Operating and Service Manual

Agilent N9355B/C/F and N9356B/C
Power Limiter

Agilent Technologies

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Notices

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General Information

Power Limiter Overview

The Agilent N9355/6 series limiter is an instrument accessory that can be used to protect input circuitry from transients and accidental overloads.

The power limiters cover frequencies up to 50 GHz and provide two different limiting thresholds, 10 dBm and 25 dBm (except N9355F, which provides a limiting threshold of 10 dBm only). Table 1 lists the five models of power limiters available.

Table 1 List of Power Limiters

Model	Frequency Range	Typical Limiting Threshold	Connector Type
N9355B	10 MHz to 18 GHz	10 dBm	Type N (m), (f)
N9355C	10 MHz to 26.5 GHz	10 dBm	3.5 mm (m), (f)
N9355F	10 MHz to 50 GHz	10 dBm	2.4 mm (m), (f)
N9356B	10 MHz to 18 GHz	25 dBm	Type N (m), (f)
N9356C	10 MHz to 26.5 GHz	25 dBm	3.5 mm (m), (f)

Features

- Broad frequency range up to 50 GHz maximizes the operating range of your instrument.
- High power protection prevents damage by undesired ESD and excess RF power.
- Exceptional return loss improves calibration accuracy.
- Low insertion loss maximizes available power.
- Bi-directional utilization eliminates orientation errors.
- Integrated DC block provides protection from DC transients.

Specifications

Specifications refer to the performance standards or limits against which the power limiters are 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 italics.

Table 2 RF Specifications for N9355B and N9356B Power Limiters

Agilent Model Number	N9355B	N9356B
Frequency Range	10 MHz to 18 GHz	
Insertion Loss	<1.75 dB	
Return Loss (VSWR)[1]	>15 dB (1.43)	
Maximum Continuous Input Power	1 W	6 W
Limiting Threshold	*10 dBm (typical)*	*25 dBm (typical)*
Maximum Leakage Power[2]	24 dBm	27 dBm
Maximum DC Voltage		
@25°C	30V	
@85°C	16V	
Turn On Time	<100 ps	
Impedance	*50 Ohm (nominal)*	
Dimension		
Length	3.236 in. (82.2 mm)	
Diameter	1.189 in. (30.2 mm)	
Connectors[3]	Type N	

1. Return loss specification from 10 MHz to 30 MHz is 8.5 dB (VSWR 2.2).
2. At maximum continuous power.
3. Device is suitable for bilateral operation. Input and output ports may be interchanged.

Table 3 RF Specifications for N9355C and N9356C Power Limiters

Agilent Model Number	N9355C	N9356C
Frequency Range	10 MHz to 26.5 GHz	
Insertion Loss	<2.00 dB	<2.25 dB
Return Loss (VSWR)[1]	>15 dB (1.43)	
Maximum Continuous Input Power	1 W	4 W
Limiting Threshold	*10 dBm (typical)*	*25 dBm (typical)*
Maximum Leakage Power[2]	24 dBm	27 dBm
Maximum DC Voltage		
@25°C	30V	
@85°C	16V	
Turn On Time	<100 ps	
Impedance	*50 Ohm (nominal)*	
Dimension		
Length	2.17 in. (55.2 mm)	
Diameter	0.55 in. (14.0 mm)	
Connectors[3]	3.5 mm	

1. Return loss specification from 10 MHz to 30 MHz is 8.5 dB (VSWR 2.2).
2. At maximum continuous power.
3. Device is suitable for bilateral operation. Input and output ports may be interchanged.

Table 4 RF Specifications for N9355F Power Limiter

Agilent Model Number	N9355F
Frequency Range	10 MHz to 50 GHz
Insertion Loss	<2.00 dB (10 MHz to 26.5 GHz) <2.75 dB (26.5 GHz to 40 GHz) <3.50 dB (40 GHz to 50 GHz)
Return Loss (VSWR)[1]	>10 dB (1.92)
Maximum Continuous Input Power	0.63 W
Limiting Threshold	*10 dBm (typical)*
Maximum Leakage Power[2]	24 dBm
Maximum DC Voltage	
@25°C	30V
@85°C	16V
Turn On Time	<100 ps
Impedance	*50 Ohm (nominal)*
Dimension	
Length	1.870 in. (47.5 mm)
Diameter	0.634 in. (16.1 mm)
Connectors[3]	2.4 mm

1. Return loss specification from 10 MHz to 30 MHz is 8.5 dB (VSWR 2.2).
2. At maximum continuous power.
3. Device is suitable for bilateral operation. Input and output ports may be interchanged.

Figure 1 illustrates the typical insertion loss and return loss of N9355B and N9356B below the limiting threshold.

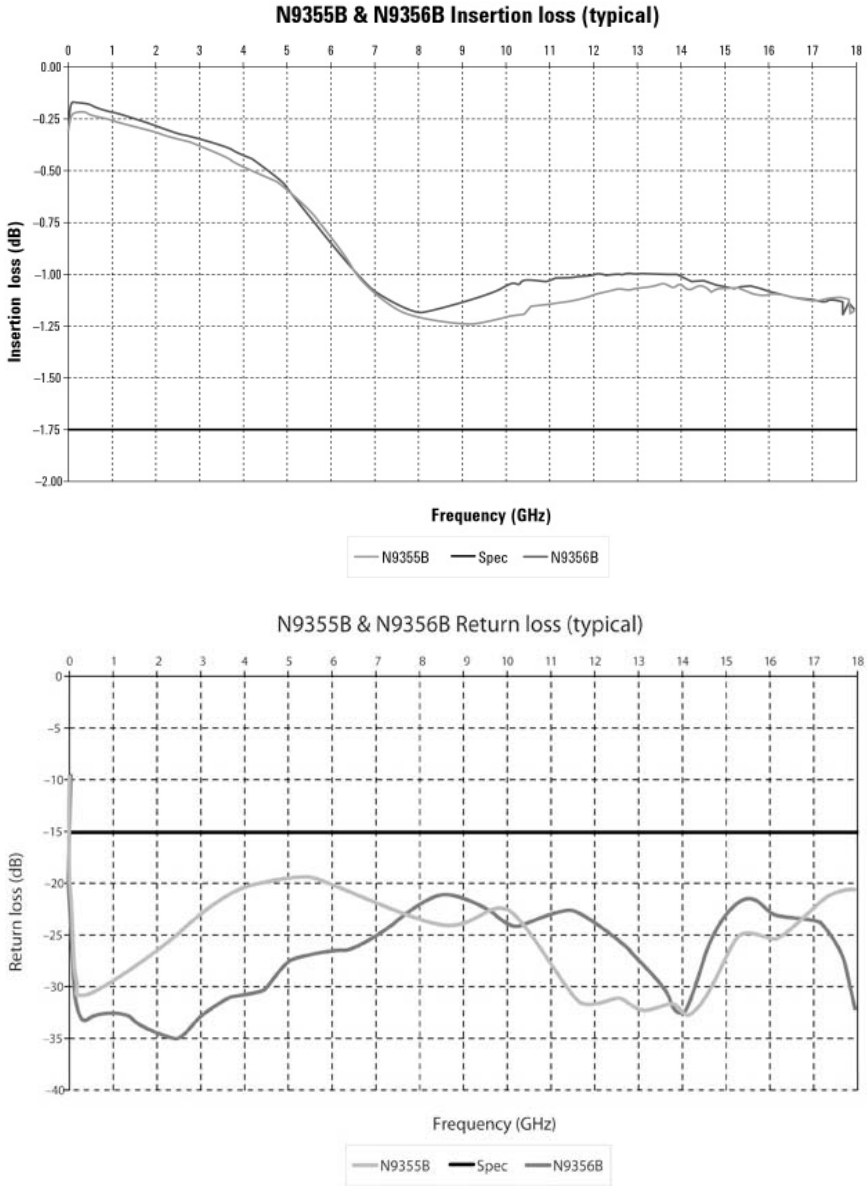

Figure 1 Typical Insertion Loss and Return Loss of N9355B and N9356B

Figure 2 illustrates the typical insertion loss and return loss of N9355C and N9356C below the limiting threshold.

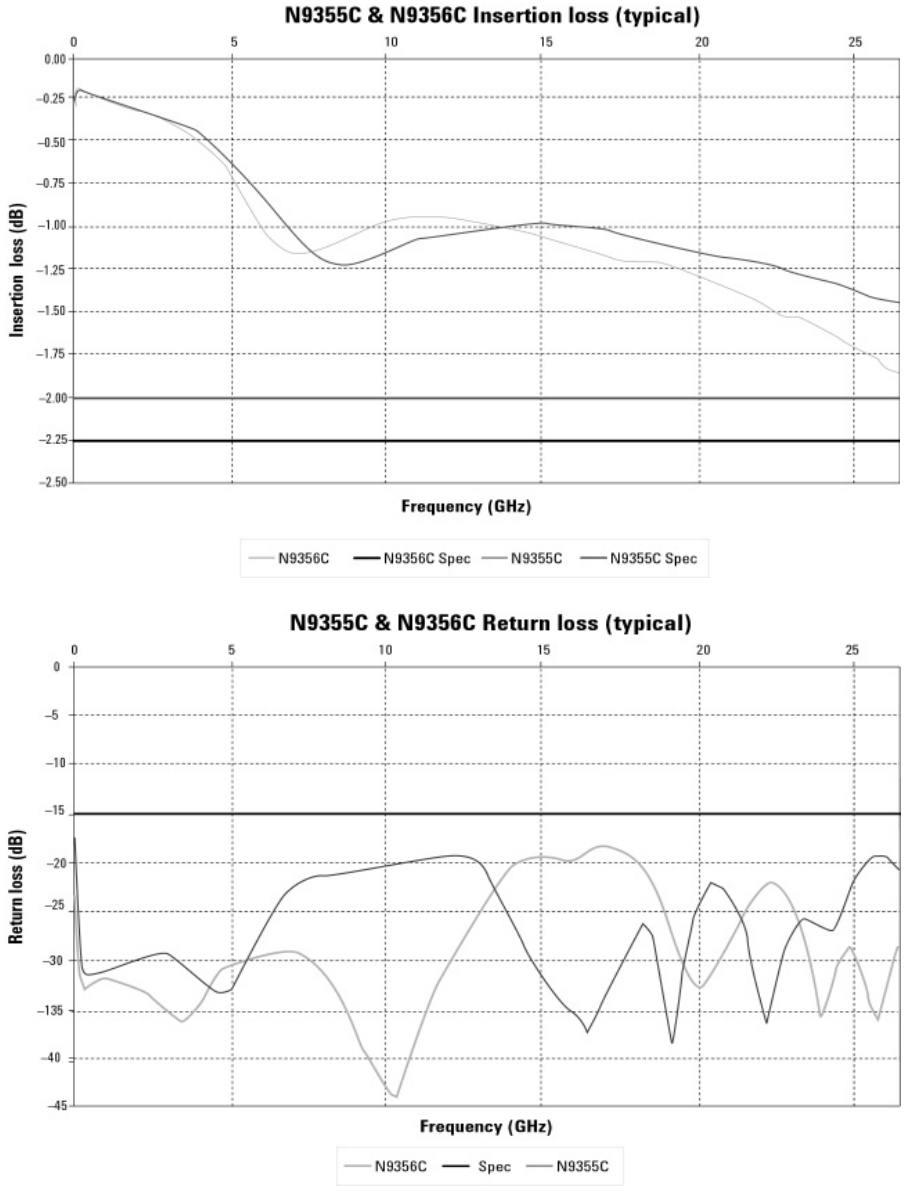

Figure 2 Typical Insertion Loss and Return Loss of N9355C and N9356C

Figure 3 illustrates the typical insertion loss and return loss of N9355F below the limiting threshold.

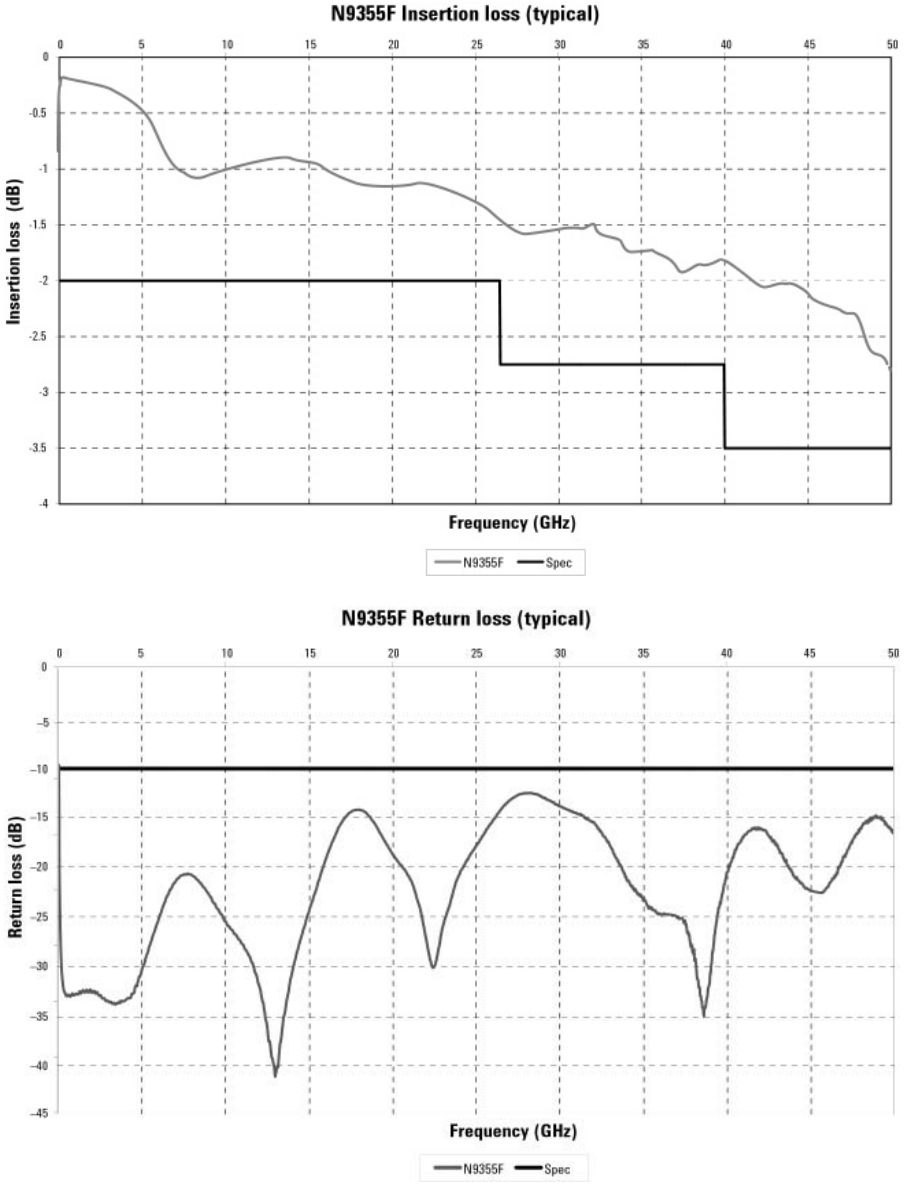

Figure 3 Typical Insertion Loss and Return Loss of N9355F

Power limiting is non-linear and depends on the input power and the ambient temperature. The typical measurements shown on Figure 4 are measured at ambient temperature of 25°C.

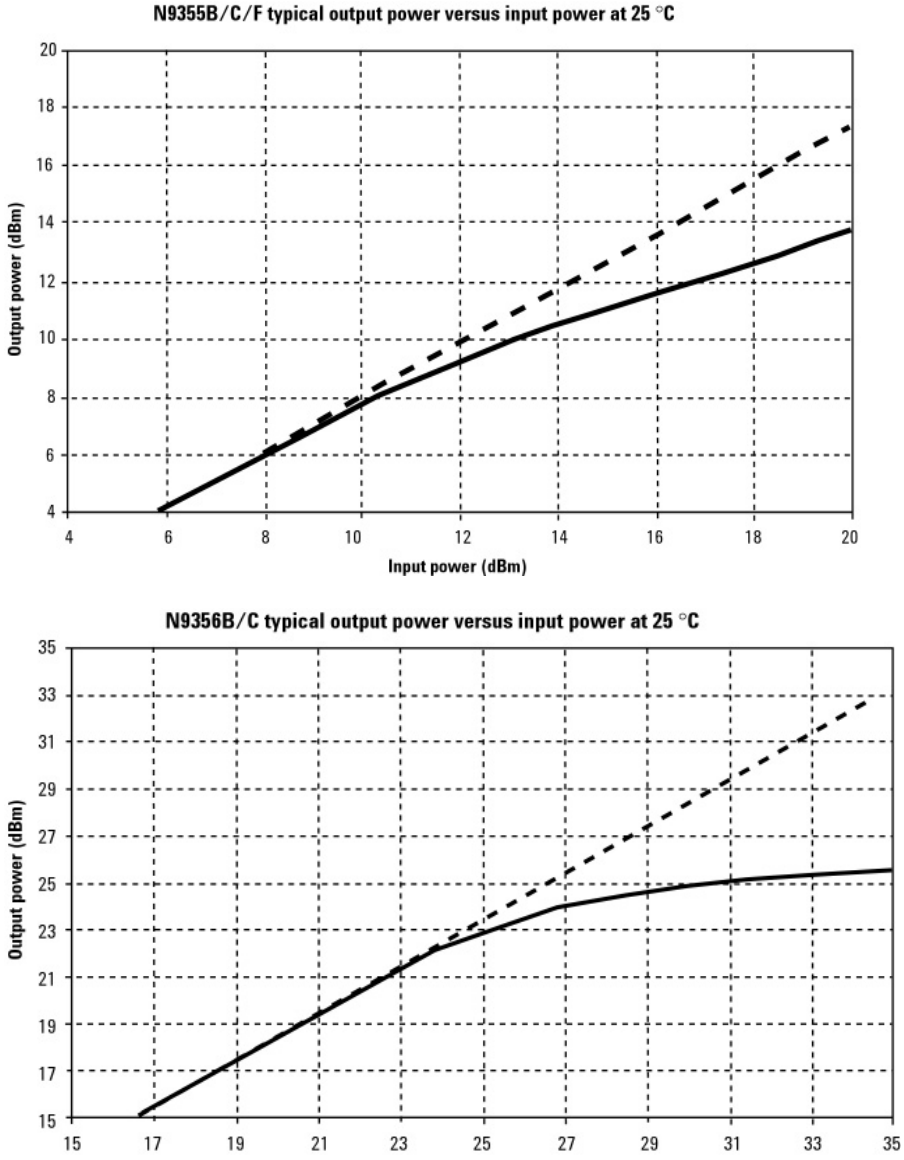

Figure 4 Typical Output Power Versus Input Power

Environmental Specifications

The N9355B/C/F and N9356B/C power limiters are designed to fully comply with Agilent Technologies' product environmental specifications as shown in Table 5.

Table 5 N9355B/C/F and N9356B/C Power Limiters Environmental Specifications

Temperature:	
Operating	0°C to +55°C
Storage	-40°C to +70°C
Cycling	-65°C to +150°C, 10 cycles @ 20°C per minute, 20 minutes dwell time per MIL-STD-833F, Method 1010.8, Condition C (modified)
Humidity:	
Operating	50% to 95% RH at 40°C, one 24 hour cycle, repeated 5 times
Storage	<95% RH at 40°C, 5 days
Shock:	
Half-sine, smoothed	1000 G @ 0.5 ms, 3 shock pulses per orientation, 18 total per MIL-STD-833F, Method 2002.4, Condition B (modified)
Vibration:	
Broadband random	50 to 2000 Hz, 7.0 G rms, 15 minutes, per MIL-STD-833F, Method 2026-1 (modified)
Altitude:	
Storage	<4,600 meters (15,000 feet)
ESD Immunity:	
Center Contact Discharge	2 kV for N9355B/C/F per MIL-STD-883B 6 kV for N9356B/C per IEC 61000-4-2

Installation

Initial Inspection

1. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically.

- Check for mechanical damage such as scratches or dents.
- Procedures for checking electrical performance are given under “Operator’s Check” or “Performance Tests’.

2. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Agilent Technologies Sales and Service office. Refer to the Service and Support information 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 Service and Support information in the front matter of this manual for the Agilent Technologies nearest 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 model number and serial number.

Operating Instruction

Operator's Check

The operator's check is supplied to allow the operator to make a quick check on the power limiters prior to use or if a failure is suspected.

CAUTION DO NOT apply more than 1W average power for N9355B/C, 0.63W average power for N9355F, 6W average power for N9356B and 4W average power for N9356C. Permanent damage to the limiter's diodes could result.

Description

All four s-parameters of the power limiter are measured using a network analyzer that is already calibrated with the necessary settings. The equipment setup is as illustrated in Figure 5.

NOTE The power limiter is a bidirectional device, incident power can be applied to either port. Therefore both S12 and S21 can be measured.

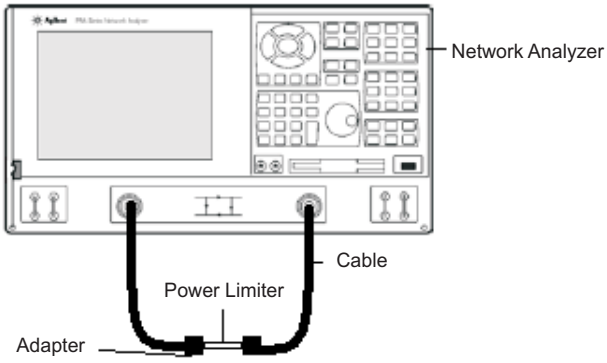

Figure 5 Equipment Setup to Measure S-Parameter

The limiting threshold of the power limiter can be measured using a signal source, a power sensor, a power meter and an attenuator as illustrated in Figure 6.

NOTE Please check the maximum input power of the power sensor. If the output power from the power limiter exceeds the maximum input power of the power sensor, an attenuator is required to avoid damaging the power sensor.

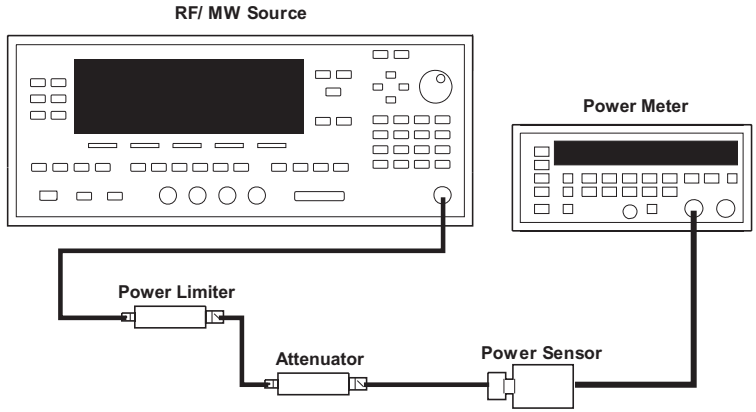

Figure 6 Equipment Setup to Measure Limiting Threshold

S-Parameter Measurement

Quick-Check Procedure

Use correct cables and adapters on the test ports of the network analyzer. Refer to Figure 5 for equipment setup.

1. Calibrate a network analyzer using appropriate settings and setup if necessary.
2. Measure the S21 or/and S12 of the power limiter. Compare with the specification to verify its electrical performance.
3. Measure the S11 and S22 of the power limiter. Compare with the specification to verify its electrical performance.

Limiting Threshold Meausurement

Quick-Check Procedure

In order to verify the limiting specifications listed in Table 2, Table 3 and Table 4, refer to Figure 6 for equipment setup.

1 Increase signal source power slowly from below 10 dBm to 30 dBm for N9355B/C/F, or from 25 dBm to 35 dBm for N9356B/C, and observe the output power.

2 Compare your results with the graphs in Figure 4.

NOTE If an attenuator is added to your equipment setup in measuring limiting threshold, add the attenuation value to the power meter reading to get the actual measured power.

Performance Tests

The power limiters can be tested to the accuracy of the specifications with a network analyzer, power meter or equivalent equipment of suitable accuracy. If a network analyzer or power meter are available, refer to the procedures in the respective instrument's operating manual to test the instruments.

Service Instructions

Repair

The N9355B/C/F and N9356B/C power limiters are not recommended for repair as all parts are not easily removed. Repair efforts will cost more than a replacement power limiter.

Maintenance

The connectors, particularly the connector faces, must be kept clean.

For instructions on connector care, refer to the Microwave Connector Care Quick Reference Card (08510-90360).

Replacement Parts

Table 6 lists the replacement parts for Agilent N9355B/C/F and N9356B/C power limiters.

Table 6 Replacement Parts for N9355B/C/F and N9356B/C

Description	Agilent Part Number	Qty
Replacement item for N9355B	N9355-66001	1
Replacement item for N9355C	N9355-66002	1
Replacement item for N9355F	N9355-66003	1
Replacement item for N9356B	N9356-66001	1
Replacement item for N9356C	N9356-66002	1