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# User's Guide

## HP 70875A Noise Figure Measurements Personality

HP Part No. 70875-90001
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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 70875A measurement solution.

Some main features of the noise figure measurements 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.
- Multiple-point test-limit capability.
- Simultaneous display of swept noise figure and gain measurement results.
- Variable measurement bandwidth control.
- 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.
- Chapter 2, "Making Measurements" guides you through measurement examples. The recommended test equipment table, methods for optimizing measurement results, and measurement configuration information are located in this chapter. The default-configuration settings are listed here as well.
- Chapter 3, "Menu Key Descriptions" provides the menu diagrams for the DLP and a description of each menu key in alphabetical order.
- Chapter 4, "Specifications, Characteristics, and System Verification" provides the measurement specifications and characteristics along with a verification test.
- 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 are located in this chapter.

# Contents

# Figures

# Tables

# 1

# Getting Started

The noise figure and gain measurements require an HP 70000 Series spectrum analyzer. The information about measurements in this guide assume you are using an HP 70620B preamplifier module and an HP 346B/C noise source.

The sections in this chapter provide the following:

- Instructions for installing the HP 70875A Noise Figure Measurements Personality into an HP 70000 series spectrum analyzer
- Instructions for verifying that the personality was installed correctly

## 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 MMS display. |
| `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 left- and right-hand sides 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 70875A DLP.

### To dispose previously installed DLPs

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

1. Press (INSTR PRESET) on the spectrum analyzer.
2. Erase the current user programs (DLPs) and analyzer calibration from user memory.

   Press the front panel (MENU) key. Then press the softkeys `Misc`, `MORE`, `service`, `erase/restart`, `ERASE ALL`, `CONFIRM ERASE`. The analyzer will then erase internal memory and all instrument settings. When the MEASURE light on the HP 70900B front panel begins to blink, the memory erase is complete. To return analyzer control to the display, press (DISPLAY), `NEXT INSTR`.

### To load the noise figure and gain measurement DLP

After the memory is cleared, insert the HP 70875A measurement personality card into the display's front panel card reader slot. Match the card's arrow with the arrow printed above the card slot.

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

1. Press the front-panel (MENU) key.
2. Press the softkeys `Misc`, `MORE`, `catalog & MSI`, `HP-MSIB CARD`. The display will show the contents of the memory card. If the message `2053 Storage device error` appears, the wrong MSIB column address for the 70004A display may be selected. To fix this, press the front panel numeric key(s) for the correct display MSIB column number, then press `ENTER`. The 2053 error message can also be caused by having the HP 70004A display selecting the wrong mass storage unit. To correct this, press (DISPLAY), `Mass Storage`, `msi`, `Memory Card`.
3. The file labeled `HP70875A` is the Noise Figure Measurements DLP. To load it into internal memory, press the `LOAD FILE` softkey, enter the file number from the display, then press `ENTER`. Wait about 40 seconds while the LED next to the card reader slot on the HP 70004A display is flashing.
4. Press the (USER) front panel key. The soft key in the upper right-hand corner of the display should read `NF_GAIN DLP`. This indicates that the noise figure measurements personality has been loaded into internal memory.

## Verifying DLP Installation

To verify that the noise figure measurement personality has been correctly loaded into internal memory, use the following procedure:

1. Press (INSTR PRESET) on the spectrum analyzer.
2. If the UNCOR warning appears on the display, the spectrum should be calibrated. To do this, connect the Calibrator output on the HP 70900B module to the RF Input on the preamplifier module. Then press (MENU), Amptd, CAL ALL. The calibration routine runs several minutes, depending on the module configuration. The routine ends when the End of Calibration message appears on the display.
3. Press the (USER) front panel key, then press the NF_GAIN DLP softkey. When the DLP completes its initialization, the noise figure measurements personality top level menu will appear on the display as shown in Figure 1-1.
4. To return to the normal spectrum analyzer mode, press the EXIT NF softkey.

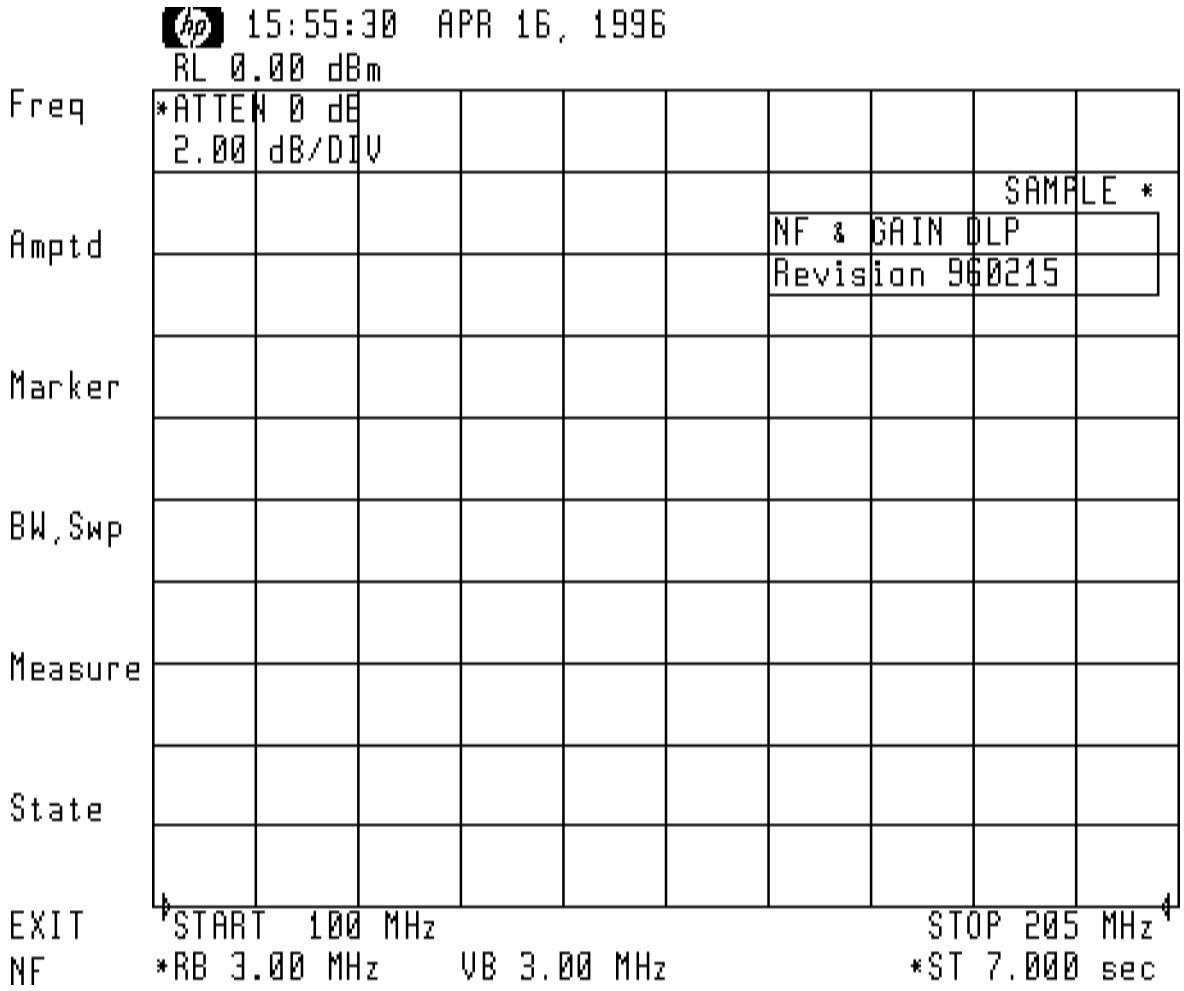



**Figure 1-1. Noise Figure Personality Main Menu**

# 2

# 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

  Using the default configuration
  Entering measurement frequencies
  Entering points to be measured
  Entering time and BW parameters
  Entering external losses
  Adjusting the RF attenuator
  Enabling or disabling the internal preamp
  Entering noise source case temperature
  Editing noise source ENR data
- Calibrating for Measurements
- Making Noise Figure and Gain Measurements on an Amplifier
- Making Output ENR Measurements on an Amplifier
- Making Measurements on a Frequency Converter
- Adjusting the Results Display
- Using Display Markers
- Testing Results with Limit Lines
- Making Hard Copies

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 70000 Series Spectrum Analyzer | HP 71100C, HP 71209A, HP 71210C, or HP 71910A | 70900B firmware rev 940120 or later |
| Noise Source | HP 346B/C Noise Source | Frequency range: 10 MHz to 26.5 GHz<br>ENR: 12 to 17 dB<br>10 MHz to 18 GHz, SWR: 1.25<br>18 MHz to 26.5 GHz, SWR: 1.35<br>Power requirement: 28 Vdc (±1 Vdc) |
| System Preamplifier | HP 70620B Opt.001 Preamplifier Module | Frequency Range: 100 KHz to 26.5 GHz<br>Noise Figure: 16 dB to 26.5 GHz<br>Input SWR: 3:1 (maximum) |

## 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 known error sources such as SWR and ENR uncertainty.
- Use a narrower measurement bandwidth than the bandwidth of the device under test.

## Configuring for Measurements

Before a measurement can be made, measurement parameters and states need to be set, if they are to be changed from default states. The following pages show how to configure the measurement by entering parameters.

It is assumed that the analyzer is already operating in the noise figure measurement mode. For information on invoking the noise figure measurement mode, refer to Chapter 1, "Verifying DLP Installation".

### To use the default configuration

The noise figure personality has a default configuration. By invoking the default configuration, you will have a known state from which to make further modifications. Refer to the following steps:

1. Press `State` in the main (left-hand) menu.
2. Press `DEFAULT STATE` in the right-hand menu to set up the default configuration. The message `\Default State Restored\` appears on the display.

**Note** When you exit the noise figure measurement mode and return to normal spectrum analyzer operation, the noise figure configuration is stored by the DLP. When the noise figure mode is again invoked, the original noise figure configuration is restored.

### To enter measurement frequencies

The frequency range of the noise figure measurement setup is 10 MHz to the maximum input frequency of the RF section used in the spectrum analyzer. You can easily measure a device whose output frequency range falls within this span without additional hardware.

#### To measure below 10 MHz

To measure a device having a frequency range below the 10 MHz specification of the HP 70875A 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 70620B 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 `Freq` in the main (left-hand) menu.
2. Press `FrqConv YES NO` to underline NO (the default setting) when you are measuring a device other than a frequency converter.
3. Press `START FREQ` and `STOP FREQ` to enter the start and stop frequencies of the DUT.

#### To measure frequency converting devices

The measurement personality frequency menu supports two modes. The first mode described above is for non-frequency converting devices. The second mode is for 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 `Freq` in the main (left-hand) menu.
2. Press `FrqConv YES NO` to underline YES when you are measuring a frequency conversion device.
3. 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 span must equal the IF span even if it results in a "backwards" sweep condition.

---

- Press `RF STRT FREQ` and `RF STOP FREQ` to enter the RF frequency values of the DUT.
- Press `IF STRT 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 800 points can be measured, as listed in Table 2-2 below. You can modify the speed of measurements via the time-BW menu keys.

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

1. Press `Freq` in the main (left-hand) menu.
2. Press `POINTS` in the right-hand menu.
3. Enter the number of points, from 1 to 800, you want to measure.
4. Press the front-panel ENTER key to complete data entry.

If you choose to enter one point, the measurement will be made at the Start Frequency for non-conversion mode or the RF Start Frequency for conversion mode. For a single-point measurement, the results display will be text. For a multi-point measurement, the results display will be a graph.

**Table 2-2. Points Entered vs Points Measured**

| Number Entered | Actual Number of Points Measured |
|---|---|
| 1 | 1 point |
| 2 | 1 point |
| 3<=N<=800 | N points |
| 800<N | 800 points |

## To enter time-BW parameters

Enter time-bandwidth measurement parameters via the `BW,Avg` main menu key.

### To enter the measurement bandwidth

To set the measurement bandwidth, use the following steps:

1. Press `BW,Avg` in the main (left-hand) menu.
2. Press `RES BW` and use the front-panel data keys, enter a measurement bandwidth.
   - Use 3 MHz measurement bandwidth, except when measuring narrow band devices.
   - For narrow band devices, use a bandwidth narrower than the device bandwidth.
3. Terminate data entry by pressing a frequency units key.

### To enter the averaging time

To set the averaging time, use the following steps:

1. Press `BW,Avg` in the main (left-hand) menu.
2. Press `AVG TIME` and use the front-panel data keys, enter an averaging time value.
   - 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).
3. Terminate data entry by pressing a time units key.

### To enter the time-bandwidth product

There is an inverse, square-root proportionality between repeatability and the time-BW factor. By doubling the time-bandwidth product in a noise figure measurement, the measurement repeatability can be increased by a factor of the square root of two. By setting the averaging time to AUTO, the averaging time will be automatically adjusted so that the time-bandwidth product is a constant. To set the time-bandwidth product in MHz-seconds, multiply the desired averaging time in seconds by the measurement bandwidth in MHz. Increasing the time-bandwidth value can reduce the measurement's repeatability error. The following steps guide you through data entry.

1. Press `T*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 `AVGTIME AutoMan` to underline Auto, so that the averaging time is automatically calculated to keep the time-bandwidth product constant.

## 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.

---

**Note** Note that only positive dB values can be entered as external losses.

---

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

Do not enter corrections for the loss encountered at the point labeled "System Loss" shown in Figure 2-1 and Figure 2-2. System loss is automatically factored into the final measurement result.

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

1. Press the `State` main (left-hand) menu softkey.
2. Press the `Ext Losses` right-hand softkey. Enter known loss values designated as:

   `SOURCE LOSS`
   `INPUT LOSS`
   `OUTPUT LOSS`

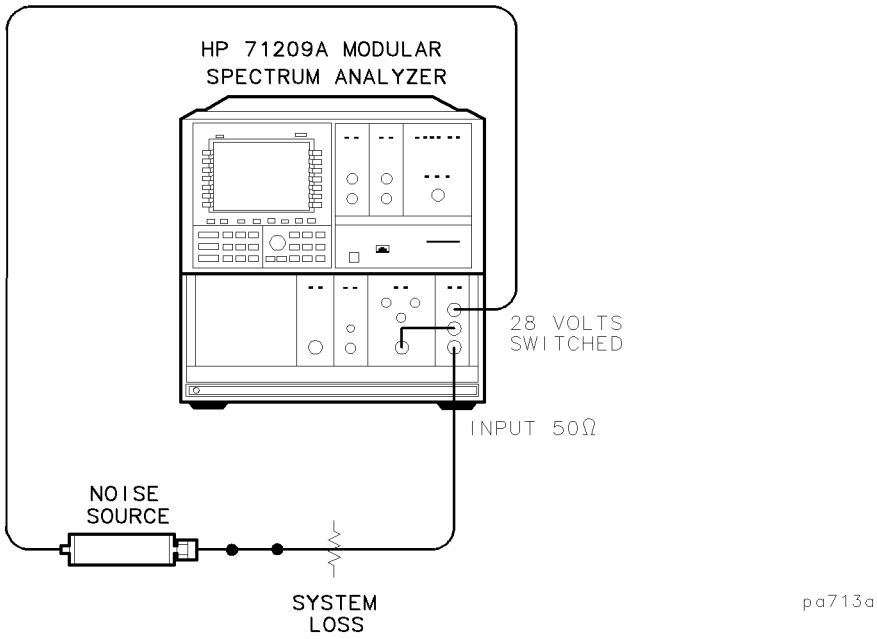



**Figure 2-1. System Loss Location During Calibration**

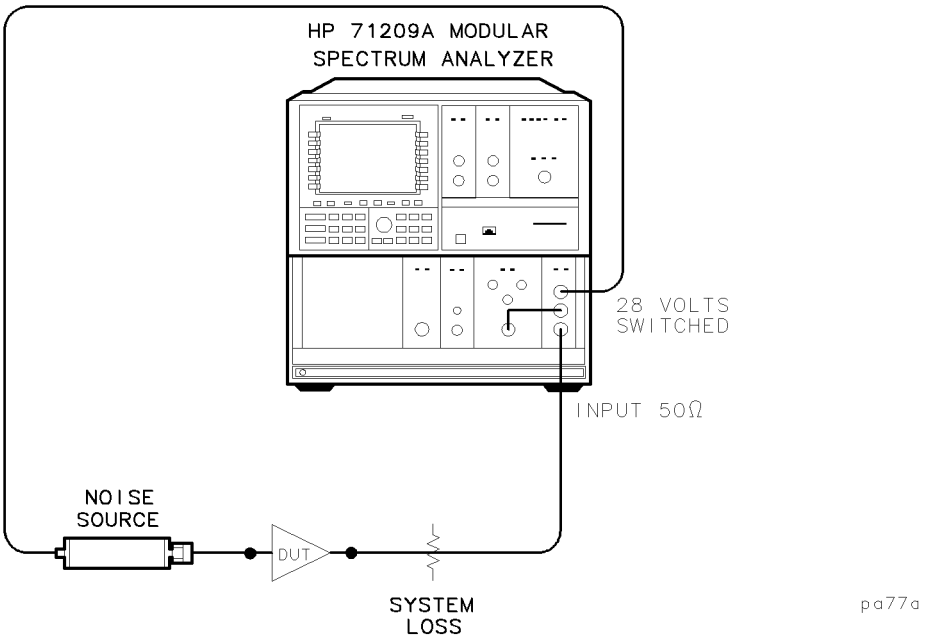



**Figure 2-2. System Loss Location During Device Measurement**

- Press SOURCE LOSS and enter the known loss value present at the location indicated in Figure 2-4 or Figure 2-3. The loss is subtracted from the noise source excess noise ratio (ENR).

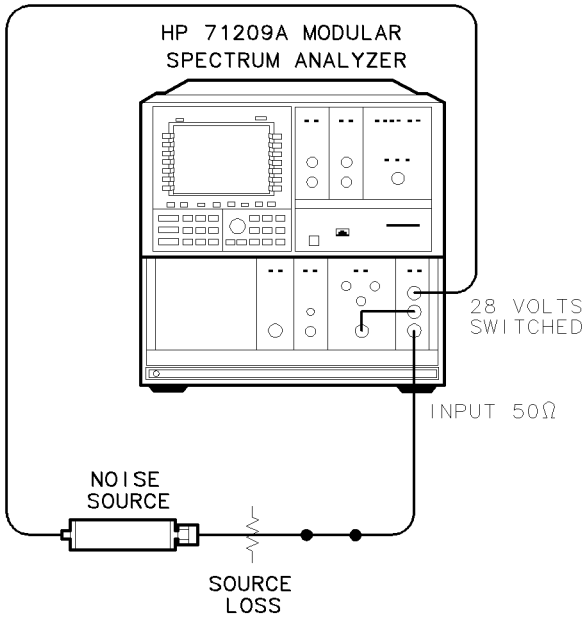



**Figure 2-3. SOURCE LOSS Location During Calibration**

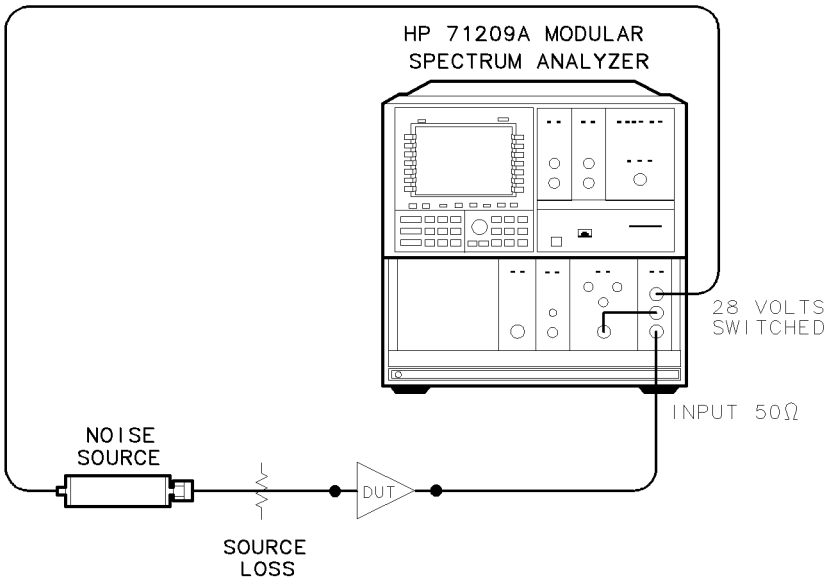



**Figure 2-4. SOURCE LOSS Location During Device Measurement**

- Press INPUT LOSS and enter the known loss value present at the location indicated in Figure 2-5 or Figure 2-6 as the input loss. The input loss of the DUT is added to its noise figure, but subtracted from its gain.

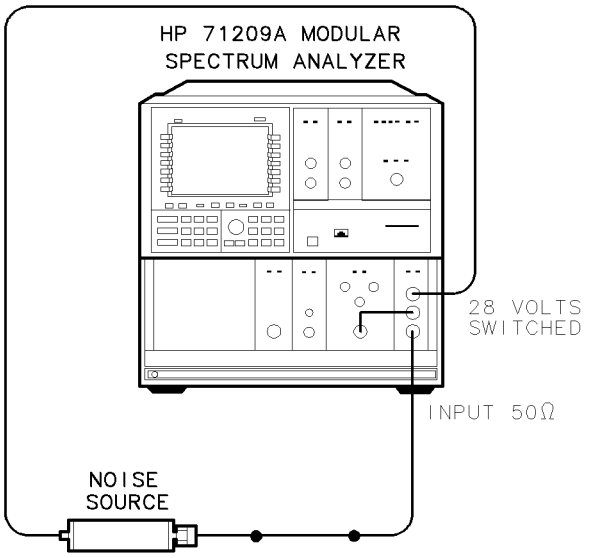



**Figure 2-5. INPUT LOSS Location During Calibration**

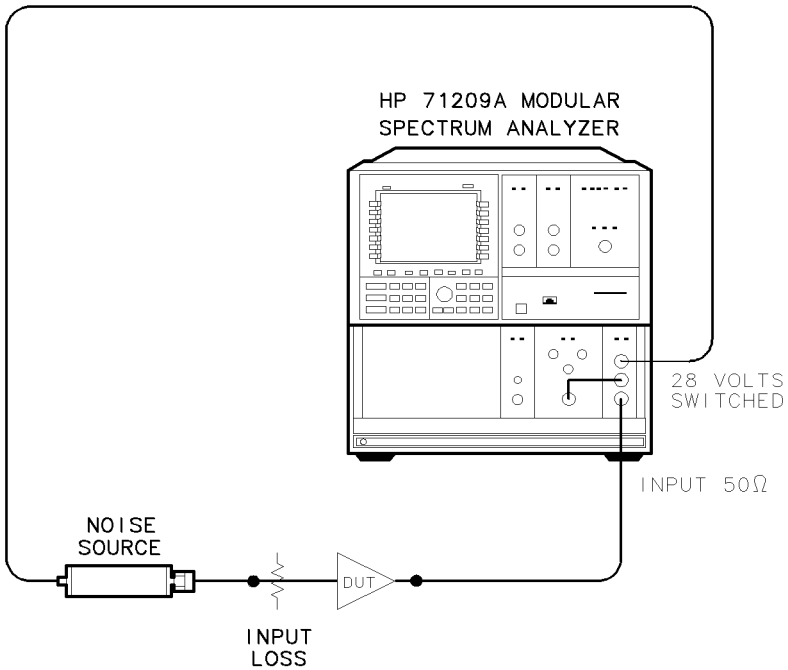



**Figure 2-6. INPUT LOSS Location During Device Measurement**

- Press OUTPUT LOSS and enter the known loss value present at the location indicated in Figure 2-7 or Figure 2-8 as the output loss. The output loss is subtracted from the gain or the device under test, but proportionally calculated into its noise figure.

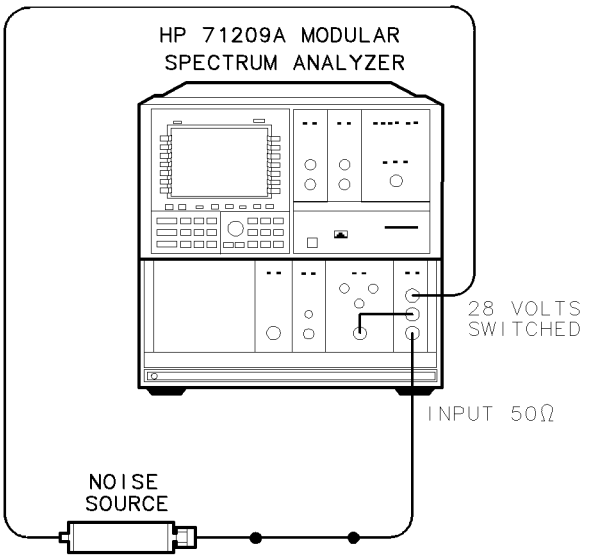



**Figure 2-7. OUTPUT LOSS Location During Calibration**

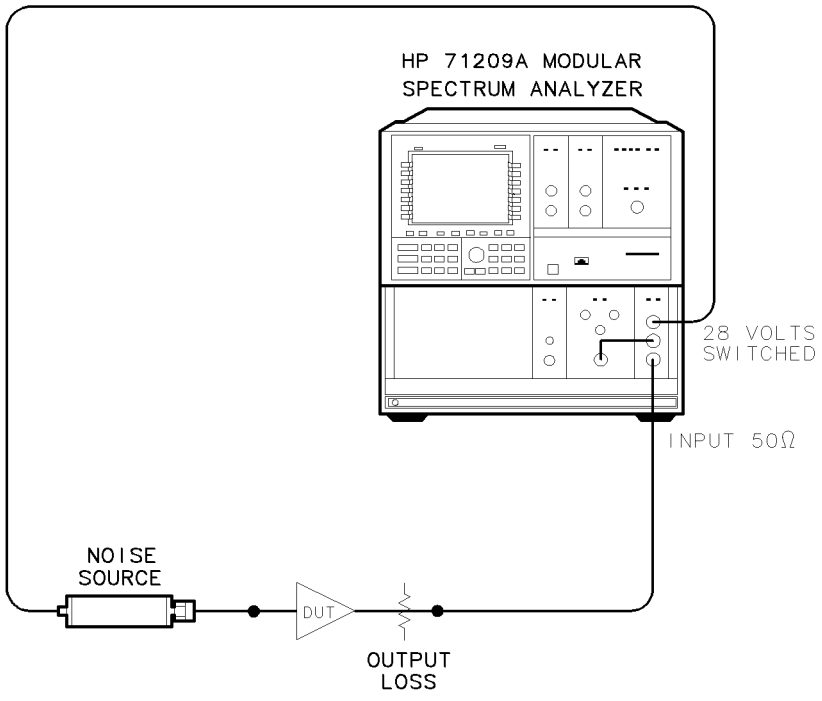



**Figure 2-8. OUTPUT LOSS Location During Device Measurement**

## To adjust RF attenuator

The input attenuator in the RF section can be adjusted with the noise figure measurements personality. When the preamp is enabled, an attenuation value of 0 will generally provide the best system noise figure. However, high gain devices can have high levels of output noise power which can overload the preamp and cause measurement inaccuracy. In this case, the preamp can be disabled and the input attenuator should be set to prevent overloading of the input mixer in the RF section. To set the RF attenuator, refer to the following steps:

1. Press `Amptd` in the main (left-hand) menu.
2. Press `ATTEN` in the right-hand menu. Use the front-panel data keys to enter the exact values, then complete the data entry by pressing the `dB` units key.

---

**Note** In using the `ATTEN` softkey, values can be entered that do not correspond to actual attenuator hardware capability. Refer to the spectrum analyzer operation manual to determine valid attenuator range and step size. Check the annotation in the upper left-hand corner of the display for the actual RF attenuator state.

---

## To disable or enable internal preamp

The internal MMS preamp (HP 70621A, HP 70620A or HP 70620B module) can be enabled or disabled (amplifier bypassed). Bypassing the preamp is useful in testing high gain devices whose output noise would overload the internal preamp. In this case, noise figure calibration may not work well due to the relatively high noise figure of the spectrum analyzer, but an uncorrected noise figure measurement could still be made (uncorrected noise figure measurements do not require a cal). Refer to the following steps:

1. Press `State` in the main (left-hand) menu.
2. Press `MORE 1 of 2` in the right-hand menu.
3. Press `INT AMP OnOff` to underline "Off" to disable the internal preamp, or "On" to enable the internal preamp.

## 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 `State` in the main (left-hand) menu.
2. Press `MORE 1 of 2` in the right-hand menu.
3. Press `SOURCE TEMP` and enter the ambient temperature of the testing environment. Retain the default setting of 17°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 knob or use it very carefully. The RPG knob 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 internal files.

**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 in calculating corrected results.

### To edit ENR data tables

Press `State`, then `EditSrc ENR`. The currently active ENR table data is displayed. Refer to Figure 2-9 for an example of an ENR table.

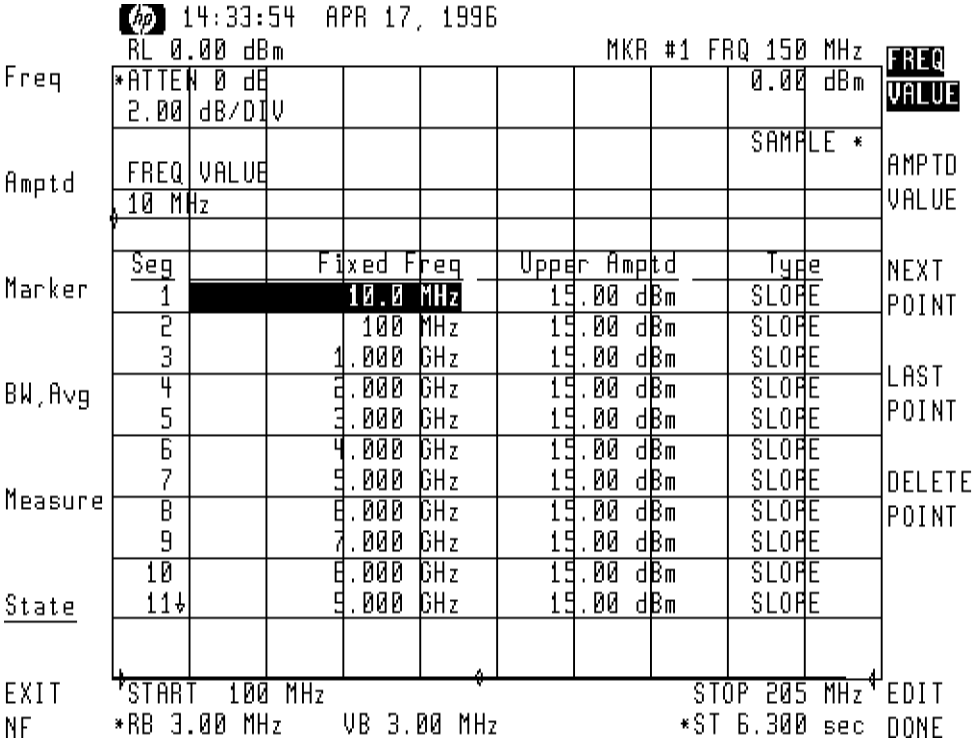



**Figure 2-9. The ENR Data Table Editor Screen**

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

1. Press `FREQ VALUE`, `AMPTD VALUE`, `NEXT POINT`, or `LAST POINT` to move the entry window to a new or existing ENR-data point.
2. Change the table values as explained below:

- Change the frequency value using the front-panel data keys and terminate the entry with the frequency units softkey.
- Change the amplitude value using the front-panel data keys and terminate the entry with the dBm units softkey.

---

**Note** Use the dBm units key for entering amplitude, even though the noise source label uses dB as the units of ENR

---

- 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 file, use the `SAVE ENR` softkey as explained in the following section.

### To save ENR data tables

To save the ENR data to a memory file, press `EDIT DONE`, then follow the steps below:

1. Press the `State` main (left-hand) menu softkey. Then press the `save` right-hand softkey.
2. Press `MSI IntCard` to underline the save destination you want to use. "Int" chooses the spectrum analyzer internal memory files. "Card" selects the MSIB memory card reader on the front panel of the HP 70004A display.
3. Press `SAVE ENR`, then enter the memory register number you wish to use, then press ENTER on the front panel.

---

**Note** External card files and internal files 1 to 4999 are available.
Be aware that ENR data is stored as limit line files (l_1 to l_4999) in either internal or external (card) memory.
To help keep track of ENR files, it is recommended to use the last four digits of the noise source serial number for the file storage number.

---

**WARNING** **When storing limit line files during normal spectrum analyzer operation, be careful not to write over existing ENR tables. The ENR table used in measurements is stored in the l_0 limit line file in internal memory.**

---

### To recall ENR data tables

ENR data tables may be recalled from spectrum analyzer memory, or from a memory card file. To recall existing ENR data tables, refer to the steps below:

1. Press the `State` main (left-hand) menu softkey. Then press the `recall` right-hand softkey.
2. Press `MSI IntCard` to underline the recall memory you want to use. "Int" chooses the spectrum analyzer internal memory files. "Card" selects the MSIB memory card reader on the front panel of the HP 70004A display.
3. Press `RECALL ENR`, then enter the file number you wish to use, then press `ENTER`.

**Note** ENR data tables are prefixed "I_" in spectrum analyzer memory or in memory card memory.

To verify the recall of the ENR data, use the table editing technique described earlier in this section.

## Calibrating for Measurements

The calibration procedure minimizes the effects of losses, noise, and gain factors due strictly to the measurement setup. It must be performed prior to corrected Noise Figure and Gain measurements or ENR measurements.

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.

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

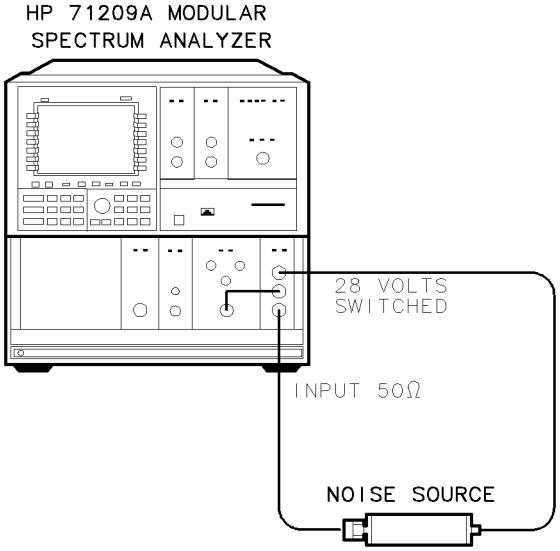



**Figure 2-10. Basic Calibration Setup**

For calibration, refer to the steps below:

1. Connect the test equipment as illustrated in Figure 2-10. Be sure to include your specific connectors, cables and adapters required for making your measurement.
2. Press the `Measure` main (left-hand) softkey, then press the `CAL` right-hand softkey. The message `\Connect NS to SA INPUT, Press CAL\` appears on the display. Press the `CAL` softkey again to start the calibration routine.
3. Refer to Figure 2-11 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 RFstart, and RFstop (for frequency converter measurements) after calibration does not require measurement recalibration. However, changing other measurement configuration parameters will require recalibration before corrected measurements can be made.

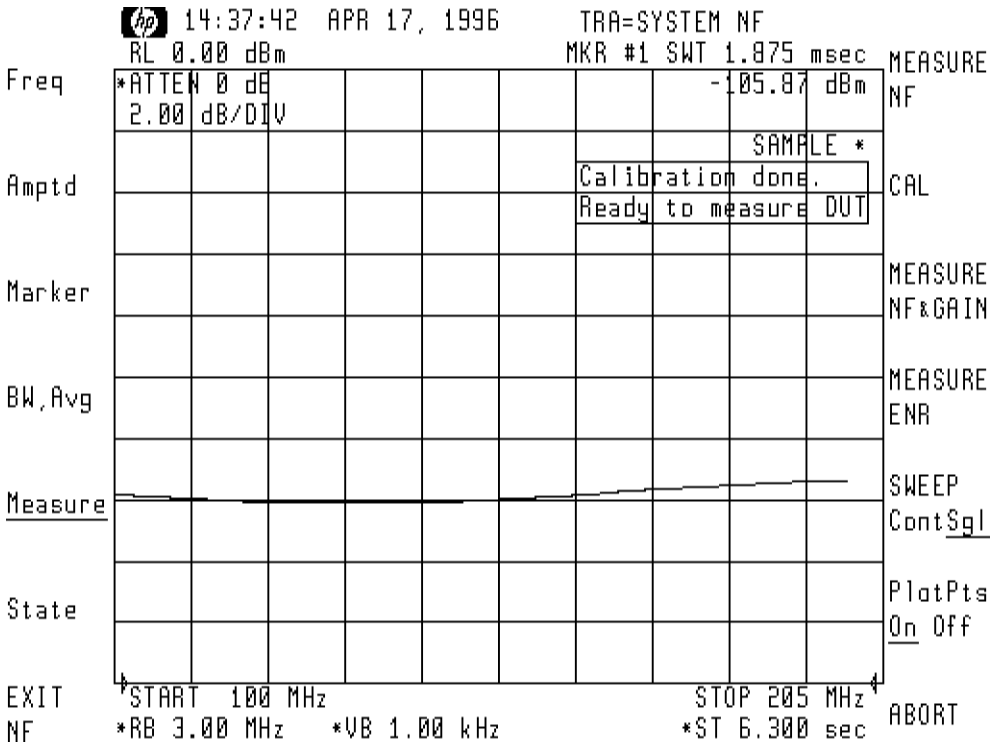



**Figure 2-11. Calibration Completion Display**

## Measuring Noise Figure and Gain of an Amplifier

To measure the noise figure and gain of an amplifier, use the following procedure.

### Configuring for the measurement

Refer to the "Configuring for Measurements" pages for information on configuring the noise figure measurement. Use the frequency values that are unique to the device you are testing. Be sure to underline `No` in the `FrqConv Yes No` key.

#### Calibrate the measurement setup

To calibrate the measurement setup, include all the hardware and cabling required for your measurement, unless you have entered DUT input and/or output losses. Use the procedure listed in "Calibrating for Measurements" to calibrate the measurement setup. At the end of the measurement, a message appears to indicate calibration completion.

#### To measure the amplifier

To measure an amplifier, connect the equipment as indicated in Figure 2-12. Press the `Measure` main softkey. For a corrected noise figure and gain measurement, press `MEASURE NF&GAIN` twice. If you do not calibrate, press `MEASURE NF` two times to begin an uncorrected noise figure measurement. Refer to Figure 2-13 for an example of the measurement results. The noise figure is in Trace A, and the gain is in Trace B.

**Note** Uncorrected noise figure measurements can be made, however, there will be no gain measurement trace.

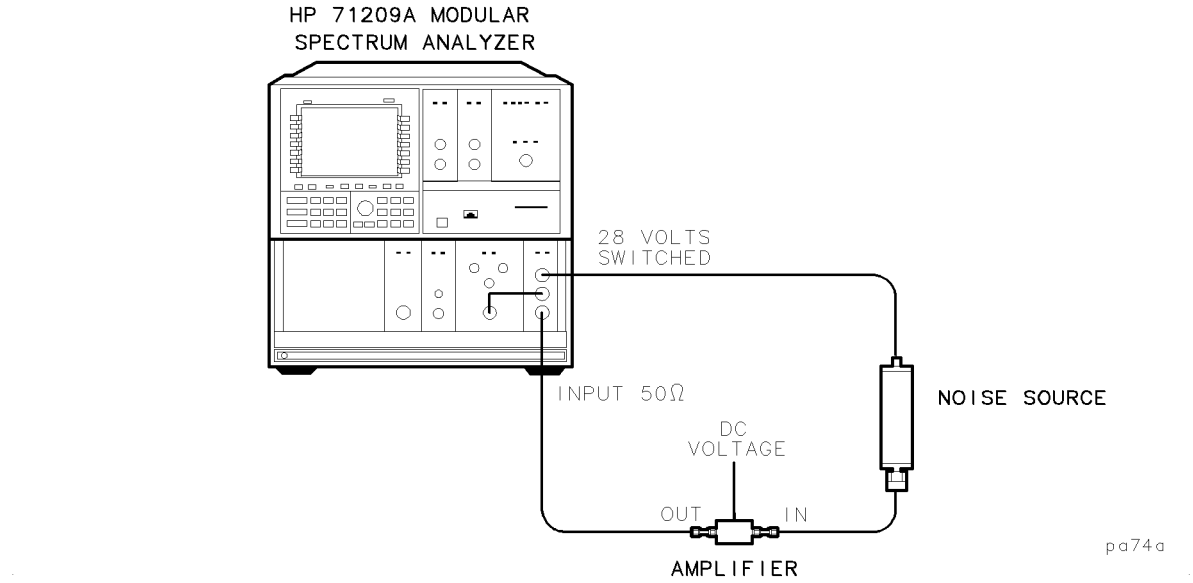



**Figure 2-12. Measuring Amplifier Noise Figure and Gain**

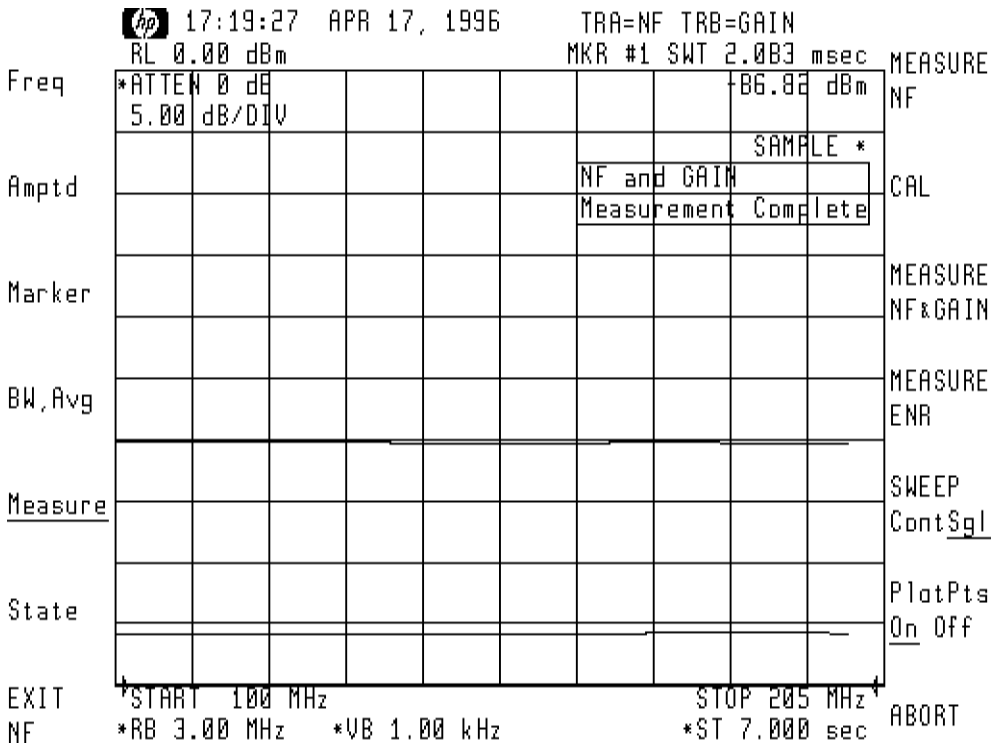



**Figure 2-13.**
**Noise Figure and Gain Measurement of an Amplifier.**
**Upper trace is gain, lower trace is noise figure.**

## Measuring Amplifier Output ENR

The HP 70875A Noise Figure Measurements Personality can also measure the output excess noise ratio of a device. This is useful in characterizing devices which have very high noise figures. It can also be used to compare a noise source to a known reference noise source. To measure the output ENR of an amplifier, use the following procedure.

### Configuring for the measurement

Refer to the "Configuring for Measurements" pages for information on configuring the noise figure measurement. Use the frequency values that are unique to the device you are testing.

**Note** Be sure to underline `No` in the `FrqConv Yes No` key. An output ENR measurement can only be made in the frequency non-conversion mode.

### Calibrate the measurement setup

To calibrate the measurement setup, include all the hardware and cabling required for your measurement, unless you have entered DUT output losses. Use the procedure listed in "Calibrating for Measurements" to calibrate the measurement setup. At the end of the measurement, a message appears to indicate calibration completion.

### To measure the amplifier

To measure an amplifier, connect the equipment as indicated in Figure 2-14. Press the `Measure` main softkey. For an output ENR measurement, press `MEASURE ENR` twice. Refer to Figure 2-15 for an example of the measurement results.

**Note** An output ENR measurement cannot be made unless a calibration has been previously performed. If configuration parameters are changed, a calibration must be made before an output ENR measurement can be made.

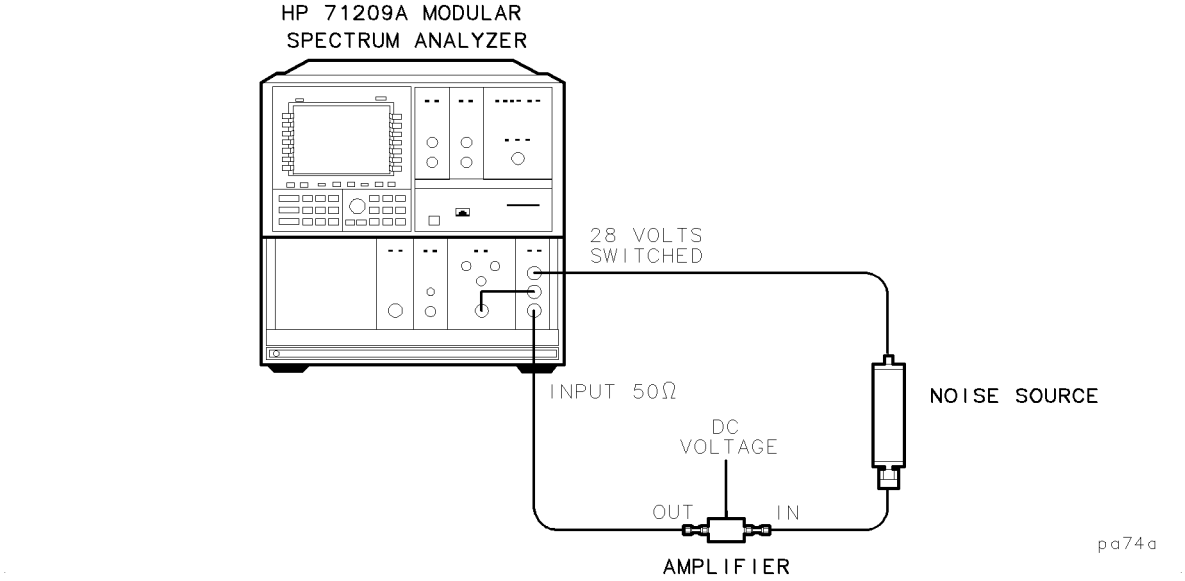



**Figure 2-14. Measuring Amplifier Output ENR**

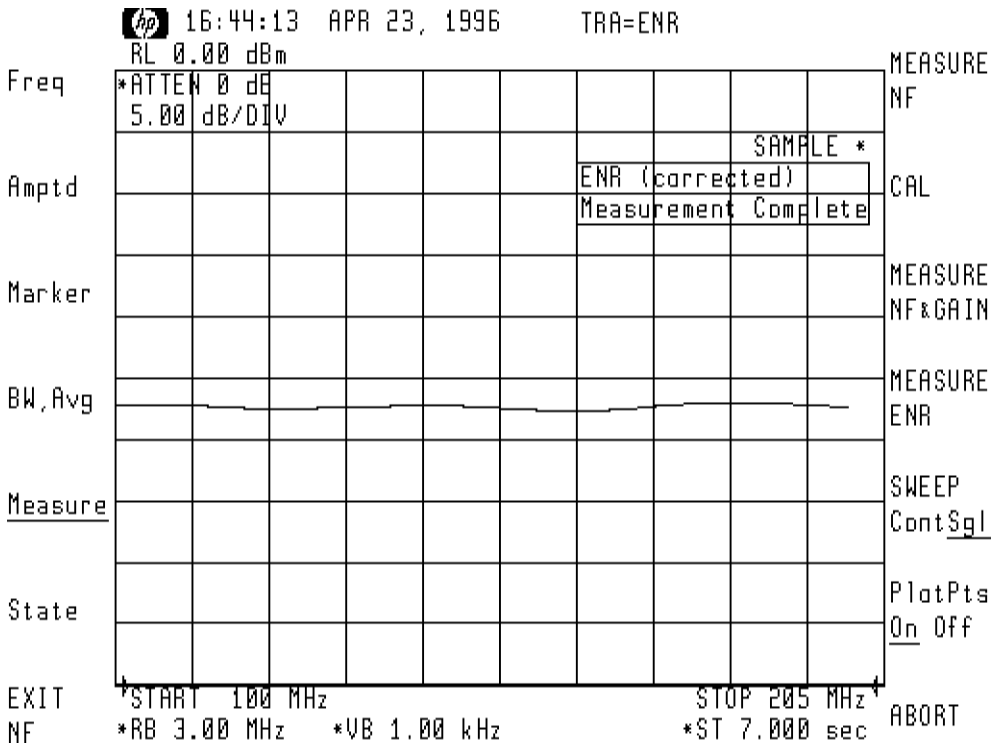



**Figure 2-15. Amplifier Output ENR Results Example**

## Measuring a Frequency Converter

To measure the noise figure and gain of a frequency converting device such as a mixer, use the following procedure.

### Configuring for the measurement

Refer to the "Configuring for Measurements" pages for information on configuring the noise figure 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.

- Be sure to underline `Yes` in the `FrqConv Yes No` key.
- Enter the RF and IF frequencies of the device you are testing. *The RF and IF spans must be equal.*
- The IF start frequency must correspond with the RF start frequency, even if the resulting values cause a "backwards sweep" condition (IF start frequency is greater than the IF stop frequency).

#### Calibrate the measurement setup

To calibrate the measurement setup, include all the hardware and cabling required for your measurement, unless you have entered DUT input and/or output losses. Use the procedure listed in "Calibrating for Measurements" to calibrate the measurement setup. At the end of the measurement, a message appears to indicate calibration completion.

#### To measure a frequency converting device

Press the `Measure` main softkey. To measure the noise figure and gain of a frequency converter, connect the equipment as indicated in Figure 2-16, then press `MEASURE NF&GAIN` twice. If you do not calibrate, press `MEASURE NF` two times to begin measurements. Refer to Figure 2-17 for an example of the measurement results. The noise figure is in Trace A, and the gain is in Trace B.

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

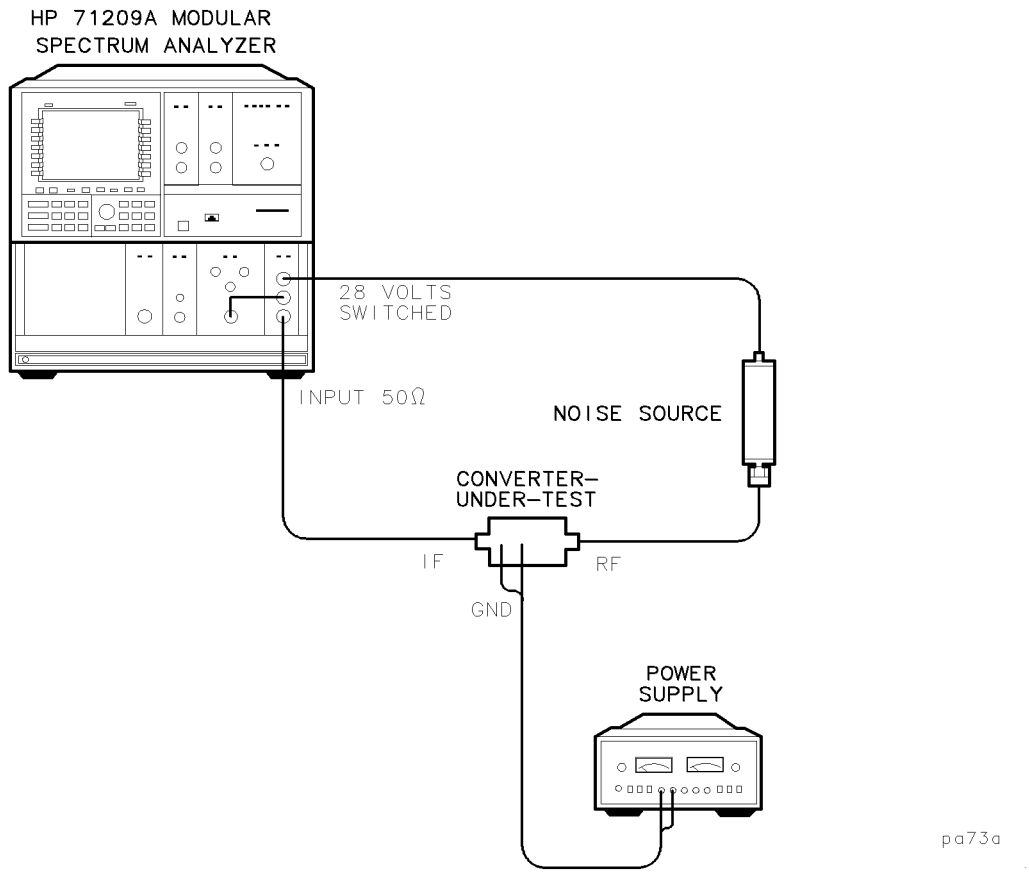



**Figure 2-16. Measuring a Frequency Converting Device**

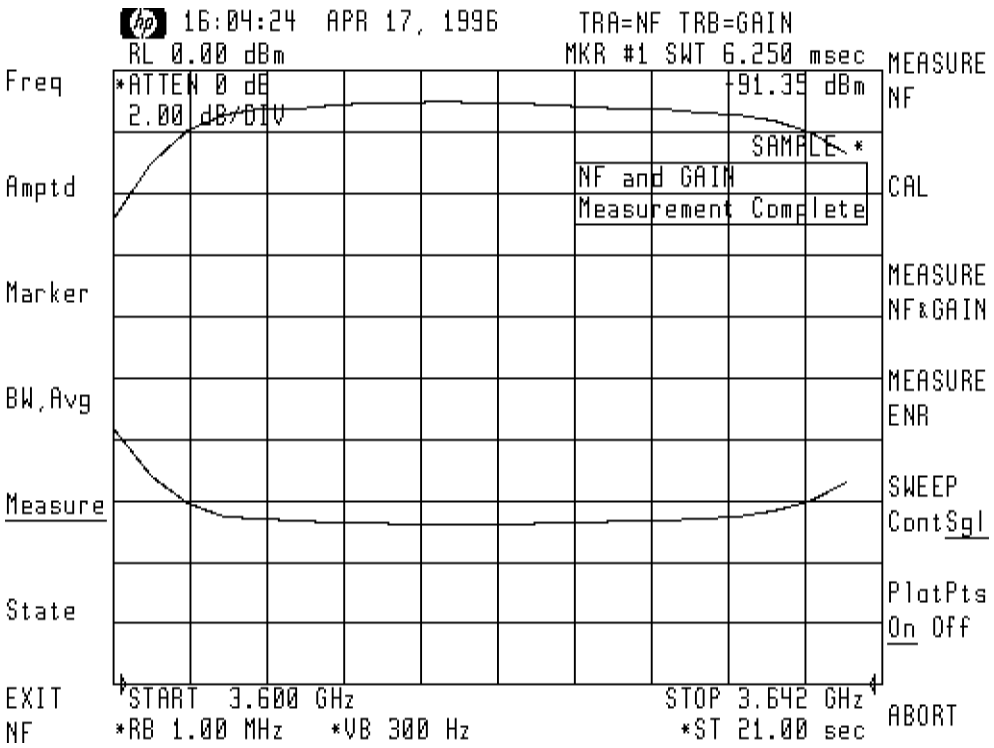



**Figure 2-17.**
**Noise Figure and Gain Measurement of a Frequency Converter.**
**Upper trace is gain, lower trace is noise figure.**

## Double Sideband Converter Corrections

**Note**

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
```

## Testing a Multiband Converter

**Note**

This measurement personality allows you to test a device such as a multiband-frequency converter 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.

## Adjusting the Results Display

For multi-point measurements (number of frequency points >1), the results display is a graph. The amplitude scale can be adjusted for better viewing with softkey functions found under the `Amptd` main (left-hand) menu:

### To adjust Reference Level

To adjust the display reference level, press the `REF LVL` left-hand softkey and use one of the following methods:

- Use the ⇧ and ⇩ keys to change the reference level in 1 division increments.
- Use the front-panel data keys to enter exact values. Terminate data-key entry with the `dBm` key.
- Use the RPG knob to change the value in small dB increments.

### To adjust Reference Level Position

To adjust the display reference level position, press the `REF LVL POSN` left-hand softkey and use one of the following methods:

- Use the ⇧ and ⇩ keys to change the reference level position in 1 division increments.
- Use the front-panel data keys to enter exact values. Terminate data-key entry with the `ENTER` key.
- Use the RPG knob to change the value in one division increments.

### To adjust Amplitude Scale

To adjust the display amplitude scale, press the `LOG dB/DIV` right-hand softkey and use one of the following methods:

- Use the ⇧ and ⇩ keys to change the reference level in 1-3-10 multiples.
- Use the front-panel data keys to enter exact values. Terminate data-key entry with the `dB` key.
- Use the RPG knob to change the value in small dB increments.

**Note** The `REF LVL`, `REF LVL POSN`, and `LOG dB/DIV` functions only affect the results display. They do not affect instrument settings during calibration or measurements.

## To use Display Markers

Markers can be placed on the measurement traces to read out amplitude and frequency values. Marker functions are found under the `Marker` main (left-hand) menu:

### To turn markers On or Off

Press `MKR NRM On Off` to underline "On" to turn the marker on, or "Off" to remove the marker from the display. Marker frequency and amplitude are shown in the active function area and in the upper right corner of the display. To move the marker:

- Use the ⇧ and ⇩ keys to move the marker in one division increments.
- Use the front-panel data keys to enter exact frequency values. Terminate data-key entry with a frequency units key.
- Use the RPG knob to move the marker in single data point increments.

### To use delta markers

Press `DELTA` to place two markers on the display for delta measurements. The difference between the two markers' frequency and amplitude are shown in the active function area and in the upper right corner of the display. To move the delta marker:

- Use the ⇧ and ⇩ keys to move the marker in one division increments.
- Use the front-panel data keys to enter exact frequency values. Terminate data-key entry with a frequency units key.
- Use the RPG knob to move the marker in single data point increments.

### To move the marker to the highest or lowest amplitude

Press `HIGHEST PEAK` to place the active marker at the highest amplitude point on the trace.

Press `MINIMUM POINT` to place the active marker at the lowest amplitude point on the trace.

### To set the reference level equal to the marker amplitude

Press `-> RL` to set the display reference level equal to the marker amplitude value.

### To calculate a marker noise temperature

The equivalent noise temperature in °K of a marker on the noise figure trace can be displayed by pressing the `MARKER TEMP` softkey.

---

**Note** The marker temp feature does not give useful information when used with the marker delta function or the gain trace.

---

### To move the marker between the noise figure and gain traces

Press `MKR TRA A B C` to underline "A" to place the marker on the noise figure trace, or "B" to place the marker on the gain trace.

---

**Note** Trace A is used for noise figure or output ENR results. Trace B is used for device gain results. Trace C is used during device measurement, and is not a results display.

---

## Testing Results with Limit Lines

For multi-point measurements with graphical results, limit lines can be used for Pass/Fail testing of the noise figure trace (Trace A). Three types of limit line segments are available:

- `FLAT` draws a zero-slope line between the beginning points of two segments, producing limit-line values equal in amplitude for all frequencies between the two points.
- `SLOPE` draws a sloped line between the beginning points of two segments, producing linearly interpolated limit-line values for all frequencies between the two points.
- `POINT` specifies a limit value for the beginning point of a segment only.

### To edit limit line data tables

Press the `Amptd` main (left-hand) menu, then press the `Limit Lines` softkey. The currently active limit line data table is displayed. Refer to Figure 2-9 for an example of a limit line table.

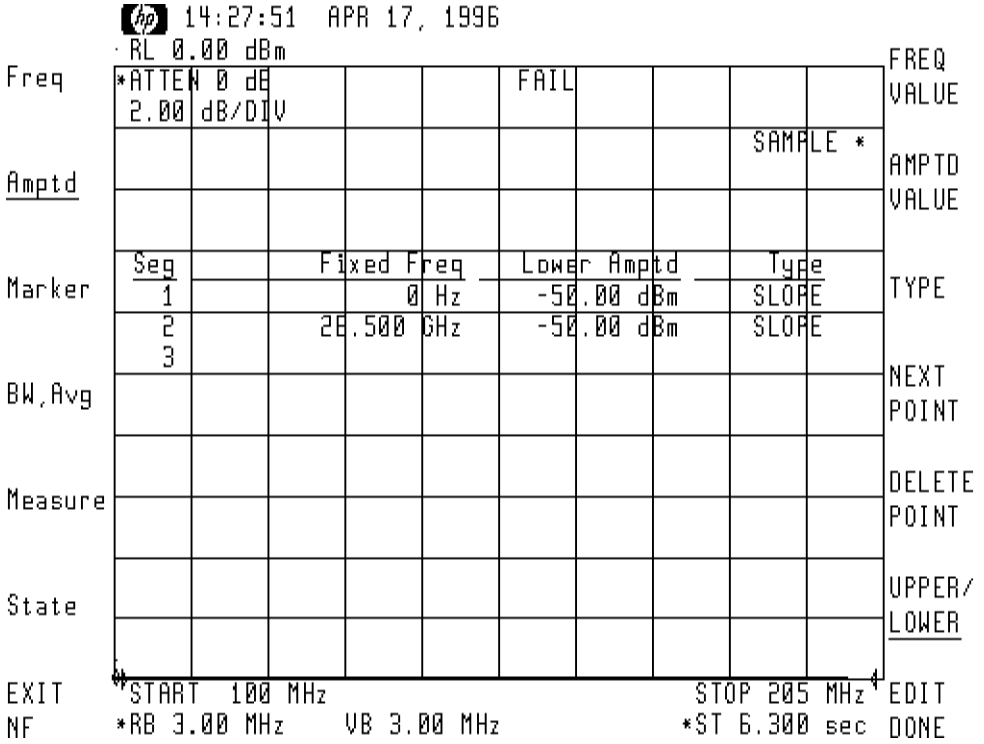



**Figure 2-18. The Limit Line Table Editor Screen**

To enter the limit line data, refer to the following steps:

1. Press `UPPER/LOWER` to select either the upper limit line table or the lower limit line table.
2. Press `FREQ VALUE`, `AMPTD VALUE`, `TYPE` or `NEXT POINT` to move the entry window to a new or existing limit line data point.
3. Change the frequency, amplitude, or line type table values as explained below:
   - Change the frequency value using only the front-panel data keys with the frequency units key.

- Change the amplitude value using only the front-panel data keys with the dBm units key.

**Note** Use the dBm units key for entering amplitude, even though the units of noise figure are dB.

- Change the line segment type by pressing `TYPE` and then selecting `SLOPE`, `FLAT`, or `POINT`
- 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 limit line table is available to test measurement results.

4. To store the limit line table to a memory file, use the `SAVE LIMIT` softkey as explained in the following section.

### To save limit line tables

To save the limit line table data to a memory file, follow the steps below:

1. Press the `State` main (left-hand) menu softkey. Then press the `save` left-hand softkey.
2. Press `MSI IntCard` to underline the save destination you want to use. "Int" chooses the spectrum analyzer internal memory files. "Card" selects the MSIB memory card reader on the front panel of the HP 70004A display.
3. Press `SAVE LIMIT`, then enter the memory register number you wish to use, then press ENTER on the front panel.

**Note** External card files and internal files 1 to 4999 are available.

Be aware that limit line data is stored as limit line files (l_5001 to l_9999) in either internal or external (card) memory.

**WARNING** **When storing limit line files during normal spectrum analyzer operation, be careful not to write over existing limit line files. ENR tables are stored in files l_0 through l_4999. Limit lines are stored in files l_5000 through l_9999.**

### To recall limit line tables

Limit line tables may be recalled from spectrum analyzer memory files, or from memory card files. To recall existing limit line tables, refer to the steps below:

1. Press the `State` main (left-hand) menu softkey. Then press the `recall` left-hand softkey.
2. Press `MSI IntCard` to underline the recall memory you want to use. "Int" chooses the spectrum analyzer internal memory files. "Card" selects the MSIB memory card reader on the front panel of the HP 70004A display.
3. Press `RECALL LIMIT`, then enter the file number you wish to use, then press ENTER on the front panel.

**Note** Limit line data tables are prefixed "l_" in spectrum analyzer memory or in memory card memory.

To verify the recall of the limit line data, use the table editing technique described earlier in this section.

### To enable limit line testing

A noise figure trace on the display can be tested against the limit lines using the following procedure:

1. Press the `Amptd` main (left-hand) menu softkey.
2. Press the `LIMITS On Off` softkey to underline `On` to enable limit line testing or `Off` to disable limit line testing.

The `PASS` or `FAIL` message for the limit line test appears at the top center of the display.

## Making Hard-Copies

Connect the HP 70004A display to an HP-IB printer and use the front-panel (PRINT) key to generate prints.

Consult the HP 70004A Display Operation Manual for details about using printers and plotters.

# 3

# Menu Key Descriptions

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

## Menu Pages

The menu pages of the HP 70875A Noise Figure Measurements Personality are shown in Figure 3-1 to Figure 3-13. The main menu keys are always present on the left hand side of the display. Keys on the right-hand side of the display are of two types:

1. Key labels which are in all capital letters are either immediately executed (e.g. `MEASURE NF`) or require a subsequent keyboard numeric input (e.g. `POINTS`).
2. Key labels which contain lower-case letters reassign new key labels to the right-hand softkeys, thus leading to a new menu page (e.g. `EditSrc ENR`).

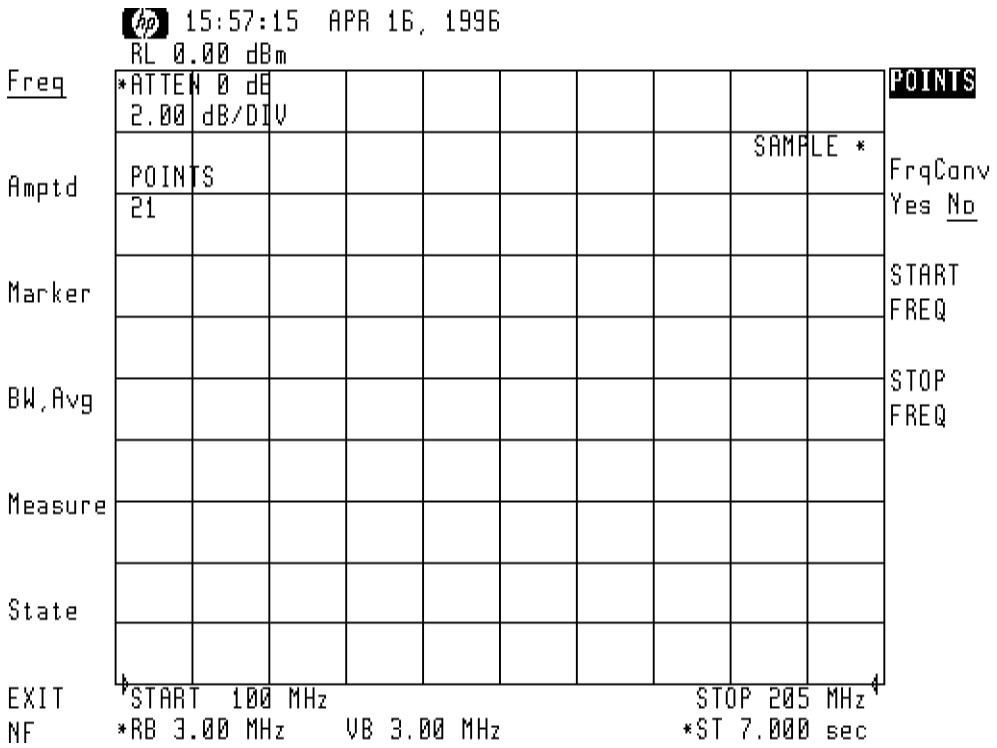



**Figure 3-1. The Frequency (non-converting) Menu Page**

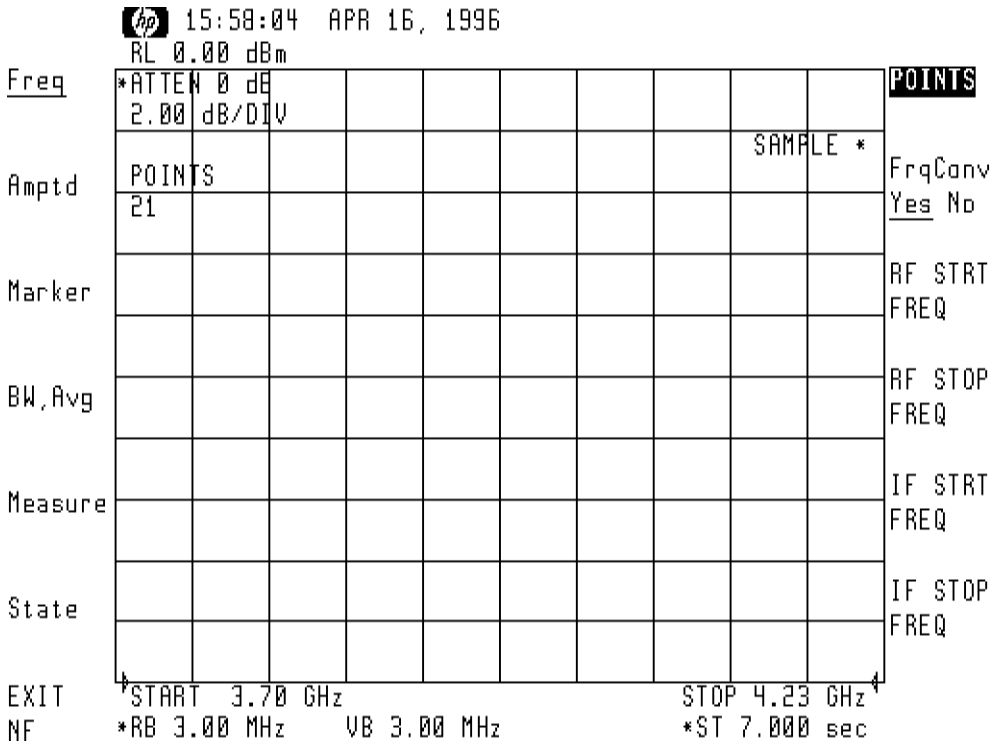



**Figure 3-2. The Frequency (converting) Menu Page**

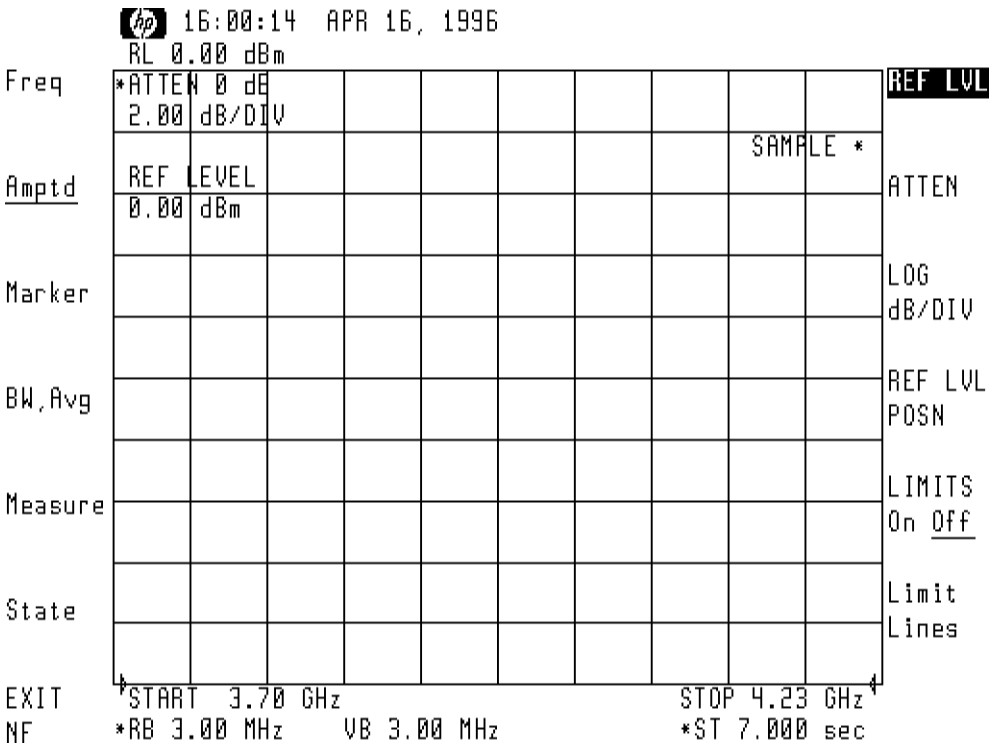



**Figure 3-3. The Amplitude Menu Page**

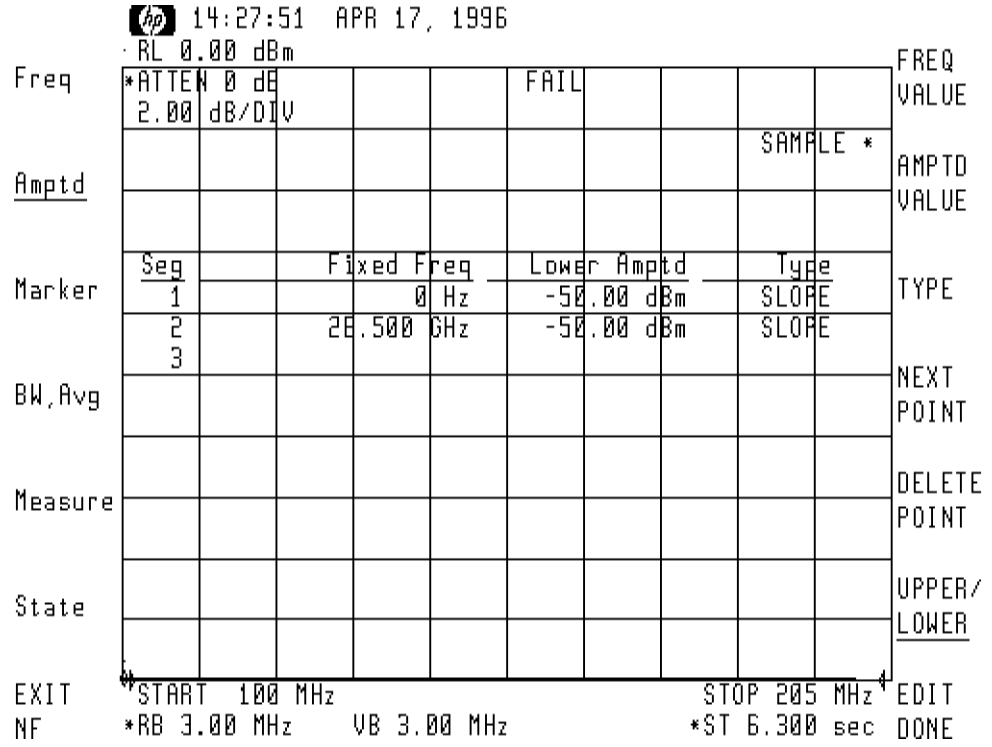



**Figure 3-4. The Limit Lines Edit Menu Page**

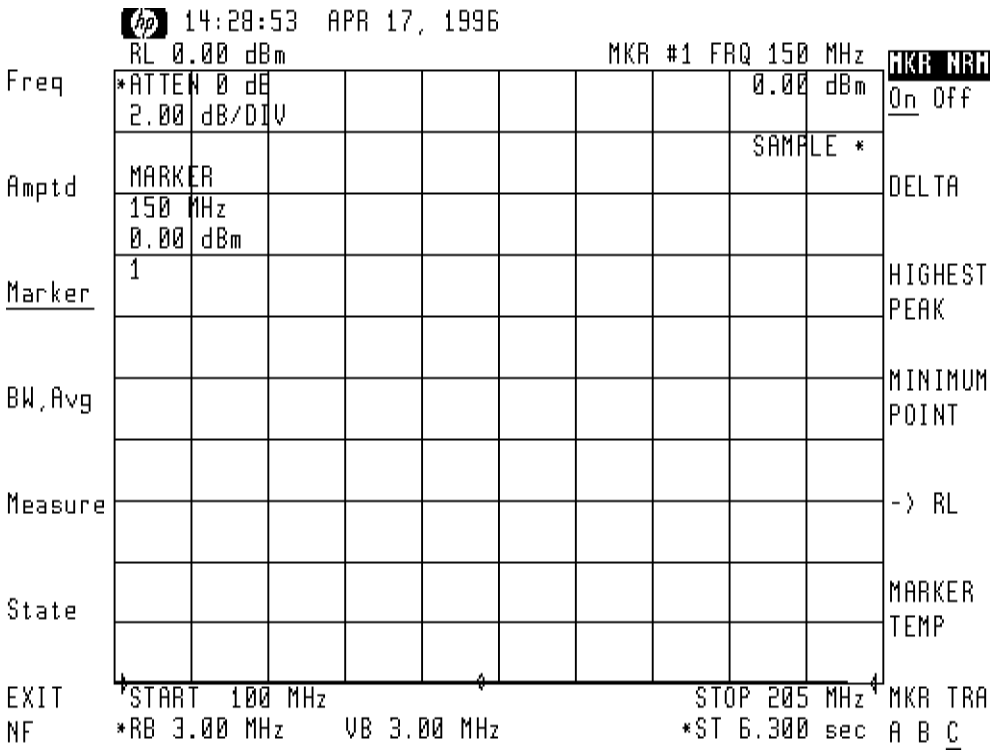



**Figure 3-5. The Marker Menu Page**

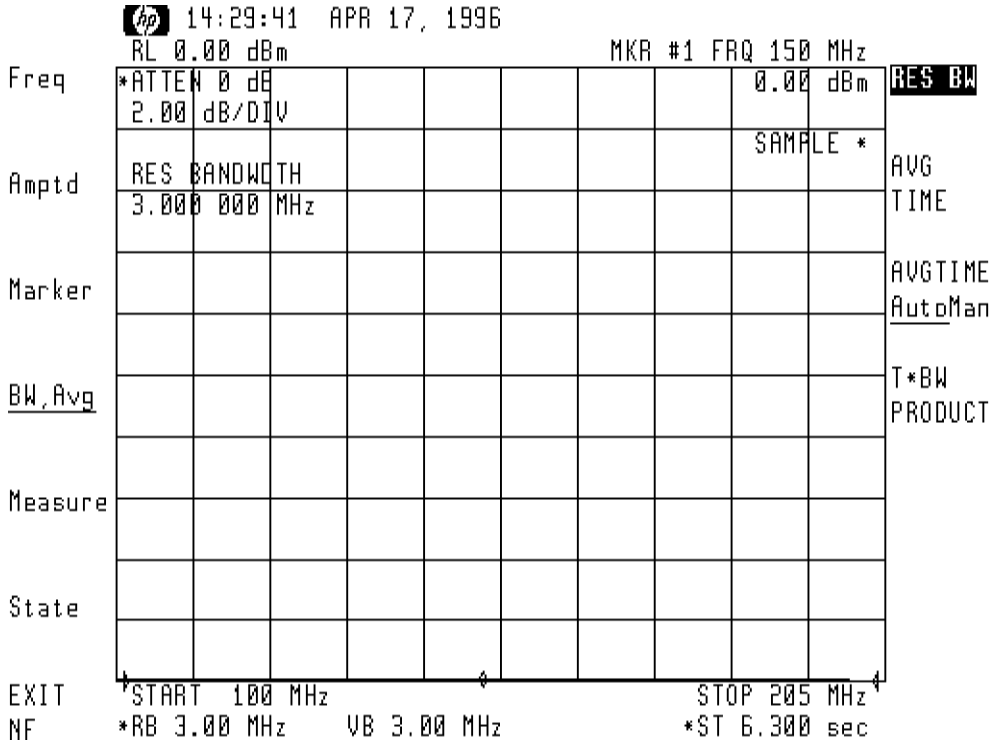



**Figure 3-6. The Bandwidth & Averaging Menu Page**

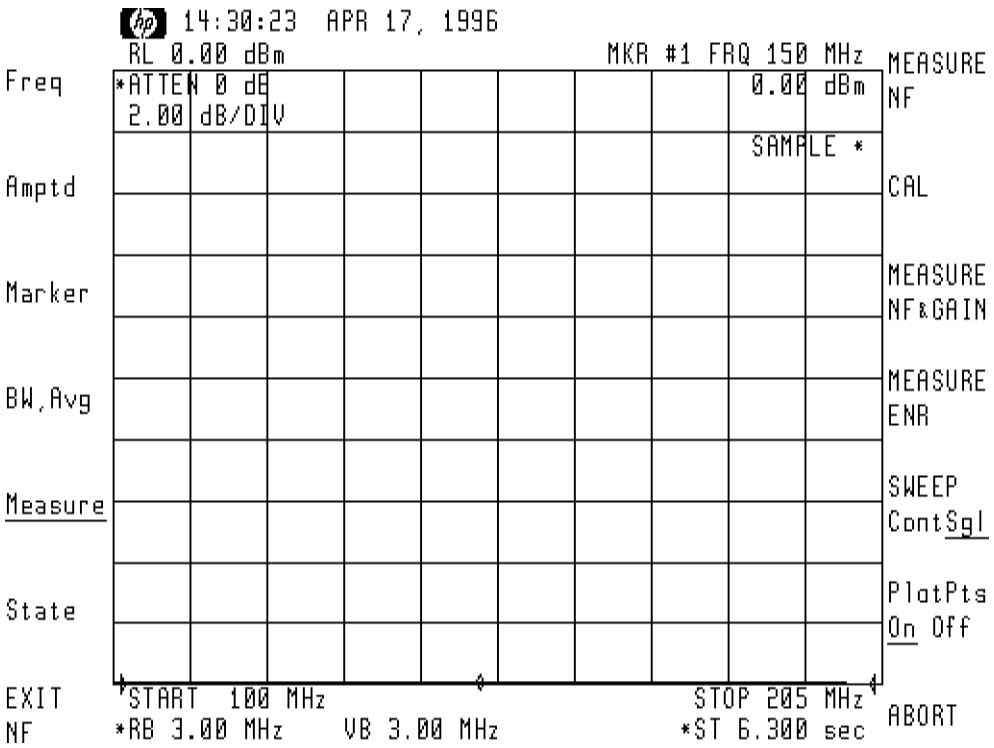



**Figure 3-7. The Measure Menu Page**

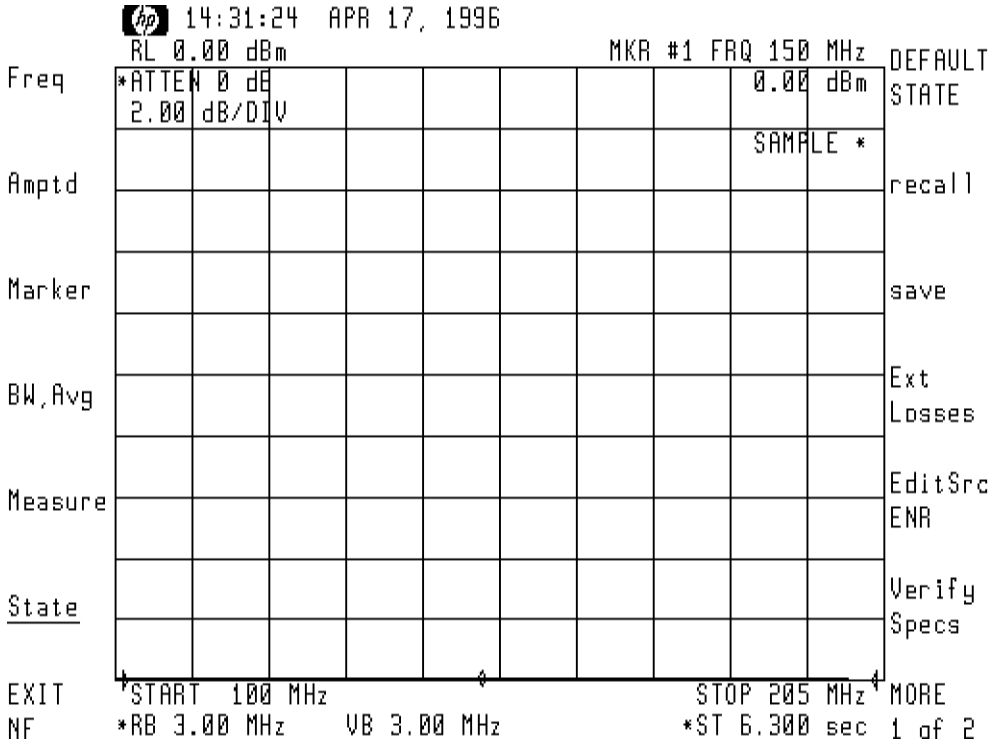



**Figure 3-8. The State Menu Page 1**

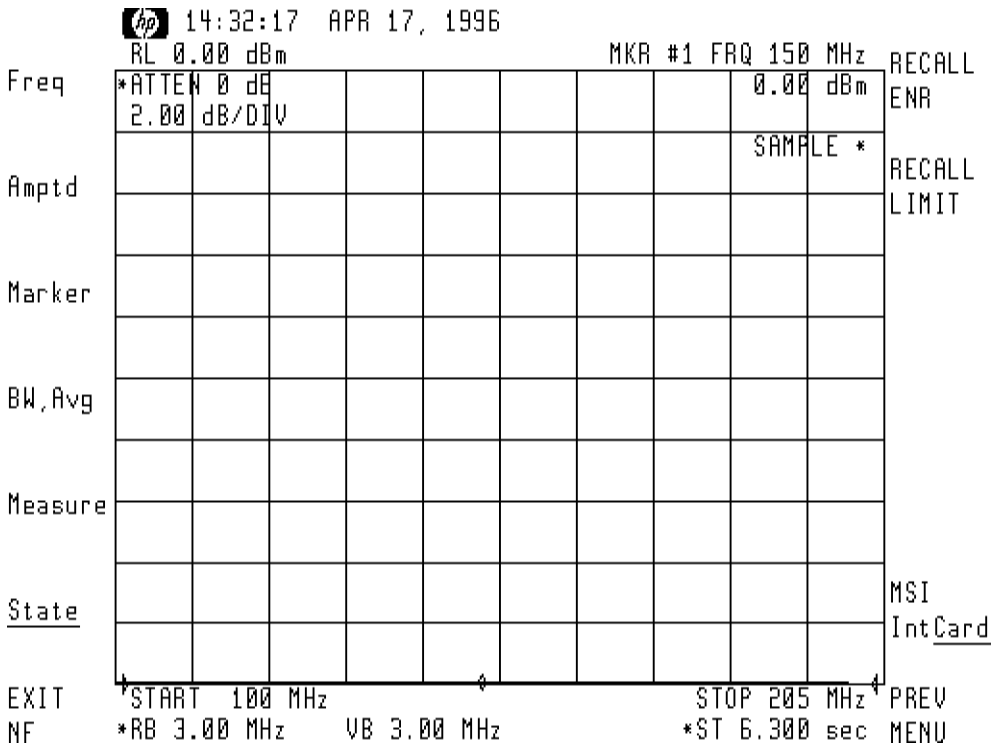



**Figure 3-9. The Recall Menu Page**

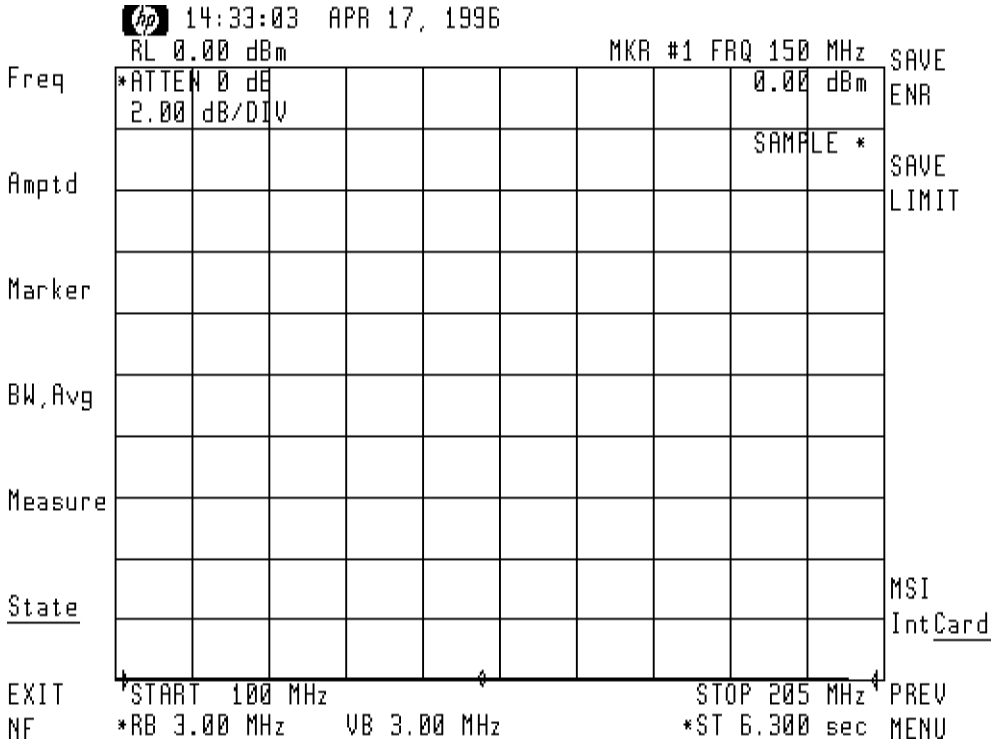



**Figure 3-10. The Save Menu Page**

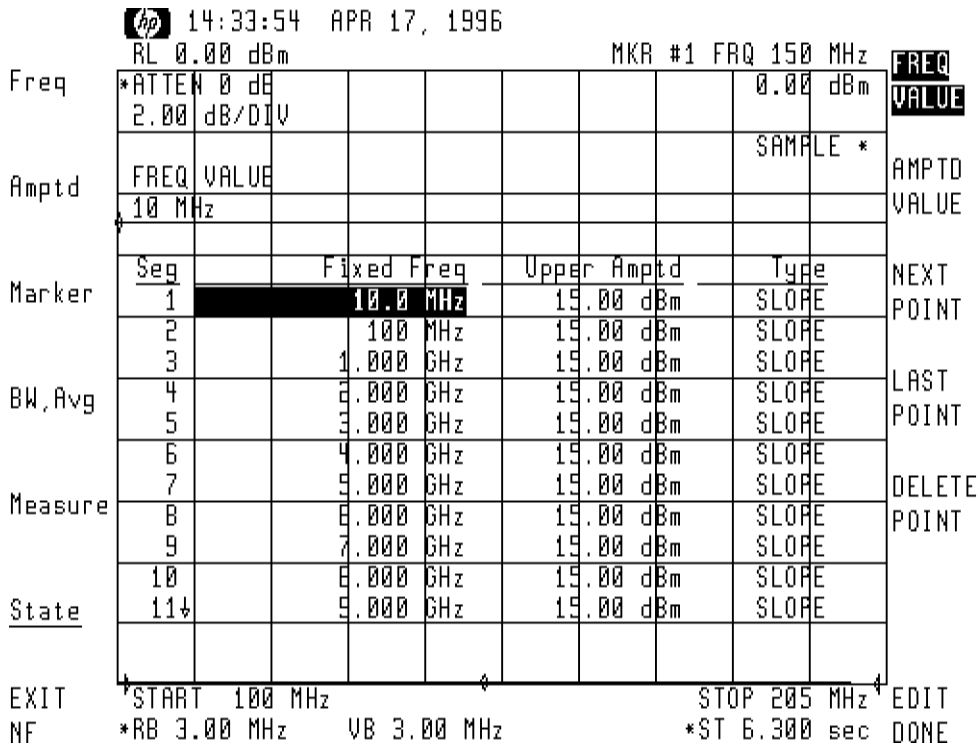



**Figure 3-11. The Edit ENR Source Menu Page**

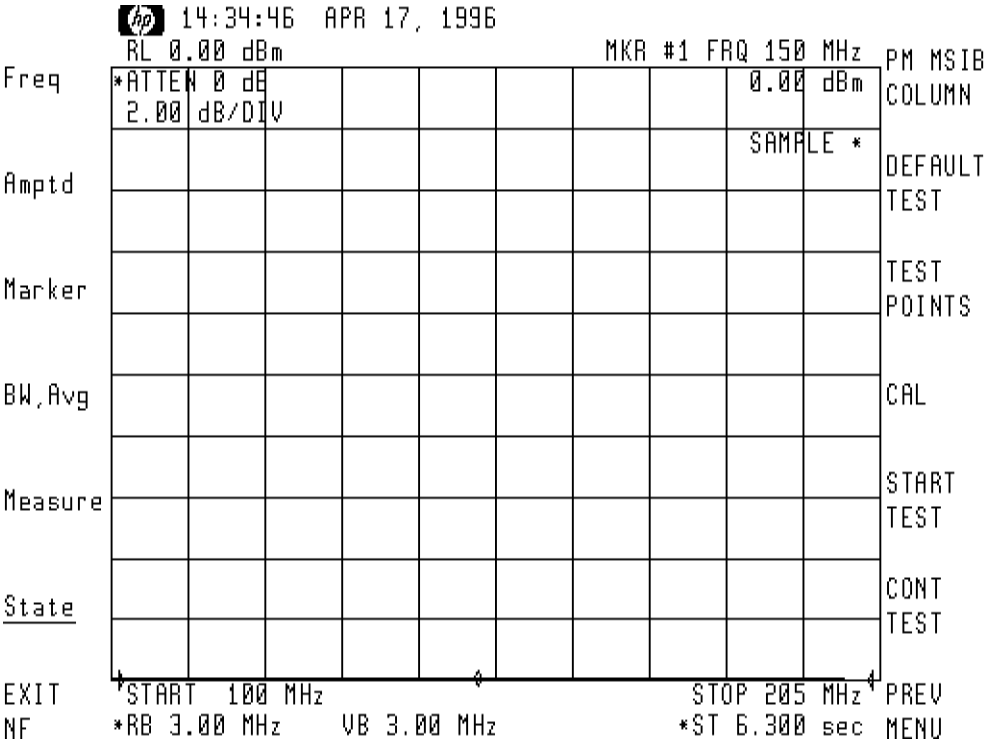



**Figure 3-12. The Verify Specs Menu Page**

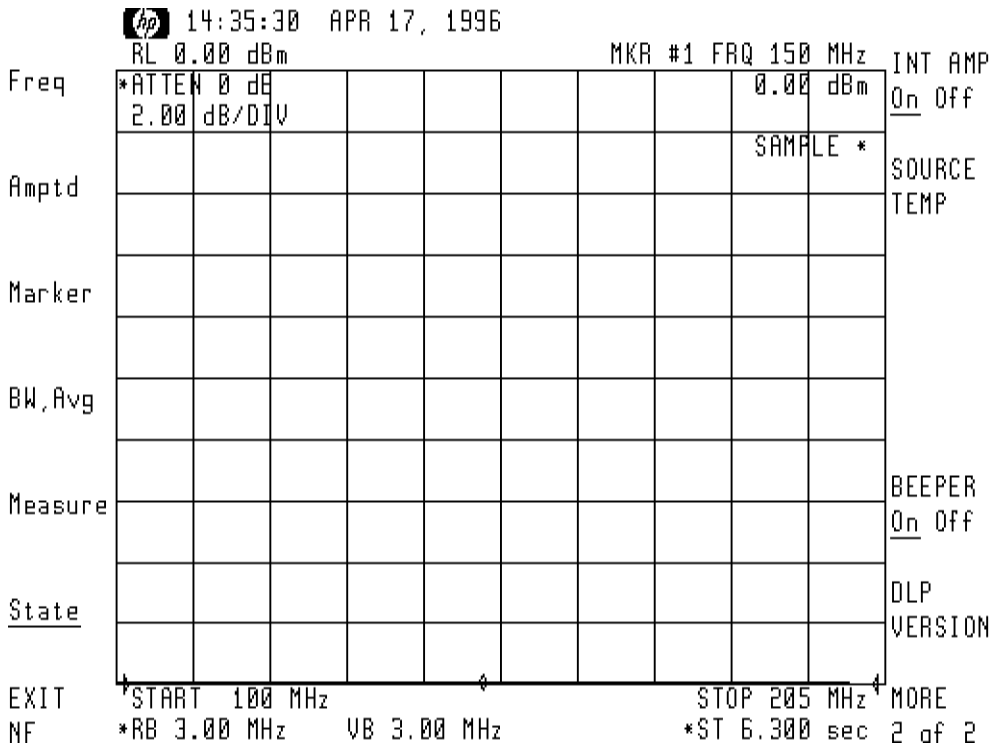



**Figure 3-13. The State Menu Page 2**

## Menu Key Descriptions

In this section, in alphabetical order, the menu keys are listed and described. Refer to the previous illustrations in Figure 3-1 to Figure 3-13 for the location of the HP 70875A Noise Figure Measurements Personality keys.

ABORT

Select this key in the `Measure` menu to interrupt a calibration or measurement sequence that is currently in progress.

AMPTD VALUE

Select this key in the `Limit Lines` or `Edit SrcENR` menus to highlight an entry in the amplitude column of the limit line table for editing.

ATTEN

Select this key in the `Amptd` menu to display or change the spectrum analyzer RF input attenuator setting. When the preamp is enabled, an attenuation value of 0 will generally provide the best system noise figure. However, high gain devices can have high levels of output noise power which can overload the preamp and cause measurement inaccuracy. In this case, the preamp can be disabled and the input attenuator should be set to prevent overloading of the input mixer in the RF section.

**Note** In using the `ATTEN` softkey, values can be entered that do not correspond to actual attenuator hardware capability. Refer to the spectrum analyzer operation manual to determine valid attenuator range and step size. Check the annotation in the upper left hand corner of the display for the actual RF attenuator state.

AVG TIME

Select this key in the `BW, Avg` menu to display or change the measurement 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 1000 s, in steps of 0.1 s below 1 s, and steps of 1 s above. With the `AVG TIME AutoMan` softkey set to AUTO, the value of AVG TIME is determined by the value of `T*BW PRODUCT` divided by `RES BW`.

AVG TIME AutoMan

Select this key in the `BW, Avg` menu to set the averaging time-resolution bandwidth coupling mode.

When `AVG TIME Auto` is selected, the value of `AVG TIME` is determined by the value of `T*BW PRODUCT` divided by `RES BW`.

When `AVG TIME Man` is selected, the value of `AVG TIME` can be set independently from the settings of `T*BW PRODUCT` and `RES BW`.

BEEPER On Off

Select this key on page 2 of the `State` menu to turn the end-of-measurement beeper ON or OFF. The beeper is useful in notifying the operator that the measurement has completed. The beeper hardware is in the HP 70004A Display.

CAL

Select this key in the `Measure` menu to initiate the system calibration routine. The calibration procedure minimizes the effects of losses, noise, and gain factors due strictly to the measurement setup. It must

be performed prior to corrected Noise Figure and Gain measurements or ENR measurements.

CONT TEST

Select this key in the `Verify Specs` menu to continue the verification test sequence after the input noise power to the spectrum analyzer has been adjusted.

DEFAULT STATE

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

**Table 3-1.**
**Noise Figure Personality Default Parameters**

| Parameter | Default Setting |
|---|---|
| Attenuator | 0 dB |
| Average Time | Auto mode |
| Beeper Mode | ON |
| Frequency Conversion | Off |
| IF Start Frequency(conversion) | 1.950 GHz |
| IF Stop Frequency(conversion) | 1.450 GHz |
| Input Loss | 0.0 dB |
| Limitest | Off |
| Mass Storage | Memory Card (MSIB) |
| Output Loss | 0.00 dB |
| Plot Points | On |
| Points | 21 |
| Preamplifier | Enabled |
| Reference Level | 0 dB |
| Reference Level Position | 0 |
| Resolution Bandwidth | 3 MHz |
| RF Start Frequency(conversion) | 3.70 GHz |
| RF Stop Frequency(conversion) | 4.20 GHz |
| Start Frequency (non conversion) | 100 MHz |
| Stop Frequency (non conversion) | 200 MHz |
| Source Case Temperature | 17.0°C |
| Source Loss | 0.00 dB |
| Sweep Mode | Single |
| Time-BW Product | 1 MHz–sec |
| Vertical Scale | 2 dB/div |

DEFAULT TEST

Select this key in the `Verify Specs` menu to restore default test configuration parameters. These parameters are listed in Table 3-2 on the following page:

**Table 3-2. Verification Test Default Parameters**

| Parameter | Default Setting |
|---|---|
| Attenuator | 0 dB |
| Average Time | Auto mode |
| Frequency Conversion | Off |
| Input Loss | 0.0 dB |
| Limit Test | On |
| Mass Storage | internal |
| Output Loss | 0.00 dB |
| Plot Points | On |
| Points | 31 |
| Preamplifier | Disabled |
| Reference Level | 0 dB |
| Reference Level Position | 5 |
| Resolution Bandwidth | 3 MHz |
| Start Frequency (non conversion) | 320 MHz |
| Stop Frequency (non conversion) | 320 MHz |
| Source Case Temperature | 17.0°C |
| Source Loss | 0.00 dB |
| Sweep Mode | Single |
| Time-BW Product | 3 MHz−sec |
| Vertical Scale | 0.5 dB/div |

DELETE POINT

Select this key in the `Limit Lines` or `Edit SrcENR` menus to delete a data point in the limit line table.

DELTA

Select this key in the `Marker` menu to turn the trace delta marker ON or OFF. The delta marker can then be positioned relative to the reference marker to make delta measurements.

DLP VERSION

Select this key on page 2 of the `State` menu to display the the software revision date of the Noise Figure Measurements personality software.

EDIT DONE

Select this key in the `Limit Lines` or `Edit SrcENR` menus to exit the limit line table editing mode.

EditSrc ENR

Select this key in the `State` menu to enter the noise source ENR editing mode.

EXIT DLP

Pressing this main menu key will cause the analyzer to exit the Noise Figure Measurements personality and return to the last spectrum analyzer state that existed before the personality was entered.

Ext Losses

Select this key in the `State` menu to select the external losses menu.

FREQ VALUE

Select this key in the `Limit Lines` or `Edit SrcENR` menus to highlight an entry in the frequency column of the limit line table for editing.

FrqConv Yes No

Select this key in the `Freq` menu to choose the frequency conversion mode. The default setting is off, or `NO`. Set frequency conversion to `YES` for testing receivers, mixers, or other frequency conversion devices. The `FrqConv Yes` menu includes RF and IF start- and stop-frequency parameters. The frequency span of the RF and IF values must equal. The default values are listed in Table 3-1 in this section.

HIGHEST PEAK

Select this key in the `Marker` menu to position the active trace marker to the highest amplitude point on the trace.

IF STOP FREQ

Select this key in the `Freq` menu when conversion is set to YES. Enter the IF stop frequency for frequency conversion measurements. The valid range of frequencies is equal to the frequency range of the spectrum analyzer.

IF STRT FREQ

Select this key in the `Freq` menu when conversion is set to YES. Enter the IF start frequency for frequency conversion measurements. The valid range of frequencies is equal to the frequency range of the spectrum analyzer.

INPUT LOSS

Select this key in the `Ext 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.

INT AMP On Off

Select this key in the second page of the `State` menu to enable the system preamp (ON) or bypass the preamp (OFF).

LAST POINT

Select this key in the `Edit SrcENR` menu to move the entry window to the last data point in the table.

Limit Lines

Select this key in the `Amptd` menu to enter the limit line editing mode.

LIMITS On Off

Select this key in the `Amptd` menu to turn the limit testing function `On` or `Off`.

LOG dB/DIV

Select this key in the `Amptd` menu to display or change the measurement scale for the results display.

MARKER TEMP

Select this key in the `Marker` menu to display the marker noise temperature in °K.

MEASURE ENR

Select this key in the `Measure` menu to initiate a DUT output Excess Noise Ratio measurement sequence. Before this measurement can begin, the measurement configuration and system calibration must have been completed.

MEASURE NF

Select this key in the `Measure` menu to initiate the uncorrected noise figure measurement sequence.

**Note** Uncorrected noise figure measurements can be made, however, there will be no gain measurement trace.

MEASURE NF&GAIN — Select this key in the `Measure` menu to initiate the corrected noise figure and gain measurement sequence. Before this measurement can begin, the measurement configuration and system calibration must have been completed.

MINIMUM POINT — Select this key in the `Marker` menu to position the active trace marker to the lowest amplitude point on the trace.

MKR NRM On Off — Select this key in the `Marker` menu to turn the trace marker ON or OFF.

MKR TRA A B C — Select this key in the `Marker` menu to move the marker to trace A, B, or C.

**Note** Trace A is used for noise figure or output ENR results. Trace B is used for device gain results. Trace C is used during device measurement, and is not a results display.

MORE 1 of 2 — Select this key in the `State` menu to display more state choices. The `MORE 1 of 2` key displays the following menu:

- `INT AMP On Off`
- `SOURCE TEMP`
- `BEEPER On Off`
- `DLP VERSION`
- `MORE 2 of 2`

MORE 2 of 2 — Select this key in the `State` menu to return to the previous menu page.

MSI IntCard — Select this key in the `recall` menu to select the location for storing or retrieving files. When INT is selected, internal analyzer memory will be accessed. When CARD is selected, the external MSIB device (memory card reader on the front panel of the HP 70004A display) is accessed.

NEXT POINT — Select this key in the `Limit Lines` or `Edit SrcENR` menus to move the entry window to the next data point in the limit line table.

OUTPUT LOSS — Select this key in the `Ext 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*.

PlotPts On Off — Select this key in the `Measure` menu to turn the end-of-measurement results plotting ON or OFF.

PM MSIB COL — Select this key in the `Verify Specs` menu to enter the MSIB column address of the HP 70100A Power Meter module used in the verification test.

**Note** The MSIB column address of the Power Meter module must be entered before starting the verfication test.

POINTS

Select this key from the `Freq` menu to enter the number of frequency points to measure. The values from the points measured are used in noise figure and gain calculations. You can measure from 1 to 800 points. The personality sets points to the nearest actual number as listed below:

| Number Entered | Actual Number Points Measured |
|---|---|
| 1 | 1 point |
| 2 | 1 point |
| 3<=N<=800 | N points |
| 800<N | 800 points |

PREV MENU

Select this key to return to the previously displayed menu.

recall

Select this key in the `State` menu to select the recall menu.

RECALL ENR

Select this key in the `recall` menu to select and recall a noise source ENR table from memory. An ENR table can be recalled from an existing table stored in the internal memory or from a table stored on a memory card, depending on the setting of MSI. The recalled table is then applied in all subsequent measurements. The valid range of ENR files is 1 to 4999.

RECALL LIMIT

Select this key in the `recall` menu to select and recall a limit line table from memory. A limit line table can be recalled from an existing table stored in the internal memory or from a table stored on a memory card, depending on the setting of MSI. The recalled table is then compared against trace A data when limit testing is turned ON. The valid range of limit line files is 1 to 4999.

REF LVL

Select this key in the `Amptd` menu to display or change the reference level for the results display.

REF LVL POSN

Select this key in the `Amptd` menu to display or change the reference level position for the results display.

RES BW

Select this key in the `BW, Avg` menu to display or change the measurement IF bandwidth. The valid range is 1 KHz to 3 MHz.

RF STOP FREQ

Select this key in the `Freq` menu when `Freq Conv` is set to `Yes`. Display or change the RF stop frequency value for a measurement. The valid range of RF frequencies is from 0.0 kHz to 1E26 Hz.

RF STRT FREQ

Select this key in the `Freq` menu when `Freq Conv` is set to `Yes`. Display or change the RF start frequency value for a measurement. The valid range of RF frequencies is from 0.0 kHz to 1E26 Hz.

—>RL

Select this key in the `Marker` menu to set the results display reference level equal to the active marker amplitude.

save

Select this key in the `State` menu to select the save menu.

SAVE ENR

Select this key in the `save` menu to save a noise source ENR table to memory. An ENR table presently in use by the analyzer can be saved to internal memory or to the external memory card, depending on the setting of MSI. The valid range of ENR file numbers is 1 to 4999.

SAVE LIMIT

Select this key in the `save` menu to save a limit line table to memory. A limit line table presently in use by the analyzer can be saved to internal memory or to the external memory card, depending on the setting of MSI. The valid range of limit line file numbers is 1 to 4999.

SOURCE LOSS

Select this key in the `Ext Losses` menu to enter the loss compensation factors that exist due to the noise source.

SOURCE TEMP

Select this key in the second page of the `State` menu to enter the noise-source case temperature. The range of this parameter is 0°C to 1000°C. The default temperature value is 17°C.

---

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

---

START FREQ

Select this key in the `Freq` menu to enter the start frequency setting of a non-frequency conversion measurement. The valid range of frequencies is equal to the frequency range of the spectrum analyzer.

START TEST

Select this key in the `Verify Specs` menu to initiate the verification test sequence.

STOP FREQ

Select this key in the `Freq` menu to enter the stop frequency setting of a non-frequency conversion measurement. The valid range of frequencies is equal to the frequency range of the spectrum analyzer.

SWEEP ContSgl

Select this key in the `Measure` menu to select either CONTINUOUS or SINGLE sweep measurements. The continuous mode is generally useful only in the single point measurement mode, with `POINTS` set to 1.

T*BW PRODUCT

Select this key in the `BW, Avg` menu to adjust the time-bandwidth product. This product is the averaging time multiplied by the measurement bandwidth in Megahertz-seconds. Changing the time-BW product while averaging mode is set to AUTO causes the measurement time to change, but not the measurement bandwidth.

TEST POINTS

Select this key in the `Verify Specs` menu to display or change the number of measurement points in the verification test.

TYPE

Select this key in the `Limit Lines` menu to select an entry in the type column of the limit line table for editing. Three types of limit line segments are available:

- `FLAT` draws a zero-slope line between the beginning points of two segments, producing limit-line values equal in amplitude for all frequencies between the two points.
- `SLOPE` draws a sloped line between the beginning points of two segments, producing linearly interpolated limit-line values for all frequencies between the two points.

- `POINT` specifies a limit value for the beginning point of a segment only.

UPPER/LOWER

Select this key in the `Limit Lines` menu to select the upper or lower limit line table for editing.

Verify Specs

Select this key in the `State` menu to select the verify specifications menu.

# 4

# 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

The specifications in Table 4-1 apply only for the following configuration:

- HP 70875A Noise Figure Measurements Personality
- HP 70908A RF Section (22 GHz) or HP 70909/10A RF Section (26.5 GHz)
- HP 70900B LO/Control Section with firmware Rev.940120 (B.05.00) or later
- HP 70903A IF Section
- HP 70902A IF Section
- HP 70620B Opt.001 Preamp
- HP 346B (18 GHz) or HP 346C (26.5 GHz) Noise Source

All specifications apply over 0-55°C. The Noise Figure Measurements 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 ALL has been run.

**Table 4-1. Specifications**

| Specification | Performance Limits | Conditions |
|---|---|---|
| **Noise Figure Measurement** | | |
| Range | 0 to 30 dB | |
| Resolution | 0.01 dB | |
| Instrumentation Uncertainty* | | |
| | ±0.5 dB | 10 MHz-2.9 GHz, Measurement Bandwidth = 3 MHz |
| | ±0.6 dB | 2.9-26.5 GHz, Measurement Bandwidth = 3 MHz |
| **Gain Measurement** | | |
| Range | 0 to +30 dB | |
| Resolution | 0.01 dB | |
| Instrumentation Uncertainty* | | |
| | ±0.5 dB | 10 MHz-2.9 GHz, Measurement Bandwidth = 3 MHz |
| | ±0.6 dB | 2.9-26.5 GHz, Measurement Bandwidth = 3 MHz |
| **Input** | | |
| Frequency Range | 10 MHz to 22 GHz | Using HP 70908A RF Section |
| | 10 MHz to 26.5 GHz | Using HP 70909A or 70910A RF Section |
| System Noise Figure | | |
| | < 11 dB | 10 MHz - 2.9 GHz |
| | < 12 dB | 2.9 - 12.8 GHz |
| | < 18 dB | 12.8 - 22.0 GHz |
| | < 21 dB | 22.0 - 26.5 GHz |
| Input SWR | < 2.4:1 | 10 MHz - 2.9 GHz |
| | < 2.2:1 | 2.9 - 12.8 GHz |
| | < 3.0:1 | 12.8 - 26.5 GHz |
| **IF Processing** | | |
| IF Bandwidths | 1 KHz to 3 MHz | in 10 percent increments |
| Noise Averaging | 20 mSec to 1000 Sec | |

* For DUT NF ≤ 15 dB and (DUT NF + DUT gain) ≥System Noise Figure

# System Performance Verification

The procedure in this section verifies the instrumentation accuracy of the spectrum analyzer for noise figure measurements. The procedure measures the analyzer's log scale fidelity using a noise signal as the source. All other items in Table 4-1 are standard spectrum analyzer specifications and are verified using the procedures listed in the Installation and Verification Manual for the particular spectrum analyzer model being used.

## 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 30 dB in 1 dB steps.

The test measures the deviation of the spectrum analyzer noise power measurement compared to a power meter measurement. The peak-to-peak deviation over the 30 dB measurement range is the instrumentation uncertainty of the spectrum analyzer for making noise figure measurements.

The test begins with a band-limited noise signal applied to the spectrum analyzer input. The input Excess Noise Ratio is measured for this first point. Then the noise level is reduced in 1 dB increments, measuring ENR with the spectrum analyzer and input power with the power meter at each point. The difference between the spectrum analyzer and the power meter measurements are plotted, normalized to the first measurement point. Limit lines are drawn on the display, and a PASS/FAIL indication is shown, depending on the results of the test.

### Related Spectrum Analyzer Specifications

Log Scale Fidelity

### Equipment required for the measurement

The performance verification test equipment is listed below:

HP 70000 Series Spectrum Analyzer ..... HP 71100C/71209A/71210C
Noise Source ..... HP 346C
Power Meter ..... HP 70100A
Dual Amplifier (two required) ..... HP 8447A, Option 001
Low Power Sensor ..... HP 8485D
321.4 MHz Bandpass Filter ..... 9135-0252
Power Splitter ..... HP 11667B
Coaxial, 1 dB Step Attenuator ..... HP 8494A, Option 001
Coaxial, 10 dB Step Attenuator ..... HP 8595A, Option 001
Type-N Interconnect Kit ..... HP 11716A
Termination 50 Ohm BNC(M) ..... 1250-0207

Cables
50Ω BNC Cable,(23 cm) (four required) ..... HP 10502A
SMA Cable,(75 cm) ..... 5021-9039

Adapters
SMA (m) to BNC (f), (three required) ..... 1250-1200
Type N (m) to BNC (f) ..... 1250-1472
Type N (m) to SMA (f) ..... 1250-1250

## Calibrate the Spectrum Analyzer

The spectrum analyzer should be calibrated prior to the verification test. To do this, the analyzer should be in its normal spectrum analyzer mode. Connect the Calibrator output on the HP 70900B module to the RF Input on the preamplifier module. Then press (MENU), `Amptd`, `CAL ALL`. The calibration routine runs several minutes, depending on the module configuration. The routine ends when the `End of Calibration` message appears on the display.

## Zero and Calibrate the Power Meter

Follow the instructions in the HP 70100A Power Meter Operating Manual to zero and calibrate the power sensor. Make sure that the correct Cal Factor Table for the sensor in use has been stored in the sensor table of the HP 70100A.

---

**CAUTION** Do not calibrate the HP 8485D without the reference attenuator. The reference attenuator prevents damage to the HP 8485D low power sensor.

---

## Calibrate For ENR Measurements

Connect the noise source to the Preamp Module RF input as shown in Figure 4-1. If the analyzer is not already in noise figure measurement mode, press the (USER) front panel key, then press the `NF_GAIN DLP` softkey to invoke the noise figure measurements personality.

If you have not previously entered the ENR table for the noise source that you are using, do so now using the procedure given in Chapter 2.

Enter the spec verification menu by pressing `State`, `Verify Specs`. Press the `DEFAULT TEST` softkey to set the analyzer to a default state that can be used for performing the verification. Press the `CAL` softkey to perform a system calibration. The routine ends when the `Calibration done, Ready to measure DUT` message appears on the display.

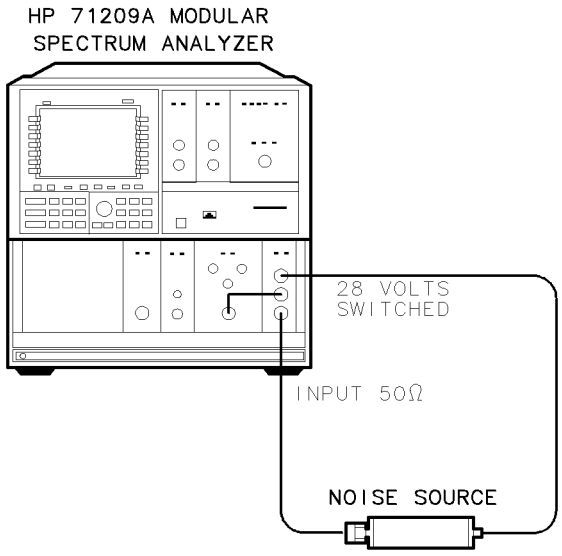



**Figure 4-1. Calibration Setup for ENR Measurements**

## Perform the Verification Test

Connect the equipment as shown in Figure 4-2. Note that the noise source is not used in this setup. Then use the following procedure:

1. Select the power meter on the HP 70004A display. Set the power meter measurement frequency to 320 MHz. Then adjust the step attenuators so that the power meter reads within 1 dB of -30 dBm.
2. Select the spectrum analyzer on the HP 70004A display. In the spec verification menu, press the `PM MSIB COLUMN` softkey. The personality will display the expected MSIB column address for the HP 70100A Power Meter module. If the displayed address is not the correct address for the power meter that is to be used in the measurement, key in the correct address and press `ENTER`. This establishes an MSIB communications link between the spectrum analyzer and the power meter.
3. Press the `START TEST` softkey. The message `Connect SA and PM to Splitter, Press CONT` will appear on the display. Press the `CONT TEST` softkey to initiate an ENR measurement. When the measurement is complete, the message `Adjust Noise Power, Press CONT TEST` will appear on the display. The ENR measurement result will appear at the lower left corner of the display.
4. Increase the present attenuator setting by 1 dB (which may require adjustment of both the 1 dB and 10 dB step attenuators). Press the `CONT TEST` softkey to initiate another ENR measurement. Wait for the message `Adjust Noise Power, Press CONT TEST` to appear on the display. The displayed ENR measurement result should be approximately 1 dB less than the previous value. Repeat this step until the message `ENR measurement error vs Power Meter` appears on the display. This completes the verification test.

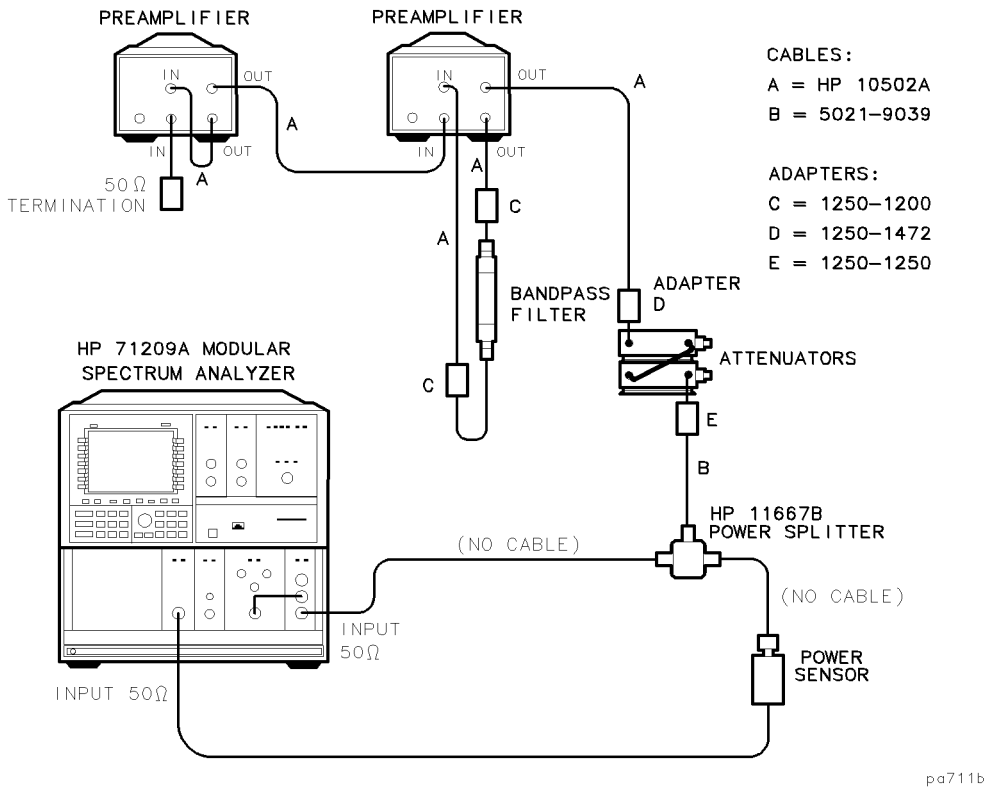



**Figure 4-2. Verification Test Setup**

## Interpreting the Verification Test Results

An example verification test result display is shown in Figure 4-3. Trace A in the display is a measurement of the error in the spectrum analyzer's measurement of noise power relative to the noise power measurements made by the power meter. The vertical axis represents the error of the spectrum analyzer measurement in dB units. The horizontal axis represents the relative power levels at which the measurements were made, with the highest power level (first measurement) at the left and the lowest power level (last measurement) at the right.

Specification limit lines for the analyzer's instrumentation accuracy are also displayed. A `PASS` message at the top center of the display indicates that the measured performance is within the specifications. A `FAIL` message indicates that the analyzer has failed the test.

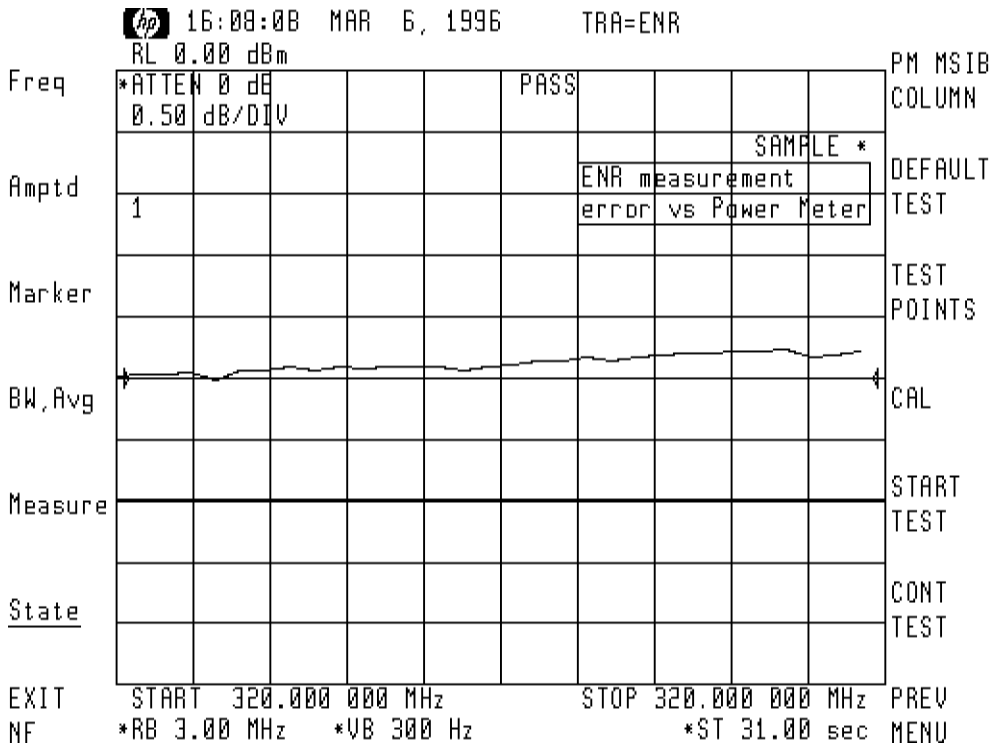



**Figure 4-3. Example Verification Test Result**

## If Verification Fails

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

- Be sure that the spectrum analyzer, power meter and noise figure 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 verification testing.
- Try to complete the verification test in one sitting.
- It may be helpful to write down the attenuator settings and check them off as they are used to prevent the possibility of repeated or missed steps.

# 5

# 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 HP Sales or Service Office.

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

## Measurement Personality Messages

The messages in Table 5-1 indicate that an operation error has occurred that could affect measurement accuracy. The messages in Table 5-2 provide information to you and typically appear during measurement personality operation.

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

| Message Displayed (numeric order) | Description |
|---|---|
| ERR 3210 Noise too high | The measurement personality has encountered a signal that is above the expected measurement range. The measured signal must not exceed the analyzer reference level minus 10 dB. If the DUT gain is too high, attenuate its output and enter the output loss correction. If a spurious signal is present, eliminate the signal or change the frequency range or 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.<br><br>You can also press the EXIT NF softkey, switch to spectrum analyzer mode, and evaluate the information in the signal you are measuring. Press (USER) key and the NF_GAIN DLP softkey to return to the noise figure measurement configuration you were using. |
| ERR 3211 System gain too low | During calibration, the measured noise has dropped more than 5 dB below the first point value. If your measurement is at low frequencies, chose a narrow enough measurement bandwidth to avoid the 0 Hz spectrum analyzer LO feedthrough signal. |
| ERR 3212 CAL needed for meas | A calibration must be performed before a corrected noise figure and gain or ENR measurement can be made. Changes in the measurement configuration prior to these measurements require that you repeat the calibration. |
| ERR 3213 FrqConv must be OFF | ENR measurements can only be made in the non-frequency converting mode. |
| ERR 3214 UNCOR warning | The analyzer must be calibrated before entering the Noise Figure Measurements personality. Press the EXIT NF softkey to switch to spectrum analyzer mode. Connect the 300 MHz calibrator signal to the preamp RF input. Press the (MENU) key, then press the Amptd, and CAL ALL softkeys. After the calibration is complete, press the (USER), then press the NF_GAIN DLP softkey to return to the noise figure measurement configuration you were using. |

**Table 5-2. Measurement Personality Information Messages**

| Message Displayed (alpha order) | Description |
|---|---|
| `Adjust Noise Power, Press CONT TEST` | This messages prompts the operator to adjust the ENR power level during the verification test. See Chapter 4 for details. |
| `Calibrating ...` | The calibration routine is beginning. The message identifies the beginning. |
| `Calibration done. Ready to measure DUT.` | This message appears when system calibration is finished. Connect the device to be tested and begin making measurements. |
| `Connect DUT OUTPUT to SA IN, Press ENR` | After pressing the `MEASURE ENR` measurement softkey, be sure to connect the output of the Device Under Test to the spectrum analyzer (preamp) RF input, then press the `MEASURE ENR` softkey again. |
| `Connect NS to DUT INPUT, Press MEAS NF` | After pressing the `MEASURE NF` measurement softkey, be sure to connect the noise source to the Device Under Test input, then press the `MEASURE NF` softkey again. |
| `Connect NS to DUT INPUT, Press NF&GAIN` | After pressing the `MEASURE NF&GAIN` measurement softkey, be sure to connect the noise source to the Device Under Test input, then press the `MEASURE NF&GAIN` softkey again. |
| `Connect NS to SA INPUT, Press CAL` | After pressing the `CAL` measurement softkey, be sure to connect the noise source to the spectrum analyzer (preamp) RF input, then press the `CAL` softkey again. |
| `Connect SA and PM to Splitter, Press CONT` | After pressing the `START TEST` softkey, be sure to connect the Spectrum Analyzer (preamp) RF input and the Power Meter sensor to the splitter, then press the `CONT TEST` softkey. See Chapter 4 for details on the verification test. |
| `Default State Restored` | This message appears after the `DEFAULT STATE` softkey has been pressed, indicating that the noise figure measurements state has been restored. |

**Table 5-2. Measurement Personality Information Messages (continued)**

| Message Displayed (alpha order) | Description |
|---|---|
| `ENR (corrected) Measurement Complete` | The ENR measurement has completed. |
| `ENR measurement error vs Power Meter` | The performance verification test has completed. The displayed results show ENR measurement error vs ENR power level. |
| `EXIT NF, then CAL before using NF&GAIN` | The spectrum analyzer must be calibrated before accurate noise figure measurements can be made. See Error Message 3214 for details. |
| `Loading last instrument state ...` | The Noise Figure Measurements Personality is loading and restoring the previous noise figure measurement state. |
| `Making PM Measurement` | During the performance verification test, this message appears indicating that the Power Meter measurement is in progress. |
| `Measurement ABORTED` | A measurement error has occurred that would affect results accuracy. The measurement has stopped. |
| `Measuring ENR` | The ENR measurement is running in the single sweep mode. |
| `Measuring ENR (Continuous)` | The ENR measurement is running in the continuous sweep mode. |
| `Measuring NF and GAIN` | The Noise Figure and Gain measurement is running in the single sweep mode. |

**Table 5-2. Measurement Personality Information Messages (continued)**

| Message Displayed (alpha order) | Description |
|---|---|
| `Measuring NF and GAIN (Continuous)` | The Noise Figure and Gain measurement is running in the continuous sweep mode. |
| `Measuring uncorr'd NF` | The uncorrected Noise Figure measurement is running in the single sweep mode. |
| `Measuring uncorr'd NF (Continuous)` | The uncorrected Noise Figure measurement is running in the continuous sweep mode. |
| `NF and GAIN Measurement Complete` | The Noise Figure and Gain measurement has completed. |
| `NF (uncorrected) Measurement Complete` | The uncorrected Noise Figure measurement has completed. |
| `Normal Spectrum Analyzer Operation` | This message appears after the `EXIT NF` softkey has been pressed, indicating that the previous spectrum analyzer state has been restored. |
| `Perform CAL before ENR measurement` | The CAL routine must be run before an ENR measurement can be made. |
| `Perform CAL before NF&Gain measurement` | The CAL routine must be run before a corrected Noise Figure and Gain measurement can be made. |
| `Perform CAL before STARTing TEST` | The CAL routine must be run before the verification test can be run. |

**Table 5-2. Measurement Personality Information Messages (continued)**

| Message Displayed (alpha order) | Description |
|---|---|
| PM Measurement Complete | During the performance verification test, this message appears indicating that the Power Meter measurement is complete. |
| Set PM MSIB Column | Using the numeric keypad, press the MSIB column address of the HP 70100A Power Meter module to be used in the verification test, then press ENTER. |
| Set Power Meter MSIB COLUMN first | The personality has not found a power meter module at the existing address. Using the numeric keypad, press the MSIB column address of the HP 70100A Power Meter module to be used in the verification test, then press ENTER. |

## 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 70875A 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 or Service offices.

# 6

# Programming

This chapter is a reference for the HP 70875A Noise Figure Measurements Personality. It is a command dictionary; commands are organized alphabetically.

The chapter contains the following information:

- Reference Tables
- Syntax Conventions
- Command Reference
- Programming Examples

# Reference Tables

Table 6-1 is organized according to function. Table 6-2 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. If the command name contains an underscore character, it is a command unique to the Noise Figure Measurements Personality and detailed information on it can be found in the HP 70875A Command Reference. If the command name does not contain and underscore character, it is a standard HP 70900B command and information on it can be found in the HP 70900B Programming Manual.

**Table 6-1. Functional Index**

| Function Group | Command | Ranges or Description |
|---|---|---|
| Frequency | _PTS | 1 to 800 Points.<br>Enter or query the number of frequency points measured. |
| | _FCONV | 1 (conversion on); 0 (conversion off)<br>Select or query the frequency conversion mode. |
| | _FSTART (non-conversion) | Frequency range of spectrum analyzer<br>Enter or query the measurement start frequency value. |
| | _FSTOP (non-conversion) | Frequency range of spectrum analyzer<br>Enter or query the measurement stop frequency value. |
| | _IFSTART | Frequency range of spectrum analyzer<br>Enter or query the measurement IF start frequency. |
| | _IFSTOP | Frequency range of spectrum analyzer<br>Enter or query the measurement IF stop frequency. |
| | _RFSTART | 0.0 Hz to 1E26 Hz<br>Enter or query the measurement RF start frequency. |
| | _RFSTOP | 0.0 Hz to 1E26 Hz<br>Enter or query the measurement RF stop frequency. |

**Table 6-1. Functional Index (continued)**

| Function Group | Command | Ranges or Description |
|---|---|---|
| Amplitude | _RL | -300 to 300 dB |
| | | Enter or query the reference level for the results display. |
| | _AT | 0 to maximum RF section attenuation in dB |
| | | Enter or query RF input attenuator setting. |
| | _LG | 0.01 to 20 dB |
| | | Enter or query the measurement scale for the results display. |
| | _RLPOS | 0 to 10 |
| | | Enter or query the reference level position for the results display. |
| | _LIMITEST | 0 (limit line testing turned OFF); 1 (limit line testing turned ON) |
| | | Activate limit line testing. |
| | _LIMIDONE | End limit line table edit mode and store table contents into file l_5000 in internal memory. |
| Marker | MKN | Position active marker on trace according to frequency. |
| | MKD | Position marker relative to reference marker, according to frequency. |
| | MKPK | Position marker at peak on the trace. |
| | MKMIN | Move displayed marker to lowest point on trace. |
| | MK_RL | Set results display reference level equal to marker value for active trace. |
| | _MKTEMP | Query the marker noise temperature in °K. |
| | MKTRACE | Move marker to another trace. |

**Table 6-1. Functional Index (continued)**

| Function Group | Command | Ranges or Description |
|---|---|---|
| BandWidth, Averaging | _BW | 1.0 kHz to 3 MHz<br>Enter or query the measurement bandwidth. |
| | _AVGTIME | 100.0 ms to 1000 s<br>Enter or query the measurement averaging time value. The value affects the measurement time per measurement point. |
| | _TBWAUTO | 1 (auto mode selected); 0 manual mode (selected).<br>Select or query the time-bandwidth mode. |
| | _TBW | 0.0001 to 3000 MHz−seconds<br>Enter or query the time-bandwidth product. |
| Measure | _MNF | Initiate the uncorrected noise figure measurement. |
| | _CAL | Initiate the noise figure and gain measurement calibration routine. |
| | _MNFG | Initiate the corrected noise figure and gain measurement. |
| | _MENR | Initiate the Excess Noise Ratio measurement. |
| | _CONT | 0 (single sweep); 1 (continuous sweep).<br>Enter or query the measurement sweep state. |
| | _PLOTPTS | 0 (measurement results not displayed on screen); 1 (results displayed on screen).<br>Enter or query the results display state. |

**Table 6-1. Functional Index (continued)**

| Function Group | Command | Ranges or Description |
|---|---|---|
| State | _DEFAULTS | Sets all measurement parameters to default values. Refer to Chapter 3, Table 3-1, Noise Figure and Gain Default Parameters, in this guide. |
| | _RCLENR | 1 to 4999<br>Enter or query the noise source serial number for recalling ENR data from file. |
| | _RCLLIM | 1 to 4999<br>Enter or query the limit line number for recalling limit line data from file. |
| | _MSI | 0 (internal memory); 1 (memory card).<br>Select location for storing files. |
| | _SAVENR | 1 to 4999<br>Enter or query the noise source serial number for saving ENR data to file. |
| | _SAVLIM | 1 to 4999<br>Enter or query the limit line number for saving limit line data to a file. |
| | _SLOSS | Enter or query the value of loss value affixed to the output of the noise source used in the measurement. |

**Table 6-1. Functional Index (continued)**

| Function Group | Command | Ranges or Description |
|---|---|---|
| | _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. |
| | _ENRDONE | End Noise Source ENR table edit mode and store table contents into file l_0 in internal memory. |
| | _PREAMP | 0 (preamp disabled); 1 (preamp enabled). |
| | | Enter or query the internal preamp state. |
| | _TEMPC | 0.0°C to 1000°C |
| | | Enter or query the noise source case temperature in °C. |
| | _BEEP | 0 (beeper OFF); 1 (beeper ON). |
| | | Activate end−of−measurement beeper. |
| | _REVNFG | Query the Noise Figure and Gain software revision date. |
| Noise Figure Mode Control | _NFMODE | 0 (Exit Noise Figure Measurement Mode); 1 (Activate Noise Figure Measurement Mode) |
| | | Enter or query Noise Figure Measurement mode control. |
| Output Data | _SENR | Query Noise Source ENR trace data. |
| | _HI | Query measured DUT output noise power trace data (noise source ON). |
| | _LOW | Query measured DUT output noise power trace data (noise source OFF). |
| | _NFSA | Query measured system noise figure trace data (output of _CAL). |
| | _NF | Query measured DUT corrected noise figure trace data (output of _MNF or _MFNG). |
| | _GAIN | Query measured DUT gain trace data (output of _MNFG). |
| | _ENR | Query measured DUT output Excess Noise Ratio trace data (output of _MENR). |

## Alphabetical Reference Table

The following table describes 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 1 command to initiate the noise figure measurements mode.

**Table 6-2. Commands in Alphabetical Order**

| Command | Corresponding Key | Description |
|---|---|---|
| _AVGTIME | AVG TIME | Enter or query the measurement averaging time value. The value affects the measurement time per measurement point.<br>The range is from 100.0 ms to 1000 s, in steps of 0.1 s below 1 s, and steps of 1 s above. |
| _AT | ATTENUATOR | Enter or query the RF input attenuator setting. |
| _BEEP | BEEPER On OFF | Activate end–of–measurement beeper.<br>0 indicates beeper OFF; 1 indicates beeper ON. |
| _BW | RES BW | Enter or query the measurement resolution bandwidth. |
| _CAL | CAL | Initiate system calibration. |
| _CONT | CONT SWEEP | Enter or query the measurement sweep state.<br>0 indicates single sweep; 1 indicates continuous sweep. |
| _DEFAULTS | DEFAULT STATE | Set all measurement parameters to default values. |
| _ENR | none | Query measured DUT output Excess Noise Ratio trace data (output of _MENR). |
| _ENRDONE | EDIT DONE | End Noise Source ENR table edit mode and store table contents into file l_0 in internal memory. |
| _FCONV | FrqConv 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. |

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

| Command | Corresponding Key | Description |
|---|---|---|
| _FSTOP | STOP FREQ | Enter or query the measurement stop frequency value. All frequency values are converted to Hz. |
| _GAIN | none | Query measured DUT gain trace data (output of _MNFG). |
| _HI | none | Query measured DUT output noise power trace data (noise source ON). |
| _IFSTART | IF STRT FREQ | In frequency conversion mode, enter or query the measurement IF start 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. |
| _LIMIDONE | EDIT DONE | End limit line table edit mode and store table contents into file l_5000 in internal memory. |
| _LIMITEST | MSI | Activate limit line testing.<br>0 indicates limit line testing turned OFF; 1 indicates limit line testing turned ON. |
| _LG | LOG dB/DIV | Enter or query the measurement scale for the results display. |
| _LOW | none | Query measured DUT output noise power trace data (noise source OFF). |
| _MENR | MEASURE ENR | Initiate the Excess Noise Ratio measurement. |
| MK_RL | –> RL | Set results display reference level equal to marker value for active trace. |
| _MKTEMP | MARKER TEMP | Query the marker noise temperature in °K. |
| _MNF | MEASURE NF | Initiate the uncorrected noise figure measurement. |

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

| Command | Corresponding Key | Description |
|---|---|---|
| _MNFG | MEASURE NF&GAIN | Initiate the corrected noise figure and gain measurement. |
| _MSI | MSI | Select location for storing files.<br>0 indicates internal memory; 1 indicates HP-MSIB device (memory card). |
| _NF | none | Query measured DUT corrected noise figure trace data (output of _MNF or _MFNG). |
| _NFMODE 0 | EXIT NF | Disable noise figure mode. Returns analyzer to last state before _NFMODE 1 was invoked. |
| _NFMODE 1 | NF_GAIN DLP | Activates noise figure mode. Initially required before sending or querying noise figure and gain measurement commands. |
| _NFSA | none | Query measured system noise figure trace data (output of _CAL). |
| _OUTLOSS | OUTPUT LOSS | Enter or query the value of loss affixed to the output of the device under test. |
| _PLOTPTS | PLOT PTS | Enter or query the results display state.<br>0 indicates measurement results will not be displayed on screen; 1 indicates results will be displayed. |
| _PREAMP | INT PREAMP | Enter or query the internal preamp state.<br>0 indicates preamp disabled; 1 indicates preamp enabled. |

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

| Command | Corresponding Key | Description |
|---|---|---|
| _PTS | POINTS | Enter or query the number of frequency points measured. If the number of points is set to 1, measurement results will be displayed as text. If the number is greater than 1, the results will be displayed as a graph. |
| _RCLENR | RECALL ENR# | Enter or query the noise source serial number for recalling ENR data. |
| _RCLLIM | RCL LIMIT# | Enter or query the limit line number for recalling limit line data. |
| _REVNFG | DLP VERSION | Query the Noise Figure and Gain software revision date. |
| _RFSTART | RF STRT FREQ | In frequency conversion mode, enter or query the measurement RF start frequency. |
| _RFSTOP | RF STOP FREQ | In frequency conversion mode, enter or query the measurement RF stop frequency. |
| _RL | REF LEVEL | Enter or query the reference level for the results display. |
| _RLPOS | REF LVL POSN | Enter or query the reference level position for the results display. |
| _SAVENR | SAVE ENR# | Enter or query the noise source serial number for saving ENR data. |
| _SAVLIM | SAVE LIMIT# | Enter or query the limit line number for saving limit line data. |
| _SLOSS | SOURCE LOSS | Enter or query the value of loss value affixed to the output of the noise source used in the measurement. |
| _TBW | T*BW PRODUCT | Enter or query the time-bandwidth product in MHz−seconds. |
| _TBWAUTO | AVG TIME AutoMan | Select or query the time-bandwidth mode.<br>1 indicates auto mode; 0 indicates manual mode. |
| _TEMPC | NS TEMP,DegC | 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:

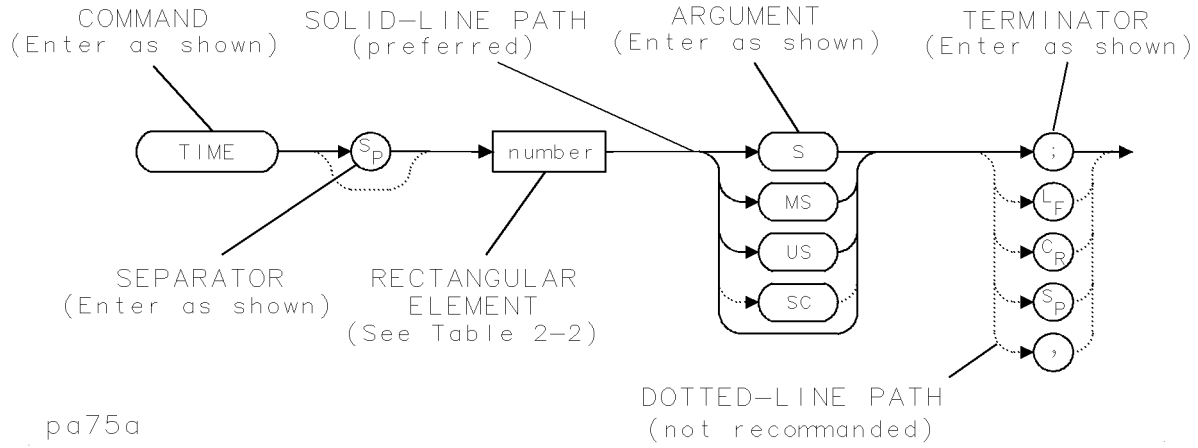



**Figure 6-1. Syntax Structure Description**

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 a description of the command function.

# _AVGTIME

Use the _AVGTIME command to enter an averaging time value.

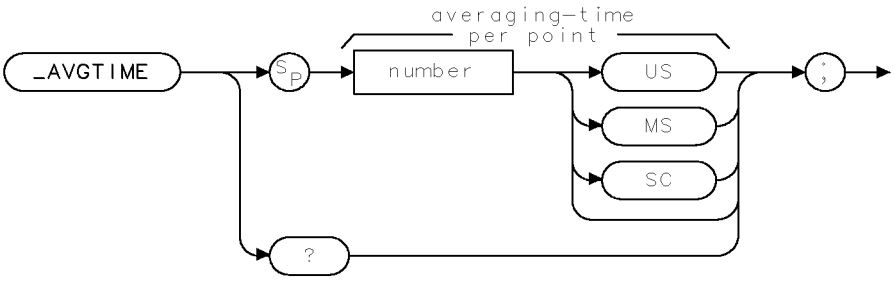



**Figure 6-2. _AVGTIME Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0.333 seconds |
| **Default Units** | s (seconds) |
| **Range** | 0.1 sec to 1000 sec |
| **Prerequisite Command** | _NFMODE 1 |
| **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. By increasing the averaging time, the measurement repeatability can be improved.

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

See Example 4, lines 150, 160.

## Query Response

The response is displayed in seconds.

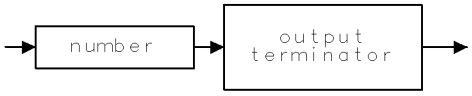



**Figure 6-3. _AVGTIME Query Response Syntax**

# _AT

Use the _AT command to enter an RF input attenuation value.

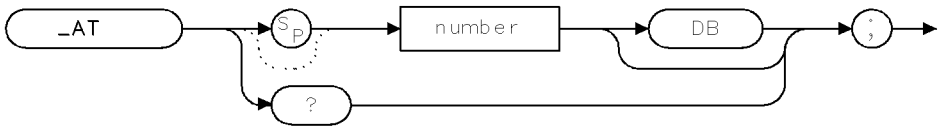



**Figure 6-4. _AT Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0 dB |
| **Default Units** | dB |
| **Range** | 0 dB to maximum RF section attenuation |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _PREAMP |

## Description

Use the _AT command to set the input attenuation of the RF section. When the preamp is enabled, an attenuation value of 0 will provide the best system noise figure. For devices under test that have high gain, the preamp can be disabled and the input attenuator should be set to prevent overloading of the input mixer in the RF section.

## Example

See Example 4, lines 200, 210.

## Query Response

The response is displayed in dB. To determine the actual attenuator setting, query the standard AT spectrum analyzer command instead of the _AT command.

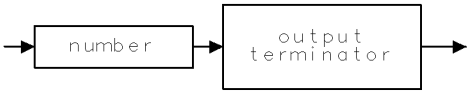
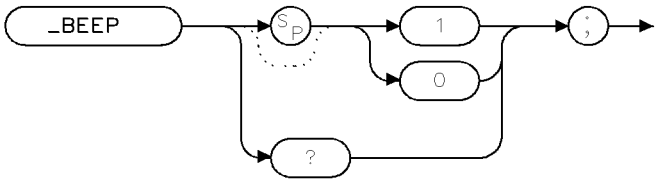



**Figure 6-5. _AT Query Response Syntax**

# _BEEP

Use the _BEEP command to turn the end-of-measurement beeper ON or OFF




beep

**Figure 6-6. _BEEP Syntax**

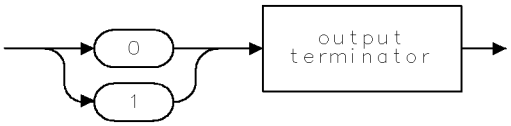
| Item | Description |
|---|---|
| **Default Value** | 1 (ON) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | none |

## Description

Use the _BEEP command to turn the end-of-measurement beeper ON or OFF. The beeper is useful in notifying the operator that the measurement has completed. The beeper hardware is in the HP 70004A Display.

## Query Response

The response displays the beeper mode.




QFCONV

**Figure 6-7. _BEEP Query Response Syntax**

# _BW

The _BW command selects or queries the measurement resolution bandwidth.

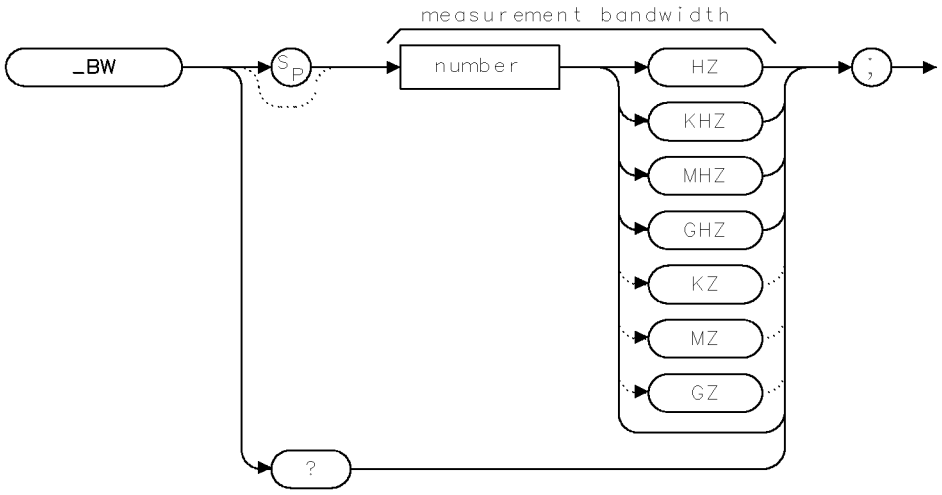



**Figure 6-8. _BW Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1.0 MHz |
| **Default Units** | Hz |
| **Range** | 1.0 kHz to 3 MHz |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _TBWAUTO, _TBW |

## Description

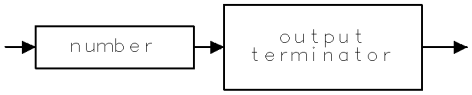
The value of the _BW sets the measurement bandwidth. Changing the measurement resolution bandwidth when _AVGTIME AUTO is selected changes the averaging time. The new sweep time is the time-bandwidth product divided by the measurement bandwidth.

## Example

See Example 3, lines 120, 130.

## Query Response

The response is displayed in Hz.

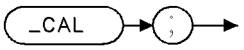



qpts

**Figure 6-9. _BW Query Response Syntax**

# _CAL

The _CAL command initiates the system calibration routine.




xcal

**Figure 6-10. _CAL Syntax**

Prerequisite Command: _NFMODE 1

## 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) must be entered prior to executing calibration.

## Example

See Example 3, lines 250-290.

# _CONT

Use the _CONT command to turn continuous measurement ON or OFF

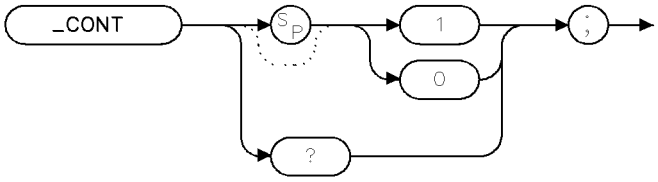



**Figure 6-11. _CONT Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 (ON) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _PTS, _MNF, _MNFG, _MENR |

## Description

Use the _CONT command to turn the continuous measurement mode ON or OFF. In the continuous measurement mode, any measurement that is initiated will repeat until _CONT 0 is sent to the analyzer. It is generally used only in the single-point mode, when _PTS is set to 1.

## Query Response

The response displays the continuous measurement mode.

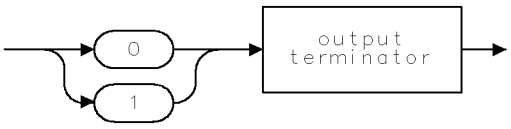



**Figure 6-12. _CONT Query Response Syntax**

# _DEFAULTS

Use the _DEFAULTS command to set the measurement parameters to a default state.


deflts

**Figure 6-13. _DEFAULTS Syntax**

Prerequisite Command: _NFMODE 1

## Description

Entering the _DEFAULTS command sets the measurement parameters to a known default state. The default values are:

_AT 0DB

_BEEP 1

_BW 3MZ

_CONT 0

_FCONV 0

_FSTART 100MZ

_FSTOP 200MZ

_IFSTART 1950MZ

_IFSTOP 1450MZ

_INLOSS 0DB

_LIMITEST 0

_LG 2

_MSI 1

_NFMODE 1

_OUTLOSS 0

_PLOTPTS 1

_PREAMP 1

_PTS 21

_RFSTART 3.7E9

_RFSTOP 4.2E9

_RL 0

_RLPOS 0

_SLOSS 0

_TBW 1

_TBWAUTO 1

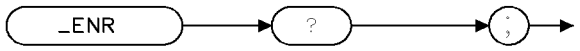
_TEMPC 17

## Example

See Example 4, line 80.

# _ENR

_ENR is used to query the measured DUT output Excess Noise Ratio trace data.




enr

**Figure 6-14. _ENR Syntax**

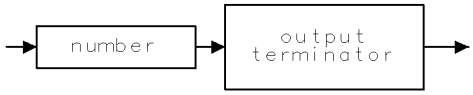
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _MENR |

## Description

The _ENR command is used to query the measured DUT output Excess Noise Ratio trace data. It must be preceeded by the _MENR command to have valid data in it.

## Example

Similar to _NF command. See Example 4, lines 290, 320.




QFSTAR

**Figure 6-15. _ENR Query Response Syntax**

# _FCONV

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

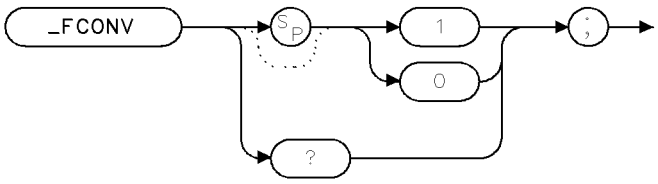



**Figure 6-16. _FCONV Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0 (non-conversion) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _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 source ENR data, while the measurement is tuned to the IF frequencies during a measurement.

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

## Example

See Example 4, line 100.

## Query Response

The response displays the frequency conversion mode.

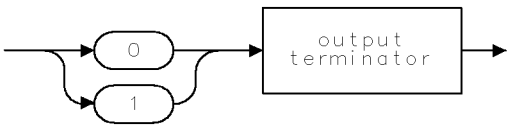



**Figure 6-17. _FCONV Query Response Syntax**

# _FSTART

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

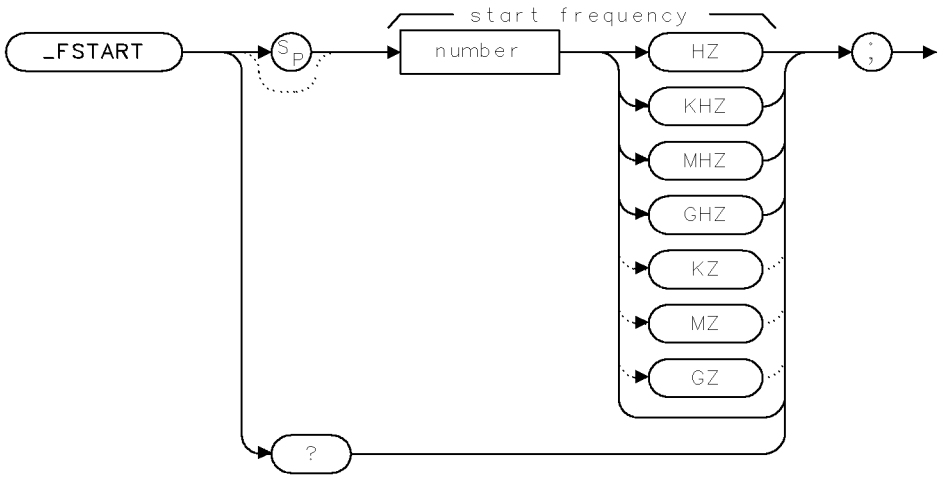



**Figure 6-18. _FSTART Syntax**

| Item | Description |
|---|---|
| **Default Value** | 100 MHz |
| **Default Units** | Hz |
| **Range** | Spectrum analyzer frequency range |
| **Prerequisite Command** | _NFMODE 1 |
| **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

See Example 3, line 100.

## Query Response

The response displays the start frequency value in Hz.

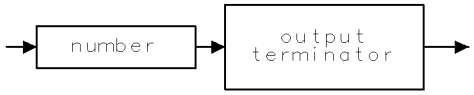



**Figure 6-19. _FSTART Query Response Syntax**

# _FSTOP

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

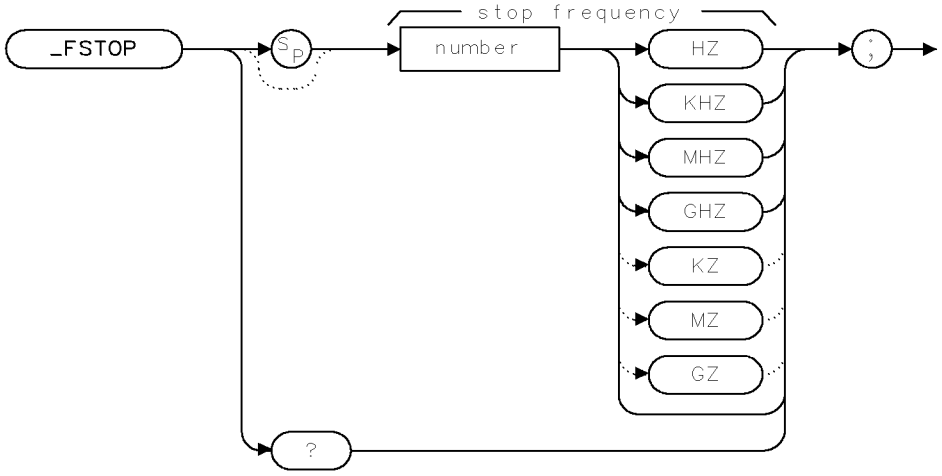



**Figure 6-20. _FSTOP Syntax**

| Item | Description |
|---|---|
| **Default Value** | 200 MHz |
| **Default Units** | Hz |
| **Range** | Spectrum analyzer frequency range |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _FSTART, _FCONV |

## 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.

## Example

See Example 3, line 110.

## Query Response

The response displays the stop frequency value in Hz.

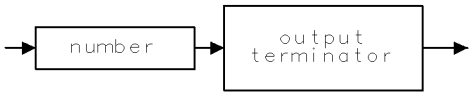
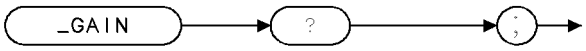



**Figure 6-21. _FSTOP Query Response Syntax**

# _GAIN

_GAIN is used to query the measured DUT gain trace data.




gain

**Figure 6-22. _GAIN Syntax**

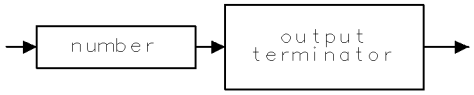
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _MNFG |

## Description

The _GAIN command is used to query the measured DUT gain trace data. It must be preceeded by the _MNFG command to have valid data in it.

## Example

See Example 3, lines 650, 670.

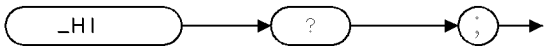



QFSTAR

**Figure 6-23. _GAIN Query Response Syntax**

# _HI

_HI is used to query the measured DUT output noise power trace data (noise source ON).




hi

**Figure 6-24. _HI Syntax**

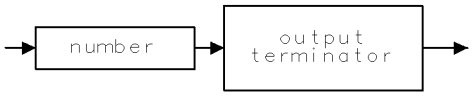
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _CAL, _MENR, _MNF, _MNFG |

## Description

The _HI command is used to query the measured DUT output noise power trace data (while the noise source was ON). It must be preceeded by the _CAL, _MENR, _MNF, or _MNFG command to have valid data in it.

## Example

See Example 3, lines 550,570.




QFSTAR

**Figure 6-25. _HI Query Response Syntax**

# _IFSTART

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

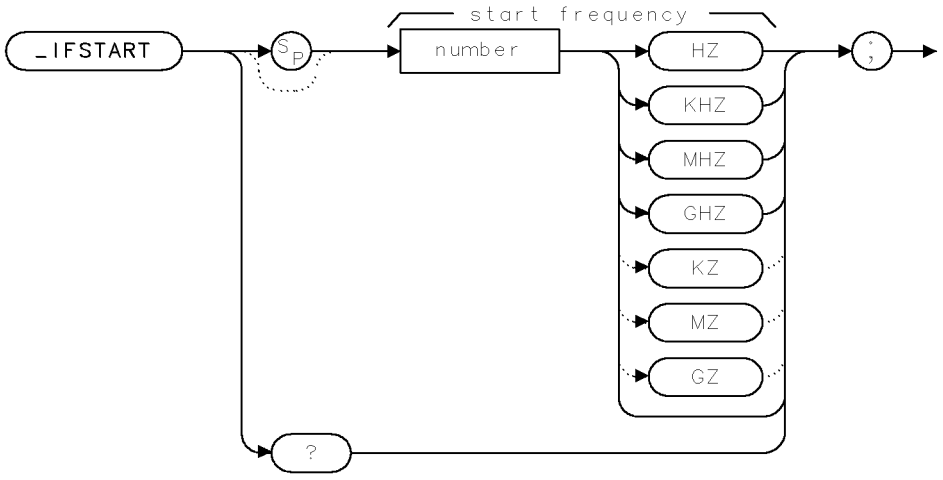



**Figure 6-26. _IFSTART Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1.95 GHz |
| **Default Units** | Hz |
| **Range** | Spectrum analyzer frequency range |
| **Prerequisite Command** | _NFMODE 1 |
| **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.

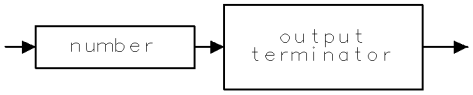
Reverse sweep, such as when the IF start frequency is greater than the IF stop frequency, is allowed.

## Example

See Example 4, line 110.

## Query Response

The response displays the current IF start frequency value.




QIFSTA

**Figure 6-27. _IFSTART Query Response Syntax**

# _IFSTOP

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

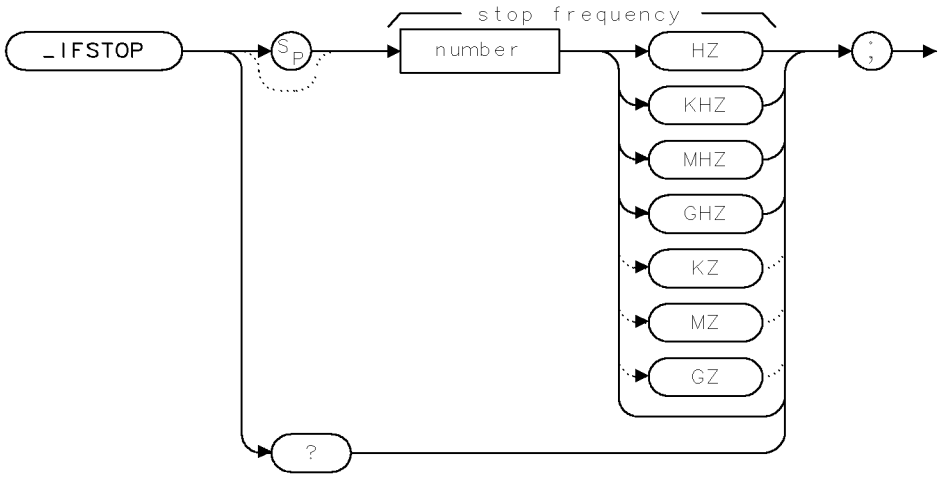



**Figure 6-28. _IFSTOP Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1450 MHz |
| **Default Units** | Hz |
| **Range** | Spectrum analyzer frequency range |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _FCONV, _RFSTART, _IFSTART, _RFSTOP |

## Description

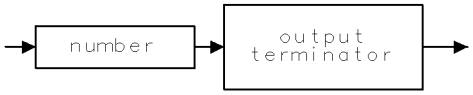
Use the _IFSTOP command to set or query the IF stop frequency value. The IF start and stop frequency span must match the RF stop and start frequency span. The frequency conversion device under test determines the ranges of values. Frequency conversion needs to be selected for these values to be active.

## Example

See Example 3, line 120.

## Query Response

The response displays the current IF stop frequency value.




QIFSTO

**Figure 6-29. _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.

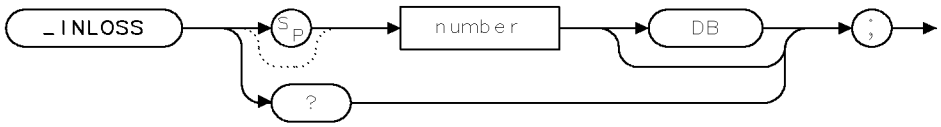



**Figure 6-30. _INLOSS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0.0 dB |
| **Default Units** | dB |
| **Range** | –99.90 dB to +99.90 dB |
| **Prerequisite Command** | _NFMODE 1 |
| **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 6-31. 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.

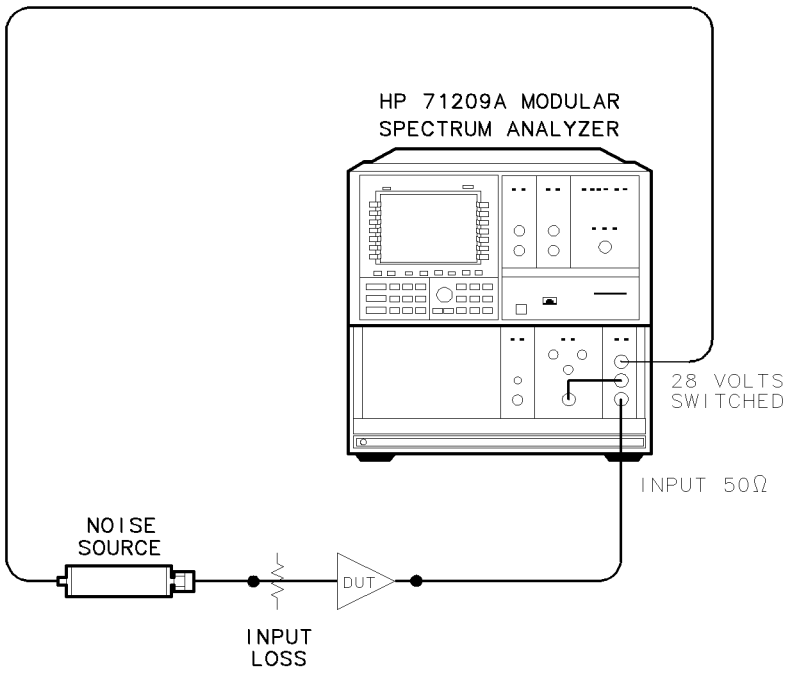



**Figure 6-31. Location of Input Loss Characteristic**

## Example

See Example 4, line 180.

## Query Response

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

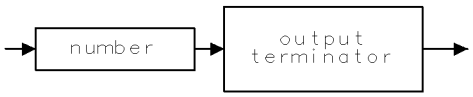



**Figure 6-32. _INLOSS Query Response Syntax**

# _LIMITEST

Use the _LIMITEST command to turn the limit-line testing of noise figure results ON or OFF.

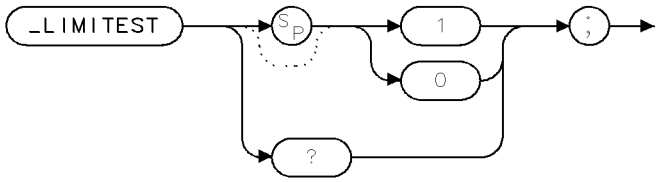



**Figure 6-33. _LIMITEST Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0 (OFF) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | LIMIFAIL, _LIMISAV, _LIMIRCL, _MSI |

## Description

The _LIMITEST command is used to turn the limit-line testing of noise figure results ON or OFF. The data in Trace A is compared to the limits in l_5000 in internal memory. The LIMIFAIL command can be used to determine if the test is a PASS or a FAIL.

## Example

See Example 3, lines 750-810.

## Query Response

The response displays the limit test mode.

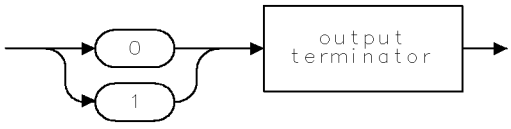



**Figure 6-34. _LIMITEST Query Response Syntax**

# _LG

Use the _LG command to set the display scale for the measurement results.

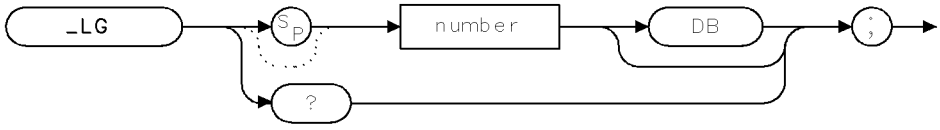



**Figure 6-35. _LG Syntax**

| Item | Description |
|---|---|
| **Default Value** | 10.0 dB |
| **Default Units** | dB |
| **Range** | 0.1 dB to +20 dB |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _RL |

## Description

Use the _LG command to set or query the scale for the results display. Changing the scale does not effect system calibration; therefore, it can be adjusted before or after the measurement.

## Example

See Example 3, line 340.

## Query Response

The response displays the current scale value.

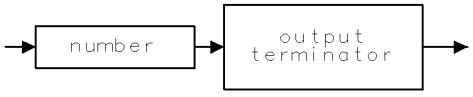
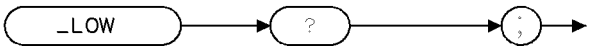



**Figure 6-36. _LG Query Response Syntax**

# _LOW

Use _LOW to query the measured DUT output noise power trace data (noise source OFF).




low

**Figure 6-37. _LOW Syntax**

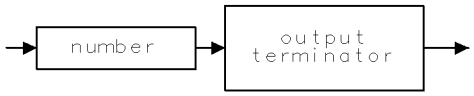
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _CAL, _MENR, _MNF, _MNFG |

## Description

The _LOW command is used to query the measured DUT output noise power trace data (while the noise source was OFF). It must be preceeded by the _CAL, _MENR, _MNF, or _MNFG command to have valid data in it.

## Example

See Example 3, lines 580-600.

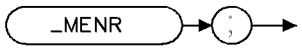



QFSTAR

**Figure 6-38. _LOW Query Response Syntax**

# _MENR

Use the _MENR command to initiate the Excess Noise Ratio measurement sequence.




xmeas

**Figure 6-39. _MENR Syntax**

Prerequisite Commands: _NFMODE 1, _CAL

## Description

Use the _MENR command to initiate a DUT output Excess Noise Ratio measurement. Before measurements can begin, the measurement configuration and system calibration (if an accurate ENR measurement 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 trace _ENR. The element 1 corresponds with the start frequency, and the element N corresponds with the stop frequency, where N equals the number of _PTS.

**Description of Variables**

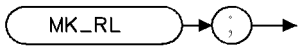
| Array or Variable Name | Description | Units = |
|---|---|---|
| _ENR | The 800-point trace _ENR holds the output ENR measurement data. | dB |

## Example

Similar to _MNFG. See Example 3, lines 220-300.

## MK_RL

Use the MK_RL command to set the results display reference level to the marker level.




mkrl

**Figure 6-40. MK_RL Syntax**

| Item | Description |
|---|---|
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | MKN, MKPK, MKTRACE |

### Description

The MK_RL command is used to set the results display reference level to the marker level. When in the _NFMODE 1 setting, use the MK_RL command instead of the standard MKRL spectrum analyzer command.

### Example

See Example 3, line 400.

# _MKTEMP

Use _MKTEMP to calculate and query the marker noise temperature in °K.

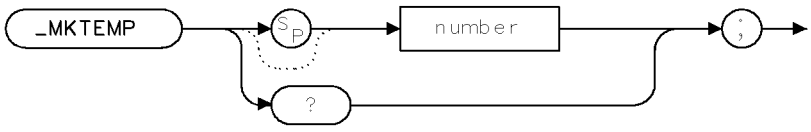



**Figure 6-41. _MKTEMP Syntax**

| Item | Description |
|---|---|
| **Default Value** | none |
| **Default Units** | none |
| **Range** | any integer |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | MKN, MKPK, MKTRACE |

## Description

Use the _MKTEMP command followed by any integer to perform a marker noise temperature calculation.

Then use the _MKTEMP command to query the marker noise temperature in °K. A marker must be present on the noise figure trace (trace A) to use _MKTEMP.

## Example

See Example 3, lines 470-500.

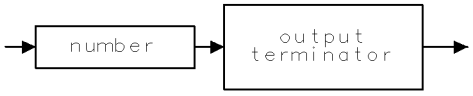
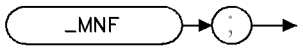



**Figure 6-42. _MKTEMP Query Response Syntax**

# _MNF

Use the _MNF command to initiate the uncorrected noise figure measurement sequence.




mn f

**Figure 6-43. _MNF Syntax**

Prerequisite Commands: _NFMODE 1

## Description

Use the _MNF command to initiate an uncorrected noise figure measurement. An uncorrected noise figure measurement does not remove the contribution of the measurement system (preamp + spectrum analyzer) noise figure from the result. Before measurements can begin, the measurement configuration must have been completed. Because no second stage correction is made, _CAL is not necessary. 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 trace _NF. The element `1` corresponds with the start frequency, and the element `N` corresponds with the stop frequency, where N equals the number of _PTS.

**Description of Variables**

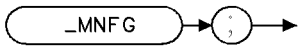
| Array or Variable Name | Description | Units = |
|---|---|---|
| _NF | The 800-point trace _NF holds the noise figure measurement data. | dB |

## Example

See Example 4, lines 240-270.

# _MNFG

Use the _MNFG command to initiate the corrected noise figure and gain measurement sequence.




mnfg

**Figure 6-44. _MNFG Syntax**

Prerequisite Commands: _NFMODE 1, _CAL

## Description

Use the _MNFG command to initiate a corrected noise figure and gain 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 `N` corresponds with the stop frequency, where N equals the number of _PTS.

**Description of Variables**

| Array or Variable Name | Description | Units = |
|---|---|---|
| _NF | The 800-point trace _NF holds the noise figure measurement data. | dB |
| _GAIN | The 800-point trace _GAIN holds the gain measurement data. | dB. |

## Example

See Example 3, lines 220-300.

# _MSI

Use the _MSI command to select the location for storing or retrieving files.

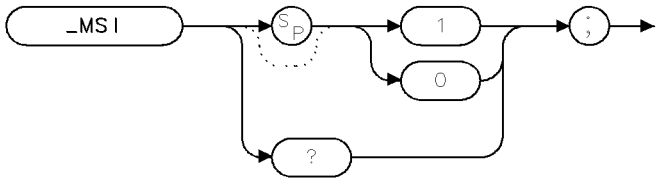



**Figure 6-45. _MSI Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 (MSIB) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | none |
| **Related Commands** | _LIMISAV, _LIMIRCL, _SAVENR, _RCLENR |

## Description

The _MSI command is used to select location for storing or retrieving files. A value of 0 selects INTERNAL memory. A value of 1 selects MSIB (memory card). _MSI performs a function similar to the standard MSI command, but should be used instead of MSI for storing and retrieving limit lines and ENR tables that will be used by the noise figure measurement personality.

## Example

See Example 1, lines 170,210, Example 2, lines 190,230, and Example 3, lines 190,760,

## Query Response

The response displays the mass storage setting.

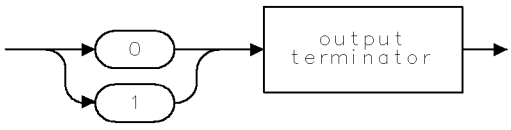
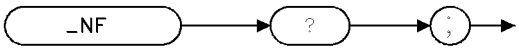



**Figure 6-46. _MSI Query Response Syntax**

# _NF

Use _NF to query the measured DUT noise figure trace data.




nf

**Figure 6-47. _NF Syntax**

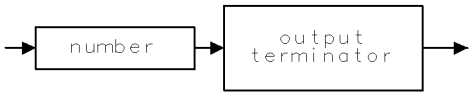
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _MNF, _MNFG |

## Description

The _NF command is used to query the measured DUT noise figure trace data. It must be preceeded by the _MNF, or _MNFG command to have valid data in it.

## Example

See Example 3, lines 620-640 and lines 680-730




QFSTAR

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

# _NFMODE

Use the _NFMODE command to enable or disable the noise figure measurement mode.

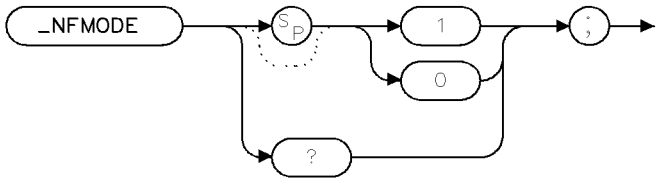



**Figure 6-49. _NFMODE Syntax**

| Item | Description |
|---|---|
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | none |
| **Related Commands** | most NF measurement commands |

## Description

The _NFMODE command is used to enable or disable the noise figure measurement mode. _NFMODE 1 is used to enable the noise figure measurement mode. _NFMODE 0 is used to disable the noise figure measurement mode and return to normal spectrum analyzer operation. Most of the commands in the noise figure measurement personality must be preceded by a _NFMODE 1 command to work correctly.

Note that if the analyzer is already in the noise figure measurement mode, subsequent _NFMODE 1 commands will be ignored. Likewise, if the analyzer is in its normal spectrum analyzer mode, subsequent _NFMODE 0 commands will be ignored.

## Example

See Example 3, line 70 , Example 4, lines 70,350

## Query Response

The response displays the noise figure measurement mode.

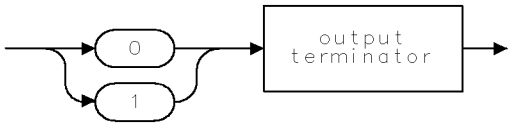
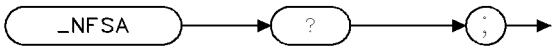



**Figure 6-50. _NFMODE Query Response Syntax**

# _NFSA

Use _NFSA to query the measured system noise figure trace data.




nfsa

**Figure 6-51. _NFSA Syntax**

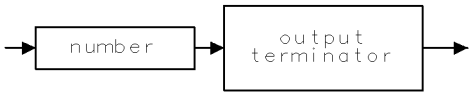
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | _CAL, _MENR, _MNFG |

## Description

The _NFSA command is used to query the measured system (preamp + spectrum analyzer noise figure trace data. It must be preceeded by the _CAL command to have valid data in it.

## Example

Similar to _NF. See Example 3, lines 620-640.



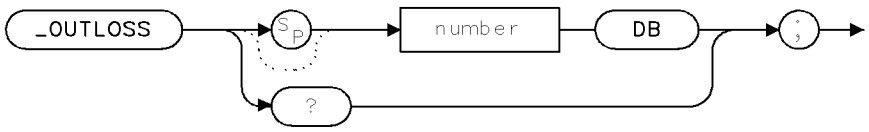

QFSTAR

**Figure 6-52. _NFSA 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.




XOUTLO

**Figure 6-53. _OUTLOSS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0.00 dB |
| **Default Units** | dB |
| **Range** | −99.90 to +99.90 dB |
| **Prerequisite Command** | _NFMODE 1 |
| **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 6-54. 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.

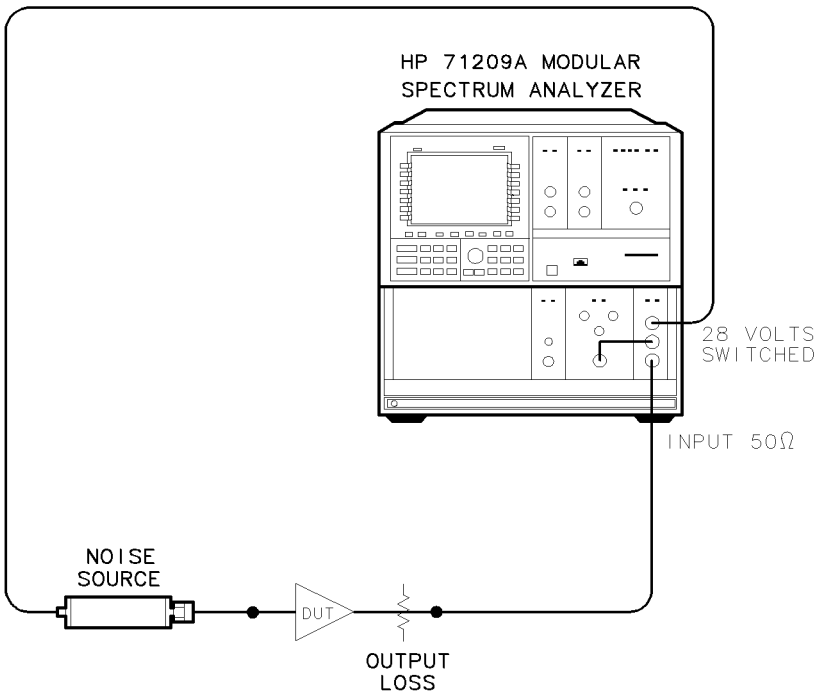



**Figure 6-54. Location of Output Loss Characteristic**

## Example

See Example 3, line 190.

## Query Response

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

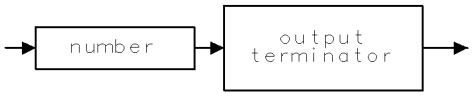



**Figure 6-55. _OUTLOSS Query Response Syntax**

# _PLOTPTS

Use the _PLOTPTS command to enable or disable results plotting on display.

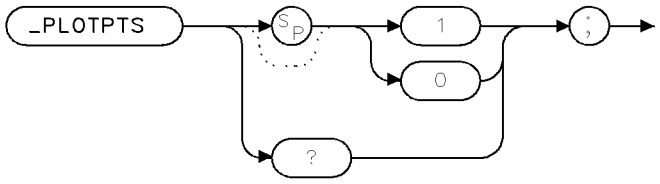



**Figure 6-56. _PLOTPTS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 (ON) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _CAL, _MENR, _MFN, _MNFG |

## Description

The _PLOTPTS command is used to enable or disable the transfer of measurement results to Trace A and Trace B for display. _PLOTPTS 1 is used to enable results plotting to the display. _PLOTPTS 0 is used to disable results plotting to the display.

_PLOTPTS 0 is useful when the spectrum analyer is being driven by a remote computer, to reduce overall measurement time if display is not needed. Note that with _PLOTPTS 0, Trace A and Trace B do not contain valid measurement results.

## Example

See Example 4, line 220

## Query Response

The response displays the measurement results display mode.

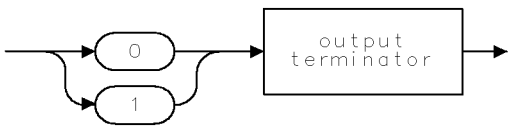



**Figure 6-57. _PLOTPTS Query Response Syntax**

# _PREAMP

Use the _PREAMP command to enable or disable the internal preamp.

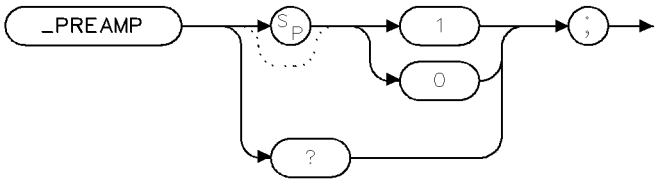



**Figure 6-58. _PREAMP Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 (enabled) |
| **Default Units** | none |
| **Range** | 0 or 1 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _CAL, _MENR, _MFN, _MNFG |

## Description

The _PREAMP command is used to enable or disable the internal preamplifier (HP 70620B or HP 70621A). _PREAMP 1 is used to enable the preamp. _PLOTPTS 0 is used to disable (bypass) the preamp.

_PREAMP 0 is useful in testing high gain devices whose output noise would overload the internal preamp. In this case, _CAL may not work well due to the relatively high noise figure of the spectrum analyzer, but the _MNF uncorrected noise figure measurement could still be made.

## Example

See Example 4, lines 240-270

## Query Response

The response displays the internal preamp mode.

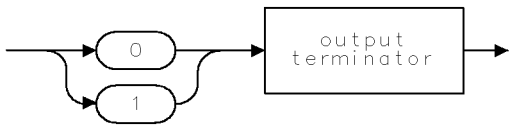



**Figure 6-59. _PREAMP Query Response Syntax**

# _PTS

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

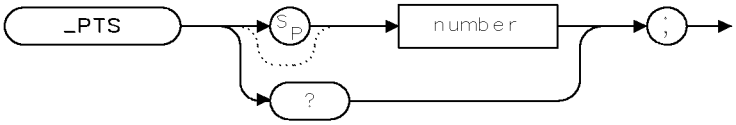



**Figure 6-60. _PTS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 21 |
| **Default Units** | none |
| **Range** | 1 to 800 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _FSTART, _FSTOP, _IFSTART, _IFSTOP, _RFSTART, _RFSTOP |

## Description

Use the _PTS command to set or query the number of measurement points.

The number of measurement points determines number of equally spaced frequency points evaluated for noise figure and gain. If the number of points is set to 1, measurement results will be displayed as text. If the number is greater than 1, the results will be displayed as a graph.

| Number Entered | Actual Number Points Measured |
|---|---|
| 1 | 1 point |
| 2 | 1 point |
| 3<=N<=800 | N points |
| N>800 | 800 points |

## Example

See Example 3, line 90 or Example 4, line 90

## Query Response

The response displays the current number of points selected.

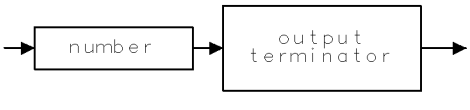



**Figure 6-61. _PTS Query Response Syntax**

# _RCLENR

Use the _RCLENR command to recall and use a noise source ENR table in measurements.

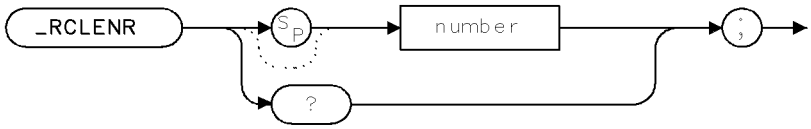



**Figure 6-62. _RCLENR Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 |
| **Default Units** | none |
| **Range** | 1 to 4999 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _MSI, _SAVENR |

## Description

An ENR table can be recalled from an existing table stored in the internal memory or from a table stored on a memory card, depending on the setting of _MSI. The recalled table is then applied in all subsequent measurements.

**Note** The noise figure measurement personality always uses the table stored in the l_0 limit line file in internal memory to perform calculations of noise figure and gain. The purpose of the _RCLENR command is to copy the contents of the specified file (either in internal memory or externally on a memory card) into the l_0 limit line file in internal memory.

## Example

See Example 3, lines 180-200

## Query Response

The response displays the file number that the noise source ENR table is recalled from.

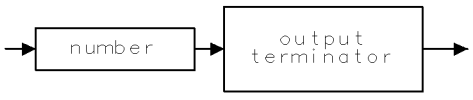
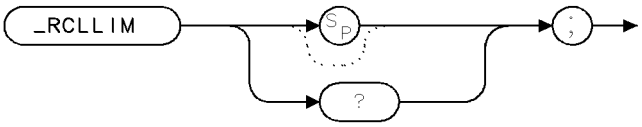



**Figure 6-63. _RCLENR Query Response Syntax**

# _RCLLIM

Use the _RCLLIM command to recall and use a limit line table for comparing against results.




rcllim

**Figure 6-64. _RCLLIM Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 |
| **Default Units** | none |
| **Range** | 1 to 4999 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _LIMITEST, _MSI, _SAVLIM |

## Description

A limit line table can be recalled from an existing table stored in the internal memory or from a table stored on a memory card, depending on the setting of _MSI. The recalled table is then used to compare against the measurement results with the _LIMITEST command.

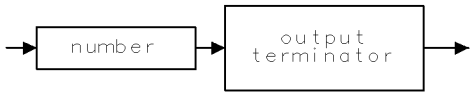
**Note** The noise figure measurement personality always uses the table stored in the I_5000 limit line file in internal memory to perform limit line comparisons against the measured results. The purpose of the _RCLLIM command is to copy the contents of the specified file (either in internal memory or externally on a memory card) into the I_5000 limit line file in internal memory.

## Example

See Example 3, lines 750-810

## Query Response

The response displays the file number that the limit line table is recalled from.

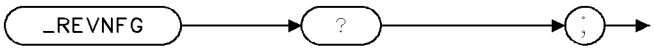



QOUTLO

**Figure 6-65. _RCLLIM Query Response Syntax**

# _REVNFG

Use _REVNFG to query the Noise Figure and Gain software revision date.




revnfg

**Figure 6-66. _REVNFG Syntax**

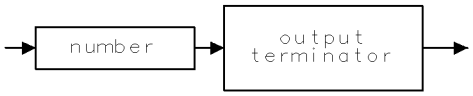
| Item | Description |
|---|---|
| **Prerequisite Command** | none |
| **Related Commands** | none |

## Description

The _REVNFG command is used to query the software revision date of the Noise Figure and Gain personality software.

## Query Response

The response displays the revision date in year/month/date sequence.




QFSTAR

**Figure 6-67. _REVNFG Query Response Syntax**

# _RFSTART

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

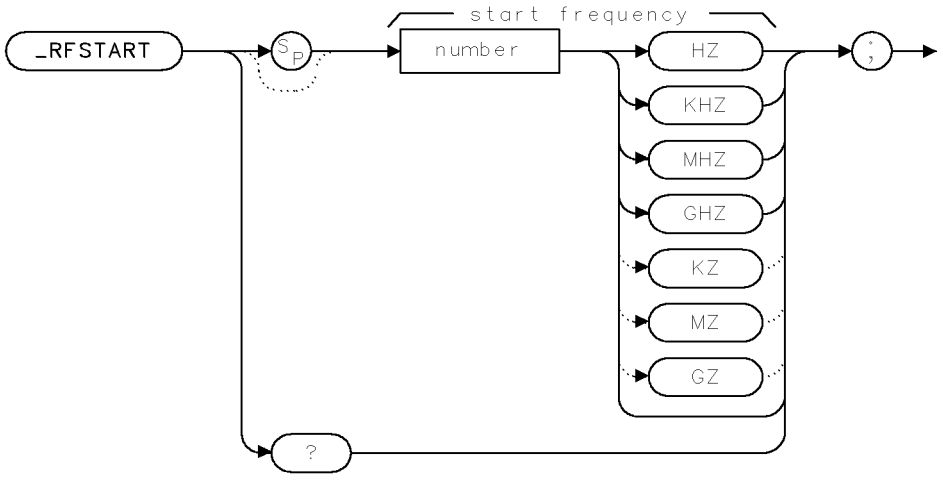



**Figure 6-68. _RFSTART Syntax**

| Item | Description |
|---|---|
| **Default Value** | 3.70 GHz |
| **Default Units** | Hz |
| **Range** | 0.0 Hz to 1E26 Hz |
| **Prerequisite Command** | _NFMODE 1 |
| **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

See Example 4, line 130.

## Query Response

The response displays the current RF start frequency value.

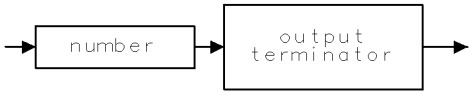



**Figure 6-69. _RFSTART Query Response Syntax**

# _RFSTOP

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

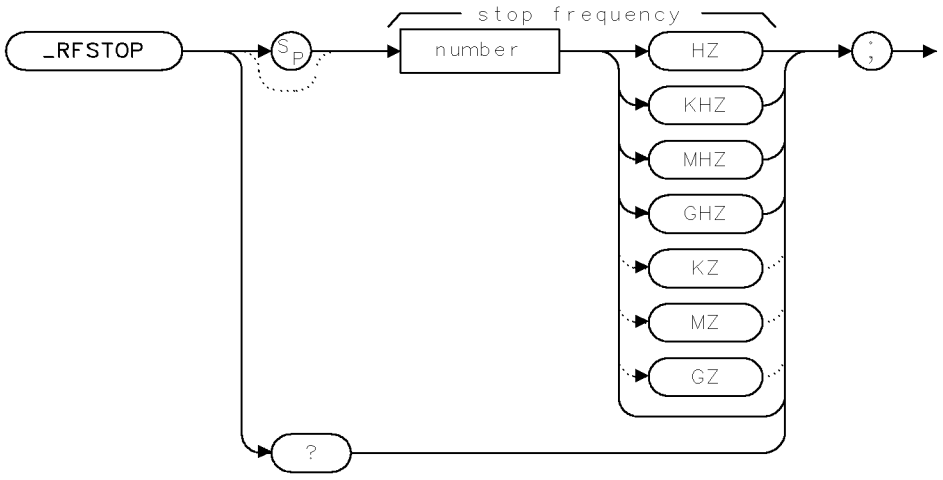



**Figure 6-70. _RFSTOP Syntax**

| Item | Description |
|---|---|
| **Default Value** | 4.20 GHz |
| **Default Units** | Hz |
| **Range** | 0.0 Hz to 1E26 Hz |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _FCONV, _IFSTART, _IFSTOP, _RFSTART |

## Description

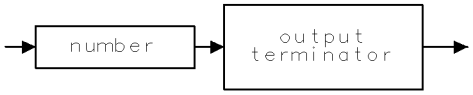
Use the _RFSTOP command to set or query the RF stop frequency value. The RF start and stop frequency span must match the IF stop and start frequency span. Frequency conversion needs to be selected for these values to be active.

## Example

See Example 4, line 140.

## Query Response

The response displays the current RF stop frequency value.

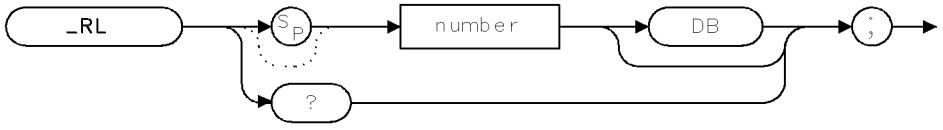



QRFSTO

**Figure 6-71. _RFSTOP Query Response Syntax**

# _RL

Use the _RL command to set the display reference level for the measurement results.




rl

**Figure 6-72. _RL Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0 dB |
| **Default Units** | dB |
| **Range** | -300 dB to +300 dB |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _LG, _RLPOS |

## Description

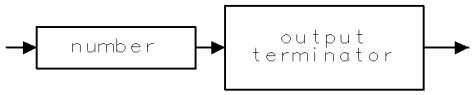
Use the _RL command to set or query the reference level for the results display. Changing the reference level does not effect system calibration; therefore, it can be adjusted before or after the measurement.

## Example

See Example 3, line 330.

## Query Response

The response displays the current display reference level value.




QGAINS

**Figure 6-73. _RL Query Response Syntax**

# _RLPOS

Use the _RLPOS command to set the display reference level position for the measurement results.

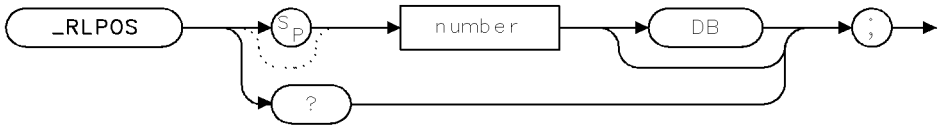



**Figure 6-74. _RLPOS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0 |
| **Default Units** | none |
| **Range** | 0 to 10 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _LG, _RL |

## Description

Use the _RLPOS command to set or query the reference level position for the results display. There are eleven reference level positions on the display, starting with 0 at the bottom and ending with 10 at the top. Changing the reference level position does not effect system calibration; therefore, it can be adjusted before or after the measurement.

## Example

See Example 3, line 350.

## Query Response

The response displays the current display reference level position value.

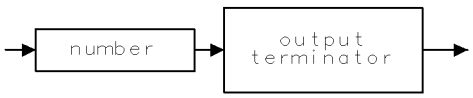



**Figure 6-75. _RLPOS Query Response Syntax**

## _SAVENR

Use the _SAVENR command to save a noise source ENR table in internal or external memory.

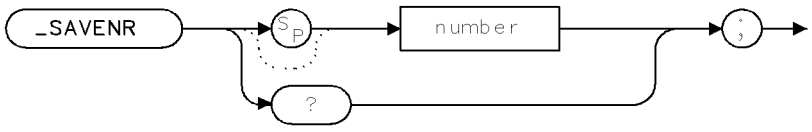



**Figure 6-76. _SAVENR Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 |
| **Default Units** | none |
| **Range** | 1 to 4999 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _MSI, _RCLENR |

### Description

The _SAVENR command is used to save the noise source ENR table presently in use into internal memory or a memory card, depending on the setting of _MSI.

**Note** The noise figure measurement personality always uses the table stored in the l_0 limit line file in internal memory to perform calculations of noise figure and gain. The purpose of the _SAVENR command is to copy the contents of the l_0 limit line file to the specified file (either in internal memory or externally on a memory card).

### Example

See Example 1, lines 200-220

### Query Response

The response displays the file number that the noise source ENR table is will be saved to.

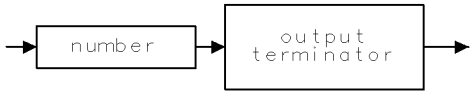



**Figure 6-77. _SAVENR Query Response Syntax**

# _SAVLIM

Use the _SAVLIM command to save a limit line table in internal or external memory.

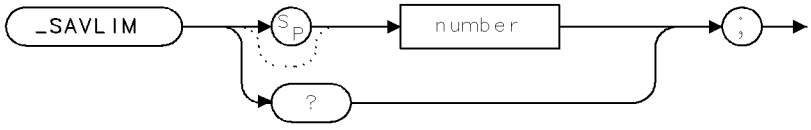



**Figure 6-78. _SAVLIM Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 |
| **Default Units** | none |
| **Range** | 1 to 4999 |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _LIMITEST, _MSI, _RCLLIM |

## Description

A limit line table presently being used by the noise figure personality can be saved to internal memory or an external memory card, depending on the setting of _MSI.

**Note** The noise figure measurement personality always uses the table stored in the l_5000 limit line file in internal memory to perform limit line comparisons against the measured results. The purpose of the _SAVLIM command is to copy the contents of the l_5000 limit line file to the specified file (either in internal memory or externally on a memory card).

## Example

See Example 2, lines 220-240

## Query Response

The response displays the file number that the limit line table is saved to.

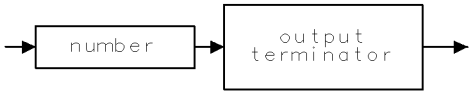



**Figure 6-79. _SAVLIM Query Response Syntax**

# _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.

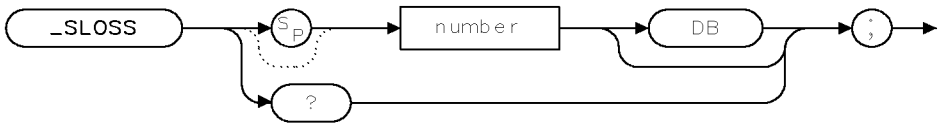



**Figure 6-80. _SLOSS Syntax**

| Item | Description |
|---|---|
| **Default Value** | 0.00 dB |
| **Default Units** | dB |
| **Range** | –99.90 to +99.90 dB |
| **Prerequisite Command** | _NFMODE 1 |
| **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 6-81. The loss value is based on cables and other loss factors that are required in the measurement system.

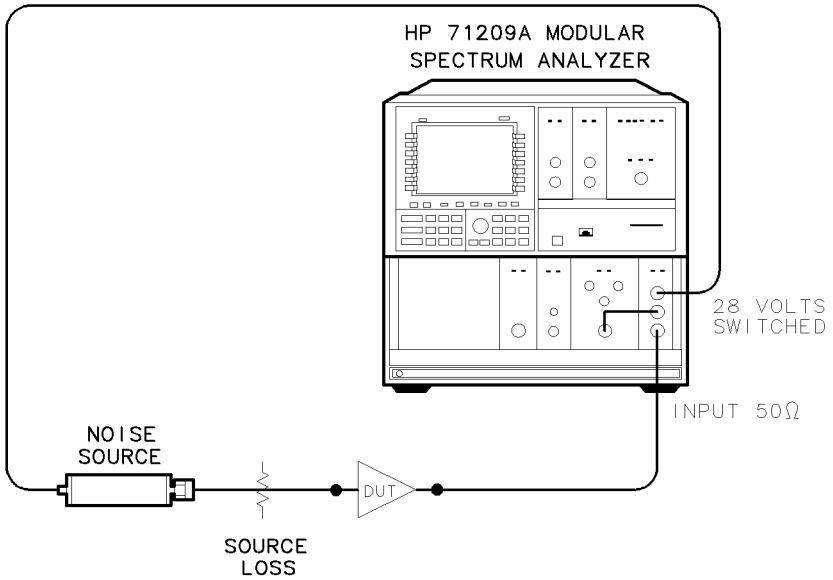


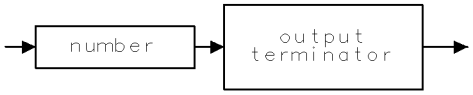

**Figure 6-81. Location of Noise Source Loss Characteristic**

## Example

See Example 4, line 190

## Query Response

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

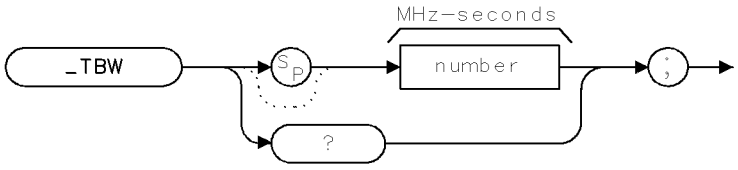



QSLOSS

**Figure 6-82. _SLOSS Query Response Syntax**

# _TBW

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




XTBW

**Figure 6-83. _TBW Syntax**

| Item | Description |
|---|---|
| **Default Value** | 1 MHz-s |
| **Default Units** | MHz-s |
| **Range** | 0.0001 to 3,000 MHz-s |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _TBWAUTO, _BW |

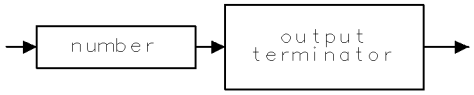
## Description

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.

## Query Response

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

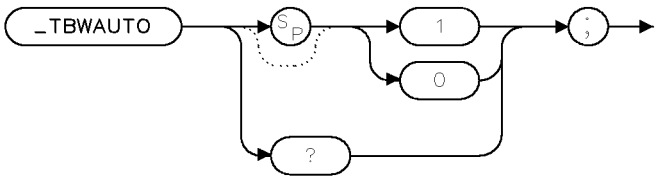



QTBW

**Figure 6-84. _TBW Query Response Syntax**

# _TBWAUTO

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




xtbwau

**Figure 6-85. _TBWAUTO Syntax**

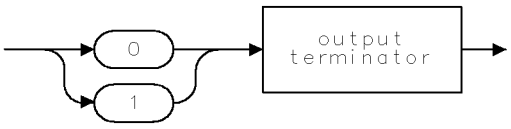
| Item | Description |
|---|---|
| **Default Value** | 1 (ON) |
| **Default Units** | none |
| **Range** | 1 (ON) or 0 (OFF) |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | _TBW, _BW, _AVGTIME |

## Description

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

## 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.

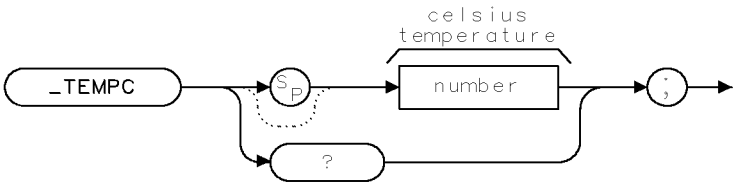



QTBWAU

**Figure 6-86. _TBWAUTO Query Response Syntax**

# _TEMPC

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




xtempc

**Figure 6-87. _TEMPC Syntax**

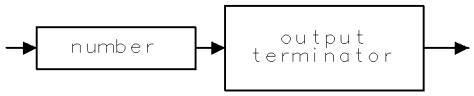
| Item | Description |
|---|---|
| **Default Value** | 17°C |
| **Default Units** | °C |
| **Range** | 0.0° to 1000°C |
| **Prerequisite Command** | _NFMODE 1 |
| **Related Commands** | none |

## 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.

## Query Response

The response displays the current temperature selected.




QTEMPC

**Figure 6-88. _TEMPC Query Response Syntax**

# Example Programs

## Creating and Saving Noise Source ENR Tables

```
10    !
20    ! EXAMPLE 1
30    !
40    ! This example demonstrates the creation and saving of Noise Source ENR tables.
50    !
60    ! Create a new noise source ENR table:
70    OUTPUT 718;"LIMIDEL;"               ! Erase contents of limit line table.
80    OUTPUT 718;"LIMILINE 5;"            ! ENR table will contain 5 points.
90    OUTPUT 718;"LIMIHALF UPPER;"        ! ENR tables only use upper limit line.
100   OUTPUT 718;"LIMISEG 1E7,13.25,SLOPE;"! First point: freq=10MHZ,ENR=13.25dB
110   OUTPUT 718;"LIMISEG 5E9,13.61,SLOPE;"! Next point: freq=5GHz, ENR=13.61dB
120   OUTPUT 718;"LIMISEG 1E10,14.78,SLOPE;"! Next point: freq=10GHz,ENR=14.78dB
130   OUTPUT 718;"LIMISEG 15E9,15.23,SLOPE;"! Next point: freq=15GHz,ENR=15.23dB
140   OUTPUT 718;"LIMISEG 20E9,15.27,SLOPE;"! Last point: freq=20GHz,ENR=15.27dB
150   OUTPUT 718;"LIMITEST OFF;"          ! Turn limit test OFF.
160   OUTPUT 718;"LIMIDONE;"              ! Finish limit line table editing.
170   OUTPUT 718;"_MSI 0;"                ! Select internal memory for saving.
180   OUTPUT 718;"LIMISAV 0;"             ! Save ENR table in limit line 0 (NF personality looks for
                                            source ENR table here).
190   !
200   ! Save noise source ENR table in external memory card:
210   OUTPUT 718;"_MSI 1;"                ! Select external memory card.
220   OUTPUT 718;"_SAVENR 4999;"          ! Save ENR table as l_4999 on memory card.
230   END
```

## Creating and Saving Limit Line Tables

```
10    !
20    ! EXAMPLE 2
30    !
40    ! This example demonstrates the creation and saving of limit line tables.
50    !
60    ! Create a limit line table:
70    OUTPUT 718;"LIMIDEL;"                ! Erase contents of limit line table.
80    OUTPUT 718;"LIMILINE 3;"             ! Limit line table will contain 3 points.
90    OUTPUT 718;"LIMIHALF UPPER;"         ! Edit upper limit line.
100   OUTPUT 718;"LIMISEG 1E7,4.0,SLOPE;"  ! First point: freq=10MHZ, 4.0dB
110   OUTPUT 718;"LIMISEG 5E9,5.0,SLOPE;"  ! Next point: freq=5GHz, 5.0dB
120   OUTPUT 718;"LIMISEG 20E9,7.0,SLOPE;" ! Last point: freq=20GHz, 7.0dB
130   OUTPUT 718;"LIMIHALF LOWER;"         ! Edit lower limit line.
140   OUTPUT 718;"LIMISEG 1E7,2.0,SLOPE;"  ! First point: freq=10MHZ, 2.0dB
150   OUTPUT 718;"LIMISEG 5E9,1.0,SLOPE;"  ! Next point: freq=5GHz, 1.0dB
160   OUTPUT 718;"LIMISEG 20E9,0.0,SLOPE;" ! Last point: freq=20GHz, 0.0dB
170   OUTPUT 718;"LIMITEST OFF;"           ! Turn limit test OFF.
180   OUTPUT 718;"LIMIDONE;"               ! Finish limit line table editing.
190   OUTPUT 718;"_MSI 0;"                 ! Select internal memory for saving.
200   OUTPUT 718;"LIMISAV 5000;"           ! Save limit line in l_5000 in internal memory
                                             (NF personality looks for limit line table in l_5000).
210   !
220   ! Save limit line table in external memory card:
230   OUTPUT 718;"_MSI 1;"                 ! Select external memory card.
240   OUTPUT 718;"_SAVLIM 4999;"           ! Save limit line table as l_9999 (value+5000) on memory
                                             card.
250   END
```

## Corrected Non-Conversion Noise Figure and Gain Measurements

```
10    !
20    ! EXAMPLE 3
30    !
40    ! This example demonstrates corrected non-conversion noise figure and gain measurement.
50    !
60    ! Set-up Noise Figure Measurement configuration:
70    OUTPUT 718;"_NFMODE 1;"             ! Select NF Measurements mode.
80    OUTPUT 718;"_DEFAULTS;"             ! Set all measurement configuration parameters to default
                                            values.
90    OUTPUT 718;"_PTS 11;"               ! Set the number of measurement points to 11.
100   OUTPUT 718;"_FSTART 1.2GZ;"         ! Set the non-conversion mode start frequency to 1.2 GHz.
110   OUTPUT 718;"_FSTOP 2.5GZ;"          ! Set the non-conversion mode stop frequency to 2.5 GHz.
120   OUTPUT 718;"_BW 1MZ;"               ! Set the resolution bandwidth to 1 MHz.
130   OUTPUT 718;"_TBW 0.5;"              ! Set the time*bandwidth product to 0.5 MHz-Sec.
140   OUTPUT 718;"_TEMPC 19;"             ! Enter the case temperature of the noise source as 19
                                            degrees C.
150   OUTPUT 718;"DONE?;"                 ! Query Spectrum Analyser for the calibration routine
                                            status.
160   ENTER 718;Done                      ! Get the status condition.
170   !
180   ! Recall a noise source ENR table from the external memory card:
190   OUTPUT 718;"_MSI 1;"                ! Select the external memory card.
200   OUTPUT 718;"_RCLENR 4999;"          ! Recall the ENR table saved in l_4999 on the memory card.
210   !
220   ! Make a corrected noise figure and gain measurement:
230   DISP "CALIBRATION - CONNECT NOISE SOURCE OUTPUT TO PREAMP INPUT, THEN PRESS CONTINUE."
240   PAUSE
250   OUTPUT 718;"_CAL;"                  ! Initiate the system calibration.
260   OUTPUT 718;"DONE?;"                 ! Query Spectrum Analyser for the calibration routine
                                            status.
270   ENTER 718;Done                      ! Get the status condition.
280   DISP "CALIBRATION DONE, CONNECT DUT BETWEEN NOISE SOURCE OUTPUT AND PREAMP INPUT, PRESS
      CONTINUE."
290   PAUSE
300   OUTPUT 718;"_MNFG;"                 ! Initiate noise figure and gain measurement.
310   !
320   ! Adjust the display for viewing traces:
330   OUTPUT 718;"_RL 1DBM;"              ! Adjust display reference level to 1 dB.
340   OUTPUT 718;"_LG 1DB;"               ! Adjust display scale to 1 dB/div.
350   OUTPUT 718;"_RLPOS 5;"              ! Set reference level position to 5th division from
                                            bottom of screen.
360   !
370   ! Place a marker on the noise figure trace and read it.
380   OUTPUT 718;"MKTRACE TRA;"           ! Place marker on trace A (noise figure trace)
390   OUTPUT 718;"MKPK;"                  ! Place marker at peak of noise figure trace.
400   OUTPUT 718;"MK_RL;"                 ! Set reference level to marker amplitude.
410   OUTPUT 718;"MKA?;"                  ! Query marker amplitude.
420   ENTER 718;A                         ! Read value.
430   PRINT "Peak Noise Figure=",A
440   OUTPUT 718;"MKF?"                   ! Query marker frequency.
450   ENTER 718;A                         ! Read value.
460   PRINT "Frequency=",A,"Hz"
470   OUTPUT 718;"_MKTEMP 0;"             ! Calculate marker noise temperature.
480   OUTPUT 718;"_MKTEMP?;"              ! Query marker noise temperature.
490   ENTER 718;A                         ! Read value.
500   PRINT "Noise Temperature=",A,"degrees K"
510   !
520   ! Query output data:
530   OUTPUT 718;"_SENR[1]?;"             ! Query noise source ENR first point.
540   ENTER 718;Senr                      ! Read data value.
550   PRINT "Noise Source ENR=",Senr
560   OUTPUT 718;"_HI[1]?;"               ! Query DUT output noise first point.
570   ENTER 718;Hi                        ! Read data value.
```

```
580   PRINT "DUT Output Noise (Source ON)=",Hi
590   OUTPUT 718;"_LOW[1]?;"              ! Query DUT output noise first point.
600   ENTER 718;Low                       ! Read data value.
610   PRINT "DUT Output Noise (Source OFF)=",Low
620   OUTPUT 718;"_NF[1]?;"               ! Query measured Noise Figure first point.
630   ENTER 718;Nf                        ! Read data value.
640   PRINT "DUT Noise Figure=",Nf
650   OUTPUT 718;"_GAIN[1]?;"             ! Query measured DUT Gain first point.
660   ENTER 718;Gain                      ! Read data value.
670   PRINT "DUT Gain=",Gain
680   DIM Nftrace(1:800)                  ! Dimension an 800 point array to hold the NF trace.
690   OUTPUT 718;"_NF?;"                  ! Query measured Noise Figure entire trace.
700   ENTER 718;Nftrace(*)                ! Read trace data.
710   FOR N=1 TO 11                       ! Print the first 11 points.
720   PRINT "Point",N,"NF=",Nftrace(N)
730   NEXT N
740   !
750   ! Turn limit line checking ON and read PASS/FAIL:
760   OUTPUT 718;"_MSI 1;"                ! Select external memory card.
770   OUTPUT 718;"_RCLLIM 4999;"          ! Recall limit line l_9999 on memory card.
780   OUTPUT 718;"_LIMITEST 1;"           ! Turn limit test function ON.
790   OUTPUT 718;"LIMIFAIL?;"             ! Query limit line test results.
800   ENTER 718;A                         ! Read data.
810   PRINT "FAIL?",A
820   END
```

## Frequency Conversion Measurement Mode

```
10    !
20    ! EXAMPLE 4
30    !
40    ! This example displays the frequency conversion measurement mode, and the use of external
        loss corrections.
50    !
60    ! Set-up Noise Figure Measurement configuration:
70    OUTPUT 718;"_NFMODE 1;"             ! Select NF Measurements mode.
80    OUTPUT 718;"_DEFAULTS;"             ! Set all measurement configuration parameters to default
                                            values.
90    OUTPUT 718;"_PTS 25;"               ! Set the number of measurement points to 25.
100   OUTPUT 718;"_FCONV 1;"              ! Turn frequency conversion mode ON.
110   OUTPUT 718;"_IFSTART 400MZ;"        ! Set the frequency conversion measurement IF start
                                            frequency to 400 MHz.
120   OUTPUT 718;"_IFSTOP 600MZ;"         ! Set the frequency conversion measurement stop frequency
                                            to 600 MHz.
130   OUTPUT 718;"_RFSTART 650MZ;"        ! Set the conversion measurement RF start frequency to
                                            650 MHz.
140   OUTPUT 718;"_RFSTOP 850MZ;"         ! Set the conversion measurement RF stop frequency to
                                            850 MHz, which results in a span equal to the IF span
                                            of 200 MHz
150   OUTPUT 718;"_TBWAUTO 0;"            ! Set the averaging time mode to manual.
160   OUTPUT 718;"_AVGTIME 1S;"           ! Set the averaging time to 1 second per measurement point.
170   OUTPUT 718;"_SLOSS 0.1DB;"          ! Enter the 0.1 dB loss that exists in the setup, during
                                            calibration and measurement, at the noise source output.
180   OUTPUT 718;"_INLOSS 1DB;"           ! Enter the 1 dB losss that exists in the measurement
                                            setup, following calibration, and is present at the
                                            DUT input.
190   OUTPUT 718;"_OUTLOSS 2 DB;"         ! Enter the 2 dB loss that exists in the measurement
                                            setup, following calibration, and is present at the
                                            DUT output.
200   OUTPUT 718;"_AT 10DB;"              ! Set RF section input attenuation to 10 dB during
                                            measurements.
210   OUTPUT 718;"_PREAMP 0;"             ! Turn internal preamp OFF.
220   OUTPUT 718;"_PLOTPTS 0;"            ! Turn results display OFF for faster remote operation.
230   !
240   ! Make an uncorrected noise figure measurement:
250   OUTPUT 718;"_MNF;"                  ! Initiate uncorrected noise figure measurement.
260   OUTPUT 718;"DONE?;"                 ! Query Spectrum Analyzer for the measurement status.
270   ENTER 718;Done                      ! Get the status condition.
280   !
290   ! Query Measured Noise Figure Data:
300   OUTPUT 718;"_NF[1]?;"               ! Query measured Noise Figure data.
310   ENTER 718;A                         ! Read data value.
320   PRINT "Noise Figure=",A
330   !
340   ! Exit Noise Figure Measurement Mode:
350   OUTPUT 718;"_NFMODE 0;"             ! Exit NF measurement mode.
360   END
```

# Index