The Punk'n Pi

Design By Erik Vincent

A unique sounding Big Muff Pi adaption using Op Amps in place of transistors; this effect embodies the sound of the iconic tone achieved by Billy Corgan on the Smashing Pumpkins album Siamese Dream. But it is not just a one trick pony. The version of the big muff is edgy with a more 'modern' tone signature then the previous versions of Big Muffs.

This pedal uses the standard 3 pot control of Volume, Tone, and Sustain. Using easy-to-find components, including common op amps, this design still embodies the classic sound of a Big Muff Pi with a much more dramatic tone stack.

This layout is small enough to fit into a 1590B enclosure.

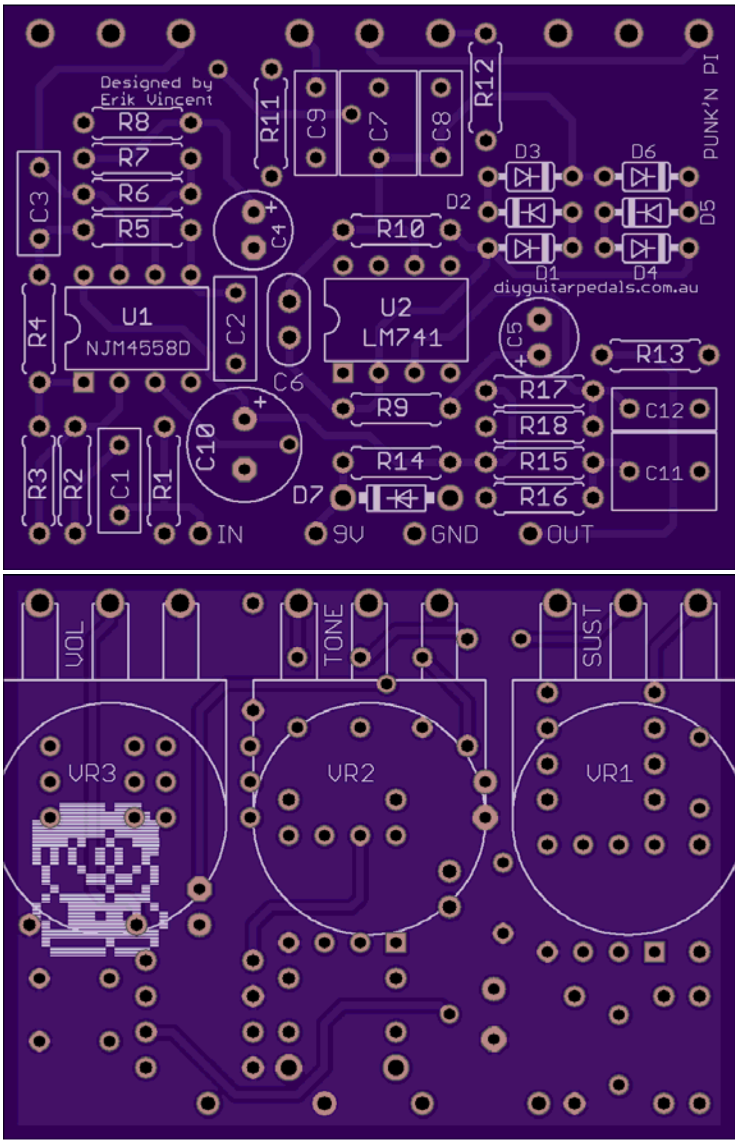
Bill of Materials, Stock Punk'n Pi

Capacitor		Resistor	
C1	150nF (film)	**R1**	1M
C2	10nF (film)	**R2**	56K
C3	4.7nF (film)	**R3**	330K
C4	10µF (Electrolytic)	**R4**	10K
C5	4.7µF (Electrolytic)	**R5**	47K
C6	150pF (ceramic)	**R6**	560K
C7	1µF (film)	**R7**	62K
C8	100nF (film)	**R8**	47K
C9	120nF (film)	**R9**	8.2K
C10	220µF (Electrolytic)	**R10**	470K
C11	1µF (film)	**R11**	5.6K
C12	220nF (film)	**R12**	1.2K
		R13	100K
Diode		**R14**	47
D1	1N4448	**R15**	220K
D2	1N4448	**R16**	220K
D3	1N4448	**R17**	820K
D4	1N4448	**R18**	1M
D5	1N4448		
D6	1N4448	**Potentiometer**	
D7	1N4001	**Volume**	10kb (16mm)
		Tone	10kb (16mm)
ICs		**Sustain**	50kb (16mm)
U1	JRC4558		
U2	LM741		

Bill of Materials, Black Toner

Capacitor		Resistor	
C1	150nF (film)	**R1**	1M
C2	10nF (film)	**R2**	56K
C3	4.7nF (film)	**R3**	330K
C4	10µF (Electrolytic)	**R4**	10K
C5	4.7µF (Electrolytic)	**R5**	47K
C6	150pF (ceramic)	**R6**	560K
C7	1µF (film)	**R7**	62K
C8	3.9nF (film)	**R8**	47K
C9	10nF (film)	**R9**	8.2K
C10	220µF (Electrolytic)	**R10**	470K
C11	1µF (film)	**R11**	20K
C12	220nF (film)	**R12**	22K
		R13	100K
Diode		**R14**	47
D1	1N4448	**R15**	220K
D2	1N4448	**R16**	220K
D3	1N4448	**R17**	820K
D4	1N4448	**R18**	1M
D5	1N4448		
D6	1N4448	**Potentiometer**	
D7	1N4001	**Volume**	10kb (16mm)
		Tone	100kb (16mm)
ICs		**Sustain**	50kb (16mm)
U1	JRC4558		
U2	LM741		

REV -



PCB Spacing
The Punk'n Pi PCB is spaced for 1590B sized enclosures or larger

Pot Spacing
The Punk'n Pi PCB mounted potentiometers are spaced for Alpha 16mm potentiometers.

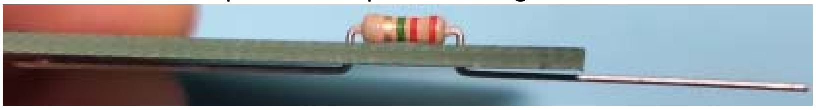
1. Soldering Order.

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

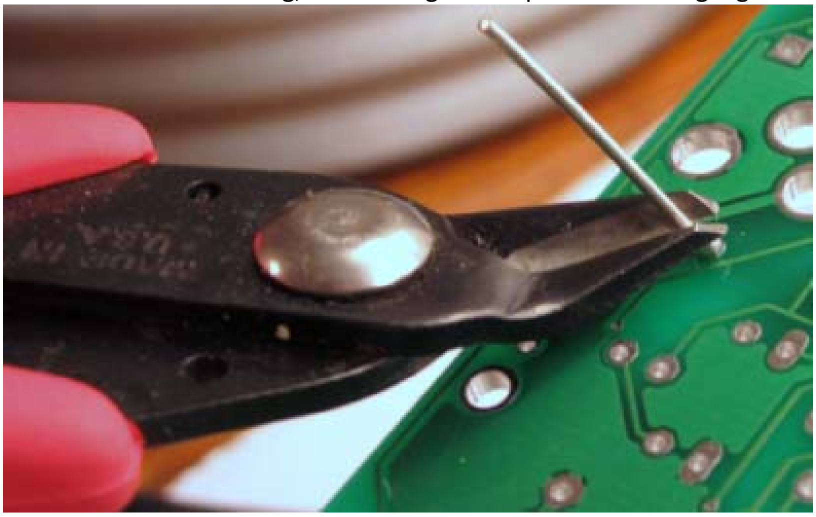
For the Punk’n Pi, the best order would be: resistors, diodes, ceramic capacitors, IC sockets (if socketing), ICs (if not socketing), film capacitors, electrolytic capacitors, wiring, potentiometers.

1.1 Resistors.

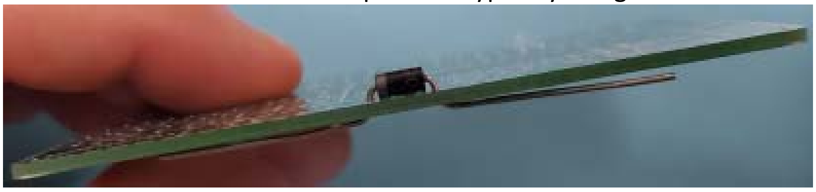
Resistors are small passive components designed to create a resistance of passage of an electric current.



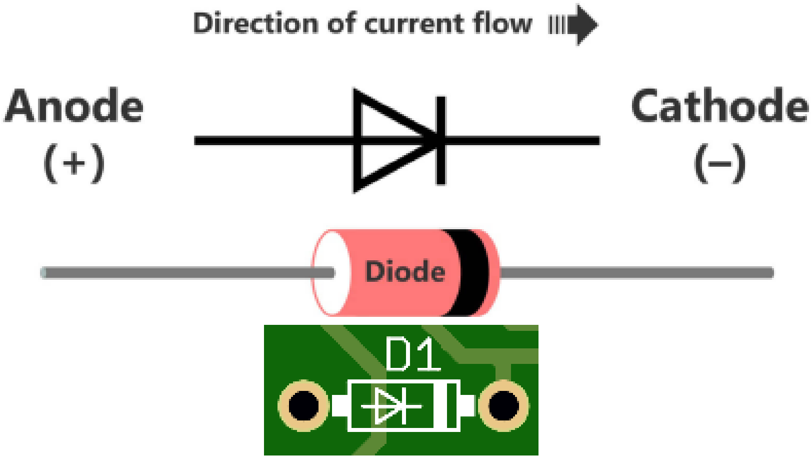
For this pedal we will be using 1/4 Watt resistors. These can either be 5% tolerance carbon resistors, or 1% tolerance metal film resistors. Orientation of “which way is up” doesn’t matter, so you can install them either way. After installation and soldering, do not forget to clip the remaining legs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



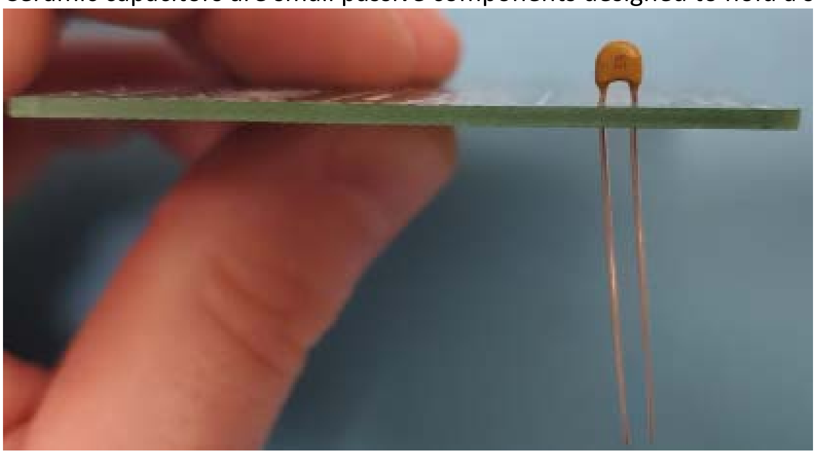
1.2 Diodes.
Diodes are semiconductor components typically designed to allow the flow electric current to go in one direction only.



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.



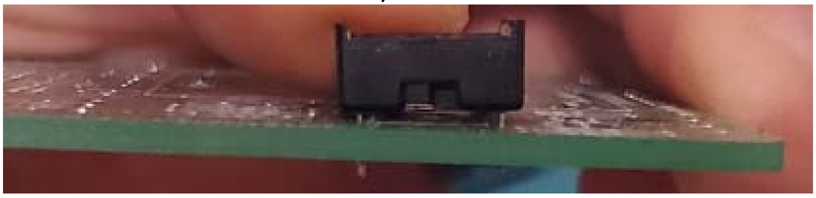
1.3 Capacitors (ceramic).
Ceramic capacitors are small passive components designed to hold a small amount of charge in a circuit.



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.

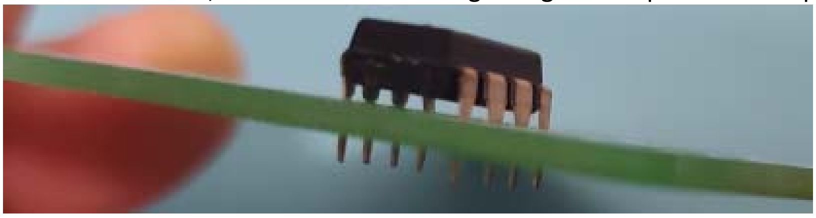
These are holders that allow easy installation and uninstallation of ICs.



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.

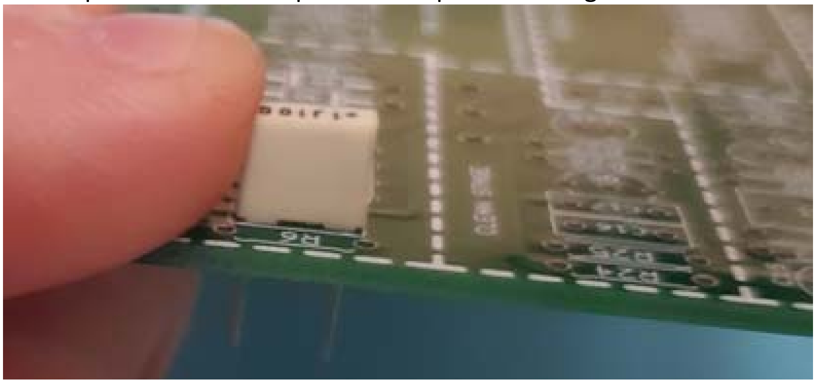
Also known as ICs, these are small analog or digital components that provide specific electrical functions.



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).

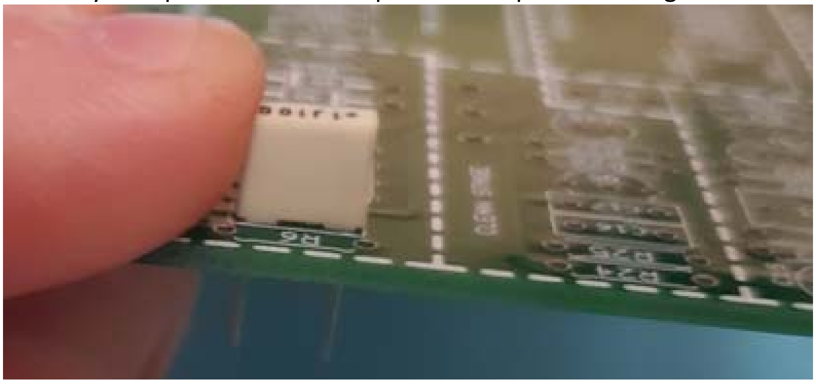
Film capacitors are small passive components designed to hold a small amount of charge in a circuit.



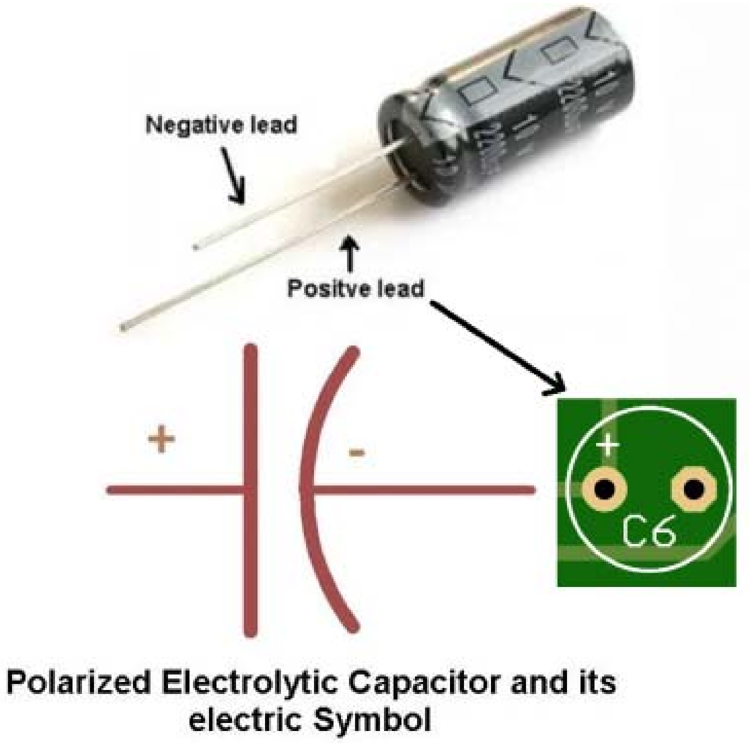
Orientation of “which way is up” doesn’t matter, so you can install them either way. After installation and soldering, do not forget to clip the remaining legs from the PCB.

1.7 Capacitors (electrolytic).

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



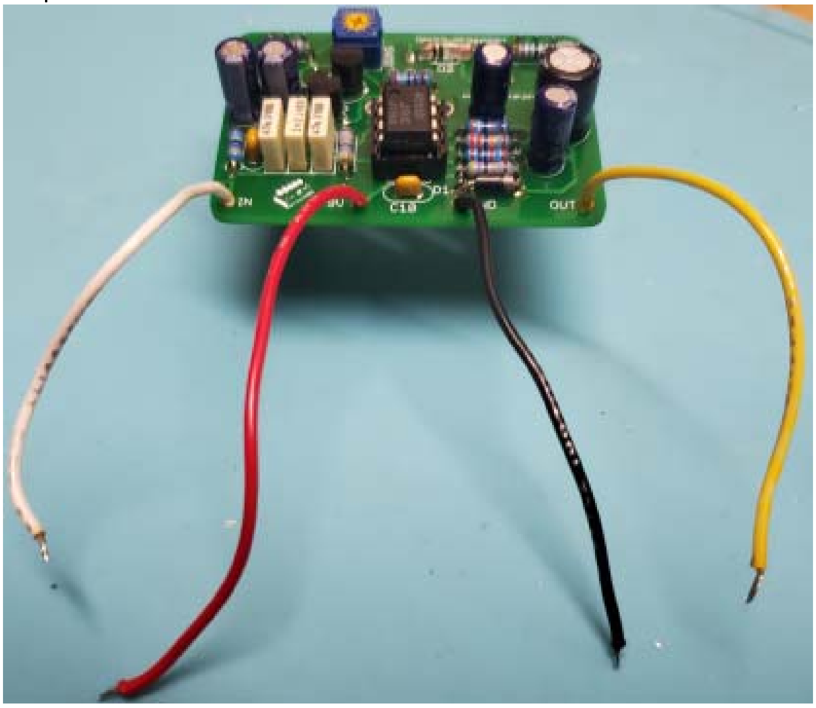
Electrolytic capacitors are typically polarized, so orientation will matter.



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

1.8 Wiring.

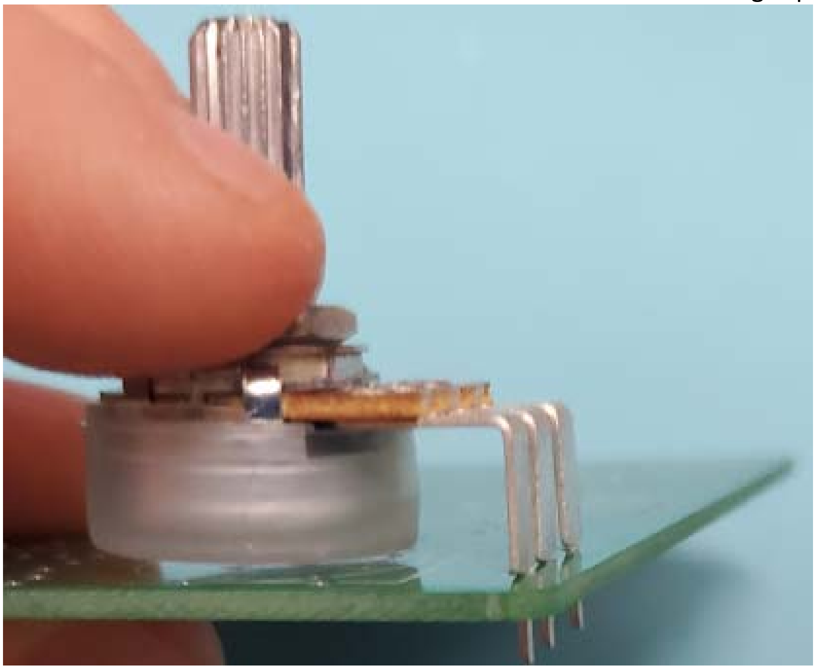
Wires used for the pedal are for delivering power over the hot and ground wires as well as signal for the input and output.



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.

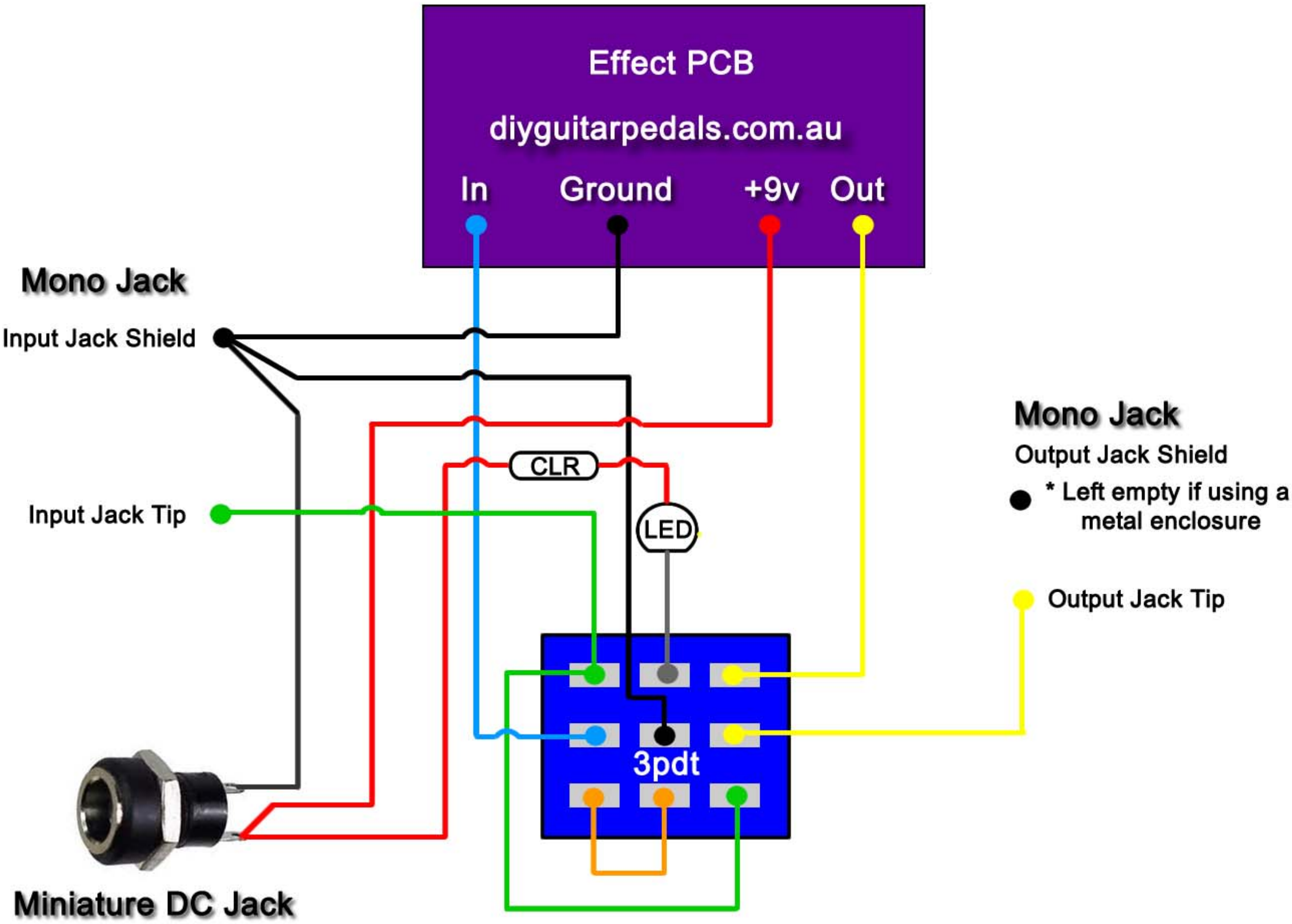
Potentiometers are variable resistors that are used for controlling aspects of the pedal.



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.

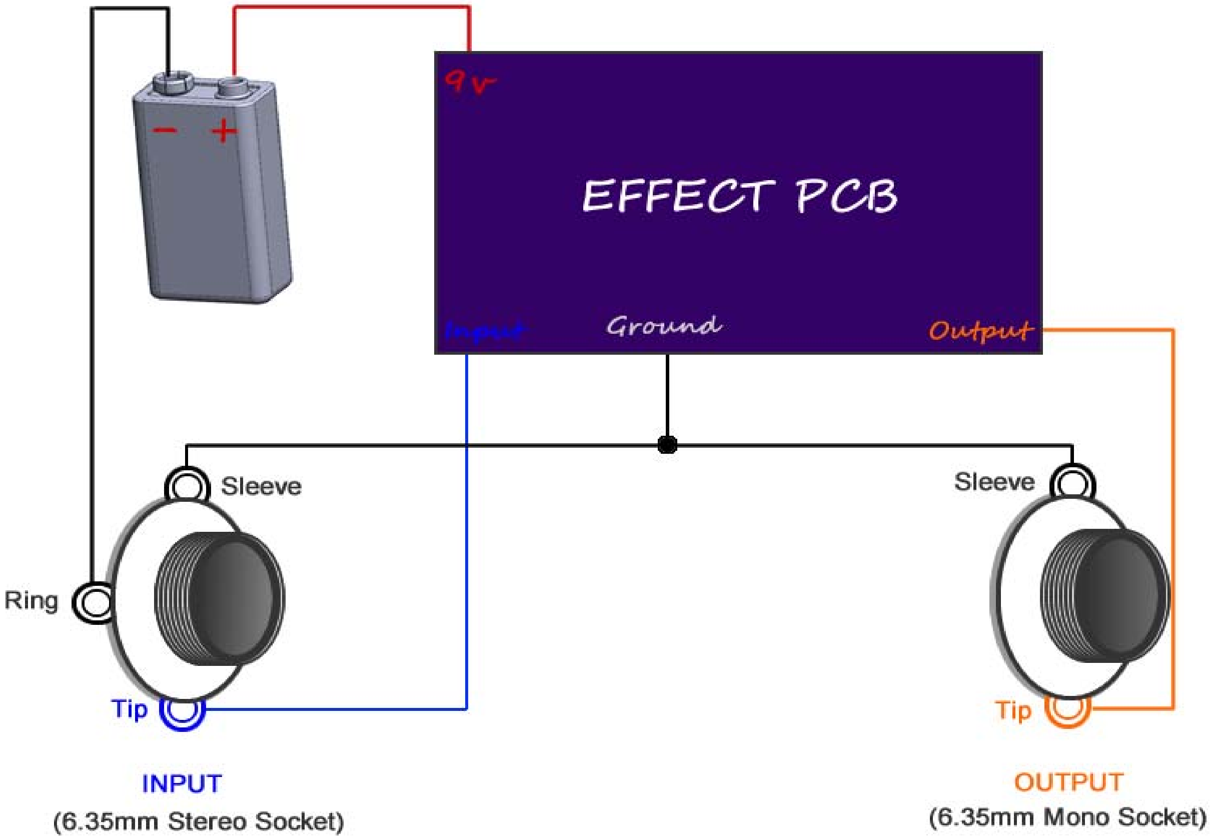
1.10 Off Board Wiring Diagram.

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



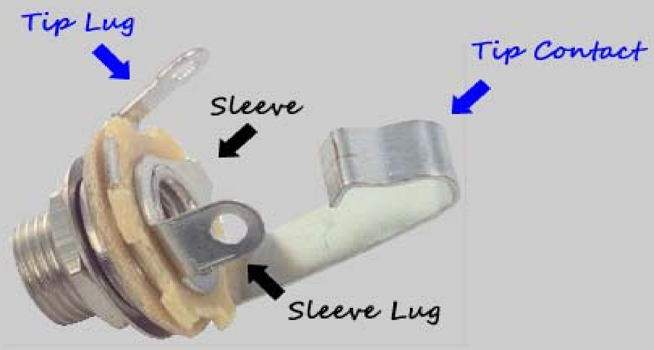
Testing Your Effect

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



Input and Output Sockets

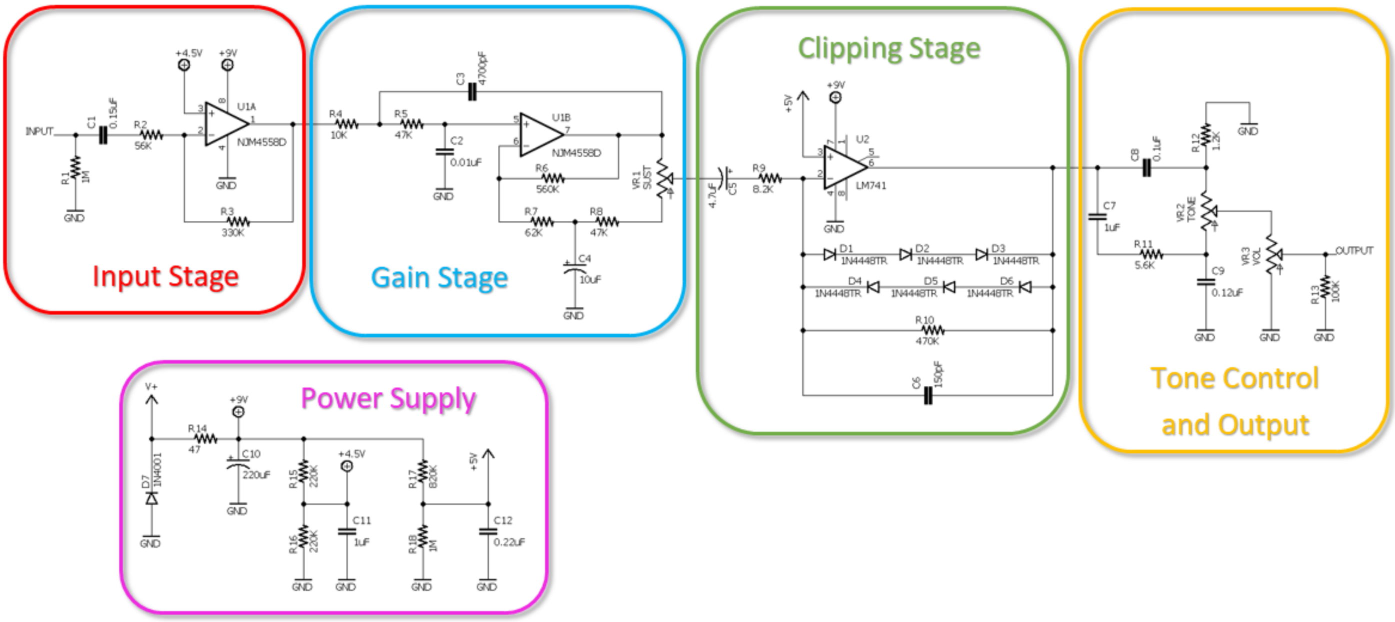
Pay close attention to the lugs of your sockets. Look at them side on so that you can distinguish the sockets individual layers. For instance the tip lug is connected to tip contact. The stereo jack looks the same as the socket below except it has an extra lug and contact for "Ring".



Punk’n Pi Circuit Analysis for modifying purposes.

2. Punk’n Pi Circuit.

The Punk’n Pi schematic can be broken down into some simpler blocks: Power Supply, Input Stage, Gain Stage, Clipping Stage, and Tone Control Stage with Output.



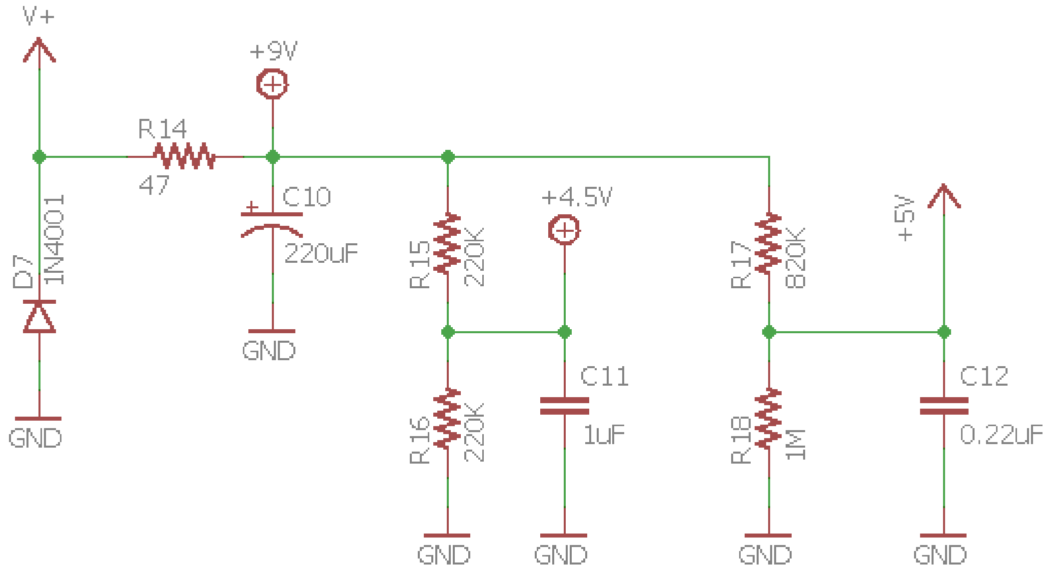
This circuit was designed around a taking the 4 transistor stages of the original Big Muff Pi and converting them down to a 3 op amp stage topology.

Grittier than the discrete 4 transistor topology of a Big Muff, this circuit also gains a more consistent sound due to the use of op amps. Furthermore, the tone shaping is a bit more exotic, utilizing the famous Big Muff Pi’s tone stack but also utilizing a Sallen-Key Filter tone shaping stage before getting to the clipping portion of the circuit.

The input impedance on the Punk’n Pi is around 53K Ω, though better than the original topology of the 4 transistor Big Muff Pi, it is rather low and will potentially overload the pickups on the guitar or to tone suck, however the rest of the circuit compensates for this with boosting and tone shaping.

3. Power Supply.

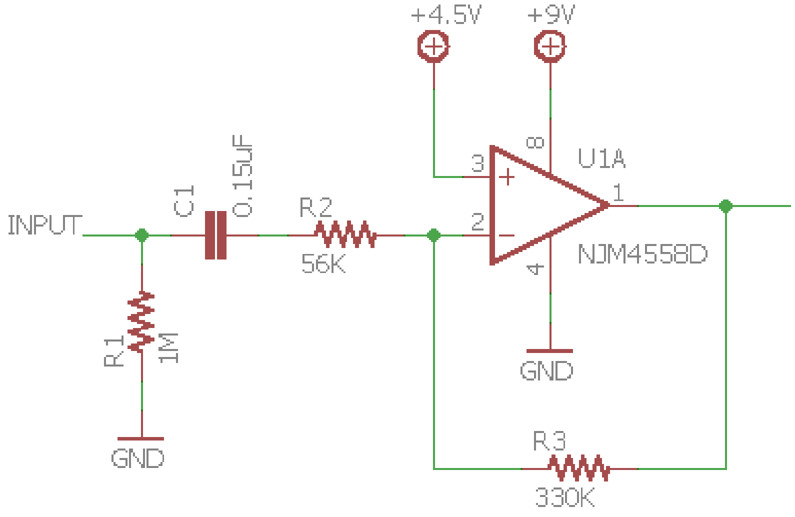
The Power Supply Stage provides the electrical power to all the circuitry as well as biasing for the op amps in the circuit. The whole power consumption is low and estimated around 5mA:



- The diode D7 protects the pedal against adapter reverse polarity connections.
- R14 along with C10 create a low pass filter of 15.4 Hz making sure no high frequency switching noise from a rogue power supply is able to bleed into the power rails. It also provides a small voltage drop of around 70mV.
- C10 is a large electrolytic capacitor used for bulk capacitance as well as a low pass filter for power.
- The resistors R15 and R16 form a voltage divider for the input and gain stages
- C11 is a large film capacitor used as a decoupling capacitor for the 4.5V bias voltage
- The resistors R17 and R18 form a voltage divider for the clipping stage and is slightly asymmetrical as this sets the bias not at the half way point (roughly 4.5V) but rather at 4.87V (roughly 5V)
- C12 is a film capacitor used as a decoupling capacitor for the roughly 5V bias voltage

4. Input Stage.

This clean boost stage is based on an inverting op-amp amplifier to prepare a boosted signal to the rest of the circuit. The Input Stage sets the pedal input impedance, shapes the frequency response and adds some gain.



- The R1 1MΩ resistor from the input to ground is an anti-pop/bleeder resistor, it will avoid abrupt pop sounds when the effect is engaged.
- The C1 150nF film capacitor is used as the input coupling capacitor, separating DC from the incoming op-amp, as well as forming a small RC filter with R2
- The R2 56K resistor acts as an RC filter with C1, as well as provides current limiting protections for the upcoming op-amp as well as sets the gain amount for said op-amp along with R3.
- The R3 330K resistor in the negative feedback loop of the inverting op-amp sets the gain along with R2.
- The U1 4558 op-amp is a low noise, general purpose op-amp used to boost and invert the signal with a set gain

4.1 Input Tone Shaping.

The 150nF capacitor, C1 along with R2 form a high-pass RC filter removing really low frequencies from entering the circuit

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

$$Low\ fc = 1 / (2\pi \cdot R_2 \cdot C_1)$$
$$Low\ fc = 1 / (2\pi \cdot 56K \cdot 150nF)$$
$$Low\ fc = 1 / (2\pi \cdot 56{,}000 \cdot 0.000000150)$$
$$Low\ fc = 18.95Hz$$

With a cut of 19Hz it will block DC and any low-frequency parasitic oscillation.

4.2 Voltage Gain.

The voltage gain is defined by the inverting operational amplifier.

$G_V = (R_3 / R_2)$

$G_V = (330{,}000 / 56{,}000)$

$G_V = 5.893\ (15.41\ dB)$

This is a decent amount of gain and enough to start really tone-shaping the signal in the next stage.

4.3 Input Impedance.

The Punk'n Pi input impedance is R2 aka RS series resistance plus the input impedance of the Input Booster stage:

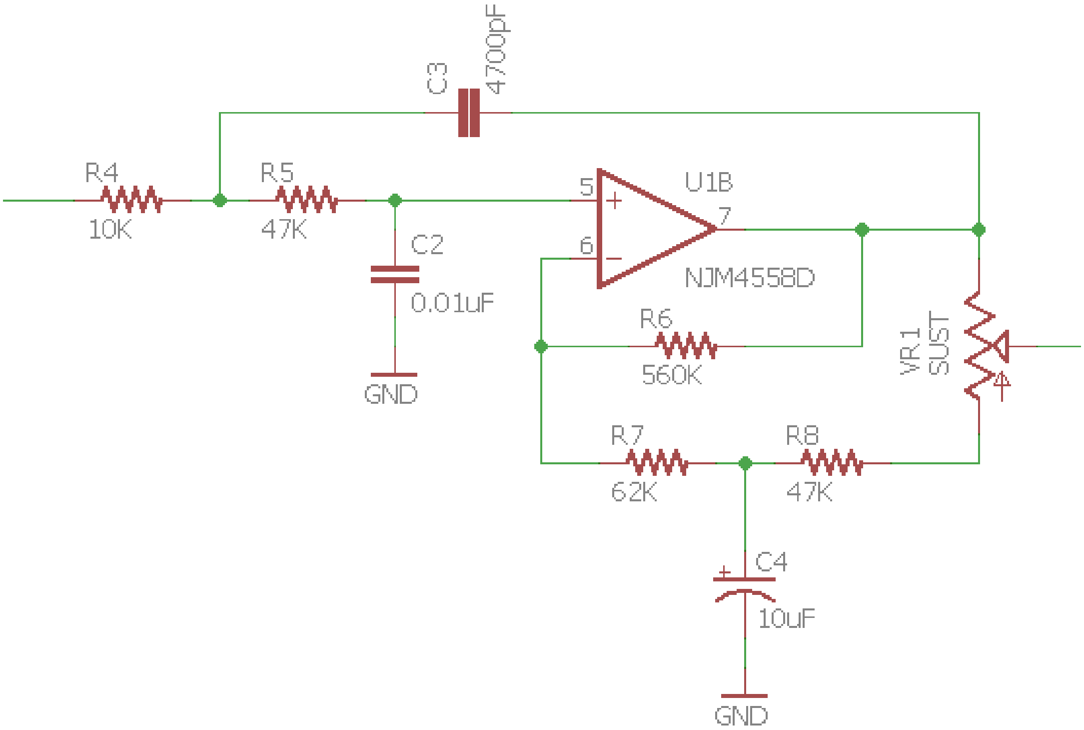
$$Zin = R_2 \,||\, R_1 = 53{,}030.30\ \Omega$$

As the anti-pop resistor, R1 also contributes to the input resistance in parallel to the rest of input impedance, it too, must be calculated to determine the full input resistance. The 53K it is indeed a low input impedance, and the guitar signal might suffer tone sucking (loss of high frequencies), although tone and volume loss is compensated by the rest of the circuit design.

Increasing the 56k R2 input resistor, the input impedance is increased but it also forms a voltage divider at the input, reducing the available voltage gain.

5. Gain Stage.

The gain stage is a non-inverting op-amp stage with a Sallen-Key Low-Pass filter behind it and a version of a bridged t filter in the negative feedback section of the op-amp.



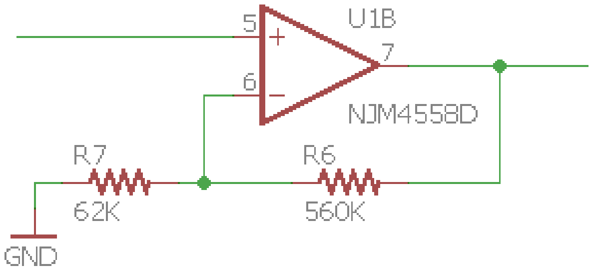
- The R4 10KΩ and R5 47KΩ are the resistors for the Sallen-Key Low Pass Filter
- The C2 and C3 film capacitors for the capacitor portion of the Sallen-Key Low Pass Filter.
- The R6 and R7 form the gain fed-forward by the Sallen-Key Low Pass Active Filter
- The C4 electrolytic capacitor is used as a path to ground for R7 and R8, forming a Bridged T Filter
- The R8 sets the minimum potential general variable gain for the op-amp via the Sustain pot
- The Sustain Pot sets maximum potential resistance in the negative feedback loop of the op-amp, thus creating gain.
- The U1 4558 op-amp is a low noise, general purpose op-amp used to selectively boost certain frequencies and cut others.

R8 stops the sustain from going to zero (you don't want zero gain, do you?) If it wasn't connected to C4, you'd have a variable resistor hanging off an op amp output with 4.5V on one side of it (from the op amp) and ground on the other end of it, so ignoring the fact the op amp wouldn't like that much, what would happen when you turned it? It would crackle, the sign of DC noise bleeding in.

C4, having a large value, like 10uF, is required for this blockage of DC noise on the negative feedback line as well as provide a ground path for R6 and R7. Being a large value is important as it forms a high-pass filter by default with R8 and the bottom half of the sustain knob. With the sustain maxed (50K) and the 47K resistor in series, we form a low pass filter with an R of 97K and a C of 10uF, which stops frequencies of under 0.164 Hz. With the sustain knob at 0, only the 47K resistor is in play, so with an R of 47K and a C of 10uF, the low pass filter blocks frequencies of 0.34 Hz. Again, this is just to remove DC harmonic noises that might be trying to creep into the op-amp circuit.

5.1 Voltage Gain.

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



$G_v = 1 + (R_6 / R_7)$

$G_v = 1 + (560{,}000 / 62{,}000)$

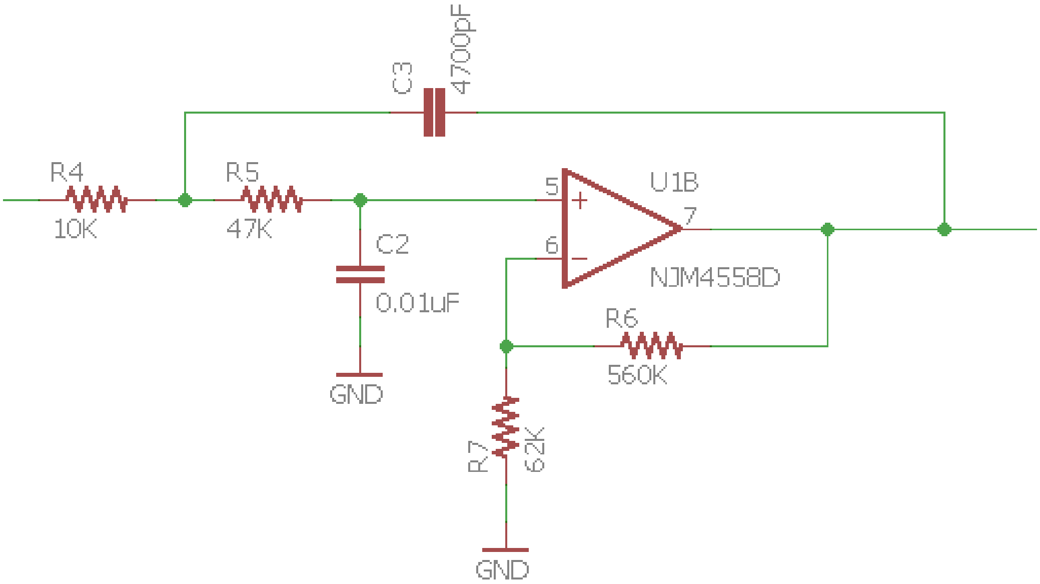
$G_v = 1 + 9.03225806451613$

$G_v = 10.03225806451613$ (20 dB)

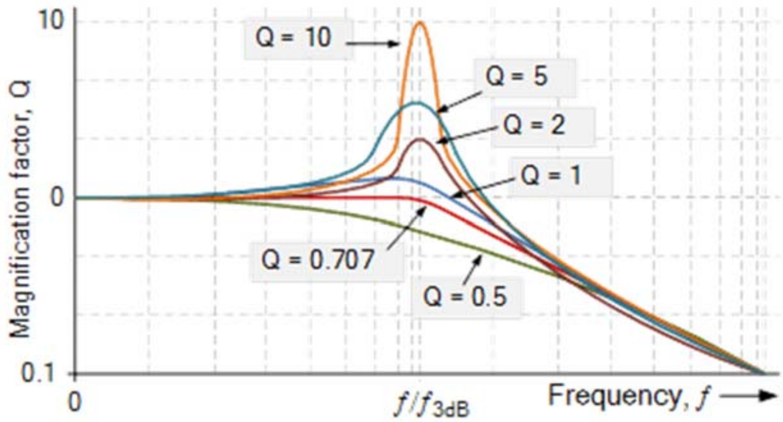
This is a large amount of gain, and is probably going to clip on the rails of the op-amp, but as we will see, due to the filtering, only some of the frequencies will be this heavily amplified.

5.2 Sallen-Key Low-Pass Filter

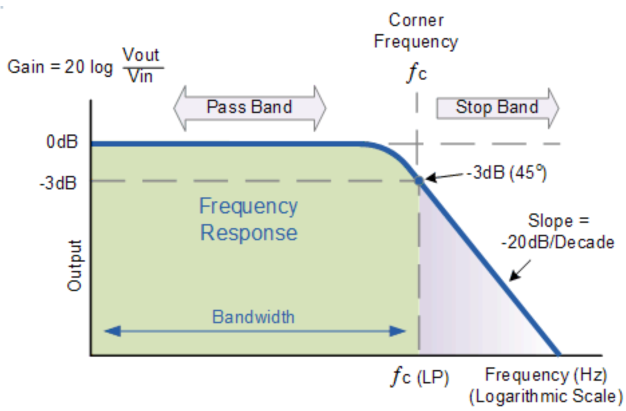
Op-Amp U1B forms a Sallen-Key Low Pass Filter to active boost a band of frequencies with a width of frequencies being boosted controlled by its Q value:



An example frequency chart of how a Sallen-Key Low-Pass Filter frequency response would look like (with example Q values):



While a passive RC Low Pass Filter looks more like this:



To calculate the cut-off frequency in this filter, we do the following:

$fc = 1 / (2\pi \cdot (\sqrt{(R_4 \cdot C_3 \cdot R_5 \cdot C_2)}))$

$fc = 1 / (2\pi \cdot (\sqrt{(10{,}000 \cdot 0.0000000047 \cdot 47{,}000 \cdot 0.00000001)}))$

$fc = 1 / (2\pi \cdot (\sqrt{0.00000002209}))$

$fc = 1 / (2\pi \cdot 0.00014862705)$

$fc = 1 / 0.00093385129$

$fc = 1{,}070.83\ Hz$

To calculate the Q (Quality Factor) in this filter, we use the gain determined from 5.1 as the value of "K"

$Q = (\sqrt{(R_4 \cdot C_3 \cdot R_5 \cdot C_2)}) / (R_4 \cdot C_2 + R_5 \cdot C_2 + R_4 \cdot C_3 \cdot (1 - K))$

$Q = (\sqrt{(10{,}000 \cdot 0.0000000047 \cdot 47{,}000 \cdot 0.00000001)}) / (10{,}000 \cdot 0.00000001 + 47{,}000 \cdot 0.00000001 + 10{,}000 \cdot 0.0000000047 \cdot (1 - 10.03225806451613))$

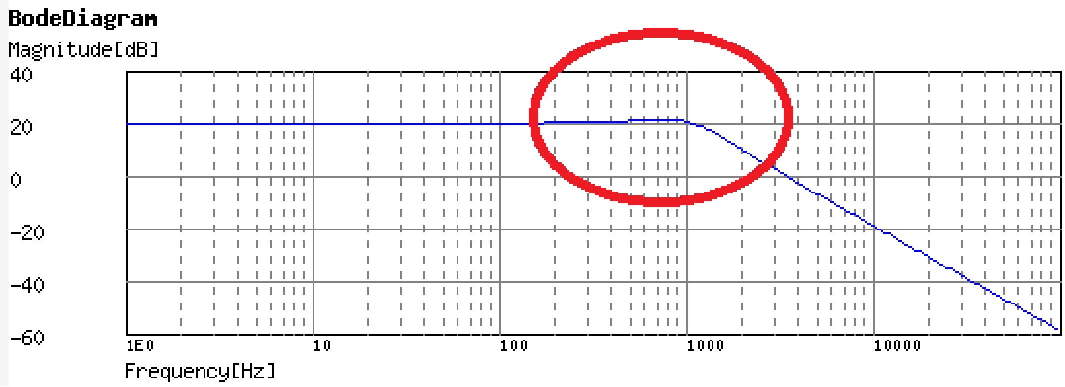
$Q = (\sqrt{0.00000002209}) / (0.0001 + 0.00047 + 0.000047 \cdot -9.03225806451613)$

$Q = 0.00014862705 / (0.0001 + 0.00047 + -0.000424516129032258 11)$

$Q = 0.00014862705 / 0.000145483870967 74189$

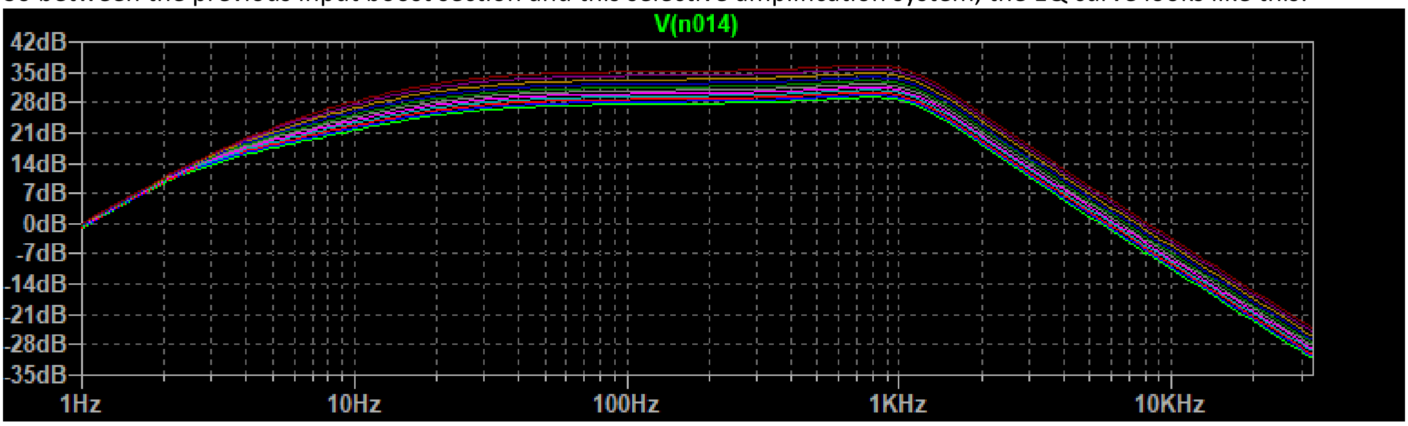
$Q = 1.021605$

This creates a filter that looks like this:



The gain is at 20dB, but as it approaches 1.07083 kHz it starts to bump up slightly with its short, but wide Q of 1.0216. After that it drops off and fades out.

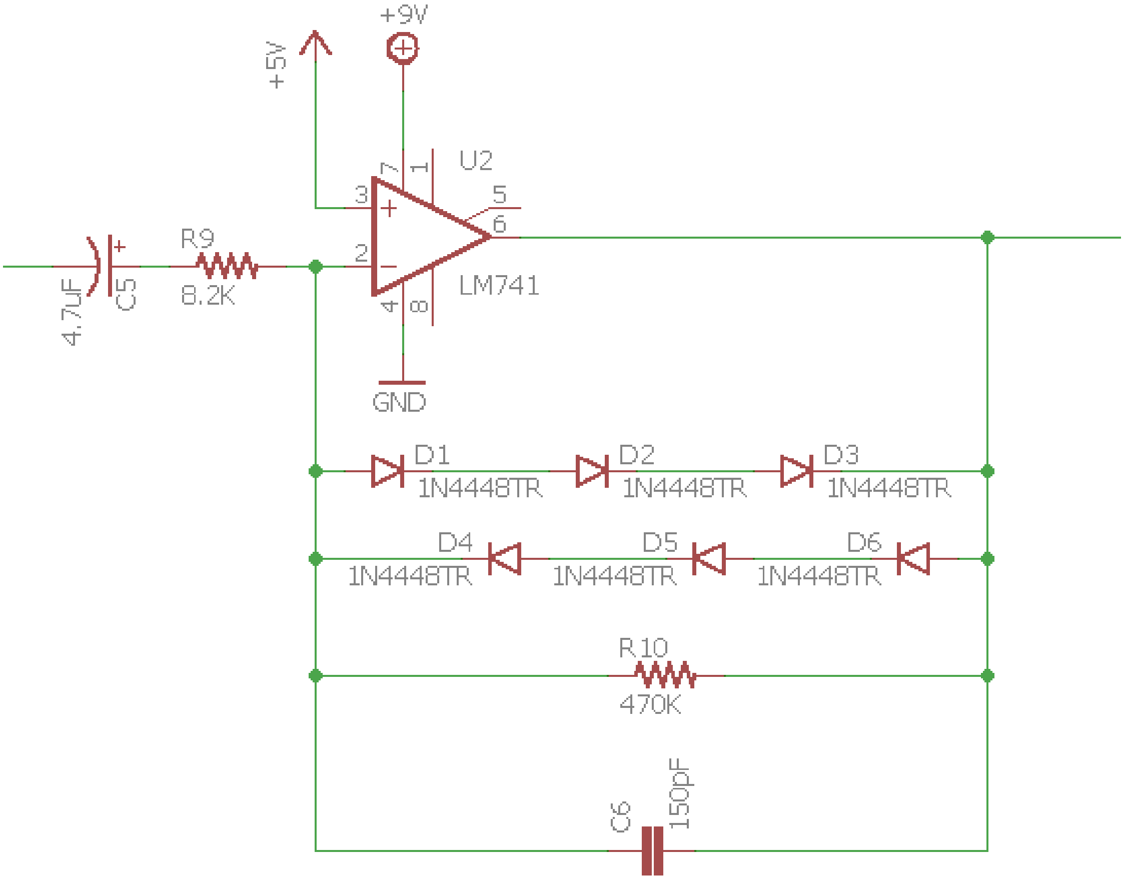
So between the previous input boost section and this selective amplification system, the EQ curve looks like this:



With the sweep of the sustain knob, the curve is generally the same with a 8dB difference between the lowest sustain and the highest.

6. Clipping Stage.

The clipping stage is based on an inverting op-amp amplifier with a slightly off-center bias that performs a lot of clipping through a chain of diodes.



- The C5 4.7µF electrolytic capacitor is a coupling capacitor, connecting the previous gain stage to this clipping stage.
- The R9 8.2KΩ resistor acts as part of an RC filter with C5, but also sets the gain of the op-amp with R10
- The R10 470KΩ resistor acts as part of an RC filter with C6, but also sets the gain of the op-amp with R9
- The C6 150pF ceramic capacitor acts as an RC filter with R10 in the negative feedback loop of U2
- The R6 and R7 form the gain fed-forward by the Sallen-Key Low Pass Active Filter
- The small switching diodes, D1 through D6, are used for soft clipping in the negative feedback loop of the op-amp U2.
- The U2 741 op-amp is a single, general purpose op-amp used to perform soft clipping of the already distorted sound.

6.1 Voltage Gain.

The voltage gain is defined by the inverting operational amplifier.

$G_v = (R_{10} / R_9)$

$G_v = (470{,}000 / 8{,}200)$

$G_v = 57.317\ (35\ dB)$

This is quite a bit of gain, especially because of the 2 gain stages before it. However, this will be pushed back due to the symmetric clipping diodes found in the feedback path of the inverting operational amplifier.

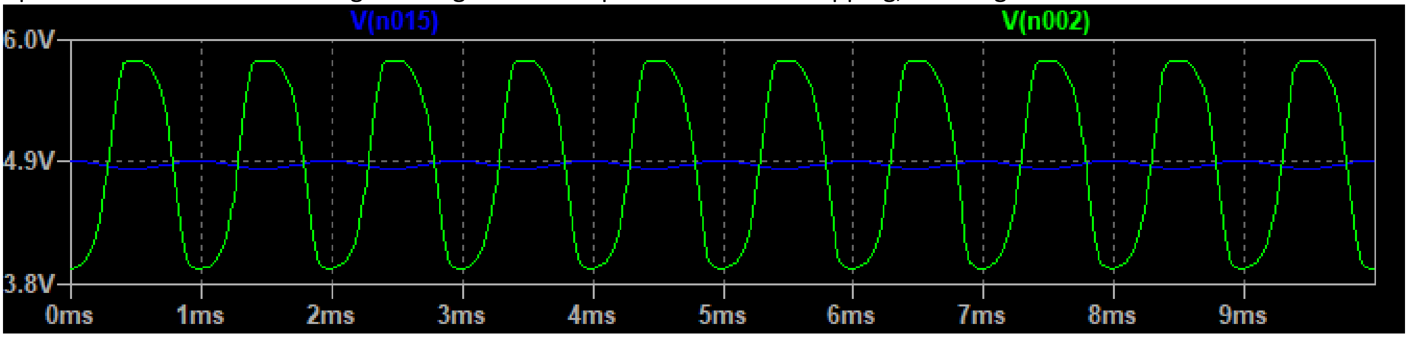
6.2 Clipping Method.

When the voltage difference (positive or negative) between the op amp output and the (-) input is bigger than the diodes forward voltage drop V_F the diode will turn on.
As the diode turns on forward biased, the equivalent resistance of the diode goes from an open circuit to a very low value (few ohms), changing the gain of the inverting op amp from a high value (57.317) down to 1.

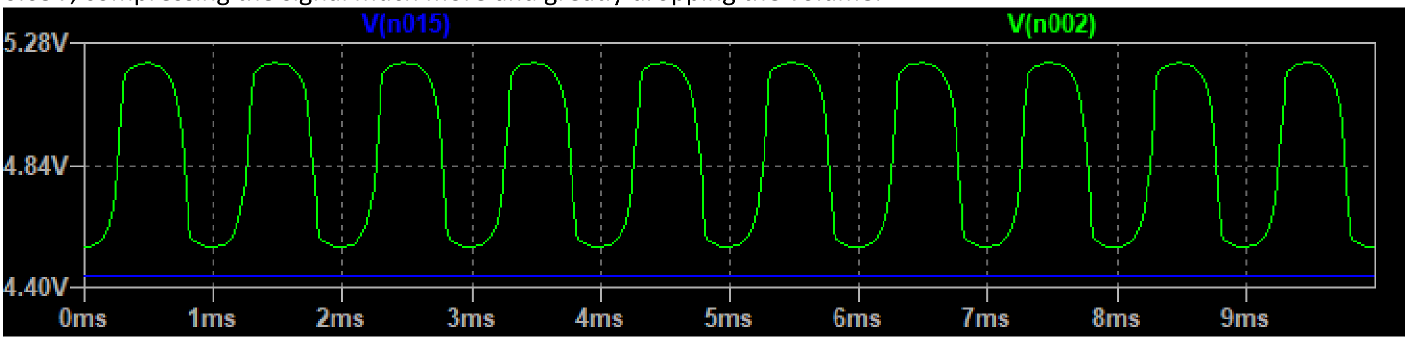
The diodes D1-D3 will clip the positive semi-cycle signal and D4-D6 will clip the negative signal semi cycle. Below is a chart of diode types and how much they clip.

Diode	Voltage Drop
Silicon Diodes (1N914, 1N4148, etc)	0.65 V
Schottky Diodes (BAT41, 1N5817, etc)	0.3 – 0.4 V
Red LEDs	1.2 – 1.4 V
Blue LEDs	2.1 V
Germanium Diodes (1N34A, 1N270, etc)	0.2 – 0.5 V

Because there are diodes in series with each other, the forward voltage drop values are added together. So in the standard build, you would have 3 switching silicon diodes in series, the forward voltage drop would be 3x 0.65V, adding up to 1.95V. This means the signal can get more amplification before clipping, allowing for louder volume.



If only populating D1 and D4, but shunting the other diodes with wire, we'd only have a forward voltage drop of 1x 0.65V, compressing the signal much more and greatly dropping the volume:



6.3 High Pass Filter prior to the Op Amp.

C5 and R9 create a high-pass filter before allowing the signal to be further amplified and clipped at the U2 op amp.

The cut-off frequency of the filter is defined by the formula:

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

$$Low\ fc = 1 / (2\pi \cdot R_9 \cdot C_5)$$
$$Low\ fc = 1 / (2\pi \cdot 8.2K \cdot 4.7\mu F)$$
$$Low\ fc = 1 / (2\pi \cdot 8{,}200 \cdot 0.0000047)$$
$$Low\ fc = 4.1\ Hz$$

This is primarily designed to remove any low frequency noise coming into the op-amp, preserving the higher frequency fuzz/distortion.

6.4 Low Pass Filter in the Feedback Loop.

The small 150pF C6 capacitor across the diodes works as a low pass filter, softening the corners of the clipped waveform and mellowing out the high end of the distortion.

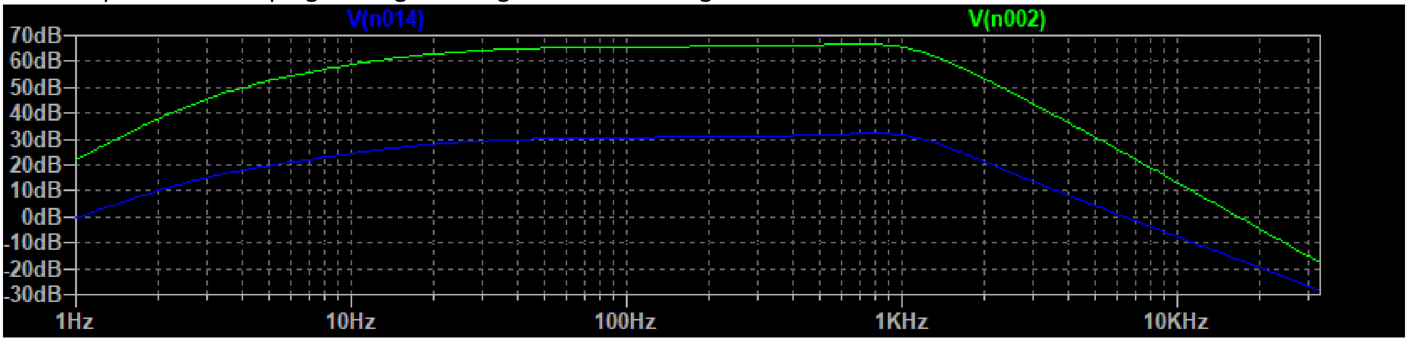
The cut-off frequency of the filter is defined by the formula:

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

$$Low\ fc = 1 / (2\pi \cdot R_{10} \cdot C_6)$$
$$Low\ fc = 1 / (2\pi \cdot 470K \cdot 150pF)$$
$$Low\ fc = 1 / (2\pi \cdot 470{,}000 \cdot 0.00000000015)$$
$$Low\ fc = 2257.5\ Hz$$

The 150pF brings the cut-off frequency to the audible frequencies and then softening the distortion.

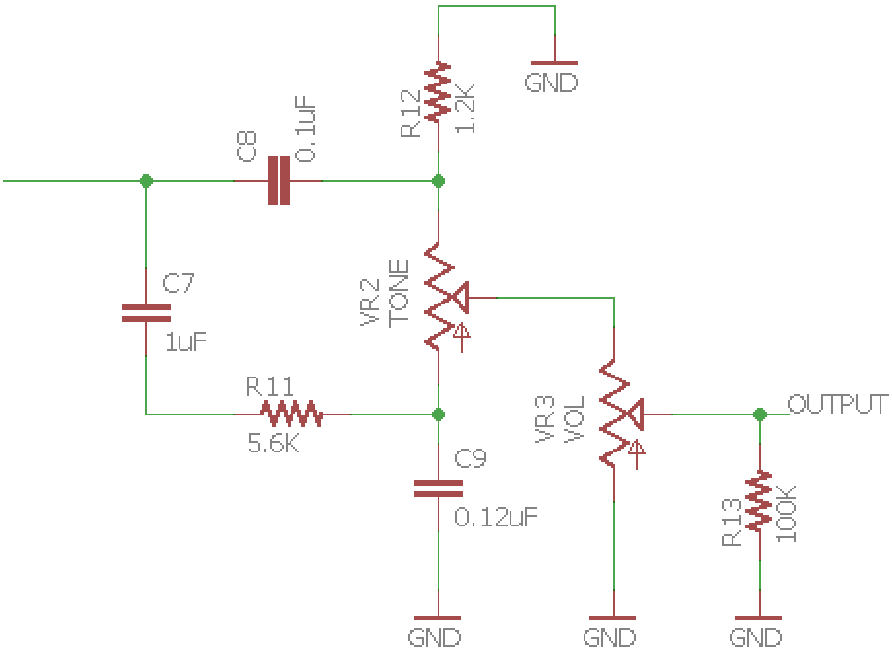
The complete tone shaping leaving this stage before entering the tone stack looks like this on a stock Punk’n Pi:



The blue line represents the EQ curve prior to the clipping stage and the green represents just after the clipping stage, basically demonstrating a similar curve that is further amplified.

7. Tone Control and Output Stage.

The Passive Tone Control has a simple and effective design: essentially it is just a combination of high-low pass filters that are mixed together by a single linear 10K *Tone* potentiometer. The cut-off points are designed so that their interweaving effect introduces a middle-frequency scoop/notch at 660 Hz when the potentiometer is set to the middle position. Following the tone control is a passive volume control



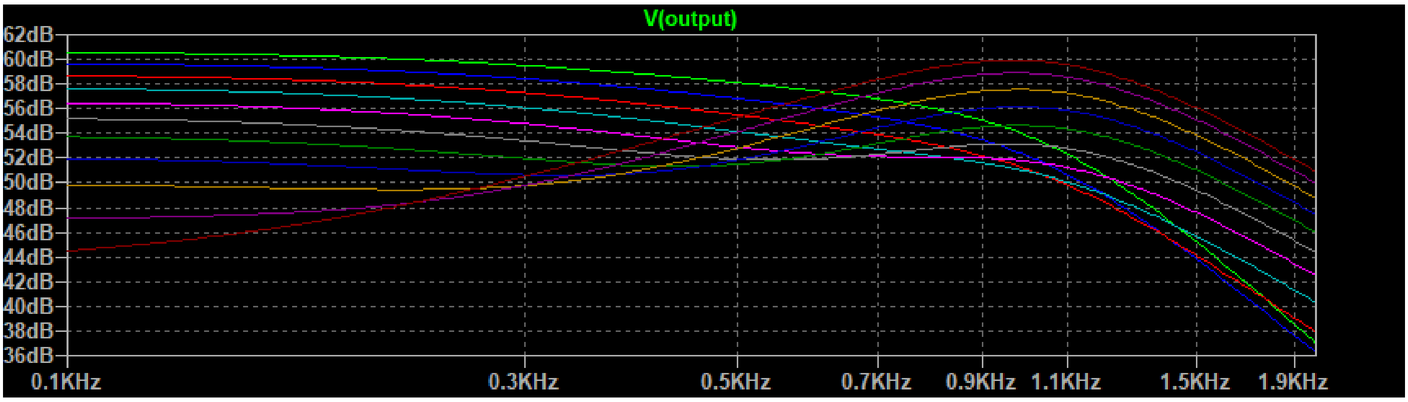
7.1 Tone Frequency Response.

This works by taking two filters, a high-pass filter (allows highs to pass through, but cuts out lows) and a low-pass filter (allows lows to pass through, but cuts out highs) and allows the user to balance between the two filters via a potentiometer. The low pass filter contains the components R11 and C9, while the high pass filter contains R12 and C8. Looking at the Russian variant, we can see what frequencies are rolled off between the two filters

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

$Low\ fc = 1 / (2\pi \cdot R_{11} \cdot C_9)$
$Low\ fc = 1 / (2\pi \cdot 5.6K \cdot 0.12uF)$
$Low\ fc = 1 / (2\pi \cdot 5{,}600 \cdot 0.00000012)$
$Low\ fc = 236.8\ Hz$

$High\ fc = 1 / (2\pi \cdot R_{12} \cdot C_8)$
$High\ fc = 1 / (2\pi \cdot 1.2K \cdot 0.1uF)$
$High\ fc = 1 / (2\pi \cdot 1{,}200 \cdot 0.0000001)$
$High\ fc = 1326.3\ Hz$



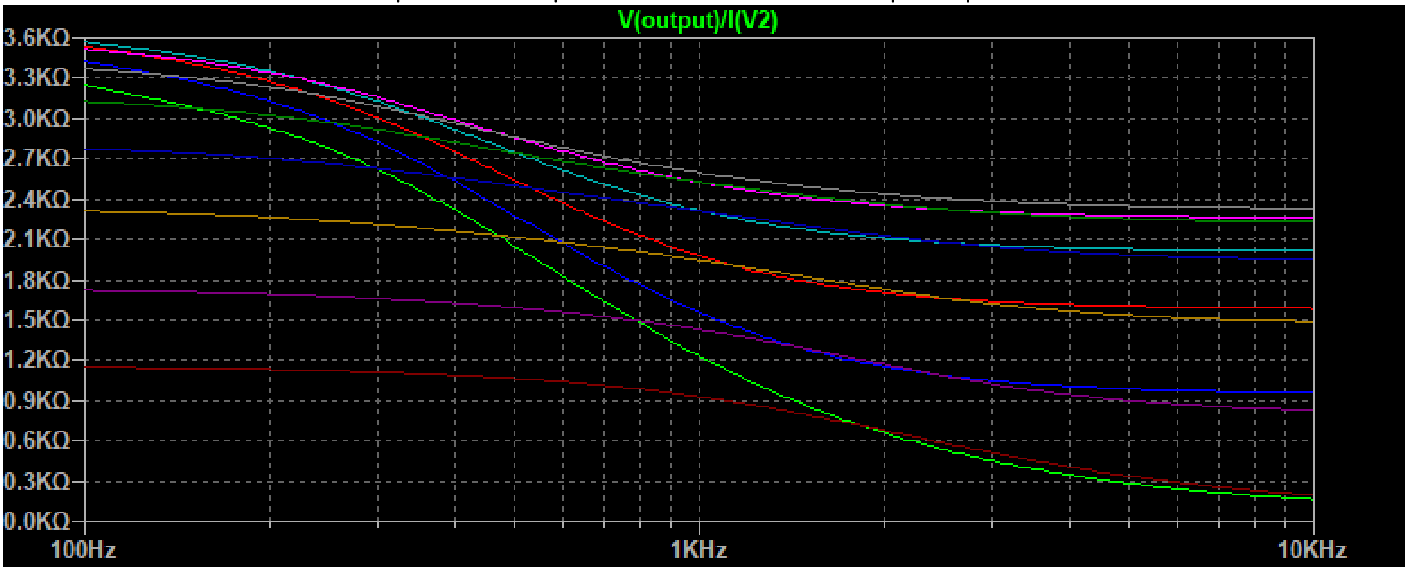
All the frequencies over 1326Hz and under 236Hz get full amplification. This also leaves a bit of a dead spot in the middle of those two frequencies which is why this tone stack is well known for “scooping the mids”. If one wants to change the tone response, simply change out the R11, R12, and C8, and C9 components in their respective filters, and calculate with the above equations to see what the response should be.

C7 is there to decouple the op amp’s DC from making it into the tone stack and is a large value to make sure all bass notes do enter

Variant	C8	C9	R11	R12	f LP Cut	f HP Cut	Notes
Big Muff Pi Triangle	3.9nF	10nF	22K	22K	723 Hz	1855 Hz	
Big Muff Pi NYC	3.9nF	10nF	39K	22K	408 Hz	1855 Hz	Wide Scoop on Mids
Big Muff Pi Sovtek	3.9nF	12nF	20K	22K	663 Hz	1855 Hz	
Big Muff Pi Ram’s Head	3.9nF	10nF	33K	33K	482 Hz	1236 Hz	
Flat Mids	10nF	10nF	39K	22K	408 Hz	723 Hz	
Mids Bump	10nF	5.6nF	39K	22K	728 Hz	723 Hz	Flipped, Boosts Mids

7.2 Output Impedance.

The Punk'n Pi output impedance is relatively tricky to calculate as the tone stack is not broken up with coupling capacitors from the output meaning how the tone knob itself is set changes the output impedance. Thankfully simulators can show the full sweep of the tone pot and demonstrate the output impedance.

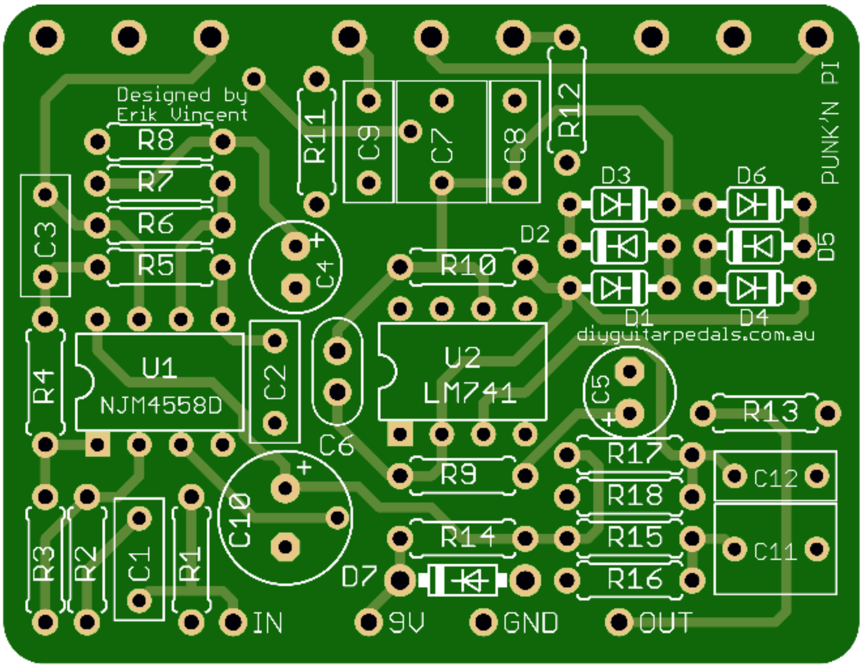


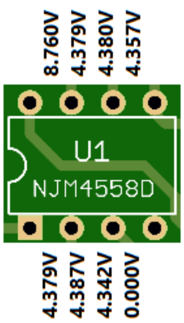
The output impedance is under 10K with the volume maxed, which is ideal. As the volume is decreased by bleeding the signal to ground, the output impedance lowers, which is still ideal. Typically, an output impedance of 100 – 10,000 is desired.

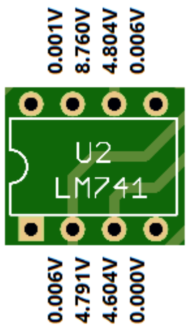
8. Voltage Readouts.

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

IC read-outs







KNOBS

- VOL: MAX
- TONE: MAX
- SUST: MAX

9. Modifications

Following is a couple of worthwhile modifications that can be applied to the Punk'n Pi.

9.1 Capacitors

C1 is used for input frequency filtering. Using higher value capacitors here will reduce bass response and help with the mid-range frequencies better. Typical ranges are 10nF to 1uF.

C6 controls the harshness of the clipping section. Lower values will allow more harshness and larger values will tame the highs, making the clipping less harsh sounding. Typical ranges are 47pF to 270pF

C8 and C9 effect the tone stack curves. See the tone-stack section for how the value calculates the changes.

9.2 Resistors

Changing the value of R3, R6, and R10 will affect the gain ratios of the three op amp stages. Increasing their values will increase the gain from that stage while decreasing it will decrease the gain values of their stage. However, when changing the values of R6 specifically, this will greatly affect the Q of the tone control, which may not be desired

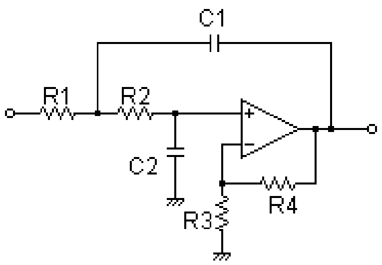
The values for R11 and R12 effect the tone-stack curves. See the tone-stack section for how the value calculates the changes.

9.3 Diodes

Changing the diodes to different types will give a different sound. Using diodes with low forward voltages, such as Germanium diodes or Schottky diodes will cause the distortion to be less harsh and open, while using diodes with high forward voltages, such as LEDs will make the distortion more harsh and compressed. Mixing the amount of forward voltages between the series D1-D3 and series D4-D6 will cause asymmetrical soft clipping, which will create more natural sounding distortions.

9.4 Tone Control – Sallen-Key Low Pass Filter and Tone Gain section

Resistors and capacitors: R4, R5, R6, R7, C2, and C3 make up the Sallen-Key Low Pass Filter. Due to the fact that these variables not only manipulate the frequency that cuts the input signal, but as well as the quality of the cut (Q) and the gain of the op amp stage itself, it is suggested that changing these values should be carefully calculated before putting into practice. Utilizing a Sallen-Key Low Pass Filter calculator would be advised



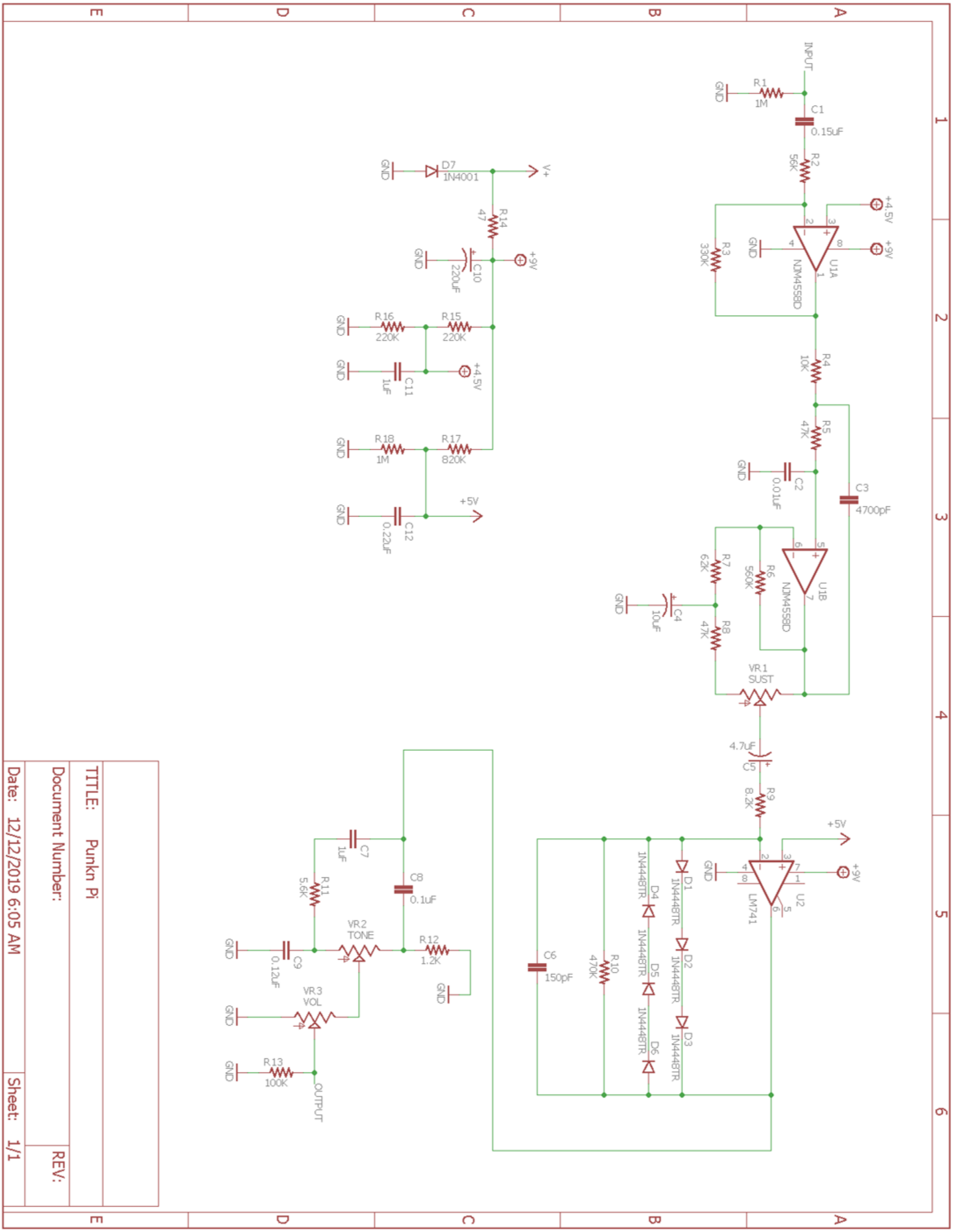
http://sim.okawa-denshi.jp/en/OPseikiLowkeisan.htm

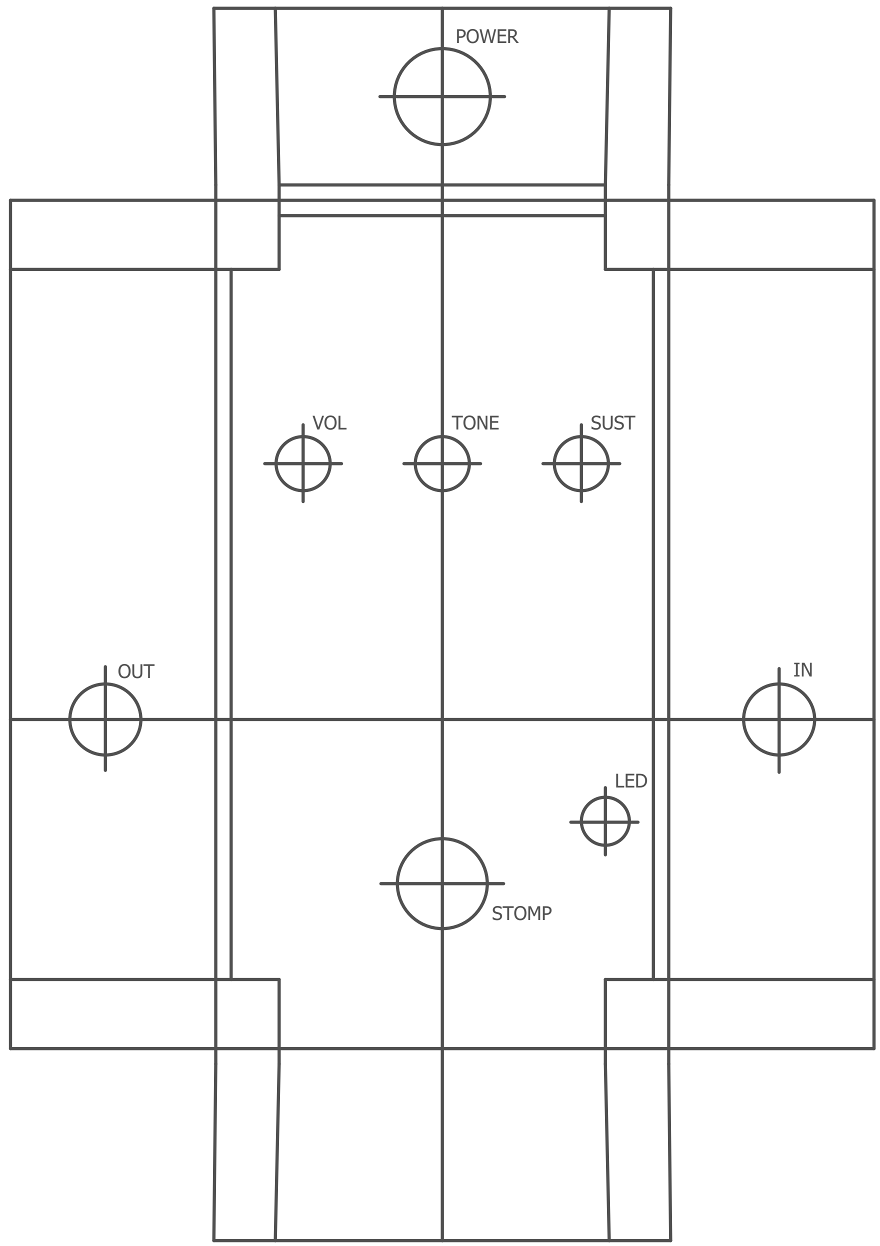
9.5 Tone Control – Big Muff Pi Tonestack

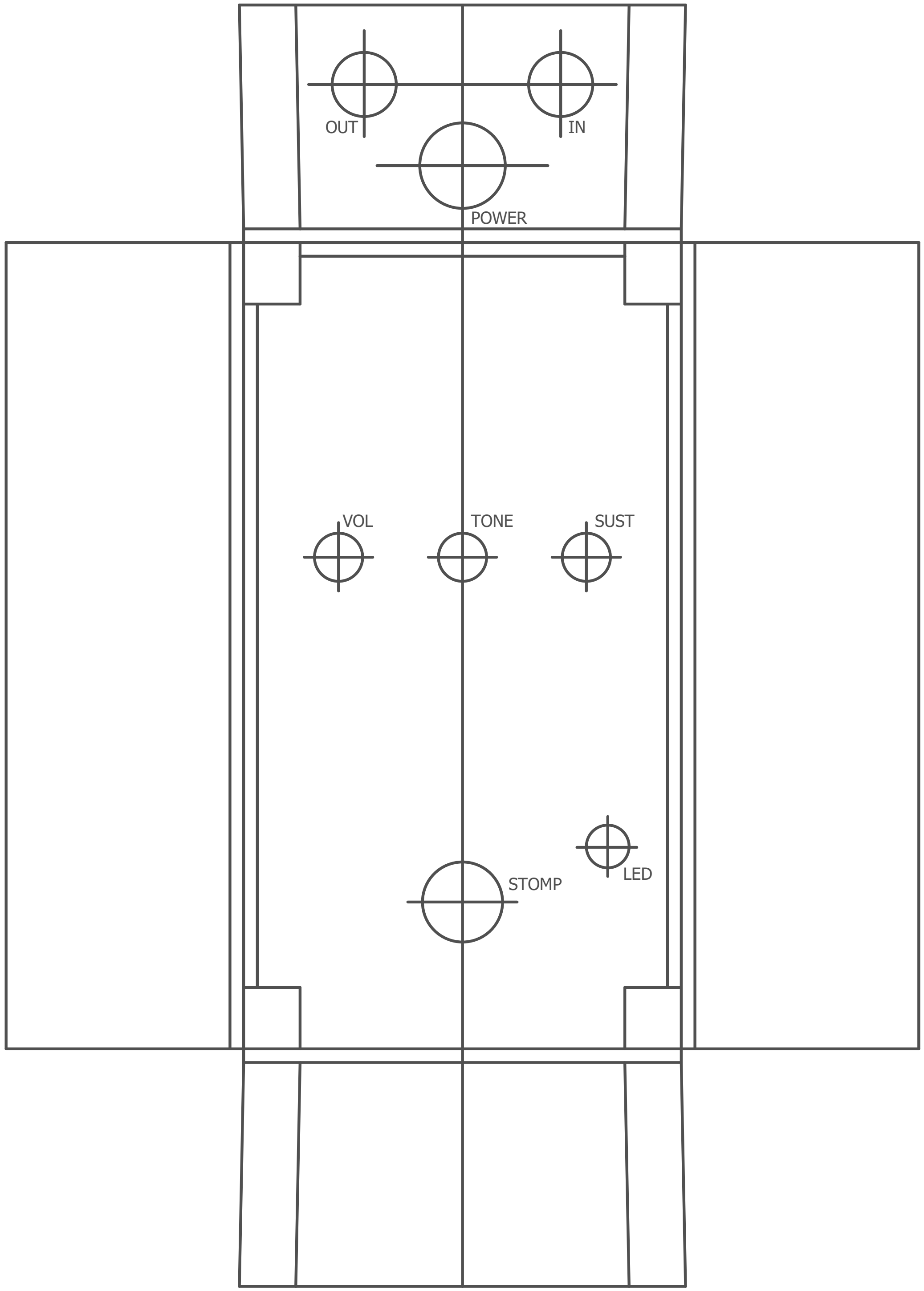
Resistors and capacitors: R11, R12, C8, and C9 make up the Big Muff Pi Tone stack along with the 10K tone pot and 100K volume pot. Changing these values change the cut off frequency points depending on where the dial is for the tone. Using a Big Muff Pi Tone Stack Calculator can help in determining where, as one rolls the dial, the frequencies are cut.

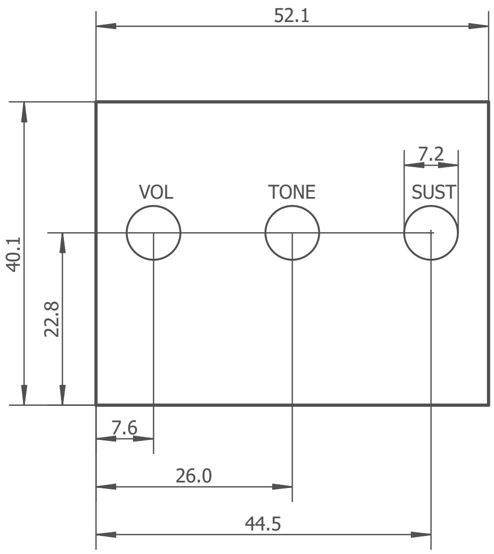
http://www.guitarscience.net/tsc/bigmuff.htm

10. Schematic




POWER
VOL
TONE
SUST
OUT
IN
LED
STOMP


OUT
IN
POWER
VOL
TONE
SUST
LED
STOMP


52.1
40.1
22.8
7.2
VOL
TONE
SUST
7.6
26.0
44.5