

## **Design of a Fast Antenna Tuner for a Synchronously Tuned Mobile HF/VHF Transmitter**

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This investigation explores the design of a fast antenna tuner to implement direct antenna modulation (DAM) or synchronous antenna tuning in the HF/VHF spectrum. Synchronous antenna tuning has been demonstrated to significantly increase the throughput of a VLF system transmitting from an electrically small antenna. This throughput increase is accomplished by retuning the transmitter every symbol period to efficiently transmit the current frequency of the frequency shift keyed (FSK) signal it is transmitting. Inspiration is drawn from this prior work at VLF to create efficient mobile HF/VHF systems using synchronous antenna tuning. Synchronous antenna tuners present two major challenges in their design: tuning element placement and design and control system design.

The placement and design of the tuning element was explored. Fast antenna tuners for mobile HF/VHF transmitters inherently requires use of robust components because electrically small antennas require high voltages or high currents through the circuit to transmit even at medium power levels. The selection and placement of a MOSFET transistor in a HF/VHF tuner using a whip antenna will be discussed. Specifically, the tradeoff between a how quickly the transistor changes state, how much voltage and power the transistor can handle, the resistance of the transistor when on, and the isolation of the transistor when off will be discussed.

The design of the control system for a fast antenna tuner was also explored. Because the target system will be mobile, the fast tuner must be capable of automatically adjusting to the changing communications channel. The challenges of automatically tuning a system that is expected to be narrowband in steady state will be discussed. The added challenge of setting up a system that is dynamically retuned to two or more frequencies that may be spaced far apart will also be discussed.