USING THE TRANSMISSION-LINE METHOD TO DERIVE A CLOSED-FORM EXPRESSION TO LOCATE THE MICROSTRIP ANTENNA 50-OHM FEEDING POINT.

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Abstract Submission Form

2006 National Radio Science Meeting

Abstract: lin32054

Date Received: November 25, 2005

Patch antennas have been widely used in the wireless communication industry due to their low profile and small size. Available space allowed in applications for the antenna is getting smaller all the time. Different dimensions of rectangular patch antennas will yield different impedances at different feeding points. It is desired to have a 50-ohm feeding point in most applications. A transmission-line method has been widely used to characterize the rectangular patch antenna. In this paper, by using the transmission-line method, we obtain a closed-form expression for the relationship between the rectangular microstrip patch antenna feeding position and the input impedance. It is simple, unique, and easy to use.

Given the input impedance, the feeding position in terms of the microstrip patch antenna width, substrate height, relative permittivity and frequency is determined. The 50-ohm feeding point can be found in a simple way by using the equation derived here.

A transmission-line method was used to express the input impedance of the patch antenna at any location (distance d from the source to the edge along the center line) in terms of the end slot radiation impedance, patch dimensions, and dielectric constant. The resulting equation was a complicated one, and it was difficult to solve for d. We simplified the analysis by limiting the patch antenna open-end effect. Then the source distance D from an ideal $1/2$-wavelength patch antenna edge was obtained as

$$D = \frac{\lambda}{2\pi} Tan^{-1}\left(\sqrt{\frac{2y - y_{in}}{y_{in}y^2 - 2y}}\right),$$

where y_{in} is the normalized input admittance of the patch (normalized to the mirostrip patch characteristic admittance) and y is the normalized patch slot radiation admittance.

The actual distance d of the source from the edge was obtained by subtracting the equivalent micrprostrip open-end length from the value of D. This equation has been applied to three cases with different patch dimensions operating at 1.8 GHz and 2.4 GHz to find the 50-ohm input impedance location. The 3D CST microwave studio software simulation tool had been used to locate the 50-Ohm input feeding location for these three cases. The tool was also used to verify the equation with input impedances different than 50 ohms. The simulation results are in good agreement with the results from the equation.

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