

#### IV. Summary/Conclusions \_\_\_\_\_ /15

A. Met project specifications? Brief summary only. /4

Refer reader to previous sections for details.

B. Unresolved problems. Brief summary only. /4

Refer to previous sections for details.

C. Suggested improvements to design. Brief /4  
summary only. Refer to previous sections for details.

D. What was learned /3

#### **Conclusion:**

This project was very successful. The radio designed and constructed met and exceeded the requirements of this project. A 1.4 MHz signal generated by radio station KLBB was filtered out, demodulated and amplified to produce a high quality audio output. The super heterodyne receiver topology provided improved filtering and stability over the traditional design approach, as well as allowed the RF amplification and demodulation to operate at a lower frequency. The demodulation utilized a slightly forward biased diode which improved the quality without using a germanium diode. Next, the audio amplification section included a LM741 stage with easily changeable gain to allow the gain of the entire system to be tunable during testing. Finally, the power system included careful ground planning and filtering to provide a minimal amount of noise. These stages combined to give more than the required filtering and gain while producing a high quality audio output with minimal power consumption.

However, despite the project's success, there were still several unresolved problems that we could not solve within the time frame and budget of this course. For example, two 1/8<sup>th</sup> of an amp fuses were blown during testing. This was probably due to spiking currents caused by the large capacitors used to keep the voltages stable. The relative inexpensiveness of these fuses and the ease with which they were replaced gave this problem a lower priority to be resolved within our timeframe. Another unresolved issue was the lack of variable gain which caused the output volume to change when the radio was moved, or when the antenna was touched. Adding this would have probably been too expensive for our design, for something with little impact on the overall average performance of the radio.

Perhaps the largest area for improvement would be an overall simplification of the entire system. The original measurements lead us to believe the signal strength at the antenna would be around 5 micro volts. To produce an 1/8<sup>th</sup> watt output using an 8 ohm speaker, we would need to output 1 volt, requiring a gain of 200000, or 106 dB. We designed the system to provide this gain using high gain bandwidth devices, and additional gain stages. However, upon testing

our hardware, it was evident that the signal in the room was much more powerful, perhaps on the order of millivolts, than had been predicted. Knowing this would have greatly simplified the design, and would be the primary reason for improving on the existing design. With the reduced gain requirements, cheaper parts with lower gain bandwidth products could have been chosen. In addition to reducing the cost of individual components, the need for a negative voltage supply could also have been eliminated, further simplifying the design. Another improvement would be in the look and structure of the case. In order to stay within budget, the cheapest case available was purchased which met our size requirements. By allocating more of the project budget to the design and look of the case, a more visually appealing radio could have been created.

Several things were learned during this project. The first was that spending extra time during the beginning of the project to verify the conditions and parameters of the project could have lead to a much easier and simpler project overall. In addition we learned that it was highly beneficial to utilize resources outside of the university. Purchases directly from Mouser or Digi-Key arrived sooner than those done through the storeroom, and always included the exact parts that were ordered. Our sponsorship by SunStone Circuits provided us with quick reliable PCB boards after several weeks of unsuccessfully working with the storeroom and machine shop. The knowledge gained in this project ensured that any future projects would be more successful than this one.