Installation and User's Guide
for
N5530S Measuring Receiver System

Agilent Technologies

Manufacturing Part Number: N5530-90004
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NOTE	*Note* calls out special information for the user's attention. It provides operational information or additional instructions of which the user should be aware.

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.

This symbol is used to mark the on position of the power line switch.

This symbol indicates that the input power required is AC.

WARNING	**This is a Safety Class 1 Product (provided with a protective earth ground incorporated in the power cord). The mains plug shall be inserted only in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING	**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

WARNING	**If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

CAUTION	Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate grounding may cause product damage.

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Where to Find the Latest Information

Documentation is updated periodically. For the latest information about Agilent Technologies N5530S Measuring Receiver Systems, including software upgrades, please visit the following Internet URL:

http://www.agilent.com/find/N5530S

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Contents

Contents

Contents

Contents

1 Introduction

This chapter provides a description of the N5530S Measuring Receiver System and the specifications required for each of its components.

N5530S Measuring Receiver Overview

The Agilent Technologies N5530S is a Measuring Receiver System consisting of an Agilent Technologies Performance Spectrum Analyzer (PSA) with option 233 license and option B7J, an Agilent Technologies Power Meter, an N5532A Sensor Module, and a personal computer loaded with N5530S Measuring Receiver Software.

This system provides precision traceable measurements of relative power for attenuator calibration, and modulation parameters for AM, FM, and PM signal generator performance tests to 26.5 GHz. The performance of the N5530S meets or exceeds the specifications of its predecessor – the HP/Agilent 8902A. Its manual and automatic user interface simulate that of the 8902A, which makes it very easy to use.

Figure 1-1 N5530S Measuring Receiver System

System Requirements

Table 1-1 PSA System Requirements

System Component	Model numbers supported
PSA with Options: 233 & B7J, 123 (above 3 GHz), and 1DS (optional)	E4440A, E4443A and E4445A Firmware Revision A.06.00 or later

Table 1-2 EPM System Requirements

System Component	Model numbers supported
Economy Power Meter	E4418A or E4418B Firmware Revision A1.08.00 or later E4419A or E4419B Firmware Revision A2.08.00 or later E4416A Firmware Revision A1.04.00 or later E4417A Firmware Revision A2.04.00 or later

Table 1-3 N5532A Sensor Module Requirements

System Component	Model numbers supported
N5532A Sensor Module	N5532A: Option 504: 100 KHz to 4.2 GHz N5532A: Option 518: 10 MHz to 18 GHz N5532A: Option 526: 30 MHz to 26.5 GHz

Table 1-4 PC Software System Requirements

System Component	Operating System Requirements
Personal Computer Software	Windows 2000 or XP professional Internet Explorer 5.0 or later

Table 1-5 PC Hardware System Requirements

Personal Computer Hardware	300 MHz Pentium or AMD-K6®1 CPU (≥ 1 GHz Recommended) 256 Mbytes RAM (512 Mbytes recommended) Available space on hard drive: 110 Mbytes for measuring receiver software installation Paging file size 256 Mbytes 60 Mbytes for .NET framework installation CD ROM drive for the installation media (can be installed via network access) GPIB interface (Agilent 82357A USB/GPIB Converter)

Other Sources of Measurement Information

Additional measurement application information is available through your local Agilent Technologies sales and service office. The following application notes provide more detailed information.

- Application Note 1449: Fundamentals of RF Microwave Power Measurements
- Application Note: 150 Spectrum Analysis Basics

  (For more information on the theory of spectrum analysis.)
- Application Note 150-1:Amplitude and Frequency Modulation (For more information on the theory of AM, FM and PM.)

Instrument Updates at www.agilent.com

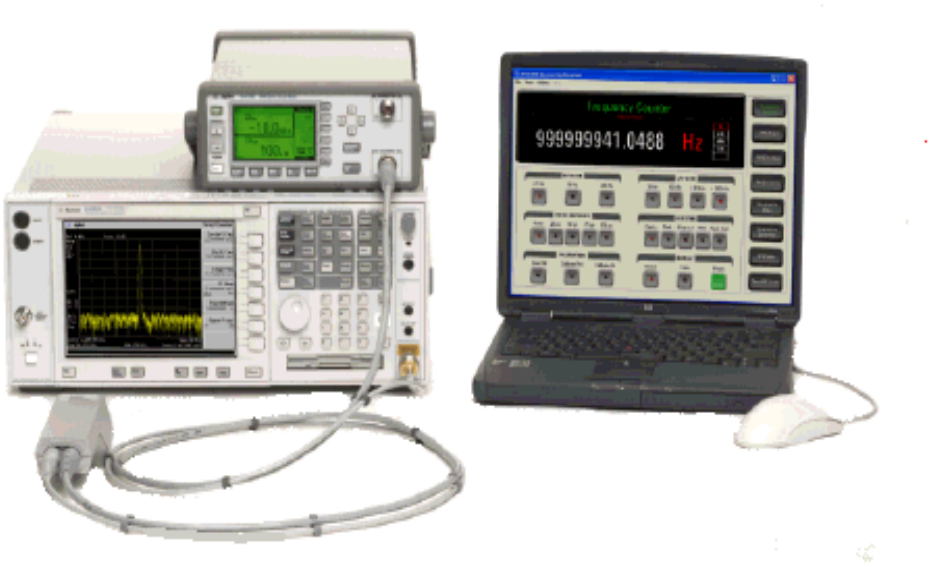
These web locations can be used to access the latest information about the instrument, including the latest software version.

http://www.agilent.com/find/N5530S

2 Installation and Setup

This chapter provides the following information that you may need when you first receive your Measuring Receiver System:

Figure 2-1 N5530S Measuring Receiver System



The image above shows the hardware setup for the N5530S Measuring Receiver System. The system is based around the PSA spectrum analyzer, EPM power meter, N5532A Sensor Module and the N5530S System Software. The system software is shown here running on the (optional) laptop personal computer.

Initial Inspection

Inspect the shipping containers and the cushioning materials for signs of stress. Retain the shipping materials for future use, as you may wish to ship the instruments to another location or to Agilent Technologies for service. Verify that the contents of the shipping container are complete. The following table lists the items shipped with the system.

Item/PartNumber	Description
Refer to Table 1-1 on page 11 to identify the PSA configuration you received.	
Refer to Table 1-2 on page 11 to identify the Economy Power Meter (EPM) you received.	
Refer to Table 1-3 on page 11 to identify the Sensor Module you received.	
E4440-10002	CD-ROM with N5530S Software
82357A	USB to GPIB Converter (Optional)
10833D	GPIB Cable - 0.5 meter (Optional)
LTPC3	Laptop computer loaded with N5530S Measuring Receiver Software, Windows 2000 or XP professional, and Internet Explorer 5.0 or later (Optional)
Standard Documentation Set	
Installation and User's Guide for N5530S Measuring Receiver System	Covers setting up the system, operation, basic measurements, and specifications.

NOTE Refer to the documentation you received with the spectrum analyzer, power meter, and sensor module for detailed information regarding their set-up, installation and operation.

Service documentation is *not* available for this system. Refer to the service options available for each system component. Do we want to say this or anything about service?

Contacting Agilent Technologies

Agilent Technologies has offices around the world to provide you with complete support for your instruments and accessories. To obtain servicing information or to order replacements, contact the nearest Agilent Technologies office listed in the table below. In any correspondence or telephone conversations, refer to your instrument or accessory by its product number and full serial number.

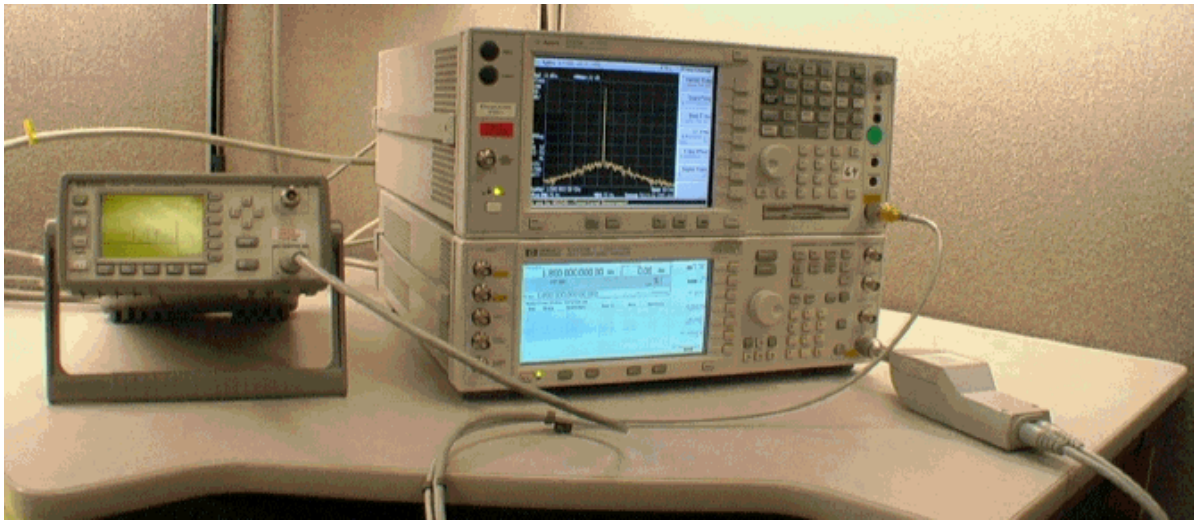
Table 2-1 Contacting Agilent Technologies

Online assistance: http://www.agilent.com/find/assist

United States (tel) 1 800 452 4844	**Latin America** (tel) (305) 269 7500 (fax) (305) 269 7599
Canada (tel) 1 877 894 4414 (fax) (905) 282-6495	**Japan** (tel) (81) 426 56 7832 (fax) (81) 426 56 7840
Europe (tel) (31 20) 547 2323 (fax) (31 20) 547 2390	**Australia** (tel) 1 800 629 485 (fax) (61 3) 9210 5947
New Zealand (tel) 0 800 738 378 (fax) 64 4 495 8950	**Asia Pacific** (tel) (852) 3197 7777 (fax) (852) 2506 9284

Setting up the System Hardware

Figure 2-2 Hardware Setup

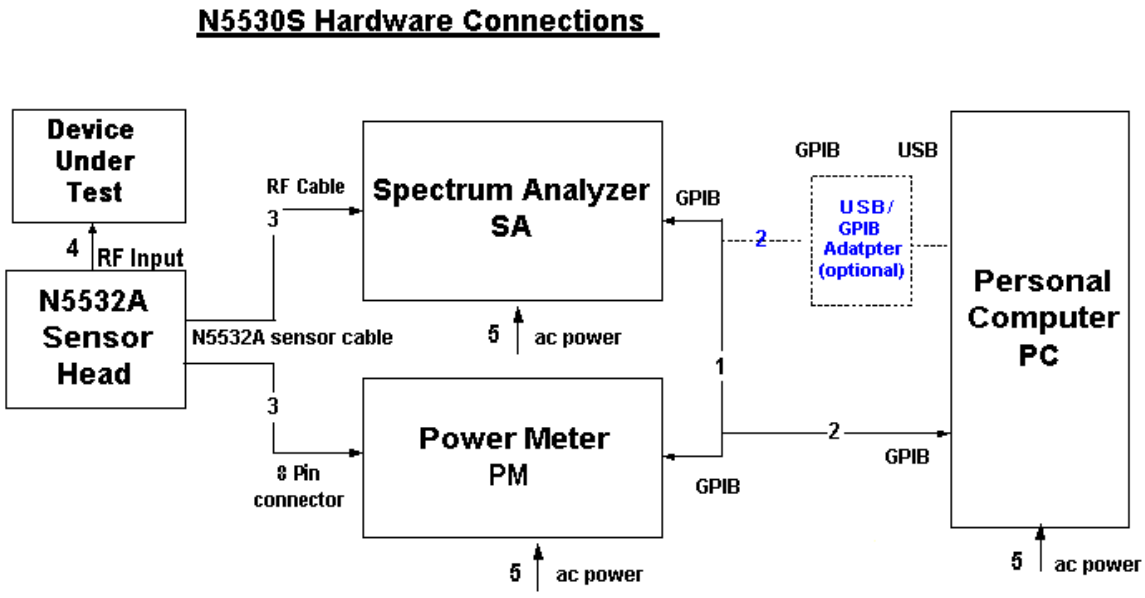


Signal generator is the device under test (DUT) (see Figure 2-2 above).

Follow these steps to setup the hardware.

1. Check your hardware to ensure it has the correct options and features:
   - Table 1-1, “PSA System Requirements,” on page 11
   - Table 1-2, “EPM System Requirements,” on page 11
   - Table 1-3, “N5532A Sensor Module Requirements,” on page 11
2. Connect the system hardware by selecting one of the following 2 configurations: (Refer to Figure 2-3 on page 18.)
   - “System PC has GPIB card installed:” on page 18.
   - “System PC has a USB port and no GPIB card installed:” on page 19

Figure 2-3 Hardware Setup Block Diagram



System PC has GPIB card installed:

1. Connect GPIB cable between the spectrum analyzer (PSA) and power meter (EPM).
2. Connect GPIB cable between the PSA and the personal computer (PC).
3. Connect the sensor module to the PSA and EPM.
4. Connect the RF input of the sensor module to the DUT RF output.

Figure 2-4 Connecting the Sensor Module to the Signal Generator (DUT)

Notice the sensor module is flush with the table to minimize stress on the connection to the signal generator.

CAUTION While connecting the sensor module to the signal generator, please

follow these recommendations:

1. Turn only the connector sleeve portion of the sensor module. Damage can occur if torque is applied to the sensor module body.

2. Ensure the sensor rests flush against a desktop. This helps prevent mechanical damage to the sensor and signal generator RF OUT connection.

NOTE Maximum torque at the connector should NOT exceed 12 in-lb (135 Ncm) for the Type-N connector or 8 in-lb (90 Ncm) for the 3.5-mm connector to avoid damage to the connector.

5. Connect power cords to the PC, PSA and EPM.
6. Apply power to the PC, PSA and EPM, then observe their self-tests.
7. Follow the procedure for "Verifying the System Connections" on page 30.

System PC has a USB port and no GPIB card installed:

1. Connect GPIB cable between the spectrum analyzer (PSA) and power meter (EPM).
2. Connect the USB/GPIB adapter between the PSA and the personal computer (PC).
3. Connect the sensor module to the PSA and EPM.
4. Connect the RF input of the sensor module to the signal generator RF output. (Refer to **Caution** on page 18.)
5. Connect power cords to the PC, PSA, EPM, and signal generator.
6. Apply power to the PC, PSA and Power Meter and observe their self-tests.
7. Follow the procedure for "Verifying the System Connections" on page 30.

Installing the System Software

The N5530S System Software running on a PC equipped with a GPIB interface handles the user interface and all instrument control. For remote programming, the N5530S software uses an industry-standard IVI-COM application-programming interface (API).

There are two software configurations:

- Software preinstalled on a PC.
- Software to be installed from a CD or web page download.

Software pre-installed on a PC.

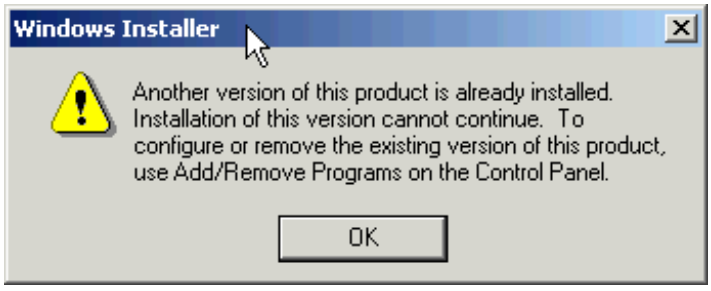
N5530S systems ordered through Agilent (with the optional PC), come with the N5530S System Software already installed and tested:

1. Connect the system as outlined in, "Setting up the System Hardware" on page 17.
2. Test the system as outlined in, "Verifying the System Connections" on page 30.

Software to be installed from a CD or web page download.

Before installing the N5530S software on the PC:

- Check that the host PC has the necessary PC Requirements. See Table 1-4 and Table 1-5 on page 11.
- Check for any existing version of the N5530S software installed, and if found, remove it. If an existing version is installed and not removed, the following message will appear during installation.

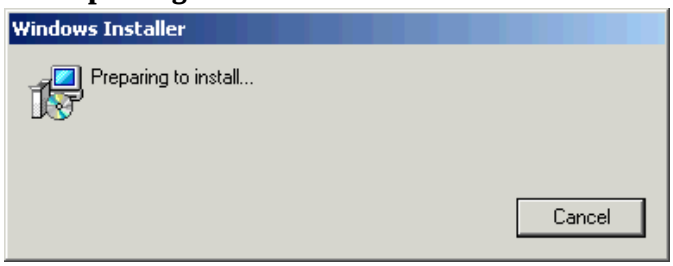


The N5530S CD contains all the software necessary for making measurements.

Start the Agilent install script by:

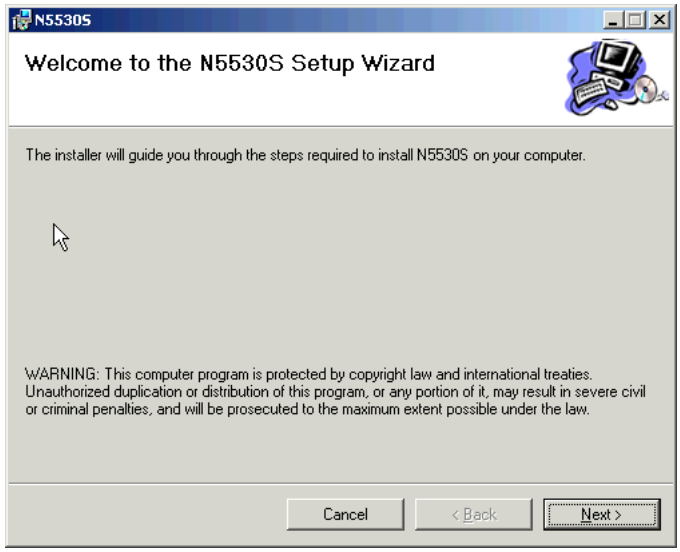
Entering the CD into the computer, in most cases the installation program will automatically run. If it does not run, you can make it run by going to the **Start** button on the PC display taskbar. Select **Start->Run** and type "`D:\Setup.exe`" in the dialog box. Please use the correct drive name for your CD in the run command.

Figure 2-5 Preparing to Install



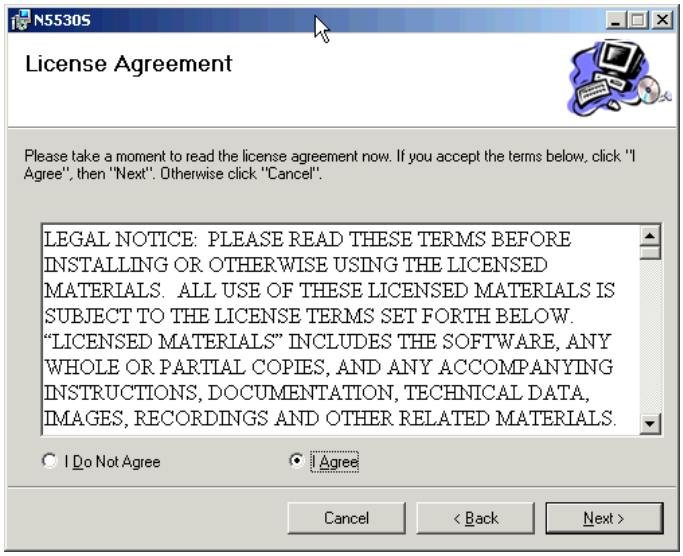
This screen will appear for a few seconds followed by:

Figure 2-6 Welcome to the N5530S Setup Wizard



Press **Next**.

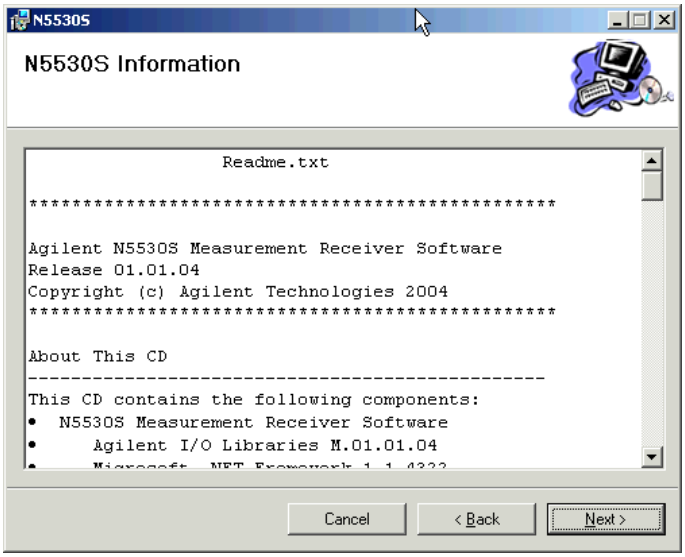
Figure 2-7 License Agreement



This window provides information on the Licensing Agreement:

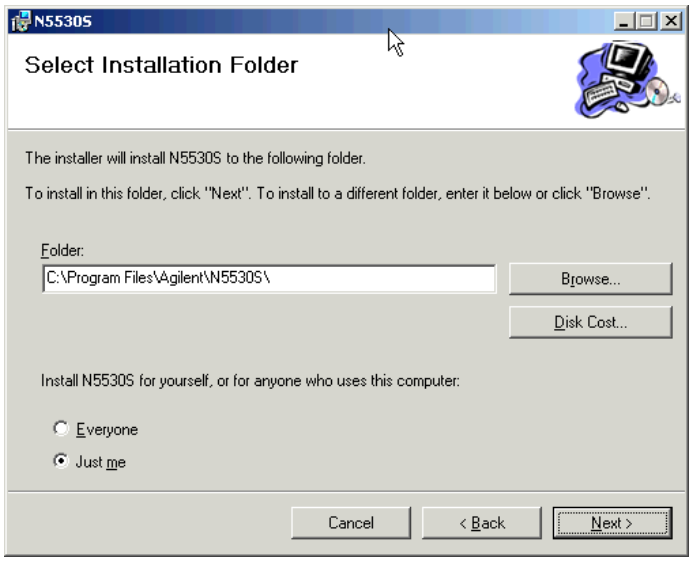
- Select the **I Agree** radio button.
- Select **Next**.

Figure 2-8 N5530S Information



This window provides "**Read Me**" information about the N5530S system software, select **Next** to continue.

Figure 2-9 **Select Installation Folder**



This window enables browsing to a folder in which to install the N5530S software. Choose between Everyone and Just me:

- Choose between **Everyone** and **Just me**:
- Select **Browse** to navigate to a folder other than the folder already selected.
- Select **Next** to continue.

Figure 2-10 **Confirm Installation**

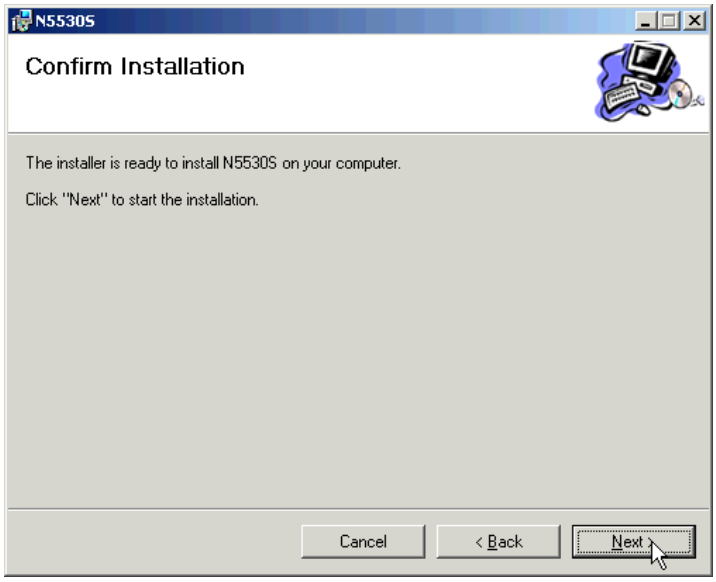
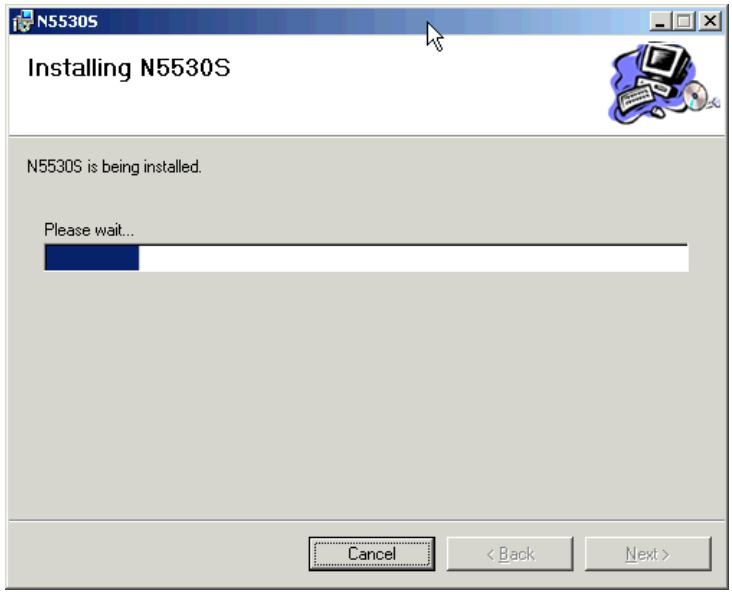


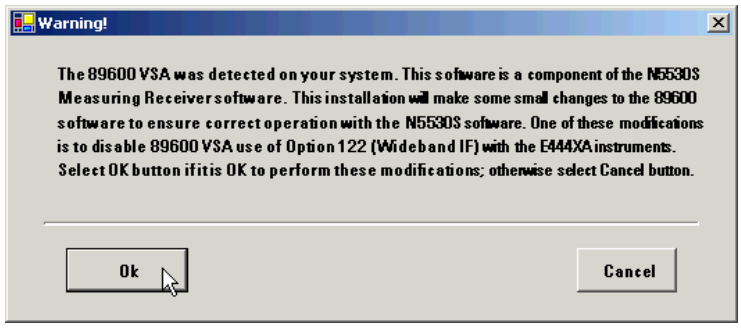
Figure 2-11 Press Next to start the installation.



This window shows the progress of the software installation.

When the installation is complete, Press **Next**.

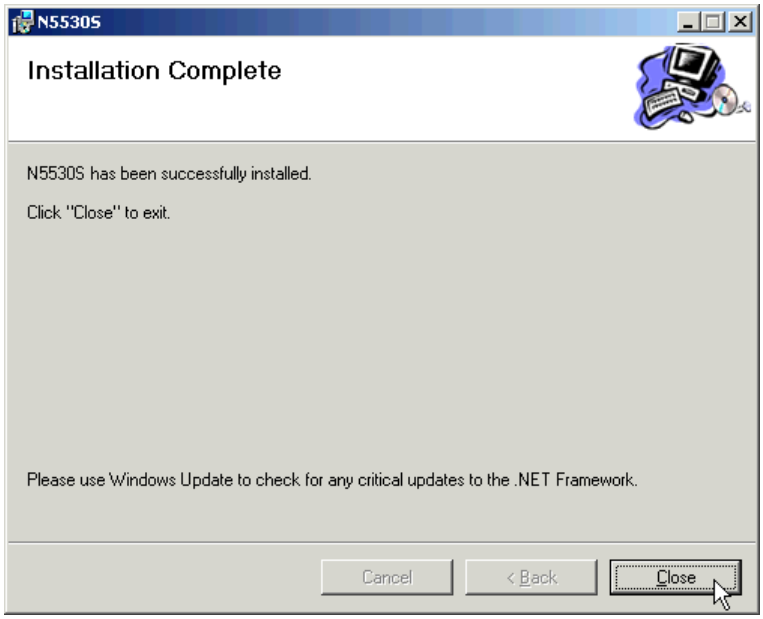
Figure 2-12 Warning, changes need to be made.



This window informs you that the N5530S System Software installation needs to disable the use of option 122 for use with the 89600 VSA Software. The 89600 VSA Software is already installed on the PC and is needed for the N5530S System Software to make measurements.

Select **OK** to continue.

Figure 2-13 Installation Complete



This window shows that the installation is complete.

Select **Close** to close the window.

Checking for N5530S installed on the PC:

- On the PC screen taskbar, select Start > Programs.
- Look for the program listed as Agilent N5530S Measurement Receiver.

Removing N5530S software from PC:

- On the PC screen taskbar, select **Start > Settings > Control Panel**.
- In the **Control Panel** window, select **Add/Remove Programs**.
- In the **Add/Remove Programs** window, select **N5530S** and then select **Remove**.

Calibration of System Components

To ensure accurate measurements, the spectrum analyzer and power meter require a self-calibration. Running a calibration before any measurement will give the most accurate results. In addition, the sensor module has unique calibration factors which need to be installed.

The calibration tasks are as follows:

1. Installing the Sensor Module Calibration Factors on page 26
2. Calibrating the spectrum analyzer (SA) on page 28
3. Calibrating the power meter (EPM) on page 29

Installing the Sensor Module Calibration Factors

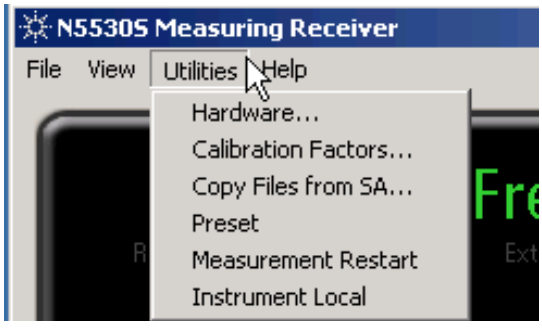
The power meter cannot make accurate measurements unless the calibration factors of the N5532A Sensor Module have been loaded into the N5530S Software. A floppy disk (*N5532A Sensor Module Data Disk*) containing unique calibration factors is included with each N5532A Sensor Module. (It is located inside the CD cover, opposite the *N5532A Sensor Module User's Guide.*

There are two methods of installing the sensor module calibration factors (cal factors) in the N5530S Measuring Receiver System.

1. "Using the PC to Load and Save the Cal Factors" on page 26
2. "Using the PSA to Save the Cal Factors to the PC" on page 27

Refer to "Editing Cal Factors and Sensor Data" on page 28 if you need to make modifications to the file.

Figure 2-14 Utilities Menu



Both methods are accessed through the Utilities drop-down menu.

Using the PC to Load and Save the Cal Factors

1. Select **Calibration Factors** to bring up the **Calibration View Edit** dialog box.

NOTE If your PC does not have a floppy disc drive, refer to the "Using the PSA to Save the Cal Factors to the PC" on page 27.

2. Insert the N5532A Sensor Module Data Disk in the PC A:\ drive.
3. Press **Load Cal File** in the **Calibration View Edit** dialog box. The **Open Calibration File** dialog box appears.
4. Navigate to the PC A:\ drive if necessary and select the `CFData.XML` file.

NOTE If you obtained the cal data from the PSA, go to the directory you specified in step 4 of the next section to load the data.

5. Press **Open**.
6. The calibration factors will be loaded into the **Calibration View Edit** dialog box.
7. Press **Apply**, then **OK**. (Skip this step and go to step 8 if you are loading the cal factors from your PC floppy drive.)
8. Press **Save Cal File** in the **Calibration View Edit** dialog box. A **Save Calibration File** dialog box opens
9. Navigate to a folder on the PC hard drive.
10. Press **Save**.
11. Press **OK** to close the dialogue box.

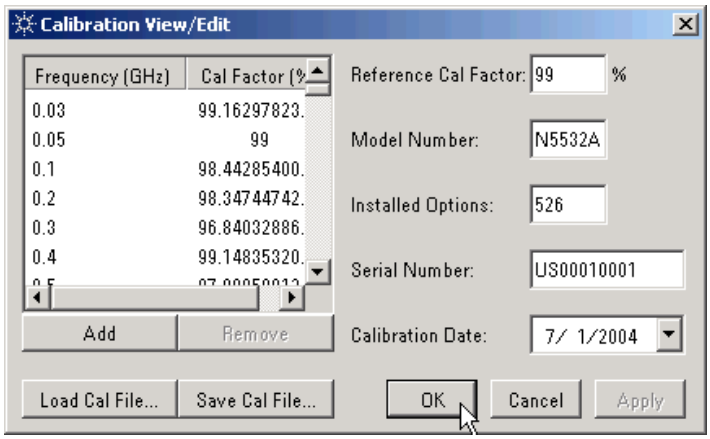
Using the PSA to Save the Cal Factors to the PC

1. Insert the N5532A Sensor Module Data Disk into the PSA floppy drive (A: drive).
2. Select **Copy Files from SA** under the **Utilities** menu option of the N5530S User Interface. This accesses the floppy drive of the PSA.
3. Click **OK** to copy the calibration factor files to the PC desktop. Three files appear on the desktop, `CALTABLE.XSL`, `CFDATA.XML`, and `CFCERT.DOC`.
4. If the files are to be copied to a folder instead of the desktop, navigate to the desired location, press the **New Folder** button, and name the new data location as you wish.
5. To load this data into the system, select **Utilities**, **Calibration Factors...** and then follow step 3 through step 7 in the section entitled, "Using the PC to Load and Save the Cal Factors" on page 26.

Editing Cal Factors and Sensor Data

Select **Utilities**, **Calibration Factors**.... to bring up the menu below.

Figure 2-15 Calibration View Edit



In the above dialog box, cal factor and sensor data can be edited in several ways:

- ***Removing a Cal Factor:***

  In the calibration factors scroll box, highlight a frequency portion of the cal factor data entry that is to be deleted and then select **Remove**. The cal factor data entry will be deleted. Select **OK** to save the change or **Save Cal File...** to browse and save the cal factor file in a different folder.

- ***Adding a Cal Factor:***

  Select anywhere in the calibration factors scroll box, and then select **Add**. A Calibration Data dialog box appears. Enter frequency and calibration factor data and then select **OK**.

Calibrating the spectrum analyzer (SA)

Follow these steps:

1. Allow the spectrum analyzer to warm-up for 30 minutes before making a calibrated measurement. To meet its specifications, the analyzer must meet operating temperature conditions.
2. Select **Calibrate SA**, in the calibration selection field in either the **Standard View** or **Advanced View**. The PSA will be calibrated by commands from the system software. The front panel display will change to display the text, "`Calibrating`...". This text will be displayed until the calibration is complete at which time the displayed text will revert back to whatever was shown before the calibration.

NOTE While running the SA calibration it is normal to hear clicking.

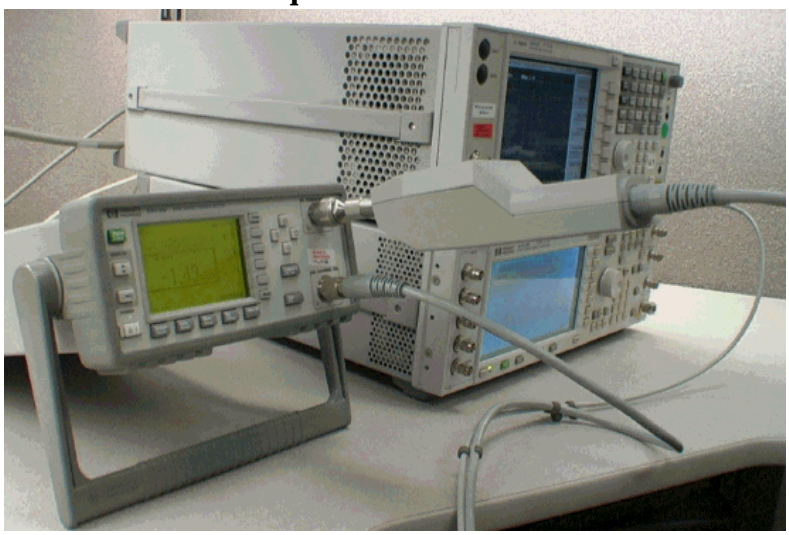
Calibrating the power meter (EPM)

NOTE Before you begin calibration, load the calibration factors, or make sure the calibration factors are valid.

There are three steps to this process:

1. Connect the N5532A Sensor Module input connector to the power meter **POWER REF** output as shown in Figure 2-16.

Figure 2-16 Sensor Module Required for EPM Calibration



2. Select **Zero PM**, in the calibration selection field in either the **Standard View** or **Advanced View**. The power meter will be zeroed by commands from the system software. The front panel display will change to display the text, "Zeroing. . .". This text will be displayed until the power meter has been zeroed, at which time the displayed text will revert back to what was shown before.
3. Select **Calibrate PM**, in the calibration selection field in either the **Standard View** or **Advanced View**. The power meter will be calibrated by commands from the system software. The front panel display will change to display the text, "Calibrating...". This text will be displayed until the calibration is complete at which time the displayed text will revert back to what was shown before the calibration.

Verifying the System Connections

With the hardware and software installed, it is now time to test the system in preparation for making measurements.

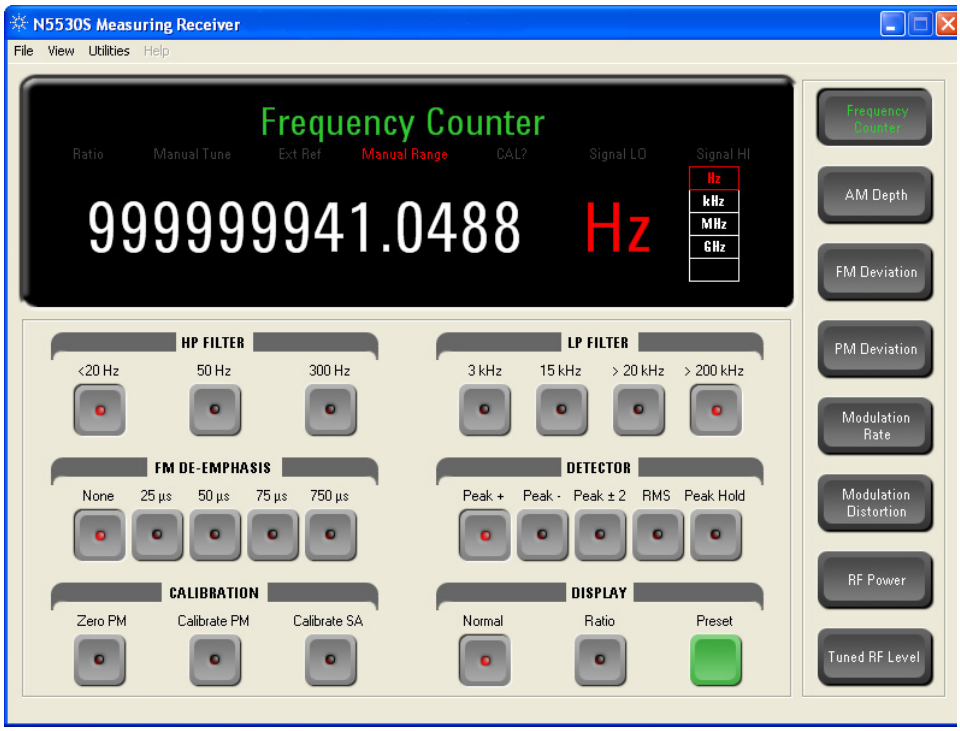
1. Turn the PC, PSA, signal generator, and power meter (EPM) on, and allow them to warm up for at least five minutes.
2. After the measuring instruments are turned on and ready, start the N5530S program by:

   • Double clicking the N5530S icon if it is available on the desktop.

   • On the PC screen taskbar, select Start > Programs > Agilent N5530S Measuring Receiver Software.

   3.The N5530S program will start up in the **Standard View**. After initializing, the system will automatically make a Frequency Counter measurement as shown here.

Figure 2-17 Standard View



NOTE The measurement display will probably not show a valid measurement reading, as the signal generator may not be set up correctly.

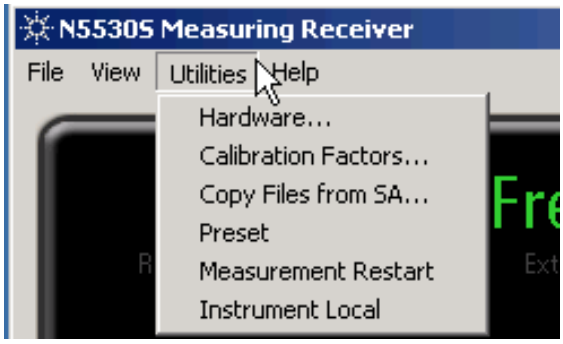
4. Make a measurement as outlined in the "Frequency Counter Measurement" on page 44.

If you have problems

If you have problems

Check that the PSA or power meter is connected by selecting **Utilities** in the program **menu bar**.

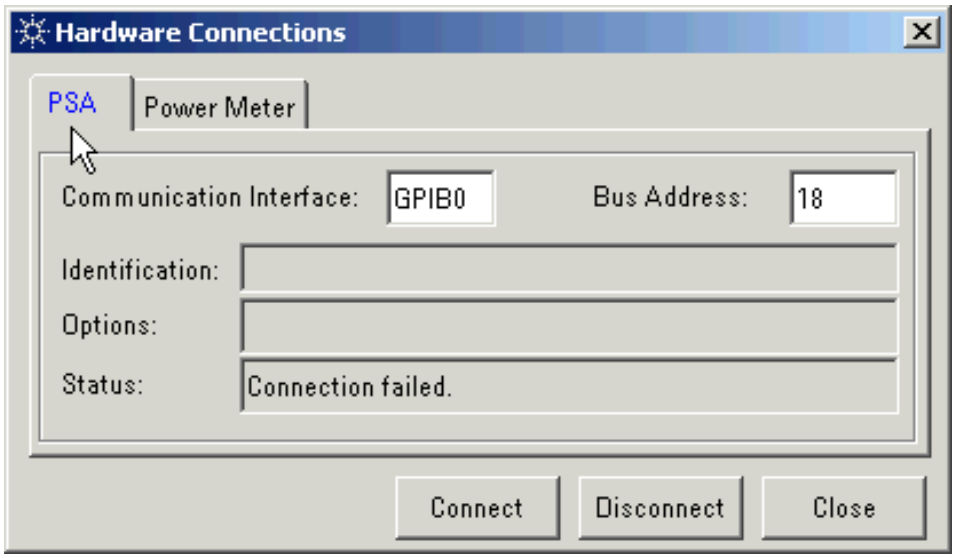
Figure 2-18 Selecting Utilities



There are four selections available from the Utilities menu.

Selecting **Hardware**... will bring up a **Hardware Connections** dialog box.

Figure 2-19 Hardware Dialogue Box



This dialog box allows the operator to view and change:

- The Communications Interface.
- The PSA and Power Meter bus address.
- To connect or disconnect the PSA and power meter.

NOTE In addition, this dialog box provides identification, installed options and

status information on the PSA and power meter.

Using an External Reference

Sharing a common frequency reference between the PSA and signal generator that is being measured considerably improves the frequency accuracy of the measurements.

For example, in a test, the system source was set to 1.2 GHz and the N5530S system set to make a **Frequency Counter** measurement. The N5530S system reading was 1.200000000006 GHz with the reference connected, and 1.200000053922 GHz without the reference connected.

Protecting Against Electrostatic Discharge

Electrostatic discharge (ESD) can damage or destroy electronic components (the possibility of unseen damage caused by ESD is present whenever components are transported, stored, or used).

Test Equipment and ESD

To help reduce ESD damage that can occur while using test equipment:

- Before connecting any coaxial cable to an analyzer connector for the first time each day, momentarily short the center and outer conductors of the cable together.
- Personnel should be grounded with a 1 MΩ resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the analyzer.
- Be sure that all instruments are properly earth-grounded to prevent build-up of static charge.

WARNING **Do not use these first three techniques when working on circuitry with a voltage potential greater than 500 volts.**

- Perform work on all components or assemblies at a static-safe workstation.
- Keep static-generating materials at least one meter away from all components.
- Store or transport components in static-shielding containers.
- Always handle printed circuit board assemblies by the edges. This reduces the possibility of ESD damage to components and prevent contamination of exposed plating.

Additional Information about ESD

For more information about ESD and how to prevent ESD damage, contact the Electrostatic Discharge Association (http://www.esda.org). The ESD standards developed by this agency are sanctioned by the American National Standards Institute (ANSI).

3 Making Measurements

This chapter describes how to make accurate measurements after the system has been installed and setup correctly.

Introduction

The N5530S Measuring Receiver System is designed to make extremely accurate measurements on RF signals. There are eight individual measurements available, as well as the capability to create a list of individual measurements to be run in what is known as batch mode.

Individual measurements are made either by using default settings, or user adjusted settings for better measurement control. All measurements are referred to as one-button measurements. After selecting and pressing the measurement button, it becomes active. Data acquisitions will automatically begin provided trigger requirements, if any, are met.

Go to the following sections to learn about how to set up measurements and which measurements are available in the N5530S system:

- "Measurement Setup" on page 37
- "Frequency Counter Measurement" on page 44
- "AM Depth Measurement" on page 45
- "FM Deviation Measurement" on page 46
- "PM Deviation Measurement" on page 47
- "Modulation Rate Measurement" on page 48
- "Modulation Distortion Measurement" on page 49
- "RF Power Measurement" on page 51
- "Tuned RF Level Measurement" on page 50
- "Batch Mode Measurements" on page 52

Measurement Setup

The **N5530S** Software opens in the **Standard View** (Figure 3-1 on page 38) which provides control of measurements, calibrations, and the information displayed. The **Advanced View** (Figure 3-2 on page 41) is used to set up measurement parameters that won't be expected to change during the measurement. These two views should be used together when setting up measurements.

The **Standard View** and **Advanced View** have three separate areas:

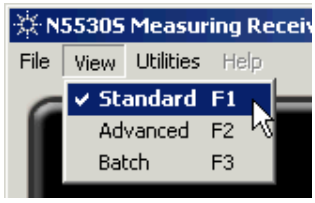
1. The measurement display, is common to both views.
2. The measurement selection buttons, is common to both views.
3. The measurement adjustment area, is different for each view.

- **Advanced View** has some measurement settings that finely control the measurement.
- **Standard View** has simple button controls that are selected and deselected using the PC mouse.

Standard View Selection

There are three ways to obtain the **Standard View**:

- Select **Standard** in the **View** menu



- Press the **F1** function key from the keyboard.
- Press the **Preset** key in the Utilities view.

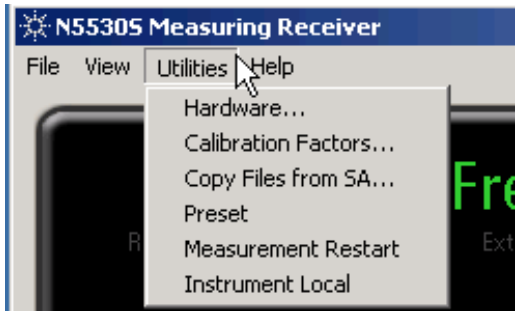
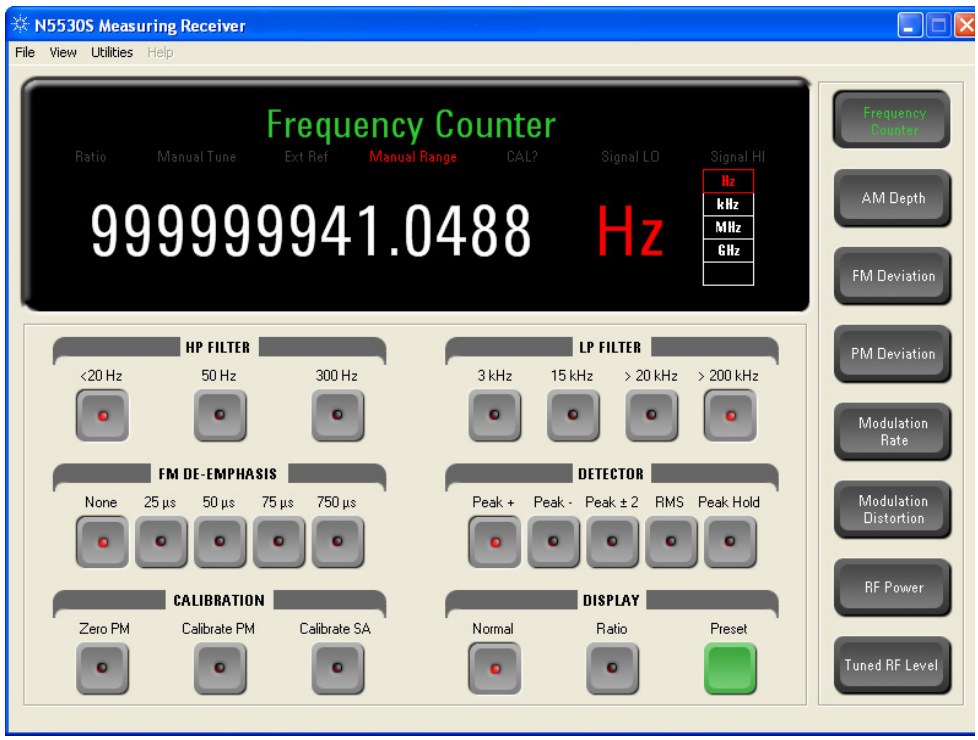


Figure 3-1 **Standard View**



Front Panel Display

There is a common display region at the top of the three display views. This display region has a black background and gives information on measurement values, instrument settings and conditions. The actual information shown in the display region will vary with each display view.

The measurement presently selected is shown at the top of the display as a title in green text. Any one of the eight measurements that can be made will appear here. The Frequency Counter measurement is shown in this example.

In addition, if the system is conducting a calibration, the words "`Calibrating`" will be displayed until the calibration is completed. As feedback to the operator, while the system is making a measurement, the green measurement title will move horizontally.

Below the measurement field is an enunciator field that gives status of the following instrument settings:

- **Ratio**: shows selection of **Normal** or **Ratio** display.

  Normal: Continuously updates, always showing the current measured value.

  Ratio: Displays the ratio between the initial value measured upon

selecting Ratio and each value measured there after. In the advanced view, you can explicitly enter the value you would like to ratio against. There are two types of units that can be selected for ratio view. These are dB and %. The default is dB.

%: Displays the percent each measured value is of the initial measured value. This measurement equation is:

[(next measured value) ÷ (Initial measured value)]^{N} X 100 = displayed value. Where N=1/2 for power measurements, and N=1 otherwise. For power measurements the values are expressed in watts not dBm.

dB: Displays the ratio of each new measurement against the initial value expressed in decibels (dB).

NOTE 20 * log10(displayed value for %) = displayed value for dB

- **Tuning**: Shows selection of **Auto** or Manual tuning.
- **Reference:** Shows selection of **Internal** or **External** frequency reference. If **External** is selected, enter the frequency value.
- **Ranging:** Shows selection of **Auto** or **Manual** ranging. If **Manual**, enter the range. (The Range is the maximum expected power at the input of the N5532A sensor module.)
- **Calibration**: Occasionally the system software will display a **CAL?** sign prompting the operator to calibrate the system.
- **Signal Hi Lo**: A **Signal HI** and or a **Signal LO** sign will appear if the input signal is above or below the system input range.

Below the enunciator strip is the measurement reading giving the measurement value and units. To the right of the measurement units is a column to change the measurement units. The measurement value is shown in white text as seen in Figure 3-1 on page 38. The decimal point is set by the units column. In this example, **Hz** are selected.

Seen at startup, a display of three dashes (---) shows that the measurement is being processed and not valid. When the measurement value is correctly calculated, the three dashes will be replaced by the measurement value.

The bottom strip of the display region is available for error message display. A **Clear** button is provided to clear the message when the error is no longer valid. The error messages and **Clear** button are in red type.

Measurement Selection Keys

The Measurement Selection Keys are a single column of eight keys on the right side of the instrument front panel, one key for each measurement. When the measurement parameters have been set up,

pressing the measurement key starts the measurement.

1. **Frequency Counter**
2. **AM Depth**
3. **FM Deviation**
4. **PM Deviation**
5. **Modulation Rate**
6. **Modulation Distortion**
7. **RF Power**
8. **Tuned RF Level**

Measurement Adjustment Keys

The Measurement Adjustment Keys are in the lower left area of the instrument front panel. These keys are used to select filters, detectors, displays and run calibrations.

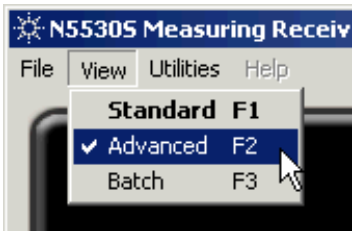
- **HP Filter**: For any measurement it is possible to switch one of three high pass filters into the measurement. Only one filter can be selected at a time. The default high pass filter value is 20 Hz.
- **LP Filter**: For any measurement it is possible to switch one of four low pass filters into the measurement. Only one filter can be selected at a time. The default low pass filter value is 300 kHz.
- **FM De-emphasis**: Most commercial grade FM transmitters call out for a de-emphasis filter on the output of the demodulator. This filter in conjunction with a pre-emphasis filter can increase performance of the communications channel by increasing the system signal to noise ratio. As a result of this, it is necessary to have the ability to make some transmitter measurements with respect to the FM De-emphasis filter. To provide this ability, four de-emphasis filters are available.
- **Detector**: Different types of transmitter measurements call out for different detectors to be used when making the various demodulation measurements. There are five detector selections available.
- **Calibration**: To ensure accurate measurements, the system needs periodic calibration. (Refer to “Calibration of System Components” on page 26.) The components that require self calibration are the PSA and EPM. Each sensor module has unique calibration factors associated with it. The calibration factors need to be entered into the N5530S Software so that accurate power measurements can be made. (Refer to “Installing the Sensor Module Calibration Factors” on page 26.)

- **Display**: In **Standard View**, the measurement value can be displayed in either **Normal** or **Ratio** mode. (Refer to the description of "Ratio" on page 38.) Associated with these two display keys is the **Preset** key.

Advanced View

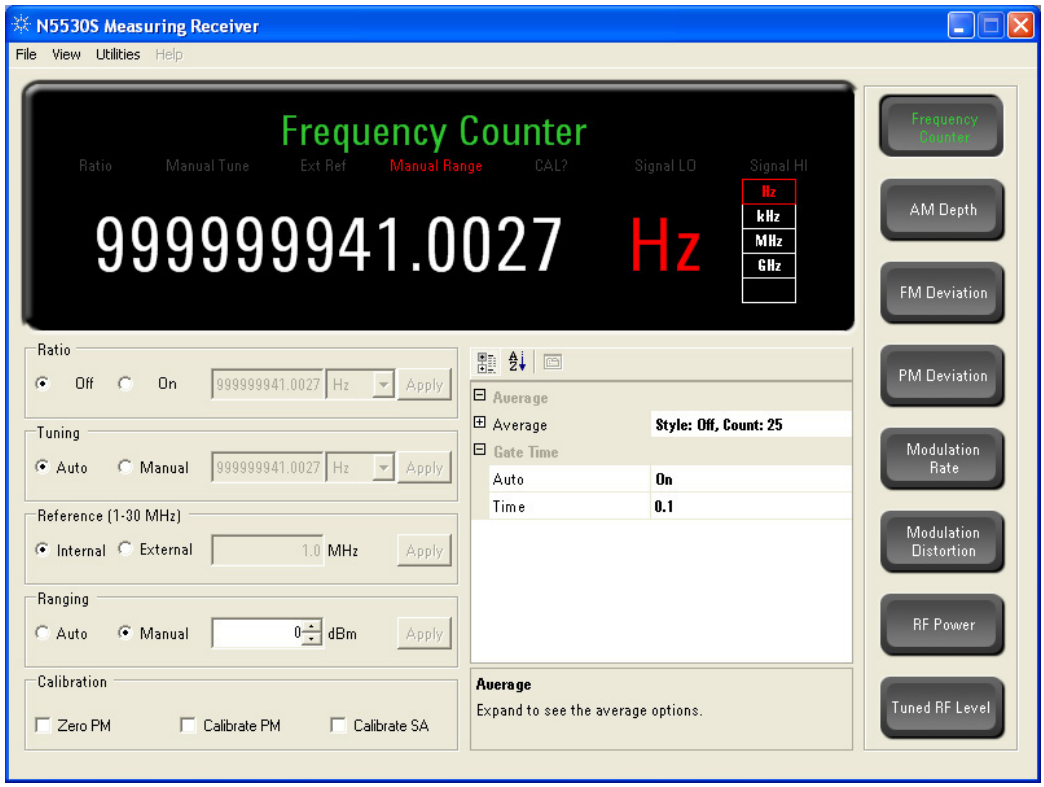
There are two ways to obtain the **Advanced View**:

- Select **Advanced** in the View menu



- Press the F2 function key from the keyboard.

Figure 3-2 Advanced View



Similar to the **Standard View**, the **Advanced View** has three sections.

1. Front Panel Display, is the same for the **Standard View**. See "Front Panel Display" on page 38
2. Measurement Selection Keys, is the same for the **Standard View**. See"Measurement Selection Keys" on page 39

3. Measurement Adjustment Area.

- **Ratio**: Selects between **Normal** and **Ratio** display. Refer to page 38 for a complete description of these selections.
- **Tuning**: Selects between **Auto** and **Manual** tuning.
- **Reference**: Selects between the **Internal** or **External** reference on the PSA. If **External**, enter the frequency value in MHz.
- **Ranging**: Selects between **Auto** and **Manual** ranging. If **Manual**, enter the manual range in dBm.
- **Calibration**: Choose between, **Zero Power Meter**, **Calibrate Power Meter** and **Calibrate Spectrum Analyzer**. See also "Installing the Sensor Module Calibration Factors" on page 26
- **Sort**: Choose between, **Categorized** and **Alphabetic.**
- **Measurement Property Page**: Depending on the measurement selected, adjustments can be made to measurement parameters. These parameters will change as required for each measurement.

Measurement Setup

Refer to the Chapter 2 , “Installation and Setup,” on page 13 to ensure your system is setup correctly. The hardware used in the measurements in this chapter are as follows:

Table 3-1 Equipment Used in Measurement Examples

Equipment	Model Number
Performance Spectrum Analyzer	Agilent E4445A
Economy Power Meter	Agilent E4418B
Sensor Module	Agilent N5532A Option 526
Economy Signal Generator	Agilent E4433B ESG
USB to GPIB converter	Agilent 82357A
Laptop Personal Computer	Agilent LTPC3

Frequency Counter Measurement

This procedure demonstrates how to make a Frequency Counter measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display the frequency of the signal.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: Off

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu. The default measurement is Frequency Counter with display units in Hz.

Step 3. Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

Step 4. Select **MHz** as display measurement units.

Step 5. The display value should read 100.00000XXXXX MHz

AM Depth Measurement

This procedure demonstrates how to make the AM Depth measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display the AM Depth of modulation of the signal.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: AM
Depth: 50%
Rate: 1 KHz

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu.

Step 3. Press **AM Depth**, to start the measurement.

Step 4. Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

NOTE See also "Modulation Rate Measurement" on page 48 and "Modulation Distortion Measurement" on page 49.

FM Deviation Measurement

This procedure demonstrates how to make the FM Deviation measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display the FM deviation of the signal.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: FM
FM deviation: 25 KHz
Rate: 1 KHz
FM ON
Modulation ON

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu.

Step 3. Set the N5530S FM De-emphasis to 25 µs.

Step 4. Press **FM Deviation**, to start the measurement.

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

NOTE See also "Modulation Rate Measurement" on page 48 and "Modulation Distortion Measurement" on page 49.

PM Deviation Measurement

This procedure demonstrates how to make the PM Deviation measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display the phase deviation of the signal.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: PM
PM deviation: 10 radians phase
Rate: 1 KHz
PM ON
Modulation ON

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu.

Step 3. Press **PM Deviation**, to start the measurement.

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

NOTE See also "Modulation Rate Measurement" on page 48 and "Modulation Distortion Measurement" on page 49.

Modulation Rate Measurement

The Modulation Rate measurement is used in conjunction with the following three measurements:

- “AM Depth Measurement” on page 45
- “FM Deviation Measurement” on page 46
- “PM Deviation Measurement” on page 47

First run one of these three measurements, then press the Modulation Rate key.

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

Modulation Distortion Measurement

The Modulation Distortion measurement is used in conjunction with the following three measurements:

- "AM Depth Measurement" on page 45
- "FM Deviation Measurement" on page 46
- "PM Deviation Measurement" on page 47

First run one of these three measurements, then press the Modulation Distortion key.

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

Tuned RF Level Measurement

This procedure demonstrates how to make the Tuned RF Level measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display that signal. The source power is stepped down and the N5530S displays the relative power.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: Off

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu.

Step 3. Press **Tuned RF Level**, to start the measurement.

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

Step 4. Press **Ratio** to establish the "reference power".

Step 5. Set the signal generator amplitude to –50 dBm.

Step 6. Wait for the N5530S system to complete the measurement. Then read the relative amplitude change.

RF Power Measurement

This procedure demonstrates how to make the RF Power measurement. The signal generator is adjusted to deliver a test signal. The N5530S system is used to measure and display the power of the signal.

Configuring the Measurement System

Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

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

RF Frequency: 100 MHz
Amplitude: 0.0 dBm
Modulation: Off

Step 2. Preset the N5530S system by selecting **Utilities**, **Preset** in the **Utilities** menu.

Step 3. Press **RF Power**, to make the measurement

Wait for the measurement to be completed. There will be three bars displayed in the measurement value area of the display until the measurement is complete.

NOTE The N5530S system uses both the RF Power and the Tuned RF Level measurements to determine the absolute amplitude of a signal below –20 dBm.

Batch Mode Measurements

The Batch Mode Measurement provides the ability to perform a list of single measurements sequentially (or only one measurement) by pressing the **Run** button in the Batch Mode View (See Figure 3-3 on page 52.)

Configuring the Measurement System

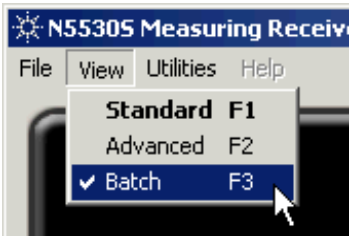
Refer to "Setting up the System Hardware" on page 17 to connect the measurement equipment.

Make sure the system is correctly calibrated, see "Calibration of System Components" on page 26.

Batch View Selection

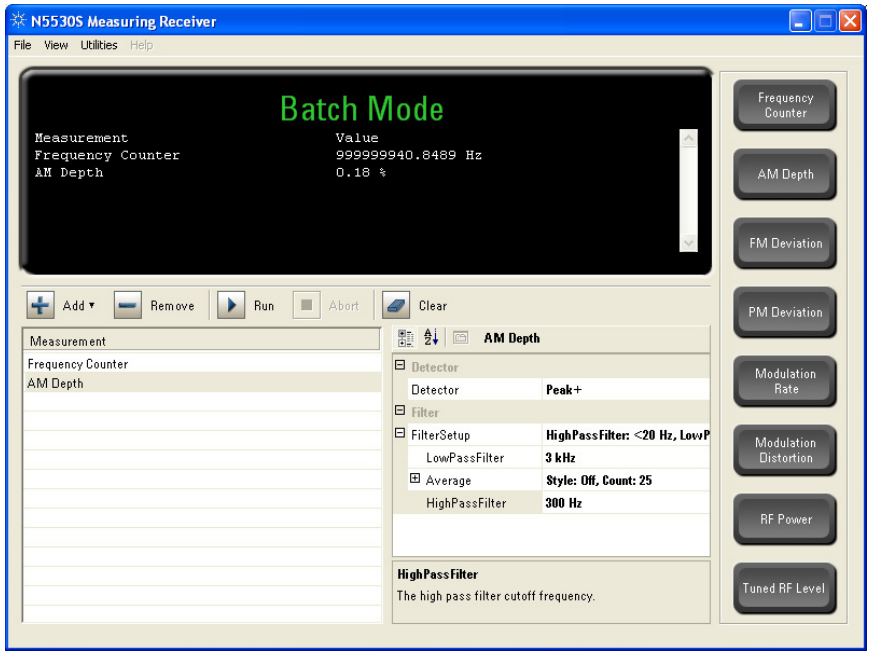
There are two ways to obtain the Batch View:

Select Batch in the View menu



Press the F3 function key from the keyboard.

Figure 3-3 **Batch Mode View**



General Batch Measurement Procedure

For a list of the equipment used in this measurement, see Table 3-1 on page 43.

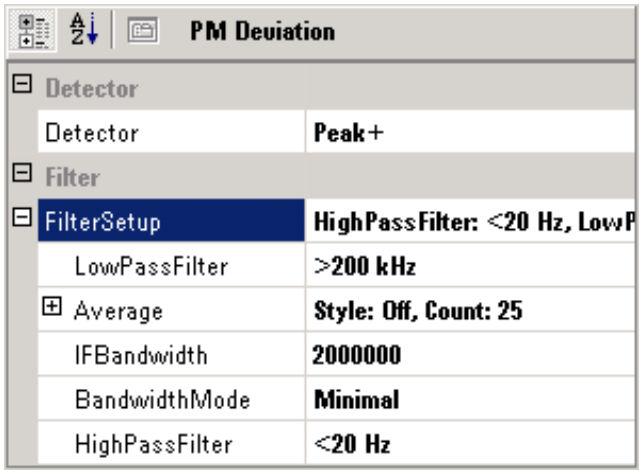
Step 1. Press "+" to view the batch measurement selection list. The eight measurements as well as other parameters and functions (i.e. Display Message Box and SCPI Command) can be selected as part of the batch measurement procedure

Step 2. Highlight a selection to add it to the list. If a measurement is added by mistake, use the "–" to remove unwanted measurements from the list.

NOTE To insert a measurement in the middle of the list, add it to the end of the list and then move it to the desired position with the PC mouse.

Step 3. Adjust parameters as necessary in the measurement property page.

Figure 3-4 Property Pages: Adjusting Measurement Parameter



Step 4. Repeat Step 1 through 3 above, until the list is complete.

Step 5. Press the **Run** key 

to start the list of measurements. The measurements occur sequentially according to the list.

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 use of the "Display Message Box" command is used to tell the operator when to turn on the appropriate modulation for each measurement.

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

RF Frequency: 1 GHz

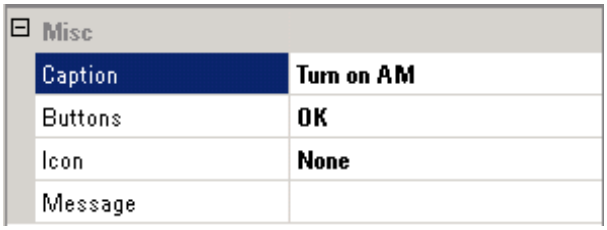
Amplitude: –10 dBm
AM Depth: 10%
Modulation Rate: 400 Hz
RF: On
Modulation: On
AM: Off
PM Deviation: 5.0 radians
PM: Off

Step 2. Add the “Display Message Box” command.

Press “+” and select **Display Message Box**.

Step 3. Hightlight the **Caption** field (located in the right portion of the display) and type “Turn on AM” in the space adjacent to this field.The OK button is automatically selected.

Figure 3-5 Creating a Message Box



Step 4. Press “+” and select **AM Depth**. Allow all options to select their default settings. (Peak+ is automatically selected for **Detector** and the **FilterSetup** defaults to <20 MHz;>200 kHz;style:Off;Count:25)

Step 5. Press “+” and select **Modulation Rate**. Allow all options to select their default settings.

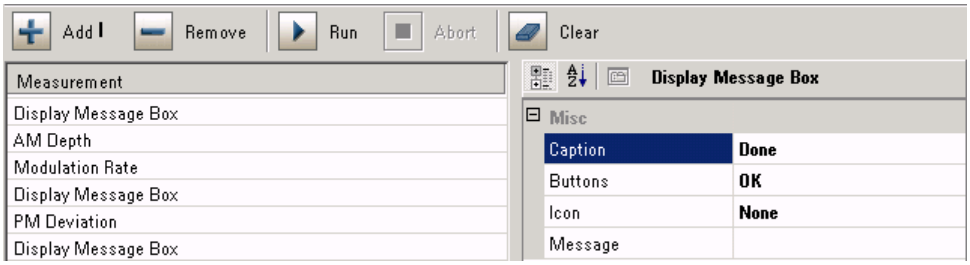
Step 6. Repeat Step 2 and 3, above. This time, type, “Turn on PM” in the space adjacent to the **Caption** field.

Step 7. Press “+” and select **PM Deviation**. Allow all options to select their default settings.

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

Repeat Step 2 and 3, above. This time, type “Done” in the space adjacent to the **Caption** field.

Figure 3-6 Complete Measurement



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.

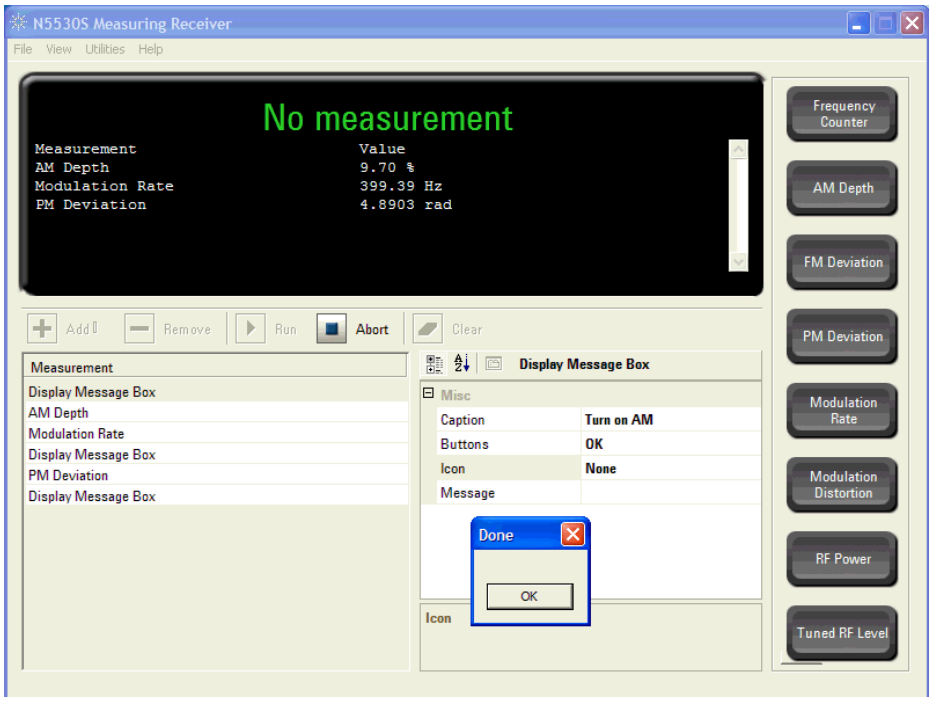
Step 11. The N5530S Software returns the percent modulation and the modulation rate to the display region.

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 N5530S Software returns the PM Deviation and displays the “Done” message box as shown in Figure 3-7 on page 55.

Figure 3-7 Results of Manual Measurement



NOTE If it seems like the N5530S Software appears to be waiting for an input, check to see if the message box is hidden behind the N5530S Software display window.

Example 2: Making a Batch Measurement Using SCPI Commands to Control the Signal Generator

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.

Step 1. Create a message box as shown in Step 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. This first command resets the signal generator. Type, "*RST" in the area where you typed the **Caption** information (in step 1 above). **Caption** now reads, **Command**.

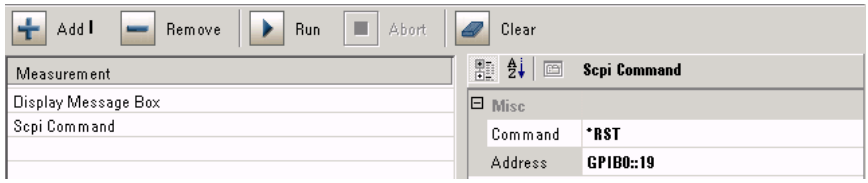
Step 3. In the Address area, type the address of your signal generator in one of the following formats:

Table 3-2

Connection	Format
GPIB	GPIB0::[address number]
LAN	TCPIP0::[hostname]
LAN	TCPIP0::[ip address]

In this example, the address is GPIB0::19.

Figure 3-8 Signal Generator Address



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 display.
Type the signal generator address in the address area.

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

Signal Generator Setting	SCPI Command
Power level = 0 dBm	POW:LEV:IMM:AMPL 0 DBM
RF = On	OUTP:STAT ON

Signal Generator Setting	SCPI Command
AM Depth = 10 %	AM1:DEPT 10 PCT
Turn AM On	AM1:STAT ON

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

Step 7. Create a "Done" message box as shown in Step 8 in Example 1 on page 54.

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 N5530S Software Program at any time.

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 takes the AM Depth measurement, returning the results to the display window.

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

Example 3: Loading Batch States and Exporting Measurement Results

Step 1. Using your PC mouse, select **Load Batch State...** from the **File** drop down menu.

Step 2. Browse to the folder which you saved the "AM Depth SCPI Meas" file from "Example 2: Making a Batch Measurement Using SCPI Commands to Control the Signal Generator" on page 56. Select it, then select **Open**. The program you created in Example 2 is now loaded and ready to run.

Step 3. Perform Step 9, 10, and 11 from Example 2, above. Now you are ready to export the measurement results.

Step 4. Export the data, by selecting **Export Results...** from the **File** drop down menu. Browse to the file location you wish to save the results. Name the file, "AM Depth Results". Close the dialogue box by selecting **Save**. These results can now be accessed by another software program.

4 Concepts

This chapter provides details about the N5530S Measuring Receiver System and explains how the various measurements are performed by the system. A list of related Agilent documents are referenced for further information.

What is the N5530S Measuring Receiver System?

This system provides precision traceable measurements of absolute and relative power for attenuator and signal generator calibration. It also provides modulation parameters for AM, FM, and PM performance tests to 26.5 GHz.

The N5530S System Software provides eight individual measurements.

- Frequency Counter
- AM Depth
- FM Deviation
- PM Deviation
- Modulation Rate
- Modulation Distortion
- RF Power
- Tuned RF Level

Also, included is a Batch Measurement Mode which enables you to setup and execute a group of individual measurements on a single DUT. This is useful when a combination of measurements are required repeatedly.

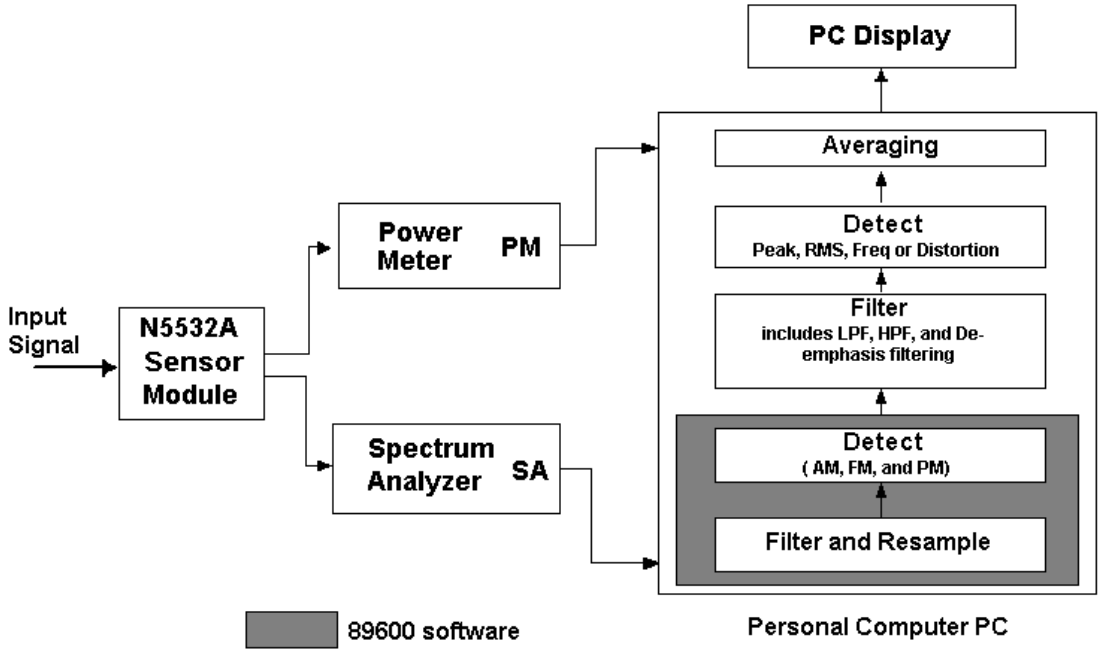
N5530S Block Diagram

A block diagram of the N5530S Measuring Receiver System (MRS) is shown below.

The system consists of:

1. N5532A Sensor Module (For specifications, refer to Table 1-3 on page 11.)
2. Power meter (EPM) (For specifications, refer to Table 1-2 on page 11.)
3. Spectrum analyzer (PSA) (For specifications, refer to Table 1-1 on page 11.)
4. Personal computer (PC) running the N5530S System Software (For specifications, refer to Table 1-4 on page 11 and Table 1-5 on page 11.)

Figure 4-1 N5530S Block Diagram



The N5532A Sensor Module receives the incoming signal from the DUT and splits it between the EPM and PSA. The RF Power measurement follows the path of the EPM, whereas all other measurements are performed using the PSA.

Measurement Theory

Refer to Figure 4-1, "N5530S Block Diagram," when studying this section.

Modulation Measurements

To make the modulation measurements, the N5530S software acquires the raw IQ data pairs from the PSA, which represent the IF signal. These pairs are then further processed by the N5530S software as described below.

Filter & Resample

This step helps reduce out of band noise and spurious signals for the purpose of presenting a clean signal for demodulation. This stage is performed by the Agilent 89600 software. Refer to the N5530S Block Diagram.

Demodulation (AM, FM, or PM)

The IQ data pairs are demodulated according to your selection of AM, FM, or PM as well as the low and high pass filters. The sample rate of the IQ data pairs are controlled by the IF Bandwidth and Bandwidth Mode coupled with the Low Pass (LP) Filter selection. The High Pass

(HP) Filter determines the measurement time.The output of this stage represents the baseband signal.

Post Demodulation Filtering

Filtering at this stage further reduces any out-of-band noise that still may be present in the signal. The parameters of this stage are determined by your selection of LP, HP, and FM De-emphasis Filters.

Detection

You determine the detection by selecting +Peak, -Peak, ± Peak/2, or RMS. All detectors except RMS, detect the many signal peaks in each given record. These peaks are averaged, then presented to the next stage. This stage ensures accurate, repeatable results. The RMS detector will measure the power contained in the baseband signal

Averaging

The detector results are then used to determine the average. The average type is selected via the user interface (or IVI- COM API). The available types are:

- **Normal**: Adds the values for each measurement and divides this number by the Count value.
- **Exponential**: Each successive data acquisition after the average count is reached is exponentially weighted and combined with the existing average. Exponential averaging weights new data more than old data, which facilitates tracking of slow-changing signals. The average will be displayed at the end of each measurement.
- **Peak Hold**: The maximum value detected during the measurement interval is displayed when this button is selected. It is ideal for detecting short modulation transients.

Average Count is an available function of this stage, letting you set a finite number of times you wish to repeat the measurement before the final average value is displayed. Intermediate results are shown for monitoring purposes, when averaging is set to a high value. You may also turn on Ratio which allows you to view the difference between the initial reading and each reading thereafter.

Display

The results are processed in the units selected and displayed. When using the IVI- COM API, the result is presented to the user software for further processing.

See also

Application Note 150: Spectrum Analysis Basics at www.agilent.com/find/an150

Application Note 150-1:Amplitude and Frequency Modulation

RF Power Measurement

This measurement is taken at the Power Meter, converted to the units you select, and displayed on your PC monitor or when using the IVI-COM API, the result is presented to the user software for further processing.

Refer to your particular Power Meter user's guide for detailed information about how power measurements are made.

See also

Application Note 1449: Fundamentals of RF Microwave Power Measurements

All Measurements Except RF Power

Data Acquisition from the PSA

For all measurements except RF Power, the PSA functions as a superheterodyne receiver. All incoming signals are converted down to an intermediate frequency (IF) of 21.4 MHz and then prepared for digitalization.

Frequency Counter and Tuned RF Level Measurements

The Frequency Counter and Tuned RF Level Measurements require the PSA to apply further digital signal processing (DSP) as shown in the two block diagrams below, to extract the frequency and power of the signal. This information is acquired by the N5530S software via GPIB and displayed on your PC.

Figure 4-2 Frequency Counter Measurement Block Diagram

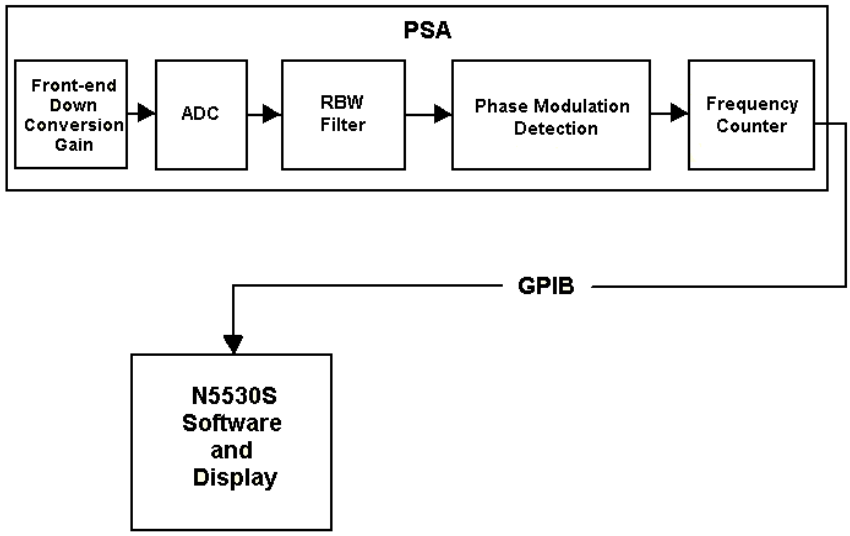
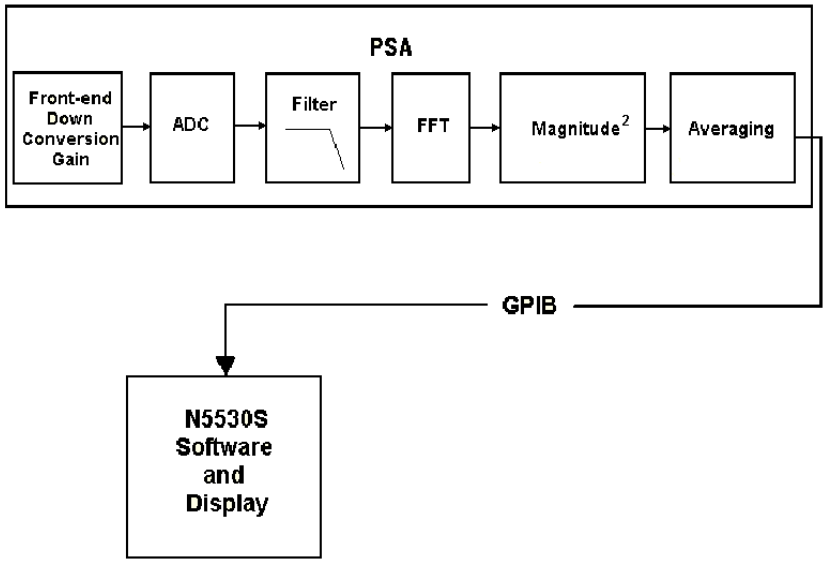


Figure 4-3 Tuned RF Level Measurement Block Diagram



5 Specifications

Definitions and Requirements

This chapter contains specifications and supplemental information for the N5530S measuring receiver system (comprised of a PSA spectrum analyzer, EPM or EPM-P power meter, N5532A sensor module and measurement software). The distinction among specifications and nominal values are described as follows.

Definitions

- Specifications describe the performance of parameters covered by the product warranty (temperature = 0 to 55 °C, unless otherwise noted).
- Typical describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80 % of the units exhibit with a 95 % confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

The following conditions must be met for the analyzer to meet its specifications.

PSA Conditions Required to Meet Specifications

- The test equipment is within its calibration cycle. See the General chapter.
- Under auto couple control, except that **Auto Sweep Time** = **Accy**
- For center frequencies <20 MHz, DC coupling applied.
- At least 2 hours of storage or operation at the operating temperature.
- The PSA has been turned on at least 30 minutes with Auto Align On selected, or, If **Auto Align Off** is selected, **Align All Now** must be run:
  - — Within the last 24 hours, and
  - — Any time the ambient temperature changes more than 3 °C, and
  - — After the analyzer has been at operating temperature at least 2 hours.

Software Conditions Required to Meet Specifications

— Auto coupled conditions

— RF Tuned Level using the “High Accuracy Mode”

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Measurements above 3 GHz

PSA Option 123 preselector bypass must be enabled to meet specifications above 3 GHz.

N5530S Measuring Receiver

This chapter contains specifications for the N5530S Measuring Receiver.

Frequency Modulation

Description	Specification	Supplemental Information
Input Power Range	–18 to +30 dBm	
Operating Rate Range		
100 kHz ≤ f_c < 10 MHz	20 Hz to 10 kHz	
10 MHz ≤ f_c < 26.5 GHz	50 Hz to 200 kHz	
Deviations		
100 kHz ≤ f_c < 10 MHz	40 kHz_{peak} maximum	
10 MHz ≤ f_c ≤ 26.5 GHz	400 kHz_{peak} maximum	
FM Accuracy		
Frequency Range / Rates / Deviations (peak) / β [a]		
250 kHz to 10 MHz / 20 Hz to 10 kHz / >200 Hz ≤40 kHz / >0.2	±2 % of reading	
10 MHz to 3 GHz / 20 Hz to 200 kHz / >200 Hz ≤400 kHz / >0.2	±2 % of reading	
10 MHz to 26.5 GHz / 20 Hz to 200 kHz / >250 Hz ≤400 kHz / >0.5	±5 % of reading	
Modulation Distortion Floor		See "Modulation Distortion" on page 73.

Description			Specification	Supplemental Information
AM Rejection				
Frequency Range	Rates	AM Depths		
150 kHz to 3 GHz	<1 kHz	≤50 %	<10 Hz peak deviation	
3 GHz to 6.6 GHz				<10 Hz
6.6 GHz to 13.2 GHz				<20 Hz
13.2 GHz to 26.5 GHz				<40 Hz
Residual FM (50 Hz to 3 kHz BW)				
Frequency				
150 kHz to 3 GHz			<1.5 Hz (rms)	
Detectors				Available: +peak, –peak, ±peak/2, peak hold, rms Not available: average (rms sinewave calibrated)

a. β is the ratio of frequency deviation to modulation rate (deviation/rate).

Amplitude Modulation

Description			Specification	Supplemental Information
Input Power Range			–18 to +30 dBm	
Operating Rate Range				
100 kHz ≤ f_c < 10 MHz			20 Hz to 10 kHz	
10 MHz ≤ f_c < 26.5 GHz			50 Hz to 100 kHz	
Depth Range			0 to 99 %	
AM Depth Accuracy[a]				
Frequency Range	Rates	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 %	±0.5 % of reading	
		5 to 20 %	±2.5 % of reading	
3 GHz to 26.5 GHz	50 Hz to 100 kHz	20 to 99 %	±1.5 % of reading	
		5 to 20 %	±4.5 % of reading	
Flatness[b]				
Frequency Range	Rates	Depths		
10 MHz to 3 GHz	90 Hz to 10 kHz	5 % to 99 %	±0.40 % of reading	
3 GHz to 26.5 GHz	90 Hz to 10 kHz	5 % to 99 %	±0.80 % of reading	
Modulation Distortion Floor				See "Modulation Distortion" on page 73.
FM Rejection (50 Hz to 3 kHz BW)				
Frequency Range	Rates	FM Deviations		
250 kHz to 10 MHz	400 Hz or 1 kHz	<5 kHz_{peak}	<0.13 % AM depth	
10 MHz to 26.5 GHz	400 Hz or 1 kHz	<50 kHz_{peak}	<0.18 % AM depth	

Description	Specification	Supplemental Information
Residual AM (50 Hz to 3 kHz BW)	<0.008 % (rms)	
Detectors		Available: +peak, –peak, ±peak/2, peak hold, rms Not available: average (rms sinewave calibrated)

a. For peak measurements 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.

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

Phase Modulation

Description		Specification	Supplemental Information
Input Power Range		–18 to +30 dBm	
Operating Rate Range		200 Hz to 20 kHz	
ΦM Accuracy			
Frequency range	Deviations		
100 kHz to 6.6 GHz	>0.7 rad >0.3 rad	±1 % of reading ±3 % of reading	
6.6 GHz to 13.2 GHz	>2.0 rad >0.6 rad	±1 % of reading ±3 % of reading	
13.2 GHz to 26.5 GHz	>4.0 rad >1.2 rad	±1 % of reading ±3 % of reading	
Maximum Deviation		4,000 radians	
Modulation Distortion Floor			See "Modulation Distortion" on page 73.
AM Rejection			
For 50 % AM at 1 kHz rate		<0.03 radians peak	50 Hz to 3 kHz BW
Detectors			Available: +peak, –peak, ±peak/2, peak hold, rms Not available: average (rms sinewave calibrated)

Modulation Reference

Description	Specification	Supplemental Information
AM Calibrator Depth and Accuracy		Not Applicable
FM Calibrator Deviation and Accuracy		Not Applicable

Modulation Frequency Counter[1]

Description	Specification	Supplemental Information
Operating Rate Range		
100 kHz ≤ f_c < 10 MHz	20 Hz to 10 kHz	
10 MHz ≤ f_c < 26.5 GHz	20 Hz to 300 kHz	
Accuracy (for demodulated signals)		
Modulation (peak)		
AM Depth ≥ 0.2 %, Deviation ≤ 400 kHz	± (0.02 Hz + Internal Reference Accuracy)	
FM β^a ≥ 0.01, Deviation ≤ 400 kHz	± (0.02 Hz + Internal Reference Accuracy)	
ΦM 0.01 radians < Phase Deviation <200 kHz/rate	± (0.02 Hz + Internal Reference Accuracy)	
Accuracy (for external signals)		See Frequency Counter section
Displayed Resolution	1 mHz	
Measurement Rate		2 readings/second
Counting Technique		FFT
Audio Input Impedance		Not applicable

a. β is the ratio of frequency deviation to modulation rate (deviation/rate).

1. With 20 Hz high pass filter

Modulation Distortion

Description		Specification	Supplemental Information
Fundamental Frequencies		200 Hz to 300 kHz	Using 50 Hz HP filter
Display Range		0.01 % to 100 % (–80 to 0 dB)	
Display Resolution		0.01 % (0.01 dB)	
Accuracy[a]		±0.2 dB of reading	
Sensitivity			
Modulation			See “Residual Noise and Distortion” section for minimum modulation levels.
External			Not applicable
Residual Noise and Distortion			
AM			
Depth	Center Frequency		
≥3 %	1 MHz to 10 MHz 10 MHz to 26.5 GHz	<0.25 % <0.35 %	rate = 1 kHz or 400 Hz, HP = 50 Hz, LP = 3 kHz
≥1 %	1 MHz to 10 MHz 10 MHz to 26.5 GHz	<0.75 % <1.0 %	
ΦM			
Deviation	Center Frequency		
≥0.4 rad ≥1.2 rad	1 MHz to 6.6 GHz	<0.3 % <0.1 %	rate = 1 kHz, HP = 300 Hz, LP = 3 kHz
≥0.8 rad ≥2.2 rad	6.6 GHz to 13.2 GHz	<0.3 % <0.1 %	
≥1.5 rad ≥4.5 rad	13.2 GHz to 26.5 GHz	<0.3 % <0.1 %	
≥1.0 rad ≥3.0 rad	1 MHz to 6.6 GHz	<0.3 % <0.1 %	rate = 400 Hz, HP = 50 Hz, LP = 3 kHz
≥2.0 rad ≥6.0 rad	6.6 GHz to 13.2 GHz	<0.3 % <0.1 %	
≥4.0 rad ≥10.0 rad	13.2 GHz to 26.5 GHz	<0.3 % <0.1 %	

Description		Specification	Supplemental Information
FM			
Deviation	Center Frequency		
≥400 Hz ≥1.2 kHz	1 MHz to 6.6 GHz	<0.3 % <0.1 %	rate = 1 kHz
≥800 Hz ≥2.5 kHz	6.6 GHz to 13.2 GHz	<0.3 % <0.1 %	
≥1.5 kHz ≥5.0 kHz	13.2 GHz to 26.5 GHz	<0.3 % <0.1 %	
≥600 Hz ≥2.0 kHz	1 MHz to 6.6 GHz	<0.3 % <0.1 %	rate = 400 Hz
≥1.4 kHz ≥3.5 kHz	6.6 GHz to 13.2 GHz	<0.3 % <0.1 %	
≥2.5 kHz ≥7.0 kHz	13.2 GHz to 26.5 GHz	<0.3 % <0.1 %	

a. Measured distortion must be greater than 3 % for the accuracy specification to apply. For distortions less than 3 %, the noise floor of the analyzer will begin to affect the accuracy of the measurement.

Modulation Filters

Description	Specification	Supplemental Information
De-Emphasis filters	25 µs, 50µs, 75 µs, and 750 µs	De-emphasis filters are single-pole, low-pass filters with nominal –3 dB frequencies of: 6366 Hz for 25 µs, 3183 Hz for 50 µs, 2122 Hz for 75 µs, and 212 Hz for 750 µs.
50 Hz High-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≥50 Hz	
300 Hz High-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≥300 Hz	
3 kHz Low-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≤3,000 Hz	

Description	Specification	Supplemental Information
15 kHz Low-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≤15,000 Hz	
30 kHz Low-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≤30,000 Hz	
300 kHz Low-Pass Filter		
Flatness	<±0.086dB (±1 %) at ≤30,0000 Hz	
De-Emphasis filter time constant accuracy		Not applicable: See deviation from ideal filter specification
Deviation from ideal filter[a]	<0.4 dB < 3 Degrees	Applicable to 25 µs, 50 µs, and 75 µs filters
High pass and low pass filter –3 dB cutoff frequency		Not applicable: digitally implemented
>20 kHz low pass filter –3 dB cutoff frequency		Not applicable: digitally implemented
Overshoot on square wave modulation		Not applicable

a. With 3 kHz Low-Pass Filter and IFBwMode set to “minimal”.

Frequency Counter

Description	Specification	Supplemental Information
Range	3 Hz to 26.5 GHz	
Sensitivity[a]		
10 kHz ≤ f_c < 100 kHz	1.0 mV_{rms} (–47 dBm)	
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)	
Maximum Resolution	0.001 Hz	
Accuracy	± (readout freq. × freq. ref. Accy + 0.100 Hz)	

Description	Specification	Supplemental Information
Modes		Frequency Error Mode is not available.
Sensitivity in Manual Tuning Mode		Using manual ranging and changing RBW settings in the Advanced Mode, sensitivity can be increased to approximately –100 dBm

a. Instrument condition: RBW ≤ 1 kHz

Internal Time Base Reference (PSA Series Specifications)

Description	Specification	Supplemental Information
Frequency Reference	10 MHz	
Accuracy	± [(time since last adjustment × aging rate) + temperature stability +calibration accuracy[a]]	
Temperature Stability		
20 to 30 °C	$\pm 1\times10^{-8}$	
0 to 55 °C	$\pm 5\times10^{-8}$	
Aging Rate	$\pm 1\times10^{-7}$/year[b]	$\pm 5\times10^{-10}$/day (nominal)
Settability	$\pm 2\times10^{-9}$	
Warm-up and Retrace[c]		
300 s after turn on		$\pm 1\times10^{-7}$ of final frequency (nominal)
900 s after turn on		$\pm 5\times10^{-8}$ of final frequency (nominal)
Achievable Initial Calibration Accuracy[d]		
Line Voltage Effects		Negligible
Short-Term Stability		Negligible

a. Calibration accuracy depends on how accurately the frequency standard was adjusted to 10 MHz. If the calibration procedure is followed, the calibration accuracy is given by the specification “Achievable Initial Calibration Accuracy”

b. For periods of one year or more.

c. Applies only when power is disconnected from instrument. Does not apply when instrument is in standby mode.

d. The achievable calibration accuracy at the beginning of the calibration cycle includes these effects:
1. The temperature difference between the calibration environment and the use environment
2. The orientation relative to the gravitation field changing between the calibration environment and the use environment
3. Retrace effects in both the calibration environment and the use environment due to unplugging the instrument
4. Settability

RF Power[12]

The Agilent N5530S measuring receiver system with the N5532A sensor modules performs RF power measurements from –20 dBm (10 µW) to +30 dBm (1 W). The N5530S must be used with Agilent power meters (E4416A, E4417A, E4418B and E4419B).

Description	Specification	Supplemental Information
RF Power Accuracy[a]		
+20 to +30 dBm		
100 kHz ≤ f_c ≤ 3 GHz [b]	±0.319 dB	±0.163 dB (Typical)
3 GHz < f_c ≤ 18 GHz [c d]	±0.332 dB	±0.170 dB (Typical)
18 GHz < f_c ≤ 26.5 GHz [d]	±0.341 dB	±0.174 dB (Typical)
–10 to +20 dBm		
100 kHz ≤ f_c ≤ 3 GHz[b]	±0.124 dB	±0.063 dB (Typical)
3 GHz < f_c ≤ 18 GHz [c d]	±0.156 dB	±0.079 dB (Typical)
18 GHz < f_c ≤ 26.5 GHz [d]	±0.176 dB	±0.089 dB (Typical)
RF Power Resolution		
Display resolution	0.001 dB	
Instrumentation Accuracy		
Logarithmic	±0.02 dB	
Linear	±0.5 %	
RF range-to-range change error		RF range-to-range change error does not apply.
Input SWR		
N5532A *Option 504*		
100 kHz to 2 GHz	<1.10:1 (ρ < 0.048)	
2 GHz to 4.2 GHz	<1.28:1 (ρ < 0.123)	
N5532A *Option 518*		

1. For latest specification updates refer to E4416A, E4417A, E4418B and E4419B power meter User's Guides.
2. These specifications are valid when the N5530S input is a CW tone.

Description	Specification	Supplemental Information
10 MHz to 2 GHz	<1.10:1 (ρ < 0.048)	
2 GHz to 18 GHz	<1.28:1 (ρ < 0.123)	
N5532A *Option 526*		
30 MHz to 2 GHz	<1.10:1 (ρ < 0.048)	
2 GHz to 18 GHz	<1.28:1 (ρ < 0.123)	
18 GHz to 26.5 GHz	<1.40:1 (ρ < 0.167)	
Zero Set (digital settability of zero)	±50 nW	
N5532A *Options 504, 518, and 526*		
Zero Drift of Meter		Zero drift of meter does not apply.
Noise[e]	<110 nW	
N5532A *Options 504, 518, and 526*		
Zero Drift of Sensors (1 hour, at constant temperature after 24 hour warm-up)	<±10 nW	
N5532A *Options 504, 518, and 526*		
RF Power Ranges of N5530S 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 × number of averages (nominal)
Displayed Units	Watts, dBm, or Volts	

a. The N5530S RF Power Accuracy is derived from the EPM/EPM-P power meter accuracy. The parameters listed in this section are components used to calculate the RF Power Accuracy. Application Note 1449-3 (P/N 5988-9215EN) explains how the components are combined to derive an overall accuracy number. The resulting calculation yields ±0.076 to 0.124 dB when measuring a +20 dBm signal and ignoring DUT mismatch. Assuming 1.5:1 DUT SWR, the calculation would return a typical accuracy of ±0.106 dB to ±0.331 dB (depending on the frequency range and power under test). Absolute and relative accuracy specifications do not include mismatch uncertainty.

b. Using N5532A *Option 504* sensor module (Refer to N5532A frequency range).

c. Using N5532A *Option 518* sensor module (Refer to N5532A frequency range).

d. Using N5532A *Option 526* sensor module (Refer to N5532A frequency range).

e. 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.

Power Reference (EPM and EPM-P Specifications)

Description	Specification	Supplemental Information
Power Output		Power output is traceable to the U.S. National Institute of Standards and Technology (NIST) and National Physical Laboratories (NPL), UK.
E4416A/E4417A	1.00 mW (0.0 dBm). Factory set to ±0.5 %	
E4418B/E4419B	1.00 mW (0.0 dBm). Factory set to ±0.7 %	
Accuracy		
E4416A/E4417A	±1.2 % for one year, 0 to 55 °C	
E4418B/E4419B	±1.2 % (±0.9 % rss) for one year, 0 to 55 °C	
Frequency		50 MHz (nominal)
SWR		
E4416A/E4417A		<1.06:1 (nominal)
E4418B/E4419B		<1.05:1 (nominal)
Front Panel Connector		Type N (f), 50 Ω

Tuned RF Level[12]

Description	Specification	Supplemental Information
Power Range		
RBW: 75 Hz		
500 kHz[a] to 3.05 GHz		
Without Preamp	–113 dBm to +30 dBm	
With Preamp (PSA Option 1DS)	–129 dBm to +16 dBm	
3.05 GHz to 6.6 GHz	–113 dBm to +30 dBm	
6.6 GHz to 13.2 GHz	–104 dBm to +30 dBm	
13.2 GHz to 19.2 GHz	–93 dBm to +30 dBm	
19.2 GHz to 26.5 GHz	–85 dBm to +30 dBm	
Operating Frequency Range	100 kHz[a] to 3 GHz	
With Option 123	3 GHz to 26.5 GHz	
Displayed Resolution	6 digits in watts or 5 digits in volts mode 0.001 dB in dBm or dB (relative) mode	
Absolute Measurement Accuracy[b] RBW: 75 Hz, Operating Temperature: 20 to 30 °C Range Frequency range: 500 kHz[a] to 3.05 GHz		"Absolute Measurement Accuracy" specifications are based on the 75 Hz RBW. Changing the RBW will alter the minimum measurable tuned RF level.
+20 dBm to +30 dBm	±(0.319 dB + 0.005 dB/10 dB step)	±(0.172 dB + 0.003 dB/10 dB step) (Typical)
–90 dBm to +20 dBm	±(0.124 dB + 0.005 dB/10 dB step)	±(0.072 dB + 0.003 dB/10 dB step) (Typical)
–113 dBm to –90.001 dBm Without Preamp	±(cumulative error[c] + 0.120 dB/10 dB step)	
–106 dBm to +16 dBm With Preamp *(PSA Option 1DS)*	±(0.124 dB + 0.005 dB/10 dB step)	±(0.072 dB + 0.003 dB/10 dB step) (Typical)

1. PSA Option 123 is required to perform "Tuned RF Level" measurements above 3 GHz
2. These specifications are valid when the N5530S input is a CW tone.

Description	Specification	Supplemental Information
–129.001 dBm to –106.001 dBm With Preamp *(PSA Option 1DS)*	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 3.05 GHz to 6.6 GHz		
+20 dBm to +30 dBm	±(0.332 dB + 0.005 dB/10 dB step)	±(0.179 dB + 0.003 dB/10 dB step) (Typical)
–90 dBm to +20 dBm	±(0.156 dB + 0.005 dB/10 dB step)	±(0.088 dB + 0.003 dB/10 dB step) (Typical)
–114 dBm to -90.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 6.6 GHz to 13.2 GHz		
+20 dBm to +30 dBm	±(0.332 dB + 0.005 dB/10 dB step)	±(0.179 dB + 0.003 dB/10 dB step) (Typical)
–81 dBm to +20 dBm	±(0.156 dB + 0.005 dB/10 dB step)	±(0.088 dB + 0.003 dB/10 dB step) (Typical)
–104 dBm to -81.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 13.2 GHz to 19.2 GHz		
+20 dBm to +30 dBm	±(0.341 dB + 0.005 dB/10 dB step)	±(0.185 dB + 0.003 dB/10 dB step) (Typical)
–70 dBm to +20 dBm	±(0.176 dB + 0.005 dB/10 dB step)	±(0.098 dB + 0.003 dB/10 dB step) (Typical)
–93 dBm to –70.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 19.2 GHz to 26.5 GHz		
+20 dBm to +30 dBm	±(0.341 dB + 0.005 dB/10 dB step)	±(0.185 dB + 0.003 dB/10 dB step) (Typical)
–62 dBm to +20 dBm	±(0.176 dB + 0.005 dB/10 dB step)	±(0.098 dB + 0.003 dB/10 dB step) (Typical)
–85 dBm to –62.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	

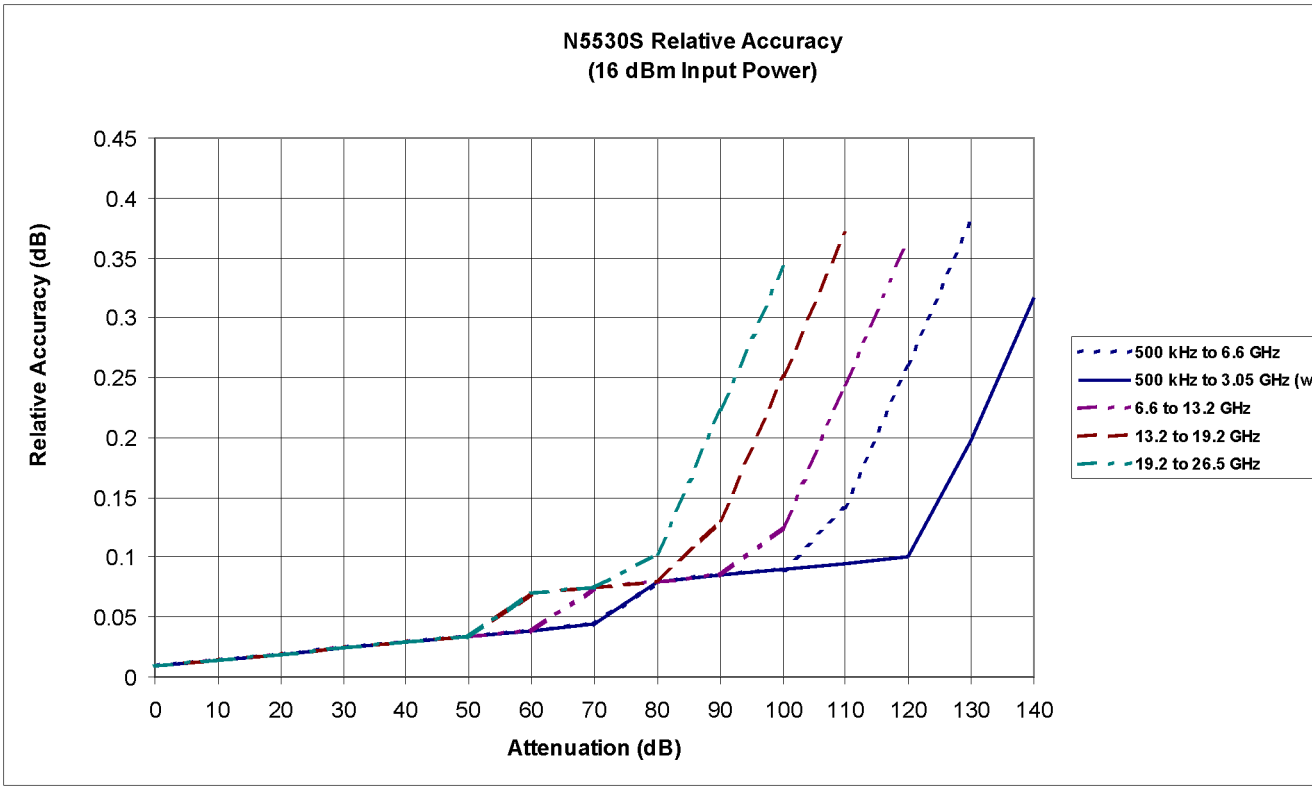
Description	Specification	Supplemental Information
Range 2 Error[d]	±0.031 dB	
Relative Measurement Accuracy[e]		"Relative Measurement Accuracy" specifications are based on the 75 Hz RBW. Changing the RBW will alter the minimum measurable tuned RF level.
RBW: 75 Hz, Operating Temperature: 20 to 30 °C Range		
Frequency range: 500 kHz[f] to 3.05 GHz		
–90 dBm to +30 dBm	±(0.009 dB + 0.005 dB/10 dB step)	
–114 dBm to –90.001 dBm Without Preamp	±(cumulative error[c] + 0.120 dB/10 dB step)	
–129 dBm to –106.001 dBm With Preamp *(PSA Option 1DS)*	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 3.05 GHz to 6.6 GHz		
–90 dBm to +30 dBm	±(0.009 dB + 0.005 dB/10 dB step)	
–114 dBm to –90.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 6.6 GHz to 13.2 GHz		
–81 dBm to +30 dBm	±(0.009 dB + 0.005 dB/10 dB step)	
–104 dBm to –81.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 13.2 GHz to 19.2 GHz		
–70 dBm to +30 dBm	+(0.009 dB + 0.005 dB/10 dB step)	
–93 dBm to –70.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Frequency range: 19.2 GHz to 26.5 GHz		
–62 dBm to +30 dBm	±(0.009 dB + 0.005 dB/10 dB step)	
–85 dBm to –62.001 dBm	±(cumulative error[c] + 0.120 dB/10 dB step)	
Input SWR	See "RF Power" Section	

Description	Specification	Supplemental Information
Measurement Time		<3 seconds for 25 averages (based on default 75 Hz RBW), nominal. <92 seconds for 900 averages (based on default 75 Hz RBW), nominal
IF Frequency		Not applicable
Acquisition Time		Not applicable
Response Time (responding to changes in level of an acquired signal)		Not applicable
Displayed Units		
Absolute		Watts, dBm, or Volts
Relative		Percent or dB

a. Using N5532A *Option 504* sensor module (Refer to N5532A frequency ranges)
b. Absolute and relative accuracy specifications do not include mismatch uncertainty.
c. Cumulative error is the sum of the error incurred when stepping from a higher amplitude level to the amplitude where 0.120/10 dB step occurs. For example, if the –90 dBm to +20 dBm specification is ±(0.124 dB + 0.005 dB/10 dB step) and the starting power is 0 dBm, then the cumulative error would be ±(0.124 dB + 9×0.005 dB), or ±0.169 dB.
d. Add this specification when the N5530S Measuring Receiver Software enters the "Range 2" state. Range 2 is entered when the measured SNR of the signal is 33 dB or less. A user can typically see that the software is in this state by examining the PSA's input attenuator. When the attenuator is set to 8 dB, then the Range 2 state has been entered. This will usually happen around these input power levels:

500 kHz to 6.6 GHz:	–63 dBm
6.6 GHz to 13.2 GHz:	–52 dBm
13.2 GHz to 19.2 GHz:	–43 dBm
19.2 GHz to 26.5 GHz:	–37 dBm

e. Using N5532A *Option 526* sensor module (Refer to N5532A frequency ranges)
f. Using N5532A *Option 504* sensor module (Refer to N5532A frequency ranges)



Above is an example of the N5530S relative accuracy at different frequency breaks when testing a 10 dB step attenuator.

RF Input

Description	Specification	Supplemental Information
Frequency Range	100 kHz to 26.5 GHz	
Maximum Operating Level	7 V_{rms} (1 W_{peak} or +30 dBm)	
Maximum Safe DC Input Level		+0.4 V
Tuning		
Normal Mode		Automatic and manual frequency entry.
Track Mode		Automatic and manual frequency entry, f_c > 10 MHz
Acquisition Time (automatic operation)		Not applicable
Input Impedance		50 Ω (nominal)

General Specifications

Description	Specification	Supplemental Information
Temperature		
Operating	0 to 55 °C	
Storage	–40 to 70 °C	
Remote Operation		IVI-COM API remote interface
EMI Compatibility		
Conducted Emissions	Compliant to CISPR Pub. 11:1997+A1 :1999+A2 :2002	
Radiated Emissions	Compliant to CISPR Pub. 11:1997+A1 :1999+A2 :2002	
Power		100 to 132V, 50 to 66 Hz; or 360 to 440 Hz; 195 to 240 V; 50 to 66 Hz E4416A/17A/18B/19B: <14 W E4440A/43A/45A: <450 W[a]
Weight		
E4440A/43A/45A		23 kg (50 lb) nominal[b]
E4416A/17A/18B/19B		4 kg (9 lb) nominal
N5532A *(Options 504/518/526)*		0.72 kg (1.5 lb) nominal
Dimensions		
E4440A/43A/45A		177 mm (H) × 426 mm (W) × 483 mm (D)
E4416A/17A/18B/19B		88.5 mm (H) × 212.6 mm (W) × 348.3 mm (D)
N5532A *(Options 504/518/526)*		51.2 mm (H) × 62.4 mm (W) × 210 mm (D)[c]

a. 450 watts is the maximum power consumption with all options installed. With no options installed maximum power consumption is less than 260 watts.
b. Without options.

c. Dimensions of sensor module body only. It does not include the length of the cables. See the N5532A specifications chapter for more detail.

N5530S Rear Panel Inputs/Outputs

Description	Specification	Supplemental Information
10 MHz Reference Output (PSA)		Switchable On/Off
Connector	BNC female	
Impedance		50 Ω (nominal)
Output Amplitude		≥ 0 dBm (nominal)
Frequency	10 MHz ± (10 MHz × frequency reference accuracy)	
10 MHz Reference Input (PSA)[a]		Note: PSA noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Connector	BNC female	
Impedance		50 Ω (nominal)
Input Amplitude Range		–5 to +10 dBm (nominal)
Input Frequency		1 to 30 MHz (nominal) (selectable to 1 Hz resolution)
Lock Range	$\pm 5 \times 10^{-6}$ of selected external reference input frequency	
LO Input		Not required
Frequency Offset Mode Remote Control Output		Not required

a. External reference accuracy affects accuracy of all measurements.

N5532A Sensor Module

This chapter contains specifications for the N5532A Sensor Module Options 504, 518 and 526.

Specifications

Description	Specification	Supplemental Information
Frequency Range		
Option 504	100 kHz to 4.2 GHz	
Option 518	10 MHz to 18 GHz	
Option 526	30 MHz to 26.5 GHz	
Power Range	+30 dBm (1 W) to –20 dBm (10 µW)	
Maximum Safe Input Power	+30 dBm	Average total power
Input SWR		
RF Power[a]		
(Option 504)		
100 kHz to 2 GHz	< 1.10:1	
2 GHz to 4.2 GHz	< 1.28:1	
(Option 518)		
10 MHz to 2 GHz	< 1.10:1	
2 GHz to 18 GHz	< 1.28:1	
(Option 526)		
30 MHz to 2 GHz	< 1.10:1	
2 GHz to 18 GHz	< 1.28:1	
18 GHz to 26.5 GHz	< 1.40:1	
Power Sensor Linearity		
Option 504		
+30 to +20 dBm	+2 % to –4 %	
< +20 dBm	negligible	

Description	Specification	Supplemental Information
Option 518		
+30 to +20 dBm	+2 % to –4 %	
< +20 dBm	negligible	
Option 526		
+30 to +20 dBm	+2 % to –4 %	
< +20 dBm	negligible	
Calibration Factors		Each sensor module is individually calibrated. The calibration factors can be loaded from the 3.5” floppy disk included with the power sensor module.

a. When connected to PSA with maximum attenuation.

General

Description	Specification	Supplemental Information
Input Impedance		50 Ω (nominal)
Input Connector		
Option 504	Type N male	
Option 518	Type N male	
Option 526	APC 3.5 mm male	
Weight		
Net		0.72 kg (1.5 lb)
Shipping		1.28 kg (2.8 lb)
Dimensions		
Sensor Module Body		51.2 mm (2 in) H × 62.4 mm (2.5 in) W × 210 mm (8.3 in) D
Length of Sensor Module Cable		1,653 mm (65 in)
Calibration Cycle	1 year	

Description	Specification	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	
Storage	–40 to 70 °C	
Altitude		
Operating	4,600 meters (approx. 15,000 feet)	
Storage	7,600 meters (approx. 25,000 feet)	
Military Specification	Type tested to the equivalent of MIL-PRF-28800F class 3	
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 61000-4-3/1995.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 61000-4-2/1995.