Design of a Microstrip Patch Antenna Radiating at 3 GHz using *Ansys HFSS*

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In Microstrip Patch Antennas (MPAs), a patch of metal foil is separated from a ground plane foil by a dielectric. They can be fed in a variety of ways, one of which is by a coaxial feed. The inner conductor of the coax is connected to the radiation patch in a coaxial feed, while the outer conductor is connected to the ground plane. MPAs are widely used because they are simple and inexpensive to manufacture using modern PCB technology, easily integrable with modern electronic devices, mechanically robust when mounted on rigid surfaces, and very versatile in terms of resonant frequency, polarisation, pattern, and impingement when the particular patch shape and mode is chosen. Additionally, adaptive elements with changeable resonant frequency, impedance, polarisation, and pattern can also be constructed by inserting loads between the patch and the ground plane.

Design Parameters

The problem statement states "Design a microstrip patch antenna using coaxial feeding in Ansys HFSS software radiating at 3 GHz". So, we are given the frequency of radiation of the antenna in the problem statement. We fix the height of the substrate and its relative permittivity based on commonly used parameters and commonly available materials. The values hence given are as follows:

$$f_r = 3\ GHz\ ; \qquad h = 1.6\ mm\ ; \qquad \epsilon_r = 4.4$$

Patch Width Calculation

$$W = \frac{c}{2f_r}\sqrt{\frac{2}{1+\epsilon_r}} = 30.4290\ mm$$

Effective Dielectric Constant

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[1 + \frac{12h}{W}\right]^{-\frac{1}{2}} = 4.031$$

Patch Length Extension

$$\Delta L = 0.412 \cdot h \cdot \frac{(\epsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\epsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)} = 0.7360\ mm$$

Patch Length Calculation

$$L = \frac{c}{2f_r\sqrt{\epsilon_{reff}}} - 2\Delta L = 23.4318\ mm$$

Results

The antenna model is given below:

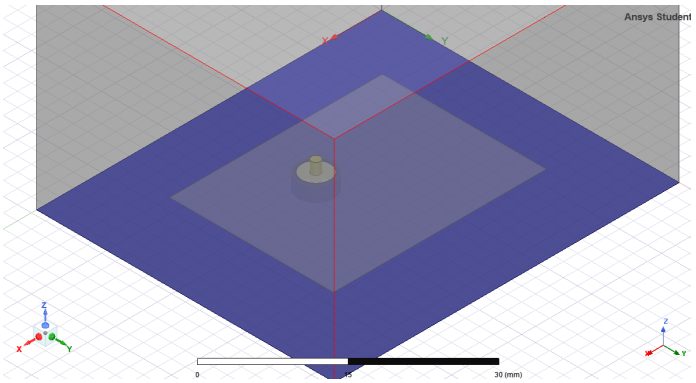

Figure 1: The Antenna Model

The variation of S-parameter magnitude with frequency for the designed antenna is as follows:

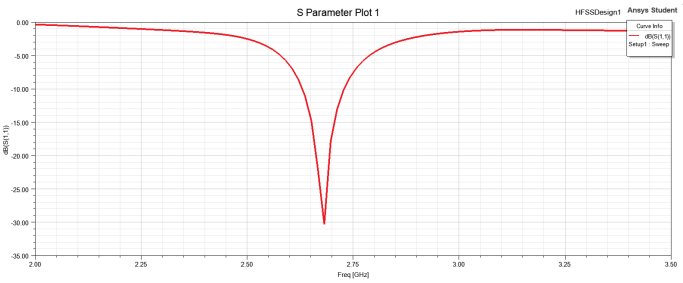

Figure 2: S-parameter vs Frequency

Other results can be found as image files in the same archive as this report.