Site Analyzer Accuracy

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What is the accuracy of a Return Loss Measurement with my Site Analyzer?

Users familiar with test equipment used in RF environments are used to understanding accuracy issues. Sometimes, the accuracy for a piece of test equipment is simply a percent of the reading. Other times, the accuracy is based on percentage of full scale or has additional offset components. One of the most common questions we receive is how to interpret the accuracy of the Site Analyzer, a device that measures the return loss of a cable and antenna system. The problem is that the actual accuracy of the Site Analyzer depends on a number of factors, and can be different for every measurement.

The largest contributing factor to accuracy on the Site Analyzer series is the impact of Directivity. Directivity is the ability for a directional device to ignore the power coming from the opposite direction. Directivity is normally calculated by taking the difference between the coupling and isolation for a directional coupler. The coupling is obtained by measuring the power loss between the main line and the coupler, in the direction of the coupler. The isolation is obtained by measuring the power loss between the main line and the coupler, in the opposite direction of the coupler (Figure 1). Since the directivity component can add constructively or destructively with the intended signal, directivity adds a positive and negative component to the overall error of a system.

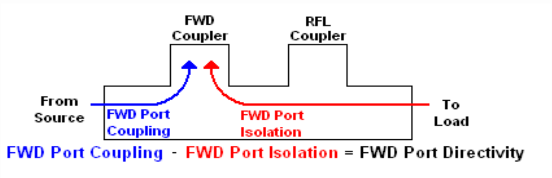


Fig. 1

The Site Analyzer is essentially measuring forward power out of the unit and reflected power back into the unit, so we need to know the directivity of both the forward and reflected power measurements to formulate the accuracy. Generally speaking, the impact of the directivity on the forward measurement is not as significant as the directivity of the reflected measurement, since the reflected power cannot be larger than the forward power. The largest impact on the forward power measurement is when both forward and reflected power are identical (0 dB return loss), in which the directivity will still only be a small component of the overall reading.

The real impact in directivity happens in the reflected measurement, since it is common for the forward power to be orders of magnitude higher than the reflected power. As the reflected power drops, due to better termination or transmission, the impact of the error from "leak in" voltage increases.

Here is a quick example of how directivity affects different levels of return loss:

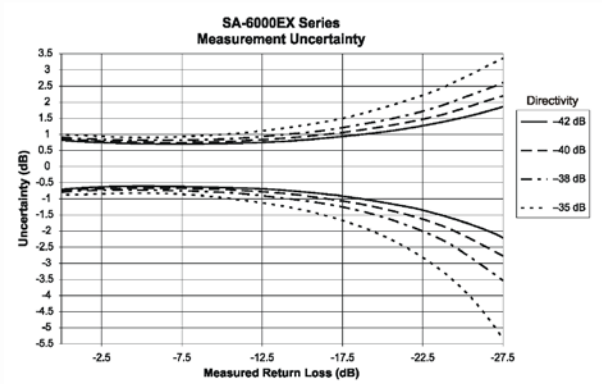
<u>System with a return loss of 6 dB and Directivity of 40 dB*</u>

Minimum RL with directivity: 6.22 dB
Maximum RL with directivity: 5.78 dB
Error from Directivity: +0.22/-0.22 dB (+/- 3.66%)

<u>System with a return loss of 25 dB and Directivity of 40 dB*</u>

Minimum RL with directivity: 26.7 dB
Maximum RL with directivity: 23.6 dB
Error from Directivity: +1.7/-1.4 dB (+6.8%/-5.6%)

From the above examples, you can clearly tell that the directivity component of error varies by the return loss of the system. When you combine this component of error with the other offset components, such as VCO accuracy and input VSWR, you get the following visual representations of overall accuracy.



Due to the impact of directivity and the way VSWR and return loss are calculated, there is no easy specification for error on either of those measurements that can be used for every application. The specific accuracy is dependent upon the performance of the system being measured.

*For more information on calculating the effect of directivity, please refer to the Bird Application Note, "Straight Talk about Directivity."