

The Zen Variations - Part 2

The Penultimate Zen's Current Source

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Intro

Welcome back to the Zen Amp Variations. This is part 2 of many parts in which we explore some of the ways to make a very simple audio amplifier. In this and parts 3 and 4 we will embellish upon the original Zen amplifier circuit, improving the performance and creating the Penultimate Zen Amp.

You may recall that the Zen Amp is a single MOSFET transistor operated in what is known as Common Source mode in which the input signal is fed to the Gate pin, the Source pin is grounded, and we take the output signal off the Drain. In order to get this arrangement to work, we have to provide this transistor with a current source, which is just what its name implies: It is a source of current which provides the power for the gain device. In the case of the Zen amp, the current source acts as a mediator between the positive voltage supply and the gain transistor, feeding the right amount of current into the circuit to provide the optimum conditions for the device.

The current source can be made as simple as a resistor (or a light bulb), but it is generally advantageous to make it out of something more complex, since using a resistor results in about 8% efficiency or so, and this being power circuit, wasting this much power gets costly and is socially incorrect. Just ask anyone who has built the Son of Zen, and they'll tell you that burning 600 watts to get 50 watts output is a bit over the edge.

In this article we will recap the operation of the original current source for the Zen, introduce an alternative current source, and then pull a trick out of the hat for a new source of current with a negative and occasionally imaginary source impedance.

The Original Source of Current

Figure 1 shows a version of the original Zen Amp. It is not exactly identical to the original circuit; I have played around with it to give continuity to this article's progress, but it is close enough.

The actual gain stage portion of the circuit is Q1 and the components attached to it on the lower half of the circuit. Q2 and the components in the upper half of the circuit make up the current source.

If you wish to improve your understanding of the lower portion of the circuit, I refer you to the original project articles, "The Zen Amplifier", Audio Amateur, issues 2/1994 and 3/1994. These can also be found on www.passdiy.com.

This type of current source is known as a constant current source. Ideally, a constant current source will deliver an exact, unwavering amount of current out of a connection (in this case the Drain of Q2) regardless of what is attached to the connection or what the voltage conditions at that node might be. If you leave this point unattached to some circuitry, an ideal constant current source will emit a small lightning bolt which will travel until it connects to something. The Zen Amp constant current source is not so ideal, but perhaps that is just as well.

The way this current source works is fairly simple. P type MOSFET Q2 will conduct current when its Gate pin becomes negatively charged relative to its Source pin. An easy way to make that happen is to use R11 to pull the Gate voltage toward ground, and with the Source pin

