

Yeah, no problem with that at all! I'll be sure to forward a pic if/when it gets the new case.

On Fri, Oct 1, 2021 at 4:37 PM Stephen L <[steveAT](#)> wrote:

Congratulations Ryan! That's great news! Excellent mental work to think about the 5089 pinout. I think doing a nice wooden case for it is a sterling idea. Would love to include a photo of it (with attribution of course) in the *Summary of Modifications* section. Let me know how it goes. I will be happy to help if anything else comes up. I can sleep a little more soundly tonight, knowing that little mystery is cleared up :)

PS: I'd like to post a summary of the finding and results in the Reader Comments section. Please let me know if you have any problem with that.

Cheers,
Steve

Ryan W wrote on 10/1/2021 6:36 PM:

Big news!! It WORKS!!

I was sitting down with it last night and after fiddling with the power supply portions for awhile and still finding no faults I started to think about what possible fault could be affecting both channels equally. It would seem to indicate an issue outside of the PCBs since the likelihood of making the exact same error on the both channels (or a blown component in the same position) would be so low. But then I realized what COULD be likely is that if I had the pinouts written down wrong for one of the transistors I replaced, I put them all in at the same time so it was pretty likely that they would be misaligned on both channels. I looked up the pinouts on all the transistors again, starting from scratch, and then went over them one at a time. Sure enough I had the 5089 pinouts in the wrong orientation on both channels. I switched them around and it was smooth sailing from there! Makes me wonder if that accounts for why there was no sound at all most of the way through the volume until the very end, where it scaled up quickly. Certainly was going to behave screwy with the biases the way I had them arranged. Luckily it appears that none of them were shorted and everything appears to be working smoothly now!

To clarify on the computer: I do have an external audio interface with my computer, it's for recording music so it has an extensive i/o with its own volume knob for the outputs. Dunno if that classifies as a pre-amp, I guess that term is situational here. I had been experimenting with the phono inputs and my record player mostly before this and that started working correctly as well with the adjustments I made last night.

So I'm all good! Now I'm gonna work on building a nicer case for it, I agree that it would look a lot better with some finished wood paneling on there. Thanks so much!

On Fri, Oct 1, 2021 at 7:43 AM Stephen L <[steveAT](#)> wrote:

Hi Ryan,

It seems that you are in an excellent position to have some fun exploring electronics! Thank you for the enjoyable romp through your background and efforts on the Cortina.

Ah yes, the turn-on thump is the notorious bugaboo of amps with a single polarity power supply. But if it'd had a bipolar supply, they couldn't have used the classic, gloriously-simple, five-transistor power amp circuit which was a key reason I was attracted to the Cortina 3070 in the first place. You may not notice the turn-on thump much these days because, to some extent, the output caps can hold their charge between turn-ons.

When you first get an old amp though, the caps may have no charge. Also, after it's been used a while after long storage, the output caps reform and their leakage drops, so they hold their charge longer. Come to think of it, if the caps are leaking a LOT at first, the leakage itself may contribute to the turn-on thump.

About an oscilloscope: If you'd like to have one, good ones go for low prices these days on eBay. This one jumped out at me in a very brief look: <https://www.ebay.com/itm/313693991364?hash=item49099e71c4:g:XfIAOSw9rVhVkhw>

But the trick would be to find one close enough to you to pick up. Just make sure it's operating well. (May I ask where you're located? I'm in Roswell, GA.) I think your inclination to avoid PC dongles is well-taken. Having a dedicated instrument for this basic function helps you concentrate on the troubleshooting instead of getting caught-up in PC and dongle issues.

When you say the cases of Q1 and Q2 do you mean the collectors? I measured both of them at 46 volts. Base and emitter were measured at 23.5 and 22 volts, respectively.

--- Yes, that's fine. I just wanted to make it easy to get a reliable check on basic power supply operation. (Didn't know you have a good background for digging into it.)

* I plugged in my external preamp from my computer into the aux spot and noted that if I turn up the incoming signal enough on the preamp (maybe about 25-40% than I normally would when I sent it out to my headphones) I can get a pretty loud output from the speakers, probably not surprising either. I am not currently playing music for long periods of time in this manner, don't see that being a good idea.

--- This is interesting but I don't completely understand what you meant by "I plugged in my external preamp from my computer into the aux". The only electronic devices here are the computer and the amp, right? I guess you meant you connected the line-level output from the computer into the aux input on the amp, eh? (There is no preamp hardware involved?) Well maybe you *did* mean there was a preamp between the computer and the Cortina. Whichever, it seems to boil down to: if you add some gain from the computer to the Cortina OR perhaps crank up the computer line level output enough, you can get a "pretty loud output from the speakers". The problem is just that you expected to get a lot more output for the level of input and volume setting. I take it that both channels are working okay like this but you are afraid something is wrong, with PC and amp volume having to be cranked up.

So maybe we just need to prove that the Cortina is putting out a reasonable amount of power for a reasonable amount of drive. Line outputs can be quite low these days. Also, headphones can be very sensitive, so if you've been listening to the Cortina on phones, you may be expecting a lot more level at low volume settings. In fact, the "Line Stage Noise Mod" section at the beginning of page-2 of the article grew out of testing it with phones. The amp had to be made a lot quieter *after* the volume control. Do you happen to have a turntable handy? You could try the phono input, cutting the PC out of the picture. Was thinking you said something about the phono...

As long as the output transistors aren't getting hot, I doubt there is any harm in operating with high levels from the PC and/or the volume setting high. In fact, I would encourage you to run it as needed to explore better what is going on but at first, you might want to have the cover off so you can check on the output transistor temperature. (Remember that there is voltage on the transistor cases though.)

* most interesting to me is that even when I cranked the incoming signal, the amp doesn't produce any sound except in the last 5% or so of the volume pot, and then it goes from silent to quite loud very quickly. Its quiet all the way up until the very last portion of gain, and its the same whether the signal coming in through the aux is cranked or not. Dunno if that indicates anything notable. But seems a bit

odd, figured it would be more consistent across the range of the pot.

--- This is troubling. Does it happen on both channels? I'll have to consider whether there is an easy way for you to characterize this effect. Perhaps you could use a program on the PC to produce noise or a tone and then use your DMM to measure output level from the amp. If the result seems bad in some way, I could compare the 3070 I have.

Steve

Ryan W wrote on 9/30/2021 6:49 PM:

I'm pretty much self taught (books and youtube) in what I know so far regarding electronics. I built a few guitar pedals about 4 years ago, I got about half of them working, all from kits or circuit designs I found online. I read a few books on general concepts at the time but it takes awhile for a lot of the ideas to really sink in, especially since I have limited opportunities to use the skills. Oh, and once I fixed a friends TV by switching out some bad caps. This project is really my first return to the hobby in a couple years and I find that a lot of the knowledge I gained earlier is starting to come together in a more coherent way. Essentially I can look at a pretty basic circuit and follow the flow and predict how it will behave but once you start throwing lots of components together it can get kind of tricky for me. My soldering skills are probably adequate but nothing to write home about. If I am locked in and not hurrying myself I can do a good job (not applying too much heat, being able to tell when the lead and pad are both hot enough to ensure it flows correctly) and I've gotten in the habit of testing continuity on pretty regularly to make sure I am making good contact.

I've read through the Make: Electronics book and a book on general electronic repair recently. I can comprehend them both fairly well at this point and feel my knowledge in the area has grown a lot recently.

The math of circuit work is certainly comprehensible to me and I can apply Ohm laws and various equations to predict correct measurements but I don't have that on any sort of instinctual level, so its pretty slow for me to do any work involving that area.

I only have a multimeter available to me currently. It has a wide range of functions but I'm definitely limited in a lot of ways, I think the upper range for capacitance measuring is 250 uf or so. I don't have an oscilloscope available to me, but I'm planning to check in with the local maker lab to see if they have one handy. I do have a program I've recently downloaded to use my computer as a multitool but I don't have any hardware to utilize it and now sure if i want to go that direction, it sounds a bit tedious and I'd also prefer not to risk messing up my computers audio devices in figuring it out. I'm gonna keep an eye on craigslist as well for a scope, hoping to come across one sooner or later.

I misread about the "HUM", you were referring to a thump that comes on through the speakers. I haven't noticed a thump via the speakers when I switch it on though, although I usually have the volume turned all the way down when I am doing a test run. I'm not sure what I heard when I first switched it on in the store, could just be misremembering things. It definitely wasn't some big show with smoke coming out, caps popping, etc.

The fuses are all in good shape still and oddly were not blown when I first bough it, despite many of the transistors seemingly shot, maybe someone had switched them. I replaced the two fuses with the recommended 2 amp fast blow kind.

When you say the cases of Q1 and Q2 do you mean the collectors? I measured both of them at 46 volts. Base and emitter were measured at 23.5 and 22 volts, respectively.

Thanks for the safety tips! I'll use them tonight to verify the transformer is working properly. I bet that when I touched the cap it shifted something near the area and created a short, that makes sense. The spark appeared right over the cap though, but it was over in an instant. Also power was not being applied when it occurred. I'll keep testing components in that area but everything appears to be functioning correctly still. And yeah, the joint that blew off was likely not a good one, it was an area that I hadn't done a full resolder job on, I have since wicked away all the old work and resoldered, looking much better now. I have also spent a lot of time checking all the other joints in recent days and touching up anything that looks suspect, hasn't seemed to get to the root of the issue yet.

Okay, so a couple updates and possible insights I gained:

- * I tested CR5-CR8 out of circuit with the diode function on my DMM and they are all still in good shape, resoldered.
- * I got some deoxit in the switches and pots to clean them up, didn't seem to make a big difference, but probably good maintenance
- * I've noticed when I switch it off after running it for awhile that none of the case on Q1-Q4 really have any heat, nor the surrounding area, probably not surprising considering it isn't doing much amplification.
- * I plugged in my external preamp from my computer into the aux spot and noted that if I turn up the incoming signal enough on the preamp (maybe about 25-40% than I normally would when I sent it out to my headphones) I can get a pretty loud output from the speakers, probably not surprising either. I am not currently playing music for long periods of time in this manner, don't see that being a good idea.
- * most interesting to me is that even when I cranked the incoming signal, the amp doesn't produce any sound except in the last 5% or so of the volume pot, and then it goes from silent to quite loud very quickly. Its quiet all the way up until the very last portion of gain, and its the same whether the signal coming in through the aux is cranked or not. Dunno if that indicates anything notable. But seems a bit odd, figured it would be more consistent across the range of the pot.

I'm gonna get back at it tonight and test the transformer and take some more voltage measurements, try to predict where it should be versus where it is.

Thanks again!

- Ryan

On Thu, Sep 30, 2021 at 5:56 AM Stephen L <[steveAT](#)> wrote:

Hi Ryan,

I've looked over the images and didn't see anything obviously wrong. First, could you fill me in about your level of experience with electronics? That will help tailor my explanations and will help guide what we can do in troubleshooting. Also, what test equipment is available? You mentioned a DMM. Do you have an oscilloscope?

You said, "I got that big "HUM" that you mentioned when it first powers on but when I turn it on now it doesn't seem to be doing that..." I don't recall writing about that; could you point me to the section you were referring to? Getting a "big hum" at power on could be a clue. The POP you heard could also be significant. Have you checked the fuses since then? What voltages are you seeing on the cases of Q1

and Q2?

You asked, "Is there a sure fire way to test the transformer to make sure its operating correctly?" Yes, you can set the DMM to read AC volts and touch the leads to the two red wires which go from the transformer to the rectifier diodes. (Polarity doesn't matter.) I would expect to read roughly 32Vrms.

By the way, regarding your comment, ("I don't know about testing it when power is turned on, I don't wanna fry myself or my equipment"), it's certainly good to to be cautious. Some advocate the "one hand rule," which is to keep one hand in your pocket while you're testing with power applied. Also, it's best to remove any rings from your hands. But it is necessary to troubleshoot with power applied. Other than the 120VAC mains wiring, the voltages in the Cortina are low enough to prevent harm to you if you make contact. I imagine the +45V (40 written on the schematic) might give an unpleasant sensation to a casual touch but technicians wouldn't normally consider it dangerous.

As you apparently discovered, the DC power supply CAN deliver a lot of current if shorted but the fuses should generally prevent much excitement. Shorting the DC supply *before* the fuses could cause damage though. Also, a short in the wrong place can damage transistors. Regarding your paragraph:

I also accidentally came in contact with the side of a power supply cap and almost immediately after it gave off a big enough spark to dislodge one of the solder joints on the diode diamond. I didn't come near either of the leads on the cap though, so I was a bit confused about what was going on there. It was the cap that mounts right alongside the housing for the power supply though, could it have been an arc from the power supply?

--- This is puzzling. The voltages aren't high enough to arc through the plastic cover of a cap or across any significant air path. There must have been metal to metal contact. It's possible that there was a short nearby and it just appeared that it was related to your being close to the side of a supply cap. I guess you mean the cap at the bottom of your first photo, IMG_20210924_000204.jpg, next to the transformer housing. That's either C8 or C9. The outside can of those is the negative side which is connected to ground. If the +45V line from the cathodes of CR6 or CR8 came into contact with ground, it would cause a spark. It's likely that some or all of the rectifiers in the "diode diamond" would be damaged. It's a good idea to replace CR5,6,7,8 if that's what happened. Any of the diode series 1N4003 thru 1N4007 can be used for that. It seems odd that "it gave off a big enough spark to dislodge one of the solder joints on the diode diamond". If so, it must have been a very poor solder joint, almost ready to break anyway.

Best Regards,
Steve

Ryan W wrote on 9/28/2021 8:03 PM:

Hi Steve, thanks for the offer to help! I'm pretty bound and determined to get things working one or another so anything you can offer is appreciated.

I checked the switches and it appears that they are working correctly (used continuity on my DMM). I also measured the resistance on the volume pot and it looks like it has edged up to about 770k ohm when cranked (manual has it listed as a 500k pot) but it still has the full range and connections are solid so I don't see that being the issue unless there's more I'm missing in terms of testing it.

Here's something though. I feel like when I plugged it in at the store (this was months ago though) I

got that big "HUM" that you mentioned when it first powers on but when I turn it on now it doesn't seem to be doing that, it seems a lot more subdued when it powers on. Like I said though, the light still comes on, so it's delivering some power. Also, when I first powered it on after my repairs and mods I distinctly remember hearing a "POP" after a few seconds, it sounded like it came from the underside somewhere, maybe a cap blowing? But when I looked closely I did not see damage anywhere on the board and afterwards the voltages I took were all correct, so I didn't know what to make of it. I also accidentally came in contact with the side of a power supply cap and almost immediately after it gave off a big enough spark to dislodge one of the solder joints on the diode diamond. I didn't come near either of the leads on the cap though, so I was a bit confused about what was going on there. It was the cap that mounts right alongside the housing for the power supply though, could it have been an arc from the power supply? I know, I know, I learned my lesson to keep my hands clear since then, especially around big caps, and I'm discharging them regularly after I power down. I'm just glad I didn't get a big shock. Is there a sure fire way to test the transformer to make sure its operating correctly? I read a bit online about checking for shorts and opens and it appears okay on that front but I don't know about testing it when power is turned on, I don't wanna fry myself or my equipment.

I have since tested all the power supply and filter caps and they all appear to be functioning correctly and correctly oriented. I replaced pretty much all the electrolytics early on the repair job since I don't have a good meter for cap measurement and I didn't want to fuss with leakage or other aging factors down the road.

My next step will probably be to remove the entire power supply diode diamond and check them out of circuit and then resolder them. They all appear fine in circuit but the joints are all kinda messy so I figure why not, not sure where else to look for the time being.

Anyway, thanks again! I'm also attaching pictures of my work so far, I don't expect you to pour over them and check all my solder joints but I figure why not, just in case I have something clearly out of whack in my build.

- Ryan