Abstract

Quality and properties of microwave circuits depend on all the circuit components. One of these components is the substrate. The process of substrate material selection is a decision-making problem that involves multicriteria with objectives that are diverse and conflicting. The aim of this work was to select the most suitable substrate material type to be used in antennas in the microwave frequency range that gives best performance and reliability of the substrate. For this purpose, a model was built to ease the decision-making that includes hierarchical alternatives and criteria. The substrate material type options considered were limited to fiberglass-reinforced epoxy laminates (FR4 $\varepsilon_r = 4.8$), aluminium (III) oxide (alumina $\varepsilon_r = 9.6$), gallium arsenide III–V compound (GaAs $\varepsilon_r = 12.8$) and PTFE composites reinforced with glass microfibers (Duroid $\varepsilon_r = 2.2$–2.3). To assist in building the model and making decisions, the analytical hierarchy process (AHP) was used. The decision-making process revealed that alumina substrate material type was the most suitable choice for the antennas in the microwave frequency range that yields best performance and reliability. In addition, both the size of the circuit and the loss tangent of the substrates were found to be the most contributing subfactors in the antenna circuit specifications criterion. Experimental assessments were conducted utilising The Expert Choice™ software. The judgments were tested and found to be precise, consistent and justifiable, and the marginal inconsistency values were found to be very narrow. A sensitivity analysis was also presented to demonstrate the confidence in the drawn conclusions.