Summary

The goal of the project was to prove this concept and implement code into a CC430. The tests conducted were used to prove that RF could be used a distance calculator. The results show that indoors had more variation and was more difficult to determine the distance, but it was still possible. The outdoor tests showed that the distance was linear for certain ranges and could be determined very well with distance. The most important spec that we were told to meet was that the stimulus would not go off past 25 feet. By using all the data that we acquired we were able to demo the product without any misfires past 25 feet. By having multiple fail safes in place we were able to make our product very robust and we were able to use TI software to verify these fail safes. We were able to successfully demo our product to our customer and by having all our design parameters easily configurable the amount of maximum distance, stimulus length, and reset time can all be configured for each specific customer.

Each of our tests has their own test description and summary for that test.

Test Description: The Transmit (Tx) and Receive (Rx) functions of the CC430 Development Kit were tested using RF Studio. This test was performed so that we have a starting point to determine the next steps for our project. The test was performed in 3 different ways:

1) 2 Dipole Antennas (Tx and Rx)
2) 1 Dipole Antenna (Rx)
3) No antenna (Tx and Rx)

The results were gathered and plotted below.

Results:

```
clear
clc
close all

x = [5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25];
y = [-34 -31.8 -31.9 -31.1 -33.8 -34.9 -36.8 -37.6 -39.3 -38.5 -38.4 -43.1 -
37.4 -35.9 -36.6 -37.1 -41.3 -38 -46.9 -40.9 -41.5];
y2 = [-79.2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
y3 = [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0];
hold on
grid minor
plot(x,y,'m','LineWidth',3)
plot(x,y2,'b','LineWidth',3)
plot(x,y3,'r','LineWidth',3)
title('dB Test')
xlabel('Distance (ft)')
ylabel('dBm')
legend('2 Dipole Antennas', 'One Dipole Antenna (Rx)', 'No Dipole Antennas')
```

Figure 1: Matlab Code Used to Create Plot

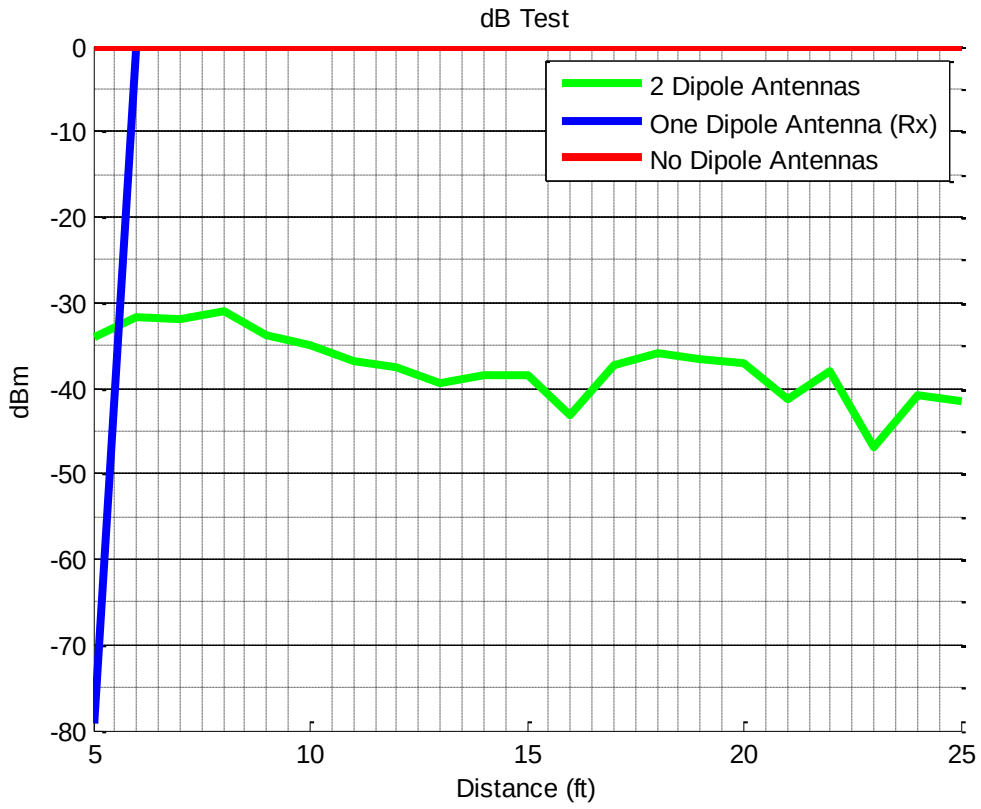

Figure 2: Results

Conclusion: As seen in Figure 2, there was no transmit success without antennas and there was little success with one antenna. With one antenna, packets were only received within the first 5 feet. The main purpose of this test was to see the dB results when transmitting packets with both antennas. Our goal was to see a change (drop in dB as the distance increased). As seen above, there was a small decrease in dB consistent for the first 15ft, and then the values just seemed to bounce around in a non-linear fashion.

We can take this information and tweak our power values or frequency to get the envelope we are looking for.

Test Description: The Transmit (Tx) and Receive (Rx) functions of the CC430 Development Kit were tested using RF Studio. This test was performed so that we have a starting point to determine the next steps for our project. The test was performed in 3 different ways:

1) Transmit (Tx) Power at 0
2) Transmit (Tx) Power at -12

The results were gathered and plotted below.

Results:

```
clear
clc
close all

x = [5 10 15 20 25];
y = [-33.2 -40 -40.2 -44.4 -45.4];
y2 = [-49 -58.4 -57.7 -58.8 -61.7];
hold on
grid minor
plot(x,y,'m','LineWidth',3)
plot(x,y2,'b','LineWidth',3)
title('dB Test')
xlabel('Distance (ft)')
ylabel('dBm')
legend('Tx Power 0', 'Tx Power -12')
```

Figure 1: Matlab Code Used to Create Plot

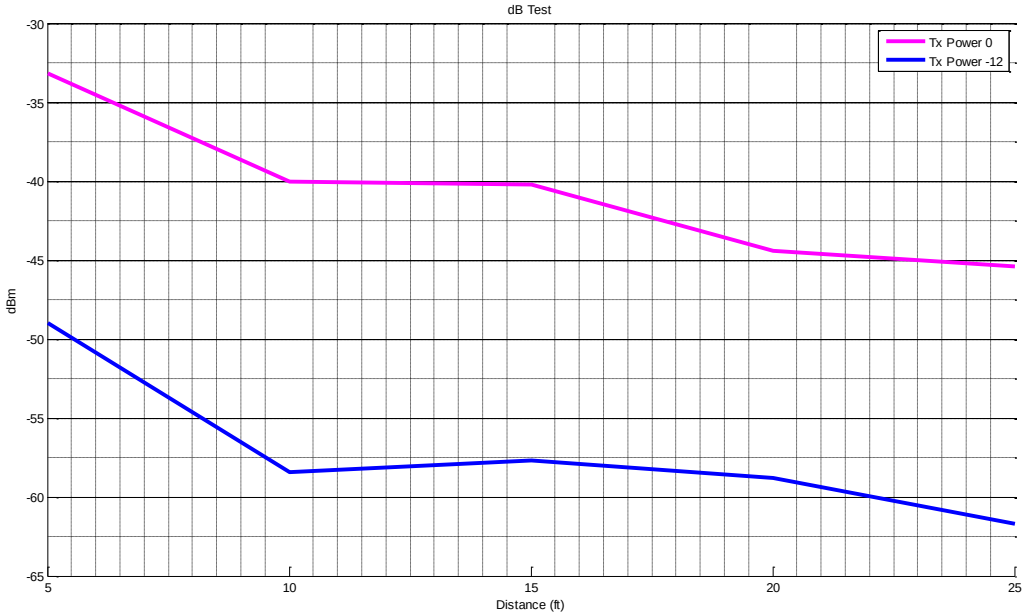

Figure 2: Results

Conclusion: The plots for each test with the different transmit powers follow the same pattern. This proves our data to be rather consistent. When comparing our data outside with the data inside, we are safe to assume the outside tests give us a much better result. This can be due to the varying RF signals that are constantly running though the buildings at RIT.

Test Description: The project is at the point now to implement the speaker and DAC. The project is to be designed to release a stimulus at a frequency of 1KHz. The code has to be altered to incorporate the pins that will run the speaker. Once the code was written, it was uploaded to one of the boards and the pin was tested using an oscilloscope. The code was written to have the pin give a signal with a duty cycle of 50%.

Results:

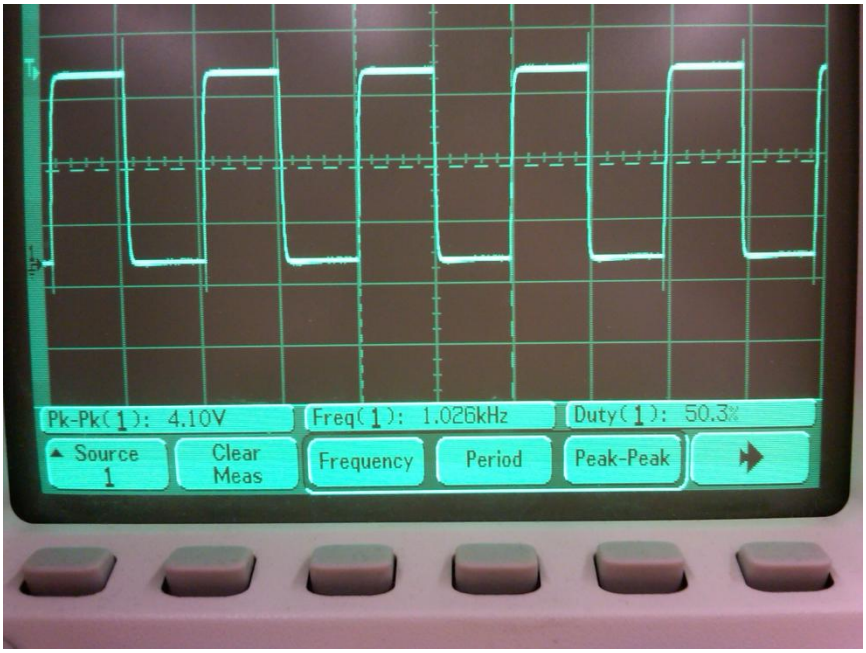

Figure 1: Capture of Square Wave probed from Pin 7 on the Dev Kit

Conclusion: This capture shows that the duty cycle is approximately 50% which is was programmed to be as well as the Frequency being close 1 kHz which is required. This needed to be verified before adding the speaker. This way we can be sure that the frequency is at the assigned value.

Test Description: This project is similar to the RF Studio test which looked at dBm vs. Distance. In this case, we used the program we developed, not the program pre-written for RF Studio.

Results:

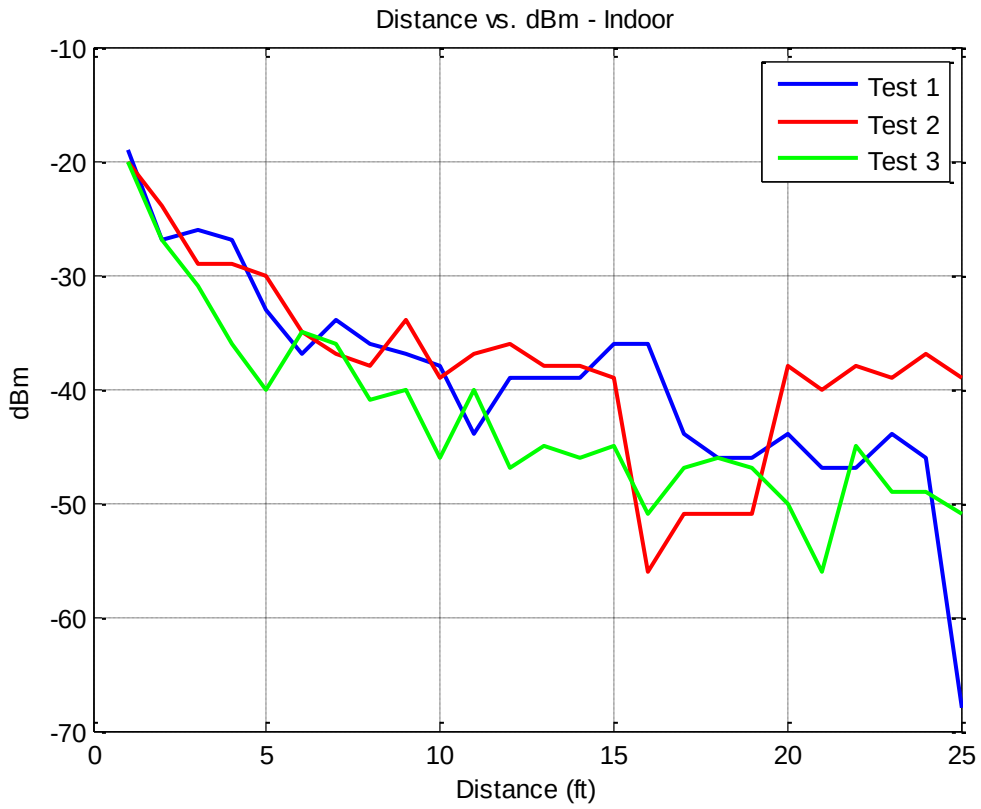

Figure 1: Indoor Results

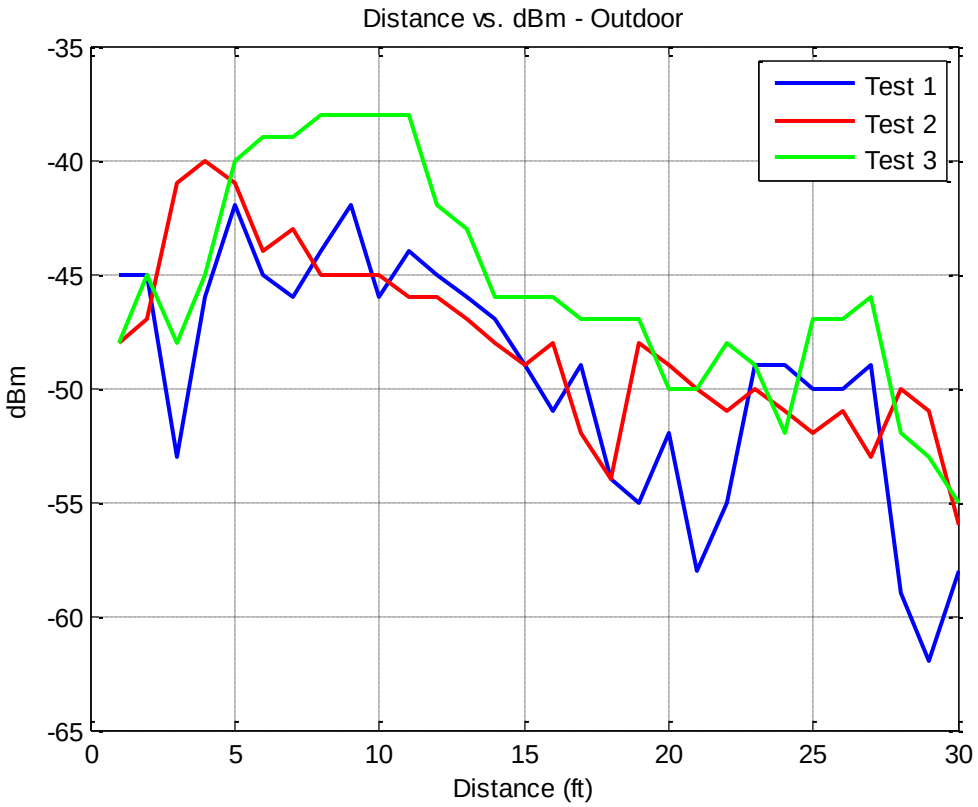

Figure 2: Outdoor Results

Conclusion: The indoor results seemed a lot better than the outdoor test, which is the opposite of what was concluded with the RF Test. One reason for this error could be due to the fact that when the testing was done outdoors, the boards were not placed level. Another test may be done where the boards are placed level outdoors..