Agilent CSA Spectrum Analyzer Stimulus/Response Measurement Suite N8995A

Technical Overview

The Agilent CSA spectrum analyzer has an optional built-in signal source and a VSWR bridge that can add powerful scalar analysis capability for stimulus/response measurements from 10 MHz to 3.0 GHz or 6.0 GHz. With the stimulus/response measurement suite, the spectrum analyzer allows you to easily and accurately measure transmission and reflection characteristics of one-port and two-port devices such as amplifiers, filters, cables, and antenna feed line systems.

Features

- Frequency range: 10 MHz to 3 GHz or 10 MHz to 6 GHz
- Internal VSWR bridge

The Agilent CSA spectrum analyzer with the optional stimulus/response measurement suite provides a broad range of testing capabilities across a variety of field and production applications including:

- Installation and maintenance
  - Wireless base stations
  - Very small aperture terminal satellites (VSAT)
  - Military and aerospace field equipment
  - TV/radio
  - Surveillance
  - Public safety
  - RF cables
  - Antenna and feed lines
- Manufacturing
  - Production line equipment verification
  - Component test
- General lab use
- University laboratory use

The stimulus/response measurement suite consists of:

- Two-port insertion loss
- One-port insertion loss
- Return loss
- Distance-to-fault

Cable Measurements

In wireless communication systems, cables, antennas, and other accessories often cause problems. To rapidly and accurately determine the distance to defects in RF cables, the distance-to-fault measurement gives an immediate overview of the state of the device under test (return loss or VSWR data versus distance).

Distance-to-fault is a one-button test in the stimulus/response measurement suite. It implements a frequency domain reflectometry (FDR) measurement technique to precisely identify and locate signal path degradations in devices, such as antenna feed line systems and connectors. The one-button operation simplifies problem detection resulting from physical deterioration, fasteners pinching cables, or antenna systems that are out of specification. Distance-to-fault is a very important diagnostic measurement tool and a valuable method for base station maintenance.

Cable Loss Measurements Beyond Distance-to-fault

The Agilent CSA spectrum analyzer and stimulus/response measurement suite can play an integral role in your overall system maintenance and service plan.

A normal transmission measurement usually does not allow for the determination of cable loss on long, already installed cables, since the cable cannot simply be connected between the signal source output and the RF input of the spectrum analyzer. However, the stimulus/response measurement suite's one-port insertion loss measurement provides this function. One end of the cable is connected to the spectrum analyzer's RF output, and the other end is terminated with a short or simply left open.

In cable and antenna measurements, signal reflections—caused by poorly matched cables, damaged cables, or faulty antennas—are measured. Signal reflection measurements can be viewed as voltage standing wave ratio (VSWR) or return loss with the Agilent CSA spectrum analyzer.

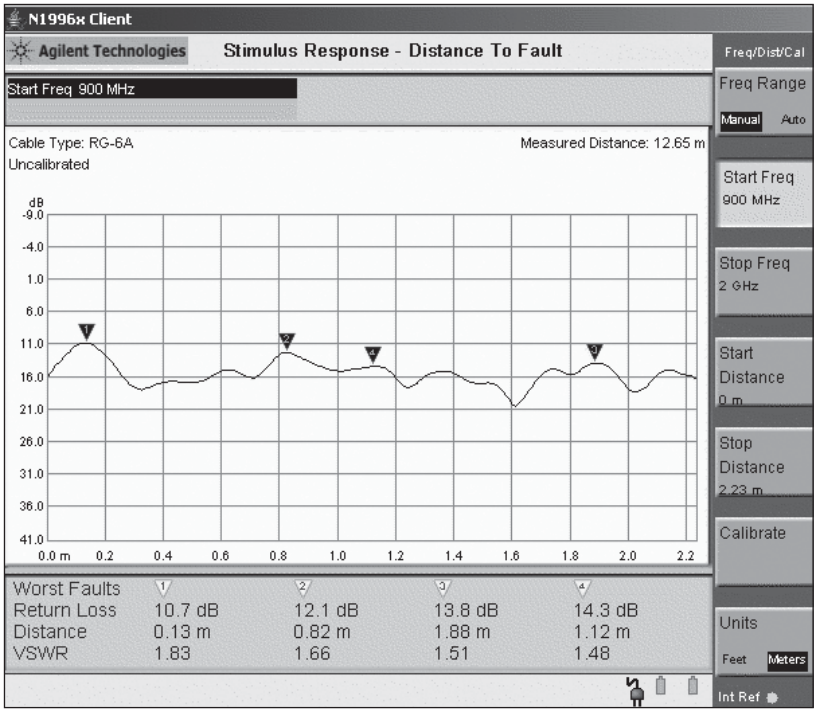

Figure 1. Distance-to-fault measurement

Figure 2. Insertion loss measurement

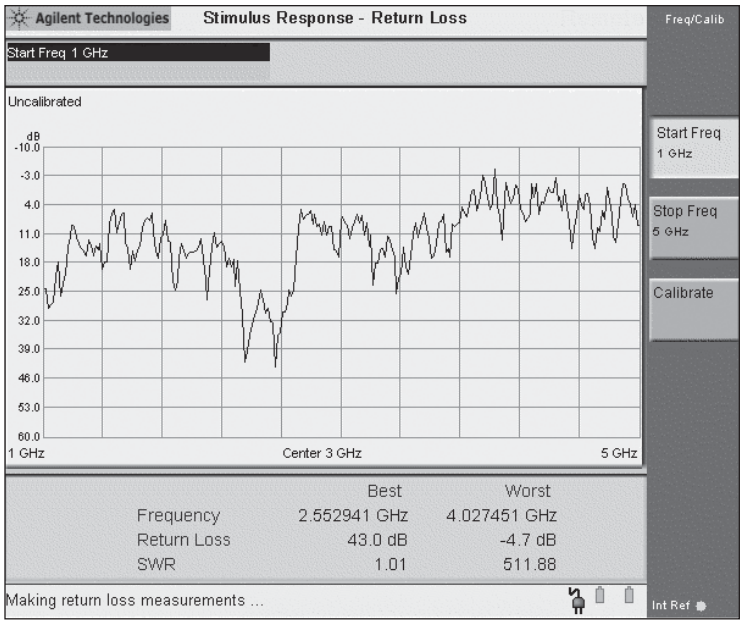

Figure 3. Return loss measurement

Tracking return loss degradations and potential cable faults will help maintenance engineers and managers optimize their transmitter performance by eliminating poorly performing components, thereby reducing down time. Ultimately, these capabilities result in improved quality of service and increased customer satisfaction.

Cost Effective Device Characterization Measurements

Usually during development or equipment inspection, any frequency selective devices such as amplifiers, filters, attenuators, cables, etc. are characterized by their performance versus frequency. Additional loss must be accounted for when measuring these kinds of devices. For example, a jumper cable placed between the Agilent CSA spectrum analyzer and the antenna feed line (or other device) will add some loss to the measurement. This is known as insertion loss.

Insertion loss measurements are important to accurately quantify the amount of loss a signal will incur as it passes through a cable, attenuator, or any other device. A vector network analyzer can perform high-end swept frequency measurements to determine insertion loss and phase response. However, this type of solution is very expensive. When the required characteristic is simply amplitude versus frequency, the Agilent CSA spectrum analyzer, with stimulus/response measurement suite, is a simple and cost effective alternative.

The Best Compact Spectrum Analyzer with Integrated Signal Source and VSWR Bridge

The combination of a spectrum analyzer and a signal source is a very difficult thing to engineer because of the extreme shielding and signal isolation required. The Agilent CSA spectrum analyzer exhibits new design innovations for high-performance and reliability in a low-cost solution. Figure 4 illustrates integrated RF/LO receiver, signal source, and VSWR bridge on one board.

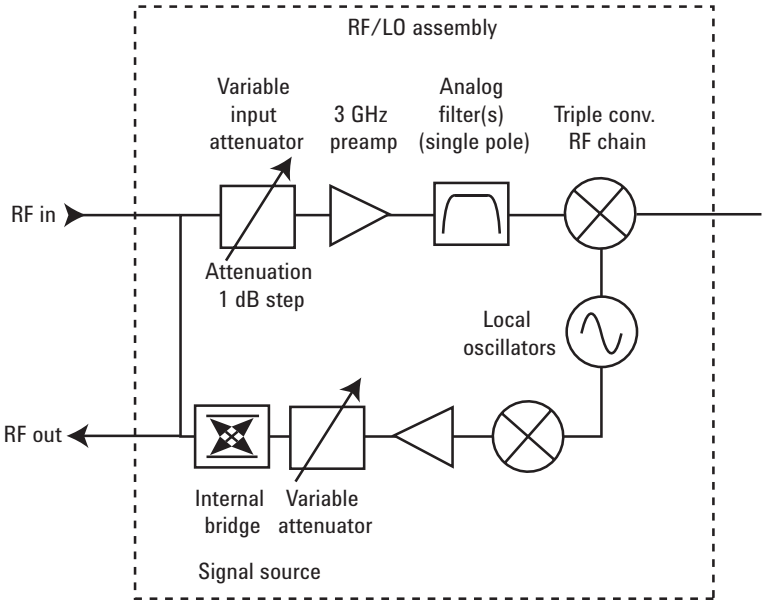

Figure 4. Highly integrated RF/LO board with internal signal source and bridge

Easy-to-Use Applications Reduce Technical Training

The built-in test diagrams help technicians step through the calibration/normalization and measurement process. The friendly graphical user interface minimizes the need for training and helps technicians master the instrument and get their work done efficiently.

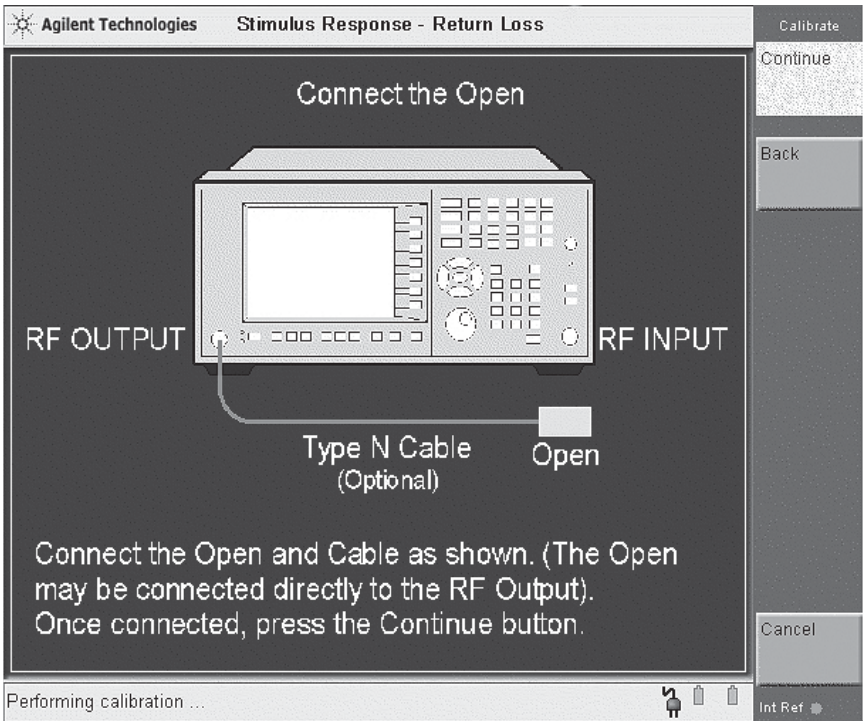

Figure 5. Screen shot of calibration help diagram

To avoid errors in fault location and eliminate uncertainty factors, precision calibration parameters must be considered or modified according to specific propagation velocity assumptions for distance-to-fault calculation and return loss measurements. The Agilent CSA spectrum analyzer provides several industry-standard cable setups that have been specified by cable manufacturers. It can also be customized by modifying parameters like the propagation velocity factor and cable attenuation (loss per meter or foot of cable).

Recommended Calibration Kit

The stimulus/response calibration kit (Option SRK) includes the open, short, and load necessary to perform distance-to-fault, return loss, and insertion loss measurements.

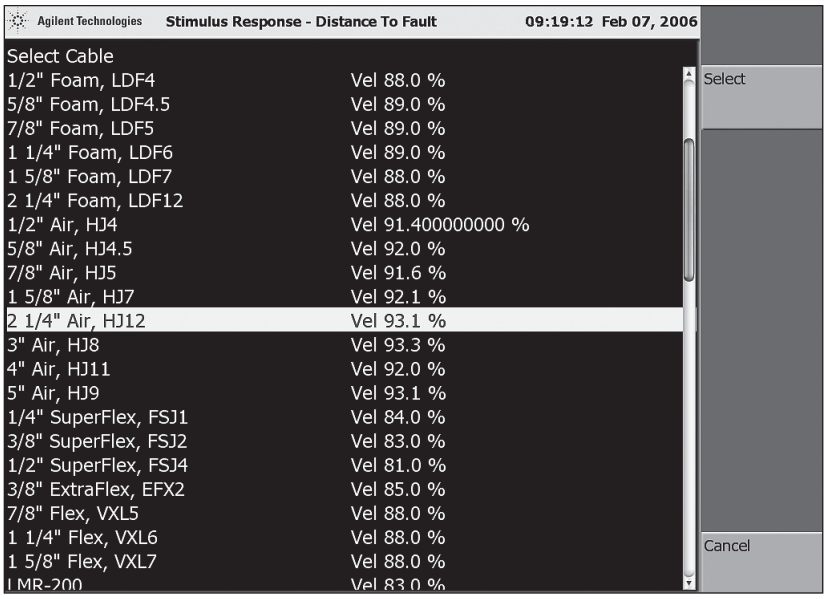

Figure 6. Built-in cable type selection for measurement setup

Required Product Options

N1996A-503	Frequency range 100 kHz to 3 GHz
N8995A-SR3	Stimulus/response suite 10 MHz to 3 GHz
N1996A-506	Frequency range 100 kHz to 6 GHz
N8995A-SR6	Stimulus/response suite 10 MHz to 6 GHz
N1996A-SRK	Stimulus/response calibration kit

N8995A Stimulus/Response Measurement Suite Specifications

Stimulus/response

Frequency range	
Option SR3	10 MHz to 3 GHz
Option SR6	10 MHz to 6 GHz
Frequency resolution	60 Hz nominal

Return loss (RF output)

Range (≥ 4 averages)			
10 MHz to 2 GHz	> 49 dB nominal		
2 GHz to 3 GHz	> 46 dB nominal		
3 GHz to 6 GHz	> 40 dB nominal		
Resolution	0.1 dB		
Display range	-5 dB to +150 dB		
SWR range	1 to 500		
Accuracy (nominal) range	< 2 GHz	< 3 GHz	< 6 GHz
Return loss from 5 dB to 10 dB	± 0.2 dB	± 0.2 dB	± 0.4 dB
Return loss from 10 dB to 20 dB	± 0.3 dB	± 0.5 dB	± 0.9 dB
Return loss from 20 dB to 30 dB	± 0.9 dB	± 1.3 dB	± 2.4 dB

Insertion loss (RF output to RF input) range

10 MHz to 3 GHz	> 70 dB nominal		
3 GHz to 5 GHz	> 50 dB nominal		
5 GHz to 6 GHz	> 25 dB nominal		
Source level range	-30 dBm to -15 dBm		
Accuracy due to limited isolation			
Frequency range	< 3 GHz	< 5 GHz	< 6 GHz
DUT[1] insertion loss 10 dB	± 0.0 dB	± 0.1 dB	± 1.4 dB
DUT insertion loss 20 dB	± 0.0 dB	± 0.3 dB	± 3.9 dB
DUT insertion loss 30 dB	± 0.1 dB	± 0.8 dB	
DUT insertion loss 40 dB	± 0.3 dB	± 2.4 dB	
DUT insertion loss 50 dB	± 0.8 dB		
Accuracy due to imperfect match			
Frequency range	< 3 GHz	< 6 GHz	
DUT return loss 5 dB	± 1.0 dB	± 1.6 dB	
DUT return loss 10 dB	± 0.5 dB	± 0.9 dB	
DUT return loss 20 dB	± 0.2 dB	± 0.3 dB	
DUT return loss 30 dB	± 0.1 dB	± 0.1 dB	

Distance-to-fault (RF output)

Range	1 m to 300 m
Resolution	$(1.5 \times 10^8)(VF)/(f_2 - f_1)$ Hz, where VF = velocity factor (typically 1% of measurement distance)
VSWR	1 to 500

1. DUT means device under test.

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Latin America:
(tel) (305) 269 7500

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

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

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