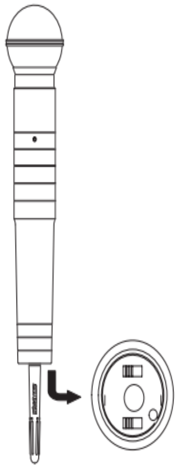
5.2 Design of Mice and Transmitter



We use a ready commercial grade EC2 Wireless Mic with operating frequency between 160MHz to 250MHz. Frequency Stability supported by the system is ±32.5 PPM, ±5.5 KHz which meets the FCC regulations. EC2 transmitter's operating range is typically 600 feet or 182.8mW at 50mW Modulation. It withstands ±15 KHz deviation using a compressor and expander system with emphasis (both pre- and de- types). Total Harmonic Distortion is average 0.4% to 0.7% maximum. The dynamic range is 80Hz to 15KHz +-2 db

6. Software Design

6.1. The Receiver Specification

The receiver specification is presented in the table below.

Non Voice Suppression	2.0 µV,2-50 µV
Output	–2 dB at 1 KΩ o/p impedance
Antenna Input Impedance	50Ω
Voltage Requirement	1.5 VDC
Current Requirement	200 Ma

6.2 Receiver Antenna Gain

The below figure shows that the antenna response is directional in nature that is when the transmitter mic is directed and kept closer to the antenna of the receiver, the gain is maximum. Gain tends to reduce around 60' angle. Also the receiver is designed mainly over human voice frequencies and the gain in optimum between 200 Hz to 5 KHz. However normal voice will typically range between 330 Hz to 3.3 KHz. Therefore this receiver fails to suppress both high frequency noise as well as low frequency noise. Therefore there is a need of LNA.

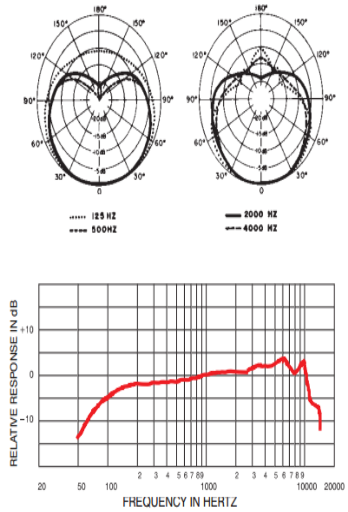


Figure 6.2: Antenna Response

7. Results and Validation

7.1 Voice Transmission over Channel

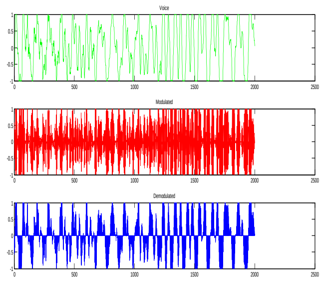


Figure 7.1: Simple Voice Transmission over Ideal Channel

For simulating voice transmission over channel we record 10sec user speech sampled at 16 KHz. We then multiply this with a carrier frequency of 200MHz as our operating frequency for the Wireless voice transmission is 200MHz. The modulated signal is passed over the ideal channel first which means that no error is induced in the channel. Finally at the receiver, the signal is multiplied with the carrier signal again. No filter is implemented. It can be seen that multiplying with carrier increases the frequency of the signal where as doing the same at the receiver recovers the original signal back again with some noise. However figure 7.1 does not clearly reveals the characteristics of the voice. Because it is rather difficult to understand the frequency domain characteristics of the signal from time domain data. Therefore we perform FFT on y, R and D signals which are actual voice, modulated and received signal respectively. Figure 7.2 Show the graph.

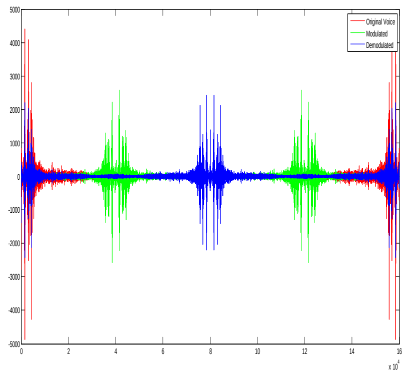


Figure 7.2: Wireless voice transmission properties in frequency domain

It can be clearly seen that in original voice (Red signal) mainly lies in the low frequency range. Modulation process changes the frequency of the signal to high frequency band (Green). Demodulation process obtains the signal in baseband (Blue). However we can clearly see that though de-modulation recover the low frequency component it does not eliminate the high frequency component. It can be seen that significant trail of blue remains in high frequencies. Hence low pass filter is an important step in receiver circuit.

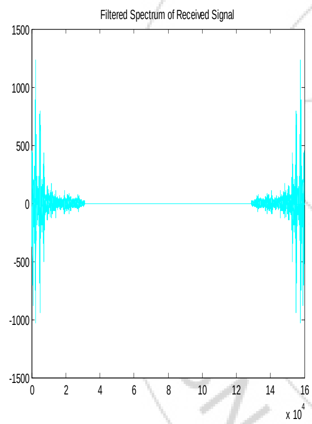


Figure 7.3: Low pass filtered received signal

After Low pass filtering stage however lifting the spectrum any further would also lift the noise band hence giving distorted signal. As any spectrum lifting also ideally lifts the noise (containing both silence as well as other signals on the same spectrum, it is highly impossible to design a filter that can lift only the voice band and suppress other parts.

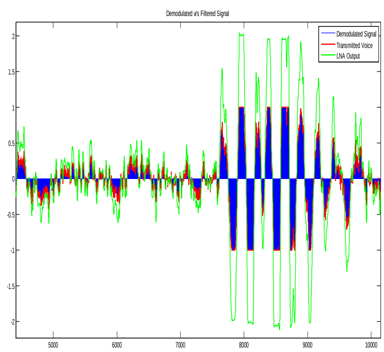


Figure 7.4: LNA Output

It can be clearly seen that the proposed LNA does not amplify the noisy signal. However it significantly lifts the voice signal. We can clearly see Green signal being much higher amplitude than that of blue demodulated signal. Thus when LNA is added at antenna stage before receiver, the signal quality improves significantly.

8. Conclusion

Low Noise Amplifiers are conventional electronics circuits used for amplifying band limited signal. This is an essential block in almost every type of communication systems. In modern day LTE based system extensively uses such amplifiers at the first stage of the receiver. The amplifier commonly being used is of type hybrid which is capable of amplifying signals from various core networks. The simulation model analyzes the transmitted voice characteristic over the communication channel and correctly presents the characteristics in term of frequency domain analysis graphs.

The system can be used to study noise figure characteristic of the receiver and design ideal system for reducing the noise. By simulating the presence and absence of LNA with antenna and by proving that using LNA can significantly improves the quality of transmission we justify our proposed design.

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