



Letter to the editor

Odiviu Popa writes:

Dear editor,

I have read with great interest the Bruno Putzey's quest for the ideal preamp, as published in Linear Audio Vol. 5. I do appreciate most of Bruno's sound design decisions and the theoretical and practical rationale behind these decisions. Adding the PCB layout (not to mention including a PCB sample in the Volume) is definitely a nice touch for the enthusiastic audio DIYer.

I would though challenge his approach for the volume control. While placing the potentiometer in the feedback loop indeed linearizes the potentiometer's inherent nonlinear characteristic, I am afraid this comes at a pretty hefty price.

Placing potential nonlinear circuit elements in the feedback loop is a widely known technique. It was occasionally taken to the extreme, for example by including the power amplifier output protection fuse in the feedback loop, so that the amplifier loop gain would compensate for the thermally induced nonlinearities in the fuse. All good, until we consider the case when the fuse blows; the amp would then remain open loop and while the speakers would certainly be protected, what would happen in the open loop circuit with the output banged toward one of the rails is not necessary pretty.

Placing the potentiometer in the feedback loop, as described in Bruno's article has, in my opinion, at least three potential problems:

- a) Is already mentioned in the article: the volume control towards low volumes gets fiddly.
- b) Potentiometers wiper gets loose in time, this is a known failure mechanism, in particular in cheap units. As the U2/7B inverting input gets open, there is no output capacitor, and the servo loop doesn't include the volume control stage, the preamp output would then bang into the supply rails. In this scenario I would really hope that the power amp is not DC coupled, so everything would resume to a loud bang in the speaker(s).
- c) The wiper noise. Potentiometer wipers get dirty in time, so there's always some wiper noise associated with the potentiometer aging. In Bruno's implementation, the wiper noise gain is the same as the inverting input gain – which may lead in time to screeches while handling the pot.

While certainly a tempting idea, I'm afraid that placing the potentiometer in the feedback loop is actually leading to more troubles than it solves. I personally believe that living with the potentiometer nonlinearities (what about using a good quality unit, or perhaps a make-before-break stepped attenuator?) is better than living with the actual or potential problems outlined above.

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Bruno Putzeys replies:

Thanks Ovidiu for taking the time to comment. I'd certainly not recommend anyone use this dirt cheap pot in a serious design, for the precise reasons you mention. You'd at least have to use a decent multi-finger wipered one, or perhaps a relay network like I do in my commercial preamp. The point of the preamp wasn't to promote a specific potentiometer configuration though but to illustrate how to get the benefit of differential signaling even if one of the stages has a common reference shared between input and output. The same situation arises when you wire the potentiometer normally and the solution is also the same (ie. reference the output of the diff amp to the potentiometer common and attach the cold terminal of the output XLR at the same spot). Only the distortion at the end of the audio band would have been higher on account of the nonlinear input capacitance of the output op amp. It is remarkable how even these "super chips" distort measurably when used in non-inverting mode with mismatched impedances.
