Agilent PSA Series Spectrum Analyzers Measuring Receiver Personality Option 233/ N5531S Measuring Receiver

Technical Overview and Self-Guided Demonstration

Key measurements include:

- Frequency counter
- Tuned RF level
- Absolute RF power
- AM depth
- FM deviation
- ΦM deviation
- Modulation rate
- Modulation distortion
- Modulation SINAD
- Audio frequency
- Audio AC level
- Audio distortion
- Audio SINAD

The Agilent PSA built-in measuring receiver personality (Option 233) is the key component that converts the general-purpose, PSA Series high-performance spectrum analyzer into the flexible N5531S measuring receiver system. The N5531S is comprised of a PSA installed with option 233 and an optional audio input (Option 107), a P-Series power meter, and a sensor module with single-input connection up to 50 GHz. By placing the receiver measurements and controls directly into the PSA, it eliminates the need for an external PC – providing a more compact measuring receiver system.

The Agilent N5531S measuring receiver system provides metrology/calibration customers with an ideal tool for calibrating signal generators and step attenuators up to 50 GHz. It enables customers to use off-the-shelf, general-purpose instruments to perform measurements with the most stringent requirements in metrology and calibration environments.

Agilent Technologies

Flexible, Compact Package with Maximum Frequency and Power Level Coverage

While building on the tradition of excellence established by Agilent Technologies' previous measuring receivers, the N5531S takes a new, more flexible approach by designing a system based on standard test instruments. It combines the PSA Series high performance spectrum analyzer with a precision P-Series power meter and specially designed sensor module to achieve the best possible measurement accuracy. This design provides a number of distinct advantages:

- The outstanding performance of the PSA Series spectrum analyzer and P-Series power meters provide superior performance specifications to meet or exceed the most challenging requirements of the metrology/calibration applications.
- The wide frequency coverage of the PSA Series spectrum analyzer enables you to make measurements up to 50 GHz without the need for external downconverters and local oscillators used by previous measuring receivers. This saves both your budget and valuable lab space, and also helps to eliminate operator errors due to complexity of the measurement system.
- The excellent sensitivity of the N5531S in tuned RF level (TRFL) measurements allows the user to calibrate step attenuators with the widest dynamic range within the required measurement uncertainty and speed.
- The audio analysis capability of the N5531S, based on the latest digital signal processing technologies, enables users to perform audio signal characterizations with superior measurement accuracy.
- In addition to a measuring receiver, you also have a high performance spectrum analyzer and power meter for general-purpose usage throughout your lab, effectively stretching your test equipment budget.
- Use equipment you already own. Owners of a PSA spectrum analyzer or P-Series power meter can purchase the additional elements needed to build up a complete N5531S system. The Agilent EPM/EPM-P Series power meter can also be used in the system but requires a LAN/GPIB gateway, such as Agilent E5810A. Since the N5531S performance specifications are derived from that of the individual instruments, no additional system calibration or verification is needed.

"EASY-to-Use" User Interfaces Simplify Instrument Usage and System Control

The built-in measuring receiver personality (Option 233) enables users to set the measurement parameters and to initiate the measurement via the PSA's front panel. One-button pressing can switch between the measuring receiver mode with others, such as spectrum analysis mode, easily and quickly. Measurement results are shown on the PSA's display.

The GPIB interface of the PSA allows remote system control through SCPI commands.

While no external PC is required for the measuring receiver to work, the optional PC software offers PC-based graphic user interface and batch operation mode, as well as a COM API-compliant remote user interface. These enhancements increase the user's capability of controlling the system locally and remotely.

Sensor Modules with Single Input Connection Ensure Measurement Integrity

The N5531S system includes a sensor module to provide a single connection to the device under test (DUT) for all RF measurements. The N5532A sensor module uses an integrated power splitter to provide independent signal paths for RF and power measurements, which ensures your measurement integrity. Previous generation sensor modules (11722A/11792A) used mechanical switches to accomplish signal separation.

By eliminating mechanical moving parts, the N5532A provides better reliability and repeatability. Four versions of the N5532A are available to cover your specific frequency range of interest up to 50 GHz.

This technical overview includes:

- Measurement capabilities
- Self-guided demonstrations and explanations
- Key specifications
- Ordering information
- Related literature

Figure 1. N5532S sensor module

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1.1 N5531S Measuring Receiver System Components

PSA spectrum analyzer and options[a]

- Select a PSA platform based on the frequency coverage: E4443A (6.7 GHz), E4445A (13.2 GHz), E4440A (26.5 GHz), E4447A (42.98 GHz), E4446A (44 GHz), or E4448A (50 GHz)
- Option 233: built-in measuring receiver personality (required)
- Option 123: switchable µW peselector bypass (required for TRFL measurements above 3 GHz)
- Option 1DS: RF preamplifier (required for meeting the best TRFL specifications below 3 GHz)[b] **or** Option 110: RF/µW internal preamplifier (required to meet the best TRFL specification at entire frequency range)
- Option 107: audio input 100 kΩ (required for audio analysis)
- Select from available PSA options for other measurement purpose (optional)

P-Series power meter[c]

- Select from available N1911A or N1912A options (optional)

N5532A sensor module (select one frequency coverage) and N191xA power meter adaptor

- Option 504: (100 kHz to 4.2 GHz)
- Option 518: (10 MHz to 18 GHz)
- Option 526: (30 MHz to 26.5 GHz)
- Option 550: (30 MHz to 50 GHz)
- Option 019: adaptor for use with the N191xA power meter (required for connecting the sensor module to the P-Series power meter). This option can be ordered standalone.
- N55315-010: LAN connection kit (required if an esternal PC is used)

1.2 Upgrade Kits

Upgrade kits for each of the required PSA options are available to upgrade existing customer units. The power meters require no additional options. The N5532A sensor modules can be purchased individually. Contact your local Agilent sales representative or access **http://www.agilent.com/find/psa_upgrades** for more information.

a You can also select any other available PSA options if desired. Refer to the "Agilent PSA Series High-Performance Spectrum Analyzers Configuration Guide (#5989-2773EN)" for option compatibilities.

b PSA options 1DS and 110 cannot coexist in a same PSA instrument. Option 1DS covers the frequency range of 100 kHz and 3.05 GHz, whereas Option 110 covers up to the maximum frequency of the PSA base instrument in use.

c You can also select an Agilent EPM or EPM-P power meter with a LAN/GPIB gateway.

2.1 Demonstration Preparation

All demonstrations use the system setup shown in the **Figure 2** on page 6. Keystrokes surrounded by [ ] indicate front panel hard keys. Keystrokes surrounded by { } indicate soft key on display.

To perform the following demonstrations, the instruments included in the N5531S measuring receiver system require these options, indicated in **Table 1**.

Table 1. Requirements of a demo set-up

Product type	Model number	Required options	
PSA Series spectrum analyzer	E4443A/45A/40A/47A/46A/48A	Option 233	Built-in measuring spectrum receiver personality
		Option 123	Switchable µW preselector bypass (required when measuring tuned RF level for freq > 3 GHz)
		Option 1DS	RF preamplifier (required for the best level sensitivity between 100 kHz and 3 GHz),
			Or
		Option 110	RF/µW preamplifier (required for the best sensitivity up to the max. freq of PSA used)
		Option 107	Audio input 100 kΩ (required for audio measurements
EPM power meter	N1911A/12A	Standard features	
Sensor module	N5532A	Option 504	100 kHz to 4.2 GHz, or
		Option 518	10 MHz to 18 GHz, or
		Option 526	30 MHz to 26.5 GHz, or
		Option 550	30 MHz to 50 GHz
		Option 019	N191xA power meter adaptor (required)

2.2 Setup of the N5531S Measuring Receiver Demo System

Connect all the instruments together as shown in **Figure 2**. An Agilent ESG (E44xxC) is used as a device under test (DUT) for both RF and audio signals (LF out) generation. The PSA's time base is used as the common reference for both the PSA and ESG. To do this, connect a BNC cable from the "10 MHz out (Switched)" connector on the PSA rear panel to the "10 MHz in" connector on the ESG rear panel.

Data communications between the PSA and the power meter are based on the TCP/IP protocol though the local-area network (LAN). For the demonstrations without PC user interface, using a cross-over LAN cable is the simplest way to connect between the E444xA PSA and the N1911A P-Series power meter, establishing a stand-alone LAN environment. For demonstrations with PC user interfaces, a LAN hub with 3 regular LAN cables is used to establish a LAN environment among the PSA, the P-Series power meter, and the PC with the measuring receiver PC user interface software.

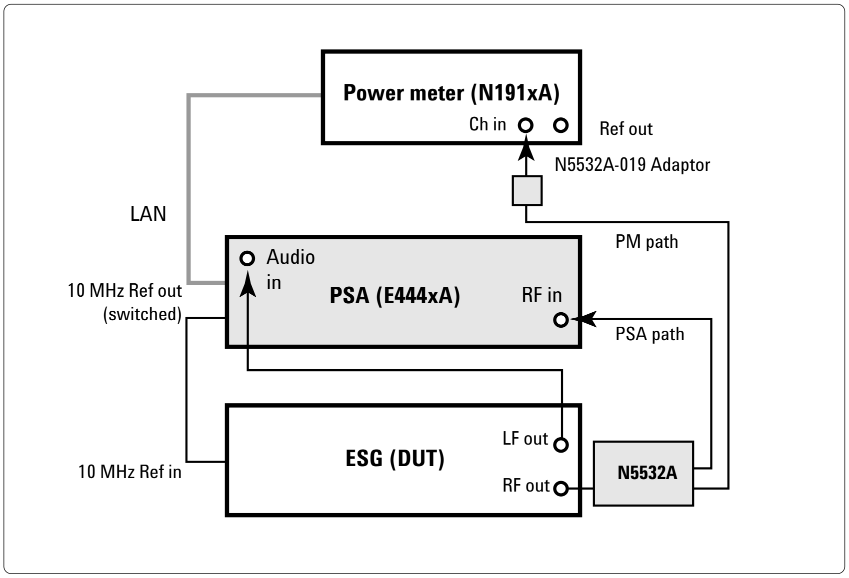

Figure 2. Demonstration System Set-Up

PSA spectrum analyzer
With the LAN cable connected, turn the power on.

Verify the "Frequency reference"

- Press [System], then {Reference}
- Press {10 MHz Out} and make sure "On" is underlined.
- At this point, verify that the ESG displays "Ext Ref" to ensure that the ESG is phase-locked to the PSA.

Establish the LAN communication between PSA and P-Series power meter (An example for using a cross-over LAN)

- **Power meter:** Press [System], {Remote Interface}, {Network Manual}. With the first IP address box highlighted; press [Select], [192], {Enter}; Press [▶] to highlight the second IP address box, press [Select], [168], {Enter}; Press [▶] to highlight the third IP address box, press [Select], [100], {Enter}; Press [▶] to highlight the last IP address box, press

[Select], [2], {Enter}. In this way, the IP address of the power meter is set up as "192.168.100.2". Similarly, one can set up the "Subnet mask" of the power meter as "255.255.255.0".

- **PSA:** Press [System], {Config I/O}, {IP Address}, [192.168.100.1], [Enter] to set up the PSA's IP address as "192.168.100.1". Press {Subnet mask}, [255.255.255.0], [Enter] to set the PSA's Subnet mask as "255.255.255.0".
- **PSA:** Press [System], {More 1 of 3}, {More 2 of 3}, {Power Meter}, {Power Meter Config}, {Power Meter IP Address}, [192.168.100.2], [Enter]. Then, press {Verify Power Meter Connection}, the grayed-out {Show Setup} should become available if the connection between the PSA and the P-Series power meter is established. Press {Show Setup} to verify the power meter information.

Load the N5532A sensor module cal factors

- **PSA:** Press [MODE], {Measuring Receiver}, [File], {Load}, {Type}, {More 1 of 2}, {Calibration Factor}. Insert the 3" floppy disk of the "N5532A sensor module data disk" into the PSA's floppy driver, and press {Dir Up}, [↑], {Dir Select} to ensure the "A" drive is selected. Then, press {Load Now} to load the cal factor file (CFDATA.XML) to the PSA.

Calibration of the power meter and the PSA

As the N5531S is used by metrology labs to calibrate signal generators and/or attenuators; achieving the best measurement accuracy and precision is of paramount importance. To ensure accurate measurements, the power meter and the PSA must first be calibrated by following the procedures below.

Calibrate the PSA:

- Without connecting to the PSA RF input
- Press [System], {Alignments}, {Align All Now}, and wait until its completion.

Calibrate the power meter:

- Connect the RF input connector of the senor module N5532A to the Power Ref connector
- On PSA: press [System], {More 1 of 3}, {More 2 of 3}, {Power Meter}, {Zero & Cal Power Meter}, and wait until its completion.

  Or:
- On the Power meter: press [Cal], {Zero+Cal}, and wait until its completion.

Upon completion of the calibration, connect the RF input connector of the sensor module to the RF output of the ESG (DUT) for measurements. Connect the SA path and power meter path of the sensor module to the PSA "RF input" and the power meter "Channel in", respectively.

ESG signal generator

Set the signal generator to 1.1 GHz and -10 dBm:

- [Freq] = [1.1] {GHz}
- [Amplitude] = [+/-] [10] {dBm}
- [Incr Set], [10] {dB}
- [RF ON]
- [MOD OFF]

Save the ESG setting in preset:

- [Utility], {Preset} to highlight "User", {Save User preset}

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Measurement 1: Frequency Counter
Frequency is one of the most fundamental measurements performed on all signal generators that generate sinusoidal continuous wave (CW) RF outputs. The Agilent PSA Series high performance spectrum analyzer offers outstanding frequency accuracy, resolution power and measurement sensitivity, and hence warrants the accuracy and precision of the frequency measurements using the N5531S. The PSA automatically tunes to and measures the frequency of carrier signals. The frequency counter automatically adjusts itself as the input level changes.

Additionally, if the nominal frequency of the signal under test is known, the measuring receiver can be manually tuned to that frequency and make accurate measurements. The manual tune is particularly useful if the signal level is so low that the automatic tune fails to find the signal. The manual tuning also allows faster measurements when the frequency of the input signal is much higher than 100 MHz.

Note: Please make sure that the modulation of the ESG is "Off" when making "Frequency Counter" measurements.

Instructions	Keystrokes
Initiate the "Measuring Receiver" personality.	[MODE], {Measuring Receiver}
Start "Frequency Counter" measurement in "Auto Tuning" mode.	[MEASURE], {Frequency Counter}
Ensure "Auto Tuning" mode is set.	[Meas Setup], press {Tuning} to underline "Auto"
Set the displayed unit to "GHz".	[AMPLITUDE], {Display Unit}, {GHz}
Change "Frequency Counter" measurement to "Manual tuning" mode.	[Meas Setup], press {Tuning} to underline "Man"
Observe the frequency counter measurement result on the PSA screen.	
Set the nominal frequency (1.1 GHz, for example) manually.	{Tuning}, [1.1], {GHz}
Observe the display on the PSA screen for the frequency reading and frequency error reading (the difference between the measured frequency and the nominal one).	

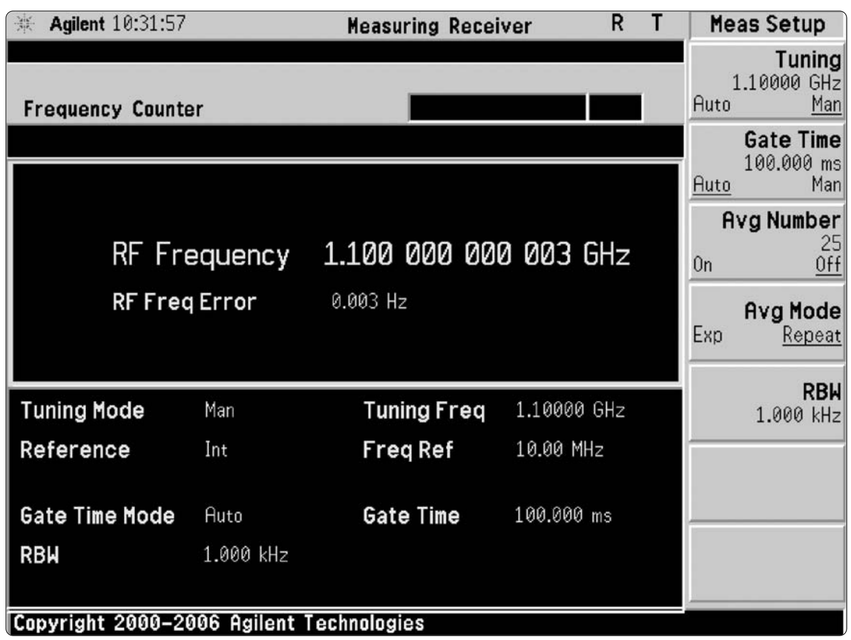

Figure 3. "Frequency counter" measurement result

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Measurement 2: RF Power

The "RF Power" quantifies the output level, in an absolute term, of a signal generator or an attenuator being calibrated. This is another common measurement for broadband RF signal qualification. The extraordinary power accuracy and wide frequency range offered by the Agilent N191xA P-Series power meter that is part of the N5531S measuring receiver system provides users the absolute confidence in their absolute RF power measurements.

Instructions	Keystrokes
Start "RF Power" measurement.	[MEASURE], {RF Power}
Set the displayed unit to "Watt".	[AMPLITUDE], {Display Unit}, {Watt}
Change back to "dBm".	{dBm}
Change the number of averaging (the averaging is defaulted as "Off").	[Meas Setup], press {Avg Number} to underline "On"
Select mode of averaging to "Exponential" or "Repeated" as needed[a].	[Meas Setup], press {Avg Mode} to underline "Exp" or "Repeat"

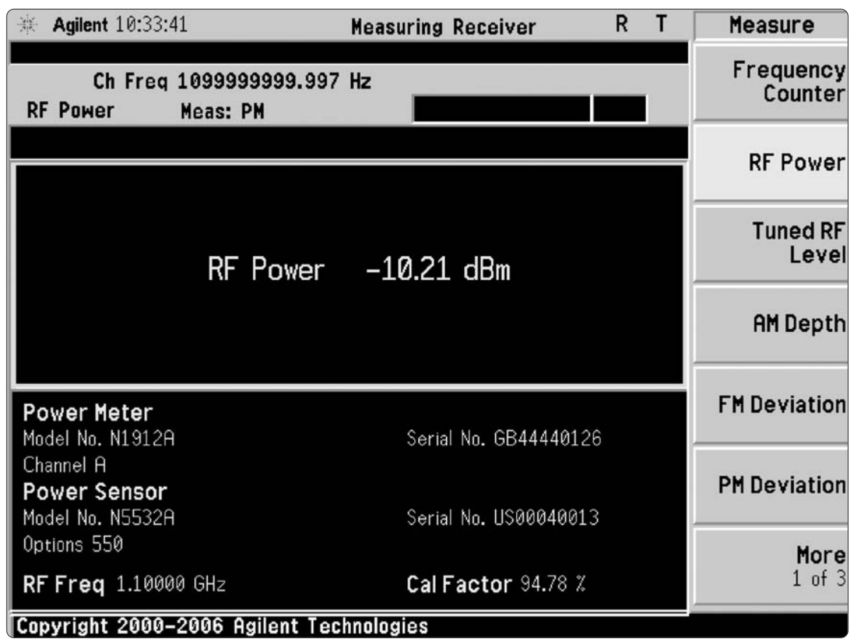

Figure 4. "RF power" measurement result

[a] In the "Repeated" mode, the averaging is reset and a new average is started after the average count is reached. By contrast, in the "Exponential" mode, each successive data acquisition after the average count is reached, is exponentially weighted and combined with the existing average.

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Measurement 3: Tuned RF Level

The "Tuned RF Level (TRFL)" test is to make power measurements with exceptional accuracy and sensitivity. Unlike the "RF Power" measurement which measures total power across a wide frequency band, the TRFL measurement tunes to the frequency of interest and is capable of measuring extremely low level of power. This is particularly useful when a step attenuator or a signal generator is tested for its step accuracy of power outputs with incremental changes.

Instructions	Keystrokes
Start "TRFL" measurement.	[MEASURE], press {Tuned RF Level}
Decrease RF output of ESG at 10 dB/step to -130 dBm.	On ESG: [AMPLITUDE], [_]
Read the display for the "Range2 Switch Level" and "Range3 Switch Level". You need to slowly change the step around those switch levels to ensure the Range-to-Range recalibrations are complete.	
Reset TRFL cal factors[a].	[Preset]
The IF BW is defaulted to 10 Hz. Adjust it to 75 Hz to speed up the measurements[b].	[Meas Setup], press {IF BW} to underline the "75 Hz"
The accuracy is defaulted to "Normal". Adjust it to "High" to meet the most stringent accuracy specs[c].	[Meas Setup], press {Accuracy} to underline "High"

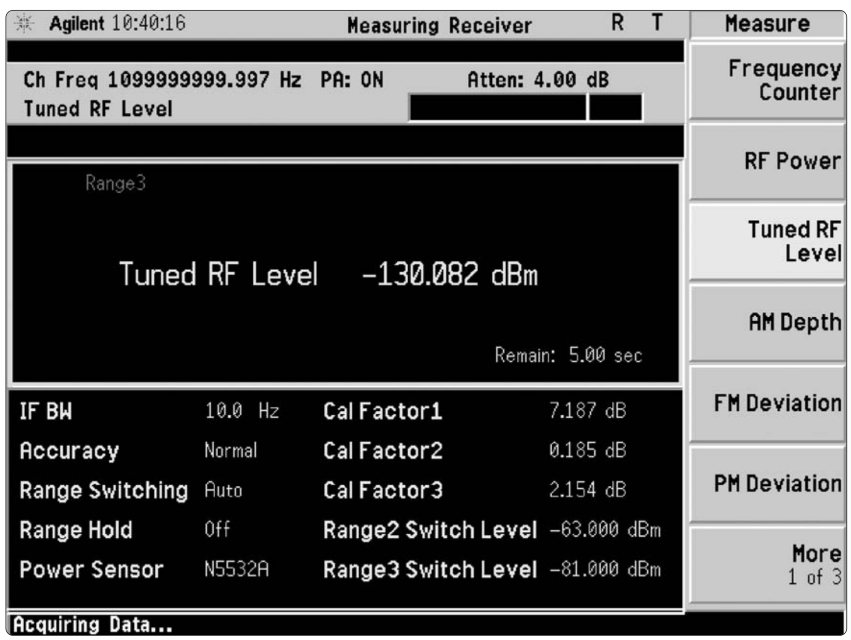

Figure 5. "TRFL" measurement result at -130 dBm

[a] To ensure the accuracy of the measurements at different settings, the TRFL cal factors need to be reset before changing the settings.

[b] The IF BW setting of "10 Hz" offers better TRFL measurement sensitivity than "75 Hz" can offer.

[c] The "Normal" accuracy mode sets the standard deviation of measurement uncertainty level to 0.05 when the signal-to-noise ratio (SNR) is high, but to 0.1 when the SNR is low. The "High" accuracy mode, by contrast, sets the standard deviation of measurement uncertainty to 0.05 for all circumstances.

Measurement 4: AM Analysis
Amplitude modulation (AM) of a sine or cosine carrier results in a variation of the carrier amplitude that is proportional to the amplitude of the modulating signal that contains information. Amplitude modulation is a linear process. The modulating signal varies the amplitude of the resultant modulated signal, therefore, adds power to the carrier.

4.1 AM depth
The AM depth is the amount of amplitude modulation. It ranges from 0% to 100%. The following modulation index (m) defines the AM depth:

In time domain:

$m = (E_{max}-E_{min})/(E_{max} + E_{min})$ (in %),

where, E_{max} and E_{min} are the maximum and minimum amplitudes (in voltage) of the modulated signal.

AM depth can be described either in a linear term (%) or in a logarithmic term (dB). Both terms are related as follows:

AM depth (in dB) = 20 x log(m)

The peak detector is used for the AM depth measurement. Using the RMS detector may introduce errors. When the modulating signal (or base band signal) is asymmetric, using +peak or –peak detector will generate different measurement results, and the ±peak/2 detector is recommended.

A waveform view is provided for a more intuitive presentation of the AM depth variation versus time for the demodulated signal.

4.2 AM modulation rates and modulation distortion
The AM modulation rate implies the frequency of the modulating signal. The modulation distortion for the AM is the undesired alterations to the modulated signal added by the modulation processes. The modulation distortion is defined as the ratio of the total unwanted

Instructions	Keystrokes
Reset the signal generator.	On ESG: [Preset]
Set 10% of the AM depth.	On ESG: [AM], {AM Depth}, [10] {%}
Set 400 Hz of AM rate.	On ESG: {AM Rate}, [400], {Hz}
Turn on AM modulation.	On ESG: press {AM Off/On} to highlight “On”
Make sure the indicator on the ESG display reads "MOD ON".	On ESG: press [Mod On/Off] to highlight “On”
To get faster measurements, the user may want to band-limit the signal using a combination of a high-pass (HPF) and a low-pass filter (LPF). Since a 400 Hz AM signal will be examined in this example, a 50 Hz HPF and a 3 kHz LPF will be selected.	[Det/Demod], {HP Pass Filter}, {50 Hz}, {LP Pass Filter}, {3 kHz}
Start AM analysis.	[MEASURE], {AM Depth}
Watch the readings for AM depth, modulation rate, distortion, and SINAD.	
Display waveform of the demodulated signal.	[View/Trace], {Demod Waveform},
Adjust the display Y scale.	[AMPLITUDE Y Scale], {Scale/Div} , [2.5], {%}, [Return]
Adjust the display X scale.	[SPAN X Scale], [1] {ms}, you should see four cycles of the demodulated signal.
Modulation rate, modulation distortion, or modulation SINAD can also be measured separately.	[MEASURE], {More 1 of 3}, {Modulation Rate}, {Modulation Distortion}, or {Modulation SINAD}

signals to the total signal:

Modulation distortion (in %) =

$$\frac{\sqrt{E_{total}^2 - E_{signal}^2}}{E_{total}}$$

where, E_{total} is the level of the total signal and E_{signal} is the level of the wanted modulating signal (in voltage) . The term $\sqrt{E_{total}^2 - E_{signal}^2}$ implies the total unwanted signals which include harmonic distortion and noise.

These measurements verify the AM quality of the signal from the DUT.

4.3 AM modulation SINAD
Modulation SINAD is defined as the ratio of the total signal power to unwanted signal (harmonics and distortion):

Modulation SINAD (in % dB)=

$$=20 \times \log \left(\frac{E_{total}}{\sqrt{E_{total}^2 - E_{signal}^2}} \right)$$

This is another way to quantify the quality of the modulation process. See instructions/ keystrokes on page 11.

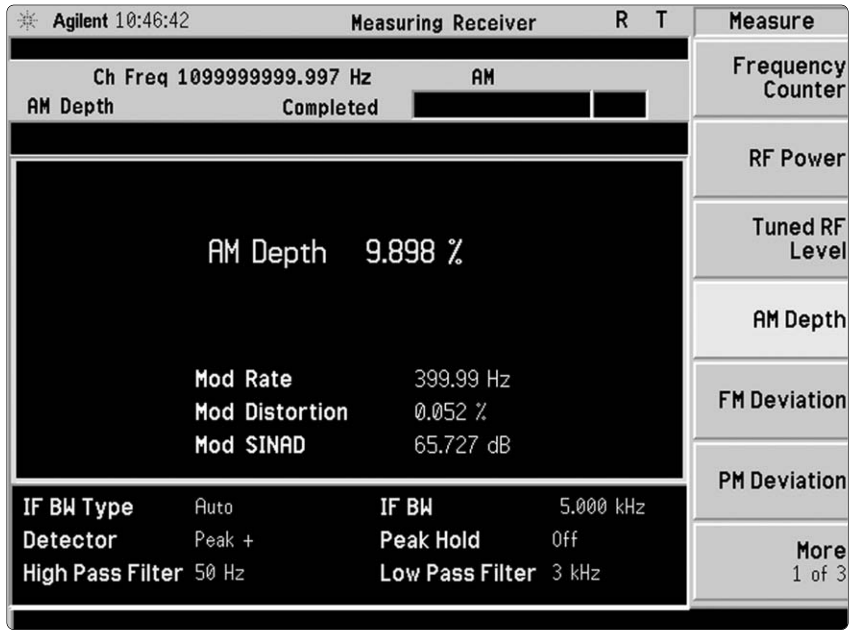

Figure 6. "AM modulation" result displayed in numerical format

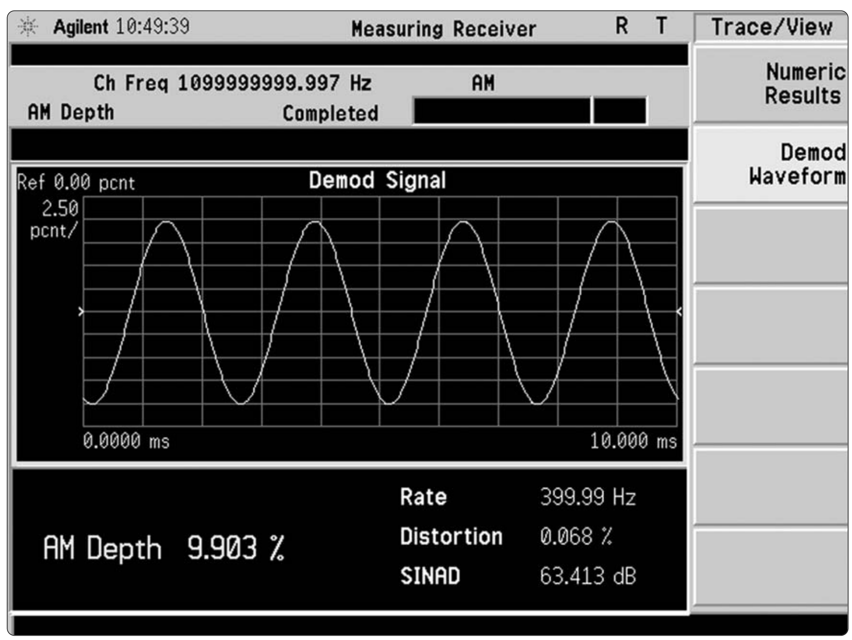

Figure 7. "AM modulation" result displayed in waveform

Measurement 5: FM Analysis
Frequency modulation (FM) is a scheme of angular (or exponential) modulation in which the modulating signal is used to vary the frequency of a carrier wave. The instantaneous frequency of the modulated carrier is directly proportional to the instantaneous amplitude of the modulating signal.

5.1 FM deviation
The FM deviation quantifies the amount of the frequency modulation. The quantity being measured is the peak frequency deviation that is the maximum frequency excursion from the average carrier frequency. In a signal generator calibration, a measuring receiver system must accurately measure the peak frequency deviation of the modulated signals to validate the given nominal values. The peak detector is used for accurate FM deviation measurements.

A waveform view displays the demodulated signal by showing the curve of FM deviation versus time, providing an intuitive picture for the quality of FM.

A series of filters (high-pass or low-pass) are provided for pre-conditioning the signal under test to achieve the best measurement results. For FM measurements, in particular, four different “FM De-Emphasis” filters with different time-constants are also offered for analyzing the pre-emphasized FM signals.

Instructions	Keystrokes
Reset the signal generator.	On ESG: Press [Preset]
Set 1 kHz of FM deviation.	On ESG: Press [FM/ΩM], {FM Deviation}, [1] {kHz}
Set 400 Hz of FM rate.	On ESG: press {FM Rate}, [400], {Hz}
Turn on FM modulation.	On ESG: Press {FM Off/On} to highlight “On”
Make sure the indicator on the ESG display should read "MOD ON".	On ESG: Press [Mod On/Off] to highlight “On”
To get faster measurements, band-limit the signal using a combination of a high-pass (HPF) and a low-pass filter (LPF). In this case, select a 50 Hz HPF and a 3 kHz LPF.	Press [Det/Demod], {HP Pass Filter}, {50 Hz}, {LP Pass Filter}, {3 kHz}
Start FM analysis.	Press [MEASURE], {FM Deviation}
Watch the readings for FM deviation, modulation rate, distortion, and SINAD.	
Display waveform of the demodulated signal.	Press [View/Trace], {Demod Waveform}
Adjust the display Y scale.	Press [AMPLITUDE Y Scale], {Scale/Div} , [250] {Hz}, [Return]
Adjust the display X scale.	Press [SPAN X Scale], [2.5], {ms}, you should see 10 cycles of the demodulated signal
Modulation rate, modulation distortion, or modulation SINAD can also be measured separately.	Press [MEASURE], {More 1 of 3}, {Modulation Rate}, {Modulation Distortion}, or {Modulation SINAD}

5.2 FM modulation rate and modulation distortion
The FM modulation rate indicates frequency of the modulating signal. When the frequency of the modulating signal (or base-band signal) increases, the highest and lowest frequencies of the modulated signal will stay the same but occur more often.

Similar to that in AM, the modulation distortion for FM is measured on the post-detection signal (or base-band signal), and is defined as a ratio of the total harmonic distortion plus noise (THD+N) to the total signal level. These parameters quantify the signal distortion created during the FM modulation process in relative term.

5.3 FM modulation SINAD
Similar to AM analysis, another way to characterize the quality of FM is to use Modulation SINAD, which is defined as the ratio of the total signal level vs. unwanted signal (harmonics and distortion) level. See instructions/keystrokes on page 13.

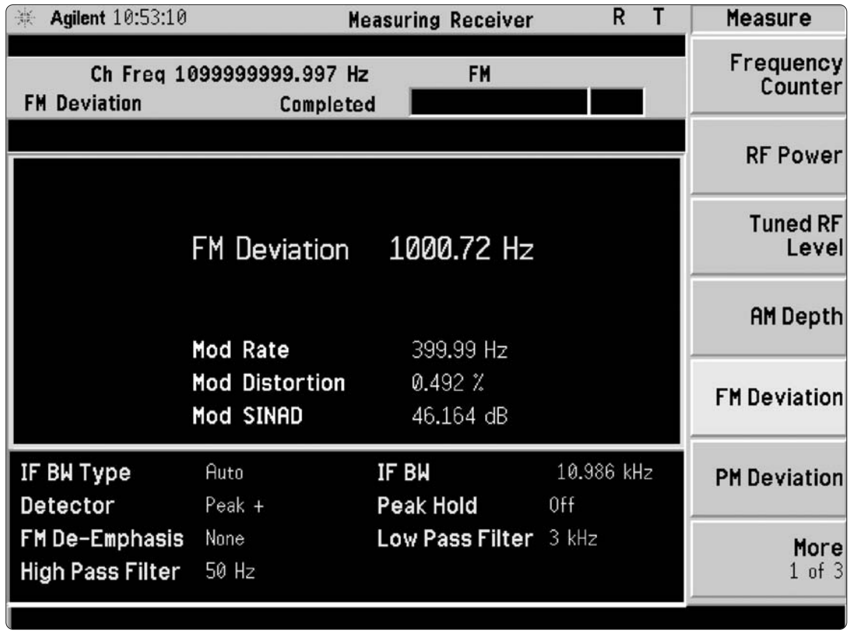

Figure 8. "FM modulation" result displayed in numerical format

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Measurement 6: Phase Modulation Analysis
Phase modulation (ΦM) is another form of angular (exponential) modulation in which the instantaneous phase deviation of the modulated carrier is directly proportional to the instantaneous amplitude of the modulating signal. ΦM and FM are very closely related, as phase is the time integral of the frequency or frequency is the time derivative of the phase.

6.1 Phase deviation
The phase deviation, or ΦM deviation, expressed in radians or in degrees, is a measure of the amount of phase modulation. The quantity being measured is the peak phase deviation, which is the maximum phase excursion from the average carrier phase.

A waveform view of the ΦM deviation measurements provides graphical displays of the demodulated signal by showing the curve of ΦM deviation versus time.

6.2 Phase modulation rate and modulation distortion
The ΦM modulation rate also indicates the frequency of the modulating signal. Increasing the frequency of the modulating signal will not alter the ΦM deviation, but will make faster phase alterations in the modulated signal.

Like the FM modulation distortion, the phase modulation distortion is also defined at the post-detection stage with the

Instructions	Keystrokes
Reset the signal generator.	On ESG: Press [Preset]
Set 0.5 rad of ΩM deviation.	On ESG: Press [FM/ΩM], , {ΩM Dev}, [0.5] {rad}
Set 400 Hz of ΩM rate.	On ESG: Press {ΩM Rate}, [400], {Hz}
Turn on ΩM modulation.	On ESG: Press {ΩM Off/On} to highlight “On”
Make sure the indicator on the ESG display reads “MOD ON”.	On ESG: Press [Mod On/Off] to highlight “On”
To get faster measurements, band-limit the signal using a combination of a high-pass (HPF) and a low-pass filter (LPF). In this case, select a 50 Hz HPF and a 3 kHz LPF.	Press [Det/Demod], {HP Pass Filter}, {50 Hz}, {LP Pass Filter}, {3 kHz}
Start ΩM analysis.	Press [MEASURE], {PM Deviation}
Watch the readings for ΩM deviation, modulation rate, distortion, and SINAD.	
Display waveform of the demodulated signal.	Press [View/Trace], {Demod Waveform}
Adjust the display Y scale.	Press [AMPLITUDE Y Scale], {Scale/Div}, [0.25] {radians}, [Return]
Adjust the display X scale.	Press [SPAN X Scale], [2.5], {ms}
	Note: You should see 10 cycles of the demodulated signal.
Modulation rate, modulation distortion, or modulation SINAD can also be measured separately.	Press [MEASURE], {More 1 of 3}, {Modulation Rate}, {Modulation Distortion}, or {Modulation SINAD}

base-band signal. The modulation distortion is the ratio of the total harmonic components plus noise to the level of the demodulated signal, i.e., the total undesired signal level to desired signal level.

6.3 Phase modulation SINAD
Similar to AM and FM, modulation SINAD can also be used to characterize the quality of the modulation of the signal. See instructions/keystrokes on page 15.

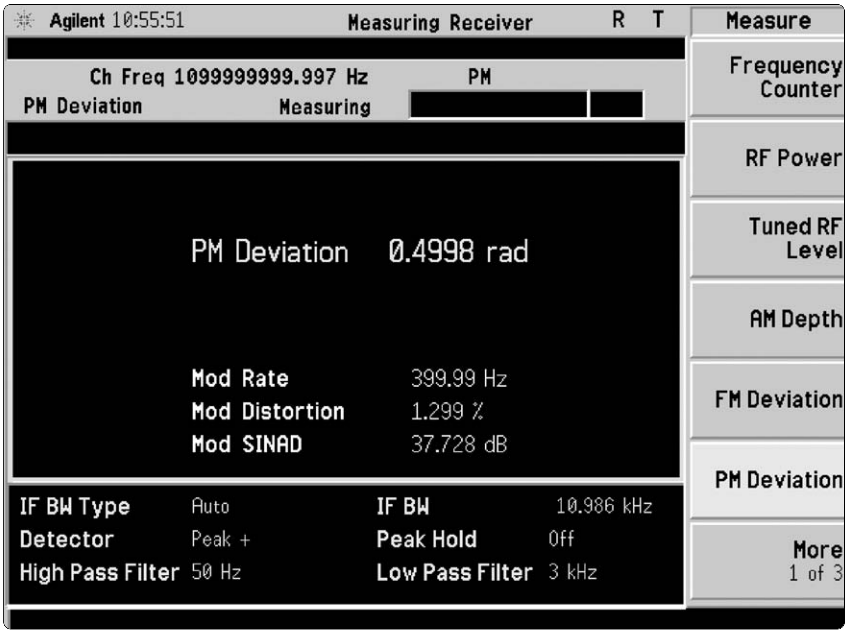

Figure 9. "Phase modulation" measurement result displayed in numerical format

Measurement 7: Audio Analysis
Audio analysis is only available when both the measuring receiver personality (Option 233) and audio input (Option 107) are installed in a PSA. Audio analysis is performed on the signal from a high-impedance audio input connector (100 kΩ) on the PSA front panel. The frequency range is 20 Hz to 250 kHz. Once any of the audio analysis related soft-keys (Audio Frequency, Audio AC Level, Audio Distortion, and Audio SINAD) is enabled, the input signal path is automatically switched from the RF input to the audio input.

7.1 Audio frequency
Audio frequency measurement accurately measures the frequency of audio signals or a demodulated signal from the audio input connector of the PSA (Option 107).

Instructions	Keystrokes
Set the LF out on the signal generator for generating audio signals.	On ESG: Press [LF Out], {LF Out Source}, {Function generator}
Set the amplitude of the audio signal to 1 Vp.	On ESG: Press {LF Out Amplitude}, [1] {Vp}
Set the frequency of the audio signal to 1 kHz.	On ESG: Press {LF Out Freq}, [1], {kHz}
Set the audio signal to sine wave.	On ESG: Press {LF Out Waveform}, {Sine}
Turn on audio signal output.	On ESG: Press {LF Out Off/On} to highlight "On"
To get faster measurements, band-limit the signal using a combination of a high-pass (HPF) and a low-pass filter (LPF). In this case, select a 300 Hz HPF and a 30 kHz LPF.	Press [Det/Demod], {HP Pass Filter}, {50 Hz}, {LP Pass Filter}, {3 kHz}
Start Audio Frequency measurement.	Press [MEASURE], {More 1 of 3}, {Audio Frequency}
Watch the readings for audio frequency in the display window.	

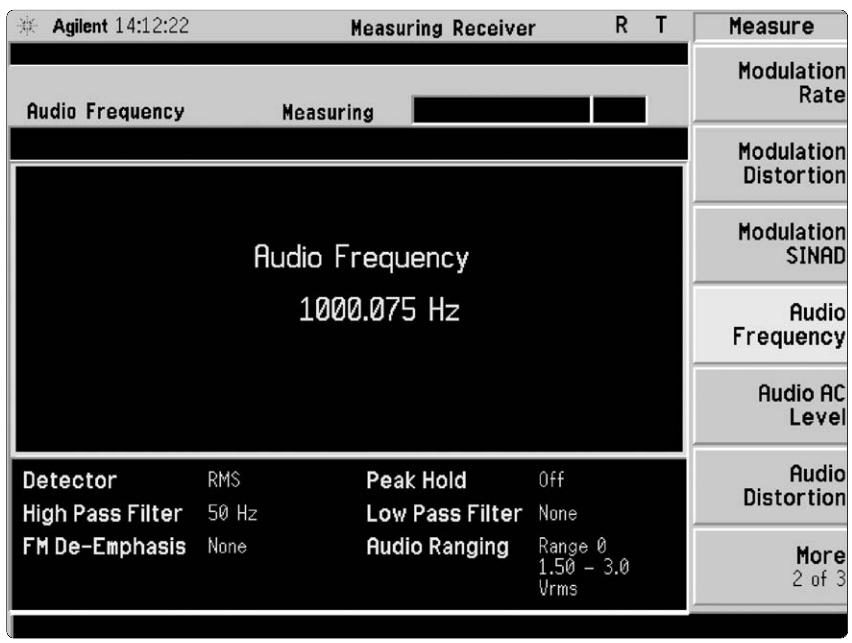

Figure 10. "Audio frequency" measurement result

7.2 Audio AC level

The audio AC level measurement is used to measure the average (rms) level of the input audio signal. The RMS detector is used for the audio AC level measurements. Absolute audio AC level measurement results are displayed in voltage unit. Additionally, relative results are displayed in dB or % of a reference level that can be manually set through the front panel of the PSA.

Instructions	Keystrokes
Set the LF out on the signal generator for generating audio signals.	On ESG: Press [LF Out]
Set the amplitude of the audio signal to 1 Vp.	On ESG: Press {LF Out Amplitude}, [1] {Vp}
Set the frequency of the audio signal to 1 kHz.	On ESG: Press {LF Out Freq}, [1], {kHz}
Set the audio signal to sine wave.	On ESG: Press {LF Out Waveform}, {Sine}
Turn on audio signal output.	On ESG: Press {LF Out Off/On} to highlight "On"
If needed, band-limit the signal using a combination of a high-pass (HPF) and a low-pass filter (LPF). In this case, we will select a 300 Hz HPF and a 30 kHz LPF.	Press [Det/Demod], {HP Pass Filter}, {50 Hz}, {LP Pass Filter}, {3 kHz}
Start audio AC level measurement.	Press [MEASURE], {More 1 of 3}, {Audio AC Level}
Watch the readings for audio AC level in the display window.	
Set a relative measurement.	Press [Amplitude], then {Display Mode} to underline "Ratio"
Set a reference level of 1 Vrms.	Press [Amplitude], then {Ratio Ref} to underline "Man", [1], {V}
Set ratio mode to logarithm.	Press [Amplitude], then {Ratio Mode} to underline "Log"
Watch the relative measurement result in the display window.	

7.3 Audio distortion

This measurement is used to quantify the distortion of the audio signal in a relative term. The audio distortion is defined as the ratio of the total distortion, including total harmonics and noises, to the fundamental audio signal level.

Instructions	Keystrokes
Set the LF out on the signal generator for generating audio signal.	On ESG: Press [LF Out]
Set the amplitude of the audio signal as 1 Vp.	On ESG: Press {LF Out Amplitude}, [1], {Vp}
Set the frequency of the audio signal as 1 kHz.	On ESG: Press {LF Out Freq}, [1], {kHz}
Set the audio signal as sine wave.	On ESG: Press {LF Out Waveform}, {Sine}
Turn on audio signal output.	On ESG: Press {LF Out Off/On} to highlight "On"
Start audio distortion measurement.	Press [MEASURE], {More 1 of 3}, {Audio Distortion}
Watch the readings for audio distortion in the display window.	

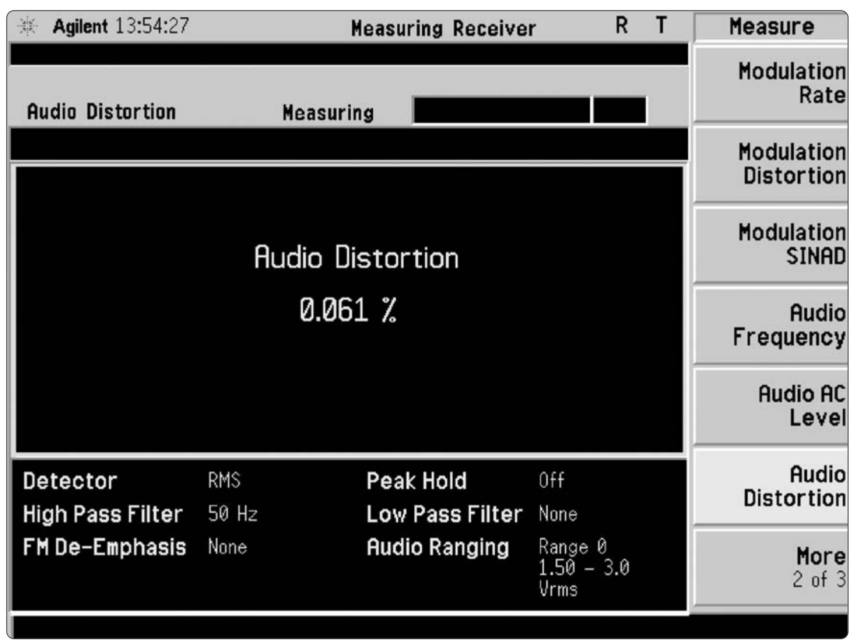

Figure 11. "Audio distortion" measurement result

7.3 Audio SINAD

In audio signal analysis, one of the most commonly used parameters to characterize the quality of an audio signal is audio SINAD. The audio SINAD is defined as the ratio of the fundamental audio signal level to the total harmonics and noise level (in voltage). The audio SINAD is often presented in logarithmic term as follows,

Audio SINAD (in dB)

$$= 20 \times \log\left(\frac{E_{total}}{\sqrt{E_{total}^2 - E_{signal}^2}}\right)$$

where, E_{signal} and E_{total} are amplitude of the wanted audio signal and the total signal (in voltage), respectively.

Instructions	Keystrokes
Set the LF out on the signal generator for generating audio signals.	On ESG: Press [LF Out]
Set the amplitude of the audio signal to 1 Vp.	On ESG: Press {LF Out Amplitude}, [1] {Vp}
Set the frequency of the audio signal to 1 kHz.	On ESG: Press {LF Out Freq}, [1], {kHz}
Set the audio signal to sine wave.	On ESG: Press {LF Out Waveform}, {Sine}
Turn on audio signal output.	On ESG: Press {LF Out Off/On} to highlight "On"
Start audio distortion measurement.	Press [MEASURE], {More 1 of 3}, {Audio Distortion}
Watch the readings for audio distortion in the display window.	

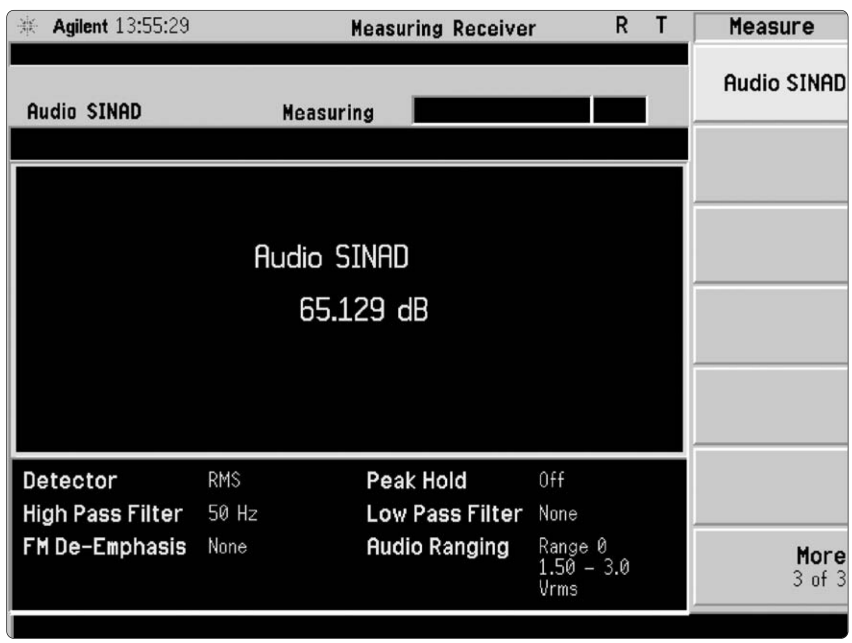

Figure 12. "Audio SINAD" measurement result

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Demonstrations for the Measuring Receiver PC User Interface Software[a]
A PC software program shipped with every PSA Option 233 offers an extension to the PSA built-in measuring receiver personality with an even more powerful user interface.

As mentioned previously, to demonstrate the PC user interfaces a LAN hub with three regular LAN cables is required to connect the PSA, the P-Series power meter, and the PC installed with the Measuring Receiver PC User Interface Software.

The PC User interface software also offers IVI-COM compliant remote user interface that allows the user to control the measuring receiver through COM API-based control software.

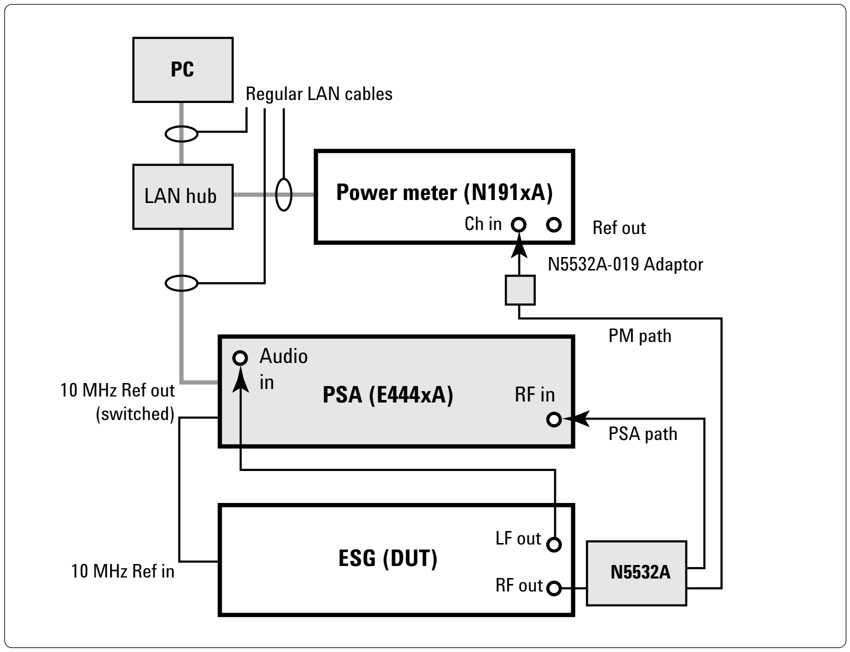

Figure 13. Demo system set up with an external PC

1. PC requirements
A basic personal computer is required to run the Measuring Receiver PC User Interface Software. The minimum PC configuration requirements are as follows:

- 300 MHz Pentium or AMD-K61 CPU
- 256 Mbytes RAM
- Minimum 100 Mbytes available space on the hard drive
- LAN interface
- A CD ROM drive for the installation media (can be installed via network access)
- Operating system: WinXP Professional (US English or Chinese version)
- Microsoft.NET framework: Version 1.1 or later
- Agilent I/O Libraries: M.01.01.04 or later
- Agilent T&M Toolkit: Version 1.1 or later

2. Connect a PC to the N5531S measuring receiver system
Connect the PC via a regular LAN cable to a LAN hub that connects the PSA and the P-Series power meter as shown in **Figure 13**.

[a] When the N5531S is under the PC software controls, the PSA front panel keys will be disabled.

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

3. Initiate the measuring receiver PC user interface software
Start the measuring receiver PC user interface software by double clicking the icon for the software.

Set the PC IP address properly so that it is included in the same LAN with the PSA and the power meter. For instance, if the IP addresses of the PSA and power meter are set to 192.168.100.1 and 192.168.100.2, respectively, set your PC's IP address to 192.168.100.3, and set the subnet mask to 255.255.255.0.

Click on "Utilities" in the Application Title Bar to pull down the utilities menu, and then click "Hardware" in the menu. Click the "PSA" tab or "Power Meter" tab in the "Hardware Connections" to key in the IP addresses for the PSA or power meter, followed by clicking the "Connection" button. Make sure that "LAN" is shown in the "Conn Mode" box. Once the PC successfully establishes communication with the PSA and the power meter, the message of "Connection successful" shows in the "Status".

4. Standard mode
By default, the PC user interface displays in the *Measuring Receiver Standard Mode* which emulates the operating panel of the traditional measuring receiver.

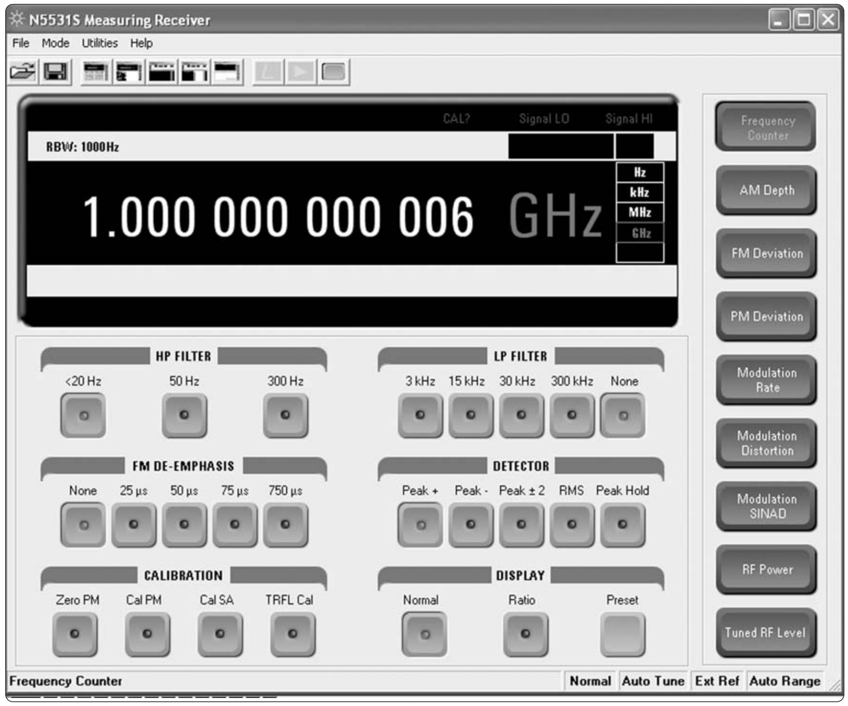

Figure 14a. Standard mode for measuring receiver

Figure 14b. Standard mode for audio analyzer

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

All the measuring receiver functionalities can be accessed by one button click on the PC user interface. Additionally, the user can also select the filter, detector types, and calibrate the PSA and power meter through the *standard mode* by one button click. To access the *standard mode* for the audio analyzer, simply press the “F3” key on your PC keyboard, or click the 5th icon from left on the menu bar, or click “Mode” on the application title bar and select “Audio Analyzer”, “Standard”.

5. Advanced mode

For more sophisticated users who want more flexibility to customize measurements, the software offers an *advanced mode*. This mode provides extensive accesses to control a wide range of instrument parameters from the PC user interface.

The advanced mode can be accessed via one of the following three ways:

- Click on “Mode” in the Application Title Bar; move the cursor to the “Measuring Receiver” or “Audio Analyzer” and then click “Advanced”, or
- On PC keyboard, press “F2” for “Measuring Receiver Advanced Mode” or “F4” for “Audio Analyzer Advanced Mode”, or
- Click the 4th icon on the menu bar for “Measuring Receiver Advanced Mode” or the 6th icon for “Audio Analyzer Advanced Mode”

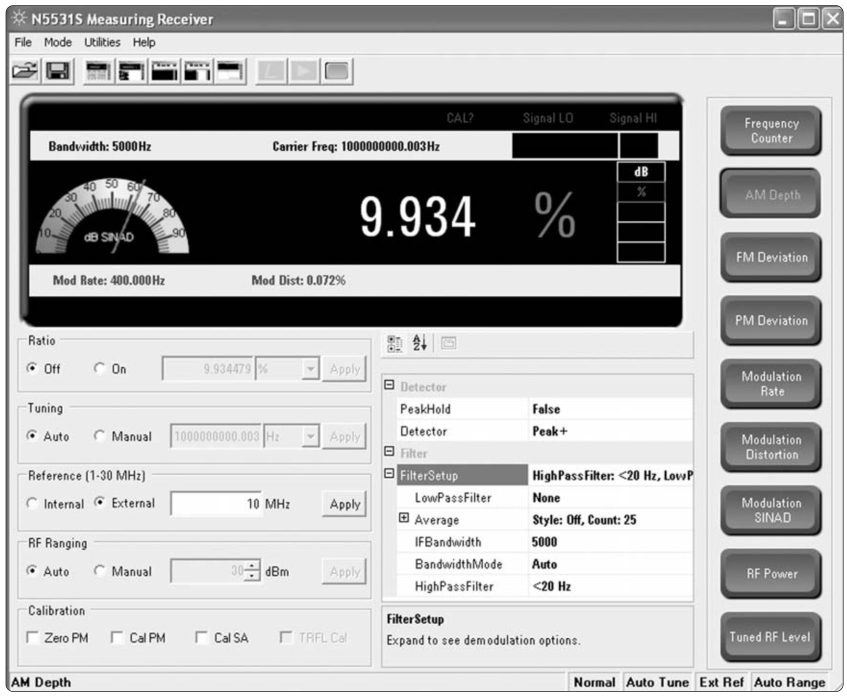

Figure 15a. Advance mode for measuring receiver

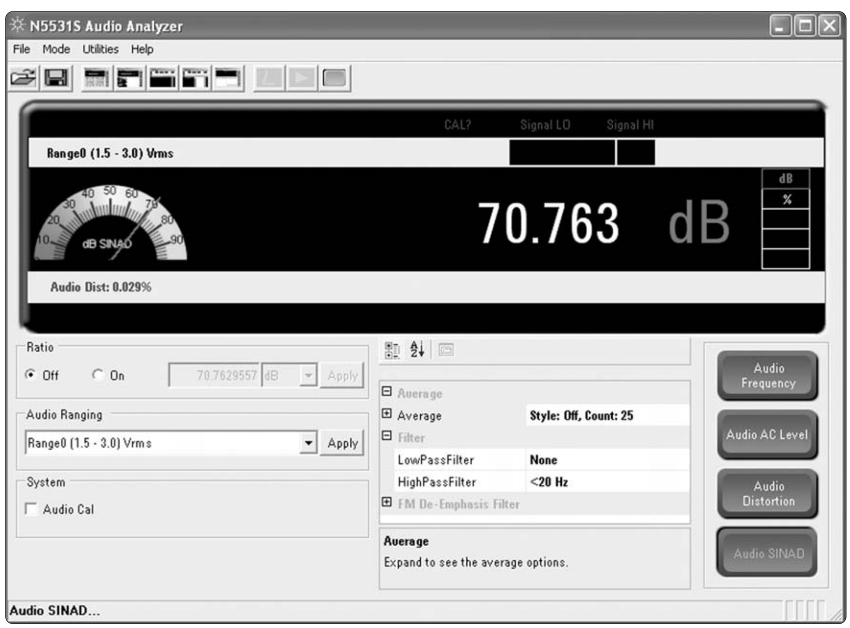

Figure 15b. Advanced mode for audio analyzer

6. Batch mode

The *"Batch mode"* enables the user to perform a series of single measurements sequentially by pressing the **Run** button in the batch mode. Also, you can add SCPI commands to the batch to control the signal generator-under-test via the GPIB connection between the signal generator and the measuring receiver, such as turn the "Modulation" to "On" or "Off". The pre-programmed command batch can be stored and re-loaded for future use. The measurement results can be exported in .xml, .csv, or .txt format for reporting purposes.

a. Click on **Mode** in the application title bar, then select **Batch**; or press F6 key on the PC keyboard, or simply click the 7th icon on the menu bar.

b. In this mode, you can string together a series of measurement commands in any order you wish, and the PSA measuring receiver personality will execute the commands in sequence.

c. Try building a measurement sequence. Click the "+" key and select a measurement. Or, click the "-" key to remove a measurement. Repeat this procedure to select 3 or 4 measurements, then click **Run**.

Example 1: Making a Batch Measurement Using Manual Control of the Signal Generator

This example shows you how to perform AM depth, modulation rate, and PM deviation in one batch measurement. The **Display Message Box** command is used to tell you when to turn on the appropriate modulation for each measurement.

Step 1. Adjust the signal generator to the following settings:

- RF frequency: 1 GHz
- Amplitude: -10 dBm
- AM depth: 10%
- Modulation rate: 400 Hz
- Modulation: On
- AM: Off
- PM deviation: 5.0 radians
- PM: Off

Step 2. Add the "Display Message Box" command.

- Press "+" and select **Display Message Box**

Step 3. Highlight the **Caption** field and type "Turn on AM" in the space adjacent to this field. The OK button is automatically selected.

Step 4. Press "+" and select **AM Depth**. Allow all options to select their default settings.

Step 5. Press "+" and select **Modulation Rate**. Allow all options to select their default setting.

Step 6. Repeat Steps 2 and 3 above. This time, type "Turn on PM" in the space adjacent to the **Caption** field.

Step 7. Press "+" and select **AM Deviation**. Allow all options to select their default settings.

Step 8. Create a message box with a caption: Done

Step 9. Press **Run**. A message box opens, stating "Turn on AM".

Step 10. Press **AM**, **On** using the signal generator front panel. Then select "OK" in the message box on your PC display.

Step 11. The measuring receiver PC user interface software returns the percent modulation and the modulation rate to the display region.

Step 12. A message box opens, stating "Turn on PM".

Step 13. Press **PM**, **On** using the signal generator front panel. Then select "OK" in the message box on your PC.

Step 14. The PC user interface software returns the PM Deviation and displays the "Done" message box.

Example 2: Making a Batch Measurement Using SCPI Commands to Control the Signal Generator through GPIB
This example shows you how to run a list of measurements, while performing all the required signal generator settings between measurements with remote commands (SCPI). How to save a batch measurement is also shown. To demo this, you will need to connect your signal generator to the PSA through a GPIB cable.

Step 1. Create a message box as shown in Steps 2 and 3 of Example 1. In the **Caption** area, type "AM Depth Measurement".

Step 2. Press "+" and select "Scpi Command" from the drop down **Add** menu. The first command resets the signal generator. Type "*RST" in the box to the right of **Command**.

Step 3. In the Address area, type the address of your signal generator in this format:

GPIB0::[address number], e.g. GPIB0::19

Step 4. Insert a SCPI command to set the signal generator frequency to 1 GHz.

- Add another SCPI Command to the batch list.
- Type "Freq:CW 1 GHZ" in the **Command** area of the PC display.
- Type the signal generator address in the address area.

Step 5. Repeat Step 4 four times. Insert the SCPI commands which set the signal generator as shown in the following table. (Remember to enter the signal generator's GPIB address with each SCPI command.)

Step 6. Add the AM Depth measurement to the batch list. You can set the measurement parameters or allow the default settings. In the example, the default settings are acceptable.

Step 7. Create a "Done" message box as shown in Step 8 of Example 1.

Step 8. Select **Save Batch State ...** from the **File** drop down menu. Type "AM Depth SCPI Meas" as the filename. The software saves the program you just created as an .xml file which you can reload into the measuring receiver PC user interface software program at any time.

Signal generator setting	SCPI command
Power level = 0 dBm	POW:LEV:IMM:AMPL 0 DBM
RF = On	OUTP:STAT ON
AM Depth = 10%	AM1:DEPT 10 PCT
Turn AM On	AM1:STAT ON

2.2 Setup of the N5531S Measuring Receiver Demo System (Continued)

Step 9. Press **Run**.

Step 10. Select "OK" when the "AM Depth Measurement" message box is displayed.

- The batch list program sets up the signal generator and performs the AM Depth measurement, returning the results to the display window.

Step 11. Press "OK" when the "Done" message box appears.

The easiest way to demo this example is to reload a saved .xml file from Step 8 above (File name: AM Depth SCPI Meas.xml on the desktop) as follows:

1. Click on the "Batch Mode" icon (the 7th from left) on the menu bar to start "Batch mode"
2. Click on **File** in the Application Title bar, then select **Load Batch State ...**.
3. In the "Load State File" window, double click the icon of the "AM Depth SCPI Meas.xml" file.
4. Skip steps 1 to 8 above, start from Step 9 forward.

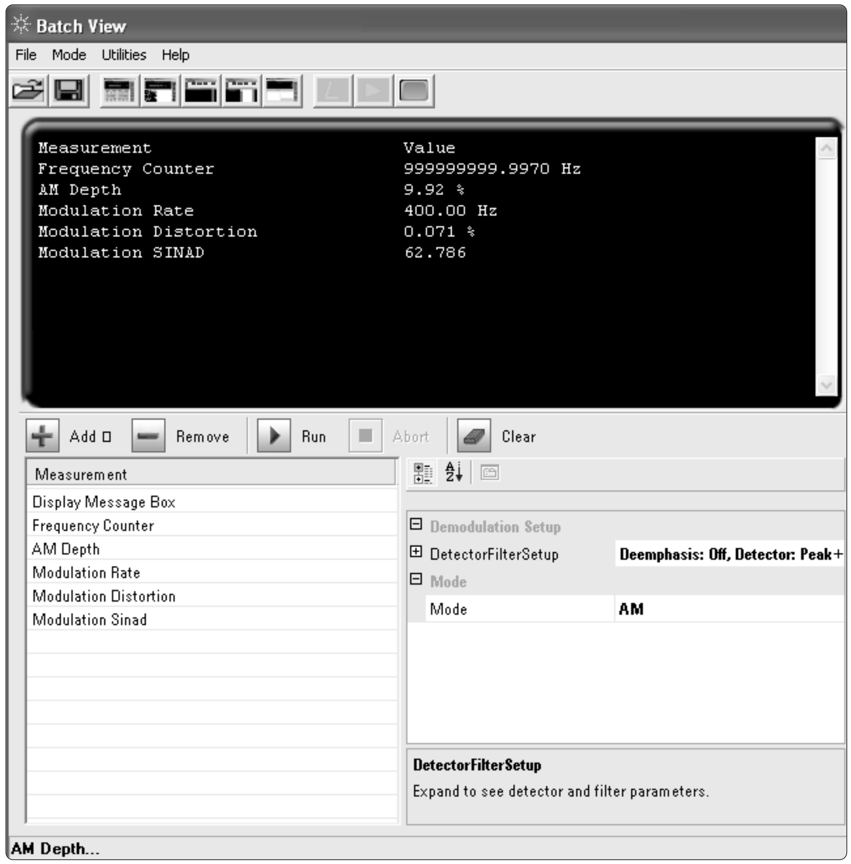

Figure 16. The "Batch mode" offered by the PC software

Key Specifications

For detailed specifications and required conditions please refer to the PSA Option 233 specifications guide.

1.1 Frequency modulation

Description				Specification	Supplemental information
Input power range[a]				-18 to +30 dBm	
Operating rate range					
		$100\ kHz \le f_c < 10\ MHz$		20 Hz to 10 kHz	
		$10\ MHz \le f_c < 50\ GHz$		50 Hz to 200 kHz	
Peak frequency deviations[a]					Peak Deviation = IFBW/2 -Modulation Rate.
		$100\ kHz \le f_c < 10\ MHz$		40 kHz maximum	$IFBW_{max}$ = 5 MHz in "Auto" mode;
		$10\ MHz \le f_c \le 50\ GHz$		400 kHz maximum	$IFBW_{max}$ = 10 MHz in "Manual" mode
FM deviation accuracy[b]					
Frequency range	**Modulation rate**	**Peak deviation**	**ß** [c]		
250 kHz to 10 MHz	20 Hz to 10 kHz	200 Hz to 40 kHz	> 0.2	±1.5% of reading	
			> 1.2	±1% of reading	
10 MHz to 6.6 GHz	50 Hz to 200 kHz	250 Hz to 400 kHz	> 0.2	±1.5% of reading	
			> 0.45	±1% of reading	
6.6 to 13.2 GHz	50 Hz to 200 kHz	250 Hz to 400 kHz	> 0.2	±2.5% of reading	
			> 8	±1% of reading	
13.2 to 31.15 GHz	50 Hz to 200 kHz	250 Hz to 400 kHz	> 0.2	±3.8% of reading	
			> 16	±1% of reading	
31.15 to 50 GHz	50 Hz to 200 kHz	250 Hz to 400 kHz	> 0.2	±8.5% of reading	
			> 32	±1% of reading	
AM rejection (50 Hz to 3 kHz BW)					
Frequency range	**Modulation rate**	**AM depths**			
150 kHz to 3 GHz	400 Hz or 1 kHz	≤ 50%		< 10 Hz peak deviation	
3 to 6.6 GHz	400 Hz or 1 kHz	≤ 50%			< 10 Hz
6.6 to 13.2 GHz	400 Hz or 1 kHz	≤ 50%			< 20 Hz
13.2 to 26.5 GHz	400 Hz or 1 kHz	≤ 50%			< 40 Hz
26.5 to 50 GHz	400 Hz or 1 kHz	≤ 50%			< 75 Hz
Residual FM (50 Hz to 3 kHz BW)					
RF frequency					
100 kHz to 6.6 GHz				< 1.5 Hz (rms)	
6.6 to 13.2 GHz				< 3 Hz (rms)	
13.2 to 31.15 GHz				< 6 Hz (rms)	
31.15 to 50 GHz				< 12 Hz (rms)	
Detectors					Available: +peak, -peak, ±peak/2, peak hold, rms

[a] The modulation rates and the peak deviations that the system is capable of measuring are governed by the instrument's IFBW (Information Bandwidth) setting. Their relationship is described by the equation: Peak deviation (in Hz) = IFBW/2 - modulation rate.

[b] When the carrier frequency f_c is less than 10 MHz, to avoid the 0 Hz frequency wrap-around, the f_c and IFBW must be chosen to satisfy $[f_c\text{-(IFBW)/2}] > 100$ kHz.

[c] ß is the ratio of frequency deviation to modulation rate (deviation/rate).

1.2 Amplitude modulation

Description			Specification	Supplemental information
Input power range			-18 to +30 dBm	
Operating rate range[a]		$100 \text{ kHz} \le f_c < 10 \text{ MHz}$ $10 \text{ MHz} \le f_c < 50 \text{ GHz}$	20 Hz to 10 kHz 50 Hz to 100 kHz	
Depth range			5 to 99%	Capable of measuring AM depth range of 0 to 99%.
AM depth accuracy[b]				
Frequency range	**Modulation rate**	**Depths**		
100 kHz to 10 MHz	50 Hz to 10 kHz	5% to 99%	±0.75% of reading	
10 MHz to 3 GHz	50 Hz to 100 kHz	20% to 99% 5% to 20%	±0.5% of reading ±2.5% of reading	
3 to 26.5 GHz	50 Hz to 100 kHz	20% to 99% 5% to 20%	±1.5% of reading ±4.5% of reading	
26.5 to 31.15 GHz	50 Hz to 100 kHz	20% to 99% 5% to 20%	±1.9% of reading ±6.8% of reading	
31.15 to 50 GHz	50 Hz to 100 kHz	20% to 99% 5% to 20%	±6% of reading ±26% of reading	
Flatness[c]				
Frequency range	**Modulation rate**	**Depths**		
10 MHz to 3 GHz	90 Hz to 10 kHz	5% to 99%	±0.30% of reading	
3 to 26.5 GHz	90 Hz to 10 kHz	5% to 99%	±0.40% of reading	
26.5 to 50 GHz	90 Hz to 10 kHz	5% to 99%	±0.60% of reading	
FM rejection (50 Hz to 3 kHz BW)				
Frequency range	**Modulation rate**	**Peak FM deviations**		
250 kHz to 10 MHz	400 Hz or 1 kHz	< 5 kHz	< 0.14% AM depth	
10 MHz to 50.0 GHz	400 Hz or 1 kHz	< 50 kHz	< 0.36% AM depth	
Residual AM (50 Hz to 3 kHz BW)			< 0.01% (rms)[d, e]	
Detectors				Available: +peak, -peak, ±peak/2, peak hold, rms

[a] When the carrier frequency f_c is less than 10 MHz, to avoid the 0 Hz frequency wrap-around, the f_c and IFBW must be chosen to satisfy $[f_c\text{-(IFBW)/2}] > 100$ kHz.

[b] For peak measurement only: AM accuracy may be affected by distortion generated by the measuring receiver. In the worst case this distortion can decrease accuracy by 0.1% of reading for each 0.1% of distortion.

[c] Flatness is the relative variation in indicated AM depth versus rate for a constant carrier frequency and depth.

[d] Preamp must be on to meet this specification for frequency range of 26.5 to 50 GHz.

[e] Follow this procedure to verify this specification: Input a clean CW signal (0 dBm) to the measuring receiver; Manually tune the frequency to the input signal; Set the PSA parameters as follows, (1) IF BW = 6 kHz, (2) Detector type = RMS, (3) High Pas Filter = 50 Hz, (4) Low Pass Filter = 3 kHz, (5) Set “RF Input Ranging” to “Man”, and decrease the input attenuation at 2 dB/step until “SigHi” message appears, and then back off 2 dB for the “SigHi” message to disappear.

Key Specifications (Continued)

1.3 Phase modulation

Description		Specification	Supplemental information
Input power range		-18 to +30 dBm	
Operating rate range	100 kHz ≤ f_c < 50 GHz	200 Hz to 20 kHz	
Maximum peak phase deviation			
	f_c < 10 MHz	450 radians[a]	
	f_c ≥ 10 MHz	12,499 radians[b]	In "Auto" mode
		24,999 radians[b]	In "Manual" mode
ΦM accuracy			
Frequency range **Deviations**			
100 kHz to 6.6 GHz > 0.7 rad		±1% of reading	
> 0.3 rad		±3% of reading	
6.6 to 13.2 GHz > 2.0 rad		±1% of reading	
> 0.6 rad		±3% of reading	
13.2 to 26.5 GHz > 4.0 rad		±1% of reading	
> 1.2 rad		±3% of reading	
26.5 to 31.5 GHz > 4.0 rad		±1% of reading	
> 1.3 rad		±3% of reading	
31.5 to 50 GHz > 8.0 rad		±1% of reading	
> 2.4 rad		±3% of reading	
AM rejection (50 Hz to 3 kHz BW)	For 50% AM at 1 kHz rate	< 0.03 rad (peak)	
Residual PM (50 Hz to 3 kHz BW)			
Frequency range			
100 kHz to 6.6 GHz		< 0.0017 rad (rms)	
6.6 to 13.2 GHz		< 0.0033 rad (rms)	
13.2 to 31.15 GHz		< 0.0066 rad (rms)	
31.15 to 50 GHz		< 0.0130 rad (rms)	
Detectors			Available: +peak, -peak, ±peak/2, peak hold, rms

[a] When the carrier frequency f_c is less than 10 MHz, to avoid the 0 Hz frequency wrap-around, the f_c and IFBW must be chosen to satisfy [f_c- (IFBW/2)] > 100 kHz. The specification of 450 radians applies for f_c = 200 kHz, IFBW = 200 kHz, and a modulation rate of 200 Hz. The specification for maximum peak phase deviation will linearly improve as the allowed IFBW increase. As f_c increases, the IFBW can increase up to the maximum allowed IFBW in "Auto" or "Manual" modes.

[b] When the carrier frequency (fc) is equal to or greater than 10 MHz, the maximum peak deviation that the instrument is capable of measuring depends on the IFBW setting and the modulation rate of the signal-under-test. The relationship is described by the equation:

Max peak deviation (in radians) = [IFBW/(2 x modulation rate in Hz)] - 1

The maximum IFBW used in "Auto" mode is 5 x 10^6 Hz, therefore, Max peak deviation (in radians) = (2.5 x 10^6/modulation rate in Hz) - 1. In "Manual" mode, the maximum IFBW can be set to 10^7 Hz, hence, Max peak deviation (in radians) = (5 x 10^6/modulation rate in Hz) - 1.

Key Specifications (Continued)

1.4 RF frequency counter

Description	Specification	Supplemental information
Range	100 kHz to 50 GHz	
Sensitivity[a]		In “Auto” mode
100 kHz ≤ f_c < 3.0 GHz	0.4 mV_{rms} (-55 dBm)	
3.0 GHz ≤ f_c ≤ 26.5 GHz	1.3 mV_{rms} (-45 dBm)	
26.5 GHz ≤ f_c ≤ 50 GHz	4.0 mV_{rms} (-35 dBm)	
Maximum resolution	0.001 Hz	
Accuracy	± (readout freq. x freq. ref. accy +0.100 Hz)	
Modes		Frequency and frequency error (manual tunning)
Sensitivity in manual tuning mode		Using manual ranging and changing RBW settings, sensitivity can be increased to approximately -100 dBm.

1.5 Audio input[b]

Description	Specification	Supplemental information
Frequency range	20 Hz to 250 kHz	
Input impedance		100 kΩ (nominal)
Maximum safe input level	7 V_{rms} or 20 VDC	

[a] Instrument condition: RBW ≤ 1 kHz.

[b] All audio measurements require PSA Option 107.

1.6 Audio frequency counter

Description	Specification	Supplemental information
Frequency range	20 Hz to 250 kHz	
Accuracy[a]		With HPF set to minimum setting of < 20 Hz
f < 1 kHz	±(0.02 Hz + f x Internal Reference Accuracy)[b]	
f ≥ 1 kHz	±3 counts of the first 6 significant digits ± f x (Internal Reference Accuracy)	
Resolution	0.01 Hz (8 digits)	
Sensitivity	≤ 5 mV	

1.7 Audio AC (RMS) level

Description	Specification	Supplemental information
Frequency range	20 Hz to 250 kHz	
Measurement level range	100 mV_{rms} to 3 V_{rms}	
Accuracy	1% of reading	
Detector mode		RMS

1.8 Audio distortion

Description	Specification	Supplemental information
Display range (20 Hz to 250 kHz BW)	0.01% to 100% (-80 to 0 dB)	
Accuracy (20 Hz to 250 kHz)	±1 dB of reading	
Residual noise and distortion	< 0.3% (-50.4 dB)	
Total noise		-73.2 dB charactristic performance
Total distortion		-74.8 dB charactristic performance

[a] Follow this procedure to verify this specification: Set an input audio signal at 100 mV. Set the PSA as follows: (1) Auto Level, (2) Auto IF BW, (3) LP is greater than the audio frequency, (4) HP = 300 Hz or less than the audio frequency, (5) Average = 5 Repeat.

[b] Refer to the "Internal Time Base Reference" section in the PSA specification guide for the "Internal Reference Accuracy".

Key Specifications (Continued)

1.9 Audio SINAD

Description	Specification	Supplemental information
Display range (20 Hz to 250 kHz BW)	0.00 to 80 dB	
Display resolution	0.01 dB	
Accuracy 20 Hz to 20 kHz	±1 dB of reading	
20 kHz to 250 kHz	±2 dB of reading	
Residual noise and distortion	50.4 dB (< 0.3%)	
Total noise		73.2 dB charactristic performance
Total distortion		74.8 dB charactristic performance

1.10 Audio filters

Description	Specification	Supplemental information
Filter flatness Non high-pass filter		<± 1% at rates > 20 Hz
50 Hz high-pass filter	< ±1% at rates > 50 Hz	
300 Hz high-pass filter	< ±1% at rates > 300 Hz	
3 kHz low-pass filter	< ±1% at rates < 3,030 Hz	
15 kHz low-pass filter	< ±1% at rates < 15,030 Hz	
30 kHz low-pass filter	< ±1% at rates < 30 kHz	
Non low-pass filter		<± 1% at rates > 250 kHz
De-emphasis filters	25 µs, 50 µs, 75 µs, and 750 µs	De-emphasis filters are single-pole, low-pass filters with nominal -3 dB frequencies of: 6,366 Hz for 25 µs, 3,183 Hz for 50 µs, 2,122 Hz for 75 µs, and 212 Hz for 750 µs.
Deviation from ideal de-emphasis filter	< 0.4 dB, or < 3°C	Applicable to 25 µs, 50 µs, and 75 µs filters. With 3 kHz Low-Pass filter and IFBW Mode set to “minimal”.

1.11 RF Power[a, b]

The Agilent N5531S measuring receiver system with the N5532A sensor modules performs RF power measurements from -20 dBm (100 µW) to +30 dBm (1 W). The N5531S must be used with Agilent P-Series power meters (N1911A, N1912A), or EPM/EPM-P Series (E4416A, E4417A, E4418B and E4419B). A LAN/GPIB gateway will be required if the EPM/EPM-P Series power meter is used.

Description		Specification				Supplemental information			
RF power accuracy (dB)									
+20 to +30 dBm	Power Meter Range 1					Typicals			
		Sensor module options				**Sensor module options**			
		#504	#518	#526	#550	#504	#518	#526	#550
	100 kHz ≤ f_c ≤ 10 MHz	±0.356	–	–	–	±0.182	–	–	–
	10 MHz < f_c ≤ 30 MHz	±0.356	±0.361	–	–	±0.182	±0.185	–	–
	30 MHz < f_c ≤ 2 GHz	±0.356	±0.361	±0.361	±0.361	±0.182	±0.185	±0.185	±0.185
	2 GHz < f_c ≤ 4.2 GHz	±0.356	±0.392	±0.422	±0.367	±0.182	±0.201	±0.217	±0.188
	4.2 GHz < f_c ≤ 18 GHz	–	±0.400	±0.422	±0.367	–	±0.205	±0.217	±0.188
	18 GHz < f_c ≤ 26.5 GHz	–	–	±0.480	±0.387	–	–	±0.247	±0.199
	26.5 GHz < f_c ≤ 50 GHz	–	–	–	±0.420	–	–	–	±0.216
-10 to +20 dBm	Power Meter Range 2 to 4					Typicals			
		Sensor module options				**Sensor module options**			
		#504	#518	#526	#550	#504	#518	#526	#550
	100 kHz ≤ f_c ≤ 10 MHz	±0.190	–	–	–	±0.097	–	–	–
	10 MHz < f_c ≤ 30 MHz	±0.190	±0.200	–	–	±0.097	±0.101	–	–
	30 MHz < f_c ≤ 2 GHz	±0.190	±0.200	±0.200	±0.200	±0.097	±0.101	±0.101	±0.101
	2 GHz < f_c ≤ 4.2 GHz	±0.190	±0.255	±0.301	±0.212	±0.097	±0.130	±0.154	±0.108
	4.2 GHz < f_c ≤ 18 GHz	–	±0.267	±0.301	±0.212	–	±0.136	±0.154	±0.108
	18 GHz < f_c ≤ 26.5 GHz	–	–	±0.380	±0.247	–	–	±0.195	±0.126
	26.5 GHz < f_c ≤ 50 GHz	–	–	–	±0.297	–	–	–	±0.152
RF power resolution	Display resolution	0.001 dB							
Instrumentation accuracy	Logarithmic	±0.02 dB							
	Linear	±0.5 %							

[a] For latest specification updates refer to N1911A/N1912A, and E4416A/17A and E4418B/19B power meter User's Guides.

[b] The N5531S RF Power Accuracy is derived from the Agilent power meter accuracy. The parameters listed in this section are components used to calculate the RF Power Accuracy. Application Note 1449-3 (literature number 5988-9215EN) does an excellent job of explaining how the components are combined to derive an overall accuracy number. The resulting calculation yields ±0.190 to ±0.297 dB when measuring a +10 dBm signal and ignoring DUT mismatch. Assuming 1.5:1 DUT SWR, the calculation would return a typical accuracy of ±0.213 to ±0.387 dB (depending on the frequency range and power under test). Absolute and relative accuracy specifications do not include mismatch uncertainty.

1.11 RF Power (Continued)

Description		Specification	Supplemental information
Input SWR			
N5532A *Option 504*	100 kHz to 2 GHz 2 GHz to 4.2 GHz	< 1.10:1 (ρ = 0.048) < 1.28:1 (ρ = 0.123)	
N5532A *Option 518*	10 MHz to 2 GHz 2 GHz to 18 GHz	< 1.10:1 (ρ = 0.048) < 1.28:1 (ρ = 0.123)	
N5532A *Option 526*	30 MHz to 2 GHz 2 GHz to 18 GHz 18 GHz to 26.5 GHz	< 1.10:1 (ρ = 0.048) < 1.28:1 (ρ = 0.123) < 1.40:1 (ρ = 0.167)	
N5532A *Option 550*	30 MHz to 2 GHz 2 GHz to 18 GHz 18 GHz to 26.5 GHz 26.5 GHz to 33 GHz 33 GHz to 40 GHz 40 GHz to 50 GHz	< 1.10:1 (ρ = 0.048) < 1.28:1 (ρ = 0.123) < 1.40:1 (ρ = 0.167) < 1.55:1 (ρ = 0.216) < 1.70:1 (ρ = 0.259) < 1.75:1 (ρ = 0.272)	
Zero set (digital settability of zero)	N5532A *Options 504, 518, 526 and 550*	±50 nW	
Noise[a]	N5532A *Options 504, 518, 526 and 550*	< 110 nW	
Zero drift of sensors (1 hour, at constant temperature after 24 hour warm-up)	N5532A *Options 504, 518, 526 and 550*	<± 10 nW	
RF power ranges of N5531S with N5532A sensor modules		-20 dBm (10 µW) to +30 dBm (1 W)	One range for power sensors
Response time (0 to 99 % of reading)			150 ms x number of averages (nominal)
Displayed units		Watts, dBm, or Volts	

[a] The number of averages at 16 (for normal mode) and 32 (for x2 mode), at a constant temperature, measured over a 1-minute interval and 2 standard deviations, Refer to the relevant power sensor manual for further information.

1.12 Tuned RF level[a, b, c]

Refer to Figure 19 on page 41 for TRFL specification nomenclature used in this section.

Description		Specification				Supplemental information
Power range						
Maximum power	Preamp off	+30 dBm				
	Preamp on	+16 dBm				
Minimum power (dBm) E4443A/45A/40A		**75 Hz RBW**		**10 Hz RBW** [d,e]		
	Frequency range	**Preamp uninstalled**	**Preamp installed**[f]	**Preamp uninstalled**	**Preamp installed**[f]	Also see Notes 1 and 2 on page 37
	100 kHz to 2 MHz	-110	-124/-110	-129	-140/-129	
	2 to 10 MHz	-115	-131/-115	-134	-140/-134	
	10 MHz to 3.05 GHz	-117	-134/-133	-136	-140/-140	
	3.05 to 6.6 GHz	-117	-117/-127	-136	-136/-140	
	6.6 to 13.2 GHz	-108	-108/-116	-127	-127/-135	
	13.2 to 19.2 GHz	-100	-100/-110	-119	-119/-129	
	19.2 to 26.5 GHz	-93	-93/-102	-112	-112/-121	
Minimum power (dBm) E4447A/46A/48A		**75 Hz RBW**		**10 Hz RBW**		
	Frequency range	**Preamp uninstalled**	**Preamp installed**[f]	**Preamp uninstalled**	**Preamp installed**[f]	Also see Notes 1 and 2 on page 37
	100 kHz to 2 MHz	-110	-124/-110	-129	-140/-129	
	2 to 10 MHz	-115	-131/-115	-134	-140/-134	
	10 MHz to 3.05 GHz	-117	-134/-133	-136	-140/-140	
	3.05 to 6.6 GHz	-114	-114/-126	-133	-133/-140	
	6.6 to 13.2 GHz	-111	-111/-123	-130	-130/-140	
	13.2 to 19.2 GHz	-109	-109/-118	-128	-128/-137	

a PSA *Option 123* is required to perform "Tuned RF Level" measurements above 3 GHz.

b These specifications are valid when the measuring receiver input is a CW tone and operating temperature is within the range of 20 to 30°C.

c Absolute and relative accuracy specifications do not include mismatch uncertainty.

d With 10 Hz RBW setting selected, the measurement automatically switches the RBW to the 1 Hz setting for SNR values < 10 dB.

e For instrument with serial number prefix below US/MY4615, the minimum power level in 10 Hz RBW setting is 10 dB higher than the values shown here. However, if the PSA contains option 107, the values shown in the table still apply.

f In the frequency range of 100 kHz to 3.05 GHz, the minimum power specifications with "Preamp installed" are presented in two values: A/B, where value A is for the PSA installed with Option 1DS, and value B is for the PSA installed with Option 110. Furthermore, in the frequency range of 100 kHz and 10 MHz, Option 110 is turned off for these measurements. Option 1DS only covers frequency range of 100 kHz and 3.05 GHz, whereas Option 110 covers up to the maximum frequency of the PSA base instrument. Those two preamplifier options cannot coexist in a same PSA instrument.

1.12 Tuned RF level (Continued)

Description		Specification				Supplemental information
Minimum power (dBm) E4447A/46A/48A		**75 Hz RBW**		**10 Hz RBW**		
	Frequency range	**Preamp uninstalled**	**Preamp installed**	**Preamp uninstalled**	**Preamp installed**	Also see Notes 1 and 2 on page 37
	19.2 to 26.5 GHz	-97	-97/-104	-116	-116/-123	
	26.5 to 31.15 GHz	-98	-98/-103	-117	-117/-122	
	31.15 to 41 GHz	-87	-87/-91	-106	-106/-110	
	41 to 45 GHz	-81	-81/-81	-100	-100/-100	
	45 to 50 GHz	-69	-69/-69	-88	-88/-88	
Relative measurement accuracy	Residual noise threshold[a] to maximum power	±(0.009 dB + 0.005 dB/10 dB step)				
	Minimum power to residual noise threshold	±(cumulative error[b] + 0.0012 x (input power - residual noise threshold power)^2)				
Residual noise threshold power (dBm)		Residual noise threshold power = minimum power +30 dB				
Range 2 uncertainty[c]		±0.031 dB				
Range 3 uncertainty[d]		±0.031 dB				
Absolute measurement accuracy	**Preamp Off**					
	+20 dBm to maximium power	±(Power Meter Range 1 Uncert + 0.005 dB/10 dB Step)				
	Residual noise to threshold power +20 dBm	±(Power Meter Range 2-4 Uncert + 0.005 dB/10 dB Step)				
	Minimum power to residual noise threshold power	±(cumulative error[e] + 0.0012 x (input power - residual noise threshold power)^2)				

[a] The residual noise threshold power is the power level at which the signal-to-noise ratio (SNR) becomes the dominant contributor to the measurement uncertainty.

[b] In relative accuracy of TRFL measurements, the "cumulative error" is the error incurred when stepping from a higher power level to the Residual Noise Threshold Power level. The formula to calculate the cumulative error is ± (0.009 dB + 0.005 dB/10 dB step). For example, assume the higher level starting power is 0 dBm and the calculated Residual Noise Threshold Power is -99 dBm. The cumulated error would be ± (0.009 + (99/10) x 0.005 dB), or ±0.0058 dB.

[c] Add this specification when the measuring receiver enters the "Range 2" state. Range 2 is entered when the "Range 1" signal-to-noise ratio (SNR) falls between 50 and 28 dB. The SNR value is tuning band dependent. A prompt of "Range 2" in the PSA display will indicate that the measuring receiver is in Range 2.

[d] Add this specification in addition to the "Range 2" uncertainty when the measuring receiver software enters the "Range 3" state. Range 3 is entered when the "Range 2" SNR falls between 50 and 28 dB. The SNR value is tuning band dependent. A prompt of "Range 3" in the PSA display will indicate that the measuring receiver is in Range 3.

[e] In absolute accuracy of TRFL measurements, the "cumulative error" is the error incurred when stepping from a higher power level to the Residual Noise Threshold Power level. The formula to calculate the cumulative error is ± (0.190 dB + 0.005 dB/10 dB step). For example, assume the higher level starting power is 0 dBm and the calculated Residual Noise Threshold Power is -99 dBm. The cumulated error would be ± (0.190 + (99/10) x 0.005 dB), or ±0.239 dB.

1.12 Tuned RF level (Continued)

Description		Specification	Supplemental information
Absolute measurement accuracy	**Preamp On**		
	Residual noise threshold power to +16 dBm	±(Power meter range 2 to 4 uncertainty + 0.005 dB/10 dB step)	
	Minimum power to residual noise threshold power	±(cumulative error[a]+ 0.0012 x (Input Power - Residual Noise Threshold Power)^2)	

Power Meter Range Uncertainty

Power Meter Range 1 Uncertainty (dB)					Typicals			
+20 to +30 dBm	**Sensor Module options**				**Sensor Module options**			
	#504	#518	#526	#550	#504	#518	#526	#550
100 kHz ≤ f_c ≤ 10 MHz	±0.356	–	–	–	±0.182	–	–	–
10 MHz < f_c ≤ 30 MHz	±0.356	±0.361	–	–	±0.182	±0.185	–	–
30 MHz < f_c ≤ 2 GHz	±0.356	±0.361	±0.361	±0.361	±0.182	±0.185	±0.185	±0.185
2 GHz < f_c ≤ 4.2 GHz	±0.356	±0.392	±0.422	±0.367	±0.182	±0.201	±0.217	±0.188
4.2 GHz < f_c ≤ 18 GHz	–	±0.400	±0.422	±0.367	–	±0.205	±0.217	±0.188
18 GHz < f_c ≤ 26.5 GHz	–	–	±0.480	±0.387	–	–	±0.247	±0.199
26.5 GHz < f_c ≤ 50 GHz	–	–	–	±0.420	–	–	–	±0.216

Power Meter Range 2-4 Uncertainty (dB)					Typicals			
-10 to +20 dBm	**Sensor Module options**				**Sensor Module options**			
	#504	#518	#526	#550	#504	#518	#526	#550
100 kHz ≤ f_c ≤ 10 MHz	±0.190	–	–	–	±0.097	–	–	–
10 MHz < f_c ≤ 30 MHz	±0.190	±0.200	–	–	±0.097	±0.101	–	–
30 MHz < f_c ≤ 2 GHz	±0.190	±0.200	±0.200	±0.200	±0.097	±0.101	±0.101	±0.101
2 GHz < f_c ≤ 4.2 GHz	±0.190	±0.255	±0.301	±0.212	±0.097	±0.130	±0.154	±0.108
4.2 GHz < f_c ≤ 18 GHz	–	±0.267	±0.301	±0.212	–	±0.136	±0.154	±0.108
18 GHz < f_c ≤ 26.5 GHz	–	–	±0.380	±0.247	–	–	±0.195	±0.126
26.5 GHz < f_c ≤ 50 GHz	–	–	–	±0.297	–	–	–	±0.152

[a] In absolute accuracy of TRFL measurements, the "cumulative error" is the error incurred when stepping from a higher power level to the Residual Noise Threshold Power level. The formula to calculate the cumulative error is ± (0.356 dB + 0.005 dB/10 dB step). For example, assume the higher level starting power is +20 dBm and the calculated Residual Noise Threshold Power is -99 dBm. The cumulated error would be ± (0.356 + (99/10) x 0.005 dB), or ±0.405 dB.

NOTE 1

As the displayed average noise level (DANL) of a spectrum analyzer becomes very low, it can reveal "residuals". These occur at discrete frequencies and arise from the various clocks and other components of the local oscillators. This is true for ALL modern spectrum analyzers. The residuals specification for the PSA Series is -100 dBm. Please take this information into consideration when you measure the TRFL level below -100 dBm. A user may apply a 50 ohm terminator to the PSA's "RF input" connector and switch to the PSA's "spectrum analysis" mode to verify the PSA residuals.

NOTE 2

The sensor module (N5532A) may generate a residual of around -100 dBm or lower at frequency of 50 MHz and its harmonics. Please take this information into consideration when you use the N5532A to measure the TRFL level below -100 dBm at 50 MHz and its harmonics.

1.12 Tuned RF level (Continued)

Description		Specification	Supplemental information
Operating frequency range			
	E4443A/45A/40A/47A/46A/48A	100 kHz to 3 GHz	
	E4443A/45A/40A/47A/46A/48A	3 to 6.7 GHz	Requires Option 123
	E4445A/40A/47A/46A/48A	6.7 to 13.2 GHz	Requires Option 123
	E4440A/47A/46A/48A	13.2 to 26.5 GHz	Requires Option 123
	E4447A/46A/48A	26.5 to 42.98 GHz	Requires Option 123
	E4446A/48A	42.98 to 44 GHz	Requires Option 123
	E4448A	44 to 50 GHz	Requires Option 123
Displayed units	Absolute		Watts, dBm, or Volts
	Relative		Percent or dB
Displayed resolution		6 digits in watts or 5 digits in volts mode 0.001 dB in dBm or dB (relative) mode	
Input SWR		See “RF Power” Section	

Graphical Relative Measurement Accuracy Specifications

E4440A, E4443A, E4445A
RBW = 10 Hz
Preamp (PA) On

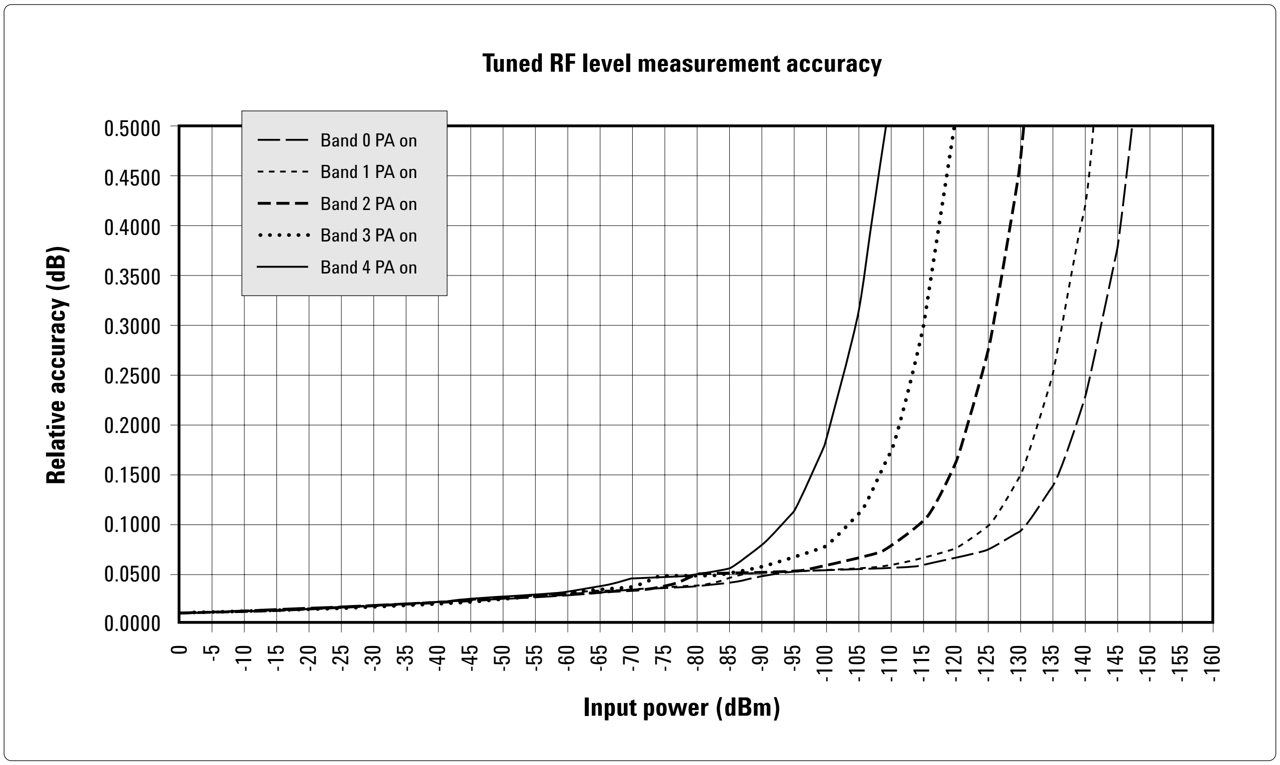

Figure 17. Relative measurement accuracy vs. input power level (for E4440A/43A/45A)

Graphical Relative Measurement Accuracy Specifications (Continued)

E4447A, E4446A, E4448A
RBW = 10 Hz
Preamp (PA) On

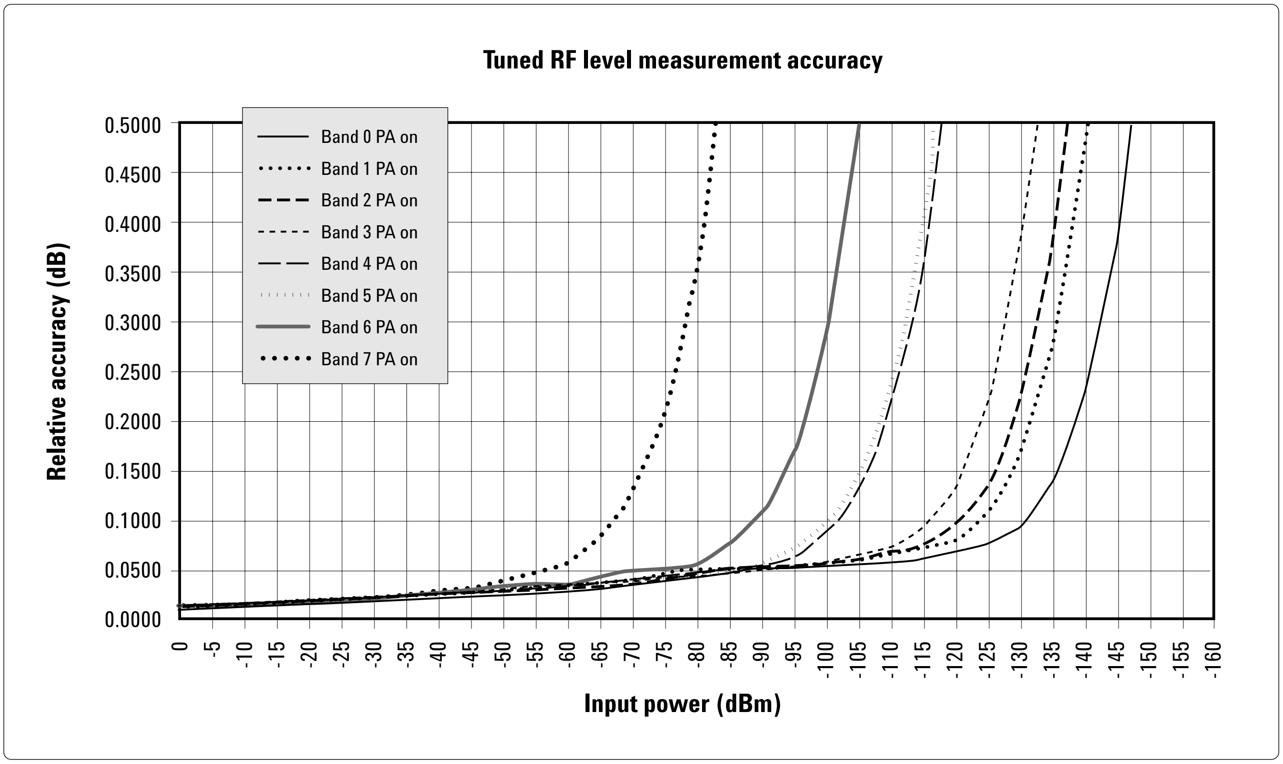

Figure 18. Relative measurement accuracy vs. input power level (for E4446A/47A/48A)

TRFL Specification Nomenclature

The tuned RF level measurement uncertainty is represented primarily by two regions. For high signal-to-noise (S/N) measurements, the uncertainty is dominated by the linearity of the measuring receiver. For low S/N measurements, the measurement uncertainty is dominated by the noise of the measuring receiver being added to the measured signal. The input power at which the uncertainty switches from linearity dominated to noise dominated is labeled as "input power at uncertainty threshold." The minimum power level is defined as the noise floor of the measuring receiver system.

Additionally, there are 2 range-to-range change uncertainties known as "Range 2 Uncertainty" and "Range 3 Uncertainty", respectively. Range 2 Uncertainty occurs when the measuring receiver switches from Range 1 to Range 2, and Range 3 uncertainty from Range 2 to Range 3. They are additive uncertainties applied to all measurements whose input powers across "Range Switch Level".

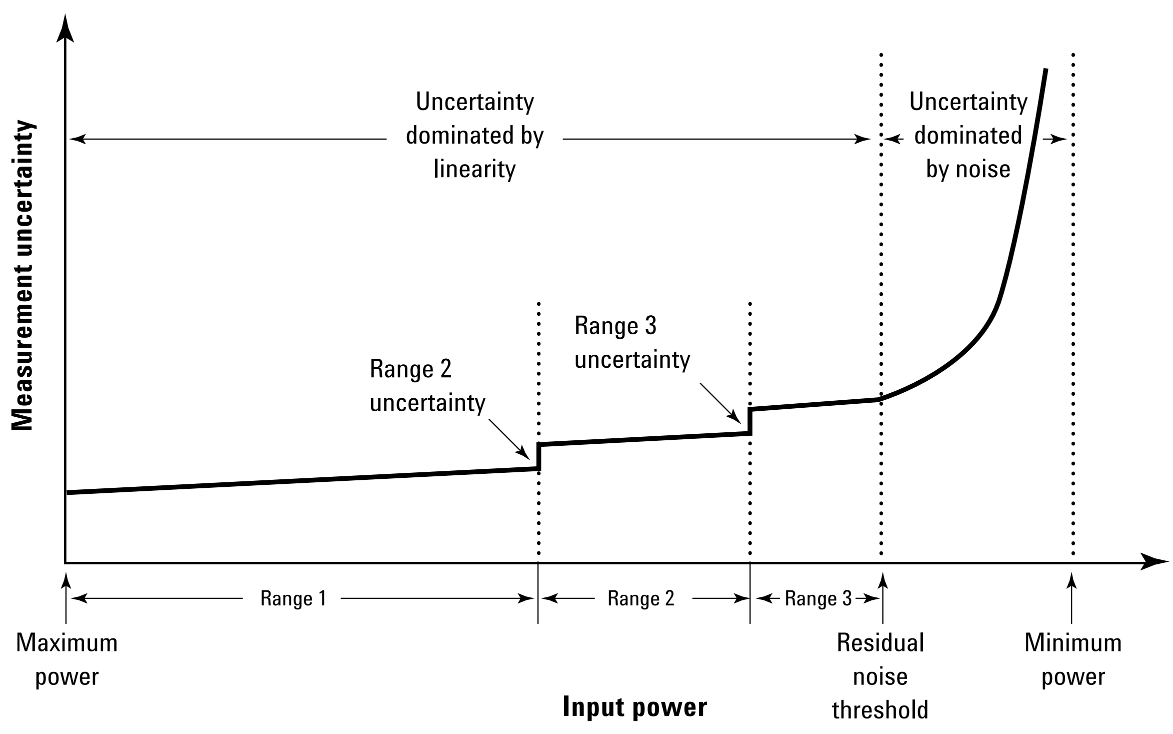

Figure 19. Measurement uncertainty vs. input power relationship

N5531S Ordering Information

The Agilent N5531S measuring receiver system is comprised of a PSA, a P-Series power meter, and an N5532A sensor module.

PSA Series spectrum analyzer

(Select one model from the following models)

- **E4443A**
  3 Hz to 6.7 GHz
- **E4445A**
  3 Hz to 13.2 GHz
- **E4440A**
  3 Hz to 26.5 GHz
- **E4447A**
  3 Hz to 42.98 GHz
- **E4446A**
  3 Hz to 44 GHz
- **E4448A**
  3 Hz to 50 GHz

PSA options (x = 0, 3, 5, 6, 7, 8)

E444xA-233
Built-in measuring receiver personality and PC software (required)

E444xA-123
Switchable µW preselector bypass (required for TRFL measurements above 3 GHz)

E444xA-1DS
RF internal preamplifier (required for the maximum TRFL measurement sensitivity below 3 GHz, not co-exists with opt 110)

E444xA-110
RF/µW internal preamplifier (required for the maximum TRFL measurement sensitivity both below and above 3 GHz, not co-exists with opt 1DS)

E444xA-107
Audio input 100 kΩ (required for audio analysis, only operational with opt 233)

Select from PSA options for other measurements (Optional, Refer to *PSA Configuration Guide* for details of option compatibility and requirements)

PSA option upgrades[a] (x = 0, 3, 5, 6, 7, 8)

E444xAU-233
Built-in measuring receiver personality and PC software (required)

E444xAU-123
Switchable µW preselector bypass (required for TRFL measurements above 3 GHz)

E444xAU-1DS
RF internal preamplifier (required for the maximum TRFL measurement sensitivity below 3.05 GHz, not co-exists with opt 110)

E444xAU-110
RF/µW internal preamplifier (required for the maximum TRFL measurement sensitivity both below and above 3.05 GHz, not co-exists with opt 1DS)

E444xAU-107
Audio input 100 kΩ (required for audio analysis, only operational with opt 233)

[a] Upgrades for certain PSA options may not be available for earlier instrument. For detailed information regarding availability and compatibility of options, please visit **http://www.agilent.com/find/psa_upgrades**.

N5531S Ordering Information (Continued)

-Series power meter
(Select one from the following models)

N1911A
P-Series single channel power meter

N1912A
P-Series dual channel power meter

Select from power meter options (optional)

N5532A sensor module
(Select one frequency option)

N5532A-504
100 kHz to 4.2 GHz, type N(m) input connector

N5532A-518
10 MHz to 18 GHz, type N(m) input connector

N5532A-526
30 MHz to 26.5 GHz, APC 3.5 (m) input connector

N5532A-550
30 MHz to 50 GHz, APC 2.5(m) input connector

N5532A-019
Adaptor to N191xA power meter (required when the N191xA power meter is used), can also be ordered standalone

(optional)
Select from N5532A options

Accessories

N5531S-010
LAN connection kit (including one LAN hub and 3 regular LAN cables) (optional)

Related Literature

Publication Title	Publication Type	Publication Number
PSA in general		
Selecting the Right Signal Analyzer for Your Needs	Selection Guide	5968-3413E
PSA Series	Brochure	5980-1284E
PSA Series	Configuration Guide	5989-2773EN
Self-Guided Demonstration for Spectrum Analysis	Product Note	5988-0735EN
Wide bandwidth and vector signal analysis		
40/80 MHz Bandwidth Digitizer	Technical Overview	5989-1115EN
Using Extended Calibration Software for Wide Bandwidth Measurements, PSA Option 122 & 89600 VSA	Application Note 1443	5988-7814EN
PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software	Product Note	5988-5015EN
89650S Wideband VSA System with High Performance Spectrum Analysis	Technical Overview	5989-0871EN
Measurement personalities and applications		
Phase Noise Measurement Personality	Technical Overview	5988-3698EN
Noise Figure Measurement Personality	Technical Overview	5988-7884EN
External Source Measurement Personality	Technical Overview	5989-2240EN
Flexible Modulation Analysis Measurement Personality	Technical Overview	5989-1119EN
W-CDMA and HSDPA/HSUPA Measurement Personalities	Technical Overview	5988-2388EN
GSM with EDGE Measurement Personality	Technical Overview	5988-2389EN
cdma2000 and 1xEV-DV Measurement Personalities	Technical Overview	5988-3694EN
1xEV-DO Measurement Personality	Technical Overview	5988-4828EN
cdmaOne Measurement Personality	Technical Overview	5988-3695EN
WLAN Measurement Personality	Technical Overview	5989-2781EN
NADC/PDC Measurement Personality	Technical Overview	5988-3697EN
TD-SCDMA Measurement Personality	Technical Overview	5989-0056EN
BenchLink Web Remote Control Software	Product Overview	5988-2610EN
IntuiLink Software	Data Sheet	5980-3115EN
Programming Code Compatibility Suite	Technical Overview	5989-1111EN
Hardware options		
PSA Series Spectrum Analyzers Video Output (Option 124)	Technical Overview	5989-1118EN
PSA Series Spectrum Analyzers, Option H70,70 MHz IF Output	Product Overview	5988-5261EN
Spectrum analyzer fundamentals		
Optimizing Dynamic Range for Distortion Measurements	Product Note	5980-3079EN
PSA Series Amplitude Accuracy	Product Note	5980-3080EN
PSA Series Swept and FFT Analysis	Product Note	5980-3081EN
PSA Series Measurement Innovations and Benefits	Product Note	5980-3082EN
Spectrum Analysis Basics	Application Note 150	5952-0292
Vector Signal Analysis Basics	Application Note 150-15	5989-1121EN
8 Hints for Millimeter Wave Spectrum Measurements	Application Note	5988-5680EN
Spectrum Analyzer Measurements to 325 GHz with the Use of External Mixers	Application Note 1453	5988-9414EN
EMI	Application Note 150-10	5968-3661E

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Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
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Your Advantage
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Phone or Fax
United States:
(tel) 800 829 4444
(fax) 800 829 4433

Canada:
(tel) 877 894 4414
(fax) 800 746 4866

China:
(tel) 800 810 0189
(fax) 800 820 2816

Europe:
(tel) 31 20 547 2111

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (080) 769 0800
(fax) (080) 769 0900

Latin America:
(tel) (305) 269 7500

Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
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