Rock Bottom EQ

Design By Erik Vincent

One of the most important effect in a person's rig is a form of EQ. The Rock bottom is a 5 band graphic EQ, and a very capable tone shaping. There are 6 pots to control (1 volume, 5 bands of EQ). This project is also quite simple with off the shelf parts.

Customizable! The Rock Bottom also allows for you to change what frequencies are being boosted or cut to the exact frequencies you need. An easy fit for a 125B enclosure and, if setup with side mounted input/output jacks and side mounted power, can also fit into a 1590B enclosure.

Bill of Materials, Stock Rock Bottom EQ

Capacitor		Resistor	
C1	10nF (film)	**R1**	2.2M
C2	10nF (film)	**R2**	470K
C3	150pF (ceramic)	**R3**	1K
C4	2.2µF (Electrolytic)	**R4**	10K
C5	47nF (film)	**R5**	10K
C6	1µF (Electrolytic)	**R6**	10K
C7	33nF (film)	**R7**	470
C8	150nF (film)	**R8**	120K
C9	6.8nF (film)	**R9**	470
C10	68nF (film)	**R10**	100K
C11	3.3nF (film)	**R11**	1K
C12	22nF (film)	**R12**	100K
C13	680pF (ceramic)	**R13**	1K
C14	1µF (Electrolytic)	**R14**	100K
C15	10nF (film)	**R15**	1K
C16	100µF (Electrolytic)	**R16**	100K
C17	47µF (Electrolytic)	**R17**	10K
		R18	10K
Diode		**R19**	10K
D1	1N4001	**R20**	47K
		R21	47K
ICs			
U1	TL072	**Potentiometer**	
U2	TL072	**Volume**	50kb (16mm)
U3	TL072	**62.5 Hz**	50kb (16mm)
U4	TL072	**125 Hz**	50kb (16mm)
		500 Hz	50kb (16mm)
		1000 Hz	50kb (16mm)
		4000 Hz	50kb (16mm)

Roll your own EQ

The Rock Bottom has been designed to allow a ridiculous amount of customization options. You can choose whatever frequencies you want for your EQ dials. Substitute the values in the "stock" BOM with the values below. We have also come up with a few configurations we liked (See below some examples). To help you with the math, we have also made up a list of common frequencies and the component values you will need.

Bill of Materials, EQ Section for bass and down-tuned guitars.

62.5 Hz, 125 Hz, 500 Hz, 1 KHz, 4 KHz

Capacitor		Resistor		Frequency
C4	2.2µF (Electrolytic)	**R7**	470	**62.5Hz**
C5	47nF (film)	**R8**	120K	**62.5Hz**
C6	1µF (Electrolytic)	**R9**	470	**125Hz**
C7	33nF (film)	**R10**	100K	**125Hz**
C8	150nF (film)	**R11**	1K	**500Hz**
C9	6.8nF (film)	**R12**	100K	**500Hz**
C10	68nF (film)	**R13**	1K	**1KHz**
C11	3.3nF (film)	**R14**	100K	**1KHz**
C12	22nF (film)	**R15**	1K	**4KHz**
C13	680pF (ceramic)	**R16**	100K	**4KHz**

Bill of Materials, EQ Section for standard-tuned guitars.

100 Hz, 250 Hz, 630 Hz, 1.6 KHz, 5 KHz

Capacitor		Resistor		Frequency
C4	1µF (Electrolytic)	**R7**	470	**100Hz**
C5	47nF (film)	**R8**	100K	**100Hz**
C6	1µF (Electrolytic)	**R9**	470	**250Hz**
C7	6.8nF (film)	**R10**	120K	**250Hz**
C8	220nF (film)	**R11**	510	**630Hz**
C9	4.7nF (film)	**R12**	120K	**630Hz**
C10	33nF (film)	**R13**	820	**1.6KHz**
C11	3.3nF (film)	**R14**	100K	**1.6KHz**
C12	22nF (film)	**R15**	510	**5KHz**
C13	680pF (ceramic)	**R16**	120K	**5KHz**

Bill of Materials, EQ Section for MESA style.

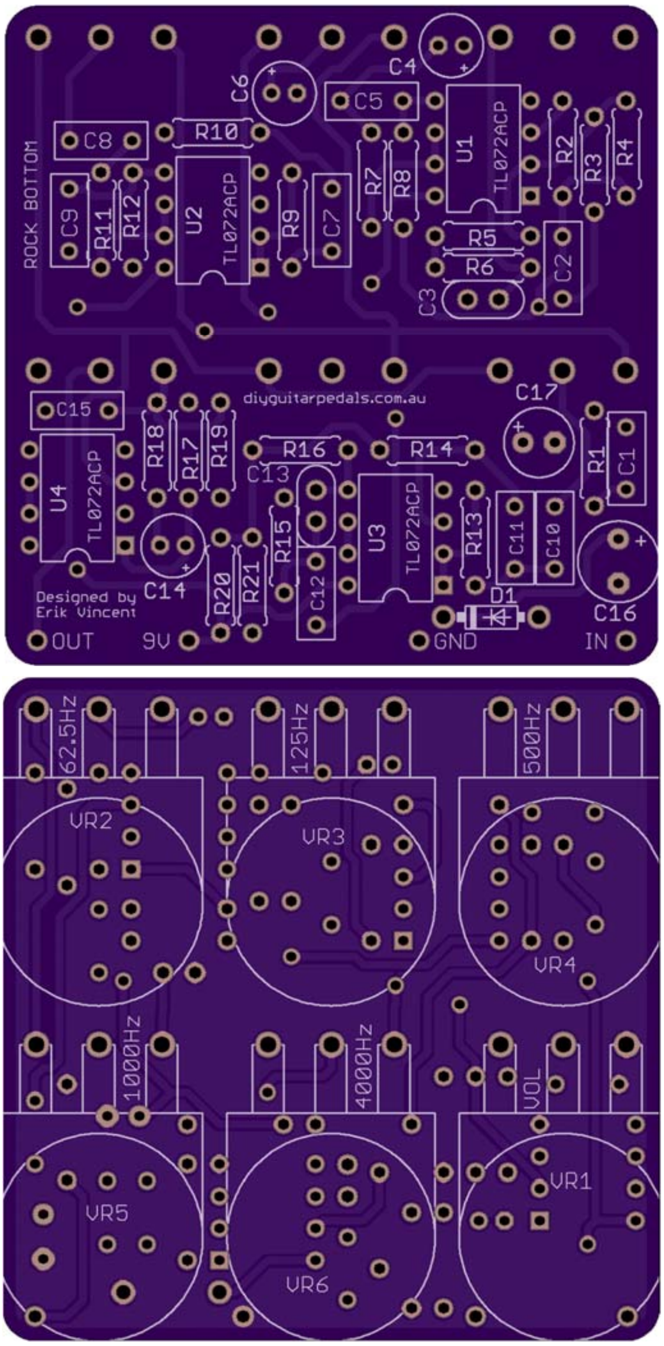
80 Hz, 240 Hz, 750 Hz, 2.2 KHz, 6.6 KHz

Capacitor		Resistor		Frequency
C4	1µF (Electrolytic)	**R7**	820	**80Hz**
C5	47nF (film)	**R8**	100K	**80Hz**
C6	1µF (Electrolytic)	**R9**	470	**240Hz**
C7	8.2nF (film)	**R10**	120K	**240Hz**
C8	100nF (film)	**R11**	820	**750Hz**
C9	4.7nF (film)	**R12**	120K	**750Hz**
C10	47nF (film)	**R13**	470	**2.2KHz**
C11	2.2nF (film)	**R14**	100K	**2.2KHz**
C12	10nF (film)	**R15**	820	**6.6KHz**
C13	680pF (ceramic)	**R16**	100K	**6.6KHz**

Bill of Materials, Sample EQ Values.

62.5 Hz, 125 Hz, 500 Hz, 1 KHz, 4 KHz

Capacitor		Resistor		Frequency
C4	2.2µF (Electrolytic)	**R7**	470	**62.5Hz**
C5	47nF (film)	**R8**	120K	**62.5Hz**
C4	1µF (Electrolytic)	**R7**	820	**80Hz**
C5	47nF (film)	**R8**	100K	**80Hz**
C4	1µF (Electrolytic)	**R7**	470	**100Hz**
C5	47nF (film)	**R8**	100K	**100Hz**
C6	1µF (Electrolytic)	**R9**	470	**125Hz**
C7	33nF (film)	**R10**	100K	**125Hz**
C6	1µF (Electrolytic)	**R9**	470	**240Hz**
C7	8.2nF (film)	**R10**	120K	**240Hz**
C6	1µF (Electrolytic)	**R9**	470	**250Hz**
C7	6.8nF (film)	**R10**	120K	**250Hz**
C8	220nF (film)	**R11**	820	**350Hz**
C9	10nF (film)	**R12**	120K	**350Hz**
C8	150nF (film)	**R11**	820	**400Hz**
C9	10nF (film)	**R12**	120K	**400Hz**
C8	150nF (film)	**R11**	1K	**500Hz**
C9	6.8nF (film)	**R12**	100K	**500Hz**
C8	220nF (film)	**R11**	510	**630Hz**
C9	4.7nF (film)	**R12**	120K	**630Hz**
C8	100nF (film)	**R11**	820	**750Hz**
C9	4.7nF (film)	**R12**	120K	**750Hz**
C10	82nF (film)	**R13**	820	**900Hz**
C11	4.7nF (film)	**R14**	100K	**900Hz**
C10	68nF (film)	**R13**	1K	**1KHz**
C11	3.3nF (film)	**R14**	100K	**1KHz**
C10	33nF (film)	**R13**	820	**1.6KHz**
C11	3.3nF (film)	**R14**	100K	**1.6KHz**
C10	47nF (film)	**R13**	470	**2.2KHz**
C11	2.2nF (film)	**R14**	100K	**2.2KHz**
C12	33nF (film)	**R15**	1K	**3KHz**
C13	820pF (ceramic)	**R16**	100K	**3KHz**
C12	22nF (film)	**R15**	1K	**4KHz**
C13	680pF (ceramic)	**R16**	100K	**4KHz**
C12	22nF (film)	**R15**	510	**5KHz**
C13	680pF (ceramic)	**R16**	120K	**5KHz**
C12	10nF (film)	**R15**	820	**6.6KHz**
C13	680pF (ceramic)	**R16**	100K	**6.6KHz**



PCB Spacing

The Rock Bottom EQ PCB is spaced for 125B sized enclosures

Pot Spacing

The Rock Bottom EQ PCB mounted potentiometers are spaced for Alpha 16mm potentiometers.

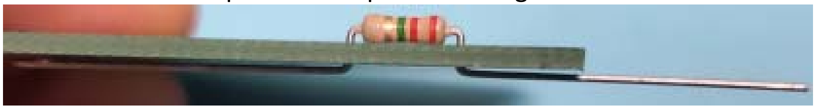
1. Soldering Order.

When soldering things to the PCB, the idea is to solder things on from lowest profile to tallest.

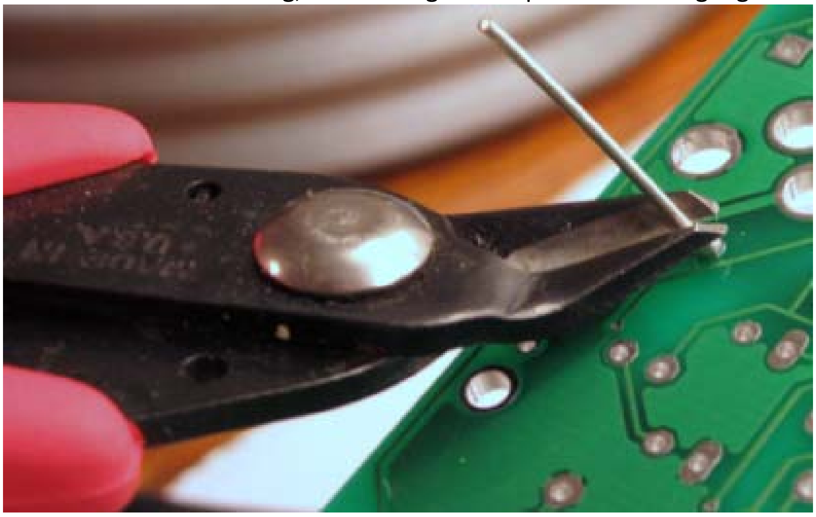
For the Rock Bottom, the best order would be: resistors, diodes, ceramic capacitors, IC sockets (if socketing), ICs (if not socketing), film capacitors, electrolytic capacitors, wiring, potentiometers.

1.1 Resistors.

Resistors are small passive components designed to create a resistance of passage of an electric current.

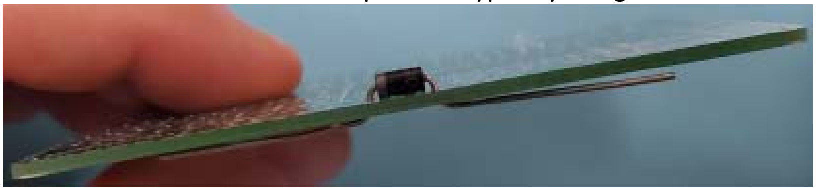


For this pedal we will be using 1/4 Watt resistors. These can either be 5% tolerance carbon resistors, or 1% tolerance metal film resistors. Orientation of “which way is up” doesn’t matter, so you can install them either way. After installation and soldering, do not forget to clip the remaining legs from the PCB.

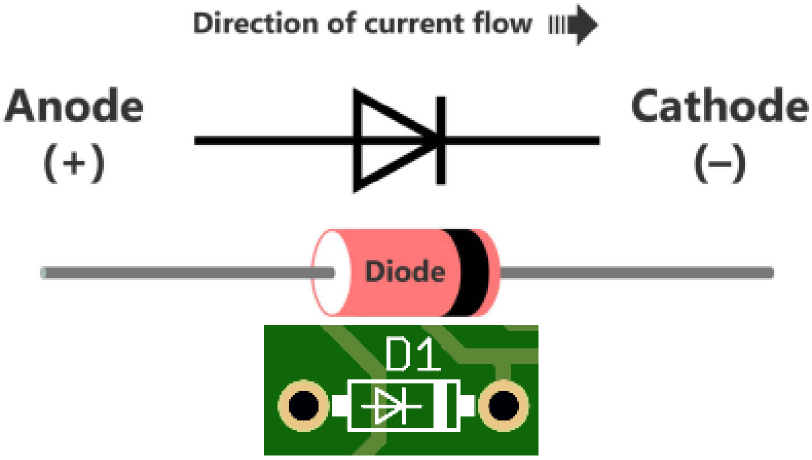


1.2 Diodes.

Diodes are semiconductor components typically designed to allow the flow electric current to go in one direction only.

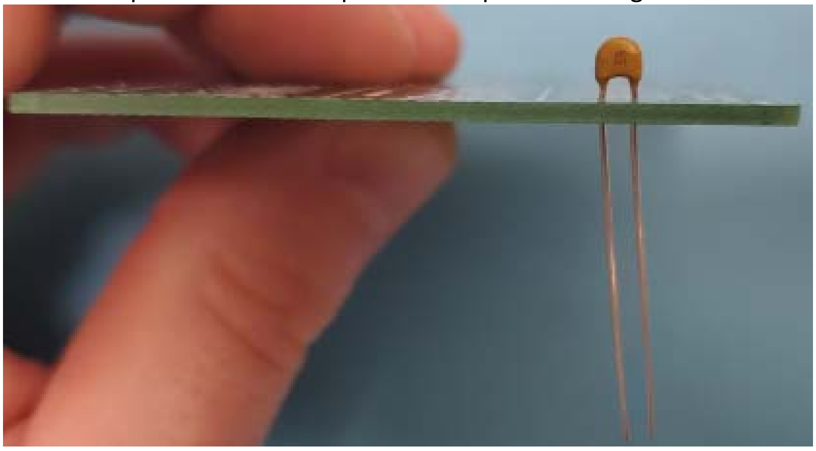


The orientation of a diode does matter based on the cathode and anode of the diode in the circuit. Make sure the stripe on the diode lines up with the stripe on the PCB's silkscreen. After installation and soldering, do not forget to clip the remaining legs from the PCB.



1.3 Capacitors (ceramic).

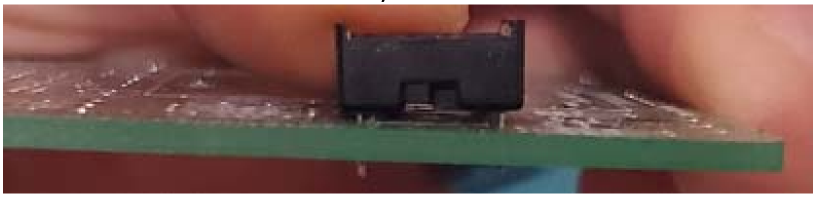
Ceramic capacitors are small passive components designed to hold a small amount of charge in a circuit.



Orientation of "which way is up" doesn't matter, so you can install them either way. After installation and soldering, do not forget to clip the remaining legs from the PCB.

1.4 IC Sockets.

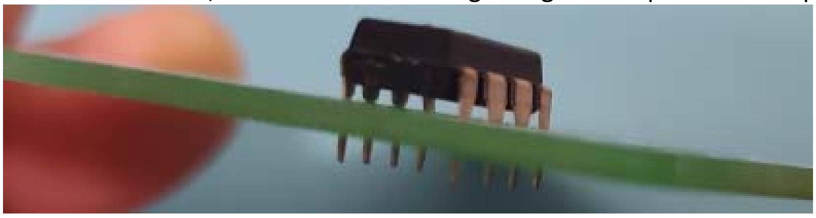
These are holders that allow easy installation and uninstallation of ICs.



These devices will have a silk screen notch to indicate an orientation with the IC or socket for the IC. Just make sure the IC notches match.

1.5 Integrated Circuits.

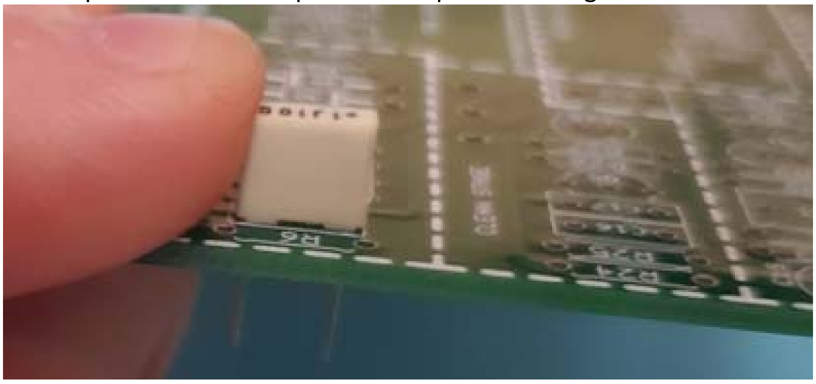
Also known as ICs, these are small analog or digital components that provide specific electrical functions.



Orientation of "which way is up" will be indicated by a notch on the silkscreen on the PCB and a dot or bar on the actual IC itself. Do make sure they match.

1.6 Capacitors (film).

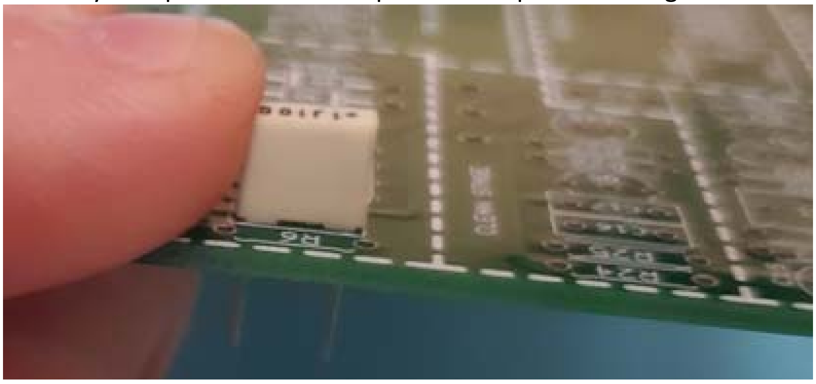
Film capacitors are small passive components designed to hold a small amount of charge in a circuit.



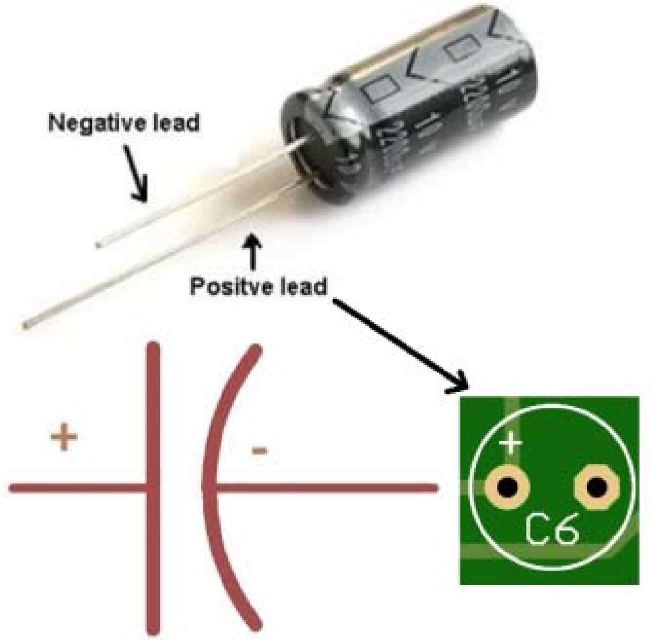
Orientation of "which way is up" doesn't matter, so you can install them either way. After installation and soldering, do not forget to clip the remaining legs from the PCB.

1.7 Capacitors (electrolytic).

Electrolytic capacitors are small passive components designed to hold a small amount of charge in a circuit.



Electrolytic capacitors are typically polarized, so orientation will matter.

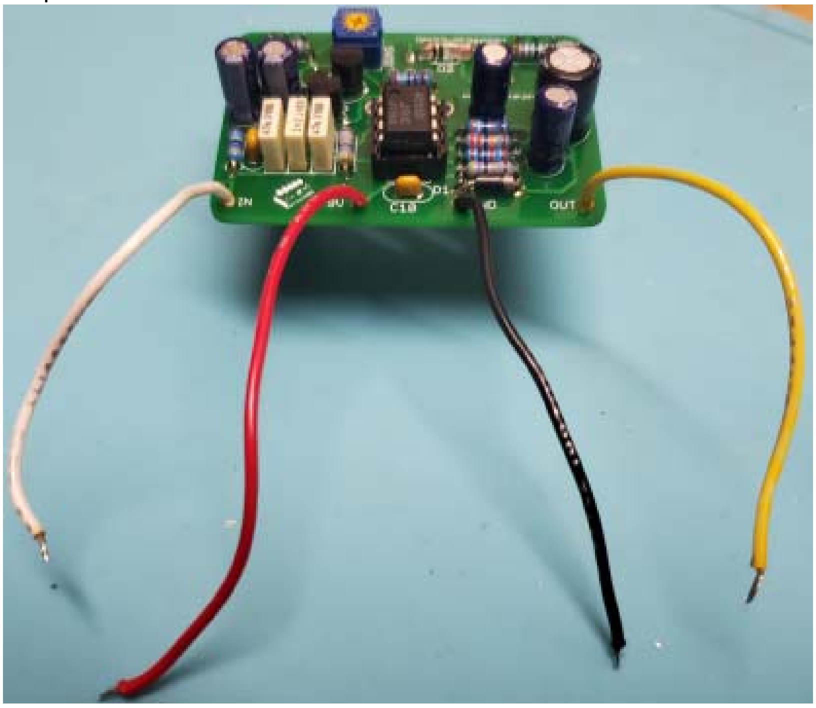


Polarized Electrolytic Capacitor and its electric Symbol

After installation and soldering, do not forget to clip the remaining legs from the PCB.

1.8 Wiring.

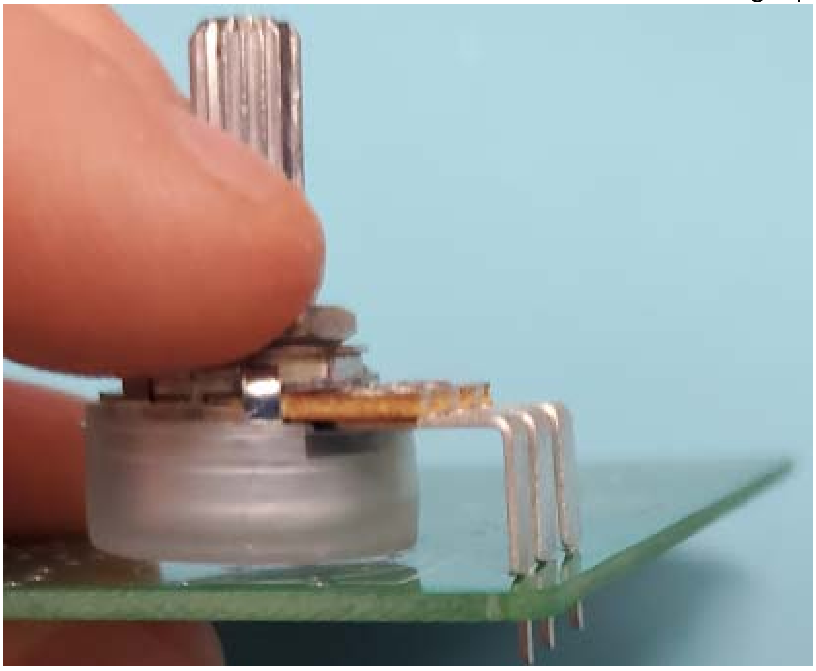
Wires used for the pedal are for delivering power over the hot and ground wires as well as signal for the input and output.



These can be installed at the very end, but in some situations, installing them before potentiometers are soldered in place can be advantageous. Colored wire doesn't change the properties, but using color codes for hot and ground wires, like red being hot, and black being ground, are common place. Typically, stranded hook-up wire, AWG 24 or 22 is used for this task. Using wire strippers, strip away about 1/8" (3mm) of the wire from either end and then using a soldering iron, tin the exposed tips with solder before installing into the PCB.

1.9 Potentiometers.

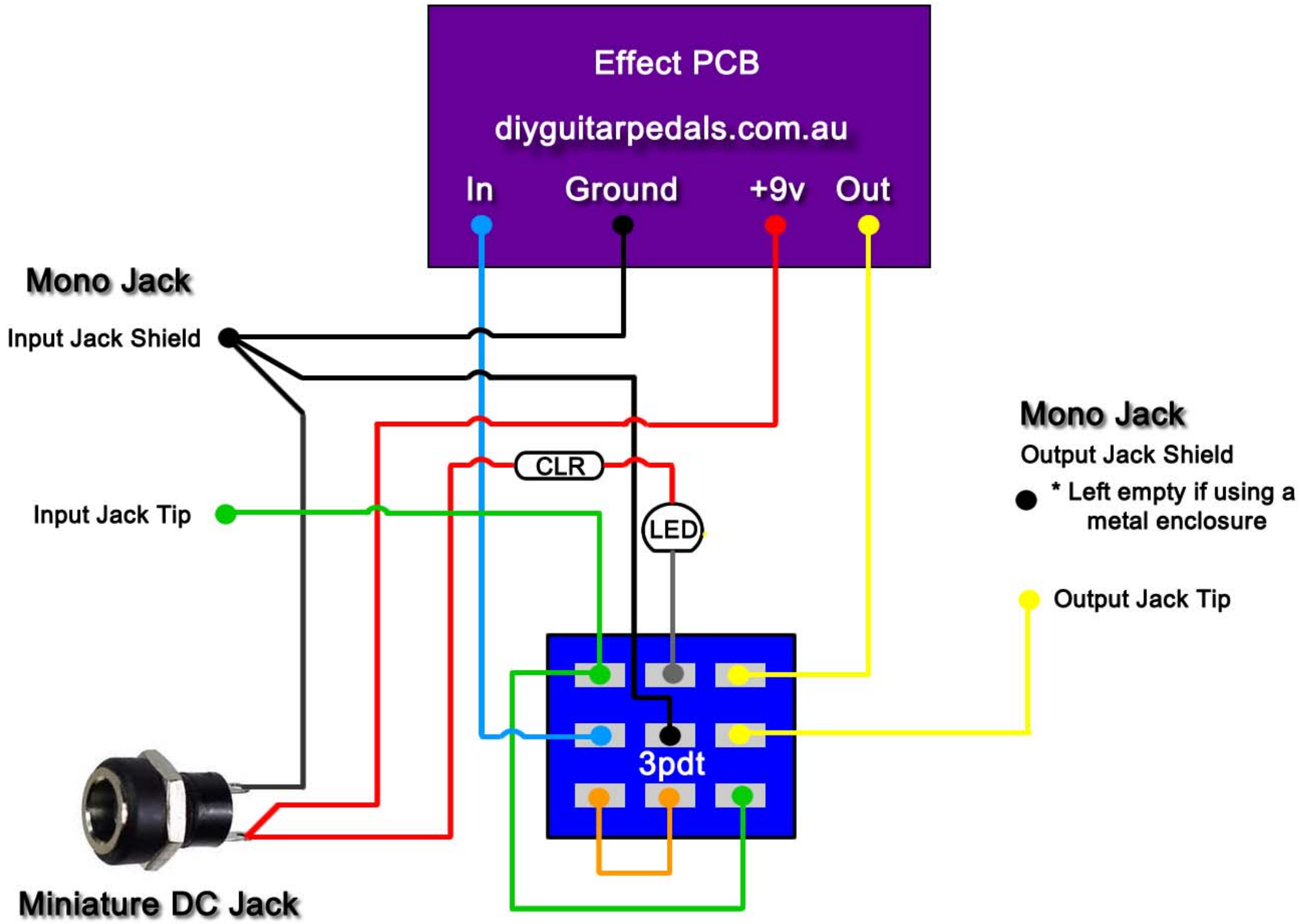
Potentiometers are variable resistors that are used for controlling aspects of the pedal.



This pedal can utilize 16mm pots. These are typically installed on the backside of the PCB and uses the included washer and jam-nut to mechanically secure the PCB to the enclosure via a strategically drilled hole on the enclosure. Orientation of potentiometer is preferred to line up the knob on the silk screen with the knob of the potentiometer.

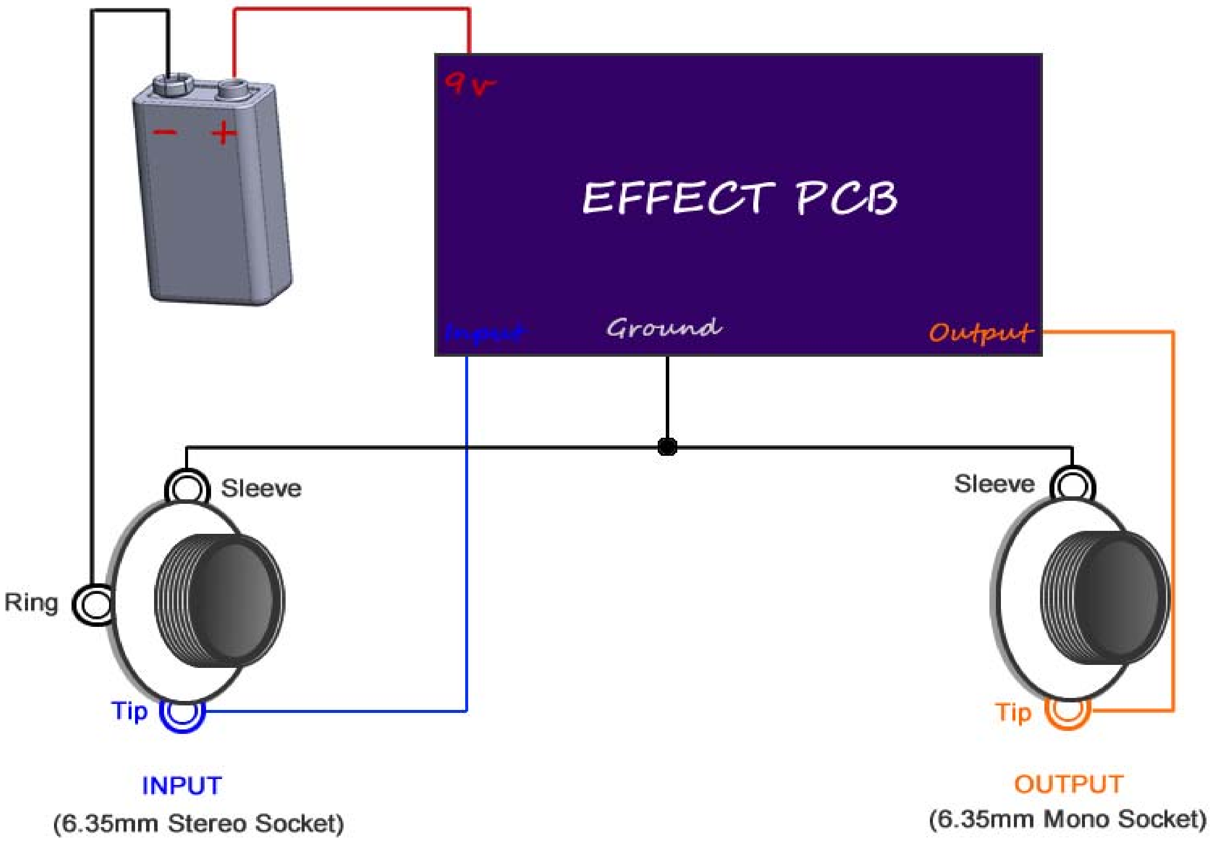
1.10 Off Board Wiring Diagram.

Potentiometers are variable resistors that are used for controlling aspects of the pedal. Using a non-switched miniature DC Jack and 2 Mono Jacks


Effect PCB
diyguitarpedals.com.au
In
Ground
+9v
Out
Mono Jack
Input Jack Shield
Input Jack Tip
CLR
LED
Mono Jack
Output Jack Shield
* Left empty if using a metal enclosure
Output Jack Tip
3pdt
Miniature DC Jack

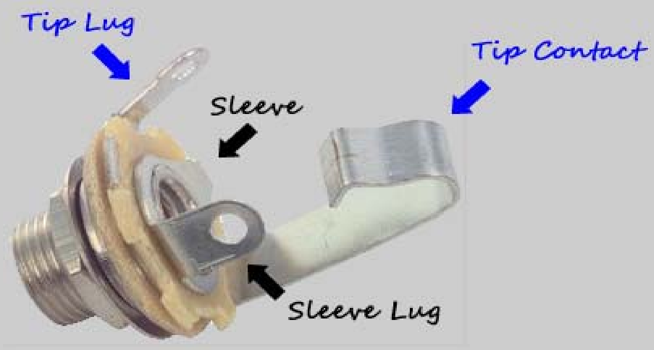
Testing Your Effect

Using aligator clips or soldering directly, wire your effect as in the following...



Input and Output Sockets

Pay close attention to the lugs of your sockets. Look at them side on so that you can distinguish the sockets individual layers. For instance the tip lug is connected to tip contact. The stereo jack looks the same as the socket below except it has an extra lug and contact for "Ring".



Rock Bottom EQ Circuit Analysis for modifying purposes.

2. Understanding EQ Notch, Peak, and "Q"

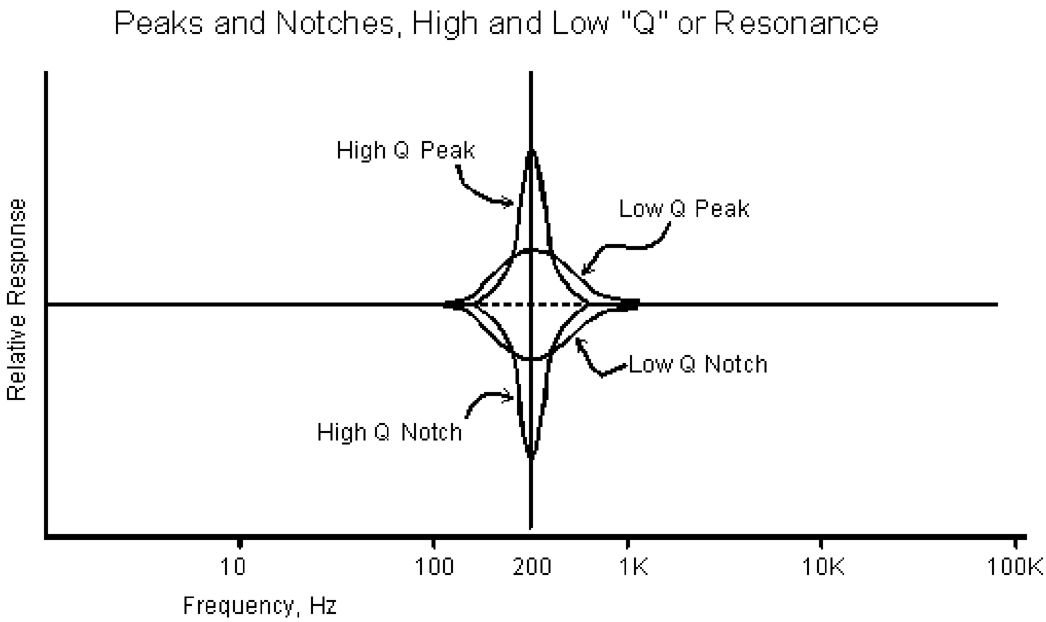
Before we begin, we should understand a few terms going into looking at the electronics:

The sound of a "wah" pedal is something most guitar pedal users and builders are familiar with. It takes a resonant peak or "bump" in the signal and it gets moved around depending on how cocked the pedal is. A notch would be the opposite, where it is a sudden reduction in level at one frequency, instead of a sudden bump. If we could get both a peak and notch in one knob, that would give us the ability to boost or cut and we can do this with what is called a Variable Q Peak/Notch filter.

We should now know what Peak and Notch are, but Q requires a bit of an explanation. The technical definition is that Q is the energy stored, divided by the energy dissipated per cycle in a system/network.

Q is a kind of measurement of resonance. A moderately resonant filter is like a wah pedal as there is a peak of frequency response at the resonant frequency of the wah. To give you an idea about how Q relates to sound, most wahs have a Q of about 2-10. Q is also related to selectivity. A high Q filter, vibrates primarily at one frequency. As Q gets lower, the resonance gets wider in frequency.

To better explain how Q relates to things, it is probably easier to see it on a graph

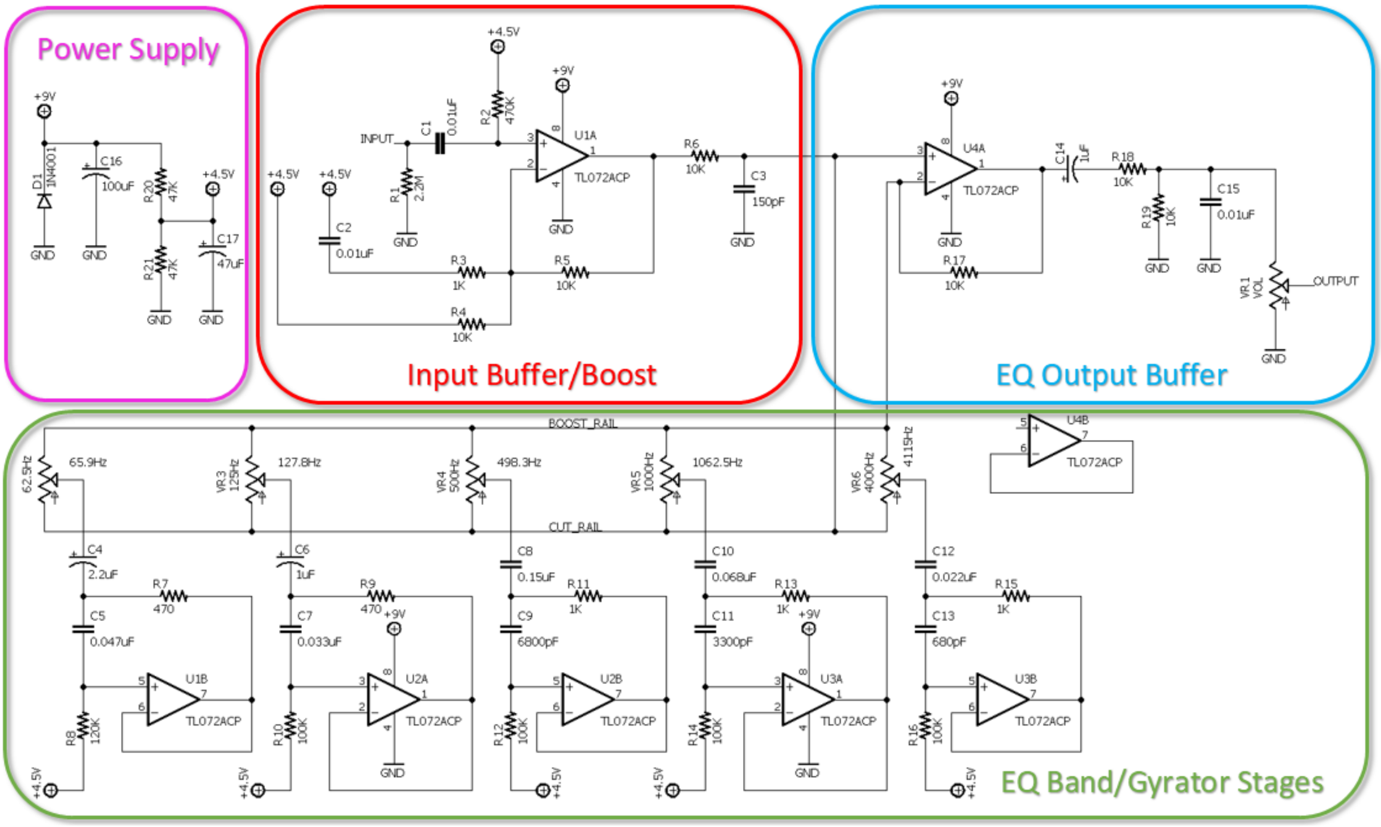


See how the low Q values are a wider bump/notch, but are also in turn, shallower, whereas the high Q values are narrower and taller?

A high Q notch is just like the reverse of a high Q peaking filter. A notch filter has a kind of a dead zone where there is very little or no response to signal, very much like a guitar string with a dead or muffled note on one fret. The higher the Q of a notch filter, the more the response is cut at the notch frequency and the narrower the band of frequencies that are cut. Low Q notches cut a broader band of frequencies by a lesser amount.

3. Rock Bottom EQ Circuit

The schematic can be broken down into some simpler blocks: Power Supply, Input Buffer/Boost, EQ Band Stages and EQ Output Buffer.



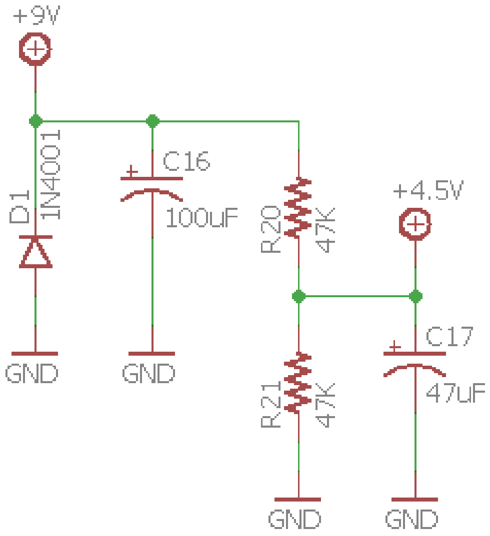
The circuit is designed around the op amp gyrators, which will be explained in detail in the EQ Band section.
The effect response is commanded using a single control per EQ band:

The EQ band knob adjusts the amount of boost or cut to a desired frequency by about 12 or so dB. If the knob is at noon, it should be at unity.

The input impedance on the Rock Bottom is close to 387 KΩ, which isn't too bad, but could be better. This is what allows the pedal to not overload the pickups on the guitar.

4. Power Supply.

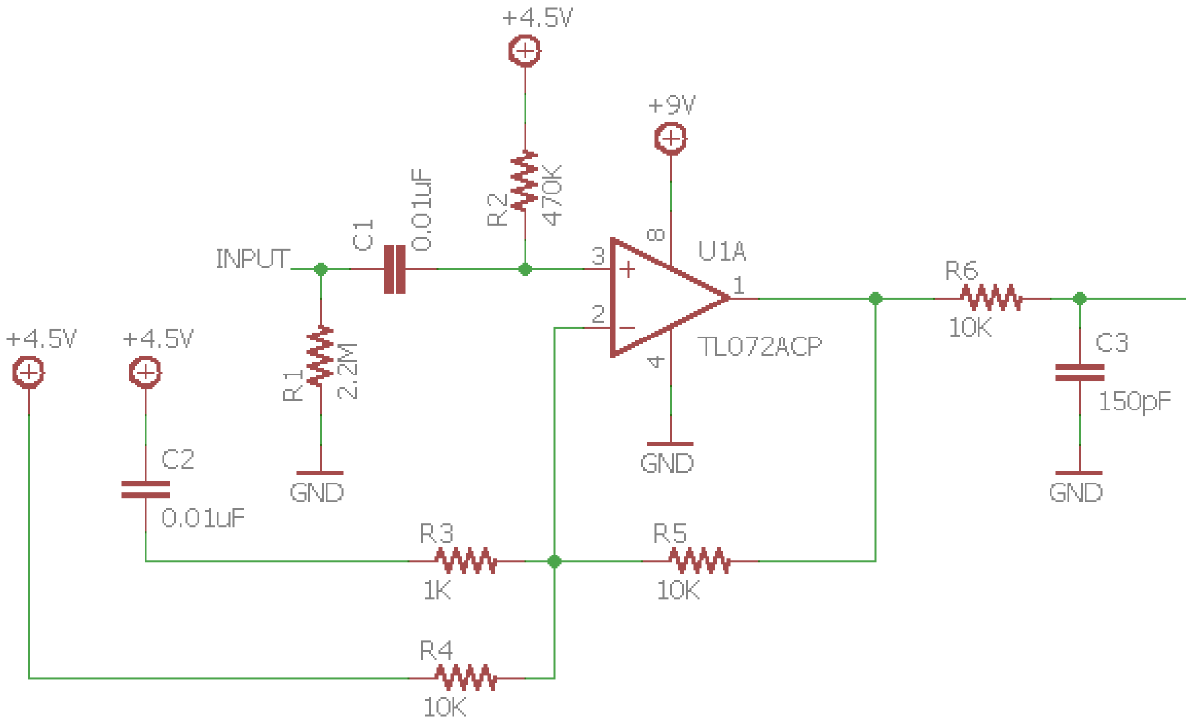
The Power Supply Stage provides the electrical power and bias voltage to all the circuitry, the whole power consumption is low and estimated around 17mA:



- The diode D1 protects the pedal against adapter reverse polarity connections.
- The capacitor C16 is a large electrolytic 100µF capacitor to remove ripple from the power supply.
- The 47KΩ resistors R20 and R21 evenly divide the 9V power supply to 4.5V, providing a bias voltage for the rest of the circuit
- The capacitor C17 is a large electrolytic 47µF capacitor to decouple the bias voltage.

5. Input Buffer/Boost.

The task of the Input Stage Buffer is to create a high input impedance so as to preserve signal integrity and avoid high-frequency signal loss. It is implemented with a non-inverting op amp with a voltage gain of 1.47



- The R1 2.2MΩ resistor from the input to ground is an anti-pop resistor, it will avoid abrupt pop sounds when the effect is engaged.
- The C1 10nF film capacitor is the input coupling capacitor connecting the input AC signal to the pedal. It also forms a small RC filter with the bias resistor, R2
- The R2 470KΩ resistor is a bias resistor for the U1A op amp, as well as a small RC filter piece along with C1.
- Resistors R3, R4, and R5 are feedback resistors that set the gain for the non-inverting op-amp U1A.
- The C2 10nF film capacitor also helps set the gain for the U1A op-amp by acting as an RC filter with R3 to selectively gain the signal.
- The R6 10KΩ resistor forms an output RC filter with capacitor C3.
- The C3 small ceramic 150pF capacitor forms an RC filter with R6 on the output of the op amp, U1A
- U1A is an op-amp that is being used as a buffer and a small boost for the signal about to diced up with gyrator tone stacks.

5.1 Input Impedance.

The input impedance is defined by the formula:

$Zin = R_1 \text{ Parallel to } R_2 \text{ Parallel to } Zin_{2TL072\ op\text{-}amp}$

If you look up the datasheet for the TL072, under the electrical characteristics, the input resistance is 10^{12}.

$$Zin = 1 / (1 / 2.2M + 1 / 470K + 1 / 1T)$$
$$Zin = 1 / (1 / 2{,}200{,}000 + 1 / 470{,}000 + 1 / 1{,}000{,}000{,}000{,}000)$$
$$Zin = 387{,}266\Omega$$

Therefore, the Rock Bottom input resistance is 387K, which is not bad, but might result in a little tone sucking. Increasing R2 to 2.2M would bring the input resistance up to 1.1M, which would be a much more ideal.

5.2 Voltage Gain.

The voltage gain is defined by the non-inverting operational amplifier.

$$G_v = 1 + (R_5 / (R_3 \,||\, R_4))$$
$$G_v = 1 + (10{,}000 / 909.09)$$
$$G_v = 1 + 11$$
$$G_v = 12 \ (20\ dB)$$

This voltage gain is a decent boost in signal before the gyrator portion of the circuit. However, the gain will be limited by op-amp characteristics, which will reduce the 20dB to a little bit of a lower value.

5.3 High Pass Filter.

The 10nF C1 input capacitor blocks DC and provides simple high pass filtering. C1 and R2 create a high pass filter.

$$fc = 1 / (2\pi RC)$$

$$fc = 1 / (2\pi \cdot R_2 \cdot C_1)$$
$$fc = 1 / (2\pi \cdot 470K \cdot 10nF)$$
$$fc = 1 / (2\pi \cdot 470{,}000 \cdot 0.00000001)$$
$$fc = 34Hz$$

With a cut of 34Hz it will block DC and any low-frequency parasitic oscillation.

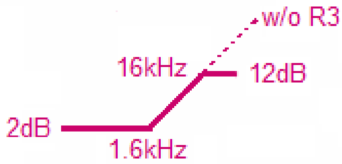
The (pin 3 +) input of the op-amp is biased to +4.5V using the R2 resistor (470KΩ), keeping the virtual ground at +4.5V and being able to amplify bipolar guitar input signals.

5.4 Low Pass Filters.

There is an RC network formed by R3 and C2 from the (-) input to bias. It is an active low pass filter, attenuating frequencies above the cut-off frequencies.

$fc = 1 / (2\pi RC)$

$fc = 1 / (2\pi \cdot R_3 \cdot C_2)$
$fc = 1 / (2\pi \cdot 1K \cdot 10nF)$
$fc = 1 / (2\pi \cdot 1{,}000 \cdot 0.00000001)$
$fc = 15.9kHz$



So with R3 included, this limits boost above the audio band that a guitar has in its range.

There is an RC network formed by R6 and C3 from output of the op amp. It is a passive low pass filter.

$fc = 1 / (2\pi RC)$

$fc = 1 / (2\pi \cdot R_6 \cdot C_3)$
$fc = 1 / (2\pi \cdot 10K \cdot 150pF)$
$fc = 1 / (2\pi \cdot 10{,}000 \cdot 0.00000000015)$
$fc = 106\ KHz$

As U1A pre-emphasizes the top of the audio band, R6 and C3 de-emphasize to result in a flat response. This fights whatever garbage that may creep-in between these two ends of this stage.

6. EQ Band Stages.

In this circuit only one op-amp (U4A) handles the actual equalizing, regardless of how many bands are needed.

6.1 Maximum Cut/Boost.

The amount of boost or cut is determined by:

$$Maximum\ Cut/Boost = 20 \cdot \log [(R_E+R_X) / R_X]$$

So, in the case of the 125 Hz circuit, RX is R9. The RE is shared value of R6 and R17.

$$Maximum\ Cut/Boost = 20 \cdot \log [(R_6+R_9) / R_9]$$

$$Maximum\ Cut/Boost = 20 \cdot \log [(10K + 470) / 470]$$

$$Maximum\ Cut/Boost = 20 \cdot \log [(10{,}000 + 470) / 470]$$

$$Maximum\ Cut/Boost = 20 \cdot \log [22.3]$$

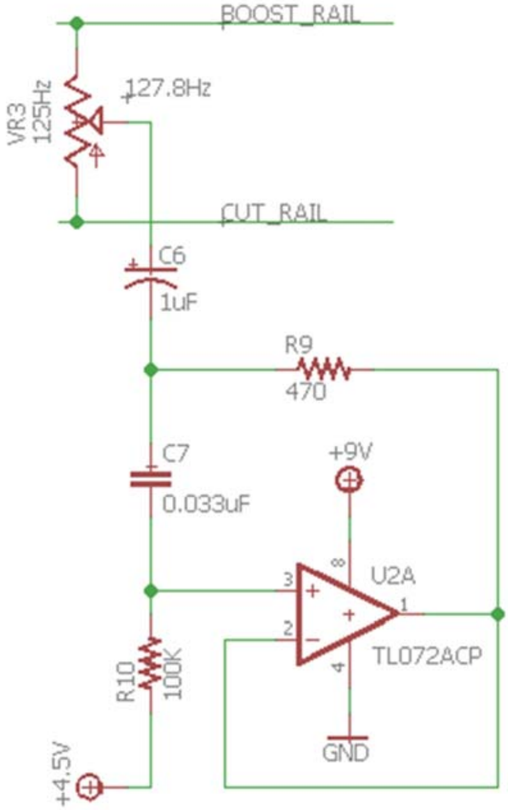
$$Maximum\ Cut/Boost = 20 \cdot 1.3478488$$

$$Maximum\ Cut/Boost = 26.957$$

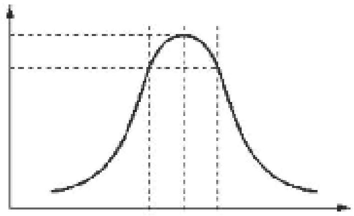
So in either changing the RE values or the RX value of the particular EQ band, you can change the boost/cut amount.

6.2 Gyrator Circuits.

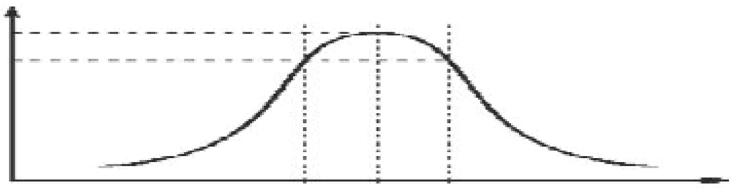
Notice that instead of using inductors that would be in a typical LC filter, a gyrator circuit is used to simulate an inductor. Below is an example of a gyrator circuit provided by the "125Hz" Boost/Cut circuit.



To manipulate the gyrator circuit, there are two things to target: Frequency in which to boost or cut, and the value of "Q Factor". The Q Factor is how pin-pointed the frequency we are effecting. A larger value for Q means a narrower and more precise frequency is being bumped or dipped. A smaller value for Q means a wider and broader frequency bump or dip, which in turn effects more frequencies around it.



Example of a Narrow Q Factor Bump



Example of a Wide Q Factor Bump

As determined by National Semiconductor, the ideal Q value is 1.7. If the Q Factor gets much higher than 4.5, though the precision gets good, undesired ringing and phase shifting issues begin. If the Q Factor gets much lower than 1.2, there is a risk that the frequency band that is primarily being targeted will be wide enough that it effects bands adjacent to it, which may be undesired. Below is how the math is used to understand the frequency cut/boost circuit for the 125 Hz.

C7 and R10 along with the opAmp form the gyrator circuit, simulating an inductor.

$$f = 1 / (2 \cdot \pi \cdot \sqrt{(C_6 \cdot C_7 \cdot R_9 \cdot R_{10})})$$
$$f = 1 / (2 \cdot \pi \cdot \sqrt{(0.000001 \cdot 0.000000033 \cdot 470 \cdot 100{,}000)})$$
$$f = 1 / (2 \cdot \pi \cdot \sqrt{(0.000001551)})$$
$$f = 1 / (2 \cdot \pi \cdot 0.0012453915047085))$$
$$f = 1 / (0.0078250439023844472))$$
$$f = 127.795 \text{ Hz}$$

$$Q = \sqrt{(C_7 \cdot R_{10} / (C_6 \cdot R_9))}$$
$$Q = \sqrt{(0.000000033 \cdot 100{,}000 / (0.000001 \cdot 470))}$$
$$Q = \sqrt{(0.0033 / 0.00047)}$$
$$Q = \sqrt{(7.021)}$$
$$Q = 2.65$$

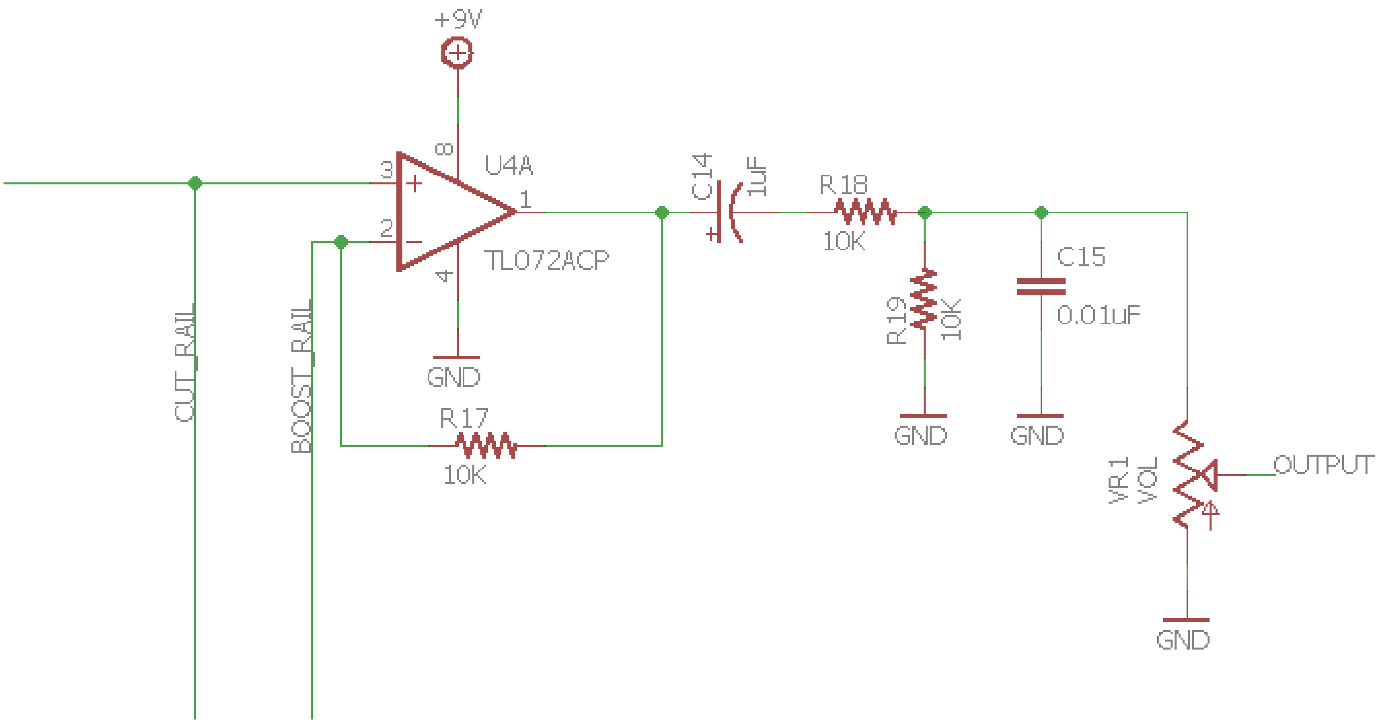
So this part of the circuit will cut or boost the frequency of around 127.795 Hz, which is pretty close to 125 Hz and it will do it with a rather narrow, but not too narrow of a Q factor of 2.65. Typically, when making these circuits, try to keep the resistor for the gyrator circuit around 100K and go no lower than 80K. Also, it is typical for the other resistor to be kept close to 1K, but as in this case, a lessor value was chosen (470 ohms) to get the desired EQ. To change frequencies, simply change the two capacitor and resistor values in each EQ circuit. Then make sure the Q Factor isn't too high or too small once the desired frequency is targeted.

6.3 Op Amps.

Typically, either TL072 op-amps are used in these circuits, but other op-amps that also have very good frequency responses are the NE5532, JRC4558, and LF353. These are primarily for EQ'ing, however, frequency boosts may overdrive an amp if boosted too much, or if other boosts are in the signal chain.

7. EQ Output Filter.

Here, we have an op amp output buffer with some passive filtering at the end, finalized with the volume knob to ground.



R17 is matched with R6 in value so that calculating boost/cut on the gyrator circuits is easier.

7.1 Output Impedance.

The output resistor network composed by R18 and R19 will limit the output current; even if the output jack is connected to ground the op-amp will see a load of at least 10KΩ, limiting the output current and protecting the operational amplifier. The output impedance is defined by the formula:

$$Zout = R_{19}\ Parallel\ to\ R_{18} + Zout_{2TL072\ op\text{-}amp}$$

If you look up the datasheet for the TL072, under the electrical characteristics, the output resistance is around 100 ohms.

$$Zout = 1 / (1 / 10K + 1 / (10K + 100))$$
$$Zout = 1 / (1 / 10{,}000 + 1 / 10{,}100)$$
$$Zout = 5{,}025\Omega$$

Therefore, the Rock Bottom output resistance is 5K, which is good, keeping signal fidelity. As a rule of thumb, it is good practice to keep output resistance of a pedal below 10K.

7.1 Low & High Pass Filters.

There is an RC network formed by C14 and R19. It is a passive high pass filter, attenuating frequencies below the cut-off frequencies.

$$fc = 1 / (2\pi RC)$$

$$fc = 1 / (2\pi \cdot R_{19} \cdot C_{14})$$
$$fc = 1 / (2\pi \cdot 10K \cdot 1uF)$$
$$fc = 1 / (2\pi \cdot 10{,}000 \cdot 0.000001)$$
$$fc = 16Hz$$

With a cut of 16Hz it will block DC and any low-frequency parasitic oscillation.

There is an RC network formed by C15 and R18. It is a passive low pass filter, attenuating frequencies above the cut-off frequencies.

$$fc = 1 / (2\pi RC)$$

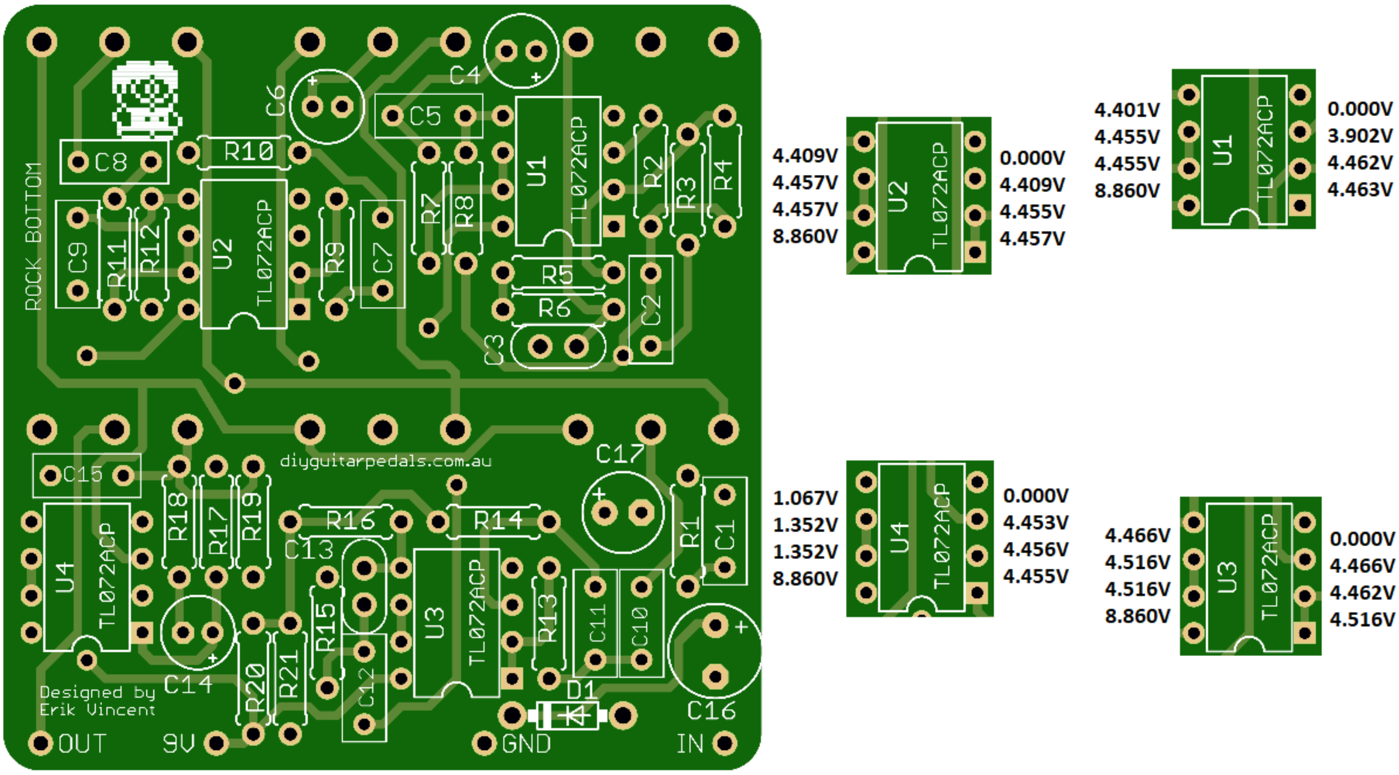
$$fc = 1 / (2\pi \cdot R_{18} \cdot C_{15})$$
$$fc = 1 / (2\pi \cdot 10K \cdot 10nF)$$
$$fc = 1 / (2\pi \cdot 10{,}000 \cdot 0.00000001)$$
$$fc = 1.6kHz$$

With a cut of 1.6kHz it will start to kill out the shrill of the top end if there is “too much”. If you want more high-end returned, decreasing C15 to a 1nF will make the frequency cut closer to 16 kHz.

8. Voltage Readouts.

Below are the voltage readouts of the ICs onboard, assuming 9V Power Supply.

IC read-outs



KNOBS

- VOL: MAX
- ALL EQ: NOON

9. Modifications

Following is a couple of worthwhile modifications that can be applied to the Rock Bottom.

9.1 Capacitors

The input capacitor C1 could be expanded to 22nF or 47nF is more bass content is to be EQ'ed. At 10nF, if cuts 33 Hz and below, where 22nF cuts closer to 15 Hz.

See section 6 on changing the capacitors to target a specific EQ point

9.2 Resistors

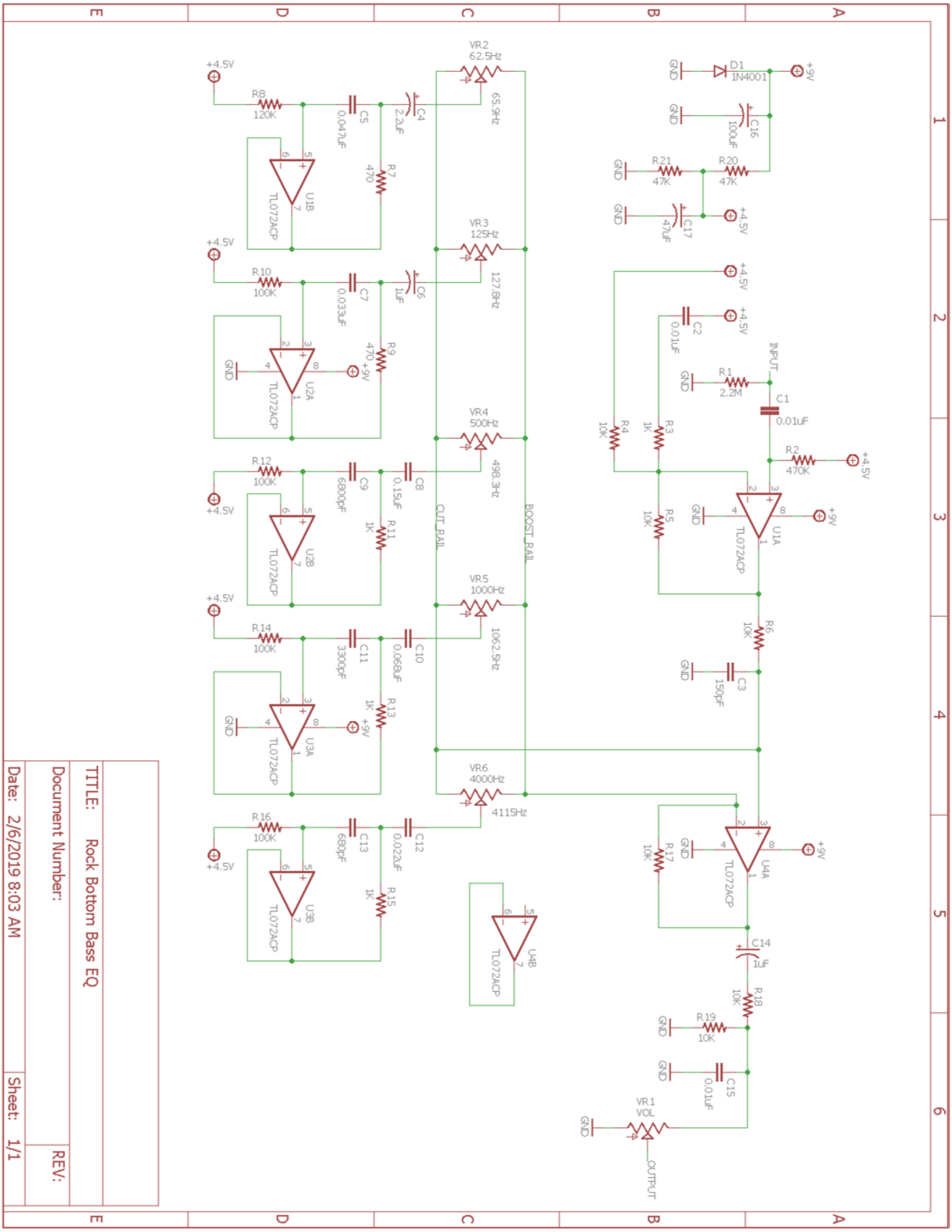
If more preamp gain is required before EQ'ing. Increasing the value of R5 from 10K to 22K or 33K will add a bit more oomph when all controls are level, though it may introduce a little bit of dirt into the signal much higher than that.

See section 6 on changing the resistors to target a specific EQ point

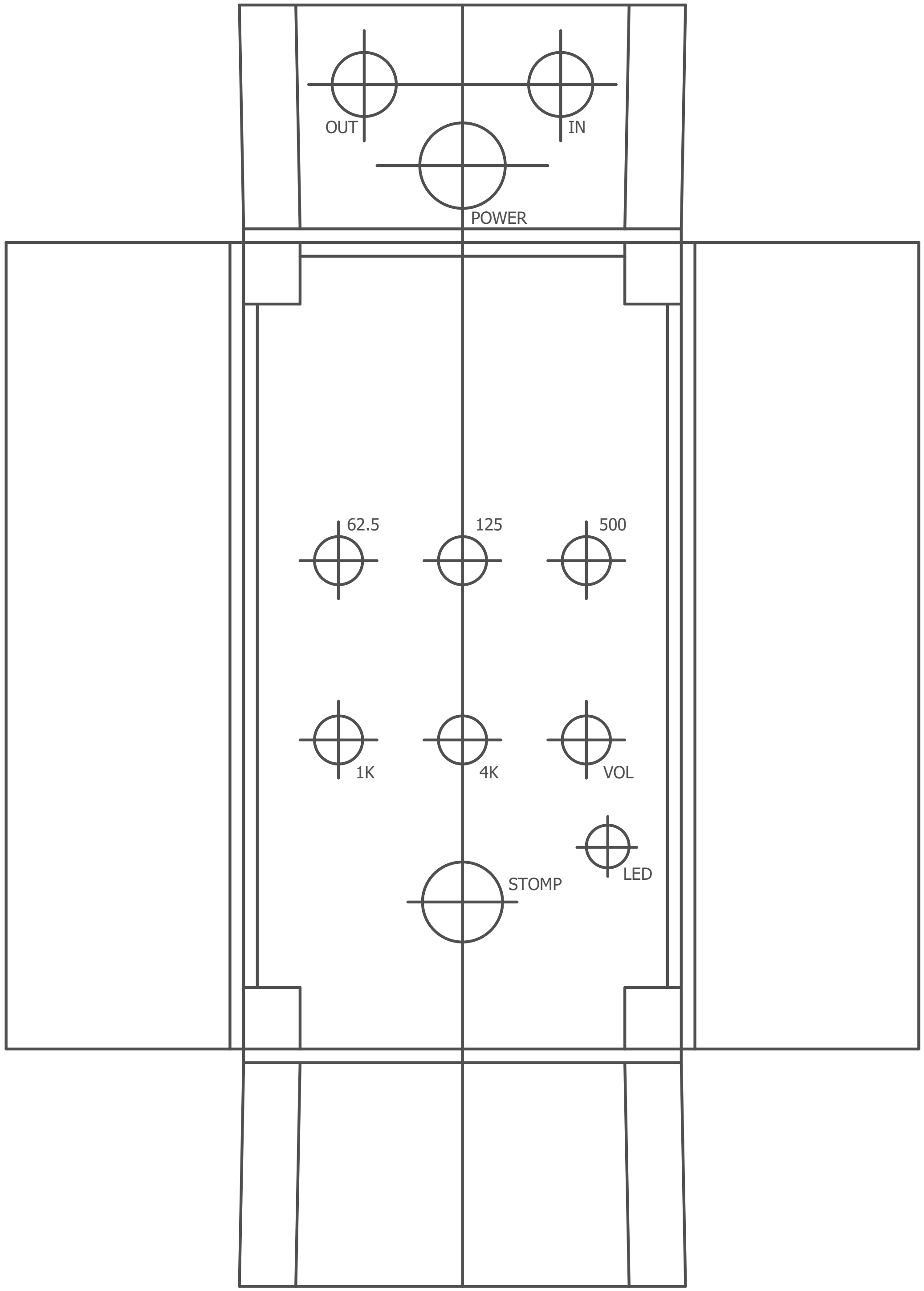
9.3 Op Amps

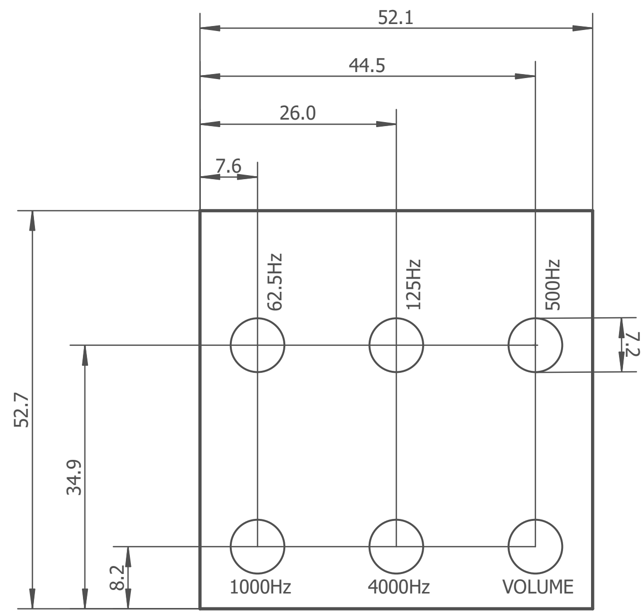
Different dual op-amps should sound similar, however, there may be a slightly different EQ curve depending on the frequency response of the op amp itself. Try different ones, such as the 4558 or the 5532 for slightly different responses. The primary thing is that it is a low noise op amp.

9. Schematic



TITLE: Rock Bottom Bass EQ
Document Number:
REV:
Date: 2/6/2019 8:03 AM
Sheet: 1/1
VR2 62.5Hz
65.9Hz
VR3 125Hz
127.8Hz
VR4 500Hz
498.3Hz
VR5 1000Hz
1062.5Hz
VR6 4000Hz
4115Hz
VR1 VOL
CUT_RAIL
BOOST_RAIL
INPUT
OUTPUT
D1 1N4001


OUT
IN
POWER
62.5
125
500
1K
4K
VOL
LED
STOMP


52.1
44.5
26.0
7.6
62.5Hz
125Hz
500Hz
7.2
52.7
34.9
8.2
1000Hz
4000Hz
VOLUME