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Subject: K200 repair / refurbishment summery update

Posted by [daveobergoenner@gmail.com](mailto:daveobergoenner@gmail.com) on Fri, 15 Aug 2014 15:45:45 GMT

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I was encouraged by SteveM to post this summery here, so others might find it more easily.

This should be (almost) the final update on the quest to repair and improve my K200a5 head. I use this amp mainly for bass BTW, into an early T&R Kustom 2-15 enclosure loaded with JBL E140-8 drivers (for a 4 ohm load).

Beyond all the bench measurements (below), I can tell ya after playing it last weekend, my K200 rig sounds AWESOME, and plays plenty loud to keep up with a LOUD drummer and guitarist!

The journey began when I started to notice the amp was distorting early, and just generally not sounding "right". After you play through an amp for many years, you just kinda know when things aren't "right" with it.

Once on the bench, I noticed my K200 was only making about 70-75 watts at the point of fairly heavy clipping on the positive side of the wave-form. There was also quite a bit of 120hz hum superimposed on the clipped wave-form. Clearly the original filter caps were tired, and due for replacement...but there was MUCH more to do.

What's been done so far (with bench measurements):

New 15,000uf 75 volt filter caps installed (had to mount them horizontally due to their height) (this completely cured the 120hz hum on the clipped wave-form)

New 25 amp bridge rectifier installed.  
(probably a good idea with such huge filter caps)

New MJ15015 output transistors were installed to replace the '75 date coded Westinghouse 2N3055's  
(these are beefed-up versions of the 2N3055 used for industrial applications. They also have very tight matching)

New driver transistors installed. I used NTE129MCP matched pairs, which is an NTE128/129 pair.

Nearly all the resistors on the PC702 output board were replaced with new carbon film versions. (many were as much as 250% of their rated resistance)

All electrolytic caps on the PC702 board were replaced with new low ESR/high temp types (Panasonic FM series).

Protection circuit diodes and transistors were replaced. (this was found to be the source of the early positive side clipping) I used "fast recovery" 1N3938 diodes. A 2N4401 NPN was used for Q705. An NTE129 PNP was used for Q709.  
(remember, those part designations will be different on the more common PC703 output board)

To reduce super-sonic noise pick-up, I rolled the high frequency response off above 20khz by adding a 330pf cap across the monitor output (to ground) from the power amp board. This made very little change at 20khz, but brought down the response at 100khz by about 10db. There's little point in having 100khz frequency response in a guitar amp IMHO.

A new, low impedance grounding buss was added from the common point of the filter caps, to the power amp and regulator boards.

I had previously changed most of the transistors on the pre-amp boards, and also on the summing/reverb board with newer, lower noise transistors. Mostly 2N4401 or 2N3904 NPN, and 2N4402 PNP. Some resistors were also changed on these boards.

The levels seem very low on the summing/reverb board, which makes it (potentially) quite noisy with the 1970 original transistors. I got my greatest reduction in hiss level from these transistor changes...more than 15db quieter afterwards. Newer transistors are MUCH quieter than what they had back then!

Since my K200a5 is a 4 channel PA head, and as a bass player I have zero need for 4 channels, I removed the power feed to the preamps for input channels 1 and 4. This reduced the noise (hiss) a db or two more.

Here are the final bench measurement results...

(all measurements done with tone controls set as close to flat response as possible...Bass at 12:00, Treble at 9:30)

All measurements done at 4 ohms into my 800 watt dummy load.

The 3% distortion point (which is defined by most folks as the point of significant clipping) now happens at 21 volts RMS. This equals 110.25 watts! The clipping is quite symmetrical now.

The amp can produce 110 watts from 30hz to 20khz at clipping. The frequency response is fairly flat over this range too...+/- 1.5db.

Below clipping, the distortion is mostly below 0.2%.

At lower power (5 watts) the distortion is an astonishingly low 0.04%! I attribute this to the superior matching of the driver and power output transistors, which yields very low cross-over distortion.

Noise is now more than 78db below maximum output. If you don't see the pilot light, you don't even know it's on!

(This amp had the very loud "Kustom K200 hiss" before.)

Keep in mind, all these measurements have been done from the instrument inputs on the front of the amp.

Frankly, this is WAY beyond the performance I was expecting to achieve out of a 1970, solid state, guitar/PA amp head! I hope this feedback can aid others along the way.

Many thanks to Chicago Bill, and Stevem for the advice along this journey!

Dave O.

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Subject: Re: K200 repair / refurbishment summery update

Posted by [chicagobill](#) on Fri, 15 Aug 2014 16:33:36 GMT

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Dave, thanks for posting this here. It will help others find their way through the trials and tribulations of vintage Kustom amp restoration.

Of course what you did was truly a labor of love and not the normal repair job. As I'm sure you know, this basic power amp design has been around for 50 years and is still being used today in a lot of modern amps. By replacing the old carbon comp resistors and the transistors, etc. with modern parts, you have brought the amp and the noise levels into the 21st century.

A question for you, did you do the power, freq tests, etc. with or without the fet input buffer?

Congrats on a great job!

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Subject: Re: K200 repair / refurbishment summery update

Posted by [daveobergoenner@gmail.com](mailto:daveobergoenner@gmail.com) on Sat, 16 Aug 2014 04:21:14 GMT

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Thanks Bill...couldn't have figured out that K200 protection circuit without your help!

I did all the documented measurements before I did the FET input buffer mod.

I repeated all the measurements after installing that mod, and nothing changed at all on the bench. The only difference is that now there's only a 1 meg load on the passive pickups...instead of the 50k as before.

BTW, I only modified one of the two remaining input channels...just to keep one "classic". The results have been quite stunning however. All my passive instruments sound SO much better into the FET buffered input.

Of course, my signal generator doesn't really care about the change in load.

Dave O.

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