaller value to reduce measurement time, at the cost of increased measurement repeatability error (jitter).
2. Press Help Time-BW to review the values in the measurement repeatability calculator. Refer to Figure 2-2 for an example of the repeatability calculator. Notice the "3sigma" value change as you adjust the values of the following parameters:

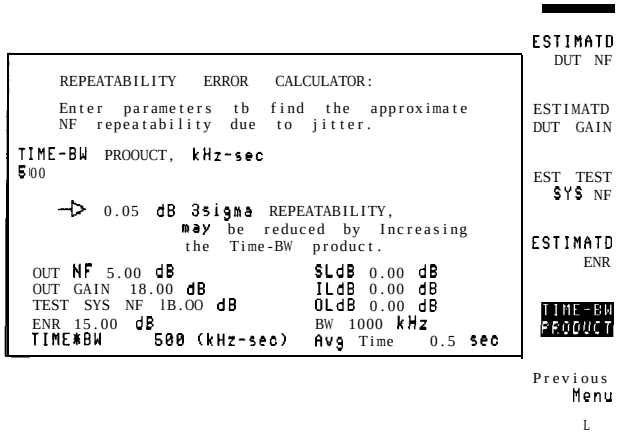


Figure 2-2. The Help Screen Time-BW Repeatability Calculator

- Press ESTIMATD DUT NF and enter the estimated noise figure value of the device you are measuring. Press ENTER. Low noise-figure devices may need more gain for more accurate noise measurements.
- Press ESTIMATD DUT GAIN and enter the estimated gain value of the device you are measuring. Press ENTER. Higher device gain tends to reduce measurement error.
- Press EST TEST SYS NF (displayed at the completion of a calibration) and enter the estimated noise figure of the system. Press ENTER.
- Press ESTIMATED ENR and enter the approximated noise source ENR value for the frequencies to be measured. Press ENTER.
- Press TIME-BW PRODUCT and enter a value. There is an inverse, square-root proportionality between repeatability and the time-BW factor.

  To reduce the repeatability error to approximately half its current amount, quadruple the value of the time-BW product.

To enter external losses

If you plan to use hardware or cables that have known losses, you can enter these values into the measurement configuration settings. When you are correcting for external losses, accurate loss values should be used to prevent introducing errors into the device measurements.

The loss corrections are also included in the repeatability error calculations.

There are four points that can contribute loss into the measurement. One of the four points is the measurement setup loss.

Do not enter corrections for the loss encountered at the point illustrated in Figure 2-3 and Figure 2-4. Measurement setup loss is automatically factored into the final measurement result.

To enter external losses

To enter corrections for the remaining three loss locations, refer to the information below:

1. Press **External** Losses . Enter known loss values designated as:

   System Loss (this value is not entered into the measurement manually)
   SOURCE LOSS

   INPUT LOSS

   OUTPUT LOSS

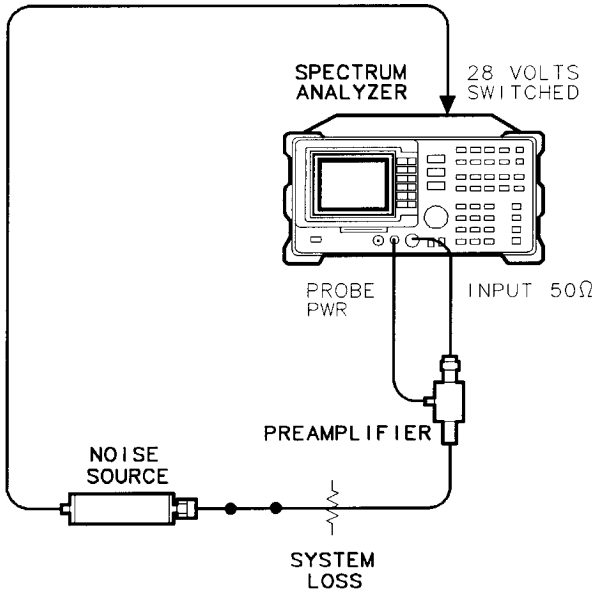


Figure 2-3. System Loss Location During Calibration

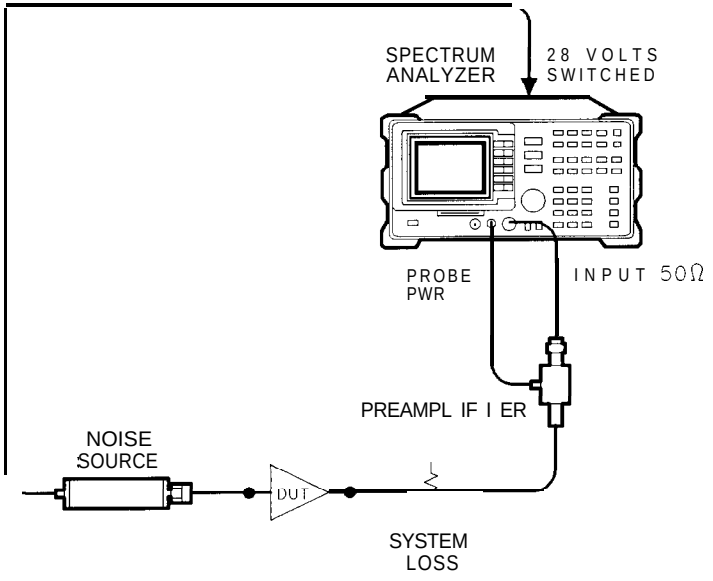


Figure 2-4. System loss location During Device Measurement

- Press SOURCE LOSS and enter the known loss value present at the location indicated in Figure 2-6 or Figure 2-5. The loss is subtracted from the excess noise ratio (ENR).

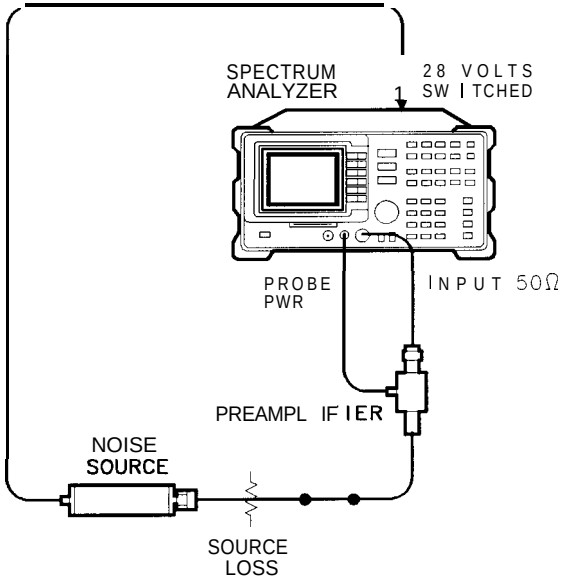


Figure 2-5. SOURCE LOSS location During Calibration

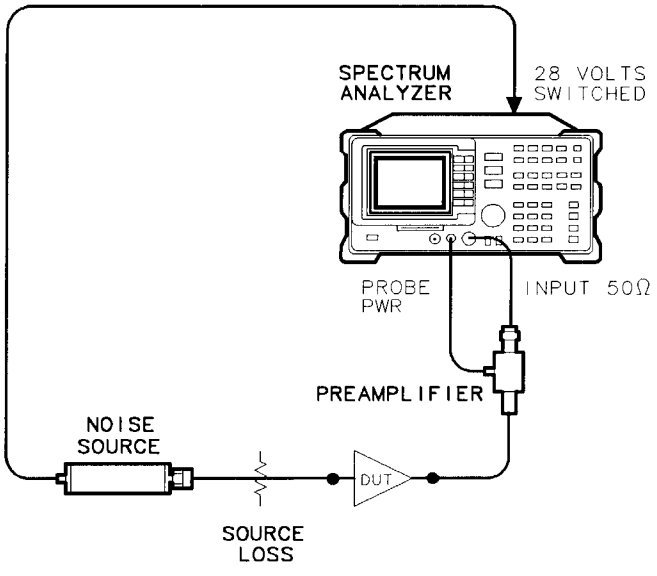


Figure 2-6. SOURCE LOSS Location During Device Measurement

- Press INPUT LOSS and enter the known loss value present at the location indicated in Figure 2-7 or Figure 2-8 as the input loss. The input loss of the DUT is added to its noise figure, but subtracted from the its gain.

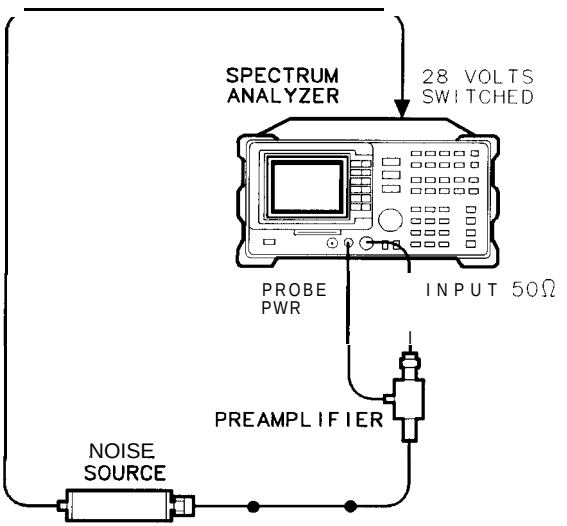


Figure 2-7. INPUT LOSS location During Calibration

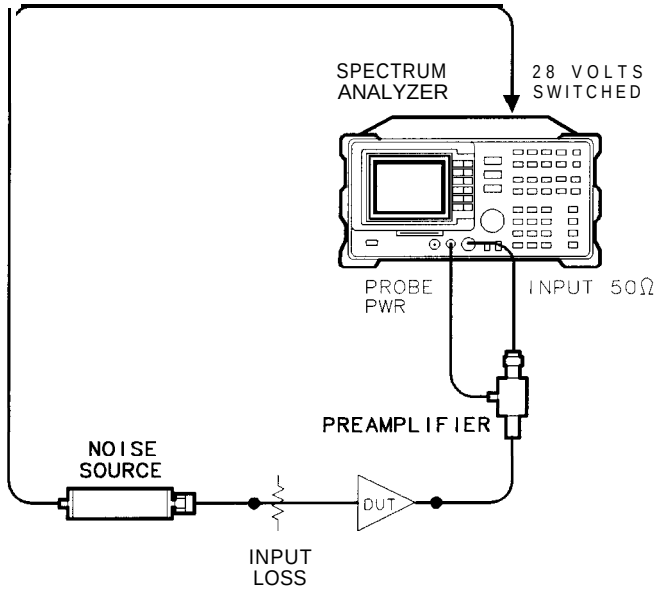


Figure 2-8. INPUT LOSS location During Device Measurement

- Press OUTPUT LOSS and enter the known loss value present at the location indicated in Figure 2-9 or Figure 2-10 as the output loss. The output loss is subtracted from the gain or the device under test, but proportionally calculated into its noise figure.

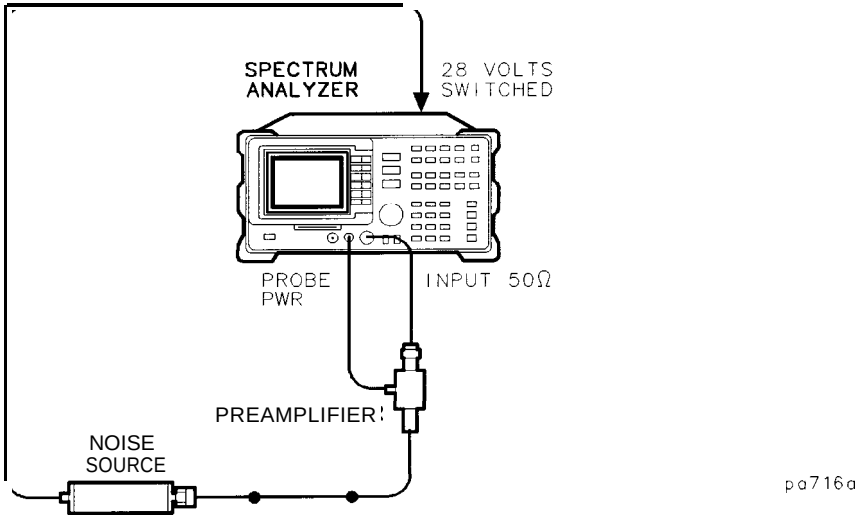


Figure 2-9. OUTPUT LOSS location During Calibration

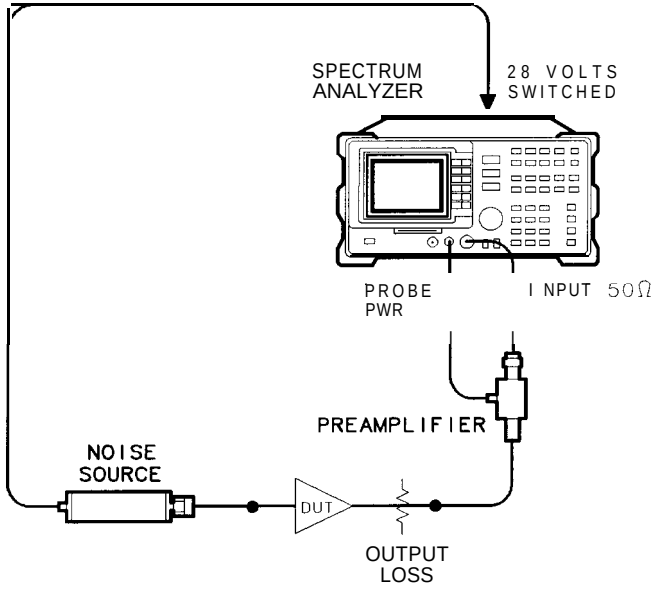


Figure 2-10. OUTPUT LOSS location During Device Measurement

To enter preamplifier gain

The gain of the measurement system preamplifier should be entered via the PREAMP GAIN key. The gain value is used during system calibration and measurement calculations. Refer to the following steps:

1. Press the Conf kg key in the main menu.
2. Press More 1 of 2 in the configuration menu
3. Press PREAMP GAIN and enter the known, minimum preamplifier gain
   - Use the ⇧ and ⇩ keys to change the gain value in 1.0 dB increments.
   - Use the RPG to change the gain value in 0.01 dB increments.
   - Use the front-panel data keys to enter exact values. Terminate data-key entry with the ENTER key.
4. Complete data entry by pressing a dB-units key.

To enter noise-source case temperature

The noise-source case temperature, or ambient temperature, contributes to measurement accuracy results. If the noise source is used to measure devices within a temperature chamber, the temperature of the chamber needs to be entered into the configuration settings. Refer to the following steps:

1. Press Canf ig in the main menu

2. Press More 1 of 2 in the configuration menu.

3. Press SOURCE TEMP and enter the ambient temperature of the testing environment. Retain the default setting of 21°C for measurements made in typical room-temperature environments.
   - Use the ⇧ and ⇩ keys to change the temperature value in 1.0°C increments. Do not press ENTER. The value is automatically accepted.
   - Either do not use the RPG or use it very carefully. The RPG will change the temperature value very fast. Small rotations cause large changes. Do not press ENTER; the value is automatically accepted.
   - Use the front-panel data keys to enter exact values, then press ENTER.

To edit noise source ENR data

The noise source's ENR (excess noise ratio) data is used by the personality to calculate measurement results. The data listed on the noise source is typically unique to each noise source. ENR data tables can be saved to, or recalled from memory cards and spectrum analyzer memory registers.

NOTE

The measurement personality arrives with a default ENR-data table installed in memory Either the default table, or the table that was last edited, saved, or recalled, is the table that is used. The ENR data is used by the personality for measurement calculations.

Be sure that the ENR-data table your measurement is using is the one you want. If you entered the noise source's serial number, look for it in the upper right-hand corner of the display

To edit ENR data tables

Press Conf ig , More 1 of 2 , then Edit ENR Data. The currently active ENR table data table is displayed. Refer to Figure 2- 11 for an example of an ENR table.

The ENR data table editor screen.

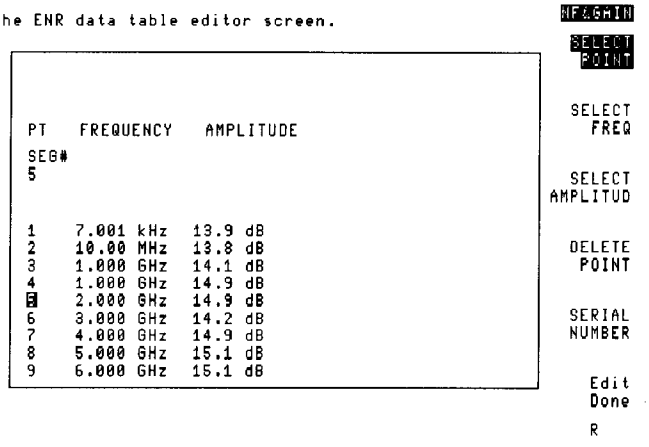


Figure 2-11. The ENR Data Table Editor Screen

When the ENR menu is first entered, the SERIAL NUMBER key is highlighted. For identification purposes, you may use the front-panel data keys, followed with the ENTER key, to assign the noise source's serial number to the data table.

The noise source serial number, however, is *not* used as an identification label within memory registers. It does appear, however, on the display when the ENR data is active.

To enter the ENR data specific to the noise source you are using, refer to the following steps:

1. Press SELECT POINT, SELECT FREQ, or SELECT AMPLITUD to edit an existing ENR-data point.
2. Change the cursor position or table values as explained below:
   - Change the data-point location with the front-panel RPG or the ⇧ and ⇩ keys.
   - Change the frequency value using only the front-panel data keys with the frequency units key. The cursor automatically moves to the next column position when you terminate data entry with a units key.
   - Change the amplitude value with the RPG as follows or with the numerical data keys.

NOTE

Enter the complete dB value listed on the noise source for each frequency point. The personality does not display the 100^{th} dB value, however it is accepted and used within the calculated measurement results.

- Press the DELETE POINT key to delete all the values of a point from the table, regardless of the highlighting position in a data point.
- Press Edit Done to return to the previous menu. The edited ENR data is used for the next measurements.

3. To store the ENR data table to a memory register, use the front-panel [SAVE] key as explained in the following section.

To save ENR data tables

To save the ENR data to memory, press Edit Done , then follow the steps below:

1. Press the front-panel [SAVE] key.
2. Press INTERNAL CARD to underline the save destination you want to use.
3. Press either ENR ⟶ INTERNL when you have chosen spectrum analyzer memory, or ENR ⟶ CARD when you have chosen memory card memory.
4. Enter the memory register number you wish to use, then press ENTER on the front panel. The message ENR DATA SAVED appears on the display.

NOTE

Memory card memory registers 0 to 999 are available.
Be aware that ENR data is stored to trace registers (TR0 to TR52) and registers ST1 through ST8 are reserved for spectrum analyzer operations only,
Trace registers (TR0 to TR52) can be used to store both ENR data and states. When using interal memory, a different register must be used for each ENR data and state saved.

WARNING

Avoid using spectrum analyzer state register 8 (ST8). The measurement personality uses ST8 for temporary storage of state and trace data.

To recall ENR data tables

ENR data tables may be stored in spectrum analyzer memory, or in a memory card memory register. To recall existing ENR data tables, refer to the steps below:

NOTE

ENR data tables are prefixed "TR" in spectrum analyzer memory, or "tNFENR" in memory card memory Refer to Table 2-4 for an explanation of the prefixes in the memory locations.

1. Press the front-panel (RECALL) key, while you are in NF&gain mode.
2. Press INTRNL CARD until the memory location you want is underlined.
   - When INTRNL is underlined, press INTRNL ⟶ ENR to display the ENR data tables in spectrum analyzer memory.
   - When CARD is underlined, press CARD ⟶ ENR to display the ENR data tables in memory card memory.
3. Use the RPG or step keys to highlight the ENR data table of interest.

4. Press LOAD FILE to begin using the ENR data for the noise source you are using for measurements.

NOTE

Register prefixes NFTST, NFTRA, and NFTRB are reserved prefixes used by the noise figure and gain personality Do not use these prefixes with your memory operations.

Assigning and Using Registers and Prefixes

The following table defines the prefixes that appear in the catalog listing of either the memory card or spectrum analyzer memory registers.

Table 2-4. Prefix Descriptions of Memory Registers

Destination. Selection	**Register** Name in Cataloo	**Prefix Description**
Save to INTERNAL STATE ⟶ INTRNL	**TR***register number*	A trace register containing the event's instrument state.
Save to INTERNAL ENR ⟶ INTRNL	**TR***register number*	A trace register containing the event's instrument state.
Save to CARD State ⟶ Card	t**NFS**_*register number*	The t indicates the file type, followed with NFS indicating a personality state.
Save to CARD ENR ⟶ Card	t NFENR-register *number*	The t indicates the file type, followed with NFENR indicating a table of noise source excess-noise-ratio data.
Save to CARD **TR&ST** ⟶ Card	t**NFTST**_*register number*	The t indicates the file type, followed with NFTST indicating an instrument state and the traces. The personality creates two hidden files [not visible in NF mode, but displayed in spectrum analyzer mode] labeled **tNFTRA** and **tNFTRB** followed with the register number.
Save to CARD Display ⟶ Card	iNF *I* _*register number*	The t indicates the file type, followed with NFI indicating a display image.

Calibrating for Measurements

The calibration procedure minimizes the effects of losses, noise, and gain factors due strictly to the measurement setup.

After entering the measurement configuration information, calibrate the measurement setup. The calibration data is stored and available for the current measurement configuration.

If you cycle power, the configuration information is not changed, however, a new calibration is recommended before you resume measuring, especially if the instrument temperature has changed.

Calibration requires the following:

- The device to be tested is ***not*** connected.
- The measurement configurations are determined.
- The noise source is connected.
- The preamplifier is connected.

NOTE

You can make noise figure measurements without completing calibration. However, the gain measurement will not be made (no gain trace displayed). An additional error occurs in the measurement results when calibration is bypassed. The error is especially noticeable when low gain devices-under-test are measured.

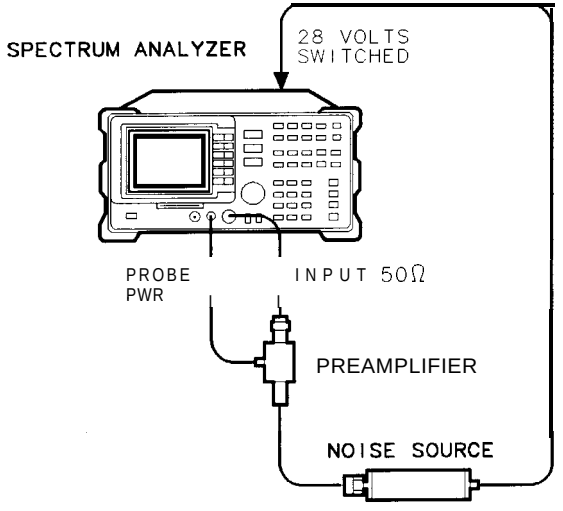


Figure 2-12. Basic Calibration Setup

For calibration, refer to the steps below:

1. Connect the test equipment as illustrated in Figure 2-12. Be sure to include your specific connectors, cables and adapters required for making your measurement.
2. Press a calibration key. Use either the measurement personality CAL key or the front-panel (CAL) key, to start the calibration routine.
3. Refer to Figure 2-13 for an example of the message displayed when calibration is completed.
4. Connect the device to test and begin making measurements. Some examples are included in this chapter.

NOTE

Changing the reference level, scale, input loss, output loss, RFstart, and RFstop (for frequency converter measurements) after calibration does not require measurement recalibration.

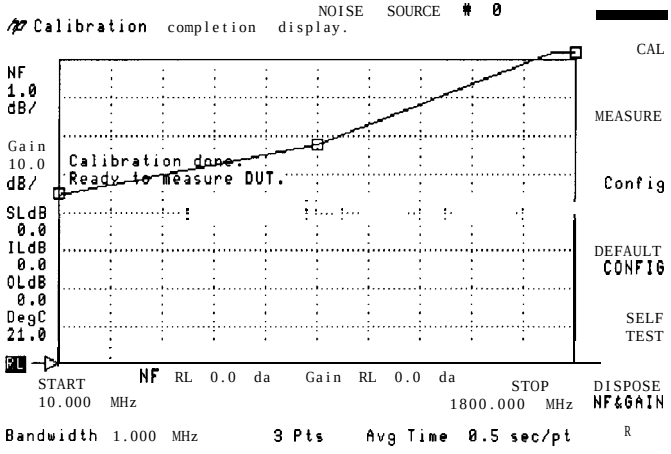


Figure 2.13. Calibration Completion Display

Making Hard-Copies

Connect the spectrum analyzer to an HP-IB printer and use the front-panel [COPY] key to generate prints.

A printer is the suggested output device.

A plotter may be used to obtain measurement output, however in some instances the plot may not yield exactly what appears on screen.

Measuring an Amplifier

To measure an amplifier, connect the equipment, but bypass the device to be tested as stated in "Calibrating for Measurements" and illustrated in Figure 2-12. Be sure to include all needed adapters, cables, and hardware required for your test.

Configuring for the measurement

Refer to the steps below to enter measurement parameters for the amplifier. The specific values are not included. Use the values unique to the device you are testing.

1. Press Conf ig in the main menu.
2. Press Freq Menu, then underline NO in the Conversion YES NO key.
3. Enter the start and stop frequencies of the device you are testing.
4. Press Previous Menu and select POINTS
   - Enter a number with the front-panel data keys, remembering that the number you enter may be translated into a number that can be used. Refer to the POINTS key description in Chapter 3, "Menu Key Descriptions."
   - Terminate the value with the ENTER key.
   - If you entered POINTS = 1, you can also enter test-limit values.
   - Return to the configuration menu by pressing Previous Menu
5. Press More 1 of 2 to enter additional measurement parameters as explained in above in "To enter time-BW parameters".

Calibrate the measurement setup

If you calibrate the measurement setup, include all the hardware and cabling required for your measurement, unless you have entered DUT input and/or output losses. At the end of the measurement, a message appears to indicate calibration completion.

1. Connect the noise source to the input of the preamplifier, with all the connectors, cables, and necessary hardware included.
2. From the main menu, press CAL

When calibration is completed, connect the device and begin measuring.

To measure the amplifier

To measure the noise figure and gain of an amplifier, connect the equipment as indicated in Figure 2-14, then press Measure If you do not calibrate, press Measure two times to begin measurements. Refer to Figure 2-15 for an example of the measurement results.

> **NOTE**
>
> Uncalibrated noise figure measurements can be made, however, there will be no gain measurement trace.

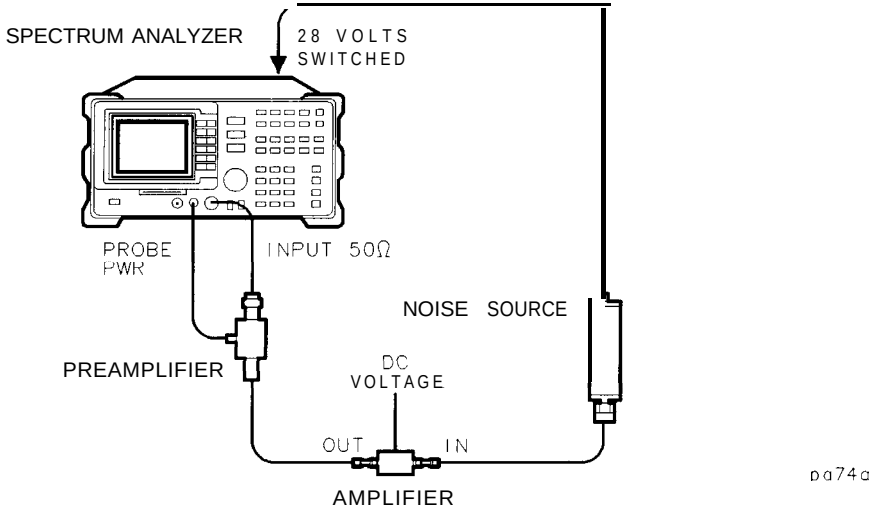


Figure 2-14. Measuring Amplifier Noise Figure and Gain

During the measurement, a new menu is presented. From the measurement menu, you can activate markers, enter a title for the measurement, change the reference level and scale, or change the sweep mode.

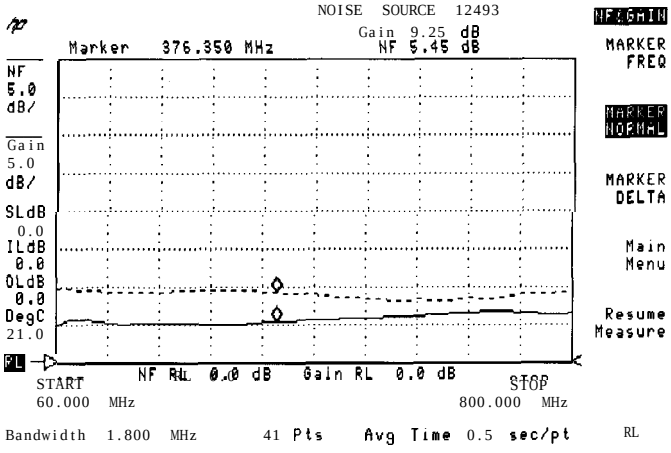


Figure **2-15.** Amplifier Measurement Results Example

Measuring a Frequency Converter

To measure the noise figure and gain of a frequency converting device such as a television tuner, connect the equipment (bypassing the device to be tested) as stated in "Calibrating for Measurements" and illustrated in Figure 2-12. Be sure to include all needed adapters, cables, and hardware required for your test.

To measure the noise figure and gain of a microwave converter, refer to product note 85719A-1, for information about configuring for the measurement.

Configuring for the measurement

Refer to the steps below to enter measurement parameters for the frequency converter. The specific values are not included. Use the values unique to the device you are testing.

1. Press Conf ig in the main menu.

2. Press Freq Menu, then underline YES in the Conversion YES NO key

   - Enter the RF and IF frequencies of the device you are testing. The *RF and IF* ***spans*** *equal must be equal.*
   - The RF start frequency must correspond with the IF start frequency, even if the resulting values cause a "backwards sweep" condition (start frequency is greater than the stop frequency).

3. Press Previous Menu and select POINTS

   - Enter a number with the front-panel data keys. Terminate the value with the ENTER key.
   - If you entered POINTS = 1, you can also enter test limit values.
   - Return to the configuration menu by pressing Main Menu

4. Press More 1 of 2 to enter additional measurement parameters.

Calibrate the measurement setup

If you calibrate the measurement setup, connect the equipment as illustrated in Figure 2-12. Enter DUT input and/or output losses as previously explained in "To enter external losses". At the end of the measurement, a message appears to indicate calibration completion.

1. Connect the noise source to the input of the preamplifier, with all the connectors, cables, and necessary hardware included.
2. From the main menu, press CAL

When calibration is complete, connect the device to begin measurements.

To measure a frequency converting device

To measure the noise figure and gain of a frequency converter, such as a TV tuner, connect the device as illustrated in Figure 2-16, then press Measure . Refer to Figure 2-17 for an example of the measurement results screen.

If you do not calibrate, press Measure two times to begin the measurement.

> **NOTE**
>
> Uncalibrated noise figure measurements can be made, however, there will be no gain measurement trace.

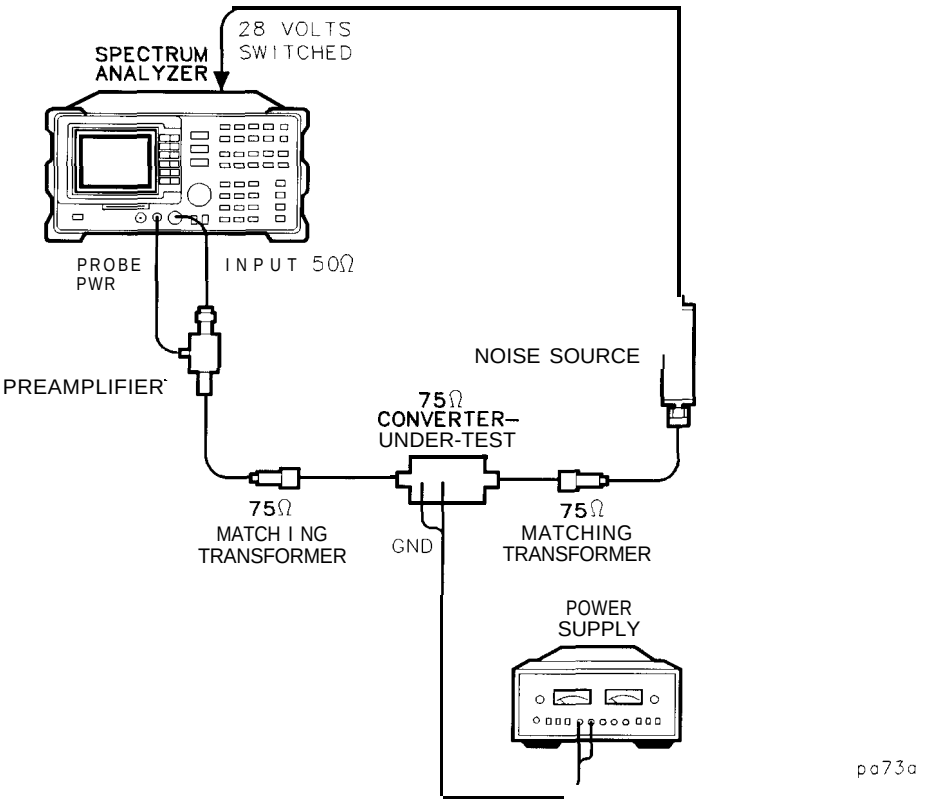


Figure 2-16. Measuring a 75Ω Frequency Converting Device

During the measurement, a new menu is presented. From the measurement menu, you can activate markers, enter a title for the measurement, change the reference level and scale, or change the sweep mode. Modifying the states of these menu keys does not require you to complete a new calibration.

Double sideband converter corrections

To correct for the effect of double sideband mixing, enter an additional -3 dB with the INPUT LOSS correction value. The actual resulting value is a sum of the loss correction of the converter input with the -3 dB algebraically added, as shown below:

For input loss = 0, + additional -3 dB, equals: -3 dB

For input loss = 5, + additional -3 dB, equals: 2 dB

Refer to product note number 85719A-1 for more information about double sideband converter measurement and for the error sources in converter measurements.

Testing a multiband-TV tuner

This measurement personality allows you to test a device such as a multiband-TV tuner at several RF input frequencies. If you keep the IF output frequency fixed, you can adjust the RF input frequency, and continue measurements *without* having to recalibrate the measurement configuration.

For frequency-conversion measurements, the RF frequency values entered in the configuration menu are used only to determine which ENR data to use. The ENR of quality noise sources is very constant over frequency, therefore, the exact RF value need not be entered, in most cases.

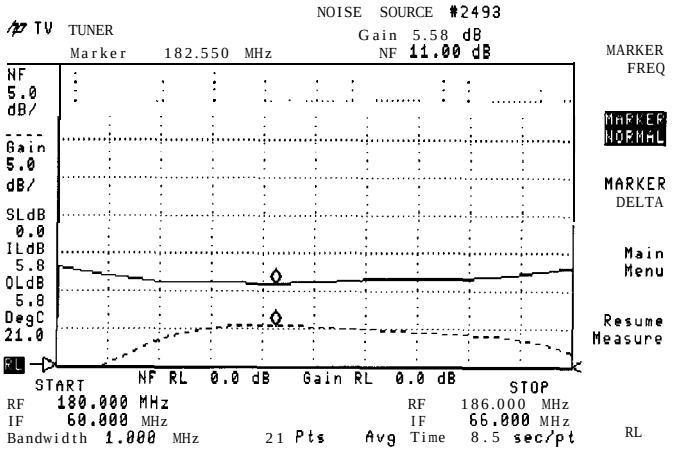


Figure 2.17. TV-Tuner Measurement Results Example

Menu Key Descriptions

Menu Key Descriptions

This chapter is a reference that contains the measurement personality menu map and the menu key descriptions. Refer to Chapter 2, “Making Measurements” for specific measurement procedures that use these keys.

The main menu of the personality is illustrated in Figure 3-1 below.

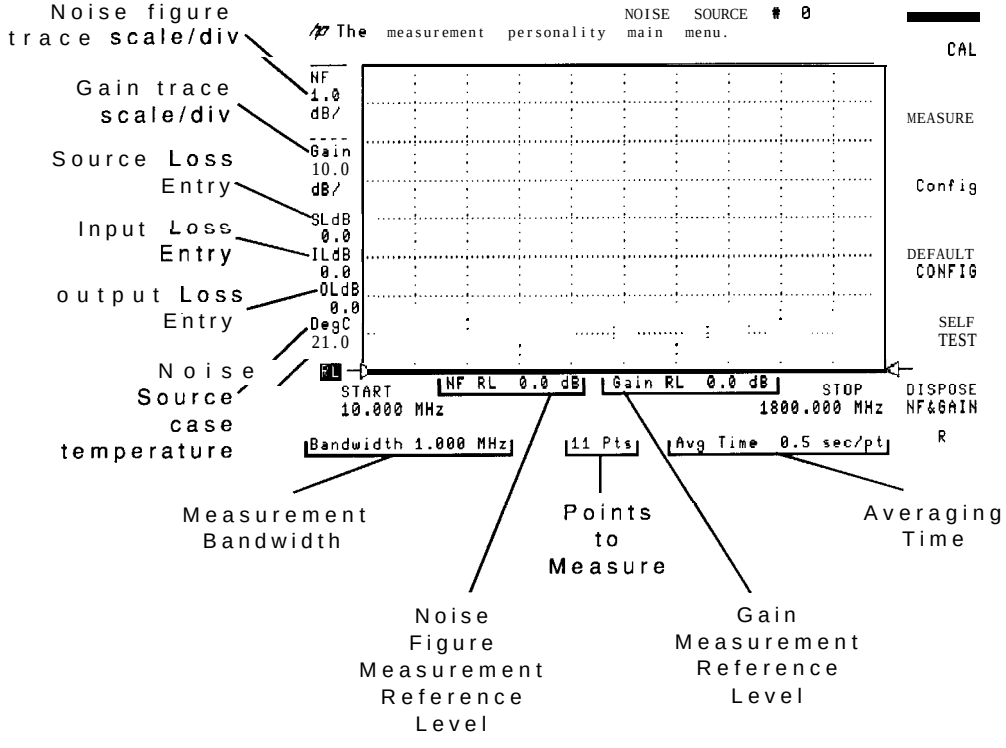


Figure 3-1. The Measurement Personality Main Menu

Menu Map

The menu map of the HP 85719A Noise Figure Measurements Personality illustrates menu flow with both solid and dotted lines.

- The dotted lines represent paths to menus or keys that appear when parameter conditions require them. As an example, the Test Limit key is available only when the number of points equals 1. If frequency conversion is set to YES, additional keys are displayed to accommodate the frequencies needed for making converter measurements.
- The solid lines represent the default configuration menu paths.

Menu Map

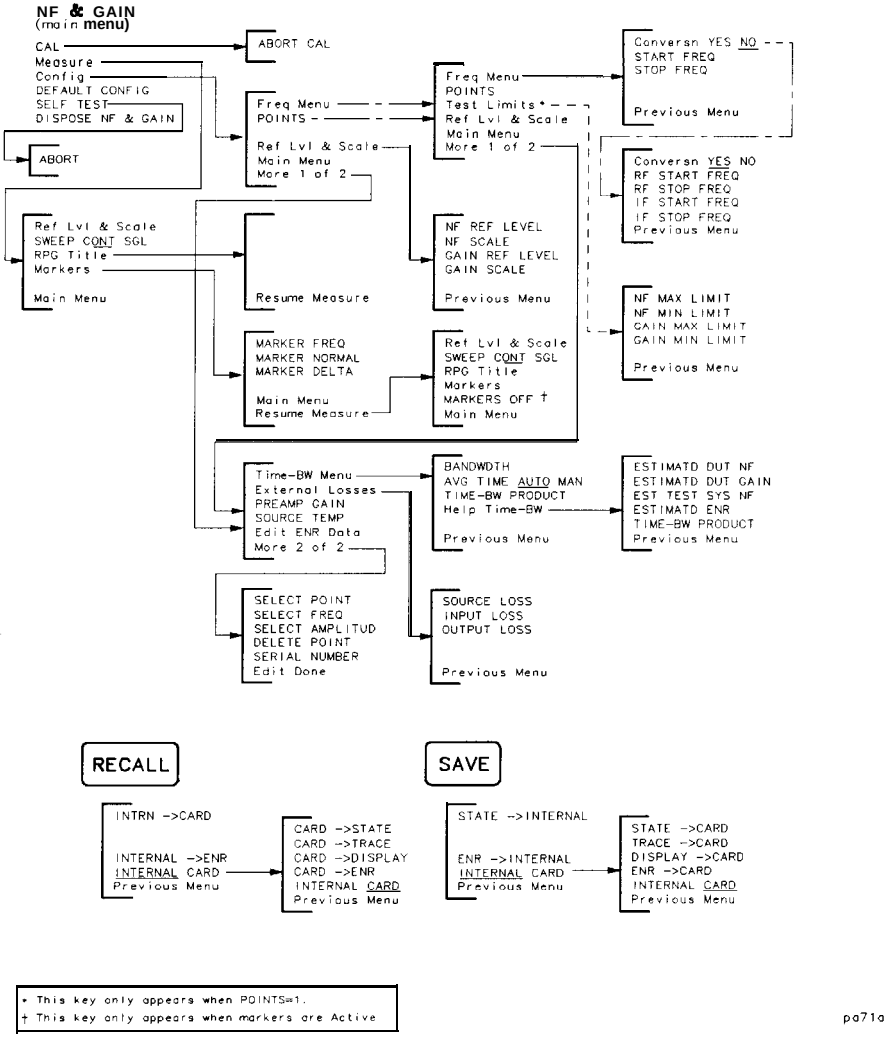


Figure 3-2. The NF & Gain Personality Menu Map

Menu Key Descriptions

In this section, in alphabetical order, the menu keys are listed and described. Refer to the previous illustration in Figure 3-2 for the location of the HP 85719A Noise Figure Measurements Personality keys.

Refer to Figure 3-1 for an illustration of the personality's main menu.

ABORT CAL

Select this key in the CAL menu to interrupt the measurement-setup calibration.

AVG TIME AUTO MAN

Select this key in the time-BW menu to set the averaging time. You can use the average-time value to reduce the effects of jitter on measurement repeatability. The longer the average time, the better the jitter reduction. The range of values is from 100 ms to 999 s; the default setting is AUTO and 100 ms. The ⇧ and ⇩ keys increment time in 0.1 second when the value is less than 1.0 second. The step increments above 1.0 second are 1 .O second.

When AVG TIME AUTO is selected, the average time value is coupled with the measurement bandwidth value. As a result,a time-bandwidth product is calculated.

When AVG TIME MAN is selected, you can change the length of measurement time for each point without changing the time-BW product.

BANDWDTH

Select this key to display or change the measurement resolution bandwidth.

CAL

Select this key in the main menu to calibrate the noise-figure and gain measurement setup. To measure device gain, system calibration must be completed. You can measure the noise figure of a device without calibrating the system, however, additional errors occur in the measurement results. The setup must include the preamplifier, noise source, adapters, and any other hardware

Menu Key Descriptions

that remains in the test setup during device measurements. Corrections entered with the INPUT LOSS and OUTPUT LOSS keys should not be included.

For calibrated measurements, changing a measurement parameter (re-configuring) requires a new calibration, except for those listed in the note at the bottom of page 2-30. Remove the DUT from the setup before recalibration.

NOTE

The front-panel (CAL) key is available anytime during the noise figure and gain measurements to calibrate the system for accurate noise figure measurements. The gain trace does not appear until the measurement system is calibrated.

The calibration data is used to calculate the corrected noise figure and gain results. When a calibration is performed, the noise is measured for each selected calibration point. The calibration points are equally spaced between the start- and stop-frequency settings. The number of points and the frequency values are set in the Calibration menu. If these values are changed, recalibration is required for measurement accuracy.

You can change the reference level and scale values during measurements to improve trace readability without re-calibrating the setup.

CARD ⟶ DISPLAY

Select this key from the front-panel (RECALL) key menu when CARD is underlined in INTRNL CARD

Pressing the CARD ⟶ DISPLAY key catalogs the

arrow keys or the RPG to highlight the instrument

display of interest. Use the LOAD FILE key to recall the register contents.

CARD ⟶ ENR

Select this key from the front-panel (RECALL) key menu when CARD is underlined in INTRNL CARD Pressing the CARD ⟶ ENR key catalogs the

registers. Use the arrow keys or the RPG to highlight the ENR data of interest. Use the

CARD ⟶ STATE

Select this key from the front-panel (RECALL) key menu when CARD is underlined in INTRNL CARD Pressing the CARD ⟶ STATE key catalogs the

arrow keys or the RPG to highlight the instrument state of interest. Use the LOAD FILE key to recall

Config

front-panel (CONFIG) configuration menu. Use the configuration menu to set the measurement parameters. With the

scale, RF START and RF STOP frequency, changing configuration settings after calibration is completed

made before resuming measurements. Default configuration settings are listed in Table 3-1 of this

Conversn YES/NO

Select this key in the frequency menu to choose the

is off, or NO Set frequency conversion to YES for testing receivers, mixers, or other frequency

includes IF start- and stop-frequency parameters. The frequency span of the RF and IF values must Table 3-

this section.

Menu Key Descriptions

DEFAULT CONFIG

Select this key in the main menu to restore default configuration parameters. These parameters are listed in Table 3-1 on the following page:

Table 3-1. Noise Figure and Gain Default Parameters

Parameter	Range	Default Setting
Average Time	100.0 msec to 999.0 sec	0.5 sec/pt, and Auto mode
Bandwidth	1.0 kHz to maximum spectrum analyzer resolution bandwidth	1.0 MHz
Conversion IF Start Frequency	Frequency range of spectrum analyzer	1.45 GHz
Conversion IF Stop Frequency	Frequency range of spectrum analyzer	950.0 MHz
Conversion RF Start Frequency	0.0 Hz to 999.0 GHz	3.70 GHz
Conversion RF Stop Frequency	0.0 Hz to 999.0 GHz	4.20 GHz
ENR Table Data	1 to 79 data points (the 80th data point is reserved for program use)	15.0 dB (all frequency points)
Estimated DUT Gain	-99.90 dB to +99.90 dB	10.0 dB
Estimated DUT NF	0.00 dB to +99.90 dB	5.0 dB
Estimated Test System NF	0.00 dB to +99.90 dB	10.0 dB
Estimated Noise Source ENR	-119.0 dB to 100.0 dB	15.0 dB
Gain Minimum Limit *(For points set to 1)*	-99.90 dB to +99.90 dB	-99.90 dB
Gain Maximum Limit *(For points set to 1)*	-99.90 dB to +99.90 dB	99.90 dB
Gain Reference level	-99.90 dB to +99.90 dB	0.0 dB
Gain Scale	0.10 dB to 99.90 dB	10.0 dB
Input Loss	-99.90 dB to +99.90 dB	0.0 dB
Noise Figure Minimum Limit *(For points set to 1)*	0.00 dB to 99.90 dB	0.0 dB
Noise Figure Maximum Limit *(For points set to ii*	0.00 dB to 99.90 dB	99.90 dB
Noise Figure Scale	0.10 dB to 99.90 dB	2.0 dB/div
Noise Figure Reference Level	-99.90 dB to 99.90 dB	0.00 dB
Noise Source Serial Number	0 to 9999	0
output toss	-99.90 dB to +99.90 dB	0.00 dB
Points	1 to 401	11
Preamplifier Gain	0.0 dB to 99.90 dB	22.0 dB
Start Frequency (non conversion)	Frequency range of spectrum analyzer	10.0 MHz
Stop Frequency (non conversion)	Frequency range of spectrum analyzer	1.8 GHz
Source Case Temperature	—273.0°C to 999.0°C	21.0°C
Source Loss	-99.90 dB to +99.90 dB	0.00 dB
Time-BW Product	1 to 16,000 kHz—s, or 1 to 999 x BW (in kHz), whichever is less	500 kHz—sec

Menu Key Descriptions

DELETE POINT

Select this key in the edit ENR data menu to delete the highlighted ENR data from the table displayed. The segment highlighted is deleted and the list of points is automatically renumbered.

DISPLAY ⟶ CARD

Select this key from the front-panel (SAVE) key menu when CARD is underlined in INTRNL CARD

Pressing the DISPLAY ⟶ CARD key saves the display to the memory card.

DISPOSE NF&GAIN

Select this key in the main menu to erase the noise figure and gain DLP from spectrum analyzer memory.

Edit Done

Select this key in the edit ENR data menu when you have finished editing ENR data and have saved the edited data in a table. The Edit Done key returns you to the previous noise figure and gain measurement menu. The edited ENR data is then used until it is replaced by the next edit or recall ENR data.

Presetting the instrument or cycling its power does not cause new ENR data to be used. If desired, use the front panel (SAVE) key to store the table in either a memory card or spectrum analyzer register.

Edit ENR Data

Select this key in the configuration (more 1 of 2) menu to display the ENR (excess noise ratio) data tables for review or editing. Up to 79 data points can be saved in memory (the 80^{th} register is used by the measurement personality for the noise source serial number).

You can edit any ENR data table saved in internal or card memory. The ENR calibration factors for a noise source are used in measurement calculations to improve the accuracy of the noise figure and gain measurements.

ENR ⟶ CARD

Select this key from the front-panel (SAVE) key menu when CARD is underlined in INTRNL CARD .

	Pressing the ENR ⟶ CARD key saves the ENR data to a register you choose.
ENR ⟶ INTRNL	Select this key from the front-panel (SAVE) key menu when INTRNL is underlined in INTRNL CARD . Pressing the ENR ⟶ INTRNL key saves the ENR data to a specified spectrum analyzer memory register.
ESTIMATD DUT GAIN	Select this key in the help Time-BW menu to display or change the device-under-test estimated gain value. If loss corrections are entered, do not include them again in estimated DUT gain values. The loss value is automatically included as part of the repeatability calculations. The resulting repeatability value is displayed on the spectrum analyzer screen.
ESTIMATD DUT NF	Select this key in the help Time-BW menu to access the device-under-test estimated noise figure value. The value of the DUT noise figure is used in the Help Time-BW menu repeatability calculator. Input loss and output loss effects are included automatically.
ESTIMATD ENR	Select this key in the Help Time-BW menu to access the estimated ENR value. The averaged ENR value is acceptable. The amount of (if any) noise source input loss is subtracted automatically from the estimated ENR factor.
EST TEST SYS NF	Select this key in the Help Time-BW menu to display or change the estimated test system noise-figure value. The loss present (if any) at the system input during calibration needs to be included.
External Losses	Select this key in the configuration (more 1 of 2) menu to enter loss compensation values associated with the test setup. Determine these losses before setting up for measurements. Losses are due to components such as isolators and cables that are required for making a measurement. The measurement personality applies the loss corrections to the measurement results.

Menu Key Descriptions

Freq Menu	Select this key in the configuration menu to display the frequency settings menu. The menu keys that appear are different for conversion versus non-conversion parameters.
GAIN MAX LIMIT	Select this key, which appears only *if the number* of ***points*** = *1*, in the test limits menu. Select this key to display or change the maximum-gain limit settings. The range of settings is from -99.90 dB to +99.90 dB.
GAIN MIN LIMIT	Select this key, which *appears only* ***if*** *the number* of ***points*** = *1*, in the test limits menu. Select this key to display or change the minimum-gain limit settings. Test limit measurement results are displayed during single-point measurements.
GAIN REF LEVEL	Select this key in the reference level and scale menu to display or change the gain reference level setting for a measurement. The scale range is from 0.10 dB/div to 99.90 dB/div.
GAIN SCALE	Select this key reference level and scale menu to display or change the gain scale setting for a measurement. The scale range is from 0.10 dB/div to 99.90 dB/div.
Help Time-BW	Select this key in the frequency menu to display the repeatability calculator. The calculator can help you determine values to control the measurement repeatability factor.
IF START FREQ	Select this key in the frequency menu when conversion is set to YES. Enter the IF start frequency for frequency conversion measurements. The frequency range corresponds with the upper frequency limit of the spectrum analyzer in use.
IF STOP FREQ	Select this key in the frequency menu when conversion is set to YES. Enter the IF stop frequency for frequency conversion measurements. The frequency range corresponds with the upper frequency limit of the spectrum analyzer in use.

INPUT LOSS	Select this key in the external losses menu to enter the dB loss value located at the input of the device under test. The loss is entered and due to components required in the test setup for making measurements, but the components were *not* included in test-setup calibration.
INTRNL CARD	Select this key from the front-panel (SAVE) or (RECALL) key menus. Pressing the INTRNL CARD key underlines and designates either internal or card as the memory location.
INTRNL ⟶ ENR	Select this key from the front-panel (RECALL) key menu when INTRNL is underlined in INTRNL CARD. Pressing the INTRNL ⟶ ENR key catalogs the internal memory ENR data registers. Use the arrow keys or the RPG to highlight the ENR data of interest. Use the LOAD FILE key to recall the register contents. This ENR data is used for all measurements, until new ENR data is recalled, edited, or saved.
INTRNL ⟶ STATE	Select this key from the front-panel (RECALL) key menu when INTRNL is underlined in INTRNL CARD. Pressing the INTRNL ⟶ STATE key catalogs the internal memory state registers. Use the arrow keys or the RPG to highlight the instrument state of interest. Use the LOAD FILE key to recall the register contents.
Markers	Select this key in the measurements menu to select the marker menu. A new key labeled MARKERS OFF appears after the Markers key is selected. Markers are not activated by pressing Markers , but by pressing any marker-function key in the marker menu.
MARKER DELTA	Select this key in the marker menu to get a delta readout between points along both the noise figure and gain traces. The separate readouts appear in the upper left-hand corner of the display.

Menu Key Descriptions

MARKER FREQ

Select this key in the marker menu to position the marker at a specific frequency. Use the front-panel data keys to enter specific frequency values. Avoid using the RPG as its response time is very slow in this mode. Press the MARKER NORMAL key to use the RPG and get a frequency readout.

MARKER NORMAL

Select this key in the marker menu use normal marker operation. The marker readout appears in the upper left-hand corner of the display. Use the RPG to locate the markers on the trace.

MARKERS OFF

Select this key to turn off the markers on the noise figure and gain traces. This key only appears after markers are activated with the Markers key.

Main Menu

Select this key from the configuration or measurements menu to display the top-level menu of the noise figure and gain measurements personality. The main menu keys are listed below:

- CAL
- Measure
- Config

. DEFAULT CONFIG

. SELF TEST

- DISPOSE NF&GAIN

Measure

Select this key from the main menu, after completing measurement configuration, to measure the noise figure and gain characteristics of a device. Menus that follow allow you to use the marker function to evaluate measurement results. You can also enter a label and store the measurement results in either spectrum analyzer or memory card registers. If measurements are not preceded with a complete calibration, the warning, Calibration needed is displayed. You can either press Measure again to make un-calibrated measurements, or press CAL again and complete the calibration.

Menu Key Descriptions

NOTE

Gain results are not available during un-calibrated measurements.

More 1 of 2

Select this key in the configuration menu to display more configuration choices. The More 1 of 2 key displays the following menu:

- Time-BW Menu
- External Losses
- PREAMP GAIN
- SOURCE TEMP
- Edit ENR Data
- More 2 of 2

More 2 of 2

Select this key in the more 1 of 2 configuration menu to return to the previous configuration menu level.

NFREFLEVEL

Select this key in the reference level and scale menu to display or change the noise Egure reference level setting for a measurement. The scale range is from 0.10 dB/div to 99.90 dB/div.

NF SCALE

Select this key reference level and scale menu to display or change the noise Egure scale setting for a measurement. The scale range is from 0.10 dB/div to 99.90 dB/div.

OUTPUT LOSS

Select this key in the external losses menu to enter loss compensation factors that exist due to devices connected between the output connector of the device under test and the system preamplifier and present during the measurement. These devices include cables and isolators that are attached during the measurement, but *not during calibration*.

Menu Key Descriptions

POINTS

Select this key from the edit ENR data menu to enter the number of frequency points to measure. The values from the points measured are used in noise Egure and gain calculations. You can measure from 1 to 401 points, only certain numbers of points are allowed. The personality sets points to the nearest actual number as listed below:

Number Entered	Actual Number Points Measured
1	1 point
2	2 points
3	3 points
4 to 5	5 points
6 to 7	6 points
8 to 9	9 points
10 to 13	11 points
14 to 18	17 points
19 to 23	21 points
24 to 34	26 points
34 to 45	41 points
46 to 65	51 points
66 to 90	81 points
91 to 150	101 points
151 to 300	201 points
301 to 401	401 points

PREAMP GAIN

Select this key in the help time-BW menu to enter the system preamplifier gain value when other than an HP 87405A preamplifier is used. The range for preamplifier gain is 0.0 dB to 99.90 dB. The default setting is 22.00 dB.

Previous Menu

Select this key to return to a previously displayed menu.

RECALL	Select this front-panel key to recall ENR data, a display, an instrument state, or measurement trace from either the memory card or spectrum analyzer memory.
Ref Lvl & Scale	Select this key in the configuration menu or measurements menu to display the reference level scale menu. Changes to the reference level and scale values during measurements does not require a re-calibration.
Resume Measure	Select this key in the markers menu to continue a measurement after you have used the marker keys or used the RPG title mode.
RF START FREQ	Select this key in the frequency menu when conversion is set to YES. Display or change the RF start frequency value for a measurement. The range of RF frequencies is from 0.0 kHz to 999 GHz.
RFSTOPFREQ	Select this key in the frequency menu when conversion is set to YES. Display or change the RF stop frequency value for a measurement. The range of RF frequencies is from 0.0 kHz to 999 GHz.
RPG Title	Select this key in the measurements menu to display the alpha-numeric title window. Press the front-panel NEXT key after you have entered the title, then press Resume Measure to return to the measurement menu.
SAVE	Select this front-panel key to save a measurement state, a measurement result, a display, or an ENR table in memory. Either a memory card (if one is installed) or the spectrum analyzer memory registers may be used for ENR and state data.
SELECT AMPLITUD	Select this key in the edit ENR data menu to modify an amplitude value.
SELECTFREQ	Select this key in the edit ENR data menu to modify a frequency value.
SELECT POINT	Select this key in the edit ENR data menu to choose a data point in the table displayed.

Menu Key Descriptions

SELF TEST
Select this key to start the DLP self test procedure. The function checks that the noise card hardware is working properly.

SERIAL NUMBER
Select this key in the edit ENR data menu to enter the four digits of the noise source's serial number if desired. The serial number is not used as the label in the memory registers, however it appears on the spectrum analyzer display during measurements when the ENR data is active.

SWEEP SNGL CONT
Select this key in the measurements menu to set the spectrum analyzer to single-sweep or continuous-sweep mode. The single sweep function begins after the existing measurement sweep is completed.

SOURCE LOSS
Select this key in the losses menu to enter the loss compensation factors that exist due to the noise source.

SOURCE TEMP
Select this key in the configuration (more 1 of 2) menu to enter the noise-source case temperature. The range of this parameter is $-273.0°C$ to $999.9°C$. The preset temperature value is $21°C$.

Environmental Temperature Testing

If you are testing devices in extreme temperatures conditions, the value you enter serves as a correction to measurement results.

START FREQ
Select this key in the frequency menu to enter the start frequency setting of a non-frequency conversion measurement. The range of frequencies is from 100 kHz to the upper frequency limit of the spectrum analyzer.

STATE ⟶ CARD

Select this key from the front-panel (SAVE_) key menu when CARD is underlined in INTRNL CARD

Pressing the STATE ⟶ CARD key saves the instrument state on the memory card.

STATE ⟶ INTRNL

Select this key from the front-panel (SAVE) key menu when INTRNL is underlined in INTRNL CARD

Pressing the STATE ⟶ INTRNL key saves the instrument state in the internal memory register that you select.

STOP FREQ

Select this key to enter the stop frequency setting of a non-frequency conversion measurement. The range of frequencies is from 100 kHz to the upper frequency limit of the spectrum analyzer.

Test Limit

Select this key (which only appears when the number of points = 1) in the configuration menu to set minimum and maximum limits for a measurement. The test limit keys are described in this section. The key are listed below:

- GAIN MAX LIMIT
- GAIN MIN LIMIT
- NF MAX LIMIT
- NF MIN LIMIT

Measurements that are made while limits are set, provide results specific to the single frequency point selected. The display indicates whether both the noise figure and gain results pass or fail.

Time-BW Menu

Select this key in the frequency menu to enter time and bandwidth values. Select a measurement bandwidth with the BANDWDTH key that is appropriate for the measurement. The product of the time value multiplied by the measurement bandwidth, can be controlled to effect jitter (measurement repeatability).

If measurement to measurement repeatability is important, use a longer average time (with the AVG TIME key) for measurements. You can also accelerate measurement time by increasing the measurement bandwidth when AVG TIME AUTO is selected.

TIME-BW PRODUCT

Select this key in the configuration or the help time-BW menus to adjust the time-bandwidth product. This product is the average time multiplied by the measurement bandwidth in kilohertz-seconds. Changing the time-BW product while averaging time is set to AUTO mode causes the measurement time to change, but not the measurement bandwidth.

TR & ST-CARD

Select this key from the front-panel (SAVE_) key menu when CARD is underlined in INTRNL CARD

Pressing the TR & ST-CARD key saves the instrument trace and state on the memory card.

4

Specifications, Characteristics, and Verification

Specifications, Characteristics, and Verification

This chapter contains Table 4-1 measurement specifications and characteristics as well as procedures to verify the specifications.

The chapter is organized as follows:

- The table of specifications and characteristics
- The performance verification test

Specifications and Characteristics

All specifications apply over 0-55°C. The Noise Figure and Gain measurement personality specifications are valid after 2 hours of storage at a constant temperature, within the operating temperature range, 30 minutes after the spectrum analyzer is turned on, and after CAL FREQ and CAL AMPTD have been run.

NOTE

These specifications apply when an HP 87405A Preamplifier and a noise source ENR of 14 dB to 16 dB is used with the measurement setup. If other hardware is used, the specifications are not valid.

Table 4-1. Specifications

Specification	Performance limits	Conditions
Noise Figure Measurement		
Range	0 to 25 dB	
Resolution	0.01 dB	
"Instrumentation Uncertainty		For noise figure $\leq$15 dB
	±0.55 dB	Measurement Bandwidth = 3 kHz
	±0.5 dB	Measurement Bandwidth = 1 MHz
*Instrumentation Uncertainty *(typical)*	±0.3 dB	For noise figure $\leq$20 dB Measurement Bandwidth = 3 kHz to 1 MHz
Gain Measurement		
Range	0 to +40 dB	
Resolution	0.01 dB	
"Instrumentation Uncertainty		For noise figure $\leq$15 dB
	±0.65 dB	Measurement Bandwidth = 3 kHz
	±0.5 dB	Measurement Bandwidth = 1 MHz
"Instrumentation Uncertainty *(typical)*	±0.3 dB	Measurement Bandwidth = 3 kHz to 1 MHz
Input		
Frequency Range	10 MHz to 2.9 GHz	When used with HP 8594E Spectrum Analyzer
System Noise Figure	< 12 dB	
Input SWR	< 2:1	
Maximum Svstam Input Power	-45 dBm	At HP 87405A Preamplifier input
Measurement		
Measurement Bandwidth [3 dB Resolution Bandwidths]	1.0 kHz to 3 MHz	
. For [NF + gain] $\leq$35 dB Spectrum analyzer residual responses $\leq$10 x Log [measurement bandwidth in Hz] -160 dBm		

System Performance Verification

The procedure in this section verifies the log scale fidelity of the spectrum analyzer using a noise signal as the source. The specifications are derived from the known performance of the spectrum analyzer hardware.

The HP 85719A measurements personality is not installed during the service DLP, verification procedure. The service DLP file available on the HP 85719A noise figure measurements personality card must be installed before the following verification procedure can be performed.

Service Test Function Keys Descriptions

There are five softkeys associated with the service DLP. After completing the service DLP and installing the HP 85719A measurements personality, an additional service-related key labeled SELF TEST is available. The SELF TEST key is in the main menu of the HP 85719A noise figure measurements personality.

The five service DLP keys, and the SELF TEST key descriptions follow:

28V ON OFF	Press this key to turn the spectrum analyzer's rear-panel +28 Vdc supply on or off. When ON is underlined, the +28 Vdc is activated to supply current to the noise source.
SETUP	Press this key and the program presets the spectrum analyzer, then sets the parameters required for performing the verification test. You enter the resolution bandwidth, the program applies noise corrections to the normal log fidelity corrections, and the + 28 Vdc is activated. Pressing [PRESET] disables the noise corrections.
SYSNOISE	Press this key during the verification procedure to record the spectrum analyzer noise floor before

	making measurements. This data is used in subsequent calculations.
DEVIATN	Press this key to calculate the noise figure and gain accuracy. The verification test determines the largest deviation in adjacent 3 dB steps. The deviation data is entered into the spectrum analyzer, and the resultant calculation is displayed.
SELF TEST	Select this key if the HP 85719A noise figure measurements personality is installed, to initiate an additional self-test procedure. The function checks the current from the rear-panel +28 Vdc supply and checks that the noise card hardware is working properly.
MEASURE	Press this key during the verification test and the spectrum analyzer sweeps, then displays the results of the measurement in dB RL.

Verification Test Description

Performance verification of the spectrum analyzer hardware is achieved by measuring the accuracy of changes in noise power over an input range of -7 dB RL to -60 dB RL in 3 dB steps.

Ultimately, the test Ends the largest deviation between adjacent 3 dB steps. This data is used to calculate the noise accuracy and gain.

The test begins with a large noise signal applied to the spectrum analyzer input. The noise level is reduced 3 dB and the difference in the trace level is measured.

This measurement is achieved with the service DLP included on the HP 85719A noise measurements personality ROM card. System noise errors are measured and incorporated into the final calculations.

Related Spectrum Analyzer Adjustments

Log Scale Fidelity
Cal Attenuator

Equipment required for the measurement

The performance verification test equipment is listed below:

HP 859XE Series Spectrum Analyzer HP 8591E/93E/94E/95E/96E
HP 85719A noise card ..... Option 119
Power Meter (must have averaging) ..... HP 437A or HP 438B
Preamplifier (two required) ..... HP 8447A, Option 011
Low Power Sensor ..... HP 8481D
321.4 MHz Bandpass Filter 9135-0252
Power Splitter ..... HP 11967A
Coaxial, 1 dB Step Attenuator ..... HP 8494A, Option 001
Coaxial, 10 dB Step Attenuator ..... HP 8595A, Option 001
Fixed, 20 dB Attenuator ..... HP 8591A, Option 020
Type-N Interconnect Kit ..... HP 11716A

Cables
50Ω BNC Cable 8120-2682
Type N Cable, 61 cm (24 inches) (five required) . . HP 11500B

Adapters
SMA (m) to Type N (f) 1250-1562
Type N (m) to SMA (m) 1250-1250
Type N (m) to Type N (m) 1250-0778
Type N (m) to BNC (f) 1250-0780

Calibrate the System

Connect the equipment as shown in Figure 4-1. Allow each piece of equipment to warm up according to its manufacturer's documentation.

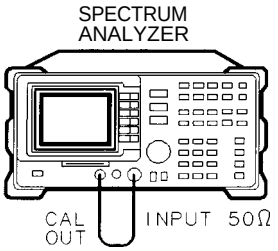


Figure **4-1.** CAL **FREQ** and CAL AMPTD Setup

1. Calibrate the spectrum analyzer.
   - Press the front-panel (PRESET) key, wait for the preset to complete.
   - Press (CAL), then CAL FREQ & AMPTD
   - Wait for the completion of the spectrum analyzer's self-calibration routine (approximately 5 to 10 minutes).
   - Press (CAL STORE) to save the calibration data.
2. Calibrate the measurement system power meter and power sensor.
   - Connect the power sensor to the sensor input connector on the power meter.
   - Zero and calibrate the HP 437A power meter and the HP 8481D power sensor as described in the HP 437A operation manual.

CAUTION Do not calibrate the HP 8481D without the reference attenuator. The reference attenuator prevents damage to the HP 8481D low power sensor.

Load the Service DLP

Delete any previously installed DLPs from user memory.

1. Press the following front-panel keys to purge user memory, then install the service DLP:
   - (CONFIG) and More 1 of 3
   - DISPOSE USER MEM , and again DISPOSE USER MEM
   - (RECALL), INTERNAL CARD , select CARD.
   - Catalog Card.
   - CATALOG ALL
2. Select the file labeled dNFSRVC.
   - Press LOAD FILE and wait for the file to load.
   - Press (MEAS/USER), and again MEAS/USER . The service DLP softkeys should appear on the display.
   - Press +28V ON OFF , and select ON.

Measure the Noise Level at 1 MHz RBW

Connect the equipment as shown in Figure 4-2.

Notice that the 20 dB attenuator is connected temporarily between the power splitter and the power sensor. The power sensor is later connected directly to the power splitter.

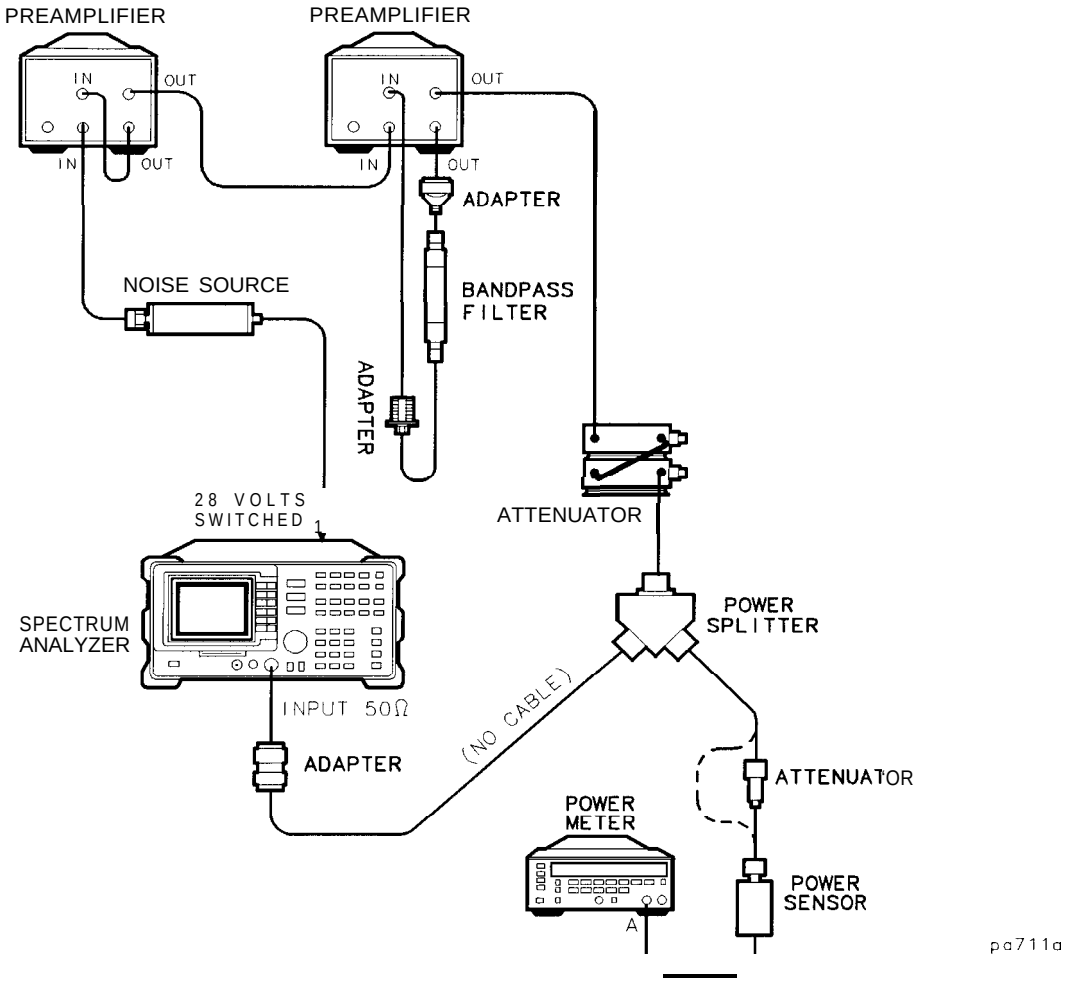


Figure **4-2.** Noise Figure and Gain Accuracy Test Setup

Check the power level output of the noise source in the test setup.

1. Set both attenuators to 0 dB attenuation. Check that the power level reading on the power meter is -26 dBm ±10 dB. This power level ensures that the power output from the last amplifier is 0 dBm ±10 dB.
2. Adjust the step attenuators for a -25 dBm ±1 dB reading on the power meter. Record the attenuator settings in Columns 1 and 2 of Figure 4-3.

3. Press SETUP Wait for the completion of the setup routine. Enter 1 MHz when prompted for the bandwidth.

Check the system noise level.

4. Set the HP 8495A attenuator to 120 dB, press SYSNOISE , then read the system noise level.

> NOTE
>
> The SYSNOISE readout should be <-57 dB RL to achieve optimum results.

5. Return the HP 8495A attenuator to the values determined in step 2.

Measure the change in noise level between attenuator settings.

6. Press MEASURE , then record the value displayed on the spectrum analyzer screen in Figure 4-3, column 3, as the Noise Level Readout in dB RL.

7. On the power meter, press (REL). The power meter readout should be 0 dB.

   You may need to press (REL) two times to ensure a 0 dB readout.

> NOTE
>
> If the reading on the power meter is unstable, you may need to use power-meter averaging. Press (MNL FILTER), and enter a value (such as 5) to enable power-meter averaging.

8. Increment the step attenuators 3 dB and record the attenuator settings in Figure 4-3, columns 1 and 2.

9. Record the absolute value of the power meter reading to 2 decimal places as the Power Meter Readout in Figure 4-3, Column 5.
10. Repeat steps 6 through 9 until the total attenuator setting equals 30 dB.
11. Remove the 20 dB fixed attenuator from the power sensor and connect the power sensor directly to the power splitter.
12. Press (REL) to establish a new power meter reference, then continue making measurements as before.

    Stop making measurements just before the Noise Level Readout on the spectrum analyzer measures less than -60 dB RL.

    As an example:

    If the **Noise Level** Readout is -58.2 **dB** RL, stop testing because the next **Noise Level Readout would be <-60 dB** RL.

Enter the measured results into the Figure 4-3 as explained in the steps and illustrated in the example table below:

1. Begin with the value of the first measurement in Column 3, "Noise Level Readout."
2. Subtract the first measurement value from the second measurement value recorded in Column 3.
3. Enter the resulting difference into column 4, "Change in Noise Level."
4. Subtract the second reading recorded in Column 3, "Noise Level Readout" from the third reading. Again, record the resulting difference in Column 4.
5. Continue finding adjacent-measurement differences and recording the results in column 4. As an example:

   If the first "Noise Level" measurement = -7.20 **dB RL,**
   and the second "Noise Level" measurement = -10.28 **dB** RL
   the resulting "Change in Noise Level" = 3.08 **dB**

Example of the Noise Level Worksheet for RBW 1 MHz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Attenuator Settings	1 **dB** Attenuator Settings	Noise level Readout	Change in Noise level	power Meter Readout	Deviation between Adjacent Steps
(dB)	**(dB)**	**(dB RL)**	**(dB)**	**(dB)**	**(dB)**
				____ REF _ _	____ N/A ____

Find the deviation between adjacent steps.

1. Subtract the absolute value recorded in "Power Meter Readout," Column 5, from the absolute value recorded in "Change in Noise Level," Column 4.
2. Record the absolute value of the results in Column 6 as the "Deviation Between Adjacent Steps. "
3. Find the value of the largest change in Column 6 of "Deviation Between Adjacent Steps" and record as the LARGEST DEVIATION below:

   LARGEST DEVIATION _____ dB

4. Press **DEVIATN** . Use the front-panel DATA keys and enter the LARGEST DEVIATION value, then press ENTER.

   The display readout should be within the following limits:

   NF ERROR >-0.5 _____ < 0.5 dB, ±0.08 dB uncertainty
   GAIN ERROR >-0.5 _____ <0.5 dB, ±0.08 dB uncertainty

Table 5-1. Noise Level Worksheet. RBW 1 MHz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Atten Settings (dB)	1 dB Atten Settings (dB)	Noise Level Readout (dB RL)	Change in Noise Level (dB)	Power Meter Readout (dB)	Deviation in Adj Steps (dB)
				REF	N/A

Figure 4-3. Noise level Worksheet, RBW 1 MHz

Measure the Noise Level at 3 kHz RBW

Connect the equipment as previously shown in Figure 4-2.

Notice that the 20 dB attenuator is connected temporarily between the power splitter and the power sensor. The power sensor is later connected directly to the power splitter.

1. Adjust the step attenuators for a -25 dBm ±1 dB reading on the power meter. Record the attenuator settings in Columns 1 and 2 of Figure 4-4.
2. Press **SETUP** Wait for the completion of the setup routine.
3. Enter 3 kHz when prompted for the bandwidth.

Check the system noise level.

4. Set the HP 8495A attenuator to 120 dB, press SYSNOISE , then read the system noise level.

> NOTE
>
> The SYSNOISE readout should be <−57 dB RL to achieve optimum results

5. Return the HP 8495A attenuator to the values determined in step 2.

Measure the change in noise level between attenuator settings.

6. Press **MEASURE** , then record the value displayed on the spectrum analyzer screen in Figure 4-3, column 3, as the Noise Level Readout in dB RL.
7. On the power meter, press (REL). The power meter readout should be 0 dB.

   You may need to press (REL) two times to ensure a 0 dB readout.

NOTE

If the reading on the power meter is unstable, you may need to use power-meter averaging. Press (MNL FILTER), and enter a value (such as 5) to enable power-meter averaging.

8. Increment the step attenuators 3 dB and record the attenuator settings in Figure 4-3, columns 1 and 2.
9. Record the absolute value of the power meter reading to 2 decimal places as the Power Meter Readout in Figure 4-3, Column 5.
10. Repeat steps 6 through 9 until the total attenuator setting equals 30 dB.
11. Remove the 20 dB fixed attenuator from the power sensor and connect the power sensor directly to the power splitter.
12. Press (REL) to establish a new power meter reference, then continue making measurements as before.

    Stop making measurements just before the Noise Level Readout on the spectrum analyzer measures less than -60 dB RL.

Enter the measured results into the Figure 4-4. Refer to the following steps:

1. Begin with the value of the first measurement in Column 3, "Noise Level Readout. "
2. Subtract the first measurement value from the second measurement value recorded in Column 3.
3. Enter the resulting difference into column 4, "Change in Noise Level."
4. Subtract the second reading recorded in Column 3, "Noise Level Readout" from the third reading. Again, record the resulting difference in Column 4.
5. Continue finding adjacent-measurement differences and recording the results in column 4.

Find the deviation between adjacent steps.

1. Subtract the absolute value recorded in "Power Meter Readout, " Column 5, from the absolute value recorded in "Change in Noise Level," Column 4.

2. Record the absolute value of the results in Column 6 as the "Deviation Between Adjacent Steps."
3. Find the value of the largest change in Column 6 as the "Deviation between Adjacent Steps" and record the LARGEST DEVIATION below:

   LARGEST DEVIATION _____ dB

4. Press DEVIATN Use the front-panel DATA keys and enter the value recorded above, then press ENTER.

The display readout should be within the following limits:

NF ERROR >-0.55 _____ <0.55 dB, ±0.08 dB uncertainty
GAIN ERROR >-0.65 _____ <0.65 dB, ±0.08 dB uncertainty

Purge the service OLP from memory

At the completion of the verification procedure, remove the DLP from user memory.

1. Press (PRESET) to purge the noise-correction values from memory.
2. Press (CONFIG), then More 1 of 3 .
3. Press DISPOSE USER MEM , and again DISPOSE USER MEM to remove the service DLP from user memory.

Table 5-2. Noise Level Worksheet, RBW 3 MHz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Atten Settings	1 dB Atten Settings	Noise Level Readout	Change in Noise Level	Power Meter Readout	Deviation in Adj Steps
(dB)	(dB)	(dB RL)	(dB)	(dB)	(dB)
				___ REF ___	___ N/A ___

Figure 4-4. Noise level Worksheet, RBW 3 kHz

If Verification Fails

If the verification test does not pass, refer to the following tips:

- Be sure that the spectrum analyzer self-calibration routines were completed just prior to running the verification test.
- Leave the amplifiers on overnight and just before beginning service testing, if possible. A small change in temperature can cause a large change in noise amplitude.
- Be sure the spectrum analyzer has been powered on for 2 hours at a stable, ambient temperature before beginning service testing.
- Try to complete the verification test in one sitting.
- Make precise measurements the Erst time since the test is tedious and difficult.
- Use cables that have threaded connectors. BNC cables and connectors lack noise immunity and can introduce random noise unrelated to the device under test.

If You Have a Problem . . .

If You Have a Problem . . .

This chapter contains a table of several messages that you may encounter as you use the measurement personality. Depending on your measurement complexity, additional messages may occur that are not listed here. If necessary, contact any sales and service representative listed in Chapter 1, Table l-l, HP Sales and Service Offices.

Information about packaging and general problem with suggested solutions are also included.

Measurement Personality Messages

The messages in Table 5-1 provide information to you and typically appear during measurement personality operation.

Table **5-1.** Measurement Personality Information Messages

Message Displayed (alpha order)	Description
Calibrating	The calibration routine is beginning. The massage identifies the beginning.
Calibration done. Ready to measure DUT.	This massage appears when system calibration is finished. Connect the device to be tasted and begin making measurements.
Calibration not valid. System NF correction will not be applied.	This massage warns you that if certain measurement parameters are modified, the correction data no longer applies. You can continua measuring noise figure however no gain measurement is made.
Computing new LOG corrections. Please wait	Following a new spectrum analyzer calibration, the measurement personality calculates new correction values. This massage identifies that there is a time lapse.
Connect noise source. Press the key again to begin calibration.	Connect the noise source output to the INPUT 50Ω connector on the system preamplifier and calibrate the system.
DLP will be disposed! Press the key again if you are sure.	Pressing the DISPOSE key in a down-loadabla program erases the DLP from memory.

Table **5-1.** Measurement Personality Information Messages (continued)

Message Displayed (alpha order)	Description
ENR data recalled	You have recalled ENR data from memory.
ENR data saved	You have saved ENR data in memory.
ENR data selected	You have chosen ENR data.
Excessive gain or signal present	The measurement personality has encountered a signal that is above the expected measurement range. If the DUT gain is in excess of the specifications in Table 4-1, attenuate its output and enter the output loss correction. If a spurious signal is present, eliminate the signal or change the frequency range o points to "miss" the signal. If your measurement is at low frequencies, chose a narrow enough measurement bandwidth to avoid the 0 Hz spectrum analyzer LO feedthrough signal. You can also press the front-panel (MODE) key, switch to spectrum analyzer mode, and evaluate the information in the signal you are measuring. Press (MODE) again to return to the noise figure measurement menu you were using.
Inadequate system gain. Check connections and/or preamp gain for error.	The probe power connector on the preamplifier needs connected into the PROBE PWR input on the front panel on the spectrum analyzer or the preamplifier gain value is entered incorrectly.
INVALID CARD: TYPE	Make sure the memory card is installed correctly and is the right one.
Invalid frequencies! RF start-stop span nust equal IF Start-stop span.	The RF stop and start frequency span is different from the IF start and stop span. These must be the same.

Table 5-1. Measurement Personality Information Messages (continued)

Message Displayed (alpha order)	Description
Loading LOG corrections.	Loading the log corrections routine takes a moment. This message identifies that time lapse.
Newer firmware required: *REV 26.08.92* or later.	The firmware in the spectrum analyzer does not support the noise figure end gain measurements DLP.
Noise card failed	The noise-source drive option card has exhibited trouble.
Noise card not installed	Make sure the noise-source drive option card is properly installed.
Noise card passed	The noise-source drive option card is functioning properly.
Noise signal not found	The noise source signal is not present during the self-test routine.
SAVE LOCK ON!!	The internal memory (SAVE LOCK) is locked.
SAVE: REG	You have saved to memory.
Setting configuration to default	The default settings for the measurement personality are being recalled for use

Table **5-1.** Measurement Personality Information Messages (continued)

Message Displayed (aloha order)	Description
Single frequency mode. Test limits may be entered.	When points=l, you can enter test limits for the measurement. Refer to the nenu key descriptions for more information.
State recalled	you have recalled a state from memory.
State saved	you have saved the instrument state.
Testing noise card	The noise-source drive option card operation is getting tested.
Traces % state recalled	You have recalled a state end traces from memory.
Traces & state saved	You have saved traces and the associated state
Warning! Recalibration needed if measurement parameters are changed.	When you went to measure calibrated noise figure end gain, any configuration parameters changes made prior to or during a measurement, requires that you repeat the noise figure end gain calibration routine. However, you can measure noise figure without recalibrating, but not gain.

Returning the Instrument for Service

In the event that you need to return your spectrum analyzer to the factory for service on the noise figure and gain measurement personality, refer to the steps below:

- Record any error messages that were displayed and enclose a copy of this information with the instrument being returned.
- Fill in a blue service-repair card located at the end of this chapter. Enclose the card with the instrument being returned.
- Repackage the HP 85719A measurements personality memory card and spectrum analyzer in the original packaging materials, or with commercially available materials described in the following steps:

  1. Wrap the instrument in anti-static plastic to reduce the potential of electrostatic discharge damage.
  2. Use the original materials or a strong shipping container that is double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength. The carton must be both large enough and strong enough to accommodate the instrument and allows at least three to four inches on all sides for packaging materials.
  3. Surround the instrument with at least three to four inches of packaging material, or enough to prevent the instrument from shifting within the carton.

     If packaging foam is unavailable, the best alternative is SD-240 Air Cap™ from Sealed Air Corporation in Commerce, CA 90001. The pink-colored Air Cap does not contribute to static charge.

     Wrap the instrument several times in this material to both protect the instrument and prevent shifting within the carton.

- Seal the shipping container with strong nylon adhesive tape.
- Mark the shipping container "FRAGILE, HANDLE WITH CARE" to encourage careful handling.
- Retain copies of all shipping papers.
- Ship the instrument to one of the HP sales and service offices listed at the end of Chapter 1, "Getting Started. "

6

Programming

Programming

This chapter is a reference for the HP 85719A Noise Figure and Measurements Personality. It is a command dictionary; commands are organized alphabetically.

The chapter contains the following information:

- Reference Tables
- Syntax Conventions
- Command Reference

Reference Tables

The first reference table is organized according to function. The second table lists all measurement personality commands alphabetically.

Functional Index Table

The functional table groups the commands according to measurement personality function.

To find a programming command that performs a particular function, first refer to the following table where commands are categorized by function. Once the desired command is found in the functional index, refer to the command in the chapter.

Table 6-1. Functional Index

Function Group	Command	Ranges or Description
Calibration	-CAL	Initiate the noise figure and gain measurement setup calibration routine
Configuration Other than frequency end ime-bandwidth control]	-DEFAULTS	Sets all measurement parameters to default values. Refer to Chapter 3 Table 3-1, Noise Figure and Gain Default Parameters, in this guide.
	_ENR	Enter or recall ENR data.
	_CONN	Allows the control of external equipment via the auxiliary interface connector during the noise figure mode or noise figure calibration.
	_FCONV	1 (conversion on); 0 [conversion off) Select or query the frequency conversion mode.
	_PTS	1 to 401 Points. Enter or query the number of frequency points measured.
	_TEMPC	0.0°C to 1000°C Enter or query the noise source case temperature in °C.
Frequency [non-conversion]	_FSTART	Frequency range of spectrum analyzer Enter or query the measurement start frequency value. All frequency values are converted to Hz.
	_FSTOP (non-conversion)	Frequency range of spectrum analyzer Enter or query the measurement start frequency value. All frequency values are converted to Hz.
Frequency Conversion	_IFSTART	0 to 26.5 GHz Enter or query the measurement IF start frequency.
	_IFSTOP	Frequency range of spectrum analyzer Enter or query the measurement IF stop frequency.
	_RFSTART	0.0 Hz to 999 GHz Enter or query the measurement RF start frequency.
	_RFSTOP	0.0 kHz to 999.0 GHz Enter or query the measurement RF stop frequency.

Table 6-1. Functional Index (continued)

Function Group	Command	Ranges or Description
osses	_INLOSS	Enter or query the value of loss that is affixed to the input of the device under test.
	_OUTLOSS	Enter or query the value of loss affixed to the output of the device under test.
	_SLOSS	Enter or query the value of loss value affixed to the output of the nois source used in the measurement.
Measuring	-MEASURE	Initiate the noise figure and gain measurement.
	_NFMODE	Activates noise figure mode. Initially required before sending or queryin noise figure and gain measurement commands.
IF Mode Control	_NFMODE	Activates noise figure mode. Initially required before sending or queryin noise figure and gain measurement commands.
Reference Level and Scale	-GLVL	0.00 to 99.90 dB Enter or query the reference level for the gain trace.
	_GSCALE	0.10 to 99.90 dB Enter or query the measurement scale for the gain trace.
	_NFLVL	0.00 to 99.90 dB Enter or query the reference level for the noise figure trace.
	_NFSCALE	0.10 dB to 99.90 dB Enter or query the measurement scale for the noise figure trace in dB/div.
Time-Bandwidth	_AVGTIME	100.0 ms to 999.0 s Enter or query the measurement averaging time value. The value affect the measurement time per measurement point.
	-BW	1.0 kHz to 5 MHz Enter or query the measurement bandwidth.
	-TBW	100 to 100000 Enter or query the time-bandwidth product in kHz—seconds.
	_TBWAUTO	1 [auto-mode selected]; 0 [manual-mode selected] Select or query the time-bandwidth mode.

Alphabetical Reference Table

The following table listing describe the commands available with the noise figure and gain measurements personality.

Prior to using any of the following commands, be sure to send the _NFMODE command to initiate the noise figure measurements mode.

Table 6-2. Commands in Alphabetical Order

Command	Corresponding Key	Description
_AVGTIME	AVG TIME **AUTO/MAN**	Enter or query the measurement averaging time value. The value affec the measurement time per measurement point. The range is from 100.0 ms to 999.0 s.
-BW	BANDWIDTH	Enter or query the measurement bandwidth.
-CAL	CAL	Initiate system calibration.
_CONN	none	Controls external equipment via the auxiliary interface connector during noise figure mode or noise figure calibration.
_ENR	CARD-ENR **INTERNAL⟶ENR**	Enter or recall ENR data.
-DEFAULTS	DEFAULT **CONFIG**	Set all measurement parameters to default values.
_FCONV	Conversion **YES/NO**	Select or query the frequency conversion mode. A query response of 1 indicates frequency conversion is selected; 0 indicates non-conversion is selected.
_FSTART	START FREQ	Enter or query the measurement start frequency value. All frequency values are converted to Hz.
_FSTOP	STOP FREQ	Enter or query the measurement start frequency value. All frequency values are converted to Hz.
_GLVL	**GAIN** REF LVL	Enter or query the reference level for the gain trace.
_GSCALE	GAIN SCALE	Enter or query the measurement scale for the gain trace in dB/div.

Table 6-2. Commands in Alphabetical Order (continued)

Command	Corresponding Key	Description
_IFSTART	IF START FREQ	In frequency conversion mode, enter or query the measurement IF star frequency.
_IFSTOP	IF STOP FREQ	In frequency conversion mode, enter or query the measurement IF stop frequency.
_INLOSS	**INPUT** LOSS	Enter or query the value of loss that is affixed to the input of the device under test.
_LABEL	none	Redraw (refresh) the display annotation, especially following transitions between frequency conversion and non-frequency conversion modes.
-MEASURE	Measure	Initiate the noise figure and gain measurement.
_NFLVL	**NF** REF LEVEL	Enter or query the reference level for the noise figure trace.
_NFMODE	**NF&GAIN**	Activates noise figure mode. Initially required before sending or queryin noise figure and gain measurement commands.
_NFSCALE	NF SCALE	Enter or query the measurement scale for the noise figure trace in d B/div.
_OUTLOSS	OUTPUT LOSS	Enter or query the value of loss affixed to the output of the device under test.
_PTS	POINTS	Enter or query the number of frequency points measured. If the numb of points is set to 1, measurement limits can be entered.
_RFSTART	RF START FREQ	In frequency conversion mode, enter or query the measurement RF star frequency.
_RFSTOP	RF STOP FREQ	In frequency conversion mode, enter or query the measurement RF stop frequency.
_SLOSS	SOURCE LOSS	Enter or query the value of loss value affixed to the output of the nois source used in the measurement.
_TBW	TIME-BW PRODUCT	Enter or query the time-bandwidth product in kHz—seconds.
_TBWAUTO	AVG TIME AUTO/MAN	Select or query the time-bandwidth mode. 1 indicates auto mode; 0 indicates manual mode.
_TEMPC	SOURCE TEMP	Enter or query the noise source case temperature in °C.

Command Syntax Description

Command syntax is represented pictorially as shown in Figure 6-1 below:

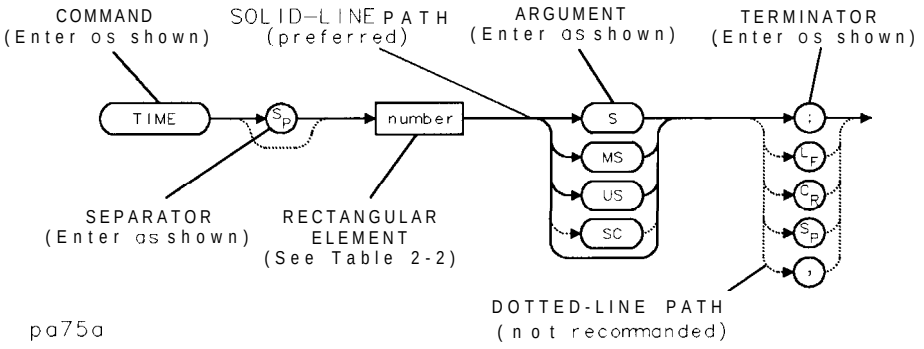


Figure 6-1. Syntax Structure Description

Descriptions of the syntax diagram symbols (or elements) are described below:

- Ovals enclose command mnemonics. The command mnemonic must be entered *exactly* as *shown* in diagrams.
- Circles and ovals surround secondary keywords or special numbers and characters. The characters in circles and ovals are considered reserved words and must be entered *exactly as shown* in diagrams.
- Rectangles surround the description of a syntax element. The element may be parameters, or variables, related to the command. The range of choices is listed in a table accompanying each command.

Syntax diagram elements are connected either with solid or dotted lines

Solid-line paths represent *recommended* command paths. Combinations of elements generated by following the lines in the proper direction, creates syntactically correct commands.

Command Reference

This section contains the alphabetical reference of the commands listed in Table 6-2. Each command description includes a syntax diagram, parameters as appropriate, and sample programs using the HP BASIC command language.

_AVGTIME

Use the _AVGTIME command to enter an averaging time value.

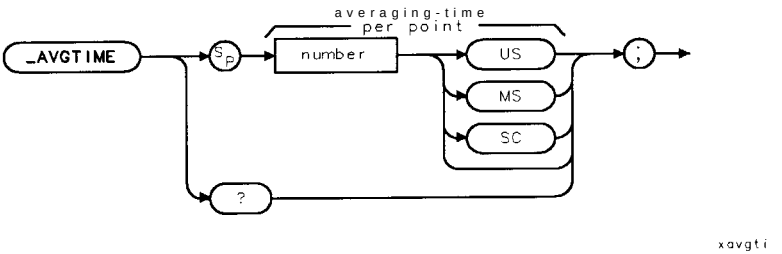


Figure 6-2. **_AVGTIME** Syntax

Item	Description
Default Value	0.5 seconds
Default Units	s [seconds]
Range	0.1 sec to 999.0 sec
Prerequisite Command	_NFMODE
Related Commands	_TBWAUTO, _TBW

Description

When _AVGTIME is set to automatic mode, the averaging time for measurements is automatically determined. The speed of the measurement affects the jitter, or repeatability, of the measurement.

In automatic mode, the time-bandwidth product is divided by the measurement bandwidth to determine the averaging time per point.

In manual mode, just the measurement time is changed, the time-bandwidth value is not recalculated.

Example Program

```
10 OUTPUT 718;"_NFMODE;"          ! Select the noise figure and gain measurements mode.
15 OUTPUT 718;"_DEFAULTS;"        ! Set all measurement configuration parameters to default values.
20 OUTPUT 718;"_TBW 300; _BW 1MHZ;" ! Set the time-measurement bandwidth value to 300, and change the measurement bandwidth to 1 MHz.
30 OUTPUT 718;"_AVGTIME 1;"       ! Set the averaging time to 1 second per measurement point.
40 OUTPUT 718;"_CAL;"             ! Calibrate the measurement setup for the new parameters.
50 OUTPUT 718;"DONE?;"            ! Query the spectrum analyzer for the calibration routine status.
60 ENTER 718;DONE                 ! Get the status condition.
70 DISP "CALIBRATION DONE, PRESS CONTINUE WHEN READY TO MEASURE." ! Display the calibration-done message.
75 PAUSE                          ! Wait for the key to be pressed.
80 OUTPUT 718;"_MEASURE;"         ! Make a calibrated noise figure and gain measurement.
90 END
```

Query Response The response is displayed in seconds.

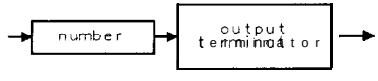


Figure 6-3. _AVGTIME Query Response Syntax

_BW

The -BW command selects or queries the measurement resolution bandwidth.

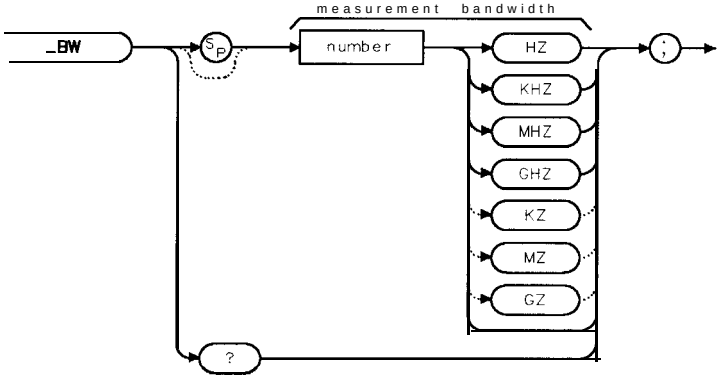


Figure 6-4. _BW Syntax

Item	Description
Default Value	1.0 MHz
Default Units	Hz
Range	1.0 kHz to Maximum spectrum analyzer resolution bandwidth
Prerequisite Command	_NFMODE
Related Commands	_TBWAUTO, -TBW

Description The value of the -BW sets the measurement bandwidth. Changing the measurement resolution bandwidth when _AVGTIME AUTO is selected changes the averaging time. The new sweep time is the time-bandwidth product divided by the measurement bandwidth.

Example Program

```
10 OUTPUT 718;"_NFMODE;"
15 OUTPUT 718;"_DEFAULTS;"
20 OUTPUT 718;"_TBW 300; _BW 1MHZ;"
30 OUTPUT 718;"_AVGTIME 1;"
40 OUTPUT 718;"_CAL;"
50 OUTPUT 718;"DONE?;"
60 ENTER 718;DONE
70 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
75 PAUSE
80 OUTPUT 718;"_MEASURE;"
90 END
```

Select the noise figure and gain measurements mode.

Set all measurement configuration parameters to default values.

Set the time-measurement bandwidth value to 300, and change the measurement bandwidth to 1 MHz.

Set the averaging time to 1 second per measurement point.

Calibrate the measurement setup for the new parameters.

Query the spectrum analyzer for the calibration routine status.

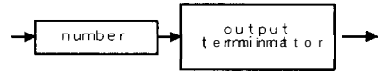
Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

Make a calibrated noise figure and gain measurement.

Query Response The response is displayed in Hz.



qpts

Figure 6-5. -BW Query Response Syntax

_CAL

The -CAL command initiates the system calibration routine.

xcal

Figure **6-6.** -CAL Syntax

Prerequisite Command: -NFMODE

Description Entering the -CAL command initiates the system calibration routine. The device under test is not connected. In addition, all measurement parameters (conversion, RF and IF frequencies, points, and so forth) are entered prior to executing calibration.

Example Program

```
20 OUTPUT 718;"_NFMODE;"          Turn on noise figure measurements personality mode.
30   OUTPUT 718 ;"-DEFAULTS;"     Set all of the measurement parameters to the default values.
40 OUTPUT 718;"_PTS 3;"           Set the number of measurement points to 3.
50   OUTPUT 718;"_CAL;"           Calibrate the measurement setup.
60   OUTPUT 718,"DONE?:.,"        Query the spectrum analyzer for the calibration routine status.
70   ENTER 718;DONE               Get the status condition.
80 DISP "CALIBRATION DONE, PRESS  Display the calibration-done message.
CONTINUE WHEN READY TO MEASURE."
85   PAUSE                        Wait for the key to be pressed.
90 OUTPUT 718; "-MEASURE; "       Make a calibrated noise figure and gain measurement.
100 END
```

_CONN

The _CONN command is used to control external hardware (relays, etc.) via the auxiliary interface connector.

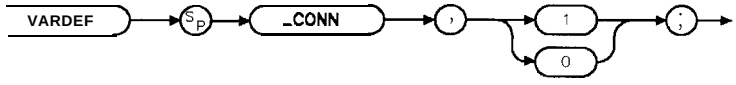


Figure 6-7. **_CONN** Syntax

Related Commands: _NFMODE, -CAL

Description

When the auxiliary interface connector is enabled (VARDEF **_CONN,1;**), the voltage on control line C (CNTLC) is changed to a transistor-transistor logic (TTL) high level when in NFMODE and returns to a low level when in spectrum analyzer mode.

The voltage on control line D (CNTLD) is changed to a TTL high level when a NF calibration is performed and returns to a low level when the calibration is finished.

When the auxiliary interface connector is disabled (VARDEF **_CONN,0;**), the voltage on the control lines will go to a TTL low level after an instrument preset (IP), and will not be affected by the 85719A personality.

_ENR

_ENR is a DLP defined trace containing the noise source ENR (excess noise ratio) table.

Description An ENR table can be entered from an existing table stored in the internal memory or from a table stored on a memory card. A new ENR table can also be entered.

> **NOTE**
>
> If an ENR data table is not entered remotely, either the default table or the table that was last edited, saved, or recalled will be used.

The following procedures should be used to load the the ENR table whenever it is desired to change the ENR data used by the Noise Figure Measurements Personality.

To Recall an Existing ENR Table

To recall an existing ENR table stored in the internal memory, complete the following command line:

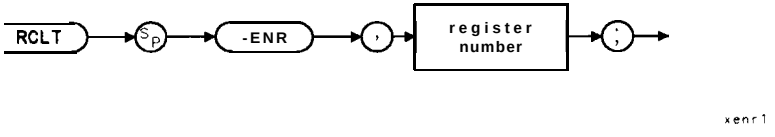


Figure 6.8. **_ENR** Syntax, Recalling Existing Table from Internal Memory

Register number range: 0 to 52

Example Program

```
10 OUTPUT 718;"IP;"                    Presets spectrum analyzer:
20 OUTPUT 718;"RCLT _ENR, 1;"          Loads ENR table from internal, memory.
30 OUTPUT 718;"_NFMODE;"               Enters NF mode.
```

To recall an existing ENR table stored on a memory card, complete the following command line:

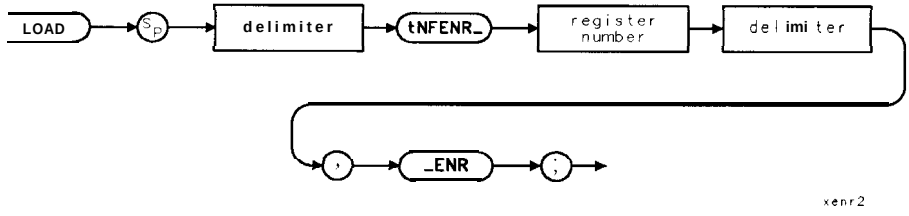


Figure 6-9. **_ENR** Syntax, Recalling Existing Table from Memory Card

Register number range: 0 to 99
Delimiter: Matching characters of the following: ~ | \ @ = / ^ $ % ! ' : " &

Example Program

```
10 OUTPUT 718;"IP;"                    Presets spectrum analyzer:
20 OUTPUT 718;"LOAD %tNFENR_5%, _ENR;" Loads ENR tablefrom memory card register 5.
30 OUTPUT 718;"_NFMODE;"               Enters NF mode.
```

To Create a New ENR Table

To enter a new ENR table, complete the following command line:

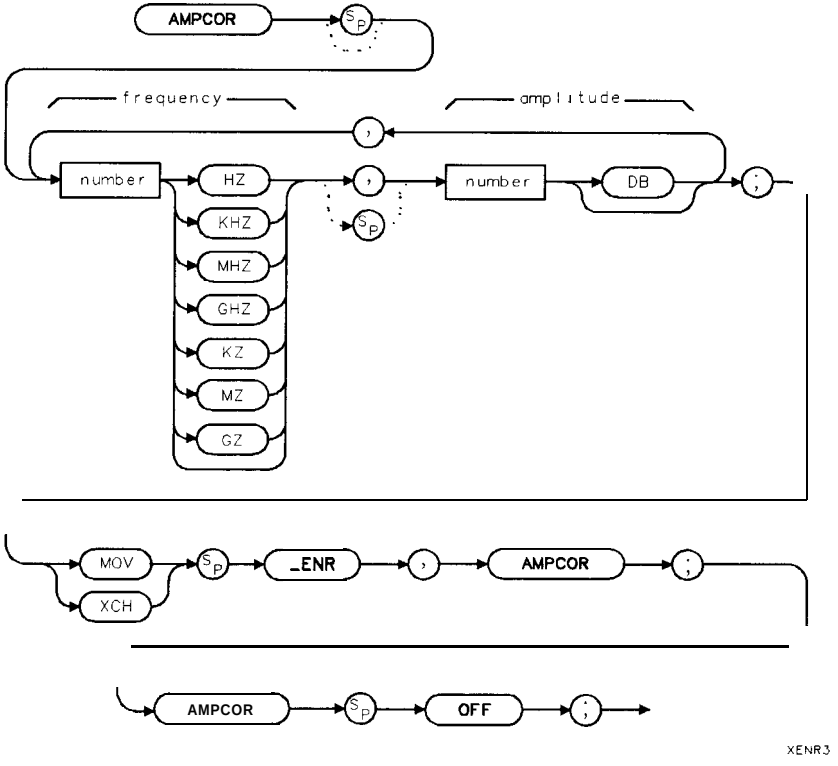


Figure **6-10.** **_ENR** Syntax, Creating a New **_ENR** Table

Number: any real or integer number.

NOTE

The noise source serial number can be stored in _ENR[401].

```
60 OUTPUT 718;"MOV _ENR[401],2493;"
```

Stores serial number 2493.

Example Program

```
10 OUTPUT 718;"IP;"                          Presets spectrum analyzer.
20 OUTPUT 718;"XCH AMPCOR, _ENR;"            Stores previous contents
                                             of AMPCOR in _ENR.
30 OUTPUT 718;"AMPCOR 100MHz,                Storesfrequency-amplitude
15.5dB, 1GHz, 16.6dB, 2GHz, 15.8dB;"         pairs in spectrum ana-
                                             lyzer: Notice that frequen-
                                             cies are in ascending order.
40 OUTPUT 718;"XCH _ENR, AMPCOR;"            Moves ENR table into _ENR
                                             and replaces the previous
                                             AMPCOR contents
50 OUTPUT 718;"AMPCOR OFF;"                  Turns off the amplitude
                                             correction.
60 OUTPUT 718;"MOV _ENR[401], 2493;"         Stores serial number 2493.
70 OUTPUT 718;"_NFMODE;"                     Enters NF mode.
```

_FCONV

Use the _FCONV command to select either frequency conversion mode or non-conversion mode.

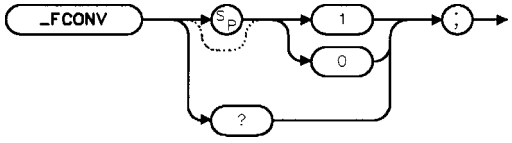


Figure **6-1** 1. **_FCONV** Syntax

Item	Description
Default Value	0 (non-conversion)
Default Units	none
Range	0 or 1
Prerequisite Command	_NFMODE
Related Commands	_LABEL, _FSTART, _FSTOP, _RFSTART, _RFSTOP, _IFSTART, _IFSTOP

Description Use the -FCONV command to select either frequency conversion or non-frequency conversion mode. When frequency conversion mode is selected, the specified RF start and stop frequencies are used to look up ENR data, while the measurement is tuned to the IF frequencies during a measurement.

When non-frequency conversion mode is selected, the ENR data corresponding to the measurement frequency is used.

Following a transition from frequency conversion to non-frequency conversion mode, send the -LABEL command to update (redraw) the screen annotation.

Example Recall ENR datafromthe memory card.

Program

```
20 OUTPUT 718;"_NFMODE;"
30 OUTPUT 718;"_DEFAULTS;"
40 OUTPUT 718;"MSI CARD;"
50 OUTPUT 718;"LOAD tNFENR_33,TRC;"
60 OUTPUT 718;"MOV _ENR,TRC;"
70 OUTPUT 718;"_FCONV 1;"
80 OUTPUT 718;"_LABEL;"
90 OUTPUT 718;"_IFSTART 400MHZ;"
100 OUTPUT 718;"_IFSTOP 600MHZ;"
110 OUTPUT 718;"_RFSTART 650MHZ;"
120 OUTPUT 718;"_RFSTOP 850MHZ;"
130 END
```

Turn on noise figure measurementspersonality mode.

Set all measurement configuration parameters to default values.

Establish the memory card i/o path to recall ENR data from a card.

Recall from a memory card, the ENR data stored as tNFENR, register 33.

Move the ENR data to TRC.

Turn the frequency conversion mode ON.

Redraw display *annotation for frequency conversion mode measurement state.*

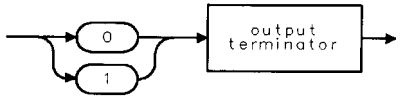
Set the frequency conversion measurement IF start frequency to 400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Query Response The response displays the frequency conversion mode.



QFCONV

Figure 6-12. **_FCONV** Query Response Syntax

_FSTART

Use the _FSTART command to enter the start frequency for non-conversion mode measurements.

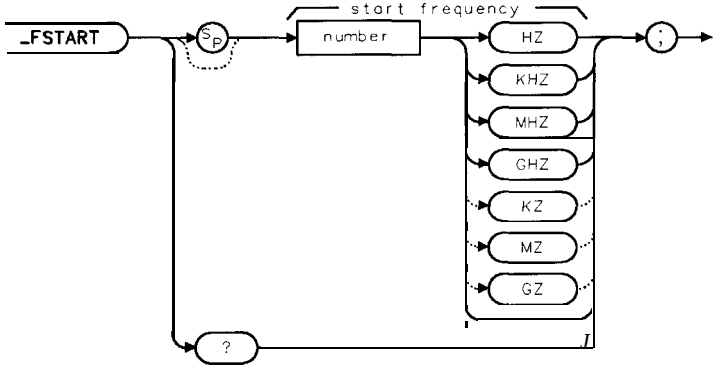


Figure **6-13. _FSTART** Syntax

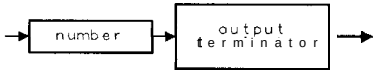
Item	Description
Default Value	10.0 MHz
Default Units	HZ
Range	Spectrum analyzer frequency range
Prerequisite Command	_NFMODE
Related Commands	_FCONV, _FSTOP

Description Use the _FSTART command for non-frequency conversion measurements. Enter or query the start frequency. The start frequency is typically the lowest frequency of the device under test.

Example Program

```
20 OUTPUT 718;"_NFMODE;"          Turn on noisejigure measurements personality mode.
30 OUTPUT 718;"_DEFAULTS;"        Set all measurement configuration parameters to default values.
40 OUTPUT 718;"_FSTART 300MHZ;"   Set the non-conversion mode start frequency to 300 MHz.
50 OUTPUT 718;"_FSTOP 1200MHZ;"   Set the non-conversion mode stop frequency to 1200 MHz.
60 END
```

Query Response The response displays the start frequency value in Hz.



QFSTAR

Figure 6-14. _FSTART Query Response Syntax

_FSTOP

Use the _FSTOP command to enter the stop frequency for non-conversion mode measurements.

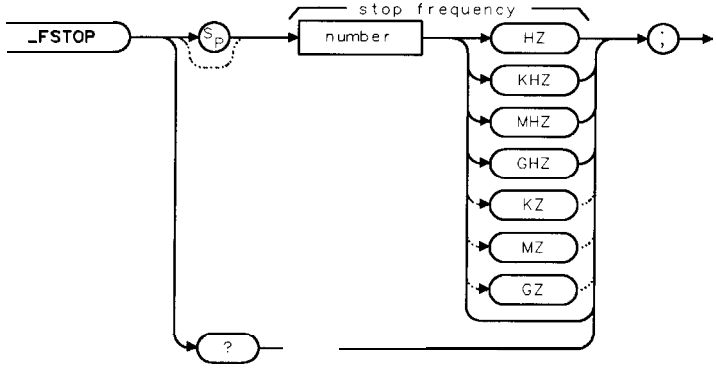


Figure 6-15. _FSTOP Syntax

Item	Description
Default Value	*1.8* GHz
Default Units	Hz
Range	Spectrum analyzer frequency range
Prerequisite Command	_NFMODE
Related Commands	_FSTART, _FCONV

Example Program

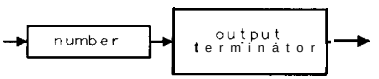
```
20 OUTPUT 718;"_NFMODE;"
30 OUTPUT 718; "-DEFAULTS;"
40 OUTPUT 718; "_FSTART 300MHZ;"
50 OUTPUT 718; "_FSTOP 1200MHZ;"
```

Turn on noise figure measurements person&it y mode.
Set all measurement configuration parameters to default values.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.

```
60 END
```

Description Use the _FSTOP command for non-frequency conversion measurements. Enter or query the stop frequency. The stop frequency is typically the highest frequency of the device under test.

Query Response The response displays the stop frequency value in Hz.



QFSTOP

Figure **6-16. _FSTOP** Query Response Syntax

_GLVL

Use the _GLVL command to set the reference level for the gain measurement results.

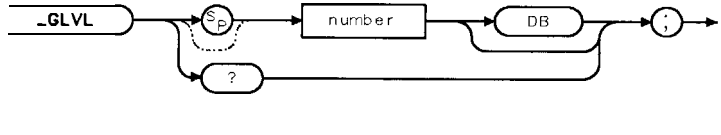


Figure 6-17. **_GLVL** Syntax

Item	Description
Default Value	0.00 dB
Default Units	dB
Range	-99.90 dB to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_GSCALE, _NFLVL, _NFSCALE

Description Use the _GLVL command to set or query the gain measurement reference level. Changing the reference level does not affect system calibration, therefore, it can be adjusted after calibration.

Example Program

```
10   OUTPUT 718;"_NFMODE;"
20 OUTPUT 718; "-DEFAULTS;"
30  OUTPUT 718;"_PTS 3;"
40   OUTPUT 718;"_FSTART 300MHZ;"
50  OUTPUT 718; "_FSTOP 1200MHZ;"
```

Turn on noise figure measurements personality mode.
Set all measurement configuration parameters to default values.
Set the number of measurement points to 3.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.

```
60 OUTPUT 718;"_CAL;"                                  Calibrate the measurement
                                                       setup.
70 OUTPUT 718;"DONE?;"                                 Query the spectrum ana-
                                                       lyzer for the calibration
                                                       routine status.
80 ENTER 718;DONE                                      Get the status condition.
90 DISP "CALIBRATION DONE, PRESS                       Display the calibration-
CONTINUE WHEN READY TO MEASURE."                       done message.
100 PAUSE                                              Wait for the key to be pressed.
110 OUTPUT 718;"_MEASURE;"                             Make a calibrated noise
                                                       figure and gain measurement.
120 OUTPUT 718;"_GLVL 10DB; _GSCALE 5DB;"              Set the gain trace refer-
                                                       ence level to 10 dB. Set the
                                                       scale for the gain trace to
                                                       5 dB.
130 END
```

Query Response The response displays the current gain reference level value.

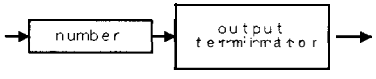


Figure 6-18. _GLVL Query Response Syntax

_GSCALE

Use the _GSCALE command to set the reference level for the gain measurement results.

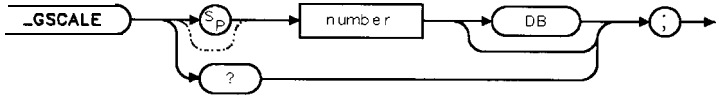


Figure **6-19. _GSCALE** Syntax

Item	Description
Default Value	10.0 dB
Default Units	dB
Range	0.10 dB to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_GLVL, _NFLVL, _NFSCALE

Description Use the _GSCALE command to set or query the display scale for the gain measurement. Changing the scale does not effect system calibration; therefore, it can be adjusted during the measurement.

Example Program

```
20 OUTPUT 718; "_NFMODE;"
30  OUTPUT 718;"-DEFAULTS;"
40 OUTPUT 718;"_PTS 3;"
50 OUTPUT 718; "_FSTART 300MHZ;"
60 OUTPUT 718;"_FSTOP 1200MHZ;"
```

Turn on noise figure measurements personality mode.
***Set all** measurement configuration parameters to default values.*
Set the number of measurement points to 3.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.

```
70 OUTPUT 718;"_CAL;"                                  Calibrate the measurement
                                                       setup.
80 OUTPUT 718;"DONE?;"                                 Query the spectrum ana-
                                                       lyzer for the calibration
                                                       routine status.
90 ENTER 718;DONE                                      Get the status condition.
100 DISP "CALIBRATION DONE, PRESS                      Display the calibration-
CONTINUE WHEN READY TO MEASURE."                       done message.
105 PAUSE                                              Wait for the key to be pressed.
110 OUTPUT 718;"_MEASURE;"                             Make a calibrated noise
                                                       figure and gain measurement.
120 OUTPUT 718;"_GLVL -10DB; _GSCALE 5DB;"             Set the gain trace refer-
                                                       ence level to -10 dB. Set
                                                       the scale for the gain trace
                                                       to 5 dB.
130 END
```

Query Response The response displays the current scale value.

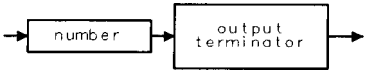


Figure 6-20. _GSCALE Query Response Syntax

_IFSTART

Use the _IFSTART command to enter the IF start frequency for a frequency-conversion noise figure and gain measurement.

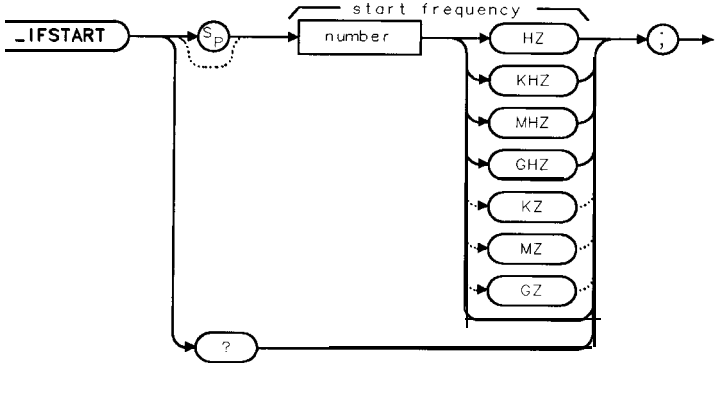


Figure 6-21. _IFSTART Syntax

Item	Description
Default Value	1.45 GHz
Default Units	Hz
Range	Spectrum analyzer frequency range
Prerequisite Command	_NFMODE
Related Commands	_FCONV, _RFSTART, _RFSTOP, _IFSTOP

Description Use the _IFSTART command to set or query the IF start frequency value. The IF start and stop frequency spans must match the RF stop and start frequency span. Frequency conversion needs to be selected for these values to be active.

Reverse sweep, such as when the IF start frequency is greater than the IF stop frequency, is allowed.

Example Program

```
20 OUTPUT 718;"_NFMODE;"
25 OUTPUT 718;"_DEFAULTS;"
30 OUTPUT 718;"_FCONV 1;"
35 OUTPUT 718;"_LABEL;"
40 OUTPUT 718;"_IFSTART 400MHZ;"
50 OUTPUT 718;"_IFSTOP 600MHZ;"
60 OUTPUT 718;"_RFSTART 650MHZ;"
70 OUTPUT 718;"_RFSTOP 850MHZ;"
80 END
```

Turn on noise figure measurements personality mode.

Set all measurement configuration parameters to default values.

Turn the frequency conversion mode ON.

Redraw display annotation for frequency conversion mode measurement state.

Set the frequency conversion measurement IF start frequency to 400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Query Response The response displays the current IF start frequency value.

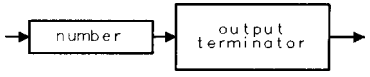
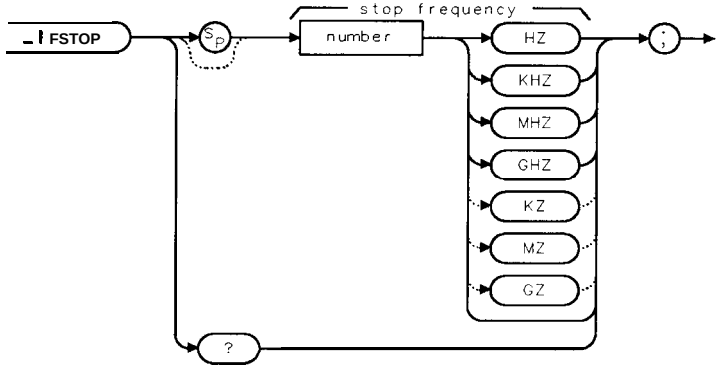


Figure **6-22. _IFSTART** Query Response Syntax

_IFSTOP

Use the _IFSTOP command to enter the IF stop frequency for a frequency-conversion noise figure and gain measurement.



xifsto

Figure 6-23. **_IFSTOP** Syntax

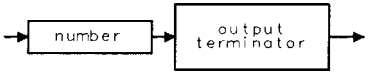
Item	Description
Default Value	950 MHz
Default Units	Hz
Range	Spectrum analyzer frequency range
Prerequisite Command	_NFMODE
Related Commands	_FCONV, _RFSTART, _IFSTART, _RFSTOP

Description Use the _IFSTOP command to set or query the IF stop frequency value. The IF start and stop frequency span must match the RF stop and start frequency span. The frequency conversion device under test determines the ranges of values. Frequency conversion needs to be selected for these values to be active.

Example Program

```
20 OUTPUT 718;"_NFMODE;"          ! Turn on noise figure measurementspersonality mode.
25 OUTPUT 718;"_DEFAULTS;"        ! Set all measurement configuration parameters to default values.
30 OUTPUT 718;"_FCONV 1;"         ! Turn the frequency conversion mode ON.
35 OUTPUT 718;"_LABEL;"           ! Redraw display annotation for frequency conversion mode measurement state.
40 OUTPUT 718;"_IFSTART 400MHZ;"  ! Set the frequency conversion measurement IF start frequency to 400 MHz.
50 OUTPUT 718;"_IFSTOP 600MHZ;"   ! Set the frequency conversion measurement IF stop frequenc y to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.
60 OUTPUT 718;"_RFSTART 650MHZ;"  ! Set the non-conversion mode start frequenc y to 650 MHz.
70 OUTPUT 718;"_RFSTOP 850MHZ;"   ! Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.
80 END
```

Query Response The response displays the current IF stop frequency value.



QIFSTO

Figure 6-24. **_IFSTOP** Query Response Syntax

_INLOSS

Use the _INLOSS command to correct for the dB loss values that exist at the input of the device under test.

> NOTE
>
> If the loss is present when the calibration is made, do not enter a loss value with this command. These losses are introduced into the measurement setup after calibration is completed.

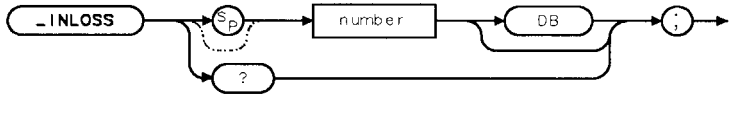


Figure **6-25. _INLOSS** Syntax

Item	Description
Default Value	0.0 dB
Default Units	dB
Range	-99.90 dB to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_OUTLOSS, _SLOSS

Description

Use the _INLOSS command to enter or query the dB loss value set for the input of the device under test, as illustrated in Figure 6-26. The loss value is based on cables and other loss factors that are in the measurement system.

Generally, a positive input-loss value is entered. A negative input-loss value indicates additional gain is present.

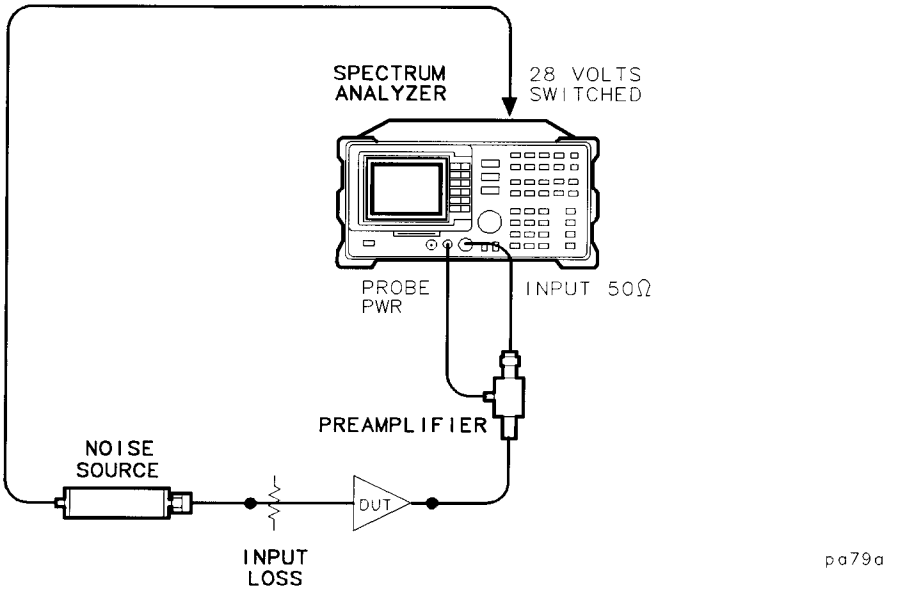


Figure 6-26. Location of Input Loss Characteristic

Example Program

```
20  OUTPUT 718;"_NFMODE;"          Turn on noise figure measurements personality mode.
25  OUTPUT 718;"_DEFAULTS;"        Set all measurement configuration parameters to default values.
30  OUTPUT 718;"_PTS 3;"           Set the number of measurement points to 3.
40  OUTPUT 718;"_FSTART 300MHZ;"   Set the non-conversion mode start frequency to 300 MHz.
50  OUTPUT 718;"_FSTOP 1200MHZ;"   Set the non-conversion mode stop frequency to 1200 MHz.
```

```
60 OUTPUT 718;"_INLOSS 2DB;"
```
Enter the 2 dB loss that exists in the measurement setup, following calibration, and is *present at the input* **of** *the device under test.*

```
70 OUTPUT 718;"_OUTLOSS 3.2DB;"
```
Enter the 3.2 dB loss that exists in the measurement setup, following calibration, and is *present at the output* **of** *the device under test.*

```
80 OUTPUT 718;"_SLOSS 0.1DB;"
```
Enter the 0.1 dB loss that exists in the setup, during calibration, at the output **of** *the noise source.*

```
90 OUTPUT 718;"_CAL;"
```
Calibrate the measurement setup.

```
100 OUTPUT 718;"DONE?;"
```
Query the spectrum analyzer **for** *the calibration routine status.*

```
110 ENTER 718;DONE
```
Get the status condition.

```
120 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
```
Display the calibration-done message.

```
125 PAUSE
```
Wait **for** *the key to be pressed.*

```
130 OUTPUT 718;"_MEASURE;"
```
Make a calibrated noise *figure and gain measurement.*

```
140 OUTPUT 718;"_GLVL -10DB;"
```
Set the gain trace **reference** *level to -10 dB.*

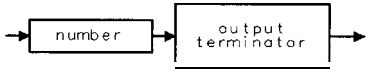
```
150 OUTPUT 718;"_GSCALE 10DB;"
```
Set the scale **for** *the gain trace to 10 dB per division.*

```
160 OUTPUT 718;"_NFLVL 0DB;"
```
Set the noise figure trace reference level to 0.0 dB.

```
170 OUTPUT 718;"_NFSCALE 10DB;"
```
Set the scale **for** *the noise figure trace to 10 dB per division.*

```
180 END
```

Query Response The response displays the current input loss value being used for measurement calculations.



QINLOS

Figure 6-27. _INLOSS Query Response Syntax

_LABEL

Use the -LABEL command to refresh the screen annotation following the selection of conversion or non-conversion with the -FCONV command.

xlabel

Figure 6-28. -LABEL Syntax

Description

Use the -LABEL command, especially after transitioning between frequency conversion and non-conversion measurements to update the display annotation with accurate settings.

Example Program

```
20 OUTPUT 718; "_NFMODE;"
25  OUTPUT 718; "-DEFAULTS; "
30 OUTPUT 718; "_FCONV 1; "
35 OUTPUT 718;"_LABEL;"
40 OUTPUT 718;"_IFSTART 400MHZ;"
50 OUTPUT 718;"_IFSTOP 600MHZ;"
60  OUTPUT 718; "_RFSTART 650MHZ;"
70  OUTPUT 718; "_RFSTOP 850MHZ;"
80 END
```

Turn on noise figure mode.

Set measurement configuration parameters to default.

Turn the frequency conversion mode ON.

Redraw display annotation for frequency conversion mode measurement state.

Set the frequency conversion measurement IF start frequency to 400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

_MEASURE

Use the -MEASURE command to initiate the noise figure and gain measurement sequence.

xmeas

Figure 6-29. -MEASURE Syntax

Prerequisite Command: _NFMODE

Description Use the -MEASURE command to initiate a measurement. Before measurements can begin, the measurement configuration and system calibration (if an accurate noise figure measurement or a gain trace is desired) must have been completed. Either accept the default configuration values, or refer to Table 6-2 for the list of commands available for setting measurement configuration.

The measurement results are located in the traces -NF and -GAIN. The element 1 corresponds with the start frequency, and the element 401 corresponds with the stop frequency.

Description of Variables

Array or Variable Name	Description	Units
_NF	The 401-point trace _NF holds the noise figure measurement date.	hundredths of a dB
-GAIN	The 401-point trace -GAIN holds the gain measurement data.	Divide the results by 100 to convert date to dB.

Example Program

```
20 OUTPUT 718;"_NFMODE;"
30 OUTPUT 718;"_DEFAULTS;"
40 OUTPUT 718;"_FCONV 1;"
45 OUTPUT 718;"_LABEL;"
50 OUTPUT 718;"_IFSTART 400MHZ;"
60 OUTPUT 718;"_IFSTOP 600MHZ;"
70 OUTPUT 718;"_RFSTART 650MHZ;"
80 OUTPUT 718;"_RFSTOP 850MHZ;"
90 OUTPUT 718;"_CAL;"
100 OUTPUT 718;"DONE?;"
110 ENTER 718;DONE
120 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
125 PAUSE
```

Turn on noise figure measurementspersonality mode.

Set all measurement configuration parameters to default values.

Turn the frequency conversion mode ON.

Redraw display annotation for frequency conversion made measurement state.

Set the frequency conversion measurement IF start frequency to 400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Calibrate the measurement system.

Query the spectrum analyzer for the calibration routine status.

Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

```
130 OUTPUT 718;"_MEASURE;"          ! Make a calibrated noise figure and gain measurement.

140 INTEGER I
150 REAL G_data(1:401)              ! The array to hold gain measurement trace data.

160     FOR I=1 TO 401              ! Query the gain trace for data.
170         OUTPUT 718;"_GAIN[";I;"]?;"
180         ENTER 718;G_data(I)     ! Enter the data.
190         G_data(I)=G_data(I)/100 ! Convert the data to dB units.

200     NEXT I
210 REAL N_figure(1:401)            ! The array to hold noise figure measurement trace data.

220     FOR I=1 TO 401              ! Query the noisejigure trace for data.
230         OUTPUT 718;"_NF[";I;"]?;"
240         ENTER 718;N_figure(I)   ! Enter the data.
250         N_figure(I)=N_figure(I)/100 ! Convert the data to dB units.

260     NEXT I
270 END
```

_NFLVL

Use the -NFLVL command to set the reference level for the noise figure measurement results.

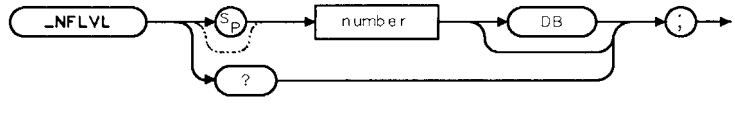


Figure **6-30. _NFLVL** Syntax

Item	Description
Default Value	0.00 dB
Default Units	dB
Range	-99.90 dB to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_NFSCALE, -GLVL, _GSCALE

Description

Use the -NFLVL command to set or query the noise figure measurement reference level. Changing the reference level does not affect system calibration, therefore, it can be adjusted during the measurement.

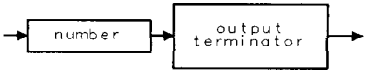
Example Program

```
20  OUTPUT 718;"_NFMODE;"
25  OUTPUT 718;"-DEFAULTS;"
30 OUTPUT 718;"_PTS 3;"
40  OUTPUT 718;"_FSTART 300MHZ;"
50 OUTPUT 718; "_FSTOP 1200MHZ;"
```

Turn on noise figure measurements personality mode.
Set all measurement configuration parameters to default values.
Set the number of measurement points to 3.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.

```
60 OUTPUT 718;"_CAL;"                                  Calibrate the measurement
                                                       system.
70 OUTPUT 718;"DONE?;"                                 Query the spectrum ana-
                                                       lyzer for the calibration
                                                       routine status.
80 ENTER 718;DONE                                      Get the status condition.
90 DISP "CALIBRATION DONE, PRESS                       Display the calibration-
CONTINUE WHEN READY TO MEASURE."                       done message.
95 PAUSE                                               Wait for the key to be pressed.
100 OUTPUT 718;"_MEASURE;"                             Start the calibrated noise
                                                       figure and gain measurement.
110 OUTPUT 718;"_NFLVL 5DB; _NFSCALE 1DB;"             Set the noise figure trace
                                                       reference level to 5 dB. Set
                                                       the noise-figure scale for 1
                                                       dB.
120 END
```

Query Response The response displays the current noise figure reference level value.



QNFLVL

Figure 6-31. _NFLVL Query Response Syntax

_NFMODE

Use the _NFMODE command to control instrument mode state.

XNFMOD

Figure 6-32. **_NFMODE** Syntax

Description Use the _NFMODE command to initiate remote, noise figure and gain mode measurements.

Example Program

```
10 OUTPUT 718;"IP;"                          ! Preset the spectrum analyzer
20 OUTPUT 718;"_NFMODE;"                     ! Turn on noise figure measurements personality mode.
25 OUTPUT 718;"_DEFAULTS;"                   ! Set all measurement configuration parameters to default values.
30 OUTPUT 718;"_PTS 3;"                      ! Set the number of measurement points to 3.
40 OUTPUT 718;"_FSTART 300MHZ;"              ! Set the non-conversion mode start frequency to 300 MHz.
50 OUTPUT 718;"_FSTOP 1200MHZ;"              ! Set the non-conversion mode stop frequency to 1200 MHz.
60 OUTPUT 718;"_CAL;"                        ! Calibrate the measurement system.
70 OUTPUT 718;"DONE?;"                       ! Query the spectrum analyzer for the calibration routine status.
80 ENTER 718;DONE                            ! Get the status condition.
90 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."             ! Display the calibration-done message.
95 PAUSE                                     ! Wait for the key to be pressed.
100 OUTPUT 718;"_MEASURE;"                   ! Start the calibrated noise figure and gain measurement.
```

```
110 OUTPUT 718;"_GLVL 10DB; _GSCALE 5DB;"
120 END
```

Set the gain trace reference level to 10 dB (available only if the measurement system is calibrated. Set the scale for the gain trace to 5 dB.

_NFSCALE

Use the _NFSCALE command to set the reference level for the noise Egure measurement results.

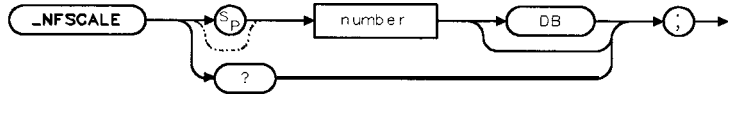


Figure 6-33. **_NFSCALE** Syntax

Item	Description
Default Value	2 dB/div
Default Units	dB
Range	0.10 dB to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_NFLVL, -GLVL, _GSCALE

Description Use the -NFSCALE command to set or query the display scale for the noise Egure measurement. Changing the scale does not effect system calibration; therefore, it can be adjusted without requiring recalibration.

Example Program

```
20  OUTPUT 718; "_NFMODE;"
30  OUTPUT 7 18 ; "-DEFAULTS ; "
40  OUTPUT 718; "_PTS 3; "
50 OUTPUT 718;"_FSTART 300MHZ;"
60  OUTPUT 718 ;"_FSTOP 1200MHZ;"
```

Turn on noise figure measurementspersonality mode.
Set all measurement conjiguration parameters to default values.
Set the number of measurement points to 3.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.

```
70 OUTPUT 718;"_CAL;"
```
Calibrate the measurement system.

```
80 OUTPUT 718;"DONE?;"
```
Query the spectrum analyzer for the calibration routine status.

```
90 ENTER 718;DONE
```
Get the status condition.

```
100 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
```
Display the calibration-done message.

```
105 PAUSE
```
Wait for the key to be pressed.

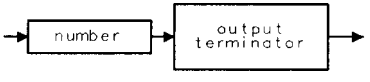
```
110 OUTPUT 718;"_MEASURE;"
```
Start the calibrated noise figure and gain measurement.

```
120 OUTPUT 718;"_GLVL 10DB; _GSCALE 10DB;"
```
Set the gain trace reference level to 10 dB. Set the scale for the gain trace to 10 dB per division.

```
130 OUTPUT 718;"_NFLVL ODB; _NFSCALE 5DB;"
```
Set the noise figure trace reference level to 0.0 dB. Set the scale for the noise figure trace to 5.0 dB per division.

```
140 END
```

Query **Response** The response displays the current scale value.



QNFSCA

Figure 6-34. **_NFSCALE** Query Response Syntax

_OUTLOSS

Use the _OUTLOSS command to correct for the dB loss value that exists at the output of the device under test, before the input to the system preamplifier.

> **NOTE**
>
> If the loss is present when the calibration is made, do not enter a loss value with this command. These losses are introduced into the measurement setup after calibration is completed.

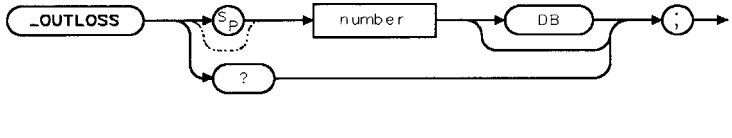


Figure 6-35. **_OUTLOSS** Syntax

Item	Description
Default Value	0.00 dB
Default Units	dB
Range	-99.90 to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_INLOSS, _SLOSS

Description

Use the _OUTLOSS command to enter or query the dB loss value set for the output of the device under test, as illustrated in Figure 6-36. The loss value is due to cables and other loss factors that are required in the measurement system.

Generally, a positive output-loss value is entered. A negative output-loss value indicates additional gain is present.

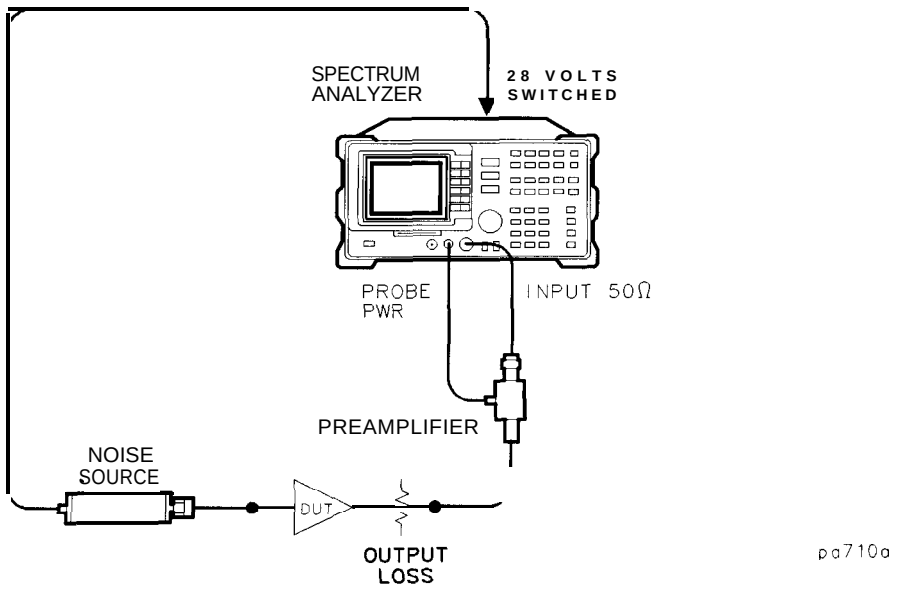


Figure 6-36. location of Output Loss Characteristic

Example Program

```
20  OUTPUT 718;"_NFMODE;"
30  OUTPUT 718 ; "-DEFAULTS ; "
40  OUTPUT 718 ; "_PTS 3 ;"
50  OUTPUT 718; "_FSTART 300MHZ;"
```

Turn on noise figure measurements personality mode.

***Set** all measurement configuration parameters to default values.*

Set the** number of measurement points to **3.

***Set the** non-conversion mode start frequency to 300 MHz.*

```
60 OUTPUT 718;"_FSTOP 1200MHZ;"
70 OUTPUT 718;"_INLOSS 2DB;"
80 OUTPUT 718;"_OUTLOSS 3.2EDB;"
90 OUTPUT 718;"_SLOSS 0.1DB;"
100 OUTPUT 718;"_CAL;"
110 OUTPUT 718;"DONE?;"
120 ENTER 718;DONE
130 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
140 OUTPUT 718;"_MEASURE;"
150 OUTPUT 718;"_GLVL -10DB; _GSCALE 10DB;"
160 OUTPUT 718;"_NFLVL ODB; _NFSCALE 5DB;"
170 END
```

Set the non-conversion mode stop frequency to 1200 MHz.

Enter the 2 dB loss that exists in the measurement setup, following calibration, and is present at the input of the device under test.

Enter the 3.2 dB loss that exists in the measurement setup, following calibration, and is present at the output of the device under test.

Enter the 0.1 dB loss that exists in the measurement setup, following calibration, and is present at the output of the noise source used in the measurement.

Calibrate the measurement setup.

Query the spectrum analyzer for the calibration routine status.

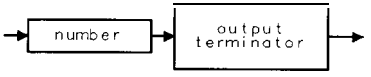
Get the status condition.

Display the calibration-done message.

Set the gain trace reference level to -10 dB. Set the scale for the gain trace to 10 dB per division.

Set the noise figure trace reference level to 0.0 dB. Set the scale for the noise *figure trace to 5.0 dB per division.*

Query Response The response displays the current output loss value being used for measurement calculations.



QOUTLO

Figure **6-37. _OUTLOSS** Query Response Syntax

_PGAIN

Use the _PGAIN command to select the number of measurement points.

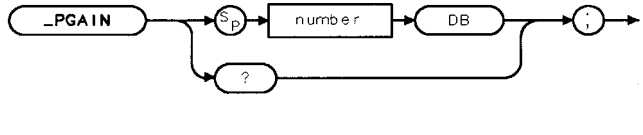


Figure 6-38. **_PGAIN** Syntax

Item	Description
Default Value	22.0 dB
Default Units	dB
Range	0 to +99.90 dB
Prerequisite Command	_NFMODE

Description

Use the _PGAIN command to enter or query the minimum gain of the preamplifier used in the measurement system. If the HP 87405A probe-powered preamplifier is used, the 22.0 dB default setting is automatic. For other preamplifiers, enter the appropriate gain.

Example Program

```
20 OUTPUT 718; "_NFMODE;"          Turn on noise figure measurements personality mode.
30 OUTPUT 718;"_DEFAULTS;"         Set all of the measurement parameters to the default values.
40 OUTPUT 718;"_PGAIN 12;"         Set the preamplifier gain to 12 dB.
50 OUTPUT 718;"_CAL;"              Calibrate the measurement setup.
60  OUTPUT 718;"DONE?;"            Query the spectrum analyzer for the calibration routine status.
70 ENTER 718;DONE                  Get the status condition.
```

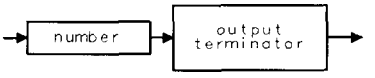
```
80 DISP "CALIBRATION DONE, PRESS CONTINUE WHEN READY TO MEASURE."
85 PAUSE
90 OUTPUT 718;"_MEASURE;"

100 END
```

Display the calibration-done message.

Wait for the key to be pressed.

Make a calibrated noise figure and gain measurement.

Query Response The response displays the current preamplifier gain value.

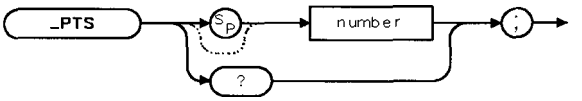


QGAINL

Figure 6.39. _PGAIN Query Response Syntax

_PTS

Use the -PTS command to select the number of measurement points.



xpts

Figure 6-40. -PTS Syntax

Item	Description
Default Value	11
Default Units	none
Range	1 to 401
Prerequisite Command	_NFMODE
Related Commands	-MEASURE

Description Use the _PTS command to set or query the measurement point.

The number of measurement points determines number of equally spaced frequency points evaluated for noise figure and gain.

Number Entered	Actual Number Points Measured
1	1 point
2	2 points
3	3 points
4 to 5	5 points
6 to 7	6 points
8 to 9	9 points
10 to 13	11 points
14 to 18	17 points
19 to 23	21 points
24 to 34	26 points
34 to 45	41 points
46 to 65	51 points
66 to 90	81 points
91 to 150	101 points
151 to 300	201 points
301 to 401	401 points

Example Program

```
20 OUTPUT 718;"_NFMODE;"
30 OUTPUT 718;"_DEFAULTS;"
40 OUTPUT 718;"_PTS 3;"
50  OUTPUT 718;"_CAL;"
60  OUTPUT 718;"DONE?;"
70  ENTER 718;DONE
80 DISP "CALIBRATION DONE, PRESS CONTINUE WHEN READY TO MEASURE."
85  PAUSE
```

Turn on noise figure measurements personality mode.

Set all of the measurement parameters to the default values.

Set the number of measurement points to 3.

Calibrate the measurement setup.

Query the spectrum analyzer for the calibration routine status.

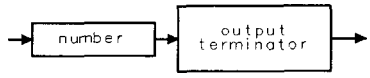
Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

```
90 OUTPUT 718;"_MEASURE;"        Make a calibrated noise
                                 figure and gain measurement.
100 END
```

Query Response The response displays the current number of points selected.



qpts

Figure 6-41. -PTS Query Response Syntax

_RFSTART

Use the _RFSTART command to enter the RF start frequency for a frequency-conversion noise figure and gain measurement.

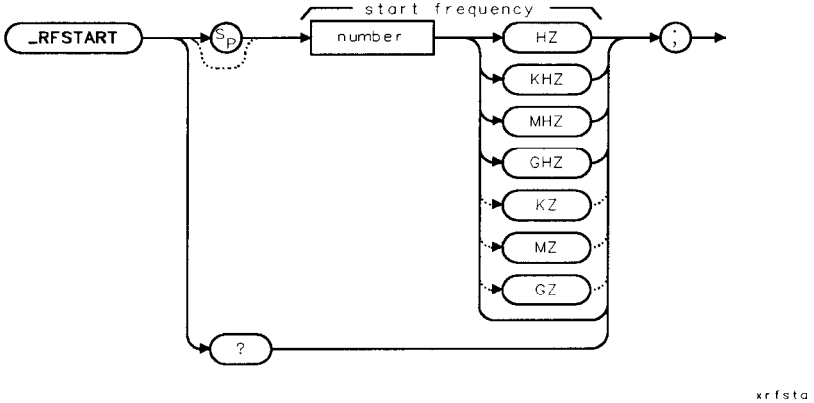


Figure 6-42. **_RFSTART** Syntax

Item	Description
Default Value	3.70 GHz
Default Units	HZ
Range	0.0 Hz to 999 GHz
Prerequisite Command	_NFMODE
Related Commands	_FCONV, _IFSTART, _IFSTOP, _RFSTOP

Description

Use the _RFSTART command to set or query the RF start frequency value. The RF start and stop frequency span must match the IF stop and start frequency span. Frequency conversion needs to be selected for these values to be active.

Example Program

```
20 OUTPUT 718;"_NFMODE;"
25 OUTPUT 718;"_DEFAULTS;"
30 OUTPUT 718;"_FCONV 1;"
35 OUTPUT 718;"_LABEL;"
40 OUTPUT 718;"_IFSTART 400MHZ;"
50 OUTPUT 718;"_IFSTOP 600MHZ;"
60 OUTPUT 718;"_RFSTART 650MHZ;"
70 OUTPUT 718;"_RFSTOP 850MHZ;"
80  OUTPUT 718;"_CAL;"
90  OUTPUT 718;"DONE?;"
100 ENTER 718;DONE
110 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
115 PAUSE
120 OUTPUT 718;"_MEASURE;"
130 END
```

Turn on noise figure measurements personality mode.

Set all measurement configuration parameters to default values.

Select frequency conversion mode.

Redraw display annotation for frequency conversion mode measurement state.

Set the frequency conversion measurement IF start frequency to 400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Calibrate the measurement system.

Query the spectrum analyzer for the calibration routine status.

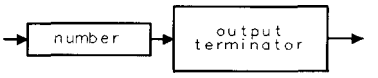
Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

Make a calibrated noise figure and gain measurement.

Query **Response** The response displays the current RF start frequency value.



QRFSTA

Figure 6-43. **_RFSTART** Query Response Syntax

_RFSTOP

Use the _RFSTOP command to enter the RF stop frequency for a frequency-conversion noise figure and gain measurement.

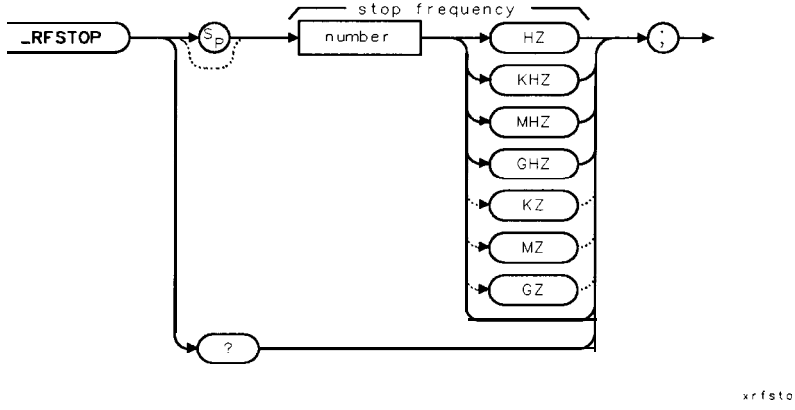


Figure 6-44. **_RFSTOP** Syntax

item	Description
Default Value	4.20 GHz
Default Units	HZ
Range	0.0 Hz to 999 GHz
Prerequisite Command	_NFMODE
Related Commands	_FCONV, _IFSTART, _IFSTOP, _RFSTART

Description Use the _RFSTOP command to set or query the RF stop frequency value. The RF start and stop frequency span must match the IF stop and start frequency span. Frequency conversion needs to be selected for these values to be active.

Example Program

```
20 OUTPUT 718;"_NFMODE;"
25 OUTPUT 718;"_DEFAULTS;"
30 OUTPUT 718;"_FCONV 1;"
35 OUTPUT 718;"_LABEL;"
40 OUTPUT 718;"_IFSTART 400MHZ;"
50 OUTPUT 718;"_IFSTOP 600MHZ;"
60 OUTPUT 718;"_RFSTART 650MHZ;"
70 OUTPUT 718;"_RFSTOP 850MHZ;"
80 OUTPUT 718;"_CAL;"
90 OUTPUT 718;"DONE?;"
100 ENTER 718;DONE
110 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
115 PAUSE
120 OUTPUT 718;"_MEASURE;"
130 END
```

Turn on noise figure measurements personality mode.

Set all measurement configuration parameters to default values.

Turn the frequency conversion mode ON.

Redraw display annotation for frequency conversion mode measurement state.

Set the frequency conversion measurement IF start frequency to 400 MHz

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Calibrate the measurement system.

Query the spectrum analyzer for the calibration routine status.

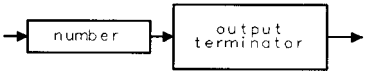
Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

Make a calibrated noise figure and gain measurement.

Query Response The response displays the current RF stop frequency value.



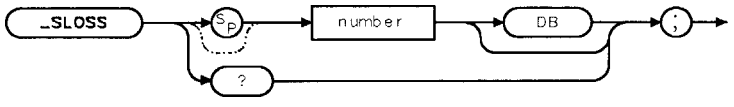
QRFSTO

Figure 6-45. **_RFSTOP** Query Response Syntax

_SLOSS

Use the _SLOSS command to correct for the dB loss values that exist between the input of the device under test and the noise source.

This loss exists during the calibration procedure and during the measurement.



XSLOSS

Figure 6-46. **_SLOSS** Syntax

Item	Description
Default Value	0.00 dB
Default Units	dB
Range	-99.90 to +99.90 dB
Prerequisite Command	_NFMODE
Related Commands	_INLOSS, _OUTLOSS

Description

Use the _SLOSS command to enter or query the dB loss value located at the noise source used in the measurement system, as illustrated in Figure 6-47. The loss value is based on cables and other loss factors that are required in the measurement system.

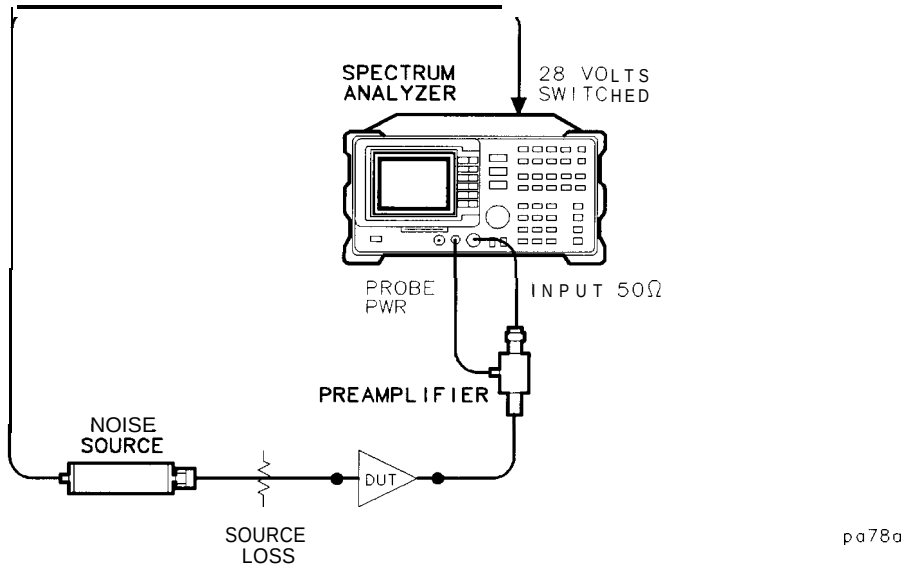


Figure 6-47. location of Noise Source loss Characteristic

Example Program

```
20 OUTPUT 718;"_NFMODE;"
30 OUTPUT 718;"_DEFAULTS;"
40 OUTPUT 718;"_PTS 3;"
50 OUTPUT 718;"_FSTART 300MHZ;"
60 OUTPUT 718;"_FSTOP 1200MHZ;"
70 OUTPUT 718;"_INLOSS 2DB;"
```

Turn on noisejigure measurements personality mode.
Set all measurement configuration parameters to default values.
Set the number of measurement points to 3.
Set the non-conversion mode start frequency to 300 MHz.
Set the non-conversion mode stop frequency to 1200 MHz.
Enter the 2 dB loss that exists in the measurement setup, following calibration, and is present at the input of the device under test.

```
80 OUTPUT 718;"_OUTLOSS 3.2EDB;"
90 OUTPUT 718;"_SLOSS 0.1DB;"
100 OUTPUT 718;"_CAL;"
110 OUTPUT 718;"DONE?;"
120 ENTER 718;DONE
130 DISP "CALIBRATION DONE, PRESS
CONTINUE WHEN READY TO MEASURE."
135 PAUSE
140 OUTPUT 718;"_MEASURE;"
150 OUTPUT 718;"_GLVL -10DB; _GSCALE 10DB;"
160 OUTPUT 718;"_NFLVL ODB; _NFSCALE 5DB;"
170 END
```

Enter the 3.2 dB loss that exists in the measurement setup, following calibration, and is present at the output of the device under test.

Enter the 0.1 dB loss that exists in the measurement setup, following calibration, and is present at the output of the noise source used in the measurement.

Calibrate the measurement setup.

Query the spectrum analyzer for the calibration routine status.

Get the status condition.

Display the calibration-done message.

Wait for the key to be pressed.

Set the gain trace reference level to -10 dB. Set the scale for the gain trace to 10 dB per division.

Set the noise figure trace reference level to 0.0 dB. Set the scale for the noise figure trace to 5.0 dB per division.

Query Response The response displays the current output loss value being used for measurement calculations.

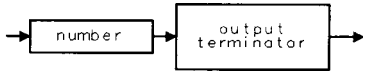


Figure 6-48. **_SLOSS** Query Response Syntax

_TBW

Use the -TBW command to enter the time bandwidth product for use in measurements.

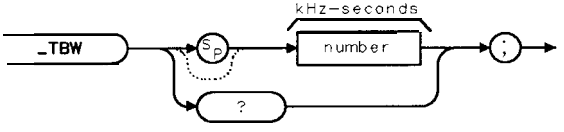


Figure 6-48. _TBW Syntax

Item	Description
Default Value	500 kHz-s
Default Units	kHz-s
Range	1 to 16,000 kHz-s, or 1 to 999 x BW (in kHz) - whichever is less
Prerequisite Command	_NFMODE
Related Commands	_TBWAUTO, - B W

Description

Use the _TBW command to enter or query the time-bandwidth product. The time-bandwidth product is used to calculate an averaging time appropriate for a given measurement bandwidth when TBW AUTO mode is selected. Refer to the _TBWAUTO command.

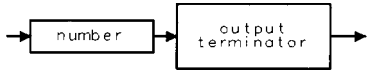
The time-bandwidth product affects the measurement-to-measurement repeatability. An increase in time-bandwidth reduces the repeatability error.

Example Program

```
10  OUTPUT 718; "_NFMODE;"          Select the noise figure and
                                    gain measurements mode.
20  OUTPUT 718; "-DEFAULTS;"        Set all measurement con-
                                    figuration parameters to
                                    default values.
30  OUTPUT 718;"_TBW 300;"          Set the time-measurement
                                    bandwidth value to 300.
40  OUTPUT 718; "_CAL;"             Calibrate the measurement
                                    setup for the new parameters.
```

```
50   OUTPUT 718;"DONE?;"          Query the spectrum analyzer for the calibration routine status.
60   ENTER 718;DONE               Get the status condition.
70 DISP "CALIBRATION DONE, PRESS  Display the calibration-done message.
CONTINUE WHEN READY TO MEASURE."
75   PAUSE                        Wait for the key to be pressed.
80   OUTPUT 718;"_MEASURE;"       Make a calibrated noise figure and gain measurement.
90   END
```

Query Response The response displays the time-bandwidth product used when auto mode is selected.



QTBW

Figure 6-50. -TBW Query Response Syntax

_TBWAUTO

Use the -TBWAUTO command to select either automatic or manual time-bandwidth mode for use in measurements.

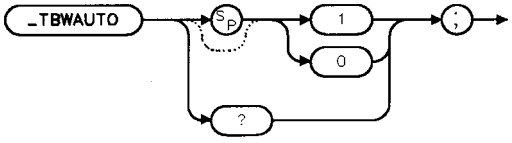


Figure 6-51. -TBWAUTO Syntax

Item	Description
Default Value	1 (ON)
Default Units	none
Range	1 (ON) or 0 (OFF)
Prerequisite Command	_NFMODE
Related Commands	_TBW, _BW, _AVGTIME

Description Use the -TBWAUTO command to enter or query the measurement time-bandwidth mode. The automatic tune-bandwidth mode provides an automatically calculated averaging time. The calculations are derived from the time-bandwidth product divided by the measurement bandwidth.

Example Program

```
10  OUTPUT 718; "_NFMODE;"
20 OUTPUT 718;"_DEFAULTS;"
30 OUTPUT 718; "_TBW 300; "
40  OUTPUT 718 ; "_TBWAUTO 0 ;"
```

Select the noise figure and gain measurements mode.

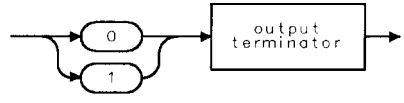
Set all measurement configuration parameters to default values.

Set the time-measurement bandwidth value to 300.

Set the averaging time mode to manual.

```
45 OUTPUT 718;"_AVGTIME 1;"      Set averaging time to 1
                                 second per measurement
                                 point.
50 OUTPUT 718;"_CAL;"            Calibrate the measurement
                                 setup for the new parameters.
60 OUTPUT 718;"DONE?;"           Query the spectrum ana-
                                 lyzer for the calibration
                                 routine status.
70 ENTER 718;DONE                Get the status condition.
80 DISP "CALIBRATION DONE, PRESS Display the calibration-
CONTINUE WHEN READY TO MEASURE." done message.
85 PAUSE                         Wait for the key to be pressed.
90 OUTPUT 718;"_MEASURE;"        Make a calibrated noise
                                 figure and gain measurement.
100 END
```

Query Response The response displays the current time-bandwidth measurement mode. If a 1 is returned, the mode is automatic. If a 0 is returned, the mode is manual and the measurement time and bandwidth settings are determined by you.



QTBWAU

Figure 6-52. -TBWAUTO Query Response Syntax

_TEMPC

Use the _TEMPC command to enter the celsius case-temperature value of the noise source used for making measurements.

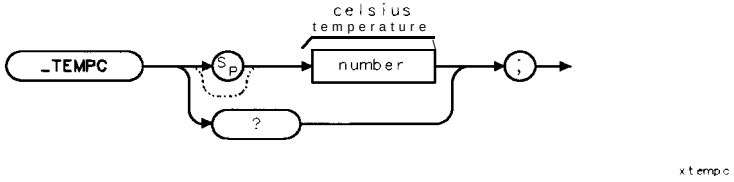


Figure 6-53. **_TEMPC** Syntax

Item	Description
Default Value	21°C
Default Units	°C
Range	-273.0' to 999.0°C
Prerequisite Command	_NFMODE
Related Commands	none

Description Use the _TEMPC command to enter or query the case temperature of the noise source being used for measurements. The case temperature is determined by the temperature of the environment where the measurements are being made.

Example Program

```
20 OUTPUT 718; "_NFMODE;"
25 OUTPUT 718; "-DEFAULTS;"
40 OUTPUT 718;"_FCONV 1;"
45  OUTPUT 718;"-LABEL;"
```

Turn on noise figure measurements personality mode.
Set all measurement configuration parameters to default values.
Turn the frequency conversion mode ON.
Redraw display annotation for frequency conversion mode measurement state.

```
50 OUTPUT 718;"_IFSTART 400MHZ;"
60 OUTPUT 718;"_IFSTOP 600MHZ;"
70 OUTPUT 718;"_RFSTART 650MHZ;"
80 OUTPUT 718;"_RFSTOP 850MHZ;"
90 OUTPUT 718;"_TEMPC 19;"
100 OUTPUT 718;"_CAL;"
110 OUTPUT 718;"DONE?;"
120 ENTER 718;DONE
130 DISP "CALIBRATION DONE, PRESS CONTINUE WHEN READY TO MEASURE."
140 OUTPUT 718;"_MEASURE;"
150 END
```

Set the frequency conversion measurement IF start frequency to -400 MHz.

Set the frequency conversion measurement IF stop frequency to 600 MHz. The span is 200 MHz and must equal the RF start and stop frequency span.

Set the non-conversion mode start frequency to 650 MHz.

Set the non-conversion mode stop frequency to 850 MHz, which results in a span equal to the IF frequency span of 200 MHz.

Enter the case temperature of the wise source as 19°C.

Calibrate the system for measurements.

Query the spectrum analyzer for the calibration routine status.

Get the status condition.

Display the calibration-done message.

Make a calibrated noise figure and gain measurement.

Query Response The response displays the current temperature selected

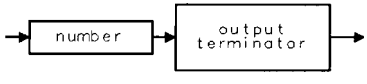


Figure 6-54. _TEMPC Query Response Syntax

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