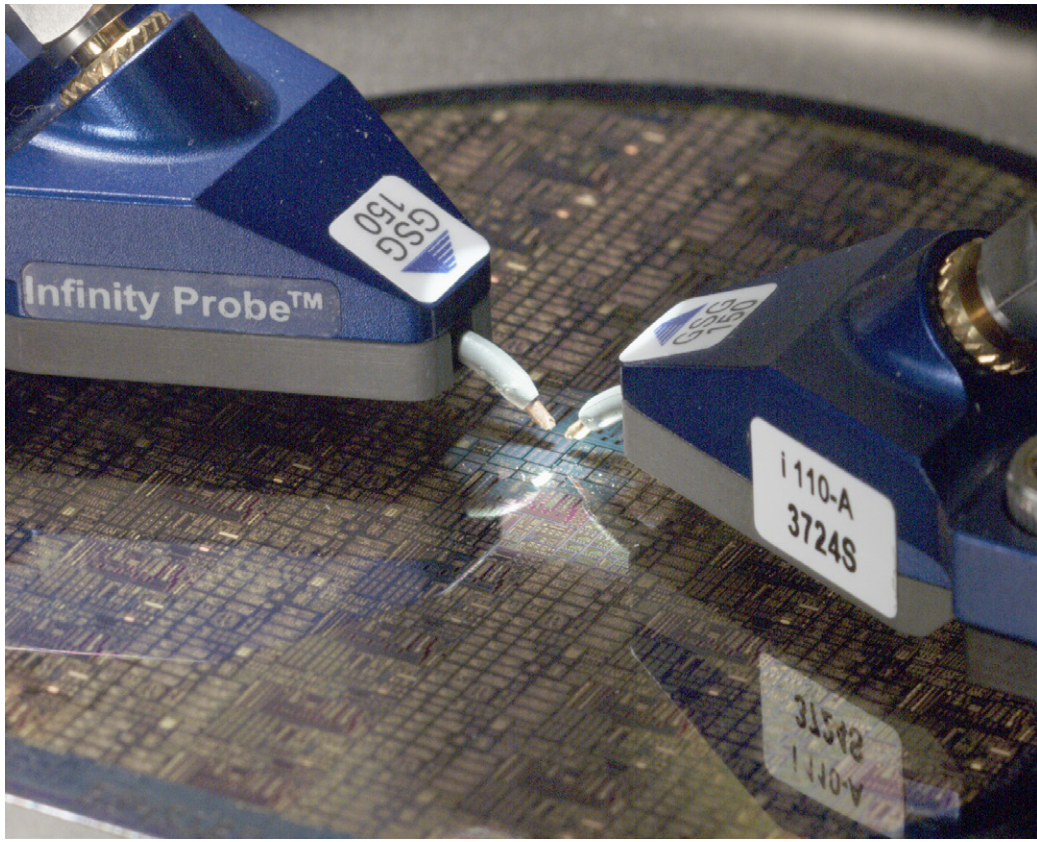
Four Functions that Enhance Your Network Analysis

eBook

KEYSIGHT

INTRODUCTION

Gone are the days of simple design and straightforward test. Smaller, more integrated devices drive up R&D and manufacturing device test times, slowing your time to market. Tests requiring multiple instruments and fixtured test methods are inevitable, and these tests slow R&D and manufacturing test to a crawl. Setting up, configuring, and calibrating multiple instruments is a complex, expensive, and slow process that can take hours just to execute one test on one device.



There is a better way.

A network analyzer that performs multiple accurate measurements on a single connection saves time and simplifies your processes. Advanced network analyzer capabilities and options can help you stay ahead of the curve characterizing modern devices.

Explore how the following advanced network analyzer functions enable you to meet the challenges of modern device test:

- Time domain
- Spectrum analysis
- Gain compression
- Automatic fixture removal

Contents

Advanced Network Analysis

SECTION 1

Time Domain Reflectometry

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Time Domain Reflectometry

As digital system bit rates increase, interconnect signal integrity drastically impacts system performance. Fast and accurate analysis of interconnect performance in both the time and frequency domains becomes critical to ensure reliable system performance. There's no need to spend time and effort switching to an oscilloscope for your time domain characterization. Instead, use your network analyzer's Time Domain Reflectometry (TDR) function to convert frequency domain measurements to the time domain with an Inverse Fourier Transform.

TDR on your network analyzer unlocks powerful methods for investigating your devices.

Fault Location – In a frequency domain response, you can see ripples due to mismatches, but you cannot see where the reflections are occurring in your cable or device. Switching to the time domain helps you see the physical location of mismatches, cable bends, or other physical defects.

Impedance Measurements – The reflection coefficient, S11, of a device is proportional to the input impedance of the device. In the time domain, the S11 of each device in a system can be viewed as a response to an impulse or step function. This time domain response provides the position and actual impedance of each circuit component.

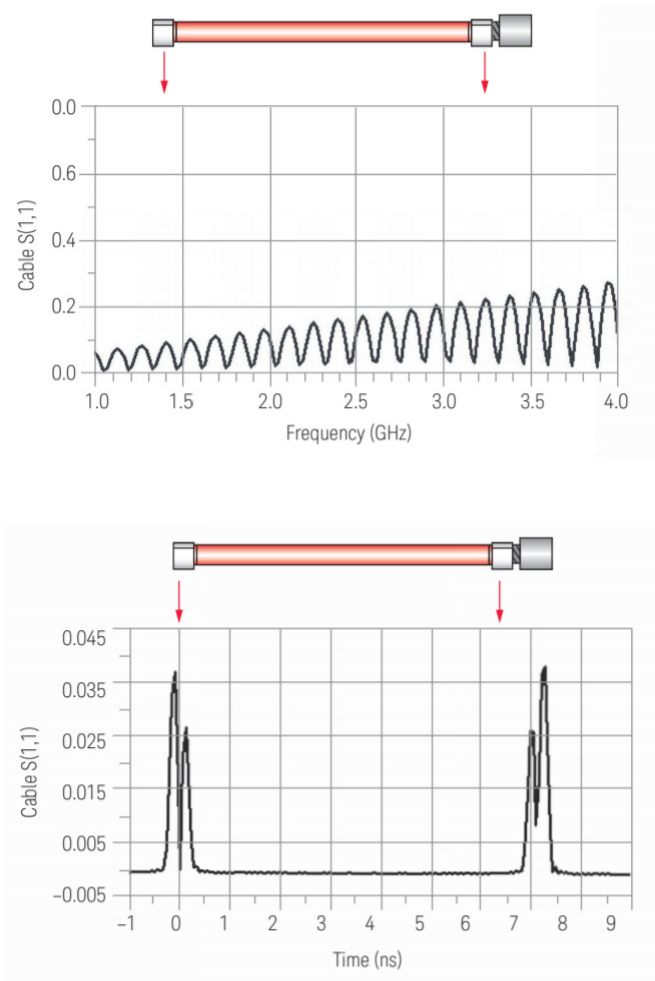

Figure 1. Mismatch between connectors and cable

Learn More

Application note:
Time Domain Analysis Using a Network Analyzer

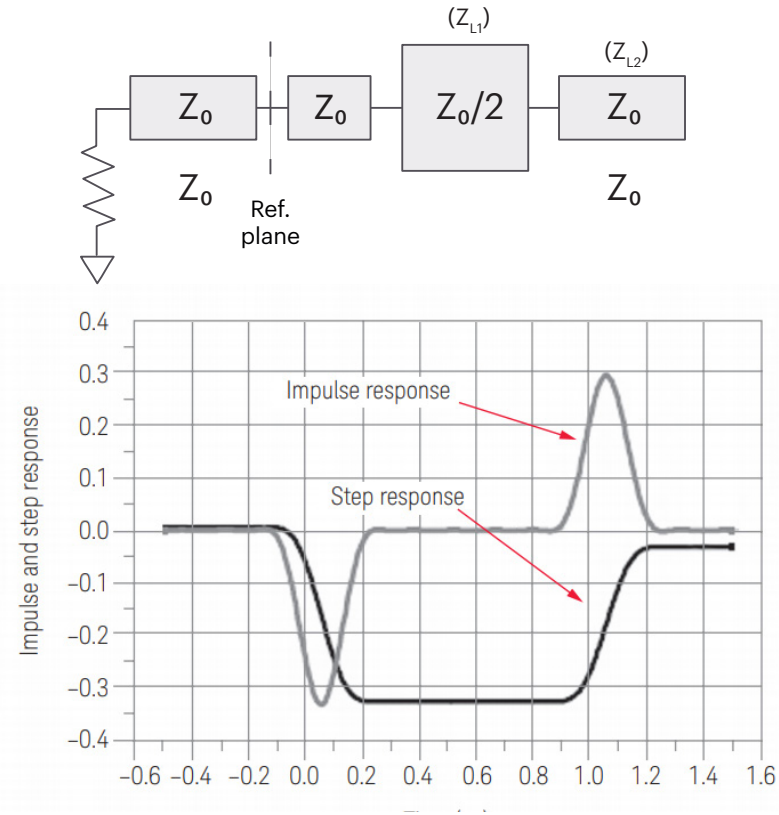

Figure 2. Low-pass step and impulse responses of impedance changes

TDR relies on DC extrapolation from low frequency data points. For the most accurate DC extrapolation, use an ECal module with a DC option.

Gating – When you are designing and troubleshooting an assembly, selectively removing reflection and transmission responses simplifies your analysis by letting you focus only on the response of interest. Gating in the time domain enables you to see the response of each component individually for easier designing and debugging.

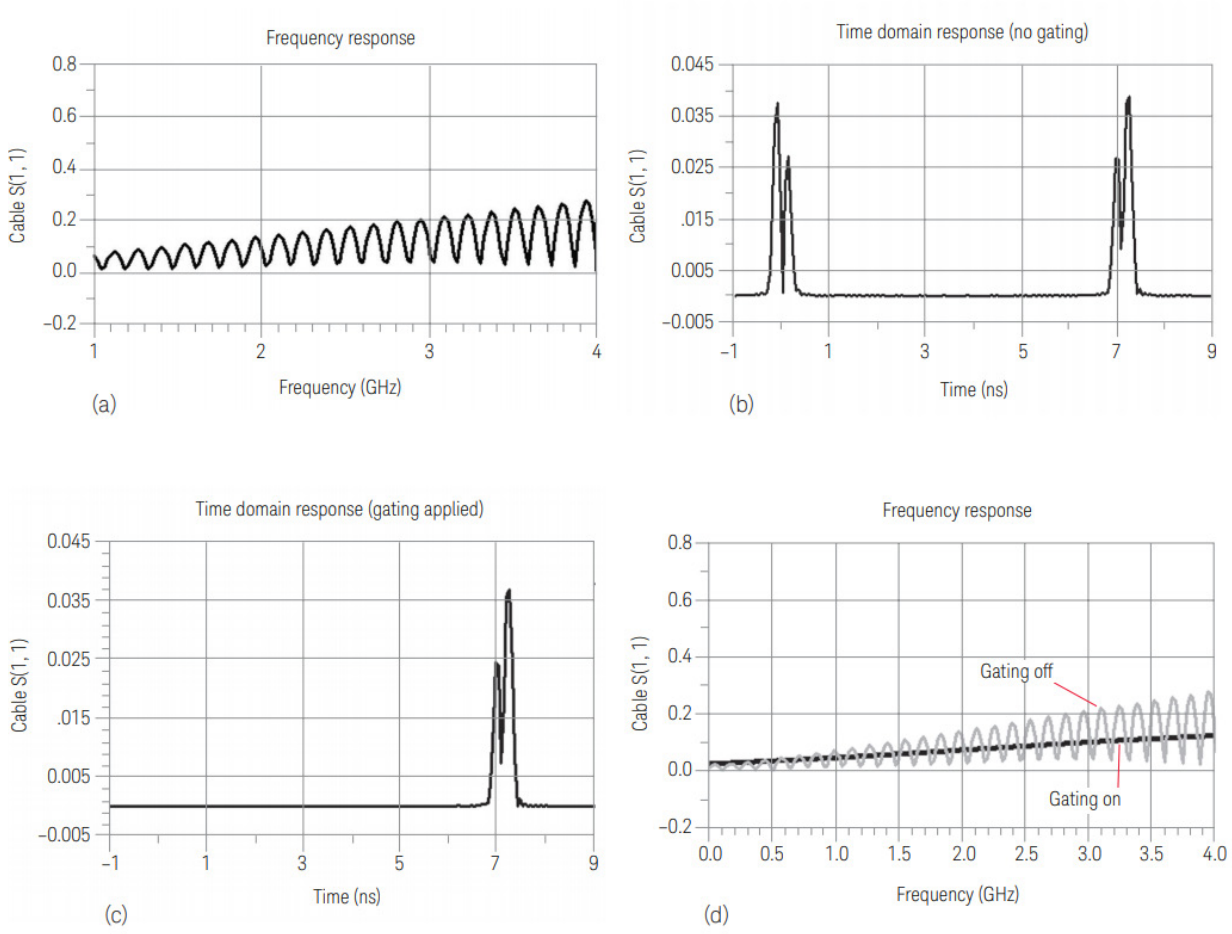

Figure 3. Sequence of gating to remove the response of a discontinuity

You can also simulate real-world operating conditions with eye diagram tests and jitter simulation on an active device. Testing your device or circuit with real-world stimuli minimizes your design iterations by providing early insights into how the finished product will perform.

SECTION 2

Spectrum Analysis

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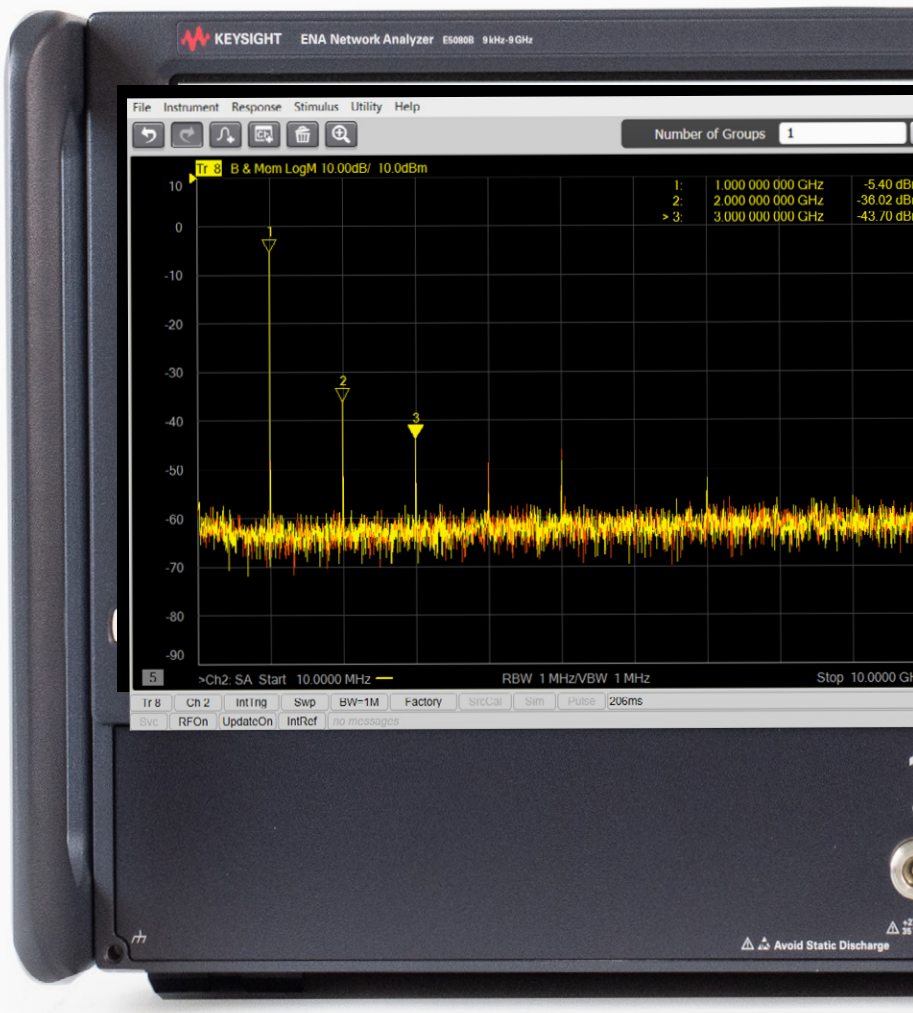
Spectrum Analysis

Modern device development often involves both network and spectrum analysis. A spur from an out-of-band signal can cause errors in network analyzer measurements, especially on devices with gain. Spurs can come from many sources and can be difficult to pinpoint. Searching for spurs has traditionally been done with a spectrum analyzer and a signal generator. Performing the spur search with an external spectrum analyzer takes time – you need to connect your device to the signal analyzer and signal generator, then sweep and search for spurs.

You can eliminate switching time and complex hardware setups by performing spectrum analysis on your network analyzer. Modern network analyzers contain powerful processors, accurate sources, and excellent receivers. These features make network analyzers versatile enough to provide fast and accurate spur searches. Keep in mind, spectrum analysis within a network analyzer helps with debugging, but a standalone spectrum analyzer is required for complete spectrum and pre-compliance testing.

With a spectrum analysis-enabled network analyzer, you can quickly investigate anomalies by simultaneously viewing both spectrum and network measurements on your network analyzer. Viewing the spectrum and network outputs of your device under test, based on the same stimulus, helps you debug faster without setting up a second instrument.



Learn More

- Application Note: *Spectrum Analysis Basics*
- Webcast: *Spectrum Analysis Fundamentals*

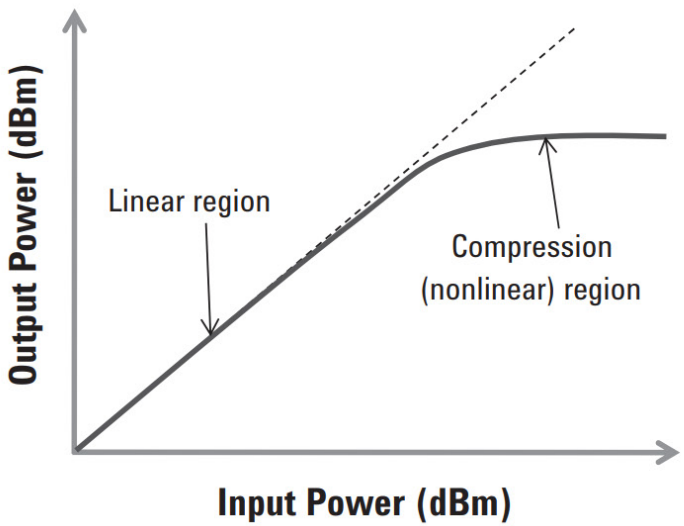
SECTION 3

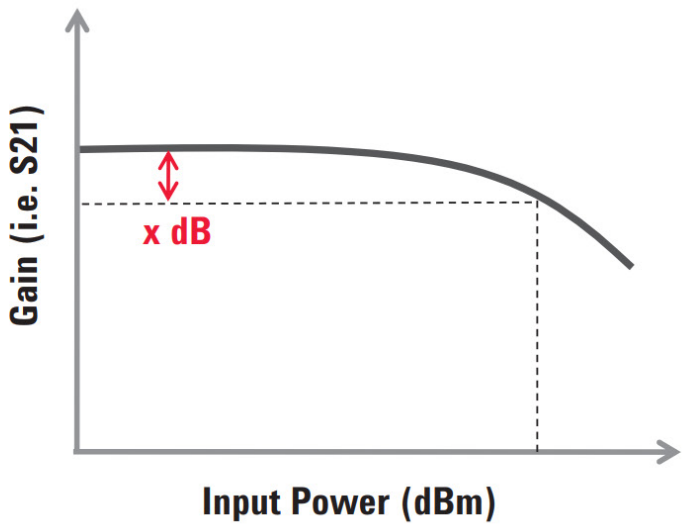
Gain Compression

Gain Compression

Gain compression defines the point in an amplifier where the output of a device no longer follows linear gain and becomes nonlinear (compressed). This critical specification for amplifiers must be measured across the entire operating frequency range to ensure reliable operation.

Devices with wide frequency ranges require many frequency and power data points for gain compression characterization. Setting up measurements and manipulating data involves significant operator intervention. Tedious compression measurements increase test time and introduce sources of error. As higher frequencies in the millimeter wave range become mainstream, you need the ability to quickly characterize over wide frequency ranges.





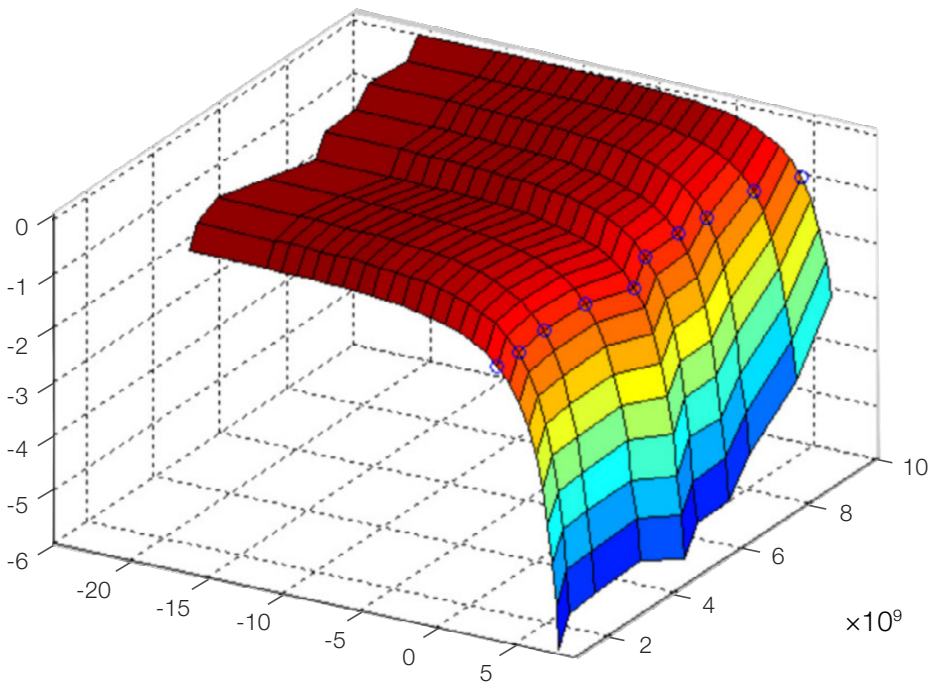
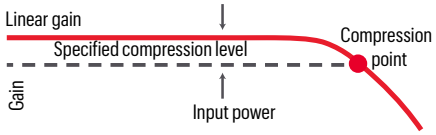


Figure 4. 3D visualization of compression points across a frequency range

A gain compression application provides fast and accurate automated compression measurements. Automating the measurement and the analysis provides consistent results and allows you to measure more compression methods in less time.

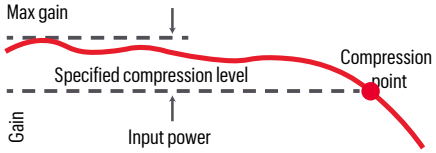
Compression from linear gain

The linear gain is measured using the specific linear (input) power level. The compression point is calculated as the linear gain minus the specified compression level.



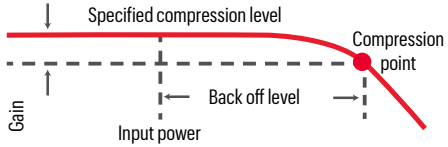
Compression from max gain

The highest gain value that is found at each frequency is used as the max gain. The compression point is calculated as the max gain minus the specified compression level.



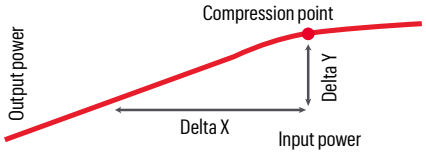
Compression from back off

The gains at two input powers that are different with the specified back off level are compared. The compression point is found as the highest input power with the gain difference of the spevcified compression level.



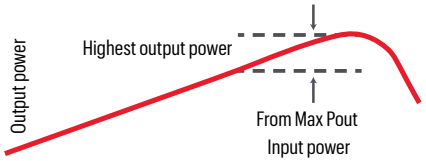
X/Y compression

The output powers at two input powers that are different with the specified delta X are compared. The compression point is found as the highest input power with the output power difference of the specified delta Y.



Compression from saturation

The compression point is found at the highest output power minus the value specified as "From Max Pout".



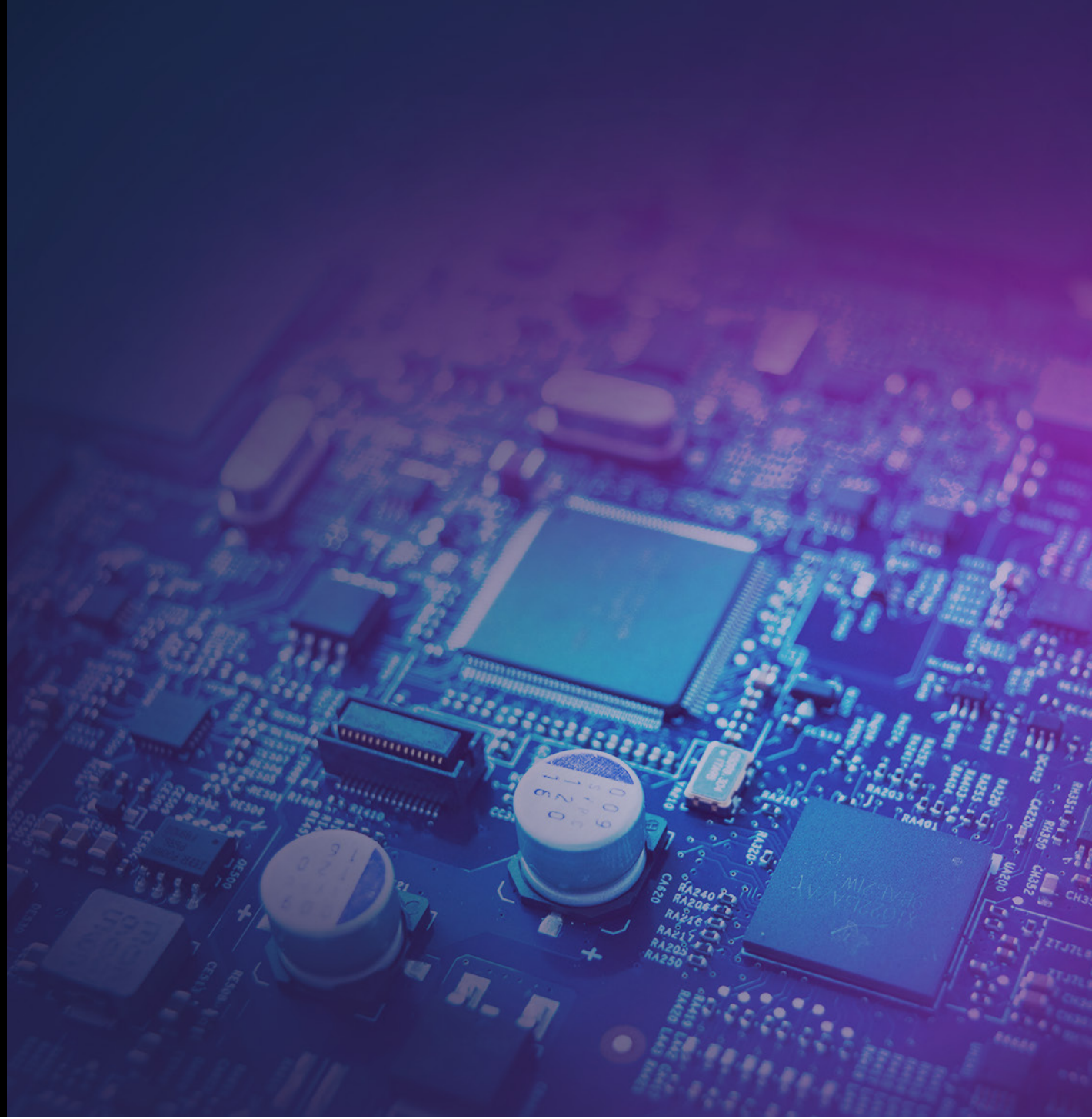
Automated compression measurements keep your devices safe from dangerous power levels. Adaptive sweeps gently increase power near a device's compression point to avoid overdriving it.

Learn More

Support: *What is Gain Compression?*

SECTION 4

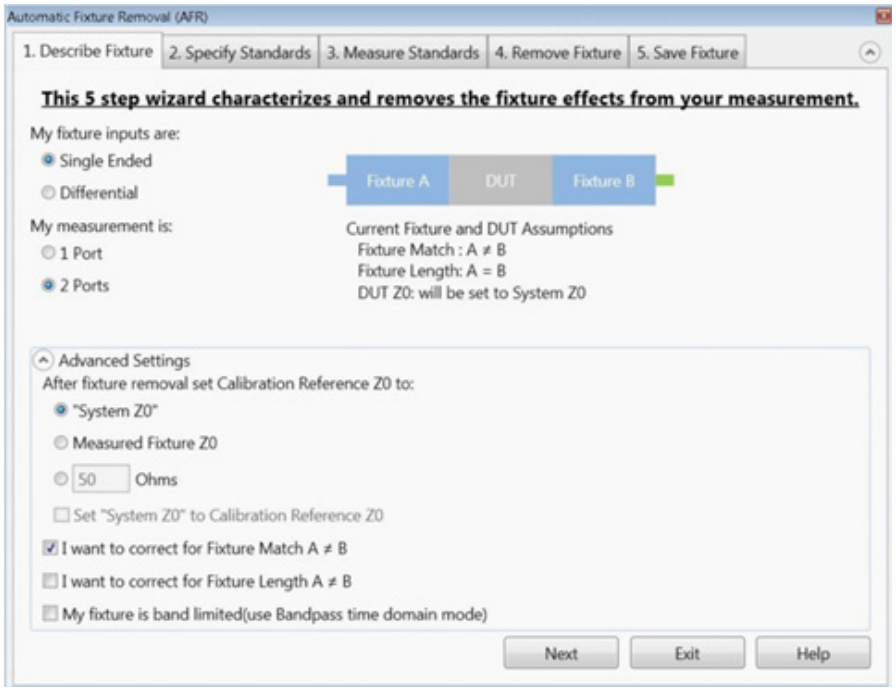
Automatic Fixture Removal



Automated Fixture Removal

Many modern devices do not have coaxial connections and require fixtures to connect to a coaxial instrument. You might need to use probes to measure on-wafer devices or clamp a small device into a coaxial adapter. Anything between your device and your instrument introduces uncertainty into your measurements, including fixtures. Tedious calibration steps to remove fixture effects slow down your measurements and require specialized calibration standards.

Automatic Fixture Removal provides a wizard to guide you through the setup, then performs all the measurements and correction for you. You can even export the de-embed files to immediately apply the fixture removal on other instruments.



Learn More

- Application Note: *Automatic Fixture Removal*
- Learn more about how automatic fixture removal simplifies de-embedding

SECTION 5

A New Class of Network Analyzers

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A New Class of Network Analyzers

When you need to test more than just S-parameters, let your network analyzer do the work for you. Instead of configuring separate instruments for time domain and spectrum analysis, simplify your setup by performing all your measurements with your network analyzer. Take the manual analysis and configuration out of gain compression, automatic fixture removal, and more with dedicated software applications.

These are just some of the many challenges that the new E5080B, P50xxA Series, and M980xA Series network analyzers are designed to meet. A wide range of software applications including spectrum analysis, noise figure, and pulsed-RF measurements provides a simple solution for your complex devices.

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