Building the Amplifier Measuring Attenuator

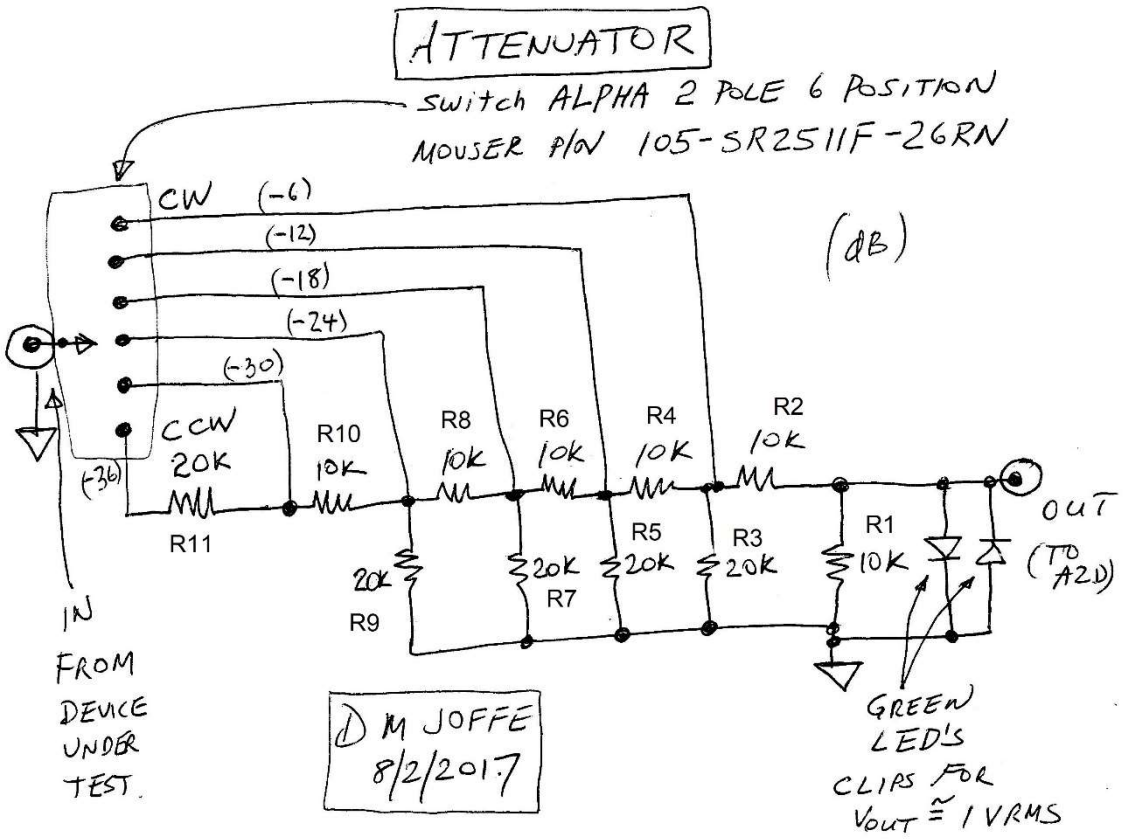
Background

You can use a sound card to measure amplifier distortion. A standard sound card only accepts about 1 volt RMS before it overloads. If you put a much more than 1 volt RMS into the sound card's A2D, you can damage it.

This article describes how to build a combination of a switchable attenuator and protection circuit. The switchable attenuator drops the signal level enough to keep from overloading the A2D. The protection circuit keeps the amp from damaging the A2D no matter which attenuator setting you select.

Circuit Description

Figure 1 shows the circuit of the switchable attenuator and protector.



The amplifier under test connects to the RCA jack on the left side of the schematic. From there, the signal connects to a 6-position selector switch. The attenuation of the switch increases as the selector turns counter-clockwise.

Consider what happens when the switch is fully clock-wise. The input signal from the amp under test connects through the (-6) labeled position of the switch, R2 and R1. R2 and R1 form a voltage divider that cuts the signal level in half, an attenuation of -6 dB. The two green LEDs look like open circuits so long as the voltage across them is less than about 1.4 volt. Thus the -6 position can accommodate amplifier outputs of up to about 1 or two volts RMS.

If you've adjusted the amplifier for more output than 1 or 2 volts RMS, you'll have to move the switch counter clockwise. In the (-12) position, the signal is applier to R4. Applying the input voltage to R4 results in the output voltage being ¼ of the input voltage, corresponding to -12 dB.

Adjusting the Attenuator

Here's the idea. You want to turn the attenuator as far clockwise as you can without overloading the input of the A2D. How do you know that the A2D is overloading?

1. If the LEDs light up, you don't have enough attenuation set, and you have to move the switch counter clockwise.
2. As a sanity check, even if you think you have the right setting, you might rotate the switch one more position counter clockwise. If the distortion doesn't change, then the previous position probably supplied enough attenuation.

You want the selector as far clockwise as possible to maximize the dynamic range of the A2D, but not so far that the resulting signal overloads the A2D.

Building the Attenuator

I built the attenuator in a metal "Bud" Box, part number CU-3005-A, purchase on Amazon. The RCA connectors were purchased long ago from Radio shack. I mounted them directly in holes drilled into the top of the chassis. That makes for a nice ground plane and shield that automatically connects the grounds of the RCA connectors together.

The electrical components were all purchased from Mouser, www.mouser.com, and are listed in the table below:

Quantity	Description	Mouser P/N
6	10K, ¼ Watt, 1% metal film resistors	660-MS1/4DCT52R1002
5	20K, ¼ Watt, 1% metal film resistors	660-MF1/4DCT52R2002F
2	Green LEDs	604-WP3A8GD
1	2 pole 6 position selector switch	105-SR2511F-26RN

Most of the resistors can be soldered on the switch. R1 and the two LEDs can be installed across the output RCA jack. R2 straddles the switch and the output RCA jack. Pictures of the construction technique follow.

I've included two sets of pictures…One set is the original one that I built. The other set shows one built by Craig. Note that he has made the LED's visible, so you get a quick indication of when you're overdriving the attenuator and sound-card.

Figure 1 – Assembled attenuator, built by Dan

Figure 2 – assembled version, as built by Craig, with LED's visible to show overload

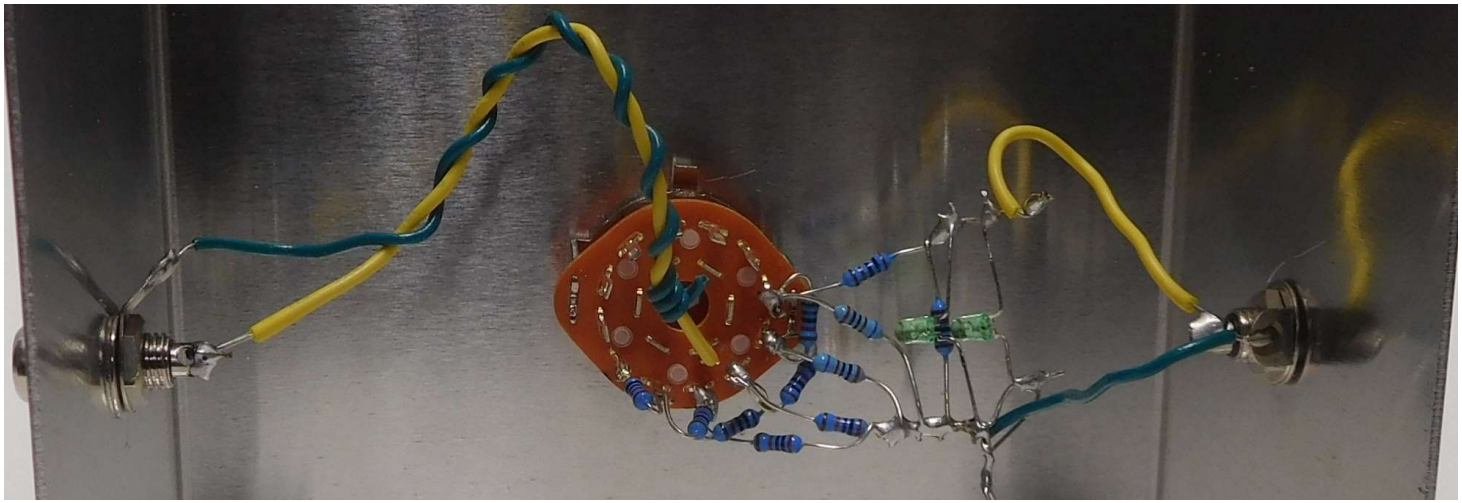


Figure 2 – Inside the assembled attenuator. Green wire from the input (left) RCA is twisted and wrapped around the yellow wire to form a shield. It is not connected anywhere on the switch.

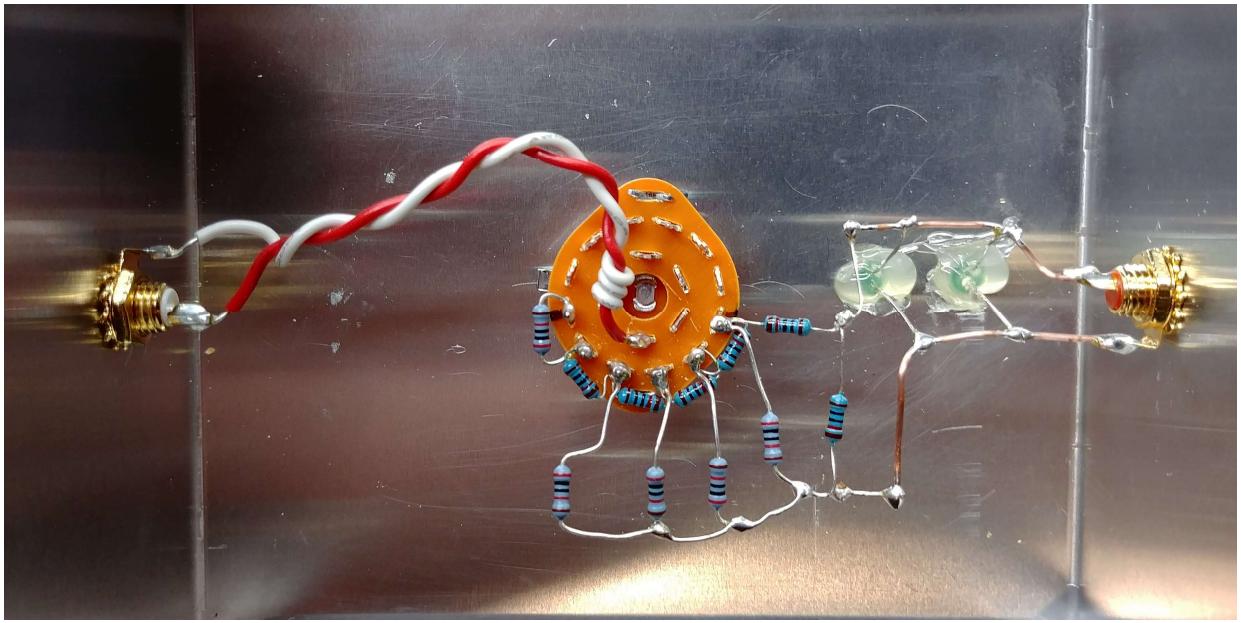


Figure 3 – Craig's layout is neater than mine. Note that he made the LED's visible, so you can see when you're over-driving the A2D, and hence are in protection mode.