

Hi Folks,

I am still working on my K100 which now appears to be a version from prior to Rev. 3 since it has no Q131. I am struggling to get the dead half of my power amp working. I have tried several things including replacement of the output transistors, drivers and most all of the resistors in the neighborhood. I may try replacement of the bias diodes next, but here are a few symptoms/questions for you guys:

- * At the base of Q126, collector of Q124 I am reading about 26.6 volts. This looks pretty consistent with the K100-1 schematic (same circuit), but the K100-2 schematics show 32.8 at the same location. Is 32.8 wrong? Seems odd that it would show up as 32.8 on the rev. 3 drawing and not have been corrected by the rev. 4 drawing - especially when it is 26.9 volts on the K100-1 schematics.
- * The problem I have is that the channel driven by Q128 and Q2 is not working. If I drive the output relatively hard and look at the signal at the base of Q2, I get approximately square wave of maybe 1/2 volt or so and no real contribution at the speaker terminal. (good news, is that I am getting about 10 watts out of the other channel operating class A until I hit asymmetrical distortion. Earlier stages don't appear to be distorting too soon or asymmetrically.)
- * This is the same thing that happened with the original driver transistors. I replaced Q127 with a 2n3440 and have tried the original transistor as well as a 2n25415 and a 2n5416 for Q128. Currently the 2n5416 is in and when it was installed I immediately got a high current draw situation with things getting hot. I shut down the amp and need to address that. But otherwise, I get the base drive signal mentioned above which is the basic problem. Any reason these transistors shouldn't work?
- * I disconnected the protection circuit at the diodes to see if that was a contributor but there was no change (except that perhaps not having it in could have contributed to the high current situation when I later tried the 2n5416).
- * I replaced the 1 ohm resistors which had drifted with a pair of matched resistors. I also replaced the 95 ohm resistors in the protection circuit with 100 Ohm 1% (they were 5% in my circuit - should I try to get closer to 95 ohms?). R205 and R207 were replaced with 1% 2 Watt resistors. Most if not all relevant resistors have been replaced with metal or carbon film resistors of correct value.
- * It appears that the Q1 side is working well and putting out about 10 watts into 8 ohms before asymmetrical distortion sets in. No sign of unreasonable asymmetrical distortion in stages prior to the driver.
- * It seems to me that Q2 and Q128 must be turned on suggesting a bias problem. Perhaps the diodes are bad. They test good in-circuit, but I know that is not always reliable. I shorted out all the diodes which I think should have likely led to an output from Q2 (albeit with crossover distortion), but saw the same signal at the base of Q2.

* I replaced the power transistors Q1 and Q2 with matched MJ15015s for good measure and nothing seems wrong there. They test the same when I pull the wires as they did out of the circuit and Q1 is obviously working like a champ.

* Some DC readings Q126 collector =-3.6V, Q128 Base =-0.7V, Q124 Base = 47mv, emitter=0.6V, Q125 base=54mV. I forgot to bring other voltage readings with me.

I am at a loss at this point. Any suggestions would be appreciated. I have double checked my replacement resistors to assure myself that I didn't do anything wrong, but if something seems suspicious, I'll triple check.

Thanks,
Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [stevem](#) on Fri, 03 Oct 2014 16:05:38 GMT

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I do not have the time right now to go over what you have posted in detail right now, but I will latter, but I need a clarification from you as to what you mean when you say that on one channel you get hardly any power output, but on the other you get some 10 watts.
The K100 -2 only has one channel, is this a pA head?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Fri, 03 Oct 2014 17:14:25 GMT

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Sorry, poor choice of words. I mean one half of the push-pull output is not working - all push, no pull. Q1 seems to provide up to about 10 watts of output prior to starting to clip and Q2 essentially contributes nothing to the output. Sorry for the confusion.
Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [chicagobill](#) on Fri, 03 Oct 2014 19:28:46 GMT

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Jerrybass1955 wrote on Fri, 03 October 2014 12:14Q1 seems to provide up to about 10 watts of output prior to starting to clip and Q2 essentially contributes nothing to the output.
I'm still confused, Q1 is working up to 10 watts and Q2 is off? From your posts, you are looking at the signal with an oscilloscope right? Then what does the waveform look like at the output, top and bottom of the sine wave both there?

What are the voltages at Q2 and at Q1?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Fri, 03 Oct 2014 20:27:08 GMT
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Sorry for the further confusion Bill.

I'll have to check the voltages again after I change the driver back - hopefully this evening. I somehow missed bringing all of my notes with me today.

I am indeed using a scope, and that is what threw me. Thanks for asking about the power. I just realized my math error. I am getting about 9V peak-to-peak sine wave on the scope at the speaker terminal (nice sine wave) before clipping starts (on one side of the waveform). Obviously, having thought about it, that is more like 1 watt rather than 10 watts**! But it appears that the output is all coming from Q1. The base of Q1 is a nice sine wave. The base of Q2 is the crappy little square wave I described.

** I guess if Kustom had thought of it, I would probably be working on a K200 (watts x 4)

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Sat, 04 Oct 2014 13:07:14 GMT
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Here is a bit more data - DC voltages:

Q1 E+.06, B+.62, C+40.1

Q2 E-39.9, B-39.3, C-.03

Q126 E-33.3, B-25.8, C-3.6 -> is B at -25.8 OK, some schematics say -32.8, others about -26?

Q127 E+.62, B+1.2, C 39.9

Q128 E-.023, B-.62, C-.39

Power supplies were at about 40.5 and 8.3 or so last night. Varies a bit with my line voltage which runs a little high.

Seems like something is turning Q128 and Q2 on pretty hard I guess, but can't figure what it is unless it is the diodes.

I reconnected the protection circuit on the scope, but I couldn't see anything that looked overly suspicious. Any thoughts?

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [steven](#) on Sat, 04 Oct 2014 23:19:40 GMT
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I am not home now to try and rap my head around this , but off the top of my head a 9 volt peak to peak sign wave into a 8 ohm load sounds like about 10 watts to me!

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [chicagobill](#) on Sun, 05 Oct 2014 04:19:59 GMT
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Looks like Q128 Collector voltage has a decimal that shouldn't be there. What are the voltages at Q124 and Q125?

The -26 volts at the base of Q126 is bothersome to me as the differential voltage between the base and the emitter should be less than a volt, you've got 6 volts.

Have you tested other resistors in the power amp? How about the tantalum caps?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Mon, 06 Oct 2014 15:10:25 GMT
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Looks like I won't get back to this for a few days, but I wanted to comment.

Bill, you are right, that looks fishy there to me too. Took the measurements rather quickly and didn't really think about it until you pointed it out. I'll take the measurements again when I get back to the bench in a few days. For now, I pulled the board out to clean up resin and do a detailed visual inspection to see if I spot something amiss. I'll re-measure when I get done and post back in a few days.

As far as power, unless my math fails me, for a sine wave $V_{rms} = V_{peak}/\sqrt{2} = V_{p-p}/(2*\sqrt{2})$, so $9V_{p-p} \Rightarrow 3.2V_{rms}$
 $Power = V*I = V^2/R$ so for $3.2V_{rms} \Rightarrow (3.2)*(3.2)/8 \text{ watts} = 1.2 \text{ watts}$. But in 60s 70s Kustom puffery math, it probably does equal about 10 watts!

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [steven](#) on Tue, 07 Oct 2014 11:13:03 GMT
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What resistive load where you driving the amp into and was that 9 volts p to. P clipping ?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Tue, 07 Oct 2014 14:37:38 GMT
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I was driving an 8 ohm resistive load.

Made some progress last night, but don't know how much. I cleaned up the solder side of the board to get rid of most of the resin and scraped between close solder joints to assure no threads of solder between them. I then did a bright light and magnified inspection of both sides of the board. Didn't find any part replacement errors, but I found a broken transistor lead, a carbon comp resistor that may have a hairline crack and a couple of questionable solder joints. After I fix those, I will take more readings if there are still problems. Cross your fingers!

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Fri, 10 Oct 2014 15:27:26 GMT
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Good News! Doing the repairs based on my last post seems to have the power amp going. I read just over 20Vrms at the output with an 8 ohm load. That is just over 50 watts, so I guess it is pretty much working now. I didn't bother re-measuring all of the DC voltages, but I am reading about 26 volts at the emitter of Q124 and about 32v at the emitter of Q125. VBE is around .6 or so for both. Oddly, I still see the small square wave-like signal at the base of Q2, but the output looks pretty good and sounds clean.

One significant power amp section issue remains - It seems that Q124 is a bit unstable. A touch of the emitter with a voltmeter probe sends it into oscillation at about 18Khz. I am also seeing a bit of oscillation or ringing at one side of the output signal just before it clips. Tracing back, it seems to start at Q124 (nothing at Q108 - recall I don't have a Q131), so I suspect the two symptoms may be the same problem. Q126 has been replaced with a 2n3440, so I guess the load is a little different, but it may just be a bad transistor at Q124 or something. Anyone have thoughts about this phenomenon? I am going to replace Q124 (and probably 125 to get a reasonable match), but if that doesn't work, what do you suggest (or what do you suggest instead). And should I use 2n4249s or a more modern transistor (note the voltages are a bit high in this area - Q125 has over 30 volts from collector to emitter.)

Thanks guys and sorry about the earlier wild goose chase.

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [chicagobill](#) on Fri, 10 Oct 2014 17:01:45 GMT
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Glad to hear that it's working again. The oscillation is probably due to the replacement transistors

that you have used.

I've had this happen in the larger heads when all of the outputs and drivers have been changed to modern parts. It doesn't always happen just sometimes when the moon is full and the frost is on the punkin.

I figure that the newer transistors have been built using modern technology that allows them to work at higher frequencies than the old transistors could. So what was a stable circuit now has ultrasonic parasitic oscillations that are caused by lead dress, pc layout, etc.

I usually add snubber caps on the drivers and it will go away. That reminds me, did you check C140 on Q126? Do you have a C140 on your version of the board?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [Jerrybass1955](#) on Fri, 10 Oct 2014 18:35:44 GMT

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Hi Bill,

I do have a C140 and it is 47pf. I was also considering upping that value to 100-150pf while I am in there since the new transistor likely has a wider bandwidth. Q124 and 125 are real live 2n4249's, but I pulled them and tested them - one had very high gain and the other pretty low gain (below spec - maybe 70 or less if I recall). I matched a couple of 4249's up pretty close and replaced both with moderately high gain 4249s. Perhaps I should see if I have a pair that are lower gain and swap them out? I also wonder if replacement with a less noisy transistor would minimize the any noise contribution from kicking off the oscillation. Any advice?

Where would you put a snubber on Q124? Across R194? Collector to base? Any suggested value? I tried jumpering a cap in to see if I could get rid of the oscillation, but with about 8 inches of lead I didn't have much luck. Tapping a relatively large cap across R194, I could get the oscillation to stop and stay gone for a while after I removed it, but clipping seemed to kick it off again.

Jerry

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp
Posted by [chicagobill](#) on Fri, 10 Oct 2014 19:37:22 GMT

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I add the snubber from C to B on the drivers and that usually fixes it, but I don't remember if I've ever done this on K100 head or not. I use a 47 or a 56 pf ceramic cap. Like I said this doesn't happen that often, but it does happen.

As for the higher value on the pre-driver, it might help, but I don't know when it will start to effect the high end response of the amp.

Matching the two differential inputs will help to reduce any output stage offset voltage, but I don't think that it will help to stop the oscillation.

And of course be sure to check all of the grounds and C139 for that matter. Remind me what parts have been replaced in the power amp section so far, the output ballasts and the voltage dividers in the protection circuit, the driver transistors, what else?

Subject: Re: K100-2- Pre-Rev-3...no Q131...1/2 the power amp

Posted by [Jerrybass1955](#) on Fri, 10 Oct 2014 20:29:54 GMT

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This part of the amp was rather extensively rebuilt.

Q124 and 125 replaced with same transistor type but matched

Q126 and 127 replaced with 2n3440

Q128 replaced with 2n3416

Q129 and 130 original

Q1 and Q2 replaced with matched MJ15015

CR107 and 108 replaced with 1n4148

All polarized caps replaced with Panasonics

Most resistors replaced with carbon film or metal film.

Ceramic caps are original.

1 ohm resistors replace with matched set

R207 and 205 replaced with metal film 2Watt resistors (after one fried while the amp was not working right).

Q108 was replaced with a 2n2222 (I believe).

Voltage divider resistors in protection ckt was replace (R213 and 214 are now 100K 1%, R209 and 212 are 510 ohm 5% carbon films that I selected to match).

Heat sinks added to Q127 and 128.

Jerry
