Waveguide Loss is Not a Measurable Quantity

Paul L. Smith
South Dakota School of Mines and Technology
Rapid City, South Dakota

Some weather radar equations used as the basis for calibration of reflectivity measurements contain the waveguide loss as an explicit factor. However, in practice the waveguide loss in an installed radar system is not a measureable quantity.

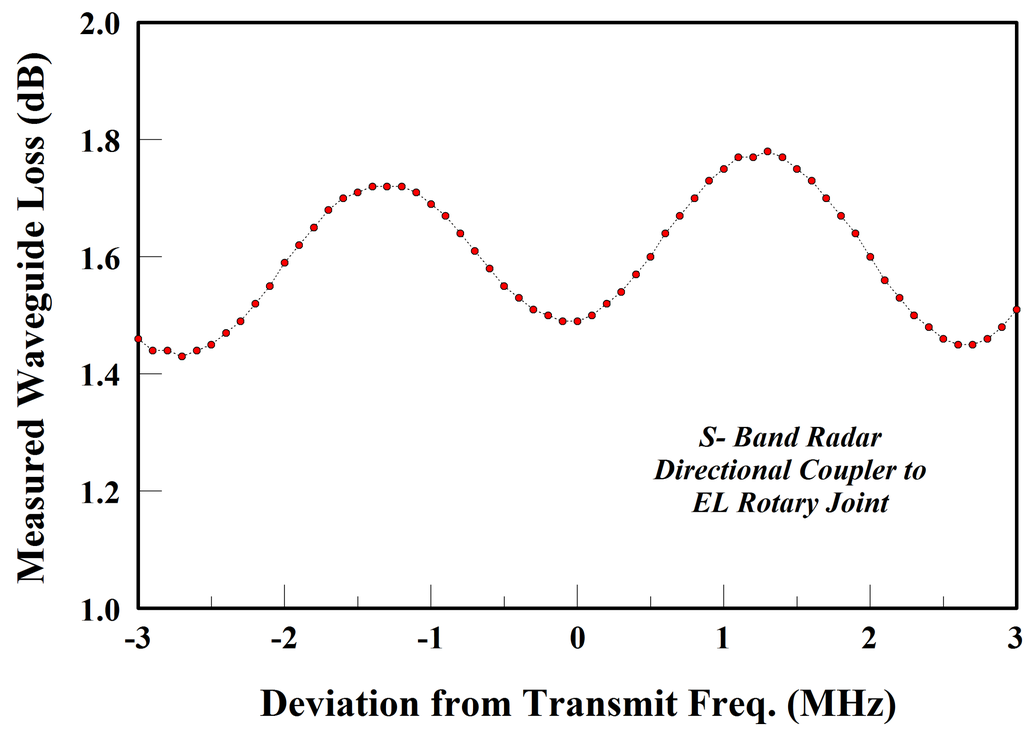
The straightforward procedure involves injecting a known CW test signal at one point, near the directional coupler used for transmit power measurements and receiver calibration, and measuring the power received at another point on the antenna.

- The first problem is that it is rarely, if ever, possible to incorporate the entire waveguide run from the directional coupler to the antenna feed horn in this measurement.
- Secondly, the measured loss involves a combination of the ohmic losses along the waveguide run and the mismatch losses related to impedance discontinuities along the path.

Result: **Contribution to uncertainty in reflectivity calibration = 2 X uncertainty in waveguide loss value**

The measured value consequently varies with frequency. The radar transmit signal spans a range of frequencies, and the test setup disrupts the mismatch configuration present in actual operation. In practice the two "waveguide loss" components cannot be separated, and it is therefore unclear what waveguide loss value applies under normal operating conditions.

Example from a NEXRAD-like radar:



Preferred solution: Work from measurements at the forward port of the directional coupler. Any waveguide losses up to that point are accounted for in the transmit power measurement and the receiver calibration. Losses on the antenna side of the coupler are incorporated into the effective antenna system gain, as measured with a standard-gain horn in the far field or a calibration sphere. *This includes the loss along the full length of the waveguide run, as well as the radome loss.*

No direct measurement of waveguide loss is needed.

This research was partially supported by the State of South Dakota.

Paul.Smith@sdsmt.edu