Agilent N8201A Option 219 Performance Downconverter Synthetic Instrument Module

Noise Figure Measurement Personality Guide

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Notices

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1
Getting Started

Introduction

The noise figure measurement personality, available on the Agilent Technologies N8201A Option 219 performance downconverter synthetic instrument module, provides a suite of noise figure and gain measurements including system calibration.

A key measurement in the development of devices and systems is its noise figure. The overall noise figure of a system is one of the limiting factors in its performance. Making noise figure measurements can be a tedious manual process. But with Agilent's noise figure measurement systems, these measurements can be fast and easy with accurate results. Meet many of your measurement needs with a one-analyzer solution from Agilent.

- Perform system calibration easily and quickly.
- Analyze the device noise figure in several different formats.
- Characterize the noise figure of frequency conversion devices.
- Easily calculate measurement uncertainty.

The Agilent N8201A Option 219 offers high performance spectrum analysis up to 26.5 GHz with powerful one-button measurements, a versatile feature set, and a leading-edge combination of flexibility, speed, accuracy and dynamic range.

The noise figure measurements personality provides noise figure and gain measurements over the frequency range of the N8201A with specified measurements over the 10 MHz to 3 GHz range.

Noise figure measurements:

- entering ENR values
- calibration
- noise figure and gain
- using display features
- measurement uncertainty calculator
- mixer as the DUT
- mixer as part of system

You need the following equipment to use the Noise Figure Measurement personality:

- Noise Figure Measurement Personality Option 219
- Option 1DS Internal Preamp (100 kHz to 3 GHz)
- Option 110 Internal Preamp (100 kHz to 50 GHz)

Agilent Technologies recommends that you install either Option 1DS (Internal 100 kHz - 3 GHz Preamp) or Option 110 (Internal 100 kHz - 50 GHz Preamp), depending on your measurement needs. Option 1DS gives best performance in the 100 kHz to 3 GHz range. Option 110 enables you to perform measurements above

3 GHz up to the frequency limits of your N8201A. If you ever have to measure above 3 GHz, then choose Option 110. The preamp is required for specified performance at all frequencies.

Specifications

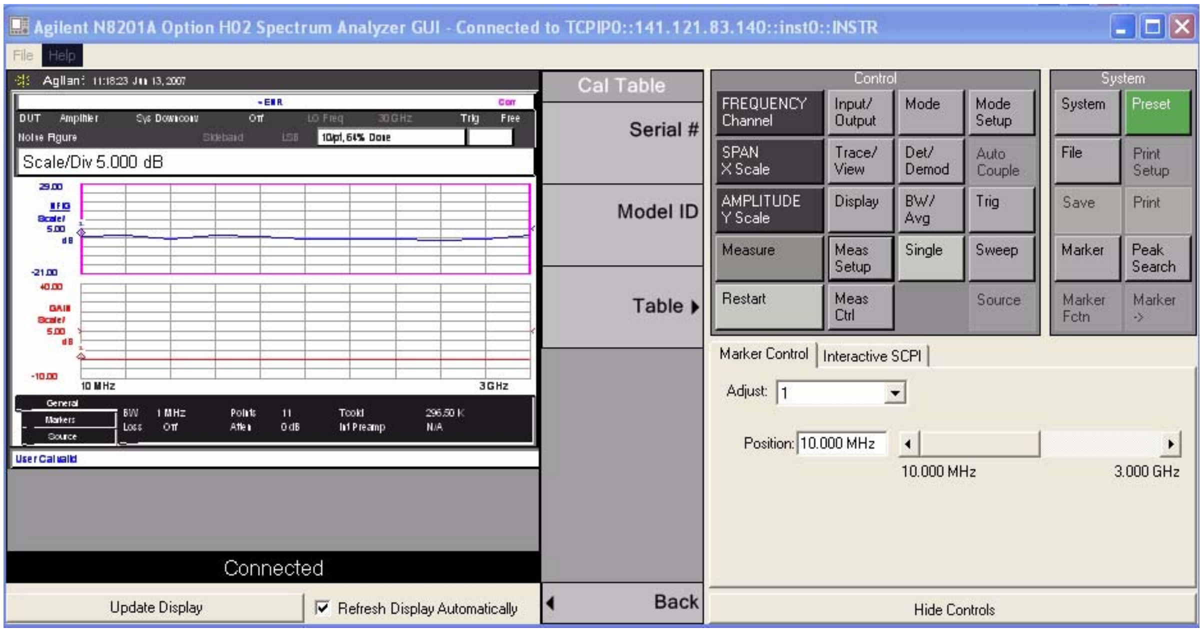
Performance specifications can be found in the *N8201A Data Sheet*.

Available Measurement Personality Options

Table 1 Measurement Personality Options

Available Personality Options	Option Number
Noise Figure measurement personality	219
Phase noise measurement personality	226

Overview of the N8201A Option H02 Spectrum Analyzer GUI



File Menu

The File menu allows you to specify a N8201A performance downconverter to monitor with the Spectrum Analyzer GUI (Graphical User Interface).

Connect

Enter the IP (Internet Protocol) or VISA address of the instrument you wish to control with the Spectrum Analyzer GUI.

Disconnect

Terminates the connection between the Spectrum Analyzer GUI and the spectrum analyzer.

Exit

Closes the Spectrum Analyzer GUI application.

Help Menu

Provides information about the current version of the Spectrum Analyzer GUI.

Left Pane

Display Area

Replicates the actual hardware spectrum analyzer display.

Update Display

When clicked, the GUI display is updated with the current view of the hardware's spectrum analyzer display.

Refresh Data Automatically

When selected, automatically updates the GUI display to match the hardware's spectrum analyzer display several times per second. Note that using this function slows down the response time of the GUI.

Center Pane

Displays the menu keys for the currently selected front panel key. For example, clicking Mode in the right pane, identifies "Mode" in the title area of the center pane and the Mode menu keys under the title.

Right Pane

Front Panel Keys

Displays the front panel keys. Once a front panel key has been clicked, the associated menu keys are displayed in the center pane.

Marker Control

Provides control over the four markers.

Adjust Specifies one of the four markers for adjustment.

Specified In Spectrum Analysis mode, you display the position indicator as points or trace units.

Position Displays the current position of the selected marker. You can also type in a desired value for the marker position.

Position Slider Allows movement of the selected marker. Click and drag the slider bar to move the marker, or for fine tuning use the left and right arrow keys.

Interactive SCPI Tab

Command Allows you to enter a SCPI programming command to control the instrument. Some functions do not have a menu key and are only available by entering a SCPI command.

Send Writes what you have entered in the Command text box to the I/O buffer.

Read Reads the response that the instrument places on the I/O buffer.

Send & Read Writes to the I/O buffer and then reads the response from the I/O buffer.

Instrument Session History Displays a listing of recent activity.

Clear Clears the information in the Instrument Session History area.

Hide Controls

Conceals the right pane of the GUI allowing full screen display of the graph area.

Show Controls

Displays the front panel keys (right pane) along with the graph area. This key is only available when Hide Controls is the active function.

Starting the Noise Figure Personality

1. Connect the N8201A to the PC using Agilent Synthetic Instrument Finder or Agilent Synthetic Instrument GUI. Refer to the *N8201A Performance Downconverter User's Guide* for more information.
2. Click **Start** > **Programs** > **Agilent SI Tools** > **N8201A Option H02 Spectrum Analyzer GUI** to open the N8201A Option H02 Spectrum Analyzer GUI.
3. Click **File** > *Connect* and enter the VISA address for the N8201, and then click *OK*.
4. Click **MODE** > *Noise Figure* to start the Noise Figure measurement personality.
5. Click **Measure** > *Monitor Spectrum*, *Log Plot*, or *Spot Frequency* to choose the applicable measurement type.

Saving the Instrument State

Saving an instrument state when in Noise Figure mode will save the entire measurement mode and measurement setup with the exception of trace and limit lines. This means that when you save the state and all of the current settings, including:

- ENR data
- Frequency Lists
- Loss Compensation Lists
- Resolution Bandwidth settings
- Calibration data

To Save the Instrument State:

1 Click **File** > *Save*.
2 Click *Type* > *State*.
3 Select the *Destination of the Device* Instrument or PC.
4 Specify the *File Name*
5 Click *Save Now*

Loading a state that has been saved at any time from the Noise Figure mode will force the N8201A to switch to Noise Figure mode, and will overwrite any existing settings with those that were valid when the state was last saved.

NOTE Limit lines and trace data are not saved in the instrument state. They must be explicitly saved using the **File** and **Save** keys, and setting **Type** to the appropriate setting

Table 2 Saving the Instrument State

Table / Parameter	Saved in State*	Saved as a file	Survives Preset	Survives Mode Switch	Survives Power Cycle
ENR Tables	Yes	Yes	Yes	Yes	Yes
Freq List	Yes	Yes	No	Yes	No
Loss Comp Table	Yes	Yes	No	Yes	No
Limit Lines	No	Yes	Yes	Yes	Yes
Correction data (Calibration)	Yes	No	Yes	Yes	No

* Settings saved in a Save State operation can be recalled by pressing the File, Load and Type keys. They can also be recalled using a Power On Last or a User Preset operation.

2
Making Basic Measurements

This chapter describes how to make basic noise figure measurements with the N8201 Option 219 Noise Figure Measurement application. It also covers the most common measurement related tasks.

What You will Find in this Chapter

Tips for Using the Measurement Examples

- Setup diagrams through out the Measurement chapters show a PSA series spectrum analyzer as the measuring device. The N8201A performance downconverter can be used as the measuring device as well. Notice that the Noise Source Drive Out +28 V is located on the front panel of the N8201A.
- All front panel key presses are indicated in **bold** text.
- All sub menu key presses are indicated in *italic* text.
- Make sure that you have selected the Noise Figure measurement personality.
  - Click **Mode** > *Noise Figure*
  - Click **Measure** > *Noise Figure*.
- You can choose to maximize the N8201 Option H02 Spectrum Analyzer GUI display. The advantage of doing this is that most of the sub menu keys are available on one page. Also, the display area will be much larger.
- If you choose to leave the Spectrum Analyzer GUI window at its default size, you may have to click *More 1 of ...*. to get to the desired function.
- While going through the measurement examples, you may want to select **Refresh Display Automatically**. This way you can see changes as you apply them. This selection can slow down the processing time of the instrument, therefore; during normal testing you may choose to have this feature turned off.
- All sub menu keys that contain number or text values, for example Start Frequency, are editable. CliN8201A Noise Figure Measurement Personality Guideck on the numeric entry to change the value. Use the PC's keyboard to enter the desired value and then type in the first letter of the units designator.

G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
Enter key		10^{0}
m	mil	10^{-3}
u	micro	10^{-6}
n	nano	10^{-9}

Entering Excess Noise Ratio (ENR) Data

You can enter ENR data for the noise source you are using as a table of values or as a single spot value. The values held in the table can be used for measurements at a range of frequencies as well as at a fixed frequency.

The single spot value is used either for measurements at a single frequency, or for measurements across a range of frequencies that is narrow enough such that the ENR value does not change significantly across that range.

There are two types of noise source. The first type, for example, an Agilent 346B, is a normal noise source that is powered by a pulsed +28 V supply. These need their ENR data to be entered manually, either by using the ENR data previously stored (such as that supplied with Agilent noise sources) or by using the keyboard to enter values into the ENR table.

Selecting a Common ENR Table

You can use the same, Common, ENR table both for calibration and for making measurements, or you can use separate Measurement ENR and Calibration ENR tables. You need separate measurement and calibration tables when separate noise sources are used for DUT measurements and for calibration. An example of this is when you are using frequency converters, and the calibration range is different than the measurement range.

NOTE ENR tables can contain up to 401 frequency points.

To use the same ENR table for calibration and measurement:

1 Click **Meas Setup** > *ENR* > *Common Table* to select *On*. This configures the downconverter to use a common ENR table both for measurements and for calibration.

The default setting for Common Table is On. In this mode the Cal Table... is not accessible.

To use different ENR tables for calibration and measurement, click *Common Table* to select *Off*.

When Common Table is set to Off, the Cal Table... key is accessible. Cal Table... gives you access to the ENR table of the noise source used to calibrate the N8201A.

When Common Table is set to Off, the Meas & Cal Table... function is also accessible. This gives you access to the ENR data table for the noise source used to make measurements.

When Common Table is set to On, the Meas Table... is used as the Common Table, and is used for both calibration and measurement. The Spectrum Analyzer GUI sub menu keys will then refer to the Meas & Cal Table... instead of the Meas Table....

Entering ENR Table Data for Noise Sources

You can manually enter ENR data in the form of an ENR table in three other ways:

- You can load the ENR data diskette, supplied with every Agilent noise source, onto your PC then load the ENR table into the Spectrum Analyzer GUI.
- You can load the ENR data from the internal memory, where the data has been previously stored.
- You can manually input the required frequencies and corresponding ENR values.

Normal noise sources from Agilent Technologies have the ENR values printed on the body of the device. These ENR values are also provided in the form of a calibration report, and on a diskette which is supplied with every Agilent noise source. Load this diskette onto your PC and then load it into the Spectrum Analyzer GUI. The values printed on the noise source itself are only shown to two decimal places. The values stored on a diskette are correct to three decimal places.

To load ENR data from diskette or from memory

If the noise source you are using has its ENR data supplied or previously stored on a diskette or internal memory, you can load this ENR data into the Spectrum Analyzer GUI as follows.

1. If the ENR file is on diskette, insert the diskette into the floppy drive of the PC.
2. Click **File** > *Load* to access the file system.
3. Click *Type* to select the type of file you wish to load, either the *ENR Meas Common Table* or the *ENR Cal Table*.
4. Click *Source Device PC*.
5. Click *File Path* to locate the ENR data file.
6. Once you have highlighted the correct file, click *Load Now.*

To enter ENR table data manually

1. Click **Meas Setup** > *ENR* > *Meas & Cal Table...* > *Table*.

   An ENR table appears on the display. Select a current row for editing, or add data for a new row. You can also delete an entry by selecting the entry and pressing the keyboard's Delete key. (see Figure 1).

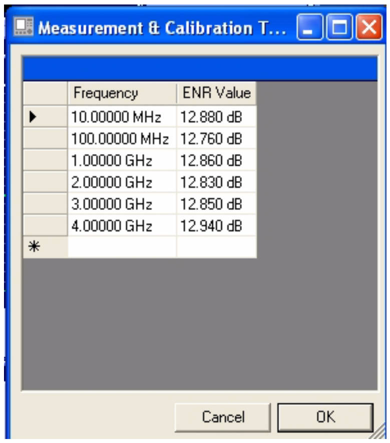


Figure 1 An ENR Table

- Optional Step

  Click *Serial #* and enter the noise source serial number using the keyboard.
- Optional Step

  Click *Model ID*, and enter the noise source model number using the keyboard.

2 After completing the ENR table, click *OK* > *Back* to return to the ENR menu.

Saving an ENR Table

You can save an ENR table either to the downconverter's internal memory or to the PC as follows:

1 Click **File** > *Save*.

2 Select the type of file you wish to save by clicking *Type* and then either *ENR Meas Common Table* or *ENR Cal Table*.

3 Click *Destination Drive Instrument/PC* to select where you wish to save the ENR

4 Click *File Name* and choose an applicable file name.

   Although the file extension is shown in the default filename, you must not include the file extension when specifying your own filename. The file extension is determined by the type of file you are saving and is added automatically to the filename you specify.

5 Click *Save Now* to save the file.

Entering a Spot ENR Value

A Spot ENR value can be applied across the whole measurement frequency range, or when making a measurement in fixed frequency mode, you can enter a specific spot ENR value corresponding to the fixed frequency.

To enter a Spot ENR value:

1 Click **Meas Setup** > *ENR* > *Spot* > *Spot ENR*.
2 Enter an ENR value using the keyboard. The default value is 15.20 dB.
3 Press the keyboard’s **Enter** key to terminate.

If you are using a noise source with a calibrated ENR list and the frequency you want to measure is not a listed ENR value, then you need to interpolate the ENR list to an appropriate value.

To Enable Spot ENR Mode

1 Click **Meas Setup** > *ENR* > *Mode Table/Spot* with Spot underlined.

Entering a Spot T_{hot} Value

When making a manual measurement you can enter a specific Spot T hot value. The Spot T hot value is applied across the whole measurement frequency range

To enter a Spot T_{hot} value:

1 Click **Meas Setup** > *ENR* > *Spot* > *Spot T hot*.
2 Enter a T_{hot} value and units terminator using the keyboard. The default value is 9892.80 K
3 Press **Enter** on the keyboard to terminate.

You can enter T_{hot} temperatures in degrees centigrade (C), in degrees Fahrenheit (F), or in Kelvin (K). Whatever units you use when entering the T_{hot} temperature, the temperature will be converted automatically and displayed in K. For example, if you enter 100 C, the displayed value will be converted to 373.15 K.

To Enable Spot T_{hot} Mode

1 Click **Meas Setup** > *ENR* > *Mode Table/Spot* with Spot underlined.
2 Click *Spot* > *Spot State ENR/Thot* with Thot underlined.

Setting the T_{cold} value

When making measurements in different ambient temperature conditions you can change the T_{cold} value manually.

The default temperature value is set at 296.50 K (23.25° C or 73.85° F). The T cold key is set to Default to confirm this default temperature.

Changing the User T_{cold} value manually

To change the User T_{cold} value:

1 Click **Meas Setup** > *ENR* > *T cold Default/User* so that User is underlined.

2 Enter the T_{cold} temperature and units terminator using the keyboard.

3 Press **Enter** on the keyboard to terminate.

You can enter T_{cold} temperatures in degrees centigrade (C), in degrees Fahrenheit (F), or in Kelvin (K). Whatever units you use when entering the T_{cold} temperature, the temperature will be converted automatically and displayed in K.

Setting the Measurement Frequencies

Before you set the frequencies you want to measure, you need to select a frequency mode. Three frequency modes are available:

- **Sweep** — the measurement frequencies are obtained from the start and stop (or equivalent center and span) frequencies and the number of measurement points.
- **List** — the measurement frequencies are obtained from the frequency list entries.
- **Fixed** — the measurement frequency is taken at a single fixed frequency.

Using Sweep Frequency Mode

In sweep frequency mode you set the start and stop frequencies (or equivalent center and span frequencies) over which the sweep is made. You also need to set the number of measurement points. These measurement points are equally spaced over the frequency span. The maximum number of points is 401 and the default number of points is 11.

CAUTION If you change the span after a calibration, and the calibration has been made over a narrower frequency range, the calibration is invalid.

To make a measurement over a specific frequency range:

1. Click **Frequency/Channel** > *Freq Mode* > *Sweep*.
2. Set the frequency range by using the keyboard to enter the *Start Freq* and *Stop Freq* frequencies with the units terminator. For example, G for Gigahertz, M for Megahertz, and so on.
3. Press **Enter** on the keyboard to terminate.
4. Click *Points* and type in the number of measurement points and then press **Enter** to terminate.

The time required to make a measurement or to calibrate is proportional to the number of measurement points that you specify.

Using List Frequency Mode

List frequency mode allows you to enter the frequency points where measurements are made. This allows you to specify measurement points, for example, in areas of interest that would otherwise have less coverage in the sweep mode. List Frequency mode can also be used to avoid making measurements at frequencies where spurs are known to exist.

Frequency lists are limited to 401 entries.

To set the downconverter to use the data in the frequency list table:

1 Click **Frequency/Channel** > *Freq Mode* > *List*.

You can create a frequency list in the following ways:

- Manually, by specifying each individual point.
- Loading a list from the instrument’s internal memory or from the PC where the data has been previously stored.

To Create a Frequency List Manually

1 Click **Frequency/Channel** > *Freq Mode* > *List* > *Frequency List*.

A Frequency List table appears on the display.

Figure 2 An Empty Frequency List

You do not need to enter the frequency values in ascending order, as the Spectrum Analyzer GUI continually sorts the values into ascending order.

2 Select a current row for editing, or add data for a new row.

Once data is entered for a frequency point the next frequency point in the table is automatically highlighted.

3 Save the Frequency List to the instrument’s internal memory or to the PC using the **File** key. Refer to “Saving an ENR Table" on page 21 for more information.

Using Fixed Frequency Mode

The fixed frequency mode is used when you want to make a measurement at a single frequency.

If you have not entered the noise source ENR data which you intend using for the fixed frequency mode measurement, you may specify a spot ENR value and set the ENR mode to Spot.

To set a fixed frequency:

1 Click **Frequency/Channel** > *Freq Mode* > *Fixed*.

2 Click *Fixed Freq* and enter the frequency value with the first letter of the units terminator. For example, “G” for Gigahertz.

Setting the Bandwidth and Averaging

Effect of Bandwidth and Averaging on Speed, Jitter, and Measurement Accuracy

Jitter is a natural occurrence when measuring noise. To reduce jitter you must increase the number of averages or increase the measurement bandwidth.

If the bandwidth is reduced, you need to increase the number of averages to maintain the same uncertainty.

The greater the number of averages chosen, the more accurate the measurement, as this reduces jitter on the measurement. However, this has to be considered against how long it takes to complete the measurement.

There is therefore a trade off between speed and the accuracy/uncertainty of a measurement.

Selecting the Resolution Bandwidth Value

When the Res BW is set to Auto, the bandwidth is set automatically, and is dependent on measurement frequency.

At measurement frequencies of 3 MHz or above, the resolution bandwidth is set automatically to 1 MHz.

At measurement frequencies less than 3 MHz, the resolution bandwidth is set automatically to 10% of the measurement frequency.

When the Res BW is set to Man, you can manually specify the resolution bandwidth from a minimum of 1 Hz to a maximum of 8 MHz. The lower the resolution bandwidth setting, the longer the measurement will take. With a Res BW setting of 1 Hz, each measurement point may take up to 6000 seconds.

Setting Averaging

Increased averaging reduces jitter and provides more accurate measurement results. However, the measurement speed is sacrificed. The maximum number of averages allowed is 1000, and the default value is 10. The default setting, however, is Off.

Enabling averaging

Averaging can be enabled by setting the Averaging to On. To disable averaging set Averaging to Off.

Setting the Number of Averages

To set the number of averages you want:

1. Click **Meas Setup** > *Avg Number* to *On*.
2. Click on the numeric entry field and enter the desired number of averages.
3. Press **Enter** to accept the new value.

Selecting the Averaging Mode

Averaging Mode is permanently set to Repeat. No other form of averaging is available.

With Repeat averaging, each point in a sweep is measured an Avg Number of times and the average figure evaluated, before moving on to the next point in the sweep.

Calibrating the N8201A

To compensate for the noise contribution of the N8201A and associated cabling in the measurement path, a calibration is necessary. The calibration measures the N8201A's noise contribution with no DUT (device under test) in place. This correction is often referred to as the second stage calibration. The correction is then applied to the measurement with the DUT in place.

To perform a calibration you need to enter the ENR values and set up the frequency range, number of measurement points, the bandwidth, the averaging, and measurement mode to be used during the measurement.

If you alter the frequency range after you have calibrated the N8201A, it changes the calibration status to either the uncorrected or the interpolated corrected state. Before you can make another measurement to the specified accuracy, you will need to either recalibrate the N8201A, or recall a previously saved state file in which the calibration data has been saved.

Corrected Measurements

You can make corrected measurements only at frequencies which are covered by the current calibration. Attempting to make corrected measurements at frequencies less than the lowest calibration frequency or greater than the highest calibration frequency will generate an error and invalidate the calibration.

To proceed you must either:

- perform a calibration over the desired measurement frequency range
- change the measurement frequency to one covered by the existing calibration
- perform uncorrected measurements. Uncorrected measurements actually measure the noise figure of the N8201A and any associated components in the input path. This can be useful if you wish to use the Uncertainty Calculator.

If you perform a measurement outside the calibrated range of the N8201A, Noise Figure Correction is automatically set to Off and a message is displayed stating User Cal invalidated, freq outside cal range. If you then change your measurement frequency back to a frequency within the calibrated range, the previous error message will be replaced by a message stating User Cal valid. Noise Figure Correction, however, will still be set to Off. You will need to switch it On again to make a corrected measurement.

When to Perform a Calibration

To make corrected measurements, you must calibrate the N8201A whenever:

- You cycle the power of the N8201A.
- You Preset the N8201A.
- You select a measurement frequency or frequency range outside the currently calibrated range.

- You change the RBW setting across the 1.5 MHz boundary. That is, if you change from an RBW value less than or equal to 1.5 MHz to one that is greater, or from an RBW value greater than 1.5 MHz to one that is at 1.5 MHz or lower.
- There is a large temperature variation since the last calibration.
- The input signal level can no longer be measured using one of the calibrated input attenuator ranges.
- When an invalid result is detected and the condition is indicated by a “xx”. See “Indicating an Invalid Result" on page 46 for an explanation of these conditions.

Interpolated Results

When the location of measurement points is changed without exceeding the range of frequencies being measured, interpolation between calibration points is used and a new calibration is not required. Similarly, when the RBW is changed without crossing the 1.5 MHz boundary, the power at each calibration point is re-estimated, and a new calibration is not required. Interpolation, however, is not perfect; it is therefore always better to perform a new calibration.

The locations of the measurement points, that is, the frequencies at which measurements are made, change whenever the start frequency, the stop frequency, or the number of points is changed.

Calibration Indicator

Whenever anything within the N8201A changes to invalidate the current calibration, the message UnCorr is displayed in red at the top left-hand corner of the display. If the N8201A has been successfully calibrated for the current frequency and measurement settings, the message Corr is displayed in green text at the top right-hand corner of the display.

Interpolated Calibration

Whenever anything within the N8201A changes to force the current calibration to interpolate the calibration data, the green Corr message at the top right-hand corner of the display switches to a yellow ~Corr message at the top center of the display. This would happen, for example, if you change the RBW after calibrating but before measuring.

To Perform a Calibration

1. Verify that the correct ENR table is loaded in the Spectrum Analyzer GUI, or input the ENR values of the noise source into the Common or Calibration Table.

   See “Entering ENR Table Data for Noise Sources" on page 20 for more details.

2. Click **Meas Setup** > *ENR* > *Common Table Off* > *Cal Table...*. The calibration table will now be displayed.

3 Configure the measurement parameters (frequency range, number of points, bandwidth, averages, and measurement mode) you want to use for the measurement.

4 Connect the noise source between the N8201A Noise Source Drive Out +28 V (Pulsed) and the RF input put.

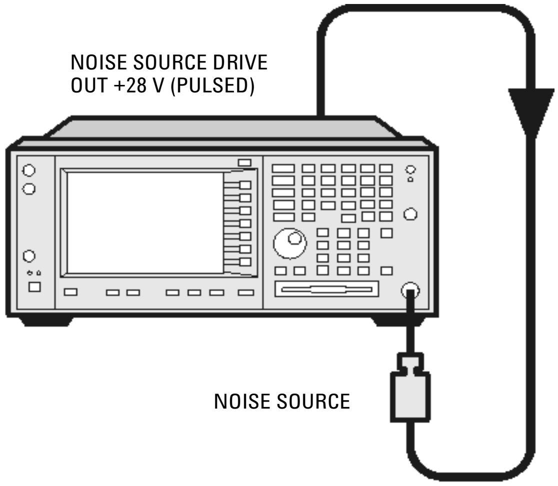


Figure 3 Calibration Setup

You may need to use connector adaptors to connect the noise source output to the N8201A RF input during calibration. The connectors you use need to be included in the measurement. If you remove these connectors for the measurement, you need to apply Loss Compensation to compensate for any loss caused by the connectors' removal.

5 If required select an input attenuator range,

- Click **Input/Output** > *Noise Figure Corrections On* > *Input Cal* and set the *Min Atten* and *Max Atten* input attenuation.

See "Selecting the Input Attenuation Range" on page 32 for mode details on input attenuation.

6 Click **Meas Setup** > *Calibrate* to initiate the calibration.

When the calibration is finished the calibration indicator changes from a red UnCorr display to a green Corr display. Also the Noise Figure Corrections key (**Input/Output** *Noise Figure Corrections* > *NF Corrections On/OFF*) allows you to make corrected or uncorrected measurements by switching between On and Off respectively.

Measurement performance above 3 GHz is not specified. If you do not have either Option 110 high band preamplifier or an external preamp, and you are calibrating above 3 GHz, the calibration data will vary significantly. Measurements made with this calibration data might be valid, but only if the device you are testing has a high gain. If this is not the case, the measurement accuracy will be poor. See the *N8201A Performance Downconverter Specifications Guide* for more detail on operating above 3 GHz.

When using external preamplifiers or high-gain DUTs, ensure that neither the external pre-amp (or the high-gain DUT) nor the internal pre-amp go into compression as this will affect the accuracy of your measurements. If you suspect that one or other of the pre-amps is going into compression, use attenuation prior to that pre-amp to prevent compression. Note that the N8201A's internal attenuator will only affect compression occurring in the internal pre-amp. It will not have any effect on any compression occurring in the external pre-amp.

Selecting the Input Attenuation Range

The Noise Figure Measurement Personality, Option 219, has a default input attenuation calibration range of 0 dB to 8 dB, and a step size of 4 dB.

In the Option 219 Noise Figure application, the attenuators cannot autorange. There is therefore a risk of overdriving the N8201A. If the signal power level is greater than –35 dBm the preamp will go into compression and the accuracy of your results will be adversely affected. In most cases, 0 dB attenuation is adequate. A guide to the input powers that can be handled by the N8201A at each frequency range is shown in Table 3 on page 33.

To check for overdriving of the N8201A, that is, compression occurring at the preamp stage, set the attenuation to 0 dB and note the noise figure of your DUT. Now increase the attenuation by one step. If your noise figure changes by more than 0.5 dB, attenuation is required. Repeat this process until you have found the lowest level of attenuation that gives you a stable noise figure result, and use this attenuation level for your measurements.

Table 3 Power Detection and Ranging [*]

Frequency	Attenuation Setting	Maximum Input Power for High Accuracy	Approximate DUT Characteristics
200 kHz to 3 GHz[†]	0 dB	–35 dBm	Over the full bandwidth, a DUT with NF = 5 dB and Gain = 36 dB, or a DUT with NF = 15 dB and Gain = 29 dB
200 kHz to 3 GHz[b]	4 dB	–39 dBm	Over the full bandwidth, a DUT with NF = 5 dB and Gain = 40 dB, or a DUT with NF = 15 dB and Gain = 33 dB
200 kHz to 3 GHz[b]	8 dB	–43 dBm	Over the full bandwidth, a DUT with NF = 5 dB and Gain = 44 dB, or a DUT with NF = 15 dB and Gain = 37 dB
200 kHz to 3 GHz[b]	12 dB	–47 dBm	Over the full bandwidth, a DUT with NF = 5 dB and Gain = 48 dB, or a DUT with NF = 15 dB and Gain = 41 dB

* The figures given in the table (above) for 200 kHz to 3 GHz assume a 5 dB ENR noise source and that the preamp is On. The figures for 3 GHz to 50.0 GHz assume a 15 dB ENR noise source.

† If the DUT has a narrower bandwidth than the 200 kHz to 3 GHz specified here, the DUT characteristics can be increased accordingly. For example, if the DUT has a bandwidth of 100 MHz, the DUT characteristics can be increased by a factor of 10 x log(3 x 10^9 / 100 x 10^6), that is, by 15 dB. In this example with an attenuation setting of 0 dB, the Gain of a DUT with a 15 dB Noise Figure can be increased from 29 dB to 44 dB.

To select the input attenuation calibration range:

1 Click **Input/Output** > *Noise Figure Corrections* >*Input Cal*.

2 Set the attenuator range using *Min Atten* and *Max Atten*, and enter the required attenuation calibration range. Use Table 3 on page 33 as a guide to what range you require.

Setting the Input Attenuation after a Calibration

The attenuators cannot autorange. Hence, when making a measurement you must manually set the input attenuation to avoid overdriving the N8201A. To set the input attenuation:

1 Click **Input/Output** >*Attenuation* and enter the desired measurement attenuation.

Displaying the Measurement Results

The Spectrum Analyzer GUI features a color display and a comprehensive set of display features to allow you to analyze the measurement results in detail, or to quickly obtain pass/fail indication.

The following display format features are available:

- Graph, Table or Meter mode display
- Single or dual-graph display allowing any two available result types to be displayed simultaneously
- Combine option to display two result types on the same graph
- Markers for analyzing a trace, and for displaying point data more accurately than can be done with a trace alone
- Save the current active trace data to memory
- Switch the graticule on or off
- Switch display annotation on or off

Selecting the Display Format

You can display the measurement results in either:

- Graph format
- Table format
- Meter format

The default display provides a display of noise figure and gain on the dual-graph display. The upper graph is noise figure and the lower graph is gain.

In all formats you can choose two result parameters you want to display.

To set the display format:

1. Click **Trace/View** > *View* > *Graph*, *Table* or *Meter* to select the display mode you want.

Navigating Around the Display

Active Graph

The active graph is highlighted by a green border. Noise Figure is the active graph by default.

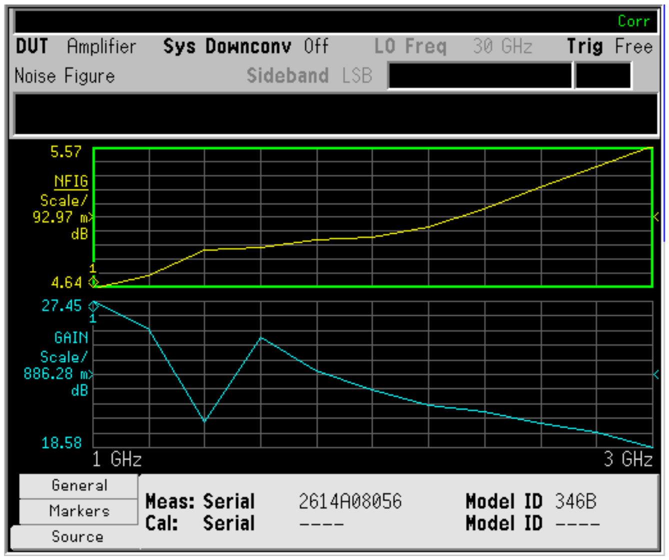


Figure 4 Dual-graph display

Changing the Active Graph

To change the active graph, click **Trace/View** > *Display* > *A Only* or *B Only*. This allows you to set the upper or lower graph as the active graph.

Viewing the Full Screen

You can fill the entire display and remove the menu keys from the display.

1 At the bottom right pane of the window, click **Hide Controls**.

2 To return to a normal display, click **Show Controls** on the right side of the window.

Selecting Result Types to Display

You can choose to display any pair of measurement results in all of the display format modes.

The measurement result types are as follows, with their units in parentheses:

- Noise Figure (dB)
- Noise Factor (linear power, measured in watts)
- Gain (dB)
- Y Factor (dB)
- T effective (Kelvin, K)
- P hot (dB)
- P cold (dB)

To specify which measurement results are displayed

1 Click **Trace/View** > *Result A* and select the result type that you want to display. These results will be displayed in the left portion of the display window when Meas View is set to Graph, and in the upper portion of the display when Meas View is set to Table.

2 Click *Result B* and select the result type that you want to display. These results will be displayed in the left portion of the display window when Meas View is set to Graph, and in the upper portion when Meas View is set to Table.

   If you click **Amplitude/Y Scale** while *Meas View* is set to Graph, the scale menu keys for the active measurement are shown.

Graphical Features

Viewing a single graph

While in graph format mode, you can **Trace/View** > *Display* > *A Only* or *B Only* so that the active graph fills the display as a single graph, as shown in Figure 5.

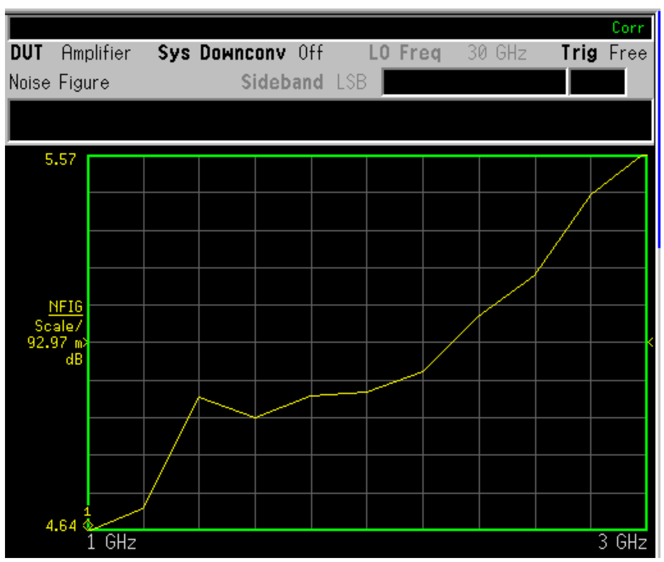


Figure 5 Displaying a single graph

NOTE When in single graph mode, click **Trace/View** > *Display* > *A Only* or *B Only* to display the other single graph.

Combining two traces on the same graph

You can combine the upper and lower graphs from a dual-graph display into a single combined display. By default, the Combined setting is Off and the graphs are not combined.

When combining two graphs, the Y-scale result limits are not re-scaled. Both graphs have their own Y-scale result limits which are indicated in different colors. These colors correspond to the colors of the traces in the combined graph.

To combine the two graphs:

1 Click **Trace/View** > *View* and ensure *Graph* is selected.

2 Click *Combined On/Off* to the On setting to combine the two currently displayed graphs on the same graph.

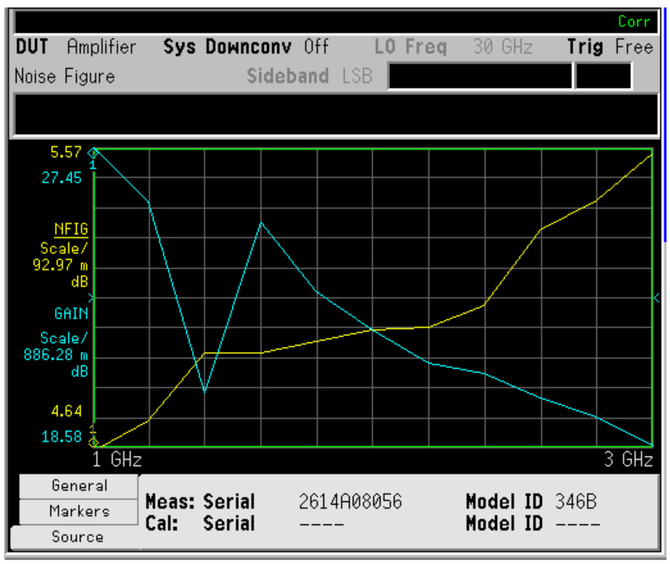


Figure 6 Typical display with two traces combined on the same graph

Turning the Graticule On and Off

When Graticule On/Off is set to On, the graticule divisions are displayed on the screen. This is the default setting. When Graticule is set to Off, the graticule lines are not displayed on the screen.

To turn the graticule on or off:

1 Click **Display** >*Preferences* > *Graticule On/Off*.

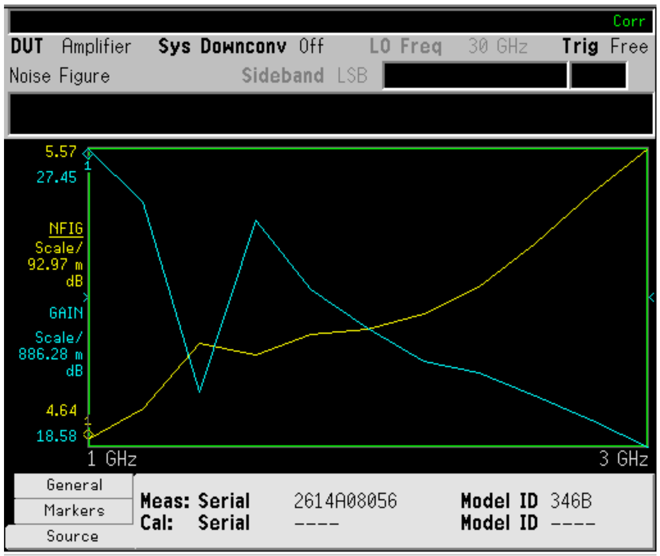


Figure 7 Typical Graph with Graticule Switched Off

Turning the Display Annotation On or Off

When Annotation On/Off is set to On, the annotation is displayed on the screen. This is the default setting. When Annotation is set to Off, the annotation is not displayed on the screen.

To turn the annotation on or off:

1 Click **Display** > *Preferences* > *Annotation* Off or On as required.

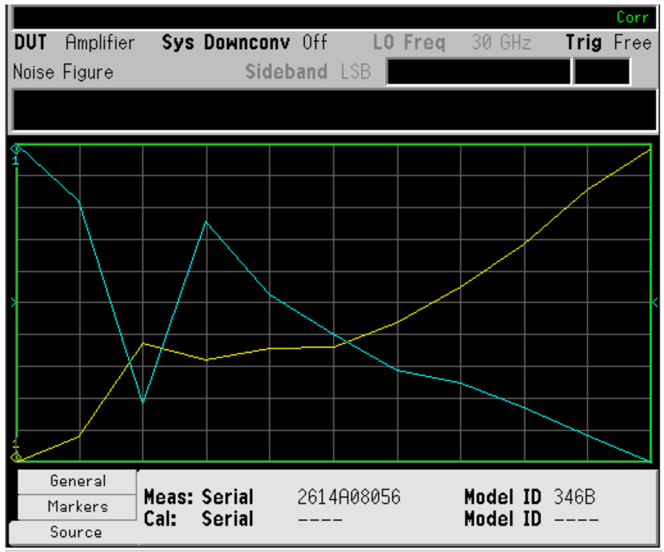


Figure 8 Typical Graph with Annotation Switched Off

Setting the Scaling

You can set the result's scale parameters in the active graph.

1 Click **Amplitude/Y Scale** to set the scale.

2 To change the active graph, click **Trace/View** > *Display* and select the desired graph view.

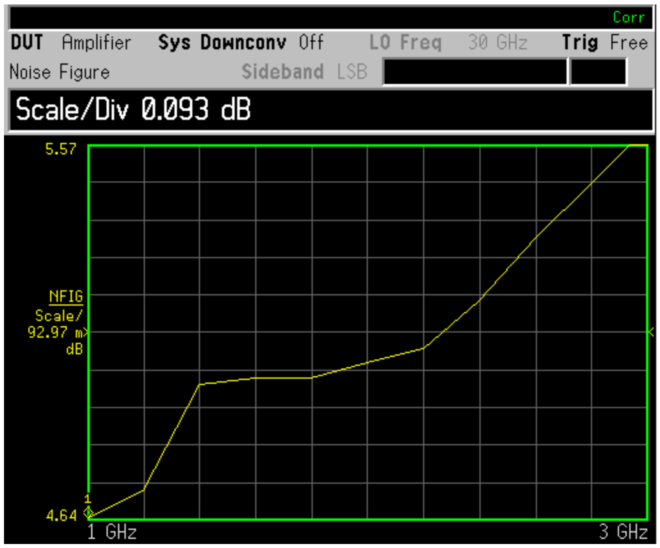


Figure 9 Typical Noise Figure Displayed on a Graph

3 Click **Amplitude/Y Scale**.

4 You can set the scale for the measurement display manually, or click *Auto Scale*.

Selecting Auto Scale selects the optimum values for Ref Value and Scale/Div.

Note that if limit line Display is set to On, and Autoscale is pressed or the scale is changed, the limit lines may no longer appear in the display.

Setting Noise Figure Scale

The following procedure can also be applied to other result types.

To make Noise Figure the active screen and set up the noise figure parameters, use the following procedure.

5 Click **Trace/View** > *Display* > *Result A* or *Result B* depending on whether you want the Noise Figure results displayed in the upper (Result A) or lower (Result B) graph.

6 Click *Noise Figure* or *Noise Factor.*

If you select the Noise Factor function, the graph will display Noise Factor instead of Noise Figure results. Noise Factor results are displayed on a power (watts) scale.

7 Click **Amplitude/Y Scale** > *Scale/Div* and change the scale per division value.

8 Type in the values with the keyboard and then press **Enter** to accept the changes.

Instead of setting the Scale/Div manually, you can let the N8201A choose a suitable value that will cause the measurement trace to be displayed over the full height of the display window.

To do this, click *Auto Scale*.

Setting the Reference Value

1 Click *Ref Value* and change the reference value using keyboard. Values that are entered are automatically converted to dB.

Working with Markers

The marker functions only apply when you are working in graph format.

Marker functions measure the frequency and measurement results by placing a diamond-shaped marker at a point on the trace. The measurement results displayed depend on the result type selected.

The Spectrum Analyzer GUI has four markers. The markers are coupled to both the lower graph trace and upper graph trace.

Each marker can be enabled as a normal or delta marker. The active marker's frequency is displayed in the active function area, and at the bottom of the screen. The enabled marker's results are displayed under the Markers tab bar at the bottom of the display.

Selecting Markers

To select a marker:

1 Click **Marker** > *Select Marker* to select the desired marker: 1, 2, 3, or 4.

The active marker is identified by being underlined in the Marker key label.

2 Click **Marker >** *Mode* > *Normal or Delta* to select your type of marker(s).

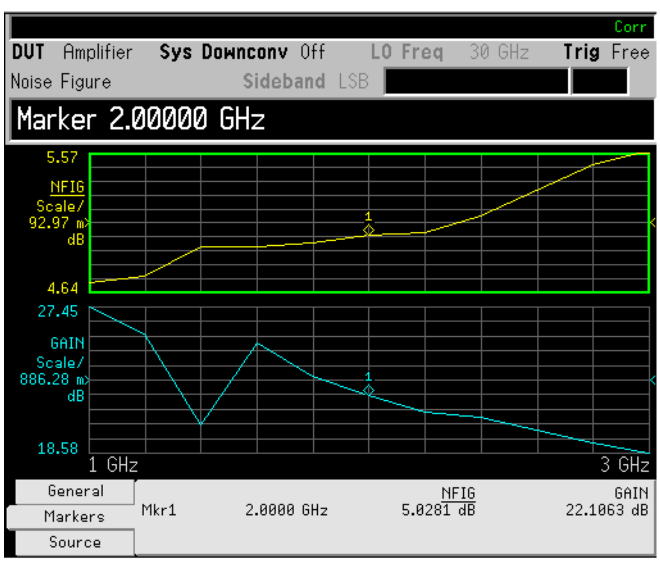


Figure 10 A Normal State Marker

A marker is now placed on each trace. Use the Marker Position entry box or slider to move the marker. The marker frequency and marker result are displayed under the Marker tab bar which is below the graph display. Their frequency values are also displayed in the active function area.

A marker can only be placed on a point where a measurement has been made. It is not possible to place a marker at an interpolated position on the graphs.

To turn an active marker off

- To turn an active marker off, click **Marker** > *Mode* > *Off*.
- To turn off all markers, click **Marker** > *Markers All Off*. This also removes the marker annotation from the marker tab at the bottom of the screen, and the marker frequency from the active function area.

To change the active marker

The default active marker setting is Marker(1).

1 To change the active marker, click **Marker** > *Select Marker*. This moves the active marker from Marker(1) to Marker(2). Click it again and it moves the active marker from Marker(2) to Marker(3). This process is repeated until it returns to the Marker(1).

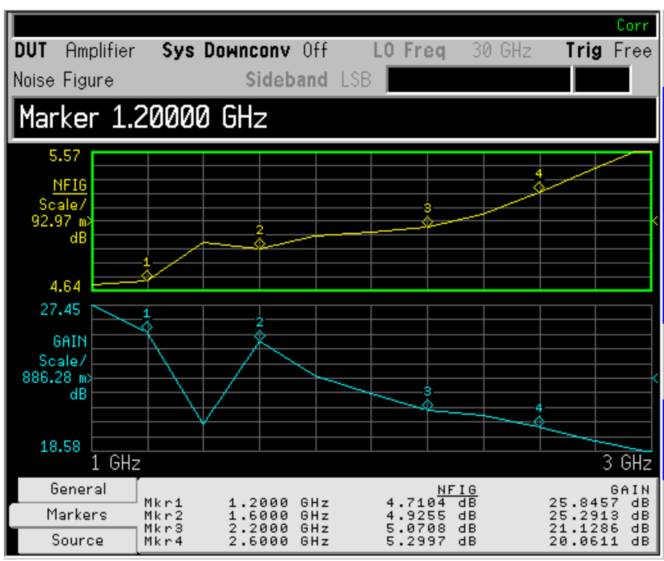


Figure 11 Four Normal State Markers

Changing the Marker States

To use Delta Markers

The Delta key places a reference marker at the current position of the active marker. The delta markers enable you to measure the difference between the reference marker and the delta marker position on the trace. Use the Marker Control positioned to place the delta marker to the point on the trace you want to measure. The position of the reference marker remains fixed. The delta marker has its frequency and measurement result value differences annotated relative to the reference marker on the marker tab at the bottom of the screen. The delta marker has its actual frequency value is displayed in the active function area. See Figure 12.

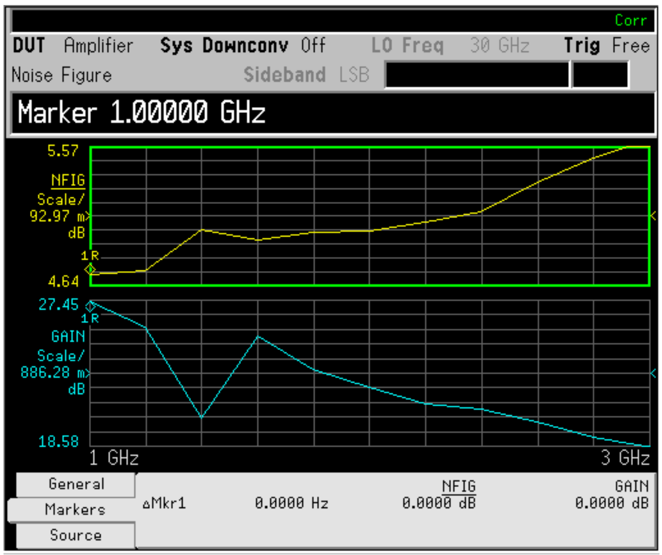


Figure 12 The Delta Marker State enabled

To activate a Delta marker:

1 Click **Marker** > *Select Marker* to select the marker of interest.

2 Click *Mode* > *Delta*.

3 Use the Marker Position text box or slide bar to move the Delta marker from the reference marker. The annotation on the marker tab at the bottom of the screen displays the difference between the reference marker and the delta marker. The frequency of the delta marker is displayed in the active function area at the top of the display.

Searching with Markers

The Peak Search key accesses a further menu which allows you to place an active marker on the minimum or maximum points of a trace when using a Normal marker. When using Delta markers, you can search for the Minimum Peak to Maximum Peak on the trace.

It should be noted that the Search function operates on the active trace. The active trace is always indicated by underlining of the name of the measurement. When two measurements are shown in two separate windows on the display, that is, when Combined is set to Off, the active trace is also indicated by a green border surrounding the graph.

The marker on the second trace, that is, the marker on the inactive trace, is positioned at the same frequency position as the marker on the active trace.

Searching for Min or Max Point

You need to have activated a Normal marker to perform a minimum or maximum search.

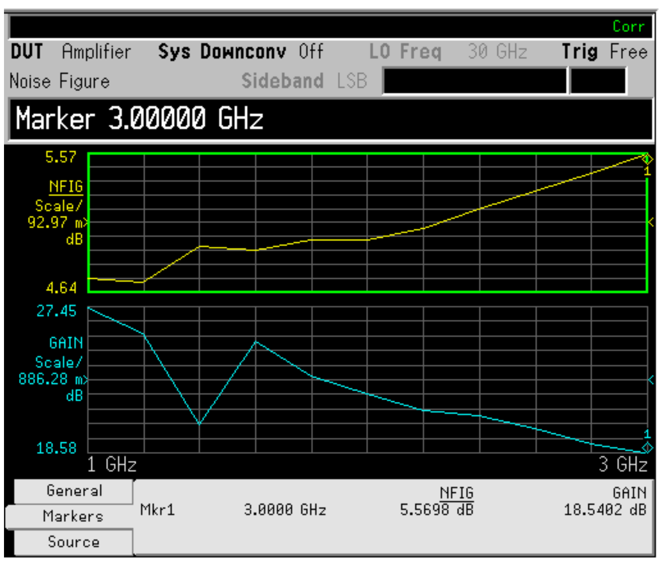


Figure 13 Typical Trace showing Maximum Point Found

To search for the maximum point:

1. Click **Peak Search**.
2. Click *Search Type* > *Maximum*.
3. Click *Continuous On* if you want the marker to constantly move to the maximum peak.

The marker is now placed at the maximum point of the active trace.

Searching for Peak to Peak Points

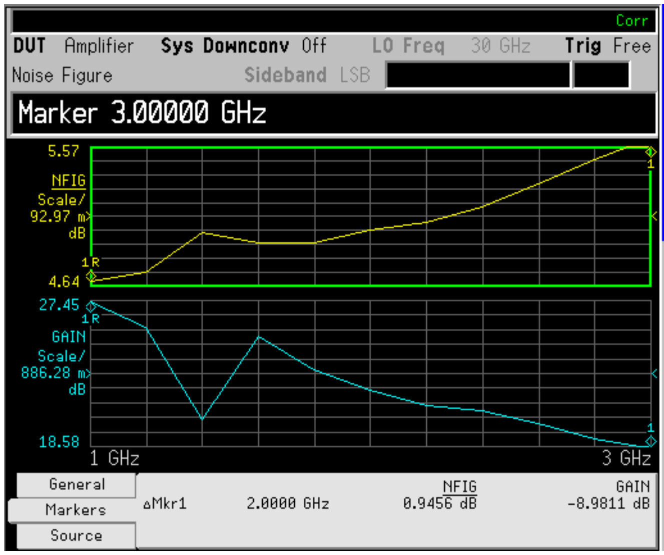


Figure 14 Peak to Peak Found

1 Click **Peak Search**.
2 Click *Search Type >Pk-Pk*.

The markers are now on the maximum and minimum points of the trace. The annotation displays the difference between the two points.

3 If you want to continuously find the maximum and minimum points on the trace, set Continuous to On.

Indicating an Invalid Result

When an invalid result is detected while in graph display format, the graph is drawn at the top of the screen for the current measurement point and a special marker indicator is displayed. Also in table and meter formats the same special indicators are used to display an invalid result.

Several invalid result conditions may exist simultaneously. These conditions are ranked in order of severity and only the most severe condition present is displayed.

The ranking order is:

Table 4 Ranking Order of Invalid Result Conditions

Ranking Order	Invalid Result Condition	Marker Indicator
1	Hot power ≤ cold power	“==”
2	Corrected calculation not possible	“xx”
3	Measurement result calculation invalid	“--”

The ranked order 2 only occurs if a corrected measurement is requested and either:

- The input range used at this measurement point is not calibrated.
- The input range is calibrated, but the calibration data is invalid at this point.

Example of a Basic Amplifier Measurement

Noise figure measurements are made by measuring the output power of the DUT for two different input noise power levels. The high and low power inputs come from a calibrated noise source. The noise source is switched on and off in rapid succession. High power input to the N8201A uses the noise power generated when the noise source is switched on, and low power input uses the noise power generated at ambient temperature with the noise source switched off.

This section uses a DUT to show how a basic noise figure measurement and various basic operations are performed. The DUT used is a low noise amplifier with a usable frequency range of 20 MHz to 3.0 GHz. The specifications of interest to the example are listed in Table 5.

Table 5 The Example DUT Specifications

Frequency Range	Typical Gain	Minimum Gain	Typical Noise Figure
20 MHz to 3 GHz	20 dB	14 dB	4.8 dB

The example sets a frequency range of interest of 1.0 GHz to 2.0 GHz. The purpose of the measurement is to verify the specified table results are as stated over the frequency range of interest.

When you are making measurements, follow the procedure and change the values to meet your needs.

For these basic measurements confirm the **Mode Setup** > *Dut Setup* is in the default setting. This status is displayed above the graphs as follows:

- DUT: Amplifier
- Sys Downconv: Off

Calibrating the Noise Figure Downconverter

The first step is to calibrate the N8201A.

1 Turn the N8201A on and wait for the power-up process to complete.

NOTE To obtain greater accuracy, it is recommended the N8201A warm up for at least one hour with Alignment, Auto Align set to On.

2 Click **System** > *Power On/Preset* > *Preset Type* > *Mode*.

3 Click **Preset** to return the N8201A to its factory-default state.

4 Click **Mode** > *Noise Figure* to set the measurement mode to Noise Figure.

5 Click **Measure** > *Noise Figure* to set the measurement to Noise Figure.

6 Click **Meas Setup** > *ENR* > *Mode Table/Spot* to *Table*.

7 On the same menu, click *Common Table On/Off* to On.

8 Again on the same menu, click *Meas & Cal Table...* > *Table* to enter the ENR values of the noise source. See Table 6.

In this example, a 346B noise source is used which has the following Frequency/ENR pairs up to 2 GHz (covering the required frequency range of 1.0 GHz to 2.0 GHz):

Table 6 Example Noise Source ENR/Frequency values

Frequency (GHz)	ENR dB
.01	15.13
.10	15.39
1.0	15.21
2.0	15.02

9 Click **Frequency/Channel** to set the frequency parameters of the measurement:

- *Freq Mode — Sweep*
- *Start Freq — 1.0 GHz*
- *Stop Freq — 2.0 GHz*
- *Points — 15*

10 Click **Meas Setup** to set the averaging you want.

- *Averaging — On*
- *Averages — 5*

11 Click **BW/Avg** > *RBW Auto* and enter 1 MHz.

12 Click **Input/Output** > *Noise Figure Corrections* > *Input Cal* > to change the *Min Atten* and *Max Atten*, if required.

This example uses the default minimum input attenuation of 0 dB, and the default maximum input attenuation of 8 dB.

13 Connect the noise source input to the Noise Source Drive Out +28 V Pulsed port on the front panel of the N8201A using the appropriate cable. Connect the noise source output to the RF Input as shown in Figure 15.

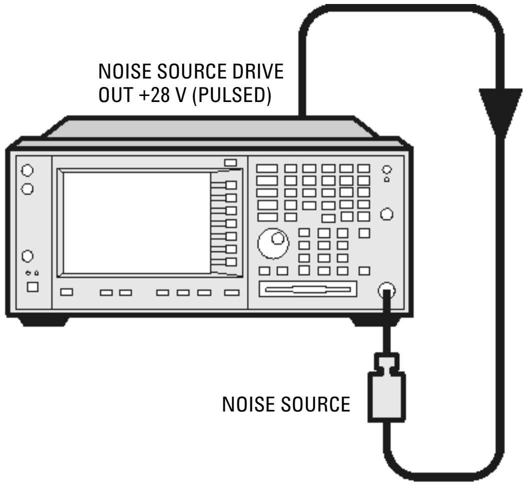


Figure 15 Calibration Setup with Normal Noise Source

14 Click **Meas Setup** > *Calibrate* to calibrate the N8201A.

A graph similar to Figure 16 is now displayed.

With calibration completed and no device under test inserted, both gain and noise figure with Corrected set to On are near 0 dB. This shows that the N8201A has removed the noise contribution from the measurement system. Since the input is noise, which is random in its nature, there is some variation above and below zero.

Measurement performance above 3 GHz is not specified. If you do not have either Option 110 High Band Preamp or an external preamp, and you are calibrating above 3 GHz, the calibration data will vary significantly. Measurements made with this calibration data might be valid, but only if the device you are testing has a high enough gain and noise figure, such that the sum of these is about 35 dB or more. Otherwise, the measurement accuracy will be poor.

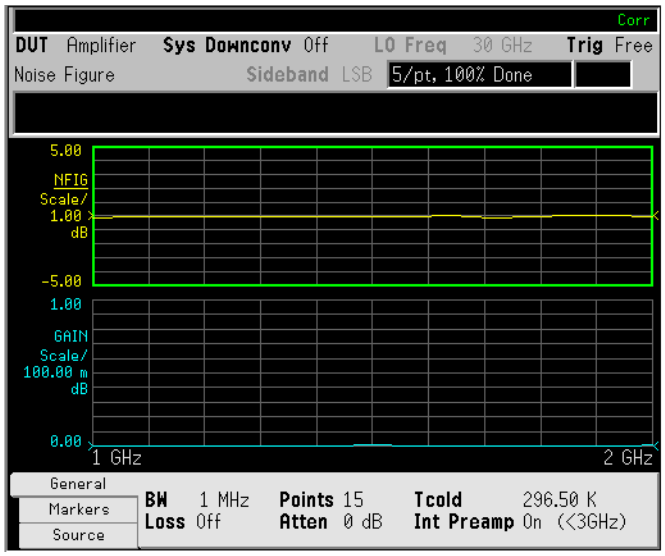


Figure 16 Typical Graph after calibration is complete

15 Click **Trace/View** > *View* > *Table*.

A result similar toFigure 19 is now displayed. The expectation is approximately 0 dB of noise figure and gain. It may be better to view these results using table format mode.

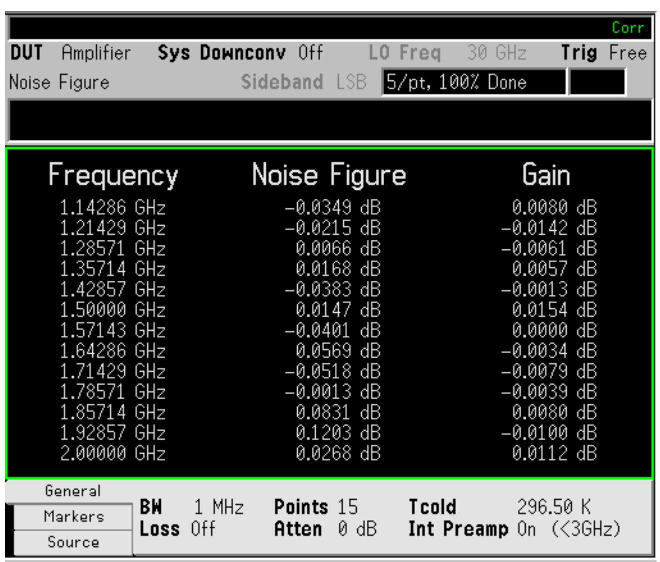


Figure 17 Typical Tabulated Results after Calibration

Making Measurements

To make noise figure measurements once calibration is complete:

1 Disconnect the noise source from the RF input of the N8201A

2 Connect the DUT to the N8201A RF input.

3 Connect the noise source output to the DUT input as shown in Figure 18.

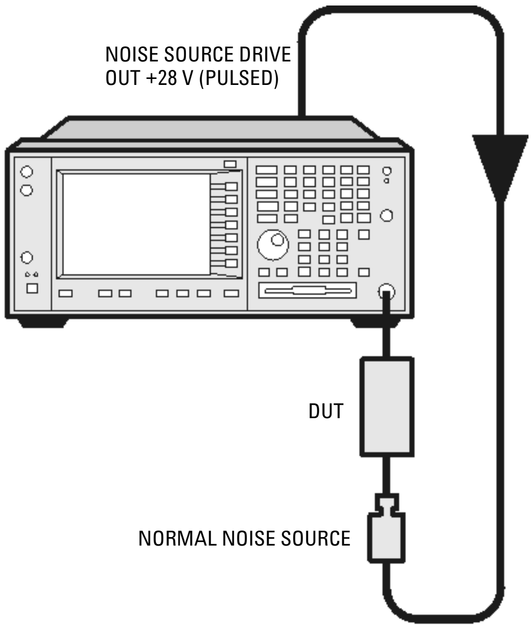


Figure 18 Connecting the DUT to make a measurement

After the DUT and noise source are connected, the measurement result appears on the Spectrum Analyzer GUI display. If it does not, click Restart. If you want to get a continuous update, ensure Sweep is set to Cont. This is located under the Sweep key menu.

A result similar to Figure 19 is now displayed.

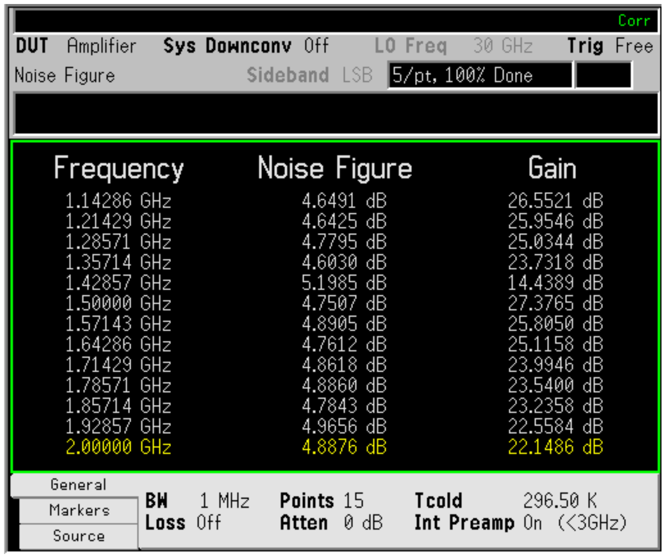


Figure 19 Typical Tabulated Results after Measurement

4 Click **Trace/View** > *View* > *Graph*. A graphical result similar to Figure 20 is now displayed.

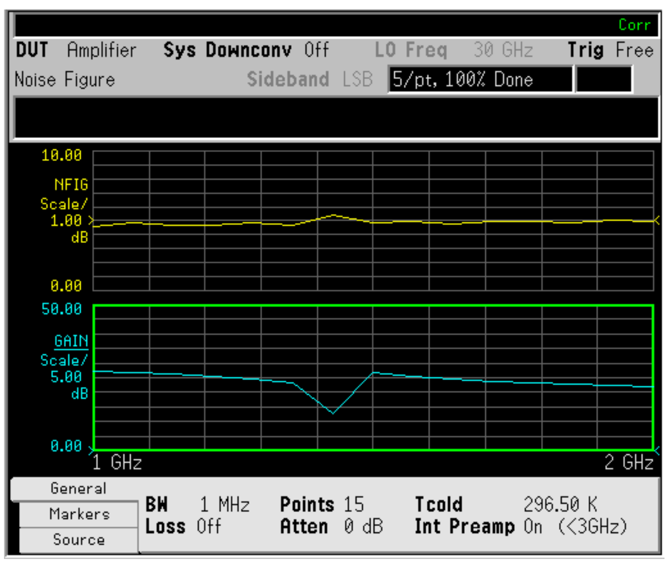


Figure 20 Typical Graphical Results after Measurement

The results shown in Figure 19 and Figure 20 shows the DUT has an average noise figure of 4.8 dB, an average gain of 23 dB and a minimum gain of 14.4389 dB. The device under test therefore meets its manufacturer’s specification over the frequency range of interest.

Further Information on Noise Figure Measurements

Agilent Technologies produces three application notes about noise figures and their measurement. These are:

- *Application Note 57-1*

  Fundamentals of RF and Microwave Noise Figure Measurements
- Application Note 57-2

  Noise Figure Measurement Accuracy - the Y-Factor Method
- *Application Note 57-3*

  10 Hints for Making Successful Noise Figure Measurements

All three application notes are available from the Agilent website at:

http://www.agilent.com/find/psa

3
Advanced Features

This chapter describes how to use the Limit Lines and Loss Compensation features with the Noise Figure Measurement personality.

What You will Find in this Chapter

Tips for Using the Measurement Examples

- Setup diagrams through out the Measurement chapters show a PSA series spectrum analyzer as the measuring device. The N8201A performance downconverter can be used as the measuring device as well. Notice that the Noise Source Drive Out +28 V is located on the front panel of the N8201A.
- All front panel key presses are indicated in **bold** text.
- All sub menu key presses are indicated in *italic* text.
- Make sure that you have selected the Noise Figure measurement personality.
  - Click **Mode** > *Noise Figure*
  - Click **Measure** > *Noise Figure*.
- You can choose to maximize the Spectrum Analyzer GUI display. The advantage of doing this is that most of the sub menu keys are available on one page. Also, the display area will be much larger.
- If you choose to leave the Spectrum Analyzer GUI window at its default size, you may have to click *More 1 of ...*. to get to the desired function.
- While going through the measurement examples, you may want to select **Refresh Display Automatically**. This way you can see changes as you apply them. This selection can slow down the processing time of the instrument, therefore; during normal testing you may choose to have this feature turned off.
- All sub menu keys that contain frequency units, for example Start Frequency, are editable. Click on the numeric entry to change the value. Use the PC's keyboard to enter the desired value and then type in the first letter of the units designator. For example, G for gigahertz.

Setting up Limit Lines

Limit lines can be set to mark lower or upper boundaries of the active traces and they can also be set to notify you of a failure when a trace exceeds a limit line. Two limit lines can be applied to a single trace, for example, allowing an upper and lower boundary limit to be specified.

The Noise Figure application (Option 219) features four independent Limit Lines. Limit Line 1:A and Limit Line 2A are applied to the upper graph, and Limit Line 3B and Limit Line 4B are associated with the lower graph.

Selecting a Limit Line

1 Click **Display** > *Limits* > *Limit Line 1A, 2A, 3B, 4B*.

   Each time Limit Line 1A, 2A, 3B, 4B is clicked, the selected limit line moves the active indicator from Limit Line 1A to Limit Line 2A

2 Click *Limit Line 1A, 2A, 3B, 4B* again and the active indicator moves from Limit Line 2A to Limit Line 3B. This process is repeated until it returns to the Limit Line 1A.

Setting the Type of Limit Line

You can set the Limit Line to be an upper limit or lower limit and test the trace against this limit line setting.

To set the limit line type,

1 Click **Display** > *Limits*> *Limit Line 1A, 2A, 3B, 4B* to select the desired limit line.

2 Click *Type Upper/Lower*.

Select Upper if you want it to be above the trace or Lower if you want it to be below the trace. Each of the four limit line needs to be set up separately.

Enabling Testing Against a Limit Line

You can set the Limit Line to test against the trace. If a result fails testing, it is reported in the upper right hand corner of the display. In table mode you also see the reported result failure.

To set the testing of the trace against the limit line,

1 Click **Display** > *Limits*> *Limit Line 1A, 2A, 3B, 4B* to select the desired limit line.

2 Click *Test On/Off*.

Each of the four limit lines needs to be set up separately.

After a failure the LIMITS FAIL: indicator remains displayed until:

- a complete sweep has been performed with the Limit Line test passing at every point

- you switch Test to Off
- you change the limit line type
- you click Restart

Displaying a Limit Line

1 Click **Display** > *Limits> Limit Line 1A, 2A, 3B, 4B* to select the desired limit line.
2 Set *Display On/Off* to On to display the limit line on the graph.

   Each of the four limit lines needs to be set up separately.

Switching all the Limit Lines Off

To switch all the Limit Lines off,

1 Click **Display** > *Limits* > *Limit Line 1A, 2A, 3B, 4B* to select the desired limit line.
2 Click *Disable All Limits*.

   This simultaneously switches off all Limit Lines, regardless of what graph or trace they are associated with. Both Test and Display settings remain unaffected.

   When a limit line is switched off the limit line data is not affected.

Creating a Limit Line

To set up limit lines, you need to specify the frequencies, the Y-axis value and whether or not it is to be connected to the previous limit line point. The limit line consists of a table of entries, each of which is a frequency-limit-connected group.

The Limit or Y-axis value is a dimensionless unit, hence you need to know what Y-axis scale you are working in before you set this.

When you change the result parameter, the Limit or Y-axis values are not converted. This is due to the value being dimensionless.

To create a limit line:

1 Click **Display** > *Limits* > *Limit Line 1A, 2A, 3B, 4B* to select the desired limit line.
2 Set the *Display* to *On* to display the limit line.
3 Click *Edit...*.

You are presented with a Limit Line table.

4 Click on the first *Frequency* value (or to the first empty frequency field if you wish to keep the existing frequency values) and enter the frequency using the keyboard. Finish by entering the first letter of the units terminator. For example, “M” for megahertz.

5 Enter the *Limit* or Y-axis unit value and terminator corresponding the frequency you just entered.

A limit line unit value to be useful is derived from the scale values you are using to display the trace.

6 Set *Connected* to *Yes* or *No*.

When Connected is set to Yes it connects that point to the previous point to form a continuous line. To disconnect a point, set Connected to No, this disconnects it from the previous point. Figure 21 the connections and Figure 22 shows the graphical result with limit line Display set to On.

When the Limit Line Test is set to On, and a trace crosses over the limit line, the test is only performed between connected points. Also, if you are making a fixed frequency measurement, you only need to specify that frequency value. The limit line will be tested on that single point.

7 Repeat this process until the limit line is defined. Limit line tables can have a maximum of 101 entries.

8 Click *OK* to return to the limit line menu.

9 To save a limit line, click **File** > *Save* > *Type State* > *Limit* > *Source* >

10 Select the applicable limit line for saving (for example, *Limit 1A*)

11 Click *Destination Drive PC/Instrument.*

12 Click *File Name* and enter a file name for the limit line. The file name extension (.LIM) will automatically be applied to the limit line file.

13 Click *Save Now.*

You can load a previously saved Limit Line table. However, you need to specify which limit line number you want loaded.

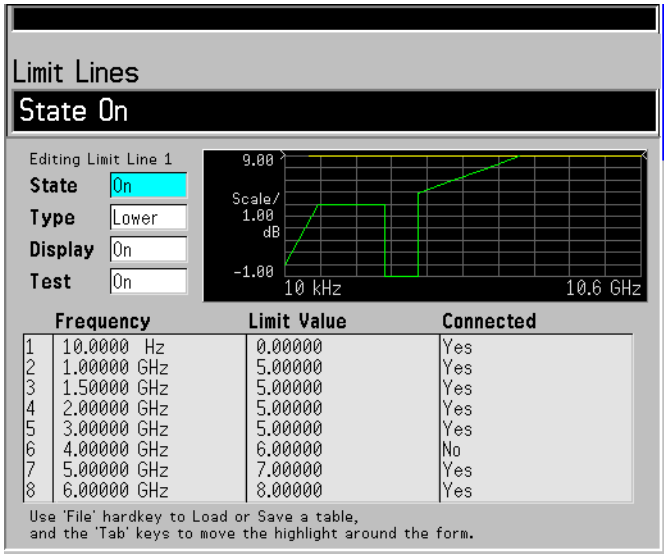


Figure 21 Typical Limit Line Connections in Table

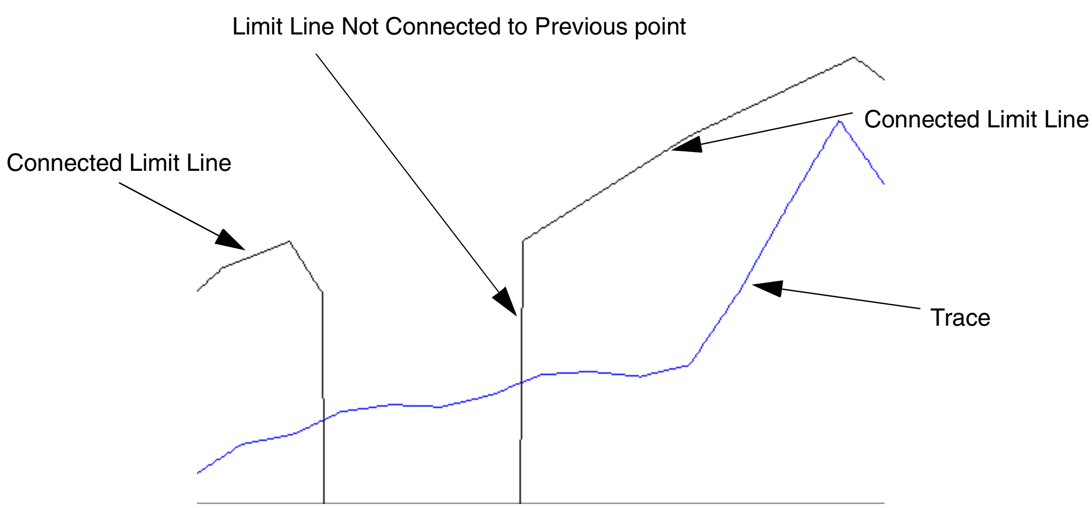


Figure 22 Limit Line Connections Displayed

Using Loss Compensation

You can configure the Noise Figure application (Option 219) to compensate for losses due to cabling and connectors, and those due to temperature effects that occur in the measurement setup. These can be between the Noise Source and the DUT (Before DUT), or between the DUT and the N8201A RF input (After DUT), or both. Loss compensation can be set either by specifying a single, fixed loss value which gets applied at all frequencies, or using various loss values, specified in a table, applied across the frequency span. In the table mode, linearly interpolated values are used between each table entry.

Any device that causes loss will also generate excess noise, and this excess noise is proportional to the absolute temperature of the device causing the loss. You can compensate for this extra noise by specifying the temperature of the device causing the loss. This temperature dependent compensation is applied at all frequencies.

Examples where Loss Compensation is applied

This is important in cases such as:

- Amplifiers with waveguide input, where a lossy waveguide-to-coax adapter is needed.
- Transistors, where input and output tuners are required.
- Non-50Ω converters (such as TV tuners and amplifiers) where matching pads or transformers are required.
- Compensation for fixed attenuators used to improve SWR.
- Double sideband measurement modification (of receivers and mixers) to approximate single sideband results.

Configuring Fixed Loss Compensation

To configure fixed loss compensation follow the example below:

1 Click **Input/Output** > *Loss Comp* > *Setup* > *Loss Comp Before DUT* (or the applicable function) > *Fixed*.

   A fixed loss compensation value cannot be entered or changed if the Before DUT field or the After DUT field is not set to Fixed. It is selected by highlighting the Fixed key.

2 To set the loss compensation value before the DUT, click *Loss Comp Before Fixed Val* and input the required value (in dB) for the loss occurring before the DUT.

   The lower limit is –100.000 dB, the upper limit is 100.000 dB, and the default is 0.000 dB.

3 Click *Loss Comp Before Temp* to enter the temperature of the device (in Kelvins) where the loss is occurring. This will normally be room temperature, which is 296.5 K.

NOTE It is important that you enter the correct temperature. Leaving the Temperature set to the default value of 0.00K will result in incorrect noise figure measurements.

Configuring Table Loss Compensation

To configure table loss compensation proceed as follows.

1 Click **Input/Output** > *Loss Comp* > *Loss Comp Before DUT* (or appropriate function) > *Table*

2 Click *Back* > *Before DUT Table* to access the compensation table.

3 Use the keyboard to enter the frequency and loss values, and then click *OK* to close the table.

   The frequency value requires the first letter of the units terminator, for example, "G" for Gigahertz. The loss value will be defaulted to dB.

   Loss Compensation tables can have a maximum of 401 entries.

4 Click Back > Setup > Loss Comp Before Temp to enter the temperature of the devices which are causing the loss. Room temperature requires a value of 296.5 K.

   It is important that you enter the correct temperature. Leaving the Temperature set to the default value of 0.00K will result in incorrect noise figure measurements.

You can load a previously saved Loss Compensation table.

1 Click **File** > *Load* > *Type* > *Loss Comp Before DUT* > *Source Device PC/Instrument*.

2 Click *File Name* and locate the desired file, then click *OK*.

3 Click *Load Now.*

Noise Figure Uncertainty Calculator

The measurement uncertainty calculator can be used to calculate the RSS (root sum square) measurement uncertainty. Measurement uncertainty is caused by device mismatch and other properties of the noise source, the device under test, and the N8201A downconverter. Once you measure or identify the various device characteristics, they can be entered into the Spectrum Analyzer GUI and it will calculate the RSS uncertainty.

This makes a frequency-independent calculation using one ENR uncertainty value. While it provides a good estimation of the measurement uncertainty, you may want more accuracy. You may want to use more accurate values for ENR, gain, and VSWR; or calculate values at a specific frequency of interest or at multiple frequencies. Refer to Application Note 57-2, Agilent part number 5952-3706E, for more information about calculating noise figure uncertainties. This document can be found at: http://www.agilent.com/find/nfu.

Noise Source

For the highest accuracy, and therefore the most meaningful results, you should select ‘User Defined’ as the Noise Source whenever the actual value of the noise source calibration data is available. This allows you to enter the uncertainty of the Excess Noise Ratio (ENR) and the 50 Ω match (in dB, VSWR, or Reflection Coefficient), which can be from any noise source from any manufacturer. In addition, default values are provided giving typical parameters for noise sources from Agilent Technologies.

DUT

The device under test will be either an amplifier, upconverter, or downconverter. You will have to enter the measured (or documented) values for its noise figure, input match, output match, and gain into the fields in the calculator. (Gain is only required for an amplifier.)

Instrument

N8201A default values are provided. These are reasonable defaults for measurements below 3 GHz using the built-in preamp (Option 110 or Option 1DS). For more accurate calculations, you will need to input the values that are appropriate for your particular measurement and setup.

RSS value

The calculator provides the square root of the sum of the squares (RSS) of the various contributions to uncertainty. This is the recommended way to calculate the total measurement uncertainty since each of the contributing factors are random in nature.

System Up Converters and Down Converters

The calculator is designed to calculate uncertainty for a measurement where the DUT is either an amplifier, a downconverter or an upconverter. It is not designed to calculate the uncertainty when measuring a DUT that is in a measurement setup that includes a system downconverter or system upconverter.

Example Calculation:

1 Access the uncertainty calculator click **Mode Setup** > *Uncertainty Calculator*.

Suppose that you are testing an amplifier. You must enter the device characteristics into the appropriate DUT fields on the calculator form.

2 Choose from the list of functions and enter the applicable value. Use the keyboard to specify the desired value, then press **Enter**.
   - gain = 20 dB
   - noise figure = 4 dB
   - input match = 1.4
   - output match = 1.4

3 Now read out the calculated RSS uncertainty from the results field at the bottom of the display.

4
Making Frequency Converter Measurements

This chapter describes how to make measurements outside the baseband frequency range of the Noise Figure Measurement personality.

What You will Find in this Chapter

Tips for Using the Measurement Examples

- Setup diagrams through out the Measurement chapters show a PSA series spectrum N8201A as the measuring device. The N8201A performance downconverter can be used as the measuring device as well. Notice that the Noise Source Drive Out +28 V is located on the front panel of the N8201A.
- All front panel key presses are indicated in **bold** text.
- All sub menu key presses are indicated in *italic* text.
- Make sure that you have selected the Noise Figure measurement personality.
  - Click **Mode** > *Noise Figure*
  - Click **Measure** > *Noise Figure*.
- You can choose to maximize the Spectrum Analyzer GUI display. The advantage of doing this is that most of the sub menu keys are available on one page. Also, the display area will be much larger.
- If you choose to leave the Spectrum Analyzer GUI window at its default size, you may have to click *More 1 of ...*. to get to the desired function.
- While going through the measurement examples, you may want to select **Refresh Display Automatically**. This way you can see changes as you apply them. This selection can slow down the processing time of the instrument, therefore; during normal testing you may choose to have this feature turned off.
- All sub menu keys that contain frequency units, for example start frequency, are editable. Click on the numeric entry to change the value. Use the PC's keyboard to enter the desired value and then type in the first letter of the units designator. For example, G for gigahertz.

Overview of Frequency Converter Measurements

1 Click **Mode Setup** > *DUT Setup...* > *DUT* to select the type of DUT being measured.

For more details on the available DUT types, see “DUT Types" on page 68.

Selecting the type of DUT displays the applicable functions for that type of DUT.

2 Set the remaining parameters for the measurement.

System Downconverter When measuring an amplifier type DUT, this allows you to specify whether or not the system downconverter is to be used in the measurement.

NOTE System Downconverter is only applicable when the DUT Type is Amplifier. The system downconverter can not be used with upconverters and downconverters.

Ext LO Frequency When measuring an up converting DUT, or a down converting DUT, this allows you to specify the fixed LO frequency being fed into the DUT. It also allows you to specify the LO frequency from the system downconverter.

Sideband Specifies whether the measurement is to measure the lower sideband (LSB), the upper sideband (USB), or both upper and lower sideband, double sideband (DSB).

When measuring upconverter noise, only upper and lower sidebands can be measured at any one time. Double sidebands are not applicable.

When measuring downconverter noise, or an amplifier type DUT with the system downconverter, you can measure upper sideband (USB), lower sideband (LSB), or double sideband (DSB).

Frequency Context When the DUT is a downconverter or an upconverter, or you are using the system downconverter with an amplifier, you can select whether the frequencies displayed on the Spectrum Analyzer GUI represent the frequencies before or after conversion. Selecting a Frequency Context of IF Analyzer Input (Mode Setup > DUT Setup > Freq Context > IF Analyzer Input), specifies that the frequencies displayed are after the conversion, that is, the frequencies leaving the DUT or the system downconverter, and entering the N8201A. Selecting RF DUT Input as the Frequency Context (Mode Setup > DUT Setup > Freq Context > RF DUT Input) specifies that the frequencies displayed are the frequencies before the conversion That is, the frequencies entering the DUT. These are the same start and stop frequencies that are displayed in the Frequency Channel menu.

3 Configure the measurement (measurement frequency range, number of measurement points and averages and so forth) using the **Frequency/Channel** and **BW/Avg** keys.

For more details on configuring measurements, including calibration, see Chapter 2, “Making Basic Measurements.

DUT Types

Available modes

The Noise Figure measurement personality (Option 219) allows you to measure the following types of DUT. You set the DUT Type by clicking **Mode Setup** > *DUT Setup...*.

- Amplifier: The DUT is an amplifier-type device with no frequency conversion. This is the basic measurement mode where the measurement frequency is within the N8201A’s frequency range.

  The Amplifier DUT is for any DUT that does not perform frequency conversion and includes amplifiers, filters, attenuators and so forth.

  If you wish to measure the noise figure of an amplifier at a frequency outside the range of the N8201A, set DUT to Amplifier, and set System Downconverter to On. The LO must be fixed
- Downconv: The DUT is a frequency downconverter (that is, frequency downconversion occurs in the DUT itself). The LO must be fixed.
- Upconv: The DUT is a frequency upconverter (that is, frequency up conversion occurs in the DUT itself). The LO must be fixed.

Noise figure measurements involving frequency converters are necessary when:

- The frequency conversion is part of the DUT. For example, the DUT is a mixer or a receiver.
- The frequency conversion is part of the measurement test set-up. The DUT is to be measured at a higher frequency than the N8201A’s frequency range covers, hence an external mixer and local oscillator are added to the measurement test set-up to convert this frequency to a frequency within the N8201A's range.

The Noise Figure measurement personality (Option 219) can make a single frequency conversion, either in the DUT, or as an added system downconverter, which configures the N8201A as a frequency range extender.

The Noise Figure measurement personality can not control an external LO source remotely. You can only specify a fixed frequency for that LO, so any sweeping must be done by the internal LO under the control of the N8201A.

Basic Measurement — No Frequency Conversion

The basic measurement setup is shown in Figure 23, allowing you to compare more complex setups with it.

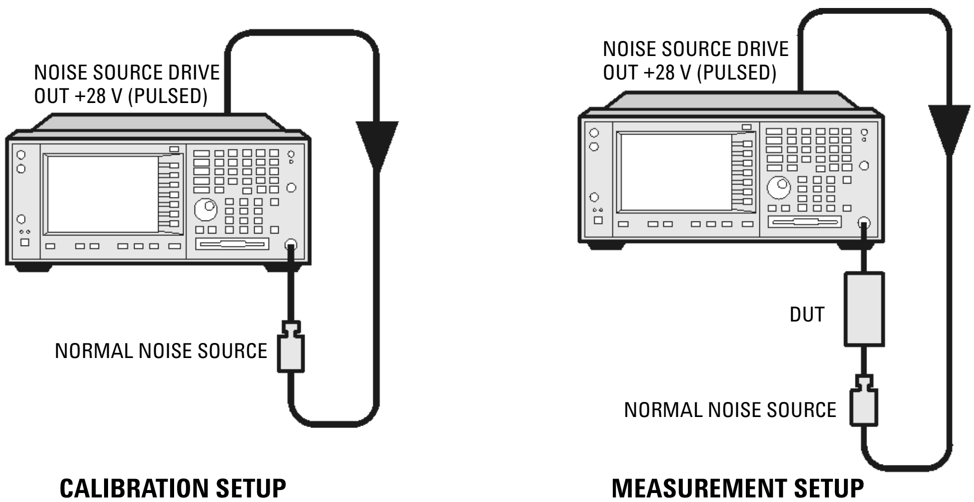


Figure 23 Basic Noise Figure Measurement - No Frequency Conversion

When you are performing an uncorrected measurement, the result is the measured noise figure of all of the components after the noise source. When the calibration setup is connected and the calibration performed, the Noise Figure measurement personality measures its own noise figure and that of the connection set up. If you then make a corrected measurement, the contribution of the calibration setup is subtracted from the uncorrected result, giving a corrected measurement of the DUT only.

1 Click **Mode Setup** > *DUT Setup...* to access the DUT Setup menu.

2 Click ***DUT*** > *Amplifier*.

3 *System Downconverter On/Off*.

Frequency Down Converting DUT

In this mode, the DUT contains a frequency down converting device, for example, a mixer or receiver.

Making this measurement, the external Local Oscillator (LO) remains locked at one frequency and the Noise Figure measurement personality does the sweeping. It is not possible to control a variable frequency on the external LO.

Variable IF Fixed LO (equivalent to Mode 1.4 on an 8970B Noise Figure Meter)

This is an overview of the key presses needed to set up this type of measurement, see "Frequency Restrictions" on page 104, and "Fixed LO Measurements" on page 90 for an example of this measurement. This shows how to make an LSB measurement. However, you need to change the settings and apply the appropriate filtering. For greater detail on this see "Measuring a Frequency Converting DUT" on page 82.

1 Click **Mode Setup** > *DUT Setup...* to access the DUT Setup menu. Set the values on the DUT Setup form as shown in the following table.

DUT	DownConv
System Downconverter	Disabled
Ext LO Frequency	Enter a value
Sideband	LSB, USB or DSB.
Frequency Context	IF Analyzer Input or RF DUT Input. This determines whether you specify the measurement frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input). See Frequency Context (below) for a more detailed description.
Diagram	Calibration or Measurement. This does not affect the measurement or calibration, but indicates how the noise source, the DUT and the N8201A should be set up.

Frequency Context

You can select whether to specify the frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input).

IF Analyzer Input: Specify the frequencies at the N8201A's input, that is, at the DUT output after downconversion has taken place.

Specify the start frequency and stop frequency by clicking the FREQUENCY/Channel key. The frequencies you specify are the frequencies at which the N8201A will make its measurements. These are the same frequencies that are shown on the results graph, in the results table, and on the results meter.

The RF start and RF stop frequencies are also displayed on the setup diagram. These are calculated from the specified IF start and IF stop frequencies, and the external LO frequency.

RF DUT Input: Specify the frequencies at the DUT input, that is, before downconversion has taken place.

Specify the start frequency and stop frequency by clicking Frequency Channel and entering the appropriate values. The frequencies you specify are the frequencies at the input to the DUT. These frequencies are then converted by the upconverter before being measured by the N8201A, and consequently do not represent the frequencies actually being measured by the N8201A.

The frequencies displayed on the results graph, in the results table, and on the results meter are the DUT input frequencies that you have specified. These displayed result frequencies do not represent the actual frequencies being measured by the N8201A.

The IF start and IF stop frequencies are also displayed on the setup diagram. These are calculated from the specified RF start and RF stop frequencies, and the external LO frequency.

NOTE

When making a DSB measurement with the Frequency Context set to RF DUT Input, (Mode Setup > DUT Setup > Freq Context > RF DUT Input) the frequencies you specify as the RF start and RF stop frequencies refer to the lower sideband only. There is no ambiguity when making USB or LSB measurements, or when specifying frequencies at the N8201A input, that is, with Frequency Context of IF Analyzer Input (Mode Setup > DUT Setup > Freq Context > IF Analyzer Input).

When making DSB measurements, it is important that the IF frequency is much smaller than the LO frequency. This is because the ENR values in the ENR table can only be applied to one frequency, which is the LO frequency. The ENR values can not be applied simultaneously to both the upper sideband and to the lower sideband. The ENR values are therefore applied to the midpoint between the upper sideband and the lower sideband, and this equates to the LO frequency.

Consequently, the higher the IF frequency is in comparison to the LO frequency, the further apart the upper and lower sidebands will be. The further these upper and lower sidebands are from the LO frequency, the less accurate will the ENR value be.

Another potential source of error is the frequency response of the DUT. If the frequency response varies over the measurement range, from lower to upper frequency, the noise figure results will only represent an average value.

It is recommended for greatest accuracy that the IF frequency be no greater than 1% of the LO frequency when making double sideband measurements. When making a swept measurement, no frequency in the swept frequency band should exceed 1% of the LO frequency.

Filtering is needed to remove the unwanted sideband when making single-sideband measurements. Filtering is also needed to filter out any LO leakage in the IF path. Ideally any filters should be included in the calibration path. However, if they are not in the path, you can enter loss compensation to account for any additional error.

The N8201A has a 3.0 GHz low pass filter which needs to be taken into account when planning the filter requirements during measurement and calibration.

Frequency Up Converting DUT

In this mode, the DUT contains a frequency up converting device, for example, a mixer used in the transmit path of a radio.

Making this measurement, the external Local Oscillator (LO) remains locked at one frequency and the Noise Figure measurement personality does the sweeping. It is not possible to control a variable frequency on the external LO.

Filtering is needed to remove the unwanted sideband when making single-sideband measurements. Filtering is also needed to filter out any LO leakage in the IF path. Ideally any filters should be included in the calibration path. However, if they are not in the path, you can enter loss compensation to account for any additional error.

The N8201A has a 3.0 GHz low pass filter which needs to be taken into account when planning the filter requirements during measurement and calibration.

Variable IF Fixed LO (equivalent to Mode 1.4 with SUM Sideband on an 8970B Noise Figure Meter)

This is an overview of the key presses needed to set up this type of measurement. For further details on frequency restrictions, see “Frequency Restrictions" on page 104.

For an example of this measurement, see“Fixed LO Measurements" on page 90. This shows you how to make an LSB measurement. However, you need to change the settings and apply the appropriate filtering.

1 Click **Mode Setup** > *DUT Setup...* to access the DUT Setup form.

2 Set the values on the DUT Setup form as shown in the following table.

DUT	UpConv
System Downconverter	Disabled
Ext LO Frequency	Enter a value
Sideband	LSB or USB
Frequency Context	IF Analyzer Input or RF DUT Input. This determines whether you specify the measurement frequencies at the DUT input (RF DUT Input) or at the N8201A’s input (IF Analyzer Input). See Frequency Context (below) for a more detailed description.
Diagram	Calibration or Measurement. This does not affect the measurement or calibration, but indicates how the noise source, the DUT and the N8201A should be set up.

Frequency Context

Select whether to specify the frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input).

IF Analyzer Input: Specify the frequencies at the N8201A RF input, that is, at the DUT output after up conversion has taken place.

Specify the start frequency and stop frequency by clicking FREQUENCY Channel. The frequencies you specify are the frequencies at which the N8201A will make its measurements. These are the same frequencies that are shown on the results graph, in the results table, and on the results meter.

The RF start and RF stop frequencies are also displayed on the setup diagram. These are calculated from the specified IF start and IF stop frequencies, and the external LO frequency.

RF DUT Input: Specify the frequencies at the DUT input, that is, before up conversion has taken place.

Specify the start frequency and stop frequency by clicking FREQUENCY Channel. The frequencies you specify are the frequencies at the input to the DUT. These frequencies are then converted by the upconverter before being measured by the N8201A, and consequently do not represent the frequencies actually being measured by the N8201A.

The frequencies displayed on the results graph, in the results table, and on the results meter are the DUT input frequencies that you have specified. These displayed result frequencies do not represent the actual frequencies being measured by the N8201A.

The IF start and IF stop frequencies are also displayed on the setup diagram. These are calculated from the specified RF start and RF stop frequencies, and the external LO frequency.

System Downconverter

The DUT is a non-frequency converting device (for example an amplifier or filter) and its frequency is higher than the N8201A's measurement range. Frequency down conversion is required within the measurement system, using a mixer external to the DUT, to convert the signal of interest to the frequency range of the N8201A.

Making this measurement, the external local oscillator (LO) remains locked at one frequency and the Noise Figure measurement personality executes the sweeping. It is not possible to control a variable frequency on the external LO.

Filtering is needed to remove the unwanted sideband when making single-sideband measurements. Filtering is also needed to filter out any LO leakage in the IF path. Ideally any filters should be included in the calibration path. However, if they are not in the path, you can enter loss compensation to account for any additional error.

The N8201A has a 3.0 GHz low pass filter which needs to be taken into account when planning the filter requirements during measurement and calibration of any measurement made at or below 3 GHz.

Fixed LO Variable IF (equivalent to Mode 1.2 on an 8970B Noise Figure Meter)

This is an overview of the key sequences needed to set up this type of measurement. See "Frequency Restrictions" on page 104 for the restrictions applicable to this measurement. See "Measurements with a System Downconverter" on page 97 for an example of this type of measurement. You will need to change the settings and apply the appropriate filtering. For greater detail on this, see "Measuring a Frequency Converting DUT" on page 82.

1 Click **Mode Setup** > *DUT Setup...* to access the DUT Setup form.

2 Set the values on the DUT Setup form as shown in the following table.

DUT	Amplifier
System Downconverter	On
Ext LO Frequency	Enter a value
Sideband	LSB, USB or DSB
Frequency Context	IF Analyzer Input or RF DUT Input. This determines whether you specify the measurement frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input). See Frequency Context (below) for a more detailed description.
Diagram	Calibration or Measurement. This does not affect the measurement or calibration, but indicates how the noise source, the DUT and the N8201A should be set up.

Frequency Context

Select whether to specify the frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input).

IF Analyzer Input: Specify the frequencies at the N8201A's input, that is, at the DUT output after up conversion has taken place.

Specify the start frequency and stop frequency by clicking **Frequency Channel**. The frequencies you specify are the frequencies at which the N8201A will make its measurements. These are the same frequencies that are shown on the results graph, in the results table, and on the results meter.

The RF start and RF stop frequencies are also displayed on the setup diagram. These are calculated from the specified IF start and IF stop frequencies, and the external LO frequency.

RF DUT Input: Specify the frequencies at the DUT input, that is, before up conversion has taken place.

Specify the start frequency and stop frequency by clicking **Frequency Channel**. The frequencies specified are the frequencies at the input to the DUT. These frequencies are then converted by the upconverter before being measured by the N8201A, and consequently do not represent the frequencies actually being measured by the N8201A.

The frequencies displayed on the results graph, in the results table, and on the results meter are the DUT input frequencies that you have specified. They are also used to determine the ENR values used in the calculations. These displayed result frequencies do not represent the actual frequencies being measured by the N8201A.

The IF start and IF stop frequencies are also displayed on the setup diagram. These are calculated from the specified RF start and RF stop frequencies, and the external LO frequency.

When making a DSB measurement with RF DUT Input, the frequencies you specify as the RF start and RF stop frequencies refer to the LSB only. There is no ambiguity when making USB or LSB measurements, or when specifying frequencies at the N8201A input. That is, with Frequency Context of IF Analyzer Input (Mode Setup > DUT Setup > Freq Context > IF Analyzer Input).

When making DSB measurements, it is important that the IF frequency is much smaller than the LO frequency. This is because the ENR values in the ENR table can only be applied to one frequency or, in the case of a swept measurement, to one set of frequencies. The ENR values can not be applied simultaneously to both the upper sideband and to the lower sideband. The ENR values are therefore applied to the midpoint between the upper sideband and the lower sideband, and this equates to the LO frequency.

Consequently, the higher the IF frequency is in comparison to the LO frequency, the further apart the upper and lower side bands will be. The further these upper and lower sideband are from the LO frequency, the less accurate will the ENR value be.

Another potential source of error is the frequency response of the DUT. If the frequency response varies over the measurement range, from lower to upper frequency, the noise figure results will only represent an average value.

It is recommended for greatest accuracy that the IF frequency be no greater than 1% of the LO frequency when making double sideband measurements. When making a swept measurement, no frequency in the swept frequency band should exceed 1% of the LO frequency.

Comparison of the 8970B, the NFA Analyzer and the Option 219 Noise Figure Measurement Application

Table 7 shows the relationship between the 8970B noise figure analyzer and the N8201A Noise Figure Measurement application.

Table 7 8970B / NFA / Option 219 Measurement Cross Reference

8970B	NFA Series	N8201A Option 219
Mode 1.1: Swept LO	System Downconverter Fixed IF Variable LO	Not supported
Mode 1.2: Fixed LO	System Downconverter Variable IF Fixed LO	System downconverter Fixed LO
Mode 1.3: Swept LO	Down converting Fixed IF Variable LO	Not supported
Mode 1.4: Fixed LO	Down converting Variable IF Fixed LO	DUT = Downconv Fixed LO
Mode 1.3 with SUM Sideband: Swept LO	Up converting Fixed IF Variable LO, USB	Not supported
Mode 1.4 with SUM Sideband: Fixed LO	Up converting Variable IF Fixed LO, USB	DUT = Upconv Fixed LO Side band = USB

Choosing and Setting Up the Local Oscillator

Selecting a Local Oscillator for Extended Frequency Measurements

Because of reciprocal mixing, noise components in the LO are converted into the IF band applied to the N8201A. This converted LO noise causes the measured noise figure to be higher than the noise figure of the mixer.

If the mixer is to be used with a particular LO in its final application, its noise figure should be measured with the same LO. The measurement then gives the noise figure for the combination of extended frequency device and LO in the final system.

For testing of extended frequency measurements, the LO must have a low noise floor over frequencies equal to the LO ± IF. It is also important that the LO has low broadband noise because any noise at the IF frequency will pass through to the IF and distort the results.

Effect of high LO spurious signals and noise on mixer measurements with low L-to-I rejection.

The spurious level of the LO also has to be low. At frequencies where there is a high spurious signal, the noise figure measured will have a peak at that IF. For example, ideally the LO’s noise, including spurious, needs to be below –90 dBm. If a mixer has higher isolation, then the noise of the LO can be higher since the mixer will be better able to reject the LO’s noise.

This is especially necessary if the mixer has a poor balance, or L-to-I isolation. With low isolation, the mixer is more likely to pass the LO noise through and thus increase the measured noise figure.

L-to-I rejection is the mixer’s ability to reject the fundamental, harmonics and spurious signals of the LO, and not allow them to pass through to the IF output.

Selecting a Local Oscillator

Here are several criteria that must be met when choosing the LO:

- It should have a frequency appropriate to the DUT’s frequency range, IF range, and sideband chosen.
- It should have sufficient power to drive mixers (typically, +7 dBm)
- It should have excellent frequency accuracy and repeatability (typically, the same as the N8201A.)

The last point, frequency accuracy, deserves further comment. There are three frequency-dependent components in a noise figure measurement that must all be aligned to make an accurate measurement at the IF. The need for frequency accuracy is the main reason for recommending a synthesized source for the LO, such as the Agilent 83712B synthesized CW generator.

Other LOs may be used, but should be tested to determine that their noise is sufficiently low, as LO noise can cause an increase in noise figure for the mixer/LO combination, and calibration of the system may not be possible. A broadband, high gain amplifier at the LO output usually generates unacceptable noise. This is almost always the case when a heterodyne-type sweep oscillator or signal generator is used.

When making DSB measurements, it is important that the IF frequency is much smaller than the LO frequency. This is because the ENR values in the ENR table can only be applied to one frequency or, in the case of a swept measurement, to one set of frequencies. The ENR values can not be applied simultaneously to both the upper sideband and to the lower sideband. The ENR values are therefore applied to the midpoint between the upper sideband and the lower sideband, and this equates to the LO frequency.

Consequently, the higher the IF frequency is in comparison to the LO frequency, the further apart the upper and lower sidebands will be. The further these upper and lower sidebands are from the LO frequency, the less accurate will the ENR value be.

Another potential source of error is the frequency response of the DUT. If the frequency response varies over the measurement range, from lower to upper frequency, the noise figure results will only represent an average value.

It is recommended for greatest accuracy that the IF frequency be no greater than 1% of the LO frequency when making double sideband measurements. When making a swept measurement, no frequency in the swept frequency band should exceed 1% of the LO frequency.

Connecting the System

Figure 24 shows the connection diagram options you use to calibrate the N8201A with Option 219, and after calibration, to measure a DUT, whether it is a downconverter, an upconverter, amplifier, or a filter. It does not show where to place a filter to remove any unwanted sideband or input noise.

Setting Up the Noise Figure Analyzer

You can connect the 10 MHz timebase references, thus locking the N8201A and the LO to the same frequency reference.

1 Click **System** > *Reference*, and check that 10 MHz Out is set to On.

2 Connect the N8201A 10 MHz OUT to the 10 MHz Ref In of the LO.

To connect the 10 MHz reference output from the LO to the N8201A, ensure that External Reference is selected.

1 Click **System** > *Reference* and check that Freq Ref is set to 10 MHz and to Ext.

2 On the N8201A connect the 10 MHz Ref Out of the LO to the EXT REF IN.

To connect the N8201A and make your measurements:

1 Turn the N8201A on and click **Preset** to return the N8201A to a known state. Go into the Noise Figure mode if the preset is not set to *Mode*.

2 Enter the ENR values in to the N8201A. Refer to“Entering Excess Noise Ratio (ENR) Data" on page 19.

3 Follow the procedure to calibrate the system, and measure the DUT.

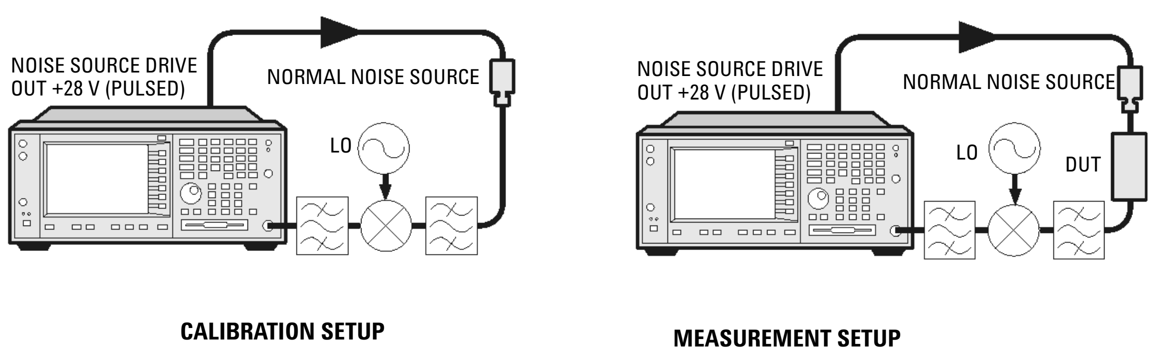


Figure 24 Setting Up a N8201A for Frequency Converting DUT Measurement

Measuring a Frequency Converting DUT

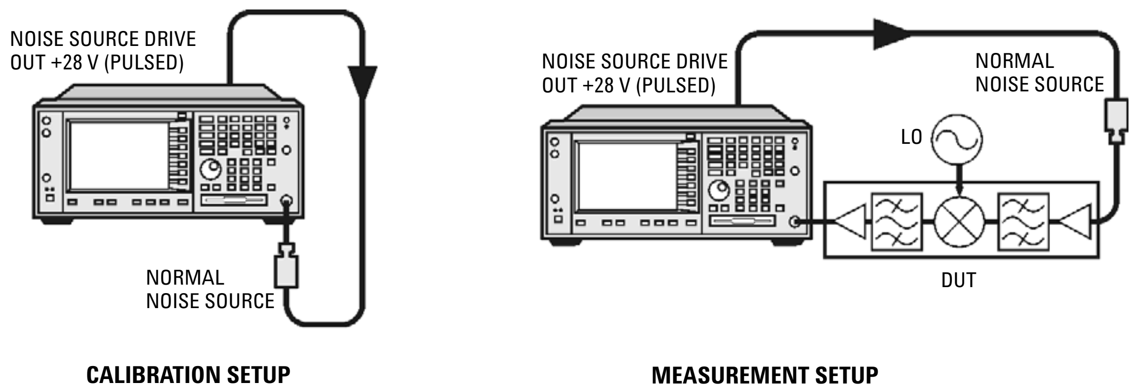


Figure 25 Frequency Converting DUT Measurement

In this measurement, the DUT performs frequency conversion in the measurement setup. However, there is no frequency conversion in the calibration setup, as is shown in Figure 25. The purpose of the calibration setup is to allow the N8201A to measure its own noise figure and sensitivity with the noise source. This must be performed across the frequency range to which the N8201A will tune when performing the measurement.

For both calibration and for measurement, a normal noise source must be connected to the NOISE SOURCE DRIVE OUT+28 V (PULSED) on the front panel of the N8201A.

The LO frequency reference may be connected to the 10 MHz OUT on the N8201A. This locks the LO and the N8201A together for greater measurement accuracy.

For these measurements click **Mode Setup** > *DUT Setup...* and set the following parameters:

DUT	Upconv or Downconv
System Downconverter	Not accessible
Ext LO Frequency	Enter a value for the LO's frequency
Sideband	LSB, USB or DSB (Downconverters only)
Frequency Context	IF Analyzer Input or RF DUT Input. This determines whether you specify the measurement frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input). See Frequency Context (below) for a more detailed description.
Diagram	Calibration or Measurement. This does not affect the measurement or calibration, but indicates how the noise source, the DUT and the N8201A should be set up.

Frequency Context

You can select whether to specify the frequencies at the DUT input (RF DUT Input) or at the N8201A's input (IF Analyzer Input).

IF Analyzer Input: Specify the frequencies at the N8201A's input, that is, at the DUT output after up conversion has taken place.

Specify the start frequency and stop frequency by clicking FREQUENCY Channel. The frequencies you specify are the frequencies at which the N8201A will make its measurements. These are the same frequencies that are shown on the results graph, in the results table, and on the results meter. When the measurement is made, the N8201A calculates the input frequency to the DUT, and using the appropriate values from the noise source ENR table, interpolates as necessary and measures the DUT.

The RF start and RF stop frequencies are also displayed on the setup diagram. These are calculated from the specified IF start and IF stop frequencies, and the external LO frequency.

RF DUT Input: Specify the frequencies at the DUT input, that is, before up conversion has taken place.

Specify the start frequency and stop frequency by clicking FREQUENCY Channel. The frequencies you specify are the frequencies at the input to the DUT. These frequencies are then converted by the upconverter before being measured by the N8201A, and consequently do not represent the frequencies actually being measured by the N8201A. When the measurement is made, the N8201A calculates the input frequency to the N8201A, and using the appropriate values from the noise source ENR table, interpolates as necessary and measures the DUT.

The frequencies displayed on the results graph, in the results table, and on the results meter are the DUT input frequencies that you have specified. These displayed result frequencies do not represent the actual frequencies being measured by the N8201A.

The IF start and IF stop frequencies are also displayed on the setup diagram. These are calculated from the specified RF start and RF stop frequencies, and the external LO frequency.

When making a double sideband (DSB) measurement with Frequency Context set to RF DUT Input, (Mode Setup > DUT Setup > Freq Context > RF DUT Input) the frequencies you specify as the RF start and RF stop frequencies refer to the lower sideband only.

The Upconverter and Downconverter modes include any DUT that performs frequency conversion, whether a simple single mixer or a complex receiver structure.

Sidebands and Images

For any measurement involving frequency conversion, you need to consider the exact frequency ranges involved, and make decisions about the filtering requirements for the specific measurement. For example, there may be several different methods of measuring a mixer, and the method chosen may be set by the choice of available filters.

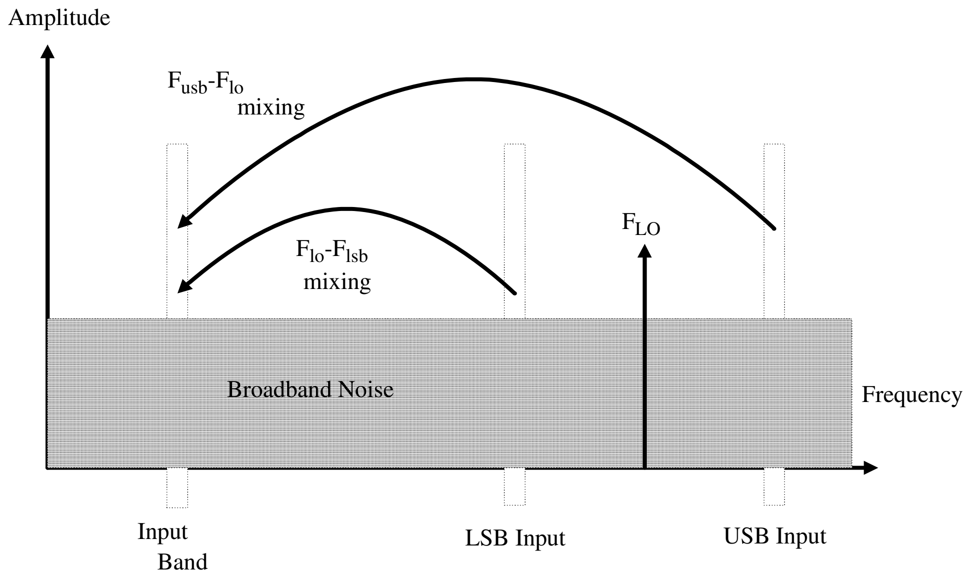


Figure 26 Sidebands and Images with Down Conversion

Simple, ideal, mixers output signals on both the sum and difference of their RF and LO frequencies. Hence, for a fixed output frequency and a fixed LO frequency, there are two different input frequencies that are converted to the output frequency. This is shown in Figure 26.

The noise sources used in noise figure measurements are broadband. When using a downconverter, there is a probability that noise will be presented to a simple mixer in both the upper and lower input frequency bands that are converted into the same IF output band to which the N8201A is tuned. The N8201A receives mixer-created noise from the two frequency bands which are superimposed. The noise is random, and hence the two power levels combine by simple addition. Similarly, the N8201A receives noise-source-created noise from the two frequency bands combined as added power. Any measurement where two mixing products are combined like this is usually termed double sideband (DSB).

It is conventional to call the higher frequency band of an image pair the upper sideband (USB) and the lower frequency band of an image pair the lower sideband (LSB).

Non-ideal mixers exhibit some unwanted behaviors:

- Some of the input signal leaks directly to the output.
- Some of the LO signal, and its harmonics, leak directly to the output.
- Mixing products are created between the input signal and the harmonics of the LO.

There are other unwanted products involving input signal harmonics, but these tend to be less troublesome than those above, provided the mixer is operated at a level within its linear range.

Signal Leakage

Direct signal leakage of input signal through to a mixer's output can occur, because the noise sources cover a broad frequency range. Signal leakage is not normally a problem unless the noise source has a large variation in ENR, or the mixer's RF-to-IF leakage is high.

LO Leakage

The LO power is normally greater than the largest input signal that a mixer is intended to operate with. The LO power leaking from the mixer's output is at a high level compared to the signal levels involved in the noise figure measurement. Hence, LO leakage needs to considered when measuring noise figure of a frequency converting DUT.

If the LO frequency is low enough to be passed by the input filter of the N8201A's RF section (a 3.0 GHz low pass filter), the LO leakage can prevent successful measurement of the DUT noise figure. Desensitization by LO leakage can be avoided by adding a filter between the DUT and the N8201A to remove the LO frequency component.

Low pass filters with cutoffs at low frequencies, may exhibit spurious resonances and leakage at low microwave frequencies. It may be necessary to use a pair of low pass filters, one microwave, one RF, in order to assure a stopband attenuation over a wide frequency range.

LO Harmonics

Many mixers are operated by sinusoidal LO signals. LO harmonics can be formed in the mixer at significantly high levels. It is common for the specified LO input level for a diode mixer to be chosen to operate the diodes between saturation and off conditions, hence making the mixer act as a switch. LO harmonic derived products from industry standard double-balanced mixers may be similar in level to what they would have been with a square-wave LO signal. Instead of just being sensitive at one pair of frequencies $[F_{LO} \pm F_{IF}]$, the mixer input is sensitive at a series of pairs:

$$[F_{LO} \pm F_{IF}] + [2F_{LO} \pm F_{IF}] + [3F_{LO} \pm F_{IF}] + [4F_{LO} \pm F_{IF}] + [5F_{LO} \pm F_{IF}] + \ldots$$

Filtering is needed to eliminate the noise input to the DUT at these higher order frequencies. However, their frequencies may be great enough that the mixer attenuates them, making them insignificant.

Single Sideband Measurements

Most mixer applications involve single sideband (SSB) mixing - either LSB or USB, hence it is ideal to make noise figure measurements on a mixer in the circumstances in which it is used. Making an SSB measurement requires suitable filters to remove the unwanted image, any LO leakage, and other unwanted mixer products. This may require filters that are not readily available, or that are expensive, and a DSB measurement may be chosen as a compromise when measuring a downconverter or using the System Downconverter. There is no general guidance on what filtering is needed. Each case needs individual consideration.

Items to be considered are:

- Decide the frequency ranges that must be covered; Input, LO, and Output.
- Calculate the frequency range that the unwanted image will cover.
- Calculate the frequency range that the LO harmonic modes will cover.
- Choose a filter to go between the noise source and the DUT, that will pass the wanted input band and stop the unwanted input bands.
- Consider the LO frequency range (and harmonics), and whether or not a filter is needed to protect the N8201A input from being desensitized by LO leakage in the 0 - 3.5 GHz range.
- Choose a filter, if necessary, to go between the DUT and the N8201A.

If any of these ranges conflict, making the filter requirements impossible, the measurement could be split into a group of smaller ranges, with different filters for each.

If the DUT is a complicated mixer, it may already contain filters to operate the mixer in single sideband mode over the frequency range of interest. A mixer in its final application exhibits the same problems that make noise figure measurement difficult, hence the application will need similar filtering to that needed during noise figure measurement.

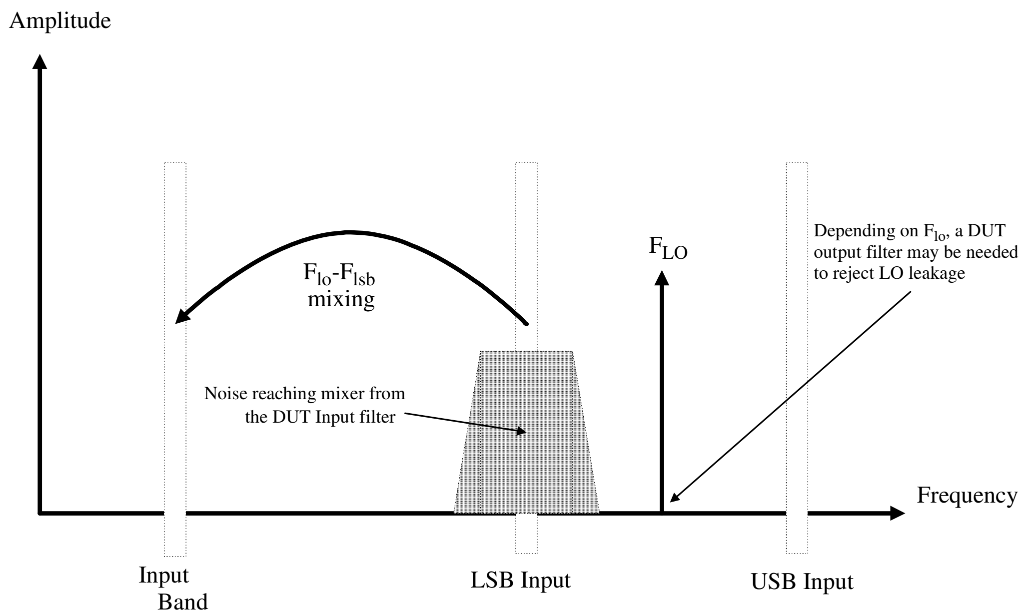


Figure 27 Single Sideband Mixer Measurements

Figure 27 shows an SSB mixer measurement (Downconverter, LSB) where a filter makes it single sideband. If the IF frequency is lowered, the N8201A is tuned to a lower frequency, and the USB and LSB bands will move closer to the LO frequency. This makes filtering more difficult. If the IF is lowered further, a point is reached where filtering is not possible and SSB measurements cannot be made. The width of the filter limits where the LO or IF frequencies sweep to make a measurement.

The N8201A performs frequency calculations and controls the frequency for a variety of mixer modes. However, you have to determine the filter requirements, and provide those filters in the measurement setup.

'Downconverter' means that the output frequency, (IF) is lower than the input, (RF).

'Upconverter' means that the output frequency, (IF) is higher than the input (RF).

The N8201A can handle SSB mixer measurements in modes defined by the following combinational choices:

- DUT: Upconverter, Downconverter, or Amplifier with System Downconverter On.
- Sideband: LSB or USB.

Double Sideband Measurements

Double sideband (DSB) measurements can only be made when the DUT is a downconverter, or when the DUT is an amplifier and the system downconverter is On. DSB techniques can be useful when making noise figure measurements under the following conditions:

- When adequate filters for image-free SSB measurements are not available.
- When frequency ranges have to be covered that make SSB filters impractical or impossible.

DSB measurements do not eliminate the need for filtering. However, they can greatly simplify the filtering needed. This benefit is achieved at the loss of frequency resolution.

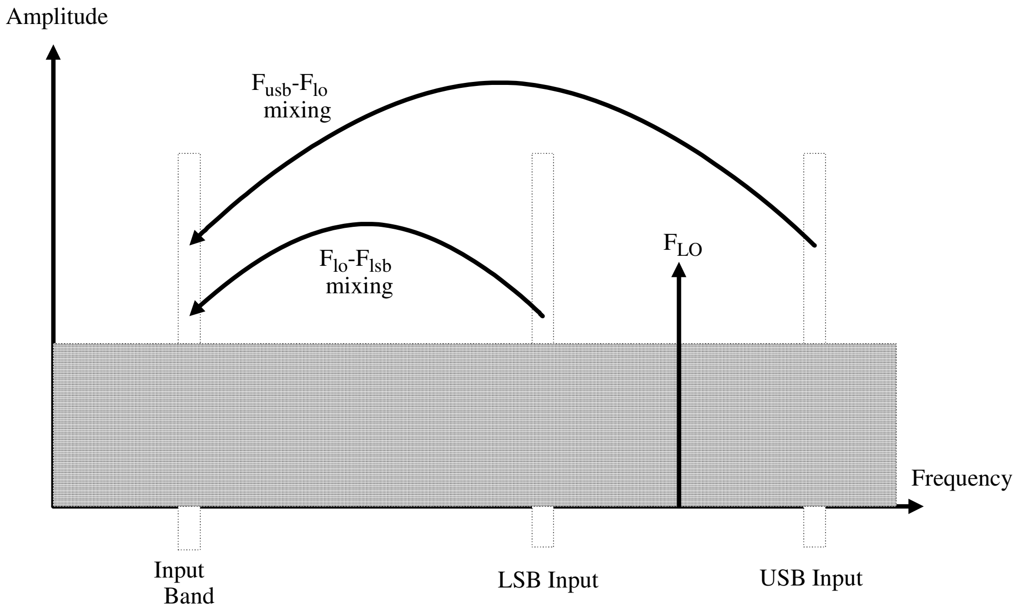


Figure 28 Double Sideband Measurements

Figure 28 shows a double sideband, downconversion, mixing. Noise from two separated RF bands are mixed into the IF band, where the power addition takes place.

DSB measurements are made with the noise from a pair of separate bands, symmetrically arranged about the LO frequency. The IF frequency value should be low, ideally no larger than 1% of the LO frequency. As the two sidebands, the USB and the LSB, are generated at frequencies equal to LO±IF. This technique maintains the two bands close together. This is necessary because the assumption is made that the variations in noise source ENR, gain, and noise figure are constant between the two bands. ENR values are applied to the mid-point between the upper and lower sidebands, and this equates to the frequency of the LO.

Figure 28 shows that noise from two bands are combined during the measurement. During calibration, when the DUT was not connected, only one band (at the IF frequency) was used.

If the assumptions about the parameters being flat over frequency between the two sidebands are valid, your results will show a doubling in power (3 dB increase) in noise level during the measurement of any down converting DUTs. There is also a doubling of measured power when using the System Downconverter, but compensation is not required because the calibration power is also doubled.

This 3 dB increase in measured power with down converting DUTs can be corrected using the Loss Compensation Setup menu

1 Click Input/Output > *Loss Comp.*
2 Click *Loss Compensation Before DUT* and set to *Fixed.*
3 Enter a Fixed Value of –3 dB.
4 Click *Loss Comp Before Temp* to set the noise source's cold temperature.

The DSB power addition occurs for both the hot and cold noise from the noise source, and the noise created in the input of the DUT. A temperature value can be assigned to this loss using Loss Comp Before Temp. Using the cold temperature of the noise source (often assumed to be 290 Kelvin) corrects for this, and the N8201A will give corrected results comparable to those that would have been given by an SSB measurement.

DSB measurements are not appropriate for making measurements where DUT performance, or noise source ENR, have significant variation over the frequency range $[F_{LO} \pm F_{IF}]$.

When making a DSB measurement with Frequency Context set to RF DUT Input (Mode Setup > DUT Setup > Freq Context > RF DUT Input), the frequencies you specify as the RF start and RF stop frequencies refer to the LSB only.

LO Leakage (with specific DSB information)

LO leakage is a problem when working in the 200 kHz to 3 GHz range. It can be avoided by tuning the LO to frequencies greater than 3.5 GHz. Above 3.0 GHz, the N8201A's input filter progressively attenuates the LO signal. For a DSB downconverter measurement with the LO frequency below 3.5 GHz, a low pass filter will be needed. The cutoff frequency must be chosen to pass the IF frequency of the measurement. The amount of attenuation over the LO frequency range has to be sufficient to reduce the LO leakage down to the broadband (10.0 MHz - 3 GHz) noise level presented to the N8201A input.

With most DSB downconverter measurements, the IF is made low, with respect to, the RF and LO frequencies, so filter needs are not complex.

Low pass filters with cutoffs at low frequencies, may exhibit spurious resonances and leakage at low microwave frequencies. It may be necessary to use a pair of low pass filters, one microwave, one RF, in order to assure a stopband attenuation over a wide frequency range.

LO Harmonics (with specific DSB information)

Many mixers have product pairs associated with harmonics of the LO. Depending on the mixer, these could be at a sufficient level to distort the measured noise figure results. To avoid this, insert an input filter between the noise source and the DUT. A high pass filter may also be needed in this location if signal leakage is a problem.

There is no general guidance on what filtering is needed. Each case needs individual consideration:

- Decide the frequency ranges that have to be covered; Input, LO, and Output.
- Calculate the frequency range that the LO harmonic modes will cover.
- If LO harmonic related products are a problem, choose a filter to go between the noise source and the DUT, that will pass the wanted input band and stop the LO harmonic modes. If the frequency ranges are wide, the measurement may have to be split into frequency ranges with different filters for each.
- Consider the LO frequency (and harmonics). Is a filter needed to protect the N8201A input being desensitized by LO leakage in the 0 to 3.5 GHz range?
- Choose a filter, if necessary, to go between the DUT and the N8201A.

The N8201A can handle DSB mixer measurements when using a downconverter, or when the System Downconverter is On.

Fixed LO

As the LO frequency is fixed, there is no sweep at the DUT input. This means that as the two sideband input pairs diverge, their average remains fixed. This feature can be useful for measuring a complex DUT where the effect of variation of performance of the post-mixer stage over IF frequency is of interest.

Because the LO frequency is held constant, it is the IF frequency at the N8201A input that is swept. Figure 29 illustrates this mode.

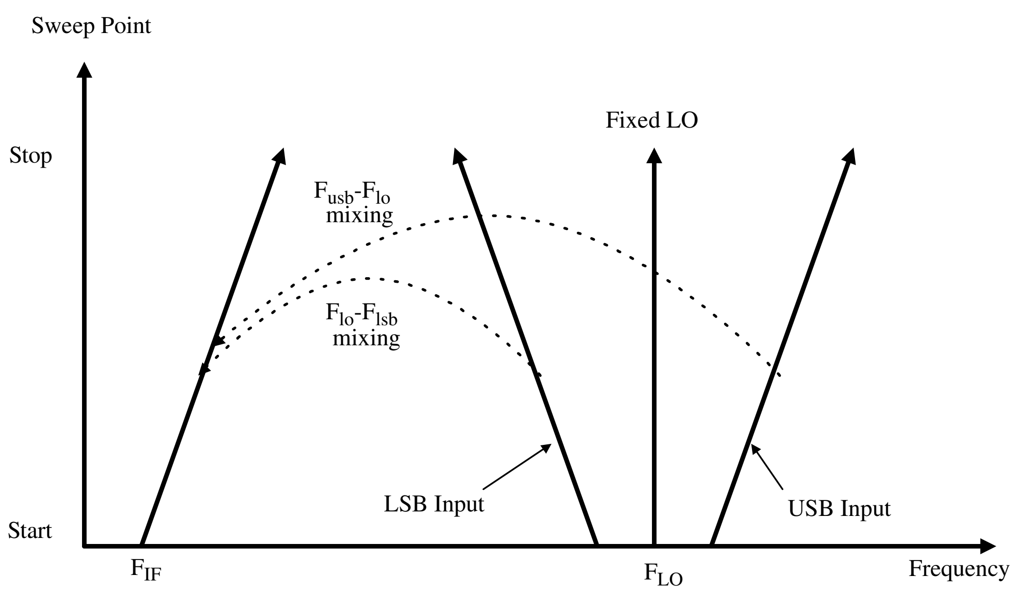


Figure 29 Fixed LO Measurements

Making Frequency Converting DUT Measurements

An example is provided on the following pages using the N8201A to make a fixed frequency measurement. The LO is locked at a specified frequency, and a lower sideband (LSB) measurement of a mixer is made. The example can be modified to make measurements where the IF is swept. Also, from the example, upper and double sideband measurements can be made. The changes in the example's procedure are explained in each case.

Calibration of the measurement system is similar to a basic calibration, the noise source is connected directly to the RF input of the N8201A and a calibration is made. The DUT is then placed between the noise source and the N8201A, and a corrected measurement is made.

The RF input section on the N8201A has a built-in 3.0 GHz low pass filter. This filter needs to be accounted for when planning the filter requirements during calibration and measurement.

Making Down Converting DUT Measurements using a Fixed LO and Fixed IF (Equivalent to Mode 1.4 on an 8970B Noise Figure Analyzer)

Both double and single sideband measurements may be made in this mode. This measurement may be useful to choose the optimum IF for a mixer or receiver, or to measure how a mixer's or a receiver's noise figure and gain vary with IF.

Lower Sideband Measurement

A signal generator is used to supply an LO at 970 MHz. Setting the RF frequency of interest to 900 MHz, with the LO of 970 MHz provides an IF of 70 MHz. This also meets with the need to maintain the LO frequency out of the N8201A's passband. See Figure 30.

In the example, a 900 MHz band pass filter is used between the noise source and the DUT to remove the upper sideband. (see Figure 30).

A 70 MHz band pass filter is used between the DUT and the N8201A to remove all signals except the 70 MHz signal in which we are interested.

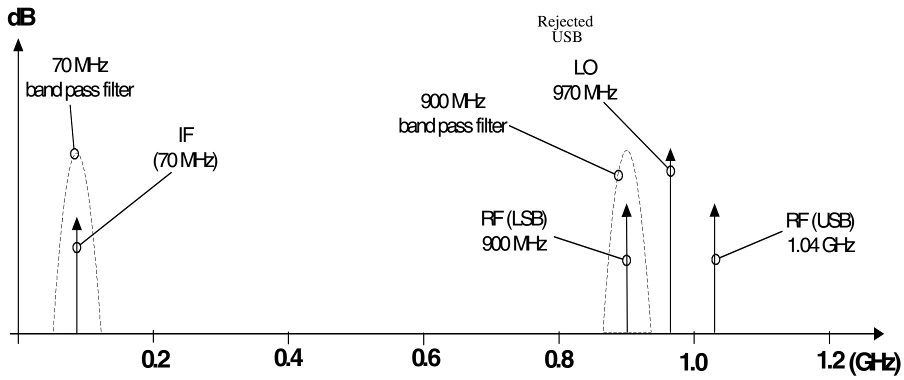


Figure 30 Fixed LO (970 MHz) and Fixed IF (70 MHz), LSB Spectrum

Initial Setup Procedure

Follow the overview procedure of the initial set up.

1 Power Up the N8201A and the LO. You need to wait for the recommended warm up time to get accurate measurement results.
2 Connect the 10 MHz reference, if required. see “Connecting the System" on page 81.
3 Load the ENR values for the chosen noise source. See “Entering Excess Noise Ratio (ENR) Data" on page 19 for more detail.
4 Set up the LO. See “Choosing and Setting Up the Local Oscillator" on page 79 for more detail.
5 Connect the system and add filtering where required. Figure 31 on page 93 shows the connections.

Setting Up the DUT

1 Click **Mode Setup** > *DUT Setup*.... The DUT Setup form is displayed. Confirm that the DUT field is set to *DownConv*.
2 Click *Ext LO Frequency* and use the keyboard to enter the LO frequency of 970 MHz. (Enter “M” as the units designator for megahertz.)
3 Click *Sideband* and choose the lower sideband by clicking *LSB*.
4 Click *Frequency Context* and select *IF Analyzer Input*. This means that we will specify the frequency at the analyzer’s input (70 MHz), and the RF frequency will be calculated by the noise figure application.

In this example measurement, 70 MHz bandpass and 200 MHz low-pass filters have been used between the DUT and the N8201A. These filters have been added at this calibration stage to remove any errors that they might contribute from the final result.

Setting Frequency, Frequency Mode, and Averaging

1 Click **FREQUENCY Channel**. Use the keyboard to specify the frequency mode and frequency parameters. In this example of a fixed frequency noise figure measurement on a downconverter, the appropriate settings are

- *Freq Mode*: *Fixed*
- *Fixed Freq*: *70 MHz*

There are two possible frequencies you can enter - the RF frequency (before down conversion) or the IF frequency (after down conversion). In this example, we previously specified that the Frequency Context was IF Analyzer Input, so a value of 70 MHz is used.

2 To configure the rest of the measurement, click **Meas Setup**. Use the keyboard to specify the remaining measurement parameters. In this example, the appropriate settings are:

- *Averaging*: ON (You can only set averaging to on for N8201A Option 110 instruments.)
- *Average Number*: *10*
- *Internal preamp*: *On*

Calibration of the Measurement Setup

Calibration of the setup for a noise figure measurement is specific to the frequency you have set. If you change the frequency after calibration, you will have to recalibrate the measurement.

To connect the noise source and N8201A for calibration, see Figure 31. Connect any After DUT filtering prior to calibration.

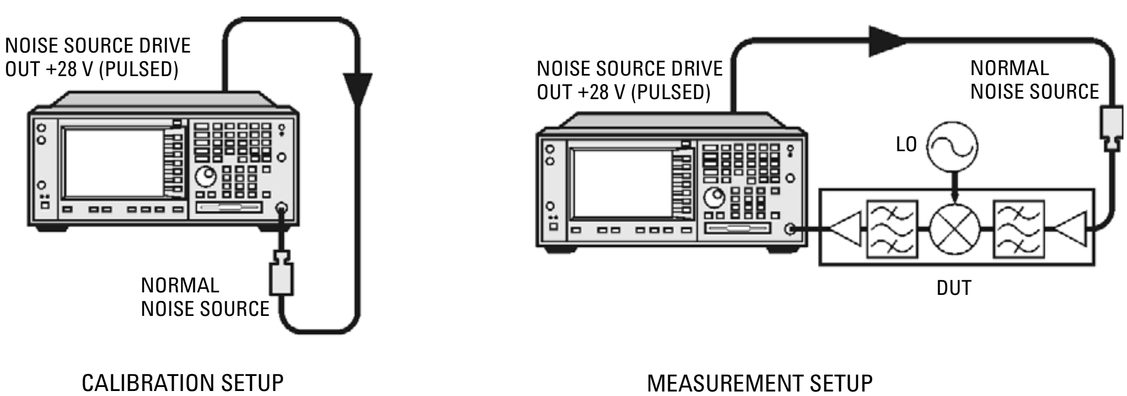


Figure 31 Frequency Converting DUT Calibration and Measurement

1 Click **Meas Setup** > *Calibrate*.

When calibration is complete the measurement system is calibrated at the mixer input. The red `Uncorr` text changes to green `Corr` text in the top right hand side of the display.

2 Click **Trace/View** > *View* > *Meter* to see the calibration results.

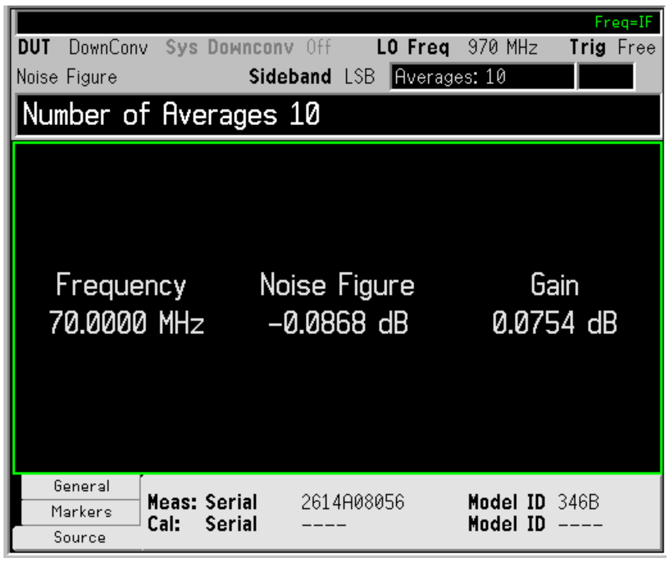


Figure 32 Typical Calibration Results

After calibration the instrument will not be jittering near 0 dB with no DUT inserted. This is because the instrument is now using the ENR value for the RF, while the input is tuned to the IF. When the DUT is added, the noise figure analyzer measures the noise figure of the DUT. If the configuration is arranged to reject one sideband, the SSB result is displayed. If both sidebands are converted by the mixer the DSB result is displayed.

Making the Corrected Noise Figure and Gain Measurement

A measurement corrected for the noise contributed by the N8201A may now be made. Insert the DUT into the system as shown in Figure 31.

1 Click **Trace/View** > > *View* > *Meter* to display the results. A typical display of noise figure and gain (conversion loss) is shown in Figure 33.

The filtering used for this example measurement comprised:

- 900 MHz bandpass filter between the noise source and the DUT
- 70 MHz bandpass and 200 MHz low-pass filters between the DUT and the N8201A

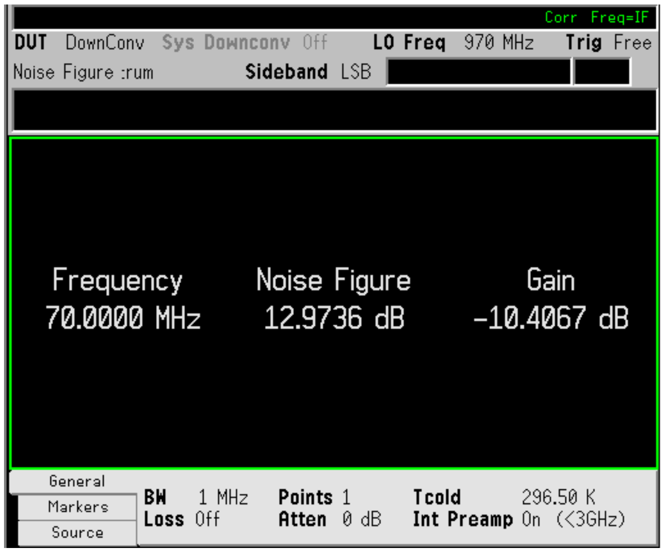


Figure 33 Typical Microwave Results

Once you have successfully made the measurement you may want to save the set up for future measurements. This can be done by saving the state. For more details, see the PSA Series Spectrum Analyzers User’s and Programmer’s Guide.

Upper Sideband Measurement

The USB measurement set up is similar to the LSB measurement procedure described in “Lower Sideband Measurement" on page 91. However, the filtering requirements will be different because the LSB has to be filtered out. Follow the LSB procedure, and in the DUT Setup... form select USB as the sideband option.

Double Sideband Measurement

The DSB measurement set up is similar to the LSB measurement procedure described in “Lower Sideband Measurement" on page 91. Follow the LSB procedure, and in the DUT Setup... form select the DSB as the sideband option.

If the assumptions about the parameters being flat over frequency between the two sidebands are valid, your results will show a doubling in power (3 dB increase) in noise level during a DSB measurement. This can be corrected using the Loss Compensation Setup screen

1 Click Input/Output > *Loss Comp.*
2 Click *Loss Compensation Before DUT* and set to *Fixed.*
3 Enter a Fixed Value of –3 dB.
4 Click *Loss Comp Before Temp* to set the noise source’s cold temperature.

The DSB power addition occurs for both the hot and cold noise from the noise source, and the noise created in the input of the DUT. A temperature value can be assigned to this loss using Loss Before Temp function. Using the *Cold* temperature of the noise source (often assumed to be 290 Kelvin) corrects for this, and the N8201A will give corrected results comparable to those that would have been given by an SSB measurement.

Making Up Converting DUT Measurements using a Fixed LO and Variable IF (Equivalent to Mode 1.4 with SUM on an 8970B Noise Figure Meter)

Lower Sideband Measurement

The lower sideband measurement set up is similar to the LSB measurement procedure described in “Lower Sideband Measurement" on page 91. However, with an up converting measurement, the RF is the lower frequency, and the IF is the higher frequency to which you will convert. Follow the LSB procedure, and in the DUT Setup... form ensure the LSB is the sideband option is selected, and select Upconv instead of Downconv as the DUT. The filtering requirements will be different as you need to remove the LO signal from the IF path.

Upper Sideband Measurement

The upper sideband measurement set up is similar to the LSB measurement procedure described in “Lower Sideband Measurement" on page 91. However, with an up converting measurement, the RF is the lower frequency, and the IF is the higher frequency to which you will convert. Follow the LSB procedure, and in the DUT Setup... form ensure the LSB is the sideband option is selected, and select Upconv instead of Downconv as the DUT. The filtering requirements will be different as you need to remove the LO signal from the IF path.

Measurements with a System Downconverter

A system downconverter can be thought of as a frequency extender for the N8201A, to allow measurements to be made on DUTs at frequencies the N8201A does not cover in its frequency range.

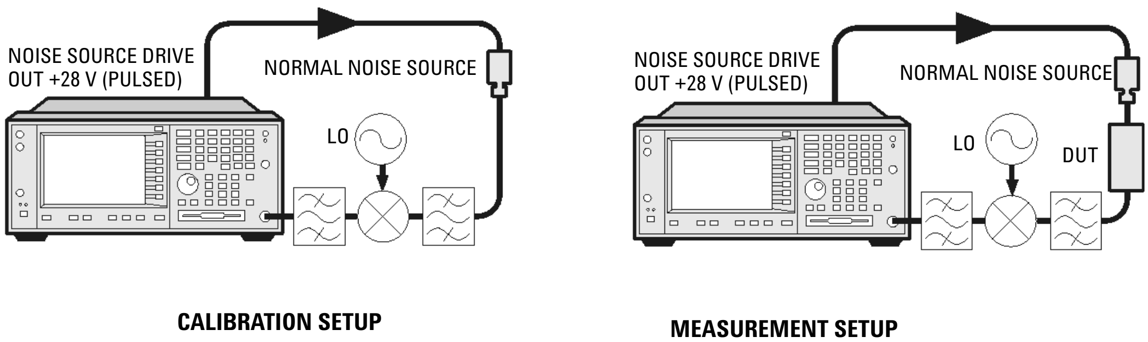


Figure 34 System Downconverter Calibration and Measurement

A system downconverter is part of the measuring system, and is present in both the calibration setup and the measurement setup (see Figure 34.) During calibration the noise performance of both the N8201A and the system downconverter are measured. Because of this, when corrected measurements are performed, the results then apply to the DUT only. ENR data for the same frequency range is used for both calibration and measurements

The N8201A has the capability to control a single frequency conversion, so system downconverter measurements under the N8201A's control are limited to non-frequency converting DUTs.

The N8201A can be used in much more complex systems, with multiple frequency conversions between the DUT and measurement system. However, the control of such systems is application-specific. You need to perform frequency calculations to suit that particular system, account for the effects of any DSB conversions, determine filter requirements, and calculate the appropriate ENR values for calibration and measurement.

USB, LSB or DSB?

If the DUT is broadband, a system downconverter could operate in USB, LSB, or DSB mode, and the same circumstances occur in both calibration and measurements, hence DSB sideband power addition corrections are not needed. Corrected measurements cancel any sideband summation effects.

If the DUT is narrowband and a DSB system downconverter is used, the calibration setup will operate in true DSB mode. However, the measurement setup mode will be influenced by the DUT's selectivity.

The possibilities fit into two groups and a third situation which should be avoided:

- The DUT bandwidth is much greater than the LSB-USB separation, so a normal DSB measurement results.
- The DUT bandwidth is much less than the LSB-USB separation, and the sweep width is less than the USB-LSB separation, so a SSB measurement results. This needs a gain correction factor due to the DSB calibration.

There is a third situation and this must be avoided. This is where the DUT selectivity can resolve the individual sidebands of the DSB measurement and the sweep is wide enough to scan the DUT across them. Different parts of the measurement plot are in different modes. USB, LSB and DSB could occur in different places on the same plot, with gradual changes between them, set by the shape of the DUT's frequency response. Variable gain correction would be needed across the plot and the corrections needed would change if adjustments to the DUT changed its shape.

Measurement Modes with a DSB System Downconverter

The N8201A only supports the use of a fixed LO, with any frequency sweeping being done by the N8201A. The benefits of a DSB measurement are minimal filter requirements, and wide frequency coverage. DSB measurements are appropriate for wideband DUTs. Their disadvantages, covered in "USB, LSB or DSB?" on page 97, make them inappropriate for narrowband DUTs. The usual aim is to choose as low a frequency IF as possible, in order to minimize the separation between the sidebands, and thus get the optimum resolution possible. Figure 35 shows this.

When making DSB measurements, it is important that the IF frequency is much smaller than the LO frequency. This is because the ENR values in the ENR table can only be applied to one frequency or, in the case of a swept measurement, to one set of frequencies. The ENR values can not be applied simultaneously to both the upper sideband and to the lower sideband. The ENR values are therefore applied to the midpoint between the upper sideband and the lower sideband, and this equates to the LO frequency.

Consequently, the higher the IF frequency is in comparison to the LO frequency, the further apart the upper and lower sidebands will be. The further these upper and lower sidebands are from the LO frequency, the less accurate will the ENR value be.

Another potential source of error is the frequency response of the DUT. If the frequency response varies over the measurement range, from lower to upper frequency, the noise figure results will only represent an average value.

It is recommended for greatest accuracy that the IF frequency be no greater than 1% of the LO frequency when making double sideband measurements. When making a swept measurement, no frequency in the swept frequency band should exceed 1% of the LO frequency.

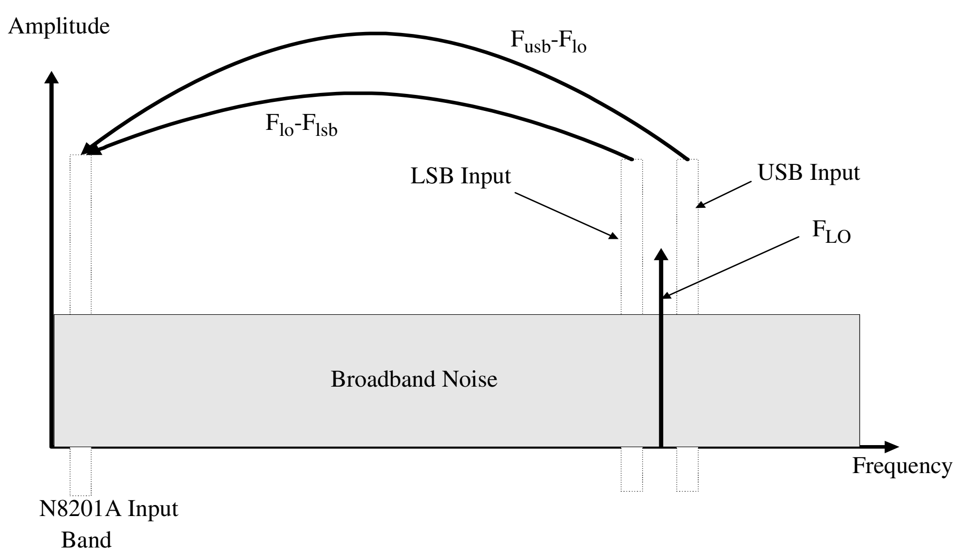


Figure 35 DSB System Downconverter Measurements

DSB system downconverter measurements have implicit linear averaging of DUT characteristics. The same ENR values are used for both the USB and LSB frequencies, and are taken from the average frequencies of the USB and the LSB. This corresponds to the LO frequency. Results returned are the average of the two sideband powers.

For microwave measurements, above 3.5 GHz, the N8201A's input filter will reject LO leakage from the downconverter, otherwise a filter is needed between the system downconverter and the N8201A. Also, considerations about mixer LO harmonic modes apply.

Measurement Modes with an SSB System Downconverter

The N8201A can perform frequency calculations for USB, for LSB, or for USB system downconverter conversions.

The filtering requirements will be measurement-specific.

Figure 36 shows how filtering makes an LSB measurement, and Figure 37 shows a USB downconversion measurement.

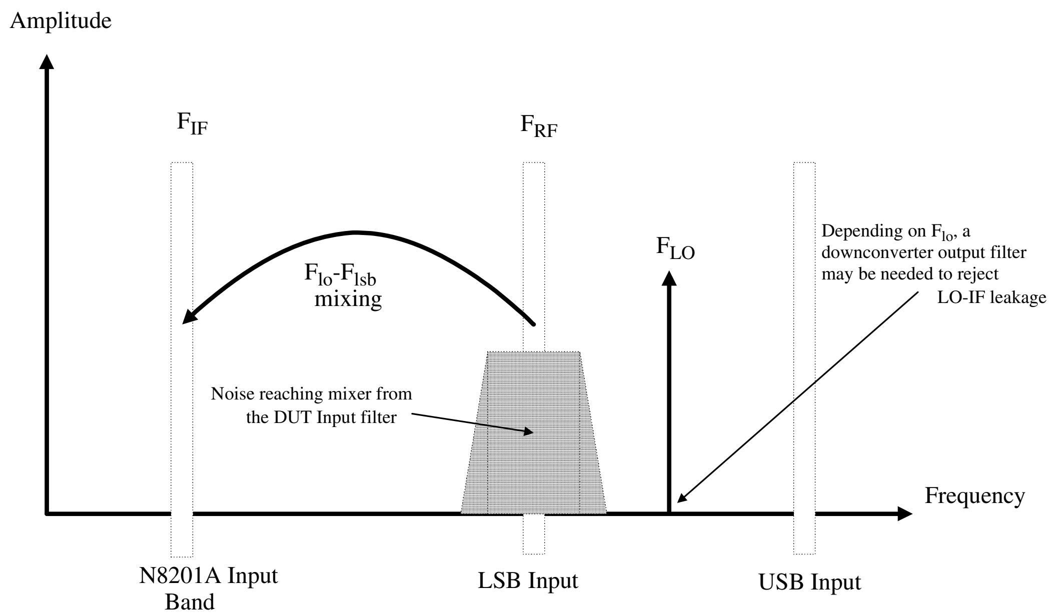


Figure 36 LSB System Downconverter Measurements

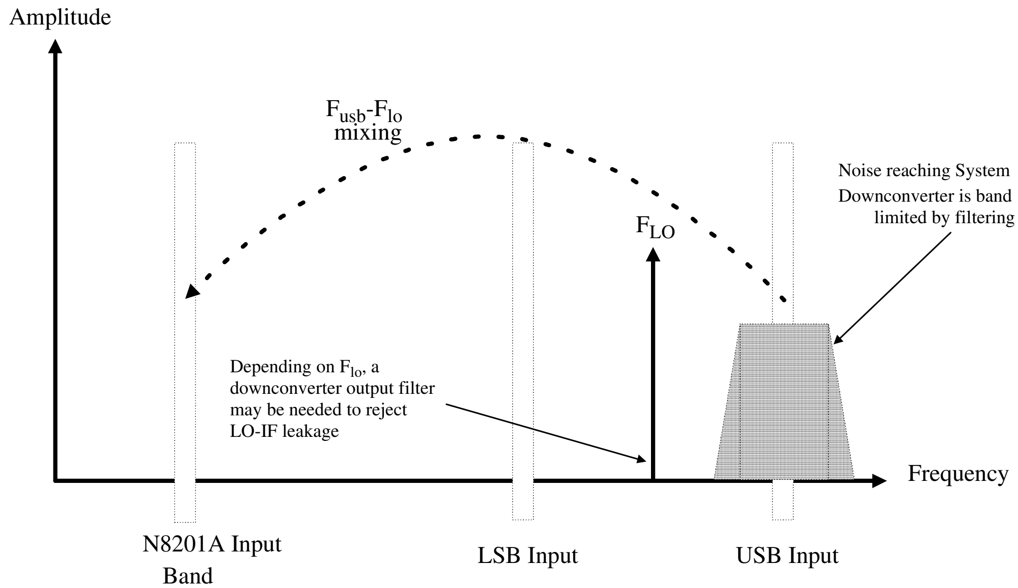


Figure 37 USB System Downconverter Measurements

Ideally choose a high IF frequency for the conversion to separate the USB and LSB bands, thus simplifying the filter requirements.

The filter needed to make an SSB measurement could be part of the DUT, or a measurement-specific filter must be obtained and applied at the input to the system downconverter.

The bandwidth of the SSB filter limits the maximum frequency range over which a measurement can be swept. Therefore SSB measurements are not suited to very wideband DUTs.

Filtering is needed to select the wanted sideband. A swept noise figure measurement is then possible even if the though LO cannot be swept.

FIXED LO, LSB

The main benefit of the fixed LO system downconverter modes is that a programmable synthesized LO is not needed.

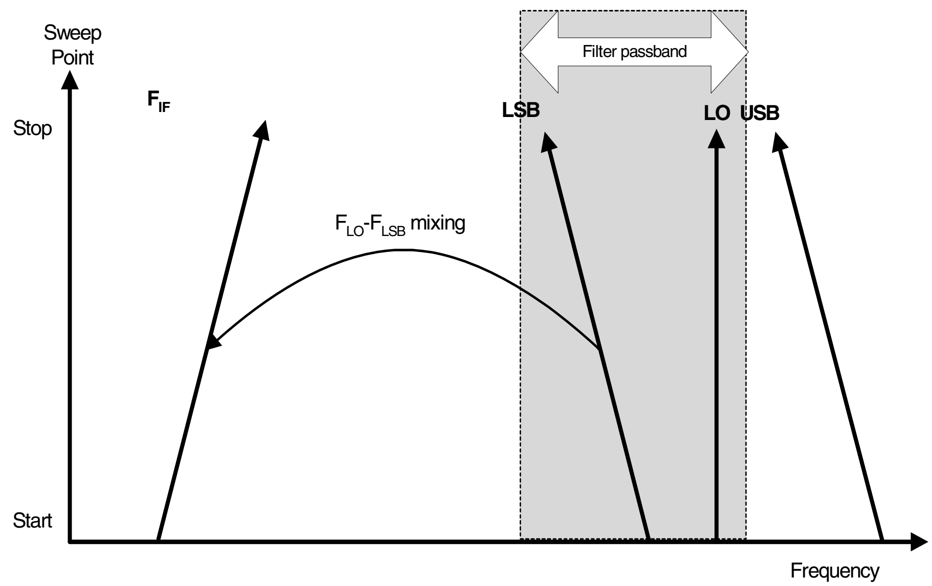


Figure 38 LSB Measurements

Figure 38 shows how the N8201A sweeps its own input frequency so that as the LSB tunes, the frequency increases across the sweep. The filter required is either a low pass or a band pass. The maximum sweep width is now limited to the maximum IF frequency, less an allowance for the filter transition band.

FIXED LO, USB

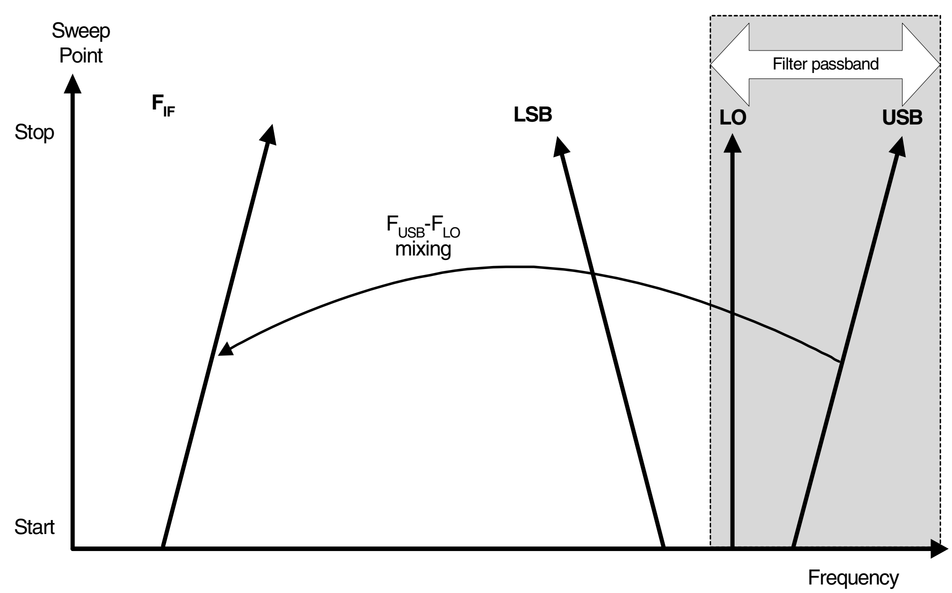


Figure 39 USB Measurements

Figure 39 shows that as the N8201A is tuned in the normal direction, that is, from a low frequency to a high frequency, the USB and the IF vary in unison. The filter can be a band pass or high pass, and the sweep width is again limited to the maximum IF frequency, less an allowance for the filter transition band.

Frequency Restrictions

To assist you in troubleshooting problems that you may have encountered when setting up these measurement modes, the restrictions that apply to the different types of measurements are detailed on the following pages.

The N8201A will only return messages if the frequencies used at the ports of the frequency converter fall outside the valid range that the N8201A can handle. Under such conditions, a valid measurement cannot be performed. Within these limits, it is up to you to specify valid frequencies at all ports for the type of DUT currently selected.

Glossary of Restricted Terms

Table 8 is a description of the terms used in the restrictions.

Table 8 Restricted Terms

Term	Description
IF	The output from DUT frequency or the tuned frequency of the N8201A
IF_{START}	IF_{START} is lower than IF_{STOP}.
IF_{STOP}	IF_{STOP} is higher than IF_{START}.
RF	The input to DUT frequencies
RF_{START}	RF_{START} is lower than RF_{STOP}.
RF_{STOP}	RF_{STOP} is higher than RF_{START}.
F_{LO}	External LO

General Restrictions

In noise figure measurements, the following general restrictions apply:

- The IF frequency range is limited to a minimum of 10 kHz, and a maximum of 26.5 GHz.
- The RF frequency range is from 1 Hz to 325 GHz, depending on the DUT setup.

Regardless of whether the input frequencies are RF frequencies or IF frequencies, the Frequency/Channel menu is used to enter these frequency values.

- The minimum frequency separation between consecutive points is 10 Hz.

Frequency Down Converting DUT

In this measurement, the DUT contains a frequency down converting device. Two examples are a mixer or receiver. These are the applicable restrictions:

LSB Restrictions

With LSB measurements, the following restrictions apply:

- $RF_{STOP} < F_{LO}$
- $RF_{START} > IF_{STOP}$
- F_{LO} - $RF_{STOP} \geq 10$ kHz

USB Restrictions

With USB measurements, the following restrictions apply:

- $RF_{START} > F_{LO}$
- $IF_{STOP} < F_{LO}$
- RF_{START} - $F_{LO} \geq 10$ kHz

DSB Restrictions

With DSB measurements, the following restrictions apply:

- $RF_{START} > IF_{STOP}$

Frequency Up Converting DUT

In this measurement, the DUT contains a frequency up converting device. One example is a mixer used in a transmitter.

LSB Restrictions

With LSB measurements, following restrictions apply:

- $IF_{STOP} < F_{LO}$
- $IF_{START} > RF_{STOP}$

USB Restrictions

With USB measurements, the following restrictions apply:

- $IF_{START} > F_{LO}$
- $RF_{STOP} < F_{LO}$

System Downconverter

The DUT is a non-frequency converting device, for example an amplifier or filter measurement, and its frequency is outside the N8201A's measurement range or outside its range of maximum accuracy. Frequency down conversion is required within the measurement system, in other words, using a mixer, external to the DUT, to convert the signal of interest to the frequency range of the N8201A.

LSB Restrictions

With LSB measurements, the following restrictions apply:

- $RF_{STOP} < F_{LO}$
- $RF_{START} > IF_{STOP}$
- F_{LO} - $RF_{STOP} \geq 10$ kHz

USB Restrictions

With USB measurements, the following restrictions apply:

- $RF_{START} > F_{LO}$
- $IF_{STOP} < F_{LO}$
- RF_{START} - $F_{LO} \geq 10$ kHz

DSB Restrictions

With DSB measurements, the following restrictions apply:

- $RF_{START} > IF_{STOP}$

5
Front-Panel Key Reference

This chapter details the front-panel keys and menu keys. The front-panel keys are listed alphabetically and are described with their associated menu keys. The menu keys are arranged as they appear in the N8201A Option H02 Spectrum Analyzer GUI menus.

Key Descriptions and Locations

This chapter provides information on the Noise Figure measurement mode functions only.

AMPLITUDE Y Scale

NOTE The following functions are the same for both display A and display B.

Scale/Div

Sets the units per vertical graticule division in the measurement window on the display. If more than one measurement window is displayed (for example, when making Noise Figure measurements), the active window is indicated by a green border. The active window can be changed by clicking **Trace/View** > *Display.*

Ref Value

Ref Value is only available when **Measure** > *Noise Figure is selected.*

Specifies the amplitude level represented by the Ref Position (see below) on the graticule display. The units of measurement are either dB or Kelvin, depending on the measurement being displayed in the active window.

Ref Position

Ref Position is only available when **Measure** > *Noise Figure is selected.*

The reference position on each trace is indicated by a small chevron (the '>' and '<' signs) at either side of the graticule. The value of this reference position on the graticule is specified with the Ref Value key (see above). The Ref Position key allows you to vary the position of the reference trace between top, center, and bottom of the graticule.

Top

Sets the reference position to the top line of the graticule. Its position is indicated by a small chevron on either side of the graticule.

Ctr

Sets the reference position to the center of the graticule. Its position is indicated by a small chevron on either side of the graticule.

Bot

Sets the reference position to the bottom line of the graticule. Its position is indicated by a small chevron on either side of the graticule.

Auto Scale

Auto Scale is only available when **Measure** > *Noise Figure is selected.*

Automatically sets both the Scale/Div and the Ref Value to values that are suitable for the current trace data.

Ref Level

Reference Level is only available when **Measure** > *Monitor Spectrum is selected.*

Specifies the absolute amplitude level represented by the top line on the graticule display. The units of measurement are dB.

Attenuation

Attenuation is only available when **Measure** > *Monitor Spectrum is selected.*

Adjusts the input attenuation in 2 dB increments on the N8201A. The N8201A input attenuator reduces the power level of the input signal delivered to the input mixer. If set manually, the attenuator is recoupled when Attenuation (Auto) is selected.

Optimize Ref Level

Optimize Ref Level is only available when **Measure** > *Monitor Spectrum is selected.*

Optimizes the Reference Level and Attenuation settings for the current signal. The reference level will be set to a value that keeps the signal as close as possible to the top of the display. Attenuation will be set to a level that maintains a maximum mixer level of –20 dBm.

BW/Avg

Activates the resolution bandwidth function, and displays the menu keys that control both the bandwidth and averaging functions.

Res BW

Sets the resolution bandwidth. Resolution bandwidth is the 3 dB bandwidth of the N8201A's resolution bandwidth filter. It is called resolution bandwidth because two closely-spaced equal amplitude signals are just resolved if they are separated by an amount equal to the N8201A 3 dB bandwidth.

Sweep time is coupled to RBW. As the RBW changes, the sweep time (if set to Auto) is changed to maintain amplitude calibration.

Manual

Allows you to set the 3 dB filter bandwidth (RBW) of the N8201A's resolution bandwidth filter.

You can specify the Resolution Bandwidth in 10% steps from 1 Hz to 3 MHz, plus bandwidths of 4, 5, 6, or 8 MHz.

If an unavailable bandwidth is entered with the keyboard, the closest available bandwidth is selected.

Auto

Automatically sets the resolution bandwidth for the best results. At measurement frequencies greater than 3 MHz, the resolution bandwidth will be set to 1 MHz. For measurement frequencies below 3 MHz, the resolution bandwidth will be set to 10% of the measurement frequency.

After the N8201A has been calibrated, changing the RBW setting to a value which crosses the 1.5 MHz boundary will invalidate the calibration data. This will happen if your RBW setting is changed from a value above 1.5 MHz to one that is lower than or equal to 1.5 MHz, or if it is changed from a value below or equal to 1.5 MHz to one that is higher. You must recalibrate the N8201A for the new setting.

The available range is from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth (VBW) may be chosen by selecting 50 MHz.

Video BW (Auto) selects automatic coupling of the video BW filter to the resolution bandwidth filter using the ratio set by the VBW/RBW key.

Video BW Auto/Man

Video BW Auto/Man is only available when **Measure** > *Monitor Spectrum is selected.*

Enables the N8201A’s post-detection filter from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth (VBW) may be chosen by selecting 50 MHz. Video BW Auto selects automatic coupling of the video bandwidth filter to the resolution bandwidth filter using the VBW/RBW ratio set by the VBW/RBW key.

Sweep time is coupled to video bandwidth. As the VBW is changed, the sweep time (when set to Auto) is changed to maintain amplitude calibration. This occurs because of common hardware between the two circuits, even though the video bandwidth filter is not actually “in-circuit” when the detector is set to Average. Because the purpose of the average detector and the VBW filter are the same, either can be used to reduce the variance of the result.

Although the VBW filter is not “in-circuit” when using the Average detector, the Video BW key can have an effect on (Auto) sweep time, and is not disabled. In this case, reducing the VBW setting increases the sweep time, which increases the averaging time, producing a lower-variance trace.

However, when the EMI Average detector is selected, Video BW is restricted to 1 Hz. while the sweep time is set to Auto.

When using the average detector with either Sweep Time set to Manual, or in zero span, the VBW setting has no effect and is disabled (greyed out).

A “#” mark appears next to VBW on the bottom of the display when it is not coupled. To couple the video bandwidth, click Video BW Auto.

VBW/RBW

VBW/RBW is only available when **Measure** > *Monitor Spectrum is selected.*

Sets the ratio between the video and resolution bandwidths. Setting video bandwidth wider than resolution bandwidth (VBW/RBW ratio > 1.000) provides best peak measurements of signals such as wideband radar pulses. Setting VBW narrower than RBW (VBW/RBW ratio <1.000) reduces the variance of noise-like signals and makes spectral components close to the noise floor easier to view.

Span/RBW

Span/RBW is only available when **Measure** > *Monitor Spectrum is selected.*

Selects the ratio of the span to the resolution bandwidth. A factory preset sets the ratio to 106:1.

Det/Demod

Det/Demod functions are available in **Measure** > *Monitor Spectrum mode only. In Noise Figure mode, Average detection is used.*

Detector

Allows you to select a specific detector for a particular measurement.

When discussing detectors, it is important to understand the concept of a trace "bucket." For every trace point displayed, there is a finite time during which the data for that point is collected. The N8201A has the ability to look at all of the data collected during that time and present a single point of trace data based on the detector mode. The interval during which the data for that trace point is being collected, is called the "bucket." Thus, a trace is more than a series of single points. It is actually a series of trace "buckets." The data may be sampled many times within each bucket.

The detector in use is indicated on the left side of the display.

Normal

Displays the peak of CW-like signals and maximums and minimums of noise-like signals.

Average

Displays the average of the signal within the bucket. The averaging method depends upon Avg/VBW Type selection of either Log-Pwr Avg (Video) or Pwr Avg (RMS).

Peak

Displays the maximum of the signal within the bucket.

Because a spectral component's true peak may not be found, neither average nor sample detectors measure amplitudes of CW signals as accurately as peak or normal, but they do measure noise without the biases of peak detection.

Sample

Displays the instantaneous level of the signal at the center of the bucket represented by each display point.

Because a spectral component's true peak may not be found, neither average nor sample detectors measure amplitudes of CW signals as accurately as peak or normal, but they do measure noise without the biases of peak detection.

Negative Peak

Displays the minimum of the signal within the bucket.

Quasi Peak

A fast rise and fall detector used in making CISPR EMI compliant measurements. Quasi-peak detection is a weighted form of peak detection. During quasi-peak detection, the displayed response drops as the repetition rate of the measured signal decreases. This signal weighting is accomplished by circuitry with specific charge (1 millisecond) and discharge (600 milliseconds) time constants. For continuous wave signals, peak and quasi-peak values are the same.

EMI Average

Displays the instantaneous level of the signal at the center of the bucket, just like the sample detector.

EMI Peak

Displays the maximum of the signal within the bucket using CISPR related bandwidths.

MIL Peak

Displays the maximum of the signal within the bucket using MIL related bandwidths.

Display

Accesses the menu keys that allows you to see and setup different measurement displays.

Limits

Limit functions are only available when **Measure** > *Noise Figure is selected.*

Limit lines can be defined to compare the data to your defined limits and indicate a pass or fail condition. Limits accesses menus that allow you to create, modify, and change the properties of limit lines. There are two limit line sets in the GUI.

Limit Line 1:A, 2:A, 3:B, 4:B

Selects the limit line for editing. Limit lines 1A and 2A are available for Display A (the top display), limit lines 3B and 4B are available for Display B (the bottom display).

Limit State On/Off

Turns the limit state On or Off. The limit state can be on for testing purposes even if the limit line display is set to off (Display Off).

Type Upper/Lower

Defines the limit you are editing as either an upper or lower limit. An Upper limit fails if the trace exceeds the limit. A Lower limit fails if the trace falls below the limit.

Display On/Off

Turns limit-line display On or Off.

Test On/Off

Turns the testing of the limit line On or Off. If the trace is at or within the bounds of the set limit, `PASS LIMIT#` is displayed in green in the upper-left corner of the measurement area where `#` is the number of the selected limit line. Only positive margins are allowed for lower limits and only negative margins are allowed for upper limits. If the trace is out of the limit boundaries, `FAIL LIMIT#` is displayed in red.

Edit...

Allows you to modify the limit line table for the selected limit line. That is, 1:A, 2:A, 3:B, 4:B.

Disable All Limits

Turns off the display of all limit lines.

Preferences

Preferences is only available when **Measure** > *Noise Figure is selected.*

Accesses a menu of selections to customize the display's appearance.

Graticule

Displays or hides the graticule lines on the display.

Annotation

Displays or hides the annotation pertaining to the current display.

Display Line

Display Line is only available when **Measure** > *Monitor Spectrum is selected.*

Activates an adjustable horizontal line that is used as a visual reference line. The line has an amplitude that corresponds to its vertical position relative to the reference level. The value of the display line appears on the left side of the display below the label Dl. The display line can be adjusted by clicking the numeric value and using the keyboard to enter a new value.

File

Displays a menu of functions that enable you to load, save, and manage data on the N8201A's internal drive or to your PC. You can recall, save, copy, delete, or rename files of instrument states, trace data, and screen captures.

You can save the following types of files:

- State - A file that contains a copy of the state of the N8201A at the time the file is saved. The settings of most N8201A functions are saved in the state files but not traces, limits, and corrections. When a State file is loaded into the N8201A, the N8201A is restored to the same state as when the file was saved. Some settings are not saved in the State files, for example the time/date display style and auto-alignment state; these settings are called "persistent." In this manual, each function describes whether that function is saved in "Instrument State" or is persistent.
- Trace - A file that contains a copy of the trace data for one or more traces. There are two formats for trace files, Trace + State and CSV files.
  - **Trace + State:** A file that contains the trace data and a copy of the current N8201A state. The trace and state are stored in an internal data format (TRC), which cannot be loaded into a PC, but can be loaded back into the N8201A. Traces can be loaded individually or as a group. When a Trace + State file is loaded into the N8201A the trace data that was on the screen, when saved, is loaded into the N8201A. This enables you to view the trace as it looked when it was saved. Because the state data is also saved, the N8201A settings, including all the annotation on the screen, is restored as well. To preserve the trace data, the traces contained in the saved files are placed in View mode (see Trace/View, page 146) so that they are not immediately overwritten by new trace data. This means that you can save traces while making a measurement, and later load them back into the N8201A, where you can print them or transfer them to a computer, in CSV format, for analysis. If you wish to compare two saved traces, place traces in view mode before saving them. This prevents the trace from being rewritten based on a state change from subsequent loads.
  - **CSV:** A file that contains trace data in comma-separated values format (CSV, standard PC spreadsheet format), can be read into a spreadsheet for analysis. Most spreadsheet programs support CSV format. They cannot be loaded back into the N8201A.
- Limits - A file that contains a copy of the N8201A limit sets at the time the file is saved. Limits provide data sets to determine whether a trace has exceeded preset specifications. Limit sets can hold up to 200 points and can only be saved individually. Refer to the File > Save > Source key description, page 120. When you load a Limits file into the N8201A, you restore all of the limit sets that were in the instrument at the time of the save.

- Corrections - A file that contains a copy of the N8201A correction tables at the time the file is saved (CBL, ANT, OTH, AMP). Corrections provide a way to adjust the trace display for preset gain factors (such as for cable loss). A correction set can hold up to 200 points. Pressing Corrections activates the Source key. Refer to the File, Save, Source key description, page 131. When you load a Corrections file into the N8201A, you restore all of the corrections values that were in the instrument at the time of the save.

Browse User Directory

Opens the instrument directory where the stored data files are located.

Load

Accesses a menu to load stored files into the instrument.

Load Now

Loads the selected file into the instrument.

Type

Allows you to select the desired type of instrument-data files to be displayed. Common types of instrument data files include trace data, limit line data, and amplitude correction data.

Table 9 Instrument Data File Types

Type	Format	Destination	Extension
State	State		STA
Trace	Trace + State	Trace 1, 2, 3 or all traces	TRC
	Comma separated trace values	Trace 1, 2, 3 or all traces	CSV
Limit	Internal data format		LIM
Screen	Bitmap		GIF
	Reverse bitmap		GIF
Corrections	Internal data format		ANT, CBL, OTH, and AMP
Measurement Results	Comma separated values		CSV
ENR Meas Common Table	Internal data format		ENR
ENR Cal Table	Internal data format		ENR
Loss Comp Before DUT	Internal data format		LOS
Loss Comp After DUT	Internal data format		LOS
Freq List	Internal data format		LST

Destination

When the file type is set to Trace, Destination accesses the keys to load either Trace 1, 2, 3 or All traces.

When the file type is set to Corrections, Destination accesses the keys to select Antenna, Cable, Other, or User as the type of correction to load.

When the file type is set to Limits, Destination accesses the keys to load either Limit Line 1, 2, 3, or 4. Limit sets can only be loaded individually.

Source Device

Specifies either the N8201A or the PC as the source of the saved files.

File Name

Opens the dialog box allowing selection of a previously stored file. Depending on the Source Device selected, a different dialog box will appear.

Instrument Opens the Load File from Instrument window where the saved files are stored.

PC Opens Windows Explorer allowing you to navigate to the saved files.

Save

Accesses a menu to save a file to either the instrument or the PC.

Save Now

Saves the specified file.

Type

Allows you to select the desired type of instrument-data files to be saved. Common types of instrument data files include trace data, limit line data, and amplitude correction data. See Table 9.

Format

When Trace is selected as the file type, then you can either choose to save the trace data as Trace + State or as a CSV file. See page 117 for more information on these file formats.

Source

When the file type is set to Trace, Source accesses the keys to save either Trace 1, 2, 3 or All traces. Saving all traces saves all traces in a single file.

When the file type is set to Corrections, Source accesses the keys to select Antenna, Cable, Other, or User as the type of correction to save.

When the file type is set to Limits, Source accesses the keys to save either Limit Line 1, 2, 3, or 4. Limit sets can hold up to 200 data points and can only be saved individually.

Destination Device Instrument PC

Specifies either the N8201A or the PC as the destination drive for the saved files.

File Name

Opens the dialog box allowing you to save a file. Depending on the Source Device selected, a different dialog box will appear.

Instrument Opens the Load File from Instrument window where the saved files are stored.

PC Opens Windows Explorer allowing you to navigate to the directory where the saved files are stored.

FREQUENCY Channel

Accesses the menu of frequency functions.

Freq Mode

Available in **Measure** > *Noise Figure only.*

Specifies either swept, list, or fixed frequency modes. The selected frequency mode is displayed in the menu key.

Sweep

The measurements are made at frequencies generated from the selected frequency range and the number of measurement points.

Fixed

The measurements are made at a fixed frequency.

List

The measurements are made at the frequencies specified in the frequency table.

Start Freq

Sets the frequency at which the measurement sweep starts. In the graphical format, the trace starts at the left side of the graticule. When Start Freq is selected its value is displayed above the graticule.

When measuring at frequencies below 20 MHz, Agilent recommends that you switch to DC coupling for greater measurement accuracy.

CAUTION Do not switch to DC Coupling if the input signal contains a DC component. You risk permanently damaging the N8201A's front end mixer if you do this.

Stop Freq

Sets the frequency at which the measurement sweep stops. In the graphical format, the trace stops at the right side of the graticule. When you change the Stop frequency, the Span and Center Frequencies will be adjusted to keep the measurement frequency range centered. When Stop Freq is selected its value is displayed above the graticule.

Center Freq

Sets the frequency at which the measurement frequency range is centered. When you change the Center Frequency, the Start and Stop Frequencies are adjusted without modifying the Span setting. When Center Freq is selected its value is displayed above the graticule.

Points

Available in **Measure** > *Noise Figure only.*

Sets the number of discrete equidistant frequency points at which measurements are made during Sweep frequency mode. The maximum number of points allowed is 401. The default value is 11. The number of points is shown at the bottom of the display.

The maximum number of 401 points is conditional, as this number is limited by the frequency span. Where the minimum resolution between any two points is set at 10 kHz, the frequency's measurement range must be greater than 4 MHz to achieve 401 points.

Freq Offset

Available in **Measure** > *Monitor Spectrum only.*

When set to Man, the Frequency Offset can be set by using the keyboard and selecting the first letter of units designator. For example "G" for gigahertz. The default setting for frequency offset is Man.

When set to Auto, the frequency offset settings are calculated automatically using the settings under DUT Setup.

The frequency offset is used to account for frequency conversions external to the N8201A. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the N8201A. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Factory Preset or manually set the frequency offset to 0 Hz.

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the N8201A, but only the displayed frequency values. Offsets are not added to the frequency count readouts. Entering an offset does not affect the trace display.

Frequency Context (Mode Setup, DUT Setup...) must be set to RF for the Auto setting of Freq Offset to have any effect. When the Frequency Context is set to IF, and Freq Offset is set to Auto, the frequency offset will be set to 0 Hz. All frequencies are displayed as they are at the N8201A input, that is, after the DUT.

Fixed Freq

Sets the frequency point used in fixed frequency measurements. When Fixed Freq is selected its value is displayed in the left and right lower annotation as start and stop values respectively.

Freq List…

Accesses a form to enter or edit a frequency list.

The frequency list allows you to enter a list of frequencies at which measurements are to be made. Frequency lists are limited to 401 entry points. The number of points is shown at the bottom of the display.

The frequencies are automatically sorted in ascending order, and duplicate frequencies are allowed. When a frequency is duplicated in the table, that frequency will be measured once for each entry.

Input/Output

Displays a menu that allows you to control the input and output signals to and from the N8201A.

Noise Figure Corrections

Available in **Measure** > *Noise Figure only.*

Accesses menus that allow you to set Noise Figure Correction On or Off, and to enter the minimum and the maximum attenuation values used in calibration.

Noise Figure Corrections

Selects either corrected and uncorrected results.This key is grayed out unless a valid calibration (Meas Setup, Calibration...) has been performed.

On Displays corrected data.

Off Displays uncorrected data.

If you change the frequency range to greater than the current calibration, the message `"User Cal invalidated; Freq outside cal range"` is displayed. If you want corrected measurements over a greater range, you need to calibrate the N8201A again before making this measurement.

If you change the frequency range to less than the current calibration, the message `"User Cal will be interpolated"` is displayed. This demonstrates that the N8201A is using interpolated results and interpolated errors may be introduced.

Min Atten

Changes the RF attenuator's minimum input attenuation during calibration. The range is from 0 dB to 40 dB and can be set in 4 dB steps. The default value is 0 dB.

Max Atten

Changes the RF attenuator's maximum input attenuation during calibration. It can be set in 4 dB steps. The default value is 8 dB.

Loss Comp

Available in **Measure** > *Noise Figure only.*

Accesses features which allows the N8201A to compensate for losses. For example, the losses could be due to additional cabling either before or after the DUT's measurement or both. You can compensate for this loss either by using the same fixed value over the whole frequency span, or by using values that vary across the frequency span and which have been specified in a table.

Setup...

Brings up the Loss Compensation form, allowing you to specify the parameters associated with loss compensation.

Loss Compensation Before DUT Allows you to specify what type of Loss Compensation is used before the Device Under Test: Fixed, Table, or none.

Off - No loss compensation is made before the DUT.

Fixed - Loss Compensation is at a fixed value over the entire frequency span.

Table - Loss Compensation varies across the frequency span, using values specified in a table.

Loss Comp Before DUT Fixed Value Sets the amount of compensation, before the device under test, as a fixed value. This is only valid if the Before DUT (Fixed) is enabled. You can enter the value as dB or linear. However, the linear value is converted to dB. The lower limit is –100.000 dB and the upper limit is 100.000 dB. The default value is 0.000 dB.

Loss Comp Before DUT Temp Sets the temperature of loss compensation, before the device under test, as a fixed value. This is only valid if Before DUT is enabled. You can enter the value as K (Kelvin), C (degrees Celsius), or F (degrees Fahrenheit). However, the C and F values are converted to K. The lower limit is 0.00K and the upper limit is 29,650,000.00 K. The default value is 0.00K.

Loss Comp After DUT Specifies what type of Loss Compensation is used after the Device Under Test.

Off - No loss compensation is made after the DUT.

Fixed - Loss Compensation is at a fixed value over the entire frequency span.

Table - Loss Compensation varies across the frequency span, using values specified in a table.

Loss Comp After DUT Fixed Val Sets the amount of compensation, after the device under test, as a fixed value. This is only valid if the After DUT (Fixed) is enabled. You can enter the value as dB or linear. However, the linear value is converted to dB. The lower limit is –100.000 dB and the upper limit is 100.000 dB. The default value is 0.000 dB.

Loss Comp After DUT Temp Sets the temperature of loss compensation, after the device under test, as a fixed value. This is only valid if After DUT is enabled. You can enter the value as K, C, or F. However, the C and F values are converted to K. The lower limit is 0.00K and the upper limit is 29,650,000.00 K. The default value is 0.00K.

Before DUT Table...

Brings up the Loss Compensation Before DUT editor.

After DUT Table...

Brings up the Loss Compensation After DUT editor.

Attenuation

Available in **Measure** > *Noise Figure only.*

Adjusts the input attenuation. The range of settings is limited by the Min Atten and Max Atten settings (see page 124). Within this range, it can be set in 4 dB steps. The N8201A input attenuator reduces the power level of the input signal delivered to the input mixer.

Input/Output

Available in **Measure** > *Noise Figure only.*

Displays the functions that control some of the N8201's signal input and outputs.

CAUTION Do not switch to DC Coupling if the input signal contains a DC component. You risk permanently damaging the N8201A front end mixer if you do this.

RF Coupling

Specifies alternating current (AC) or direct current (DC) coupling at the N8201A RF input port. Selecting AC coupling switches in a blocking capacitor that blocks any DC voltage present at the input. This decreases the input frequency range of the N8201A, but prevents damage to the input circuitry of the N8201A if there is a DC voltage present at the RF input.

In AC coupling mode, signals less than 20 MHz are not calibrated. You must switch to DC coupling to see calibrated frequencies of less than 20 MH. Note that the message **DC Coupled** will be displayed when DC is selected.

Some amplitude specifications apply only when coupling is set to DC coupling.

RF

Selects the front panel RF port as the signal input.

Amptd Ref

Selects the 50 MHz, –25 dBm internal amplitude as the signal input.

Marker

Marker functions are available in **Measure** > *Noise Figure mode only.*

Displays a menu to set each of the four markers to mark or display a particular measurement.

Select Marker

Selects one of the four possible markers. Having selected one of the markers, use the other softkeys on this menu to specify the type of marker or measurement.

Mode

Normal

Sets the specified marker to be a normal marker. That is, it marks the point of the frequency offset that you specify, and then the N8201A measures and displays the phase noise at this point.

Delta

Activates a pair of markers at your current frequency offset. The marker that is indicated by an 'R' on the display is fixed while the second marker can be moved using the arrow keys or entering a value in the Position box. The frequency difference and the phase noise difference between these two points is displayed.

Off

Switches the specified marker off.

Marker All Off

Switches all markers off. All markers are removed from the graticule display, and if the marker table is also being displayed, all entries will be removed from it.

Meas Ctrl (Control)

These functions allow you to pause and resume the currently selected measurement and to select between continuous and single measurements.

Restart

Restarts a previously paused measurement at the beginning. If the current measurement is still in progress, it will stop it as soon as possible and restart it from the beginning.

Measure Single/Cont

Switches the N8201A between triggering a Continuous measurement/sweep or triggering a Single measurement. The front panel Single key also puts the N8201A in single measurement mode.

Pause

Pauses the currently running measurement. Pressing Pause will toggle between pausing and resuming the measurement. If an averaged measurement is in progress, the average counter is frozen when the measurement is halted.

Meas Setup

Displays a menu that allows you to enter custom setup parameters for a measurement. The setup menu displayed depends on whether the Monitor Spectrum or the Noise Figure measurement was selected in the MEASURE menu.

Avg Number

Allows you to specify the number of measurements that will be averaged. After the specified number of average counts, the Avg Mode setting determines the averaging action. You can also set the averaging function to On or Off.

On

Enables the measurement averaging.

Off

Disables the measurement averaging.

Avg Mode

Selects the type of termination control used for the averaging function. This determines the averaging action after the specified number of measurements (average count) is reached.

For **Measure** > *Noise Figure mode, Avg Mode is set to Repeat.*

Exp

After the average count is reached, each successive data acquisition is exponentially weighted and combined with the existing average.

Repeat

After the average count is reached, the averaging is reset and a new average is started.

Calibrate

Available for **Measure** > *Noise Figure only.*

Performs the internal calibration routine. The calibration is similar to a measurement except that the device under test is not in the measurement path. It is used to correct any noise added by the second stage test system.

The values generated during a calibration are used to correct subsequent measurements as long as the calibration remains valid or until the next calibration.

ENR

Available for **Measure** > *Noise Figure only.*

Accesses a menu which allows you to select a noise source preference, enter the ENR (Excess Noise Ration) table, specify a T_{cold} temperature, specify a spot T_{hot} temperature, or select a spot frequency ENR value.

Mode

Selects the mode for measurement: Spot or Table.

Table Sets the ENR mode to Table. All ENR data is taken from the table of data.

Spot Sets the ENR mode to Spot. All ENR table data is ignored, and a single value specified in SPOT ENR or SPOT T hot is used instead.

Common Table

Turns the Common ENR Data Table On or Off.

On Uses the same noise source ENR data during both the measurement and the calibration.

Off Uses separate noise source ENR data is used for the measurement and the calibration.

Meas & Cal Table

Displays the form allowing you to enter the ENR table data that is used for both measurement and calibration.

Serial # Specifies the serial number of the noise source associated with the ENR table. Use the keyboard to enter the numeric value. The value is displayed in the highlighted area and in the active function area. To complete the entry press Enter.

Model ID Specifies the model number of the noise source associated with the ENR table. Use the keyboard to enter the value. The value is displayed in the highlighted area and in the active function area. To complete the entry press Enter.

Table Allows you to enter new ENR data with the associated frequencies or edit existing data.

Meas Table...

Available when Common Table is Off.

Displays the form allowing you to enter the ENR table data that is used for measurement. This measurement ENR table is used for measurements when Common Table (see “Common Table" on page 130) is switched Off. When Common Table is switched On, this same table of ENR data is used both for measurements and for calibration.

Serial # Specifies the serial number of the noise source associated with the ENR table. Use the keyboard to enter a value. The value is displayed in the highlighted area and in the active function area. To complete the entry press Enter.

Model ID Specifies the model number of the noise source associated with the ENR table. Use the keyboard to enter a value. The value is displayed in the highlighted area and in the active function area. To complete the entry press Enter.

Table Allows you to enter new ENR data with the associated frequencies or edit existing data.

Cal Table...

Available when Common Table is Off.

Displays the form allowing you to enter the ENR table data that is used for calibration. This calibration ENR table is used for calibration when Common Table (see “Common Table" on page 130) is switched Off. When Common Table is switched On, the table of ENR data that is used for measurements will also be used for calibration, and the data in this calibration table will therefore not be used.

Serial # Specifies the serial number of the noise source associated with the ENR table. Use the keyboard to enter a value. The value is displayed in the highlighted area and in the active function area. To complete the entry press the Return key or the ESC key, or use the Tab key to move to the next field.

Model ID Specifies the model number of the noise source associated with the ENR table. Use the keyboard to enter a value. The value is displayed in the highlighted area and in the active function area. To complete the entry press the Return key or the ESC key, or use the Tab key to move to the next field.

Table Allows you to enter new ENR data with the associated frequencies or edit existing data.

Spot

Sets a single value for SPOT ENR or SPOT T hot.

Spot State Sets the Spot State to either ENR or T hot.

Spot ENR Sets the amplitude of the ENR Spot

Spot T hot Sets the T hot temperature. T hot is the virtual temperature that the noise source is operating at when turned on.

T cold Default/User

Sets the T cold temperature. T cold is the ambient temperature that the noise source is operating at when the noise source is turned off.

Available for ***Measure*** *> Noise Figure only.*

Int Preamp

Turns the internal preamplifier On or Off manually.

For Monitor Spectrum mode, Internal Preamp is set to On. For Noise Figure mode, Internal Preamp is set to off.

MEASURE

Accesses menu keys that allow you to make Monitor Spectrum, and Noise Figure measurements.

Monitor Spectrum

Displays the frequency spectrum and gives access to the functions associated with making a frequency spectrum measurement.

Noise Figure

Gives you access to the range of Noise Figure measurements and parameters.

MODE

Accesses menu keys allowing you to select the measurement mode of the N8201A. Additional measurement personality software must be installed and activated in the N8201A for the other mode keys to be labeled and functional.

Spectrum Analysis

Accesses the spectrum analyzer menu keys and associated functions.

Noise Figure

Accesses the Noise Figure measurement personality menu keys and associated functions. This allows you to setup and make valid Noise Figure measurements.

This menu will have additional entries if other personalities have been installed, for example, Phase Noise.

Mode Setup

Accesses a menu allowing you to view information about the Noise Figure application and to set the noise figure measurement parameters back to their factory default settings.

DUT Setup...

Allows you to prepare the N8201A to make noise figure measurements on specific devices. The keys you will see depend on the parameter that you are setting.

DUT

Specifies the type of DUT that you are testing.

Amplifier Sets the DUT to Amplifier when you are testing a device that performs no frequency conversion of its own. The device can be used with or without an external system downconverter.

UpConv Sets the DUT to upconverter when you are testing a device that performs internal frequency up conversion.

DownConv Sets the DUT to downconverter when you are testing a device that performs internal frequency down conversion.

System Downconverter On/Off

Selects whether or not the System Downconverter is On or Off. This is only accessible if the Device Under Test is set to Amplifier. See above.

Ext LO Freq

Specifies the LO frequency of the device specified under DUT at 30 GHz.

Sideband

Sets the measurement side-band selection to either lower side-band (LSB), Upper side-band (LSB), or Double side-band (DSB).

Freq Context

Determines how frequencies are interpreted when using a frequency converting device.

RF DUT Input The frequencies are displayed as they are when leaving the DUT or the system downconverter, that is after any frequency conversion has taken place. These are the frequencies that the N8201A is actually measuring.

IF Analyzer Input The frequencies are displayed as they are when entering the DUT, that is before any frequency conversion has taken place.

Uncertainty Calculator

Displays the Uncertainty Calculator. This makes a frequency-independent calculation using one ENR uncertainty value. While it provides a good estimation of the measurement uncertainty, you may want more accuracy. You may want to use more accurate values for ENR, gain and VSWR, or calculate values at a specific frequency of interest or at multiple frequencies.

Refer to Application Note 57-2, Agilent part number 5952-3706E, for more information about calculating noise figure uncertainties. This document can be found at: http://literature.agilent.com/litweb/pdf/5952-3706E.pdf. Refer also to Application Note 57-3, Agilent part number 5980-0288E, for hints for making successful noise figure measurements. This document can be fount at http://literature.agilent.com/litweb/pdf/5980-0288E.pdf.

RSS NF Meas Uncertainty

Sets the Root Sum of Squares measurement uncertainty to 4 dB.

Noise Source Model

Selects a predefined noise source model using the displayed default values, or allows you to define your own noise source.

User Defined Defines a noise source, and allows you to specify its parameters manually.

Agilent 346A Selects Agilent 346A if you are using an Agilent Technologies 346A noise source. The ENR uncertainty and match for this noise source will be set automatically.

Agilent 346B Select Agilent 346B if you are using an Agilent Technologies 346B noise source. The ENR uncertainty and match for this noise source will be set automatically.

Agilent 346C Select Agilent 346C if you are using an Agilent Technologies 346C noise source. The ENR uncertainty and match for this noise source will be set automatically.

ENR Uncertainty

Sets and views the Excess Noise Ratio (ENR) Uncertainty of the noise source.

Match

Sets and views the 50 ohm Match of the User Defined noise source. The match can be entered as Return Loss, VSWR, or as a Reflection Co-efficient. You do not need to specify the unit of measurement, if any. The value you enter is used to determine the what the entry is, as described below:

A value less than 0 Return Loss, unit of measurement is dB.

A value greater than or equal to 0 and less than 1 Reflection coefficient, no unit of measurement.

A value greater than or equal to 1 VSWR, no unit of measurement.

DUT Noise Figure

Sets the noise figure of the DUT.

DUT Gain

Sets the gain of the DUT.

DUT Input Match

Sets the 50 ohm input match of the DUT.

DUT Output Match

Sets the 50 ohm output match of the DUT.

Instrument Noise Figure

Sets the noise figure of the N8201A.

Instrument NF Uncertainty

Sets the noise figure uncertainty of the N8201A.

Instrument Gain Uncertainty

Sets the gain uncertainty of the N8201A.

Instrument Input Match

Sets the instrument input match.

Peak Search

Places a marker on the highest peak and displays the search menu. Peaks that are less than 1% of the current span away from 0 Hz are ignored. For example, if Span is 1 MHz, peaks will not be found between –10 kHz and +10 kHz. If no valid peak is found, an error (No Peak Found) is displayed. To clear this message, press ESC before attempting another search.

Minimum

Moves the active marker to the minimum detected amplitude value on the current trace.

Maximum

Moves the active marker to the maximum detected amplitude value on the current trace.

Pk-Pk

Finds and displays the amplitude and frequency differences between the highest and lowest trace points by setting a reference marker on the peak signal and placing a ⊗ marker on the minimum signal.

Preset

Provides a convenient starting point for making most measurements.

The parameter settings depend on the preset type (user, mode, or factory) selected from the System keys. If the preset type is set to Factory, pressing Preset results in an immediate N8201A preset to the factory defaults. If it is set to User, pressing Preset accesses a menu that allows you choose the preset settings from either the factory default values or the settings you have previously defined as the User preset state. Refer to "Power On/Preset" on page 143.

User Preset

Restores the N8201A to a user defined state. The state was defined from the System menu when the Power On/Preset function was selected and Save User Preset was pressed. If you did not save a user state, then the current power-up state is stored as the user preset file for use when Preset is pressed.

Factory Preset

A full factory preset is executed so the N8201A is returned to the factory default state. The preset type can be set to Factory from the Power On/Preset function in the System menu.

Mode Preset

Restores the mode defaults of the current mode, or of the mode that was in use when the N8201A was turned off or powered down.

Source

Source is only available in **Measure** > *Monitor Spectrum mode.*

Allows you to turn the noise source On or Off manually.

Noise Source

Toggles between the On and the Off settings.

On

Switches the noise source On.

Off

Switches the noise source Off.

SPAN X Scale

Span

Sets the frequency range symmetrically about the center frequency.

Full Span

Full Span is only available in **Measure** > *Monitor Spectrum mode.*

Changes the measurement span to the full span of the N8201A.

Zero Span

Zero Span is only available in **Measure** > *Monitor Spectrum mode.*

Changes the measurement span to 0 Hz.

Sweep

Sweep Time

Specifies the sweep time for the measurement or allows the N8201A set it automatically. For a Noise Figure measurement, the sweep time is set to a predefined value based on the RBW setting.

Manual

Adjusts the sweep time manually using the keyboard.

Auto

Determines the sweep time automatically. The sweep time will be affected by the RBW setting.

Sweep

Specifies whether the N8201A sweeps (or measures) continually, or whether it performs a single sweep and then stops.

Single

Performs one single measurement and then stops. You have to press Single every time you want to make another measurement.

Cont

Continuously measures the signal it is receiving and repeatedly updates the plots and the measurements.

Points

Points is only available in **Measure** > *Monitor Spectrum mode.*

Specifies the number of data points used to generate the display.

System

Displays the System menu keys to control overall system functions.

Show Errors

Accesses a menu to display the last several errors reported. The most recent error will appear at the top of the list. If the same error message occurs several times the error message will be incremented rather than added to the list as a new error message.

Update Error List

When On, the error list will be updated with new errors.

Verbose SCPI

Adds additional information to the error messages returned by the SYSTem:ERRor? command. It indicates which remote command was executing when the error occurred and what about that command was unacceptable.

Clear Error Queue

Clears the error queue from the Show Errors display.

Power On/Preset

Determines the state of the instrument when the power is first turned on.

Power On Last/Preset

Sets the power On state to the last instrument settings used before power Off, or to the instrument preset state, which is determined by the Preset Type as described below.

Preset Type

Enables you to select what type of preset will be initiated when you select the Preset front panel key.

User Sets the preset state to the user-defined settings. If you have not saved a user state, then the instrument will save the power-up state for you to use as a default user preset state.

Mode Sets the preset state to the current mode factory default instrument state.

Factory Restores the factory default instrument state. A factory preset switches the N8201A to Spectrum Analyzer mode and resets the settings of all the modes to the factory defaults (That is, Spectrum Analysis Mode with continuous sweep).

Save User Preset

Saves the current state of the N8201A into the User Preset state register. After the state is saved, go to System, Power On/Preset, Preset Type, User in order to have this state used as the preset state.

Time/Date

Displays the menu keys used to set and display the real-time clock.

Time Date On/Off

Turns the display of the real time clock on or off.

Date Format MDY/DMY

Sets the date display to month-day-year or day-month-year. It is set to a month-day-year format when the instrument system defaults are restored.

Set Time

Sets the time of the real-time clock. Enter the time in 24 hour HHMMSS format.

Set Date

Sets the date of the real-time clock. Enter the date in the YYYYMMDD format.

Alignments

Displays functions that control the automatic alignment of the instrument and loads default values for the alignment system.

Auto Align

Turns the instrument automatic alignment on or off, or alerts you that alignments are needed.

On Initiates an automatic alignment.

Alert Notifies you when an automatic alignment needs to be run. A 3 degree (Celsius) temperature change or a time span of 24 hours since the last successful alignment will trigger an alert that alignments need to be done, but no alignments will be performed without user input.

Off The instrument will not initiate any visible alignments or alerts.

Align All Now

Immediately executes an alignment cycle of all the subsystems (that is Align RF, Align IF, Align ADC, and Align Current Sys Gain). The instrument will stop any measurement currently underway, perform the full alignment, then restart the measurement from the beginning (similar to pressing the Restart key). All other operations are stopped and the alignments will be visible on the display.

Align Subsys

Access the functions to immediately execute an alignment of one of the subsystems (that is, Align RF, Align IF, Align ADC, and Align Current Sys Gain). When one of the subsystem alignments is started all other operations are stopped.

Align RF Initiates an alignment of the RF assembly.

Align IF Initiates an alignment of the IF assembly.

Align ADC Initiates an alignment of the ADC circuitry.

Align Current IF Flatness Initiates an alignment of the current IF flatness, for the purpose of improving absolute amplitude within FFT sweeps and improving group delay in some digital demodulation measurements.

Align Current Sys Gain Initiates a fine-tuning adjustment of the system gain, primarily to correct for small amplitude variations that occur as resolution bandwidth is switched.

Restore Align Defaults

Loads the default values for the alignment system, turns on the frequency correction, and resets the timebase to the factory values. Align All Now must be executed three times after initiating a Restore Alignments Defaults function to meet specifications.

Restore System Defaults

Resets the system settings, including most “persistent” functions, to their factory defaults. Persistent functions are things such as the time/date display style and auto-alignment state. These are parameters that are unaffected by a power cycle or an instrument preset.

It also performs a Factory Preset that resets the N8201A to the Spectrum Analysis Mode. It does *not* reset user data such as saved instrument states.

Trace/View

Trace/View functions are only available in **Measure** > *Noise Figure mode.*

Accesses the View and Trace menu keys that allow you to set and view the measurement result information. The menu options will vary depending on the measurement that is selected under the Measure menu.

View

Graph

Displays the measurement results in the form of a graph.

Table

Displays the measurement results in the form of a table.

Meter

Displays the measurement results in the form of a textual display.

Combined

When you have chosen to view the measurement results in the form of a Graph, you can refine the view further by choosing either to combine the results in one graph, or to display the results in two separate graphs.

On

Select On to combine the measurement results in one graph on the display.

Off

Select Off to display the measurement results in two separate graphs on the display.

Display

Displays the two graphs at the same time, or either one separately.

Both

Displays both measurement graphs in the display window.

A Only

Displays graph A in the display window.

B Only

Displays graph B in the display window.

Result A

Determines the type of measurement result to be displayed in the upper graph window in Graph view, and in the left hand column in the Table and Meter views. The type of measurement result can be selected from the following list:

Noise Figure

Selects Noise Figure as the measurement result, and dB as the unit of measurement.

Noise Factor

Selects Noise Factor as the measurement result, which is a unitless measurement.

Gain

Selects Gain as the measurement result.

Y-Factor

Selects Y-Factor as the measurement result.

T effective

Selects equivalent temperature as the measurement result.

P hot

Selects hot power density as the measurement result.

P cold

Selects cold power density as the measurement result.

NOTE

Noise Factor measurements lack a unit of measurement as the results represent the ratio of two ratios, that is, they represent the ratio of the signal to noise ratio at the input signal to the signal to noise ratio at the output. Ref Level and Scale/Div values can still be entered in dB, but these values will be converted to linear values, and displayed in the results graph/table as linear values.

Conversely, Noise Figure, Gain, Y-Factor, Phot, and Pcold all use dB as the unit of measurement, but Scale/Div and Ref Level can all be entered as a unitless ratio. This ratio will be automatically converted to dB for display in the Graph, Table or Meter views.

T effective results are always displayed in Kelvin. For T effective measurements, Scale/Div and Ref Level can be entered in Celsius (C) or Fahrenheit (F), but will be converted to Kelvin for display in the Graph, Table or Meter views.

Result B

Determines the type of measurement result to be displayed in the lower graph window in Graph view, and in the right hand column in the Table Meter views. The type of measurement result can be selected from the following list:

Noise Figure

Selects Noise Figure as the measurement result.

Noise Factor

Selects Noise Factor as the measurement result, which is a unitless measurement

Gain

Selects Gain as the measurement result.

Y-Factor

Selects Y-Factor as the measurement result.

T effective

Selects equivalent temperature as the measurement result.

P hot

Selects hot power density as the measurement result.

P cold

Selects cold power density as the measurement result.

NOTE

Noise Factor measurements lack a unit of measurement as the results represent the ratio of two ratios, that is, they represent the ratio of the signal to noise ratio at the input signal to the signal to noise ratio at the output. Ref Level and Scale/Div values can still be entered in dB, but these values will be converted to linear values, and displayed in the results graph/table as linear values.

Conversely, Noise Figure, Gain, Y-Factor, Phot, and Pcold all use dB as the unit of measurement, but Scale/Div and Ref Level can all be entered as a unitless ratio. This ratio will be automatically converted to dB for display in the Graph, Table or Meter views.

T effective results are always displayed in Kelvin. For T effective measurements, Scale/Div and Ref Level can be entered in Celsius (C) or Fahrenheit (F), but will be converted to Kelvin for display in the Graph, Table or Meter views.

Trig

Displays menu keys for selecting the trigger mode of a sweep or measurement. When in a trigger mode other than Free Run, the N8201A will begin a sweep only with the proper triggering condition.

Trigger

Accesses a menu of trigger modes.

Free Run

Sets the trigger to start a new sweep as soon as the last one has ended (continuous sweep mode) or immediately (single sweep mode).

Video

Activates the trigger condition that allows the next sweep to start if the detected RF envelope voltage crosses a level set by the video trigger level. When Video is pressed, a line appears on the display. The N8201A triggers when the input signal exceeds the trigger level at the left edge of the display. The line remains on the display as long as video trigger is the trigger type.

Line

Sets the trigger to start a new sweep to be synchronized with the next cycle of line voltage.

Trigger In

Sets the trigger to start a new sweep whenever the external voltage (connected to the front panel Trigger In) passes through approximately 1.5 V.

RF Burst

Sets the trigger to start by an RF burst envelope signal.

Trig Slope

Sets the trigger polarity to positive to trigger on the rising edge, or negative to trigger on the falling edge.

Trig Delay

Sets the trigger delay to Off.

NOTE

Trigger Delay is not available in Free Run mode, so turning Free Run on turns off Trigger Delay, but preserves the value of Trigger Delay.

6
Language Reference

These commands are only available when the Noise Figure mode has been selected using INSTrument:SELect NFIGURE or INSTrument:NSELect 219. If the Noise Figure mode is selected, commands that are unique to another mode are not available.

CALCulate Subsystem

This subsystem is used to perform post-acquisition data processing. In effect, the collection of new data triggers the CALCulate subsystem. In this instrument, the primary functions in this subsystem are markers and limits.

The SCPI default for data output format is ASCII. The format can be changed to binary with FORMat:DATA which transports faster over the bus.

Test Current Results Against all Limits

```
:CALCulate:CLIMits:FAIL?
```

Queries the status of the current measurement limit testing. It returns a 0 if the measured results pass when compared with the current limits. It returns a 1 if the measured results fail any limit tests.

Noise Figure Measurement

Noise Figure—Number of Points on a Limit Line

```
:CALCulate[:NFIGure]:LLINe[1]|2|3|4:COUNT?
```

Queries and returns the number of sets of points in the selected limit line. One set of points comprises a frequency value (in Hz), an amplitude limit value (unitless), and a 1 or a 0 determining connectivity to the previous point.

Factory Preset: 2

Range: 0 - 101 point-sets.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Specifying Point Values for a Limit Line

```
:CALCulate[:NFIGure]:LLINe[1]|2|3|4[:DATA]
    <frequency>,<amplitude>,<connected>[<frequency>,<amplitude>,
    <connected>]
```

```
:CALCulate[:NFIGure]:LLINe[1]|2|3|4[:DATA]?
```

Specifies the limit line values.

The amplitude values of the limit lines have no units of their own. Instead they take on the units of the graph to which the limit line is applied. If the units of the graph are changed then the limit line values take on the new units without rescaling.

`<frequency>` - is a frequency in Hz. Frequency values do not allow units (for instance, MHz) to be specified. They are always in Hz.

`<ampl>` - amplitude values are unitless.

`<connected>` - connected values are either 0 or 1. A 1 means this point is connected to the previously defined point to define the limit line. A 0 means this is a point of discontinuity and is not connected to the preceding point.

Limit lines 1 and 2 apply to the trace that is displayed in the upper graph. Limit lines 3 and 4 apply to the trace that is displayed in the lower graph.

Factory Preset: 10,0,1,2.65e+10,0,1

Range: 0 - 101 point-sets.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Limit Line Display Control

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:DISPlay[:STATe] OFF|ON|0|1

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:DISPlay[:STATe]?

Turns the display of a limit line On or Off. Limit line checking still occurs even when the limit line display has been turned off.

Factory Preset: On

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode. A Limit Line Display State of On will be overridden if the Limit Line State is set to Off.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Limit Line State Control

:CALCulate[:NFIGure]:LLINe[1]|2|3|4[:STATe] OFF|ON|0|1

:CALCulate[:NFIGure]:LLINe[1]|2|3|4[:STATe]?

Turns the limit line state On or Off. When the limit line state (this command) is Off, both the display and the testing of the limit line are disabled, regardless of their individual ON|OFF settings. When the limit line state is set to On, the display and the testing of the limit line are both enabled, and their individual ON|OFF settings then come into effect.

Factory Preset: Off

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Limit Line Test Control

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:TEST[:STATe] OFF|ON|0|1

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:TEST[:STATe]?

Turns the limit line trace testing On or Off for the specified limit line.

Factory Preset: Off

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode. A Limit Line Test State of On will be overridden if the Limit Line State is set to Off.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Limit Line Type Control

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:TYPE UPPer|LOWer

:CALCulate[:NFIGure]:LLINe[1]|2|3|4:TYPE?

Sets the limit line type. An upper limit line defines the maximum allowable value when comparing with the data, and a lower limit line defines the minimum allowable value.

Factory Preset: UPPer

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Limits, Limit Line, Edit...

Noise Figure—Marker Band Pair Mode

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:BPAir:MODE NORMal:REFerence

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:BPAir:MODE?

Specifies which marker within a pair of linked markers (the band pair) is to be controlled using the Marker Position scroll bar.

Factory Preset: NORMal

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Marker, Mode, Delta

Noise Figure—Marker Mode

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:MODE POSition|DELTa|BPAir

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:MODE?

Sets the marker mode for the specified marker. The three valid marker modes are:

Normal (POSition)

Activates a single marker on the displayed traces. The marker's number is displayed above the marker on the display. The marker's position can be changed using the keyboard. The marker's amplitudes are updated automatically.

DELTa

Activates a pair of delta markers on the displayed traces. Once you activate the DELTa markers, the position of the reference marker is fixed. Only the position of the delta marker can be changed.

Band Pair (BPAir)

Activates a pair of delta markers on the displayed traces. When band pair (BPAir) markers are activated, both the reference marker's position and the delta marker's position can be changed.

Factory Preset: OFF

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Marker

Noise Figure—Marker Search Continuous

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:SEARch:CONTinuous OFF|ON|0|1

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:SEARch:CONTinuous?

Searches continuously for maximum, minimum, or peak-to-peak points for the current marker. When set to On, a peak search is performed after every measurement sweep.

Factory Preset: OFF

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Peak Search

Noise Figure—Marker Search Type

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:SEARch:TYPE MAXimum|MINimum|PEAK

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:SEARch:TYPE?

Specifies the type of search performed by the specified marker. The three valid types of search are:

MAXimum

Searches for and finds the highest peak on the trace. This is not valid when the marker mode is set to Band Pair.

MINimum

Searches for and finds the lowest trough on the trace. This is not valid when the marker mode is Band Pair

PEAK

When a peak search is performed, the Band Pair markers are placed on the highest and the lowest points of the trace. The reference marker is placed on the highest point of the trace, and the delta marker on the lowest.

Factory Preset: MAXimum

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

All of these searches can be made continuous by switching Continuous to ON (See “Noise Figure—Marker Search Continuous" on page 158.), or by repeatedly pressing the ‘Find...’ softkey.

Front Panel Access: Peak Search

Noise Figure—Marker State

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:[:STATe] OFF|ON|0|1

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:[:STATe]?

Turns the specified marker On or Off.

Factory Preset:

- Marker 1 - On
- Markers 2, 3, and 4 - Off

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Marker

Noise Figure—Marker X Position

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:X <freq>

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:X?

Sets the X-axis position of the specified marker on the trace. When setting the X-axis position, the unit of measurement is assumed to be Hz unless you specify otherwise. When querying the X-axis position, the result is always returned in Hz.

Factory Preset: None

Range: Same as the measurement range

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Peak Search

Noise Figure—Marker Y Position

:CALCulate[:NFIGure]:MARKer[1]|2|3|4:Y?

Returns two comma-separated values representing the current marker’s positions on the two traces. Each value is in the Y-axis unit of the relevant trace.

Factory Preset: None

Range: Same as the measurement range

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: TAB (until the marker table becomes visible)

Noise Figure—DUT Gain

:CALCulate:UNCertainty:DUT:GAIN <value>

:CALCulate:UNCertainty:DUT:GAIN?

Specifies the measured gain of the device under test (DUT).

Factory Preset: 20.00 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—DUT Input Match

:CALCulate:UNCertainty:DUT:MATCh:INPut <value>

:CALCulate:UNCertainty:DUT:MATCh:INPut?

Specifies the measured Input Match of the DUT.

Factory Preset: 1.500

Range: –100 to 100

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The unit of measurement, which can be dB, VSWR (Voltage Standing Wave Ratio) or Reflection Coefficient, is calculated from the input value.Negative values are assumed to be return loss in dB, values equal to or greater than 1 represent VSWR, and values greater than or equal to zero and less than 1 represent the reflection coefficient.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—DUT Output Match

:CALCulate:UNCertainty:DUT:MATCh:OUTPut <value>

:CALCulate:UNCertainty:DUT:MATCh:OUTPut?

Specifies the measured Output Match of the DUT.

Factory Preset: 1.500

Range: –100 to 100

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The unit of measurement, which can be dB, VSWR (Voltage Standing Wave Ratio) or Reflection Coefficient, is determined by the input value. Negative values are assumed to be return loss in dB, values equal to or greater than 1 represent VSWR, and values greater than or equal to zero and less than 1 represent the reflection coefficient.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—DUT Noise Figure

:CALCulate:UNCertainty:DUT:NFIGure <value>

:CALCulate:UNCertainty:DUT:NFIGure?

Specifies the measured Noise Figure of the Device Under Test (DUT).

Factory Preset: 3.0 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Instrument Gain

:CALCulate:UNCertainty:INSTrument:GAIN <value>

:CALCulate:UNCertainty:INSTrument:GAIN?

Specifies the gain of the N8201A. The Instrument Gain is set by default to pre-calculated values of 0.17 dB.

Factory Preset: - 0.17 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Instrument Match

:CALCulate:UNCertainty:INSTrument:MATCh <value>

:CALCulate:UNCertainty:INSTrument:MATCh?

Specifies the measured Match of the N8201A. The Instrument Match is set by default to a pre-calculated VSWR value of 1.60 f.

Factory Preset: 1.6000

Range: –100 to 100

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The unit of measurement, which can be dB, VSWR (Voltage Standing Wave Ratio) or Reflection Coefficient, is determined by the input value. Negative values are assumed to be return loss in dB, values equal to or greater than 1 represent VSWR, and values greater than or equal to zero and less than 1 represent the reflection coefficient.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Instrument Noise Figure

:CALCulate:UNCertainty:INSTrument:NFIGure <value>

:CALCulate:UNCertainty:INSTrument:NFIGure?

Specifies the measured Noise Figure of the N8201A. The default settings are 6.0 dB. More appropriate values can be found in the relevant specifications guides.

Factory Preset: 6.0 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Instrument Noise Figure Uncertainty

:CALCulate:UNCertainty:INSTrument:NFIGure:UNCertainty <value>

:CALCulate:UNCertainty:INSTrument:NFIGure:UNCertainty?

Specifies the measured Noise Figure Uncertainty of the N8201A. The default setting of 0.05 dB is good for most measurements.

Factory Preset: 0.05 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—RSS Uncertainty

:CALCulate:UNCertainty:RSS?

Queries and returns the Root Sum Squared (RSS) Uncertainty value. The RSS Uncertainty value, expressed in dB, is a measure of the overall uncertainty of your noise figure measurement. It is calculated from all the individual uncertainty parameters known to the N8201A. An indicated RSS Uncertainty value of *x* dB means that your measurement's uncertainty is ± *x* dB.

Factory Preset: Calculated

Range: Any positive value < 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Noise Source ENR Uncertainty

:CALCulate:UNCertainty:SOURce:ENR <value>

:CALCulate:UNCertainty:SOURce:ENR?

Sets the Excess Noise Ratio (ENR) Uncertainty of your noise source.

Factory Preset: 0.20 dB

Range: –100 dB to 100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The ENR Uncertainty can only be modified when your noise source is User Defined. For greatest accuracy, set your noise source to User Defined, and enter the value specific to your noise source.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Noise Source Match

:CALCulate:UNCertainty:SOURce:MATCh <value>

:CALCulate:UNCertainty:SOURce:MATCh?

Sets the Match of your noise source.

Factory Preset: 1.1500

Range: –100 to 100

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The unit of measurement, which can be dB, VSWR (Voltage Standing Wave Ratio) or Reflection Coefficient, is determined by the input value. Negative values are assumed to be return loss in dB, values equal to or greater than 1 represent VSWR, and values greater than or equal to zero and less than 1 represent the reflection coefficient.

The Noise Source Match can only be modified when your noise source is User Defined.

Front Panel Access: Mode Setup, Uncertainty Calculator...

Noise Figure—Noise Source Match

:CALCulate:UNCertainty:SOURce:TYPE <value>

:CALCulate:UNCertainty:SOURce:TYPE?

Specifies the type of noise source you will be using for your measurements. The three pre-defined noise sources, Agilent Technologies' models 346A, 346B and 346C have pre-defined match and uncertainty figures which cannot be changed. Only by selecting a source type of USER (user defined) can you change the match and uncertainty figures.

Factory Preset: 346B

Range: USER|346A|346B|346C

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, Uncertainty Calculator...

CONFigure Subsystem

The CONFigure commands are used with several other commands to control the measurement process. The full set of commands is described in the section “MEASure Group of Commands" on page 189.

Selecting measurements with the CONFigure/FETCh/MEASure/READ commands sets the instrument state to the defaults for that measurement and to make a single measurement. Other commands are available for each measurement to allow you to change: settings, view, limits, etc. Refer to:

SENSe:<measurement>, SENSe:CHANnel, SENSe:CORRection, SENSe:DEFaults, SENSe:DEViation, SENSe:FREQuency, SENSe:PACKet, SENSe:POWer, SENSe:RADio, SENSe:SYNC

CALCulate:<measurement>, CALCulate:CLIMits

DISPlay:<measurement>

TRIGger

The INITiate[:IMMediate] or INITiate:RESTart commands will initiate the taking of measurement data without resetting any of the measurement settings that you have changed from their defaults.

Configure the Selected Measurement

:CONFigure:<measurement>

A CONFigure command must specify the desired measurement. It will set the instrument settings for that measurement’s standard defaults, but should not initiate the taking of data. The available measurements are described in the MEASure subsystem.

If CONFigure initiates the taking of data, the data should be ignored. Other SCPI commands can be processed immediately after sending CONFigure. You do not need to wait for the CONF command to complete this 'false' data acquisition.

Configure Query

:CONFigure?

The CONFigure query returns the name of the current measurement.

DISPlay Subsystem

The DISPlay controls the selection and presentation of textual, graphical, and TRACe information. Within a DISPlay, information may be separated into individual WINDows.

Full Screen Display

:DISPlay:FSCReen[:STATe] OFF|ON|0|1

:DISPlay:FSCReen[:STATe]?

For Noise Figure Mode only:

:DISPlay:FSCREEN|FULLSCREEN[:STATe] ON|OFF|1|0

:DISPlay:FSCREEN|FULLSCREEN[:STATe]?

When the full screen function is activated, the measurement window expands horizontally over the entire instrument display. That is, it turns off the display of the softkey labels. Pressing any other key that results in a new menu will cancel the full screen function.

State Saved: Not saved in state.

Factory Preset: Off

Factory Default: Off

Front Panel Access: None

Example: DISP:FSCR ON

Set the Display Line Level

:DISPlay:MONitor:WINDow:TRACe:Y:DLINe <power>

:DISPlay:MONitor:WINDow:TRACe:Y:DLINe?

Sets the vertical position of the display line.

Factory Preset: –25 dBm

Range: –170 dBm to 30 dBm

Default Unit: dBm

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: When in Monitor Spectrum measurement, Display

Set the Display Line State

:DISPlay:MONitor:WINDow:TRACe:Y:DLINe:STATe ON|OFF|1|0

:DISPlay:MONitor:WINDow:TRACe:Y:DLINe:STATe?

Enables or disables the display line.

Factory Preset: OFF

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display > Limits

Set the Y-Axis Scale per Division

:DISPlay:MONitor:WINDow:TRACe:Y[:SCALe]:PDIVision <dB>

:DISPlay:MONitor:WINDow:TRACe:Y[:SCALe]:PDIVision?

Sets the Y-axis scale per division.

Factory Preset: 10 dB

Range: 0.1 dB to 20 dB

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Amplitude > Scale/Div

Set the Reference Level

:DISPlay:MONitor:WINDow:TRACe:Y[:SCALe]:RLEVel <dB>

:DISPlay:MONitor:WINDow:TRACe:Y[:SCALe]:RLEVel?

Sets the amplitude reference level for the Y-axis. The reference level is the amplitude power represented by the top graticule on the display.

Factory Preset:

With no pre-amp present: –20 dBm

With pre-amp (either On or Off): –50 dBm (automatically adjusted according to power)

Range:

Without pre-amp, or pre-amp OFF: –170 dBm to 30 dB

With pre-amp ON: –170 dBm to –10 dBm

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: When in Monitor Spectrum measurement, Amplitude

Set Display Annotation On/Off

:DISPlay[:NFIGure]:ANNotation[:STATe] ON|OFF|1|0

:DISPlay[:NFIGure]:ANNotation[:STATe]?

Turns the display of the annotation on or off.

Factory Preset: ON

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Preferences

Date and Time Display

:DISPlay[:NFIGure]:ANNotation:CLOCk:DATE:FORMat MDY|DMY

:DISPlay[:NFIGure]:ANNotation:CLOCk:DATE:FORMat?

Allows you to set the format for displaying the real-time clock. To set the date time use :SYSTem:DATE <year>,<month>,<day>.

Factory Preset: DMY

Remarks: This parameter is persistent, which means that it retains the setting previously selected, even through a power cycle.

Front Panel Access: System, Time/Date, Date Format MDY DMY

Date and Time Display

:DISPlay[:NFIGure]:ANNotation:CLOCk[:STATe] OFF|ON|0|1

:DISPlay[:NFIGure]:ANNotation:CLOCk[:STATe]?

Turns on and off the display of the date and time on the N8201A display. The time and date pertain to all windows.

Factory Preset: On

Remarks: This parameter is persistent, which means that it retains the setting previously selected, even through a power cycle.

Front Panel Access: System, Time/Date, Time/Date On Off

Noise Figure Corrections

:DISPlay[:NFIGure]:DATA:CORRections[:STATe] ON|OFF|1|0

:DISPlay[:NFIGure]:DATA:CORRections[:STATe]?

Enables or disables the display of corrected data. An error will be returned if a user calibration has not been performed prior to issuing this command.

Factory Preset: ON

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input, Noise Figure Corrections

Select Results for Display (A)

:DISPlay[:NFIGure]:DATA:TRACe[1]
NFIGure|NFACtor|GAIN|YFACtor|TEFFective|PHOT|PCOLd

:DISPlay[:NFIGure]:DATA:TRACe[1]?

Selects the type of measurement results to be displayed in the upper display window when in graph view, or in the center column in the table or meter views.

The seven types of result are:

- NFIGure - Noise figure
- NFACtor - Noise factor (linear noise figure)
- GAIN - Gain

- YFACtor - Y-factor
- PHOT - Hot power density
- PCOLd - Cold power density

Factory Preset: NFIGure

Range: NFIGure, NFACtor, GAIN, YFACtor, TEFFective, PHOT or PCOLd

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Trace/View, Result A

Select Results for Display (B)

:DISPlay[:NFIGure]:DATA:TRACe2
NFIGure|NFACtor|GAIN|YFACtor|TEFFective|PHOT|PCOLd

:DISPlay[:NFIGure]:DATA:TRACe[1]?

Selects the type of measurement results to be displayed in the lower display window when in graph view, or in the right column in the table or meter views.

The seven types of result are:

- NFIGure - Noise figure
- NFACtor - Noise factor (linear noise figure)
- GAIN - Gain
- YFACtor - Y-factor
- PHOT - Hot power density
- PCOLd - Cold power density

Factory Preset: NFIGure

Range: NFIGure, NFACtor, GAIN, YFACtor, TEFFective, PHOT or PCOLd

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Trace/View, Result B

Select Results Format

:DISPlay[:NFIGure]:FORMat GRAPh|TABLe|METer

:DISPlay[:NFIGure]:FORMat?

Selects the format in which the measurement results will be displayed. It is not necessary to capture new data when you change the results format. This means that you can capture data in a single sweep, and then view this data in any of the three views.

- GRAPh - Displays the results graphically
- TABLe - Displays the results in a table with one line per discrete frequency
- METer - Displays the results at one specified frequency

Factory Preset: GRAPh

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Trace/View, View

Set Graticule On or Off

:DISPlay[:NFIGure]:GRATicule[:STATe] ON|OFF|1|0

:DISPlay[:NFIGure]:GRATicule[:STATe]?

Specifies whether or not the graticule lines will be displayed.

Factory Preset: ON

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Display, Preferences

Set Graph View

:DISPlay[:NFIGure]:TRACe:COMBined[:STATe] ON|OFF|1|0

:DISPlay[:NFIGure]:TRACe:COMBined[:STATe]?

Specifies whether the two graph traces are displayed on separate graphs or in one combined graph with two scales.

- ON - Both traces are displayed on one graph with two scales
- OFF - The two graphs are displayed separately on the screen

Factory Preset: OFF

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Trace/View, View

Noise Figure - Set the Y-Axis Scale per Division

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:PDIVision <result>, <value>

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:PDIVision?

Sets the Y-axis scale per division for the specified graph window. The graph window is determined by the <result> setting, which can be one of:

- `NFIGure` — Noise Figure
- `NFACtor` — Noise Factor
- `GAIN` — Gain
- `YFACtor` — Y-Factor
- `TEFFective` — Effective Temp
- `PHOT` — Hot Power Density
- `PCOLd` — Cold Power Density

If the graph window that you have specified with this command is not visible, the new scaling will take effect the next time that the window is displayed.

Factory Preset: Presets are dependent on the <result> setting as follows:

- Noise Figure — 1.0 dB
- Noise Factor — 0.74189
- Gain — 5.0 dB
- Y Factor — 1.0 dB
- Effective Temp — 200 K
- Hot Power Density — 1.0 dB
- Cold Power Density — 1.0 dB

Range: The ranges are dependent on the <result> setting as follows:

- Noise Figure — 0.001 dB to 20 dB
- Noise Factor — 0.001 to 100
- Gain — 0.001 dB to 20 dB
- Y Factor — 0.001 dB to 20 dB
- Effective Temp — 0.1 K to 20,000,000 K
- Hot Power Density — 0.001 dB to 20 dB
- Cold Power Density — 0.001 dB to 20 dB

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Amplitude

Noise Figure - Set the Y-Axis Reference Value

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:RLEVel:VALue <result>, <value>

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:RLEVel:VALue?

Sets the Y-axis reference value for the specified graph window. The graph window is determined by the <result> setting, which can be one of:

- `NFIGure` — Noise Figure
- `NFACtor` — Noise Factor
- `GAIN` — Gain
- `YFACtor` — Y-Factor
- `TEFFective` — Effective Temp
- `PHOT` — Hot Power Density
- `PCOLd` — Cold Power Density

If the graph window that you have specified with this command is not visible, the new reference value will take effect the next time that the window is displayed.

Factory Preset: Presets are dependent on the <result> setting as follows:

- Noise Figure — 4.0 dB
- Noise Factor — 2.51189
- Gain — 15.0 dB
- Y Factor — 5.0 dB
- Effective Temp — 1000 K
- Hot Power Density — 5.0 dB
- Cold Power Density — 5.0 dB

Range: The ranges are dependent on the <result> setting as follows:

- Noise Figure — –100 dB to 100 dB
- Noise Factor — 0 to 1×10^9
- Gain — –100 dB to 100 dB
- Y Factor — –100 dB to 100 dB
- Effective Temp — –100,000,000 K to 100,000,000 K
- Hot Power Density — –100 dB to 100 dB

- Cold Power Density — –100 dB to 100 dB

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Amplitude

Noise Figure - Set the Y-Axis Reference Position

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:RPOSition <result>, <value>

:DISPlay[:NFIGure]:TRACe:Y[:SCALe]:RPOSition?

Sets the Y-axis reference position for the specified graph window. The graph window is determined by the <result> setting, which can be one of:

- `NFIGure` — Noise Figure
- `NFACtor` — Noise Factor
- `GAIN` — Gain
- `YFACtor` — Y-Factor
- `TEFFective` — Effective Temp
- `PHOT` — Hot Power Density
- `PCOLd` — Cold Power Density

If the graph window that you have specified with this command is not visible, the new reference position will take effect the next time that the window is displayed.

Factory Preset: CENTer for all <result> settings

Range: TOP|CENTer|BOTTom for all <result> settings

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Amplitude

Zoom Window

:DISPlay:[NFIGure]:ZOOM:WINDow OFF|UPPer|LOWer

:DISPlay:[NFIGure]:ZOOM:WINDow?

Selects the upper or lower window and expands it to fill the entire display.

- `OFF` — Returns the display to dual display.
- `UPPer` — Zoom the upper window.

- `LOWer` — Zoom the lower window.

Factory Preset: OFF

Remarks: You must be in Noise Figure to use this command. Use :INSTrument:SELect NFIGURE to set the mode.

FETCh Subsystem

The FETCh? queries are used with several other commands to control the measurement process. These commands are described in the section on the “MEASure Group of Commands" on page 189. These commands apply only to measurements found in the MEASURE menu.

This command puts selected data from the most recent measurement into the output buffer (new data is initiated/measured). Use FETCh if you have already made a good measurement and you want to look at several types of data (different [n] values) from the single measurement. FETCh saves you the time of re-making the measurement. You can only fetch results from the measurement that is currently active.

If you need to make a new measurement, use the READ command, which is equivalent to an INITiate[:IMMediate] followed by a FETCh.

:FETCh <meas>? will return valid data only when the measurement is in one of the following states:

idle

initiated

paused

Fetch the Current Measurement Results

:FETCh:<measurement>[n]?

A FETCh? command must specify the desired measurement. It will return the valid results that are currently available, but will not initiate the taking of any new data. You can only fetch results from the measurement that is currently selected. The code number n selects the kind of results that will be returned. The available measurements and data results are described in the “MEASure Group of Commands" on page 189.

FORMat Subsystem

The FORMat subsystem sets a data format for transferring numeric and array information. The TRACe[:DATA] command is affected by FORMat subsystem commands.

Byte Order

:FORMat:BORDer NORMal|SWAPped

:FORMat:BORDer?

Selects the binary data byte order for numeric data transfer. In normal mode the most significant byte is sent first. In swapped mode the least significant byte is first. (PCs use the swapped order.) Binary data byte order functionality does not apply to ASCII.

This command selects the binary data byte order for data transfer. It controls whether binary data is transferred in normal or swapped mode. This command affects only the byte order for setting and querying trace data for the command :TRACe[:DATA] and query :TRACe[:DATA]?

Normal mode is when the byte sequence begins with the most significant byte (MSB) first, and ends with the least significant byte (LSB) last in the sequence: 1|2|3|4. Swapped mode is when the byte sequence begins with the LSB first, and ends with the MSB last in the sequence: 4|3|2|1.

Factory Preset: Normal

Remarks: You must be in the Spectrum Analysis, Basic or Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Numeric Data Format

:FORMat[:TRACe][:DATA] ASCii|REAL[,32]

:FORMat[:TRACe][:DATA]?

Controls the format of data input/output, that is, any data transfer across any remote port. The REAL and ASCII formats will format data in the current display units. The format of state data cannot be changed. It is always in a machine readable format only.

This command specifies the formats used for trace data during data transfer across any remote port.

For corrected trace data (:TRACe[:DATA] with parameter <trace_name>), REAL and ASCii formats will provide trace data in the current amplitude units. INTeger format will provide trace data in mdBm. The fastest mode is INTeger,32.

For uncorrected trace data (:TRACe[:DATA] with parameter RAWTRACE), UINTeger and INTeger formats apply to RAWTRACE queries, and return uncorrected ADC values. The fastest mode is UINTeger,16.

For state data, the format cannot be changed. It is always in a machine readable format only.

Corrected Trace Data Types **:TRACe:DATA?<trace_name>**	
Data Type	**Result**
ASCii	Display Units
INT,32 (fastest)	Internal Units
REAL,32	Display Units
REAL,64	Display Units

Uncorrected Trace Data Types **:TRACe:DATA? RAWTRACE**	
Data Type	**Result**
INT,32	Uncorrected ADC Values
UINT,16 (fastest)	Uncorrected ADC Values

ASCII - Amplitude values are in ASCII, in amplitude units, separated by commas. ASCII format requires more memory than the binary formats. Therefore, handling large amounts of this type of data, will take more time and storage space.

Integer,16 - Binary 16-bit integer values in internal units (dBm), in a definite length block.

Integer,32 - Binary 32-bit integer values in internal units (dBm), in a definite length block.

Real,32 or Real,64 - Binary 32-bit (or 64-bit) real values in amplitude unit, in a definite length block. Transfers of real data are done in a binary block format.

UINTeger,16 - Binary 16-bit unsigned integer that is uncorrected ADC values, in a definite length block. This format is almost never applicable with current measurement data.

A definite length block of data starts with an ASCII header that begins with # and indicates how many additional data points are following in the block. Suppose the header is #512320.

- The first digit in the header (5) tells you how many additional digits/bytes there are in the header.
- The 12320 means 12 thousand, 3 hundred, 20 data bytes follow the header.

- Divide this number of bytes by your selected data format bytes/point, either 8 (for real 64), or 4 (for real 32). In this example, if you are using real 64 then there are 1540 points in the block.

Example: FORM REAL,64

Factory Preset:

Real,32 for Spectrum Analysis mode

ASCII for Basic and Noise Figure modes

Remarks: The acceptable settings for this command change for the different modes as described above.

INITiate Subsystem

The INITiate subsystem is used to initiate a trigger for a measurement. These commands only initiate measurements from the MEASURE front panel key or the “MEASure Group of Commands" on page 189. Refer also to the TRIGger and ABORt subsystems for related commands.

Take New Data Acquisition for Selected Measurement

:INITiate:<measurement>

Initiates a trigger cycle for the measurement specified, but does not return data. The valid measurement names are described in the MEASure subsystem.

If your selected measurement is not currently active, the instrument will change to the measurement in your INIT:<meas> command and initiate a trigger cycle.

This command is not available for the one-button measurements in the Spectrum Analysis mode.

Example: INIT:NFIG

Continuous or Single Measurements

:INITiate:CONTinuous OFF|ON|0|1

:INITiate:CONTinuous?

Selects whether a trigger is continuously initiated or not. Each trigger initiates a single, complete, measurement operation.

When set to ON another trigger cycle is initiated at the completion of each measurement.

When set to OFF, the trigger system remains in the “idle” state until an INITiate[:IMMediate] command is received. On receiving the INITiate[:IMMediate] command, it will go through a single trigger/measurement cycle, and then return to the “idle” state.

Example: INIT:CONT ON

Factory Preset: On

***RST:** Off (recommended for remote operation)

Front Panel Access: Meas Control, Measure Cont Single

Take New Data Acquisitions

:INITiate[:IMMediate]

Triggers the instrument, if external triggering is the type of trigger event selected. Otherwise, the command is ignored. Use the TRIGer[:SEQuence]:SOURce EXT command to select the external trigger.

The instrument must be in the single measurement mode. If INIT:CONT is ON, then the command is ignored. The desired measurement must be selected and waiting. The command causes the system to exit the “waiting” state and go to the “initiated” state.

The trigger system is initiated and completes one full trigger cycle. It returns to the “waiting” state on completion of the trigger cycle. Depending upon the measurement and the number of averages, there may be multiple data acquisitions, with multiple trigger events, for one full trigger cycle.

Example: INIT:IMM

Remarks: •

See also the *TRG command and the TRIGger subsystem.

Use :FETCh? to transfer a measurement result from memory to the output buffer. Refer to individual commands in the FETCh subsystem for more information.

Front Panel Access:

Sweep, Sweep Cont Single

Single

Meas Control, Measure Cont Single

Pause the Measurement

:INITiate:PAUSe

Pauses the current measurement by changing the current measurement state from the “wait for trigger” state to the “paused” state. If the measurement is not in the “wait for trigger” state, when the command is issued, the transition will be made the next time that state is entered as part of the trigger cycle. When in the paused state, the N8201A auto-align process stops. If the N8201A is paused for a long period of time, measurement accuracy may degrade.

Example: INIT:PAUS

Front Panel Access: Meas Control, Pause

Restart the Measurement

:INITiate:RESTart

Applies to measurements found in the MEASURE menu. It restarts the current measurement from the "idle" state regardless of its current operating state. It is equivalent to:

INITiate[:IMMediate]

ABORt (for continuous measurement mode)

Example: INIT:REST

Front Panel Access:

Restart

or

Meas Control, Restart

Resume the Measurement

:INITiate:RESume

Resumes the current measurement by changing the current measurement state from the "paused state" back to the "wait for trigger" state. If the measurement is not in the "paused" state, when the command is issued, an error is reported.

Example: INIT:RES

Front Panel Access: Meas Control, Resume

INPut Subsystem

The INPut subsystem controls the characteristics of all the instrument input ports.

RF Attenuation Setting

:INPut[:NFIGure]:ATTenuation <power>

:INPut[:NFIGure]:ATTenuation

Sets the attenuation value for the RF/Microwave input.

This command has the same effect as

:SENSe:NFIGure:MANual:RF|:MWAVe:FIXed <power>

Factory Preset: 0 dB

Range: 0 dB to 40 dB in 4 dB steps

The Range is never lower than the Min. RF Attenuation setting, and never higher than the Max. RF Attenuation.

Front Panel Access: Input, Attenuation

Maximum Microwave Attenuation Setting

:INPut[:NFIGure]:ATTenuation:MWAVe:MAXimum <integer>

:INPut[:NFIGure]:ATTenuation:MWAVe:MAXimum

See “RF Attenuation Setting" on page 184.

This command gives backwards compatibility with Agilent Technologies’ Noise Figure Analyzers (NFAs). It is functionally identical to the command

:INPut[:NFIGure]:ATTenuation[:RF]:MAXimum <integer>

Minimum Microwave Attenuation Setting

:INPut[:NFIGure]:ATTenuation:MWAVe:MINimum <integer>

:INPut[:NFIGure]:ATTenuation:MWAVe:MINimum

See “Minimum Microwave Attenuation Setting" on page 184.

Provides backwards compatibility with Agilent Tecnologies’ Noise Figure Analyzers (NFAs). It is functionally identical to the command

:INPut[:NFIGure]:ATTenuation[:RF]:MINimum <integer>

Maximum RF Attenuation Setting

:INPut[:NFIGure]:ATTenuation[:RF]:MAXimum <integer>

:INPut[:NFIGure]:ATTenuation[:RF]:MAXimum

Sets the maximum RF attenuation setting when a calibration is performed.

Use this command and the minimum RF attenuation command to limit the attenuation range used during calibration. See “Minimum Microwave Attenuation Setting" on page 184.

Factory Preset: 0 dB

Range: 0 dB to 40 dB in 4 dB steps

Never lower than the Min. RF Attenuation setting.

Front Panel Access: Input, Noise Figure Corrections, Input Cal

Minimum RF Attenuation Setting

:INPut[:NFIGure]:ATTenuation[:RF]:MINimum <integer>

:INPut[:NFIGure]:ATTenuation[:RF]:MINimum

Sets the minimum RF attenuation setting when a calibration is performed.

Use this command and the maximum RF attenuation command to limit the attenuation range used during calibration. See“Maximum RF Attenuation Setting" on page 185.

Factory Preset: 0 dB

Range: 0 dB to 40 dB in 4 dB steps

Never higher than the Max. RF Attenuation.

Front Panel Access: Input, Noise Figure Corrections, Input Cal

RF Input Port Coupling

:INPut:COUPling AC|DC

:INPut:COUPling? AC|DC

Selects AC or DC coupling for the front panel RF INPUT port. A blocking capacitor is switched in for the ac mode.

Instrument damage can occur if there is a DC component present at the RF INPUT and DC coupling is selected.

Factory Preset: (3 Hz - 26.5 GHz) - AC

Front Panel Access: Input/Output (or Input), Coupling AC DC

INSTrument Subsystem

This subsystem includes commands for querying and selecting instrument measurement (personality option) modes.

Select Application by Number

:INSTrument:NSELect <integer>

:INSTrument:NSELect?

Selects the measurement mode by its instrument number. The actual available choices depends upon which applications are installed in the instrument.

1= SA

8 = BASIC

14 = PNOISE (phase noise)

219 = NFIGURE (noise figure)

If you are using the SCPI status registers and the analyzer mode is changed, the status bits should be read, and any errors resolved, prior to switching modes. Error conditions that exist prior to switching modes cannot be detected using the condition registers after the mode change. This is true unless they recur after the mode change, although transitions of these conditions can be detected using the event registers.

Changing modes resets all SCPI status registers and mask registers to their power-on defaults. Hence, any event or condition register masks must be re-established after a mode change. Also note that the power up status bit is set by any mode change, since that is the default state after power up.

Example: INST:NSEL 219

Factory Preset: Persistent state with factory default of 1

Range: 1 to x, where x depends upon which applications are installed.

Front Panel Access: MODE

Select Application

:INSTrument[:SELect] SA|PNOISE|BASIC||NFIGURE

:INSTrument[:SELect]?

Selects the measurement mode. The actual available choices depend upon which modes (measurement applications) are installed in the instrument. A list of the valid choices is returned with the INST:CAT? query.

Once an instrument mode is selected, only the commands that are valid for that mode can be executed.

1 = SA

8 = BASIC

14 = PNOISE (phase noise)

219 = NFIGURE (noise figure)

If you are using the status bits and the analyzer mode is changed, the status bits should be read, and any errors resolved, prior to switching modes. Error conditions that exist prior to switching modes cannot be detected using the condition registers after the mode change. This is true unless they recur after the mode change, although transitions of these conditions can be detected using the event registers.

Changing modes resets all SCPI status registers and mask registers to their power-on defaults. Hence, any event or condition register masks must be re-established after a mode change. Also note that the power up status bit is set by any mode change, since that is the default state after power up.

Example: INST:SEL PNOISE

Factory Preset: Persistent state with factory default of Spectrum Analyzer mode.

Front Panel Access: MODE

MEASure Group of Commands

This group includes the CONFigure, FETCh, MEASure, and READ commands that are used to make measurements and return results. The different commands can be used to provide fine control of the overall measurement process, like changing measurement parameters from their default settings. Most measurements should be done in single measurement mode, rather than measuring continuously.

The SCPI default for the format of any data output is ASCII. The format can be changed to binary with FORMat:DATA which transports faster over the bus.

Command Interactions: MEASure, CONFigure, FETCh, INITiate and READ

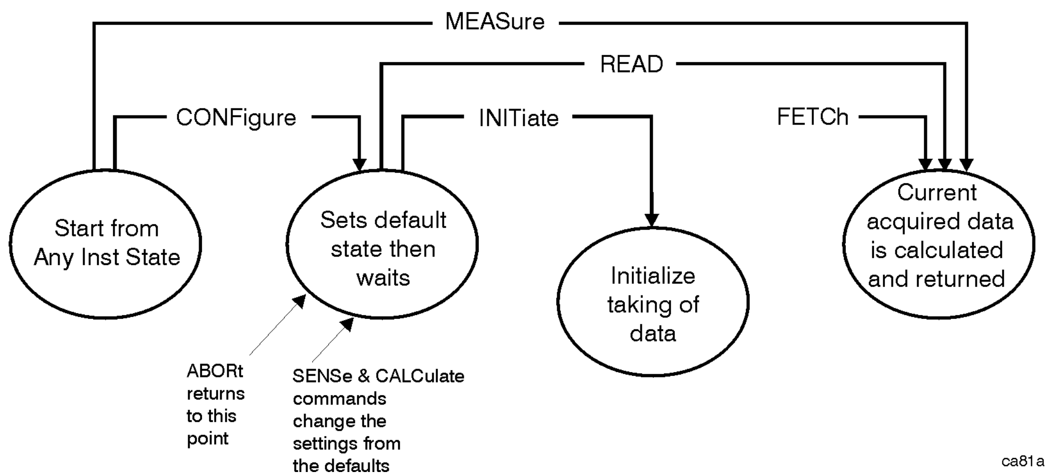


Figure 40 Measurement Group of Commands

Measure Commands:

:MEASure:<measurement>[n]?

This is a fast single-command way to make a measurement using the factory default instrument settings. These are the settings and units that conform to the Mode Setup settings (e.g. radio standard) that you have currently selected.

- Stops the current measurement (if any) and sets up the instrument for the specified measurement using the factory defaults
- Initiates the data acquisition for the measurement
- Blocks other SCPI communication, waiting until the measurement is complete before returning results.
- After the data is valid it returns the scalar results, or the trace data, for the specified measurement. The type of data returned may be defined by an [n] value that is sent with the command.

  The scalar measurement results will be returned if the optional [n] value is not included, or is set to 1. If the [n] value is set to a value other than 1, the selected trace data results will be returned. See each command for details of what types of scalar results or trace data results are available.

  ASCII is the default format for the data output. (Older versions of Spectrum Analysis and Phase Noise mode measurements only use ASCII.) The binary data formats should be used for handling large blocks of data since they are smaller and faster than the ASCII format. Refer to the FORMat:DATA command for more information.

If you need to change some of the measurement parameters from the factory default settings you can set up the measurement with the CONFigure command. Use the commands in the SENSe:<measurement> and CALCulate:<measurement> subsystems to change the settings. Then you can use the READ? command to initiate the measurement and query the results. See Figure 40 on page 189.

If you need to repeatedly make a given measurement with settings other than the factory defaults, you can use the commands in the SENSe:<measurement> and CALCulate:<measurement> subsystems to set up the measurement. Then use the READ? command to initiate the measurement and query results.

Measurement settings persist if you initiate a different measurement and then return to a previous one. Use READ:<measurement>? if you want to use those persistent settings. If you want to go back to the default settings, use MEASure:<measurement>?.

Configure Commands:

:CONFigure:<measurement>

This command stops the current measurement (if any) and sets up the instrument for the specified measurement using the factory default instrument settings. It sets the instrument to single measurement mode but should not initiate the taking of measurement data unless INIT:CONTinuous is ON. After you change any measurement settings, the READ command can be used to initiate a measurement without changing the settings back to their defaults.

The CONFigure? query returns the current measurement name.

Fetch Commands:

:FETCh:<measurement>[n]?

This command puts selected data from the most recent measurement into the output buffer. Use FETCh if you have already made a good measurement and you want to return several types of data (different [n] values, e.g. both scalars and trace data) from a single measurement. FETCh saves you the time of re-making the measurement. You can only FETCh results from the measurement that is currently active, it will not change to a different measurement.

If you need to get new measurement data, use the READ command, which is equivalent to an INITiate followed by a FETCh.

The scalar measurement results will be returned if the optional [n] value is not included, or is set to 1. If the [n] value is set to a value other than 1, the selected trace data results will be returned. See each command for details of what types of scalar results or trace data results are available. The binary data formats should be used for handling large blocks of data since they are smaller and transfer faster then the ASCII format. (FORMat:DATA)

FETCh may be used to return results other than those specified with the original READ or MEASure command that you sent.

INITiate Commands:

:INITiate:<measurement>

This command is not available for measurements in all the instrument modes:

- Initiates a trigger cycle for the specified measurement, but does not output any data. You must then use the FETCh<meas> command to return data. If a measurement other than the current one is specified, the instrument will switch to that measurement and then initiate it.

  For example, suppose you have previously initiated the ACP measurement, but now you are running the channel power measurement. If you send INIT:ACP? it will change from channel power to ACP and will initiate an ACP measurement.

- Does not change any of the measurement settings. For example, if you have previously started the ACP measurement and you send INIT:ACP? it will initiate a new ACP measurement using the same instrument settings as the last time ACP was run.

- If your selected measurement is currently active (in the idle state) it triggers the measurement, assuming the trigger conditions are met. Then it completes one trigger cycle. Depending upon the measurement and the number of averages, there may be multiple data acquisitions, with multiple trigger events, for one full trigger cycle.

READ Commands:
:READ:<measurement>[n]? • Does not preset the measurement to the factory default settings. For example, if you have previously initiated the ACP measurement and you send READ:ACP? it will initiate a new measurement using the same instrument settings. • Initiates the measurement and puts valid data into the output buffer. If a measurement other than the current one is specified, the instrument will switch to that measurement before it initiates the measurement and returns results. For example, suppose you have previously initiated the ACP measurement, but now you are running the channel power measurement. Then you send READ:ACP? It will change from channel power back to ACP and, using the previous ACP settings, will initiate the measurement and return results. • Blocks other SCPI communication, waiting until the measurement is complete before returning the results If the optional [n] value is not included, or is set to 1, the scalar measurement results will be returned. If the [n] value is set to a value other than 1, the selected trace data results will be returned. See each command for details of what types of scalar results or trace data results are available. The binary data formats should be used when handling large blocks of data since they are smaller and faster then the ASCII format. (FORMat:DATA)

Monitor Spectrum

Measures the power levels across the specified spectral band using one of three traces. By default, the N8201A’s entire range is measured.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section. See the SENSe:MONitor commands for more measurement related commands.

:CONFigure:MONitor

:FETCh:MONitor[n]

:READ:MONitor[n]

:MEASure:MONitor[n]

Front Panel Access: Measure, Monitor Spectrum

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Table 10 Measurement Results Available

n	Results Returned
n=1 (or not specified)	Trace 1 data if available, otherwise nothing
2	Trace 2 data if available, otherwise nothing
3	Trace 3 data if available, otherwise nothing

Noise Figure Measurement

Returns a set of thirteen noise figure measurement results in a specified order and separated by commas. The order in which the thirteen results are returned is shown in the table below, and they represent the last data measured in the last measurement sweep that was made.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:CONFigure[:NFIGure]

:INITiate[:NFIGure]

:FETCh[:NFIGure]?

:READ[:NFIGure]?

:MEASure[:NFIGure]?

Front Panel Access: Trace/View, Result A and B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

NFIGure
Measurement Results Returned
Returns the following scalar results, in order. T_{cold} scalar value Corrected scalar result for Noise Figure Corrected scalar result for Noise Factor Corrected scalar result for Gain Corrected scalar result for Effective Temperature Corrected scalar result for Hot Power Density Corrected scalar result for Cold Power Density Uncorrected scalar result for Noise Figure Uncorrected scalar result for Noise Factor Uncorrected scalar result for Gain Uncorrected scalar result for Effective Temperature Uncorrected scalar result for Hot Power Density Uncorrected scalar result for Cold Power Density

Noise Figure Measurement - Gain Results

Returns the Gain values used in calculating the measurement results. The returned values are in the default units of dB.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA]:CORRected:GAIN?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA]:CORRected:GAIN?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA]:CORRected:GAIN?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Noise Factor Results

Returns the Noise Factor values used in calculating the measurement results. The returned values are linear.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFACtor?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFACtor?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFACtor?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Noise Figure Results

Returns the Noise Figure values used in calculating the measurement results. The returned values are in the default units of dB.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFIGure?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFIGure?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:NFIGure?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Cold Power P_{cold} Density Results

Returns the Cold Power values from the most recently completed swept frequency measurement. The returned values are in the default units of dB.

The instrument makes cold power measurements with the noise source switched off. The reported value is a power level which is relative to the power at the input.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PCOLd?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PCOLd?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PCOLd?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Hot Power P_{hot} Density Results

Returns the Hot Power values from the most recently completed swept frequency measurement. The returned values are in the default units of dB.

The instrument makes hot power measurements with the noise source switched on. The reported value is a power level which is relative to the power at the input.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PHOT?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PHOT?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:PHOT?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Effective Temperature Results

Returns the Effective Temperature values from the most recently completed swept frequency measurement. The returned values are in the default units of degrees Kelvin.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:TEFFective?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:TEFFective?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA](:CORRected|:UNCorrected)
:TEFFective?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - T_{cold} Results

Returns the T_{cold} values used in calculating the measurement results. The results returned are from the most recently completed swept measurement if :ARRay has been selected, or from the most recently completed fixed measurement if :SCALar has been selected. The returned values are in the default units of degrees Kelvin.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA]:TCOLd?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA]:TCOLd?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA]:TCOLd?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

Noise Figure Measurement - Y Factor Results

Returns the Y Factor values from the most recently completed swept frequency measurement. The results returned are from the most recently completed swept measurement if :ARRay has been selected, or from the most recently completed fixed measurement if :SCALar has been selected. The returned values are in the default units of dB.

Sweep results are returned as a list of comma separated values, one value for each measurement frequency.

You must be in Noise Figure mode to use these commands. Use INSTrument:SELect NFIGURE to set the mode.

The general functionality of CONFigure, FETCh, MEASure, and READ are described at the beginning of this section.

:FETCh[:NFIGure]([:ARRay]|:SCALar)[:DATA]:UNCorrected :YFACtor?

:READ[:NFIGure]([:ARRay]|:SCALar)[:DATA]:UNCorrected :YFACtor?

:MEASure[:NFIGure]([:ARRay]|:SCALar)[:DATA]:UNCorrected :YFACtor?

Front Panel Access: Trace/View, Result A or B

After the measurement is selected, press Restore Meas Defaults to restore factory defaults.

MMEMory Subsystem

The purpose of the MMEMory subsystem is to provide access to mass storage devices such as internal drives. If mass storage is not specified in the filename, the default mass storage will be used.

Refer also to :CALCulate and :TRACe subsystems for more trace and limit line commands.

The MMEMory command syntax term <file_name> is a specifier having the form: drive:name.ext, where the following rules apply:

“drive” is “C:”

“name” is a DOS file name of up to eight characters, letters (A-Z, a-z) and numbers (0-9) only (lower case letters are read as uppercase)

“ext” is an optional file extension using the same rules as “name,” but consists of up to three characters total. (The default file extension will be added if it is not specified.)

Load a Noise Figure ENR Table from a File

:MMEMory:LOAD:ENR CALibration|MEASurement, <file_name>

Loads the ENR data in the file <file_name> to the specified correction set.

Example: :MMEM:LOAD:ENR MEASurements, “C:TEST.ENR”

Front Panel Access:

File, Load, Type, ENR Cal Table, Source Device Instrument/PC, File Name, Load Now

File, Load, Type, More, ENR Meas/Common Table, Source Device Instrument/PC, File Name, Load Now

Load a Noise Figure Frequency List Table from a File

:MMEMory[:NFIGure]:LOAD:FREQuency, <file_name>

Loads the frequency data in the file <filename> to the frequency table.

Example: :MMEM:LOAD:FREQuency, “C:TEST.LST”

Front Panel Access: File, Load, Type, Freq List, Source Device Instrument/PC, File Name, Load Now

Load a Limit Line from Memory to the Instrument

:MMEMory:LOAD:LIMit LLINe1|LLINe2|LLINe3|LLINe4,<file_name>

Loads a limit line, from the specified file in mass storage to the instrument. Loading a time limit line deletes any frequency limit lines. Similarly, loading a frequency limit line deletes any time limit lines. If you do not specify the file extension, the instrument will assume your file has an extension of .LIM. If your file has no extension, the instrument will not find the file.

Example: :MMEM:LOAD:LIM LLIN2,“C:mylimit.lim”

Front Panel Access: File, Load, Type, Limits, Source Limit 1 or Limit 2, Source Device Instrument/PC, File Name, Load Now

Load a Noise Figure Loss Compensation Table from a File

:MMEMory:LOAD:LOSS BEFore|AFTer, <file_name>

Loads the Loss Compensation data in the file <file_name> to the specified loss compensation table.

Example: :MMEM:LOAD:LOSS BEFore, “C:TEST.LOS”

Front Panel Access:

File, Load, Type, Loss Comp Before DUT, Device Destination Instrument/PC, File Name, Load Now

File, Load, Type, Loss Comp After DUT, Device Destination Instrument/PC, File Name, Load Now

Store a Noise Figure ENR Table to a File

:MMEMory:STORe:ENR CALibration|MEASurement, <file_name>

Stores the ENR calibration or measurement data to the file <file_name>.

Example: :MMEM:STORe:ENR MEASurement, “C:TEST.ENR”

Front Panel Access:

File, Store, Type, ENR Cal Table, Source Device Instrument/PC, File Name, Save Now

File, Store, Type, ENR Meas/Common Table, Device Destination Instrument/PC, File Name, Save Now

Store a Limit Line in a File

:MMEMory:STORe:LIMit LLINe1|LLINe2,<file_name>

:MMEMory:STORe:LIMit LLINe1|LLINe2|LLINe3|LLINe4,<file_name>

Stores the current limit line to the specified file in memory. If you do not specify the file extension, the instrument will assign an extension of .LIM.

Example: MMEM:STOR:LIM LLIN2,"C:mylimit.lim"

Remarks: This command will fail if the <file_name> already exists. There is no SCPI short form for parameters LLINE1|LLINE2.

Front Panel Access: File, Save, Type, Limits, Source Limit 1 or Limit 2, Device Destination Instrument/PC, File Name, Save Now

Store a Noise Figure Frequency List Table to a File

:MMEMory[:NFIGure]:STORe:FREQuency, <file_name>

Stores the frequency data in the specified Frequency table to the file <file_name>.

Example: :MMEM:STORe:FREQuency, "C:TEST.LST"

Front Panel Access: File, Save, Type, Freq List, Device Destination Instrument/PC, File Name, Save Now

Store a Noise Figure Loss Compensation Table to a File

:MMEMory:STORe:LOSS BEFore|AFTer, <file_name>

Stores the Loss Compensation data in the specified Loss Compensation table to the file <file_name>.

Example: :MMEM:STORe:LOSS BEFore, "C:TEST.LOS"

Front Panel Access:

File, Save, Type, Loss Comp Before DUT, Device Destination Instrument/PC, File Name, Save Now

File, Save, Type, Loss Comp After DUT, Device Destination Instrument/PC, File Name, Save Now

Store a Measurement Results in a File

:MMEMory:STORe:RESults filename.csv

Saves the measurement results to a file in memory. The file name must have a file extension of .csv and will be in the CSV (comma-separated values) format.

Example: MMEM:STOR:RES ‘C:mymeas.csv’

Front Panel Access: File, Save, Type, Measurement Results, Device Destination Instrument/PC, File Name, Save Now

Store a Trace in a File

:MMEMory:STORe:TRACe TRACe1|TRACe2|ALL, <file_name>

Stores the specified trace or traces to the specified file in memory. The file is in comma separated value (CSV) format, with the data stored in <frequency>/<amplitude> pairs.

Example: MMEM:STOR:TRAC TRACE2,“C:mytrace.trc”

Front Panel Access: File, Save, Type, Trace, Source, Device Destination Instrument/PC, File Name, Save Now

OUTPut Subsystem

The OUTPut subsystem controls the characteristics of the source output port.

Turn Noise Source On/Off

:OUTPut:] OFF|ON|0|1

:OUTPut:MONitor:NOIse[:STATe]?

Turns the noise source On or Off.

Factory Preset: Off

Front Panel Access: Source

READ Subsystem

The READ? commands are used with several other commands and are documented in the section on the “MEASure Group of Commands” on page 301.

Initiate and Read Measurement Data

:READ:<measurement>[n]?

A READ? query must specify the desired measurement. It will cause a measurement to occur without changing any of the current settings and will return any valid results. The code number n selects the kind of results that will be returned. The available measurements and data results are described in the “MEASure Group of Commands” on page 301.

SENSe Subsystem

These commands are used to set the instrument state parameters so that you can measure a particular input signal. Some SENSe commands are only for use with specific measurements found under the MEASURE key menu or the “MEASure Group of Commands" on page 189. The measurement must be active before you can use these commands.

The SCPI default for the format of any data output is ASCII. The format can be changed to binary with FORMat:DATA which transports faster over the bus.

Bandwidth Commands

Resolution Bandwidth

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution] <freq>

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution]?

Enables you to select the 3.01 dB resolution bandwidth (RBW) of the N8201A in 10% steps from 1 Hz to 3 MHz, plus bandwidths of 4, 5, 6, or 8 MHz.

If an unavailable bandwidth is specified, the closest available bandwidth is selected.

Sweep time is coupled to RBW. As the RBW changes, the sweep time (if set to Auto) is changed to maintain amplitude calibration.

Factory Preset: 3 MHz

Range: 1 Hz to 8 MHz.

Default Unit: Hz

Front Panel Access: BW/Avg

Video Bandwidth

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo <freq>

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo?

Specifies the video bandwidth.

You can change the N8201A post-detection filter from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth (VBW) may be chosen by selecting 50 MHz.

Factory Preset: Automatically calculated

Range: 1 Hz to 8 MHz, plus 50 MHz.

Default Unit: Hz

Front Panel Access: BW/Avg

Video Bandwidth Automatic

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:AUTO OFF|ON|0|1

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:AUTO?

Couples the video bandwidth to the resolution bandwidth, using the VBW/RBW ratio that you have set.

Factory Preset: ON

Front Panel Access: BW/Avg

Video to Resolution Bandwidth Ratio

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:RATio <numeric>

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:RATio?

Specifies the ratio of the video bandwidth to the resolution bandwidth.

Factory Preset: 1.0

Range: 0.00001 to 10

Front Panel Access: BW/Avg

Configure Commands

Downconverter Fixed LO Frequency

[:SENSe]:CONFigure:MODE:DOWNconv:LOSCillator:FREQuency <value>

[:SENSe]:CONFigure:MODE:DOWNconv:LOSCillator:FREQuency?

Sets the down converter fixed LO frequency.

This noise figure application (Option 219) can only measure fixed LO devices.

Factory Preset: 30 GHz

Range: 1 Hz to 325 GHz

Default Unit: Hz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Downconverter, Ext LO Freq

Downconverter Frequency Context

[:SENSe]:CONFigure:MODE:DOWNconv:FREQuency:CONText RF|IF

[:SENSe]:CONFigure:MODE:DOWNconv:FREQuency:CONText?

Determines whether the frequencies are displayed before any down conversion has taken place (RF), or after any down conversion (IF). It is only when the frequency context is set to IF that the displayed frequencies represent the actual frequencies that the N8201A is measuring.

RF - Frequencies are displayed as they are when they enter the DUT, that is, before any frequency conversion has taken place.

IF - Frequencies are displayed as they are when they leave the DUT, that is, after any frequency conversion has taken place. These are therefore the frequencies entering the N8201A.

Factory Preset: IF

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, Frequency Context

Downconverter LO Offset

[:SENSe]:CONFigure:MODE:DOWNconv:LOSCillator:OFFSet LSB|USB|DSB

[:SENSe]:CONFigure:MODE:DOWNconv:LOSCillator:OFFSet?

Sets the type of offset for the downconverter.

LSB - Lower Sideband (Signal frequency < LO frequency).

USB - Upper Sideband (Signal frequency > LO frequency)

DSB - Double sideband (no offset).

Factory Preset: LSB

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

You must have specified the DUT type as Downconverter to use this command. Use [:SENSe]:CONFigure:MODE:DUT to set the DUT type.

Front Panel Access: Mode Setup, DUT Setup, Sideband

Select DUT type

[:SENSe]:CONFigure:MODE:DUT AMPLifier|DOWNconv|UPConv

[:SENSe]:CONFigure:MODE:DUT?

Sets the type of DUT whose noise figure is to be measured.

AMPLifier - the DUT is an amplifier that performs no frequency conversion. It can be used with or without an external system downconverter.

DOWNconv - the DUT performs its own frequency down conversion. A DOWNconverter cannot be used with an external system down converter.

UPConv - the DUT performs its own frequency up conversion. An upconverter cannot be used with an external system downconverter.

Factory Preset: AMPLifier

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Amplifier

System Downconverter Control

[:SENSe]:CONFigure:MODE:SYSTem:DOWNconv[:STATe] ON|OFF|1|0

[:SENSe]:CONFigure:MODE:SYSTem:DOWNconv[:STATe]?

Specifies whether or not there is a system downconverter. A system downconverter reduces high frequencies that are beyond the range of the N8201A to a lower frequency which the N8201A can measure.

ON or 1 - you are using a system downconverter.

OFF or 0 - you are not using a system downconverter.

Factory Preset: OFF

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Your DUT must be set to type AMPLifier. Use [:SENSe]:CONFigure:MODE:DUT to set the DUT type.

Front Panel Access: Mode Setup, DUT Setup, System Downconverter On/Off

System Fixed LO Frequency

[:SENSe]:CONFigure:MODE:SYSTem:LOSCillator:FREQuency <value>

[:SENSe]:CONFigure:MODE:SYSTem:LOSCillator:FREQuency?

Sets the system fixed LO frequency.

This noise figure application (Option 219) can only measure fixed LO devices.

Factory Preset: 30 GHz

Range: 1 Hz to 325 GHz

Default Unit: Hz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Amplifier, System Downconverter On, Ext LO Freq

System Frequency Context

[:SENSe]:CONFigure:MODE:SYSTem:FREQuency:CONText RF|IF

[:SENSe]:CONFigure:MODE:SYSTem:FREQuency:CONText?

Determines whether the frequencies are displayed before any conversion has taken place (RF), or after any conversion (IF). It is only when the frequency context is set to IF that the displayed frequencies represent the actual frequencies that the N8201A is measuring.

RF - Frequencies are displayed as they are when they enter the DUT, that is, before any frequency conversion by the system downconverter has taken place.

IF - Frequencies are displayed as they are when they leave the DUT, that is, after any frequency conversion has taken place. These are therefore the frequencies entering the N8201A.

Factory Preset: RF

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Amplifier, System Downconverter On, Frequency Context

System LO Offset

[:SENSe]:CONFigure:MODE:SYSTem:LOSCillator:OFFSet LSB|USB|DSB

[:SENSe]:CONFigure:MODE:SYSTem:LOSCillator:OFFSet?

Sets the type of offset for the system.

LSB - Lower Sideband (Signal frequency < LO frequency).

USB - Upper Sideband (Signal frequency > LO frequency)

DSB - Double sideband (no offset).

Factory Preset: LSB

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Double Sideband (DSB) is only available when the System Downconverter is On.

Front Panel Access: Mode Setup, DUT Setup, Sideband

Upconverter Fixed LO Frequency

[:SENSe]:CONFigure:MODE:UPConv:LOSCillator:FREQuency <value>

[:SENSe]:CONFigure:MODE:UPConv:LOSCillator:FREQuency?

Sets the upconverter fixed LO frequency.

This noise figure application (Option 219) can only measure fixed LO devices.

Factory Preset: 30 GHz

Range: 1 Hz to 325 GHz

Default Unit: Hz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Upconverter, Ext LO Freq

Upconverter Frequency Context

[:SENSe]:CONFigure:MODE:UPConv:FREQuency:CONText RF|IF

[:SENSe]:CONFigure:MODE:UPConv:FREQuency:CONText?

Determines whether the frequencies are displayed before any up conversion has taken place (RF), or after any up conversion (IF). It is only when the frequency context is set to IF that the displayed frequencies represent the actual frequencies that the N8201A is measuring.

RF - Frequencies are displayed as they are when they enter the DUT, that is, before any frequency conversion by the upconverter has taken place.

IF - Frequencies are displayed as they are when they leave the DUT, that is, after any frequency conversion has taken place. These are therefore the frequencies entering the N8201A.

Factory Preset: IF

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Mode Setup, DUT Setup, DUT, Upconverter, Freq Context

Upconverter LO Offset

[:SENSe]:CONFigure:MODE:UPConv:LOSCillator:OFFSet LSB | USB

[:SENSe]:CONFigure:MODE:UPConv:LOSCillator:OFFSet?

Sets the type of offset for the system.

LSB - Lower Sideband (Signal frequency < LO frequency).

USB - Upper Sideband (Signal frequency > LO frequency)

Factory Preset: LSB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFigure to set the mode.

Front Panel Access: Mode Setup, DUT Setup, Sideband

Default Reset

[:SENSe]:DEFaults

Restores personality Mode Setup defaults.

Front Panel Access:

Remarks: This command sets all the SENSe defaults but has no effect on the MEASure default settings. Use the CONFigure:<measurement> command to set measurement defaults

Monitor Spectrum Measurement

Commands for querying the Monitor Spectrum measurement results and for setting to the default values are found in the "MEASure Group of Commands" on page 189. The equivalent front panel keys for the parameters described in the following commands, are found under the Meas Setup key, after the Monitor Spectrum measurement has been selected from the MEASURE key menu.

Monitor Spectrum—Average Count

[:SENSe]:MONitor:AVERage:COUNt <integer>

[:SENSe]:MONitor:AVERage:COUNt?

Sets the number of data acquisitions that will be averaged. After the specified number of average counts, the averaging mode (terminal control) setting determines the averaging action.

Factory Preset: 10

Range: 1 to 1,000

Remarks: You must be in the Phase Noise or Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, Avg Number

Monitor Spectrum—Averaging State

[:SENSe]:MONitor:AVERage[:STATe] OFF|ON|0|1

[:SENSe]:MONitor:AVERage[:STATe]?

Turns averaging on or off.

Factory Preset:

On for GSM, Bluetooth

Off for Phase Noise and Noise Figure.

Remarks: You must be in the Phase Noise or Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, Avg Number

Monitor Spectrum—Averaging Termination Control

[:SENSe]:MONitor:AVERage:TCONtrol EXPonential|REPeat

[:SENSe]:MONitor:AVERage:TCONtrol?

Selects the type of termination control used for the averaging function. This determines the averaging action after the specified number of data acquisitions (average count) is reached.

Exponential - After the average count is reached, each successive data acquisition is exponentially weighted and combined with the existing average.

Repeat - After reaching the average count, the averaging is reset and a new average is started.

Factory Preset: Exponential

Remarks: You must be in the Phase Noise or Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, Avg Mode

Monitor Spectrum—Resolution Bandwidth

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution] <freq>

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution]?

Enables you to select the 3.01 dB resolution bandwidth (RBW) of the N8201A in 10% steps from 1 Hz to 3 MHz, plus bandwidths of 4, 5, 6, or 8 MHz.

If an unavailable bandwidth is specified, the closest available bandwidth is selected.

Sweep time is coupled to RBW. As the RBW changes, the sweep time (if set to Auto) is changed to maintain amplitude calibration.

Factory Preset: 1 MHz

Range: 1 Hz to 8 MHz

Default Unit: Hz

Front Panel Access: BW/Avg

Monitor Spectrum—Resolution Bandwidth Automatic

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution]:AUTO OFF|ON|0|1

[:SENSe]:MONitor:BANDwidth|BWIDth[:RESolution]:AUTO?

Couples the resolution bandwidth to the frequency span.

When set to Auto, resolution bandwidth is auto coupled to span. The ratio of span to RBW is set by Span/RBW. The factory default for this ratio is approximately 106:1 when auto coupled. When Res BW is set to Man, bandwidths are entered by the user, and these bandwidths are used regardless of other N8201A settings.

Factory Preset: ON

Front Panel Access: BW/Avg

Monitor Spectrum—Video Bandwidth

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo <freq>

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo?

Specifies the video bandwidth.

You can change the N8201A post-detection filter from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth (VBW) may be chosen by selecting 50 MHz.

Factory Preset: 3 MHz

Range: 1 Hz to 8 MHz, plus 50 MHz

Default Unit: Hz

Front Panel Access: BW/Avg

Monitor Spectrum—Video Bandwidth Automatic

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:AUTO OFF|ON|0|1

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:AUTO?

Couples the video bandwidth to the resolution bandwidth, using the VBW/RBW ratio that you have set.

Factory Preset: ON

Front Panel Access: BW/Avg

Monitor Spectrum—Video to Resolution Bandwidth Ratio

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:RATio <numeric>

[:SENSe]:MONitor:BANDwidth|BWIDth:VIDeo:RATio?

Specifies the ratio of the video bandwidth to the resolution bandwidth.

Factory Preset: 1.00000

Range: 0.00001 to 10

Front Panel Access: BW/Avg

Monitor Spectrum—Type of Detection

[:SENSe]:MONitor:DETector[:FUNCtion] NORMal |POSitive|NEGative|AVERage

[:SENSe]:MONitor:DETector[:FUNCtion]?

Specifies the detection mode.

Normal detection displays the peak of CW-like signals and maximums and minimums of noise-like signals.

Positive peak detection displays the highest sample level measured during each sampling period.

Negative peak detection displays the lowest sample level measured during each sampling period.

Average detection displays the average of the samples taken during each sampling period. The averaging method depends upon AVG Type selection (voltage, power or log scales).

Factory Preset: AVERage

Range: NORM | POS | NEG | AVER

Front Panel Access: Det/Demod, Detector

Monitor Spectrum—Center Frequency

[:SENSe]:MONitor:FREQuency[:CENTer] <freq>

[:SENSe]:MONitor:FREQuency[:CENTer]?

Sets the center frequency.

Factory Preset: 1.5 GHz

Range: 0 Hz to 26.5 GHz

Remarks: The center frequency range shifts up or down depending on the Frequency Offset settings.

Default Unit: Hz

Front Panel Access: FREQUENCY/Channel, Center Freq

Monitor Spectrum—Frequency Offset

[:SENSe]:MONitor:FREQuency:OFFSet <freq>

[:SENSe]:MONitor:FREQuency:OFFSet?

Enables you to input a frequency offset value to account for frequency conversions external to the N8201A. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency and all other absolute frequency settings in the N8201A. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Factory Preset or set the frequency offset to 0 Hz.

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the N8201A, but only the displayed frequency values. Offsets are not added to the frequency count readouts. Entering an offset does not affect the trace display.

Factory Preset: 0 Hz

Range: –325 GHz to +325 GHz

Default Unit: Hz

Front Panel Access: FREQUENCY/Channel, Freq Offset

Monitor Spectrum—Frequency Offset Auto

[:SENSe]:MONitor:FREQuency:OFFSet:AUTO ON|OFF|1|0

[:SENSe]:MONitor:FREQuency:OFFSet:AUTO?

Allows you to specify whether the N8201A compensates automatically for a frequency changing device, or whether you wish to set the compensation manually. Setting a value on ‘ON’ or ‘1’ makes the compensation automatic, and setting to ‘OFF’ or ‘0’ set the compensation to manual.

Manually setting the Frequency Offset to 0 Hz is equivalent to disabling the feature.

Factory Preset: On

Front Panel Access: FREQUENCY/Channel, Freq Offset

Monitor Spectrum—Frequency Span

[:SENSe]:MONitor:FREQuency:SPAN <freq>

[:SENSe]:MONitor:FREQuency:SPAN?

Sets the frequency span. Setting the span to 0 Hz puts the N8201A into zero span.

Factory Preset: 2.9900 GHz

Range: 10 Hz to 26.5 GHz

Default Unit: Hz

Front Panel Access:

SPAN/X Scale, Span

or

SPAN/X Scale, Zero Span

Monitor Spectrum—Automatic Frequency Span to RBW Ratio

[:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO OFF|ON|0|1

[:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO?

Selects between automatic and manual coupling of the span to the resolution BW ratio that will be used for displaying signals.

Factory Preset: On (Auto)

Range: Off|On|0|1

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: BW/Avg, Span/RBW

Monitor Spectrum—Ratio of Frequency Span to RBW

[:SENSe]:FREQuency:SPAN:BANDwidth|BWIDth[:RESolution]:RATio <val>

[:SENSe]:FREQuency:SPAN:BANDwidth|BWIDth[:RESolution] :RATIO?

Sets the automatic coupling of the span to the resolution BW to be used for displaying signals. The value is entered as the ratio of span:RBW.

Factory Preset: 106

Range: 2 to 1000

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: BW/Avg, Span/RBW

Monitor Spectrum—Full Frequency Span

[:SENSe]:MONitor:FREQuency:SPAN:FULL

Sets the frequency span to full scale.

Factory Preset: 26.49 GHz

Front Panel Access: SPAN/X Scale, Full Span

Monitor Spectrum—Zero Frequency Span

[:SENSe]:MONitor:FREQuency:SPAN:ZERO

Sets the frequency span to zero.

Front Panel Access: SPAN/X Scale, Zero Span

Monitor Spectrum—Start Frequency

[:SENSe]:MONitor:FREQuency:STARt <freq>

[:SENSe]:MONitor:FREQuency:STARt?

Sets the start frequency.

Factory Preset: 10 MHz

Range: –100 MHz to 26.49 GHz

The valid range of Frequency Start settings (above) applies when Frequency Offset is set to 0 Hz. Frequency Offset settings greater than 0 Hz have the effect of shifting the entire range up by the Frequency Offset.

Default Unit: Hz

Front Panel Access: FREQUENCY/Channel, Start Freq

Monitor Spectrum—Stop Frequency

[:SENSe]:MONitor:FREQuency:STOP <freq>

[:SENSe]:MONitor:FREQuency:STOP?

Set the stop frequency.

Factory Preset: 3.0 GHz

Range: –99.99999 MHz to 26.49 GHz

The valid range of Frequency Start settings (above) applies when Frequency Offset is set to 0 Hz. Frequency Offset settings greater than 0 Hz have the effect of shifting the entire range up by the Frequency Offset.

Default Unit: Hz

Front Panel Access: FREQUENCY/Channel, Stop Freq

Monitor Spectrum—RF Port Input Attenuation

[:SENSe]:MONitor:POWer[:RF]:ATTenuation <rel_power>

[:SENSe]:MONitor:POWer[:RF]:ATTenuation?

Sets the RF input attenuator. This value is set at its auto value if RF input attenuation is set to auto.

Factory Preset: 10 dB

Range: 0 to 70 dB

Default Unit: dB

Front Panel Access: AMPLITUDE/Y Scale, Attenuation

Monitor Spectrum—RF Port Input Attenuator Auto

[:SENSe]:MONitor:POWer[:RF]:ATTenuation:AUTO ON|OFF|1|0

[:SENSe]:MONitor:POWer[:RF]:ATTenuation:AUTO?

Selects the RF input attenuator range to be set either automatically or manually.

ON - Input attenuation is automatically set as determined by the reference level setting.

OFF - Input attenuation is manually set.

Factory Preset: ON (auto)

Front Panel Access: AMPLITUDE/Y Scale, Attenuation

Monitor Spectrum—Internal Preamp

[:SENSe]:MONitor:POWer[:RF]:GAIN[:STATe] ON|OFF|1|0

[:SENSe]:MONitor:POWer[:RF]:GAIN:[:STATe]?

Turns the internal preamp on or off. This requires you to have Option 1DS or Option 110 installed.

Factory Preset: ON (if available)

Front Panel Access: Meas Setup, Int Preamp

Monitor Spectrum—Optimize Reference Level

[:SENSe]:MONitor:POWer[:RF]:RANGe:AUTO

Optimizes the reference level and the attenuator settings for the current signal in the current span. To prevent possible damage to the N8201A, the values are set with the noise source turned ON.

The Reference Level is set so that the signal is kept as close as possible to the top of the display. Attenuation is set to a level such that the mixer input never exceeds –20 dBm. All attenuation settings are allowed, including 0 dB.

Factory Preset:

Front Panel Access: Amplitude, Optimize Ref Level

Monitor Spectrum—Trace Points

[:SENSe]:MONitor:SWEep:POINts?

Queries the number of trace points.

Factory Preset: 601

Range: 101 to 8192

Front Panel Access: Sweep

Monitor Spectrum—Sweep Time

[:SENSe]:MONitor:SWEep:TIME <value>

[:SENSe]:MONitor:SWEep:TIME?

Specifies the sweep time of the measurement.

Factory Preset: Automatically calculated

Range:

1 µs to 2 ksecs in zero span

1 ms to 2 ksecs in swept mode

Front Panel Access: Sweep

Monitor Spectrum—Time Mode

[:SENSe]:MONitor:SWEep:TIME:AUTO OFF|ON|0|1

[:SENSe]:MONitor:SWEep:TIME:AUTO?

Specifies whether the sweep time is set automatically or manually.

Factory Preset: ON (Auto)

Remarks: If set to **AUTO**, the sweep time will be affected by the RBW setting.

Front Panel Access: Sweep

Noise Figure Measurement

Commands for querying the noise figure measurement results and for setting to the default values are found in the MEASure group of commands. The equivalent front panel keys for the parameters described in the following commands are found under the Meas Setup key, after the Noise Figure measurement has been selected from the MEASURE key menu.

Noise Figure—Average Count

[:SENSe][:NFIGure]:AVERage:COUNt <integer>

[:SENSe][:NFIGure]:AVERage:COUNt?

Sets the number of data acquisitions that will be averaged. After the specified number of average counts, the averaging mode (terminal control) setting determines the averaging action.

Factory Preset: 10

Range: 1 to 1000

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, Avg Number

Noise Figure—Averaging State

[:SENSe][:NFIGure]:AVERage[:STATe] OFF|ON|0|1

[:SENSe][:NFIGure]:AVERage[:STATe]?

Turns averaging on or off.

Factory Preset: OFF

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

The SCPI command :CONFigure:NFIGure does not switch averaging ON, but rather sets averaging to the factory default of OFF.

Front Panel Access: Meas Setup, Avg Number

Noise Figure—Averaging Termination Control

[:SENSe][:NFIGure]:AVERage:TCONtrol?

Queries the type of termination control used for the averaging function. This determines the averaging action after the specified number of data acquisitions (average count) is reached.

REPeat - After reaching the average count, the averaging is reset and a new average is started.

Factory Preset: REPeat

Range: REPeat only

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

It is not possible to perform exponential averaging on noise figure measurements, so repeat averaging is always used.

Front Panel Access: Front Panel access is disabled (grayed out) as REPeat is the only option.

Noise Figure—Resolution Bandwidth

[:SENSe][:NFIGure]:BANDwidth|BWIDth[:RESolution] <freq>

[:SENSe][:NFIGure]:BANDwidth|BWIDth[:RESolution]?

Enables you to select the 3.01 dB resolution bandwidth (RBW) of the N8201A in 10% steps from 1 Hz to 3 MHz, plus bandwidths of 4, 5, 6, or 8 MHz.

If an unavailable bandwidth is specified, the closest available bandwidth is selected.

Sweep time is coupled to RBW. As the RBW changes, the sweep time (if set to Auto) is changed to maintain amplitude calibration.

Factory Preset: 1 MHz

Range: 1 Hz to 8 MHz

Default Unit: Hz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: BW/Avg

Noise Figure—Resolution Bandwidth Automatic

[:SENSe][:NFIGure]:BANDwidth|BWIDth[:RESolution]:AUTO OFF|ON|0|1

[:SENSe][:NFIGure]:BANDwidth|BWIDth[:RESolution]:AUTO?

Couples the resolution bandwidth to the frequency span.

When set to Auto, the RBW is set to a value that gives you the best results. The actual RBW settings used for various frequencies is shown in the table below.

Table 11 RBW Auto Settings

Measurement Frequency	Resolution Bandwidth
< 3 MHz	Measurement Frequency / 10
3 MHz or higher	1 MHz

When set to Auto, resolution bandwidth is auto coupled to span. The ratio of span to RBW is set by Span/RBW. The factory default for this ratio is approximately 106:1 when auto coupled.

When Res BW is set to Man, bandwidths are entered by the user, and these bandwidths are used regardless of other N8201A settings.

Factory Preset: ON (Auto)

Range: ON (Auto) | OFF (Manual)| 1 | 0

Remarks:

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

For valid results below 10 MHz, the N8201A must be DC coupled.

Instrument damage can occur if there is a DC component present at the RF INPUT and DC coupling is selected.

Noise Figure—Calibrate

[:SENSe][:NFIGure]:CORRection:COLLect[:ACQuire] STANdard

Calibrates your measurement for use with a specific noise source. When issuing this command, the ENR (Excess Noise Ratio) data must already have been entered into the ENR table, or into the Calibration Table if Common Table has been switched off.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Example: CORR:COLL STAN

Front Panel Access: Meas Setup, Calibrate

Noise Figure—Number of Entries in Calibration ENR Table

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:COUNt?

Returns the number of pairs of entries (that is, frequency and amplitude pairs) in the calibration ENR (Excess Noise Ratio) table.

Factory Preset: Not applicable

Range: 1 to 401 frequency/amplitude point pairs.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Cal Table...

Noise Figure—Calibration ENR Table Data

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:DATA <frequency, <amplitude>[,<frequency>, <amplitude>]

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:DATA?

Enters data into the current calibration ENR table. Once entered the table can be stored in a file.

It is not possible to specify units with this command and values are taken to be in Hz and dB. The query returns values in Hz and dB.

Factory Preset: Not applicable

Range: 1 to 401 pairs of frequency and amplitude figures.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Cal Table...

Noise Figure—Noise Source ID for Calibration ENR Table

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:ID :DATA <string>

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:ID :DATA?

Enters the ID of the noise source associated with the ENR table used for calibration. The ID is stored with the ENR table when saving it to file.

Factory Preset: Not applicable

Range: Quoted string of up to 12 characters (for example, '346B').

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Cal Table...

Noise Figure—Noise Source Serial Number for Calibration ENR Table

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:SERial :DATA <string>

[:SENSe][:NFIGure]:CORRection:ENR:CALibration:TABLe:SERial :DATA?

Enters the serial number of your noise source into the calibration table. This uniquely identifies the specific noise source associated with this calibration data.

Factory Preset: Not applicable

Range: Quoted string of up to 20 characters (for example, '2037A00729').

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Cal Table...

Noise Figure—Common ENR Table Control

[:SENSe][:NFIGure]:CORRection:ENR:COMMon[:STATe] ON|OFF|1|0

[:SENSe][:NFIGure]:CORRection:ENR:COMMon[:STATe]?

Enables and disables the common ENR table. When enabled, the measurement ENR table is used for both calibration and measurement. When disabled, calibration uses its own table.

Factory Preset: ON

Range: ON|OFF|1|0

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Common Table

Noise Figure—Number of Entries in Measurement ENR Table

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe:COUNt?

Queries the number of entries in the measurement ENR (Excess Noise Ratio) table.

Factory Preset: Not applicable

Range: 0 to 401 frequency/amplitude point pairs.

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Meas Table...

Noise Figure—Noise Source ID for Measurement ENR Table

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe:ID :DATA <string>

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe:ID :DATA?

Enters the ID of the noise source associated with the ENR table used for measurement. The ID is stored with the ENR table when saving it to file.

Factory Preset: Not applicable

Range: Quoted string of up to 12 characters (for example, ’346B’).

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Meas Table...

Noise Figure—Noise Source Serial Number for Measurement ENR Table

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe :SERial:DATA <string>

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe :SERial:DATA?

Enters the serial number of the noise source associated with the ENR table used for measurement. The serial number is stored with the ENR table when saving it to file.

Factory Preset: Not applicable

Range: Quoted string of up to 20 characters (for example, ’2037A00729’).

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Meas Table...

Noise Figure—Measurement ENR Table Data

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe:DATA <frequency, <amplitude>[,<frequency>, <amplitude>]

[:SENSe][:NFIGure]:CORRection:ENR[:MEASurement]:TABLe:DATA?

Enters data into the current measurement ENR table. Once entered the table can be stored in a file.

It is not possible to specify units with this command and values are taken to be in Hz and dB. The query returns values in Hz and dB.

Factory Preset: Not applicable

Range: 0 to 401 frequency/amplitude point pairs

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Meas Table...

Noise Figure—ENR Mode

[:SENSe][:NFIGure]:CORRection:ENR:MODE TABLe|SPOT

[:SENSe][:NFIGure]:CORRection:ENR:MODE?

Selects between table and spot ENR operation.

TABLe – ENR values are taken from the ENR table.

SPOT – A single ENR value is applied at all frequencies.

Factory Preset: TABLe

Range: TABLE or SPOT

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, ENR Mode

Noise Figure—ENR Spot Value

[:SENSe][:NFIGure]:CORRection:ENR:SPOT <value>

[:SENSe][:NFIGure]:CORRection:ENR:SPOT?

Sets the ENR value used when spot ENR is enabled.

The ENR data can be entered in units of dB, Kelvin (K), degrees Celsius (CEL) or degrees Fahrenheit (FAR). The default unit is dB.

For T_{hot} values below 290 K see the commands in “Noise Figure—ENR Spot Value" on page 231 and “Noise Figure—ENR THot Value" on page 231.

Factory Preset: 15.2 dB

Default Unit: dB

Range: –7.0 dB to 50 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Spot

Noise Figure—ENR T_{Hot} Value

[:SENSe][:NFIGure]:CORRection:ENR:THOT <value>

[:SENSe][:NFIGure]:CORRection:ENR:THOT?

Sets the ENR value used when spot ENR is enabled.

The ENR data can be entered in units of Kelvin (K), degrees Celsius (CEL) or degrees Fahrenheit (FAR). The default unit is Kelvin.

This command would normally be used to enter ENR values below 290 K. See the commands under “Noise Figure—ENR Spot Value” on page 353 and “Noise Figure—ENR Spot Value” on page 353.

Factory Preset: 9892.8 K (equivalent to the Spot ENR default of 15.2 dB)

Default Unit: K

Range: 0 K to 29,650,000 K

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Spot T Hot

Noise Figure—After DUT Loss Compensation Mode

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:MODE FIXed|TABLe

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:MODE?

Sets the mode of operation for the After DUT Loss Compensation.

TABLe – the After DUT Loss Compensation table is used.

FIXed – a single, fixed After DUT Loss Compensation value is used for all frequencies.

Factory Preset: FIXed

Range: FIXed or TABLe

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, After DUT Table...

Noise Figure—After DUT Loss Compensation State

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer[:STATe] ON|OFF|1|0

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer[:STATe]?

Enables or disables the After DUT Loss Compensation.

Factory Preset: OFF

Range: ON|OFF|1|0

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Setup...

Noise Figure—Number of Entries in After DUT Loss Compensation Table

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:TABLe:COUNt?

Returns the number of frequency/amplitude pairs of entries in the After DUT Loss Compensation table.

Factory Preset: 0

Range: 0 to 401 frequency/amplitude point pairs

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, After DUT Table...

Noise Figure—After DUT Loss Compensation Table Data

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:TABLe:DATA <frequency>, <amplitude>[,<frequency>, <amplitude>]

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:TABLe:DATA?

Enters frequency/loss pairs into the After DUT loss table. This can be up to a maximum of 401 pairs.

You cannot specify units with this command. Frequencies are assumed to be in Hz and loss values are in dB.

Factory Preset: None

Range: Frequency: 10 Hz to upper frequency limit of the N8201A

Amplitude: –200 dB to 200 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, After DUT Table...

Noise Figure—After DUT Loss Compensation Fixed Value

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:VALue <value>

[:SENSe][:NFIGure]:CORRection:LOSS:AFTer:VALue?

Specifies the single After DUT Loss Compensation value that is applied at all frequencies. You cannot specify units with this command. All loss values are given in dB.

This compensation loss value will only be applied if the Compensation After DUT State is set to On, and if the Compensation After DUT is set to Fixed.

Factory Preset: 0 dB

Range: –100 dB to +100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Setup..., Fixed

Noise Figure—Before DUT Loss Compensation Mode

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:MODE FIXed|TABLe

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:MODE?

Sets the mode of operation for the Before DUT Loss Compensation.

TABLe – the Before DUT Loss Compensation table is used.

FIXed – a single, fixed Before DUT Loss Compensation value is used for all frequencies.

Factory Preset: FIXed

Range: FIXed or TABLe

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Before DUT Table...

Noise Figure—Before DUT Loss Compensation State

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore[:STATe] ON|OFF|1|0

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore[:STATe]?

Enables or disables the Before DUT Loss Compensation.

Factory Preset: OFF

Range: ON|OFF|1|0

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Setup...

Noise Figure—Number of Entries in Before DUT Loss Compensation Table

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:TABLe:COUNt?

Returns the number of frequency/amplitude pairs of entries in the Before DUT Loss Compensation table.

Factory Preset: 0

Range: 0 to 401 frequency/amplitude point pairs

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Before DUT Table...

Noise Figure—Before DUT Loss Compensation Table Data

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:TABLe:DATA <frequency>,
<amplitude>[,<frequency>, <amplitude>]

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:TABLe:DATA?

Enters frequency/loss pairs into the Before DUT loss table. This can be up to a maximum of 401 pairs.

You cannot specify units with this command. Frequencies are assumed to be in Hz and loss values are in dB.

Factory Preset: None

Range:

Frequency: 10 Hz to upper frequency limit of the N8201A

Amplitude: –200 dB to 200 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Before DUT Table...

Noise Figure—Before DUT Loss Compensation Fixed Value

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:VALue <value>

[:SENSe][:NFIGure]:CORRection:LOSS:BEFore:VALue?

Specifies the single Before DUT Loss Compensation value that is applied at all frequencies. You cannot specify units with this command. All loss values are given in dB.

This compensation loss value will only be applied if the Compensation Before DUT State is set to On, and if the Compensation Before DUT is set to Fixed.

Factory Preset: 0 dB

Range: –100 dB to +100 dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output, Loss Comp, Setup..., Fixed

Noise Figure—Spot ENR Mode

[:SENSe][:NFIGure]:CORRection:SPOT:MODE ENR|THOT

[:SENSe][:NFIGure]:CORRection:SPOT:MODE?

The command “Noise Figure—ENR Spot Value" on page 231 cannot be used to enter values below 290 K. The command “Noise Figure—ENR THot Value" on page 231 can enter temperature values below 290 K. This command selects which value is used in making measurements.

Factory Preset: ENR

Range: ENR or THOT

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, Spot, Spot State

Noise Figure—User T_{cold} Control

[:SENSe][:NFIGure]:CORRection:TCOLd:USER[:STATe] ON|OFF|1|0

[:SENSe][:NFIGure]:CORRection:TCOLd:USER[:STATe]?

Turns manual control of the TCold value On or Off. When set to Off, the default value of 296.5 K is used.

Factory Preset: Off

Range: ON|OFF|1|0

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, T cold

Noise Figure—User T_{cold} Value

[:SENSe][:NFIGure]:CORRection:TCOLd:USER:VALue <temperature>

[:SENSe][:NFIGure]:CORRection:TCOLd:USER:VALue?

Sets the Tcold value in units of Kelvin (K), degrees Celsius (CEL) or degrees Fahrenheit (FAR). This is the applied value when User Tcold is enabled.

Factory Preset: 296.5 K

Range: 0 K to 29,650,000 K

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, T cold

Noise Figure—Correction After DUT Temperature

[:SENSe][:NFIGure]:CORRection:TEMPerature:AFTer <temperature>

[:SENSe][:NFIGure]:CORRection:TEMPerature:AFTer?

Sets the after DUT temperature in units of Kelvin (K), degrees Celsius (CEL) or degrees Fahrenheit (FAR).

Factory Preset: 0 K

Range: 0 K to 29,650,000 K

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, T cold

Noise Figure—Correction Before DUT Temperature

[:SENSe][:NFIGure]:CORRection:TEMPerature:BEFore <temperature>

[:SENSe][:NFIGure]:CORRection:TEMPerature:BEFore?

Sets the before DUT temperature in units of Kelvin (K), degrees Celsius (CEL) or degrees Fahrenheit (FAR).

Factory Preset: 0 K

Range: 0 K to 29,650,000 K

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup, ENR, T cold

Noise Figure—Detector

[:SENSe][:NFIGure]:DETector[:FUNCtion] AVERage

[:SENSe][:NFIGure]:DETector[:FUNCtion]?

Sets and returns the current Detector mode settings.

AVERage is the only valid setting for this command.

Factory Preset: AVERage

Range: AVERage

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Det/Demod

Noise Figure—Center Frequency Value

[:SENSe][:NFIGure]:FREQuency:CENTer <frequency>

[:SENSe][:NFIGure]:FREQuency:CENTer?

Sets the center frequency when Frequency Mode is set to Sweep.

The frequency can be entered in units of Hz, kHz, MHz or GHz. The query always returns the value in Hz.

Factory Preset: 1.505 GHz

Range: 10 kHz to 325 GHz

Remarks:

You will need to use a frequency downconverter to reach the N8201A’s maximum center frequency of 325 GHz. Without a frequency downconverter, your center frequency will be limited to 10 kHz to 26.49 GHz

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel

Noise Figure—Fixed Frequency Value

[:SENSe][:NFIGure]:FREQuency:FIXed <frequency>

[:SENSe][:NFIGure]:FREQuency:FIXed?

Sets the frequency used when fixed frequency mode is enabled.

The frequency can be entered in units of Hz, kHz, MHz or GHz. The query always returns the value in Hz.

Factory Preset: 1.505 GHz

Range: 0 Hz to 325 GHz

Remarks:

You will need to use a frequency downconverter to reach the N8201A’s maximum fixed frequency of 325 GHz. Without a frequency downconverter, your maximum fixed frequency will be 0 Hz to 26.49 GHz.

You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel

Noise Figure—Frequency List Data

[:SENSe][:NFIGure]:FREQuency:LIST:DATA <frequency>[,<frequency>]

[:SENSe][:NFIGure]:FREQuency:LIST:DATA?

Enters frequency values into the frequency table. These values represent the frequencies at which the noise figure will be measured. The frequency table can hold up to 401 values. Once loaded, the table can be stored in a file.

You cannot specify units with this command and values are assumed to be Hz. The query returns values in Hz.

Factory Preset: Not applicable

Range: 1 to 401 frequencies (in Hz)

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode, and your Frequency Mode must be set to List.

Front Panel Access: Frequency/Channel

Noise Figure—Number of Entries in the Frequency List

[:SENSe][:NFIGure]:FREQuency:LIST:COUNt?

Returns an integer representing the number of frequency values in the frequency table.

Factory Preset: Not applicable

Range: 1 to 401

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel, Freq List

Noise Figure—Frequency Mode

[:SENSe][:NFIGure]:FREQuency:MODE SWEep|FIXed|LIST

[:SENSe][:NFIGure]:FREQuency:MODE SWEep?

Selects the method by which measurement frequencies are generated.

`SWEep` - frequency values are generated from the start frequency, the stop frequency, and the number of points parameters

`FIXed` - the fixed frequency value is used

`LIST` - frequencies are taken from a User defined frequency list

Factory Preset: SWEep

Range: SWEep, FIXed or LIST

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel

Noise Figure—Frequency Span

[:SENSe][:NFIGure]:FREQuency:SPAN <span>

[:SENSe][:NFIGure]:FREQuency:SPAN?

Selects the frequency span.

The frequency can be entered in units of Hz, kHz, MHz or GHz. The query always returns the value in Hz.

Factory Preset: 2.990000 GHz

Range: 100 Hz to 325 GHz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Span/X Scale

Noise Figure—Start Frequency Value

[:SENSe][:NFIGure]:FREQuency:STARt <start frequency>

[:SENSe][:NFIGure]:FREQuency:STARt?

Selects the start frequency that is used when the Frequency Mode has been set to SWEep, or when you are using the Fill... option in the Frequency List Form.

The frequency can be entered in units of Hz, kHz, MHz or GHz. The query always returns the value in Hz.

Factory Preset: 10 MHz

Range: 10 kHz to (325 GHz minus the minimum span setting)

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel

Noise Figure—Stop Frequency Value

[:SENSe][:NFIGure]:FREQuency:STOP <stop frequency>

[:SENSe][:NFIGure]:FREQuency:STOP?

Selects the stop frequency that is used when the Frequency Mode has been set to SWEep, or when you are using the Fill... option in the Frequency List Form.

The frequency can be entered in units of Hz, kHz, MHz or GHz. The query always returns the value in Hz.

Factory Preset: 3 GHz

Range: (10 Hz plus the minimum span setting) to 325 GHz

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency/Channel

Noise Figure—Internal Preamp Control

[:SENSe][:NFIGure]:POWer[:RF]:GAIN[:STATe] ON|OFF|1|0

[:SENSe][:NFIGure]:POWer[:RF]:GAIN[:STATe]?

Turns the internal preamp On or Off.

If the preamp is switched On, a correction is applied to compensate for the gain of the preamp so that the results still show the value at the INPUT connector. If you are using Option 1DS, the preamp is removed from the circuit, and the correction is not applied. If you are using Option 110, the correction is applied at all frequencies from 100 kHz up to the maximum frequency of your N8201A.

Using your internal preamp (if available) dramatically improves the noise figure over the 100 kHz to 3 GHz frequency range (Option 1DS), or at all frequencies above 100 kHz (Option 110). If you are measuring within the range of your preamp, you should always have the internal preamp switched On unless either you are using an external preamp, or your DUT has sufficient gain.

If the internal preamp is On, this is indicated by “PA” being displayed on the left side of the screen. The internal preamp is not available if Input Mixer (Int) has been selected (Option AYZ).

Factory Preset: ON (if available)

Range: ON or OFF, 1 or 0

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Meas Setup

Noise Figure—Number of Points in a Sweep

[:SENSe][:NFIGure]:SWEep:POINts <integer>

[:SENSe]:SWEep:POINts?

Sets the number of points in a sweep.

Factory Preset: 11

Range: 2 to 401

Default Unit: Points

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Frequency

Noise Figure—Microwave Attenuation

[:SENSe][:NFIGure]:MANual:MWAVe:FIXed <attenuation>

[:SENSe][:NFIGure]:MANual:MWAVe:FIXed?

Sets the attenuation to be used. The attenuation can be set in 4 dB increments.

Factory Preset: 0 dB

Range: 0 dB to 40 dB, but within the minimum and maximum attenuation range.

Default Unit: dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output

This command has the same effect as

`:INPut[:NFIGure]:ATTenuation:VALue <power>.` See “RF Attenuation Setting" on page 184.

Noise Figure—RF Attenuation

[:SENSe][:NFIGure]:MANual:RF:FIXed <attenuation>

[:SENSe][:NFIGure]:MANual:RF:FIXed?

Sets the attenuation to be used. The attenuation can be set in 4 dB increments.

Factory Preset: 0 dB

Range: 0 dB to 40 dB, but within the minimum and maximum attenuation range.

Default Unit: dB

Remarks: You must be in the Noise Figure mode to use this command. Use INSTrument:SELect NFIGURE to set the mode.

Front Panel Access: Input/Output

This command has the same effect as

`:INPut[:NFIGure]:ATTenuation:VALue <power>.` See “RF Attenuation Setting" on page 184.

SOURce Subsystem

The SOURce subsystem controls the signal characteristics of the source.

Noise Source Preference

:SOURce[:NFIGure]:NOISe[:PREFerence] NORMal

:SOURce[:NFIGure]:NOISe[:PREFerence]?

Sets the noise source to be NORMal type

Factory Preset: NORMal

Range: NORMal

Front Panel Access: No front panel access

TRACe Subsystem

TRACe subsystem controls access to the instruments internal trace memory.

Refer also to :CALCulate and :MMEMory subsystems for more trace and limit line commands.

Query Trace Maximum Amplitude

:TRACe[:NFIGure][:DATA]:CORRected|:UNCorrected:AMPLitude:MAXimum? <trace>

Returns the maximum amplitude of the given trace and the frequency at which it occurs. The returned values are comma separated and the amplitude value precedes the frequency.

When corrected results are requested, <trace> can be one of:

- GAIN, returning results in dB
- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

When uncorrected results are requested, <trace> can be one of:

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K
- YFACor, returning results in dB

You must be in Noise Figure mode to use this command.

Front Panel Access: Not available

Query Trace Minimum Amplitude

:TRACe[:NFIGure][:DATA]:CORRected|:UNCorrected:AMPLitude:MINimum? <trace>

Returns the minimum amplitude of the given trace and the frequency at which it occurs. The returned values are comma separated and the amplitude value precedes the frequency.

When corrected results are requested, <trace> can be one of:

- GAIN, returning results in dB
- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

When uncorrected results are requested, <trace> can be one of:

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K
- YFACor, returning results in dB

You must be in Noise Figure mode to use this command.

Front Panel Access: Not available

Query Trace Amplitude

:TRACe[:NFIGure][:DATA]:CORRected|:UNCorrected:AMPLitude [:VALue]? <trace>,<freq>

Returns the amplitude value of the given trace at the specified frequency.

When corrected results are requested, <trace> can be one of:

- GAIN, returning results in dB
- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

When uncorrected results are requested, <trace> can be one of:

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

- YFACor, returning results in dB

You must be in Noise Figure mode to use this command.

Front Panel Access: Not available

Query Trace Delta

:TRACe[:NFIGure][:DATA]:CORRected|:UNCorrected:DELTa? <trace>,<freq1>,<freq2>

Returns the value obtained by subtracting the amplitude at frequency1 from that at frequency2.

When corrected results are requested, <trace> can be one of:

- GAIN, returning results in dB
- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

When uncorrected results are requested, <trace> can be one of:

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K
- YFACor, returning results in dB

You must be in Noise Figure mode to use this command.

Front Panel Access: Not available

Query Trace Peak to Peak

:TRACe[:NFIGure][:DATA]:CORRected|:UNCorrected:PTPeak? <trace>

Returns the difference between the maximum and minimum amplitude values on the given trace and the frequency difference between the two frequency points where the maximum and minimum occur. The returned values are comma separated and the amplitude value precedes the frequency.

When corrected results are requested, <trace> can be one of:

- GAIN, returning results in dB

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K

When uncorrected results are requested, <trace> can be one of:

- NFACtor, returning linear results
- NFIGure, returning results in dB
- PCOLd, returning results in dB
- PHOT, returning results in dB
- TEFFective, returning results in degrees K
- YFACtor, returning results in dB

You must be in Noise Figure mode to use this command.

Front Panel Access: Not available

7
Troubleshooting Guide

Common Problems and their Resolution

Below is a list of some of the more common problems associated with making noise figure measurements, and hints on their resolution.

Results are wrong at low frequencies

The AC/DC coupling needs to be set to DC Coupling. DC Coupling is required for greatest accuracy when measuring frequencies below 20 MHz.

When changing to DC Coupling, make sure there is no DC component being fed into the N8201A's input port as this could seriously damage the hardware.

When changing to DC Coupling, make sure there is no DC component being fed into the analyzer's input port as this could seriously damage the hardware.

Spurs in the Frequency Band you are Measuring

If there are any spurs in the frequency band that you are measuring, these can affect the measurement. Signals as low as –60 dBm can affect your noise figure measurement. Use the Monitor Spectrum measurement with **Preamp** switched **On** and **Attenuation** set to **0 dB** to look for spurs. The Agilent Technologies application note *57-2 Noise Figure Measurement Accuracy - the Y-Factor Method* has more information in the *Preventing Interfering Signals* section. This application note is available from the Agilent website at http://www.agilent.com.

DSB Measurement on a Downconverter - Measurement are too Low

If you are making a DSB measurement on a down converting DUT, you must enter a **Loss Compensation** of **–3 dB** at a **Temperature** of **290 K**. This is because both double sidebands fold down to the same IF frequency, thus doubling the measured power.

This does not apply if you are using the System Downconverter because both sidebands are present in the calibration and in the measurement.

Does the LO Signal Contain Broadband Noise at the IF?

When testing Frequency Converters, make sure that the LO signal does not contain broadband noise at the IF frequency. To eliminate broadband noise at the LO, insert a high-pass filter on the LO port when measuring a downconverter. When measuring an upconverter, insert a low-pass filter on the LO port. These filters must pass signals at the LO frequency, but not at the IF frequency.

My Results are too High or too Low

When you are using Loss Compensation, it is important to set the correct DUT temperature. Setting the Temperature to 290 K will compensate for the noise as well as the gain. Leaving the DUT Temperature at 0 K will result in only the gain being compensated.

What Sort of Tolerances Should I Expect in my Measurement?

If you are not sure what level of tolerance to expect in your results, you can use the Uncertainty Calculator (See “Noise Figure Uncertainty Calculator" on page 63.) to calculate the expected result tolerances. This will give you a guide to your expected measurement accuracy.

The Measurement Accuracy is not what I Expected

For maximum accuracy, it is advisable not to attempt to measure noise figures greater than 10 dB above the relevant ENR value of the noise source.

‘Check that the DUT is not overdriving the analyzer. “Power Detection and Ranging" on page 33 gives some guidance on the levels required.

To check for overdriving of the analyzer, that is, compression occurring at the preamp stage, set the attenuation to 0 dB and note the noise figure of your DUT. Now increase the attenuation by one step (either 4 dB or 5 dB, depending on your analyzer) by pressing the up-arrow key. If your noise figure changes by more than 0.5 dB, attenuation is required. Repeat this process until you have found the lowest level of attenuation that gives you a stable noise figure result, and use this attenuation level for your measurements.

When using external pre-amps or high-gain DUTs, ensure that neither the external pre-amp (or the high-gain DUT) nor the internal pre-amp go into compression as this will affect the accuracy of your measurements. If you suspect that one or other of the pre-amps is going into compression, use attenuation prior to that pre-amp to prevent compression. Note that the analyzer’s internal attenuator will only affect compression occurring in the internal pre-amp. It will not have any effect on any compression occurring in the external pre-amp.

Measurements are Taking too Long

If your measurements are taking too long, you can reduce the time taken by switching **Averaging** to **Off**, by increasing the **Resolution Bandwidth**, and by reducing the **Number of Points** on a swept measurement.

If the measurement is taking longer than about 8 minutes, it is advisable to switch **Alignments** to **Off** because the measurement will restart itself every time the analyzer realigns itself.

Calibration is Taking too Long

If you find that your calibration is taking too long, you can reduce the calibration time by reducing the frequency span or the attenuation range. This reduces the number of frequency points at which the analyzer is calibrated. Either increase the minimum frequency in the calibration range, or decrease the maximum frequency.

Calibration Data > 3 GHz is not what I Expected

Measurement performance > 3 GHz is not specified. If you do not have a preamp and you are calibrating above 3 GHz, the calibration data will vary significantly. Measurements made with this calibration data might be valid, but only if the device you are testing has a high enough gain and noise figure, such that the sum of these is about 35 dB or more. The measurement accuracy will be poor. See “Problems Measuring Above 3 GHz" on page 255.

Problems Measuring Above 3 GHz

A preamp is needed for measurements > 3 GHz. Agilent Option 110 (100 kHz to 50 GHz Internal Preamp) is ideal for this purpose. While it is possible to make valid measurements without a preamp, measurement accuracy is usually poor. The following curves describe the noise figure measurement error for DUTs with various gains and noise figures.

N8201A Frequency Range: >3 GHz (Non-Warranted)
Assumptions: Measurement Frequency 12 GHz, Instrument NF = 26.5 dB, Instrument VSWR = 1.4, Instrument Gain Uncertainty = 2.2 dB, Instrument NF Uncertainty = 0.05 dB, Agilent 346B Source with Uncertainty = 0.2 dB, Source VSWR = 1.25, DUT input/output VSWR = 1.5

Curves for Positive Error Ranges for DUT NFs of 5, 10, and 15 dB

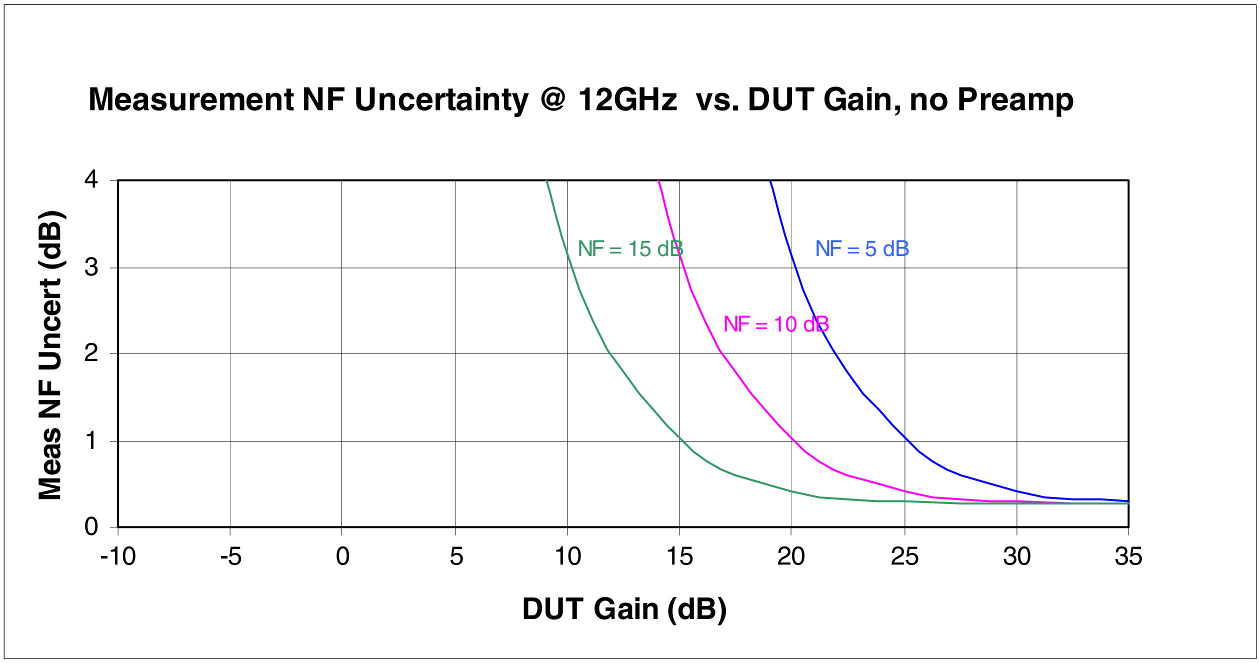


Figure 41 Without Preamp - Nominal NF Error vs. DUT Gain

To use these curves you must be able to estimate the NF and Gain performance of the device that you want to test. Use these values to estimate the amount of measurement error.

For Example, if your DUT has NF = ~5 dB and gain = 20 dB. Plotting these values on the curves will give you an estimated error between ±3 dB. This amount of measurement uncertainty is probably too large for the your measurement needs.

Now add a preamp to the measurement system. Assume this external preamp has NF = 6dB and gain = 23 dB.

Assume that the measurement is being made at 12 GHz where the NF = 26.5 dB. Then the combined NF of the preamp + N8201A is ~8 dB. The following curves describe the noise figure measurement error for various DUTs, when the preamp is being used with the N8201A

Note that the Friss equation can be used to figure out what level of preamp performance is needed for the N8201A desired frequency range. See also Figure 43 on page 257 below for nominal N8201A noise figure values.

N8201A Frequency Range: >3 GHz (Non-Warranted)
Assumptions: Same as above, with the addition of an external pre-amp. With an external pre-amp, the pre-amp/analyzer combination NF is 7.93 dB; the external pre-amp alone has a gain of 23 dB and an NF of 6 dB. Instrument VSWR is now that of the external pre-amp; VSWR = 2.6

Curves for Positive Error Ranges for DUT NFs of 5, 10, and 15 dB

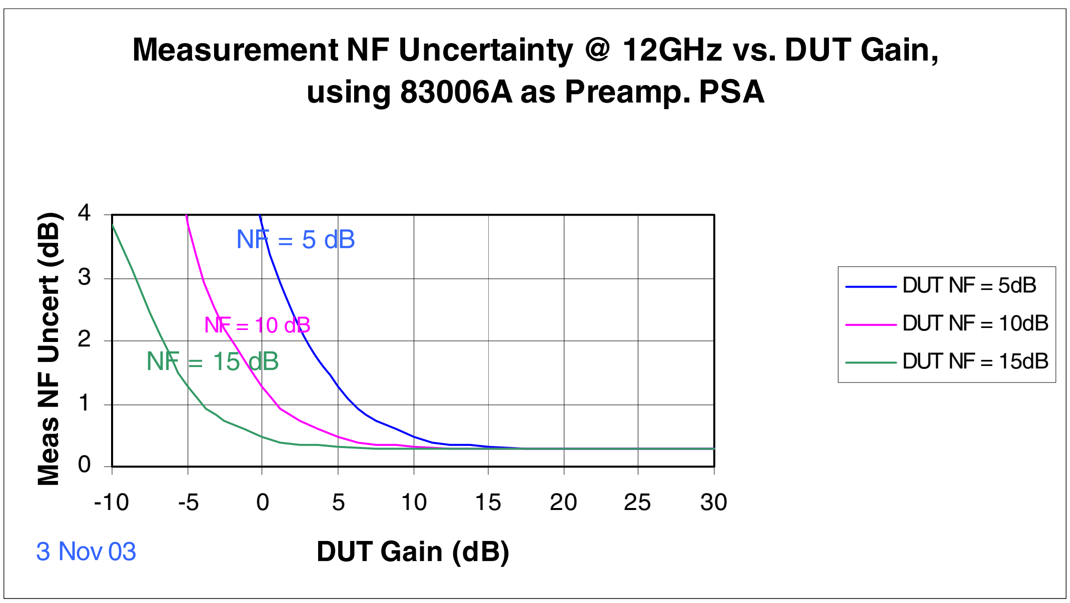


Figure 42 Computed Noise Figure Uncertainty versus DUT Gain, Non-warranted Frequency Range

Now suppose you have the same DUT with NF = ~5 dB and gain = 20 dB. Plotting these values on the curves will give you an estimated error that is very small, so the N8201A can be used for this measurement.

Suppose you measure a different DUT that has no gain and has NF = 5 dB. Plotting these DUT values on the above curves gives about 4 dB measurement error. So this second DUT's measurement results would have an unacceptable measurement error.

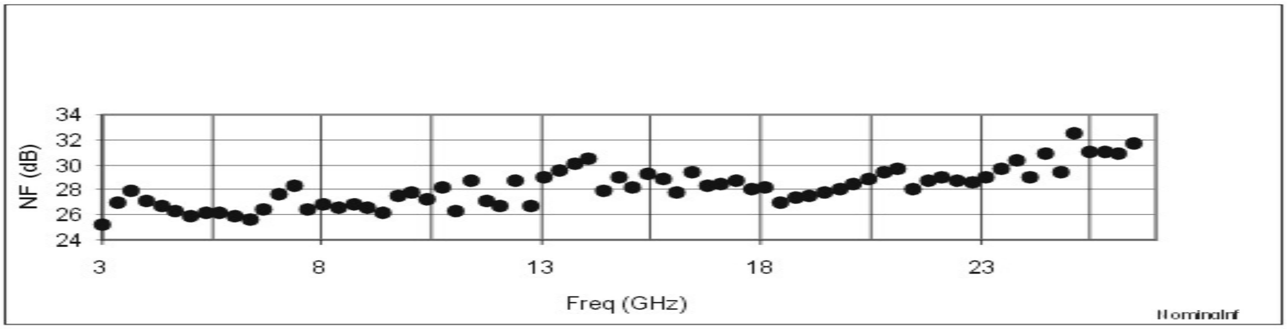


Figure 43 No Preamp - Nominal Noise Figure*

* Graph shows measurements made with one sample analyzer

8
Contacting Agilent Technologies

Contacting Agilent

Agilent on the Web

You can find information about technical and professional services, product support, and equipment repair and service on the Web: http://www.agilent.com.

1 Click on the **Test & Measurement** link then click on **Select a Country**.
2 Click on the **Contact Us** link for contact information.