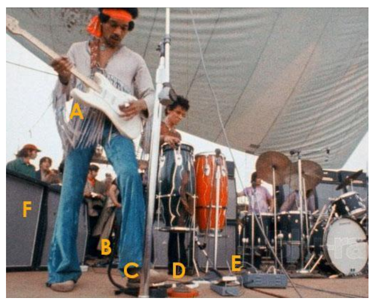
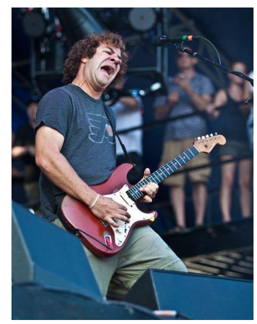
Fuzz Face Guitar Pedal Workshop

What is a guitar pedal?

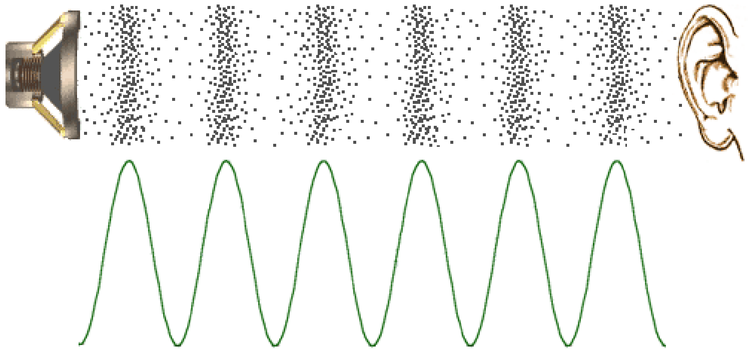
This may seem like a silly question for an experienced guitarist, as you already know how to get the tone you want by setting gain, bass, treble, reverb, delay etc. The truth of the matter is, you may already be a master at analog signal processing without even knowing it. Many guitar players have an excellent *practical* understanding of signals and their properties, now you can take a peek at some of the *theory* and see how it all actually works.





Electronic Instruments

This entire workshop is going to take place mostly in terms of “electric” instruments, so what does that actually mean? Electric instruments are unique in that they directly translate string vibrations into an analog electrical signal. For the rest of the workshop, the word signal, which refers to the electrical signal created by an instrument, and the word waveform which refers to the sound wave itself will be referred to interchangeably. For our purposes they are the same.

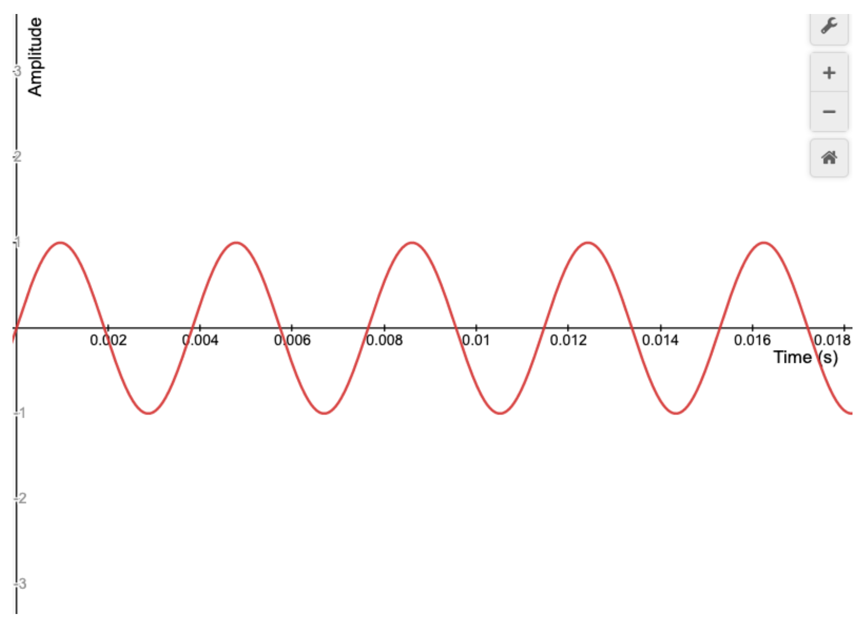


The sound wave (top) created by an instrument and its equivalent electric signal (bottom).

Pure Tone and Waveforms of Notes

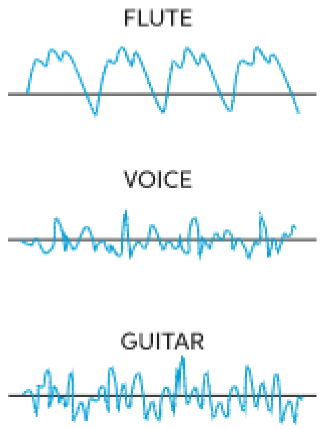
Before understanding how to add effects to a guitar, we must first understand some characteristics of its signal. You are probably familiar with the concepts of pitch and scale, but have you ever wondered exactly why instruments sound different even if they have the same pitch or frequency? First, we start with the most mathematically simple instrument there is, a *tuning fork*. This instrument (if you want to call it that) makes a “pure” sound wave that looks something like this.

Sound Wave from a Middle C (C_4) Tuning Fork

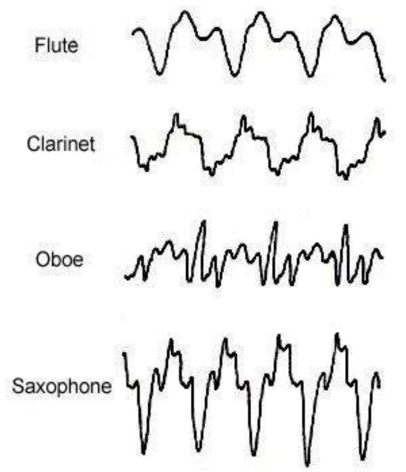


Nobody asked, but the mathematical definition here is $f(t) = sin(261.63 * 2\pi t)$

The signal here is really simple but it is also really annoying to actually listen to and that is why nobody plays the tuning fork. Below are what sound waves of some actual instruments look like:



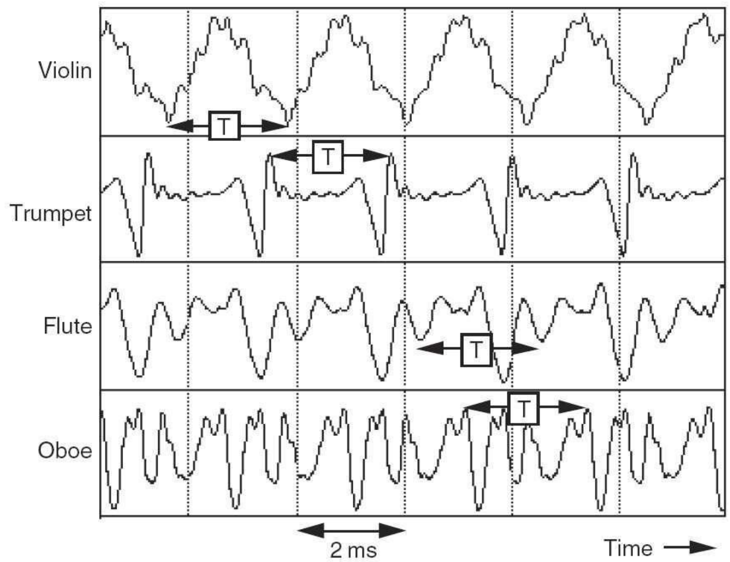
Same Note!



Same Note pt 2!

Insert picture of Scope output of pure tone

Even though these signals look different, they are actually all representing the same note. This is because a note is defined by its *frequency*. Two instruments can make sound waves of the same frequency that have a different shape. If you look below, you can see that all these waves look unique, but have the same frequency/period (T).



The same note played by various instruments.

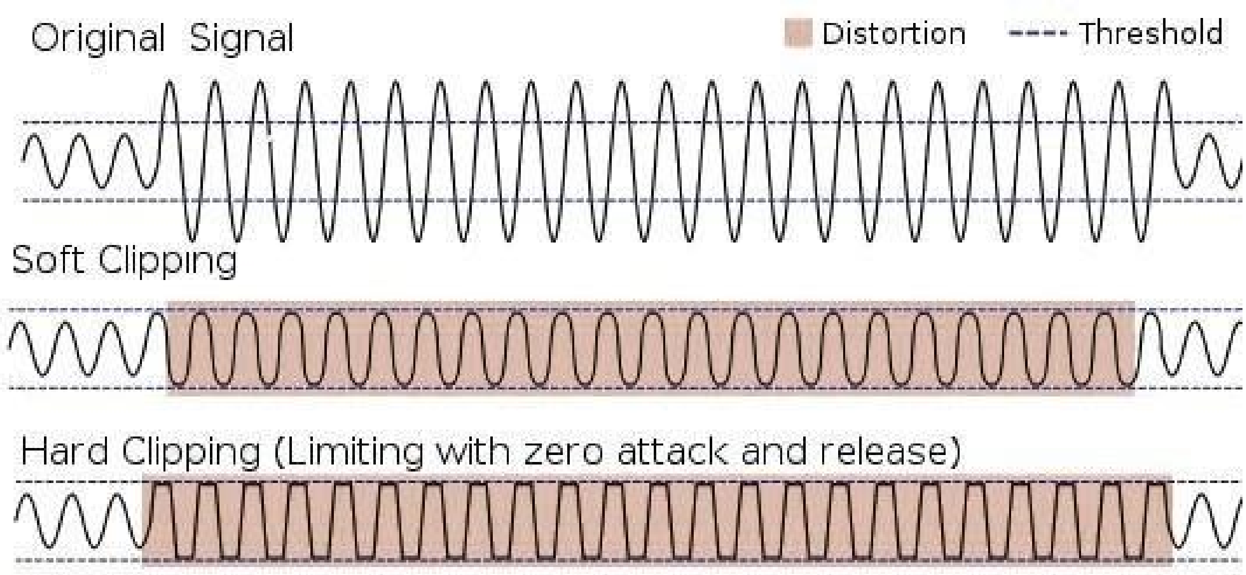
Hopefully you have not gotten lost or discouraged at this point, but as a reminder, you most likely already have a practical understanding of these concepts, and you don't have to be a mathematician to be a good musician!

If you are interested you can still look at the frequencies and wavelengths of an even-tempered scale here: pages.mtu.edu/~suits/notefreqs.html

Characteristics of a Pedal

Now that you have an understanding of what a guitar signal looks like, we can start to visualize some of the effects you already know. Since a guitar signal is pretty complicated, we are going to look at effects being applied to smooth, pure signals. The pedals will have the same effect on a guitar signal, but the resulting waveform will me much more complicated.

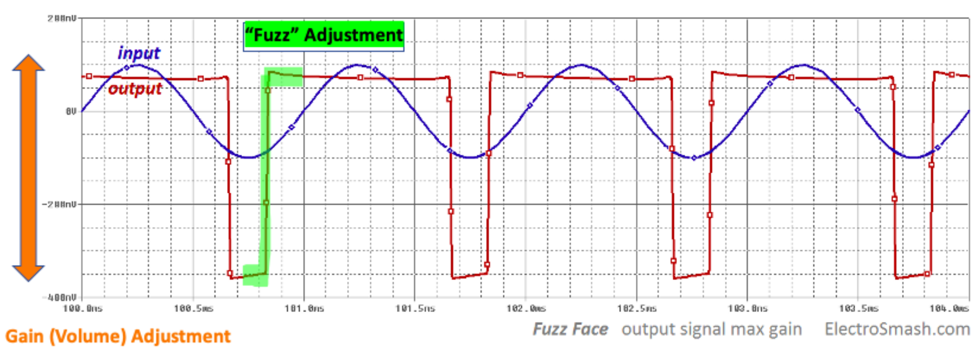
Insert picture Scope output with distortion.



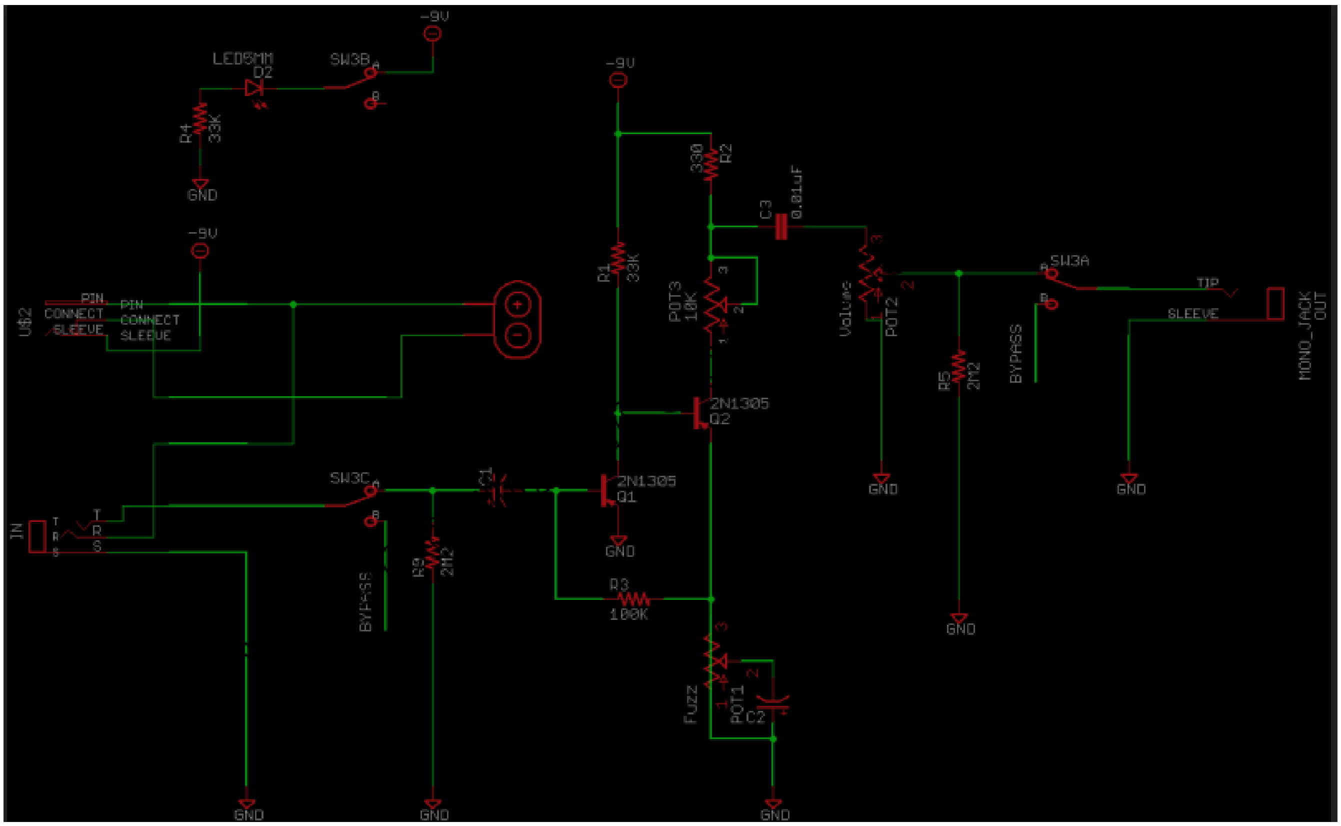
Above we have a visualization of a fuzz/distortion pedal. You already know what these signals sound like, now you know what they look like! (Notice how adjusting the attack varies the steepness of the wave.

Pedal Design

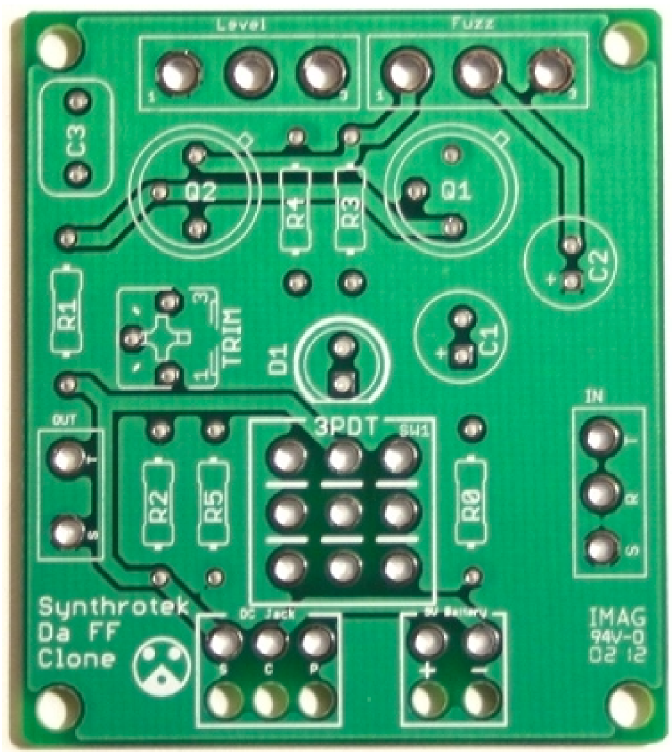
For the last conceptual bit of this workshop, we can take a very brief look at the electronic design of a fuzz pedal.



Above is the output of the pedal (red) and the input (blue). The Fuzz face pedal only has two adjustment knobs, Volume and Fuzz. You can visualize how these adjustments change the input signal above. The actual electrical design of the pedal looks to be simple, but it requires an understanding of network analysis and BJTs, something we aren't going to get into. **Now, all that's left to do is assemble the pedal according to the design.**

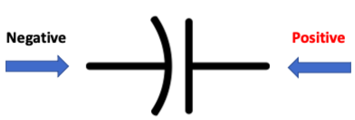
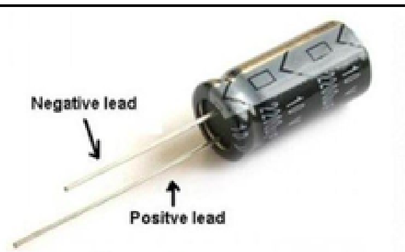


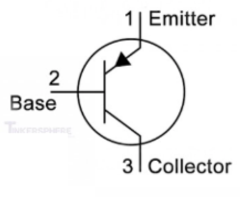
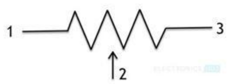
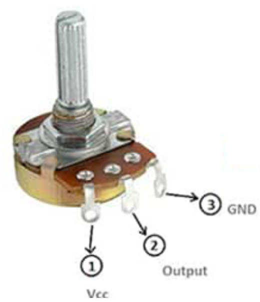
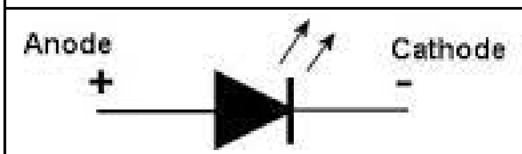
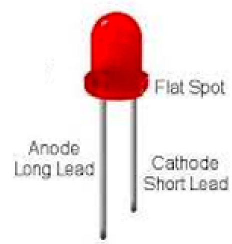
Fuzz Face Pedal Circuit Diagram



Fuzz Face Pedal Circuit Board

Diagram Key:

Symbol / Name	Component
 Resistor	
 Capacitor	

 PNP Transistor	
 Potentiometer	
 LED	

The easiest way to assemble this will be to use the BOM to identity the part R1, R2, R3 etc. and then solder it into the labeled board. NOTE: the DC jack and LED bezel are both optional.

Resistors are identified by their colored stripes, below are the color patterns for the Resistors used. You can also use the BOM to identify them.

Resistor	**Value**	**Colors**
R0	1M ohm	**brown - black - green - gold**
R1	33k ohm	**orange - orange - gold**
R2	1k ohm	**brown – black - red - gold**
R3	100k ohm	**brown – black – yellow - gold**
R4	1k ohm	**brown - black - red - gold**
R5	1M ohm	**brown - black - green - gold**

Assembly Instructions