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However, we respectfully insist that all posts be made in English.

Bill Lawrence Q-Filter, an analysis

of...

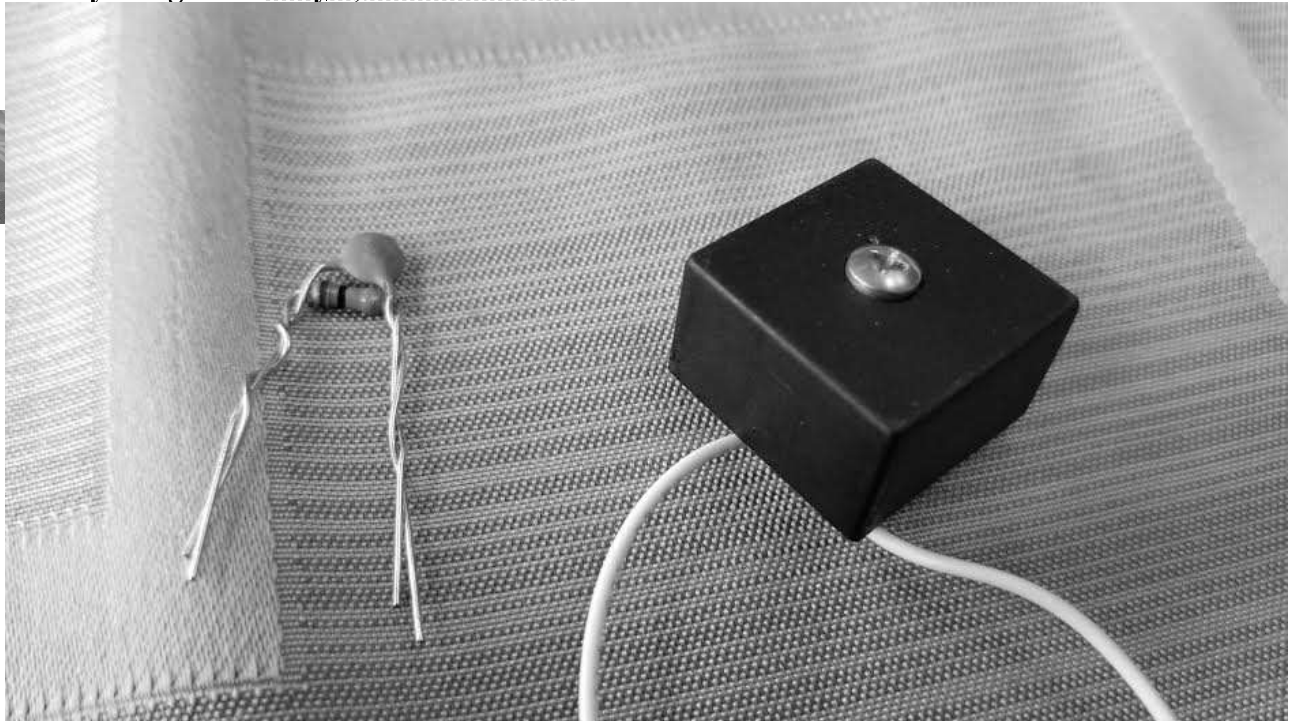
[antigua](#)

Moderator



Posts: 1,355
Likes: 138

[Bill Lawrence Q-Filter, an analysis of...](#) Thread started May 2, 2018 at 2:32am
Post by [antigua](#) on May 2, 2018 at 2:32am



I bought a Bill Lawrence Q-Filter www.wildepickups.com/Q-filter.html in order to take it apart and see what's going on, and possibly to use it.

Altogether, the inductor shows an inductance value of 2.18H @ 1kHz. The Wilde Pickups website

rates it at 1.8H, but it seems the value drifts rather easy if the retaining screw is loosened or tightened. The DC resistance is 49.6 ohms. I can't measure the wire gauge without undoing some of the coil, but it's certainly larger than 42AWG, and appears to be about a couple hundred turns.

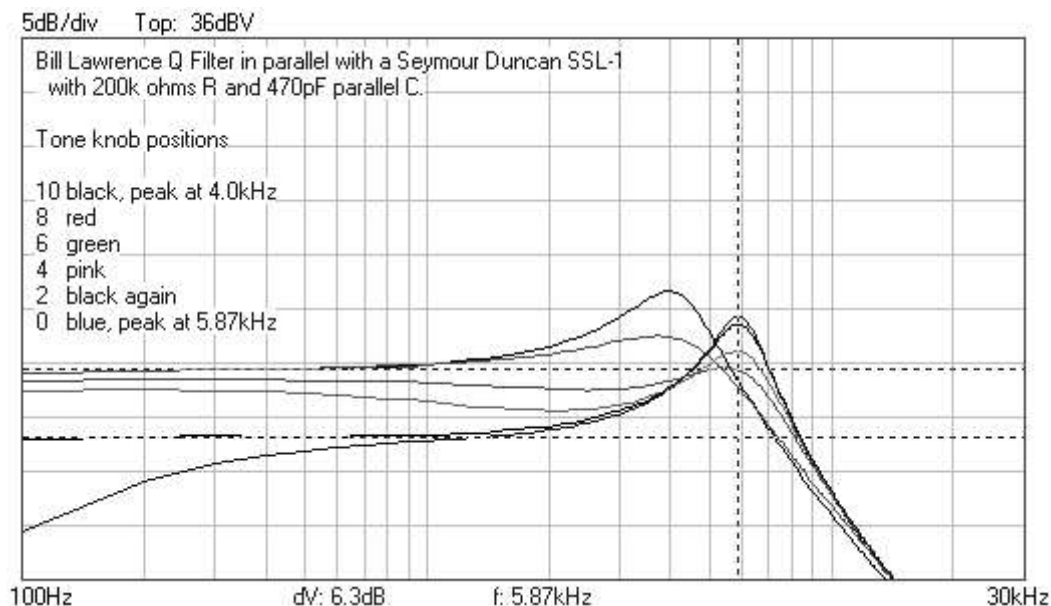
The inductor is a ferrite pot core type, which allows it to achieve very high inductance relative to the turns of wire on the coil. 2.18H is in the ballpark of a Strat pickup, having nearly 8,000 turns of wire, but without much to show for a core aside from a few ALNiCo pole pieces.

With both pots in place, but without the steal screw through the center, the inductance reads 630.0mH SER @1kHz, and about the same in PAL mode. Without the upper upper pot, the inductance drops to 8.94mH SER 16.03mH PAR @ 1kHz, which really goes to show the value of having a completed magnetic circuit.

Wilde Pickups also threw in a parallel resistor and cap treble bleed for free. The cap is 10nF and the resistor is 10k.

The name "Q-Filter" is not an especially fitting name, as it's little more than a high inductance inductor with a rather low series resistance. The tone pot that you connect the Q-Filter to would more rightfully be called a "Q filter", and it has this effect whether or not you use an inductor, or a typical capacitor. Supposedly the "Q-Filter" name is a reference to the fact that the low series resistance allows the guitar pickup to maintain a high Q factor when used in conjunction with this rather high value inductor.

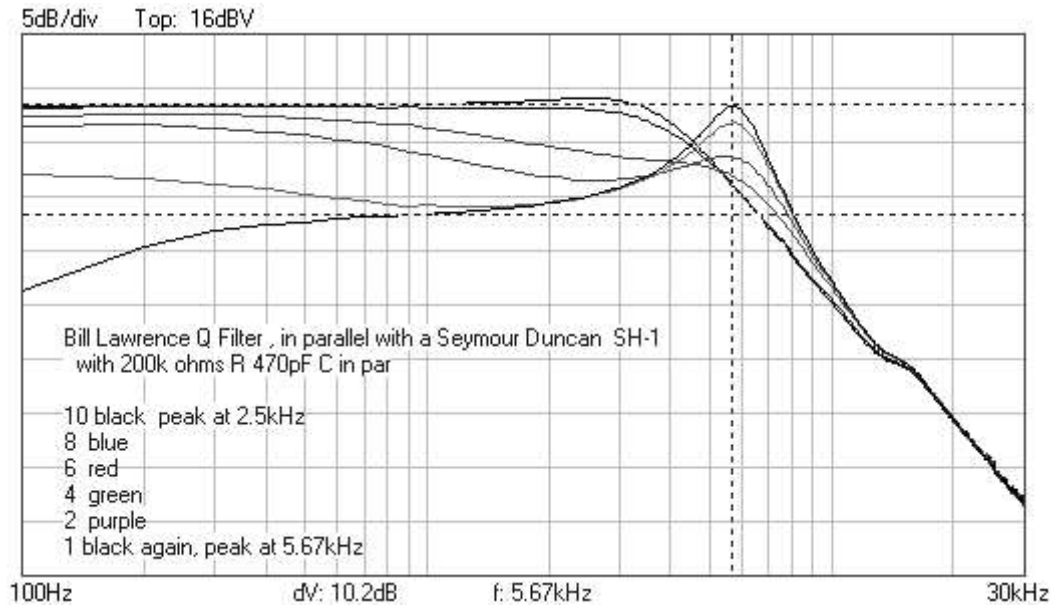
Here is a practical frequency response plot of an SSL-1 with a Q-Filter, wired in place of a tone cap, using a 250k pot.



To a large extent, this behaves like the reverse of a capacitor. There is a strong resonance at one frequency when the tone pot is all the way up, and another strong resonance when the pot is turned all the way down. When a typical cap is used, then at zero the resonant peak is at a lower frequency, but with an inductor, it ends up at a higher frequency. However, throughout most of the pot's sweep in between, the resonances flattens out, and it's in that respect the tone pot is acting as a legitimate "Q" control, and this is the case regardless of whether a cap or an inductor is used.

The major difference though, between using a cap and in inductor, is that there is an overall drop in amplitude output, -6.3dB with the SSL-1, which is very a noticeable drop in volume.

Here is the same test conducted with a Seymour Duncan SH-1N, "'59 neck":

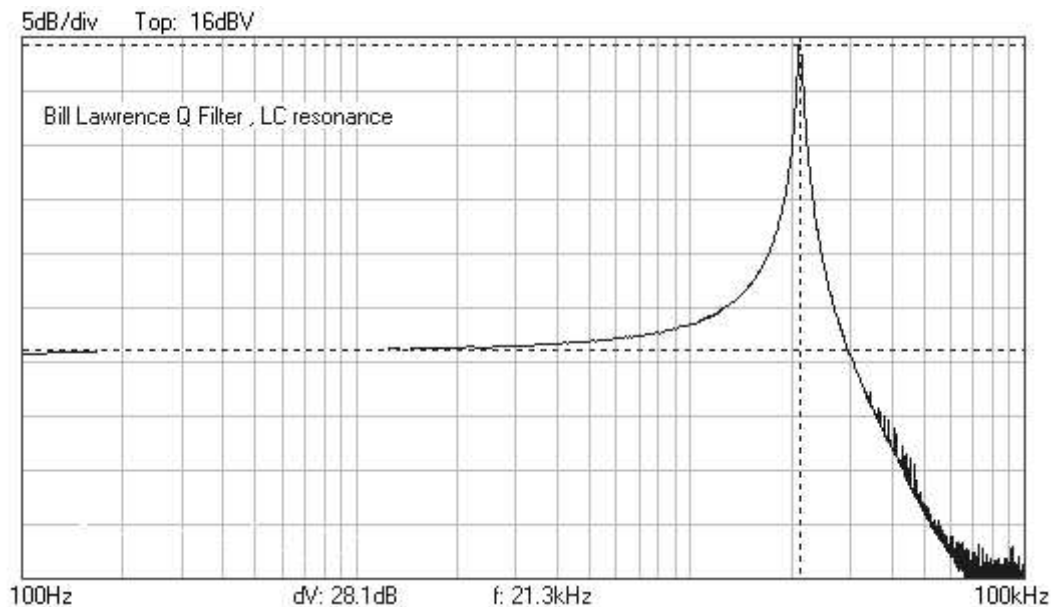


The curves are similar overall, although interestingly the full open resonance with the Q-Filter / inductor is much, much higher than the normal Q factor of the pickup as-is, which is almost completely flat. In this case the Q-Filter might cause the SH-1 to sound "muddy" throughout the sweep, becoming a lot more clear as you reach the bottom, but by the time you get to the bottom, there is also substantial drop in output.

The problem in this case is that the Q-Filter at 2 henries has only half the inductance of the SH-1 neck. If an inductor closer to 4 henries is used, the effects wouldn't be so dramatic, and it would likely be more usable. I notice that Wilde Pickups offers a 3 henry Q filter "for bass", so a person could just buy the bass version, and use that instead.

In general, if you were trying to use a parallel inductance to virtually "unwind" a pickup, you'd get the best result with an inductor that has an inductance which is close to that of the pickup. Since most "hot" pickups on the market, such as a JB, or an SSL-5, which you might want to "unwind" have inductance of well over 5 henries on average, a 2 henry Q Filter falls well short of that. You could make your own 5 henry inductor using the same basic parts, or just combine two or three Q Filters in parallel, though that multiplies the costs.

Here is an LC plot of the Q-Filter itself, which has a resonant peak of 12.3kHz, and a very high Q factor, which puts the intrinsic capacitance at about 26pF.

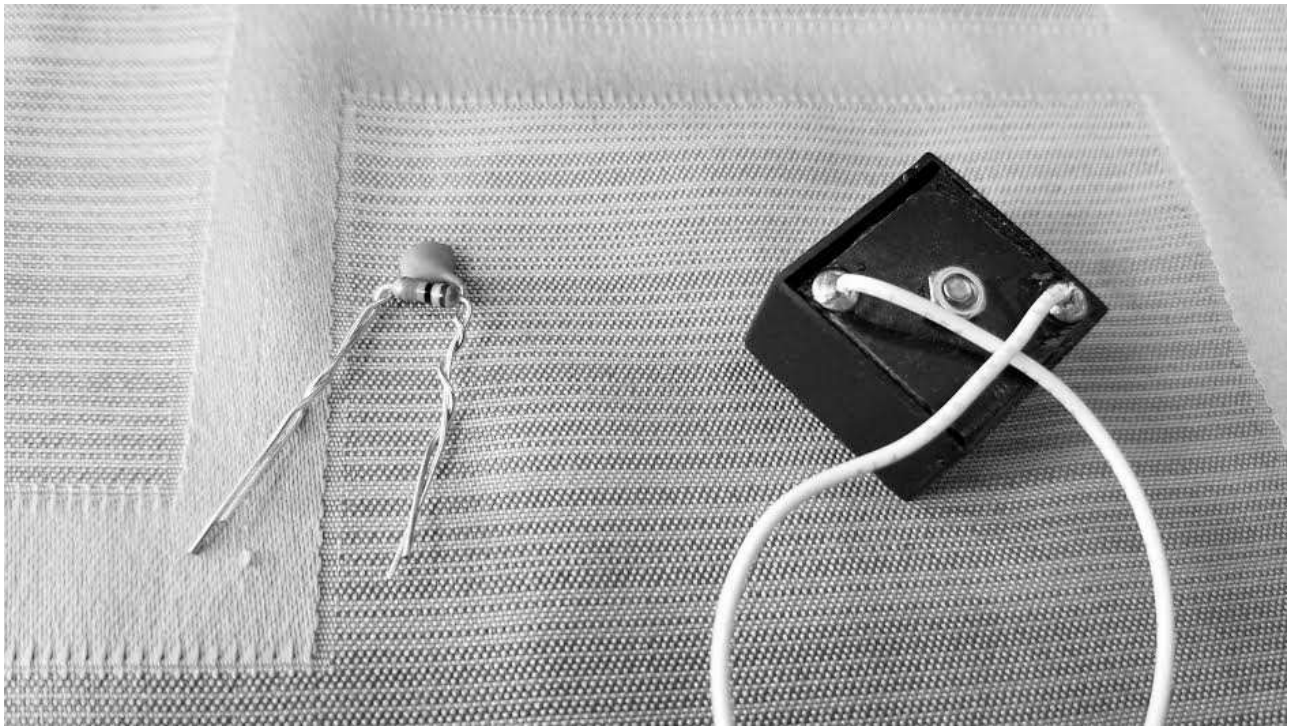


Wile Pickups sells the Q Filter for \$24, though they can be made at home for much less. Similar [ferrite pot cores with coil formers](#) cost about \$1-\$2 a piece on eBay, and supposing you use 38AWG magnet wire, the spool might cost \$10, but you'd have enough wire to create dozens of inductors.

If you just want one Q filter, it's easier to pay the \$24, but if you wanted to create several of them, or if you wanted to match the inductor value to the pickups, making them at home would be a good way to go. You can see from the picture below what a pot core inductor looks like. It appears that it only has two to three hundred turns of wire, so they would be quite a bit easier to produce than a guitar pickup. You could simply use a drill as your winder, or wind it by hand if your wrist can take it.

In lieu of a wind counter, you could check the DC resistance and use that a way to gauge how much wire you've put on the coil former, though you'd probably want an LCR meter, such as the DER EE DE-5000, so that you could determine the exact inductance values you've achieved.

Pics:



JohnH
Global
Moderator

★★★★★★
★★★★

Bill Lawrence Q-Filter, an analysis of... Reply #1 posted May.2, 2018 at 3:31am via mobile
Post by JohnH on May.2, 2018 at 3:31am

Interesting that these are within range of making a home-made version. When you analyse guitar circuits with added inductors, such as Varitone etc, it always seems like the most interesting tonal variations would come from having a few more Henries than that to dial in with a pot.



Premier
MasterMind!!

Posts: 5,882
Likes: 212



stratotarts
Wiring Expert
★★★★★



Bill Lawrence Q-Filter, an analysis of... Reply #2 posted May.2., 2018.at 8:47am
Post by stratotarts on May.2., 2018.at 8:47am
It would be interesting to see the curves with the treble bleed circuit in place.

Guacamole in my shoes.
Posts: 250♂
Likes: 17

antigua
Moderator
★★★★★
★★

Bill Lawrence Q-Filter, an analysis of... Reply #3 posted May.2., 2018.at 1:09pm
Post by antigua on May.2., 2018.at 1:09pm



May.2., 2018 at 8:47am stratotarts said:
It would be interesting to see the curves with the treble bleed circuit in place.

Posts: 1,355♂
Likes: 138
I used your integrator with the 200k ohms/470pF switch toggled on in order to show a "real life" end result, so the treble bleed would be across a volume pot voltage divider we're pretending is on "10", so the treble bleed would be out of circuit in this case. Do you mean assuming the volume were turned down to 5? We could model that with LTSpice, but I suspect you'd just sort of see a more aggressive low end roll off due to the combination of high pass filtering.

blademaster2
Wiring Expert
★★★★★

Bill Lawrence Q-Filter, an analysis of... Reply #4 posted May.2., 2018.at 4:34pm
Post by blademaster2 on May.2., 2018.at 4:34pm



I used a 1H inductor in the bridge tone circuits of all of my guitars. It definitely is more interesting sounding to me than capacitor tone circuits.

On my guitars if you use the neck pickup with its tone turned down all the way, and then mix in the bridge pup using the volume control with this gadget in place on the tone circuit (also turned down to low) it makes a pretty decent wah-wah sound.

Posts: 302♂
Likes: 37

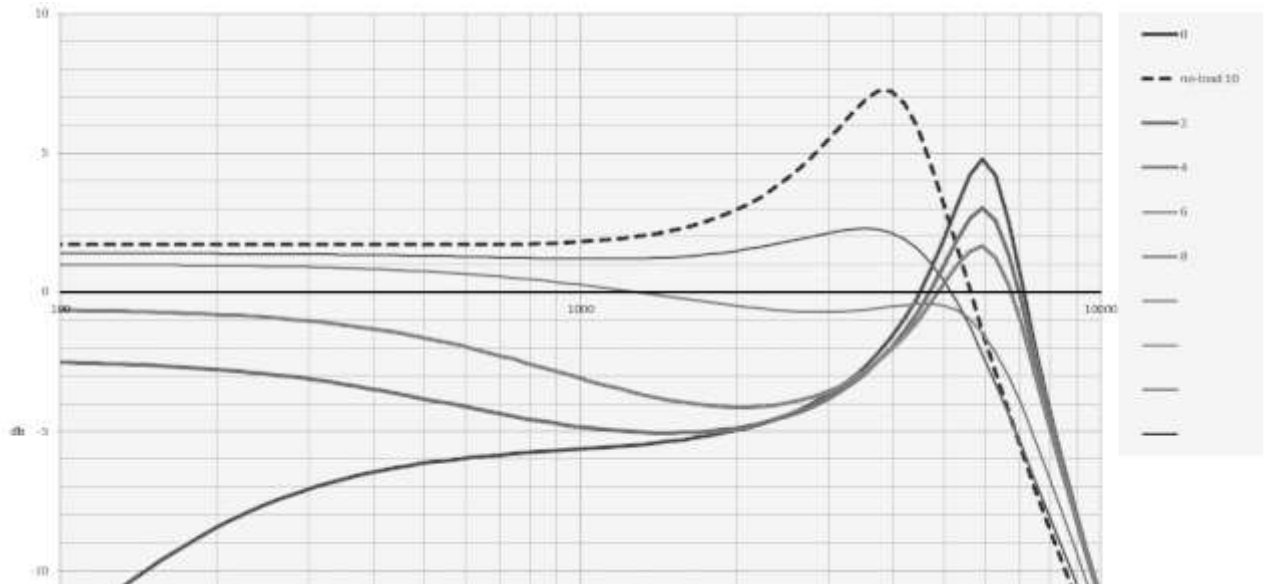
JohnH
Global Moderator
★★★★★
★★★★

Bill Lawrence Q-Filter, an analysis of... Reply #5 posted May.2., 2018.at 5:04pm antigua likes this
Post by JohnH on May.2., 2018.at 5:04pm

I tried modelling your SSL1 Q filter test with GF. It came out pretty close (as it should, since my model was based on your pickup!)



Premier
MasterMind!!
Posts: 5,882
Likes: 212



Some variation is due to the pot, where yours was with a real 250k tone pot and the model assumes a theoretical 250k with a bilinear taper with 10% at mid turn.

Also, my plots assumed no tone pot/Q filter at max, eg like no-load, since that matched the test better. Is that what you had?

Last Edit: May 2, 2018 at 5:08pm by JohnH

Bill Lawrence Q-Filter, an analysis of... Reply #6 posted May 3, 2018 at 12:06am

Post by antigua on May 3, 2018 at 12:06am

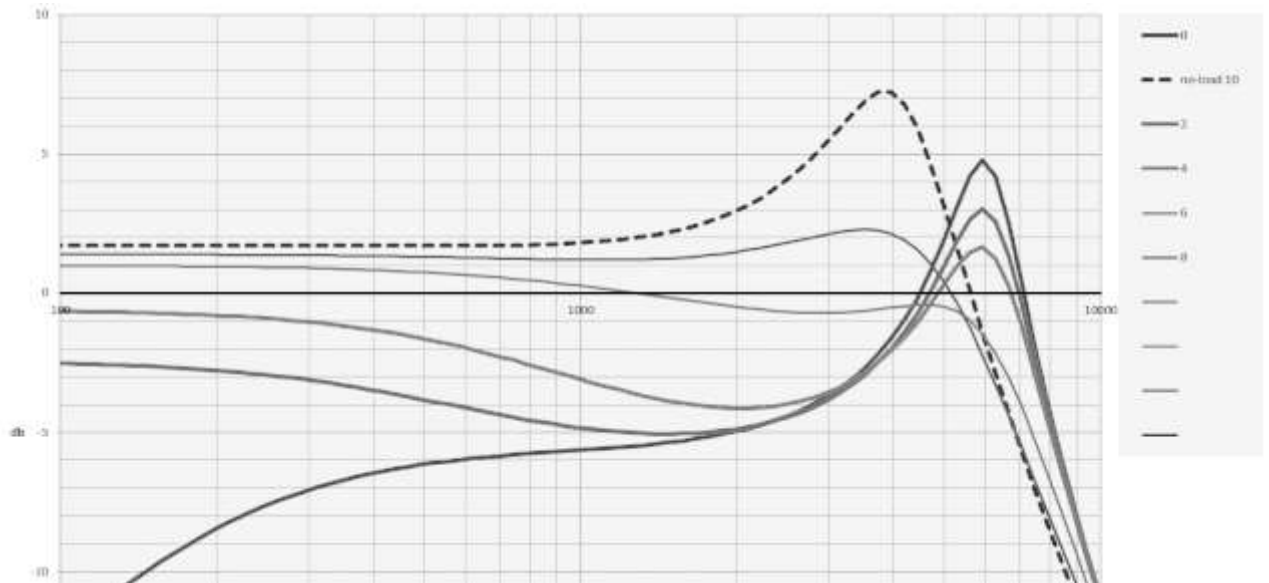
antigua
Moderator



May 2, 2018 at 5:04pm JohnH said:

I tried modelling your SSL1 Q filter test with GF. It came out pretty close (as it should, since my model was based on your pickup!)

Posts: 1,355
Likes: 138



Some variation is due to the pot, where yours was with a real 250k tone pot and the model assumes a theoretical 250k with a bilinear taper with 10% at mid turn.

Also, my plots assumed no tone pot/Q filter at max, eg like no-load, since that matched the test better. Is that what you had?

I was using a 250k audio taper pot, together with the 200k test load. What input impedance value do you use? I modeled it also with LTSpice and got a result similar to yours, but the practical plots looked nicer and were more realistic, but the good news is that it can be used as a means of selecting an ideal inductance value for a given selection of pots and pickups.

The inductance changed pretty readily just by loosening or tightening the retaining screw that holds the two pot cores together, so if you modeled curved differ, another thing to try is adjusting the Q filter's inductance value. 2.2H was measured with with screwed tightly, but if it was a little looser it could drop down in to the 1H range.

I ordered a few ferrite pot cores to make some of my own high inductance inductors. It's looks like a fun and easy undertaking.

Last Edit: ~~May.3, 2018 at 12:08am~~ by [antigua](#)

[JohnH](#)
Global
Moderator



[Bill Lawrence Q-Filter, an analysis of... Reply #7](#) posted ~~May.3, 2018 at 2:36am~~ via mobile
Post by JohnH on May.3, 2018 at 2:36am

I was trying to model the same as the test, with a 200k 470pF load, plus the Q filter through another 250k pot. I got the same peak frequencies and general shape, so I also agree that such models can help design with these gadgets.

Premier
MasterMind!!
Posts: 5,882
Likes: 212



[pj](#)
Apprentice
Shielder



[Bill Lawrence Q-Filter, an analysis of... Reply #8](#) posted ~~May.5, 2018 at 7:55pm~~ via mobile
Post by pj on May.5, 2018 at 7:55pm

I suspect the little cr network is the network that bill used to suggest for putting in series with the coil to limit the severity of the cut by the Q filter, in much the same way as the 100k resistor in the Gibson Vari tone. I've got a copy of the paperwork somewhere I'll try and find it and upload. Bills preferred treble bleed values were 330pf and 80k if I remember correctly.

I also have a Kent Armstrong Tone Choke which I suspect is much the same thing though it is potted.

Posts: 48
Likes: 5

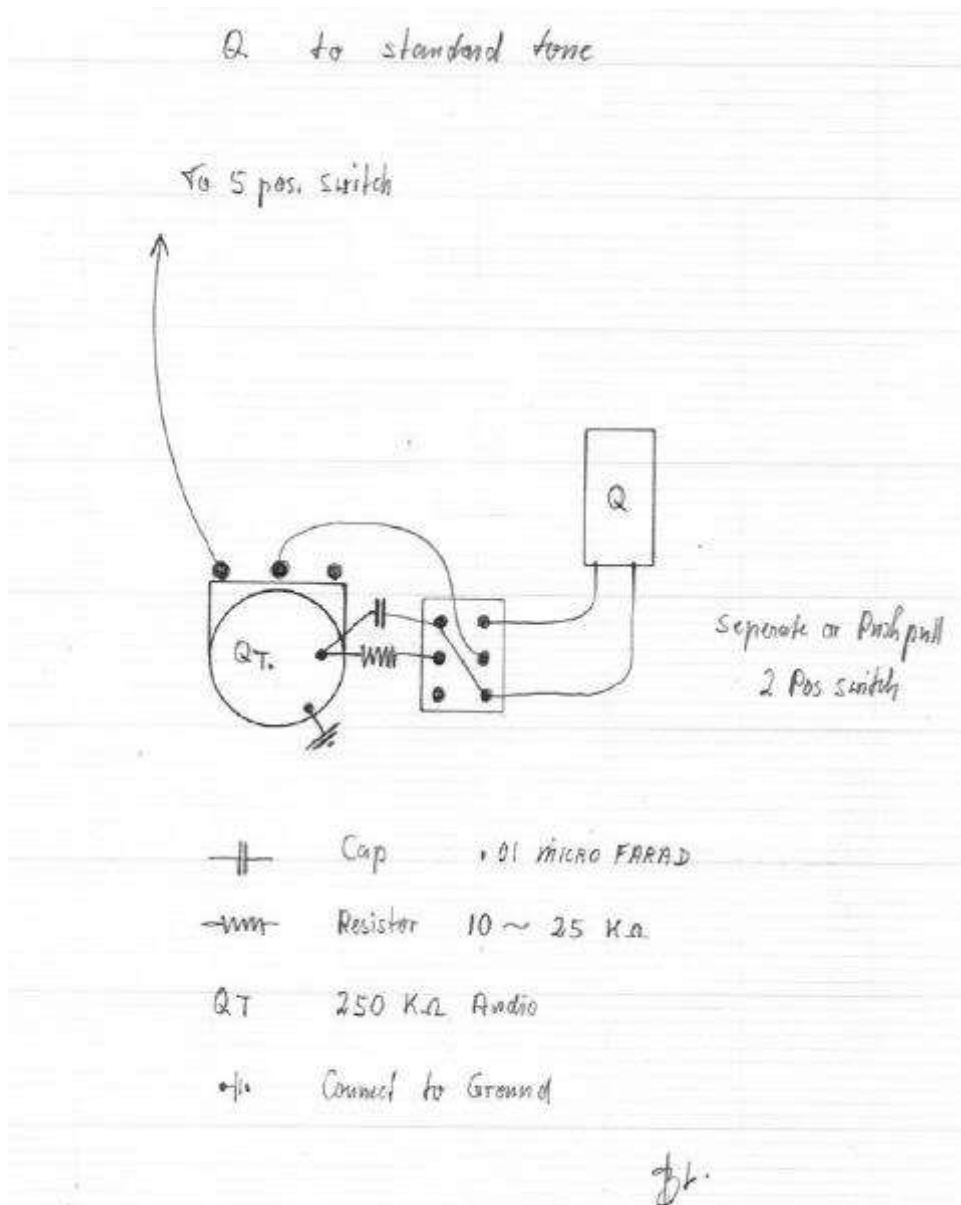
Last Edit: ~~May.6, 2018 at 3:16am~~ by [pj](#)

[Bill Lawrence Q-Filter, an analysis of... Reply #9](#) posted ~~May.5, 2018 at 8:13pm~~
Post by pj on May.5, 2018 at 8:13pm





Posts: 48
Likes: 5



antigua
Moderator



Bill Lawrence Q-Filter, an analysis of... Reply #10 posted May 6, 2018 at 12:05pm pj likes this
Post by antigua on May 6, 2018 at 12:05pm

May 5, 2018 at 8:13pm pj said:

Posts: 1,355
Likes: 138

I suspect the little cr network is the network that bill used to suggest for putting in series with the coil to limit the severity of the cut by the Q filter, in much the same way as the 100k resistor in the Gibson Vari tone. I've got a copy of the paperwork somewhere I'll try and find it and upload. Bills preferred treble bleed values were 330pf and 80k if I remember correctly.

I also have a Kent Armstrong Tone Choke which I suspect is much the same thing though it is potted.

That's interesting. I'll model that up and see what pops out.

Note that you're missing a connection on the DP/DT from bottom left to top right.

I think the general idea of allowing the Q filter to swap with a typical cap by way of push pull is a good mod. I think it could even be pre-fabricated and sold to guitarists who want bass and treble tone control functionality, without having to source a choke or Q filter and follow wiring diagrams.

Last Edit: May.6, 2018 at 12:40pm by [antigua](#)

pj
Apprentice
Shielder
☆☆

[Bill Lawrence Q-Filter, an analysis of... Reply #11](#) posted May.6, 2018 at 12:34pm via mobile
Post by pj on May.6, 2018 at 12:34pm

Yes that would be useful for people who don't want to get too involved.



That's as the diagram came from Bill/Becky.

There's also another one I'll load.

The way its connected on the diagram makes for a tone in one position with the coil disconnected and then brings the coil and resistor in the other position.

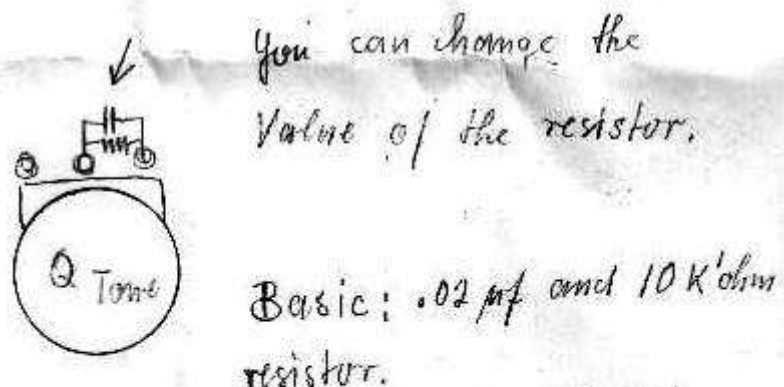
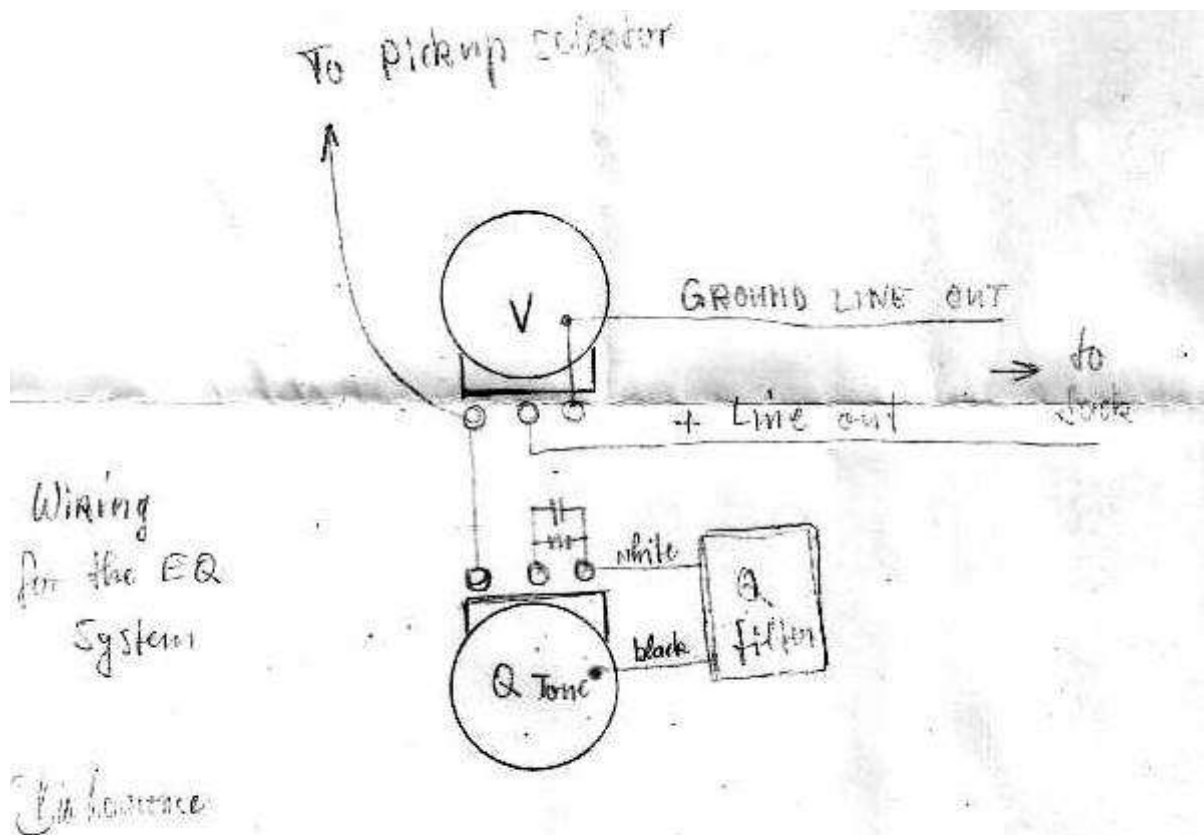
Posts: 48
Likes: 5

I'll see if I can find the other diagram he sent and try and get lucky with the image uploader again.
Cheers

pj
Apprentice Shielder☆☆
[Bill Lawrence Q-Filter, an analysis of... Reply #12](#) posted May.6, 2018 at 12:38pm
Post by pj on May.6, 2018 at 12:38pm



Posts: 48
Likes: 5



for Neck P'np you may try a 5 K Ω Resistor,
for Bridge P'np you may try a 25 K Ω Resistor.

antigua
Moderator



Bill Lawrence Q-Filter, an analysis of... Reply #13 posted May.6, 2018.at.12:52pm pj likes this
Post by antigua on May.6, 2018.at.12:52pm
[oops... brb]

Posts: 1,355
Likes: 138

Last Edit: May.6, 2018.at.1:00pm by antigua

pj
Apprentice
Shielder

Bill Lawrence Q-Filter, an analysis of... Reply #14 posted May.6, 2018.at.12:57pm
Post by pj on May.6, 2018.at.12:57pm

Perhaps it's as much to stop the cap popping. I found less resistance was better think I went with 10k and 22n



Posts: 48
Likes: 5

antigua
Moderator

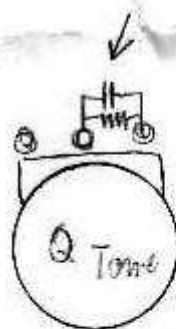
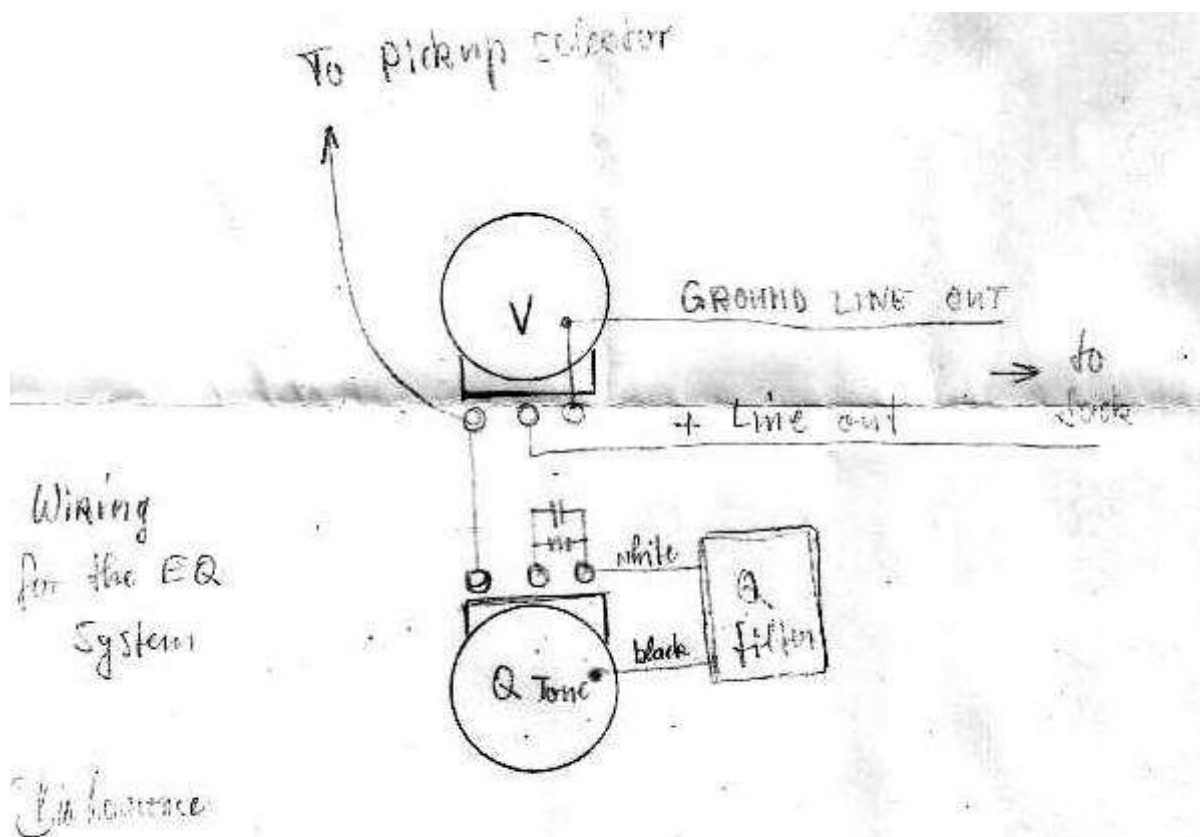


Bill Lawrence Q-Filter, an analysis of... Reply #15 posted May 6, 2018 at 2:06pm
Post by antigua on May 6, 2018 at 2:06pm



Posts: 1,355♂
Likes: 138

May 6, 2018 at 12:38pm pj said:

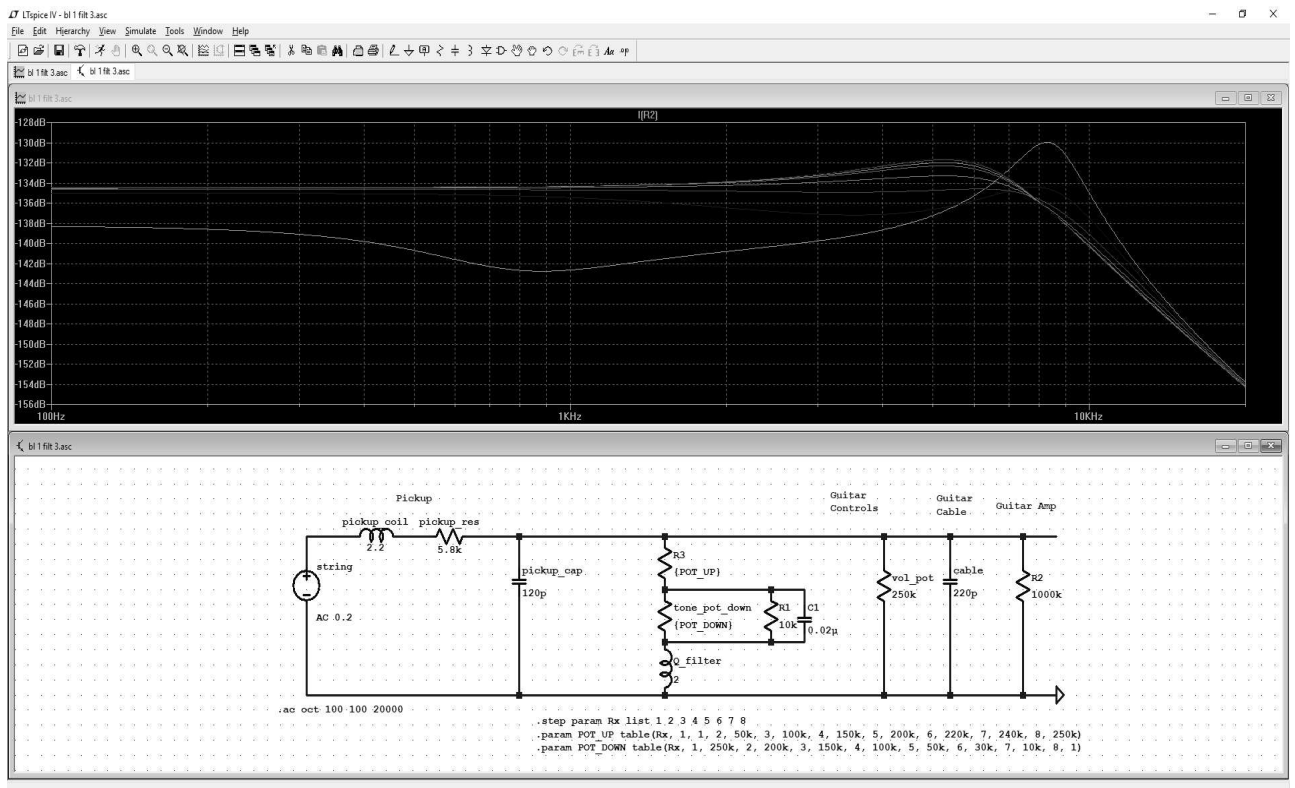


You can change the value of the resistor.

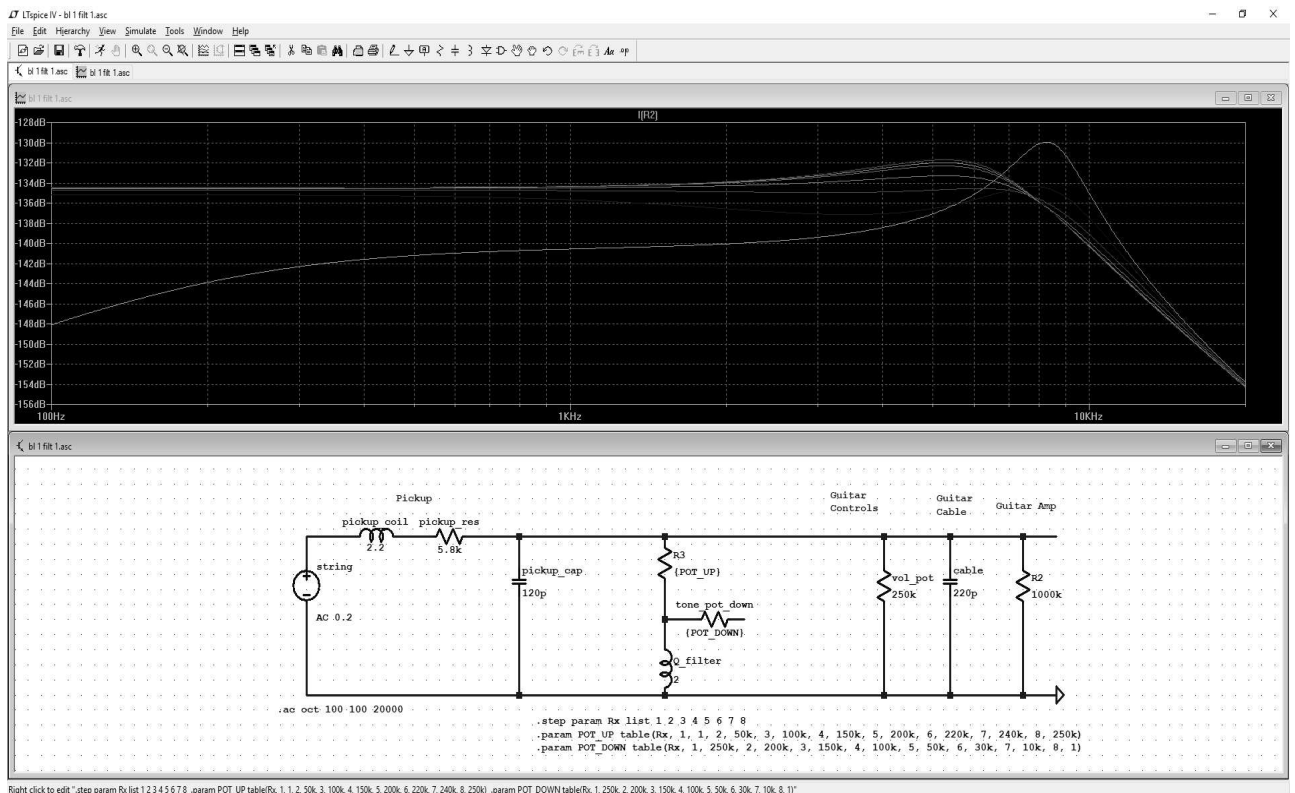
Basic: .02 μ F and 10 K Ω resistor.

for Neck P'np you may try a 5 K Ω Resistor,
for Bridge P'np you may try a 25 K Ω Resistor.

Here is a tone control wired as depicted, and 250k pot with a 0.02 μ F C and 10k R in parallel across the center and right lugs, with the left lug connected to hot, and the right lug connected to the inductor and then to ground:

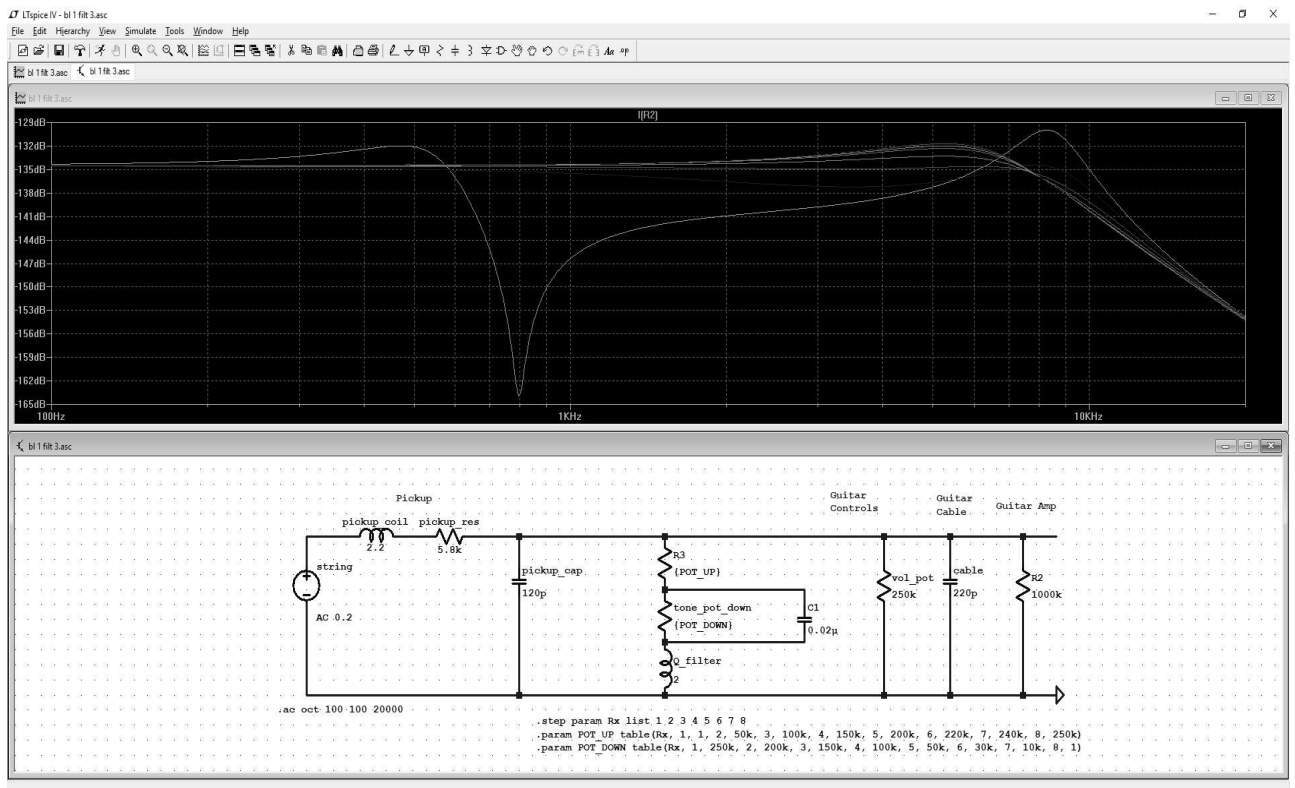


And here is a typical tone control with and inductor in place of a cap. The other side of the pot's resistance is left open.

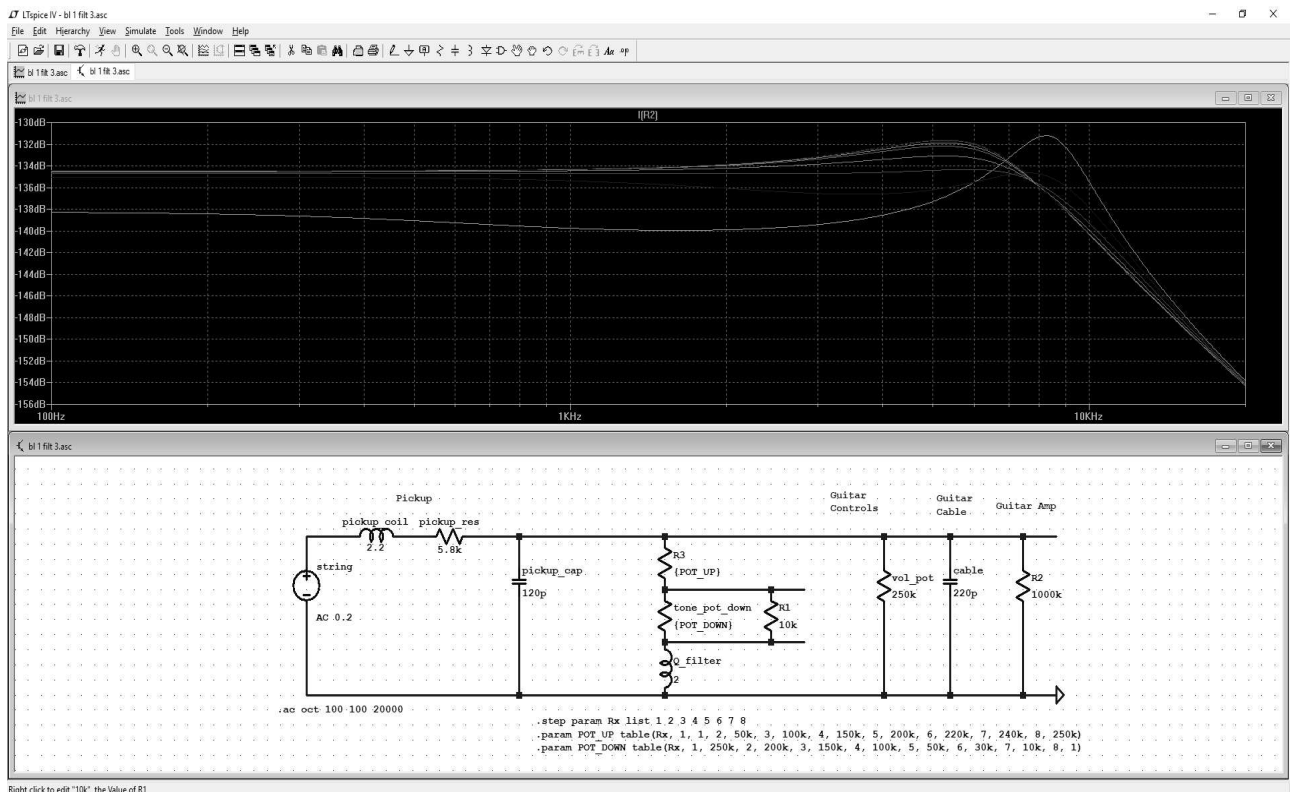


So it does appear that the wiring that includes the cap and resistor pair help to retain some low end, compared to wiring it like a normal cap.

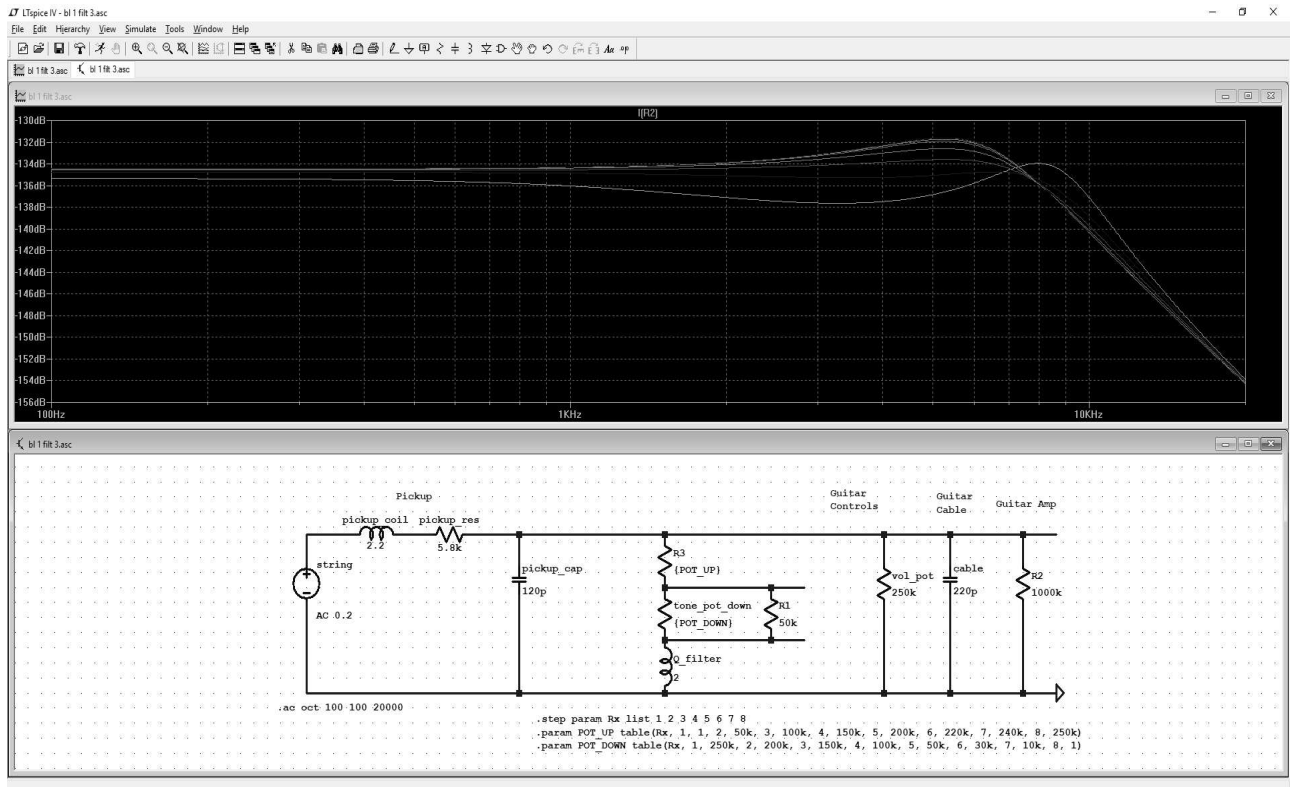
If the resistor is removed, leaving only the cap, there is an interesting band stop around 800Hz, similar to a Veritone circuit:



If the cap is removed, leaving only the resistor across the center and right lugs, then the circuit is similar to simply putting a resistor in series with the tone control itself. It appears the low end is not attenuated as dramatically if the real resistance of the tone control never reaches zero:



If the resistor is set to a higher value of 50k, more low end is retained and the Q remains flatter. A trim pot might be helpful for getting a perfect balance of increasing treble without gutting the low end.



pj
Apprentice
Shielder



Posts: 48
Likes: 5

[Bill Lawrence Q-Filter, an analysis of...](#) Reply #16 posted May.7.,2018.at.6:56am via mobile
Post by pj on May.7.,2018.at.6:56am

Thank you for going to those lengths. Seeing the bode plots and models makes me wonder whether I wouldn't have been better fiddling a bit longer and trying smaller cap values that would intersect the inductors slope a little further up, leaving the resistor out for a higher Q. Working on the half the cap twice the frequency principle, it would be quite easy to put a notch in the mids similar to that created by the Fender tone stack. A great option for those with champ-like simple valve combos to have a less in-your-face rhythm tone.

Thanks again for your exploration and effort.

antigua
Moderator



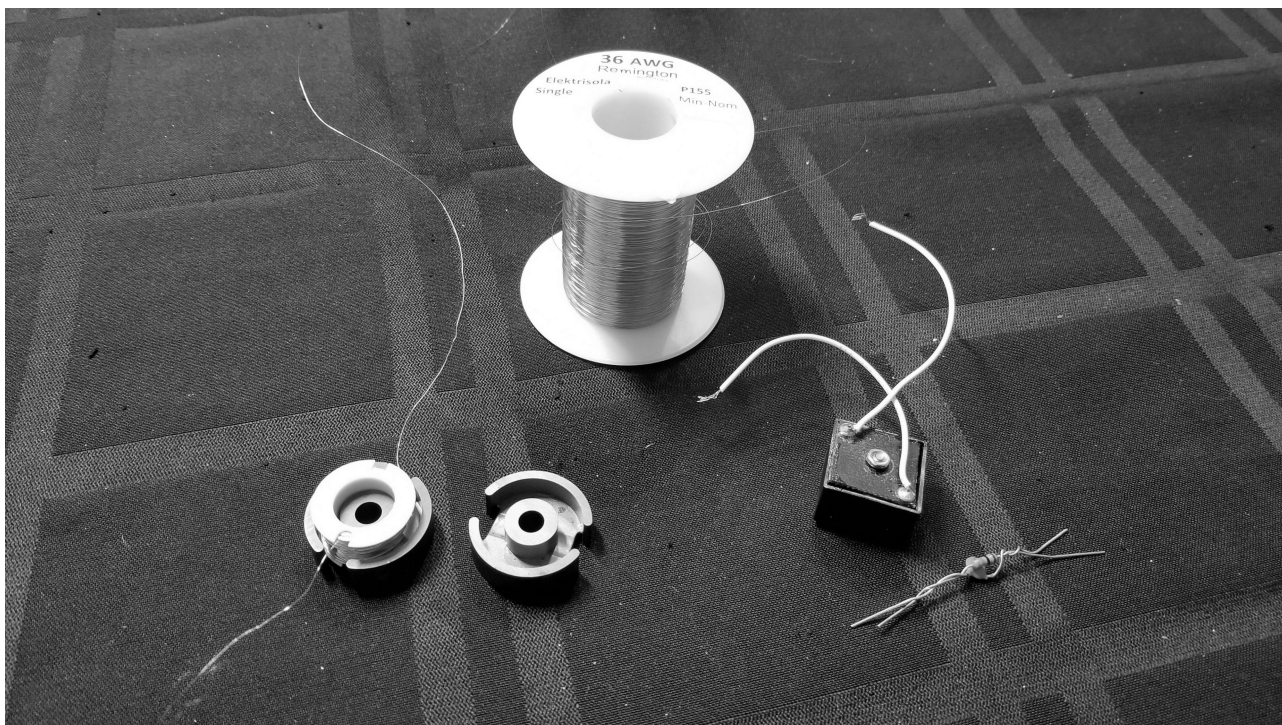
Posts: 1,355
Likes: 138

[Bill Lawrence Q-Filter, an analysis of...](#) Reply #17 posted Mar.24.,2019.at.6:42pm
Post by antigua on Mar.24.,2019.at.6:42pm

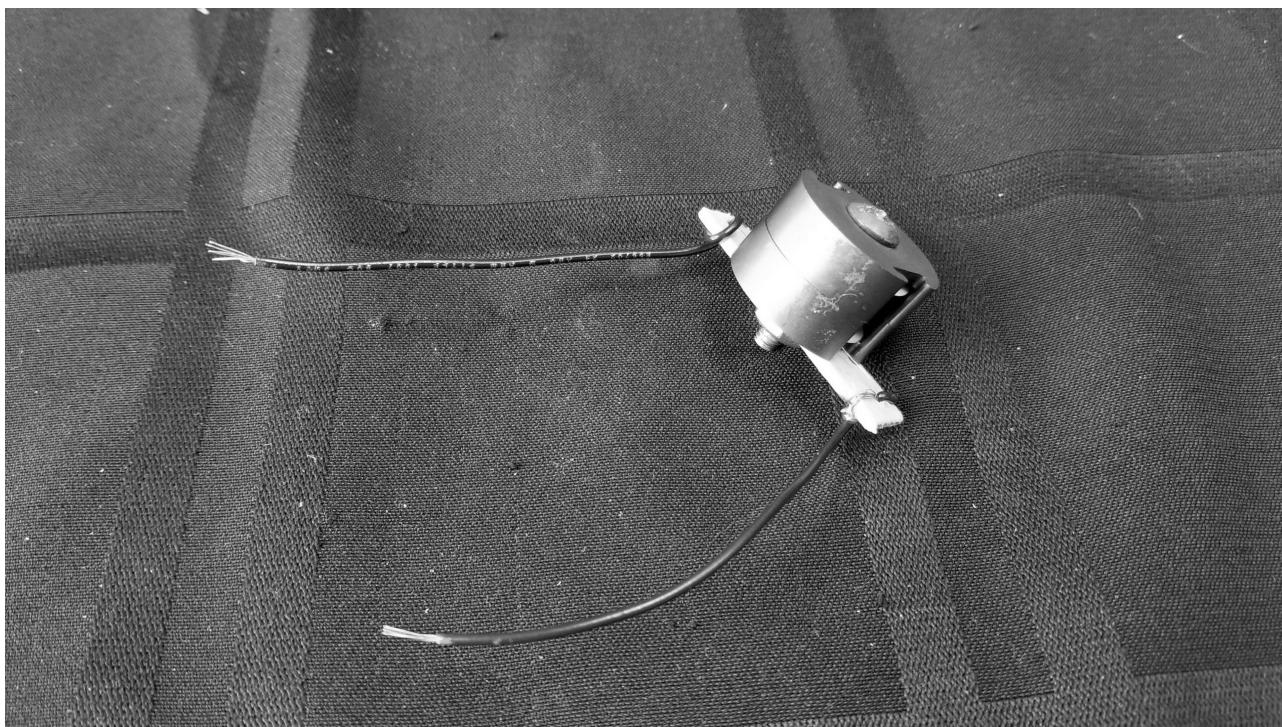
Even though I have a Q Filter on hand, I was interested in just trying to make one, so I bought some pot cores and magnet wire and wound the bobbin up with a drill. Since the drill didn't have a turn counter, I don't know how many turns of wire it took, but I found that I pretty much needed to fill the bobbin up in order to get past 2 henries, and I guess that after about three to four hundred turns it was maxed out, and the final inductance was around 3 henries.

The Q Filter currently costs about \$34, and all said and done, the parts needed to make my own cost about that much, but I have enough parts to make a total of five inductor / Q Filters, and plenty of wire to spare.

pot core on the left, Bill Lawrence Q Filter on the right:



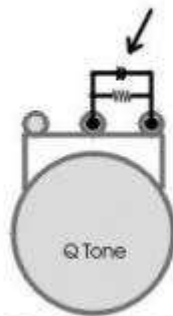
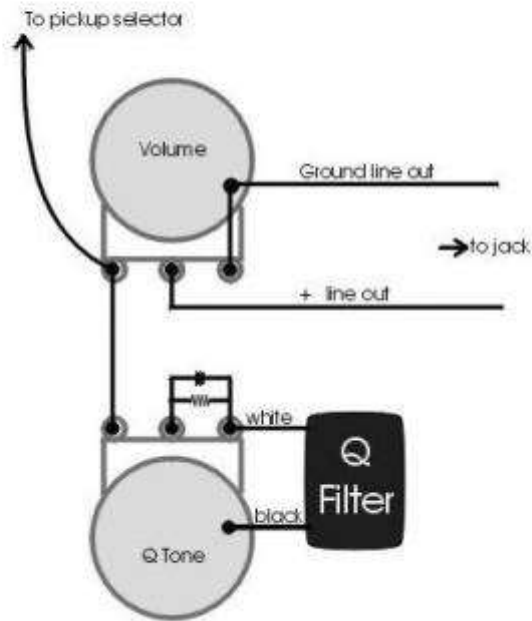
Put together, using a Popsicle stick with some drilled holes as a means to join the tiny magnet wire with the much thicker hookup wire:



The Q Filter wiring scheme suggests that the tone control also incorporate a cap and a resistor on the control pot, so that once the tone control reaches the minimum, the cap and resistor are in series with the inductor / "Q filter", which yields an outcome similar to a Gibson Veritone control.

Wiring for the EQ System

By Bill Lawrence

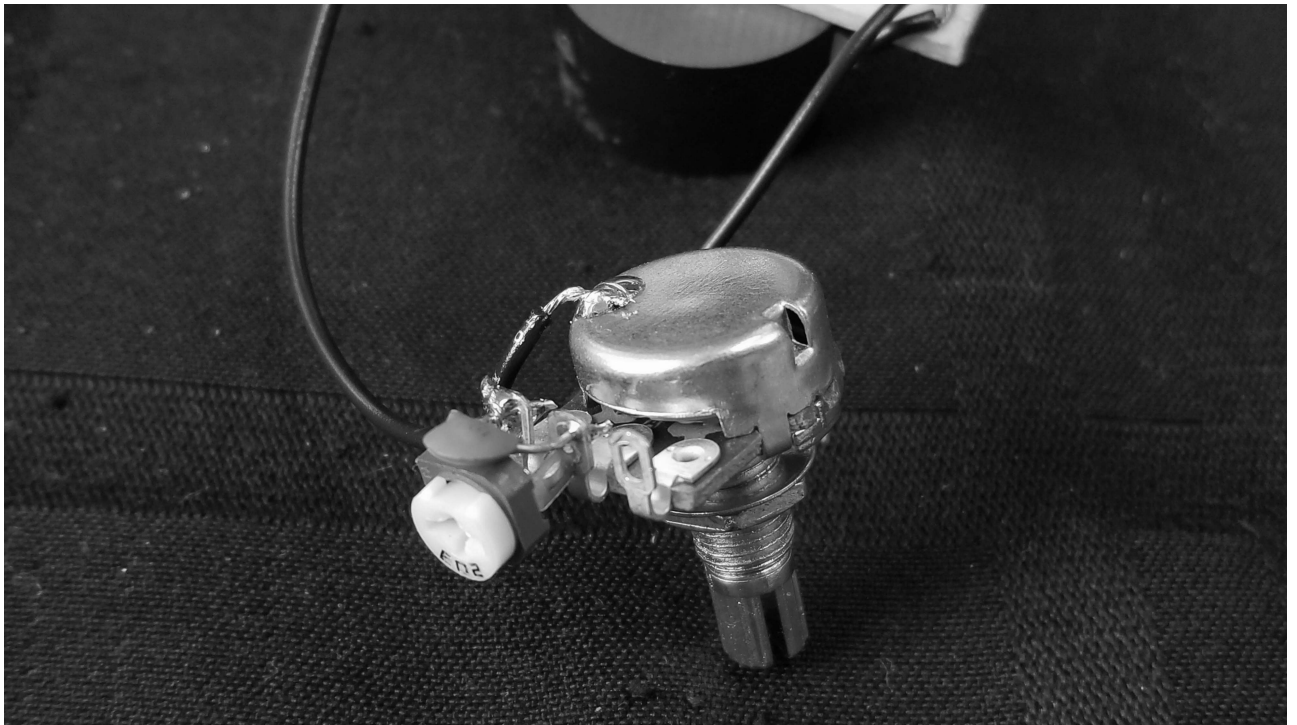


You can change the value of the resistor.

Basic: .02 uf and 10 kOhm resistor

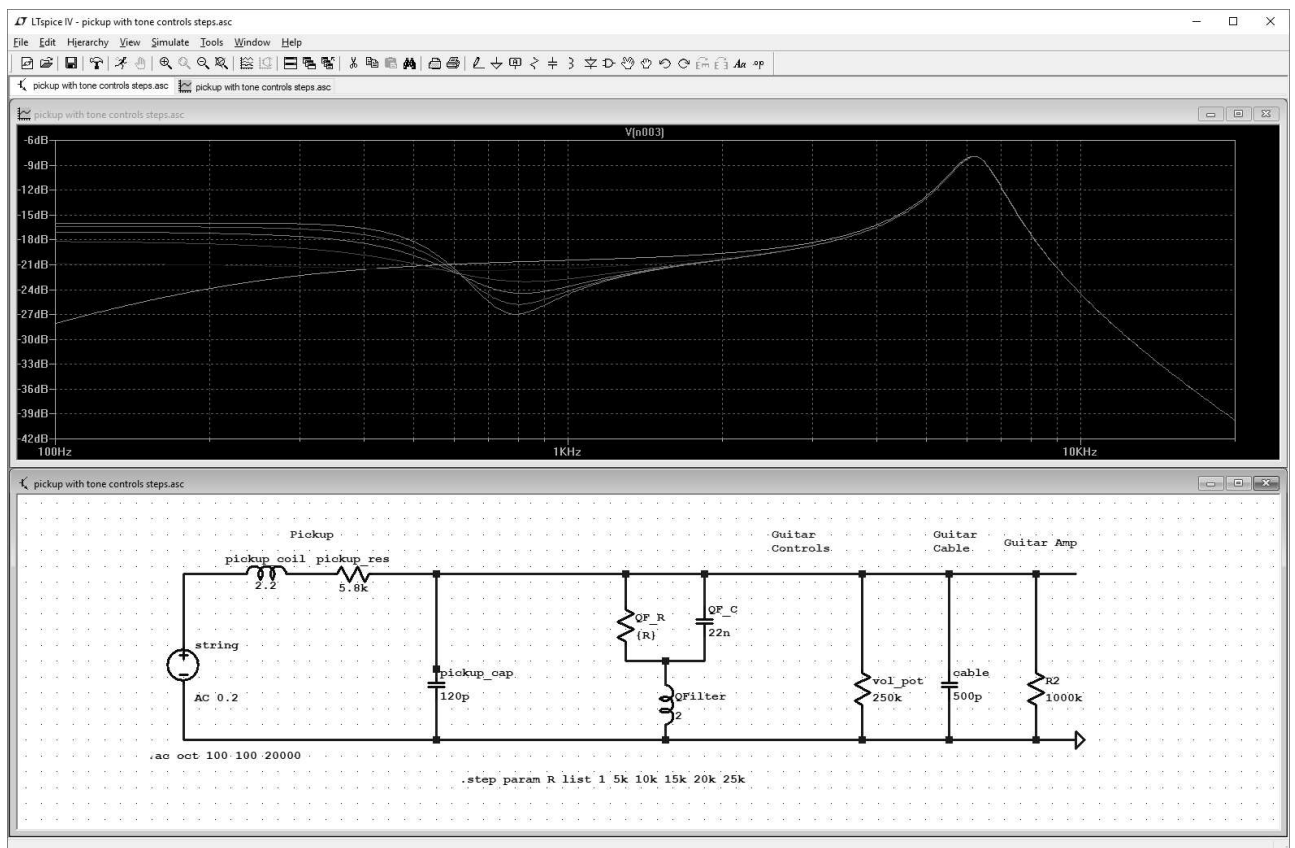
For Neck p'up you may try a 5 kOhm resistor
For Bridge p'up you may try a 25 kOhm resistor

As you can see the schematic recommends several different resistances, to taste, so I used a 20k trim pot instead:



What I found testing by ear is that the bass response increases as the resistance is increased.

I made an LTSpice model to get a more exact idea of what has happening:



The bright green line represents near zero resistance (bass drops off sharply), and the lines that rise above the green lines represent increasing degrees of resistance, up to 25k ohms (bass increases, mids decrease).

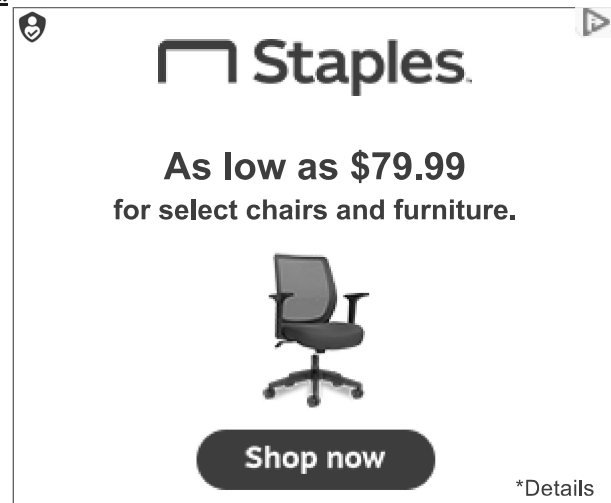
Where as a Veritone toggles between caps in order to move the mid scoop frequency, the capacitance value is fixed in this case, so the variable resistance serves to alter the amplitude of the bass and the mid scoop. If you were to replace the 0.02uF cap with a smaller value, the mid scoop increases in frequency, while a larger value cap decreases the frequency where the mid scoop occurs.

I settled at about 10k, to get some bass roll off, but not a complete bottom-out, as you can see happens with the bright green line. If you go for the full 25k, there is virtually no bass roll off at all, and you're left with a tone control that slightly scoops the mids while pushing the resonant frequency upwards by about 1 to 2kHz. If you're the type of person who hates a tone control that takes away bass, you might like the Q filter with a 25k resistor, but if you're buying/making a Q filter in order to get a counterpoint to the stock tone control, 10k seems like a good choice.

With a bright Fender neck pickup, the Q filter with 10k resistance almost produces sound like an acoustic guitar. It's easily more convincing than a piezo in a Strat, so if you're interested in piezo pickups for Strat, I'd definitely suggest this as an alternative. Here's a demo someone made with a Tele, you can see what I mean:

[MEDIA=youtube]YnSX1Fyy7Oc[/MEDIA]

Last Edit: Mar. 24, 2019 at 6:44pm by [antigua](#)



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