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## The Frequency of an Electric Guitar and How a Tuner Defines its Note

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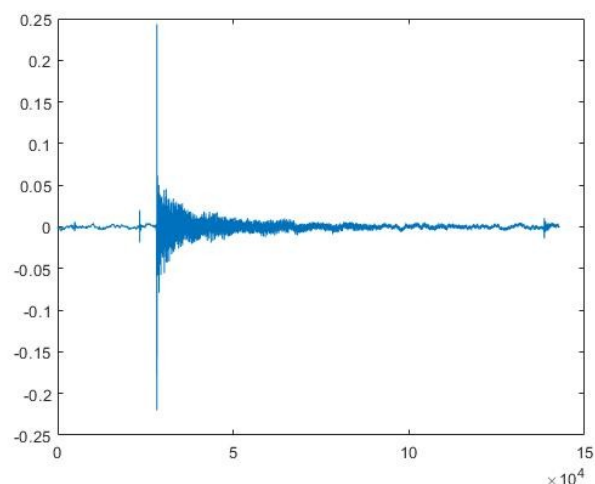
# The Frequency of an Electric Guitar and How a Tuner Defines its Note

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How a guitar tuner measures the frequency of a guitar and the best way to develop this kind of tuner.

The guitar can always be in different keys in order to make it sound the way you want it to for a specific song and the best way to make it sound a different way is by tuning it with a guitar tuner. But, how does a guitar tuner tune a guitar just by listening to the frequencies of the strings on the guitar when it's played? This paper will help elaborate on the idea of how a guitar tuner measures the frequency of a guitar's string and the best way to build a guitar tuner.

In order for a guitar tuner to measure what frequency a string is being played at is for the guitarist to pluck their string in order to make a sound. The guitar tuner detects that frequency and shows it to the guitarist. What the guitar tuner sees is something like that in Figure 1 which shows the waveform of the low E guitar string.



This part of the guitar tuner does not tell us much about how the guitar tuner measures the frequency of the guitar string, but if we zoomed in a bit more it could help explain a little bit more. In Figure 2 you can see how the waveform fluctuates a bit more clearly over a given time interval.

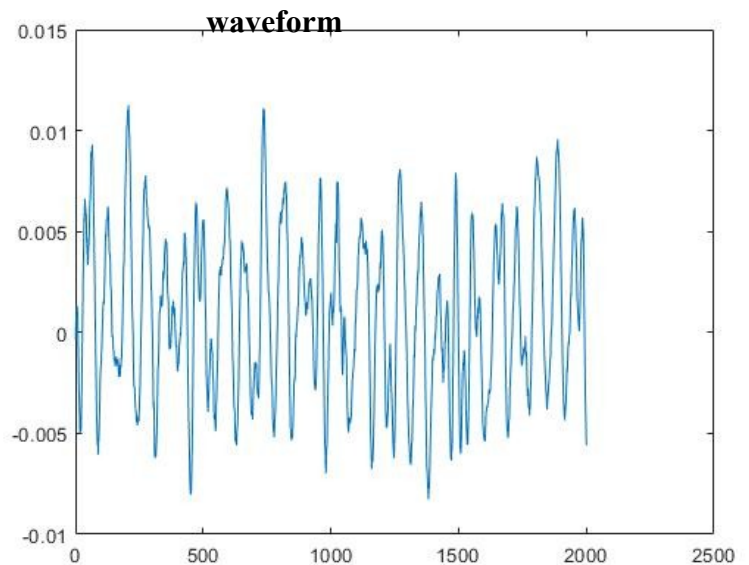
What this waveform allows us to see is where the waves hit at the highest points. If we decide to shift the waveform one point over itself towards the right and take another sample of it, you will get a certain frequency, but we want to do this multiple times. Doing this multiple times allows us to see exactly where the

highest peak value is which then in turn gives us the correct frequency of the guitar string. When doing this in MATLAB, I was able to send out a small list of code using the wav file I made of the low E string and was able to find the highest peak value of the frequency which was about 82Hz which is roughly the frequency of a low E string. If this

were done using the guitar tuner, it could be done the same way. What the guitar tuner could then do is send that frequency to an LCD to show the guitarist how close they are to the given frequency/guitar chord.

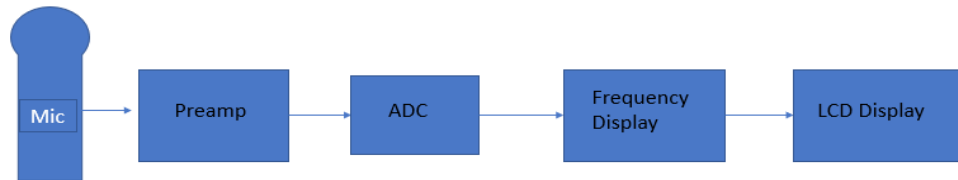
The best way to make this guitar tuner can be shown in Figure 3 where it has a microphone to detect the frequencies given off by the guitar strings. It should also have a preamp to convert the low and weak frequencies into high sounding frequencies. Those frequencies picked up by the preamp should then be fed into an analog-to-digital converter to make the sounds picked up from the microphone into a digital output. The digital output can then be detected by a frequency

**Figure 1. Low E guitar string**



**Figure 2. Low E Chord zoomed in.**

detector to then display something like that of Figure 1 and 2. Which can then finally be displayed to the guitarist as a guitar chord and tell them how flat or sharp they are in comparison with the given chord.



**Figure 3. Guitar tuner flowchart**

Building a guitar tuner like this should be simple and easy to manage. Not only that, but it should be cost effective and could be scaled down too so that anyone who wants to tune their guitar near or far they could do it with something like this.