

Design and Practical Realization of a Top Loaded Monopole Antenna for HF Vehicular Communications

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This paper discusses the study and resulting implementations of a top loaded monopole antenna for vehicular on the move HF communications. The main goal of the study is to minimize the monopole height while maintaining the required 24 kHz instantaneous bandwidth in the frequency range from 10 to 30 MHz. Having low profile antenna is important for reducing the overall profile of the platform as well as for eliminating interference with low lying obstacles. The main approach used in this work is the capacitive top loading with an objective to reduce the antenna profile to less than 1 m from 7.5 m height quarter-wavelength monopole at 10 MHz. It is shown that the antenna profile is 0.9 m when a circular hat top loading with radius of 0.5 m is utilized. However, when the physical implementation is considered, more practical variations need to be engineered.

The first considered realization is an extended vehicle spoiler. A car spoiler naturally has the same shape as a loaded monopole antenna and would also be very easy to implement onto a vehicle. The second practical realization considered is an airplane tail. An airplane tail can be excited to perform like a top-loaded monopole and can also be easily integrated onto a vehicle. The third practical consideration is a metal umbrella. An umbrella naturally looks like a monopole with a wire meshed top loading. Umbrellas are also easily deployable and lightweight. For low-cost options, an umbrella monopole antenna was fabricated and tested both stand-alone as well as while integrated on a US Marines vehicle M-ATV. Numerical results show that a regular umbrella functions well as a top loaded monopole antenna and conducted measurements verify that observation. Impedance and bandwidth measurements are discussed. Other considerations discussed include antenna mount location on the vehicle and a practical wideband matching system for the antenna.