Design and Calibration of a Closed Loop Laboratory RF Propagation Section

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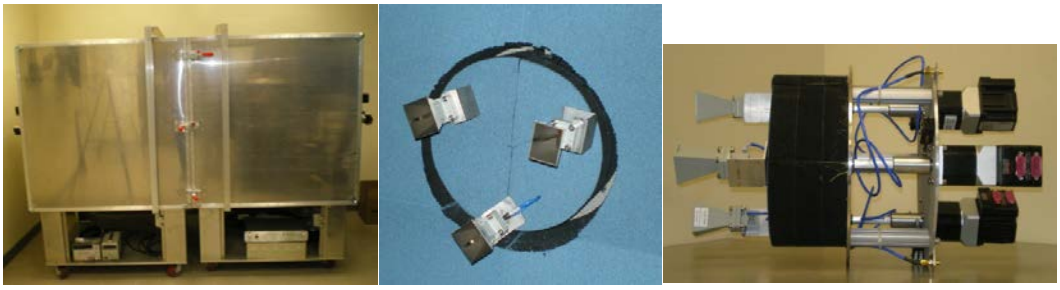
The Closed Loop Laboratory (CLL) includes an RF propagation section using broadband dual-ridged horn antennas (DRHA) in an absorber lined chamber. The aluminum chamber is constructed in two halves, 4 ft. (W) x 4 ft. (H) x 4 ft. (L) connected by clamps so it can be opened as needed as shown in Figure 1. Three DRHAs are mounted in the center of each end of the 8 ft. chamber on metal shafts oriented in a triangle pattern with independent rotation control. The entire 3-horn assembly is installed with clamps so that they can be removed (see Figure 1). All the cables/connectors used to connect the Network Analyzer to the propagation section inputs are calibrated out of the measurements. However, the short cables between the input to the chamber and the horn input are not included so the insertion loss of these cables are measured separately and the data corrected for this additional loss. The corrected transmission and coupling data represent the calibration of the entire RF propagation section. Calculated path loss and numerical results are shown to demonstrate that the chamber performance can be approximated by free space simulations of the 6-horn configuration.

The calculated or numerical results are not exact since they do not include all the various scattering effects versus frequency owing to the absorber lined chamber with horn mounting hardware and motor assembly. It will be shown that the idealized model can produce unrealistic results for cross-polarized horns especially when using symmetry. But the numerical model does approximately capture the influence of the 6-horn configuration so can be useful for modeling the various experiments that can be conducted in the CLL propagation section. In this manner some expectation of the measured results can be obtained through simulation. In addition a numerical model can be useful to estimate dynamic range and the influence of an arbitrary polarization mismatch. Although the measured data for the CLL propagation section with corrections represent its calibrated performance as installed, the numerical model can also be useful for additional insight into the utility and limitations of experiments conducted in the CLL facility.



(a) (b) (c)

Figure 1. Closed Loop Laboratory 8 ft. RF propagation section showing (a) exterior view, (b) interior view and (c) motorized horn assembly removed.