Electrically Small Antenna

Andy Liu | Eliana Petreikis | Kogan Sam | Matthew Tom | Naveed Kazi

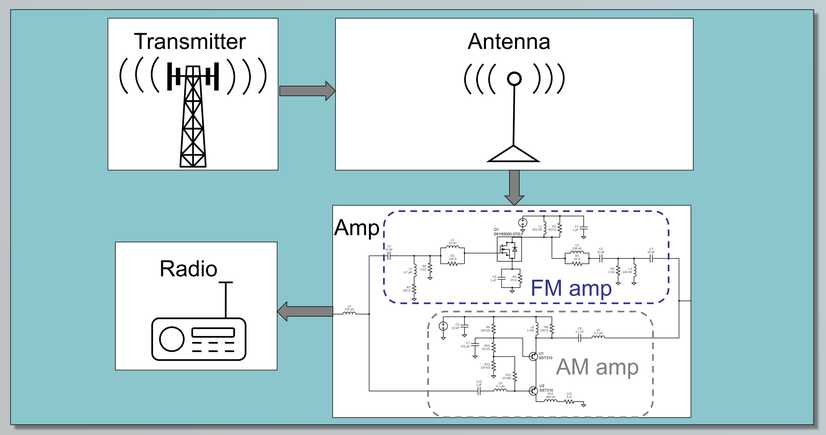
Background

Low frequency communication over long distances may not require physical wires for connection, but it does require large, cumbersome systems. Scaling down the size of these systems disturbs the needed properties for clean communication, so a different approach is needed to maintain efficient communication while reducing the size of the package.

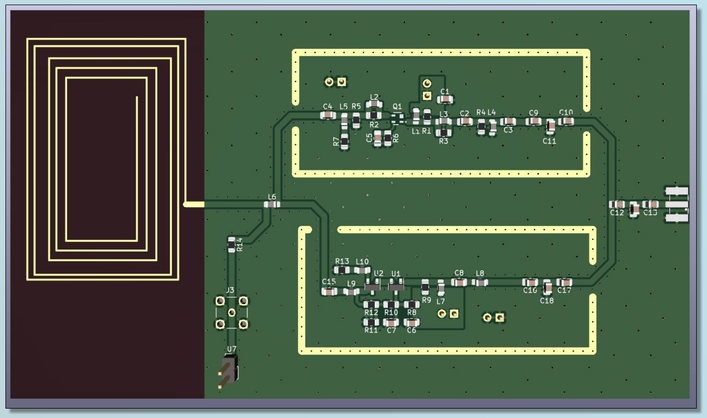
Overview

Our electrically small antenna is an integrated package that combines high-impedance low-noise buffer amplifiers with a 20-cm antenna. It is capable of receiving signals within the AM (530-1710 kHz) and FM (76-108 MHz) ranges. These amplifiers are the key to reducing the size of the system. This technology can be applied to other lower frequencies as well.

Functional Flow Diagram

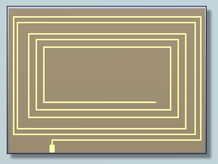


Final Design

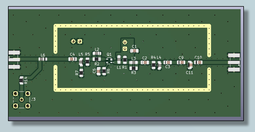


Fully integrated system that includes an Antenna and AM/FM amplifier

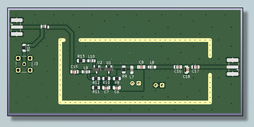
Design Components



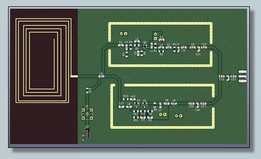
Antenna(s)
The PCB Monopole designed to be low impedance and to radiate uniformly.



FM Amplifier
The FM amplifier processes signals within a 76-108 MHz frequency range.

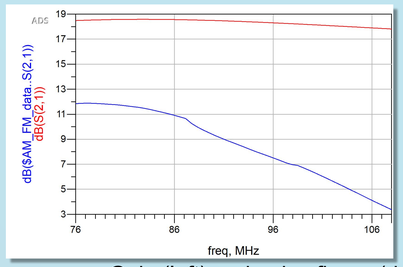


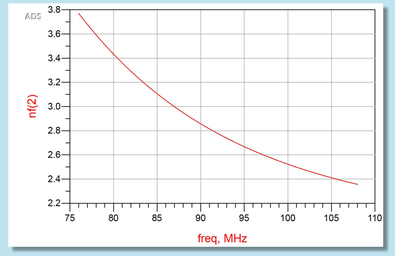
AM Amplifier
The AM amplifier processes signals within a 530-1710 kHz frequency range.



Integrated System
Fully includes the Antenna and AM/FM amplifier

FM Frequency Range

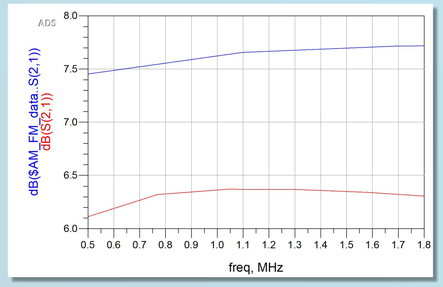


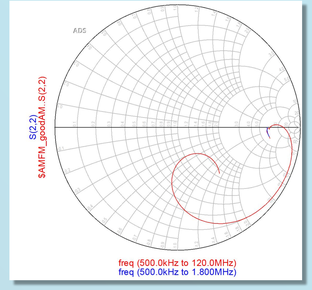


Gain (left) and noise figure (right) plots for FM frequency range.

- Gain: <15dB, varies by less than 1dB over FM range
- Noise Figure: <5dB over entire FM range
- Unconditionally stable over frequency range: StabMeas > 0, StabFact > 1

AM Frequency Range

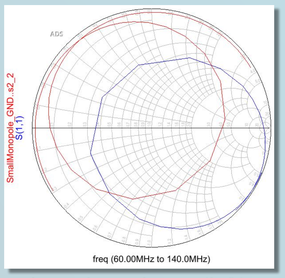


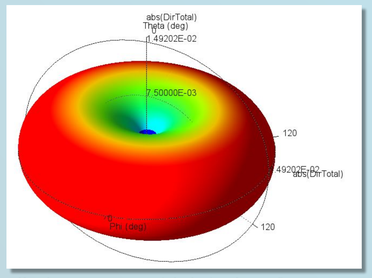


Gain (left) and output impedance (right) plots for AM frequency range.

- Gain: <13dB, varies by less than 1dB over AM range
- Output Impedance: close to 300 ohms
- Unconditionally stable over frequency range: StabMeas > 0, StabFact > 1

Antenna





Input impedance (left) and radiation pattern (right) plots for antenna.

- Antenna requires a linear dimension under 20cm
- Design for uniform radiation and a low real impedance

Acknowledgements:
We would like to thank our professor Ilan Ben-Yaacov as well as our advisor Vicki Chen and our TA Phillippe Rerolle. We would also like to thank our HRL sponsors Jae Song and Carson White.