RF Power Amplifier Design and Testing

Functional Requirements List and Performance Specifications

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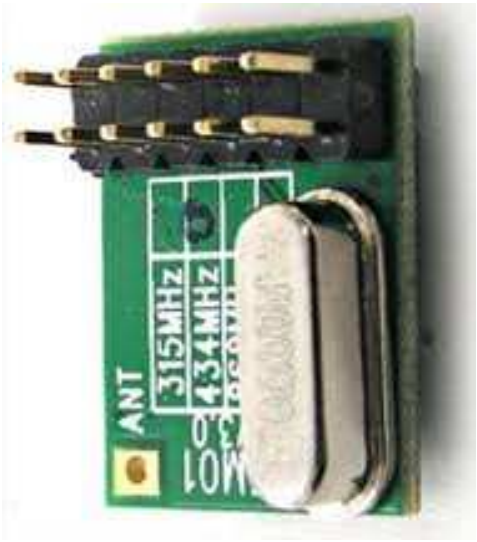


Introduction:

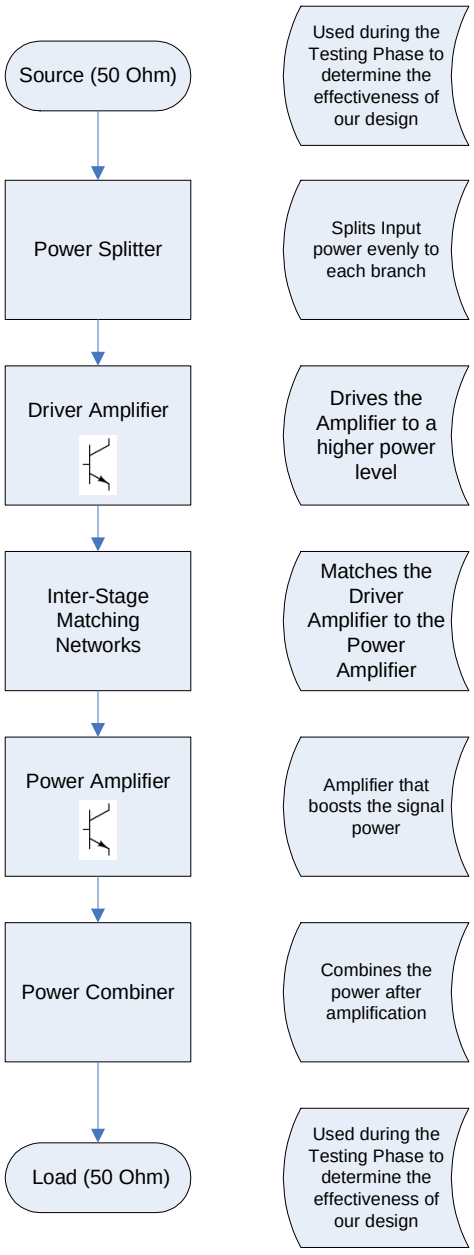
An RF power amplifier is a type of electronic amplifier used to convert a low-power radio-frequency signal into a larger signal of significant power, typically for driving the antenna of a transmitter. It is usually optimized to have high efficiency, high output power, good return losses on the input 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. 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.

After simulating the amplifier using Agilent ADS it will be fabricated and extensive testing will begin to see if it meets the design specifications. 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. Once this is version is tested we will fabricate an integrated version that incorporates the whole design. This will include the power splitter, both sets of driver and power amplifiers, the impedance matching circuitry, 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 will be measured, which will give us the gain and return losses, linearity, and efficiency. Time permitting we will demo our power amplifier in conjunction with other applications.

Complete 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.
- Output Power: The system will be designed to output 1 W.
- Efficiency: 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.

Additional Information

In order to accomplish these specifications we will need two sets of amplifiers, one of Driver Amplifiers and one of Power Amplifiers. These will be paired with each other to create the branches of our system. The matching networks for that go between the amplifiers and the power splitter/combiner sections will be designed in the lab after the amplifiers acquired.

References:

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