Transmission Line Feeding in Antenna Design: Exploring the Four-Square Array

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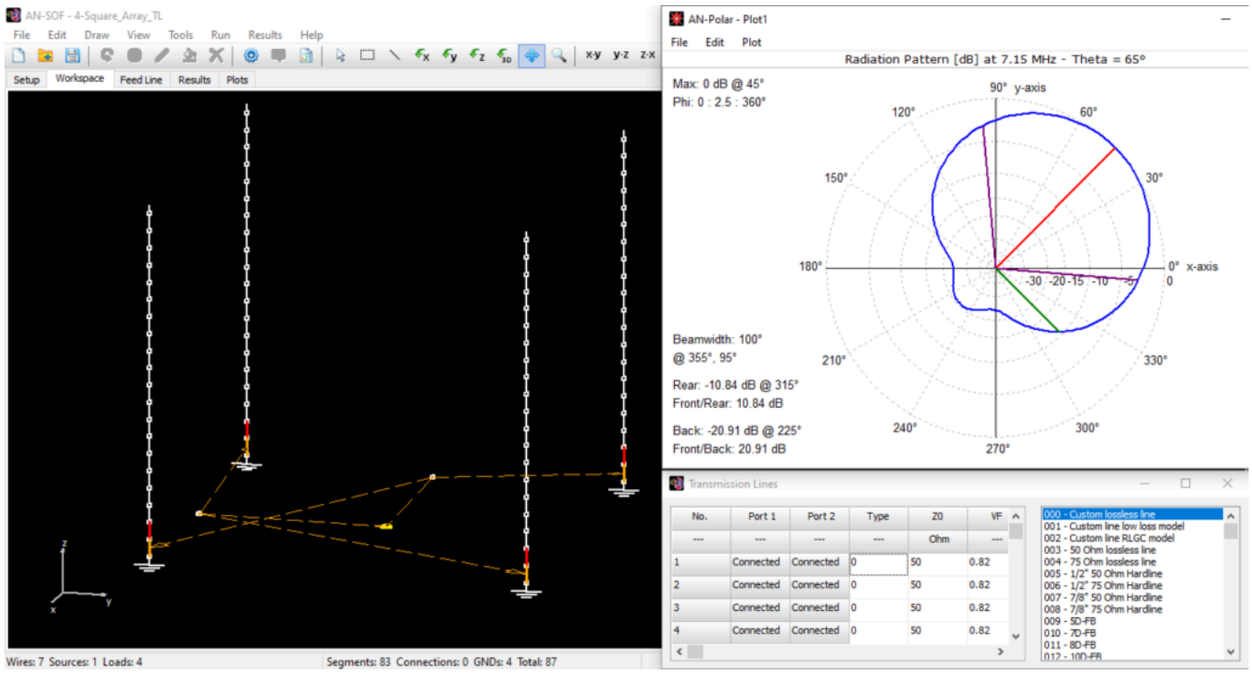
Explore the Four-Square Array: a phased array using six transmission lines in its feeding system. Perfect for directional control, it combines simplicity and performance for RF engineers, ham operators, and antenna designers.

As the **AN-SOF Antenna Simulator** enables implicit modeling of **transmission lines**, this feature allows users to define a transmission line by specifying its characteristic impedance, velocity factor, length, connection ports, and losses. One particularly valuable application of this transmission line modeling capability is in the design and analysis of feeding systems for **phased arrays**. A prime example of a versatile phased array that leverages transmission lines in its feeding system is the **four-square array**. This configuration consists of four vertical elements, each measuring **1/4-wavelength** in height and arranged in a square formation. It serves as an excellent tool for both radio enthusiasts and professionals seeking a straightforward yet effective phased array for controlling the main lobe direction of the antenna's radiation pattern.

The figure below illustrates the layout of the four-square array and its corresponding radiation pattern. When treating the four vertical elements as a **4-port network**, calculations indicate that an **18-Ohm resistor** must be added at the base of each monopole to achieve the desired directional radiation pattern. Additionally, the feeding system of this array incorporates **six transmission lines**, each meticulously configured for specific lengths and interconnections. Detailed specifications for this setup can be found in **Chapter 8, Section "The Four-Square Array,"** of the **19th edition of the ARRL Antenna Book**.



Four-Square Array antenna configuration with a radiation pattern slice at θ = 65° (elevation 25°). The window in the bottom right corner displays settings for the transmission lines used in the antenna's feeding system.

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Here are some of the key properties that make the four-square array an attractive choice for antenna enthusiasts and professionals:

1. **Forward Gain**: 3.3 dBi, assuming an average ground.
2. **Beamwidth**: The array provides a **3 dB beamwidth of 100°**.
3. **Horizontal Front-to-Back Ratio**: 20 dB or better over a **130° angular range**.
4. **Symmetry for Directional Switching**: Due to its symmetric design, the four-square array allows for directional switching in **90° increments**.

By implementing the feeding system described in this model, the four-square array demonstrates excellent performance characteristics, with any limitations primarily arising from environmental factors. Moreover, the array's design facilitates the integration of a **remote switching mechanism**, enabling seamless adjustment of the array's direction as needed.

Whether you are a **ham radio operator**, a **DXer**, or a professional in the field, the four-square array represents a compelling and versatile option for your next antenna project. Its combination of simplicity, performance, and adaptability makes it a standout choice for applications requiring precise control over radiation patterns.

See Also:

- **Extended Double Zepp (EDZ): A Phased Array Solution for Directional Antenna Applications**

About the Author

Tony Golden

ANTENNA SIMULATION ENGINEER & PHYSICS PH.D. With over 25 years of experience in Computational Electromagnetics, I'm a dedicated researcher specializing in antenna modeling and design. As the founder of Golden Engineering LLC, I develop intuitive yet powerful simulation tools to help RF engineers optimize designs, educators demonstrate concepts, and hobbyists bring antenna projects to life.

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