Agilent N4985A System Amplifiers

Operating and Service Manual

Agilent Technologies

Notices

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Contents

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1 Introduction

This chapter provides an overview of the N4985A Amplifiers.

Product Overview

High Performance Broadband RF Amplifier

The N4985A-S30 and N4985A-S50 system amplifiers are high performance, broadband amplifiers featuring baseband RF (<100 kHz) through millimeter wave frequency coverage. These amplifiers, which have many uses in research, development, or production-line environment, are a useful addition to the laboratory where RF, microwave, or millimeter wave measurements are made. Typical applications include:

- RF Source Amplifier.
- Mixer LO Amplifier.
- Noise Figure LNA and Noise Figure System Amplifier.
- Pulse Amplifier and time domain applications.
- Digital communication systems.
- Antenna research and development.
- General purpose RF gain block.

N4985A-S30 Amplifier

N4985A-S50 Amplifier

Figure 1-1 Agilent N4985A-S30/S50 amplifier

High Performance System Amplifier

The N4985A-P15 and N4985A-P25 are high performance, broadband amplifiers with excellent power and gain up to 50 GHz, which have many uses in research, development, or production-line environment. These amplifiers are a useful addition to the laboratory where RF, microwave, or millimeter wave measurements are made. Typical applications include:

- Driver for high power amplifiers such as TWT or linear power amplifiers.
- Overcome system losses such as long transmission lines, power dividers, etc.
- Antenna research and development; antenna characterization systems.
- Broadband RF characterization.

N4985A-P15 Amplifier

N4985A-P25 Amplifier

Figure 1-2 Agilent N4985A-P15/P25 amplifier

Features of the Agilent N4985A Amplifiers

The N4985A is a high performance amplifier featuring broadband frequency coverage.

Model	Frequency Range	Gain
N4985A-S30	100 kHz to 30 GHz	30 dB
N4985A-S50	100 kHz to 50 GHz	30 dB
N4985A-P15	10 MHz to 50 GHz	25 dB
N4985A-P25	2 GHz to 50 GHz	27 dB

N4985A-S30 and N4985A-S50

- The amplifier is designed to be a multi-use laboratory RF amplifier as a gain block for frequency domain applications or as a time domain pulse amplifier.
- The amplifier's small size and versatile performance make it an excellent selection as a general purpose gain block with moderate power output in a single package potentially replacing two or three narrower band amplifiers.

N4985A-P15 and N4985A-P25

- The amplifier is designed to be easily used in laboratory and test applications.
- It is small in size and has built-in bias power supplies allowing close placement to the measurement or source reference plane. Its high gain helps to compensate for system losses such as long transmission lines and system components.

Applications

The N4985A-S30 and N4985A-S50 system amplifiers are an often needed companion to synthesized signal generators and microwave sources. The small size of the amplifiers allows close placement to the DUT or test fixture. High gain and greater than 20 dBm output power will overcome long cable losses from the signal source and provide the additional output power needed in many development and test applications.

The N4985A-P15 and N4985A-P25 are test amplifiers designed for broadband power and gain applications. It is ideally suited for saturated RF amplifier testing, driving TWT amplifiers, or as an antenna system amplifier. High gain and typically 22 dBm output power at 50 GHz will overcome long cable losses from the signal source, and will provide additional power required in many development and test applications.

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2 Installation

This chapter provides you important information on how to check and prepare your instrument for operation.

Initial Inspection

1. Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically. Check for mechanical damage such as scratches or dents. Procedures for checking electrical performance are given under “Performance Verification" on page 40.
2. If the contents are damaged or defective, contact your nearest Agilent Technologies Service and Support Office. Refer to “Contacting Agilent’’ in the front matter of this manual. Agilent Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
3. If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and materials or their equivalents. Agilent Technologies can provide packaging materials identical to the original materials. Refer to “Contacting Agilent’’ in the front matter of this manual for the Agilent Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container ***FRAGILE*** to insure careful handling. In any correspondence, refer to the instrument by its model number and serial number.

Service and Recalibration

If your N4985A amplifiers require service or repair, contact the nearest Agilent office for information on where to send it. Refer to "Contacting Agilent" in the front matter of this manual. The performance of the N4985A can only be verified by specially-manufactured equipment and calibration standards from Agilent. The recommended interval for recalibration is 12 months.

Related Documentation

This Operating and Service Manual is shipped with the product. It is also available at http://www.agilent.com/find/N4985A.

Operating and Safety Precautions

Observe the following guidelines before connecting or operating the N4985A System Amplifiers.

ESD Damage

Protection against electrostatic discharge (ESD) is important while handling and operating the N4985A.

Static electricity can build up on your body and can easily damage sensitive components when discharged.

Static discharges too small to be felt can cause permanent damage to the unit.

To prevent damage from ESD:

- ***Use*** a grounded antistatic mat in front of your test equipment and wear a grounded wrist strap attached to it when handling or operating the N4985A.
- ***Wear*** a heel strap when working in an area with a conductive floor.
- ***Ground*** yourself before you clean, inspect, or make a connection to the N4985A. You can, for example, grasp the grounded outer shell of the analyzer test port or cable connector briefly.
- ***Avoid*** touching the exposed connector pins.

Connector Care

Because connectors can become defective due to wear during normal use, all connectors should be inspected and maintained to maximize their service life.

- Inspect the mating surface each time a connection is made. Metal particles from connector threads often find their way onto the mating surface when a connection is made or disconnected.
- Clean dirt and contamination from the connector mating surface and threads. This simple step can extend the service life of the connector and improve the quality of your calibration and measurements.
- Gage connectors periodically. This not only provides assurance of proper mechanical tolerances and thus connector performance, but can also indicate situations where the potential for damage to another connector may exist.

CAUTION The N4985A can be damaged if excessive torque is applied to the connectors.

The recommended torque value is 8 lb-in torque for 2.4 mm and 2.92 mm, 5 lb-in torque for 1.85 mm DCA sampling head.

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3 Specifications

This chapter provides the specifications of the N4985A Amplifiers.

General Specifications

Specifications

Specifications refer to the performance standards or limits against which the N4985A is tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as "typical", "nominal", or "approximate", and are printed in italic.

Table 3-1 N4985A-S30 and N4985A-S50 specifications

Model	Agilent N4985A-S30		Agilent N4985A-S50	
Frequency	100 kHz to 30 GHz		100 kHz to 50 GHz	
Gain (dB)	30 dB		30 dB	
Small signal gain	27 (min), 30 (typ)	1 GHz to 26 GHz	27 (min), 30 (typ)	1 GHz to 26 GHz
			24 (min), 27 (typ)	26 GHz to 45 GHz
Output power (at P_{sat}) (dB)	20 (min), 22 (typ)	100 kHz to 26 GHz	20 (min), 22 (typ)	100 kHz to 26 GHz
			20 (typ)	26 GHz to 40 GHz
			17 (typ)	40 GHz to 50 GHz
Input match S_{11} (dB)	–10 (typ)	1 GHz to 26 GHz	–10 (typ)	1 GHz to 26 GHz
			–8 (typ)	26 GHz to 45 GHz
Output match S_{22} (dB)	–10 (typ)	1 GHz to 26 GHz	–10 (typ)	1 GHz to 26 GHz
			–8 (typ)	26 GHz to 45 GHz
Noise figure (dBm)	5 (typ)	2 GHz to 30 GHz	5 (typ)	2 GHz to 3 GHz
			6 (typ)	30 GHz to 40 GHz
2nd harmonics H_2 (dBc) @P_1	–30 (typ)	2 GHz to 25 GHz	–30 (typ)	2 GHz to 25 GHz

Table 3-2 Additional specifications for N4985A-0A3

	Description	Minimum	Typical	Maximum
S21 (V)	Output eye amplitude	7	7.5	—
	Input eye amplitude	—	0.5	—
S21 (ps)	Jitter additive (rms)	—	< 0.5	< 1
Tr/Tf (ps)	Rise/fall time	—	< 8	< 10

Table 3-3 Additional specifications for N4985A-0A5

	Description	Minimum	Typical	Maximum
S21 (V)	Output eye amplitude	7	7.5	—
	Input eye amplitude	—	0.5	—
S21 (ps)	Jitter additive (rms)	—	< 0.5	< 1
Tr/Tf (ps)	Rise/fall time	—	< 8	< 10

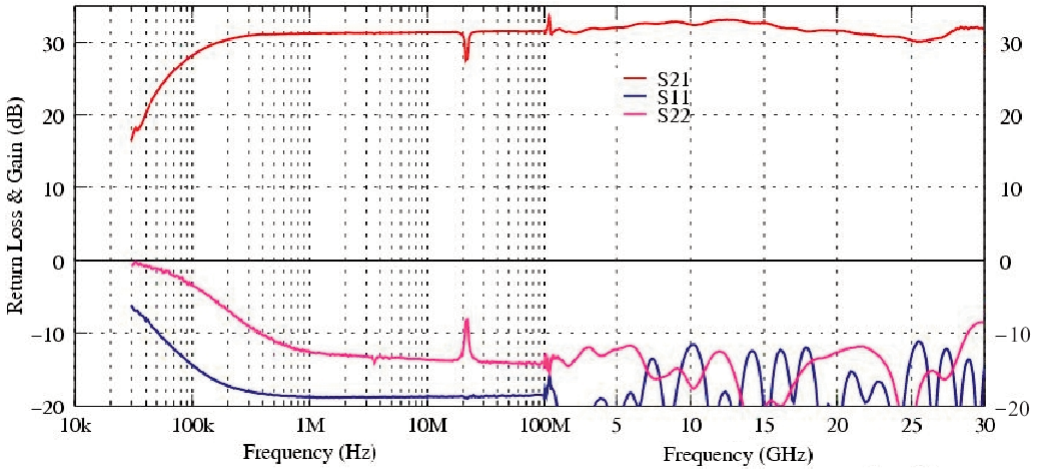

Figure 3-1 Small signal parameters versus frequency (for N4985A-S30)

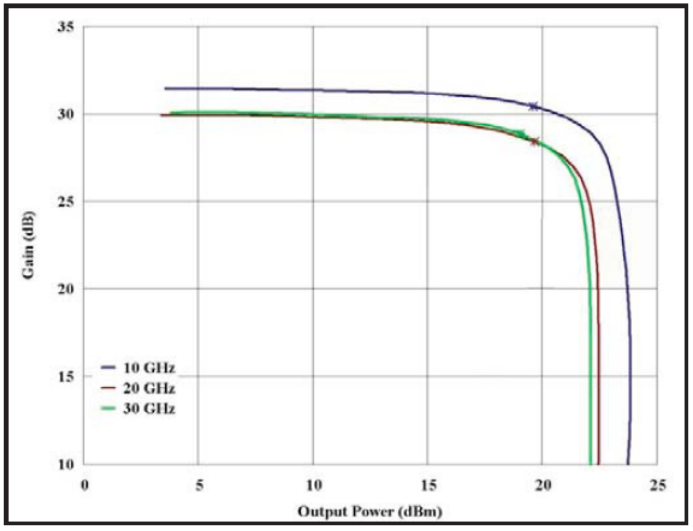

Figure 3-2 Gain versus output power (P_{1dB} indicated with *) [for N4985A-S30]

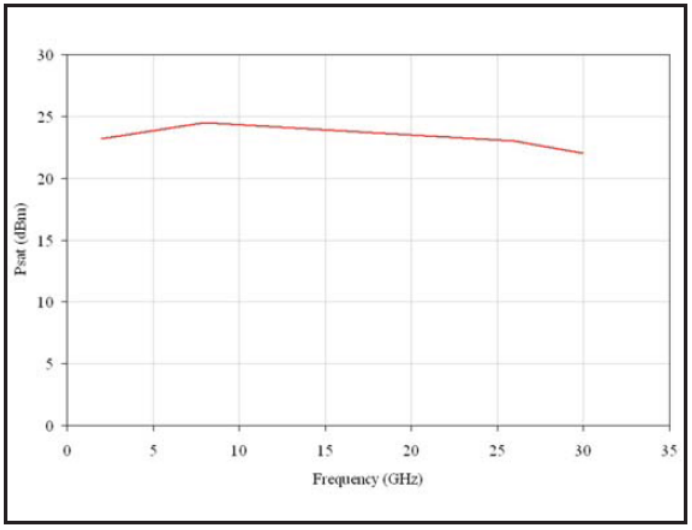

Figure 3-3 Saturated output power (for N4985A-S30)

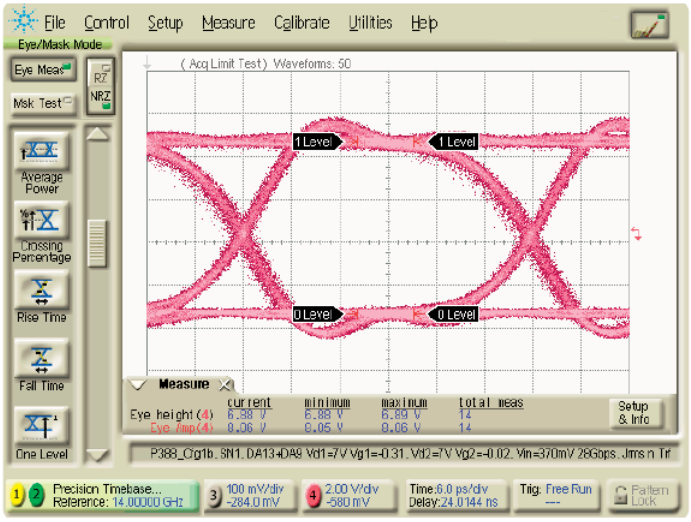

Figure 3-4 N4985A-0A3 ($2^{31} - 1$) EYE: >7 V output (1.5 V/div)

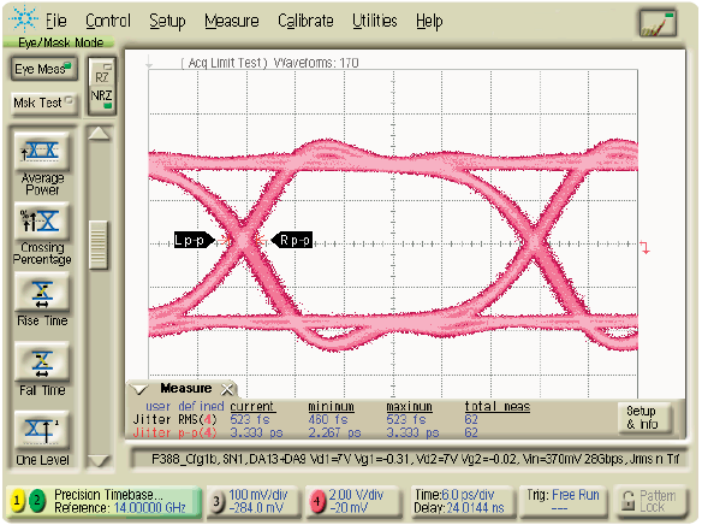

Figure 3-5 N4985A-0A3 ($2^{31} - 1$) EYE: <500 fs added rms jitter (5 ps/div)

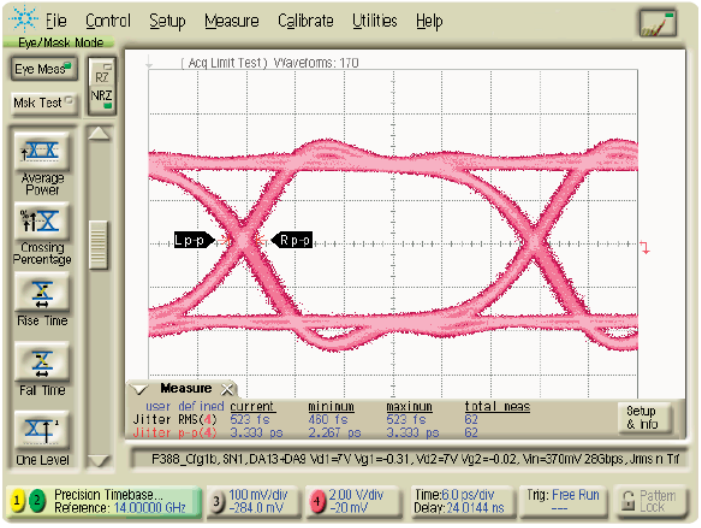

Figure 3-6 N4985A-0A3 ($2^{31} - 1$) EYE: <10 ps Tf/Tf (5 ps/div)

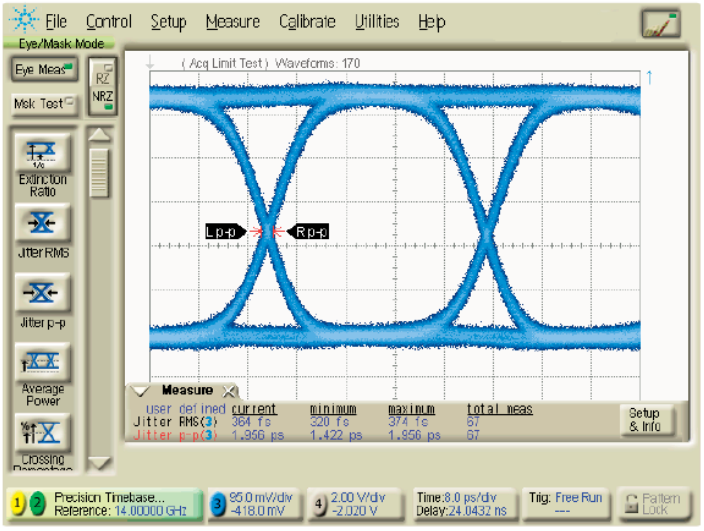

Figure 3-7 N4985A-0A3 ($2^{31} - 1$) EYE: Input signal from PRBS generator

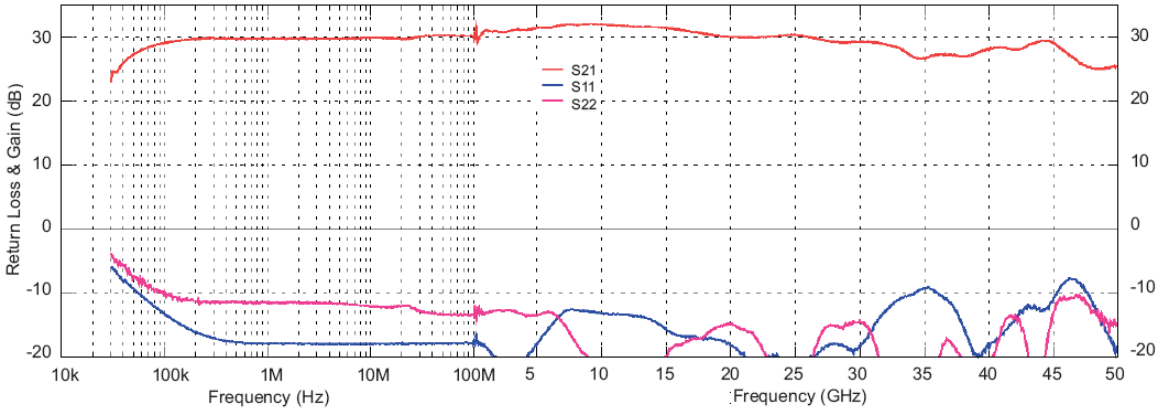

Figure 3-8 Small signal parameters versus frequency (for N4985A-S50)

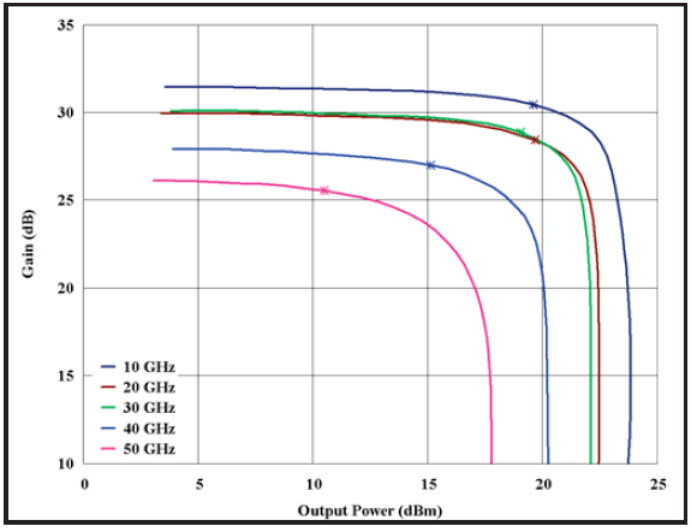

Figure 3-9 Gain versus output power (P_{1dB} indicated with *) [for N4985A-S50]

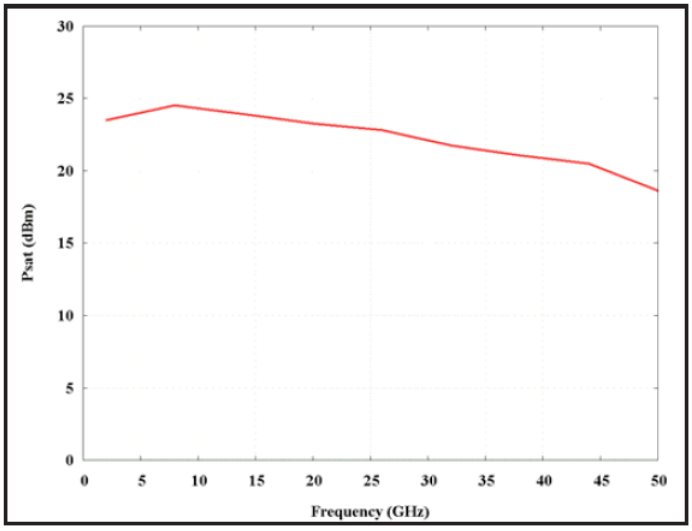

Figure 3-10 Saturated output power (for N4985A-S50)

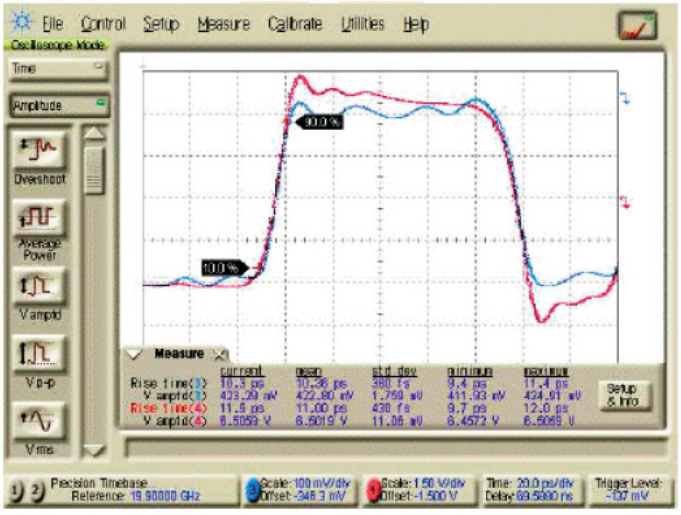

Figure 3-11 Input pulse = Ch3, 420 m Vppk, 10.4 pS rise time
Output pulse = Ch4, 6.5 Vppk, 11.0 pS rise time (for N4985A-S50)

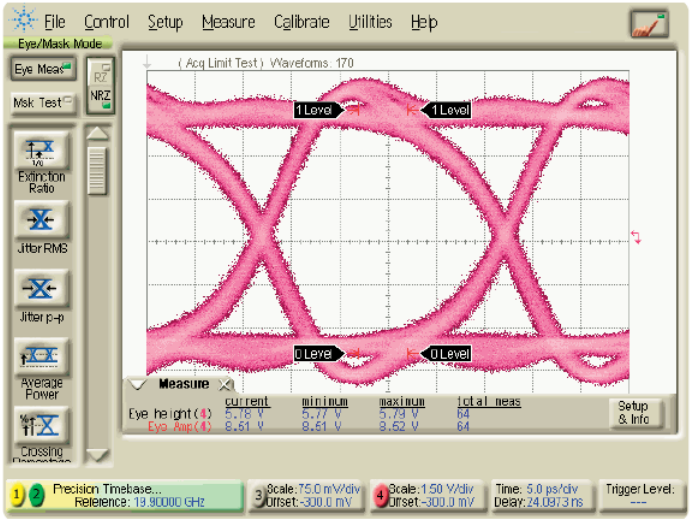

Figure 3-12 N4985A-0A5 (2^{31} – 1) EYE: >7 V output (1.5 V/div)

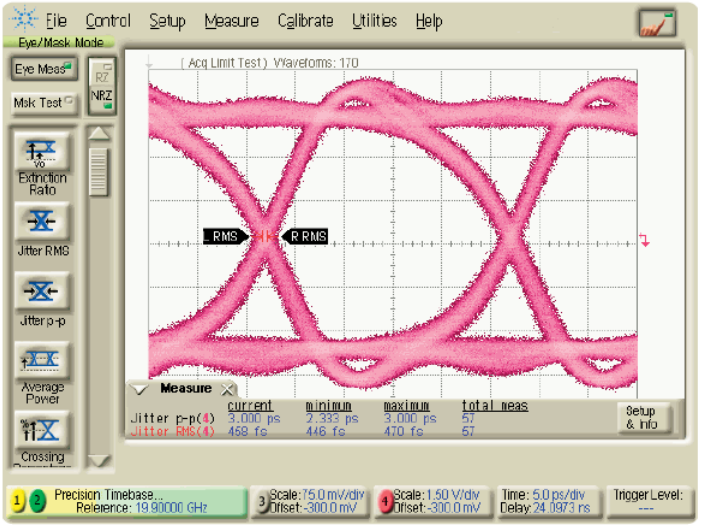

Figure 3-13 N4985A-0A5 (2^{31} – 1) EYE: <500 fs added rms jitter (5 ps/div)

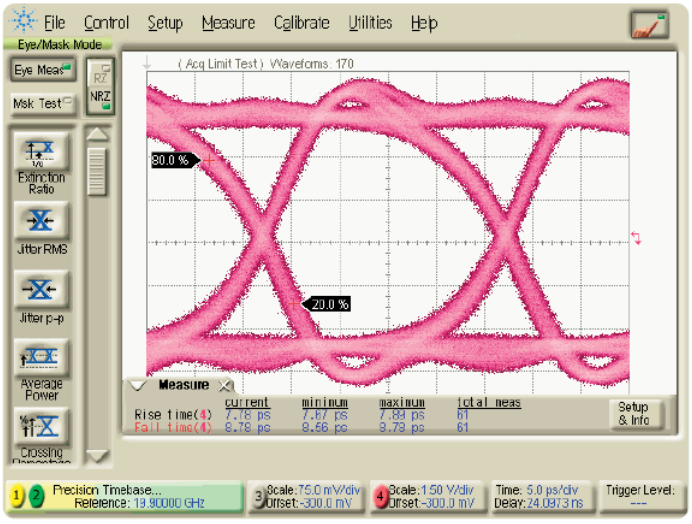

Figure 3-14 N4985A-0A5 (2^{31} – 1) EYE: <10 ps Tf/Tf (5 ps/div)

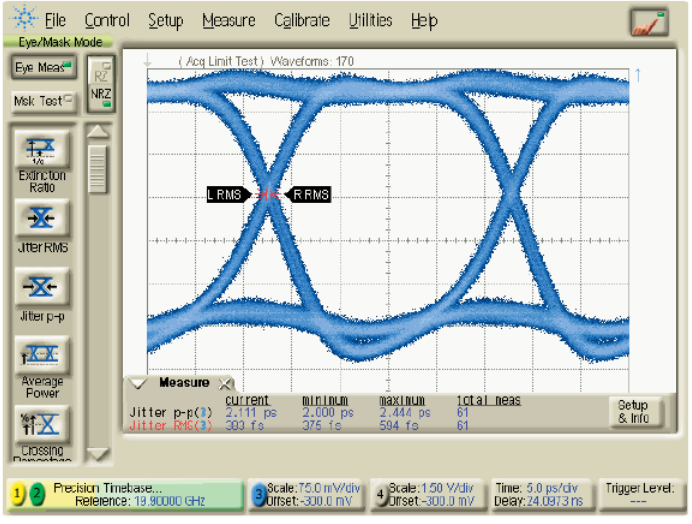

Figure 3-15 N4985A-0A5 (2^{31} – 1) EYE: Input signal from PRBS generator

Table 3-4 N4985A-P15 and N4985A-P25 specifications

Model	Agilent N4985A-P15		Agilent N4985A-P25	
Frequency	10 MHz to 50 GHz		2 GHz to 50 GHz	
Gain (dB)	30 dB		30 dB	
Small signal gain	20 (min), 25 (typ)	10 MHz to 2 GHz	25 (min), 29 (typ)	2 GHz to 10 GHz
	25 (min), 29 (typ)	2 GHz to 10 GHz	24 (min), 28 (typ)	10 GHz to 30 GHz
	24 (min), 28 (typ)	10 GHz to 30 GHz	21 (min), 25 (typ)	30 GHz to 40 GHz
	21 (min), 25 (typ)	30 GHz to 40 GHz	17 (min), 24 (typ)	40 GHz to 50 GHz
	17 (min), 24 (typ)	40 GHz to 50 GHz		
Output power (at P_{sat}) (dB)	20 (min), 24 (typ)	10 MHz to 2 GHz	26 (min), 30 (typ)	2 GHz to 10 GHz
	26 (min), 30 (typ)	2 GHz to 10 GHz	25 (min), 29 (typ)	10 GHz to 30 GHz
	25 (min), 29 (typ)	10 GHz to 30 GHz	23 (min), 27 (typ)	30 GHz to 40 GHz
	23 (min), 27 (typ)	30 GHz to 40 GHz	20 (min), 24 (typ)	40 GHz to 50 GHz
	20 (min), 24 (typ)	40 GHz to 50 GHz		
Output power (P_{1dB}) (dB)	17 (min), 22 (typ)	10 MHz to 2 GHz	24 (min), 28 (typ)	2 GHz to 10 GHz
	24 (min), 28 (typ)	2 GHz to 10 GHz	23 (min), 27 (typ)	10 GHz to 30 GHz
	23 (min), 27 (typ)	10 GHz to 30 GHz	21 (min), 25 (typ)	30 GHz to 40 GHz
	21 (min), 25 (typ)	30 GHz to 40 GHz	17 (min), 22 (typ)	40 GHz to 50 GHz
	17 (min), 22 (typ)	40 GHz to 50 GHz		
Input match S_{11} (dB)	–15 (typ)	10 MHz to 2 GHz	–15 (typ)	2 GHz to 10 GHz
	–15 (typ)	2 GHz to 10 GHz	–15 (typ)	10 GHz to 30 GHz
	–15 (typ)	10 GHz to 30 GHz	–10 (typ)	30 GHz to 40 GHz
	–10 (typ)	30 GHz to 40 GHz	–8 (typ)	40 GHz to 50 GHz
	–8 (typ)	40 GHz to 50 GHz		

Table 3-4 N4985A-P15 and N4985A-P25 specifications (continued)

Model	Agilent N4985A-P15		Agilent N4985A-P25	
Output match S_{22} (dB)	–6 (typ)	10 MHz to 2 GHz	–15 (typ)	2 GHz to 10 GHz
	–15 (typ)	2 GHz to 10 GHz	–10 (typ)	10 GHz to 30 GHz
	–10 (typ)	10 GHz to 30 GHz	–6 (typ)	30 GHz to 40 GHz
	–6 (typ)	30 GHz to 40 GHz	–6 (typ)	40 GHz to 50 GHz
	–6 (typ)	40 GHz to 50 GHz		
Reverse isolation (dB)	–60 (typ)	10 MHz to 2 GHz	–60 (typ)	2 GHz to 10 GHz
	–60 (typ)	2 GHz to 10 GHz	–60 (typ)	10 GHz to 30 GHz
	–60 (typ)	10 GHz to 30 GHz	–50 (typ)	30 GHz to 40 GHz
	–50 (typ)	30 GHz to 40 GHz	–50 (typ)	40 GHz to 50 GHz
	–50 (typ)	40 GHz to 50 GHz		
Noise figure (dBm)	9 (typ)	2 GHz to 10 GHz	9 (typ)	2 GHz to 10 GHz
	9 (typ)	10 GHz to 30 GHz	9 (typ)	10 GHz to 30 GHz
	10.5 (typ)	30 GHz to 40 GHz	10.5 (typ)	30 GHz to 40 GHz
	12 (typ)	40 GHz to 50 GHz	12 (typ)	40 GHz to 50 GHz
2nd harmonics H_2 (dBc) @P_1	–40 (typ)	10 MHz to 2 GHz	–40 (typ)	2 GHz to 10 GHz
	–40 (typ)	2 GHz to 10 GHz	–40 (typ)	10 GHz to 30 GHz
	–40 (typ)	10 GHz to 30 GHz	–35 (typ)	30 GHz to 40 GHz
	–35 (typ)	30 GHz to 40 GHz	–30 (typ)	40 GHz to 50 GHz
	–30 (typ)	40 GHz to 50 GHz		
3rd harmonics H_3 (dBc) @P_1	–20 (typ)	10 MHz to 2 GHz	–20 (typ)	2 GHz to 10 GHz
	–20 (typ)	2 GHz to 10 GHz	–20 (typ)	10 GHz to 30 GHz
	–20 (typ)	10 GHz to 30 GHz	—	30 GHz to 40 GHz
	—	30 GHz to 40 GHz	—	40 GHz to 50 GHz
	—	40 GHz to 50 GHz		

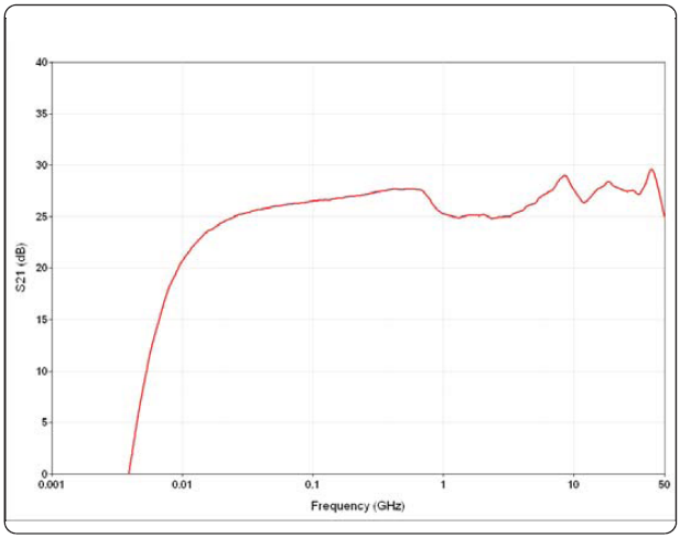

Figure 3-16 Typical N4985A-P15 performance (S21)

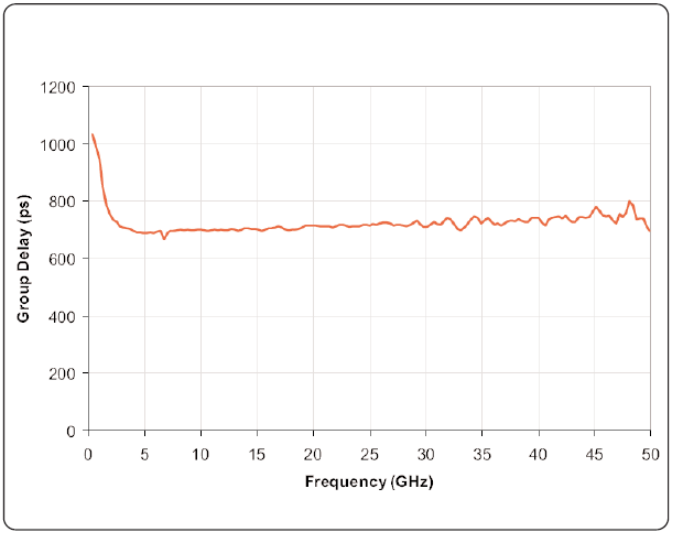

Figure 3-17 Typical N4985A-P15 performance (group delay)

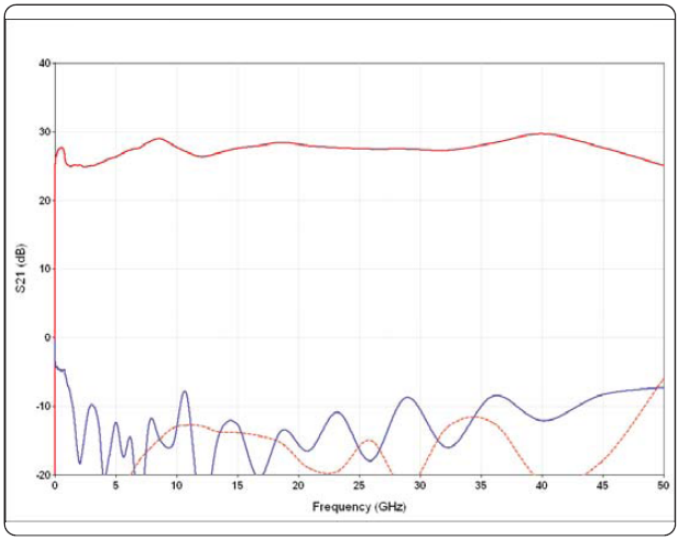

Figure 3-18 Typical N4985A-P15 performance (S11, S22)

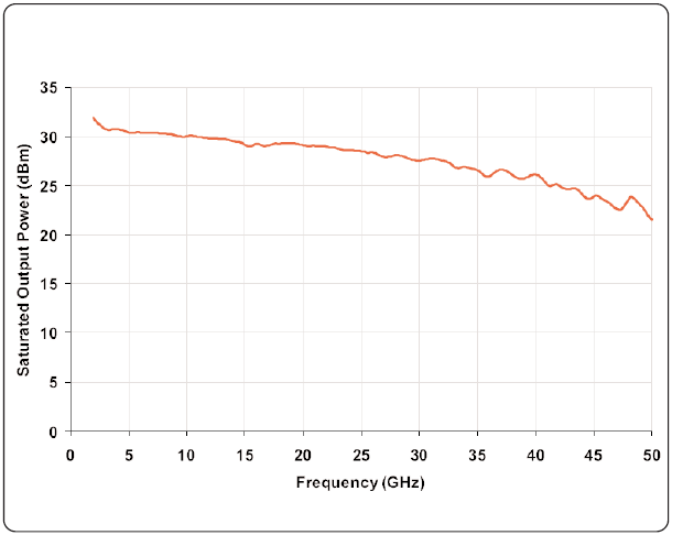

Figure 3-19 Typical N4985A-P15 performance (saturated output power)

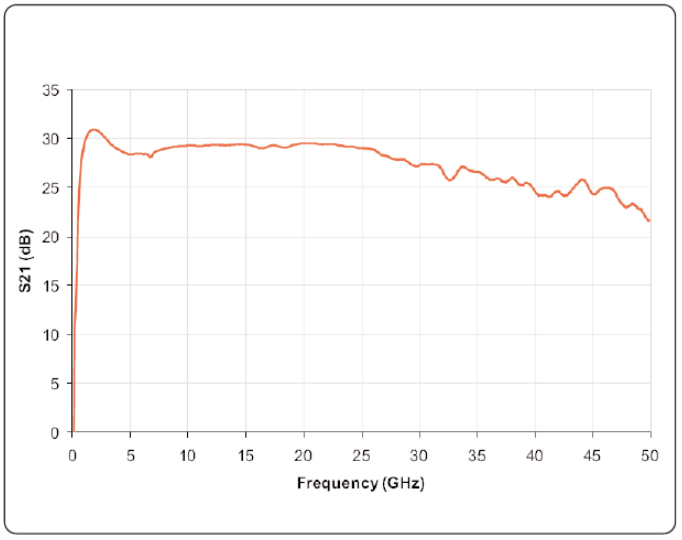

Figure 3-20 Typical N4985A-P25 performance (S21)

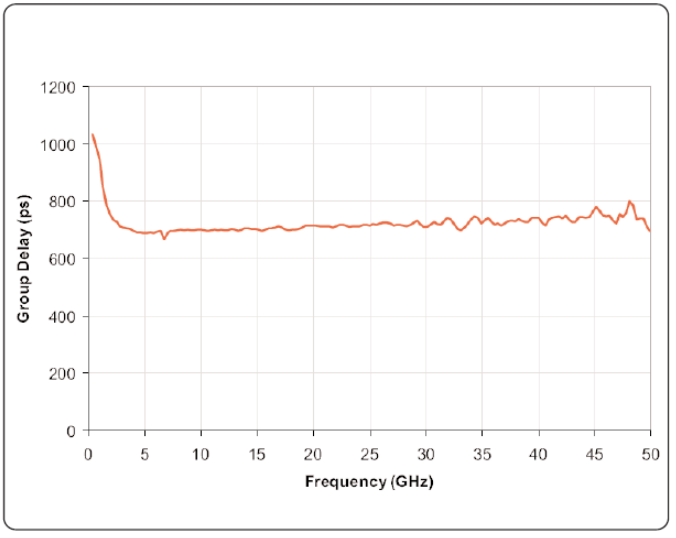

Figure 3-21 Typical N4985A-P25 performance (group delay)

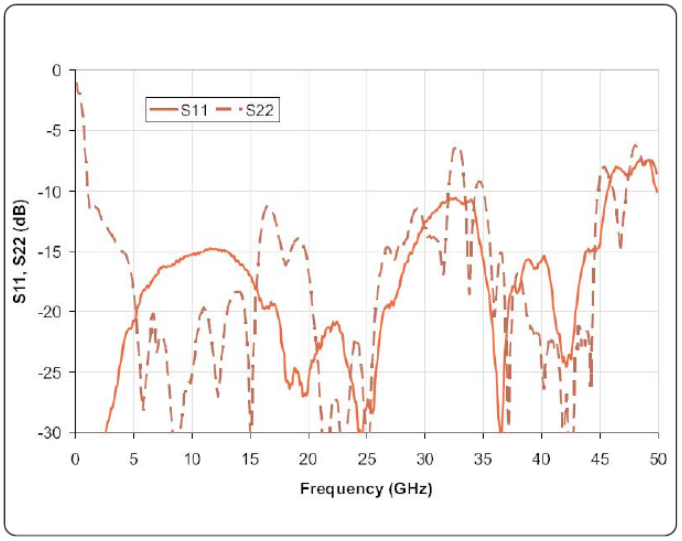

Figure 3-22 Typical N4985A-P25 performance (S11, S22)

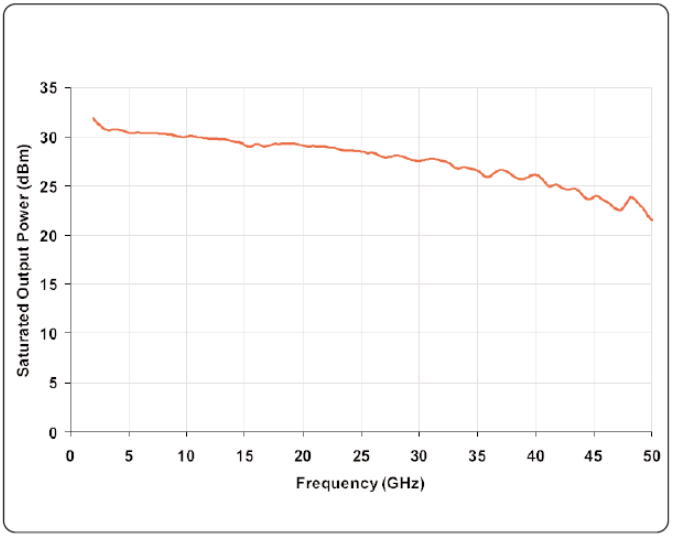

Figure 3-23 Typical N4985A-P25 performance (saturated output power)

Supplementary Specifications

Table 3-5 Supplementary specifications for the N4985A Amplifiers[1]

Model	Agilent N4985A-S30	Agilent N4985A-S50	Agilent N4985A-P15	Agilent N4985A-P25
Bias voltage and current	9 Vdc at 500 mA	9 Vdc at 500 mA	9 Vdc at 1.5 A	9 Vdc at 1.5 A
RF connectors	2.92 mm (f)	2.92 mm (f)	2.4 mm (f)	2.4 mm (f)
Survival input power	20 dBm	20 dBm	26 dBm	26 dBm
Operating temperature	0 to +55 °C	0 to +55 °C	0 to +55 °C	0 to +55 °C

[1] Including the power supply and the DC power supply cable.

Physical Specifications

Table 3-6 Physical specifications for the N4985A Amplifiers

Model	Agilent N4985A-S30	Agilent N4985A-S50	Agilent N4985A-P15	Agilent N4985A-P25
Net weight	*0.26 kg*	*0.26 kg*	*1.03 kg*	*1.03 kg*
Shipping weight	*1.8 kg*	*1.8 kg*	*3.2 kg*	*3.2 kg*
Shipping dimensions				
• Length	90 mm	90 mm	114 mm	114 mm
• Width	90 mm	90 mm	140 mm	140 mm
• Height	25 mm	25 mm	70 mm	70 mm

Mechanical Dimensions[1]

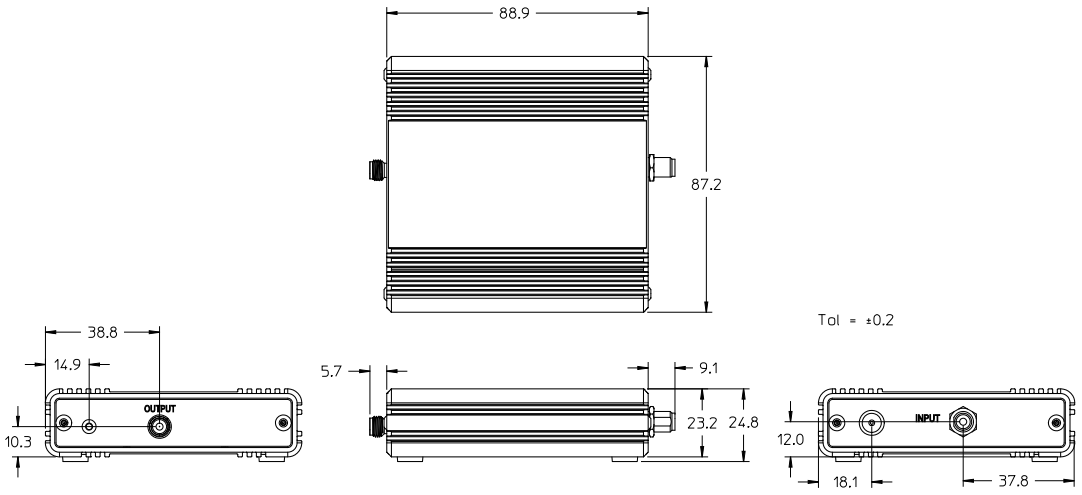

Figure 3-24 Mechanical dimensions of the N4985A-S30/S50 amplifier

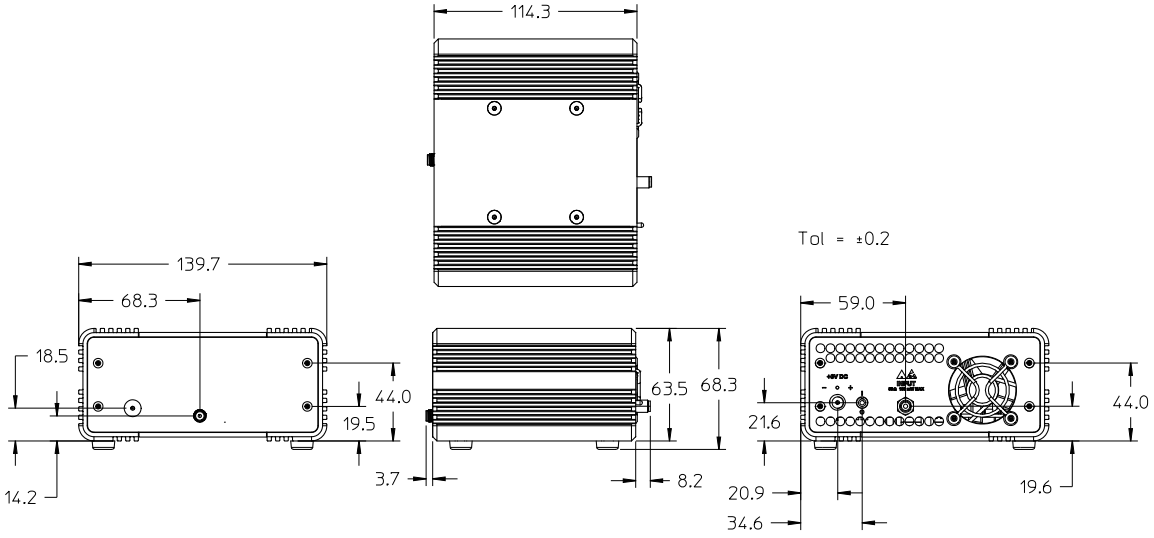

Figure 3-25 Mechanical dimensions of the N4985A-P15/P25 amplifier

[1] Dimensions in millimeters.

4
Operation Guide

This chapter provides the operating instructions for the N4985A Amplifiers.

Operating Instructions

Performance Verification

The figures below show the setup used to verify the performance of the N4985A Amplifiers.

A calibrated power splitter (or calibrated coupler) connected to the amplifier input reference plane and to power sensor A, as shown, establishes the input power level. The output power is measured on power sensor B. Measurements of gain versus output power at frequencies of interest establish the amplifier performance.

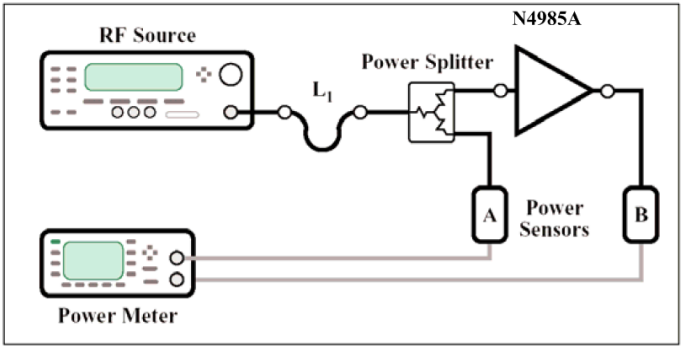

Figure 4-1 Verification setup with a power splitter

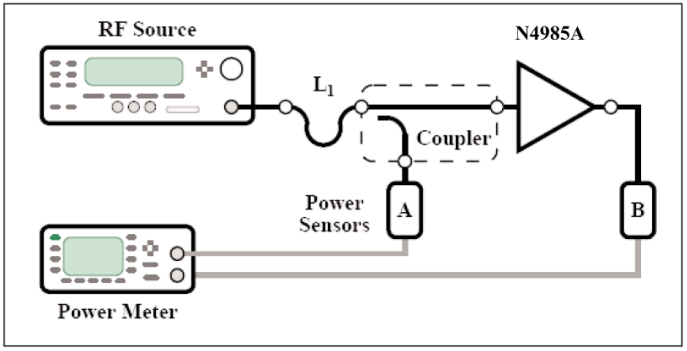

Figure 4-2 Verification setup with a calibrated coupler

Example Application

The N4985A amplifies the RF Source output power to the level needed to characterize DUT performance.

The small size of the N4985A is easy to place close to the DUT input "*Reference Plane*". The high gain of the amplifier easily overcomes the cable losses from the remote RF Source.

The figure below shows an amplified RF power measurement system using the N4985A.

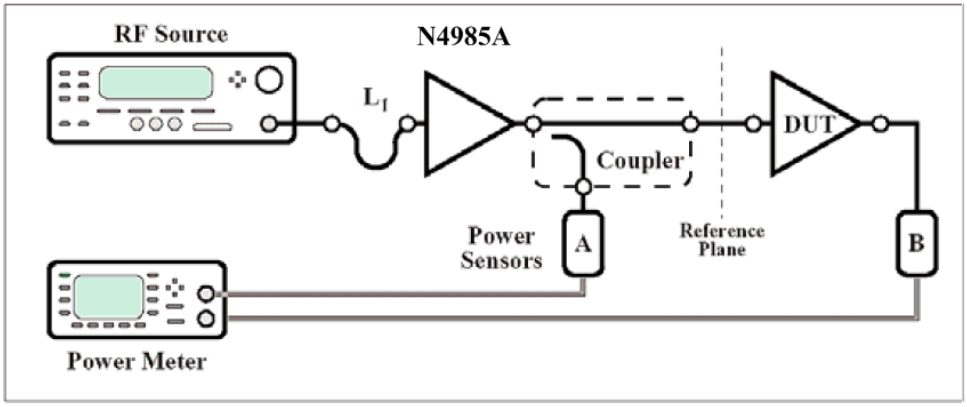

Figure 4-3 Example of an amplified RF power measurement system

The DUT is characterized by setting the power level at the DUT input "*Reference Plane*" and measuring the output power at various input power levels for each test frequency.

The RF Source, used in this example, is a laboratory grade Synthesized Source or Signal Generator with precise amplitude control (e.g. Agilent 83650L RF Source). The power levels are measured using a power meter with two measurement port sensors (A and B) (e.g. Agilent E4419B).

An RF power coupler provides a small, proportional amount of the amplified power to power sensor A as shown in the above figure.

Service and Maintenance

Service

The N4985A does not have internal adjustments and should not be opened; it should only be repaired by service-trained personnel. Should it become necessary to return the N4985A for repair or service, contact your nearest Agilent Sales and Service Center.

Maintenance

The connectors of the N4985A, particularly the connector faces, must be kept clean. Agilent recommends that the connectors be periodically inspected and cleaned if necessary. For instructions on the connection and maintenance of your connectors, refer to the Connector Care Quick Reference Card (08510-90360).