



LAB 9 - Analysis Of A Half Wave And Folded Dipole Antenna

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Purpose:

To compare the SWR bandwidth of a half wave dipole antenna and a dipole antenna.

Equipment:

- Agilent 8712ES RF Vector Network Analyzer
- Handheld antenna analyzer (SWR).
- A length of copper wire
- Plastic insulators
- A center fed receptacle to serve as a feed point for the half wave dipole antenna.
- A simple matching balun and plastic spacers for the folded dipole antenna.

There are two parts to this experiment. First you will need to fashion a simple halfwave dipole and folded dipole antenna. Elevate the antennas in the lab by fixing both ends to supporting structures in a horizontal orientation or implement an anechoic chamber if available. Determine the lengths required for these antennas to operate optimally at 140 MHz. Show calculations in the lab report. SWR values will be collected from both antennas and analyzed. A plot of the results can be compared to those presented by the VNA. The VNA can be used to confirm SWR bandwidth and center fed impedance. The second part requires the student to use an antenna analysis package (ex. NEC4WIN from web) and enter the correct antenna geometry to compute a range of characteristics including field patterns.

Note: If lab periods are scheduled as two hour sessions this lab exercise could be performed over a two week period.

PART A:

Procedure:

In this exercise you will be collecting data to observe the characteristics of Standing Wave Ratio (S.W.R.) over a range of frequencies for the two horizontal dipole antennas . One is a half wave dipole and the other is a folded dipole. Use the handheld antenna analyzer to sweep the antenna over a range of frequencies below and above the 140 MHz. Tabulate values from the SWR meter (placed near the antenna) over this range with an adequate number of sample points to develop a graph.

1. Do this for both antennas.
2. Connect the Vector Network Analyzer to the 1/2 wave dipole and set to MEAS1. Set the frequencies to sweep through the same range as your tables. Select SWR from FORMAT and observe the shape of the graph. Save the data on a floppy to compare with the graph that you will plot as per the procedure. Go back to FORMAT and observe the SMITH CHART characteristics.
3. Repeat step 2 for the folded dipole antenna.



4. Include a graph of S.W.R. versus FREQUENCY for both antennas based on your SWR values collected with the R.F. signal generator and SWR meter.

PART B:

This part of the exercise requires the use of an Antenna analysis package. NEC4WIN is one that is recommended and evaluation copies are available on line.

1. After opening NEC4WIN enter the antenna GEOMETRY, as per your calculations, under ANTENNA SETUP. Place the HEIGHT of the antenna five wavelengths above ground. Set the FREQUENCY to 140 MHz.

To enter geometry click 'GEOMETRY' and the click 'ADD WIRE'. If you would like to see an example open the file called 20mdip.n4w and view the geometry settings. Even though the values will be different, because it is a different operating frequency, the orientation of the antenna is the same. You will need to specify the location and number of sources for your antenna. This antenna will use one source and it is placed at the centre. Viewing the antenna geometry under PLOT will help you with this. Count the number of segments to determine the centre fed point.

NOTE: Make sure that the impedance of the line is set to the correct value for each of the antennas. This can be set under OPTIONS and changing COAX IMPEDANC

2. Click O.K. if you are satisfied with your settings.
3. To view the radiation patterns of your antenna go to PLOT. View the following combinations of FAR FIELD patterns:
 - a.) Zenith and azimuth at your default elevation of five wavelengths above GROUND and FREE SPACE. Provide a printout of the radiation patterns for both. You may toggle between GROUND PLANE and FREE SPACE under ANTENNA SETUP.
 - b.) Zenith and azimuth a quarter wavelength and a half wavelength above ground. Account for the difference in your lab report.
4. Go to COMPUTE and select RESONANCE. Set a suitable range of frequencies above and below resonance at 0.5 MHz steps. Record the IMPEDANCE at optimum resonance.
5. Repeat this process for the folded dipole antenna. Make sure you change the line impedance to 300 ohms for this antenna. Note: You can adjust the spacing between the folded elements to get closer to 300 ohms and trial and error your results by returning each time to COMPUTE and RESONANCE until a reasonable value is achieved.

Note: The following image illustrates a possible antenna layout.

