The James Vanden Berg Mods

A very special thank you to Mr. Vanden Berg for
allowing me to add his work to my site.

Fender Hot Rod Deluxe - Circuitry Modifications

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I present here three of the modifications that I have performed on my own Fender Hot Rod Deluxe. I've done others, but these three had the most significantly positive impact on the performance and versatility of this unit. **NOTE: NO INDIVIDUAL SHOULD ATTEMPT ANY REPAIR OR MODIFICATION TO ANY AMPLIFIER WITHOUT PROPER EXPERIENCE AND UNDERSTANDING.** Amplifiers, particularly tube amplifiers, contain potentially lethal voltages. If you don't know what you are doing, refer these jobs to a qualified and experienced repair technician. In addition, you may be jeopardizing your 5-year warranty on this unit by making ANY changes to the circuitry. The projects I describe here are all 100% reversible, so save your stock parts in case you ever want to put the unit back to stock condition.

I bought this amp because I liked the sound. I had some repair experience with them, and I found them to be extremely easy to service and to be built rather well considering their price. I was looking for an affordable tube combo amp in a small package that gave me a good sound and enough volume to cut through a band onstage. I wanted to be able to take this unit to sit in with other bands (not as a primary performance rig: I have a rack setup with which I am perfectly happy). I've tried a few other inexpensive units (models from Hughs and Kettner and several Peaveys), but I learned that what sounds good by itself in the showroom or bedroom often doesn't have what it takes live with a band. So it was yet again with this amp. It sounded fabulous by itself, but when I played at higher volumes with other instruments, I found that the bass seemed to overwhelm the sound and that I couldn't seem to bleed enough of it out with the tone controls. The amp lacked mids and sounded flabby. Also, the lead channel just seemed too fuzzy and unfocused. I also found it difficult to dial in a low volume practice setting on the lead channel.

LEAD MASTER REPLACEMENT

Since the owner's manual came with a schematic, I studied it to see if there was anything I could do about these issues. I found the problem with the lead mode volume control was pretty straightforward: these turkeys had put a LINEAR taper pot in there where an AUDIO taper pot belonged. All volume controls should be audio taper. That's why they're called "audio" taper. The ear hears sound levels exponentially, on a logarithmic scale. A sound with ten times the power of another sound we perceive as TWICE as loud, not ten times as loud. If we use a linear taper potentiometer in a standard volume control circuit, we will hear "10" as only twice as loud as "1." If we use an audio taper pot, "10" will sound ten times as loud as "1," which is what we expect. Since 10=10 no matter what, an audio taper pot will have a much lower level "1" than a linear taper pot. Fender's engineers know this. Therefore, Fender has been using this trick for some time

on their solid-state amps, which are primarily targeted to the lower end of the market where the less experienced players buy. A player walks into the music store, plugs in and turns up to "2." The amp wails like a banshee, and he/she immediately turns the volume down to about "1/2" so as not to be expelled from the store. The player thinks, "wow, if this thing is this loud at 2, it must have just gobs of volume in reserve. If I buy this amp, my drummer will never be able to drown me out again!" Cha-ching, another amp sold.

Since I use this amp more often for practice than performance, I need to be able to easily dial in a lower volume, so I just replaced the lead mode volume control (labeled MASTER on the chassis) with an audio taper pot. Here's how:

Justin's comments: Here's a pic of my very sloppy version of this mod. Professional huh? It was the first mod I ever did to this amp. I used an old 250K mini-pot that was in my Japanese '62 Reissue Strat—basically because it was the exact size of the old pot and was logarithmic. Regular sized pots didn't want to fit in the HRDx's chassis. I had trouble unsoldering the pots 3 lugs and 4-point grounding "wings". I ended up cutting those grounding wing things off. The holes the wings left were so big I couldn't fill it with a wire, so I just left them in there and soldered a wire from the pot's casing to the wings. Not too pretty, but did I mention it works great?

If you're good with your hands you may want to check out this excellent tutorial on replacing the Master and making it look professional!

Note: The electric tape you see was done to try to fix a shorting problem I had a while ago. It was NOT the pot, I just put it there to see if it solved the problem. It did not fix it. You do NOT need electrical tape around it on the chassis. The problem was later solved, which was something completely different.

1. First, bleed off any residual voltage from the power supply. An easy way is to turn the amp on, let it warm up for a few minutes, and then LEAVING THE STANDBY SWITCH "ON," turn the POWER switch to OFF. Unplug the amp from the wall. This allows the warmed-up tubes to drain the power supply for you. Remove the back panel (6 screws), all control knobs, and nuts on the controls and jacks. Check one of the filter caps with a voltmeter to be sure there are no lethal voltages left. Any remaining voltage can be discharged with an alligator lead. Remove the 6 screws holding the main circuit board to the chassis, and then remove the 1 screw holding the ground wire that goes from the board to the chassis over by the input jacks.

2. Carefully pull the circuit board down and away from the chassis. It is very easy to damage the controls against the upper lip of the chassis, so be extremely careful here. Now you have access to the solder side of the circuit board.

3. Unsolder and remove the MASTER control (R26, 100kB). Now, the only drop-in replacement that I'm aware of which will accomplish our goal is the same control that is being used for the clean VOLUME control (R6, 250kA). I haven't actually tried one of these, but I have used 250kA pots, and I couldn't hear any difference at all. If you have this pot on hand, great. Solder it in, reverse steps 1 and 2, and you're finished. If not, any good quality 100kA to 250kA pot that will fit can be used. In fact, I don't see any reason why a 500kA wouldn't work. After all, vintage amps routinely used 1meg pots as volume controls. Carvin makes an excellent small body 500kA pot, which they use for the tone controls on their guitars. I used a similar sized unit from a scrap circuit board I had lying around. DO NOT TRY A RADIO SHACK CONTROL. I tried their 100kA pot on a friend's unit, and it doesn't even turn on until after "3." This was not due to a defective

pot. I opened it and found that this was the way it was designed. What crap! If your replacement can't be soldered directly to the circuit board, you will have to run short jumpers from the pot's terminals to the points on the PC that the old pot was soldered to. No big deal.

When putting the circuit board back into the chassis, pay attention to the Bright switch, the Drive and More Drive switches, and particularly the LED. They sometimes don't want to line up properly and it wouldn't take much force to break them. Also, the plastic threads on the jacks of this unit are ridiculously easy to strip if you cross-thread them or over-tighten them. Be as careful as you can.

Since the first draft of this document, I've discovered something about this modification that I didn't like. The good news is that I've also discovered a very easy remedy. I was sitting in with a friend's band at a party. We were playing pretty loudly, and I noticed that I had to set my lead master control to about 8 or 9 to equal the clean channel at 4 or 5. This bugged me because it didn't seem like there was much more volume available (there actually was; the difference between 9 and 10 was HUGE), so I went back to the schematic later to see what I could do. I found that Fender had built in some attenuation into the lead master circuit to balance their linear taper pot with the clean channel's audio taper pot. The remedy is to remove this attenuation. I did this by merely soldering a jumper wire across R45 (47K), which you find near the lead master control. This just about doubles the volume of the lead signal. So now, with the new control and the overall volume boosted, you have an amp with more available lead volume than a stock unit, but which is also easier to control at low volumes. The best of both worlds!]

TONE CONTROL MODIFICATION TO BETTER CONTROL BASS RESPONSE

Why does this amp sound so flabby in the low end? Part of the reason lies in the speaker/cabinet combination. I've plugged this amp into other speakers to compare and found that the stock speaker/enclosure seems to really favor the bottom end, particularly for a 1-12 combo. This is great, because it means that the speaker and cabinet are very efficient for these critical lows, and if we can control the amount of bottom end the amp sends to the speaker, we can get great volume without working the amp too hard. The problem lies in the tone control section. I compared this circuit with other vintage Fenders, and the most critical difference is in the way that the Midrange control is wired. If you look at most of the older designs with a midrange control (such as a vintage Twin Reverb), the Mid control is wired with the wiper tied to the high side of the pot, just like the bass control. This effectively turns the potentiometer into a variable resistor (a variable resistor is a 2-terminal device, whereas a potentiometer is a 3-terminal device that is used as a voltage divider, as in a volume control). On these amps, you can turn the volume all the way off by turning all the tone controls to 0. This then allows you to more precisely balance the lows and highs coming through the tone circuit.

The Mid control on this amp is a 25kA pot. ("A" stands for audio taper). Thus, the stock circuit in this amp puts 25,000 ohms at all times between the bottom of the bass control

and ground. On vintage Fenders without a mid control, the resistor in its place was usually only 6.8k. On models with a mid control, such as the Twin Reverb, the pot was only 10k, so even with the mid turned up all the way, it didn't have the same low-end response as the stock circuit in this HR Deluxe. The larger the value of this midrange resistor, the more bass and low-mid the amp has, regardless of the setting of the bass control.

Have you ever seen a "Loudness" switch on an older stereo? The Loudness circuit boosts the bass and treble and is intended for low-volume situations to compensate for the fact that the human ear hears midrange frequencies (where most speech resides) more acutely at low levels than deep lows or high trebles. As volume increases, this effect reduces. If you play a stereo at high volume with the Loudness switch engaged, it can sound flabby because the bass frequencies are now over-amplified for our ears. This is precisely what's happening with this Fender HR Deluxe. It sounds great at low levels, but the bass overwhelms the tone at higher volumes.

Fixing this takes very little effort:

Follow steps 1 and 2 above. Solder a jumper between the left and middle terminals of the mid control (when facing the amp from the rear, as you would be when working on it). That's it. You can now reverse steps 1 and 2 and try it out. If you did it right, you should now be able to turn your volume down to 0 by turning all of your tone controls to 0. More importantly, you can now dial in just the right amount of low end with the mid and Bass controls. Remember, they're interactive. The higher you set the mid control, the more bass you will get.

Justin's comments: Instead of using wire I took a small piece of solder and melted it into place. This creates a very unobtrusive jumper that's easy to remove. Be sure to test your jumper with an ohm meter to make sure it passes current.

LEAD MODE-ONLY TREBLE CONTROL

Now that you can dial out more bass than before, you may notice that your lead mode sounds thinner than you want it. I sure did. I also felt that the high end was always too fuzzy for my taste.

What makes for a good preamp-based lead sound? Many designers feel that you must strip a signal of some of its bass before the overdrive stages, and then tame the high end after distortion is created. This gives a smoother, tighter sound. Marshall has been doing this for years by using small value cathode bypass capacitors in the first few stages. Unfortunately, this also gave those earlier Marshalls a thinner clean sound than the Fenders. Most people preferred Marshall for lead, Fender for clean.

Fender took a similar approach in this amp by using a capacitor to thin out the signal in the lead mode before the overdrive stages (C23), and then using another capacitor to filter out some highs at the Master control (C11). My modification allows you to tailor the amount of high frequency cut after the distortion stages by replacing C11 with a standard treble control. Unfortunately, this requires removing the Presence control.

I didn't want to drill any holes in this amp, so something had to go. Since I normally set the Presence to one setting and left it there all the time, it was a simple thing to substitute a fixed resistor in its place. Here's how:

1. Play the amp with your main axe and set the Presence control where you like it. Follow steps 1 and 2 in the first mod, being careful not to rotate the shaft of the Presence control while removing the knob from the shaft or while removing the PC board from the chassis. Measure the resistance between the two outside terminals of the control and write it down. Unsolder and remove the Presence control. Obtain a resistor of a value close to what you measured, the closer the better. I used a 6.8k 1/4W resistor. Cut the leads to size and solder this in where the two outside terminals of the control were. I recommend placing the body of the resistor on the solder side of the board and NOT sticking the leads through the board to the component side. You may need room on the component side of the board for the new control, such as the one I recommend below, and you don't want the leads of the resistor to touch the body of the pot, which will be grounded against the chassis.

2. Unsolder and remove C11 (this is right next to the Master control). Obtain a good quality 50k to 100k pot. Now, in this situation Radio Shack does have a control you can use: RS 271-092. This control is a 100kB (linear taper) pot, which is readily available today just about everywhere in the US for $1.99, no shipping. This pot has a larger body than the Fender pots and a much larger shaft, which you will need to cut to length before doing any soldering. I just clamp the shaft in a vice and cut it with a hacksaw. The stock knob will still work with it. You will also need to break off the tab on the shaft side of the body of this pot. This tab is for aligning the pot on a chassis, but since this chassis has no corresponding hole, the tab will prevent the pot from sitting flush against the chassis.

3. Obtain a decent quality .01uF cap. It doesn't need a high voltage rating. I used a 50V Mylar cap. Use anything but a ceramic type; they aren 't very good for audio applications. They are only used in amps like this one because they are cheap. It's rare to find ceramic caps in high-end amplifiers. Trim the cap's leads to about ½ inch and solder one lead to the middle terminal of your new control. Solder a 3-inch jumper wire to the other lead of the cap. I recommend shrink tubing over this connection. Hold the new control with the shaft towards you and the terminals facing up. The terminal on the right needs a 3-inch jumper wire soldered to it. Solder the other end of this jumper to the right side hole where C11 used to be. Solder the lead attached to the cap to C11's other hole. The third terminal of your control is not used in this circuit.

4. Replace and secure the circuit board. Carefully fasten the new control through the hole where the Presence control was. I recommend using a lock washer between the body of the control and the chassis. Be careful not to short out the pot's terminals against the lip of the chassis when tightening down the control's nut. You don't have much room here.

5. Reverse steps 1 and 2.

Play the unit in lead mode. You now have the ability to dial in as much sizzle as you want in the lead modes. With the "Presence" control set at 10, you have a bit more treble than when you started. With it set at 0, you have a pretty muddy tone. (This control has no effect over the clean sound.) I usually have mine set around 4 or 5. This seems to be where the most dramatic changes take place. I found this modification to be the single most effective change I've made to this amp. It was the difference between me keeping it or selling it.

Since the first draft of this document, I have changed the control in my unit to a 50kA pot. I found that I never turned the pot up past half rotation, and I wanted more control over the region in which I did use it. Therefore, the new pot gives me a much wider usable region for dialing in the perfect sound.

It is possible to do this modification without sacrificing the Presence control, but it would require adding a pot somewhere else. This means drilling a hole in the chassis or placing a miniature pot on the circuit board (this second option would result in a control which is only adjustable with the back panel off, which I find unacceptable). It's up to you.

OTHER CHANGES TO CONSIDER

When I was experimenting with the tone control section, I did some research. Dave Funk of Thunderfunk Amplifiers has written an excellent text on tube amps. He recommended changing the bass cap (C5) to .022uF, changing the treble cap (C7) to 500pF, silver mica, and changing the slope resistor (R12) from 130K to 56K. I tried them all and like them. I didn't hear much difference with the bass cap, but the treble cap and slope resistor made a noticeable difference. The increase in value of the treble cap basically shifts the treble response down and allows more hi-mids through as the treble control is turned up. This gives the amp more bite and cut-through without making it shrill. This is similar to what Boogie did on their Mark II amps, though not as drastic. They had a pull function on one of the controls (called "Treble Shift") that added a 750pF cap in parallel with the 250pF treble cap. The lowering of the value of the slope resistor increases the overall midrange response of the amp.

The above mods have been in place on my amp for several years now. The following mods are more recent. I needed to get over my reluctance to drill a hole in the chassis.

LEAD MODE BASS-BOOST CONTROL

The reason that the Drive/More Drive modes have less bass that the clean channel is because most amp designers try to reduce bass frequencies before overdrive stages in order to avoid the harsh splattery sound that results. Fender achieved this on the HRD amps with capacitor C23. This cap is attached to the plate (pin 1) of the first stage of the first tube (V1A). C23 couples the signal to R52 (180K) which then feeds R7 (the Drive

control). C23 reduces bass response because of it's small value (1.5nF). Notice that the clean volume control (R6) is fed by a much larger cap (C18, 0.022uF).

You can recover much, or all, of your bass response in the Drive modes simply by increasing the value of C23. You might try 4.7nF (0.0047uF, or 4700pF)On my amp, I went a step further and installed a separate bass control at this point in the circuit. To accomplish this, you need to install an additional control somewhere on the amp. I chose to put it on the underside of the chassis near the preamp tubes. Here's what I did:

Install an additional 0.022uF 400V capacitor off the plate of V1A. I just soldered it to the positive side of C23. Attach the other end of the new cap to the input of the new control. I used a shielded stereo cable, like you might scavenge off some defective headphones. For the control I used a Carvin 500k audio taper pot. Attach the other side of the pot to ground, and attach a 220k resistor from the wiper of the new control to the negative side of C23. What you have just done is to create an alternate signal path around C23, but this new path is full-frequency (meaning all the lows are present) because of the value of the new cap. The control allows you to blend in the bass that you were missing before. At minimum, your Drive channel should sound stock (missing lotsa lows). As you turn up the new control, you will hear the bass come back. This control can be touchy, and it doesn't take a high setting to get plenty of bass.

LEAD MODE SPARKLE BOOSTS

I have two different mods here. Both of these boost the pre-distortion high frequency content of the lead modes. One is the installation of a bright switch that is only active in the lead modes, just as the existing bright switch is only active in the clean mode. This new bright switch engages the same circuitry as the stock bright switch. The other mod involves using a FET to switch C3 (look at the grid of V2A) into the circuit on the MORE DRIVE mode only. This cap is only in this circuit to prevent squealing when in MORE DRIVE mode. However, in the stock circuit, C3 is also engaged in DRIVE mode, where it only succeeds in taking away some pre-distortion high end.

This amp has an interesting bright circuit. Most older amps used a switched capacitor across a volume control to achieve a “bright” circuit. This technique was very effective at low volumes, but lost effectiveness at higher volumes. In contrast, the bright circuit on the HRD amps involves switching in/out C4 in the cathode circuit of V1B. This produces a boost in treble that is not affected by changes in volume. The bright circuit is made active in the HRD through the relay K1B, which grounds one end of the bright switch through pins 11 and 13. When the amp is switched to a lead mode, the relay opens pin 11, thus preventing the bright switch from bringing C4 into the cathode circuit. If you wanted the bright switch to work in the lead modes just like it works in the clean mode, you could easily solder a jumper across R102 (you don’t even have to pull the board to do this.) In fact, you can test drive this idea with an alligator lead.

1. With the amp off, remove the back panel. CAREFULLY attach an alligator lead across R102 (thus shorting it out).

2. Turn the amp on and play it in a DRIVE mode. Use the bright switch to turn this circuit on an off. Decide if it's something you want. I personally prefer having it on.

I decided that I wanted to have a separate bright control for the lead modes, so I had to do something a little more complicated.

1. Drill a hole and attach a SPST switch on the underside of the chassis. Connect one side of the switch to the pole on S1A that is directly connected to C4.

2. Connect the other side of the switch to pin 9 of K1B. Now, your new "Lead Bright" switch will only be active when your amp is in a lead mode. Your sock bright switch should still behave as before.

Relay K1B performs another function besides activating the bright switch. In lead modes, it connects C3 to ground, effectively killing some highs at the grid of V2A. As I mentioned before, this was necessary for the MORE DRIVE mode. If you remove this cap, MORE DRIVE will squeal like crazy. However, you will also find that the DRIVE mode is much more lively, with a shimmer nearly rivaling the clean mode. Wouldn't it be nice if C3 was only in the circuit in MORE DRIVE mode, but was out for DRIVE mode? You can do this, but you will need an N-channel JFET to act as your switch. A J111 will work great, but in a pinch you can use a Radio Shack version. I did, and it worked fine (and has for 2 years now). Radio Shack only sells one N-channel JFET in a T092 case style (I've forgotten the number).

1. Using the above safe disassembly procedures, pull the circuit board.

2. Cut the foil trace connecting pin 9 of K1B and the junction of C3/R27.

3. Attach the drain of the JFET to the junction of C3/R27. Attach the source to pin 9 of K1B. Attach the gate to the junction of Q1/Q2 (their gates are tied common)

4. Reassemble and test drive.

I'm not going to tell you exactly where to place the FET or how to attach it securely. I'll leave that up to you to figure out. If you are trying mods at this level, you are probably pretty handy with a soldering iron. I will suggest that a properly placed bead of hot glue can work wonders.

Your new JFET will act as a switch that is only turned on when MORE DRIVE is engaged. This way, C3 is only robbing highs from the grid of V2A in MORE DRIVE mode, thus keeping the amp from squealing. You will (hopefully) notice an increase in high end for the DRIVE mode. On my amp, with all of the above mods, I can make the DRIVE mode sound virtually identical to the clean mode, but with breakup.

Since both of these mods increase treble before the drive stages, you get more definition in your lead modes but without an increase in harshness that would accompany a corresponding increase in post-distortion treble.

If you try any of these modifications, please let me know what you think of the results. I'm curious to find out if these help others as they've helped my friends and me. E-mail, write, or call (last resort).

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