

A Low-Profile, Wideband, Vertically-Polarized Antenna with Directional Radiation Patterns in the Azimuth Plane

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HF, VHF, and UHF bands are commonly used for many communications applications including military systems. Monopole whip antennas are widely used at these frequency bands. However, whip antennas are high-profile, narrowband antennas that can only provide omni-directional radiation patterns in the azimuth plane. In certain applications, HF, VHF, or UHF antennas that provide directional radiation patterns are required. Examples include applications where multiple antennas are mounted on the same platform, resulting in co-site interference between the antennas operating in the same band and jamming and electronic warfare applications where a significant amount of RF energy is to be radiated towards a given direction while minimizing radiation in undesired directions. In such applications, antennas providing cardioid-shaped patterns can be used.

In this presentation, we present a low-profile, vertically-polarized, wideband antenna array capable of providing cardioid-shaped directional radiation patterns in the azimuth and elevation planes over a broad bandwidth. The proposed antenna array is composed of four individual wideband radiators placed in a compact volume. Each wideband radiator is a half loop in the shape of a bent-diamond arm. Each half loop is fed at its center and its other end is short circuited to the ground plane. Two of the loops are fed in phase and the other two are fed out of phase. When fed in phase, the two half loops show omni-directional radiation while demonstrating a figure-eight radiation when fed out of phase. These two modes of operation are then combined properly to emulate the desired cardioid-shaped radiation patterns. Therefore, the antenna elements are fed using a proper feed network with appropriate amplitude and excitation phases. The feed network is composed of a power divider and a phase shifter to provide the appropriate amplitude and excitation phase values. A prototype of the proposed antenna array is designed to operate from 1-2 GHz (2:1 bandwidth). The antenna has a compact size with electrical dimensions of $0.65\lambda_{min} \times 0.46\lambda_{min} \times 0.094\lambda_{min}$ at its lowest frequency of operation. This antenna demonstrates cardioid-shaped radiation patterns both in the H- and E-plane while mounted over the ground plane. Details of the design of the structure as well as the measurement results of the fabricated prototype will be presented and discussed at the symposium.