Stepped Attenuators – The Final Instalment?

Neville Roberts

I have been running my WAD PreII pre-amp very satisfactorily for some time with a stepped attenuator using a 2-pole 23-way wafer switch and a set of standard Philips metal film resistors. With reference to Figure 1, the attenuator is of the shunt design where Rx is fixed and the switch selects the appropriate value of Ry to give the required attenuation. The advantage of this design is that there is only one pair of resistors in the circuit at any one time, as compared to a resistor string attenuator where all the resistors are in circuit. As every resistor generates its own noise, minimising the number of resistors in the signal path is very desirable. However, a shunt design presents a variable input impedance to the signal source, depending on the switch position. Although this is not a great problem in practice, it is not an ideal situation.

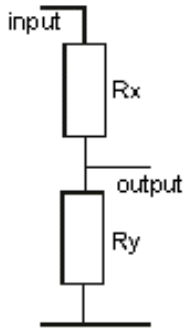

Figure 1. The potential divider of each step.

I was therefore delighted to find a commercially available attenuator of the switched ladder design that switches pairs of resistors for each step and therefore presents a constant input impedance to the signal source. It is currently available directly from the manufacturer, KYC in Taiwan, via eBay through their 'Buy It Now' facility that bypasses the bidding process and makes the transaction like a normal internet purchase. I cannot give the exact web page address at this will vary each time the item is re-registered on the site, so just search for "VISHAY DALE Stereo Stepped Attenuator". Alternatively, contact KYC via email on kyc111@hotmail.com. Several values of attenuator are available, including 50KΩ and the 100KΩ version that I required for my WAD PreII. The cost of the attenuator is 1,750 Taiwan dollars, (which is under £29) and postage to the UK was quoted as 6.50 US dollars – all very confusing! However, this works out at less than £33 including postage to the UK. For a design that uses 88 good quality metal film resistors and a military standard switch, this has to be a real bargain! From the copious photographs provided on the eBay web page, it looked very well made and was worth the money for the switch alone. The web page also contains the input and output connection information as well as all dimensions. I therefore took the plunge and ordered the 100KΩ version. It arrived safely from Taiwan after about a fortnight from placing the order and making my payment.

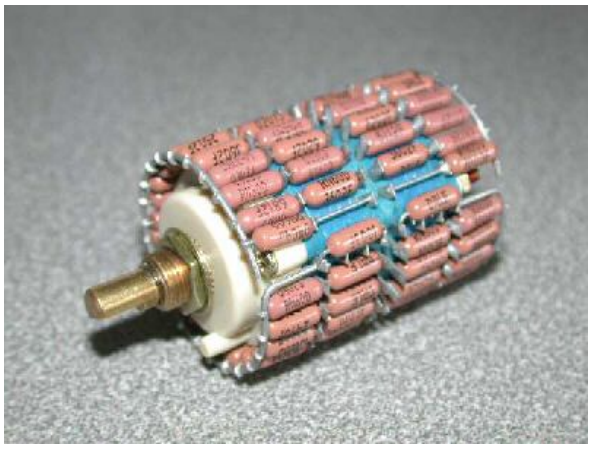

Figure 2. The Vishay-Dale attenuator.

As previously mentioned, a switched ladder design switches pairs of resistors for each step. For stereo, this requires a 4-pole switch. The attenuator utilises a high quality military specification 4-pole 23-way switch with silver-plated contacts and Vishay-Dale metal film

resistors (see Figure 2). In this design, both Rx and Ry are selected by two sets of switches, thus overcoming the limitations of the shunt design.

The approximate attenuations for each position are shown in the following table:

Step	Attenuation (dB)
1	Infinity
2	60
3	55
4	50
5	45
6	40
7	38
8	36
9	34
10	31
11	29
12	27
13	25
14	23
15	21
16	18
17	16
18	14
19	12
20	10
21	6
22	3
23	0

The unit is certainly beautifully made and a lot smaller and neater than the one I had previously made with a 2-pole wafer switch. The switch has an aluminium end plate fitted to help keep the contacts clean, and the contacts themselves have been coated with a special lubricant. Even the nuts clamping the whole assembly together had been painted with a locking varnish! Suffice to say that I was very impressed with the build quality of the unit, and I had no trouble fitting it into my pre-amp (see Figure 3). However, would it sound as good as my previous attenuator?

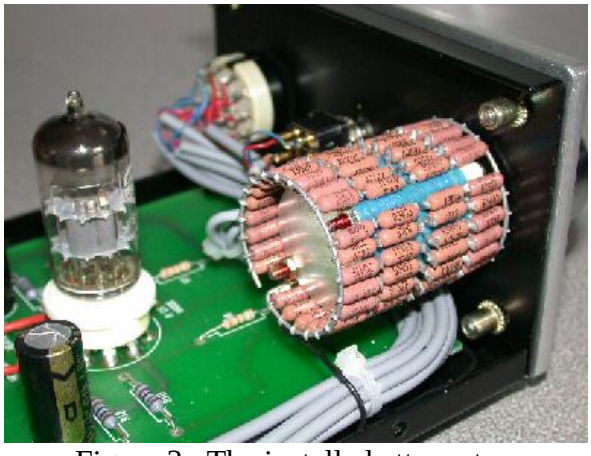

Figure 3. The installed attenuator.

After allowing my system to warm up, I did some listening tests. First impressions were that there was a lot of depth to the sound and that it sounded fuller. However, as I tried different records, I realised that I had more bass, but at the expense of top end. I

had lost the clarity and detail I was used to with a particular record that I know very well. In fact, a harpsichord recording of Bach's Partitas sounded decidedly muddy! The effect of more bass and less clarity was pushing the sound stage backward which had given my initial impression of more depth. Needless to say I was very disappointed!

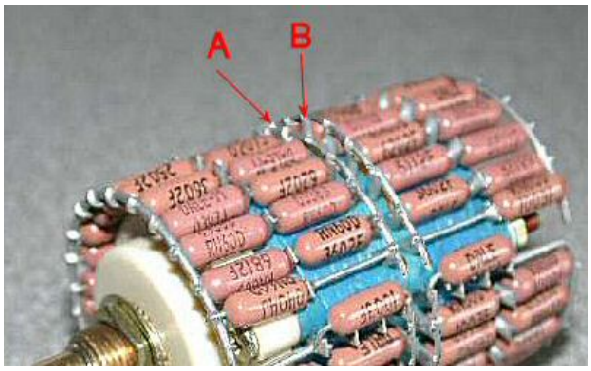

Figure 4. The attenuator with the shorting loops fitted.

I discussed this with a friend of mine, which resulted in a suggestion that the resistors may well need a burning-in period of around 100 hours before they start sounding their best, but could this really make such a difference? Of course, one could simply leave the pre-amp on for four days playing a CD on repeat, but this would only run in one position of the switch and this would need to be repeated for each position. This was not a feasible solution, especially for someone as impatient as I am! The only proper way to run in the unit was to find a way of running the attenuator with a signal passing through all the 88 resistors simultaneously! This is not as difficult as it might at first seem and was accomplished by connecting all 23 steps of both channels in parallel. The trick is to run loops of wire around the top ends of the Rx resistors and solder the wire to each leg. The temporary loops of wire for each channel can be seen at points 'A' and 'B' in Figure 4. Connect an audio signal to this wire and the earth end wire on both channels and you will have signal running through all the resistors.

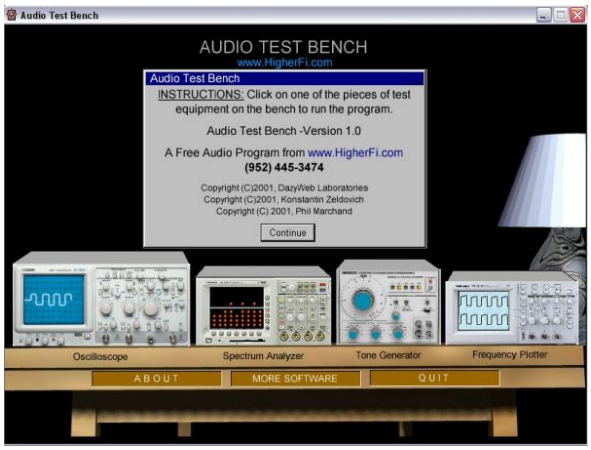

Figure 5. Audio Test Bench Software

A makeshift signal generator can be created with the aid of a computer fitted with an normal sound card and using a little program downloaded from the internet that produces white noise or sine waves. It is bundled with a package called Audio Test Bench which is available from http://www.HigherFi.com from their software downloads section (see Figures 5 and 6). To set things up, simply wire the attenuator to a plug that fits into the sound card output socket from the computer. With a 100KΩ attenuator wired up as previously described will load the computer's sound card with just over 4KΩ on each channel, which is well within the capabilities of the computer to supply a signal of an acceptable level. Set the program to produce either a steady tone, or better still white noise so that signal across the entire audio spectrum is being generated and leave the computer

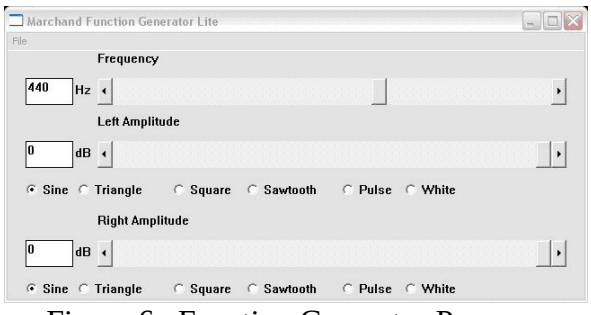

Figure 6. Function Generator Program

running for four days. After this treatment, the attenuator should be thoroughly run-in - on all steps!

At the end of the running-in period, the attenuator was disconnected from the computer and the shorting loops of wire removed. I have to confess to being a little sceptical as I wired the unit back into my pre-amp. Would I be able to tell a difference? I switched on my system and allowed it to warm up. I then slipped my trusty 'test record' of Vivaldi's Concerto in A minor for Oboe and Strings F.VII/5 (Telefunken 6.42355 AW) onto the turntable. Before the run-in period, it had sounded muddy. What a difference now! It had regained all the clarity and detail of my previous attenuator, and gained a bit more! The bass had also tightened up, but had retained all the depth and fullness of the sound that I had experienced initially, as demonstrated on my recording of Stravinsky's The Firebird Suite (The Atlanta Symphony Orchestra - Telarc digital recording DG-10039) with a clear bass drum rumbling through the opening section.

It is truly amazing what a difference the running-in period makes. The attenuator has surpassed all my expectations and is definitely superior to my previous shunt attenuator. Buying direct from Taiwan may put some people off, unless they are used to trading through the internet, but it is quite straightforward, especially if use is made of the intermediate secure payment mechanisms that are available (and free to use for the purchaser). However, this must be an opportunity for someone to set themselves up as a UK importer – all you suppliers out there, please note!

In any case, this is a genuine bargain and bearing in mind that my previous shunt attenuator was a significant improvement over the original Alps Blue potentiometer, the Vishay-Dale ladder attenuator is an essential upgrade to any high-end pre-amp.

--ooOoo--