# EE 483L/583L Antennas for Wireless Communications (Spring 2025)
# Laboratory 5- Rhombic Antenna Input Measurements

## Introduction

In this laboratory, you will use the network analyzer to measure the input impedance of a rhombic antenna, shown in Figure 1, located on the *x*-*z* plane above a ground plane at $z = 0$.

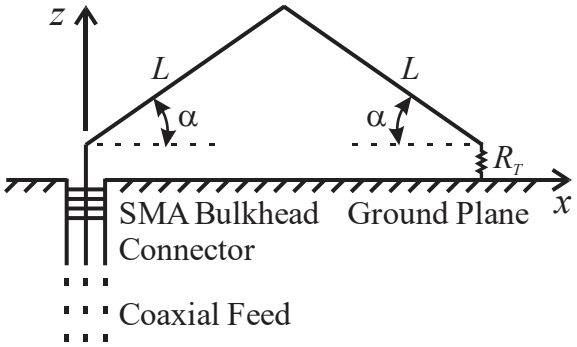


**Figure 1** Rhombic antenna geometry (not to scale)

**Experiment** (You may work in groups of two.)

1) The instructor will have the rhombic antenna, ground plane, 6' coaxial cable, adapters, Keysight E5063A vector network analyzer (VNA), Agilent 85033E 3.5mm Calibration Kit, caliper, tape measure, protractor, etcetera available. Include an equipment table with all relevant equipment information in logbook, i.e., description, manufacturer, and model number (as applicable).
2) Take picture(s) showing the antenna & ground plane.
3) Measure relevant dimensions and parameters of the physical rhombic antenna.
4) If necessary, power on the VNA. Connect a Type N (m) - SMA (f) adapter and the 6' coaxial cable to Port 1 of the VNA.

**Wear a static wristband whenever working with the VNA!**

**Torque coaxial connections using torque and box wrenches (mechanical support)!**

5) To begin, select the frequency range and settings for the VNA. The frequency should range from 2.5 GHz to 8.5 GHz in steps of 25 MHz. Calculate and record the number of data points $N_{dat}$ required. Use data averaging with an averaging factor of 8. Press the Format button and use the mouse to select <Smith> and then <R +jX> to display an impedance Smith chart.
6) Per earlier lab, calibrate the VNA to the reference plane of the SMA (m) connector on the open end of the coaxial cable.
7) Connect cable to the SMA (f) bulkhead connector below the ground plane. Draw a block diagram(s) of the test set-up.
8) The SMA (f) bulkhead connector introduces an electrical delay to the measurement. Set the electrical delay to $\Delta t_{delay}$ **= 0.1022 ns**. [The instructor 'shorted' the center pin of the connector to the ground plane. Then, he activated Marker 1 and put it at $f_{mid} = 5.5$ GHz. For a short circuit, the marker should be at the 0 Ω point where $\Gamma = 1\angle\pm180°$ on the Smith chart. He used the <Electrical Delay> function of the VNA to move Marker 1 near the 0 Ω point. Then, he switched to the phase format display and refined the electrical delay so the phase was ±180°.]

9) Change the display format back to an impedance Smith chart.
   - Save a screen shot of the Smith chart display. Leave room for screen shot in logbook.
   - Save trace data.

10) If no other groups are waiting, power down the VNA.

**Analysis**

1) How did the experimental rhombic antenna dimensions and parameters compare to those used for the NEC-2 simulation done in Lab 4?
2) Create rectangular plots of resistance versus frequency and reactance versus frequency showing both the NEC-2 data (convert to equivalent rhombic monopole impedance) and measured data. Insert plots in the logbook. Comment on how the measured and NEC-2 data compare.

**Report**

- Following syllabus guidelines, compose a short report on this lab.

**Report and logbook due Wednesday, March 19, 2025 at class.**