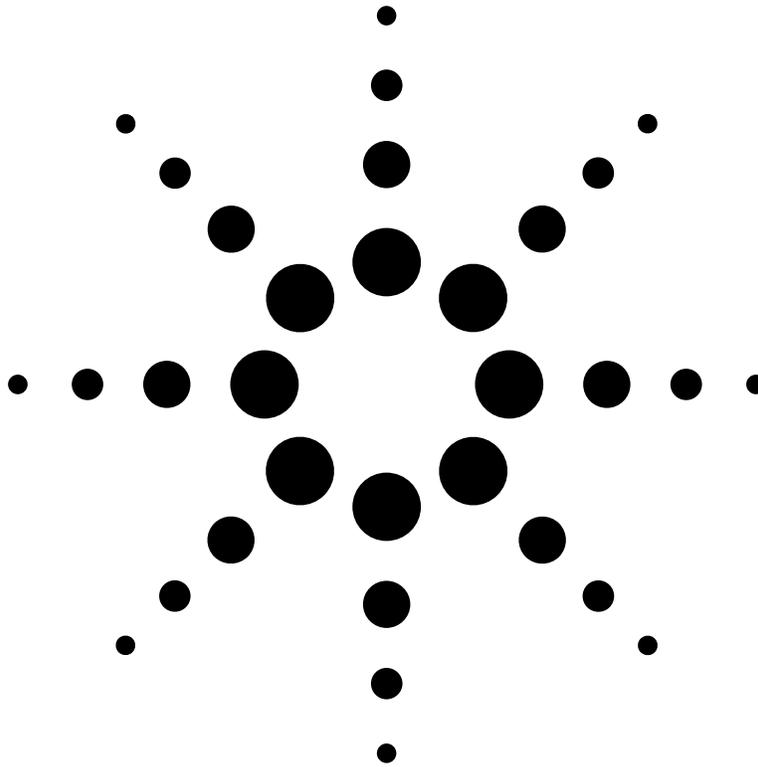


# **Agilent PNA Millimeter-Wave Network Analyzers: Analysis of Cable Length on VNA System Performance**

White Paper



Quite often, cables are used to interconnect a test fixture to the test port of a VNA. Physical layout of a system puts constrain on the length and shape of the interconnect cable. Compromises must be made between cable length, physical stress, power loss, system stability and measurement accuracy.

## Length and Physical Stress

---

Tight coaxial cable bends cause physical stress and impedance changes. These stress points are also the most susceptible to temperature changes and cause behavior instability. A longer cable with a more gentle bend may provide better stability.

## Length and Power Loss

---

Cable loss is proportional to length. If power level is not an issue, cable loss can actually improve the raw source and load match of a test port. The loss is calibrated out. It should have no impact on residual directivity, residual source match, residual reflection tracking and residual loadmatch. Residual transmission tracking should improve slightly due to better raw source and load match. This is illustrated by Figures 1 thru 5.

## Length and System Stability

---

People always assume that short length is better than long length. It is true that phase change with respect to temperature change is proportional to length. However, this is only one of the factors. If the cable needs to be moved or bend to make connections, short cables are more sensitive to such movements. The stress level on the cable's internal structure is inversely proportional to the bend radius. This is illustrated in Figure 6.

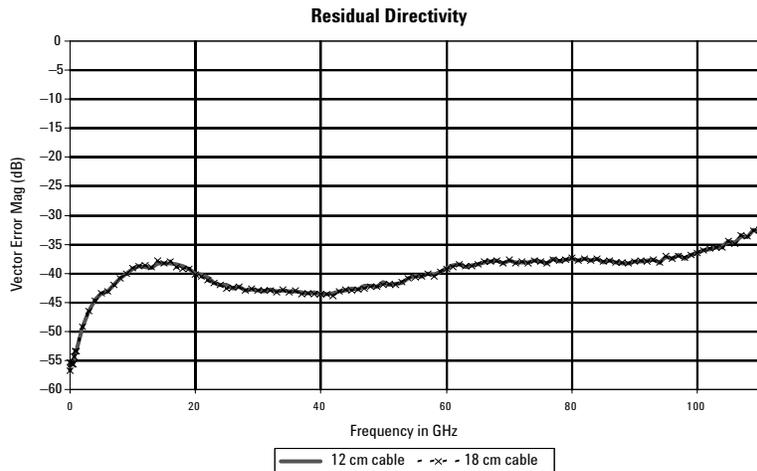


Figure 1. Comparison of residual directivity

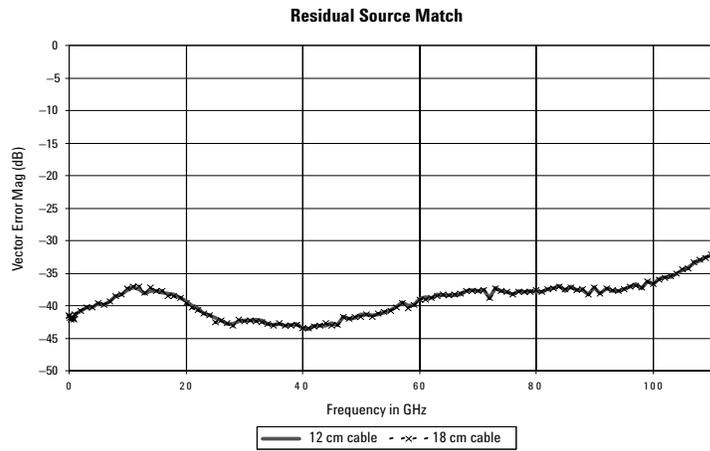


Figure 2. Residual source match compared

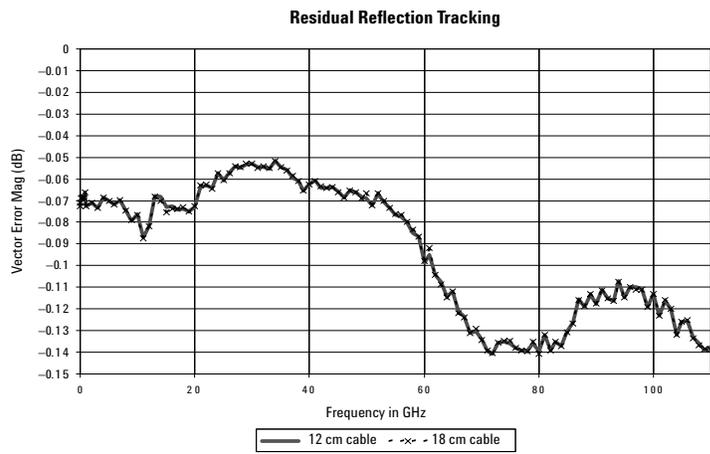


Figure 3. Residual reflection tracking compared

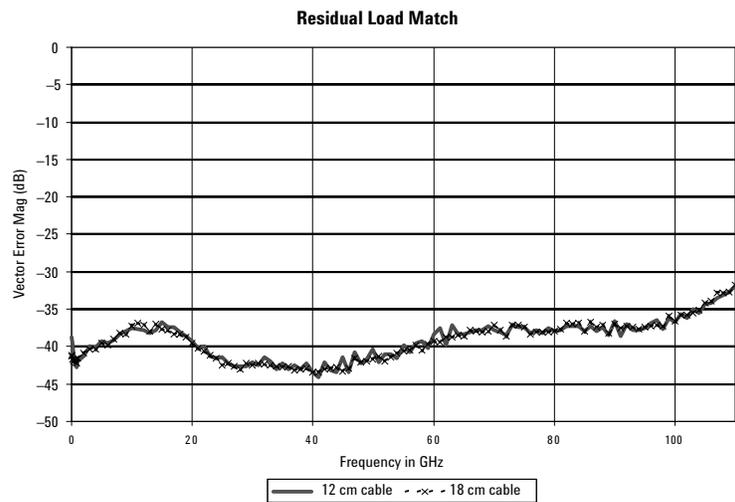


Figure 4. Residual load match compared

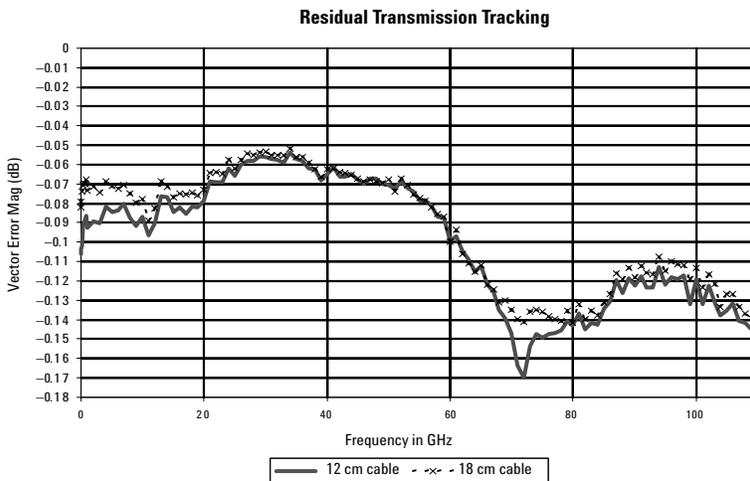


Figure 5. Residual transmission tracking compared

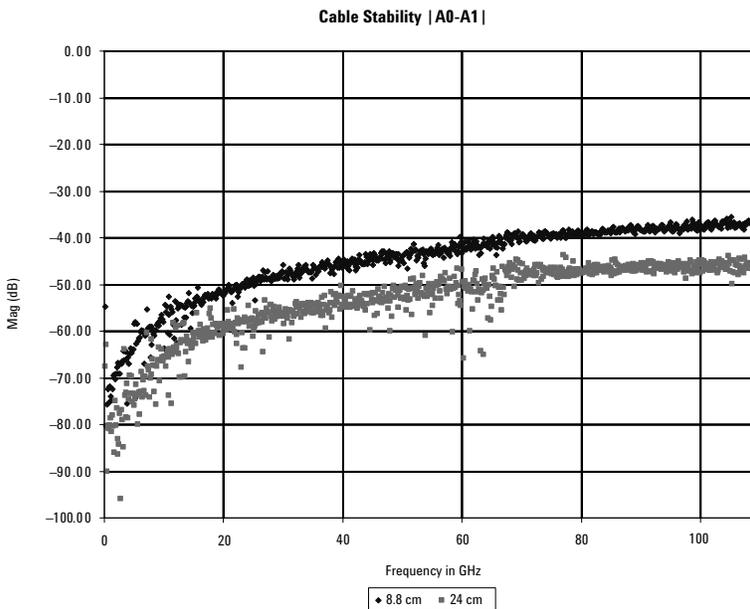


Figure 6. Vector magnitude change caused by a 1-inch movement at end of cable

## Web Resources

For additional PNA network analyzer product information and literature visit:

[www.agilent.com/find/pna](http://www.agilent.com/find/pna)

RF & MW test accessories:

[www.agilent.com/find/accessories](http://www.agilent.com/find/accessories)

### Agilent Technologies' Test and Measurement Support, Services, and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

#### Our Promise

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you receive your new Agilent equipment, we can help verify that it works properly and help with initial product operation.

#### Your Advantage

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and onsite education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

#### Agilent T&M Software and Connectivity

Agilent's Test and Measurement software and connectivity products, solutions and developer network allows you to take time out of connecting your instruments to your computer with tools based on PC standards, so you can focus on your tasks, not on your connections. Visit [www.agilent.com/find/connectivity](http://www.agilent.com/find/connectivity) for more information.

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

[www.agilent.com/find/contactus](http://www.agilent.com/find/contactus)

Product specifications and descriptions in this document subject to change without notice.

#### Phone or Fax

##### United States:

(tel) 800 829 4444  
(fax) 800 829 4433

##### Canada:

(tel) 877 894 4414  
(fax) 800 746 4866

##### China:

(tel) 800 810 0189  
(fax) 800 820 2816

##### Europe:

(tel) 31 20 547 2111

##### Japan:

(tel) (81) 426 56 7832  
(fax) (81) 426 56 7840

##### Korea:

(tel) (080) 769 0800  
(fax) (080)769 0900

##### 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](mailto:tm_ap@agilent.com)

Contacts revised: 9/17/04

© Agilent Technologies, Inc. 2004  
Printed in USA, November 22, 2004  
5989-1941EN