Technical Note

The Importance of Stable, Reliable Test Cable Assemblies

Site Master™

Introduction

Anritsu's Site Master Cable and Antenna Analyzer makes cell site analysis straight forward and convenient by providing measurement capability in both the time and frequency domains. At the heart of the Site Master is a functional vector network analyzer (VNA), utilizing sophisticated vector error correction (calibration) algorithms to remove systematic error within the measurement system. As with any VNA, its precision and accuracy depend upon the quality of the calibration. In practice, a flexible cable assembly, commonly called a test port extension, is used to connect calibration standards to the instrument and facilitate access to the cell site connections. No matter how precise the calibration standards used or how skilled the operator, if the test port extension is unstable, the instrument's calibration will drift and affect the measurement accuracy. To keep your Site Master operating at peak performance, Anritsu recommends using precision components for the calibration including a precision open/short/load and a high performance phase stable cable.

Vector Error Correction Basics

Anritsu's handheld products provide accurate and precise cable & antenna measurements with the help of its vector error correction. The calibration process is used to mathematically remove systematic errors. Vectors are used to mathematically represent quantities having magnitude and phase components. By measuring the magnitude/phase response of a set of known standards - an open, short, and 50-ohm load, the vector error correction process can correct for systematic errors in the measurement system – in other words, system error is removed. The measurement system includes the following components: the Site Master unit itself and the Site Master Test Port Cable Assembly. The vector error correction algorithms assume the measurement system is static and without change. Any changes within the measurement system, such as amplitude and phase distortion with flexure/temperature cannot be corrected for after the calibration is complete. Why then is it so important to use only high performance phase stable cables? An unstable test port cable assembly will adversely affect the vector error correction, producing unreliable and misleading results. Using high performance phase stable cables, precision adapters, and precision calibration components allows you to get the most from your Site Master.

Let's look at how an unstable cable assembly can affect instrument performance:

Return Loss Measurements – a frequency domain measurement to characterize the match of the transmission system by measuring the ratio of the reflected power to the incident power in decibels (dB). Using a test port cable assembly that is unstable in amplitude and phase will affect error correction at the system's reference plane. The result will be erroneous reflected power values. Even though Return Loss is a scalar measurement, it is important to measure both magnitude and phase accurately as both are used to analyze the data.

Cable Loss Measurements – a frequency domain measurement of the energy absorbed or lost by the cell tower transmission system, in decibels (dB). As with return loss, an unstable cable assembly will erode the accuracy of cable loss measurements, indicating more or less loss than is actually present.

Distance-to-Fault Measurements (DTF) – a time domain measurement which reveals the precise location of a fault or reflection within the cell tower transmission system. The DTF display shows impedance discontinuities with respect to time. The sweep is still performed in the frequency domain and with the help of mathematics, the data can be converted from the frequency to the time domain. The accuracy of the phase information will affect the accuracy of the DTF measurement and cable assemblies that are especially unstable in phase will impact the accuracy of this measurement. With many cell tower feeds well over 100-feet (30.5-meters) long, the ability to quickly and accurately locate systems faults is essential to cost-effective cell site maintenance.

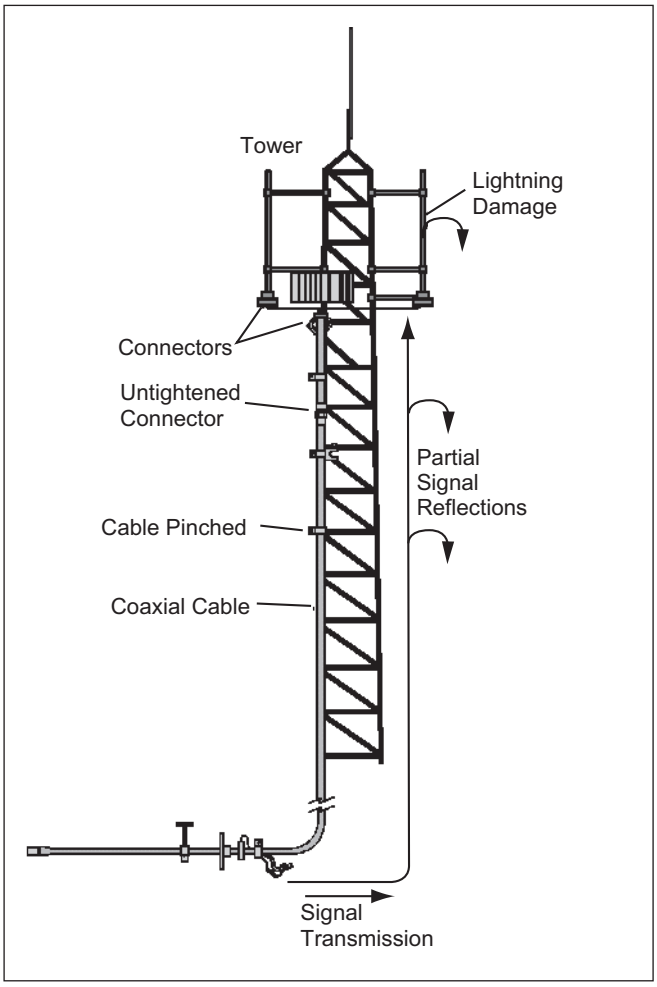

Figure 1. Typical cell tower configuration depicting possible fault locations

Accuracy and Repeatability – since every feed system within a cell site has its own unique transmission characteristics, establishing baseline performance and referencing baseline measurements are vital in assessing the health of the transmission system. In this case, accurate, repeatable measurements are crucial in identifying potential "trouble spots" within the system. Pairing your Site Master with an inferior cable assembly will impact the instrument's repeatability and accuracy, making the process of fault analysis difficult, time consuming, and costly.

The Effects of Unstable Cable on Measurement Performance – results recorded using Anritsu Site Master Model S251C. The device-under-test (DUT) is a 1.5-meter ***stable*** cable assembly, terminated at one end with a precision short, the other end is connected to the test port extension; in this case, a 0.88-meter cable assembly whose performance is ***unstable*** with flexure. Insertion loss measurements were made using the Site Master's "One-port" cable loss feature; swept frequencies: 625 MHz to 2,500 MHz. Figures 2 and 3 illustrate the change in measured DUT performance when the unstable test port extension is flexed.

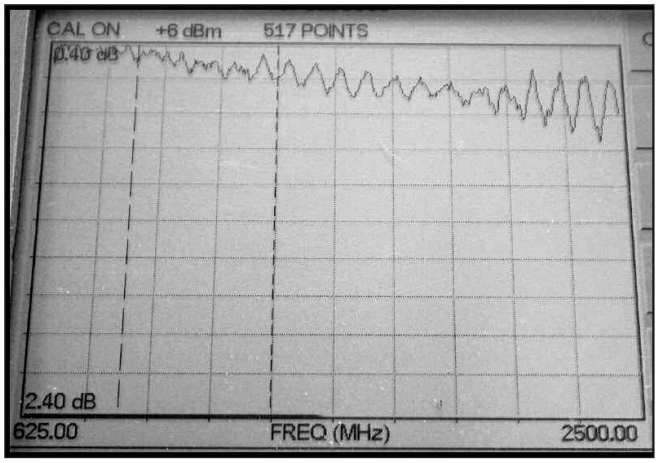

Figure 2. DUT insertion loss before movement of unstable test port extension

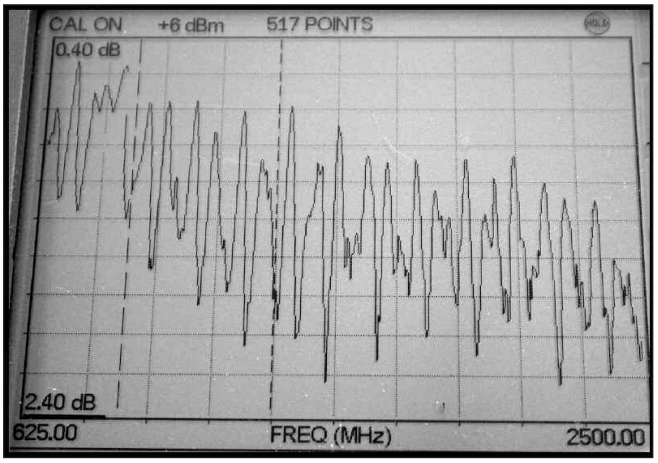

Figure 3. The same DUT's insertion loss after the unstable test port extension has been moved/flexed

Hints for maintaining the performance of your Anritsu Site Master

- Never use a damaged test port cable assembly – replace with a known good assembly before making critical measurements
- To maximize accuracy, use the shortest possible test port cable assembly that provides the needed flexibility
- During calibration and measurement, avoid flexing the test port cable more than is necessary
- Perform the short, open, load calibration on a regular basis, observing the instrument's response to the calibration standards. This will provide a visual concept as to what constitutes a "good response" and will aid in identifying calibration abnormalities
- Use only high-quality cable assemblies with your Site Master. For optimal performance Anritsu recommends SiteMaster™ Stability Enhanced Cable Assemblies

By following the guidelines described in this technical note, you'll perform more effective site sweeps, increase your productivity, and realize the full diagnostic potential of your Anritsu Site Master.

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Technical Note No. 11410-00413, Rev. A Printed in United States 2006-12