Satellite Digital Audio Radio Service Receiver Front-End

Functional Requirements List and Performance Specifications

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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 square patch with probe fed design technique will be used for the passive antenna. By probe feeding the square patch antenna, it will be able to receive LHCP signals.

System Block Diagram

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

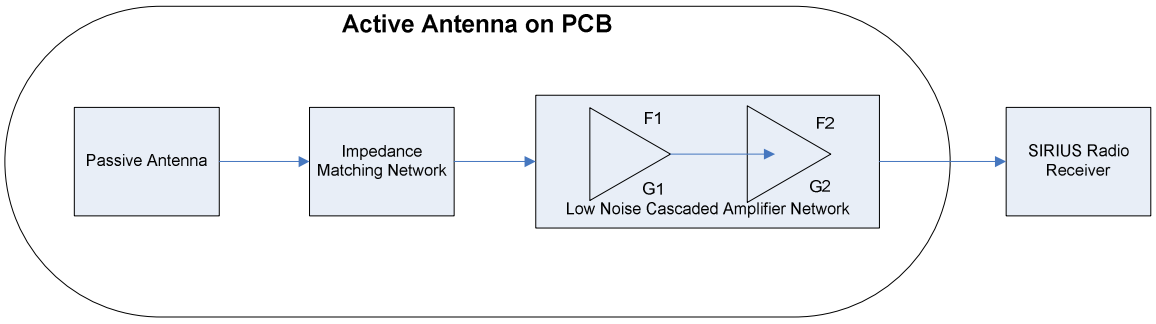

FIG 3-1: SDARS Functional Block Diagram

Antenna Requirements

- It shall be receiving signals in the frequency band from 2320 Mhz to 2332.5 Mhz (a bandwidth of 12.5Mhz)
- The VSWR shall be under 2 in the designated frequency range
- Shall be designed as a square patch, probe fed antenna to allow for Left Hand Circular Polarization (LHCP)
- Patch antenna matched in impedance to LNA network (impedance matching network)

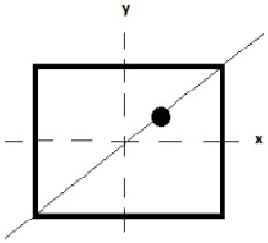

FIG 3-2: Top View of Patch Antenna, LHCP Probe Feed Alignment

LNA requirements

- The cascaded LNA network noise factor shall be less than or equal to 1dB
    - First LNA in cascaded network shall be low noise, low gain (< 0.9 dB Noise Factor, < 20 dB gain)
    - Second and all following LNAs shall have a higher gain, while allowing for a higher noise factor
- Total gain for the cascaded LNA network shall be between 40-50dB

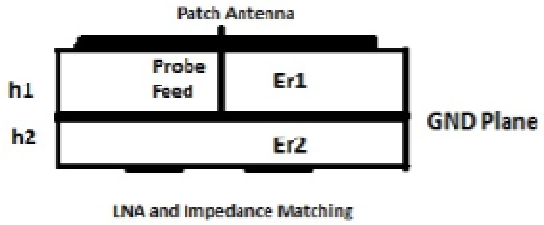

FIG 4-1: Physical Rendition of Patch Antenna and LNA Network

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

[3] Zomchek, Greg and Zeliasz, Erik. “SDARS Front-End Receiver: Senior Capstone Project Report.” Bradley University, Spring, 2001.