Ultra Wideband Amplifier
Functional Requirements List and Performance Specifications

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Functional Description

The purpose of this project is to research, design, fabricate, and test a radio frequency (RF) amplifier to be used in the Ultra Wide Band (UWB) system. This amplifier to be designed will be used in the UWB receiver. A low noise amplifier (LNA) will be designed.

Goals

- Research an amplifier design
- Fabricate and implement the design of the amplifier
- Creating and meeting specification for the UWB amplifier
- Test and implement the amplifier

System Block Diagram

A basic UWB system will have a signal pulse generator that generates a Gaussian pulse. The encoded signal is transmitted using the Gaussian pulses. The pulses are amplified and transmitted via antenna to the receiver. Once the receiving antenna receives the signal the low noise amplifier will amplify the signal before it continues on into the receiver. Figure 1 shows the system block diagram. The LNA is the subsystem that we will design. The input to the LNA is the signal received from the antenna. The antenna receives a signal from a transmitting antenna. The signal is amplified through the LNA.

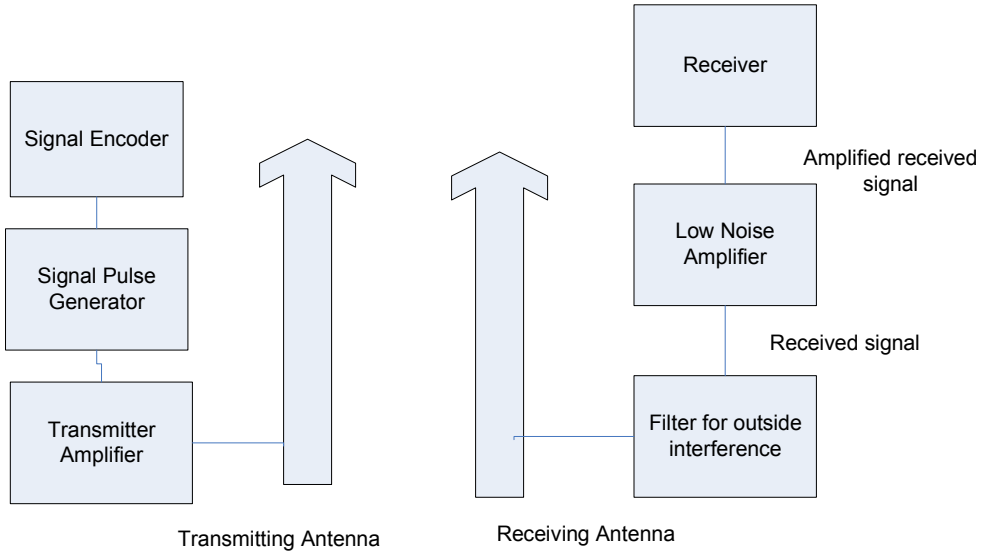

Figure 1: System Block Diagram of UWB System

Functional Requirements

The LNA will be a hybrid packaged CMOS transistor with a distributed amplifier topology. A prefabricated component will be used due to time limitations. The amplifier will amplify the signal coming from the receiving antenna without distortion and minimum power loss.

The amplifier must not interfere with outside frequencies and has to be able to operate correctly with outside interference. Table 1 shows all of the current frequency standards in the United States that will interfere with the UWB amplifier. These interferences may cause the amplifier to saturate. Design considerations will have to be done to avoid this. The exact effect of each frequency standard on the amplifier will be taken into account individually as the design process continues.

Table 1: Frequency Standards that will interfere with UWB

Standard	Frequency Range	Reference
IEEE 802.11a	5 GHz	[8]
IEEE 802.11i	2.4GHz and 5GHz	[8]
IEEE 802.16WiMAX	2GHz – 11 GHz	[9]

The required frequency range of operation is the entire UWB spectrum is 3.1 to 10.6 GHz. The desired cutoff frequency is 10.6 GHz. Amplifiers only get seventy percent of the maximum frequency desired. To get the desired cutoff frequency, the minimum f_{max} needed must be roughly 15 GHz as shown in equation 1. Ideally, the maximum frequency of about 20 - 25 GHz will be used to compensate for component loss.

Equation 1: $$\frac{10.6GHz}{.7} = f\max$$

Performance Specifications

A summary and comparison of various distributed amplifier specifications are shown in Table 2. These amplifiers are in the desired frequency ranges. Seeing these comparisons gives an idea of where to begin with the specifications for the amplifier. The desired specifications were found using Table 2. A median number was used to pick the specifications. These values are our tentative design goals. The specifications may change as the design process continues.

Desired Specifications:

Gain: 12 dB
Noise Figure: 4.5 dB
Power Dissipation: 40 mW

Table 2: Summary and Comparison of Distributed Amplifier Specifications

Reference	Gain (dB)	NF (dB)	BW (GHz)	PD (mW)	Topology	Technology
[1]	17.5	3.1	3.1-10.6	33.2	Distributed	0.18 µm CMOS
[2]	10	6.4	3.1-10.6	5.4	Distributed	0.35 µm SiGe BiCMOS
[3]	9	5.3	3.1-10.6	22	Distributed	0.18 µm CMOS
[4]	20	6.5	1.6-12.1	40	Low Power Distributed	0.35 µm SiGe BiCMOS
[5]	7.3	4.3-6.1	0-22	53	Distributed	0.18 µm CMOS
[6]	10.6	3.4-5.3	0-14	52	Distributed	0.18 µm CMOS
[7]	6	6	1-27	68.1	Distributed	0.18 µm CMOS

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