Customizing the output voltage of the diyaudio store superreg project

Ever since the Jung/Didden superreg has been available from the diyaudio store do I get emails from people asking how to customize the output voltage to their specific needs, like '*I want to power my super duper XYZDAC with a superreg, what do I need to change?*'. I hope you understand that I am not set up to provide individual consultation for this, but this little guide should help you forward. Mr. Ohm is your friend here. My references are to the schematic in the diyaudio store, for the positive output regulator; of course values are the same in the same positions for the negative regulator.

The most important insight is that in normal operation, the two inputs to the opamp are pretty much equal in voltage. As the stock unit uses a 6.9V LM329 reference diode (D5), connected to the non-inverting input, immediately **you know those opamp inputs need both to be at 6.9V.**

The output voltage is divided down by R14 and R13 for the inverting input. So if you want 10V output, R14 and R13 need to be selected so that this 10V is divided down to 6.9V at the inverting input. So there must be 6.9V across R14 and (10-6.9=3.1) across R13.
This give us a direct and simple equation: R13/R14=3.1/6.9. Assuming you select R14 first, then R13=(3.1/6.9)*R14. Like when you select R14=4.9k, then R13 needs to be (3.1/6.9)*4.9=2.2k. (You may need to play a bit with the R14 value so R13 comes out an existing value).

For the positive regulator, the system is the same but with resistors R6 and R7 instead of R13 and R14, of course.

Almost done now. You also must make sure that the opamp output is at a voltage halfway the supply voltage so it will work best. That is done by selecting zener diode value for D7 at close to half the output voltage. For instance, again for an assumed 10V output, a 4.7V or 5.1V zener would be fine; it is not at all critical. Done.

Now, some astute readers will have noticed that with this method you can only get output voltages down to 6.9V and not lower. That is correct, so if you want a 5V or 3.3V output, you must replace the reference diode D5 with something that is lower than the output voltage you want. There are a lot of 2.5V reference diodes available, and these would be good for 5V and 3.3V.
The equations will still be the same but the 6.9 value I used above should then be changed to the new value, like 2.5 in this example. It is easily seen that in the case of a 5V supply, and a 2.5V reference diode, R13 and R14 become equal.

For these low output voltages, you can use a couple of small diodes like the 1N4148 or even an LED for D7 as very low voltage zeners are relatively rare.

Don't forget to check that the reference diode D5 is set up correctly; select R5 so that there's a few mA going through D5. For example, with 12V output and the LM329, there will be (12-6.9=5.1V) across R5. For a 2mA bias into D5, R5 should then be 5.1/2=2.55k). A standard 2.2k would be fine of course. Check the ref diode data sheet for recommended bias current for your ref diode.

Last important point: as the opamp is supplied from the output voltage, you must use an opamp that will work on this voltage. For high output voltages check the maximum opamp *total* supply voltage; at the other side, for 5V or 3,3V make sure the opamp works with supplies down to those values. This may be a good opportunity to actually read a data sheet ;-).

With the stock board and on-board heat sink, the maximum output current is about 1A. Higher currents are possible but that needs major changes which are outside this blog.

Have fun,

Jan Didden