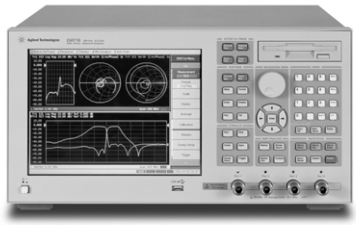
Improve the Circuit Evaluation Efficiency of Wireless LAN Chipset Design with the ENA Series Network Analyzer

Application Note



- **For WLAN Chipset Design the ENA is more than just a network analyzer.**
- **Efficient balanced device measurement without balun transfomers**
- **Efficient design improvement using built-in simulator: circuit embedding/de-embedding**
- **Ready to use on-wafer measurement solution with Cascade Microtech Probe System**

Introduction

A network analyzer is a necessary tool for wireless LAN (WLAN) chipset design, since there are so many components and circuits to be measured in the design process. A network analyzer is used not only to evaluate RF chips themselves but also to evaluate the RF circuits and components for evaluation boards.

The ENA series network analyzer is more than just a network analyzer in that the ENA provides very efficient balanced measurement. Balanced measurement is important in WLAN chipset design since the designers need to evaluate many kinds of balanced (differential) devices such as a low noise amplifier, a SAW filter, and transmission lines. Moreover, combining with the Cascade Microtech probe system, the ENA allows you to make accurate and efficient on-wafer balanced measurements as well as normal S-parameter measurements. (For details, see Additional Literature listed on next page, item 2.)

Other ENA functions useful for WLAN chipset design include matching circuit embedding/de-embedding and Touchstone data support for circuit simulation.

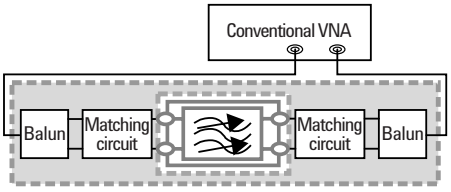


Figure 1. Conventional VNA test setup for balanced measurement

Problems of conventional method for balanced device evaluation

The conventional method of balanced device measurement using a network analyzer requires baluns (balanced-unbalanced transformers) and matching circuits. Figure 2 shows a typical balanced SAW filter measurement setup. They are necessary challenges: baluns limit measurement frequency range and designing actual matching circuits consumes valuable development time. Moreover, both of those external circuits introduce additional errors.

ENA balanced measurement solution

The ENA has a fixture simulator that can perform the balance-unbalance conversion and virtual arbitrary impedance matching by calculation. Therefore, you can get rid of baluns and actual matching circuits, which enables more efficient and accurate evaluation of balanced devices. As shown in Figure 2, a balanced measurement setup with the ENA is as simple as a normal S-parameter measurement.

A balanced amplifier measurement example is shown in Figure 3. The figure also shows two other features of the analyzer useful for WLAN chipset design, such as the powerful display capability and the built-in VBA automation. The ENA can display up to 16 traces per measurement channel, which significantly eases the evaluation of complicated devices like a balanced amplifier. The built-in VBA allows you to implement a special measurement function as if it were a standard analyzer function with simple programming. In this example, K-factor (stability factor) is displayed along with S-parameters.

Built-in Simulator enables accurate device evaluation by removing unwanted fixture effects

RF device evaluation often requires a fixture in order to connect the coaxial ports of the network analyzer to a device. For accurate device evaluation, unwanted fixture effects need to be removed.

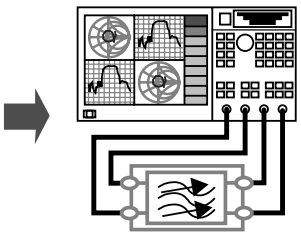


Figure 2. ENA Series test setup

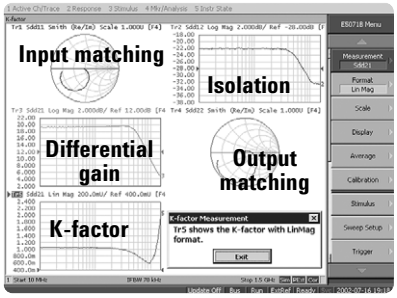


Figure 3. Balanced amplifier measurement example

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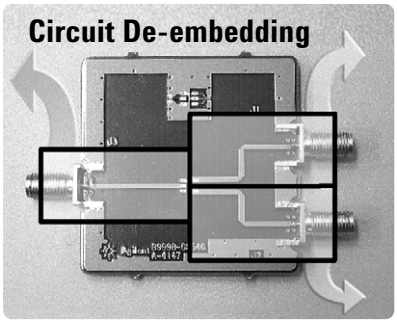

Figure 4. Fixture effect removal with circuit de-embedding

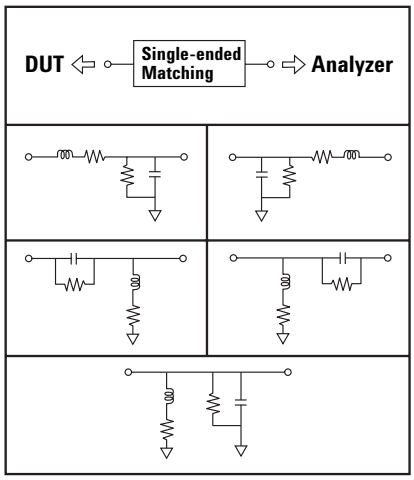

Figure 5. Matching circuits available for embedding

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The de-embedding function of the ENA's fixture simulator removes the unwanted fixture effects, according to the fixture characteristics given in 2x2 S-parameter Touchstone (.s2p) files, as shown in Figure 4. There are at least two ways for fixture characterization. One way is to use a circuit simulator like ADS. Another way is to characterize a fixture by actually measuring it with the ENA and the Cascade Microtech probe system. (For details, see item 4 of Additional Literature, listed below.)

Built-in fixture simulator facilitates design improvement

For circuit design improvement, a very useful feature of the ENA's built-in fixture simulator is that you can easily embed simple matching circuits to the measured circuit, which is particularly useful when designing evaluation boards. Figure 5 lists the matching circuits available for embedding. For example, you can see how the circuit would respond when a 1-pF shunt capacitor is added to the circuit; and the display is updated real-time when you change the matching circuits. In many cases, simple circuit simulation of this kind is enough for small design improvement, although more complicated simulation is required sometimes. The ENA supports the Touchstone format for data transfer to an external circuit simulator, such as ADS.

Additional Literature

Additional product and literature information can be found on the Agilent ENA Series Web site:
http://www.agilent.com/find/ena

For more information, please refer to the following literature:

1. *Agilent ENA Series Network Analyzer,* Product Overview
   Literature number 5988-3765EN
2. *Introduction to the Fixture Simulator Function of the ENA Series*
   Literature number 5988-4923EN
3. *On-wafer Multiport Calibration using the ENA Series with the Cascade Microtech Probe,*
   Literature number 5988-5886EN
4. *In-fixture Characterization using the ENA Series with the Cascade Microtech Probe,*
   Literature number 5988-6522EN)
5. *Evolution of Test Automation Using the Built-in VBA with the ENA Series*
   Literature number 5988-4923EN)

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