

book review

Speaker Building 201

by Ray Alden

Review By Dennis Colin

PHOTO1: SPEAKER BUILDING 201

Speaker Building 201

*A Comprehensive Course
in Speaker Design*

by Ray Alden

With 11 completely
designed speaker systems
including a 5.1 home
theater system

- Your guide to understanding
the mysteries of speakers
- A perfect mix of theory and
practical application

Build Your Own
FIRST-RATE
System

For Beginners and Serious Enthusiasts

Speaker Building 201 is refreshingly reminiscent of the technical hobbyist books of the '50s—comprehensive yet spirited, loaded with excellent illustrations, and with the apparently lost art of explaining a concept from the historical foundations (Ampère, Faraday, Ohm, Volta) to its present applications—all the while keeping it interesting. And whether discussing the science or the art, or proven examples of speaker construction, each chapter is a self-sufficient presentation of information—you can select any chapter of interest and obtain all you need on the subject.

Chapter 1, "The Adventure Begins," introduces the fundamental concepts of electricity, magnetism, and mechanics as they relate to loudspeaker driver op-

eration. Also introduced are the occasional "math tips" to facilitate understanding of multi-variable relationships. Characteristics of drivers are clearly presented, particularly regarding their selection and appropriate enclosure matching.

Chapter 2, "The 'Big Three' Parameters and the Closed Box," discusses the forces acting in a driver, then elaborates on f_s , Q , and V_{AS} . Excellent illustrations, analogies, and description supplement the mathematical relationships with intuitive understanding, a "feeling" for the interactions.

Chapter 3, "The Vented Enclosure," presents the topic with the same clarity and depth; diffraction ("spreading") loss is also discussed.

Chapter 4, "Opening Pandora's Box," deals with sealed box dimensions, conversion calculations, and the programs "Speaker Box Designer—V1" and "Win ISD."

Chapter 5, "Special Applications," presents multiple-driver systems including push-pull, MTM ("D'Appolito configuration"), and dual voice-coil drivers.

Chapter 6, "Subwoofers," presents a most excellent and understandable description of the variety of subs ranging from the relatively simple sealed box to the 6th-order bandpass sub. Calculation techniques include both the raw math and "Bass Box" Pro software. To assist in your selection of a subwoofer type, performance characteristics are related to your musical tastes, as well as your max-SPL needs.

Design of the more esoteric subwoofer types, such as the "compounds" (push-pull, isobaric) and bandpass systems, is necessarily complex. But these systems are given not only the math relationships, but also a clear understanding of the physical/acoustic phenomena taking place, e.g., the constant-pressure coupling of the two woofer cones in an isobaric (literally meaning "constant

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pressure”) system. The resulting two-w woofer compound is then understood in relation to overall system parameters.

One minor criticism is an incorrect statement on page 65: “There is no point in . . . building a subwoofer if you place it in a room too small to support the wavelengths of the lowest frequencies.” This is a common misconception: while a small room cannot support long waves, the ears don’t care about waves—they respond to *pressure* variations impinging upon the tympanic membrane (eardrum). Otherwise, how could headphones produce 20Hz (cleanly and powerfully with good phones), when the ear is now in a “room” of about one cubic inch?

What occurs is the well-known “room gain” (“cabin gain” in a car): Approximately below the frequency where a half-wavelength equals the longest room dimension, the air becomes pressurized as a whole, and is essentially “DC-coupled” to the net driver volume displacement (vent if present included). Compared with free-space (or large room) response, the woofers’ output is boosted by 12dB/octave as frequency decreases, a fact taken advantage of by car stereo deep-bass fanatics (yours truly included).

Chapters 7 and 8 present, respectively, two-way and three-way crossovers, beginning with the fundamental properties of inductors and capacitors. These chapters are an excellent presentation of both mathematical analysis and practical considerations, with many beautiful graphs and intuitive-based illustrations, including voltage/current phasor diagrams and the responses of a variety of order-number crossovers. Zobel networks, notch circuits, and real-world ambiguities are also well-covered.

Chapter 9, “Hardware and Software,”

ABOUT THE AUTHOR

Dennis Colin graduated with a BSEE from the University of Lowell (MA) and is currently an Analog Circuit Design Consultant for microwave radios. Previously a band keyboardist and a recording engineer, he has been published in the *Journal of the Audio Engineering Society*. Colin has demonstrated the audibility of phase distortion at Boston Audio Society, and has designed the “Omni-Focus” speaker (bipolar coincidental with phase—linear first—order crossover), ARP 2600 analog music synthesizer, 1kW biamp and PWM supply at A/D/S, and Class D amps.

covers various testing and calculation tools, focusing on the relevant parameters including phase, cone excursion, and vent velocity.

Chapter 10, “Crossover Optimization and Measurement Techniques,” begins with a fascinating discussion (and illustrations) of the 3D “Heyser spiral” showing the “real” and “imaginary” parts of the complex amplitude/phase versus frequency response of a speaker’s impedance (or acoustic output). Then, practical examples of crossovers in successive stages of optimization are shown.

Measurement techniques, from swept sine wave to quasi-anechoic, are clearly described, with illustrations of microphone positions, and so on. For the curious, Fourier spectral analysis of some test waveforms (sine sweeps, square waves) are shown.

Chapter 11, “Eleven Speaker Systems,” is the dessert you might want to devour first! Optimizing and measurements were performed by Dr. Joseph D’Appolito on some systems; and by Tom Roberts, speaker designer for Madisound, on others. The systems range from a small two-way, through several MTMs, a home-theater system, a horn-loaded unit, to some fairly large systems with integral subwoofers (and a standalone sub). Each system is presented complete with photo, materials list, schematic, and response measurements. This chapter alone is worth the price of the book!

Chapter 12, “Construction,” is very practical and useful for those who have—and like to use—woodworking skills.

SUMMARY

This is simply a most excellent and unusual book. Unusual in its wide-gamut format, presenting complex material in such a way as to instill both analytical and intuitive understanding in the budding speaker enthusiast, yet also containing an absolute wealth of information—technical and practical—for the advanced speaker designer. Most highly recommended! *aX*

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