

Some Thoughts on Bob Cordell's
“Designing Audio Power Amplifiers”
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I had the good fortune to receive a copy of this new audio power amp book, courtesy of McGraw-Hill and Bob Cordell. Many thanks, folks! I've known Bob Cordell since the 1970's, and I am familiar with most of his *Audio* articles and AES papers. Many of these are referenced within this book, and some are available from his website, <http://www.cordellaudio.com/>

The first thing to understand about this book is the substantial breadth and scope. It is a large book, over 600 pages including an index, divided into 31 separate chapters, and 6 parts. The titles of these parts and their page budgets give you some insight into the book's scope: [1] Audio Power Amplifier Basics (1-123), [2] Advanced Power Amplifier Design Techniques (125-274), [3] Real World Design Considerations (275-382), [4] Simulation and Measurement (383-495), [5] Topics in Amplifier Design (497-550), and [6] Class D Amplifiers (551-601). Given this lineup, you should realize that it is more than just a book on how to design audio power amps. For example, it also goes into substantial detail on the related topics of measuring the final amp results, and how to use modern simulation methods within the design process [4].

So, is this the book that teaches you everything necessary about how to build your own high quality audio power amp? No, unfortunately not. There may never be such a book! But it does offer a great deal of insight and solid background info on the workings of all the popular amplifier signal stages, i.e., bipolar and JFET differential input pair stages (IPS), the second voltage amplification stage (VAS), of various types, and output stages (OPS) of both bipolar and MOSFET types. In Chapter 3 for example, Cordell takes us through a sequence of refinements to the various stages. He proceeds step-by-step, showing the improvements/tradeoffs of such things as degenerated vs. non-degenerated input diff pairs, Darlington vs. simple and cascoded VAS, simple and paralleled OPS, and so forth, ending up with 8 distinct versions to compare. This is indeed fascinating stuff!

To give you some idea of the depth of these discussions, Cordell even goes so far as to develop his own SPICE models for use in designs, in Chapter 20. And this is after a short tutorial on how a popular SPICE simulator, LTspice, operates. This is really a superb section of the book, but not because I think SPICE is the end-all of audio design tools, as it isn't. Rather it is because I know from personal experience the frustrations of using SPICE and developing good working models. This ain't easy, and it can absolutely suck up gobs of your time. But it can offer great insights into how circuits behave, and in the end, either save you some time or provide information not available by other means.

However, one should understand upfront that this is not a cookbook of designs, it is more of a collection of design methodologies. For those looking for an array of amp designs ready to build with full part lists and PCBs, it may fall short. It does offer detailed designs at a schematic level, for example, there are Chapter 3's 8 variations mentioned above. Another is Fig. 11-17, a 125W MOSFET output amp featuring a cascoded JFET input stage. This was designed with the aid of SPICE, and related SPICE performance info is provided.

But, I can see where this type of information, short of a fully specified parts kit will cause despair on the part of those beginning to wet the feet with building audio power amps. This isn't a book that holds hands with you, nor is it on the Heathkit level, by any means. On the other hand, if you do have some experience with audio amp circuits and are seeking greater understanding, it can help you move towards that goal. It isn't overly heavy on math, but it does include many key design relationships in algebraic form, going a long way towards understanding how various amplifier blocks interact.

There are some things included that seem a bit away from the mainstream of more popular designs. A discussion of the LTC LT1166 crossover biasing chip takes up 7 pages, for instance. This seems an extravagance, given that OPS biasing is almost universally done with just a couple of resistors and small transistors. But, this particular example is more than balanced by an excellent discussion of thermally tracked biasing schemes (Chapter 14).

And, there are also a number of more esoteric things spread around here and there. Welcome are the discussions on power supplies and proper implementation thereof, grounding (always a challenge), immunity to EMI and RFI, load isolation schemes, balanced input schemes, overload control, and so on. Cordell even has some sophisticated methods for power amps *without* overall feedback, in Chapter 25. I will leave it to the readers to decide on the latter topic, but it is probably safe to say that these circuits aren't for the beginner.

All in all, this book should serve many audio folks quite well, with the caveat that beginners might not be comfortable with it. It assumes a basic understanding of transistor types, their biasing and fundamental gain configurations, as well as feedback circuit theory and op amp topologies. If you don't have this type of knowledge under your belt, some other books might help to understand this one better, down the road.

Still, I'd say that this book represents a fine effort as a first time book. I'd also note that, regardless of the number of articles and AES papers published, none of that prepares one for the assembly of a good book.... *as books require more broad and distinct skills*. And, this one isn't a dreary "by committee" production, nor is it a compilation of sections by separate, competent audio designers. It is the product of mainly one person, Bob Cordell, acting as designer, author, artwork editor, and software engineer, who produced the resulting book over a 4 year period of time. This takes not only knowledge and insight, but continuing dedication. Few engineering people that I know in the audio world have the requisite skill set to pull off such an effort, as this is a strenuous process, believe me. I tip my hat to Bob Cordell for accomplishing this, and hope some of my comments are not only helpful to the readers here, but to Bob in crafting the next edition.