A Broadband Dual-Polarized Backed-Cavity Proximity-Coupled Microstrip Patch Antenna for Ka-Band Applications

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Abstract

In this paper, a dual-polarized proximity-coupled microstrip patch antenna with a broad-bandwidth, high-isolation, and low cross-polarization levels is designed and its features are presented. The undesired radiation, inducing a high level of cross polarization in the H-plane, is suppressed using differential feeding technique for both vertical and horizontal polarizations. Many works have been devoted to enhancing the bandwidth of proximity-coupled microstrip patch antennas, such as L-probe feeding, U-slot patch, V-slot patch, semicircle probe proximity-coupled stub patch, impedance matching network, and a parasitic radiator, etc. In these methods, the maximum bandwidth that can be achieved is not more than 35%. In the proposed design, a proximity-coupled feeding mechanism is combined with a square or circular annular cavity located in the backed ground plane to effectively broaden the bandwidth of the microstrip patch antenna. The obtained bandwidth using this design can exceed 50% with optimizing the substrate thickness, dielectric constant, and the cavity dimensions. In this design two substrates with the same material have been used for both patch and feed layers. A dual-polarized antenna is designed, fabricated, and measured. The measured return loss exhibits a 10dB-impedance bandwidth of over 50% and the isolation between the V and H ports is better than 40 dB over the bandwidth. The cross-polarization levels in the E- and H-planes of both vertical and horizontal polarizations are better than 40 dB. Both simulation and experimental results for S-parameters and radiation patterns will be presented. The overall antenna array performance in the operating frequency range, $24 \sim 38$ GHz, is stable with radiation efficiency around 75%. Therefore, this antenna is a suitable candidate for Ka-Band 5G communication applications requiring higher capacity, higher data rate and wide band width. In addition, this candidate can be used in radar and communication systems to meet the increasing requirement for polarization diversity in various applications, such as polarimetric SAR and MIMO systems.