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From: **D. Hiatt Collins** (*dhiattcollins@hotmail.com*)

Date: ☑ 11/16/2001 9:44 PM

Subject: **Adding screen resistors to tweed Fenders?**

What would be the effect of adding screen resistors to a tweed Fender type circuit? Any effects on the sound? Do tubes last longer? Any issues with cathode vs. fixed-bias?

Thanks!

Hiatt

Read **318** times

From: **dpcoyle** (*dcoyle@nm.net*)

Date: ☑ 11/16/2001 9:43 PM

Subject: **Re: Adding screen resistors to tweed Fenders?**

IMO, increasing the screen resistors hardens up the distortion a little bit, but it is protective.

Dan

Read **285** times

From: **DanF** (*dformosa@optonline.net*)

Date: ☑ 11/17/2001 4:12 PM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Hi Hiatt

I experimented with screen resistor values last month, posted some questions, and the results of what I found. The screen resistor values made a much bigger difference than I expected.

I don't think that thread is still on the site. At the risk of being redundant, here's a quick recap.

My amp is similar to a Princeton 5F2 circuit (single ended 6V6 amp using a choke). I used a 5 watt potentiometer to dial in different screen grid resistance values.

Screen grid resistance:
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1) 10k ohm: sounded terrible.
2) 1k ohm: not nice at all, artificial sounding, harsh distortion.
3) 470 ohm: some improvement, but still harsh and ugly sounding.
4) 220 ohm: starting to sound better, good clean tone with a smoother transition to better-sounding distortion.
5) 100 ohm: nicer still, guitar and amp sounding great, good clean sound, really nice distortion, still has some amount of compression.
6) 10 ohm: loving it
7) no screen resistor (like the 5F2 schematic): loving it

The general consensus was that as long as the screen grid doesn't exceed maximum dissipation there should be no problem (although a resistor can offer protection in the event of a tube failure). Even with zero or minimal resistance the screen dissipation in my amp is within working levels.

Since others contributed some good info I can send you the entire thread if you are interested.

DanF

From: **D. Hiatt Collins** (*dhiattcollins@hotmail.com*)
Date: ☑ 11/19/2001 2:49 PM
Subject: **Re: Adding screen resistors to tweed Fenders?**

Thanks, that helps a whole lot! Please do send me a copy of the thread.

Hiatt

From: **KB** (*ktbktb@eatel.net*)
Date: ☑ 11/19/2001 3:10 PM
Subject: **Re: Adding screen resistors to tweed Fenders?**

All I know is Bruce says the tweeds really don't need them and sound better without them so

that's all I needed and don't even worry about it.,

KB

From: **D. Hiatt Collins** (*dhiattcollins@hotmail.com*)
Date: ☑ 11/19/2001 5:20 PM
Subject: **Re: Adding screen resistors to tweed Fenders?**

That's good enough for me too. 

Hiatt

From: **Bruce /Mission Amps** (*missionamps@aol.com*)
Date: ☑ 11/19/2001 5:24 PM
Subject: **Re: Adding screen resistors to tweed Fenders?**

I should augment that by saying that, IMHO, tweed amps using 6V6s or 6L6s that use no choke and with a much larger dropping resistor from the plate filter cap to the screen filter cap, don't seem to need any seperate screen resistors... unless the voltage applied to the screens is still way too high in comparison to the plate voltage.
But, I roller coaster myself on this screen resistor thing.
Lately, I think if the tube can take it, then use the smallest value you can if you feel the need to have them there.

El84s and EL34s seem to be horses of different colors.
I always use seperate 1K 5w screen resistors on EL34s, and I've used seperate 2w screen resistors on each EL84 tubes with values as high as 2700 ohms!!

Bruce

From:	**D. Hiatt Collins** (*dhiattcollins@hotmail.com*)
Date:	☑ 11/19/2001 9:47 PM
Subject:	**Re: Adding screen resistors to tweed Fenders?**

Thanks for that clarification! This was all brought about by musing over the 5F4/5E7 circuit which has the choke before the OT CT. I was wondering if I used a HI-V rail more like a bassman, with the choke between OT and screens, how that would affect things and whether screen resistors would be beneficial.

I have O'Connors TUT 1 and 2, and he seems pretty heavily in favor of adding screen resistors (though that may have just applied to EL34's- can't remember exactly at the moment).

I've recently finished (except for inevitable tweaking and general messing-around) a 5E3 clone that I built into yet another old bogen head. I've got about 370 B+, SS rectified. I *really* like the sound, and have been toying around with the idea of a 26-30-watter like the 5F4/5E7 with 2x12" speakers (I've got a Jensen RI C12R- considering getting a second or a C12Q to complete the pair).

Anyway, thanks for all the great info!

Hiatt

From:	**Randall Aiken** (*reaiken@aikenamps.com*)
Date:	☑ 11/20/2001 1:25 AM
Subject:	**Bruce: any tone change?**

> *El84s and EL34s seem to be horses of different colors.*
> *I always use seperate 1K 5w screen resistors on EL34s, and I've used seperate 2w screen resistors on each EL84 tubes with values as high as 2700 ohms!!*

Bruce,

Did you notice any tonal difference in EL84 at the high screen resistances? Were you running them fixed biased or cathode biased? I've found that in fixed bias at higher plate/screen voltages

(350V-375V) on EL84's, it takes a 2.5K resistor to keep the screens from glowing at full clip output.

Having said that, they seem to survive just fine with a 1K (or lower) screen resistor, even though they glow quite a bit a full power. You can get up to 18W max without overdissipating the screens, or up to 20W with the glowing screens at those voltages, while keeping the plate within it's dissipation ratings. Wonder how hardy those screens really are?

Randall Aiken

From: **Bruce /Mission Amps** (*missionamp@aol.com*)
Date: ☑ 11/20/2001 6:32 AM
Subject: **Re: Bruce: any tone change?**

I'm running my 20 watt EL84 amp fairly hard too.
The primary of the OT is around 8K, plates are 360vdc@28ma in fixed bias and no NFB... I have to use the 2700 ohm 2 watters on the sockets or the screens will fire up like a mid 60's light show. Fun to watch but I'm afraid it's a destructive event.
Tone... hmmm, well when playing full bore "rockin' dog" mode, if I don't have the 2k7 screen resistors on the sockets and the screens get glowing like that, the tubes starts adding an ugly sounding hard "kish" tone to high level peaks.
I don't know how hardy the screens are either but when running them this hard, I've found that the SOVTEK EL84s don't last as long as the JJ EL84s.
But I have no trouble making 16-18 watts very clean into a non reactive load and around 24 dirty guitar watts into a speaker with either tube.

Bruce

From: **O'Connor** (*amps@londonpower.com*)
Date: ☑ 11/24/2001 2:24 AM
Subject: **Re: Bruce: any tone change?**

If you are kind to the screens then you can brutalise the plates. This goes for any tube. And my 1k-screen-resistor standard applies to any large tube (including 6V6) but EL84 needs 2k2 minimum-- preferably 2k7 if you are intending to clip them continuously.

Generally, any sound that a "reliability" mod imparts that you do not like, can be countered with changes elsewhere, where reliability issues will be moot.

Reliability and tone do not often conflict.

Have fun
Kevin O'Connor

From: **Randall Aiken** (*reaiken@aikenamps.com*)
Date: ☑ 11/24/2001 4:30 AM
Subject: **Re: Bruce: any tone change?**

Kevin,

Have you noticed a great deal of tone change (good or bad) between, say, a 1K and a 2.7K screen resistor, when using EL84s in either fixed or cathode bias?

Randall Aiken

From: **jaysg** (*jayfbv@yahoo.com*)
Date: ☑ 11/24/2001 6:14 AM
Subject: **Re: Bruce: any tone change?**

Bruce and Randall,

Please surf over to the Marshall 18 Watt group one of these times. The amp has trivial screen protection with a 100 ohm shared resistor. The choke-position resistor is 2k. You may be able to explain issues with EI el84s. While not everybody who used them had problems, some went bye-bye.

From:	**Randall Aiken** (*reaiken@aikenamps.com*)
Date:	☑ 11/20/2001 1:03 AM
Subject:	**Re: Adding screen resistors to tweed Fenders?**

Dan:

Did you rebias to the same current after each resistor change? If not, the reduced screen voltage will change the tone a *lot*. When making comparative screen resistor changes, you *must* rebias the amp to the same operating point or you are fooling yourself (either by adjusting the bias pot or changing the cathode resistor).

I think a lot of people come to mistaken conclusions about the tone because the increase the resistor and don't change the bias. The screen voltage has a drastic effect on the bias current.

Randall Aiken

From:	**DanF** (*dformosa@optonline.net*)
Date:	☑ 11/20/2001 4:43 AM
Subject:	**Re: Adding screen resistors to tweed Fenders?**

Hi Randall

The amp is cathode biased. When varying the screen resistance I didn't make any changes to the cathode resistor. However, for screen resistor values between 500 ohms and 10 ohms, changes in voltages, currents and plate dissipation seemed negligible.

Here's what I got:

Screen resistor = 500 ohms

Cathode current mA: 38.75
Plate current mA: 37.43
Screen current mA: 1.32
Screen to cathode voltage: 296.8
Plate dissipation watts: 10.8

Screen resistor = 100 ohms

Cathode current mA: 38.77
Plate current mA: 37.44
Screen current mA: 1.34
Screen to cathode voltage: 297.2
Plate dissipation watts: 10.8

Screen resistor = 10 ohms

Cathode current mA: 38.90
Plate current mA: 37.55
Screen current mA: 1.35
Screen to cathode voltage: 298.9
Plate dissipation watts: 10.9

The readings with a 10 ohm resistor approximate having no screen resistor (while still allowing me to get a reasonable reading). Plate voltages varied only by a volt or two (288.9 to 289.7) and cathode voltages were consistent (18.6 to 18.7) as screen resistance was lowered from 500 to 10 ohms.

Differences in sound, as mentioned, were considerable. I didn't get a chance to take a full set of readings while sending a signal through the amp, which may have been interesting.

Dan

From: **Max** (*etorus@infonie.fr*)

Date: ☑ 11/20/2001 8:44 AM

Subject: **Daft idea?**

Huh,sorry guys,but i was thinking,(there's a burning smell around here,isn't it?),could someone use a lightbulb to protect thoses screens?Due to the increase in resistivity when the light fillament i thought it could work.As well i thought about that to add sag to the whole B+,any comments?

Best regards.

Max.

From: **Randall Aiken** (*reaiken@aikenamps.com*)

Date: ☑ 11/24/2001 4:27 AM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Hi, Dan,

Yes, I wouldn't expect to see any bias current differences at that low a screen resistance. You said in your original post that you went up to 10K. The typical screen current is on the order of 5mA or so, quiescent, so a 1K will only drop 5V, but a 10K will drop 50V, which would make a difference in bias current. The difference between 10 ohms and 500 is negligible, as far as current is concerned, because we are only talking about a couple of volts. Now, at full power, the screen current increases, and you will see a greater drop across the resistor, which might account for the differences you are hearing.

There must be something to the cathode biasing or single-ended operation, because I just don't hear that big a difference in tone between different values in my fixed-bias amps. The output power is lower with higher values, as expected, but the tone doesn't get "harsh" or "terrible", as long as I rebias the amp to the proper operating point. In fact, when the screen voltage is too high for the tube in question (EL84's), the larger resistor makes the amp's overdrive sound better (and the tubes last longer, too!).

I went to the trouble of sticking an amp on a spectrum analyzer with a tracking generator to see if the larger resistor affected the frequency response or harmonic overtones - there was no discernable difference between a 500 ohm, 1K, or a 2.5K. I also looked at the transient response with gated, full-clip sine waves and could see no difference. I then rigged up a switch to quickly switch between 1K and 2.5K on the fly to see if I could hear the difference, and other than a slight increase in volume, there was no difference. Maybe it's just the fixed-bias output stage characteristics that make it less immune? The plate load impedance I'm running? The OT itself? I dunno.

I guess I'll have to experiment with some SE cathode-biased amps to see if I hear the difference as drastic as you are noticing. There must be something I'm missing (hopefully, it's not a good set of ears!).

Randall Aiken

Read **82** times

From: **Steve Ahola** (*steve_ahola@yahoo.com*)

Date: ☑ 11/24/2001 9:07 AM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Randall:

Are you working more with fixed bias than cathode bias? It seems like cathode bias will smooth out a lot of things that just won't fly if you are using fixed bias...

Bruce had mentioned something about it depending on whether a resistor was used instead of a choke between the plate and the screen supply, and the value of that resistor. It seems to me that if you use a larger value resistor there, you might be able to get by with a smaller value screen resistor (or none at all for an old tweed amp).

For example, if you are using a 1K "resistive" choke and no screen resistor, isn't that kinda like having two separate 2K resistors going to the screens? [Adjust that example for the appropriate factors that I overlooked... but there is a substantial resistance between the plates and the screens— right?] In any case if you are using a resistor instead of a choke with a fixed bias amp, I think that the value of that resistor needs to be added *to some extent* to the value of the screen resistors when making tests and comparisons.

--Thanks!

Steve Ahola

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From: **Randall Aiken** (*reaiken@aikenamps.com*)

Date: ☑ 11/24/2001 4:26 PM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Hi, Steve,

Yeah, I prefer fixed bias to cathode bias, it sounds better to some cases. I did several blind A/B tests with a switch to go between the two modes, and everyone picked fixed bias *every time* as sounding better - go figure! Now, if I was shooting for a Voxy sort of amp, yes, I would use cathode bias, but for a Marshally amp, I like fixed bias. The funny thing is, I really *wanted* to use cathode bias, and was "biased" against fixed bias, but it just sounded "right" to my ears.

Maybe too many years of playing non-master Marshalls full-bore...

For the same plate supply voltage, if you use a resistor instead of a choke, you can use a smaller screen resistor simply because the screen voltage is lower to begin with (the 2K resistor drops more voltage than the DC resistance of the choke). The thing that kills the poor little EL84's, and makes their screens light up like a Christmas tree, is too high a screen voltage/current, i.e., too much screen dissipation. You can lower the voltage either way. The added benefit of your method is lower cost. The only downside is less filtering of the screen/preamp supply, which may cause more hum, and a lower preamp supply voltage.

The difference between the screen filtering resistor and the screen dropping resistor is that the voltage drop across the screen resistor is instantaneous, and follows the signal current draw (which limits the peak dissipation dynamically), while the series resistor in place of the choke has a relatively large capacitor stuck on the end of it, so it only follows the average current draw, and may result in less of a voltage drop (or more, if the stuff downstream draws a lot of current...).

I'll have to try a dropping resistor in place of the choke in my amp. Who knows, it might sound better!

Thanks!

Randall Aiken

From: **DanF** (*dformosa@optonline.net*)

Date: ☑ 11/24/2001 11:02 PM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Hi Randall

Do you have a way to view or measure the attack, when the string(s) are first plucked?

I ran the tests again (same setup: 6V6 SE with a choke), varying screen resistance between zero and 10k ohms. This time I set it up with a toggle switch to instantly compare different screen resistor values. The differences seem not to be in the tone as much as the attack. Higher screen resistor values produced more of a an instantaneous response, that I would describe as more artificial sounding, empty and a little more harsh or cold.

The decay may also be affected (although maybe the attack is really the issue and it's affecting my judgement about the decay - I'll listen again).

Although there is a difference in tone at the higher values (less bass response at 10k), the differences are more in the warmth, blending of the notes, and smoother transition into tube distortion as the screen resistance gets closer to zero.

I'm still liking the it with a screen resistor around 220 ohms or less. However, higher values were acceptable (2.5k was okay - the 10K still sounded bad), and this is of course one link in a chain (I ran the tests using a Gibson 335 with humbuckers, and a Jensen P12N.)

It's definitely a worthwhile experiment for anyone wanting to fine tune an amp.

Dan

From: **Steve Ahola** (*steve_ahola@yahoo.com*)

Date: ☑ 11/25/2001 7:03 AM

Subject: **Re: Adding screen resistors to tweed Fenders?**

Randall:

I agree with you about fixed bias vs cathode bias, at least for modern amps. Cathode bias might give your sound the "warm fuzzies" but when you crank it up you seem to lose the dynamics and definition you get with fixed bias. (I still think that cathode bias is great for those late night sessions when you have to keep the volume of your amp down... it seems to give the illusion of having the amp cranked full bore but that is all smoke and mirrors.)

I see what you mean about that 20 to 40uF cap on the other end of the "resistive choke" holding the voltage very constant compared to the actual voltages on the screens. And the preamp tubes are usually right after the screen supply, so their current draw would help stabilize the voltage, too— right?

BTW the Peavey Classic 30 and 50 amps run contrary to your suggestions... they are fixed bias with a 400 ohm/5 watt resistive choke. One pair of screen grids are connected directly to the screen supply while the other pair are tapped off the other tubes with 100 ohm/5 watt resistors (not much of a voltage drop there!).

It seems like it would be a good idea to add "real" screen resistors to these amps... How about

adding in a dropping resistor between the power supply tap and the tubes? That might be easier to execute on the pcb. Maybe my math is wrong here but wouldn't a single 250 ohm dropping resistor have a similar resistance to individual 1k resistors on each screen? (I'd probably go with a huge 250 ohm power resistor and then add smaller 1k resistors on each screen... that should make it similar to 2k resistors— right?)

One last question: with a quartet of power tubes do you see any advantage with using different valued screen resistors on each pair of tubes? Perhaps that would produce a fuller sound since each pair of tubes would have a slightly different tonality...

I'll have to try a dropping resistor in place of the choke in my amp. Who knows, it might sound better!

It seems like a lot of the modern high gain and boutique amps are using resistors instead of chokes. But replacing the resistive choke with a "real" choke (especially those humongous ones- 12H? 15H?) can improve the definition of the cranked sound considerably. I wonder if the typical Fender chokes are appropriate for modern high gain amps since they seem to slow down the response a bit...

--Thanks!

Steve Ahola

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