

Agilent Technologies

N5256/7/8A Millimeter-wave Modules

User's Guide

Use this manual with the following document:
Technical Overview 5989-7620EN

Millimeter Modules

N5256AW01, W02, W03, W05, W06, W08, W10, W12, W15, W22, X10, X12,
N5257AR02, R03, R05, R06, R08, R10, R12, R15, R22
N5258AD02, D03, D05, D06, D08, D10, D12, D15, D22



Agilent Technologies

Manufacturing Part Number: N5256-90001

Printed in USA: November 2011

Supersede February 2010

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Safety Notes

The following safety notes are used throughout this document. Familiarize yourself with each of these notes and its meaning before performing any of the procedures in this document.

WARNING

Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

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Contents

N5256/7/8A

Introduction

The Agilent Technologies N5256A, N5257A and N5258A are Millimeter-wave Modules that are manufactured for Agilent as a customer ordering convenience. This document provides information for the models and options available for each product.

For technical information refer to the Agilent Millimeter-wave Network Analyzer 10 MHz to 110 GHz, with Extensions to 1.1 THz (5989-7620EN), available on Agilent Technologies web site at: <http://cp.literature.agilent.com/litweb/pdf/5989-7620EN.pdf>

This product is warranted by OML against defective materials and workmanship. Refer to documentation supplied with this product or go to <http://www.omlinc.com> for more information.

Figure 1 OML Network Analysis Products



Description

The millimeter-wave modules are designed for use with the N5260/61/62A Millimeter-wave Module Controllers for banded vector network analyzer systems. Refer to the N5250C or N5261/62A Users Guides (N5260-90001 or N5262-90001) for system connections, operation and functional check.

The N5256AW01 is a T/R module manufactured by Virginia Diodes, Inc. (VDI). Refer to the N5256AW01 (N5256-90002) and the VDI document included with this shipment.

The N5256A “T/R” Millimeter-wave Module contains an RF source multiplier, dual directional coupler, reference downconverter and a test downconverter. The T/R Millimeter-wave Module is usually the primary module of a millimeter-wave VNA system. A single T/R module allows the measurement of S11 reflection coefficient only.

The N5257A “T” Millimeter-wave Module is a “receive only” module that contains a test downconverter to receive the test signal from a T/R Millimeter-wave Module. The use of a T module, as the second module, allows the system capability to measure S11 and S21 only.

The N5258A “T2” series is a “dual receive only” module that contains two test downconverters to receive test signals from two antennas, a power splitter or two T/R Millimeter-wave Modules.

The use of two T/R modules in the millimeter-wave VNA system allows for all four S-parameters to be measured. The test downconverters of T/R modules are the receivers for the signal from the modules sources. When the two modules waveguide are connected, S11 and S21 are measured on the forward direction, S22 and S11 are measured when the signal path is reversed.

Table 1 Model and Option List

Instrument ¹	Description
N5256A	Transmission / Reflection Modules for use with N526xA Controller.
N5257A	Single Path Transmission (Receiver) Modules for use with N526xA Controller.
N5258A	Dual Path Transmission (Receiver) Modules for use with N526xA Controller.

1. Refer to individual tables for specific model and options.

Verifying the Shipment

After the module has been unpacked, inspect the module and all accessories for any signs of damage that may have occurred during shipment. If your module or any accessories appear to be damaged or missing refer to [“Agilent Support, Services, and Assistance” on page 28](#). Use the original or comparable packaging materials to transport the module.

IMPORTANT The Agilent part number and serial number is on bottom of the module, refer to the model and serial number when requesting service or information.

N5256/7/8A Model Features

- The millimeter-wave modules have a power connector feature that is designed to operate with the N5260/61/62A Millimeter-wave Module controllers.
- The RF, LO and IF connectors are 3.5 mm female SMA type.
- RF and DC power cables are included with millimeter-wave controllers, or may be purchased separately. A separate power supply is recommended if the millimeter-wave modules are placed greater than 30 feet from the controller. The following are recommended:
 - E3615A DC Power Supply (0 to 20 V, 0 to 3 A, 60 W)
 - DC Bias Cable (N5260-60042).
- The waveguide connector use a 4-40 thread screw. The recommended screw is a 3/32 hex head screw (Agilent part number 1390-0671) and requires a 3/32 inch ball driver (Agilent part number 1710-0523), not included.
- The millimeter-wave modules have adjustable feet for leveling height when connecting to other equipment.

CAUTION Do not remove the feet. Air flow on the bottom and rear panel of the module must not be obstructed.

Table 2 Round Waveguide Flange

Frequency Range	Frequency Band	EIA Waveguide	Mil Spec Flange MLF-3955	UG-XXX/U Equivalent
325 to 500 GHz	n/a	WR-2.2	n/a	UG-387/U-M
220 to 325 GHz	n/a	WR-03	/74-005	UG-387/U-M
140 to 220 GHz	G	WR-05	/74-003	UG-387/U-M
110 to 170 GHz	D	WR-06	/74-002	UG-387/U-M
90 to 140 GHz	F	WR-08	/74-001	UG-387/U-M
75 to 110 GHz	W	WR-10	/67B-010	UG-387/U-M
60 to 90 GHz	E	WR-12	/67B-009	UG-387/U
50 to 75 GHz	V	WR-15	/67B-008	UG-385/U
33 to 50 GHz	Q	WR-22	/67B-006	UG-383/U
56 to 94 GHz	E (extended)	WR-12	/67B-M03/74-001	UG-387/U

Ordering Configurations

Table 3 N5256A Waveguide Model and Options¹

Waveguide Modules	Frequency	Waveguide Band
N5256AW02	325 to 500 GHz	WR-2.2
N5256AW03	220 to 325 GHz	WR-03
N5256AW05	140 to 220 GHz	WR-05
N5256AW06	110 to 170 GHz	WR-06
N5256AW08	90 to 140 GHz	WR-08
N5256AW10	75 to 110 GHz	WR-10
N5256AW12	60 to 90 GHz	WR-12
N5256AW15	50 to 75 GHz	WR-15
N5256AW22	33 to 50 GHz	WR-22
N5256AX10	67 to 110 GHz	WR-10
N5256AX12	56 to 94 GHz	WR-12

1. Waveguide models maybe ordered with Option 001 (Adjustable RF Attenuator), Option 002 (15 dB Gain, RF and LO Internal Amplifiers), Option 003 (Option 001 and Option 002), or Option 004 (IF amp bypass jumpers).

Table 4 N5257A Waveguide Model and Options¹

Waveguide Modules	Frequency	Waveguide Band
N5257AR02	325 to 500 GHz	WR-2.2
N5257AR03	220 to 325 GHz	WR-03
N5257AR05	140 to 220 GHz	WR-05
N5257AR06	110 to 170 GHz	WR-06
N5257AR08	90 to 140 GHz	WR-08
N5257AR10	75 to 110 GHz	WR-10
N5257AR12	60 to 90 GHz	WR-12
N5257AR15	50 to 75 GHz	WR-15
N5257AR22	33 to 50 GHz	WR-22

1. Waveguide models maybe ordered with Option 001 (15 dB Gain LO Internal Amplifier).

Table 5 N5258A Waveguide Model and Options¹

Waveguide Modules	Frequency	Waveguide Band
N5258AD02	325 to 500 GHz	WR-2.2
N5258AD03	220 to 325 GHz	WR-03
N5258AD05	140 to 220 GHz	WR-05
N5258AD06	110 to 170 GHz	WR-06
N5258AD08	90 to 140 GHz	WR-08
N5258AD10	75 to 110 GHz	WR-10
N5258AD12	60 to 90 GHz	WR-12
N5258AD15	50 to 75 GHz	WR-15
N5258AD22	33 to 50 GHz	WR-22

1. Waveguide models maybe ordered with Option 001 (15 dB Gain LO Internal Amplifier).

Content List

The following millimeter-wave module model part numbers correspond with the Agilent Technologies part numbers.

Each source module ordered includes one each of the standard accessories listed below:

- Documentation Envelope (Performance Graphs and Certificate of Compliance).
- Millimeter-wave Module (Refer to [Table 6](#), [Table 7](#) and [Table 8](#) for your specific module).
- Model N5256A includes a Waveguide Section.
- Model N5257A (W02, W03) and N5258A (W02, W03) includes a Waveguide Section.
- Model N5257A (W05, W06, W08) and N5258A (W05, W06, W08) includes a Waveguide 10 dB Attenuator.
- Model N5257A (W10, W15) and N5258A (W10, W15) includes a Waveguide 20 dB Attenuator.

Table 6 N5256A Waveguide Model

Agilent Part Number	Module Part Number
N5256A Standard	
N5256AW02	V02VNA2-T/R
N5256AW03	V03VNA2-T/R
N5256AW05	V05VNA2-T/R
N5256AW06	V06VNA2-T/R
N5256AW08	V08VNA2-T/R
N5256AW10	V10VNA2-T/R
N5256AW12	V12VNA2-T/R
N5256AW15	V15VNA2-T/R
N5256AW22	V22VNA2-T/R
N5256AX10	N5260-90004
N5256AX12	V12VNA2-TR-5694
N5256A Option 001¹	
N5256AW03-001	V03VNA2-T/R-A
N5256AW05-001	V05VNA2-T/R-A
N5256AW06-001	V06VNA2-T/R-A

Table 6 N5256A Waveguide Model

Agilent Part Number	Module Part Number
N5256AW08-001	V08VNA2-T/R-A
N5256AW10-001	V10VNA2-T/R-A
N5256AW12-001	V12VNA2-T/R-A
N5256AW15-001	V15VNA2-T/R-A
N5256AW22-001	V22VNA2-T/R-A
N5256AX10-001	N5260-60003
N5256AX12-001	V12VNA2-T/R-A-5694
N5256A Option 002²	
N5256AW02-002	V02VNA2-T/R-RLA
N5256AW03-002	V03VNA2-T/R-RLA
N5256AW05-002	V05VNA2-T/R-RLA
N5256AW06-002	V06VNA2-T/R-RLA
N5256AW08-002	V08VNA2-T/R-RLA
N5256AW10-002	V10VNA2-T/R-RLA
N5256AW12-002	V12VNA2-T/R-RLA
N5256AW15-002	V15VNA2-T/R-RLA
N5256AW22-002	V22VNA2-T/R-RLA
N5256AX12-002	V12VNA2-T/R-RLA-5694
N5256A Option 003³	
N5256AW03-003	V03VNA2-T/R-A-RLA
N5256AW05-003	V05VNA2-T/R-A-RLA
N5256AW06-003	V06VNA2-T/R-A-RLA
N5256AW08-003	V08VNA2-T/R-A-RLA
N5256AW10-003	V10VNA2-T/R-A-RLA
N5256AW12-003	V12VNA2-T/R-A-RLA
N5256AW15-003	V15VNA2-T/R-A-RLA
N5256AW22-003	V22VNA2-T/R-A-RLA
N5256AX12-003	V12VNA2-T/R-A-RLA-5694

Table 6 N5256A Waveguide Model

Agilent Part Number	Module Part Number
N5256A Option 004^{4,5}	
N5256AW03-004	V03VNA2-T/R
N5256AW10-004	V10VNA2-T/R

1. Waveguide models with Option 001 (Adjustable RF Attenuator).
2. Waveguide models with Option 002 (15 dB Gain, RF and LO Internal Amplifiers).
3. Waveguide models with Option 003 (Option 001 and Option 002), or Option 004 (IF Amplifier Bypass Jumpers).
4. Waveguide modules with IF Amplifier Bypass Jumpers.
5. Refer to [Figure 5 on page 14](#) for Option 004 rear panel features.

Table 7 N5257A Waveguide Model

Agilent Part Number	OML Part Number
N5257A Standard	
N5257AR02	V02VNA2-T/R
N5257AR03	V03VNA2-T/R
N5257AR05	V05VNA2-T/R
N5257AR06	V06VNA2-T/R
N5257AR08	V08VNA2-T/R
N5257AR10	V10VNA2-T/R
N5257AR12	V12VNA2-T/R
N5257AR15	V15VNA2-T/R
N5257AR22	V22VNA2-T/R
N5257A Option 001¹	
N5257AR02-001	V02VNA2-T-LOA
N5257AR03-001	V03VNA2-T-LOA
N5257AR05-001	V05VNA2-T-LOA
N5257AR06-001	V06VNA2-T-LOA
N5257AR08-001	V08VNA2-T-LOA
N5257AR10-001	V10VNA2-T-LOA
N5257AR12-001	V12VNA2-T-LOA
N5257AR15-001	V15VNA2-T-LOA
N5257AR22-001	V22VNA2-T-LOA

1. Waveguide models with Option 001 (15 dB Gain LO Internal Amplifier).

Table 8 N5258A Waveguide Model

Agilent Part Number	OML Part Number
N5258A Standard	
N5258AD02	V02VNA2-T2
N5258AD03	V03VNA2-T2
N5258AD05	V05VNA2-T2
N5258AD06	V06VNA2-T2
N5258AD08	V08VNA2-T2
N5258AD10	V10VNA2-T2
N5258AD12	V12VNA2-T2
N5258AD15	V15VNA2-T2
N5258AD22	V22VNA2-T2
N5258A Option 001¹	
N5258AD02-001	V02VNA2-T2-LOA
N5258AD03-001	V03VNA2-T2-LOA
N5258AD05-001	V05VNA2-T2-LOA
N5258AD06-001	V06VNA2-T2-LOA
N5258AD08-001	V08VNA2-T2-LOA
N5258AD10-001	V10VNA2-T2-LOA
N5258AD12-001	V12VNA2-T2-LOA
N5258AD15-001	V15VNA2-T2-LOA
N5258AD22-001	V22VNA2-T2-LOA

1. Waveguide models with Option 001 (15 dB Gain LO Internal Amplifier).

Front and Rear Panel Features

Figure 2 Rear Panel Power Supply Connector

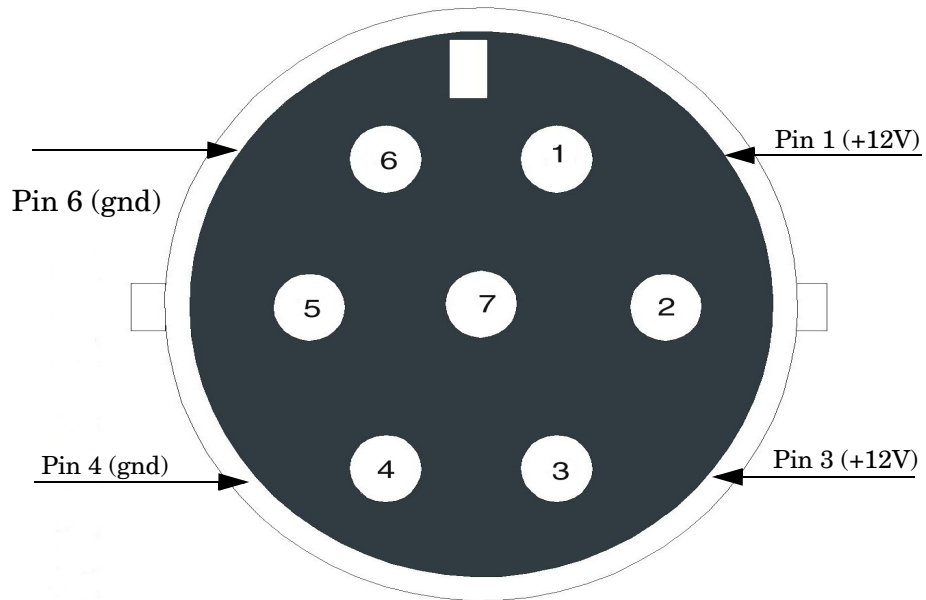


Figure 3 N5256A or N5257A Front Panel



Figure 4 N5256A Rear Panel

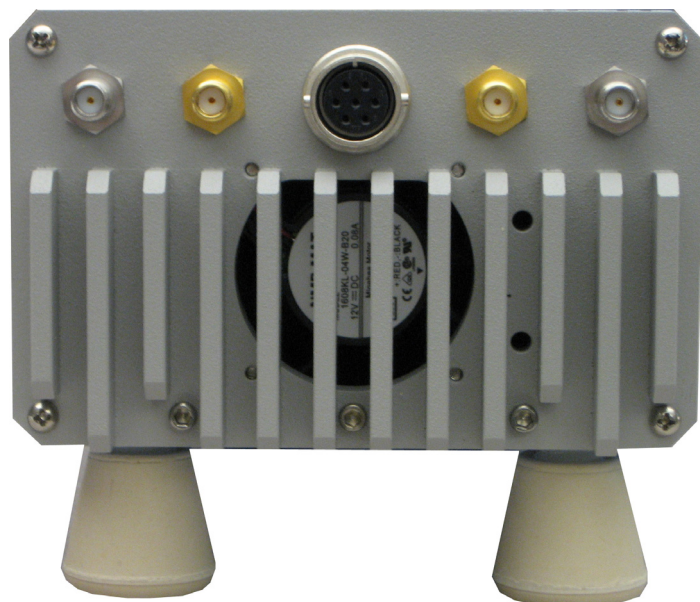


Figure 5 N5256A Option 001, 003 or 004

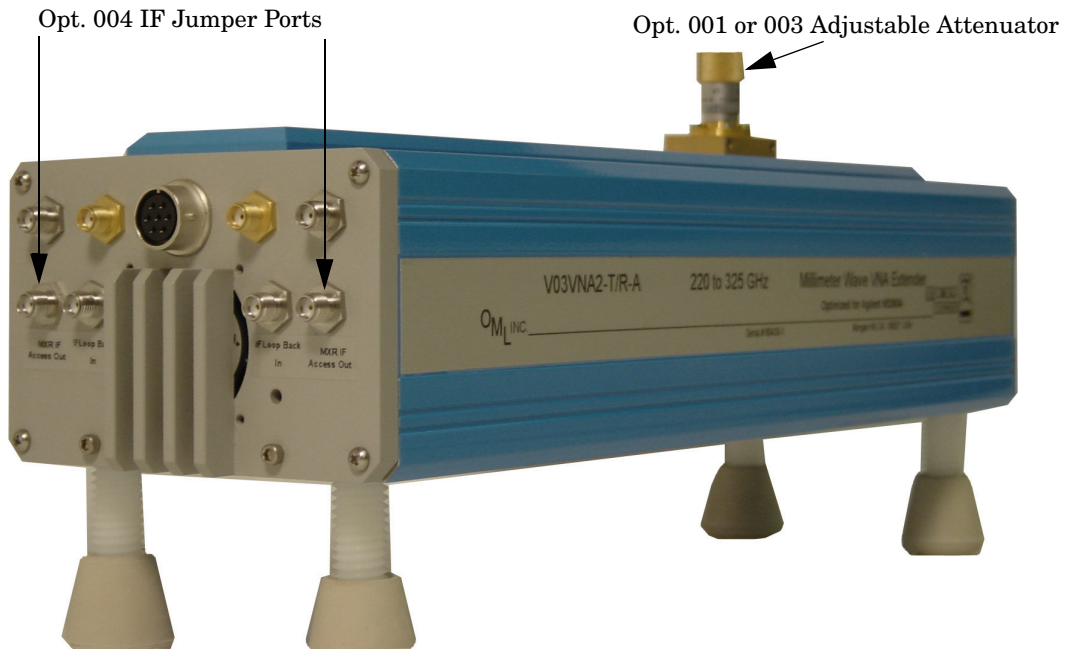


Figure 6 N5257A Single Receiver Rear Panel

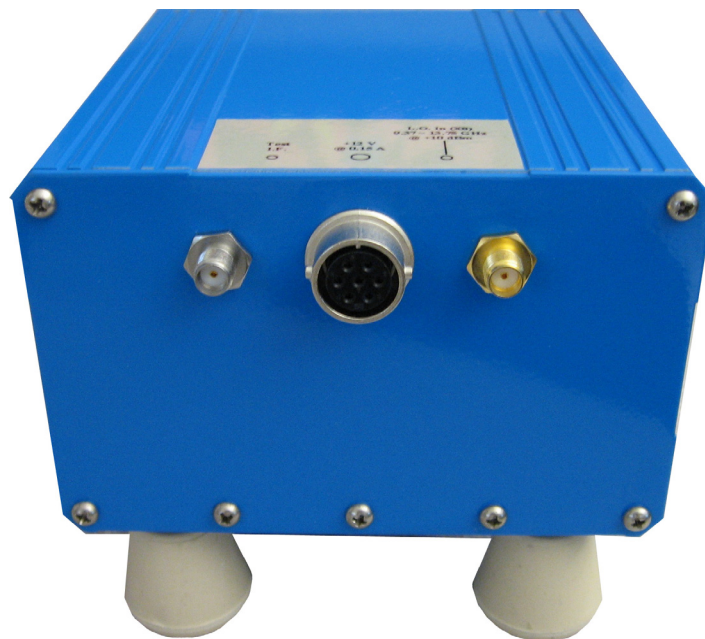
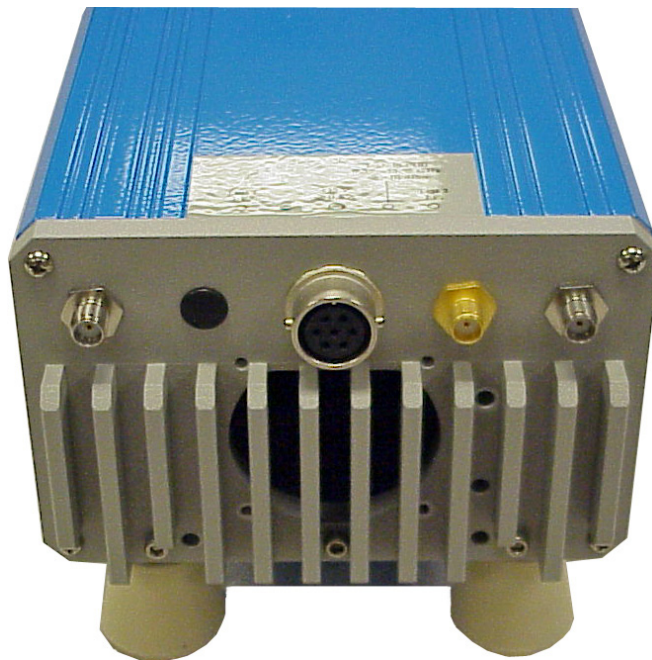


Figure 7 N5258A Dual Receiver Front Panel



Figure 8 N5258A Dual Receiver Rear Panel



Block Diagrams

Figure 9 N5256A Standard

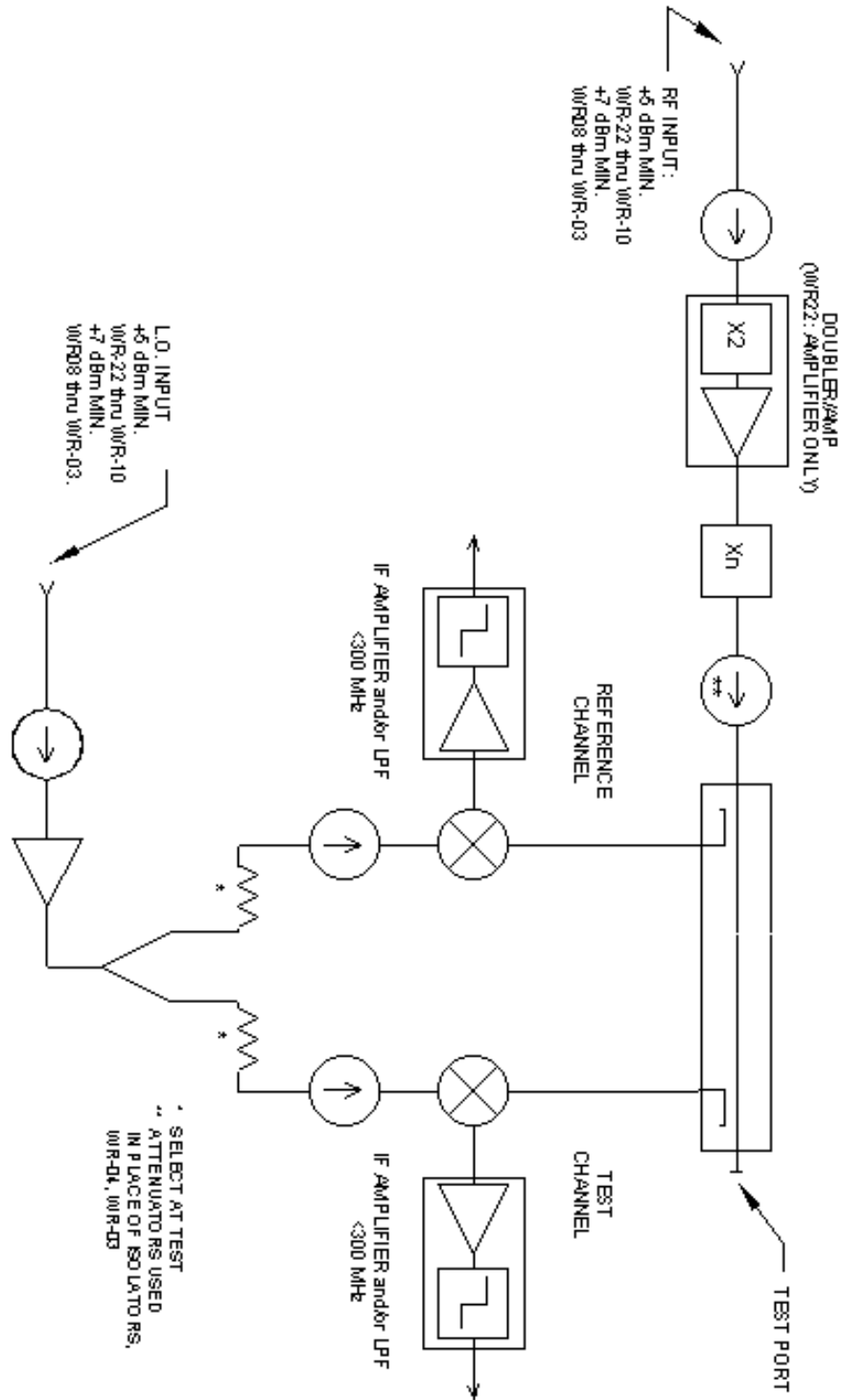


Figure 10 N5256A Option 004

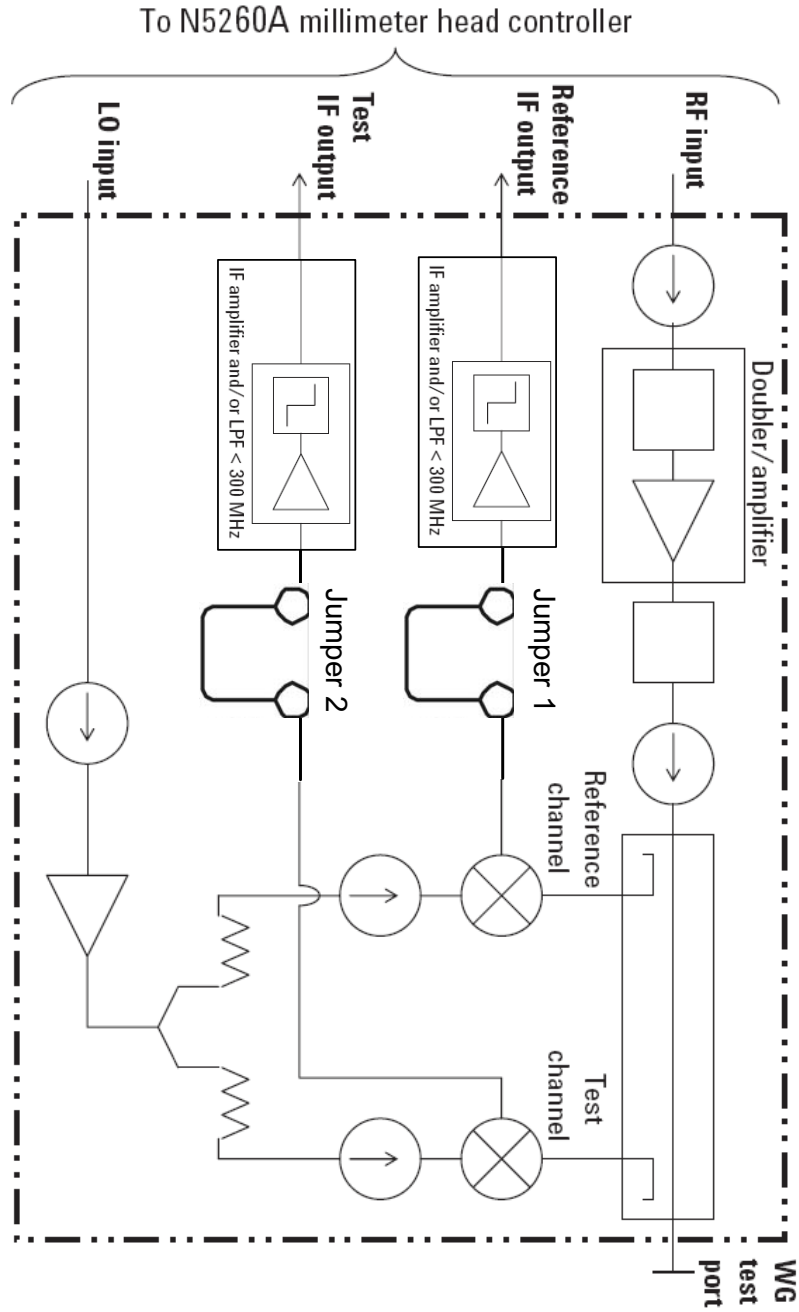


Figure 11 N5257A

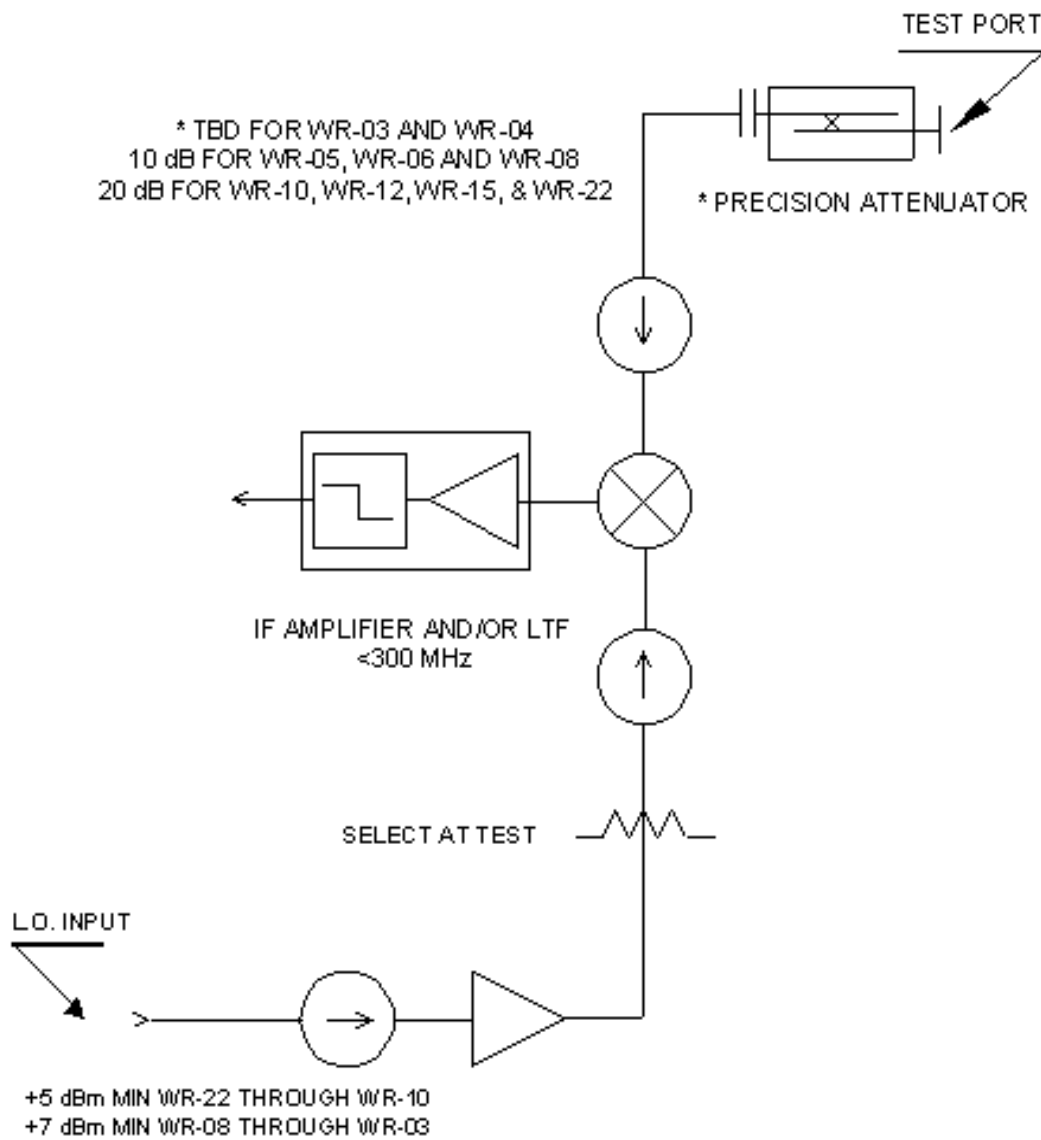
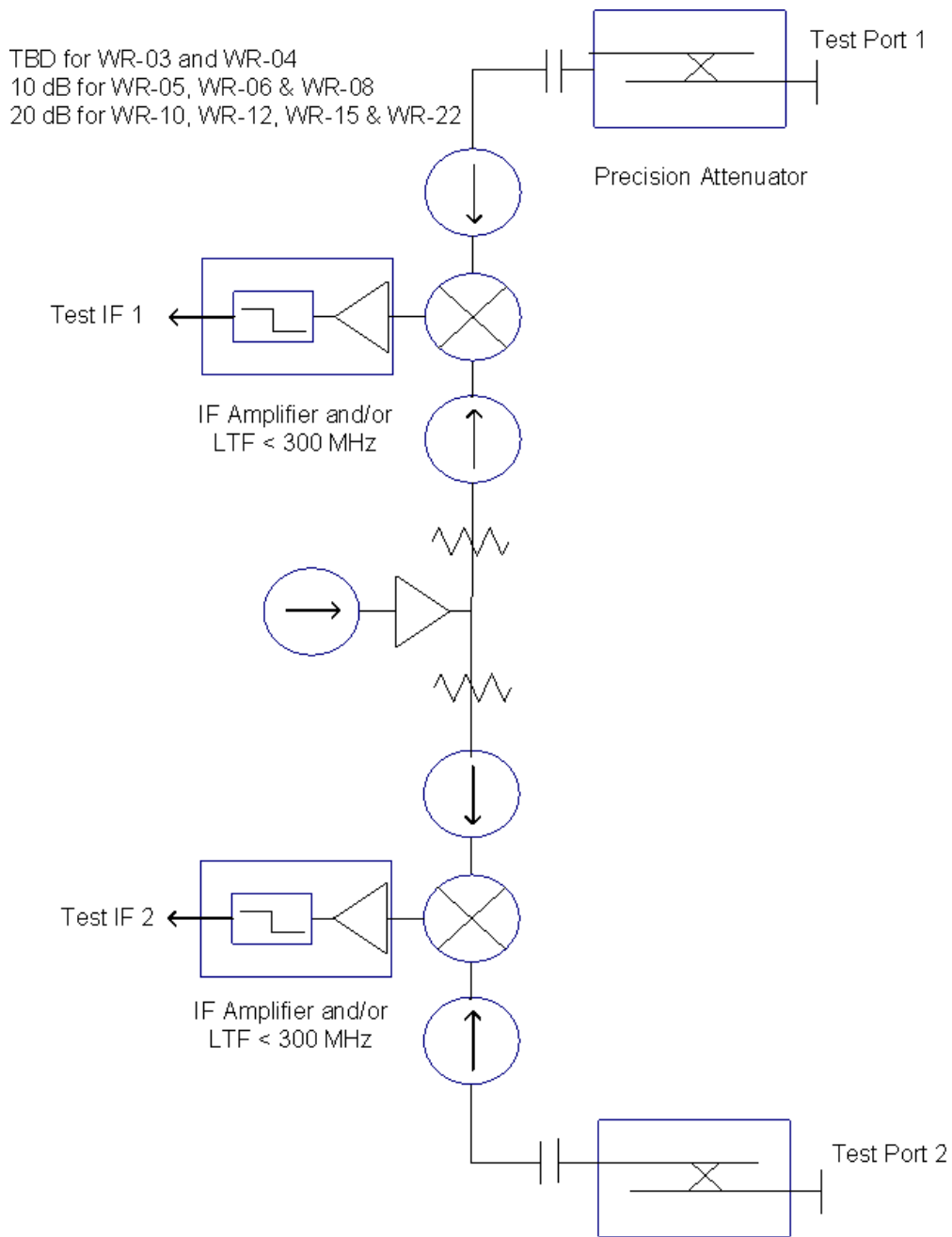


Figure 12 N5258A



Outline Drawings and Dimensions

Figure 13 VNA2-T/R Series Modules

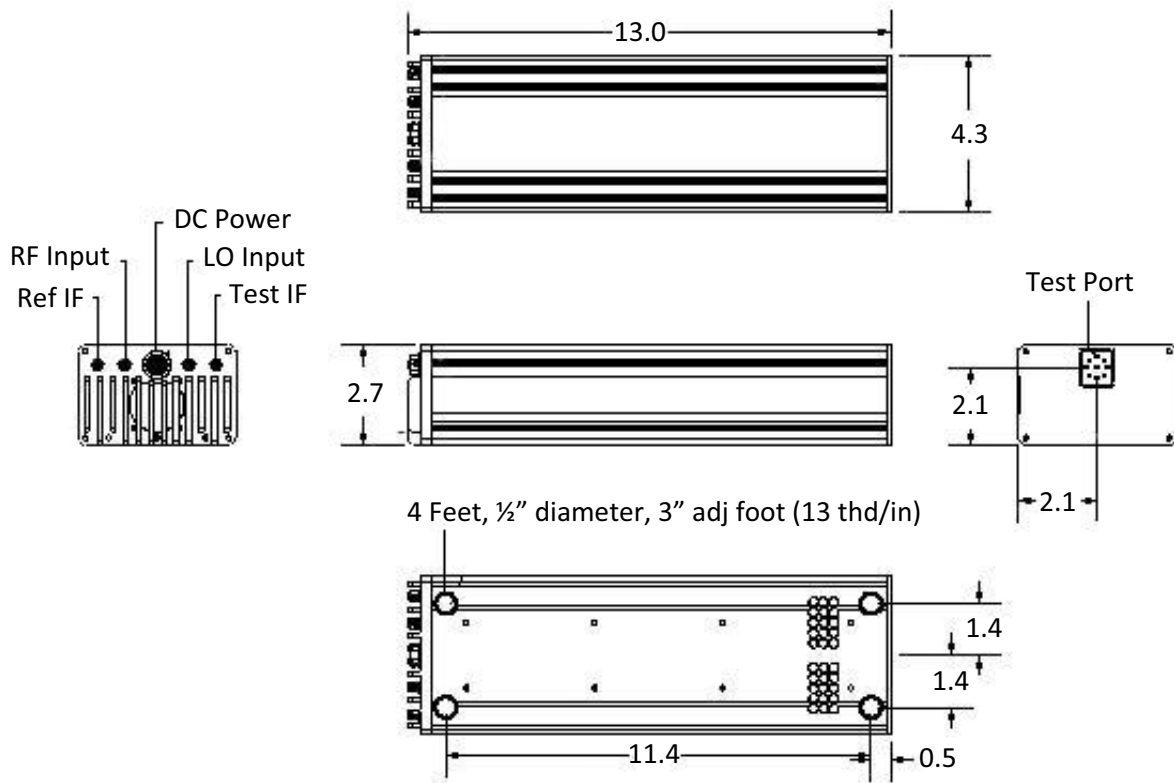
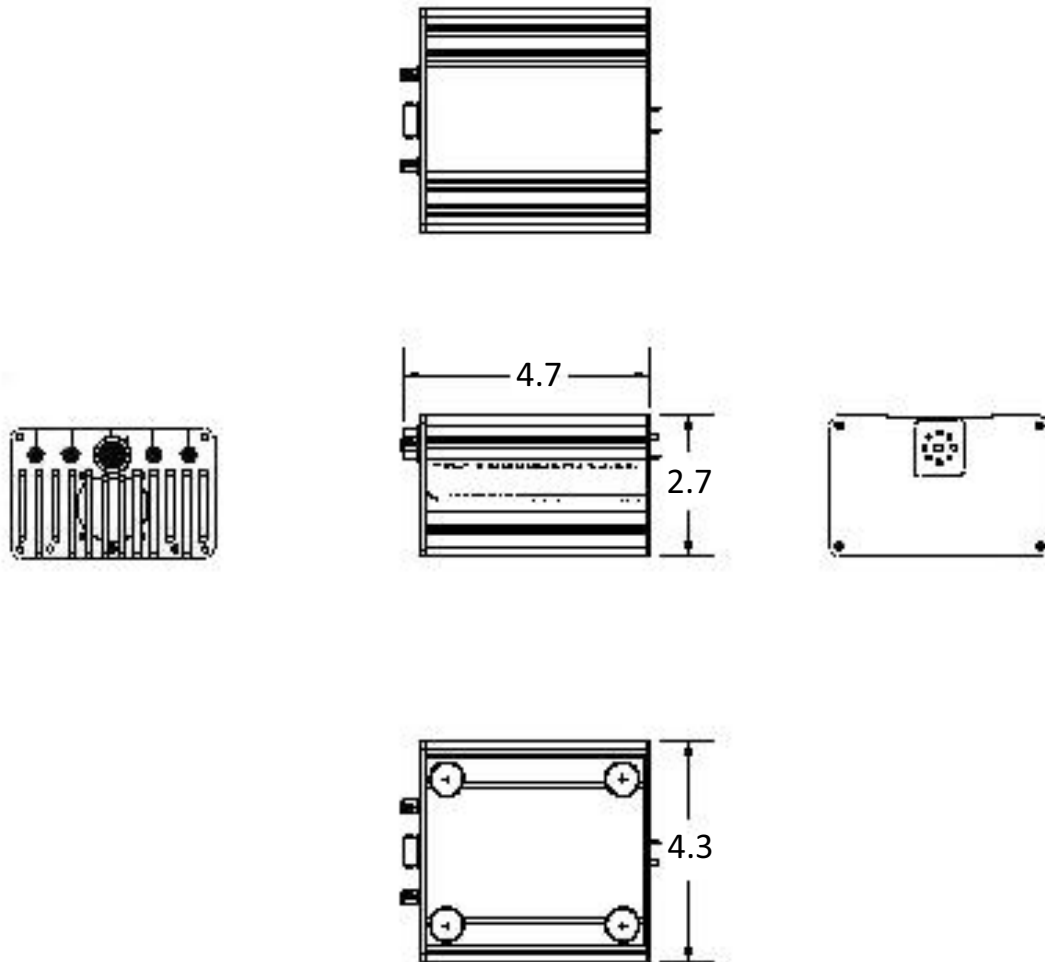


Figure 14 VNA2-T Series Modules



Safety and Regulatory Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument.

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Safety Earth Ground

WARNING **This is a Safety Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be only be inserted in a socket outlet provided with a protective 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.**

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Agilent Technologies web site at
<http://regulations.corporate.agilent.com/DoC/search.htm>

Statement of Compliance

This instrument has been designed and tested in accordance with CAN/CSA 22.2 No. 61010-1-04, UL Std No. 61010-1 (2nd Edition).

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

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 The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

CAUTION This product is designed for use in Installation Category II and Pollution Degree.

CAUTION Before switching on this instrument, make sure the supply voltage is in the specified range.

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

CAUTION Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

Servicing

WARNING These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

WARNING Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.

WARNING For continued protection against fire hazard replace line fuse only with same type and rating. The use of other fuses or material is prohibited.

WARNING These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

WARNING The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before opening.

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

WARNING The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).

Connector Care and Cleaning Precautions

Remove the power cord to the instrument. To clean the connectors use alcohol in a well ventilated area. Allow all residual alcohol moisture to evaporate, and fumes to dissipate prior to energizing the instrument.

WARNING To prevent electrical shock, disconnect the **“Agilent Technologies N5256/7/8A Millimeter-wave Modules”** from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

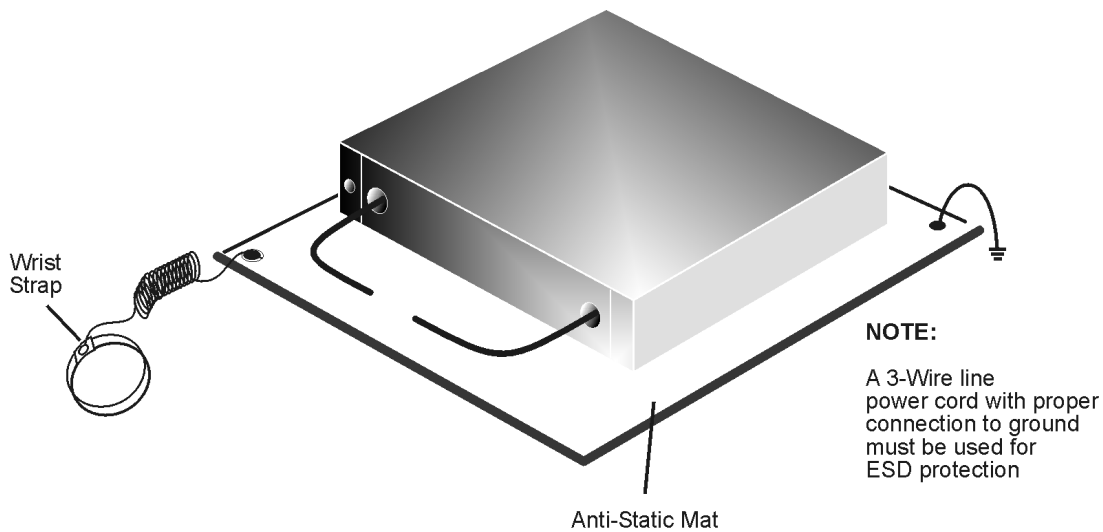
WARNING If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.

Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the instrument. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat in front of your test equipment.
- *always* wear a grounded wrist strap with grounding cord, connected to a grounded conductive table mat, having a 1 M Ω resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:
 1. Connect a short to one end of the cable to short the center conductor to the outer conductor.
 2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
 3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 15 ESD Protection Setup



ku310b

Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings



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 indicates that the instrument requires alternating current (ac) input.



This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).



This symbol indicates that the power line switch is ON.



This symbol indicates that the power line switch is in the STANDBY position.



This symbol indicates that the power line switch is in the OFF position.



This symbol is used to identify a terminal which is internally connected to the product frame or chassis.



The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)



The CSA mark is a registered trademark of the CSA International. This instrument complies with Canada: CSA 22.2 No. 61010-1-04.



This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 54)



This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).



Direct Current.



The instrument has been designed to meet the requirements of IP 2 0 for ingress and operational environment.



This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.



This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

Battery Collection

Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Agilent Technologies for disposal. Refer to [“Contacting Agilent” on page 28](#) for assistance.

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrrordnung-3. GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA<70 dB	Lpa<70 dB
Operator Position	am Arbeitsplatz
Normal Operation	normaler Betrieb
per ISO 7779	nach DIN 45635 t .19

EMC Information

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

Agilent Support, Services, and Assistance

Service and Support Options

The standard warranty is a *one-year return to Agilent Technologies service warranty*.

NOTE A periodic calibration is not required for millimeter-wave modules.

Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Internet at:

<http://www.agilent.com/find/assist>

You can also purchase accessories or documentation items on the Internet at:

<http://www.agilent.com/find>

If you do not have access to the Internet, contact your field engineer.

NOTE In any correspondence or telephone conversation, refer to the Agilent product by its model number and full serial number. With this information, the Agilent representative can determine the warranty status of your unit.

Shipping Your Millimeter Module to Agilent for Service or Repair

This product will be repaired by the vendor. Repair time may be greater than 45 days due to part availability.

If you wish to send your module to Agilent Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Refer to the Agilent model and serial number on the bottom of the module.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Agilent for instructions on where to ship your analyzer.