VC528 ST2+ RV1 CMRR Trimmer

Now that you have completed the build of your VC528 ST2+ module, we need to calibrate and adjust the RV1 trimmer potentiometer for optimum CMRR. This **must** be done before you rack the module and put it into use. There have been a few previous projects around the lab that require a similar adjustment. Peter Cornell's Green Pre comes to mind immediately. The overall concept is identical so if you have built that project and are comfortable, please feel free to apply those same technique to the VC528 ST2+.

If this is your first project with the need to adjust such a trimmer, this document will take you through the procedure, step by step.

First off, CMRR is short for *common-mode rejection ratio.* This is the ability of a device to reject signals that are common to both + and – input leads. Since the VC528 ST2+ has a balanced, *transformerless*, discrete, input amplifier stage, we have a trimmer potentiometer in the circuit to help compensate for variations in components that are used for both the + and – input signals. Even though the four 10kΩ resistors are .1% precision, this trimmer is still required.

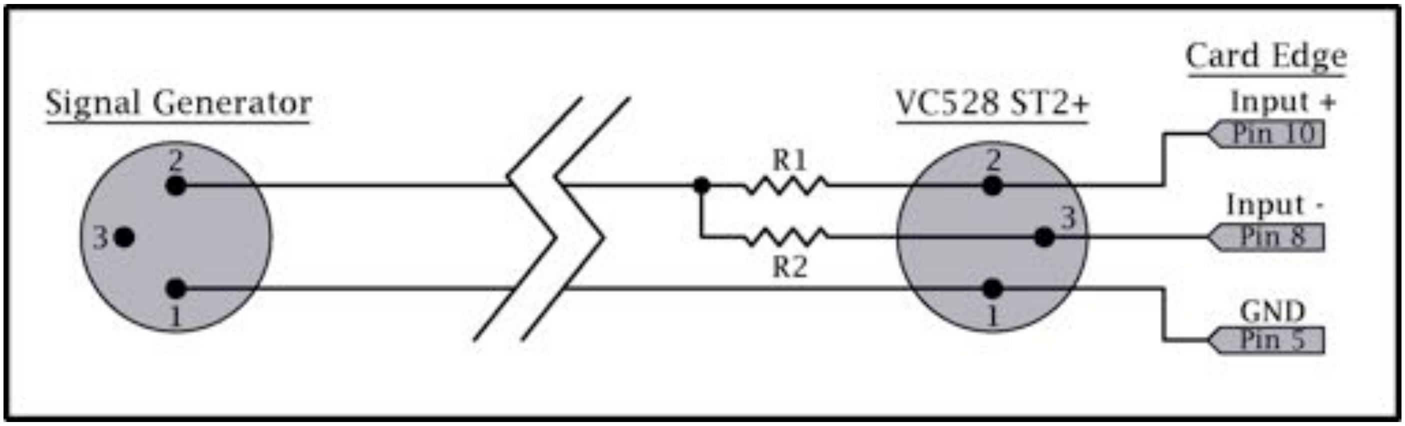
So, basically what we are going to do is inject an identical signal into both the + and – inputs of the module and adjust the trimmer so that the differential gain of the discrete opamp is null, or as close to null as we can get.

Things we will need:

- A special cable (description to follow below)
- Signal generator of some sort
- Small straight blade plastic or ceramic screwdriver (Wiha makes some nice ones)
- DMM, oscilloscope, or preferably DAW inputs
- Some nail polish (color of your choice!)
- About 10 minutes of time

OK, Let's Make a Special Cable

I have a cable near the bench that I have labeled CMRR. It's about 3 feet long and has XLR connectors on each end. Sounds normal except the male end has a matched pair of .1% precision, IRC brand, 750Ω resistors in it. The internal connections need a little more explanation so here is a schematic to help make things easy.



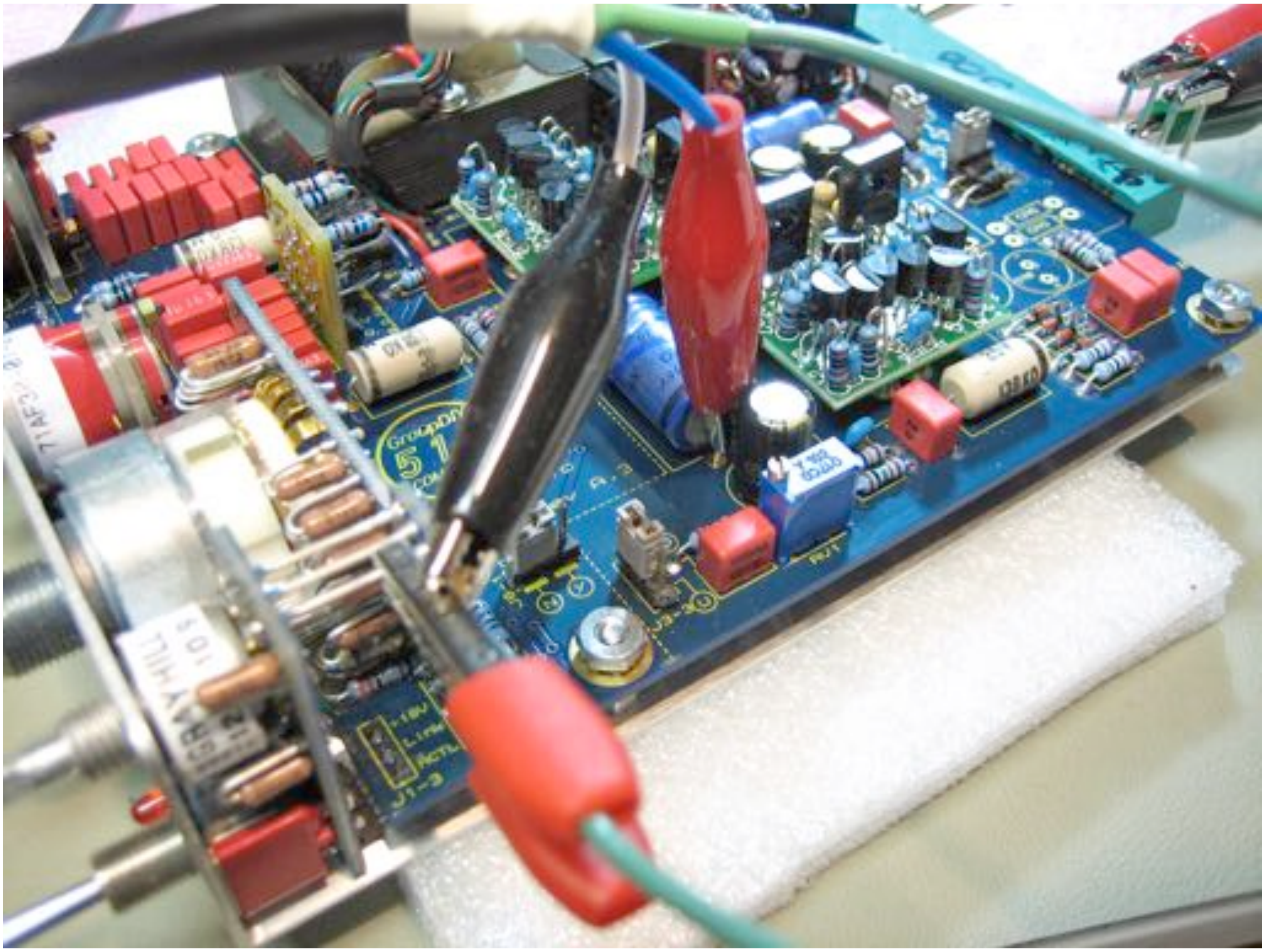
The value of R1 and R2 are not extremely important. The important thing is that they match each other to the best of your measuring equipment's tolerance. Any value between 100Ω and 1kΩ will be perfectly fine. My cable was built with 750Ω as that's what I happen to have close when I made it. I went thru eight or ten .1% IRC's and matched a pair as close as possible. If you want to maybe just solder your matched resistors to a card edge connector, that is perfectly fine to. The cable is a luxury that may make things easier if you have more than one module to adjust or think that you will in the future.

Signal Generator to VC528 ST2+ Connections

Assuming that you have your cable built or other input means ready, lets now connect to the signal generator. For the test frequency, I like to use 400Hz. If you have no other way than a DMM to measure the opamp's output, this is probably a good choice. A little lower is fine too. If I recall, Peter suggested 100Hz as most DMM's are not very accurate especially once you approach 1kHz. So, with the cable connected only to the signal generator and frequency selected, lets adjust the output for about 1V AC. Connect your DMM to the resistor end of the cable. Red probe to pin #2 and black probe to pin #1. With your DMM set to read ACV, adjust the signal generator until you read about 1V on the DMM. For my setup, I am at +9dBu which gives me just over 1V at each pin. For now, mute the outputs of your signal generator. With your VC528 module laying flat on a bench in front of you, connect the signal generator using a card edge connector. We will of course need bipolar power to the module as well. The PSU should be off at this time.

VC528 ST2+ to Monitoring Device Connections

Next we will connect our device used to monitor the output signal from the A1 discrete opamp. I prefer something with a visual numerical readout in dBu. Something like the inputs to a DAW. I myself use an Audio Precision, but the DAW concept is identical. I use a cable with alligator clips on one end and the other end an XLR. The XLR end goes to the AP's inputs. I have the alligator clips attached to the preamp as shown in the picture below. Pin 2 is to the negative end of C3. Pin 1 and 3 both connect to the solid lead that is between J2-3 on the two small PCB's.



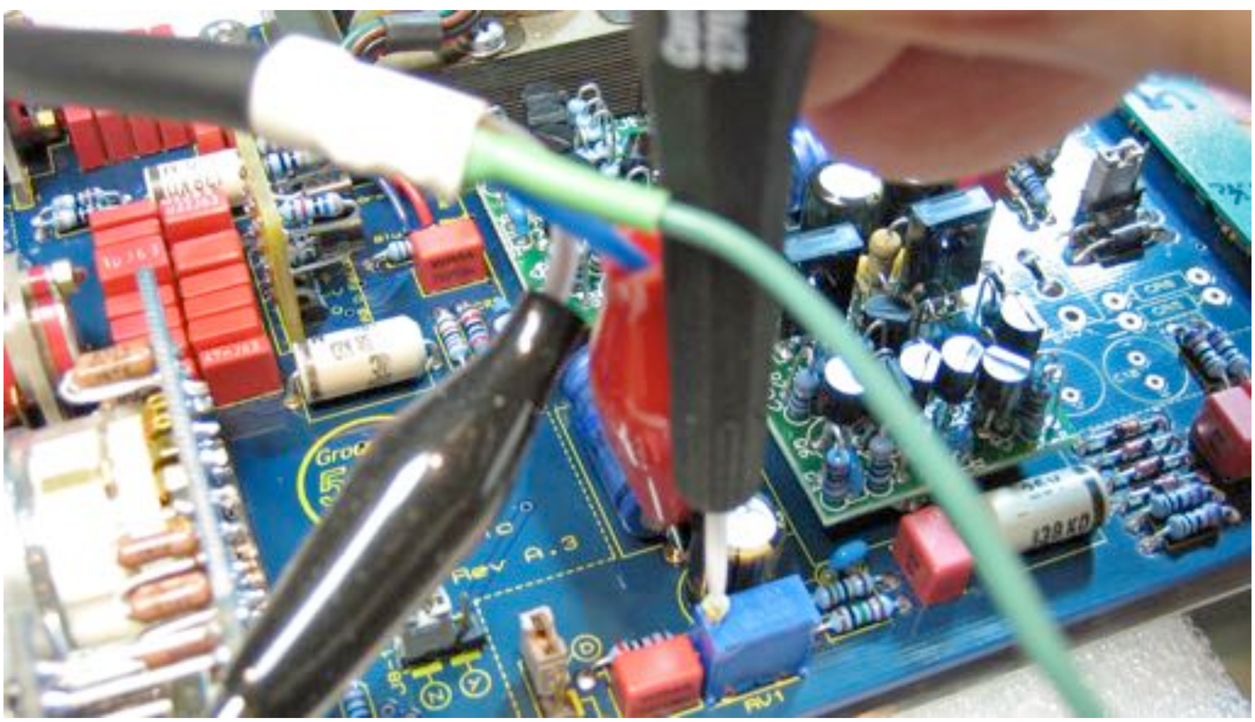
Alterations may need to be made if the inputs of your DAW do not like pin 3 shorted to ground. Some may need to let that float. If you are using a DMM or a scope, these are the same points where you can hook your probes.

Let's Turn These Things On

First, activate the signal generator's outputs. Next, turn on the PSU for the VC528 ST2+ module. Lastly, activate the DAW's input. At first power up, with my current setup, I get a reading of around –40dBu. With my bench meter connected instead of the AP, I have an AC reading of 6.9mV. This all may vary a little but is not crucial.

Making The Trimmer Adjustment

Using a plastic or ceramic screwdriver, start turning the RV1 trimmer clockwise.

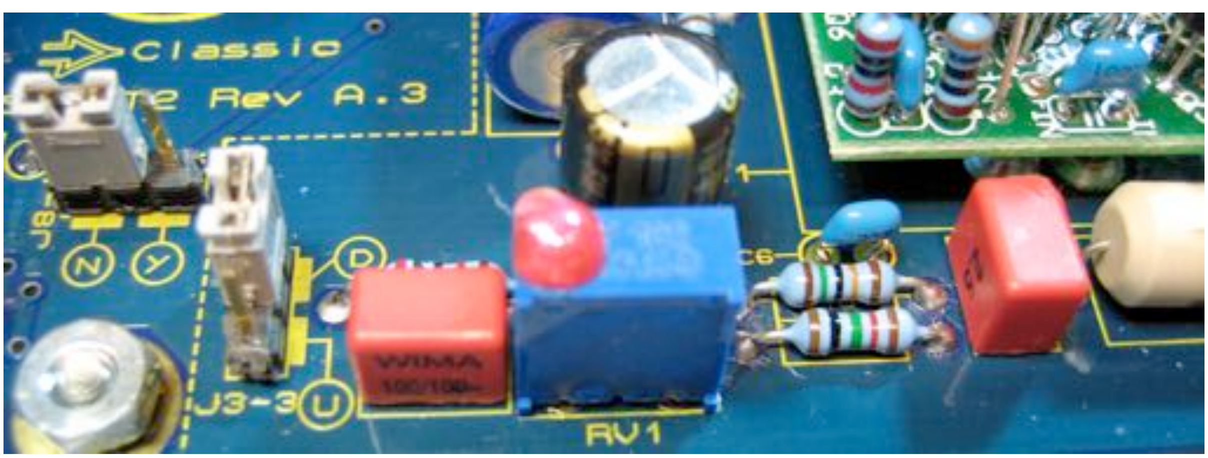


Watching the DAW screen, you will see the level decrease. Same thing if using a scope or DMM. Keep turning until you find the lowest possible value on the screen. You will get to a point where the level starts to increase again. Go back a turn or so and then turn clockwise and stop at the lowest level. For the particular module I just completed, the lowest level I could hit on the AP was flickering between –74.95dBu and –75.15dBu. This number is not the actual CMRR.

I did have my bench meter connected simultaneously. When my meter hit 0mV, the AP was at only at –68.73dBu. If you do not have a DAW or scope and are using only a DMM, I would recommend making a mental note of the trimmers position once you hit the lowest reading. From there, count the rotations until the DMM reading increases. Then go back and simply divide the rotations by two after hitting the lowest measurement. I say *lowest measurement,* because not every setup will yield a 0mV reading. A reading of .1mV or .2mV is also fine. The important thing is to find the lowest possible position for the trimmer.

The Final Step

The last thing we will do, is keep that trimmer in this position. If you don't have any Electrolube Anti-Tamper Seal around, a little dab of fingernail polish will do the trick nicely. It will keep the adjusting screw secure and it can easily be broken loose if future adjustments are required. Just a dab is enough. Whatever color you desire!



A Few Summary Thoughts and Notes

The opamp in the receiver position will dictate how low of a level you can reach during this procedure. I have noticed that I can get the lowest level while using an SL-2520 in the receiver position. A gar2520 is a close second with a gar1731 a touch behind that. From my research, there is absolutely no issue with any of the mentioned opamps. Also important to mention is that the trimmer should not need to be changed if you change receiver opamps. I believe this is mostly due to the methods that Scott and Gary both use to match the input transistor pair for their opamps.

A plastic or ceramic tipped screwdriver is recommended since they have no magnetic properties. A small jewelers screwdriver *can* work but you will probably notice your readings change slightly once you remove the tool from the trimmer.

Note: For the subject module, I had a *built by Gary*, gar2520 in the receiver stage.