

Dear Reader,

The Silonex NSL-32R2 is a terribly manufactured part. But they sound like heaven. The Lightspeed Attenuator designed by GeorgeHiFi of DIYaudio.com is by far the very best passive pre-amp I have heard. There is perfect clarity, widened sound stage, separation of instruments, and seemingly infinite detail.

This preamp is not for every system though. You need a source of less than 50 Ohms output impedance and an amp with greater than 60kOhms. If you would like to drive a different amp there is the option of having a buffer along with it. This paper does not discuss the buffer any further.

The parts necessary are:

1. 5VDC 200ma or greater regulated power supply.
2. 100k dual log/stereo potentiometer (quality does not matter in this part)
3. 4 100Ohm 1/4W resistors
4. 1k-5k trim pot
5. A few feet of high quality signal wire.

The LDR is a light dependent resistor. It is a capsule that contains an LED and a light sensitive resistive material. Shining light on the resistive material decreases the resistance and less light increases resistance. We get more light by applying more power to the LED.

Consider that there are 4 wires on the LDR. 2 wires are short. They are for the LED. There is a dot on the capsule near one of these short legs. This denotes the cathode of the LED and this takes the -V or GND. The other two wires are long and are in a sense bipolar. They are the legs of the resistor and both legs serve the same purpose so there is no negative or positive here.

If we take two of these resistor legs, one from each of two LDRs, and twist them together we have formed a potentiometer. The top resistor has one free leg and one twisted leg. The free leg gets the signal from one channel of your source. The twisted legs both are the output of this potentiometer and will go to the signal input of your amplifier. The last leg goes to signal ground. If we vary the power going to the resistor that gets the signal (series resistor) then we control the volume of the music. If we vary the value of the resistor going to ground then we vary the overall output impedance of the potentiometer. Your amp will like to see a steady output impedance. The value of the series resistor plus the value of the shunt resistor equals the output impedance of your potentiometer. So as the series resistor increases or decreases in value we want the shunt resistor to do exactly the opposite. If series is X and shunt is Y and output impedance is Z then  $X+Y=Z$  and if we decrease the resistance of X then we want to see something like  $(X-2)+(Y+2)=Z$ . Your amp wont like  $(X-10)+Y=Z-10$ .

So you can see that all we need is a mechanism to change the brightness of the LEDs in the inverse of each other. If we put 5VDC through the 100k pot we can use it like a rheostat to change the brightness of the LEDs. A dual log pot has 6 legs on it. 3 for each section as it has 2 sections. If we solder pins 1 and 2 together with a tiny piece of wire on the first section of the pot and then solder pins 2 and 3 together in the same way on the second section we have just created two variable resistors that change in resistance opposite of each other. One increases while the other decreases. Now we solder pin 3 of section 1 to pin 1 of section 2 and solder a wire from +5VDC on your power supply to this new connection between pins 1 and 2 that connects the two sections of your pot. When power flows through a resistor the resistor divides the current so we get 5V at varying current which in turn varies the LEDs brightness and hence the resistors resistance.

We need to put a 100Ohm resistor in series with the + side of each LED so that there is no chance of the LED getting to much current and burning out.

The 1k-5k trim pot is an important piece of the puzzle. This allows us to make up for matching differences. What's this? The Silonex LDRs sound better than anything but their resistance does not increase linearly and it also does not increase predictably nor does it increase in one LDR the same as it does in another LDR if you were to graph it out. So we need to buy multiple (25 or more) LDRs and

measure their resistance at several different currents, then graph it out and find LDRs that 'track' in a similar fashion. When you find two that match set them aside and begin to find another two that match each other. It is not necessary that all 4 match each other but the series resistors must match and the shunt resistors must match. It is good to have all 4 close to each other but not at all a necessity. If they series are not close to the shunt then our  $X+Y=Z$  will waver around a little bit effecting the output impedance. Small swings of output impedance are not a concern. Back to the trim pot. when the series or the shunt sets of resistors do not match each other well then we can adjust them by putting the 1k-5k multi turn trim pot in series with the one LED who's resistor is measuring a lower resistance. Now as we increase resistance to this LDR the LED dims and the resistance increases, thus we can make the LDRs match better and the balance will be correctable bringing the stereo image back to center on your sound stage I like to use a real pot as a trim pot so that I can adjust it like the volume control on the outside of my pre-amp's enclosure.

So, the summary:

1. Short pins 1 and 2 of section 1 on your dual log pot.
2. Short pins 2 and 3 on section 2 of your dual log pot.
3. Short pin 3 of section 1 with pin 1 of section 2 on your dual log pot.
4. Supply the short in step 3 with +5VDC
5. Run wires from pin 1 of section 1 to two different 100Ohm resistors.
6. Connect directly or with wire the 100Ohm resistors from step 5 to the Anode of the two series LDRs.
7. Run wires from pin 3 of section 2 to two different 100Ohm resistors.
8. Connect directly or with wire the 100Ohm resistors from step 7 to the Anode of the two shunt LDRs.
9. Run wires from -VDC of your power supply to the Cathode of each LDR.
10. Choose a series and a shunt LDR and twist one wire from each together with each other.
11. Repeat step 10 with the remaining LDRs.
12. Solder the free wire from one of your series LDRs to the signal pin of your input RCA.
13. Repeat step 12 with the other series LDR and the signal pin from the other input RCA.
14. Solder the twisted LDR leads from step 10 to the signal pin of the corresponding output RCA.
15. Repeat step 14 with the LDR leads from step 12 with the remaining output RCA signal pin.
16. Solder the LDR lead that is remaining on each series/shunt combination to Signal GND on the input and output RCA GND collars.
17. Turn it on with no source or amplifier connected and turn the volume up in a few different steps. Lets say 7 o'clock, 10 o'clock and 1 o'clock. Measure the resistance of each series LDR at each step and record it. When you find that one LDR has less resistance than the other then this is the LDR which needs a 1k-5k multi turn trim pot Remove the 100Ohm resistor from the Anode of the LDR in question and solder this trim pot in place after shorting two of its 3 pins together to make it a variable resistor.
18. Repeat the measurement parts of step 17 and adjust with the multiturn pot until both LDRs have a similar reading.
19. Plug in the CDP to the Pre-Amp and the Pre-Amp to the Amp and try it out.
20. If it is instantly loud when you have it turned down all the way then you need to reverse your wiring on your 100k dual log pot because your series resistors are getting full light and your shunt resistors are getting no light so your volume is actually all the way up. This means 1 and 2 of section 1 need to be reversed with 2 and 3 and 2 and 3 of section 2 need to be reversed with 1 and 2 and then 1 of section 1 and 3 of section 2 will be shorted and supplied +5VDC. This should solve that problem.

Many people have suggested using a linear supply. I have found switched to be fine but you could also use batteries. If you build your own supply try to double regulate using either two LM317 to step down

voltage twice to get to 5VDC or use a LM317 along with a LM7805 to double regulate. The power supply is up to you and really the ONLY place you can tweak. Sorry :) The 100k dual log pot you can now see does not need to be a quality pot. It does not carry a signal. Only the LDRs do. I suppose you could use silver signal wire and expensive RCA connectors but thats about it for tweaking. Build it and it will amaze you.