

It's probably about ten years ago that I read a letter in *Wireless World* magazine from the late, and great, M.G. Scroggie deploring the term "current dumping" to describe the amplifier topology invented and exploited by the Acoustical Manufacturing Company in the Quad 405.

Scroggie acknowledged that the term pertained to the relatively straightforward task undertaken by the output transistors in such an amplifier. However, he argued, since the current that the output transistors passed was used directly to energise the loudspeaker and thus produce sound, the role these transistors played could hardly be considered "dumping", suggesting - as the word does - that they were involved in disposing of a useless commodity.

Now dumping is an everyday word for storing precious computer data. Perhaps it is only the ever-Victorian, scatological British who could regard responsible "dumping" as the hallmark of an accountable professional life.

Not that Scroggie was criticising the development of the Quad 405. I've owned a Quad 405 as a studio amplifier for many years and it's a wonderful product. I choose to ignore the engineers and academics who consign it to the waste-paper basket of history. They - blinded by mathematics - prefer their own (faulty) reasoning to the evidence of their own senses.

Technically, current-dumping does work - believe me. It works well and it goes on working. But how exactly does it work?

In Fig. 1, I've drawn a simple power amplifier with a voltage amplification stage (A) and a complementary bipolar transistor output-stage. In many ways this looks like any other complementary power amplifier, except that there is no static bias applied to the output transistors. Negative feedback encloses the whole and attempts to maintain linearity despite the large transfer-characteristic discontinuity

introduced by the unbiased output stage.

If you breadboard something like my Fig. 1, I guarantee you'll be surprised. It doesn't sound that bad. Provided the gain/bandwidth of A1 is large enough, the output signal is remarkably undistorted, especially at low frequencies.

Essentially this arrangement would be acceptable were it possible to construct the amplifier A perfectly, so that it "slewed" infinitely quickly across the crossover "deadband". I've



and sub-bass roll-off (features which have many times saved my 405's life). It is almost certainly not the action of the amplifier topology itself which accounts for this apparent lack of subjective impact, but the effect of these other ancillary features and design decisions.

Is it, perhaps, because of this poor subjective reaction to Quad amplifiers that other manufacturers have not trodden the current-dumping route? Unlikely, more probable is that Quad's patents have prevented a

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Left by Richard Brice

tried to show the way A1 behaves by sketching the signal waveform at the bases of the two transistors.

Of course, it isn't possible to construct a perfect amplifier for A1 and, in practice, as frequency increases, crossover distortion starts to make itself heard. The essence of the idea behind current-dumping is illustrated by the inclusion of R_d (shown with dotted connections in Fig. 1). R_d feeds current directly to the load during the proportion of the output cycle when both the output transistors are off. In effect, R_d reduces the "gap" A1 is required to slew across and permits a practical amplifier to be used instead of a mythological, perfect amplifier.

Stripped of their duty during the essential and fragile crossover region, the

output transistors are only called upon to deliver drive into the load at powers above about 100mW whilst A1 does all the clever bit in between - hence the term "current-dumping" to describe the uncomplicated job they perform. In Quad's final circuit, the resistor is augmented by a capacitor and inductor which act in a reactance-bridge arrangement to enhance the effect of R_t across the whole audio bandwidth.

Despite the undeniable engineering ingenuity displayed in the 405 amplifier, Quad never seem to have earned *creme-de-la-creme* audiophile status for this product, nor indeed its heirs. However, comments that amplifiers of this stable lack "slam" or "punch", probably derive from Quad's prudent decision to employ extensive current-protection

flood of carbon-copy, current-dumping amplifiers.

Granted, Quad have kept the technology to themselves, but have they sold more amplifiers, I doubt it. Quad's undoubted reputation for reliability and solid engineering would hardly have fallen apart if they had (like everybody else) built upon their success with the 303 and continued with the development of the class A/B audio power amplifier.

True, the designers, freed of their usual commercially-rooted secrecy by the sanctions of the law, were able to write articles explaining the technique in full. But, did Quad really hope that other manufacturers, wowed by the brilliance of their idea, would opt to pay Quad a royalty for every power amplifier sold? Surely not. It's not as if they invented an amplifier without the need for a mains transformer! Interestingly, Quad's patents for current-dumping were published in 1975 which means the protection expires next year. So current dumping could yet become household bywords for high-quality amplification. Sorry Mr. Scroggie ●

