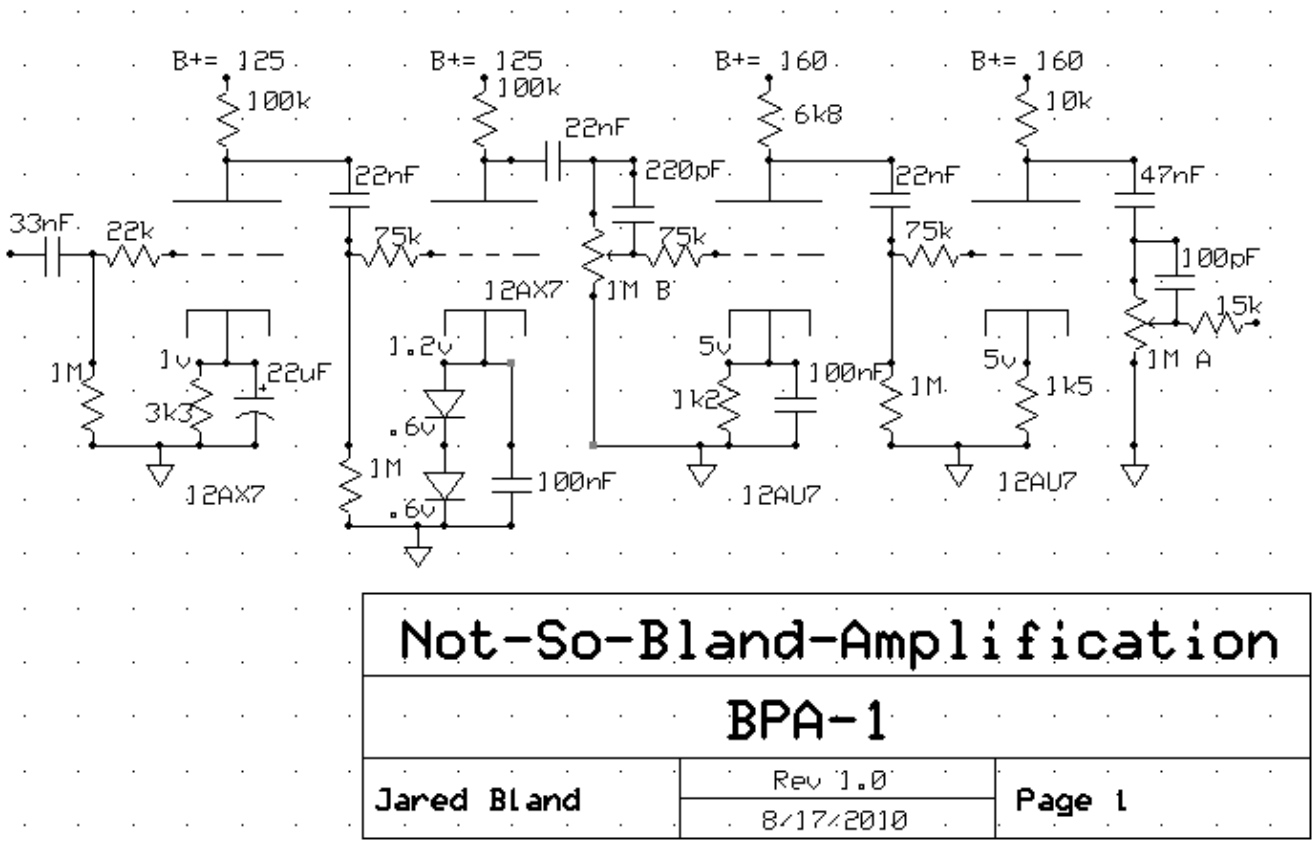
Jared Bland Tube Preamp Notes
Distorted Preamps

Fortunately, all the same rules apply as with a clean preamp. The difference is in the biasing. (More on this in tuning the preamp)

I'm going to do two designs for this, a trebly classic rock tone, and a bluesy more mid-boosted tone.

Here's the blues preamp:



If you notice, there is a voltage drop between the two tubes. This adds filtering to the power supply, PS. By using a dropping resistor, the ripples in power supply are made smaller, combined with a filtering capacitor, you can increase and tighten bass response as well as stabilize the PS. The easiest way to calculate the resistor needed is to add the current of the stages after the resistor, then use E=IR to solve for the resistor. There is a 35v drop between the two tubes. Then using E=IR you can calculate the current through each resistor.

For the first stage.

$1 = I \cdot 3300$ $I = .0004$mA

The diode stages are a little more tricky, and can't be reverse engineered with E=IR, instead, I used 2 .6v silicon diodes to create the necessary voltage drop. Using a diode for a voltage drop is a reliable way to get a fixed cathode voltage. It pretty much has 0 resistance to AC, so the capacitor isn't there to boost the gain. The capacitor is there to minimize any switching noises the diodes would create.

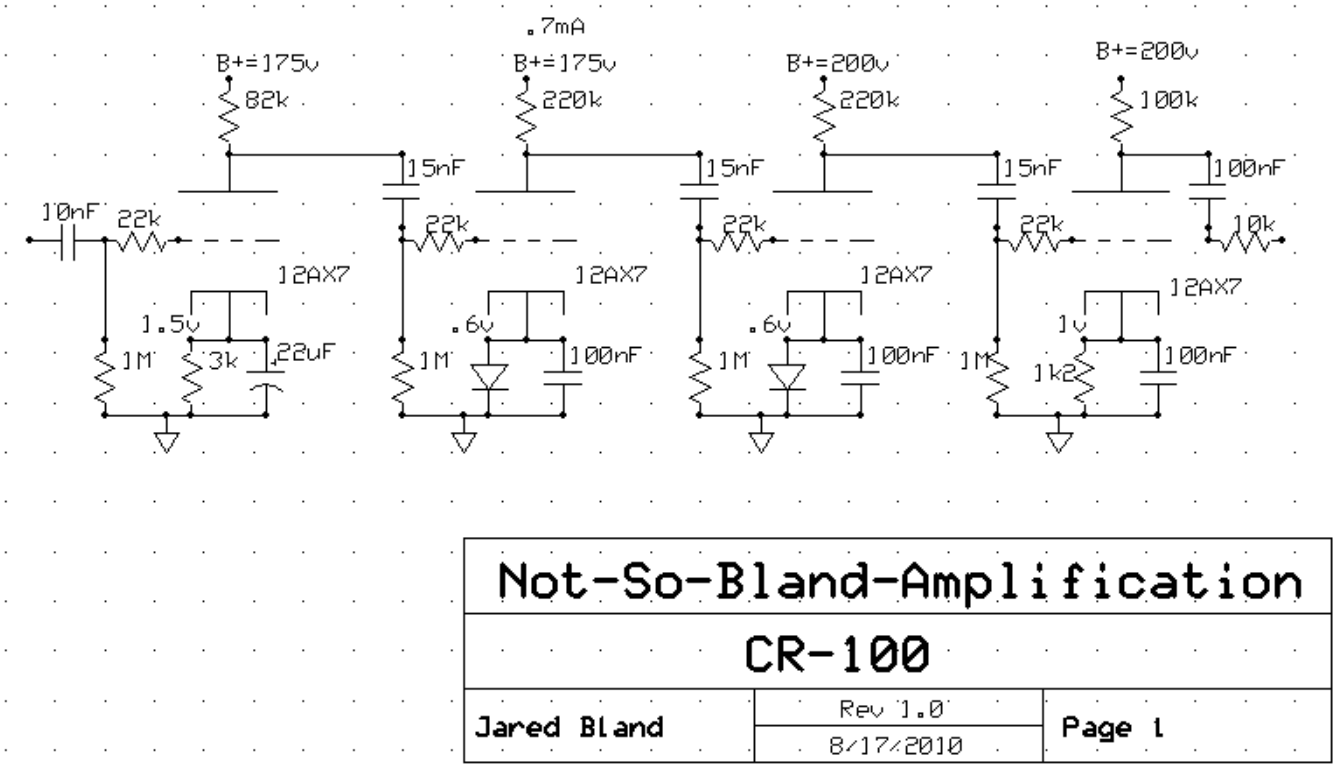
From the datasheet of a 12AX7 [2] you can detmermine the current through the diodes by drawing a load line from 125v to 1.25mA, and finding the resting current at the point 1.2v, this is roughly .3mA or .0003A

So together, the stages use .7mA of current. The two gain stages are out of phase with one another

since using a tube to amplify signal inverts the signal, this keeps the current through the dropping resistor relatively constant. So 35=.0007*R R=35/.0007=50k, 47k or 51k will work just fine. Using a 22uF capacitor will give a hearty bass response as well as ripple filtering. The beginning stages are the lowest voltage as they are the stages with the small signal, therefore needed less headroom, as well as being more susceptible to power supply ripple. The more you filter the power supply, the less ripple there will be, but the voltage will be lower the more it's filtered as well.

The 12AU7's are slightly warm biased, this should help create the bluesy tone. The large-ish grid stoppers should reduce treble response slightly, combined with the partially bypassed cathode resistors should create a mid-boosted tone. This will not only help cut through the mix, but with a light distortion, I personally find preferable. To decrease the treble response further, you can reduce the grid-leak resistor to 470k, this will shift the response down an octave.

The capacitors on the potentiometers are there to retain the treble when the pot is turned down, the inter capacitances of the pot as well as the first order filter of the DC blocking cap and potentiometer will drain treble, the pF value caps can help retain a tonal balance throughout the entire sweep of the pot.



This is pretty simple, combine a good bit of gain, with a cold bias. A cold bias is a bias that is towards the 0v grid point on the graph. A warm bias sits more naturally towards cut-off as you get a more negative point on the grid. If you look at the datasheet, you'll notice that the more negative the voltages get, the more bunched up they become, the less current will flow. This creates a softer distortion, and largely 2nd order harmonics. Grid current limiting occurs when a grid becomes positive with respect to cathode, and sharply clips giving off strong 2nd and 3rd harmonics.

Note the diodes in this design as well, they provide an easy bias for the triode. You can use different types of diodes, LEDs will typically have a larger forward voltage drop and get easily achieve a 1-4v bias. The cap across is a 100nF again, the capacitors on the cathode to ground only need to be rated roughly 1.5 times the bias voltage. Although, it's easy to get 12-25v capacitors, any in this voltage range

will suffice, and be cheap. You can reduce the capacitor to 47nF on the diodes as well. 100nF is convenient and for the voltage range will most likely be the same cost as a lower value capacitor.

The colder bias in this design will give a more rough, classic rock type of overdrive compared to the warmly biased blues preamp above. The coupling capacitors will reduce the amount of bass in the preamp. Notice that, even though we are reducing the bass in the preamp, that the first stage is fully bypassed, you always want a full audio frequency spectrum boost in the first stage of your preamp, this makes the signal less susceptible to interference. To lessen the harshness of the distortion you could add another diode in series with either of the stages, the 2nd having more influence since the signal is boosted again before it. Or, use a capacitor from anode to power supply+ which would be 175 for the first two stages, or 200 for the 2nd two stages. One more method to calm the harmonics is to hook up a capacitor from anode to cathode, this causes negative feedback reducing the signal size of the harmonics, with more feedback with increasing frequency. The final capacitor is made large to allow all of the signals to pass with relative ease, so that it could be used as a pedal, if using this as an amp's preamp, the final capacitor can be made smaller.

One last thing that is introduced more heavily in this design than the others is the different anode load line resistors. These resistors allow you to not only tailor the gain of the stage, but also the way the anode voltage is modulated from the grid voltage. I'll go into detail in the tuning of the preamp section.

References:
[1] http://tubedata.tigahost.com/tubedata/sheets/127/1/12AU7.pdf
[2] http://tubedata.tigahost.com/tubedata/sheets/127/1/12AX7.pdf