A Memorandum

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**Date:** September 11, 2018

**Subject:** Verification Report - Guitar Tuner

A guitar will be used to produce mechanical sound waves. A microphone will pick up the sound waves and convert them into electrical signals. These signals will be filtered and then amplified in order for the analog to digital converter to accurately convert the signals. The microcontroller will use digital signal processing algorithms to find the fundamental harmonic of the signal from the analog to digital converter. The frequency and note accuracy (compared to standard guitar notes) will be output to a display, which will show the frequency and whether the note is sharp or flat. The project will be powered by a battery. The functional blocks of the device are as follows: power, mechanical acoustic wave detection, signal conditioning, data acquisition, data analysis, and user interface. The functional blocks are summarized in the following table, Table 1.

**Table 1: Functional blocks of guitar tuner**

|  |  |
| --- | --- |
| Functional blocks of device | Description |
| Power | Provides appropriate power to each subcircuit of device. |
| Mechanical acoustic wave detection | Detect mechanical acoustic wave, translating it into an electrical signal. |
| Signal conditioning | Amplify signal with filtering for data acquisition. |
| Data acquisition | Translate electrical signal to digital for analysis. |
| Data analysis | Analyze digital signal to identify fundamental frequency. |
| User interface | Display results of data analysis to user. |

The power supply provides +5V ±10% with 200mV ripple capable of delivering up to 500mA. The tuner is capable of detecting frequencies from 60Hz to 440 Hz ±10%. In addition, the guitar must be farther than 1 foot from the tuner, but no more than 3 ft from tuner. Frequencies greater than 1kHz are attenuated by at least 20dB. Frequencies greater than 50Hz but less than 500Hz are amplified by at least 20dB. These results will be achieved without the use of a development board.

The guitar tuner will be demonstrated as a whole unit first, displaying the frequency of the guitar note being played by the creators. The result will not require any equipment to display the detected note as the guitar tuner will have a user interface which will accomplish this. A KLIQ Metropitch tuner will be used simultaneously to compare to the accuracy of our tuner.

The power supply will be the first module measured using the Keysight InfiniiVision DSOX2004A oscilloscope. Two probes will be used to measure over a 10Ω load to verify the ripple is less than 200mV. To measure the current, a Fluke 115 digital multimeter will be used in series with the 10Ω load to verify that the power supply can deliver up to 500mA. The Digilent Analog Discovery II is required to measure the gain in dB versus the frequency whose measurement range will be limited to less than 2kHz. This will be measured with reference to ground and output from the final stage of the operational amplifier prior to the analog to digital converter.