Subject: Transistor replacements anno 2023
Posted by claussoegaard on Wed, 18 Jan 2023 14:04:47 GMT
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Hi - me again. Still working on my K200A-2. Trying to get as much of the background hum coming out of the PC702 board to go away as possible. Tested all resistors out of circuit and found a handful of noisy ones and replaced them. That helped a lot! However, there's still some noise, and I suspect some of the transistors could be noisy/leaky. I won't go into a wall of text of my findings, but I'd like to swap a few suspect transistors out to help test the idea. So I am looking for transistor replacement help. I found an old post from 2007 from chicagobill, but even those NTE replacements he mentions I struggle finding, unless I want to try my luck with a handful of different eBay sellers. So here's what I'm looking for.

PNP: 40406 / 38734 / 2N4249 / NTE159 -- Modern/commonly available replacement?
NPN: 40408 / 36735 / NTE190 -- Modern/commonly available replacement?
NPN: 2N3567 / NTE123 -- Modern/commonly available replacement?
PNP: 2N3638 / NTE129 -- Modern/commonly available replacement?

Any help would be awesome! I could try finding the datasheets and try finding transistors with similar gain and voltage/current ratings, but I don't know enough about transistors to know if that's all I need to look out for to match them? So expertise help would be greatly appreciated!

Thanks!

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Wed, 18 Jan 2023 22:02:13 GMT
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Well first off transistors do not produce hum, then can only amplify it if it's getting feed into them.

Are you talking about hiss / white noise like when a radio is in between stations, if so then transistors can make that type of sound.

I I would first do is one at a time disconnect the wires feeding the power amp board on its left side. They are 4700 ohms/ r701 and 702.

If this lowers the noise then you know the driver / power amp section is not at fault.

With these preamp boards the volume control is after Q101 and 102.

If the volume control does not effect this noise then those two transistors which are the most likely are be that would add a lot of hiss are not the cause.

If you unhook the blue wire that feeds board 302B and run it to one of those 4700 ohm resistors you can bypass that board and prove out that preamp board.

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Fri, 20 Jan 2023 11:37:23 GMT
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All the NTE Transistors you are asking about are available from NTE parts direct.

The 129 does however need a big clip or slip on heat sink.
If by process of elimination you find that the driver/ output board is making most of the hiss then the first two or three Transistors are the likely ones.

Subject: Re: Transistor replacements anno 2023
Posted by claussoegaard on Mon, 23 Jan 2023 19:15:52 GMT
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Hi again, and thanks as always for your responses Steve.

First off - I'm still learning and probably not making the best troubleshooting decisions. So let me first explain why I was looking at PC702 and transistors. It is because I have been trying to get rid of some hum. In trying to figure out where it was coming from, I tried disconnecting the preamp boards and just pull the PC702 inputs to ground through some 2.2k resistors. And the hum was still there. So I felt I could eliminate all the preamp, effects and regulator boards, and assumed it had to be that remaining PC702 board. Then I started poking around while it was turned on, and noticed that the first three transistors on PC702 (Q701, Q702, Q703) were all quite microphonic and producing noise/crackling when I poked them. And Q703 is quite hot. Not burning, but definitely warm to the touch. I unsoldered all three and tested them on a "Atlas DCA" component tester. Interestingly Q702 had an hFE of almost 400! And looking at the 40406 and NTE159 datasheets, the max should be 200 or 250. So it's out of spec. Not sure if that even matters, but those things had me suspicious of those transistors and that board.

SO - all of that is just to explain why I was asking about transistors. I have since realized that the hum I'm hearing is 100hz hum. Checking both on a guitar tuner and my scope, to confirm it is indeed 100hz hum. On my scope it looks like ripple voltage - like a long tail waveform, if that makes sense. And it's roughly 40mV peak to peak.

Let me note that I got the brand new replacement 4500uF caps you recommended in another thread, so I am not suspecting the filter caps to be at fault here. However, just for kicks, I decided to parallel in the old caps as well. The 100hz hum is still there, but it dropped to around 30mV peak to peak.

Anyways, now that I'm done rambling, let me take a step back. Before I keep driving myself crazy with this, maybe I'm chasing something I shouldn't even be chasing? How much 100hz (or 120hz in the US) background hum should actually be expected on an amp like this, and is there a way to measure it? Maybe this is just how the noise floor is on this amp? Would love some guidance on this if you have it.

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Mon, 23 Jan 2023 22:13:25 GMT
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Hi.
With what you have gone thru so far I want to say that the low level 100hz hum that you have is due to unmatched 2n3055 output transistors.
If the pairs on each leg of the power supply are not matched close enough the. They can not phase cancel out that low mv of ripple voltage.
If you measure the ripple voltage you have on the speaker output with a volt meter you can tell which of the two pairs of outputs unmatched.

If the DC voltage you read is positive then that's the pair of outputs it coming from, if it's negative then it's the other pair that is at fault.

This is my best guess at this point for what's going on with your amp.

Subject: Re: Transistor replacements anno 2023
Posted by claussoegaard on Tue, 24 Jan 2023 08:24:17 GMT
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Thank you Steve - I will try to figure out which of the two pairs potentially are unmatched. I have a pack of six replacements, hopefully two of those match.

Follow-up questions to that:

1) Is it the hFE that needs to match so they have matching gain factor?
2) Do you know of any place that sells matched pairs, in case none of mine match and this does appear to be the issue? A quick google didn't come up with anything.

Subject: Re: Transistor replacements anno 2023
Posted by claussoegaard on Tue, 24 Jan 2023 18:11:06 GMT
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The output jack measures +0.11 VDC, which per your message means the Q3/Q4 pair (attached to positive rail) is unmatched, yeah?

That also checks out with my measurements. I measured the hFE of all four, and three of them were very close, but Q4 had almost double the hFE. I know hFE isn't the full story for matching, but still. Interestingly, both Q1 and Q2 were very close to Q3, Q5 and Q6. So I tried to swap Q1 for Q4. It took the offset DC voltage down to +0.10 VDC. Not a huge improvement, but an improvement none-the-less.

That does bring me back to my prior question - is a 0.0 VDC offset even achievable? With "perfectly matched" transistors, should I be able to basically eliminate all 100hz hum?

NTE Parts Direct is not an option for me in Europe, but I'm going to see if I can source some NTE130MP sets from somewhere else, to see just how much 100hz hum I can eliminate and report back.

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Wed, 25 Jan 2023 12:11:14 GMT
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Getting the gain matched well may only be part of the cure in trimming down the DC offset condition you are having.

Some of it can be due to how each Transistor is biased and in turn what they are idling at, just like outputs in a tube amp.

Any resistors around the driver and outputs that are over 1K in value should be 5% in tolerance. Off the top of my head I know there are a few 3900 ohm resistors in that output section .

Have you replaced c705?

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Wed, 25 Jan 2023 12:14:35 GMT
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It might be cheaper in the end as faster to just order up a fist full of 2n3055s in your neck of the woods and use the ones that match up closer then what you have now.

Just compared to the shipping cost from the US you might get 6 Transistors in hand to pick from.

Subject: Re: Transistor replacements anno 2023
Posted by claussoegaard on Thu, 26 Jan 2023 09:28:58 GMT
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I have actually replaced every single transistor on the 702 board.. I bought all the values I needed in the Vishay MRS25 series. They're 0.6W rated, and 1% tolerance. Not necessary for most spots, but I figured, why not? The reason I did that is that I started testing the old carbon comps, and the first ten all measured more than 20% over their stated value. Some as much as 50% over. And at least a few of those were super noisy on my scope. So I decided to just "screw it, I'm replacing them all". And that actually did cut down my noise a good amount. This was a few weeks ago, so the 0.1 VDC offset we're talking about here is AFTER I've replaced all those. It was way worse before, but I don't have a DC value. So in short, I think resistor-wise we should be good.

What's the deal with c705? It has been replaced, yes. Along with it's counterpart c706. They're the two big 80uF 50V caps. They were actually 100uF on the board, not 80uF like the schematic. But those had also drifted a lot. One of them measured like 140uF. So that's why I replaced those. I

used some nice nichicon ones. But I'm curious why you asked about that cap? Is it because it goes from the signal path up to the positive rail? Possibly leaking some DC onto the signal?

As for transistors, I found someone that ships NTE stuff to Europe, so decided to throw in three sets of matched pairs, so then I won't have to do the matching myself.

I'll report back how that goes, and if the hum persists after that.

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Fri, 27 Jan 2023 11:12:48 GMT
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Yes, I was thinking it might be leaky.

Subject: Re: Transistor replacements anno 2023
Posted by claussoegaard on Tue, 07 Feb 2023 09:29:49 GMT
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Do these amps, even in perfect working order, still have some amount of 100hz (120hz in the US) hum? I wonder at what point I should stop chasing more improvements? Like I mentioned above, currently I have around +0.1v DC on the output jack. I have no idea of that's "normal", "bad", "good", whatever?

Subject: Re: Transistor replacements anno 2023
Posted by stevem on Thu, 09 Feb 2023 00:36:41 GMT
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If on that positive rail you disconnect each 2n3055 one at a time does the 1/10th of a volt go away?
