Biasing the Vintage Series
(Nomad, BelAir, VT50, Vintage 33)

This chapter will outline and guide you through the procedures of biasing the Vintage series amplifier. The procedures are broken down in a step-by-step format. Each step should be accomplished before moving on to the next step.

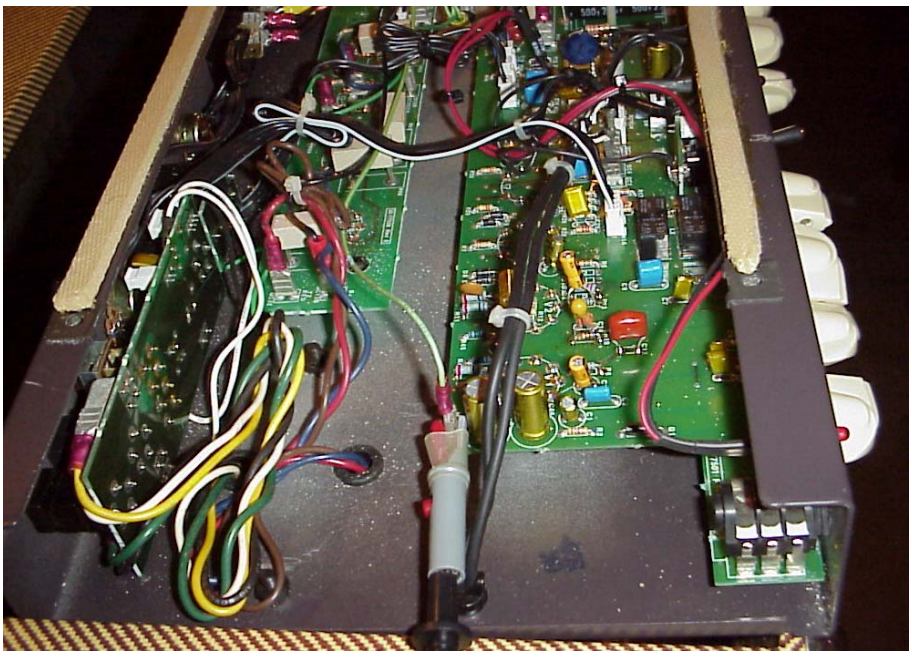
WARNING: During the course of biasing, you will be exposing yourself to dangerous voltages up to 400+ volts D.C. If you feel at anytime that you are not sure of what you will be doing, don't do it. It is recommend that you practice each step several times with the amp's power cable unplugged so if you make a mistake, you will not pay for it with a damaged amplifier or a damaged body.

The procedure we will demonstrate here is the Standby Switch method. Again, practice each step with the power cord removed from the amp.

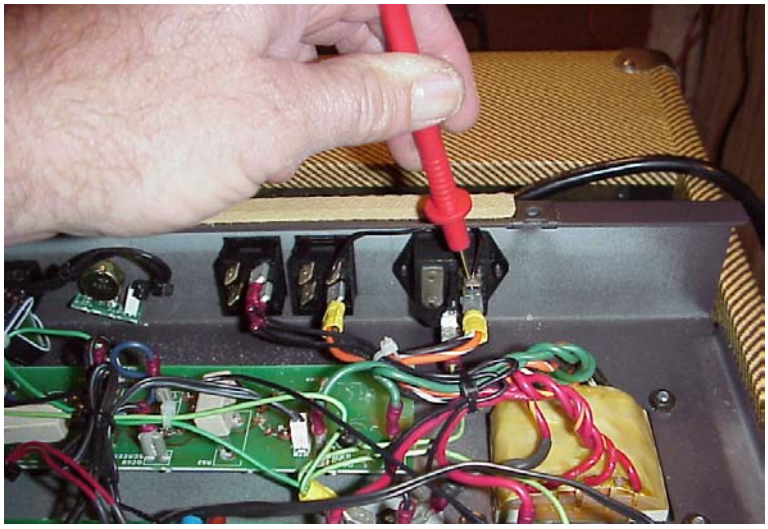
STANDBY SWITCH

- Start by disconnecting the power cable from the amplifier.
- Move the amplifier to a location where you will be able to work without being disturbed.
- I like to lay the amplifier down on it's face to work on it, with the top of the amp extending slightly beyond the edge of the bench (this is so you can lift/push on the front of the chassis to assist in removing it from the cab later). I also like to lay something soft down on the bench to protect the amp from getting marred.
- Remove the back panel
- Remove the four screws in the top of the cab that secure the chassis into the cabinet.
- Remove the screw holding the cable clamp on the reverb cable to the side of the cabinet.
- Remove the speaker cable from the jack.
- Now reach below the amp and push on the front of the chassis to push it out of the rear of the cab. At the same time lift up on the transformers to lift the chassis up and out of the cabinet. The first time you do this the chassis may be difficult to remove. It has been secured to the cabinet for a long time and has settled into place there. You have to gently persuade it to come loose and up and out of the cab.
- Once the chassis is removed from the cab tilt it backwards so that the transformers and tubes are facing down and the open chassis is facing up towards you. Slide the chassis forward so that the knobs are facing you and it will rest securely across the top of the cab and the back panel supports. See photo.

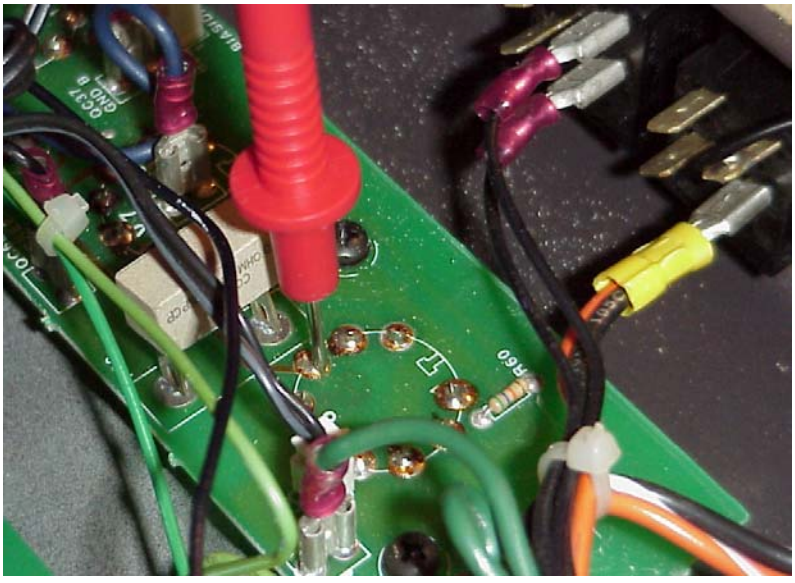
- Caution: DO NOT TOUCH ANYTHING INSIDE THE CHASSIS!! Keep your hands and fingers clear of everything inside the chassis while maneuvering it around. Even though it is unplugged there are power storage devices (capacitors) inside the amp that can maintain a charge even after turning the amp off. If you touch the wrong thing these caps can discharge into you!
- When you are ready to perform the voltage checks, you will need to insert the power cord and a speaker cable. There must be a speaker connected to the chassis whenever you apply power to the chassis. Make sure the amplifier's power switch is in the OFF position and the Standby Switch is in the Standby position.
- Get your meter out and set it to the position to measure Volts AC.
- I like to use slip-on "alligator clip" connectors on my test leads. Connect the black lead to the ground point. See photo below.



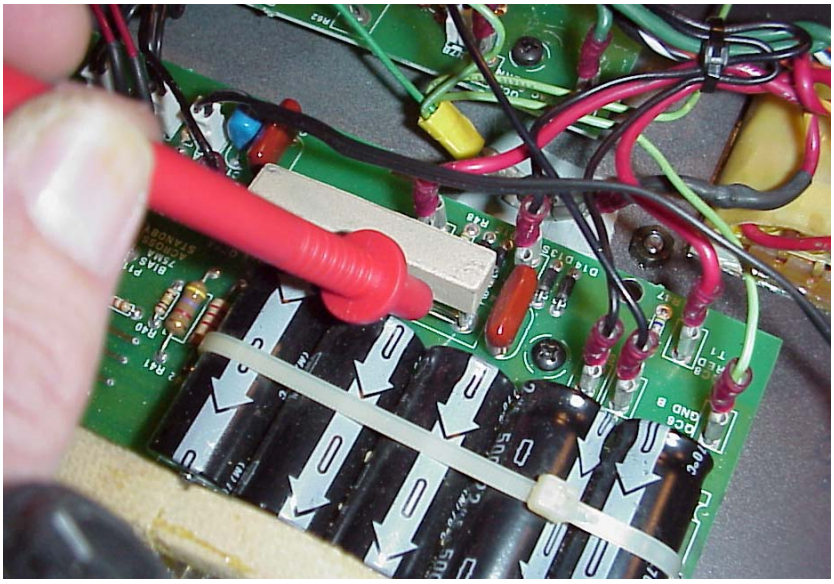
- First we want to measure the line voltage coming into the amp. With the red test lead probe touch it to the wire shown in the photo below and record the reading on the bias calculation worksheet. This is the line voltage, or the supply voltage coming into the amp. It will be in the range of 115 to 120VAC. I like to record this for future reference as it varies frequently from place to place and from time to time. And as the line voltage changes the high B+ voltage on the tube plates will also change. There is not much you can do about the line voltage, but it's good to know what it is for future reference.



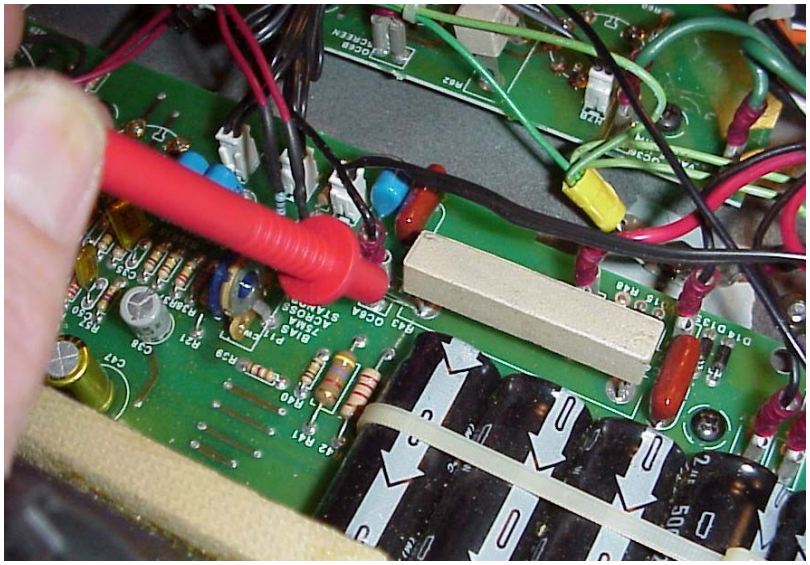
- Now we need to measure the Plate voltage. Set your meter to read Volts DC. The voltage here will be in the range of 400VDC
- Turn the Power on and after the tubes have warmed up turn the Standby Switch to On. Leave the Black lead connected to the ground point, and touch the Red test lead to pin #7 of V6. see photo below, and refer to the tube pin diagram. Note: let the amp warm up until the voltage stabilizes.



- Record the Plate voltage at the appropriate spot on the Bias Calculation Worksheet.
- Next we need to measure the voltage drop across the dropping resistor R43. Now we could place the test leads at each end of the resistor and measure the resulting voltage, but I like to measure the voltage at each end and subtract the second reading from the first to arrive at the voltage drop. This way we only need to use one hand, keeping safety first. So, first measure the voltage at the input side of the resistor now and record the reading here on the worksheet.

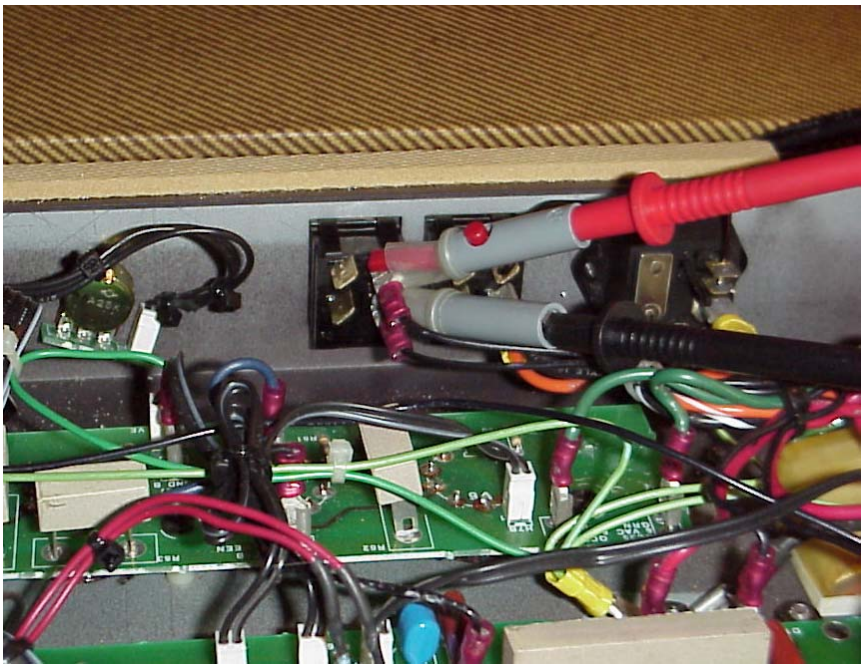


- Now measure the voltage at the output of this resistor and record the reading on the worksheet.



- Now subtract the second reading from the first and record the result. This is the voltage drop across the resistor, which will tell us how much current is flowing across the resistor. We'll use that figure later on.

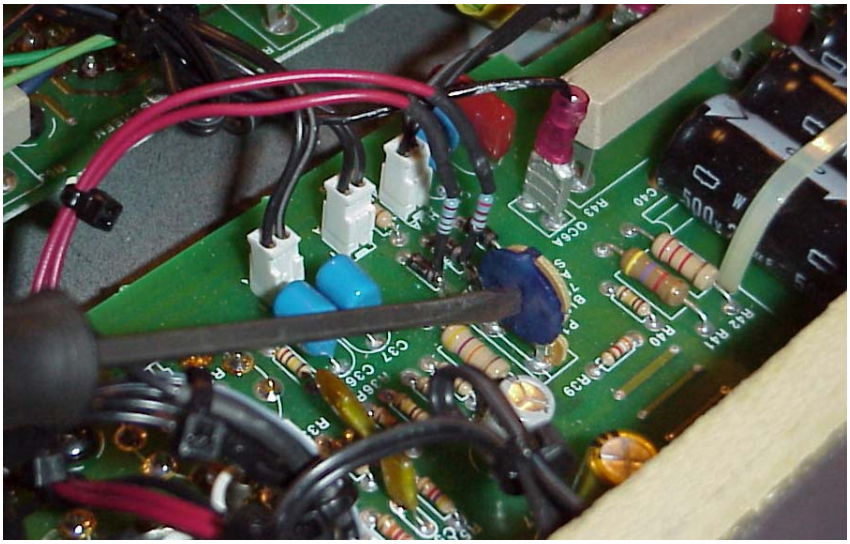
- Turn the amp off.
- Okay, now it's time to measure the current across the standby switch. This step involves both high voltage and current, safety is of the utmost importance here, please be very careful!
- Set your meter to measure DC current. The range will be around 75 to 100 milliamps.
- Again, I like to use slip-on alligator type clips on the test lead probes for this. Remove the black test lead from the ground point where it was for the previous tests and attach it to the bottom terminal of the standby switch. Actually, there are four terminals on the switch, two with wires attached and two bare. You want to attach the probe to the bottom terminal with a wire attached.
- Next attach just the slip-on alligator clip, without the test lead probe inserted, to the top terminal just above the other one. Arrange it so you will be able to slip the test lead probe into the clip after you switch on the power.
- Now turn the Power switch on, but leave the Standby switch in standby mode. Wait a minute or two to let the tubes warm up, then slip the probe from the red test lead into the open clip. This will complete the circuit through your meter, which will display the total current being consumed by all nine tubes. (the reason we slipped the test lead into the clip after switching on the power was to prevent blowing the fuse in your meter, wasn't that thoughtful?)
- Your setup should look like this:



- And the meter should be showing you the current being drawn, record it on the worksheet. Note: the current will come up slowly, be patient, let it build up until it becomes stable.

- Now it is time to do a little math. We know what the total current is, but what we need to know is how much is going through the plates (or anodes) of the tubes (the rest is being drawn by the screens of the power tubes and the plates of the pre-amp tubes). In the steps above we measured the voltage drop across resistor R43, the dropping resistor. We need to convert this voltage drop to current, so divide the voltage drop by the resistance of the resistor (350 ohms).
- In the case of my Nomad the figures are:
  Dropping resistor in = 397vdc
  Dropping resistor out = 390vdc
  Voltage drop = 7vdc
  7 / 350 = .02 or 20ma
- Now we need to subtract this from the current measured across the standby switch. Again, in the case of my Nomad the figures are:
  Current across Standby switch: 94ma
  Minus the current across the dropping resistor 20ma
  Equals – 74ma being drawn through the plates of the power tubes.
- We're not done yet. We need to convert this to power. Power (or watts) = E (volts) x I (current). In the case of my Nomad that is:
  Plate Volts = 394vdc
  x Plate current = 74ma
  Equals = 29 watts. (394 x .074 = 29.156)
- Yoohoo! We've finally got to the amount of watts being dissipated by the tube plates. But wait! We still aren't finished. We have four tubes right, so now we need to divide the total watts dissipated by four. Again, in the case of my Nomad that is:
  29 / 4 = 7.3 watts.
- We want to keep the total amount dissipated under 70%. The EL84 tubes used in the Nomad are rated at 12 watts maximum dissipation, 12 x 70% = 8.4, so at 7.3 watts we are well under 70% of max dissipation, this is good for the tubes for long life. And we are well above the range where crossover distortion would occur due to cold biasing, so in my opinion this is good. But you are free to set this bias wherever you think is best. Running the tubes colder will increase their life, but if run too cold you may experience crossover distortion. Run them too hot and they may sound really good, but you may shorten their life. 70% of max dissipation is the standard used by many to achieve the best compromise of good tone and long life. If you set it lower than that, and you like the tone, your tubes will be happy.
- Following is a worksheet you can use to measure the bias setting in your amp, then you can adjust it if need be. The adjustment is done very simply by turning the bias pot P11 one direction to increase the current and the other way to reduce the current across the Standby switch, as displayed on your meter. See photo on the next page. Note: make small adjustments, and give the amp time after each adjustment for the current to stabilize. After you set the current to where you want it to be, recheck the plate voltage, it is not unusual for it to change. If it has, re-do the math and determine the watts dissipated once again, and make adjustments to the pot as needed. Then

recheck the plate voltage again, do this until you are comfortable that the current being drawn, the watts dissipated, is where you want it to be. Make copies of the worksheet so you don't have to erase and refill it each time you use it.



This is the bias adjust pot. Turn it towards the back of the amp to reduce current, and towards the front of the amp to increase current. Make small adjustments, you will probably find that as you get the current just where you want it, it will go too far, and small adjustments either way will be too much. Be patient, make small adjustments, and let the current stabilize. Take your time and get it just right.

When you are done setting the bias, reassemble the amp in the reverse order you disassembled it. Note the four screws that hold the chassis to the cab, there are three long ones and one short one. The short one goes in the hole closest to the speaker impedance switch. Also, be careful installing the screws for the back panel, take the time to line up the screws into the holes. If it doesn't go right together try flipping the panel around and see if the holes line up better that way. Note: it is too easy to start new holes, so don't force the screws if they don't feel right. Back them out and start over until you get them started correctly. Make sure you install the speaker cable into the speaker jack before you turn on the amp again to play it.

Last thing, turn the amp on and peer into the back at the power tubes and take a good look at them, make sure the plates are not glowing, or even starting to. If they are, you set the bias too hot, and the tubes will not last.

Bias Calculation Worksheet

- ☐ Line voltage _____
- ☐ Plate Voltage _____ (Voltage at Pin #7 of any power tube)
- ☐ Dropping Res In _____ (Voltage at input of R43)
- ☐ Dropping Res Out _____ (Voltage at output of R43)
- ☐ Dropping Res Voltage Drop _____ (Dropping Res In – Dropping Res Out)
- ☐ Current across Dropping Res _____ (Voltage Drop / 350)
- ☐ Current across Standby switch _____
- ☐ Total Plate Current _____ (Current across Standby Switch – Current across Dropping Res)
- ☐ Watts Dissipated Total _____ (Plate Current x Plate Voltage)
- ☐ Watts Dissipated Per tube _____ (Watts Dissipated Total / 4)

- ☐ EL84 tubes are rated at 12 watts dissipation max. 70% of 12 = 8.4 watts. Keep watts per tube less than 8.4 for long tube life.