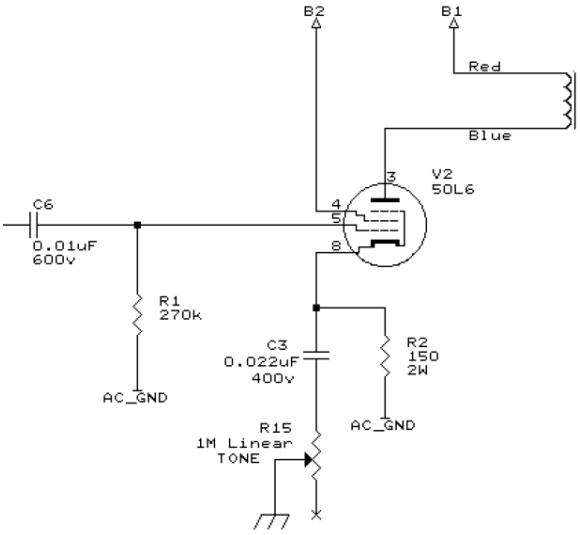
Frequency Response for AGS/Regal Model 300 Amplifier

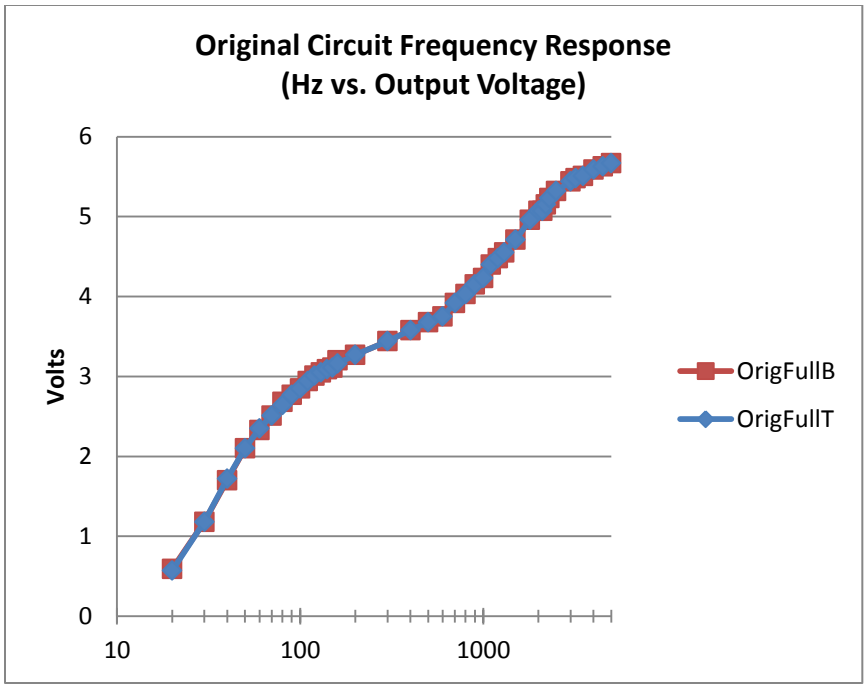
(rev 1 – last updated May 12, 2016)

The noted amplifier is fitted with a single knob for tone control –with full counter-clock-wise shown as ‘Bass’ and full clock-wise shown as ‘Treble.’

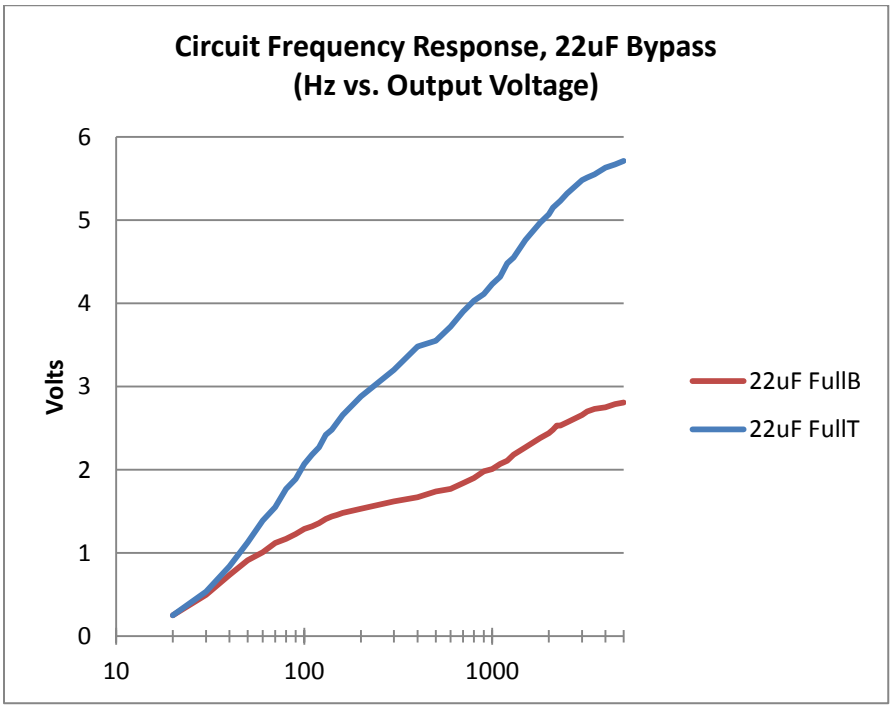
As implemented in hardware, the single tone control potentiometer is used to vary a resistance in the cathode circuit for the output tube, as illustrated in the schematic excerpt below:



While it is technically possible to vary the frequency response by adjusting the characteristics of the cathode bypass - the magnitude of the component values used in this case won’t actually provide any appreciable effect over the standard frequencies that would be encountered. Regardless of the setting of the tone control, the behaviour of the system does not change - as illustrated in the plot below (the trace lines represent the frequency response with the Tone knob at maximum bass and maximum treble):



Just to illustrate that tone control is possible with this sort of circuit - if capacitor C3 was increased by 3 orders of magnitude (e.g., a 22uF capacitor instead of the 0.022uF capacitor), then there would be some adjustment of frequency with the knob, as illustrated here:



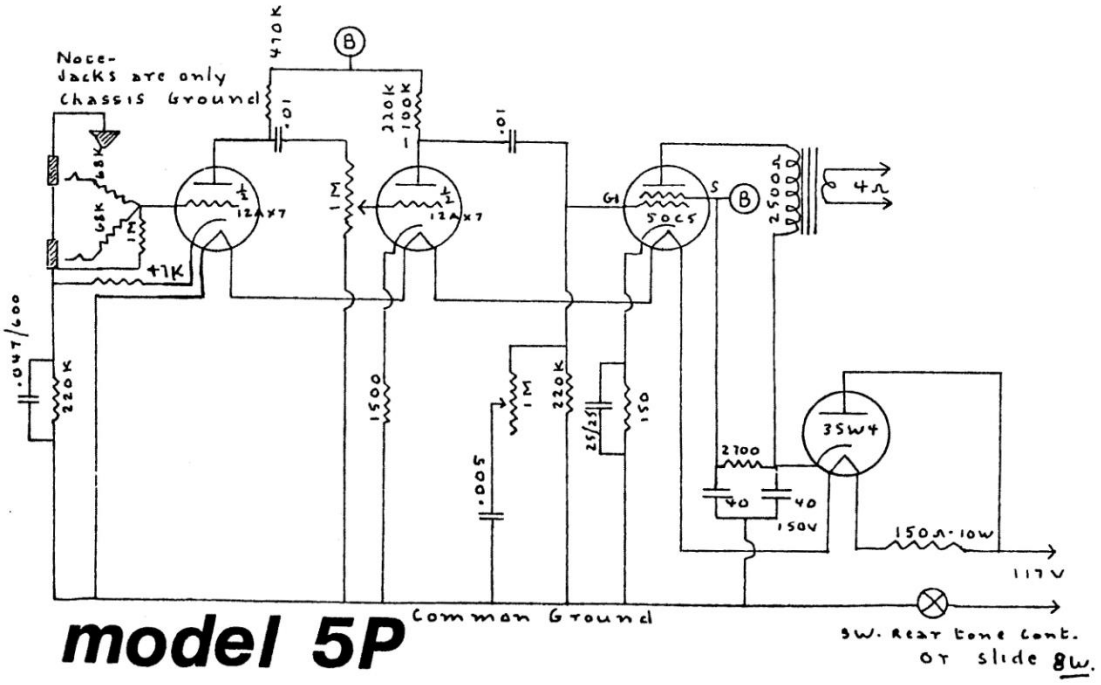
What we see here is that while the knob may be labelled “Bass” and “Treble” – the single control doesn’t really control both. Instead the knob controls just Treble, where the ‘bass’ end of the control is more accurately a ‘treble reduce’ selection.

(Note – while there was tone control seen with the 22uF capacitor, in this configuration the Tone knob only results in a significant change over a very small range of its motion).

As ineffective as the original tone control configuration is - this does appear to be how these units were shipped from the factory – as supported by the fact that separate instances of the same amplifier have been found with an identical wiring configuration.

It is unknown if the configuration was truly intentional at the factory (perhaps as a way to make the design 'different' from others - thus avoiding infringement claims to other similar amps), if it was an error in the original production information regarding the value of the components, or if the location of the connection of the capacitor/variable resistor was either specified or implemented in error.

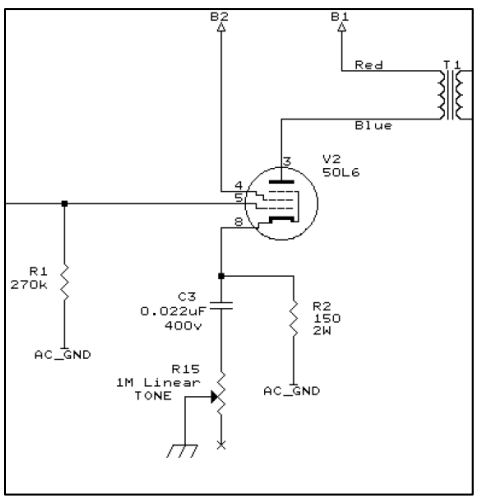
For this sort of amplifier, a more conventional approach to tone control would be to use a circuit similar to that in the Garnet Model 5P:

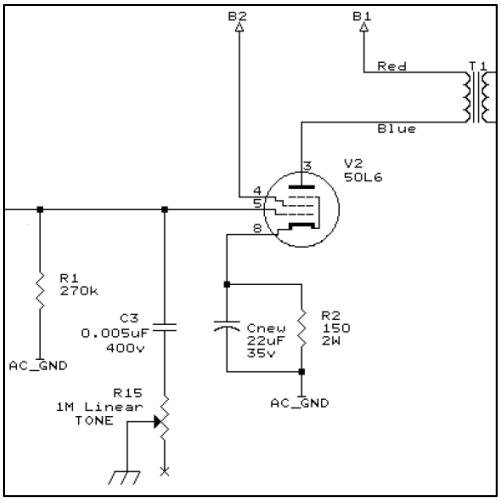


(Excerpted from 'The How and Why of Guitar Tube Amps as "Gar" Sees It', by Gar Gillies.)

In this case, the cathode of the output tube has a standard electrolytic capacitor (25uF, 25v) used to bypass the 150 ohm resistor – and the capacitor/variable resistor for tone control are connected to the input/grid of the tube.

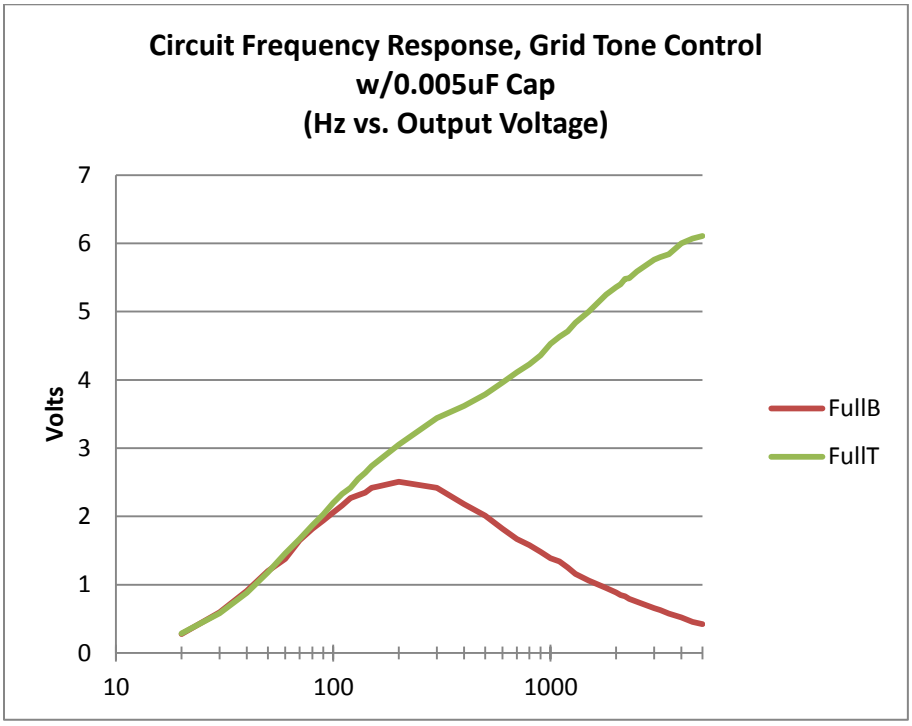
If this approach was taken for the Model 300 amplifier, the original schematic would change as illustrated below:





(Note – in order to maintain the same direction of control for the Tone knob – C3 needs to be connected to 'the other end' of potentiometer R15 since in the original circuit "minimum resistance" corresponded to maximum treble – while in the modified configuration "maximum resistance" corresponds to maximum treble).

Using this modified tone configuration, the circuit response becomes:

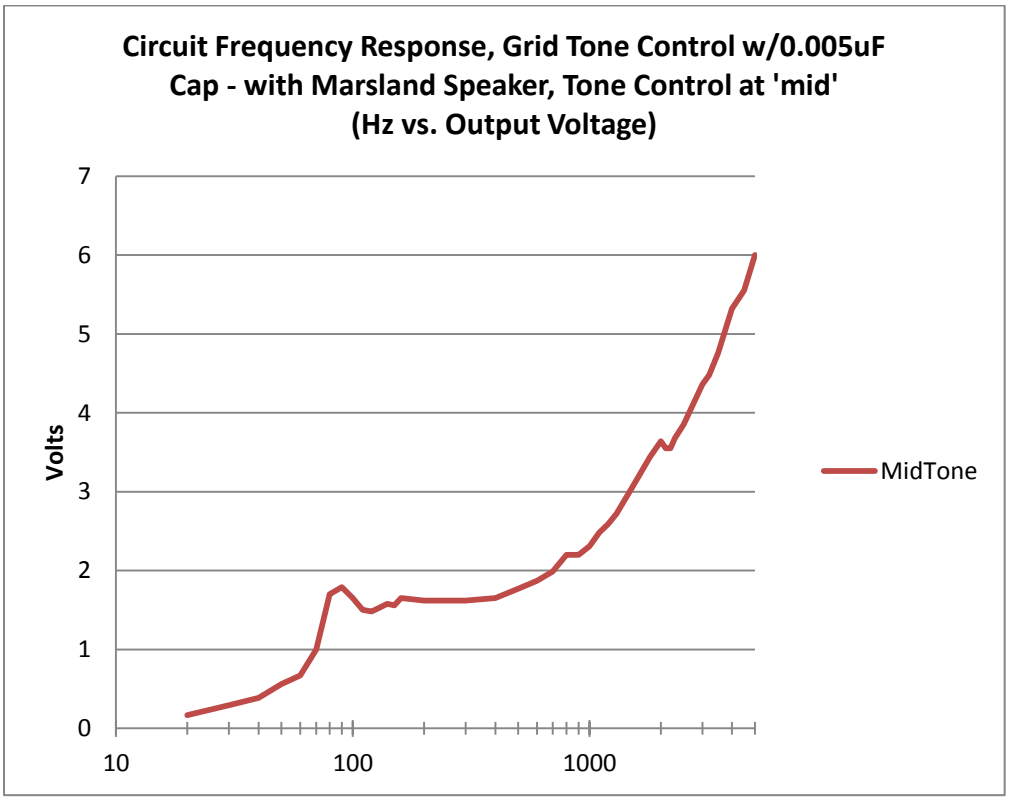


Here we can see that the change allows a quite reasonable adjustment of the response above 100 Hz or so, and is certainly more effective than the original circuit.

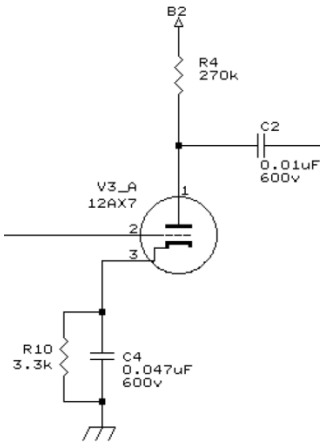
Note – the earlier response plots reflected the behaviour of the amplifier when driving a fixed 4 ohm load. (Purely resistive 4 ohm load, approx. 300mVpp input value – volume chosen so that clipping didn't occur at maximum signal level).

While this provides visibility into the overall control of tone, it doesn't necessarily reflect the end-to-end 'response' of the amplifier when connected to an actual speaker (which isn't consistently 4 ohms across its frequency range.) Speakers themselves will impart their own frequency response – including how the impedance changes with frequency.

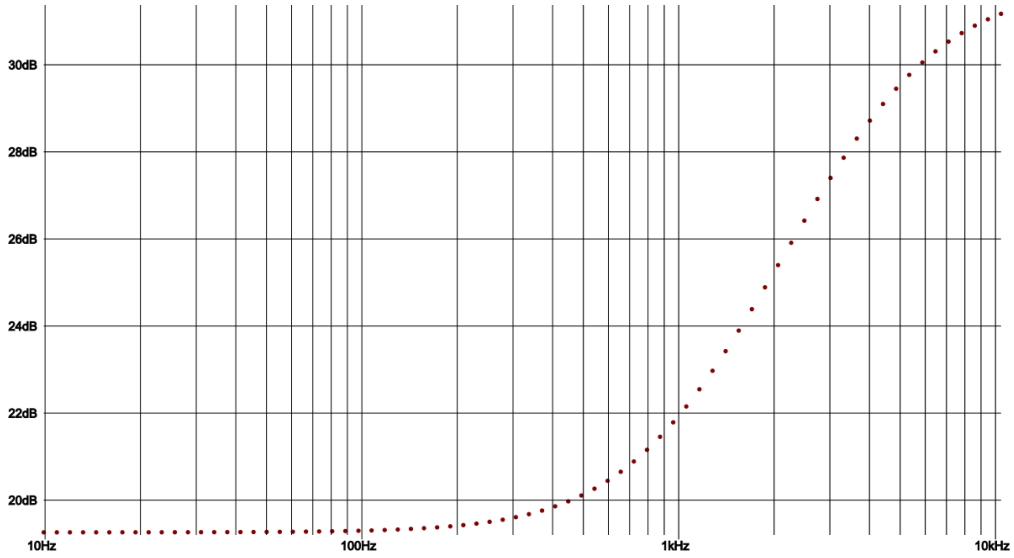
By way of an example, the following graph illustrates the response of the amplifier when driving the 8" Marsland speaker original to the factory configuration of a Model 300 combo.



Note - the input stage of the amplifier is as below:



Based on the values used, this cathode is only partially bypassed by R10/C4 – and so it won't be expected to give full gain across the full frequency range. Actually, we see a frequency response in this stage similar to the following:



Over the guitar frequency range, we have a lower bass response, and then after about 140Hz, an ever-increasing output. The response of this stage is superimposed over the tone control portion – thus impacting an overall 'increase in output with higher frequency' natural response of the end-to-end circuit.