What Does This Thing Do? -- Filter Capacitors

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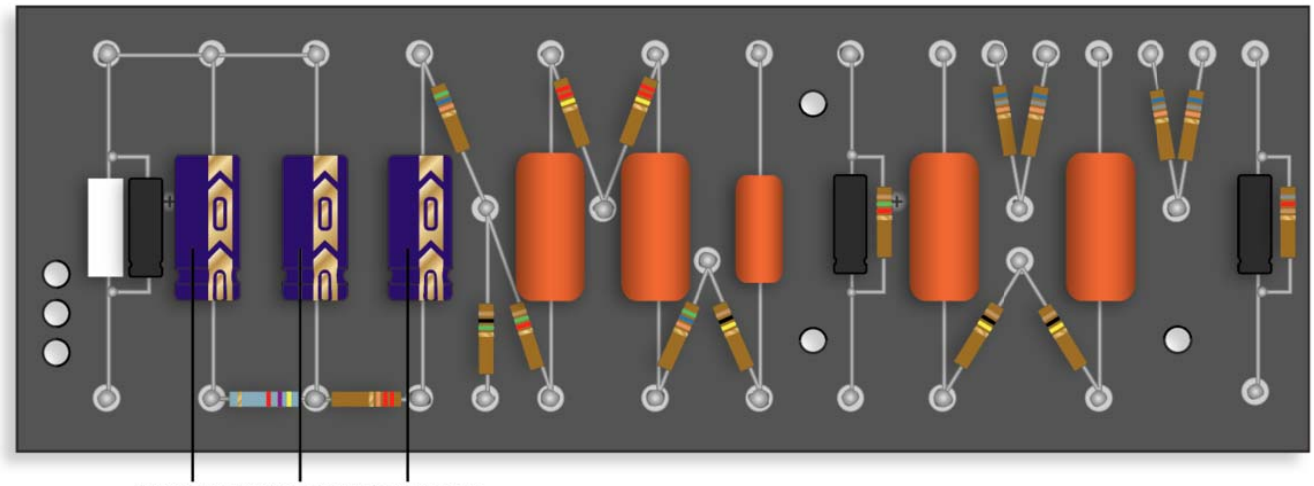
There Are A Lot Of Enigmatic Components Within Any Guitar Amp...

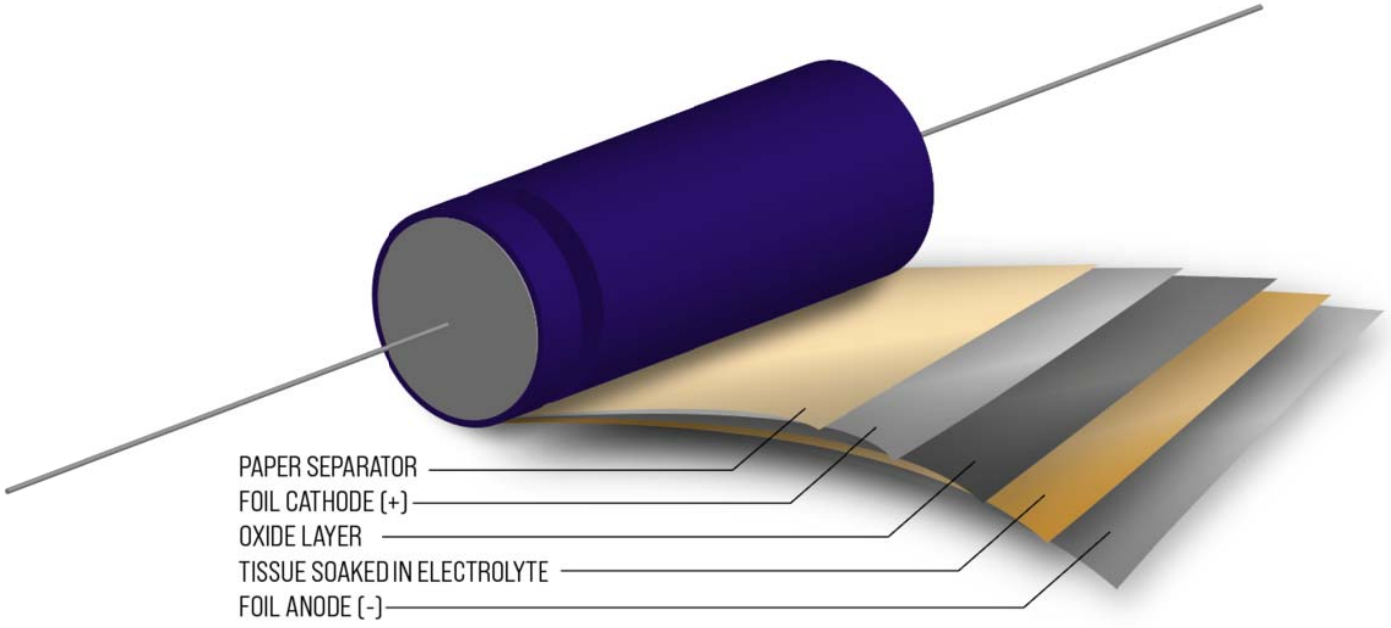
...many of which remain mysterious even to hobbyists who have built a DIY project or two. In the first part of Mojotone's new series What Does This Thing Do? we're taking a look at the filter capacitors, those chunky, cylindrical things that either lie bunked in a row inside the chassis near the power transformer, under a "cap can" on the underside of the chassis of larger Fender black- and silver-panel amps, or protruding from the top side of many Marshall-style amp chassis like stubby, permanent metal tubes.



FILTER CAPS ON A 5E3 CIRCUIT BOARD.

Filter Capacitors, Or "Caps" For Short, Are More Formally Known As Electrolytic Capacitors.

The name is derived from the fact that they are filled with an electrolyte—often in the form of paper soaked in electrolytic gel or liquid—which separates the component's positive and negative plates. In simple terms, electrolytic capacitors filter excess electronic noise from your guitar amp's electrical supply (hence the "filter cap" nickname) to reduce noise in its output. At the same time, this task also helps to determine the firmness of the amp's low-end, and to influence the overall tightness and immediacy of its playing response. It's worth noting that filter caps do these things even though they are placed in the amp's power supply, and your guitar signal never passes through them on its journey from input to output.



Like A Lot Of Things Happening Simultaneously Within Any Tube Amp, The Way In Which Filter Caps Do This Trick Is Both Rather Simple And Quite Ingenious.

The micro of “what it does”: this capacitor takes noise-inducing ripple out of a DC electrical current that passes through it from positive to negative via that electrolytic layer mentioned above, and stores it for safekeeping, while passing the “cleaner” DC current along to the next component in line. The macro of that results not only in a quieter amp, but more efficient performance from the output tubes in particular, which enhances the muscularity of the amp’s bass reproduction.

Guitar amps use several large filter capacitors to get this power-conditioning job done properly. Even smaller amps tend to use at least three, arrayed side-by-side in stages to filter the supply at points where the DC is passed along to the output transformer, the output tubes, and the preamp tubes, respectively. Larger amps might have twice as many filter caps, or more.
In the case of individual filter caps, size does matter. Those of larger value (which usually means larger size, too) are not only more efficient at reducing electrical noise, but usually serve to tighten up low-end performance proportionally, too. That being said, you can’t simply load the largest filter caps available into any given amplifier. Some smaller tube amps, and particularly those using lower-rated 5Y3 rectifier tubes, don’t perform well with electrolytic caps beyond a certain value (most data sheets indicate a maximum of 20µF, though different conditions can sometimes work with slightly higher values). Smaller electrolytics might also contribute to the traditional feel of some vintage-style amps, so it’s usually best to stick with the specs and/or schematics for any amp you’re building or working on.

One thing you’ll probably have noticed if you’ve built any amp kits already, checked out common schematics, or even observed these filter capacitors up

close, is that they have a polarity, with a “+” indicated at one end and a “–“ at the other. This is because they are directional in the way they’re connected in the circuit: the positive terminal (anode) connects to the power supply, and the negative terminal (cathode) connects to ground.

Electrolytic Capacitors Definitely Have A Limited Lifespan, Which Tends To Be Around 15 To 20 Years In Most Cases.

They might keep functioning just fine after this point, but also might fail at any time. Indications of one or more failing caps are often hears as excessive noise or a softer and “flubbier” low end than an amp of that type should produce, and proper diagnosis of this component failure—and safe replacement—is usually a job for an experienced tech.

The way in which they do their job also means that electrolytic capacitors retain a static electric charge, which can result in several hundred volts being stored within them for extended periods of time, even when the amp is switched off and unplugged. For that reason, you should never work inside the chassis of a tube amp—even one that is switched off and unplugged from the wall’s AC receptacle—without fully understanding how to safely discharge these components before contacting anything inside the amp (be aware that they are often passing this high-voltage charge along to other points within the circuit, too, so simply “not touching the caps” won’t keep you safe).

Before concluding, it’s also worth mentioning that you’ll find electrolytic capacitors doing other jobs within a tube-amp’s circuit, most commonly as smaller 25µF/25V (on average) units being used as cathode-bypass

capacitors connected around the resistors used to bias preamp tubes, and occasionally output tubes in cathode-bypassed circuits. These filter caps are not being used for their noise reducing capabilities, but are found in these positions because polarized electrolytic capacitors are physically smaller than coupling capacitors (aka tone caps) of the same value, making them an easier fit in those parts of the circuit.

#TECH AMP TUBE AMP CAPACITOR FILTER CAP

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