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A Semi-Circular Cavity Backed Substrate Integrated Waveguide MIMO Antenna for K Band Applications

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A novel design of miniaturized semi-circular cavity backed substrate integrated waveguide multiple input multiple output (MIMO) antenna is presented in this paper. The antenna elements are placed such that it forms a very compact design of dimensions 1.4λ x1.2λ x 0.15λ in millimeters on Rogers RT duroid 5880 substrate of dielectric constant 2.2 and loss tangent of 0.0009. A rectangular slot is cut on top metal ground plane of semi-circular cavity backed substrate integrated waveguide(SIW) due to which antenna is radiating perfectly in broadside direction. The 2x2 semi-circular cavity backed SIW MIMO antenna is resonating at a narrow frequency band of 18.9GHz, working in K band millimeter wave frequency region and has a return loss of -14.32dB. Good isolation is achieved between the antenna elements. The proposed MIMO antenna is highly directional in broadside direction, achieving a maximum gain of 7.7dB and peak directivity of 5.74dB.

The MIMO antenna performance parameters like Envelope Correlation Coefficient (ECC), Total Active Reflection Coefficient (TARC) and Diversity gain are found to be good and within acceptable limits. The ECC value of proposed antenna is 0.01 for the resonant frequency, which lies below 0.05. The Voltage Standing Wave Ratio (VSWR) of antenna is achieved below 1.55 for complete resonant frequency of bandwidth 400MHz, which shows good impedance matching characteristics of an antenna. The value of TARC obtained is -7.39dB at 18.9GHz which lies below 0dB, this shows that mutual coupling effect is reduced and less amount of power is reflected back in MIMO antenna.

Also, performance of the antenna is analyzed based on return loss, insertion loss, radiation pattern and surface current distribution results. The structure modeling and simulation results are done using Ansys HFSS simulation software. The proposed antenna is suitable for applications in K band like satellite communication, astronomical observation and radar.