Satellite Digital Audio Radio Service Receiver Front-End

Functional Description and Complete System Block Diagram

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October 6, 2011

Introduction

The Satellite Digital Audio Radio Service (SDARS) is primarily for entertainment broadcasting from orbital satellites and received by modules commonly found on modern automobiles. The project involves designs, simulations, fabrication, and testing of the individually designed components, such as the passive antenna and low-noise amplifier (LNA). The final system will be the integration of all the components of the active antenna (passive antenna + LNA) to receive SDARS signal by means of a SIRIUS receiver. The active antenna design must minimize physical size, while producing the best quality signal.

Goals

The goal of this project is to make an active antenna to receive frequencies from 2320 Mhz to 2332.5 Mhz. From this frequency range, the SIRIUS receiver will be able to process and play all the possible allocated radio channels. In previous years' projects for the SDARS system, students have been able to replace the manufacturer's antenna with a fabricated proximity coupled patch antenna. This antenna combined a separate Left Hand Circular Polarized (LHCP) passive antenna with low noise amplifiers in connecting the separate components. This time, the entire active antenna will be constructed with the passive antenna and low noise amplifiers combined onto a single Printed Circuit Board (PCB). Also, a completely different design technique will be used for the passive antenna. A recessed feed patch antenna design will allow the antenna to be matched to the standard 50 ohms and a diagonal slot will be used to make it LHCP.

System Block Diagram

The figure below shows the top-level design of the active antenna from our system (FIG 3-1)

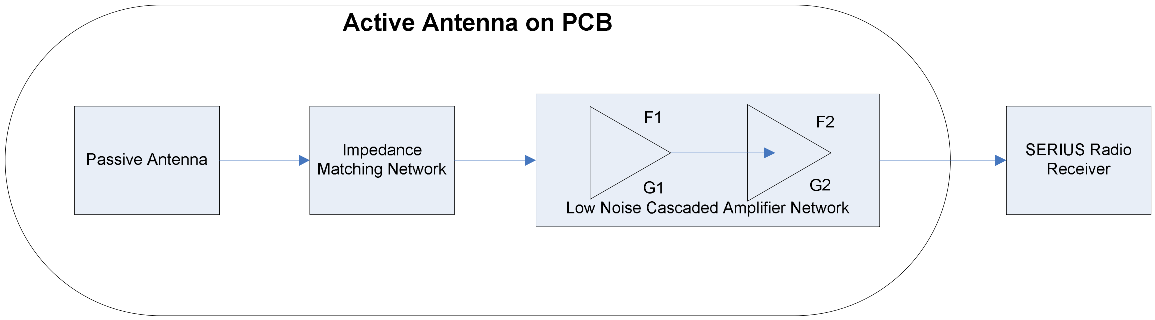

FIG 2-1: SDARS Functional Block Diagram

Antenna

The antenna is the passive portion of the paired antenna and LNA which is considered to be the "active antenna." The antenna receives the audio modulated, LHCP signal from SDARS orbiting satellite. It then feeds the signal via microstrip line into an integrated LNA for amplification. Simulations will be done using mainly Agilent ADS, PCAAD, and EM simulation software such as Momentum and Sonnet. Fabrication and testing will be used to determine actual performance. The antenna must meet several specifications to successfully receive the satellite signal:

- It will be receiving signals in the frequency band from 2320 Mhz to 2332.5 Mhz (a bandwidth of 12.5Mhz)
- The antenna will be Left Hand Circularly Polarized (LHCP)
- It will be designed as a Recessed Feed or "Inset Fed" patch antenna
- Patch antenna matched in impedance to LNA network (impedance matching network)

- 3-5 DB Gain for passive antenna

Low-Noise Amplifier (LNA)

We will be using a Low-Noise Amplifier (LNA) to strengthen the signal from the antenna while producing as little noise as possible. The low noise will be essential in order to have the receiver produce a quality audio sound. Specifications of our low-noise amplifier will be as follows:

- The cascaded LNA network noise factor should be less than or equal to 1dB
- Total gain for the cascaded LNA network should be between 40-50dB

References

[1] Lockwood, Kevin. “SDARS Front-End Receiver: Senior Capstone Project Report.” Bradley University, Spring, 2011.

[2] Balanis, Constantine A., “Microstrip Antennas,” in *Antenna Theory*, *3rd ed.* John Wiley and Sons, Inc., 2005, pp.811-882