Session's 'RetroTone' Power Amp

The 'RetroTone™' power amp design is at the heart of all post 2013 SESSION® solid state guitar amp. It enables them to perform and sound just like a vintage tube amp.

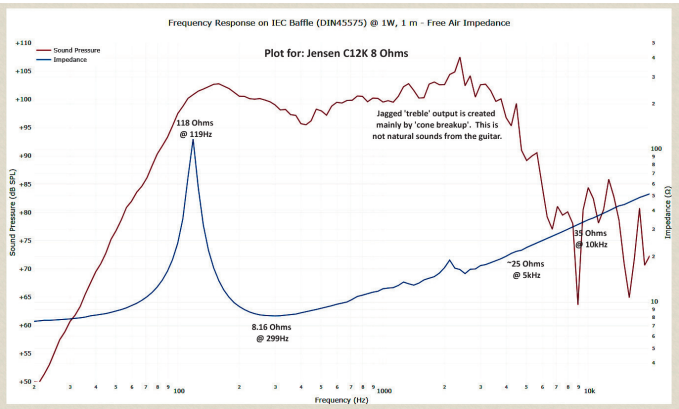
"I've heard it all before!" we hear. But to dismiss it without first hearing its benefits could be a rather foolish reaction. It would deny any guitarist of an amplifier that does provide what most players truly want... great classic tube amp equivalent tone, for less money, with lighter weight, far better reliability and without having to replace tubes every other year! RetroTone™ creates an amplifier that does everything a tube amp does… but without the hassle and costs associated with tube amps!

RetroTone™ works like this. It enables the speaker's vibrating cone to add mechanically created harmonically rich overtones that ONLY the speaker's cone can produce. To do this, the amplifier must usually be equipped with an output transformer… so that means a tube amplifier. SESSION® solid state amps have RetroTone™ circuitry which enables this same result!

What are the benefits? Well, you hear it all the time in a valve amp... or to be more accurate, an amplifier with an output transformer. The affects on the tone would still be heard if transistors were driving the output transformer! So, it's not the output valves that bring this 'tonal affect', it's a unique partnership between the transformer and speaker that's responsible.

For example... with most valve amps, you often hear a huge increase in output when you play open low E on your guitar. This is due to the speaker's natural cone resonance at between 70-120Hz. And with nearly all old transistor amps, this speaker effect is heavily suppressed by its low output impedance of the power amp's design. Making it sound cold and 'middle-y'... lacking sparkle or 'chime'.

Now, with the addition of RetroTone™, the same mechanical harmonics are naturally created by the speaker's cone. RetroTone™ mimics exactly what happens naturally in an amplifier equipped with an output transformer, warming the amp's tone and giving it that tube amp chime!



In fact, what's going on is rather similar to what happens when you excite the membrane in a kazoo by singing into it… as extreme as that comparison may seem! But, with a guitar speaker, the distorted waveform coming from the guitar amp 'excites' the speaker's thin paper cone into what is called 'cone breakup modes'. The cone buckles and twists and in doing so, produces lots of extra harmonics mechanically and are heard along with the guitar sound! Don't worry, clever speaker engineers have designed them to do this intentionally to make guitars sound more exciting, so that's nothing new!

In this document, SESSION® is explaining how solid state amps can be made differently to create the 'tone of the past' by using modern high reliability technology to exploit these 'naughty but exceedingly nice' speaker characteristics.

Because of rudimentary early designs and their resultant poor public perception, solid state amps have gained a bad reputation for tone quality and, resultantly, have been produced only as cheap beginner amplifiers… thereby strengthening guitar player's dislike of them.

So, in order to get a solid state amp to have the same characteristic tone of a tube amp, then the solid state amp must be able to replicate the unique process of the output transformer and speaker working together… and RetroTone™ does that perfectly.

To help you understand, below left is a plot for the **Jensen** 100W **C12K** 8 Ohm speaker as employed in the Fender 22W 'Deluxe Reverb' tube amplifier. That amp is said to be loud, warm and with a nice sparkle to its tone. With that same speaker installed into one of our RetroTone™ equipped 22W solid state amps, we can replicate that exact tone!

The C12K has two plots and both are important. The RED plot shows the output of the speaker. This gives us an indication of how loud the speaker will be at any given frequency. So, we can compare it with plots of other speakers to help us decide if it will be a bright or mellow speaker. Or even a dark and bass-y sounding speaker.

The BLUE plot shows the impedance of the speaker relative to the frequency of the signal that it's receiving from the amplifier. This shows that the speaker does NOT have a constant impedance. In truth, the power of most amplifiers is quoted into what is called the speaker's 'nominal' impedance… in this case approximately 8 Ohms. Nominal, because the speaker does NOT have a constant impedance.

As you can see from the BLUE plot, its impedance varies considerably with frequency. So, to work out the power at any point, we have to use a simple calculation which involves the 'output voltage' from the amplifier and the speaker's 'impedance'.

You can also see a huge spike at 119Hz where the speaker's impedance rises to 118 Ohms. At this point, the speaker's cone is at resonance. This resonance produces huge output for a relatively small amount of input power to the speaker… and this is where a tube amplifier's 'warmth' comes from. Actually, nothing to do with the properties of valves as claimed.

Usually exclusive to a tube amp, the AC voltage that drives the speaker will vary in amplitude according to the frequency of the signal. This variance is controlled by the speaker's varying impedance. So, to cut a long explanation short, the impedance inside the output transformer creates a situation where the voltage driving the speaker is allowed to rise when the speaker's impedance rises. This helps to maintain 'constant current' through the speaker and produces equal output power at all frequencies.

However, with most of the 'old' or 'cheap' solid state amp designs, those which guitarists hate and have earned solid state a bad reputation, the output voltage does not vary and this leads us to a sound quality where players say that the tone is cold or lacks sparkle and warmth. Here's the proof...

Calculating the power of a 'cheap' 100W solid state amplifier - Constant Voltage Drive

At 100W, the amp would produce 28.28VAC across the speaker's terminals… that's 28.28 Volts alternating current, not VDC - direct current.

OK, so here we go with the power calculations at different frequencies:

The calculation (simple Ohm's Law): $P = V^2/Z$

@ 119Hz P = 28.28 x 28.28/118 Ohms
P = 799.75/118 = **6.77** Watts

@ 299Hz P = 28.28 x 28.28/8 = Watts
P = 799.75/8 = **99.96** Watts

@ 5,000Hz P = 799.75/25 Ohms = **31.99** Watts

@ 10,000Hz P = 799.75/35 Ohms = **22.85** Watts

P = Power in Watts
V = Amplifier output voltage
Z = Speaker impedance in Ohms
Hz = Frequency of any signal

From these calculations, you might be able to see that, for an 'old' design solid state amp, the output power is much reduced at higher and lower frequencies. In fact, the amp is producing 100 Watts only at 299Hz! The output power at 119Hz is a mere 6.77 Watts… no, it's not a mistake! So is it any wonder that players say that solid state amps have sounded cold and lacking in warmth!

But that's now all a thing of the past. With a RetroTone™ power amp design, a SESSION® amp behaves and drives the speaker in exactly the same 'constant current' mode as a tube amp does. Hence its audio output varies in amplitude in the same way as a tube amp does. For this reason, the power output of the speaker is the same at all frequencies and leads to the same warm, sparkling character of tone to that of a tube amp!

New SESSION® amps are nothing like the old solid state amps of yesteryear. In fact, we have a program dedicated to upgrading our old Sessionette, Rockette and Duette amps from the 1980s to RetroTone™ standards.

RetroTone™ has nailed it. Hope this is helpful.

Guitar amp designer since 1967