# RF Power Amplifier Design and Testing

Final Project Proposal

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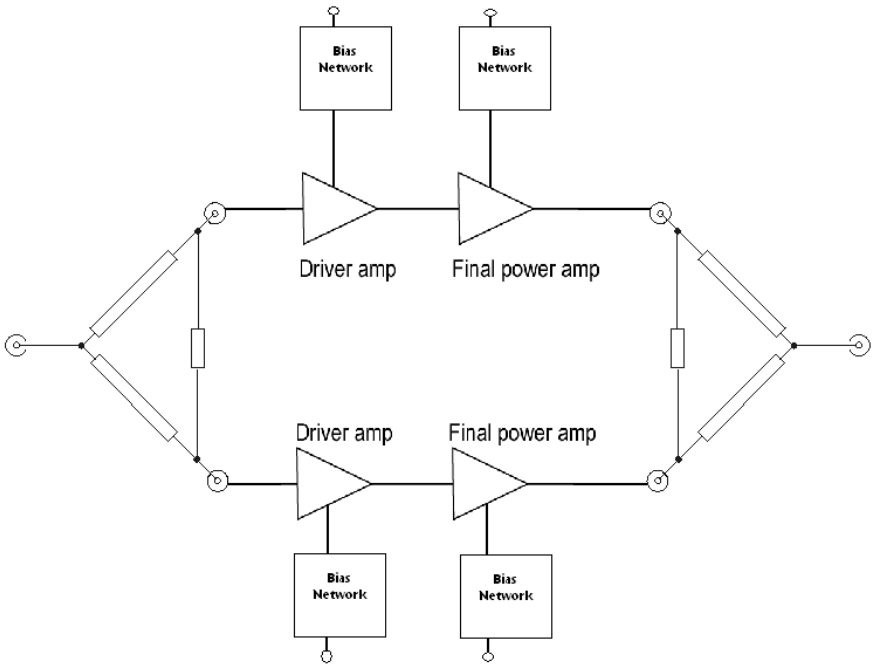


## Project Summary:

An RF power amplifier is a type of electronic amplifier used to convert a low-power radio-frequency signal into a larger signal of significant power, typically for driving the antenna of a transmitter. It is usually optimized to have high efficiency, high output power, good return losses on the input and output, and good gain. The goal of this project will be to design and test a power amplifier module that is best suited for WiMax, which provides mobile broadband connectivity to a range much greater than Wi-Fi.

## Project Description:

. The two important factors in determining a power amplifier are efficiency and linearity, which have an inversely proportional relationship (i.e. as efficiency increases, linearity decreases). Also affecting the choice of power amplifier will be the regulations and specifications of the application, particularly the frequency range and output power. After determining this information and choosing the application, the appropriate topology and architecture for the system will be selected.

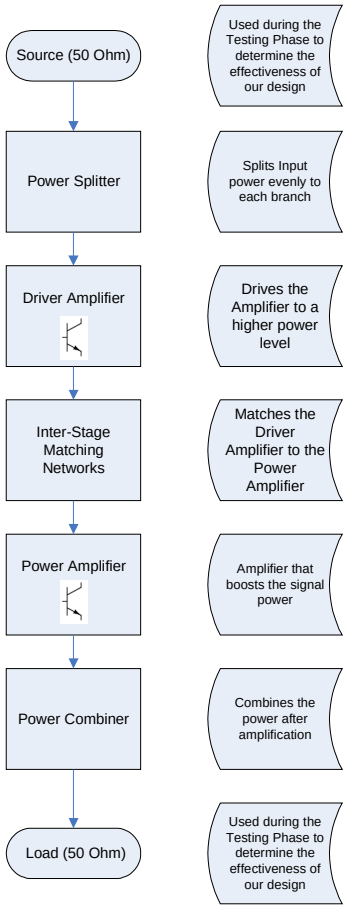
Due to input power constraints, and the limited gain of the amplifier, we will be using two sets of a driver amplifier and power amplifier in series combination. Each of these will provide half of the final output power. Because these two sets will be in parallel, we will use a power splitter and combiner to our required output power. For this architecture, we can choose between the Wilkinson Power Divider, and the Branch Line Coupler.

The actual amplifiers will be bought, including the evaluation boards which will allow us to do immediate testing and simulation before any fabrication. Once simulation is complete, we will fabricate a connector version consisting of just the driver amplifier,

power amplifier, and its corresponding impedance matching circuitry, hereafter referred to as the power amplifier module. Once this is version is tested we will fabricate an integrated version that incorporates the whole design. This will include the power splitter, the power amplifier module, and finally the power combiner.

The testing will be done in the RF lab using both the network analyzer and spectrum analyzer. At this point the S-parameters, using the Network Analyzer, will be measured, which will give us the gain and return losses. We can also determine the linearity and efficiency from the Spectrum Analyzer. We would then determine the viability of heat dissipation, in both terms of potential efficiency increase and time. Further time permitting we will demo our power amplifier module in conjunction with other applications.

**System Block Diagram:**



**Functional Requirements:**

- Frequency Range: The power and driver amplifiers must be able to operate at a single band within the 2-6 GHz range in order to be applicable to WiMax. We have found these bands to be at 2.5 GHz, 3.5 GHz, and 5.8 GHz. If for instance we chose the 2.5 GHz band, we would expect the amplifier to operate within 2.3-2.6 GHz.
- Output Power: The system will be designed to output 1 W.
- Efficiency: Efficiency will be determined by the class of the amplifier. If we use a Class A Amplifier for example, the theoretical maximum efficiency of the amplifier is 50%. This means our target efficiency will be around 40%. As efficiency decreases, linearity increases which will limit the amount of disturbance in the system.

## Schedule:

- Week 1: Receive Ordered Parts & Simulation with ADS
- Week 2: Continued Simulation
- Week 3: Simulation & Fabricate Connector Version
- Week 4: Test Connector Version & Choose Splitter/Combiner Architecture
- Week 5: Test Connector Version & Fabricate Integrated Version
- Week 6: Test Integrated Version
- Week 7: Analysis of Results
- Week 8: Determine Heat Dissipation Viability
- Week 9: Analysis of Results

- Week 10: Presentation Preparation
- Week 11: Presentation Preparation
- Week 12: Presentation

## Equipment List:

Network Analyzer
Spectrum Analyzer

## References: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